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## Rural Cardiac Screening: Leveraging Technology from a Previously Established Echocardiographic Network

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### Acknowledgement

Since the writing of this paper, sadly Dr. Francis Robicsek passed away on April 3<sup>rd</sup>, 2020. A world renowned cardiothoracic and vascular surgeon, as well as a devoted humanitarian, his foresight and wisdom made these and many other clinical and benevolent programs possible and successful.

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As reported by the Pan American Health Organization, cardiovascular diseases (CVD) are the leading cause of death globally, impacting approximately 1.8 million deaths annually in the Americas.<sup>1</sup> Latin America and the Caribbean have the highest socioeconomic disparities in the Americas, which is a contributing factor, as well as high blood pressure, high blood glucose, high cholesterol, obesity, tobacco, and alcohol abuse. CVD is a non-communicable disease that is highly preventable and treatable in the industrialized world, yet it is the leading cause of death for essentially one-third of the region's mortality, particularly those living in remote areas.<sup>2</sup>

The International Medical Outreach Program (IMO), a collaborative partnership between Atrium Health and Heineman-Robicsek Foundation, Inc. (HRF), both located in Charlotte, North Carolina, began addressing these alarming statistics in Guatemala and Belize, first by laying a solid foundation in Guatemala.

According to World Bank, it is estimated that

in Guatemala 47 percent of the total population of 17 million live in poverty.<sup>3</sup> Approximately 35% of the country's population lacks access to basic health care services, particularly in rural communities, and cardiovascular disease is the leading cause of death among non-communicable diseases.<sup>4</sup> This has been the outlook for decades.

During a trip to Guatemala in the early 1970s, Dr. Francis Robicsek, cardiothoracic surgeon and at that time Chief of the Department of Thoracic and Cardiovascular Surgery at Carolinas Medical Center, known today as Atrium Health Carolinas Medical Center, met with then-President Carlos Manuel Arana Osorio. Seeing the shortcoming of cardiovascular care in Guatemala, in 1972 the Guatemalan government supported the training of a cardiac team at Carolinas Medical Center. It began with training a young general surgeon, Dr. Raúl Cruz Molina, under the tutelage of Dr. Robicsek. The team completed the training in two years through the support of a team from the Sanger Clinic, known today as Atrium Health Sanger Heart & Vascular Institute

(SHVI). In 1974 the first cardiac procedures were performed at the Roosevelt Hospital in Guatemala City.

Seventeen years later, under the leadership of Dr. Cruz, and with the vision, guidance, and support of Dr. Robicsek, the success of the program brought about the establishment of Unidad de Cirugía Cardiovascular de Guatemala (UNICAR) in Guatemala City. Located on the campus of the Roosevelt Hospital, today UNICAR operates robust adult and pediatric cardiology and cardiac surgery programs with volumes and outcomes close to those in the United States. The institution not only treats the people of Guatemala, but also from the neighboring countries of Honduras, Belize, El Salvador, Nicaragua, and some Caribbean countries.<sup>5</sup>

UNICAR has made numerous advancements over the decades, however, it recognized the disconnect between the institution and reaching those living in rural communities.

Leadership from UNICAR and IMO met with the Guatemalan Ministry of Health in 2010 to discuss the possibility of establishing a cardiac echo network in the rural public hospitals. There were no cardiac echo sonographers in the country, and the cardiologists performed and interpreted the scans, causing a tremendous backlog of patients in need. IMO proposed training echo sonographers. The Ministry of Health fully supported the concept and suggested several hospitals to initiate the program, with UNICAR being the nucleus. In 2011, UNICAR sent a radiology technician for intensive training in cardiac echo sonography. The education and training were conducted for three months in Charlotte at the Sanger Heart and Vascular Institute (SHVI), followed by an additional 3-months apprenticeship at UNICAR in Guatemala City. Within 6-months, scanning began identifying cardiac anomalies, thus leading to subsequent medical treatment and surgical interventions. This solidified the idea and the feasibility to establish a cardiac echo network within Guatemala.<sup>6</sup>

IMO sought and was awarded grants from Heineman-Robicsek Foundation, Inc., Edwards Lifesciences Foundation, and Heineman Foundation of New York, to cover the cost of educa-

tion, training, and equipment.

Over the course of 5-years, nurses trained in echo sonography analogously to the previous training program. Consequently, the original trainee eventually became the trainer with oversight by UNICAR and SHVI Cardiologists. At the conclusion of each sonographer training, the IMO program donated a cardiac echo machine, computer, and other equipment to establish the new ECHO station. Each sonographer performs the scans, the images are sent to the computer and then electronically transferred to UNICAR for interpretation, and backup support is provided by SHVI. Diagnosis and treatment options are relayed to the primary care physician at the rural public hospital.

Ten cardiac echo sonographers have been trained, and stations have been established at rural public hospitals throughout Guatemala. Known as the Nan Van Every Cardiology Diagnostic Network (Nan Van Every CDN), there are a total of sixteen diagnostic stations throughout Central America and the Caribbean.

Simultaneously while IMO was working toward expanding the cardiology reach in Guatemala, the initial stages of a cardiac program in Belize was underway. There are over 400,000 multi-ethnic people living in Belize, and according to the Statistical Institute of Belize, 52% of the population lives in poverty. Cardiovascular disease is the leading cause of death among non-communicable diseases.<sup>7</sup>

In 2009, IMO assessed the cardiology needs in Belize and found that the country was about half a century behind in cardiovascular care. There was a need for diagnostic and interventional cardiology, as well as a cardiothoracic surgical program.

Through the support of Heineman-Robicsek Foundation, Inc., Edwards Lifesciences Foundation, and Heineman Foundation of New York, IMO began to address the cardiovascular care shortcomings in Belize.

In 2011 IMO began working with Karl Heusner Memorial Hospital Authority (KHMHA) in Belize City, the only tertiary care facility in Belize, and

Dr. Adrian Coye, the only cardiothoracic surgeon in the country. Medical equipment and supplies to establish the cardiac program were donated to KHMHA. Among the medical equipment donations were two cardiac echo stations that were established in Belize City and San Ignacio. Additionally, volunteer teams from SHVI perform diagnostic and interventional cardiac catheterizations, and supported Dr. Coye with cardiac surgeries.

While UNICAR was fully sustainable, the echo network was performing well, and the cardiac program in Belize was gaining traction, both UNICAR and KHMHA believed that more could be done to reach the most vulnerable in the rural areas.

Leveraging the Nan Van Every CDN, in 2015 IMO initiated the first free public cardiac screening events ever held in Belize and Guatemala. The screenings are modeled after SHVI's Heart of a Champion that is held annually in Charlotte, North Carolina. The scope and aim of the Guatemalan and Belizean programs are to provide a pathway for reaching disenfranchised individuals with unknown risk factors associated with cardiovascular diseases, as well as identifying potential and confirmed heart conditions.

In Guatemala, the screenings are held at the rural public hospital or nearby public clinics where a cardiac echo station resides. Similarly, in Belize the screenings are held at rural public hospitals or clinics throughout the country.

Prior to the screenings, community healthcare providers at the rural public hospitals and clinics attend lectures on cardiovascular and structural heart diseases and associated contributing factors. There is a separate meeting to discuss logistics for the events and identification of healthcare personnel who will assist with the screenings. The events are also supported by volunteers from SHVI, Carolinas College of Health Sciences and pre-medical and public health students from U.S. based universities.

Stations are set up for the comprehensive screenings: (1) demographic, family and individual health history is gathered; (2) vital signs are taken, including height, weight, tempera-

ture, SpO2 (oxygen saturation), blood pressure and glucose testing; (3) participants are seen by a primary care physician who reviews the preliminary information; (4) participants are sent for electrocardiogram; (5) participants are sent for cardiac echo; (6) participants are seen by a cardiologist who reviews all collected data, examines the patient and explains the results from tests performed; (7) participants and any accompanying family members and friends are educated on the risk factors, signs, and symptoms, as well as healthy eating habits, smoking cessation, and more to encourage a healthy lifestyle.

Participants in Guatemala with a suspected heart issue are referred to the local public hospital where a cardiac echo station is located for a more comprehensive evaluation. The completed tests are digitally forwarded via the Nan Van Every CDN for interpretation by cardiologists at UNICAR. In Belize, participants are sent to KHMHA in Belize City. Findings are discussed with the local primary care physician, after which appropriate action is determined.

Public cardiac screening events bring heart disease to the forefront in communities where there is little to no previous access and clinicians are educated to identify heart problems. What began as an echo network to provide cardiac screenings, diagnosis, and treatment to the most vulnerable population, has grown beyond individual echocardiographic stations. The network, combined with public screenings, have yielded over 38,000 patients screened, diagnosed, and/or treated since 2011. This has led to a full breadth of cardiovascular diagnoses including hypertension, coronary artery disease, congenital heart disease, and structural heart disease. Rheumatic heart disease constitutes a significant portion of structural heart diseases resulting as a long-term consequence of acute rheumatic fever which continues to be a problem among low and middle-income countries. Ten percent of those screened over the 5-year period were found to have significant cardiovascular disease.

The success of Unidad de Cirugía Cardiovascular de Guatemala (UNICAR) in Guatemala City, and the cardiology and cardiac surgical programs at Karl Heusner Memorial Hospital Author-

ity in Belize, and the Nan Van Every Cardiology Diagnostic Network, are cornerstones to scaling expansion, providing access for individuals who have little, if any recourse to seek cardiac care, and is the basis for knowledge about cardiac diseases, signs, symptoms, and prevention. Such efforts will allow potential access for medical and surgical interventions, hopefully offering a potential reduction in mortality and morbidity from cardiovascular diseases. Leveraging local public clinics, hospitals, and the Nan Van Every CDN as adjuncts to provide free public screenings has brought about awareness, education, and the capacity to capture even more undiagnosed and untreated patients, particularly the most vulnerable.<sup>Figure 1, 2</sup>

### Figure legends

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