Seventy-five years of cardiovascular rehabilitation in Mexico

Setenta y cinco años de rehabilitación cardiovascular en México

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Abstract

Patients suffering from cardiovascular disease require comprehensive medical attention that involves therapies and procedures necessary to reintegrate them optimally to their personal, family, work, and social life. Interventions aimed at achieving these goals are included in cardiac rehabilitation programs. These programs are designed to limit the harmful physiological and psychological effects of heart disease, reduce the risk of sudden death or reinfarction, control cardiovascular symptoms, stabilize or reverse the atherosclerosis process, and improve the psychosocial and vocational status of patients. These programs have existed in Mexico since the 1940s and have evolved over the years, adapting to the disease conditions present in our country, starting with therapies to treat patients with rheumatic heart disease until the application of physical exercise in patients with heart failure complexes congenital heart disease or pulmonary arterial hypertension. These activities are of a transdisciplinary nature and involve the integration of cardiologists, physiotherapists, psychologists, and nutritionists among others. At present, these programs have spread throughout the Mexican Republic thanks to rehabilitation cardiologists graduating from the main health institutions in the country such as health institutes, Mexican Social Security Institute, and Institute of Security and Social Services of State Workers. In this document, the origins of rehabilitation from the pre-Hispanic era to the present will be discussed, highlighting the contributions in teaching and research of the physicians who have practiced in this area in the aforementioned institutions.

Key words: Cardiac rehabilitation. Cardiovascular prevention. Mexico. Cardiology. Heart attack. Physiotherapy.

Resumen

Los pacientes que sufren una enfermedad cardiovascular requieren de atención médica integral que involucre las terapias y procedimientos necesarios para reintegrarlos de forma óptima a su vida personal, familiar, laboral y social. Las intervenciones

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dirigidas a alcanzar dichas metas se incluyen en los programas de rehabilitación cardíaca. Estos programas son diseñados para limitar los efectos dañinos tanto fisiológicos como psicológicos de las cardiopatías, reducir el riesgo de muerte súbita o reinfarcto, controlar la sintomatología cardiovascular, estabilizar o revertir el proceso de aterosclerosis y mejorar el estado psicosocial y vocacional de los pacientes. Dichos programas existen en México desde la década de 1940 y han evolucionado a lo largo de los años, adaptándose a las condiciones de enfermedad presentes en nuestro país, desde su inicio con terapias para tratar a pacientes cardiopatía reumática hasta la aplicación del ejercicio físico en pacientes con insuficiencia cardíaca, cardiopatías congénitas complejas o hipertensión arterial pulmonar. Estas actividades son de índole transdisciplinaria e implica la integración de cardiólogos, fisioterapeutas, psicólogos y nutriólogos, entre otros. Actualmente, estos programas se han extendido a lo largo de la República Mexicana gracias a cardiólogos rehabilitadores egresados de las principales instituciones de salud del país, como son los Institutos de Salud, el IMSS (Instituto Mexicano del Seguro Social) y el ISSSTE (Instituto de Seguridad y Servicios Sociales para los Trabajadores del Estado). En este documento se expondrán los orígenes de la rehabilitación, desde la época prehispánica hasta la actual, destacando las contribuciones en docencia e investigación de los médicos que han ejercido en esta área en las instituciones previamente mencionadas.

Palabras clave: Rehabilitación cardíaca. Prevención cardiovascular. México. Cardiología. Infarto. Fisioterapia.

Quicemitqui in yollotli... (the heart governs everything).
Florentine codex.

A patient that is discharged from the hospital after having suffered a cardiovascular event continues his or her convalescence process at home, where he/she will fully recover. With the purpose to support the patient in this process, specifically directed interventions by means of cardiovascular rehabilitation and prevention programs (PRPCV – *Programas de Rehabilitación y Prevención Cardiovascular*) have been developed since many years ago. In 1964, the World Health Organization (WHO) published its first operational definition of this kind of program. Later, in the decade of 1980, Feigenbaum masterfully described cardiac rehabilitation as "... long-term programs comprising medical evaluation, physical exercise prescription, risk factors' modification, education, and patient advice. These programs are designed to limit the harmful effects, both physiological and psychological, of heart disease, to reduce the risk of sudden death or reinfarction, control cardiovascular symptomatology, stabilize or reverse the atherosclerotic process, and improve psychosocial and vocational status of patients"¹.

These transdisciplinary activities seek the reintegration of the patient to his/her daily life, in the most comprehensive and expeditious way possible, based on physical training, education, and professional advice. Physical exercise has been used for medicinal purposes for thousands of years by civilizations such as the Egyptians or the Greeks. Hippocrates stressed that walking was the best medicine for man². In Mexico, since our ancestors, we have recognized the heart as a vital organ that requires study and care. Hence, the present manuscript seeks to relate some of the significant historical facts that have made cardiovascular

rehabilitation a current and relevant cardiologic specialty.

"Our heart gives life, supports, beats."

Fray Bernardino de Sahagún.

In the pre-Hispanic era, the heart was considered as a link between the material and the spiritual realms. Thus, constant beat (*motlatlamotla*) was synonymous with movement of life (*iolli*). Since then, heartbeat was considered to be a cyclical event (*yóllotl*), which we today call the *cardiac cycle*. Fray Bernardino de Sahagún related that, for the natives, the heart represented the source of energy and vigor for the human being. This reminds us of the modern description that the Swedish scientist Per-Olof Astrand would make in the 20th century when conducting his investigations on the bodily use or consumption of oxygen (VO_2)^{3,4}. On the other hand, the Cruz-Badiano codex (*Libellus de medicinalibus indorum herbis*, 1552) describes cardiovascular symptoms as the "unpleasant oppression of chest, heart pain, or heartbeat," and explains the use of herbalism for the treatment of said ailments. The absence of stories on any kind of preventive measure draws the attention⁴.

Although physical training was not used for therapeutic purposes, the Aztec people appreciated its effect during the training of their warriors and messengers (*painanis*), by providing them with outstanding physical abilities⁵. It should be noted that, apparently, these people treated with respect to those who suffered any kind of deformity or disability, who were socially included⁶.

Once our country was constituted as such, in 1869, in the Military Health Service, at the Military Hospital, the use of physical therapy for patients with disabilities, particularly with the use of medicinal baths, is recorded for the 1st time⁷. On the other hand, there are reports

that a couple of decades later, in Leipzig, reports appeared on the use of physical training for the care of patients with cardiovascular disease (Oertel, 1891)⁸.

In the world, the following years were marked by social turmoil, such as the Mexican and the Russian revolutions, as well as countless armed conflicts headed by two world wars. This caused unavoidable political and financial instability. In the next paragraphs, we will describe some of the most important decades of the 20th century and their relationship with cardiovascular rehabilitation programs.

The 1940s decade

In those days, there were barely over 6000 doctors in Mexico, and several institutions were created, such as the Ministry of Health, the National Institutes of Health, and the Mexican Institute of Social Security (IMSS – *Instituto Mexicano del Seguro Social*)⁹. It was on April 18, 1944, the day the National Institute of Cardiology of Mexico (INCICH – *Instituto Nacional de Cardiología Ignacio Chávez*) was officially opened, when Professor Ignacio Chávez would entrust the creation of the cardiovascular rehabilitation and physical medicine area to his brother, Dr. Nicandro Chávez Sánchez, pioneer of physical medicine in the country, together with Dr. Alfonso Tohen Zamudio (Children's Hospital of Mexico, 1943) and Dr. Leopoldo Melgar Pachiano (Military Hospital, 1946).

In those days, rheumatic fever wreaked havoc in the population and demanded the development of new modalities for diagnosis and treatment of these patients, mostly based on specific lines of research. Dr. Nicandro Chávez published a study showing the use of iontophoresis with salicylates in patients with acute rheumatic pancarditis¹⁰. It was he who also developed the “artificial fever rooms,” considering that they would accelerate the recovery of patients. Figure 1 shows Dr. Nicandro Chavez with Professors Ignacio Chavez and Enrique Cabrera.

The 1950s and 1960s decades

The arms race between the capitalist and socialist blocks was just starting, while rheumatic heart disease and its sequels remained a public health problem. Cardiology was growing along with novel methods of study and treatment such as intensive care and coronary care units, cardiac surgery with cardiopulmonary bypass pump, and the first heart transplant¹¹. Mexico was at the forefront of world cardiology in topics such as

Figure 1. Founders of cardiology and cardiac rehabilitation in Mexico. From left to right: Dr. Nicandro Chávez, Dr. Enrique Cabrera, and Dr. Ignacio Chávez Sánchez.

physiology, pharmacology, and electrocardiography. Cardiovascular rehabilitation remained without many changes¹². In the 1960s, ischemic heart disease abruptly entered the cardiologic agenda, and myocardial infarction began to be associated with atherosclerosis and dyslipidemia¹³. At the same time, several researchers highlighted the reduction of mortality through early mobilization (EM) of patients with myocardial infarction. On the other hand, sedentary subjects, such as London bus drivers, were observed to be at higher risk of developing heart conditions in comparison with more active individuals, such as the collectors of these vehicles, who were constantly moving^{14,15}. It was in this decade when the WHO defined cardiac rehabilitation (*vide supra*), a fact that would attract the eyes of multiple researchers interested in the usefulness of physical training for patients with coronary artery disease^{16,17}.

The 1970s decade

This era was marked by the beginning of an endless financial crisis. In those days, cardiology saw the birth of one of the most important milestones of science in the 20th century: thrombolysis therapy during acute myocardial infarction. Cardiac rehabilitation programs focused on the management of bedridden patients, seeking EM, mainly due to a prolonged hospital stay and, naturally, specific interest in the management of patients with coronary heart disease was arising^{18,19}.

In this era, new actors were incorporated, such as Dr. Juan Enrique Quintal Velazco, specialist in rehabilitation, who had a brief stay at the National Institute of Cardiology to continue as chief of department at hospitals such the General Hospital of Mexico, the López Mateos Hospital, and the 20 de Noviembre Hospital Center, which belongs to the Institute of Social Security and Services for State Workers (ISSSTE – *Instituto de*

Seguridad y Servicios Sociales de los Trabajadores del Estado). In the latter institution, the department of cardiovascular rehabilitation was founded in 1974^{20,21}.

Concurrently, on August 1, 1975, cardiologist Jorge Escudero de la Peña would start the cardiovascular rehabilitation program activities at the IMSS, within the facilities of what formerly was the Hospital of Chest Diseases, currently the Cardiology Hospital of the National Medical Center Siglo XXI (CMNsXXI – Centro Médico Nacional Siglo XXI). Early on that decade, Nicandro Chávez retired from the INCICH and was replaced by Pedro Fernández de la Vega and later by Jorge Marcushamer. The cardiovascular rehabilitation programs were acquiring a multidisciplinary structure that brought together the work of doctors, nurses, and physiotherapists on three phases: in hospital (I), at the hospital with outpatients (II), and domiciliary (III)²².

Research in Mexican cardiovascular rehabilitation centers focused on EM, physical training in subjects with ischemic heart disease, heart failure, post-revascularization surgery, and post-coronary intervention, as well as on primary and secondary prevention. At the same time, protocols on the use of exercise testing in different types of patients were developed and works were published on adaptation of some sports for the training of patients on cardiovascular rehabilitation (volleyball), on the establishment of clinics for smoking cessation, on the role of psychology and social work in these programs, and on the effect of cardiovascular rehabilitation on return to work. **Figure 2** shows the publications made throughout these 75 years of history, classified by institution and type of publication.

The 1980s decade

These years were represented by the end of the Cold War, the fall of the Berlin Wall, and the dismantling of the Soviet Union as a result of Mikhail Gorbachev's opening (Perestroika). Furthermore, in this decade, the first cardiac defibrillators were implanted and the first angioplasties were performed²³.

Cardiovascular rehabilitation was formally integrated into cardiovascular prevention programs, consolidating robust physical and education training programs, primarily focused on patients with ischemic heart disease. In the European Society of Cardiology, the working group headed by the Scandinavian countries, Germany, Switzerland, and Spain dominated the panorama in the old continent, whereas in the US, Froelicher and Humprey were the leaders^{24,25}.

Figure 2. Research on cardiac rehabilitation. Publications by institution and type: books, full articles, or free works in congresses. SS: Health Services (includes the National Institute of Cardiology Ignacio Chavez, National Rehabilitation Institute, National Institute of Medical Sciences and Nutrition Salvador Zubirán, General Hospital of Mexico, and National Institute of Pediatrics); IMSS: Mexican Institute of Social Security; ISSSTE: Institute of Social Security and Services for State Workers.

At the INCICH, various leading personalities served at the cardiovascular rehabilitation department, with Jorge Marcushamer, Javier Marín, Luis Méndez, Jesús A. González Hermosillo, Ma. Guadalupe Hernández, Jorge Hernández, Luis Villamar and Juana Pineda, Marcela Pérez and Sofía Bouchet, among others, standing out. In those days, the first cardiopulmonary exercise tests were performed with the use of the Douglas bag. Teaching programs specialized in cardiovascular rehabilitation were initiated, both for cardiologists and for nurses and physiotherapists²⁶.

At CMNsXXI-IMSS, Edmundo Pombo replaced Juan Rivera as head of the cardiovascular rehabilitation department, and in those days, the also cardiologist Héctor Hernández y Hernández, nurse Socorro Olvera, electrodiagnostic technician Roberto González, and physiotherapists Margarita Marín, Amira Morales, and Patricia Rosas joined the department. In the year 1985, Dr. Hernández replaced Dr. Pombo as head of the department.

The 1990s decade

This decade saw the birth of the European Union and the novelty in communications known as the Internet.

Interventional procedures were already in vogue and cardiovascular prevention was increasingly acquiring presence²⁷. Several cardiovascular rehabilitation departments arose in various public and private institutions of our country.

The first census of cardiac rehabilitation centers in Mexico was carried out in 1993 and presented at the National Congress of Cardiology in the city of Veracruz. The results were presented in a poster that identified eight centers specialized in cardiovascular rehabilitation, where programs on physical training (37%), patient and family education (62%), stress management (50%), nutrition (37%), anti-smoking clinic (12%), labor advice (25%), and advice on sexual activity (50%) were offered²⁸.

Gabriel Vázquez-Cabrer ran the cardiovascular rehabilitation program at the INCICH and implemented, together with Nurse Guadalupe Pinson, a program based on his experience acquired in units of Spain, Germany, and the USA. In those days, the effect of physical training in patients with heart failure, post-revascularization, patient reintegration to work, and patient quality of life was studied. At the end of the decade, Bonifacio Mendoza replaced Gabriel Vázquez. Many physicians, physiotherapists, and nurses from the country and abroad received academic training on cardiovascular rehabilitation at the INCICH.

At CMNsXXI-IMSS, the department was integrated by cardiologists Héctor Hernández, Patricia Camacho, and Noemí Contreras and physiotherapist René Cámara, among others. Their patients with valvular disease, congenital heart disease, systemic arterial hypertension, and coronary interventional procedures were treated. That decade was of development, both in the physical area and in the incorporation of personnel in physical medicine, psychiatry, endocrinology, physiotherapy, electrodiagnosis, nursing, social work, and nutrition. In 1991, the physiotherapists in cardiac rehabilitation chapter from the National Association of IMSS Cardiologists (ANCIMSS), currently, the National Association of Cardiologists of Mexico (ANCAM), were created.

In 1992, Gabriel Cherebetiu, a Romanian doctor, pioneered the specialty of sports medicine in our country and founded the Cardiovascular Rehabilitation Department at *Hospital Angeles del Pedregal*, as part of the Department of Cardiovascular Physiology, which he directs since then. In 1994, the Mexican Association of Cardiovascular and Pulmonary Rehabilitation A.C, first of its kind in our country, was founded.

Cardiologist Manuel Antonio Leyva Gómez started in 1995 the Cardiovascular Rehabilitation Unit at South Central Hospital of *Petróleos Mexicanos* (PEMEX) medical services and actively participated in several academic activities along with other institutions.

On that same year, the cardiovascular rehabilitation program was started at the National Institute of Rehabilitation (INR – *Instituto Nacional de Rehabilitación*) by doctor in rehabilitation Juana Zavala Ramírez, cardiologist Luis Jesús San Juan Rivas and Víctor Suárez, psychologist Angélica Ayala Balcázar, and therapists Mónica Garza Hevia, Maira Mar Fadanelli, Graciela Valero, Carmen Rosales, and Martha Ríos. Carmen Gutiérrez de Velasco was then the head of the geriatric and cardiorespiratory rehabilitation division. A couple of years later, the Cardiovascular Rehabilitation Department was created at the Naval Medical Center by cardiologist Héctor Sánchez Sierra together with Nurse Hugolina Márquez de La Paz (July 1, 1997).

By the end of the decade, Macías Hidalgo published various works on the rehabilitation program that he was running at IMSS CMN Hospital of cardiovascular and chest diseases in the city of Monterrey, NL, with the main research topics being physical training in patients with heart disease and its effect on quality of life, adherence to cardiovascular rehabilitation programs, and coronary disease early detection in women.

From the year 2000 to the present day

The arrival of the new millennium was accompanied by the global economic crisis, war on terrorism, and the creation of smartphones, which have revolutionized communications at the personal level. In the Mexican Republic, there was an unheard-of political transition and Vicente Fox took possession as the opposition president of the country.

At the National Institute of Cardiology, Hermes Ilaraza Lomelí was appointed the head of the department and adapted a cardiovascular rehabilitation and prevention program based on the European School of countries such as Switzerland, Spain, Germany, Sweden, and Italy. This transdisciplinary program includes the three areas of medical tasks: care, teaching, and research. To the previously established lines of research, the study of cardiopulmonary exercise testing, risk stratification calculators, physical training in children with heart disease and very high-risk patients, application of the sciences of complexity, perception of effort, and adaptation of new modalities of physical

Figure 3. Cardiac rehabilitation chronology in the history of cardiology, Mexican history, and universal history. Horizontal axis: at the bottom: groups of 25 years, starting in 1800 and projecting to 2025. On the same horizontal axis, in the immediate line above the years: some of the important events of universal history and Mexico. Top of the figure: some events that changed the history of medicine and cardiology (invention of the stethoscope, Rx, ECG, among others); in the top horizontal white bar, far left: famous personalities and events in the history of world cardiac rehabilitation, starting with Sir William Heberden; right end: cardiac rehabilitation guidelines from the main cardiology societies; figure center: institutions with cardiac rehabilitation available; left end of the bar: year of the opening of the cardiac rehabilitation department at each institution, as well as the years of the founding of the cardiac rehabilitation chapter at the Mexican Society of Cardiology, recognition by the Mexican Cardiology Council, founding of the Mexican Society for Heart Care (SOMECCOR), and recognition by the National Autonomous University of Mexico (UNAM) of cardiac rehabilitation high specialty courses for cardiologists and the physiotherapy in cardiac rehabilitation diploma course; below the bars of the institutions: key events in cardiac rehabilitation, such as iontophoresis, introduction of the use of cardiopulmonary stress testing, first National Registry of Cardiac Rehabilitation Programs in Mexico, first Mexican Cardiac Rehabilitation Congress, Prevention and Cardiology of Sport, and books on cardiac rehabilitation; below the cardiac rehabilitation events in Mexico, marked in white, gray, and black: main pathologies that are investigated in cardiology according to PubMed publications. *Estetoscopio*: stethoscope; Rx: X-rays; ECG: electrocardiogram; VO₂: oxygen consumption; CRVC: coronary artery bypass graft; TxCx: heart transplant; ACTP: first angioplasty; DAI: first defibrillator; *trombolisis*: thrombolysis; TAVI: transcatheter aortic valve replacement; *anticoag*: anticoagulation; *Corazón Artificial*: artificial heart; *RHC-NY*: cardiac rehabilitation in New York; ACSM: American College of Sports Medicine; AHA: American Heart Association; ESC: European Society of Cardiology; *RHCyPS*: cardiac rehabilitation and secondary prevention; *RHC en IC*: cardiac rehabilitation in heart failure; RHC: cardiac rehabilitation; *Guías*: guidelines; ACC: American College of Cardiology, INCICH: National Institute of Cardiology Ignacio Chavez; IMSS: Mexican Institute of Social Security; ISSSTE: Institute of Social Security and Services for State Workers; *TF*: physical therapy; ANCAM: National Association of Cardiologists of Mexico; PEMEX: *Petróleos Mexicanos*; AMRCVp: Mexican Cardiovascular and Pulmonary Rehabilitation Association; SEMAR: Ministry of the Navy; *Capítulo*: chapter; SMC: Mexican Society of Cardiology; CMC: Mexican Council of Cardiology; UNAM: National Autonomous University of Mexico; *Fisio*: physiotherapy; *Congreso*: congress; SOMECCOR: Mexican Society for Heart Care; PECP: cardiopulmonary stress testing; RENAPREC: National Registry of Cardiac Rehabilitation Programs; *Libro*: book; *Iontoforesis*: iontophoresis; *Enfermedad Coronaria*: coronary artery disease; *Insuficiencia Cardíaca*: heart failure; *Fiebre Reumática*: rheumatic fever; *Indep. México*: Mexican independence; *Rev. Francesa*: French revolution; *Rev. Mexicana*: Mexican revolution; *2ª Guerra M*: World War II; *Banda U2*: U2 band; *Teléfonos Inteligentes*: Smartphones; *año*: year.

activity, such as ballroom dancing or modified tennis, were incorporated.

Cardiac rehabilitation high specialty university programs, focused on the training of doctors, first included rehabilitation medicine specialists (INR-2006) and later cardiologists (UNAM, 2007), with dozens of residents having graduated so far. Similarly, the cardiovascular rehabilitation training course for physiotherapists is endorsed by the UNAM since 2014.

Both programs are available at CMNsXXI-IMSS. These courses, with theoretical and practical modality and an adequate burden of assistance work, constitute unique global models for the raining of this kind of human resources. In 2012, the Mexican Council of Cardiology awarded cardiac rehabilitation and secondary prevention programs the certificate of suitability as high specialty training in cardiology. At the CMNsXXI-IMSS, Rodolfo Herrera was appointed the head of the department and incorporated cardiovascular rehabilitation to the heart transplant program. Other doctors who stood out at the IMSS and that promoted the development of cardiac rehabilitation in this institution were Samuel Justiniano, Raúl Cantero, Jorge Hilario Jiménez, and Daniel Gasca.

At the Mexican Navy medical services, José Luis Álvarez Cabrera continued Héctor Sánchez Sierra's work as head of cardiovascular rehabilitation, along with Carlos Buenfil. When the new facilities of the High Specialty Naval General Hospital (HOSGENAES – *Hospital General Naval de Alta Especialidad*) were opened in 2008, the direction of the department remained in the hands of cardiologist Joel Álvarez Peña, who was later replaced by Azucena Rodríguez²⁹.

In 2006, rehabilitation specialist Dr. Álvaro Lomelí Rivas joined the National Institute of Rehabilitation as head of the division and managed to start the high specialty in cardiac rehabilitation, with Juana Zavala participating as associate professor. The INR specializes in the care of patients with cardiovascular disease and different types of disability, particularly patients with lower limb amputations. Subsequently, this team was joined by cardiologist Francisco Ramos. A few years later, Juana Zavala became head of the specialty and was later replaced by Ángela Solache Carranco and subsequently by Roberto Carlos Sahagún Olmos.

The cardiac rehabilitation chapter was founded in March 2003 at the Mexican Society of Cardiology, and it has had an active participation both in statutory sessions and in national congresses.

In May 2013, the Mexican Society for Heart Care (SOMECCOR) was set up, with the mission of carrying

out the study, research, teaching, exercise, dissemination and application of knowledge on cardiovascular rehabilitation, sports cardiology, and related sciences. Throughout these years, more than 60 ordinary academic sessions have been held and two national congresses were carried out (León 2013 and Veracruz 2016). SOMECCOR is recognized by the Mexican Council of Cardiology as a cardiology association dedicated to update specialists and is made up of seven chapters: cardiology, rehabilitation medicine, sports medicine, nursing, physiotherapy, prevention, and nutrition-psychology³⁰.

It is important highlighting the participation of patients in the constitution of two societies called *Enfermos del Corazón A.C.* and *Cardiópatas Unidos A.C.*, with associates of both the CMNsXXI and the National Institute of Cardiology. At present, there are several social networks that offer support to this type of patients.

To date, the National Institute of Cardiology and the CMNsXXI have increased their workforce with the incorporation of Aurora Palao and Jesús Silva to the IMSS³¹ and Jessica Rojano Castillo to the INCICH. Figure 3 summarizes the most important events in universal, cardiology, and cardiac rehabilitation history. Figure 4 includes some of the doctors, physiotherapists, and nurses who have contributed to the development of cardiac rehabilitation in Mexico.

In summary, throughout this article, we have shown how the different cardiac rehabilitation programs have emerged and evolved in our country since 1944, as a continuous adaptation to the requirements of each era, and have been consolidated as a fundamental part in current comprehensive treatment. The future holds many challenges, such as the consolidation of cardiovascular rehabilitation programs for patients with congenital heart disease or with pulmonary arterial hypertension, in addition to the serious problem entailed by the low reference rate of patients eligible for cardiovascular rehabilitation programs, along with the poor adherence of patients to medical treatment. One of the keys to face these challenges is based on the spirit of transdisciplinary teamwork focused on the resolution of problems inherent to patients with heart disease.

"We need to create by ourselves, make science by ourselves and not spend our lives praying the truths and mistakes that others bequeathed to us. As long as we fail to do this, we will be eternally left behind in the scientists' world and eternally unable to solve our problems according to our own reality."

Prof. Ignacio Chávez

Figure 4. Cardiac rehabilitation history tree. Origins and evolution. 1) Nicandro Chávez Sánchez; 2) Juan Enrique Quintal Velasco; 3) Jorge Escudero de la Peña; 4) Pedro Fernández de la Vega; 5) Manuel Antonio Leyva Gómez; 6) Juan Rivera Moreno; 7) Marcela Pérez Mancilla; 8) Gabriel Cherebetieu Domsa; 9) Edmundo Pombo Gordillo; 10) Jesús Antonio González Hermosillo; 11) Enrique Tirado García; 12) Carmen Gutiérrez de Velasco; 13) Elizabeth Pimentel Mercado; 14) Gabriel Vázquez Cabrer; 15) Jorge Hernández y Hernández; 16) Alvaro Lomelí Rivas; 17) René Cámara Escamilla; 18) Héctor Sánchez Sierra; 19) Luz María Mayela Muñoz Gutiérrez; 20) Rafael César Chávez Domínguez; 21) María del Rocío Antúnez de la Rosa; 22) Jorge Hilario Jiménez Orozco; 23) José Carlos Buenfil Medina; 24) Juana Zavala Ramírez; 25) Patricia Camacho Jiménez; 26) Bonifacio Mendoza Peña; 27) Luis Jesus San Juan Rivas; 28) Hermes Ilarraza Lomelí; 29) Rodolfo Herrera Franco; 30) María Dolores Rius Suárez; 31) Leonel Martínez Ramírez; 32) María Elena Cassaigne Guascol; 33) Joel Alvarez Peña; 34) Ángela Solache Carranco; 35) Pedro Miguel Mendoza Díaz; 36) Valesca Dorado Arias; 37) Cecilia Jiménez Pérez Campos; 38) Nancy Pacheco Beltrán; 39) Aurora Palao Mendoza; 40) Zulema Lizbeth Aranda Ayala; 41) Eleonora Montenegro; 42) J. de Jesús Alonso Sánchez; 43) Ricardo Elías Romo Escamilla; 44) Samuel Justiniano Cordero; 45) Jesús Fernández Gallegos; 46) Paula Quiroga Diguini; 47) María Esther Franco Ojeda; 48) Norma Cerón Enriquez; 49) Tania Guadalupe Hinojosa López; 50) Alejandro Almaraz Ríos; 51) Azucena Rodríguez Reyes; 52) Roberto Carlos Sahagún Olmos; 53) Raúl Cantero Colín; 54) Iván Serna Santamaría; 55) Luis Santiago Sedano Estrada; 56) Laura Villaseñor Todd; 57) Rodolfo Lerma Espinosa; 58) J. Jesús Silva Torres; 59) Jessica Rojano Castillo; 60) Pedro Alejandro Hernández; 61) César Gerardo López de la Vega; 62) Pablo Daniel Gasca Zamudio; 63) Marianna Andreina García Saldivia; 64) Jorge Antonio Lara Vargas; 65) Juan Pablo Nuñez Urquiza; 66) Paulina Lizbeth Rodríguez Herrera; 67) Jorge Emmanuel Avilés Rosales; 68) Jesús Enrique Lugo Torres; 69) Ingrid Salomé Morales Sánchez; 70) Pavel Loeza Magaña; and 71) Rodolfo Arteaga.

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Protection of people and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that no patient data appear in this article

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

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