Kidney International, Vol. 68, Supplement 97 (2005), pp. S23–S30

Sustainable and tenable renal health model: A Latin American proposal of classification, programming, and evaluation

RAFAEL BURGOS CALDERÓN and SANTOS DEPINE

Section of Nephrology, Department of Medicine, University of Puerto Rico, School of Medicine, San Juan, Puerto Rico; Special Program Administration, Ministry of Health, Buenos Aires, Argentina

Sustainable and tenable renal health model: A Latin American proposal of classification, programming, and evaluation.

Background. End-stage renal disease (ESRD) presents a major problem to public health, with complex implications for social and economic structures in every nation of the world. Clearly, Latin American and Caribbean countries are not able to meet the needs of every patient requiring dialysis treatment at ESRD. Consequently, a considerable number of patients die every year as a result of lack of resources. Aware of this serious social, ethical, and economic problem, the Latin American Society of Nephrology and Hypertension proposed a new renal health concept in the region. In December 2002, at the workshop in Valdivia, Chile, a modification to the National Kidney Foundation Classification of Chronic Kidney Disease was approved.

Project. According to modifications to the concept of chronic kidney disease approved in the Declaration of Valdivia, a new Renal Health Model was proposed. It consists of including orderly follow-up in patients' charts, starting from the earliest stage, and a model establishing a guideline for the reallocation of financial resources to guarantee continuity of treatment to patients with ESRD.

Conclusion. The implementation of the Renal Health Program in health ministries of Latin American and Caribbean countries would allow for a substantial improvement in renal health prevention and management, as a result of better distribution of financial and human resources.

Un modelo sustentable de salud renal: La propuesta Latinoamericana de evaluación y clasificación de la enfermedad renal.

Antecedentes. La insuficiencia renal crónica (IRC) representa un serio problema de salud pública, con serias implicaciones para las estructuras sociales y económicas de cada nación en el mundo. Es evidente que los países Latinoamericanos y del Caribe no tienen la capacidad de proporcionar tratamiento dialítico a todo aquel paciente con IRC que lo solicite, por lo que un número importante de ellos mueren cada año por falta de este recurso. Conciente de las implicaciones éticas, sociales y económicas que lo anterior significa, la Sociedad Latinoamericana de Nefrología e Hipertensión (SLANH) ha propuesto un nuevo concepto de Salud Renal en la región. En Diciembre del 2002, en la ciudad de Valdivia, Chile, se aprobaron las modificaciones a la Clasificación de las Enfermedades Renales de la National Kidney Foundation.

Proyecto. Las modificaciones aprobadas en la Declaración de Valdivia establecen un nuevo modelo de salud renal. Consisten en la inclusión de gráficos del seguimiento ordenado de los pacientes, iniciando desde las etapas iniciales de la IRC así como un modelo que establece la guía para la reasignación de recursos económicos que garanticen la continuidad del tratamiento del enfermo renal crónico.

Conclusion. La aplicación del Modelo de Salud Renal por los Ministerios de Salud de las naciones Latinoamericanas y del Caribe, podría resultar en una mejora sustancial en la prevención y manejo de la IRC como resultado de una mejor distribución de los recursos humanos y económicos.

End-stage renal disease (ESRD) represents a major problem for public health, and it brings about complex implications to social and economic structures of every nation in the world. Currently, an estimated 1,100,000 patients are receiving dialysis treatment worldwide at a compound cost of US $72 billion. By 2010, it is estimated that over 2,000,000 people will have started dialysis at a compound annual cost of US $1.1 trillion [1]. In the United States, there are over 320,000 patients in dialysis, and it is expected that by 2010 this figure will rise to 650,000 at a cost of US $25 billion [2].

By 1999, there were 107,953 patients receiving dialysis treatment in 17 Latin American and Caribbean nations, an average rate of 240 patients per million inhabitants, at a cost of US $1.5 billion. The cost of dialysis was equivalent to US $3.22 per inhabitant. If we compare those figures with the rate of patients in dialysis in countries with a more comprehensive health insurance, like the United States, it can be assumed that some 200,000 to 500,000 patients in our region do not receive adequate treatment [3]. For both developed and developing countries, dialysis treatment represents a serious ethical and economic issue, because it is related to the macrodistribution of scarce resources in modern societies. Assuredly, in Latin American and Caribbean countries, not all patients requiring dialysis can receive treatment, and thus a

Key words: renal health, logframe, kidney classification.

considerable number of patients die every year as a result of lack of resources.

Aware of this serious social, ethical, and economic problem, in 1997 the Latin American Society of Nephrology and Hypertension approved a renal health concept for the region. The new concept, which is based on health promotion, emphasizes the close relationship between healthy practices, risks, and prevalent community health indicators. With this model, the term "renal health" changes the focus of intervention in renal diseases and establishes adequate strategies that are included within the concept of positive health. In turn, these strategies bind the biomedical models to a socioecologic paradigm of health that includes primary, secondary, and tertiary prevention.

In February 2002, the National Kidney Foundation established chronic kidney disease as a major public health issue, especially in the United States, where it represents a high-cost condition with a poor outcome. To that effect, the term "chronic kidney disease" was defined, and a classification based on the calculation of the glomerular filtration rate (GFR) in 5 different stages was proposed [4]. This classification constitutes an important step toward establishing a common language among different stakeholders in the renal field. It also provides an extremely useful tool to establish therapeutic protocols adequate enough to reduce the progression of renal diseases. The National Kidney Foundation also emphasizes the importance of early detection of albuminuria, hypertension, and other comorbid conditions associated with chronic kidney disease.

In December 2002, a workshop called "Towards a Sustainable and Sustentable Renal Health Model" was held in Valdivia, Chile, which was sponsored by the Pan-American Health Organization, the Latin American Society of Nephrology and Hypertension, the Austral University of Chile, and the Chilean Society of Nephrology. The Declaration of Valdivia was approved on that occasion, the highlights of which are hereby presented: Latin America and the Caribbean are in the process of developing new strategies to deal aggressively with public health problems. In this context, ESRD represents a real challenge because of the important socioeconomic and ethical inequities observed in the region. Given the difficulty in allocating sufficient economic resources to provide for the needs of the indigent population, it is mandatory to recognize the full implications of developing new strategies that allow for the provision of an adequate coverage of renal health. Consequently, in order to attend to the aforementioned problems, a Renal Health Model that sets the basis of planning, programming, execution, and evaluation of the program should be adopted.

Accordingly, the following plan of action was proposed: (*1*) Establishing a system of identification of patients, according to evolutionary stages, in order to facilitate the classification of Chronic Kidney Disease of the National Kidney Foundation, with modifications proposed in the Puerto Rico classification; (*2*) establishing a referral and counter-referral system for an orderly movement of renal patients at the primary health care level; (*3*) setting targets and establishing therapeutic plans to facilitate the use of flowcharts, diagnosis, and therapeutic algorithms; and (*4*) integration of the Renal Health Model in the national public health policies of each country, using the tools of the logical framework and the matrix of allocation of activities and resources.

At the workshop in Valdivia, Chile, the Subcommittee of Renal Health of the Latin American Society of Nephrology and Hypertension proposed a modification of the National Kidney Foundation Classification of Chronic Kidney Disease (Puerto Rico classification) (Table 1). This modification consists of the inclusion of the degree of hypertension using the classification of blood pressure rates for adults aged 18 years and over recommended in the Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure. [5] A classification of A to F is assigned to each grade of arterial blood pressure. The proposed modification also includes a classification of 1 to 3 assigned to each level of albumin in urine, which should be given according to recommended definitions [6] (Table 1). Following the proposed classification, a 40-year-old man with a history of type 2 diabetes mellitus, GFR 50 cc/min, blood pressure 160/100 mm Hg, and albuminuria level 500 mg/24 h would be diagnosed with chronic kidney disease stage III, grade E, level 3, secondary to type 2 diabetes mellitus. The measurement of the GFR can be taken using the Cockcroft-Gault [7], Modification of Diet in Renal Disease [8], or Schwartz's formulas [9]. Nevertheless, as indicated by Coresh et al [10], the calibration of the serum creatinine assay is critical to avoid variation in serum creatinine value, which could prominently affect the results in the higher GFR values. Harwell [11] and Hostetter [12] have recently commented publicly on the existing barriers of measuring serum creatinine and albuminuria in the United States. These criticisms also apply to Latin American and Caribbean countries.

The proposed modification enables a more accurate follow-up and an objective evaluation of preset targets and objectives, which are accomplished by carefully using the matrix and follow-up chart. (Table 1). The matrix includes stages of GFR, grade of blood pressure control, and albuminuria to facilitate the systematization of the follow-up of the mentioned variables; it is complemented with a chart that includes main risk factors related to the progression of chronic kidney disease and cardiovascular complications in the patient. It is important to add to the chart the therapeutic interventions

Table 1. Matrix of classification, remission, and regression of chronic kidney disease follow-up and evaluation chart

FOLLOW UP CHART	VARIABLES		CLASIF	TIME (expressed in months) INITIAL								MATRIX
	GFR (cc/min)		Stage									
		> 90	I									
		89-60	II									
		59-30	III									
		29-15	IV									
		< 15	V									
	BLOOD PRESSURE (mmHg)		Grade									
		< 120/80	A									
		< 130/85	B									
		130-139/ 85-89	C									
		140-159/ 90-99	D									
		160-179/ 100-109	E									
		<= 180	F									
	ALBUMIN (mg/24hs)	(in urine) < 30	Level 1									
		30-300	2									
		> 300	3									
	RISK FACTORS	(in blood) Glucose and Hb A_1 c										
		Cholesterol and LDL										
		Ca, P y PTH										
		Hb										
	PRESCRIPTIONS											

prescribed on each control visit to obtain the best clinical assessment for an accurate evaluation of the patient with chronic kidney disease. It is also mandatory to adopt the follow-up matrix if patients with diabetes, or at least high-risk patients with diabetes, are to be treated with angiotensin-converting enzyme inhibitors or angiotensin receptor blockers, without previous screening for albumin in urine [13, 14]. Hostetter [12] has recently expressed that prophylactic treatment without previous screening can only be successful when GFR and blood pressure are monitored regularly.

Although the proposed classification of chronic kidney disease provides a better understanding of the indicators and important variables in each patient with chronic kidney disease, the ultimate goal is to obtain regression of the disease with remission and regression of proteinuria. Ruggenenti et al [15] have proposed certain variables with their respective ranges, which could be used to evaluate the above-mentioned parameters. Follow-up of these patients should be orderly and well planned. The target is not only to obtain a correct classification of each patient but to provide evidence that expected progression and regression of chronic kidney disease is achieved, and that there is adequate management of the comorbidities associated with chronic kidney disease.

SUSTAINABLE AND TENABLE RENAL HEALTH MODEL

The lack of simultaneous and coordinated strategies for the treatment of patients with renal disease has caused countries to spend excessively and inefficiently in the renal health disease process. In addition, the exponential growth of patients who will require dialysis or transplantation in the future demands an increase in the provision of funds. This situation has become a major concern worldwide for those in charge of the allocation of economic resources, especially in developing countries.

Our proposal offers a viable answer to the problem through implementation of the Renal Health Model, which has been programmed and developed to incorporate the ethics of team management at the primary health care level and the ethics concerning allocation of those resources.

Given that models are conceptual entities designed on a global, theoretical basis, each country has to provide its

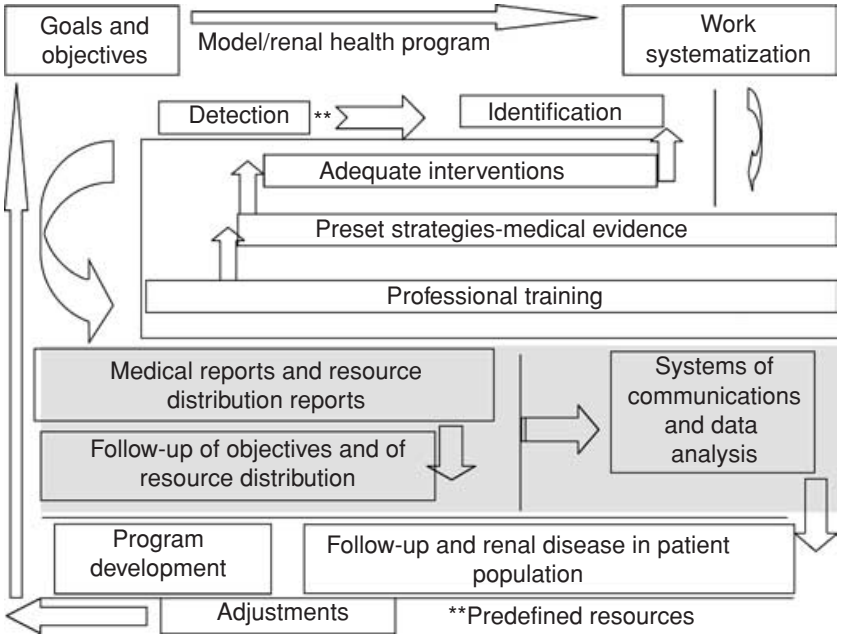

Fig. 1. Renal health model/program. Conceptual entities.

own tools according to its culture, ideology, requirements, and possibilities (Fig. 1).

The model favors work systematization, starting with professional training focused on evidence-based medicine applied to diagnosis, identification, and follow-up of renal patients through the 5 stages of evolution until dialysis treatment. The available information will allow a satisfactory achievement of preset objectives and an adequate distribution of financial and human resources. This model also provides us with tools to check the development of the program in order to make necessary adjustments to meet goals and objectives.

Thus, the framework model includes coordinated strategies such as strengthening of transplantation programs, improved mechanisms for resource allocation, private and public assistance networks, permanent training and education for specialized teams dealing particularly with the primary health care level, suitable referral and count referral systems, and systems of information and data analysis that will enable continuous evaluation of the patient and cause of the disease. These control systems will contribute to the elaboration of actuarial constructs for the provision of resources to cover demands of dialysis treatment or transplantation, according to the expected number of patients entering end-stage kidney disease (Fig. 2).

Implementation of this model, which will have to be adjusted to the particular needs of each country, will result in a reallocation of resources that are currently used for the treatment of comorbidities associated with kidney disease; these comorbidities are not dealt with comprehensively in the stages prior to dialysis or transplantation.

The Renal Health Model shows a systematic development of the program, and its strategies and/or components constitute its axial guidelines.

A first strategy consists of a proposal to generate a special fund and/or to make budget reallocations into funds for high complexity to ensure financial resources to develop programs of identification and follow-up of renal patients, or to guarantee continuity to dialysis treatments. In countries with single funds for high-complexity diseases, there is often budgetary infighting, which results in the allocation of resources according to pressure exerted either from medical groups or from patients' associations. We encourage budget reallocations, specially assigned to dialysis treatments, to guarantee continuity of treatment to patients with ESRD.

A second strategy consists of the development of components to foster the strengthening of transplantation programs and/or favoring of implementation of such programs in countries where transplantation has not yet developed as a common practice.

A third strategy is related to the health care provider sector and consists of the integration of public and private sectors to favor and/or strengthen network assistance in the primary stage of renal health care.

A fourth strategy consists of the specific development of a Renal Health Program, incorporating the concept of "renal health control," which articulates the following subcomponents: Renal disease promotion, tending to full participation of the nephrology health care team in community strategies and programs such as Healthy Municipalities and Communities and/or Conjunto de Acciones para la Reducción

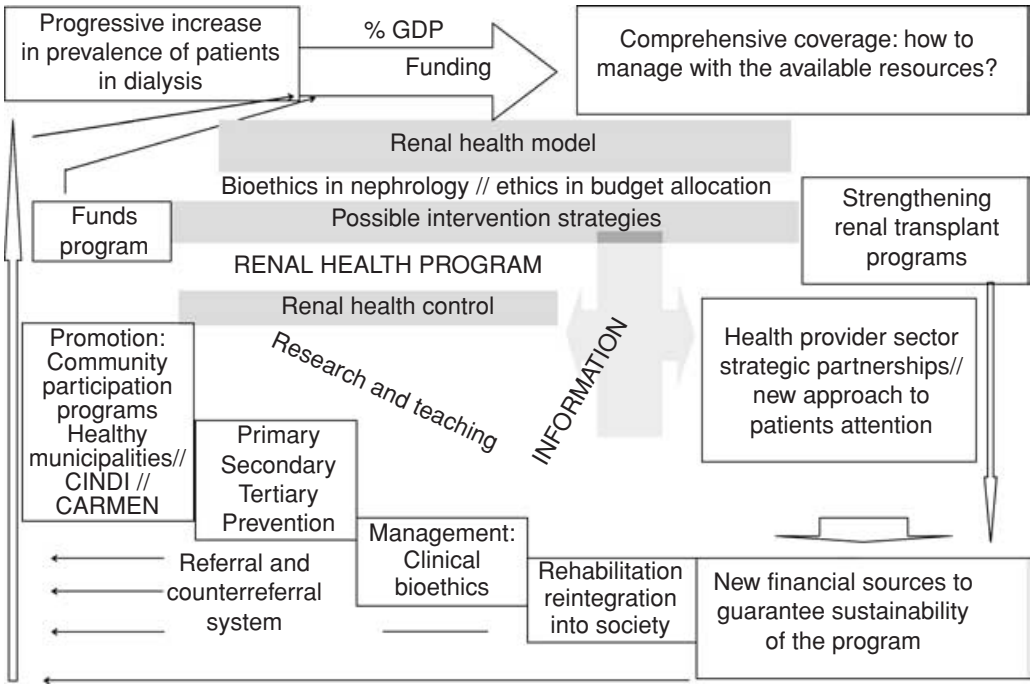

Fig. 2. Renal health model. Strategic development.

Multifactorial de las Enfermaded No Transmisibles/ Countrywide Integrated Non-Communicable Diseases Intervention (CARMEN/CINDI) programs; renal disease prevention, focusing mainly on secondary prevention. The systematization of the referral and counter referral system that aims at achieving specific targets of regression and/or remission of the disease takes place at this stage. Aggressive treatment at this time in the course of the disease is particularly important. In this work, we define secondary prevention as the period during which natural evolution of the disease occurs until the presentation of end-stage renal failure, and tertiary prevention to the treatment of comorbidities and complications related to dialysis and transplantation. The cost-efficiency impact of the strategies applied at second- and third-stage prevention has been mentioned in several publications on the subject. In a collaborative work, Rodby et al [16] conducted a study on the total population of patients with diabetes receiving dialysis in the United States. As a result, it was estimated that a total savings of US $2.4 billion in 10 years could have been made if patients had been treated with captopril to slow the progression of renal disease. In addition, Caro and colleagues [17] have demonstrated that after 30 years of treatment, the total cost of the complications for each patient with type 2 diabetes amounts to US $47,240; management of renal disease: counseling patients as to whether they should start dialysis treatment or not, according to the principles of clinical ethics; Rehabilitation programs for patients receiving dialysis treatment or transplantation; research and teaching as essential components to achieve the targets of the Renal Health Program.

A fifth strategy is to facilitate the assimilation, sharing, and dissemination of information through implementation of operational circuits and databases.

Dismantling the first level of renal management as a result of regional programs for primary health care prevents health and treasury ministries from acquiring important knowledge about the unique aspects of renal disease, such as the real demand of resources to deal with treatment of the disease, best opportunities to gain access to treatment, evaluation of quality standards, commitment and training of human resources, assignment of facilities, and best distribution of equipment and a quality control of medical supplies. These public organizations also lack adequate tools to draw up actuarial plans that will allow for budgetary estimations in order to meet demand growth.

PLANNING, PROGRAMMING, AND EVALUATION

It would not be feasible to present this proposal without its corresponding program development, in order to allow for the evaluation of outcomes concerning targets and objectives and its resulting budgetary implementation.

To that effect, we have incorporated systematic, self-assessing, matrix-related tools such as the logical framework matrix [18], matrix of allocation of activities and resources [19], matrix of classification, remission and

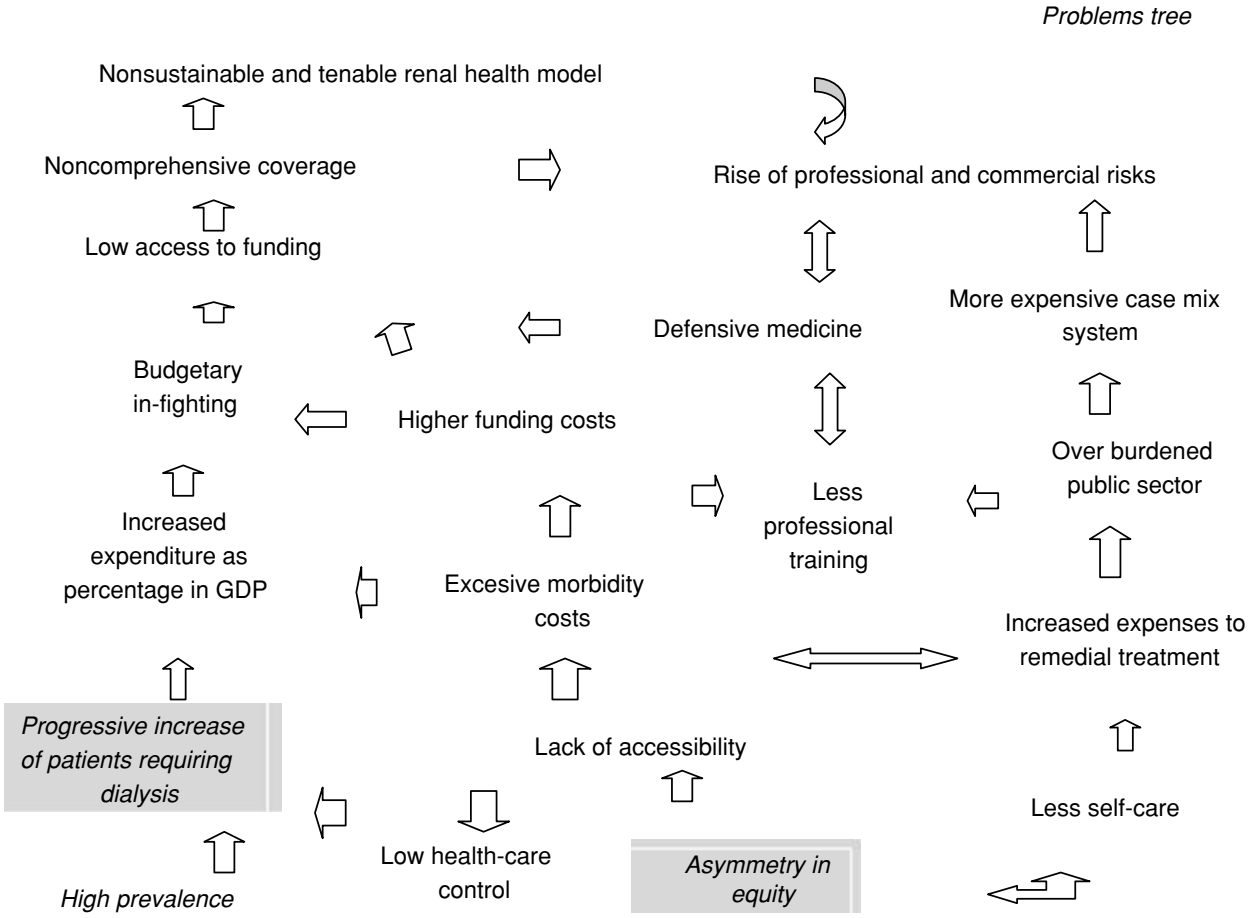

Fig. 3. Problems tree. The Problems tree represents a bunch of events that generate a nonsustainable renal health model.

regression of chronic kidney disease with its follow-up chart previously described, and an operational annual program.

To deal with the organization of the logical framework, we have identified difficulties that result from the lack of a renal health model, and we have expressed it as a collection of events that make renal health assistance nonsustainable. We have also identified the necessary strategies required to make renal health assistance sustainable and tenable. To the effect of presenting this work, they will be referred to as "Problem Tree" and "Objectives Tree," respectively. They are the starting point of the logical framework.

Our analysis emerges from 2 well-known variables: increasing incidence of ESRD requiring dialysis treatment and asymmetry in equity in an important portion of the population of Latin America and the Caribbean. (Fig. 3)

The "Problem Tree" described previously represents a collection of events that generates a nonsustainable model and an increased professional and commercial risk. The origin of these consequences lies in an inadequate funding of the sector, aggravated by practice of defensive medicine, absence of systematic training within a renal health model, and fragmented patient attention which, evaluated by means of case-mix information, lead to higher costs for medical attention at health care centers. In addition, the public sector becomes overburdened as a result of the lack of public-private network assistance and poor funding.

From the analysis of the "Problem Tree," it can be deduced that it is necessary to incorporate the following items into the "Objectives Tree": a specific program of renal health, guaranteed funding, evidence-based medical practice, public-private assistance networks, and professional training components necessary to meet the objectives of sustainability of the model, consequently lowering professional and commercial risks and gaining accessibility.

The "Objectives Tree" focuses on necessary strategies needed to make renal health assistance sustainable and tenable; that is, it concentrates centers on actual needs rather than on the demand that reaches doctors or institutions. (Fig. 4). The planning, programming, and evaluation document, Logical Framework Matrix, takes as verifiable indicators the percentage of renal health primary care units proceeding and/or redirected from

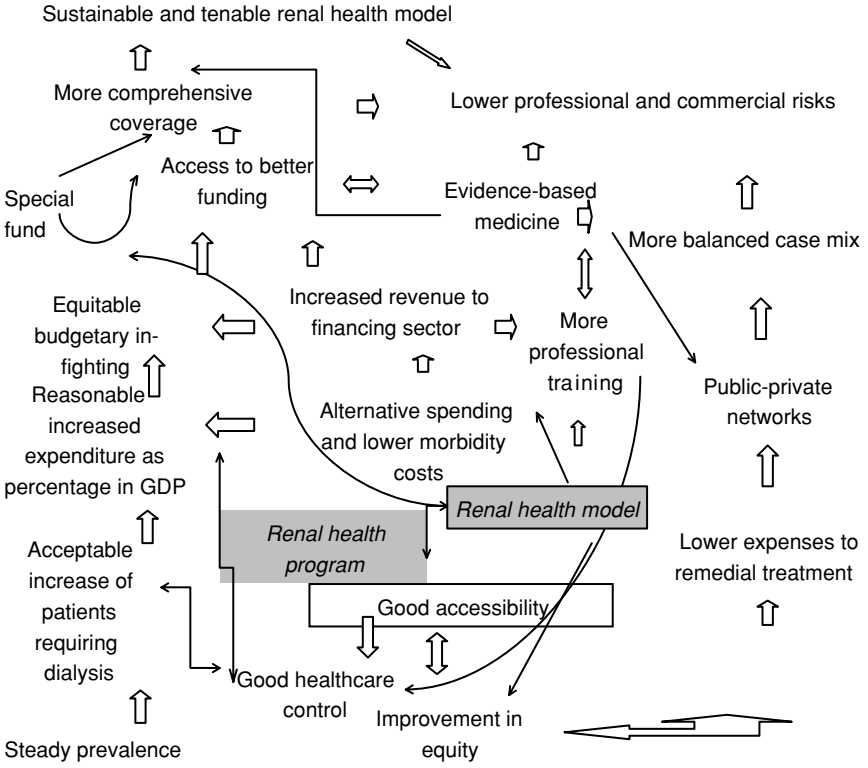

Fig. 4. Objectives tree. The Objectives tree focuses on strategies needed to make renal health assistance sustainable and tenable.

general medical practice, the percentage of trained or retrained professional staff, and budgetary disbursements for the development of activities.

The Matrix for Allocation of Activities and Resources is an instrument that enables a cost-efficient method of distribution of activities and resources that are available in each country, which avoids the possibility of wrong budgetary assignments and allows for a more systematic follow-up and assessment of results. It incorporates algorithms based on medical evidence.

CONCLUSION

The Sustainable and Tenable Renal Health Model, by means of its components and subcomponents, planning, programming and evaluation program, method of classification, indicators of remission and regression of renal disease, and other instruments linked to public health attention, could become incorporated in programs of health ministries as an invaluable tool that would allow for a cost-efficient systematization of renal health management.

ACKNOWLEDGMENTS

We are grateful to Dr. Ezequiel Bellorin Font and Dr. Sergio Mezzano for their continuous support to our project; Dr. Amilcar Challu for his contribution in the renal field; Dr. Jaime Rivera Dueño for his longstanding friendship and support; and Dr. Cynthia Pérez for her review of the manuscript.

Reprint requests to Dr. Rafael Burgos Calderón, Nephrology Section, University Hospital, P.O. Box 2116, Caparra Heights Station, San Juan, PR 00922–2116.
E-mail: tatoburgos@hotmail.com

REFERENCES

1. Lysaght MJ: Maintenance dialysis population dynamics: Current trends and long term implications. *J Am Soc Nephrol* 13:S37–S40, 2002
2. Xue JL, Ma JZ, Louis TA, *et al*: Forecast of the number of patients with end-stage renal disease in the United States to the year 2010. *J Am Soc Nephrol* 12:2753–2758, 2001
3. Challu A, Burgos R, Depine S (editors): *La Nefrología Latinoamericana*, Latin-American Society of Nephrology and Hypertension. Buenos Aires, 2000
4. K/DOQI Clinical practice guidelines for chronic kidney disease: Evaluation, classification and stratification. *Am J Kidney Dis* 39 (Suppl 2):S1–S246, 2002
5. The sixth report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC VI). *Arch Intern Med* 157:2413–2446, 1997
6. Bennett PH, Haffner S, Kasiske BL, *et al*: Screening and management of microalbuminuria in patients with diabetes mellitus: Recommendations to the Scientific Advisory Board of the National Kidney Foundation from an Ad Hoc Committee of the Council on Diabetes Mellitus of the National Kidney Foundation. *Am J Kidney Dis* 25:107–112, 1995
7. Cockcroft DW, Gault MH: Prediction of creatinine clearance from serum creatinine. *Nephron* 16:31–41, 1976
8. Levey AS, Bosch JP, Lewis JB, *et al*: A more accurate method to estimate glomerular filtration rate from serum creatinine a new prediction equation. *Ann Intern Med* 130:461–470, 1999
9. Schwartz GJ, Haycock GB, Edelman CM, Jr., Spitzer A: A simple estimate of glomerular filtration rate in children derived from body length and plasma creatinine. *Pediatrics* 58:259–263, 1976

10. Coresh J, Astor BC, McQuillan G, *et al*: Calibration and random variation of the serum creatinine assay as critical elements of using equations to estimate glomerular filtration rate. *Am J Kidney Dis* 39:920–929, 2002
11. Harwell TS, Nelson RG, Little RR, *et al*: Testing for microalbuminuria in 2002: Barriers to implementing current guidelines. *Am J Kidney Dis* 42:245–248, 2003
12. Hostetter TH: Detecting early chronic disease: Are clinical laboratories a problem? *Am J Kidney Dis* 42:392–394, 2003
13. Golan L, Birkmeyer JD, Welch HG: The cost-effectiveness of treating all patients with type 2 diabetes with angiotensin converting enzyme inhibitors. *Ann Intern Med* 131:660–667, 1999
14. Kiberd BA, Jindal KK: Routine treatment of insulin dependent diabetic patients with ace inhibitors to prevent renal failure: An economic evaluation. *Am J Kidney Dis* 31:49–54, 1998
15. Ruggenenti P, Schieppati A, Remuzzi G: Progression, remission, regression of chronic renal disease. *Lancet* 357:1601–1608, 2001
16. Rodby RA, Lewis EJ, Firth LM: An economic analysis of captopril in the treatment of diabetic nephropathy, The Collaborative Study Group. *Diabetes Care* 19:1051–1061, 1996
17. Caro J, Ward AJ, O'Brien JA: Lifetime costs of complications resulting from type 2 diabetes in the U.S. *Diabetes Care* 25:476–481, 2002
18. Pan American Health Organization (PAHO): *Project Development Follow-up Handbook*, Geneva, Switzerland, World Health Organization Regional Office, 1999
19. Depine S (editor): UNDP-International Financial Health Unit. *Guidelines to a Cost-Efficient Assignation of Activities and Resources in Primary Health Attention*, Buenos Aires, Health Ministry, 2002