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Area	109,884 km ²
Population ¹	11,288,752 (2017)
Capital	Havana
Three most populated cities:	1. Havana 2. Santiago de Cuba 3. Holguin
Official language	Spanish
Gross domestic product (GDP) ²	96.851 billion USD (2017)
GDP per capita ²	8541.2 USD (2017)
Human Development Index (HDI)	0.777
Official currency	Cuban peso
Total number of nephrologists	433
National society of nephrology	<i>Sociedad Cubana de Nefrología</i> www.sld.cu
Incidence of end-stage renal disease	2018 – 107.3 pmp
Prevalence of end-stage renal disease (on dialysis)	2018 – 299.4 pmp
Total number of patients on dialysis (all modalities)	2017 – 3289 2018 – 3352
Number of patients on hemodialysis	2017 – 3224 2018 – 3281
Number of patients on peritoneal dialysis	2017 – 65 2018 – 71
Number of renal transplantations per year	2017 – 203 2018 – 178

1. Oficina Nacional de Estadística e Información (ONEI). República de Cuba. Anuario Estadístico de Cuba 2017. Edición 2018. Disponible en: www.one.cu/aec2017.htm

2. The World Bank, <https://data.worldbank.org/country/cuba>

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Introduction

The Republic of Cuba is an archipelago made up of more than 1600 islands, islets, and cays; the capital Havana is located on the island of Cuba, the largest of the archipelago. The surface area of the Cuban archipelago is 109,884.01 km². The country has a population of 11,288,752 (2017); 20.1% are 60 years or older, and that number is expected to increase to 30.1% by 2030. Life expectancy at birth is, on average, 78.4 years, 76.5 years for men and 80.45 years for women [1].

Cuba is one of the countries with the oldest population in Latin America. The educational level is high, with a literacy rate of 99.7% [2]. Cuba has a high Human Development Index of 0.777 that ranks 73rd out of 188 countries in the world [3]. In respect to the economy, Cuba ranks as an upper middle-income country [4].

In Cuba, there is a unique state-run health system, with universal coverage and access (no exclusions), free of charge for the entire population [5]. The Cuban health system rests on the three key principles of the current strategy for universal health access and coverage as set forth by Pan American Health Organization/World Health Organization (PAHO/WHO): health as a human right, equity, and solidarity [6].

The cornerstone of the national health system (NHS) is primary health care (PHC). Since 1984, the family medicine model has been implemented in the community. Its objective is to contribute to the improvement of the population's health through integrated interventions for individuals, families, communities, and the environment [7]. The NHS has 92,084 physicians (122 inhabitants per physician). The PHC has 450 polyclinics (health-care areas), 13,131 family doctors in community clinics, and 10,869 basic health-care teams. Each team includes an internist, a pediatrician, and an obstetrician-gynecologist, among other specialists, who provide care for 100% of the population [8].

The number of specialized nephrologists amounts to 433 (57.3% of whom are women), a ratio of 38.35 per million population (pmp). A total of 229 general practitioners (GPs)

are enrolled in the 3-year specialty, provided in the 11 provincial medical universities categorized for postgraduate programs [9]. Human resource needs are established by the provincial health divisions, according to the number of centers, incidence of kidney disease, and the age of the practicing nephrologists.

Specialists in nephrology work at the hospital level and also see patients in the polyclinics located in the 168 municipalities. They carry out actions that range from primary prevention, care, consultations, referral to other specialists, rehabilitation through dialysis, and transplantation. In addition, they are involved in academic and research work according to the needs identified at institutional, provincial, or field levels. For this purpose, the analysis of health situations at each level is used as an essential tool, with a comprehensive, interdisciplinary nature, including community participation and inter-sectoral collaboration.

Cuba, a country that has been subject to a financial and economic embargo for approximately 60 years, must incur extremely high expenses every year to respond to the incidence and prevalence of patients with end-stage renal disease (ESRD). Although they are a minority of the population, these patients require medicines, consumables, and technologies for peritoneal dialysis (PD), hemodialysis (HD), and kidney transplantation [10]; all of them are internationally recognized as sources of inequities [11] in a country characterized by an increase in noncommunicable chronic diseases and aging population.

Brief History of Nephrology in Cuba

Nephrology was recognized as a specialty in Cuba with the creation of the Institute of Nephrology in December 1966. In the past, teaching, medical care, and research activities of this specialty were carried out by urology fellows/residents and pediatricians, the latter with outstanding activity since the decade of the 1950s [12].

In the capital, two pediatric centers stood out for the care of kidney diseases. In 1948, the first kidney biopsies were performed by puncture; a preliminary report was presented at the Congress of Pathology in La Plata, Argentina, in 1950. The report described the technique used in eight patients, and this work was published in the bulletin of the League Against Cancer later in the same year. Kidneys were localized through a pyelogram, and a special type of punch trocar was used which was called a microtome [13].

In the late 1950s and early 1960s, HD was sporadically performed on patients with acute kidney injury (AKI) and exogenous intoxications. With the establishment of the Institute of Nephrology by Professor Abelardo Buch López, whose name this institution bears today, a small program of

intermittent dialysis (HD and PD) for patients with ESRD began, which led to the first successful kidney transplant from a cadaveric donor in February 1970. Once the specialty was recognized, the training of nephrologists began and the first graduation occurred in 1970.

The 1970s were marked by the expansion of nephrology care to the center and east of the country, which paved the way for the national coverage of the specialty: the performance of kidney transplants from cadaveric donors and living donors (first-degree relatives), kidney transplants in children [14], as well as the progressive development of care, teaching, and research, as well as the creation of related research laboratories (physiopathology, immunology, and nuclear medicine).

The Cuban Society of Nephrology was constituted in 1974; it is a nongovernmental, civil, scientific organization, linked to similar societies. Since its creation, it has developed ten national congresses with international participation, as well as numerous courses, workshops, and training for both national and foreign nephrologists. The Latin American Society of Nephrology and Hypertension (SLANH) named Professor Abelardo Buch López, founder of the specialty in Cuba, as its honorary president.

In the 1980s, the nephrology national coverage was completed with the establishment of at least one nephrology center with the possibility of providing dialysis treatment in each province. The national coordination center for dialysis and kidney transplantation was created with headquarters in the Institute of Nephrology. Since then, its main mission has been to advise and receive information from all the nephrology centers in the country. This has made it possible to keep a record of all patients treated with RRT.

At the beginning of this century, the Cuban government decided to bring dialysis facilities closer to patients' homes. Today, we have 56 nephrology centers with dialysis possibilities throughout the country spread over 15 provinces and a special municipality, for a population of just over 11 million inhabitants.

Kidney Diseases in Cuba

Kidney diseases that require specialized care do not differ from that of most countries: hypertension, diabetes mellitus, polycystic kidney disease, glomerular diseases, uropathies, and others. Despite being geographically located in the Caribbean and close to Central America, there are no reports on chronic kidney disease of unknown cause (CKDu), also called Mesoamerican nephropathy.

In Cuba (2014) the main ESRD causes of the incident RRT patients were hypertension (37.1%), diabetes mellitus (32.1%), polycystic kidney (7.3%), and glomerular diseases (5.6%) [15].

A research study comprising 1503 renal biopsies performed in adult patients between 1988 and 2007 at the Institute of Nephrology reported the main histopathological patterns of primary glomerular diseases: focal segmental glomerulosclerosis (20.6%), mesangioproliferative glomerulonephritis (16.8%), minimal change disease (10.9%), infectious disease-associated glomerulonephritis (6.9%), and membranous glomerulonephritis (5.0%), as well as the main secondary glomerular diseases: lupus nephritis (13.6%), benign nephrosclerosis (2.6%), and systemic vasculitis (1.3%) [16].

The epidemiological Cuban study ISYS (Isle of Youth, 2004–2006) reported a chronic kidney disease (CKD) prevalence of 9.63% (stage 1, 3.02%; stage 2, 3.43%; stage 3a, 2.26%; stage 3b, 0.71%; stage 4, 0.15%; and stage 5, 0.03%) in an adult population of 55,646 people [17]. The third National Risk Factors Survey reported a prevalence of CKD (glomerular filtration rate <60 ml/min/1.73 m²) of 5.4% [18].

In Cuba, the mortality rate adjusted for glomerular and kidney diseases (N00-N19, N25-N27) has had a slight increasing trend up to 4.4 per 100,000 inhabitants, and it ranks 13th in the country's overall mortality in 2017 [8]. It is lower than the global adjusted mortality rate of 18.2 per 100,000 inhabitants reported by the Global Burden of Disease Study in 2016 [19]. The third National Risk Factor Survey also measured the risk of having a glomerular filtration rate of <60 ml/min/1.73 m², given the presence of the following risk factors: obesity 13.6%, diabetes mellitus 13.2%, hypercholesterolemia 10.2%, arterial hypertension 9.2%, smoking 5.9%, and alcohol consumption 3.5% [18].

The intervention strategy for the prevention of CKD has been based on the following pillars:

- (a) Integration with the noncommunicable diseases program
- (b) Primary health care
- (c) Medical care services for CKD patients brought closer to the communities
- (d) Interdisciplinary and inter-sectorial interventions
- (e) Surveillance
- (f) Human resource development and research

The Program for CKD Prevention (1996) is integrated into the noncommunicable diseases program, under the control of the Ministry of Public Health, which has facilitated the implementation and control of interventions [20].

Primary health care has favored the implementation of integrated preventive actions for CKD and noncommunicable diseases. The continuous assessment, risk evaluation, and classification of the population by family physicians are noteworthy. This is an organized, continuous, and dynamic process that permits planned and programmed evaluation of intervention on the health status of individuals and families, under the leadership and coordination of the basic health team.

People are screened and classified into four groups:

- Group I – apparently healthy people
- Group II – people at risk
- Group III – sick people, diagnosed with communicable or noncommunicable diseases
- Group IV – people with disabilities or handicaps

Screening records make it possible to assess the population's health status [7].

Bringing health-care services close to where patients live has been a fundamental principle in the intervention strategy. In addition to care provided by family doctors and basic health teams, nephrologists consult in certain areas of the country. Dialysis facilities have also followed such strategy through a regionalization plan.

The CKD prevention program emphasizes the active participation of the organized community for the identification of risk groups, early diagnosis through the study of renal injury markers, specific treatment of underlying kidney disease, preventing or attempting to delay disease progression and complications, patient rehabilitation, and control of the environment, for which an interdisciplinary and inter-sectorial approach is required.

CKD surveillance is integrated into the systems of the Ministry of Public Health. Passive surveillance is carried out through the registration of deaths (mortality) [8], registration of screened patients by family doctors, and registration of dialysis and kidney transplantation. Active surveillance is carried out through national risk factor surveys and population-based preventive actions, carried out periodically in 1990, 2001, and 2010 [18]. The human resource development plan and research to be carried out are scheduled according to the needs.

The CKD risk factor prevention program has made some progress including an improvement in social determinants, higher educational level in the population, control of environmental pollution with a significant reduction in the use of agrochemicals in agriculture, reduction of low birth weight to 5.1%, smoking reduction to 23.7%, and reduction of overweight to 28.9%, although obesity increased to 14.8%. In primary health care, there has been an increase in the diagnosis of diabetics (699,282), with effective glycemic control (<7 mmol/L) in 67% of them; an increase in diagnosed hypertension (2,531,803), with effective blood pressure control (<140/90 mm/Hg) in 50% of them; and more than 50% using antihypertensive agents with renal protective effect (inhibitors of angiotensin-converting enzyme). There is better control of infectious diseases; 14 infectious diseases have been eliminated, including malaria, and there is a vaccination program against 18 infectious diseases, with coverage for 100% of the population [8, 18].

In primary health care, family doctors have increased the diagnosis of CKD, but it is still not enough based on the number of expected patients.

Renal Replacement Therapy in Cuba

Our country offers integrated kidney care to patients suffering from advanced CKD who require RRT; however, in the area of dialysis, 97% of patients are on standard HD therapy with polysulfone membranes, the majority of them low flux dialyzers. Most water treatment systems are of reverse osmosis, a few with double pass reverse osmosis systems and heat sterilization. In addition, all provinces in the country have mobile water treatment systems. Convective therapies are only practiced in a small number of patients and are being introduced in two nephrology centers in the capital.

The national pharma and biotechnology industries ensure the sustainability of HD with the production of concentrate for the HD instruments, whereas home-based PD is done by importing the consumables from leading PD companies. Nationally produced recombinant human erythropoietin is provided free of charge to all patients who require it [21].

The RRT methods are kidney transplant, HD, and PD; these three methods are not antagonistic, but rather complementary to each other; a patient can switch from one to another according to clinical, psychological, or social needs, thus extending their life expectancy [22]. The possibility of providing these three therapeutic modalities is known in the world as integrated kidney care.

CKD is a complex phenomenon, a chronic non-transmissible disease, considered to be a modern epidemic in the world, due to the increase in the number of cases each year, partly due to the increase in the life expectancy of the population, allowing more time to the development and/or to the increase in the prevalence of other pathologies such as hypertension, diabetes mellitus, and obesity, which may lead to the development and/or progression of CKD. Its magnitude is a serious medical problem overwhelming the budgets of health-care services in all countries of the world, although with individual differences for each type of RRT; all separately and as a whole are costly techniques [23].

Peritoneal Dialysis

In our country, both HD and PD have been used since the 1960s. However, for circumstantial reasons, HD has had an adequate technological development, whereas PD began as a technique for hospital intermittent PD, performed mainly by nurses, using dialysis solutions packaged in nationally produced glass flasks. The medical team

involved in PD, practically from the beginning, was in charge of recording and publishing their work experiences [24–28].

Continuous ambulatory peritoneal dialysis (CAPD) and automated peritoneal dialysis (APD), was introduced in late 2007 and 2008, respectively, in both adult and pediatric patients, by the Institute of Nephrology, which is the governing center of the specialty in the country for the adults, and months later by the pediatric hospital in Havana that is the national pediatric reference center for kidney diseases.

Since it is a technique-based self-care, home-based PD has, among others, the advantage of being able to treat patients remotely, so from the Institute of Nephrology in the capital, patients are treated for all of the western provinces of the country; two other units are responsible for the care of the central provinces and another in the eastern area, using nephrology centers that are engaged in the performance of kidney transplantation and offer regional care.

After five decades using virtually the same open PD system, often three times a week, for 10 or 12 h each time, HD was, at the same time, incorporating global technological advances that allowed standard HD to be performed. Then it became difficult for nephrologists and health authorities to promote greater numbers of patients treated with PD. It was said that someone in Europe made a remark during an international congress of nephrology that “peritoneal dialysis is a second-class procedure for third-class patients, performed by fourth-class physicians” [12].

Once home-based PD was introduced in a small group of patients, it took some time to obtain results that supported the unavoidable need for changes in the distribution of patients treated with dialysis as an RRT method [29–34]. Since 2014, the Pan American Health Organization (OPAS) and the Latin American Society of Nephrology and Hypertension (SLANH) made a call to increase the rate of RRT in the countries of the region and to reach a 20% utilization of home-based PD.

At the beginning of 2017, taking into account the results obtained up to that time, the public health authorities considered increasing the number of patients treated with home-based PD and decided:

- All pediatric patients who require this procedure may have access to it, with coverage for 100% of these patients.
- To reach an annual increase of 5% of the total number of patients treated with dialysis, until reaching a proportion of 10% of patients on home-based PD and 90% on HD in the next few years, a figure equivalent to the world average at that time. This would slightly represent more than

300 patients treated with home-based PD, as well as gradually phasing out in-hospital intermittent PD.

- Home-based PD should provide regional care; this mission will initially be fulfilled by hospitals that currently have kidney transplant services.
- The Institute of Nephrology is responsible for the training of nephrology specialists and nursing staff for the care and follow-up of such patients, as well as maintaining technical and methodological advisory.

Coincidentally, the Central American Association of Nephrology and Hypertension convened a meeting of experts in PD a few months later. This conference was held in the Dominican Republic, with the purpose of evaluating the situation of this therapy in each country and stimulating its use, as it is an efficient method and with a very good cost-effectiveness ratio. After 2 days of work, a consensus document was issued, known as La Romana Declaration: "Peritoneal Dialysis, an Alternative to the Epidemic of Kidney Disease."

Among other aspects, it was recommended to promote the use of home-based PD as an excellent option for RRT, to encourage research on PD in the region, and to stimulate the development and performance of health economics studies, both nationally and among the different countries of the region, as well as to discard programs of intermittent PD, a technique associated with high morbidity/mortality that demotivates and discourages patients from receiving dialysis treatment and is no longer recommended with current clinical and scientific evidence. A summary of that consensus meeting was later published [23].

Cuba has been represented in all Latin American scientific events (except the first one) and in the PD world congresses since 2010, with the presentation of scientific papers. Nephrologists and nurses in charge of home-based PD have received training inside and outside the country. We organize and offer national and international courses accredited by the University of Medical Sciences of Havana.

Hemodialysis

In 1957, the country's first hemodialysis center for AKI and toxic coma was created [33]. Starting in 1966, with the recognition of the specialty and the creation of the Institute of Nephrology, ESRD care began in an organized manner with IPD and chronic HD. From that moment on, the creation of new nephrology centers with dialysis programs began slowly and progressively, for adult ESRD patients, in hospitals in all provinces and since 1980 in children [34].

International developments in the treatment of CKD in our country showed the magnitude of the problem. In all these years, HD development has been considered in the context of a more comprehensive health policy, which included prevention integrated with other noncommunicable diseases [35–39].

A nephrology center in the eastern part of the country developed a prototype of artificial kidney with proportional pump and single-pass dialysate, which was used in that unit and other centers in that region [40]. This project was later discarded, and the technology used has always been imported.

In 1986, the country's first HD satellite unit was created, which also provided psychological, nutritional, and physical activity support to patients, interacting closely with caregivers [41].

The national medical-pharmaceutical industry produced PD solutions (in glass flasks) and acetate-based HD concentrates, which allowed an initial sustainability for both of them, with emphasis on HD that always predominated vs. proceeding with in-hospital IPD.

The history of HD in Cuba is part of the achievements of the national health system and its uninterrupted improvement, in spite of the economic complexities of a poor country without access to international financing sources due to the economic and financial embargo of the United States [42].

The replacement of HD acetate-based concentrate with nationally produced bicarbonate-based one was achieved in 2002. The turning point in the HD development occurred in January 2003, marking the beginning of a stage of accelerated promotion of the specialty and development of its human resources and strategic projection [43]. Fifteen new nephrology centers were inaugurated and another 10 already in operation that went from having 4 or 8 HD stations to up to 18 or 22. The use of cellulose membranes was replaced and the reuse of needles and lines discarded.

But, taking into account the Ministry of Public Health's policy regarding efficient and rational use of resources, reuse of dialyzer in the same patient is permitted. The dialyzer can be reused while the residual volume is higher than 80%. The average dialyzer reuse has been 10–12 times, but reuse is not allowed more than 15 times.

The national dialysis registry allows us to precisely know the number of patients and establish, based on this information, the coverage of the needs of human, logistical, and financial resources for adequate care of these patients.

At present, after 15 years of priority care, despite all economic and financial problems, HD treatment is performed in

Table 13.1 January 2019 report

Indicators	2007	2010	2011	2015	2016	2017	2018
Nephrology-HD centers in operation	47	48	49	51	51	55	56
Total number of patients on dialysis	2353	2560	2724	3148	3189	3289	3352
ESRD prevalence (pmp)	214	228.6	243.2	281.1	284.7	292	299.4
ESRD incidence (pmp)	100	96.1	97.8	110	95	97.6	107.3
HD prevalence of patients with functional native arteriovenous fistula (%)	72.5	74.1	72	72	73.8	83	74
HD gross mortality (%)	28.3	27.9	23.8	26.4	23.2	24.6	25.4

Program coordinating center. Kidney disease, dialysis, and transplantation. National Institute of Nephrology

56 nephrology centers, all of them state-owned. More than 3300 prevalent patients are being treated, using nationally produced concentrated solutions for dialysis. Table 13.1 shows the evolution and the current RRT scenario in Cuba. We use imported high-tech equipment such as HD machines and water treatment systems (reverse osmosis); hemodiafiltration (convective therapies) is in the introduction stage. There is a decrease of hepatitis B, with marked stability in recent years, as we use nationally produced vaccines. Moreover, there is a specialty development program which includes the creation of new nephrology centers until 2025.

Renal Transplantation

The first successful kidney transplant in Cuba was performed in the early 1970s at the Institute of Nephrology. In the following years, this technology extended to the rest of the island, and Cuba currently has nine centers accredited to perform kidney transplantation of cadaveric and living donors [44].

The transplant program covers the entire population as equitably as possible; there are five organizational zones led by a regional coordinator who reports to the National Transplant Organization (NTO). In addition, the major hospitals have local coordinators who are responsible for identifying potential donors and interacting with the family in order to achieve organ and tissue donation. In Cuba, presumptive consent does not apply, i.e., families must approve donations. For now, donors are only used in the case of encephalic death; however, the first steps are being taken to include donors in controlled cardiac arrest. There is a unique selection program that is updated monthly and that takes into account criteria such as ABO and human leuko-

cyte antigen (HLA) compatibility, waiting time in RRT, age, and body weight. Likewise, patients under 19 years of age and patients with vascular capital depletion for HD are prioritized.

Traditionally, only first-degree relatives were accepted as living donors; however, at the end of 2015, in order to stimulate the performance of this type of transplants and in accordance with international practices, the donor selection criteria were broadened to include other types of relatives and patients emotionally related as children or spouses, which was approved in a resolution by the Ministry of Public Health and published in the Official Gazette [45].

During the cadaveric donor transplant operation, HLA typing and flow cytometry crossmatch are performed in most areas of the island; however, lymphocytotoxicity techniques are still applied in the eastern region, since the transplant system is not isolated from the economic impact of the embargo applied by the US government against the Cuban people. The preservation of the organs is done through simple hypothermia with standard preservation liquid. The organs are kept in the Acute Tubular Necrosis (NTA) from where they are distributed to the centers that will perform the grafts. Each transplant center is committed to serving a region that encompasses several provinces or municipalities, with their corresponding HD or PD centers. Such regions are also encouraged to create their pre-dialysis transplant consultations so that patients with advanced kidney disease, who are not yet receiving HD or PD, may choose transplantation as a replacement for kidney function.

Transplant surgical teams include anesthesiologists, surgeons, urologists, and nurses. The selection of patients is made through an automated program with a single database where all patients eligible for transplantation are registered. Nephrologists are in charge of checking patients, selecting the immunosuppression according to the individual immunological risk, and performing postoperative care. Most of the centers apply induction of immunosuppression with biological drugs, especially in cases of higher immune risk. The usual maintenance treatment is cyclosporine A or tacrolimus associated with mycophenolate mofetil or azathioprine and low doses of steroids [46]. Due to financial limitations, there are still very few patients with treatments based on other drugs such as everolimus or sirolimus, and there is no experience in Cuba with the application of belatacept. As with the rest of medical care, kidney transplantation, associated medical care, and the main immunosuppressive drugs, both induction and maintenance, are free for patients.

Clinical follow-up of transplanted patients is usually done in the same transplant center. In fact, nephrologists coordinate the rest of the specialized care required by transplanted patients. The main causes that affect the long-term survival of the graft are cardiovascular disease and chronic rejection

and to a lesser extent infections and cancer. The first-year graft survival rate of the first renal transplant was 80.4% (2013) [15].

The staff involved in kidney transplantation is trained in Cuba at the medical university and in different specialized centers, at no cost. Furthermore, there is a rich regional and global exchange through the Transplant Society of Latin America and the Caribbean (STALYC) and centers in Florida and Spain that support the training of specialists. Cuba is usually represented at regional and global congresses on kidney transplantation.

The main challenges facing the Cuban transplant system and nephrology are to increase the number of patients fit for transplant among those undergoing HD and PD, reduce organ waste during operations, and increase graft survival per year, especially by reducing surgical complications. The main achievement is the equitable and free care to all the population of patients requiring kidney transplant on the island.

Acute Kidney Injury and Critical Care Nephrology

Although the first cases of AKI were described at the beginning of the last century, this disease was “rediscovered” during the last world war in the form of crush syndrome. The concept of AKI as a syndrome was clearly and permanently established in the world medical literature in 1942, when Eric Bywaters and JH Dible studied poly-traumatized patients after the bombings of London in World War II [47]. This syndrome is usually presented as a serious and frequent complication in the clinical evolution of many diverse medical situations: the increase in complex and aggressive surgery, scientific-technical progress applied to very critical patients that allow them to prolong their life long enough to develop AKI, increased use of nephrotoxic substances, population aging, increased frequency and severity of accidents, traumas, catastrophes and natural disasters, as well as regional war conflicts have contributed decisively to the high prevalence of this condition, which offers an interesting paradox. By definition, it is potentially reversible and yet leads to death in more than half of the cases [46]. This persistently high mortality despite recent progress in pathophysiological knowledge, in diagnostic methods, and in the technological development of effective uremia treatments remains a major challenge for current medicine [48–50]. The modern management of AKI should be oriented in a multidisciplinary manner, requiring maximum understanding, intelligence, and effort from qualified personnel [51, 52].

In Cuba, in the prerevolutionary stage, there was no comprehensive health system that would allow us to accurately define the real behavior of the disease we are dealing with in

the statistical order, which makes it practically impossible for us to compare current results with previous studies. At the beginning of the 1960s, the first research studies began under the leadership of Professor Abelardo Buch López, showing that the most frequent causes of AKI were incompatible blood transfusion, complicated abortion, and hemodynamic disorders (shock), which determined that health actions were adopted in order to establish preventive and therapeutic measures.

In 1976, the Institute of Nephrology created a department with the function of a nephro-urological intensive care unit (ICU) that still maintains this profile; it is the only one with this characteristic in our country and one of the few in the world, specialized in both assistance, teaching, and research in multidisciplinary care of critical uremic patients. In the rest of the country, these patients are cared for with intensive multipurpose therapies and nephrological support. At present, Cuba has a national health system with an extensive network of polyvalent ICUs with more than 2200 beds, extended throughout the country, equipped with significant human and technological resources, providing specialized care to the entire population.

The number of people in the world who reach or exceed the seventh decade of life has increased, from just over 400 million in 1950 up to 700 million today, with a forecast of over 1 billion in 2025; thus, the total population growth will be characterized in the near future by a growing proportion of elderly people. This process, already in motion, is accompanied by a clear decrease in the birth rate and an ostensible increase in life expectancy, in such a way that demographic trends qualify population aging as a transcendental change in the distribution of population in today's world, turning it into a global phenomenon.

Our country, as a participant in the current world demographic development, is among the four most aged countries in Latin America and the Caribbean. In 1988, elderly Cubans represented 11.7% of the population; today they have increased up to 14%, and according to forecasts, the elderly in 2025 will reach 20.1% of the total population [53]. Population aging does not constitute a health problem; it is rather an achievement of humanity due to technical scientific developments. However, with aging, limitations begin to proliferate as well as a progressive risk of disease and death.

AKI in elderly people, within the framework of 60 years of age according to the classification of the WHO, has a much higher prevalence than in the general population, being considered by some to be a typically geriatric pathology. Volume depletion, hemodynamic alterations, nephrotoxic drugs, and urological obstructions are the main factors responsible for the onset of this syndrome. More and more elderly patients are being admitted to ICUs, leading to a significant increase in the frequency of AKI in such patients, leading to prolonged hospitalization and high mortality, pos-

sibly also conditioned by the severity of the same due to underlying diseases [54–57].

At the Congress of Acute Kidney Injury held in the Dominican Republic in April 2016, we presented our 16-year work experience (1999–2015): 223 patients 60 years older or more, in which we concluded that there was a predominance of male patients with parenchymal causes. A high number of patients required dialysis treatment, post-renal or obstructive causes accounting for almost half of the cases. If we take into account the total number of cases treated in that period, regardless of age, 1003 patients were treated in which there was a predominance of men over 50 years of age and parenchymal causes, two thirds of all patients required dialysis treatment, and HD/ultrafiltration was used in most of these cases [57].

Nephrology Practice in Cuba

The process to become a specialist in nephrology in Cuba is done through the residence in nephrology. First of all, the candidate must have a medical degree. Then, one of these criteria must be met: specialization in internal medicine or in general integral medicine (family medicine) or graduated as medical doctor with an academic index of 4.5 mark or more.

The training is done at institutions which have been accredited by the Ministry of Public Health and the Ministry of High Education. The residence program is given through learning modules at any nephrology center. The pathway requires 3 years of training. The first year should comprise 24 weeks in an area of internal medicine and critical care patients followed by an additional 24 weeks at an internal medicine ward and intensive care unit and another area in basic nephrology at a nephrology ward. The last 2 years in nephrology should be focused on clinical nephrology, HD, PD, renal transplantation, pediatric nephrology, urology, and others. There is a theoretical and practical examination at the end of each year, as well as one thesis and a final theoretical and practical examination at the end of the residency [58].

The second half of the twentieth century was marked by a progressive and permanent development of nephrology practice from the perspective of RRT in ESRD patients, in accordance with the development of technology and pharmaceutical industry linked to dialysis and transplantation. In Cuba, this phenomenon has occurred with a progressive increase in the number of nephrology centers and a response from the national medical-pharmaceutical industry, in terms of dialysis concentrates, solutions, and medicines, but with a strong dependence on imports of technology and expendable resources from very distant countries due to the US embargo, which prevents the use of its powerful and closed market.

The development of nephrology in Cuba: on one hand, the training of specialized personnel – up to more than 400

physicians and more than 1500 nurses specialized in nephrology – in a population of just over 11 million inhabitants and, on the other hand, the development of specialized human resources, which has allowed the progressive increase of nephrology centers, with the aim of bringing them closer to patients' homes and ensuring universal access.

There is a multidisciplinary staff at each of the nephrology centers, integrated by nephrologists, renal care, HD and PD trained nurses, psychologists, dietitians, and social workers.

Although the development of the medical pharmaceutical industry in Cuba has allowed a progressive increase in the coverage of nephrology practice, the conditions of being an underdeveloped country, with a GDP in the range of Latin American countries' average income, dependent on imports and subject to the US strict embargo, have greatly hindered technological development in the medical sector in general and the nephrology sector in particular.

Within this context, convective therapies have been introduced to adapt them to our conditions, to analyze their particularities, and to promote their subsequent implementation and extension to the rest of the country. All activities developed by the national health system are budgeted by the Cuban state, which has an important source in the system of taxes and duties established in the country. All care received by patients is free of charge, and there is no particular reimbursement policy linked to dialysis and transplantation.

Conclusion

In Cuba, since the official recognition of nephrology as a medical specialty and the foundation of the Institute of Nephrology in 1966, a progressive development has happened, expressed in the performance of scientific work and medical publications, which has allowed at all times the exchange of experiences between Cuban and international nephrologists, mainly from the Latin American area, in national, regional, and global scientific events.

We have a unique health system that ensures universal and free coverage; there are 56 nephrology centers distributed throughout the country, which offer specialized nephrology care, RRT coverage, the possibility of special laboratory tests, imaging, and kidney biopsy. For the care of such patients, the country has more than 400 nephrologists and 1500 specialized nurses who have the possibility of taking periodic refresher courses.

In Cuba, the development of public health in general, and of nephrology in particular, has been hindered by the economic and financial embargo imposed by the United States for about 60 years, which makes the acquisition of equipment and supplies more expensive. In spite of this, we have had achievements and are renown in the international arena.

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