Cancer diagnosis and telemedicine: a case study from Cambodia

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Cambodia is one of the least developed countries in the world, and presents major challenges to the provision of effective healthcare. Partners Telemedicine, a non-profit organization based in Boston, MA, is leading a pilot project to assess whether accurate diagnosis and treatment can be provided by email to patients in remote locales in the developing world. This project, in rural Cambodia, has had a beneficial impact on the public health of the communities served. There has been a reduced demand for acute care services, with patients seeking treatment earlier and adhering better to their prescribed treatment regimens for chronic diseases, and the project illustrates the potential for simple communications technology to improve care, even to some of the most impoverished communities. However, infrastructure must be improved in Cambodia to enable patients, in particular cancer patients, to receive acute care that can only be provided in distant Phnom Penh.

Key words: Cambodia, telemedicine, rural health services, developing world, delivery of health care

introduction

Cambodia is one of the least developed countries in the world, and presents major challenges to the provision of effective healthcare. Partners Telemedicine, a non-profit organization based in Boston, MA, is leading a pilot project to assess whether accurate diagnosis and treatment can be provided by email to patients in a remote rural region of Cambodia. The project has had a beneficial impact on the public health of the communities served, and illustrates the potential for simple communications technology to improve care, even to some of the most impoverished communities.

health in Cambodia

Cambodia is one of the poorest countries in the world in terms of human development and income. More than 40% of the population live below the poverty line [1], and the per capita income is US$2060, compared to, for example, US$35 750 in the USA [2]. Its human development index score of 0.54 is the second lowest in Southeast Asia, and ranks 121st internationally [2]. The overall health system performance was ranked 174th among other member states of the World Health Organization [3]. Cambodia has the lowest utilization rates of health services in the region, with an estimated average annual rate of 0.29 medical contacts per person with the public health services [4]. This may largely be due to lack of access — Cambodia has the lowest ratio of physicians to population in the region (one per 6400 persons) [4]. This compares to a rate of one per 360 persons in the USA.

Poor health system performance is associated with very poor health outcomes for Cambodians. The life expectancy at birth is 57.4 years, compared to 77.0 years in the USA [2]. Infant mortality is 96 per 1000 live births in Cambodia (versus 7 in the USA), and only one-third of births may be attended by a skilled health professional [2].

Furthermore, inequalities within Cambodian society in income and access to education and health care are markedly higher in many remote rural areas. The HDI score is almost 25% higher in urban regions compared to rural areas [4]. The human poverty index (HPI) is also markedly higher in rural areas of Cambodia (HPI, 45) compared to urban areas (HPI, 34), reflecting poorer access to safe drinking water and health services as well as the higher rates of mortality and illiteracy [4]. While 85% of the population live in rural areas, only 13% of government health workers work there [3].

Initiatives to improve access to healthcare in less developed countries like Cambodia face major obstacles such as poor basic infrastructure and inadequate resources to train more medical personnel [5]. However, communication technologies have the potential to leapfrog such barriers to bring health care to traditionally poorly served remote regions by providing access to distant medical expertise [5]. We have initiated two monthly telemedicine clinics that are successfully providing healthcare to residents in a remote region of Cambodia with very limited medical services.

telemedicine in remote Cambodia

Partners Telemedicine is a part of Partners Healthcare, a large non-profit organization founded by two academic hospitals, the
Brigham and Women’s Hospital and the Massachusetts General Hospital. The primary purpose of Partners Telemedicine is to bring sustainable and quality healthcare to populations that are underserved in health services, usually as a function of geography. Care is provided using various communication technologies to sites in the US and in over 30 other countries on a daily basis. In principle, as much clinical information as possible is assembled at the point of care. This information is then sent via email or to a secure website or by other means to a specialist in a distant centre of expertise, who replies with an opinion that very often impacts the quality of care. Approximately 90% of care is related to oncology, and in 90% of those cases a specialist will provide a significant change to the care plan [6].

In collaboration with two non-profit organizations, the Sihanouk Hospital Center of Hope and American Assistance for Cambodia, Partners Telemedicine is running a pilot project called Operation Village Health that delivers expert health care services to two communities in Cambodia by telemedicine. The two telemedicine clinics are held at Rovieng Village Health Center in the village of Th’naut Malou and Ratanakiri Provincial Hospital in Banlung village (Figure 1), both very remote locations. Rovieng has no running water, electricity or telephones. Neither village had access to medical specialists before this program was started. Indeed, most villagers had never seen a physician or received any proper medical care.

Every month, a Cambodian nurse and an administrative assistant drive an arduous 6 h from Phnom Penh to Rovieng, or fly to Rattanakiri. The nurse is equipped with a digital camera, stethoscope, otoscope and some medications including antibiotics, analgesics, an anthelmintic, an H2-blocker, a beta-blocker and a diuretic. On the first day of the clinic, the nurse takes medical histories of patients and performs a physical examination. The single laboratory test available at Rovieng initially was a malaria smear. Patients are triaged, and for those who require further care and who give written consent, assessments are translated into English and digital photos taken where appropriate. These are then sent via email from a computer to physicians at Sihanouk Hospital Center of Hope in Phnom Penh, and Partners Telemedicine in Boston, MA.

A satellite at a nearby school provides internet connectivity, using electricity supplied by solar panels and generators. All responses from consulting physicians are received by the second day of the clinic, when patients return and are treated or referred based on the recommendations from the physicians at the two hospitals.

**impact on public health**

We performed a retrospective case review and patient surveys at the Rovieng clinic to evaluate the impact of the telemedicine clinic [7]. In the first 28 months of consultations, from February 2001 through June 2003, there were a total of 264 visits by 214 patients. The most common chief complaints at initial visit included a number that reflected chronic diseases such as diabetes and hypertension in addition to indicators of infectious disease (Table 1).

The community at Rovieng is very isolated, and any visit to the major regional hospital is a major undertaking both in time and financially for many of the villagers, so we have strived to deliver as much care of the highest quality possible in the village. Over the 28-month period the number of offsite referrals decreased significantly, suggesting that more patients were getting appropriate treatment at the clinic (Figure 2) [7]. In addition, at the start of the program the mean duration of chief complaint was 37 months, which decreased to 8 months at the end of the evaluation period (Figure 3).

A random sample of 63 patients was surveyed about the service. All were either ‘very satisfied’ or ‘satisfied’ [7].

**Table 1. Chief medical complaints at Rovieng**

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Percent of patients (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdominal pain</td>
<td>36% (76)</td>
</tr>
<tr>
<td>Palpitations</td>
<td>19% (40)</td>
</tr>
<tr>
<td>Chest pain</td>
<td>18% (38)</td>
</tr>
<tr>
<td>Headache</td>
<td>17% (36)</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td>14% (31)</td>
</tr>
<tr>
<td>Fever/chills/sweats</td>
<td>9% (20)</td>
</tr>
<tr>
<td>Neck mass</td>
<td>8% (17)</td>
</tr>
<tr>
<td>Tender neck</td>
<td>8% (17)</td>
</tr>
</tbody>
</table>

**Figure 1.** Ratanakiri Provincial Hospital. This hospital, in the remotest province of Cambodia, provides primary healthcare to approximately 30 000 people.
majority also said they were willing to pay for a visit at a median amount of US$0.63, where the average annual per capita income in the region is approximately US$40. This suggests the potential for such clinics to become sustainable over the long term.

This telemedicine clinic has therefore had a demonstrable impact on the public health of the communities being served. There has been a reduction in the demand for acute care services, patients are more likely to adhere to prescribed treatments for chronic diseases, they are presenting to the clinic earlier in the course of disease which can improve prognosis, and local doctors are becoming more aware of and addressing public health problems in the region.

point of care testing

Only one laboratory test was initially available at Rovieng clinic, a malaria smear. We have developed a portable laboratory, called 'Lab-in-a-Box', to facilitate a number of diagnostic tests at the point of care (Figure 4). The kit can provide results for blood tests (hemoglobin and glucose), urinalyses (glucose, ketones, protein, leukocyte esterase, pH, bilirubin and pregnancy), and others (fecal occult blood, Group A streptococcus). The kit includes diagnostic test procedures, and all lab equipment and resources for screening, and a symptom chart based on the results of the retrospective review of patient complaints. It is contained in a single bag that can be carried in by the attending healthcare worker. This innovation is enabling quicker diagnosis and treatment, and has reduced laboratory-associated costs in regional healthcare facilities.

cancer care in Cambodia

Although developing countries have about half the overall incidence of cancer seen in developed countries, the incidence is rising. However, the mortality is often markedly higher in the developing world [8]. The cancer-related mortality in Cambodia often compares poorly even with other less developed countries. For example, the age-adjusted mortality for cervical cancer in Cambodia (21.6/100 000 women) is markedly higher than that for all less developed countries (11.2/100 000) and dramatically more than in the developed world (4.0/100 000) [9].

According to an Institute of Medicine report, Cambodia and other countries of Southeast Asia are beginning an ‘epidemiologic transition’, where infectious diseases such as malaria and tuberculosis increasingly give way to chronic diseases such as cancer and cardiovascular disease. This is, in part, due to improvements in public health, a longer expected lifespan and the adoption of behaviours more frequently noted in developed countries such as smoking, high-fat diets, and sedentary lifestyles [10].

It has been noted that cigarette smoking rates are as high as 80–90% among Cambodian men and are known to increase the risk of not only lung cancer, but several other cancers as well. The recreational use of betel quid is also common among the rural poor in Cambodia. This chewed compound contains a mixture of areca nut, tobacco leaf, and lime and its widespread use explains the higher rates of oral and oropharyngeal cancers [10].

The World Health Organization’s International Agency for Research on Cancer (IARC) has complied extensive data for estimating the incidence, mortality and prevalence for cancer in Cambodia. Figure 5 shows estimates of the crude rate of cancer among men and women for the year 2002 [9]. The estimate of age-standardized rate (ASR) of cancers for men and women is shown in Figure 6 and represents a summary measure of the rate of cancer using a world-standardized age structure [9], which allows better comparison of populations that differ with respect to age, since age is a strong predictor of cancer.

The 5-year prevalence of cancer provides insight into the proportion of the population that is living chronically with cancer. Figures 7 and 8 show the estimates of the 5-year prevalence of cancer among Cambodian men and women in 2002, respectively [9].

At Rattanakiri Hospital, it is estimated that 5% of all patients have cancer, the most common of which are osteosarcoma, breast, testicular, uterine, thyroid and lymphoma (personal communication). Half of all cancer patients are lost to any follow-up after the first visit. Furthermore, half are advised that they must seek treatment in Phnom Penh for therapy or further tests, but the cost of transportation is prohibitive for most patients. Even in Phnom Penh, there is only one hospital where radiation therapy and chemotherapy are available. Most patients present with advanced disease, and surgery is the usual first-line therapy. At the Sihanouk Hospital Center of Hope, which collaborates with Partners Telemedicine in Operation Village
Figure 5. Crude cancer rates per 100,000 individuals in Cambodia [9].

Figure 6. Age-standardized cancer rate per 100,000 individuals in Cambodia [9].
Health, approximately 1% of patients present with cancer, and most treatment is also surgical or palliative. The most common cancers are lymphoma, gastric, breast and lung cancer. Although consultation is free, treatment must be paid for, and the full course of treatment for breast cancer at approximately US$1200 is prohibitive for most people.

**conclusions**

This pilot project has demonstrated that telemedicine can have a positive impact on the public health of very remote communities in the developing world. However, while it may overcome the obstacle of access to expert consultation, poor infrastructure and other logistical challenges can greatly limit treatment options. This telemedicine clinic is providing care for many chronic illnesses, and because of the scarcity of clinical data that could be collected for evaluation, we most frequently consult primary care physicians rather than specialists. Cancer remains a particular challenge because of the scarcity and costs of treatment anywhere in Cambodia. The satellite-based communications technology that we have used to provide health services in Cambodia may also provide other levels of service to remote regions such as K-12 education and e-commerce, which can provide overlapping benefits that may have a very positive impact on a community.

**disclosures**

Dr Kvedar’s department is the recipient of a fellowship grant from the Connetics Corporation. The authors have done research sponsored by Motorola. Dr Kvedar has an (unpaid) seat on the advisory board of RelayHealth Inc.

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**Figure 7.** Estimates of 5-year cancer prevalence for Cambodian males [9].

**Figure 8.** Estimates of 5-year cancer prevalence for Cambodian females [9].


