

# A Review of Telemedicine Business Models

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## Abstract

Telemedicine has become an increasingly popular option for long-distance/virtual medical care and education, but many telemedicine ventures fail to grow beyond the initial pilot stage. Studying the business models of successful telemedicine ventures can help develop business strategies for upcoming ventures. This article describes business models of eight telemedicine ventures from different regions of the world using Osterwalder's "Business Model Canvas." The ventures are chosen on the basis of their apparent success and their diverse value chains. The business models are compared to draw inferences and lessons regarding their business strategy and contextual factors that influenced it. Key differences between telemedicine business practices in developing and developed countries are also discussed. The purpose of this article is to inform and inspire the business strategy of the next generation of telemedicine ventures to be economically sustainable and to successfully address local healthcare challenges.

Key words: business models, developing countries, telemedicine

## Introduction

As many as 75% of e-health programs designed for healthcare professionals fail during the operational stage.<sup>1</sup> Development of a comprehensive business model for telemedicine ventures during the conceptualization phase can play a pivotal role in reducing risks and costs, while increasing their probability of success.<sup>2,3</sup> Sustainable business models must be developed in order to create value for the company as well as the patient. However, rigorous research on telemedicine business models is sparse. A review by Whitten et al.<sup>4</sup> of over 500 peer-reviewed articles found only 38 studies with quantitative data on the cost-benefit of telemedicine. Telemedicine and e-health have shown increasing promise in developing countries<sup>5</sup> and would be strengthened further with the development of a framework that identifies and distinguishes characteristics of telemedicine business models in varying contexts. Furthermore, a better overall understanding of successful business models is needed to expand telemedicine practices in an economically sustainable fashion. This article reviews eight different telemedicine business models, using Osterwalder's "Business Model Canvas" to understand value creation and enterprise operations in different contexts and specifically in developed versus developing countries.

## Materials and Methods

This article presents business models and quantitative data for eight telemedicine ventures. In order to effectively compare and contrast the ventures, it is essential to articulate them in a common business model framework. However, a common conceptualization of business models for telemedicine does not yet exist in the literature. After reviewing 103 publications from 1975 to 2009 concerning business models, Zott et al.<sup>6</sup> identified three distinctive conceptualizations of business models: (1) the business model as an archetype (such as for e-business specifically), (2) the business model as an activity system (for strategic analysis of network activity), and (3) the business model as cost/revenue architecture (for economic analysis). They also found that business model literature seemed to have shifted from an isolated firm view to a firm-centric, yet boundary-spanning, activity system view, and interest has also shifted from value capture to value creation.<sup>6</sup>

We have chosen Alexander Osterwalder's "Business Model Canvas"<sup>7</sup> as the basis for describing the following telemedicine business models because it addresses both activity systems and cost/revenue architectures. Furthermore, it uses value creation as the central starting point, followed by a systematic view of how the value is delivered and captured, reflecting the current consensus in business model conceptualizations.

Because of varied socioeconomic contexts between developed and developing regions, emphasis may be placed on different values in order to facilitate revenue generation. For example, the lack of transportation in developing countries places a higher emphasis on critical access to basic healthcare, whereas the value proposition in a developed country would more likely emphasize convenience of location. Thus, a breakdown and understanding of each component of the business model are necessary to assess the success of the telemedicine system. The "Business Model Canvas" is composed of nine building blocks:

1. **Customer segments.** Customers are the individuals or organizations paying for the telemedicine service. The customer paying is not necessarily the same as the consumer who uses the service. Although one entity may purchase the service, the benefit of the service may reach beyond the customer to a separate consumer.
2. **Value proposition.** Value is provided by the telemedicine system to the customer and the consumer. This encompasses economic value as well as social value. What keeps the customer coming back? The value proposition is the main focus of the "Business Canvas" and is especially important in highly personal healthcare industries such as telemedicine.
3. **Channels.** The primary interface is between the provider and the customers, where value is delivered. All of the telemedicine

ventures discussed in this article utilize either the Internet, the telephone infrastructure, or both.

4. **Customer relationships.** Types of relationships are maintained with customers directly and indirectly. How is a positive relationship generated between the provider and the customer?
5. **Revenue streams.** These are sources of income generation.
6. **Key resources.** These are important technology, infrastructure, or human resources that sustain the venture and are essential for delivering the value proposition.
7. **Key activities.** These are activities that the venture needs to undertake to deliver the value proposition to the customer.
8. **Key partnerships.** These are normalized relationships with other entities besides the customer to create, deliver, and capture the value.
9. **Cost structure.** This involves the costs of all business operations for the venture.

The eight telemedicine ventures selected for this study were subdivided into ventures in developed or developing countries: ventures in developed countries include Arizona Telemedicine, Myca Nutrition, and Tactive Telemedicine; ventures in developing countries include Telenor TeleDoctor, Apollo Telemedicine, Aravind Tele-Ophthalmology, SkyHealth, and People's Liberation Army (PLA) Telemedicine. These eight ventures were chosen with a focus on varying service types, revenue streams, and value propositions. Each venture has adapted its service and business model to different social, geographic, and economic contexts. Ventures were also chosen to represent a variety of healthcare fields that address either the general public or specific demographics. This review frames each telemedicine business model within the "Business Model Canvas" and discusses the similarities and differences between telemedicine ventures in developed and developing regions of the world.

## Telemedicine Ventures in Developed Countries

[Arizona Telemedicine, Myca Nutrition, and Tactive Telemedicine from the United States, Canada, and The Netherlands, respectively, have successfully been in operation for at least 5 years.](#) Each offers a unique value proposition for a target demographic of patients.

### ARIZONA TELEMEDICINE SYSTEM

In 1996, the Arizona State legislature established the Arizona State Telemedicine Program (ATP)<sup>8</sup> with a \$1.13 million federal grant.<sup>9</sup> By 2012, more than 1 million teleconsultations had been completed using the system.<sup>10</sup> ATP uses the application service provider model, which acts as a purchasing agent for member institutions' equipments and telecommunication infrastructures. The goal of ATP is to facilitate clinical service but not to provide it.<sup>8</sup> ATP also provides support for telemedicine project development.

1. **Customer segments.** [The ATP covers eight telemedicine sites connecting 55 healthcare organizations throughout the state of Arizona, mostly in areas outside urban Phoenix, Tucson, and Flagstaff.](#) These are for-profit and non-profit entities, such as the Arizona Department of Corrections and jail systems, Indian

Health Service, Navajo Nation, state health agencies, public schools, and urban and private hospitals.

2. **Value proposition.** The ATP offers reduced costs for members because of higher bargaining power compared to individual buyers. This is done through the application service provider model, where costs are shared among the members of the program. It also has a broad array of educational offerings, including training for high school teachers, grand rounds broadcasting, and continuing medical education programs.<sup>10</sup>
3. **Channels.** The membership program is managed and advertised primarily through the telehealth business office staff at the University of Arizona.
4. **Customer relationships.** Membership can be inclusive of all benefits or specific to one service. A legal contract protects members from malpractice through teleconsultations but does not cover clinical services provided in-person.
5. **Revenue streams.** Full membership is \$5,000 per year, and each service separately is \$1,500. During the 2003–2004 fiscal year (latest numbers available), memberships contributed 30% of ATP's total income, along with state funds (45%), extramural grants (24%), and the University of Arizona (1%).
6. **Key resources.** T-1 and T-3 lines are the physical infrastructure of the network and are leased from Arizona's utility companies. Specialty healthcare services and distance education rely on specialized clinicians and professors. ATP also facilitates legal advice, quality assurance, and clinical protocol development.
7. **Key activities.** A full membership includes services such as site assessment, equipment selection, purchasing services, network design, installation, and management, training, coordination of continuing education, and technical services and support.
8. **Key partnerships.** Apart from institutional memberships, the Arizona state government is a partner that continues to remain financially supportive. Partnerships with utility and telecommunications companies are formed to maintain low costs.
9. **Cost structure.** ATP must pay for the telephone lines, database, and software maintenance.

**Summary.** Arizona Telemedicine has a unique value proposition in that it reduces the cost of shared resources for very broad medical applications. Not only does the system facilitate doctor–patient sessions, but it also provides distance education for groups of patients as well as groups of doctors. This exchange of information and technical support is critical for creating a streamlined process for the relatively new program. According to Barker et al.,<sup>8</sup> the model's success was largely due to the financial contribution of the government.

### MYCA NUTRITION

Myca Nutrition is a Web and mobile video communications platform, started in 2007 in Canada by Myca Health Inc., designed to connect nutritionists with their clients. The nutritionist needs only a PC and Internet access, and the client needs only a cell phone or a PC that has video-calling capacity. A video consultation can be carried out on the nutritionist's own Web site, replacing traditional face-to-face office visits.<sup>11</sup>

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1. **Customer segments.** Myca Nutrition's service is targeted at doctors. The platform is sold to the medical sector, but the service is used by both doctors and patients.
2. **Value proposition.** Video feedback, videoconferencing, and graphic food journals combine to create an engaging experience for the clients. They become more aware of their dietary habits and medical conditions and receive periodic reminders and feedback from the nutritionist. Myca Nutrition also allows nutritionists to reach more customers by gaining search referrals through the Myca Nutrition Web site. The nutritionists can also bill directly through the Web site by paying a 5% fee.
3. **Channels.** All the services are facilitated through the Myca Nutrition Web site.
4. **Customer relationships.** Myca provides an interactive platform that enables nutritionists to create stronger relationships with their clients.
5. **Revenue streams.** Doctors are charged a monthly premium for use of the service: \$29.95 for up to 5 patients and \$89.95 for up to 100 patients. Patients may cover the service cost by paying \$12 per month. The payment model has been compared to Netflix.<sup>12</sup>
6. **Key resources.** Myca's platform utilizes Web space, HTML coding, and a secure network for storing and transmitting data.
7. **Key activities.** Along with providing the platform for doctors to engage their patients, Myca Nutrition also offers a search on its Web site that allows users to find doctors in a particular area of health expertise. Secure online billing, merchant accounts, and online shopping carts are also provided by Myca for the nutritionists and their clients.
8. **Key partnerships.** Myca Nutrition is branded in the United States as Hello Health. It has partnered with major corporations such as Qualcomm and Google, serving 16,000 and 50,000 employees, respectively.<sup>11</sup>
9. **Cost structure.** The maintenance of the online platform incurs the major cost.

**Summary.** Myca Nutrition's main value proposition is time and convenience. For clients, immediate feedback is provided on eating habits directly via the patient's cell phone or computer. This helps curb unhealthy eating habits early, instead of waiting for health symptoms or weight gain to appear. For nutritionists, Myca Nutrition provides access to real-time client data and helps them reach a broader client base. Receiving immediate updates of dietary intake increases accuracy and provides a more comprehensive view of the patient's lifestyle, creating a positive feedback loop that garners better counseling from the doctor. Thus, both parties are willing to pay for the convenience and real-time feedback that the Myca Nutrition platform offers.

### TACTIVE TELEMEDICINE

Tactive is the e-health component of Tactus Addiction, a company based in The Netherlands. More than 5,500 units of care per year are performed, with an operational budget of €1.6 million (\$2.31 million

USD). An online tool allows asynchronous interaction between counselors and patients. Aid workers for recognized mental health services conduct treatments on a franchise basis. The length of the treatment averages 12–16 weeks.<sup>13</sup>

1. **Customer segments.** Tactive aims to reach individuals with addictions as well as companies that need to address their employees' addiction problems. Tactive addresses behavioral problems like gambling, eating disorders, and drug addiction. It also provides services to other countries through franchising.<sup>14</sup>
2. **Value proposition.** Approximately 8% of the Dutch population drinks excessively, but only 10% of these people receive appropriate support. Tactive has found that 96% of its users prefer the anonymity feature in its online service. Tactive estimated that the need of professional counselors had declined from 650 to about 25 because of the asynchronous counseling technology, which had led to increased efficiencies and significant reductions in cost.
3. **Channels.** Tactive delivers its service to clients through a front-end information technology system over the Internet. This replaces the previous face-to-face communication between professional assistants and clients.
4. **Customer relationships.** In the online treatment system, a permanent worker is dedicated to one client throughout the program.<sup>13</sup> On the other side, the informative Web site sustains a self-service relationship with customers. An online forum for patients creates a community that supports recovery.
5. **Revenue streams.** Revenues are €2,000 (\$2,604 USD at the time of this publication) per patient, with a €200 (\$260 USD) per patient profit. Additional revenue is gained from franchising and reselling the application to other countries.
6. **Key resources.** From 20 to 25 professional assistants are employed, along with specialists in diagnostics and behavioral change. Maintenance and development of the platform require information technology personnel.
7. **Key activities.** Besides the main consultation activities, maintenance of the Web-based platform and continual research into effective intervention methodologies are conducted.
8. **Key partnerships.** Local, regional, and national governments provide partial funding in exchange for societal change evidenced by addiction statistics. FactorE is a technology partner. Tactus, the parent company, interacts with individual health-care insurers through Tactive.
9. **Cost structure.** Professional assistants, education, and training incur the major costs, with additional costs for coaching on digital treatment, information technology application, development, and maintenance. Tactus invested €4–4.8 million (\$5.21–6.25 million USD) to cover start-up costs, whereas the Dutch government provided €885,000 (\$1.56 million USD) to support scaling-up.<sup>15</sup>

**Summary.** Although the focus of Tactive Telemedicine is to provide a convenient way for patients to recover from addictive behaviors, the advantage of this system over traditional methods is that

Tactive provides complete anonymity to its users. Patients who receive treatment and counseling may still ask questions and form a support group, but they have the option of remaining anonymous through the online forum. This discretion provides another level of security for users, especially if treatment is sponsored by their employer. This secure and effective online treatment and counseling method provides a convenient way for both individuals and large corporations to discreetly resolve addictive behaviors.

## REVIEW

Although they utilize different business models, the three telemedicine ventures chosen from the developed world—Arizona Telemedicine, Myca Nutrition, and Tactive Telemedicine—have broad underlying principles that make them successful. All companies were started with initial funding from a financially stable, closely related funder. Arizona Telemedicine received funding from the Arizona state government, whereas Myca and Tactive were funded by their respective parent private companies. However, all ventures were able to become self-sustainable without additional external funding.

The stability and success of these ventures are closely related to the value propositions provided to their customers. Arizona Telemedicine facilitates telemedicine for doctors to patients, doctors to doctors, and institutions to institutions. Operating on a broad scale allows Arizona Telemedicine to share expensive resources among several entities. This value is passed directly to institutional customers in the form of reducing costs and indirectly to society in the form of easier access to, and more equitable distribution of, clinical services. Myca Nutrition allows nutritionist/doctors to communicate with patients frequently on a more personal level. Doctors and patients are willing to pay for this service because of increased communication without having to meet in-person. This also holds true for Tactive Telemedicine, which incorporates a privacy aspect that may be considered of highest value for clients recovering from addictions. All of these telemedicine ventures in the developed world have strong value propositions that emphasize convenient access to healthcare and health information security, which contribute to their financial long-term success.

## Telemedicine Ventures in Developing Countries

Although it originated in the developed world, the concept of telemedicine has been quickly integrated into developing countries. Five ventures—Telenor TeleDoctor (Pakistan), Apollo Telemedicine (India), Aravind Tele-Ophthalmology (India), SkyHealth (India), and PLA Telemedicine (China)—were chosen for discussion based on their large reach and longstanding success. These telemedicine systems emphasize the value of saving money and time through reducing transportation costs rather than simply making healthcare more convenient. Faster access to medical care through telemedicine is particularly valuable in developing countries because of the high patient-to-doctor ratio compared with developed countries.

### TELENOR TELEDOKTOR

TeleDoctor is a service started in March 2008 by the Telenor Telecommunications Company in Sindh, Pakistan. It is owned by the

**Telenor Group** of Norway, founded in 1855 to provide telegraph services initially.<sup>16,17</sup> It has now become the second largest GSM/cellular services provider in Pakistan, having 26.1 million subscribers.<sup>18</sup> TeleDoctor aims to connect anyone in Pakistan to a doctor by dialing one number. Callers have the convenience of being able to call 24 hours a day, 7 days a week. TeleDoctor provides secondary medical advice only, but promotes discussions regarding lab investigations, treatment, symptoms, and health awareness. Service is available in eight local languages.<sup>16</sup> Since its establishment through 2009, 500,000 unique users have used the TeleDoctor service.

1. **Customer segments.** TeleDoctor serves all customers in Pakistan that use Telenor as their mobile phone service provider. It is a “mobile network operator”-sponsored hotline.
2. **Value proposition.** TeleDoctor saves customers, especially those living in rural areas, travel time and cost to see a doctor. It offers accessibility and convenience through the use of multiple languages and direct access to a doctor through a cell phone.
3. **Channels.** TeleDoctor is advertised through Telenor’s mobile service advertisements, utilizing Telenor’s infrastructure to connect callers with doctors. Bill payment is shared through Telenor’s cell-phone usage payment structures.
4. **Customer relationships.** Callers are more familiar and loyal to the overall TeleDoctor brand and logo than to a specific doctor. TeleDoctor increases customer satisfaction by providing reliable service. Callers may choose personalized doctors based on gender, language, and specialty preferences.
5. **Revenue streams.** TeleDoctor charges callers 8 PKR (\$0.08 USD) per minute. These charges are in addition to the customer’s basic calling fee from Telenor. TeleDoctor receives, on average, 1,000 calls per day. It is estimated that reaching 10,000 calls per day will bring in enough revenue to cover all costs.
6. **Key resources.** TeleDoctor utilizes the customer base and physical infrastructure of Telenor’s wireless network to reach its callers and to connect them with doctors.
7. **Key activities.** TeleDoctor engages in advertising through Telenor to increase the number of callers.
8. **Key partnerships.** Partnership with the Telenor wireless network builds brand recognition, and the infrastructure of Telenor provides easy retail access to customers. Endorsement from the Sindh Ministry of Health also strengthens the credibility of the TeleDoctor service.<sup>16</sup>
9. **Cost structure.** Platform costs associated with infrastructure are embedded in the caller’s subscription to the mobile service provider Telenor. Outstanding revenue charged per minute to the customer (8 PKR/minute) covers marketing and doctors’ fees.

**Summary.** TeleDoctor’s main strength lies in its personalization, particularly by connecting patients to medical specialists who speak a variety of languages. In developing countries such as Pakistan, many rural communities speak a dialect, and the community members are not fluent in the national language. For gender-specific medical questions, women may be more comfortable speaking with a female

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doctor. This personalization provides a secure and accessible platform for effective communication. The 24-hour access to the system is also of great value, particularly for those who are unable to travel long distances to an emergency room or hospital after hours.

### APOLLO TELEMEDICINE

Apollo Telemedicine Networking Foundation (ATNF) is a non-profit organization started in 1999 by Apollo Hospitals Group, the largest private healthcare provider in Asia. It connects Apollo secondary care hospitals with Apollo specialty centers in India in order to mitigate the shortage of specialists in rural areas. The ATNF has become India's largest telemedicine provider, with 40 medical specialties in over 100 peripheral centers in India with additional centers overseas.<sup>19</sup>

1. **Customer segments.** Apollo primarily serves rural areas or locations with a shortage of specialists. It also works with government entities and private companies to provide quality healthcare to residents and employees.
2. **Value proposition.** Reduction of time and costs associated with travel is especially important for rural areas that have reduced or poor transportation.<sup>20</sup> Patient confidentiality and security of data transmitted are guaranteed by ATNF's adherence to all legal and patient security laws and security technologies. ATNF also achieves social impact internationally by providing teleconsultation and tele-education to 53 countries of the African Union.<sup>21</sup>
3. **Channels.** Apollo offers specialty consultations to patients through its telemedicine consultation centers. The service can be bought by a regional government for its residents or by a company for its employees.
4. **Customer relationships.** Apollo strives for social impact along with economic benefits. Through its philanthropic efforts, ATNF has established a good reputation among patients, which attracts more clients through publicity and referrals.
5. **Revenue streams.** The cost for a teleconsultation varies from \$20 to \$30 USD, usually resulting in a \$10 profit per consultation. Revenue is also generated from governmental and commercial entities that utilize ATNF's service. Patient record management provides another line of revenue. External funding has allowed ATNF to provide 6,000 free teleconsultations to financially disadvantaged individuals in and around Aragonda, India, from 2000 to 2009.<sup>20</sup>
6. **Key resources.** Software, hardware, and dedicated satellite connectivity are provided free of charge by the Indian Space Research Organization.<sup>20</sup> Medical centers, professionals, and equipment are also essential.
7. **Key activities.** Continued medical education programs are held frequently to improve the quality of Apollo physicians. Software development, construction, and upkeep of consultation centers and specialty hospitals are essential.
8. **Key partnerships.** ATNF has a partnership with the Indian Space Research Organization for bandwidth, GE for medical

equipment, Wipro for hardware, and GEMSIT for software. Cisco's technology enables the doctors to connect with patients on a laptop supported by an Internet connection and Web camera.<sup>22</sup>

9. **Cost structure.** The startup cost for an Apollo telemedicine center is \$10,611 USD.<sup>23</sup> At least 1,500 consultations per center per year are necessary to cover operational expenses.

**Summary.** Apollo Telemedicine utilizes a strong local network and customer base to maintain a successful operation at each center. Although the program does receive external funding to subsidize consultations for certain areas, centers are also utilized and financially supported by patients who pay. Its social bottom line attracts both patients and external funding sources, which collectively contribute to the success of its business model.

### ARAVIND TELE-OPHTHALMOLOGY

Aravind is the largest eye care system in the world, founded in 1976 in Madurai, India. Since its inception, Aravind has been working to eliminate needless blindness. Aravind started to implement primary vision centers in 1996 in Theni, India, in order to provide quality and affordable eye care to people living in rural villages.<sup>24</sup> The primary vision centers are connected to higher-level vision hospitals via tele-ophthalmology. An ophthalmologist interacts with the patient sitting at a remote location through videoconferencing, aided by a local doctor<sup>25</sup> who uses ophthalmic diagnostic equipment to transfer the images.

1. **Customer segments.** Aravind teleconsultation offices serve rural and low-income areas of India.
2. **Value proposition.** Sixty-three percent of blindness in India is a result of cataracts. The Aravind model tackles that issue by providing affordable, quality eye care to patients regardless of their income or status. For example, two-thirds of the outpatient visits and three-quarters of the surgeries performed at Aravind eye centers between April 2009 and March 2010 were provided free of charge. If the patient is referred to one of the main Aravind hospitals, transportation is provided for a small fee, saving the patient time and money. Furthermore, the system provides an opportunity for doctors to share their experiences.
3. **Channels.** Aravind has established three telemedicine vision centers in Theni, India, and plans to open at least 10 more. Patients receive real-time teleconsultations at the centers with an optometrist from Aravind Hospital. Each center covers a population of 45,000–50,000 people. Other telemedicine strategies have also been implemented. Internet kiosks use store-and-forward technology to reach doctors. Mobile screening vans can reach remote areas and utilize a wireless database system to record doctors' feedback.<sup>24</sup>
4. **Customer relationships.** Teleconsultations are performed by the same ophthalmologist who would examine the patient in-person. An explicit objective is to convert non-customers to

customers through eye problem screening. These patients are marginalized individuals who would normally not receive checkups because of time, distance, or financial constraints.

5. **Revenue streams.** Patients pay about \$0.50 USD for an eye exam. Extra costs are incurred when patients are sent to the hospital or when prescription medication or glasses are ordered.
6. **Key resources.** Over half of the Aravind vision centers use wireless technology (Wild-net) for their online vision consultations. Using Wild-net allows for information to be transferred 100 times faster than dial-up.
7. **Key activities.** Along with providing teleconsultations, Aravind also participates in distance education and connects eye hospitals around the world. ADRES version 3.0 software for reading and grading diabetic retinopathy has also been developed by Aravind.<sup>26</sup>
8. **Key partnerships.** Wild-net, the wireless long-distance network, was produced by the Technology and Infrastructure for Emerging Regions research group at the University of California, Berkeley, CA. This group started collaborating with Aravind vision centers in 2005.
9. **Cost structure.** Video towers cost \$2,200 USD to build, but very little to maintain.<sup>27</sup> Local nurses and staff are trained in order to eliminate the cost of hiring highly educated nurses for secretarial duties. This also allows specialists, such as hospital surgeons, to focus on their areas of expertise.

**Summary.** Aravind has a unique model that utilizes revenue from paying patients to subsidize disadvantaged patients.<sup>28</sup> To achieve this social value, volunteers and local hiring strategically reduce costs. Aravind also has a streamlined and efficient operating system, which allows for increased number of operations and decreased staffing cost.

## SKYHEALTH

SkyHealth is a pilot franchise telemedicine program started in 2008 that combines family planning and female health in rural areas around New Delhi, India. SkyHealth operates under the non-governmental organization World Health Partners. In an 18-month pilot period, SkyHealth provided 25,000 teleconsultations and 188,401 couple-years of protection (estimated protection provided by contraceptive methods during a 1-year period)—effectively preventing 107,658 unwanted pregnancies. SkyHealth has a hierarchical network of 1,200 SkyCare rural health providers, 120 telemedicine provision centers (TPCs), 16 franchise centers, 9 diagnostic clinics, and 1,400 rural pharmacies.<sup>29,30</sup> SkyHealth TPCs serve as tele-diagnostic centers and SkyCare support and coordination hubs and are situated in more centrally located villages. They connect patients with doctors at central medical facilities via the ReMeDi™ system and can either refer patients to franchisee clinics or provide transportation to a hospital. Each SkyHealth center has 7–10 SkyCare providers underneath it.

1. **Customer segments.** SkyHealth is targeted toward women in rural India as it focuses on family planning and female health.

2. **Value proposition.** In India, there is one doctor for 1,700 people, and high concentrations of doctors in large cities leave a lack of quality healthcare in rural areas.<sup>31</sup> Community members who use the system are able to have their health recorded and receive feedback without traveling long distances to a doctor or spending a lot of money. SkyHealth also enables female entrepreneurs to make money.
3. **Channels.** SkyHealth equips rural health providers in the communities with training and low-cost mobile solutions that allow them to perform diagnostics, symptom-based treatments, teleconsultations, and referrals to the TPCs. They are often the first and only point of contact for the majority of the patients. When the patients are referred to the TPCs operated by female franchisees, their information is transmitted via the online database (using dial-up) to doctors who provide feedback and assist with prescription drug delivery.
4. **Customer relationships.** Rural health providers are essential in maintaining personal customer relationships. Entrepreneurs at the TPCs are responsible for collecting and forwarding patient data to the doctor.
5. **Revenue streams.** TPCs are franchised for \$3,000 USD, which include a computer, furniture, satellite, generator, promotional materials, technical support, and training for the entrepreneur. Each patient is charged 50 INR (about \$0.90 USD) for a consultation.
6. **Key resources.** Female entrepreneurs who are trusted community members and possess at least a high school degree franchise the TPCs. Rural health partners are also engaged as entrepreneurs and trained to determine whether or not to refer patients to the TPC. For each successful referral, the rural health partner will receive a part of the patient's consultation fee.
7. **Key activities.** SkyHealth franchises TPCs to local female entrepreneurs in rural India. It provides the information, advertising materials, medical devices, and training to run the centers and to conduct consultations with clinics in the city. The SkyHealth network connects female entrepreneurs, patients in rural communities, doctors, and pharmacists.
8. **Key partnerships.** SkyHealth partners with doctors and pharmacies. Doctors are able to view patient information from the rural health centers and provide feedback. Pharmacies are key partners because they supply various means of birth control.
9. **Cost structure.** With each 50 INR (\$0.90 USD) charged to the patient per consultation, 20 INR (\$0.36 USD) is given to the TPCs, 20 INR (\$0.36 USD) is given to the rural health providers, and 10 INR (\$0.18 USD) goes to World Health Partners for administrative activities and salaries for the doctors.

**Summary.** The extensive supply chain of SkyHealth creates jobs at different organizational levels. This franchising system in turn provides much more publicity for the program than advertising alone. Each part of the supply chain is able to capitalize on its relationship with other customers. This triage system makes processes more efficient by reserving time for important medical problems. Specialized

cases that are referred to the TPC will receive more attention from a doctor, whereas basic problems can be resolved with the rural health provider. Having hierarchical levels in the supply chain increases revenue and value for the entire business model.

### PLA TELEMEDICINE

The People's Liberation Army (PLA) of China established a telemedicine network in the early 1990s that covers more than 100 bidirectional satellite stations in the army, military hospitals, and some rural army clinics.<sup>32</sup> In 2009, 2,956 teleconsultations were conducted, including 100 emergency and specialty cases. Additionally, 60,000 people attended distance education sessions.<sup>33</sup>

1. **Customer segments.** The telemedicine network of PLA serves military personnel, especially those in remote areas, free of charge. It also serves civilians for a fee.
2. **Value proposition.** The PLA telemedicine system saves patients the time and money necessary to travel to a doctor,<sup>32</sup> provides experts for advanced medical cases, and provides military personnel healthcare access at a low cost and with increased efficiency. Through telemedicine, army doctors can avoid going in-person to dangerous environments like battlefields or highlands.<sup>32</sup>
3. **Channels.** The patient's medical data are sent to a medical expert, and a consultation time is scheduled by the Military Telemedicine Network Management Center according to the workload of the entire network and the severity of the medical condition.<sup>33</sup>
4. **Customer relationships.** Civilian clients receive quality specialty consultations that are not locally available.
5. **Revenue streams.** Soldiers in service can receive PLA telemedicine service for free. In the PLA's 208 hospitals, civilians pay \$104–119 USD per consultation.<sup>34</sup>
6. **Key resources.** More than 100 experts in the Advanced Medical Research Center, 100 satellite earth stations, 1 satellite main station, and a unified Web site serve the program.<sup>33</sup> A specialty healthcare database and an online library have been established for all healthcare workers.<sup>32</sup>
7. **Key activities.** The Military Telemedicine Network Management Center and the Technological Support Center are responsible for management, software development, and maintenance. The stations are managed directly by local healthcare departments that need telemedicine service from a higher-level center. All healthcare workers involved in the telemedicine network are required to be trained and certified.<sup>33</sup>
8. **Key partnerships.** The network hardware and StarNet network management system are imported from foreign countries.
9. **Cost structure.** PLA is funded by the Chinese government, and specific costs are not available to the public at this time.

**Summary.** PLA has a basic business model that is funded for the most part by the Chinese government, although some revenue is also generated by civilians, who pay a premium for treatment. This allows the program to focus on military needs. Strong government support

of the program also means strict regulations, which contribute to the consistency and high quality of care, allowing PLA telemedicine to remain successful.

### REVIEW

Although the number of telemedicine systems in the developing world is growing, the ventures discussed in this article are well known and have a large reach of customers. It is interesting to note that in the case of Aravind, the costs for customers who cannot afford to pay are covered by a large group of middle-class paying customers. The phenomenal success of Aravind has proven that ventures that rely on a large market base and community support to subsidize expenses for the most marginalized populations are possible without significant administrative and financial burden.

Telenor and PLA are both interesting case studies in that health service was not originally the priority of the company or the government, but was rather an addition to the existing infrastructure. However, the strong infrastructure allowed for value creation by augmenting core services through telemedicine. In all the developing country ventures, existing telecommunications networks were utilized to provide services, whether through the telecom company itself or through a partnership. In this way, costs can be reduced for both the venture and the customer/consumer. Affordability and accessibility are two major value propositions for telemedicine ventures in developing countries.

### Discussion

A chart comparing the business models of the eight telemedicine ventures discussed in this article is shown in Table 1. An additional column detailing start-up funding is included as a valuable reference for early-stage ventures and is an indicator of the private or public nature of the venture. The trends in each business canvas category from the value proposition to start-up funding are discussed in this section.

Although convenience is a primary value proposition in developed countries, reducing travel time and expenses are the primary value propositions in developing countries. These value propositions apply to both the customer and the consumer (whether they are the same or different). Information storage is also valued by customers because of the convenience, reliability, and reduced costs. Other value propositions, listed in decreasing rate of appearance are, accessibility, improving the cost–quality ratio, reducing financial and institutional risk, education, and space efficiency.

An interesting trend to note in the customer segments is that the telemedicine ventures in the developed world mainly target companies and organizations, whereas those in developing or economically disadvantaged areas mainly target individuals. Arizona Telemedicine only sells memberships to health and governmental institutions, whereas ventures such as TeleDoctor and Aravind are focused on individuals within marginalized populations. Arizona Telemedicine and Myca Nutrition enable their customers to offer telemedicine services to their end consumers. Tactive does offer direct telemedicine service to individuals, but it also sells it to

Table 1. Comparison Among Eight Telemedicine Business Models from Diverse Geographic Regions and Revenue Streams

	VALUE PROPOSITION	CUSTOMER SEGMENTS	PRIMARY CHANNEL	CUSTOMER RELATIONSHIPS	KEY RESOURCES	KEY PARTNERS	KEY ACTIVITIES	REVENUE STREAMS	COST STRUCTURE	START-UP FUNDING
1. Arizona	Reduce equipment and telecommunication network cost for institution	Private and public hospitals, prisons, schools	Governmental and institutional network	Arizona Telemedicine acts as a purchasing agent and consultant for customers	IT platform, Internet, database and storage infrastructure	Arizona state government, utility and telecommunication companies	Infrastructure purchasing, platform management, training, consulting	\$5,000 per annual membership or \$1,500 per service	Shared database and communication network	\$1.13 million federal grant, Arizona state grant
2. Myca Nutrition	Timely and accurate diet monitoring platform	Nutritionists and doctors in Canada	Mobile phone	Automated service platform	IT and cell phone infrastructure	Doctors, nutritionists	Platform management	Monthly subscriptions, \$30 for 5 clients, \$90 for 100 clients	Platform development, marketing	Myca Health Inc.
3. Tactive	Improve productivity in employees, confidential personal assistance	Companies and individuals with addiction problems	Internet	Dedicated personal assistance, self-service through information	IT platform, medical professionals	Government, FactorE (technology), insurance companies, franchisees	Platform management, professional counseling	\$2,604/patient, estimated profit \$260/patient	IT development and maintenance, personnel, education, training	\$5.21–6.25 million by Tactus Equity funding
4. Tele-Doctor	Saves travel costs to doctor, 24/7 accessibility, multilingual, confidentiality, increased revenue	Rural Pakistani patients, doctors	Mobile phones	Non-dedicated personal assistance	Wireless network, doctors	Telenor wireless network, endorsed by health ministry	Platform management, medical consultation	Pay per minute, \$0.08/minute	Pay for doctors, operational costs	Telenor
5. Apollo	Reduced travel expense, specialized care, continued medical education	Organizations and individuals in rural India	Secondary care hospitals	Non-dedicated personal assistance	IT platform, healthcare specialists, satellite communication	Specialty Apollo health-care centers	Platform management, specialty consultations, medical education	\$10 per patient consultation, government and company pay total network usage fees	Data transmission, peripheral centers, consulting fees	Apollo Group
6. Aravind	Accessible and affordable eye care	Rural and low-income areas of India	Rural care centers, mobile clinics	Non-dedicated personal assistance	IT platform, medical devices, transportation services	Volunteers, the TIERS research group	Platform management, care center operations, training, education, research	Pay per consultation	Research, product manufacturing and distribution	Dr. G. Venkataswamy's personal funds
7. Sky-Health	Women entrepreneurs make money, patients save travel costs to doctor	10,000 villages in India	Rural telemedicine provision centers	Dedicated local personal assistance	IT platform, medical devices	Women entrepreneurs, rural health partners, doctors, pharmacists	Platform management, care center operations	\$3,000/franchise, \$0.90/consultation	Consultation income: 40% to entrepreneurs, 20% to rural health partners	World Health Partners NGO grant
8. PLA	Accessibility to specialized care, safety of healthcare professionals	Military personnel, civilians	Military base care center, mobile clinics	Centralized service allocation, personal assistance	IT platform, >100 medical experts, satellite, database and online library	Chinese government, military hospitals	Platform management, specialty consultations, training	Government pays for military, civilians pay \$104/consultation	Unavailable	Chinese government

IT, information technology; NGO, non-governmental organization; PLA, People's Liberation Army; TIERS, Technology and Infrastructure for Emerging Regions.

organizations in a wholesale manner. We postulate that the telemedicine market is more mature in developed countries than developing countries because of the digital divide. Therefore, telemedicine ventures in developed countries target organizations instead of individual customers because of the economy of scale and higher profits. At the same time, ventures and customers in developing countries are more attuned to the idea of just-in-time micro-payments for telemedicine services. Nevertheless, the trend of targeting organizations is gradually spreading into developing countries. For example, Apollo Telemedicine in India has also begun offering services to organizations and companies.<sup>23</sup>

Information technology and Internet access are crucial enablers of customer channels, and without them many of these ventures would not exist. In developed countries, information technology is the front-end primary customer interface, whereas in the majority of the developing world ventures there is a rural care center (brick and mortar location) that fulfills the value proposition and acts as the patient interface. This is due to limited Internet access in rural areas as well as the customer's preference for interacting with the system through a trained and reliable official. This helps rural economies by creating jobs for workers that interact with the customers. Such ventures might target their marketing efforts at the end-users but design their user interfaces and concept of operations for their trained officials.

Personal assistance-based customer relationships are common across most ventures. However, there is a distinction between dedicated and non-dedicated assistance. Telenor offers personal assistance—patients are able to have personal interaction with a doctor—but the same doctor is not assigned to the same patient every time. However, systems like SkyHealth provide dedicated personal assistance service that consistently connects the same female entrepreneur or rural health partner to the patient. Non-dedicated personal assistance is easier and less expensive to provide uniformly. Dedicated personal assistance has the advantage of providing a personal connection, which contributes to customer retention. It is essential for telepsychological treatment programs like Tactive to retain patient trust, which is attained by patients receiving progressive feedback and having treatment consistency. Whether a venture chooses dedicated or non-dedicated assistance depends more on the need of the specific healthcare provision than on whether it is based in a developing or developed country.

Portability and accessibility of the telemedicine system are equally important in developed and developing countries. Ventures operating in rural and remote areas have portable technologies because mobility of the telemedicine units is crucial to their success. Delivery of clinical consultation services relies on medical equipment, information technology infrastructure, and the employment of medical experts. However, Telenor and Myca Nutrition require only a simple cell phone and medical experts on the other end. The rapid proliferation of cell phones, especially in the African continent, opens up tremendous opportunities for cell phone-based telemedicine systems. In terms of key partnerships, the ventures save expenses by maintaining partnerships with government and private companies.

All but Myca Nutrition and TeleDoctor receive direct or indirect support from the government.

All eight ventures have comprehensive value chains achieved by peripheral activities in addition to their primary services. The Arizona Telemedicine Program provides a wide array of membership benefits, and Myca Nutrition helps doctors expand their customer base. SkyHealth, Aravind, and Apollo, all located in India, provide “end-to-end” solutions for the entire supply chain, from patients to doctors: SkyHealth provides employment for women and trustworthy members of the community in a tiered system; Aravind provides transportation for the patients to reach the hospital and arranges for follow-up appointments as well as eyeglass delivery to rural areas; and Apollo connects hospitals with specialty care centers but also works at the primary care level by using mobile telemedicine centers to reach patients in rural areas. Six of the ventures (all except Myca Nutrition and TeleDoctor) utilize readily available telemedicine platforms for educational purposes. In most cases, patients or doctors are receiving education; in the Arizona Telemedicine Program, information and data are shared among partners. The types of supporting activities are determined by local needs. In developed countries, the ventures help customers reach more clients in a convenient way, whereas in developing countries, the ventures address geographical and infrastructural constraints. The educational component, which is valued in both developed and developing countries, further strengthens the companies' social mission and leads to more effective communication between all parties.

There is a noticeable trend to develop telemedicine as a complementary part of other services. The telemedicine department of an organization and other departments can form a mutually beneficial relationship. TeleDoctor is a subset of the Norwegian telecom company, Telenor. Although TeleDoctor had not started generating enough revenue to cover all costs, having stable revenue from Telenor helped protect against financial deficits. Tactus uses its telemedicine platform Tactive to attract clients with its anonymous service. Aravind successfully provides a comprehensive care model for the patients, with telemedicine being just one arm of the larger system.

Four models of payment are prominent, each appropriate for the nature of service provided: pay per service, pay per membership, pay per treatment period, and franchising. There are also diverse ways for optimizing revenue streams. Telenor makes the payment process convenient by charging directly through the phone company. Tactive broadens its revenue stream by developing group services to company employees. It also provides statistics on addiction problems to the Dutch government and promotes social change in exchange for funding.

In three of the four case studies in developing nations (excluding SkyHealth), telemedicine ventures are privately held. This contrasts sharply with both Arizona and PLA, which are partially or completely government subsidized (here, China is considered as part of the “second” world or transitional country in terms of development). This shows a strong push by the private sector in observing the needs of a community and taking action to mitigate the problem. It also

suggests that patients are more willing to pay for telemedicine services in developing countries, where saving travel costs is viewed as a more compelling value proposition than in developed nations with reliable transportation systems.

All eight ventures except for Myca Nutrition have both social and economic goals. SkyHealth's value proposition is empowering female entrepreneurs while striving to prevent unwanted pregnancies. Aravind, mainly focused on the operation of eye hospitals, uses teleconsultations to further expand its customer base. Its screening service creates "customers out of non-customers." Social mission is integral to the Aravind eye hospital and presents an interesting hybrid model that couples economic and social bottom lines: the for-profit arm of Aravind feeds into the not-for-profit arm and helps mitigate the treatment cost for the underprivileged population. The Apollo Telemedicine Network utilizes a similar model.

## Conclusions

This article discussed the business models of eight diverse telemedicine ventures. There are other ways to create, deliver, and capture value besides the approaches discussed in this paper. One of them is selling de-identified patient information to inform public policy or develop new products. Tactive provides health statistics to the government. Industry may also find the patient information useful to develop the next generation of products and services. For example, PatientsLikeMe, which was not included in this article, is a company that collects information that patients share about their experience with the disease (including symptoms, treatment, mood, quality of life, and more) and sells it to research companies that are developing or selling new products.<sup>35</sup> This model has transformed the way patients manage their own conditions and changed the way industry conducts research and improves patient care.

In all of the telemedicine ventures discussed in this review, value chains are enhanced when the business model provides value (whether social or economic) to all entities involved. This value chain can be emphasized using Osterwalder's "Business Model Canvas." Customer segments with specific problems and needs are the starting point of all the ventures. Especially in developing countries, the cost associated with time and travel is valued much more than convenience of access. Thus, it is important to understand and consider these context-specific factors and mindsets when designing economically sustainable telemedicine ventures in developed or developing countries.

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