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**hewlett packard ehealth center: healthcare access through technology convergence**

Kajari Mukherjee, Bhuvaneashwar Subramanian, and Michael J. Rouse wrote this case solely to provide material for class discussion. The authors do not intend to illustrate either effective or ineffective handling of a managerial situation. The authors may have disguised certain names and other identifying information to protect confidentiality.

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As the leadership team meeting ended in Delhi, India, Laxmi Narayan Rao, chief technology officer of the Enterprise Group business at Hewlett-Packard India (HP),[[1]](#footnote-1) was thinking about some key issues related to scaling up HP’s eHealth Centers (eHCs). He recollected the recent barrage of emails from state governments and companies enquiring about the rapid deployment of eHCs. These centres digitally delivered affordable diagnostic support to patients in villages and remote areas of India where none was otherwise available. The solution was initially conceived and developed in 2012 as a mandate from HP’s corporate social responsibility (CSR) team to develop an affordable technological solution for rural healthcare in India. By mid-2016, there were 55 centres in operation—each was attached to a primary health centre—a miniscule number compared to what the country actually needed. The eHCs had to be scaled to bridge the physical divide between doctors in urban centres and the rural population spread across approximately 600,000 villages.[[2]](#footnote-2) Further, there were concerns within the HP leadership team about the adequacy of current strategies adopted for eHCs for both improving remote healthcare access and scaling up the model across such a large number of rural locations.

**THE INDIAN HEALTHCARE SYSTEM**

India spent comparatively little on healthcare in 2014; only 4 per cent of the country’s gross domestic product (GDP), including public and private expenditure, was dedicated to healthcare, which was lower than the global average of 8.3 per cent. Government funding for healthcare accounted for 1 per cent of the country’s GDP. This compared poorly with other emerging nations.[[3]](#footnote-3) The private sector, however, dominated the healthcare delivery segment, delivering up to 70 per cent of the total.[[4]](#footnote-4) Private healthcare infrastructure in India provided 58 per cent of hospital buildings, 29 per cent of hospitals beds, and 81 per cent of doctors, and this was expected to continue.[[5]](#footnote-5) The private sector accounted for over 82 per cent of outpatient visits, 58 per cent of inpatient expenditure, and 40 per cent births; this was a steep increase over the past three decades, when private healthcare accounted for 5–10 per cent of patient care.[[6]](#footnote-6) Although the allopathic private sector was almost non-existent in rural India, it provided 80 per cent of urban healthcare needs.[[7]](#footnote-7) More than 60 per cent of Indian healthcare spending was self-financed, one of the highest rates in the world.[[8]](#footnote-8)

The Indian government aimed for universal health coverage as part of its forward planning, but much of its potential success was dependent upon improving core health infrastructure to provide for the health needs of the approximately 70 per cent of the Indian population living in rural areas.[[9]](#footnote-9)

**Primary Healthcare in India**

India had a three-tiered public healthcare system. Primary care was the first level of contact. Secondary care was consultative, usually short term in nature, and helped primary-care physicians with their diagnostic or therapeutic needs. The tertiary level was specialized consultative care usually given in conjunction with hospitalization and advanced diagnostic support services. Public health facilities were inefficient, had poorly maintained medical equipment, were woefully small in number, and were inadequately managed and staffed. For instance, the number of doctors per 100,000 patients was 45, versus an expected rate of 85. Similarly, the number of nurses, auxiliary nurses, and midwives was 75 per 100,000 patients, versus the standard of 255.[[10]](#footnote-10) The overall shortage varied widely across states: there was one hospital bed for every 614 persons in one state, whereas another state had one such bed for every 8,789 persons.

Typically, urban hospitals were far better equipped than their rural counterparts. Urban areas commanded 73 per cent of all public hospital beds,[[11]](#footnote-11) 76 per cent of all doctors, four times the density of doctors, and three times the density of nurses compared to rural areas.[[12]](#footnote-12) However, India also had hospitals offering world-class treatment that attracted about 250,000 foreign patients annually.[[13]](#footnote-13) Factors including low cost (65–90 per cent cheaper than in the United States), international accreditations, a comprehensive range of treatments, skilled doctors and nurses, sophisticated medical technology, and infection control had made India a favoured destination for medical tourism, whose estimated worth was about US$3 billion.[[14]](#footnote-14)

Worldwide, a consensus existed that health systems undergirded by primary healthcare principles achieved better health in patients and greater health equity than systems with a specialty care orientation.[[15]](#footnote-15) In the three-tiered system of rural India, primary healthcare was provided primarily by public sector infrastructure (see Exhibits 1 and 2). Because of the shortage of infrastructure, resources, and awareness, infectious diseases dominated the morbidity pattern in rural areas, accounting for 40 per cent of total morbidity in rural areas compared to 23.5 per cent in urban areas. The primary reasons for poor healthcare indices in rural areas were poor-quality or non-existent infrastructure; large-scale vacancies in the posts of doctors and paramedical staff; poor attendance of staff, including doctors citing poor living and working conditions as reasons for their absence; poor training; and low morale. There was scant supervision of all categories of staff, including doctors. Under rules governing the employment of permanent staff, jobs had fixed salaries with no performance-based matrix and were assured until retirement.

The National Rural Health Mission, launched in 2005, was an initiative undertaken by the [government of India](https://en.wikipedia.org/wiki/Government_of_India) to address the health needs of underserved rural areas. One of the aims of the National Rural Health Mission was to provide each village with at least one trained, female community health activist, called an Accredited Social Health Activist (ASHA—meaning hope in many languages of India), selected from the village itself and accountable to its locally-elected governing body. ASHAs were responsible for creating awareness about health and its social determinants, and for mobilizing the community towards local health planning and increased utilization of and accountability for existing health services. They were provided with a drug kit to deliver first contact healthcare. This was not a permanent job; rather, ASHAs earned performance-based compensation. By March 2015, there were about 900,000 ASHAs across India.[[16]](#footnote-16) Given the state of affairs of rural healthcare facilities, India’s 12th Five-Year Plan[[17]](#footnote-17) discussed using technology for telemedicine and providing consultation support to doctors at primary and secondary facilities from specialists at tertiary centres, and for providing computers and connectivity across the three tiers of the healthcare infrastructure. However, beyond telemedicine, a delivery ecosystem was required to overcome the infrastructure and resource shortfalls. Technological intervention was required, which, in turn, needed collaborative engagement across technology companies, medical service providers, and the government.

**CORPORATE CITIZENSHIP AT THE HEWLETT-PACKARD COMPANY**

Founded in 1939, the Hewlett-Packard Company (Hewlett-Packard) incorporated “global citizenship” as part of its corporate objectives in 1957. In the words of co-founder Dave Packard, “The betterment of society is not a job to be left to a few. It’s a responsibility to be shared by all.” Hewlett-Packard exemplified the concept of global citizenship as good business by being socially responsible. Among its business drivers, Hewlett-Packard placed particular importance on aligning its innovation agenda with social goals, particularly in education and healthcare. The choice of healthcare as a social goal was aligned with the United Nations Millennium Development Goals to improve maternal health and to combat HIV/AIDS and other communicable diseases.

Hewlett-Packard invested 0.1 to 0.5 per cent of its annual revenue in creating innovations such as a cloud-based product authentication system to scan for counterfeit drugs through mobile messaging, and a network of data centres that stored, sorted, and transmitted data to improve early diagnoses of the HIV/AIDS virus in Africa.

**Corporate Social Responsibility (CSR) at HP**

The HP CSR team sponsored philanthropic initiatives such as education camps and information technology (IT) enablement in villages. In early 2011, Business for Social Responsibility (BSR),[[18]](#footnote-18) a social responsibility benchmarking firm, was engaged to evaluate and suggest potential opportunities for expanding HP’s scope of activities. BSR suggested that the primary healthcare system could benefit from technology intervention to improve healthcare access for both the urban and the rural poor. The head of CSR at HP, Sushil Bhatla, wholeheartedly agreed and spent several months identifying appropriate business groups that could create an affordable technology solution for social good.

In October 2011, Bhatla invited key members of business groups across HP to Delhi for a discussion. As the division had a consulting arm and a core product portfolio based on cloud servers and storage technologies that formed the IT backbone for enterprises, the business groups agreed to the idea of creating an affordable technology solution. At the end of the meeting, the CSR head provided $50,000 as start-up capital to fund a technological intervention to fortify the existing primary healthcare system.

**DEVELOPING THE PROTOTYPE: January 2012 to March 2013**

Bhatla believed strongly that the technology intervention to improve primary healthcare should become a viable business in the long run. HP had to identify appropriate technological solutions and collaborators to create a solution that overcame the limitations of telemedicine and had the potential to become a viable business opportunity able to be rapidly scaled. Effective diagnosis by a physician relied on a physical examination of the patient and access to historical and current patient data; this ranged from obtaining information on vital signs to getting input from prescribed diagnostic tests. Unfortunately, these aspects were not effectively met through early telemedicine initiatives in the country. Doctors were essentially comfortable with the physical clinic and could not comprehend how a technology solution could potentially provide the same experience as a brick-and-mortar clinic. Bhatla and Rao believed that this problem could be resolved if existing technology could somehow replicate an environment that was as close to the physical world as possible. They therefore busied themselves in evangelizing the idea and identifying stakeholders.

**Identifying the Data Centre as the Core of the Healthcare Solution**

To bridge the physical distance between patient and doctor, much of the core solution had to be drawn up around a data centre. A data centre was a system that facilitated the storage, processing, and transmission of digital data between computers. From the viewpoint of connecting a doctor to thousands of patients in rural areas, this meant a massive amount of data transmission. Fortunately, HP had developed a technology called ecoPOD (Performance Optimized Data) a couple of years previously.[[19]](#footnote-19) The ecoPOD was an energy efficient data centre that reduced the company’s carbon footprint and consumed 93 per cent less energy than regular data centres. This solution could create additional capacity for hospitals to store a large quantity of packaged medical data.

**Developing the Prototype Concept**

Over the course of the next three months, a core team comprising HP colleagues from corporate affairs, the enterprise group, and the social innovation department was formed. The team brainstormed about hosting the ecoPOD and connecting it to medical equipment and a videoconferencing system. After some months of detailed research, the team agreed on hosting the ecoPOD-driven healthcare centre in a modified shipping container. Shipping containers had been used in the past by several non-government organizations (NGOs) to create mobile clinics, owing to the containers’ ability to lift and shift the clinics to new locations. This ensured that the healthcare centre could be scaled without the land acquisition challenges that accompanied a brick-and-mortar facility. The team then drew up a plan for the eHC prototype (see Exhibit 3) that included the ecoPOD, a telemedicine studio, core IT infrastructure, and a placeholder for medical equipment, all of which would be housed in a shipping container of 40 × 16 ft. (about 12 × 5 metres).

**Identifying Partners**

The team believed that input from medical specialists was necessary for creating a functional eHC. They contacted the director of the Council of Scientific and Industrial Research (CSIR),[[20]](#footnote-20) Professor Samir Brahmachari, to explore a possible collaboration. The CSIR at that time was planning to build an integrated healthcare telemedicine infrastructure that would take advantage of telemedicine to provide access to quality healthcare for the rural and urban poor. The CSIR formalized an agreement with HP to provide both funding and experienced physicians to help design the prototype of the eHC.

For HP, the partnership with the CSIR provided the necessary backing of a government organization to deliver an effective solution that could be scaled across the country. It also offered access to a ready pool of medical domain experts, led by Dr. Anurag Aggarwal of the CSIR, who could effectively guide the design of a solution that was sensitive to the needs of healthcare professionals.

**Engaging an Open Cloud Technology: Creating a Real Medical Centre**

Together, the teams at the CSIR and HP wanted to create a technology solution that would mimic, as closely as possible, a real clinic. This, according to HP, could happen only through cloud computing—a technology that enabled the operation of a facility or service even when the IT infrastructure to manage it was remote, as was the case with Gmail. However, partnering with a dedicated cloud vendor was extremely expensive, and it implied vendor lock-in and possible legal implications. HP prepared for this potential challenge by adopting open source software called the Open Electronic Medical Record (Open EMR). The data stream in the eHCs and the Open EMR were connected to the cloud through the nearest mobile tower, allowing Open EMR to receive clinical data and enabling the clinical workflow. The cloud-based Open EMR connected patients at the eHCs to doctors at a tertiary care hospital. Further, doctors could enter their notes and prescriptions in the Open EMR.

**Connecting Medical Devices to the Open EMR**

One of the initial setbacks of Open EMR was that it could not record data directly from the medical devices used for patient diagnosis. After systematic due diligence that lasted for over four months, the HP team identified a host of small- and mid-sized medical device companies who were willing to collaborate with the team to develop devices that could connect and transmit recorded medical data to the Open EMR. This approach was based on a technology concept called the “internet of things,” which was simply automated data transfer between connected devices.

**The eHC Prototype**

The eHC Prototype was housed within two pre-fabricated half shipping containers, which could be easily navigated across hilly terrain. The layout included an initial patient registration area where vital signs would be recorded. Apart from the registration area were two air-conditioned telemedicine studios, along with areas for minor surgical operations, a lab area, and a pharmacy. Devices that had a digital output interface were included wherever possible in order to record data.

**Identifying a Location for the Prototype**

Despite a partnership with the CSIR, finding a location to install the eHC prototype was a challenge. Several state governments wanted to see a fully operational solution before agreeing to its installation. However, some leading members of the Haryana[[21]](#footnote-21) government were open to hosting the eHC in their state, owing to the possibility of providing primary healthcare services to villagers in the region. The CSIR and HP conducted a survey that identified Chausala as the ideal village to setup the eHC. Chausala was a small village with a population of 4,000, whose residents typically had to travel eight kilometres to access a healthcare facility. One major worry of installing the eHC in Chausala was the few hours of power availability in that location.[[22]](#footnote-22) However, water was available for the eHC, as well as a road that could transport a truck, which was essential for transporting the eHC. Over the course of a month, the CSIR and HP completed the construction of a concrete base to host the eHC, and two days after the base was completed, the eHC was transported to the location by truck and hoisted onto the base by a crane. The first prototype of the eHC was launched in December 2012.

**Manpower and Connectivity Issues**

The eHC prototype at Chausala faced challenges soon after its installation. The first was poor internet connectivity, which disrupted the interaction between doctors and patients. After conducting due diligence, the HP team identified Vodafone as the internet service provider for the eHC. The second issue was ensuring a continuous presence of paramedics and physicians. HP had partnered with a host of NGOs and a nearby medical college to provide physicians and interns to staff the eHC, which was soon catering to 3,000 patients per month. However, HP had a difficult time attracting doctors and paramedics owing to poor monetary prospects, poor living and working conditions in the rural areas, and, for some, discomfort with the technology.

**IMPLEMENTING THE eHC: MARCH 2013 TO APRIL 2014**

The eHC was a scalable solution with a potential market opportunity of $7 billion. It was therefore important for HP to ensure consistent quality in patient care delivery and a seamless technology experience in every eHC.

**Partnering With Narayana Health**

HP conducted a detailed market assessment and identified Narayana Health as a potential hospital partner for the eHCs. The selection criteria included the ability to deliver affordable care and have a wide network across India.

Founded in 2001 by Dr. Devi Shetty on the principle of providing affordable, quality care, Narayana Health was a multi-specialty hospital that had a nationwide presence, with 26 hospitals. Narayana Health had also established partnerships with several small hospitals across the country, which leveraged its services. The hospital chain was a pioneer in adopting telemedicine in India.

The value proposition of the eHC resonated well with the core principles of Narayana Health. The hospital believed the eHC could help them improve their catchment area, a boundary that provided a hospital with access to the maximum number of patients in a given region.

**Creating Studio Doctors and Paramedics**

HP designed a four-month training program for paramedics and doctors at Narayana Health to familiarize them with the technology used at the eHCs. Doctors and paramedics were trained in three aspects: the use of digital devices and recording patient information on the Open EMR; the application of camera techniques, particularly with regard to facing and positioning the camera for effective diagnosis; and standard operating procedures for paramedics to follow at the eHC. The systematic training prepared these studio doctors, as they were called, to provide a standardized healthcare experience for patients using eHC technology. For instance, it was mandatory to record the vital signs of every patient that visited the eHC. With technology support from HP, Narayana Health staffed the eHCs and the tertiary care centres with paramedics and doctors, respectively. Typically, paramedics would update patient details on the Open EMR and connect patients to specialist doctors at Narayana Health through the videoconferencing system.

**Making the Cloud-based OPEN EMR an Up-to-Date Patient Record**

Patient records in the cloud-based Open EMR were identified through a unique identifier, such as the Aadhar Card,[[23]](#footnote-23) and the information could then be accessed at any of the Narayana Health partner centres. However, because of connectivity issues, the Open EMR could not be updated in real time. To meet this challenge, HP applied a solution called asynchronous mode of data transfer, which collected all patient-specific data and stored them as a buffer. The data was then uploaded into the server and populated the cloud-based Open EMR when connectivity was better.

**Ensuring a High Level of Accountability at the eHC**

The eHCs required close supervision to ensure uninterrupted service to patients who visited the centres from nearby villages. Centres not opening on time was a frequent complaint, so a remote monitoring solution called “Eye in the Sky” was incorporated into the design. The “Eye in the Sky” was a concealed digital camera that took random snapshots inside the eHC. As the camera could be controlled remotely from Bangalore, it was possible for the HP team to review a person’s presence at the eHC at different times. The implementation of this system ensured the steady attendance of paramedics at the eHC and provided a sense of accountability to the partner hospitals.

**Operations at the eHC**

On a typical day, a patient would visit the eHC and have his or her vital signs recorded by the paramedic (see Exhibits 4 and 5). A biometric machine recorded the thumb impression of the patient, and the paramedic then created a patient profile on the Open EMR. The patient’s vital signs were entered automatically in the Open EMR from the connected patient diagnostic device. The paramedic then connected the patient with the doctor at the partner hospital through videoconference. The design of the eHCs was such that doctors could virtually make an accurate diagnosis of the patient’s medical conditions, with the advantage of performing an in-depth physical examination through the presence of paramedics and a video-enabled medical device. Upon diagnosis, the doctor entered a prescription into the patient’s medical record, which was printed for the patient at the eHC (see Exhibit 6).

SCALING UP THE E-HEALTH CENTER: MARCH 2014 to APRIL 2015

From the launch of the prototype in December 2012 until March 2014, the number of eHCs had grown to 17 across the country. Most were set up by HP either on its own or along with support from a corporate or government agency. By the end of 2015, there were 52 eHCs and 75 mobile eHCs across 17 states in India (see Exhibit 7). The number of registered patients had risen to 62,000. The prime triggers that facilitated the scaling up were the creation of a hub-and-spoke model of operation, the creation of mobile eHCs, and the development of an analytics dashboard that measured patient outcomes.

**Hub-and-Spoke Model of the eHC: The Health Hub**

eHCs were generally located within a small town or village and were accessible to patients only within their vicinity (see Exhibit 8), which created challenges for patients where an eHC was not available. Narayana Health found it difficult to expand its reach of patients. HP created a Health Hub that served as the primary area for studio doctors to consult. The Health Hub was established in either a major city or a town and connected wirelessly to several individual eHCs within a 100-kilometre radius. This allowed the pool of physicians to operate on a rotational basis for a few hours every day without disrupting their daily medical practice at clinics or hospitals. Consequently, by the end of 2015, eHCs were deployed through this model across the country and were remotely connected to the Health Hubs in major cities and towns.

**Mobile eHCs**

In addition to stationary eHCs, the HP team developed a mobile version of the eHC to serve patients in locations that lacked an eHC or who were immobile. Mobile eHCs included a telemedicine set-up such as a webcam and portable medical devices that could be packed and carried in a suitcase. These mobile eHCs were carried to the patient’s location by trained paramedics. Data from the mobile eHCs were imported into the Open EMR and patients could consult the doctor at the Health Hub.

**Analytics Dashboard**

The problem with scaling the eHCs was that there had to be a system that would measure the effectiveness of the eHCs and inform HP, Narayana Health, and the CSIR of deviances that required attention. To address this, HP developed a cloud-enabled analytics dashboard that provided an array of metrics, ranging from the number of patient visits to the most prevalent disease in the region.

**BUSINESS MODEL FOR REVENUE GENERATION**

The approximate price of a technology-enabled eHC was around $154,000. HP identified three business models for generating revenue from the eHC. The first model was a public–private partnership with the government to enable the modernization of primary healthcare centres. With the help of the CSIR, and a ready prototype, the team at HP developed partnerships with several state governments to create a technology-enabled solution to deliver healthcare. The second model was to provide the eHC solution to hospitals looking to improve their reach by expanding the catchment area. Private hospitals could expand their reach by installing and running the eHC at a fraction of the cost of setting up a brick-and-mortar hospital facility, which could cost up to $50 million, and had only to staff the eHCs with their doctors and paramedics and compensate them for their services. The third business model was to tap into the mandate of companies to spend 2 per cent of their revenue on CSR activities.[[24]](#footnote-24) Companies were interested in using the eHCs as part of their CSR initiative; the eHCs helped them to move beyond running disparate health camps or financing discrete healthcare infrastructure or equipment, to providing a long-term solution for improving access to healthcare. Such companies partnered with either local NGOs or local hospitals and healthcare workers to provide healthcare support. The companies undertaking such CSR activities were also able to capitalize on the HP brand.

For a private sector medical service provider partner like Narayana Health, eHCs started recouping operational costs—comprised of salaries and the cost of running eHCs infrastructure—and medical and diagnostics consumables from the first month of operation (see Exhibit 9). The capital invested was recouped from 14 months onwards.

**E-HEALTH CENTER OUTCOMES**

eHCs offered significant, positive health outcomes to patients (see Exhibit 10). HP and associated partner hospitals measured benefits to the patient across three parameters: cost of access to care, time-based measurements, and quality of care. Patients visiting eHCs were typically below the poverty line and earned daily wages; to access medical care, they incurred the direct costs of both transportation to the clinic and consultation. They also incurred the loss of productive time. Additionally, as direct costs were high, these patients looked for medical support only when their condition worsened, leading to an estimated three-times increased cost for diagnosis.

Owing to its proximity to the village and the efficient management of patient consultation times, the eHC reduced costs to the patient by more than 90 per cent through the elimination of costs arising from transportation, laboratory tests, and long waiting times. In an eHC, patients spent the first five minutes recording vital sign data, and then about 10 minutes in actual consultation with a physician. Apart from passing on cost advantages to the patient, the eHC also ensured improved quality of patient care. A typical concern in prescribing medication to rural patients had been poor compliance, owing to a lack of access to medicines and the absence of discipline among patients in taking their medication. The eHC addressed the issue of medication non-compliance by the use of regulated short messaging service reminders to patients on their mobile phones. Further, the analytics dashboard established across all eHCs identified patients across varied demographics with a risk for diseases, such as coronary heart failure and asthma, and then began preventive treatments.

**THE CHALLENGES OF DOING GOOD WHILE DOING BUSINESS**

HP realized that the success of the eHCs depended upon being able to demonstrate value to relevant stakeholders. There was a significant need to impress upon dismissive state officials the differentiation of the eHC solution from telemedicine (see Exhibit 11). The various parts of government bureaucracy in India did not necessarily work in tandem, and as a result, sometimes large gaps remained between interest and implementation. The HP team had realized that, for the government, it was a leap of faith to trust the eHCs model since the entire traditional healthcare infrastructure, its support systems, and its processes of checks and balances were bound to brick-and-mortar installations, and to personal contact between patient and caregiver. However, the scaling up of eHC installations was possible only with government support. HP was learning and refining its approach to engaging with various government decision-making and administrative units, and it was a time-consuming process.

Secondly, it was important for HP to deliver technology in a manner that did not disrupt the comfort of users. The eHC mimicked the real life clinical scenario to an extent that ensured a familiarity of surroundings for technology-averse physicians and paramedics. The challenges included having doctors speak while facing the camera and writing e-prescriptions, and having paramedics enter data on computers. Ensuring that a sufficient number of paramedics were available to staff the eHCs and training medical staff across the eHCs and Health Hubs in IT remained key concerns.

Thirdly, although the healthcare sector routinely used sophisticated machines and technologies for diagnostic purposes, using technology for remote healthcare consultation and record collection, storage, and retrieval was unreliable and rudimentary. Thus, a major challenge was overcoming the reluctance of hospitals and doctors to use digital solutions for healthcare delivery.

HP had successfully setup 71 eHCs through its partnership with Narayana Health and other healthcare service providers by early 2016 (see Exhibit 12). State governments were asking for the eHC as an intermediary solution for providing primary healthcare. HP planned to install 500 eHCs over the next five years, but its CSR team sensed the need for a new strategy to address the potential opportunity (see Exhibit 13). HP had to find new government and private hospital partners who had an appreciation for this healthcare technology. Further, the capability of the eHCs also had to be expanded in terms of the diagnostic and treatment services it could provide. As the HP CSR team looked at the performance dashboard of the 71 eHCs, it wondered if HP could identify many more hospital partners like Narayana Health and if doctors and paramedics in these hospitals would remain dedicated to running the eHCs.

Exhibit 1: the Three-tiered system of Rural Healthcare in India

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Category of Health Centre** | **Actual Number as of 2015** | **Average Population Coverage** | **Average Geographical Area (in sq km)** | **Average Radial Distance Covered (in km)** | **Average Number of Villages Covered** | **Serves as Referral Unit** |
| Sub-Centres | 153,655 | 3,000-5,000 | 20 | 2.54 | 4 |  |
| Primary Health Centres | 25,308 | 20,000-30,000 | 123 | 6.26 | 25 | 6 Sub-Centres |
| Community Health Centres | 5,396 | 80,000-120,000 | 577 | 13.55 | 119 | 4 Primary Health Centres |

Note: sq km = square kilometres

Source: “Rural Health Statistics 2014-15,” Ministry of Health and Family Welfare Statistics Division, last updated January 4, 2016, accessed May 31, 2016, http://wcd.nic.in/sites/default/files/RHS\_1.pdf.

Exhibit 2: Services, Resources, and Infrastructure available in rural healthcare centres

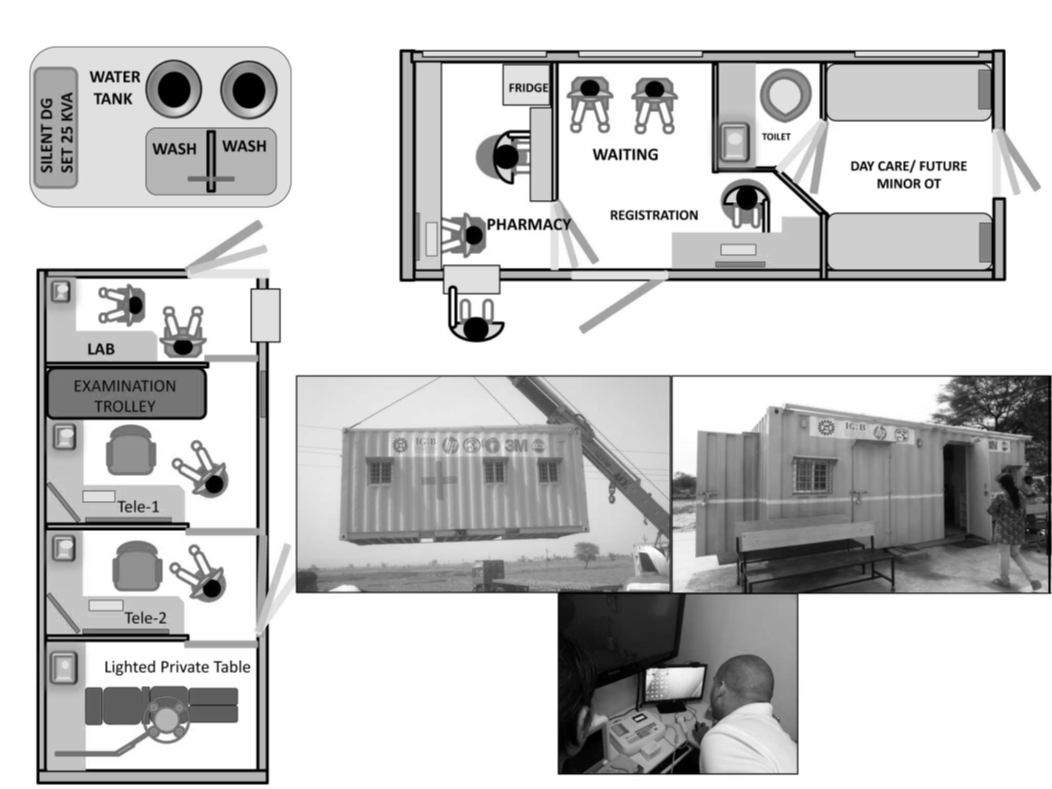
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Range of Services Provided** | **Staffing Norm** | **Infrastructure** | **Centres With no Staff or Less than the Average** |
| Sub-Centres | Behavioural change through communication;  services related to maternal and child health, family welfare, nutrition, immunization, diarrhea control, and control of communicable diseases programs | One–two female health workers and/or auxiliary nurse midwife and one male health worker |  | Without female health worker and/or auxiliary nurse midwife: 8,138;  without male health worker: 71,433; without both: 5,053 |
| Primary Health Centres | Curative, preventive, promotive, and family welfare services | One medical doctor and 14 paramedical and other staff | 4–6 beds | Without a medical doctor: 9,389 |
| Community Health Centres |  | Four specialists: surgeon, physician, gynecologist, and pediatrician supported by 21 paramedical and other staff | 30 beds with one operation theatre, X-ray, labour room, and laboratory facilities | Without a surgeon: 2,477; without a physician: 1,889; without a gynecologist and pediatrician: 2,242 |

Notes:

1. Among sub-centres, 28 per cent had no running water supply, 25 per cent had no electricity supply, and 11 per cent had no all-weather motorable road.
2. The number of primary health centres without a supply of running water, an electricity supply, or an all-weather motorable approach road was about 5 per cent of the total.
3. About 52 per cent of primary health centres had a telephone connection and 56.5 per cent had a computer.
4. The number of community health centres with all four categories of medical specialists present was 751.
5. Among community health centres, 4,224 had a computer or a statistical assistant for management information system or an accountant, 5,024 had a functional laboratory, and 2,707 had functional X-ray machines.
6. Sub-centres, primary health centres, and community health centres did not charge for any of their services.

Source: “Rural Health Statistics 2014–15,” Government of India: Ministry of Health and Family Welfare Statistics Division, last updated January 4, 2016, accessed May 31, 2016, http://wcd.nic.in/sites/default/files/RHS\_1.pdf.

Exhibit 3: The first prototype of the eHC



Note: DG = diesel generator; KVA = kilo volt ampere; OT = operation theatre

Source: Anurag Agrawal, Jaijit Bhattacharya, Nishant Baranwal, Sushil Bhatla, Salil Dube, Viren Sardana, Devender R. Gaur, Danica Balazova, Samir K. Brahmachari, “Integrating Health Care Delivery and Data Collection in Rural India Using a Rapidly Deployable eHealth Center,” *PLoS:Medicine* 10, no. 6 (2013), accessed May 31, 2016, http://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1001468.

**Exhibit 4: medical Diagnostic Devices available in the eHC**

1. Mobile electrocardiogram machines
2. Spirometers
3. Digital thermometer
4. Glucometer
5. Stethoscope

Specific biomedical information captured by these medical devices was recorded directly into the digital electronic medical recorder

Source: Company files.

Exhibit 5: possible diagnostic tests and services in the eHC

1. Outpatient department care
2. Emergency care
3. Essential medicines
4. Mother and child health services including immunizations, and prenatal and postnatal care
5. Skilled assistance at delivery
6. Comprehensive emergency obstetric procedures and newborn care

Source: Company files.

Exhibit 6: Activity Flowchart of the eHC



Note: OPD = outpatient department

Source: Company files.

Exhibit 7: Number of ehc installations

Source: Company files.

Exhibit 8: What do users of eHCs say?

Mehboob, a 52-year-old man in Adilabad, a small village in Andhra Pradesh, had been suffering from diabetes for 10 years. He had to travel 300 kilometres to Hyderabad every month for a monthly check-up and to obtain his regular stock of insulin injections. As a farmer with a meagre income of INR5,000 per month, the regular visit to Hyderabad had become unaffordable. However, in his words, with the installation of the eHC, “We don’t need to go to Hyderabad for everything; we have a high quality specialized service here near our doorstep.”

China Das, a 35-year-old woman and mother of two residing in a village within the Chakda district, described her challenges of getting quality healthcare. She recounted an incident from her childhood: “I had a deep cut in my leg and it was bleeding profusely. There was no doctor nearby. The nearest healthcare facility was in Chakda town.” She had to walk 10 minutes along a long road to the station and wait for the train, which had an irregular schedule. Upon reaching the Chakda station, she had to walk another half hour before she could reach the hospital. By then she had become very ill and had to be taken to the emergency ward. But today, with the eHC, she can bring her child quickly for effective treatment, which was previously not available.

Note: INR = ₹ = Indian rupee; US$1 = ₹67.3557 on June 30, 2016.

Source: Company files.

Exhibit 9: Revenue potential per eHC

|  |  |  |  |
| --- | --- | --- | --- |
| **Level of Care at the eHC** | **Number of Patients per Month** | **Cost per Consultation(US$)** | **Annual Revenue per eHealth Center(US$)** |
| **Primary Consultation** | 1,040 | 2.30 | 28,800 |
| **Secondary Consultation** | 260 | 15.40 | 48,000 |
| **Tertiary Consultation** | 60 | 46.15 | 33,230 |
| **Total** | | | 110,030 |

Note: Figures are estimates for representative purposes and not actuals; 25 per cent of patients attending primary consultation at the eHCs are referred for secondary consultation, and 5 per cent of secondary consultation patients are sent to tertiary consultation; Annual Revenue per eHealth Center = the number of patients per month in the eHC × consultation fee per patient × 12 months with estimate of 40 footfalls per day for primary consultation, 10 footfalls per day for secondary consultation, and 2 footfalls per day for tertiary consultation. In about 74.5 per cent of rural households, the income of the highest earning member was below US$77 per month. About 31 per cent of the total rural households could be broadly identified as “poor” where the main earner had an “insecure and uncertain” source of income and the household lived in a one-room tenement house made of non-durable material.

Source: Ruhi Tewari, “7 in 10 Homes Rural, Most Live on Less than Rs 200 a Day, Reveals New Socio-economic Census,” *The Indian Express*, July 4, 2015, accessed May 31, 2015, <http://indianexpress.com/article/india/india-others/highest-earners-in-75-rural-households-earned-below-rs-5000-secc/>; Company documents.

Exhibit 10: Cost- and Time-Based Patient Outcomes from the eHealth Center (US$)

|  |  |  |
| --- | --- | --- |
| **Criteria of Patient Outcome for Primary Healthcare Delivery (cost-based; subsidized consultation rates)** | **Before the eHealth Center** | **After the eHealth Center** |
| Transportation | $3 | 0 |
| Consultation charges | $2 | $1 |
| Lab tests (three times) | $6 | 0 |
| Total cost per patient | $11 | $1 |
| **Time-Based Outcomes per Patient** | **Before the eHealth Center** | **After the eHealth Center** |
| Wait time per patient | 45 minutes | 15 minutes |
| Consultation time per patient | 3 minutes | 15 minutes |
| Potential savings for a patient earning a daily wage of $5.00 in an 8-hour workday | $2.50  (As a result of no longer having to spend an average of four hours commuting and waiting before consultation with a physician) | $5 |

Source: Company documents.

Exhibit 11: Comparision of three universal healthcare access models

|  |  |  |  |
| --- | --- | --- | --- |
| **Technology Head-to-Head** | | | |
| **Parameter** | **HP e-Healthcare Solution** | **Standard Telemedicine Solution** | **Traditional Primary Healthcare Centre** |
| **Base Infrastructure** | Comprehensive out-of-the-box solution | Telemedicine set-up with studio at all endpoints | Brick-and-mortar with long lead times and resource-heavy model |
| **Skills and Staff Needed** | Standard paramedic with one week of training | Specialized training needed | Standard medicine domain skills |
| **Deployment Time** | An e-clinic can be set up in four to six weeks | Four weeks | Minimum of six to eight months |
| **Integration** | Full | Not possible as it is an isolated work flow | Not applicable |
| **Electronic Medical records** | Complete and includes a digital locker for each patient | Complex | Not applicable |
| **Technology Stack** | Built on open standards with an open source application (Open EMR) | Proprietary and dependent on vendor | Mostly manual and archaic |
| **Inter-operability** | Built on framework with API exchange for concurrent and future requirements | Not applicable | Not applicable |
| **Scalability** | Hub-and-spoke model enables multi-tiered reach and rapid scale | Point solution and therefore rather isolated | Extremely difficult and requires long lead times and massive funds |
| **Sustainability** | Supports multiple engagement and business models | Not applicable | Conventional model and prone to operational challenges |
| **Investments** | Capex: $100,000–140,000;opex: $22,000 per year for a comprehensive maintenance model | Capex: $20,000–100,000;opex: $20,000–30,00 per year plus break fix | Capex: over $1 million; opex: $100,000–200,000 per year |
| **Return on Investments** | 8–14 months | 12–18 Months | 5 Years Minimum |

Note: HP = Hewlett Packard India; EMR = electronic medical record; API = capex = capital expenditure; opex = operational expenditure; all dollar amounts are in US$.

Source: Company files.

Exhibit 12: Photographs of eHealth Centers





Source: “Happily Going Miles for Their Smiles: CSR Activities of US Companies in India (2015–16)—A Compendium,” American Chamber of Commerce in India, accessed May 31, 2016, www.amchamindia.com/wp-content/uploads/2016/04/AmCham-CSR-Compendium-2016.pdf.

Exhibit 13: Market Estimations for Developing and Expanding a Primary Healthcare Centre in India (in US$)

|  |  |
| --- | --- |
| Market opportunity for developing a technology-enabled primary healthcare centre | $11 billion |
| Approximate cost of modernizing an existing primary healthcare centre through information technology | $7 billion |
| Opportunity for expansion of the eHC facility for primary care | $3 billion |
| Approximate cost per eHC unit (information technology installation) | $154,000 |

Note: eHC = eHealth Center

Source: Company files.

1. References to Hewlett Packard, Enterprise Group, and eHC in this case study are attributed to Hewlett Packard Enterprise, which was formed after the Hewlett-Packard Company split into two companies in November 2015. [↑](#footnote-ref-1)
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3. “Twelfth Five Year Plan (2012–2017): Social Sectors, Volume III,” Planning Commission (Government of India) 2013, accessed May 31, 2017, <http://planningcommission.gov.in/plans/planrel/12thplan/pdf/12fyp_vol3.pdf>. [↑](#footnote-ref-3)
4. “Healthcare Infrastructure and Services Financing in India: Operations and Challenges,” PricewaterhouseCoopers, September 15, 2012, accessed May 31, 2016, www.pwc.in/assets/pdfs/publications-2012/healthcare\_financing\_report\_print.pdf. [↑](#footnote-ref-4)
5. “Improving Health and Education Service Delivery in India through Public–Private Partnerships,” Asian Development Bank, August 2010, www.adb.org/publications/improving-health-and-education-service-delivery-india-through-public-private-partnerships. [↑](#footnote-ref-5)
6. Amit Sengupta, Samiran Nundy, “The Private Health Sector in India,” BMJ: Editorials, November 17, 2005, accessed May 31, 2016, www.bmj.com/content/331/7526/1157. [↑](#footnote-ref-6)
7. Sanjeet Bagchhi,” India Has Low Doctor to Patient Ratio, Study Finds,” BMJ: News, September 30, 2015, accessed May 31, 2016, www.bmj.com/content/bmj/351/bmj.h5195.full.pdf. [↑](#footnote-ref-7)
8. Ayushi Gudwani, Palash Mitra, Ankur Puri, and Mandar Vaidya, “India Healthcare: Inspiring Possibilities, Challenging Journey,” McKinsey & Company, December 2012, accessed May 31, 2016, www.mckinsey.com/global-themes/india/india-healthcare-inspiring-possibilities-challenging-journey. [↑](#footnote-ref-8)
9. “Rural Population (% of Total Population),” The World Bank: IBRD-IDA, accessed May 31, 2016, http://data.worldbank.org/indicator/SP.RUR.TOTL.ZS. [↑](#footnote-ref-9)
10. “Twelfth Five Year Plan,” op. cit. [↑](#footnote-ref-10)
11. Vikram Patel, Rachana Parikh, Sunil Nandrai, Priya Balasubramaniam, Kavita Narayan, Vinod K. Paul, A.K. Shiva Kumar, Mirai Chatterjee, and K. Srinath Reddy, “Assuring Health Coverage for All in India,” Lancet 386 (2015): 2422-35, accessed May 31, 2016, www.globalmentalhealth.org/sites/default/files/Patel\_assuring%20health%20for%20all%20in%20India\_Lan

    cet%202015.pdf. [↑](#footnote-ref-11)
12. D. Thamma Rao, “Frontiers without Doctors,” *The Hindu,* updated June 8, 2016, accessed May 31, 2017, www.thehindu.com/news/national/frontiers-without-doctors/article4706995.ece. [↑](#footnote-ref-12)
13. “Foreigners Visiting India for Medical Treatment,” Press Information Bureau, Government of India, March 22, 2017, accessed May 31, 2017, http://pib.nic.in/newsite/pmreleases.aspx?mincode=36. [↑](#footnote-ref-13)
14. Press Trust of India (PTI), “Indian Medical Tourism Industry Touch $8 Billion by 2020: Grant Thornton,” The Economic Times, November 1, 2015, accessed May 31, 2016, http://economictimes.indiatimes.com/industry/healthcare/biotech/Health

    care/indian-medical-tourism-industry-to-touch-8-billion-by-2020-grant-thornton/articleshow/49615898.cms. All currency amounts are in U.S. dollars unless indicated otherwise. [↑](#footnote-ref-14)
15. Barbara Starfield, “Primary Care and Equity in Health: The Importance to Effectiveness and Equity of Responsiveness to Peoples’ Needs,” *Humanity & Society* (February 2009): 56–73, accessed May 31, 2016, http://journals.sagepub.com/doi/abs/10.1177/016059760903300105. [↑](#footnote-ref-15)
16. Rajani R. Ved, “India’s Community Health Worker Programme,” *International Health Policies*, June 3, 2015, accessed May 31, 2016, www.internationalhealthpolicies.org/indias-community-health-worker-programme/. [↑](#footnote-ref-16)
17. Since independence in 1947, the Indian economy had been premised on centralized and integrated five-year programs. The primary data source for the plan reports were national sample surveys carried out as successive rounds of nationwide surveys. Each round, usually a year long, covered several topics of current interest. [↑](#footnote-ref-17)
18. BSR was a global not-for-profit organization that worked with a network of 250 member companies on developing sustainable business strategies. [↑](#footnote-ref-18)
19. The EcoPod was developed through collaboration between the Enterprise Group of HP and HP Labs. [↑](#footnote-ref-19)
20. Established in 1942 as an autonomous body, the CSIR was the largest research and development organization in India, with 37 laboratories and 39 field stations or extension centres. It was primarily funded by the central Ministry of Science and Technology. [↑](#footnote-ref-20)
21. Haryana is one of the 29 states in India. [↑](#footnote-ref-21)
22. Many parts of India experienced shortage of electrical power; as a result, load shedding and intentionally engineered electric power shutdowns (where electricity delivery was stopped across various parts of a region to manage power shortages) were common and more so in rural areas. [↑](#footnote-ref-22)
23. Launched in 2009, the Aadhaar card provided a unique identification number to each citizen. Through indirect incentives, citizens were encouraged to opt for the card. For example, those who were eligible for subsidy and support under various government schemes, a direct cash transfer to their bank accounts happened after a citizen’s identity was established through Aadhaar. [↑](#footnote-ref-23)
24. In 2013, the government regulated that companies of a certain size, based on revenue and profit, had to contribute 2 per cent of their post-tax profits to CSR activities such as the abatement of hunger, health and education, women and child development, environmental sustainability, and others. Though there were no punitive measures if said budget was not spent, companies had to disclose the reason for it in their annual reports. Due to mandated CSR, companies were expected to spend $3.8 billion per year. [↑](#footnote-ref-24)