

HealthRays®

A Project Designed to Bring Digital X-ray Technology to Those in Need

Sponsored by Rotary International District 6440, Illinois, USA and international partners



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Introduction

One of the most basic tools of modern health care is the x-ray. Since its discovery just over a century ago, x-ray technology has either improved -- or in many cases saved -- the lives of millions of people. Yet the World Health Organization (WHO) estimates that two-thirds of the world's population lacks access to efficient diagnostic imaging health services. The WHO also has reported that 60% of all diagnostic procedures require x-ray technology – but this critical health tool is lacking for huge portions of the global population.

Underserved populations all over the world fall prey every year to diseases, injuries and other maladies that could be easily cured – or at least properly diagnosed – with x-ray technology. Some suffer from simple health care conditions that modern medicine overcame many decades ago.

The primary objective of HealthRays is to improve access to diagnostic radiology services throughout the world – starting with a model project in Guatemala that provides World Health Imaging System for Radiology (WHIS-RAD) digital X-ray units designed under the auspices of the WHO to better serve needy populations. WHIS-RAD x-ray technology is simple to maintain and use, specifically designed so it can be implemented at lower cost and in cities or regions lacking traditional health infrastructure, while at the same time delivering high-quality imaging capacity and radiation safety. This makes it ideal for reaching disparate populations in impoverished countries such as Guatemala.

When a digital version of WHIS-RAD x-ray technology became available over the last decade, it significantly increased the impact of the x-ray as a diagnostic tool – allowing it to be integrated with the rapid growth of telemedicine worldwide. Images from these systems can now be accessed remotely via computer by radiologists in medical centers many miles from the site of patient care, who can read them on the Internet, providing improved diagnosis and treatment options.

Recognizing the vast potential of this technology to transform lives globally, volunteers from the world's largest service organization – Rotary International – formally launched HealthRays in 2011.

The initial focus of this model project is the provision of 29 digital-imaging units in Guatemala that are sustainable in the long-term and that leverage the growing potential of telemedicine to improve the health of underserved populations. The project calls for the purchase, shipping, and installation of these units, one at a time, in regions of need throughout Guatemala. The equipment is used by local radiology

operators, trained by the Pan American Health Organization (PAHO), who acquire digital images using WHIS-RAD protocols and then provide these images to local physicians and remotely situated radiologists at more advanced medical centers for diagnosis and referral for treatment.

The project's secondary objective is to demonstrate the value of partnerships between non-governmental organizations (NGOs) and governments to provide health care services to an economically marginalized population in a developing country – paving the way for expansion of this model to underserved populations around the world.

Why Guatemala?

The Global Health Initiative reports that Guatemala is Central America's most populous country, with 14.3 million people, of which about 40% are of indigenous (Mayan) descent. Although Guatemala is a lower middle-income country with an average per capita income of \$2,700, this figure masks extreme inequalities that reflect the exclusion and disparity that affect indigenous and rural populations. For example, the average time in school among indigenous people is only 3.8 years while it is 6.5 years among the non-indigenous.

Guatemala has a national poverty rate exceeding 50% and a rate of extreme poverty of 15%. While 46% of the total population lives in rural areas, 72% of the extremely poor live in rural areas. Despite its middle-income status, Guatemala's health outcomes compare unfavorably with those of other much poorer countries. Guatemala's most vulnerable populations include women, newborns and children less than 5 years of age. The child mortality rate at 42 per 1,000 live births is the highest in Central America and the third highest in the region after Haiti and Bolivia. The maternal mortality ratio of 136 per 100,000 live births is also one of the highest in the region, and the contraceptive prevalence at 54% one of the lowest.

The PAHO reports that while the five-year cancer survival rate is between 2 and 8 percent in the majority of Latin American countries, in several Central American Countries -- including Honduras and Guatemala -- the five year survival rate is below two percent. The low survival rate, despite the prevalence of the same cancers, may reflect poor early detection and screening programs in these areas.

Recognizing these and other health vulnerabilities, Guatemala's Health Ministry conducted a national assessment that determined the need for a total of 29 digital X-ray units, to be distributed throughout the country in order to address its lack of imaging services in underserved areas.

The HealthRays initiative is aimed at addressing this situation by providing much-needed technology. One digital x-ray system will serve a population of between 50,000 and 100,000 people or more for the better part of two decades when properly maintained. With 29 units eventually installed in diverse locations throughout Guatemala, significant health impacts will be possible.

Diagnostic radiology services will provide local physicians in community hospitals/clinics with diagnostic testing results that assist in the proper treatment of such diseases and health conditions as fractures/sprains, asthma, pneumonia, congestive heart failure and tuberculosis.

The primary beneficiaries of this project are the rural and economically marginalized people in Guatemala, but eventually, the intent at the end of this project is to have built a model that can be replicated throughout the world.

Why Rotary?

HealthRays combines the global infrastructure and funding mechanisms of Rotary International – which is represented on literally every continent in the world and in more than 200 countries and geographic areas – with the technical and medical expertise of health care experts and assistance from governments and NGOs to create a new, innovative and synergistic partnership model. With more than 1 million volunteer leaders networked globally to raise funds and partner together on charitable projects, Rotary International provides a powerful foundation for mobilizing this kind of hybrid approach to a wide range of social, health and environmental issues in disparate regions of the world. In this case, 70 Rotary clubs, representing a region in Northern Illinois, USA (Rotary District 6440) are working together to advance HealthRays.

The HealthRays partnership model is more impactful and efficient in delivering vital health assistance to needy populations because it leverages the resources and focused capabilities of multiple organizations to address a single, well-defined mission.

Partners who have joined the HealthRays effort to date, in addition to Rotary District 6440, include the PAHO, Guatemala's Ministry of Public Health and Social Services and Ministry of Energy and Mines, and several other Rotary districts and clubs in the United States, Asia and Central America. The key partners signed a Memorandum of Understanding (MOU) in 2013, which formalized their working relationship.

Project Description

At the core of HealthRays is the WHO's World Health Imaging System for Radiology (WHIS-RAD) program, a 30-year old initiative with a primary objective to improve access to imaging in the developing world. Approximately 2,500 WHIS-RAD units have been installed in developing countries over the past 25 years.

HealthRays buys and installs digital WHIS-RAD units in underserved areas of Guatemala. These X-ray units assist physicians to diagnose:

- **Chest X-ray:** Pneumonia (infection), Primary or Secondary Tuberculosis (TB), Congestive Heart Failure (CHF) (pulmonary edema and pleural effusions), cardiomegaly, i.e., enlarged heart, tumors, pediatric conditions such as viral infection and asthma, trauma (fractured ribs and pneumothorax, i.e., collapsed lung)
- **Musculoskeletal X-ray:** trauma, infection and tumors, such as fractures, growth abnormalities, metabolic conditions (i.e. - Scurvy), degenerative disease, avascular necrosis, primary and secondary arthritis
- **Abdomen X-ray:** abdominal or pelvic pathology, such as: Gallstones, kidney stones, bowel obstruction, gastroenteritis
- **Face / Head:** Sinusitis, trauma, neonatal skull abnormalities

One of the most important factors in this project is the digital nature of the imaging units, which brings enormous benefits and efficiencies, surpassing the capabilities of earlier generations of imaging technology.

The units are manufactured by Spanish technology company Sociedad Española de Electromedicina y Calidad (SEDECAL) and shipped to Guatemala, where their installation is coordinated by Guatemala's Ministry of Public Health and Social Services, which also oversees training of radiology operators along with PAHO and SEDECAL. Operators can be trained in two weeks and only need a high school education to operate the equipment. The Ministry of Public Health and Social Services, working with HealthRays partners, ensures the proper maintenance of the units.

Rotary District 6440 -- along with its Rotary partners and the PAHO in Guatemala -- oversees the maintenance of standards prior to and during installation of the equipment and has committed to ensuring the long-term sustainability of all of the proposed 29 digital imaging centers. The Ministry of Energy and Mines of Guatemala provides the necessary permits to operate the digital imaging equipment. The PAHO assists in the training radiology operators and participates in the inspection of the clinics prior to installations.

To ensure quality and safety of the imaging process, Rotary District 6440 and the PAHO have jointly published a manual that provides guidelines for WHIS-RAD service in remote areas. Titled "Diagnostic Imaging in the Community- A Manual for Clinics and Small Hospitals," the manual was authored by the late Dr. Philip E.S. Palmer and Dr. Gerald Hanson, who are internationally recognized for their work with the PAHO and the WHO in radiology and radiologic safety.

It is important to note that because the imaging systems being used are digital, they are much more environmentally friendly than earlier diagnostic imaging systems, which relied upon chemicals and other polluting materials.

Working with Guatemala's Ministry of Public Health and Social Services, a master plan for 29 remote clinics has been created, which will connect these clinics with radiologists at regional hospitals. The clinics will enable radiologists to access x-ray digital images remotely via the Internet or other communications channels to the hospitals for evaluation.

To date, eight units, of a total of 29, have been installed and are functional. Each system costs approximately \$75,000. The first unit was installed at Clínica Periférica in Mixco in 2013, the second unit was installed at Clínica Periférica El Amparo in 2014 and the third unit was installed at Health Center El Paraiso II, Zona 18, also in 2014. Four additional units were installed in 2015 and 2016, in Palencia, Villa Canales, Livingston and Fraijanes. An eighth unit was installed in 2017 in Gualan.

Guatemala's Ministry of Public Health and Social Services is upgrading each of the clinics with additional funding of between \$10,000 and \$15,000, for a total enhancement of between \$290,000 and \$435,000. Total cost of the 29-unit HealthRays initiative is projected at \$2.5 million.

Key Goals and Objectives

Goal 1: Improve the health of underserved populations in Guatemala through digital X-ray technology.

- Objectives:
 - Create a sustainable network of 29 digital X-ray-equipped clinics, linking remote, underserved areas of Guatemala with modern medical centers through digital technology.

- Build a formalized partnership of stakeholders to ensure development and maintenance of the network over time.
- Develop a health-data infrastructure to enhance long-term population-health through regular collection and analysis of health-related information.

Goal 2: Improve economic conditions through creation of jobs and enhancement of productivity among underserved populations.

- Objectives:
 - Create an economic development model that ensures the training and hiring of local residents for operation and maintenance of digital X-ray centers.
 - Improve productivity of Guatemalan citizens by providing easier access to health services, reducing travel times for patients seeking care, and lowering the incidence of work absenteeism related to travel for care.
 - Collect data and information to be used for future community impact studies on links between health technology and economic development.

Goal 3: Build a replicable model for health improvement and economic development that can be implemented in other underserved areas of the world.

- Objectives:
 - Create formalized partnerships of diverse stakeholders, with connection to wide global networks (including Rotary, the WHO and other multi-national organizations).
 - Raise visibility of the HealthRays model via media outreach and public engagement.
 - Seek major donors to complete model project in Guatemala.

Benefits

HealthRays offers several major benefits:

- The equipment installed to date is already serving thousands of patients in eight underserved areas of Guatemala. When all 29 units are installed, an estimated 1.5 million to 2.5 million Guatemalans will have access to digital X-ray technology for the first time.
- A wide variety of health conditions will be addressed by this technology, ranging from relatively simple health issues such as broken bones and abscesses to much more serious conditions, including cancer and cardiovascular disease.
- Better health outcomes will result from more timely and more accurate diagnosis of conditions, and from the availability of archived, digitally retrievable images. Population health and tracking of various epidemiological conditions will be improved, thanks to better, more comprehensive public health records and data.

- Families and socio-economic conditions will benefit, and economic productivity will be enhanced, by providing access to local clinics; patients no longer will have to take time off work and travel many miles for X-ray services.
- Because the digital units will be installed in areas where x-ray service has never been available, or has been sporadic, and because local citizens will be trained as radiology operators, jobs will be created and Guatemala's economy will benefit.

Budget

The overall budget for this project is \$2.5 million, with each of 29 units broken down by cost as follows:

Digital X-Ray Unit	\$56,300
Accessories and Parts	\$3,474
IMEDIG Teleradiology Software System	\$4,250
Uninterruptible Power Supply and Conditioner	\$780
Transportation and other variable costs	\$4,946
<u>Installation and one year warranty</u>	<u>\$5,250</u>
TOTAL	\$75,000

Timeline

Since the inception of the HealthRays concept in 2011 and the development of formal working agreements with its major partners, the project has made steady progress in moving forward with clinic installations. Timelines and major milestones are highlighted below:

- **2011-2014**
 - Needs assessments and site-mapping completed; formal agreements signed with core partners, including Guatemalan government and Pan American Health Organization
 - First three clinics completed (Mixco, El Amparo, El Paraiso)
 - Trauma physicians added to staff of two clinics, reducing need for patients to travel for treatment
- **2015-2016**
 - Four clinics completed (Palencia, Villa Canales, Livingston and Fraijanes)
 - Guatemalan Coast Guard assists with delivery of HealthRays equipment
 - Rotary International President John Germ visits Villa Canales clinic
- **2017**
 - Eighth clinic completed (Gualan)
 - Project funding reaches more than \$650,000

Additional Data Collection and Research Opportunities

Researching health outcomes related to the availability of digital x-ray services in underserved areas of Guatemala will help add to the long-term effectiveness of this project. HealthRays encourages research partners to consider being a part of our efforts. A sample research proposal is included below.

Sample Rotary HealthRays Data Collection and Research Proposal

In recent discussion with representatives of the PAHO and the National Institutes of Health (NIH) in the United States, organizers of HealthRays have determined that in addition to its potential for improving the health of underserved populations, the HealthRays project has strong potential as a vehicle for the collection of much-needed data about the health of targeted populations.

With 29 identical digital imaging systems in place, located throughout Guatemala, comprehensive data could be collected that would help build a better understanding of health outcomes related to the use of digital x-ray technology, along with patterns of usage among clinics.

Potential data sets that could be gathered from the HealthRays platform include:

- Number of patients per clinic and total number of patients served
- Age and sex of patients
- Types of images processed
- Number of images requested by referring physician
- Number of images analyzed by hospital-based radiologists
- Number of referrals to hospitals for image analysis
- Number of referrals for treatment outside the clinic that obtained the image
- Types of traumas and diseases treated resulting from the use of the technology

Other data sets might also be added to these core elements, yielding a rich data bank that could be useful for a wide range of purposes – from advancing clinical knowledge to the development of health policies.

With 29 digital imaging clinics, dispersed widely throughout Guatemala, the case could be made that data collected would be representative of the entire country. This information would be invaluable for analysis of health in Central America, and various health-related organizations would be interested in turn, because of the contributions the United States makes to the WHO and the PAHO.

It is also important to recognize that the Ministry of Health and Welfare of Guatemala (MOH) would be interested in acquiring this data in order to learn how to more efficiently and cost effectively provide care.

The creation of a comprehensive data-collection project would also increase the possibility of attracting new partners to this effort, who would benefit from access to information about health strategies and outcomes.

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