

CKD Care and Research in Guatemala: Overview and Meeting Report



Pablo Garcia^{1,2}, Carlos Mendoza³, Joaquin Barnoya^{4,5}, Jose Monzón⁵, Ann C. Miller⁶, Angie Aguilar-González⁷, Julio Boj⁸, Allan Cifuentes⁹, Pedro Dávila¹⁰, David Flood^{2,11}, Carolina Guzmán-Quilo¹², Agualuz Hernandez^{10,13}, Randall Lou-Meda⁷, Eduardo Palacios¹⁴, Vicente Sánchez-Polo¹³, Regina Sosa^{10,13} and Peter Rohloff²

¹Stanford University School of Medicine, Palo Alto, California, USA; ²Centro para Investigaciones sobre la Salud Indígena, Wuqu' Kawoq | Maya Health Alliance, Tecpán, Guatemala; ³Institute of Nutrition of Central America and Panama (Instituto de Nutrición de Centroamérica y Panamá, INCAP), Guatemala; ⁴Unit for Cardiovascular Surgery (Unidad de Cirugía Cardiovascular de Guatemala, UNICAR), Guatemala; ⁵Institute of Research and Higher Studies in Health Sciences (El Instituto de Investigación y Estudios Superiores en Ciencias de la Salud, IECIS), Rafael Landívar University, Guatemala; ⁶Department of Global Health and Social Medicine, Harvard Medical School, Boston, Massachusetts; ⁷Foundation for Children with Kidney Disease (Fundación para el Niño Enfermo Renal, FUNDANIER), Guatemala; ⁸National Center for Chronic Renal Disease (Unidad Nacional de Atención al Enfermo Renal Crónico, UNAERC), Guatemala; ⁹Guatemalan Ministry of Health, Guatemala; ¹⁰Guatemalan Nephrology Association (Asociación Guatemalteca de Nefrología, AGN), Guatemala; ¹¹National Clinicians Scholars Program, University of Michigan, Ann Arbor, Michigan; ¹²Toxicology Department-SALTRA, Faculty of Chemical Sciences and Pharmacy, Universidad de San Carlos, Guatemala; ¹³Guatemalan Institute of Social Security (Instituto Guatemalteco de Seguridad Social, IGSS), Guatemala; and ¹⁴Chronic Diseases Program of the Ministry of Health of Guatemala, Guatemala

On October 14–15, 2019, the 1st Symposium to Promote Chronic Kidney Disease (CKD) Research in Guatemala was held in Guatemala City, Guatemala. The Symposium hosted more than 50 attendees, including health care professionals, policy makers, researchers, and leaders of nongovernmental organizations. The meeting's objectives were to (1) share clinical and health delivery experiences, (2) disseminate local research, and (3) establish consensus priorities for future research. In this report, we review the state of CKD nephrology in Guatemala, summarize experiences shared during the meeting from representatives of the clinical settings in Guatemala where CKD care is provided, and describe consensus priorities for future research.

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On October 14–15, 2019, the 1st Symposium to Promote Chronic Kidney Disease (CKD) Research in Guatemala was held on the campus of the Rafael Landívar University in Guatemala City, Guatemala. The Symposium was organized by the Institute of Nutrition of Central America and Panama (INCAP), the Cardiovascular Surgery Unit (UNICAR), Rafael Landívar University, and Wuqu' Kawoq. More than 50 attendees participated in the event, including government policy makers, researchers from local and US-based universities, leaders of nongovernmental organizations, and clinicians from diverse backgrounds such as nursing, primary care, and nephrology.

This meeting was an effort to understand the challenges and successes among attendees who care for patients with CKD and conduct research on kidney disease in Guatemala. In this report, we first review CKD epidemiology and the state of kidney care in Guatemala. Second, we summarize experiences shared during the meeting from representatives of the 3 primary clinical settings in Guatemala where CKD care is delivered: the National Center for Chronic Renal Disease (UNAERC), the Guatemalan Institute of Social Security (IGSS), and the Guatemalan Foundation for Children with Kidney Diseases (FUNDANIER). We conclude by describing the meeting's consensus priorities about advancing CKD research in Guatemala.

Correspondence: Peter Rohloff, 2da Avenida 3-48 Zona 3, Barrio Patocabaj, Tecpán, Chimaltenango, Guatemala. E-mail: peter@wuqukawoq.org

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Kidney Care in Guatemala

Guatemala is an upper-middle-income country in Central America that has a population of 16.4 million people.¹ The country possesses stark disparities in

Table 1. Current kidney care centers in Guatemala

Name of the center	Characteristics
Guatemalan Institute of Social Security (IGSS)	<ul style="list-style-type: none"> Serves patients with employer-funded health insurance Less than 40% of the adult population International Society of Nephrology sister program
Guatemalan Foundation for Children with Kidney Diseases (FUNDANIER)	<ul style="list-style-type: none"> Primary provider of services to children with chronic kidney disease Public-private collaboration, funded mainly by the Ministry of Health International Society of Nephrology sister program
National Center for Chronic Renal Disease (UNAERC)	<ul style="list-style-type: none"> Patients who lack health insurance Around 60% of the adult Guatemalan population Funded by the Ministry of Health

health outcomes by ethnicity and socioeconomic status despite having the highest gross domestic product in Central America. Nearly 50% of the Guatemala population is indigenous Maya, an ethnic group predominantly residing in poor, rural agricultural communities with limited access to health care.^{2,3} Guatemala also has one of the highest rates of child undernutrition (stunting) worldwide, and the dual burden of undernutrition and obesity is an emerging concern.^{4,5} Early-life exposures to malnutrition and obesity in Guatemala magnify the adult risk for noncommunicable diseases such as diabetes.⁶

Approximately 8% of the Guatemalan population has access to private health insurance and private health care.⁷ As a result, clinical care for kidney diseases in Guatemala is primarily delivered in the public-sector institutions, which include IGSS and UNAERC. A third entity, FUNDANIER, is a public-private collaboration based out of one of Guatemala's largest referral hospitals, the Roosevelt Hospital. Characteristics of the 3 entities are summarized in Table 1. As illustrated in Figure 1, UNAERC and FUNDANIER are based in the capital, Guatemala City and primarily serve patients residing in the metropolitan area. Access to renal care is a significant problem for patients with CKD in rural communities.

According to the 2014 Latin American Dialysis and Renal Transplant Registry, Guatemala reported one of the lowest estimated incident rates of CKD in the region, though these figures suggest poor access to renal replacement therapy (RRT) and systemic underdetection of CKD.⁸ Compared to other Latin American countries like Brazil with 10 nephrologists per million people,⁹ Guatemala has fewer than 5 nephrologists per million inhabitants, and most are clustered in a handful of urban centers.¹⁰ Limitations in the nephrology workforce have profound implications for health professionals and patients. A recent study at UNAERC described how health professionals experienced

significant rates of burnout in their efforts to meet the rising demand for RRT in Guatemala. These health professionals responded to an overwhelmed health system by decreasing the frequency and duration of hemodialysis (HD) sessions, triaging limited dialysis slots, and preferentially enrolling patients in continuous ambulatory peritoneal dialysis (CAPD) programs over HD.¹¹ Finally, given that approximately 75% of health care spending in Guatemala is out-of-pocket, most predialysis CKD patients are cared for by private-sector medical professionals who generally have limited knowledge of standards of chronic disease care.¹²

Epidemiologic Profile of CKD in Guatemala

Dr Eduardo Palacios, director of the National Chronic Diseases Prevention Program from the Guatemalan Ministry of Health, opened the symposium. Dr Palacios summarized the latest epidemiology of non-communicable diseases and risk factors in Guatemala. He began by sharing results from the recently conducted Guatemalan Metropolitan Area STEPwise Approach to Surveillance (STEPS) and Global School-based Student Health (GSHS) surveys.^{13,14}

Next, Dr Palacios highlighted the lack of CKD data at the population level (Table 2).^{8,13–16} The growth in volume of CKD cases in Guatemala suggests that the CKD burden is rapidly rising alongside hypertension and diabetes. One institution, UNAERC, has reported a nearly 2-fold increase in the number of new cases of stage 4 and stage 5 CKD from 2013 to 2018. Dr Palacios noted that in Guatemala's vital statistics registry CKD is one of the 15 leading causes of death. The mortality rate from CKD has increased from 5 per 100,000 in 2005 to 14 per 100,000 in 2016.

Next, Dr Pedro Dávila, from the Guatemalan Nephrology Association, provided a detailed review of CKD and RRT in Guatemala. He noted that as of 2018, there were nearly 8000 patients receiving RRT in the country. Most adults (60%) received services at UNAERC followed by IGSS (40%). Dialysis modalities differ substantially between these institutions: UNAERC tended to provide much more CAPD (61% of dialysis cases), whereas IGSS had a greater proportion of HD (82% of dialysis cases).

Dr Dávila highlighted that RRT access was a significant concern because the overall rate of RRT in Guatemala was 536 patients/million population (PMP), compared with the Latin American regional average of 709 PMP.⁸ This disparity was more pronounced when comparing UNAERC (388 PMP) with IGSS (1265 PMP). Given the extent to which CKD is underdetected, Dr

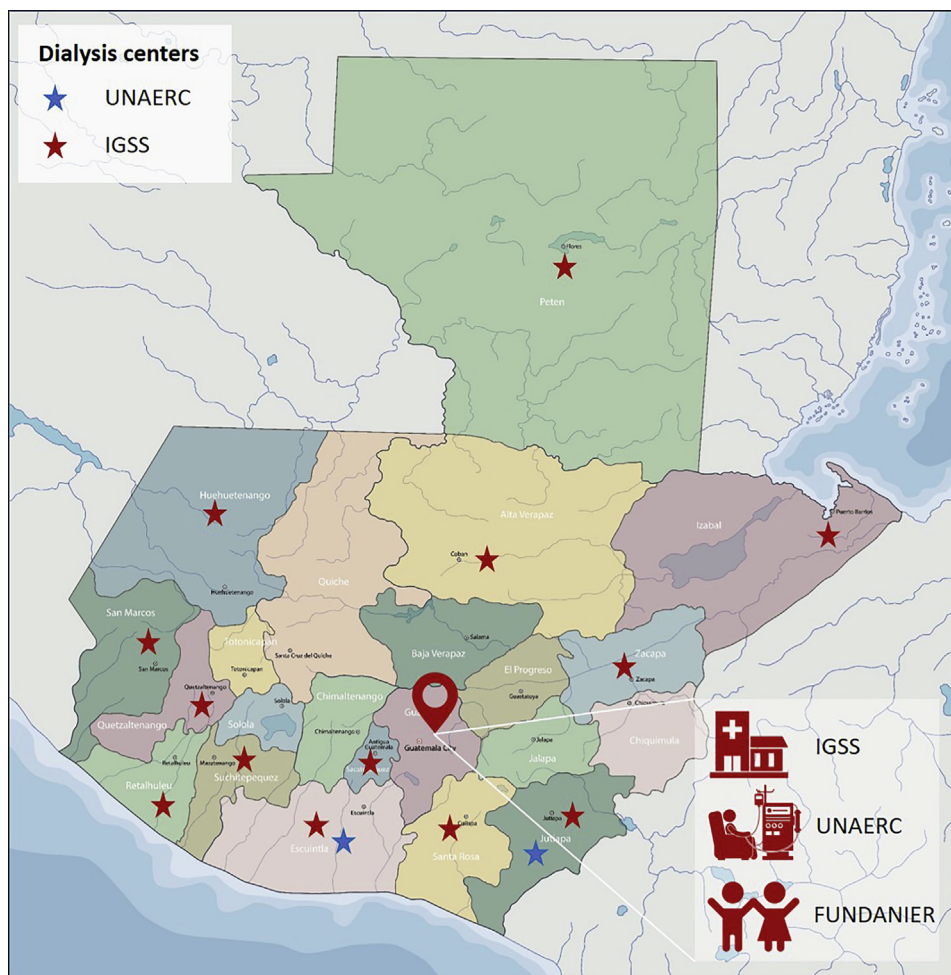


Figure 1. Map of Guatemala showing location of primary clinical settings where CKD care is provided and dialysis centers locations. All 3 primary clinical centers are located in the capital, Guatemala City. The National Center for Chronic Renal Disease (UNAERC) provides dialysis in only 3 departments. FUNDANIER, Guatemalan Foundation for Children with Kidney Diseases; IGSS, Guatemalan Institute of Social Security. Base illustration courtesy of: Iryna [Volina/stockadobe.com](https://www.shutterstock.com/user/Volina).

Davila argued that the true CKD mortality rate in Guatemala was likely significantly underestimated.

Dr Davila concluded his session by reviewing the efforts of the Guatemalan Nephrology Association and Guatemalan Ministry of Health to develop the Guatemalan Registry of Dialysis and Transplantation. They launched the online platform on March 2019 for World Kidney Day, and had registered approximately 33% of the total number of end-stage kidney disease (ESKD) cases estimated in the country. This registry will improve the understanding of CKD epidemiology in Guatemala and help with allocation of resources.^{15,16}

Clinical and Scientific Experiences at the National Center for Chronic Renal Disease (UNAERC)

A major goal of the symposium was to understand the clinical and scientific experiences of each participating institution. Dr Julio Boj, a nephrologist and director of

the primary care unit at UNAERC, shared experiences from his institution. UNAERC was established in the late 1990s by the Ministry of Health to provide kidney to poor patients without access to the social security health system (IGSS).^{17,18} Since its inception, UNAERC has grown its programs and case volume. Clinical services include predialysis clinics, pediatric and interventional nephrology physicians, CAPD and HD, and an urgent care clinic. Care is provided by a multidisciplinary team of physicians, nurses, dietitians, social workers, and psychologists. UNAERC serves a theoretical population base of around 11.5 million (those without insurance) and delivers RRT to 60% of patients with ESKD in Guatemala.

Over the past 5 years, UNAERC has experienced a 60% rise in the number of patients with CKD and ESKD enrolled in their system. Roughly 44% of their patients on RRT come from Guatemala City. UNAERC has developed strong research collaborations with local universities to help train students from diverse fields,

Table 2. Burden of CKD in Guatemala: data sources and estimates

Data Type	Estimates	Comments
National Vital Registry data	There are no existing population estimates or a surveillance system for CKD in Guatemala.	The recent population-level NCD surveys include a subnational STEPS survey and GSHS. However, neither include data on CKD. ^{13,14}
Dialysis and Kidney Transplant Registry	The national CKD National mortality rate: 14 per 100,000 The nascent Dialysis and Transplant Registry has so far captured data on roughly one-third of individuals receiving RRT.	The mortality rate from CKD has increased almost 3-fold in last decade. This registry is the first effort to compile data across centers. ^{15,16}
Center-based case series UNAERC IGSS FUNDANIER	Approximately 8000 adults receive RRT in Guatemala (60% UNAERC, 40% IGSS). Approximately 200 children receive RRT at FUNDANIER.	The RRT rate in Guatemala is 536 cases per million population, lower than the regional average of 709 per million population. These figures suggest poor access to RRT and substantial underdetection of CKD. ⁶

CKD, chronic kidney disease; FUNDANIER, Guatemalan Foundation for Children with Kidney Diseases (Fundación para el Niño Enfermo Renal); GSHS, Global School-based Student Health; IGSS, Guatemalan Institute of Social Security (Instituto Guatemalteco de Seguridad Social); NCD, noncommunicable disease; RRT, renal replacement therapy; STEPS, STEPwise Approach to Surveillance; UNAERC, National Center for Chronic Renal Disease (Unidad Nacional de Atención al Enfermo Renal Crónico).

including medicine, nutrition, and dentistry. The institution has a quality improvement (QI) program, and an example of a recent QI initiative was an intervention to improve outcomes around placement and infections for peritoneal dialysis catheters.^{19,20}

Clinical and Scientific Experiences at the Guatemalan Social Security Institute (IGSS)

Dr Vicente Sanchez-Polo, Director of the Department of Nephrology and Kidney Transplant at IGSS, spoke next. In 2017, IGSS cared for 2551 patients with ESKD, and every year the institution receives approximately 500 new cases. Similar to UNAERC, 51% of patients with ESKD come from Guatemala City. IGSS offer services in predialysis care, CAPD and HD, and kidney transplant. Since its inception, IGSS nephrologists have performed 878 kidney transplants with more than 90% originating from a living donor. Transplant patients at IGSS experience a 10% allograft dysfunction rate and have a 5% 1-year mortality rate.

IGSS has established a kidney biopsy registry, and native kidney biopsies comprise 65% of the registry. In its predialysis clinics, IGSS serves 2500 patients; more than 70% of these patients have CKD stages 3 to 5.²¹ Guatemala is geographically divided into 22 departments, analogous to US states. Dr Sanchez-Polo stated that IGSS currently has nephrologists employed in 3 of the 22 total departments in Guatemala. In 2018, IGSS leadership created a proposal to further decentralize their nephrology department and to develop clinics outside Guatemala City. They have been building around 12 HD units, 9 CAPD clinics, and 7 CKD clinics in departments throughout Guatemala.

Dr Sanchez-Polo also reviewed the state of graduate nephrology training in Guatemala. There are 3 nephrology training fellowships in Guatemala: one is a

pediatric program located at FUNDANIER, and the other 2 are adult programs—one at IGSS and another at one of the 2 main referral public hospitals. IGSS is the largest program and trains most of the adult nephrology graduates in Guatemala. As part of the International Society for Nephrology's Sister Renal Centers Program,²² IGSS has built a robust educational collaboration with the department of nephrology at Washington University in St. Louis. This collaboration has allowed their fellows to rotate at Barnes and Jewish Hospital in St. Louis, MO.

Dr Sanchez-Polo briefly described the multiple CKD research projects conducted at IGSS. One project assessed the impact of early referral of patients with CKD to a nephrology clinic, finding a significant increase in the glomerular filtration rate and a decrease in proteinuria.²³ Another study in 2016 characterized ESKD etiology among 242 patients in southwest Guatemala and found that approximately 20% patients had ESKD secondary to presumed nontraditional causes.²⁴ Given the known association between leptospirosis and CKD,^{25,26} IGSS recently conducted a case-control study to determine the association between leptospira IgG antibodies and CKD at their institution. No significant association was discovered among IGSS cases, but the researchers noted that about 50% of cases and controls were positive for leptospira antibodies.

Finally, Dr Sanchez-Polo shared the work of a task force on CKD of unknown cause (CKDu) in agricultural communities in Guatemala. This task force, first convened in 2018, includes participants from the Ministry of Health, Ministry of Labor, UNAERC, FUNDANIER, representatives of the sugar cane industry, IGSS, and the Guatemalan national university (Universidad de San Carlos de Guatemala). The task force's focus is to promote multisectoral collaborations to better understand this emerging disease.²⁷

Clinical and Scientific Experiences at the Guatemalan Foundation for Children With Kidney Diseases

FUNDANIER is the primary provider of pediatric CKD services to children with CKD in Guatemala. Dr Randall Lou-Meda shared his experience as FUNDANIER cofounder and medical director. Prior to FUNDANIER, there was no entity providing care to children and adolescents with CKD and ESKD. In 2003, a group of parents of children with CKD created FUNDANIER, with the mission to offer comprehensive nephrology treatment to children and adolescents.^{28,29} Since its inception, FUNDANIER has worked at the primary, secondary, and tertiary levels. In terms of secondary and tertiary prevention of CKD, FUNDANIER has developed and promoted Guatemala-specific guidelines for the diagnosis and treatment of pediatric CKD. To promote care for individuals with CKD, they opened a pediatric nephrology ward and an outpatient clinic and created a kidney disease database to collect epidemiologic data in Central America. Finally, they opened the first pediatric HD unit in Guatemala and the first pediatric transplant program.²⁸

In 2010, FUNDANIER signed a cooperative agreement with the Guatemalan Ministry of Health to create a comprehensive pediatric nephrology program. In 2011, FUNDANIER opened a new clinical facility at Roosevelt Hospital, which is one of the 2 tertiary-level hospitals in Guatemala. The FUNDANIER facility has an HD unit, a CAPD training area, room for minor surgeries, 9-bed ward, and conference and administrative spaces. Within this space, they were able to implement new programs to improve care, including a new socioeconomic integration program to help the patients transitioning to adulthood and a palliative care program.³⁰ This center is also the only pediatric nephrology training program in Guatemala; to date, FUNDANIER has trained 10 pediatric nephrology fellows.

Dr Lou-Meda detailed that, among the current FUNDANIER patient population, 41% are on CAPD, 27% on HD, 13% underwent a transplant, and 19% are enrolled in the predialysis clinic. Among those on RRT, the mean age is 13.5 years, 39% identified themselves as indigenous Maya, and most live in Guatemala City. Since 2008, FUNDANIER has performed a total of 100 kidney transplants, of which 88% are living donor kidneys. For these patients, the Ministry of Health guarantees immunosuppressive medications at no cost until 21 years of age. The 1-year graft survival is around 90% (living donor) and 70% (deceased donor). Another recent clinical initiative has been to collaborate with vascular surgeons from the United States to

Table 3. Themes found in published literature on CKD from Guatemala

1. Experiences of clinicians caring for CKD through case series or single-center surveys
2. Emerging dialysis registries to determine the epidemiologic profile ESKD in Guatemala
3. CKD of unknown cause in agricultural communities (CKDu, "Mesoamerican" nephropathy)

CKD, chronic kidney disease; CKDu, CKD of unknown cause; ESKD, end-stage kidney disease.

conduct a series of vascular access surgical missions. A total of 54 new pediatric patients have received an arteriovenous fistula as a result of these efforts; 85% of patients have patency at 12 months.³¹ Currently, FUNDANIER provides around 3500 HD sessions per year, and around 150 children are on dialysis.

In 2014, FUNDANIER conducted a retrospective study of the epidemiology of pediatric CKD from 2004 to 2013. Most patients (58%) came from Guatemala City. Mean age was 6.2 years, and most had CKD due to an undetermined cause (43.3%), followed by congenital anomalies of the urinary tract (27.7%).³² FUNDANIER also has assessed factors associated with medication adherence. In general, 76% of dialysis and 82% of transplant patients reported adherence, respectively. Of note, maternal educational level and higher monthly household income were associated with better adherence.³³

Establishing Collaborative CKD Research Priorities in Guatemala

Existing Published International Literature on CKD in Guatemala

There is limited literature on CKD from Guatemala, and existing literature falls into 3 broad categories (Table 3). The first relates the experiences of clinicians caring for CKD through case series or single-center surveys.³⁴ Reports have included descriptions of the barriers and facilitators to delivering peritoneal dialysis in rural areas³⁵; case mix, treatment protocols, and barriers and facilitators for treatment adherence in pediatric CKD^{28,32,33,36}; and the burden of proteinuria and CKD in a type 2 diabetes rural cohort.³⁷

Another category examines data from emerging dialysis registries to determine the epidemiologic profile of ESKD in Guatemala. In these studies, researchers have noted the preponderance of male patients, including younger men, and geographic clustering of cases around major urban referral centers (Guatemala City, Escuintla, and Quetzaltenango) and in the Southern, high-temperature coastal plain.^{24,38,39}

This latter observation—that cases of ESKD appear to be concentrated in the warmest climactic zones, where large-scale intensive sugar cane growing and other cash

crops is carried out largely by hand—has raised the hypothesis that the incidence of CKD of unknown cause in agricultural communities ("Mesoamerican" nephropathy) is rising rapidly.^{40–42} CKDu was first reported internationally in 2002, when a local nephrologist in El Salvador identified cases of CKD without the traditional risk factors (diabetes, hypertension).⁴³ Later, a group of researchers conducted a cross-sectional study in patients with CKD in El Salvador, finding that around 50% of the patients lacked traditional risk factors.⁴⁴ This study was followed by multiple reports of CKDu throughout Central America.^{45–47} A related growing literature in Guatemala has examined CKD incidence and prevalence in sugarcane workers, as well as associated risk factors such as acute kidney injury and heat stress while working in sugarcane fields.^{48–51}

Establishing Shared Research Priorities

On the second day of the symposium, participants met to review the presentations from day one, summarize the published literature on CKD, and develop shared priorities for future research. Given rising attention to CKDu regionally and worldwide, much of the conversation initially focused on CKDu. The participants reviewed data from the recently launched Dialysis and Renal Transplant Registry as well as spatial data on CKD mortality, showing a concentration of ESKD cases and mortality in the hot, lowland regions of Guatemala.^{15,16} The coastal mortality rate from CKD from vital registries is 25 per 100,000 versus 14 per 100,000 nationally. These data, as well as the series of papers emerging on sugarcane workers, all lend some credence to the notion that CKDu represents a significant portion of the emerging CKD epidemic in Guatemala.^{48–51}

Several participants, however, pointed out that the lowland regions of Guatemala also have higher rates of diabetes, obesity, and hypertension, and that the preponderance of occupational health studies and center-based studies of dialysis recipients makes it difficult to assess the true scope of the problem of CKDu and its coincidence with traditional CKD and noncommunicable disease risk factors. Clinicians from FUNDANIER and Wuqu' Kawoq reported on anecdotal evidence for higher-than-expected rates of CKD in children and women, both of which require more systematic study. Finally, data from UNAERC on difficulties accessing kidney care for Guatemala's indigenous population—largely living in the cooler highlands regions of the country—were discussed. Overall, the consensus from this discussion was that the lack of representative population-based data was the highest research priority: efforts should be made to

study the full spectrum of CKD in Guatemala and not limit focus to just CKDu or to a single geography.

Moving Toward Population-Based Research

Against this background discussion, there was therefore strong consensus that representative cohort studies, based in rural sites in Guatemala that capture the diversity of possible exposures and risk profiles, was a priority. Discussion next moved to the logistical difficulty of conducting representative population-based work in rural Guatemala. Traditional sampling approaches—such as those used for national demographic health surveys—are so time and labor intensive as to be essentially prohibitive. However, Dr Ann Miller from Harvard Medical School presented on a new methodology from an ongoing NIH-funded study in rural Guatemala⁵² showing the feasibility of satellite-based techniques to permit an efficient single-stage random population-based sample. The method has now been used in a feasibility study in 2 rural communities in Guatemala (spatially random sample of 800 individuals) efficiently and at low cost. The group agreed that this methodology and lessons learned would be a valuable way forward.

Another topic discussed at some length was how best to design population-based studies to capture exposures and clinical data of interest. Participants agreed that priorities included capturing data on (i) prevalence and risk factors for CKD in the population, (ii) access to care and the impact of access on CKD outcomes, and (iii) evolution and risk factors of progression for those with known CKD. The group reviewed recommendations on population-based studies from the International Society of Nephrology's International Consortium of Collaborators on CKDu,⁵³ as well as 2 recently published standardized research protocols from the Disadvantaged Populations eGFR Epidemiology (DEGREE) study group.^{54,55} These protocols provided guidance on most of the shared priorities, and so the group resolved to adopt them as the core approach to planning future work.

Taking Stock of Resources

A final discussion centered on resources present among the partners for facilitating field research. A major available resource was the presence of high-quality reference laboratory facilities at both INCAP and San Carlos University, including the ability to run creatinine assays using controls traceable to an isotope dilution mass spectrometry standard as well as extensive toxicologic analyses. We also discussed the capacity to provide clinical care and follow-up to individuals diagnosed with or at risk for CKD

progression. Clinicians from IGSS and UNAERC have extensive experience conducting screening campaigns and have developed protocols for triaging individuals with CKD to the appropriate level of care. Participants from Wuqu' Kawoq reported recently using these protocols in a large rural pilot with some success but noted that ongoing research on individuals' and communities' perceptions of CKD and CKD screening was needed to further enhance understanding of test results and facilitate higher adherence to referrals. Finally, multiple participants had developed and field-tested protocols for survey methods, collection and processing of biospecimens, and use of electronic data collection software.

Conclusion of the Symposium

In conclusion, the symposium was an opportunity to understand the challenges and opportunities for advancing CKD care and research in Guatemala. As a result, we reached consensus to prioritize joint efforts to conduct representative population-based studies. The goals of these studies would be to (i) define the relative importance of CKDu versus CKD from traditional causes throughout Guatemala; (ii) understand the community continuum of CKD, including factors influencing diagnosis and access to care; (iii) expand beyond the focus on occupational exposure (e.g., predominantly men) to include women and children; and (iv) expanding knowledge of CKD epidemiology in understudied rural and indigenous populations.

We concluded activities resolving to form a research consortium, with the goal of launching a population-based cohort study of CKD and CKDu in agricultural communities in rural Guatemala in 2020 or 2021, pending funding and regulatory approvals. Participating institutions in the consortium will include FUNDANIER, the Guatemalan Nephrology Association, IGSS, the Institute of Nutrition of Central America and Panama, Rafael Landívar University, San Carlos University, UNAERC, UNICAR, and Wuqu' Kawoq | Maya Health Alliance.

DISCLOSURE

All the authors declared no competing interests.

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