Systematic approach for the management of chronic kidney disease: moving beyond chronic kidney disease classification

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Purpose of review

This review has two aims: to summarize the evolution of classification criteria for chronic kidney disease (CKD) for diagnosis, prognosis and forecasting population burden of illness; to move the discussion beyond classification to intervention by introducing an approach we describe as the 'Systematic Approach for the Management of CKD' (SAM-CKD).

Recent findings

There is now ample evidence against the use of estimated GFR (eGFR) as the sole criterion for classifying CKD for the purpose of diagnosis, risk stratification and prediction of progression. There is ample evidence that significant proteinuria is a powerful predictor of progression but even more so when combined with reduced eGFR for individual and population risk projection. Hypertension also is an important indicator in CKD progression but not in all studies. Beyond classification, there are no studies addressing standardization of management of CKD to achieve the outcomes articulated by any of the practice guidelines.

Summary

In this article we have moved the discussions of CKD beyond classification by introducing a clinical management tool, SAM-CKD, which couples a broader classification model with a systematic tool for management to foster standardization of CKD management for the future.

Keywords

chronic kidney disease, chronic kidney disease management, hypertension, proteinuria, systematic management approach

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Introduction

Worldwide experience indicates that there is a gradual and steady growth of the number of patients who need kidney dialysis, kidney transplantation or both to continue living. The loss of renal function usually starts with small alterations, which are potentially reversible. In the absence of systematic programs for monitoring and control, loss of renal function leads to a silent insidously progressive chronic kidney disease (CKD). The global epidemic of diabetes mellitus, obesity and CKD [1–4], associated with high cardiovascular morbidity and mortality, deserve appropiate and effective interventions to control these conditions. Such interventions can be carried out in two areas of public health. The first is to develop public health strategies for health promotion and prevention, especially of the root causes and the negative impact of social, economic and cultural conditions that lead to living conditions which are unacceptable in today's world. These health strategies should significantly contribute to improving the health conditions of individuals and populations, for example reducing smoking and improving lifestyles. The second is to integrate the primary prevention strategies with the secondary and tertiary prevention strategies to reduce the burden and the combined effect of diabetes, obesity and CKD. In this regard, clinical nephrologists can and must help to reduce the increasing incidence and prevalence of CKD in high-risk populations, that is, people with diabetes mellitus, hypertension, family history and obesity. In their clinical practice, nephrologists have the responsibility for implementing clinical guidelines to achieve the therapeutic goals of reducing CKD progression and cardiovascular complications. Such interventions must be based on an orderly and logical sequence of activities to produce the desired results.

Materials and methods

In December 2002, the Renal Health Committee of the Latin American Society of Nephrology and Hypertension conducted a workshop in Valdivia, Chile. The outcome was the Action Plan for Latin America, with four objectives:

(1) To establish an early identification system for patients according to their evolutionary stage, encouraging the utilization of the classification system produced by the National Kidney Foundation (NKF) and the one developed in Puerto Rico.
(2) To implement a system of reference and counter-reference for an orderly transit of kidney patients through primary healthcare.
(3) To set goals and therapeutic plans that encourage the utilization of diagnostic and therapeutic flowcharts and algorithms.
(4) To integrate the Renal Health Model into the national public health policies in each of the countries using the tools of the 'Logical Framework Matrix' [5] and 'Matrix of Activities and Resource Allocation' [6].

This workshop was an essential landmark in the development of the Renal Health Model in the Latin American region.

In 2005, we proposed a 'Sustainable and Tenable Renal Health Model: a Latin American proposal of classification, programming and evaluation' that included a model framework, a classification methodology and a tool for monitoring patients [7]. The model [7] (Fig. 1), was adapted in each of the following countries and jurisdictions: Chile, Argentina, Mexico, Uruguay, Paraguay, Venezuela, Colombia, Ecuador, Commonwealth of Puerto Rico, Peru, Brazil, Bolivia, Cuba, Dominican Republic and Guatemala [8].

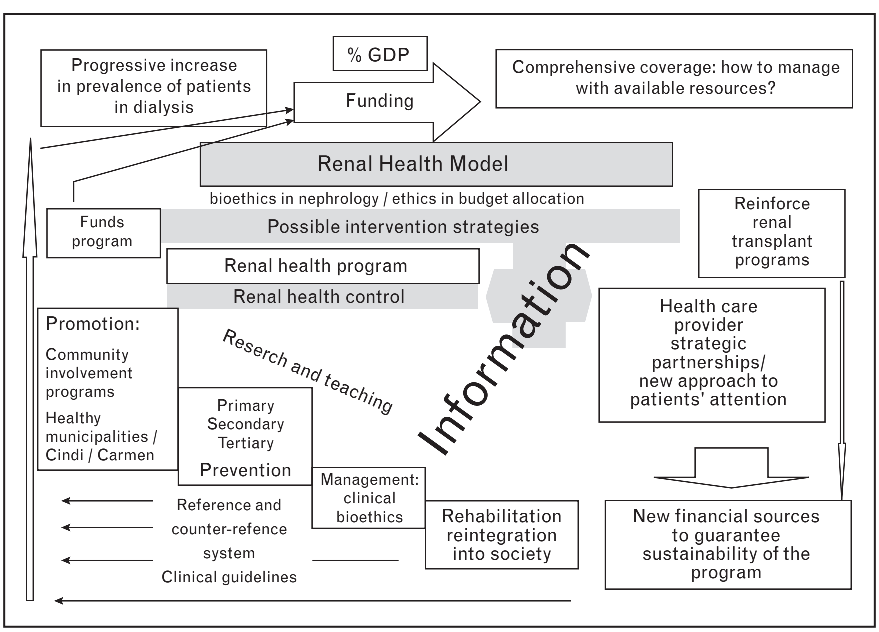
The national societies of nephrology in each of these countries or jurisidictions, in collaboration with the health ministries, are leading the processes to strengthen care at the primary care level.

The 'Logical Framework Matrix' tool was used for planning, programming and evaluation. This matrix allowed us to disaggregate the basic components of the model that make up the implementation strategies, which, once identified, provide an explicit way of assessing the need for and adequacy of resource allocation.

The main strategies are as follows:

(1) Strengthening of the transplant programs
(2) Networking all the related activities
(3) Adequate budget allocation
(4) Implementation of the renal health program
(5) Generation of a database to
    (a) prepare statistical and epidemiologic measurement,
    (b) guarantee budget allocation,
    (c) ensure efficient resource utilization,
    (d) strengthen the technical and industrial sectors related to healthcare in each country (i.e. find business opportunnities),

Figure 1 Renal Health Model



The Renal Health Model shows a systematic development of the program and it is structured in the following components: the strengthening of the transplant programs, networking, adequate budget allocation, and implementation of the Renal Health Model and generation of a database. Adapted with permission from [7].

(e) generate new sources of work and income to strengthen the Gross National Product.

The objective of the model is to improve the quality of life of kidney patients in each stage of the loop: health → renal disease → healthcare → rehabilitation → health. To this end, the model addresses the control of cardiovascular, renal and endocrine–metabolic diseases, from early detection of endothelial injury to its control mostly through secondary prevention strategies. It is in the period of secondary prevention that a systematic follow-up makes the greatest impact and gives the overall model a logical order.

Much controversy has arisen in recent nephrology literature about using the estimated rate of glomerular filtration (eGFR) as the sole risk factor for diagnosis of CKD, estimation and risk stratification of disease progression in the individual (prognosis) and at the same time using it as the sole factor in predicting risk of progression to end-stage renal disease (ESRD) in populations at risk (community epidemiology) [9–12]. This is partly because significant albuminuria has become recognized as a powerful predictor of progression at every stage of CKD.

Ishani *et al.* [13], in their 2006 paper, concluded that the presence of proteinuria in the dipstick, accompanied by a glomerular filtration rate lower than 60 ml/min/1.73 m^2 were better predictive factors for ESRD in the long term.

Figure 2 Modification of the National Kidney Foundation classification of chronic kidney disease

Agenda for the future

Integrated approach

Cardiovascular ⇄ Kidney ⇄ Endocrine-Metabolic

Modification of the NKF classification of CKD

Stages	Blood pressure, mmHg			Albuminuria
		Systolic	Diastolic	
Stage I GFR ≥ 90 ml/min Kidney damge with normal or increased GFR.	A.	< 120	< 80	1. < 30 mg/24 h mg/g
Stage II GFR = 60–89 ml/min MILD decrease in GFR	B.	< 130	< 85	2. 30–300 mg/24 h or mg/g
Stage III GFR = 59–30 ml/min Moderate decrease in GFR	C.	130–139	85–89	3. > 300 mg/24 h or mg/g
Stage IV GFR = 29–15 ml/min Severe decrease in GFR	D.	140–159	90–99	
	E.	160–179	100–109	
Stage V GFR = 15 ml/min Kidney failure or dialysis	F.	≥ 180	≥ 110	

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The proposed classification of CKD uses the NKF categories and integrates subclassification for the degree of hypertension and albuminuria that patients exhibit.

Recently, Gansevoort and de Jong [14•] have suggested including or changing the classification of CKD to include the degree of albuminuria, especially in stage 3 of CKD, because the greater the degree of albuminuria the greater the incidence of adverse renal and cardiovascular events.

Hallan *et al.* [15••] in a longitudinal study recently demonstrated that the combined hazard ratios of eGFR

Figure 3 Follow-up and Evaluation Chart

Regression and remission clinic
follow-up and evaluation chart

Name: ____________
Record No. ____________
Sex: ☐ M ☐ F
Age: ____________ Race: ____________

Classification: ____________
Stage: ____________
Diagnosis: ____________

Variables	Date	Date	Date	Date	Date	Date
Blood pressure						
Weight						
Height						
BUN						
Serum Creatinine						
Creat. Clearance or *eGFR						
Serum Albumin						
Hgb/Hct						
Serum Ferritin % Iron SAT						
U/A Protein or Albumin						
24 hr Urine for Protein						
Urine/Albumin/or Prot/Creat. Ratio						
Serum Cholesterol						
HDL, LDL						
Uric Acid						
Triglycerides						
Ca/PO4, PTH						
Ca x Product						
NaCl BUN BS						
K CO2 Creat						

*NKF-4 Variables formula
Creat, Sex, Age, Race

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Demographic data, clinical data and laboratories findings are included allowing an orderly and logical tracking of patients in clinical practice over time.

and albuminuria predicted the progression to ESRD in the large general adult population studied. This is one of the strongest validations of our reason to assign an important role to albuminuria both in our proposed modification of the NKF classification of CKD published in 2005 [7] and in the development of our clinical management tools. In the multivariant analysis, hypertension did not add to predictive power for CKD progression to ESRD after eGFR and the degree of albuminuria was integrated to the model. This finding deserves further analysis because of the importance given to hypertension in CKD progression [16–18] in the prevailing literature and common teaching. Jerum *et al.* [19•] similarly also recommended the integration of the level of albuminuria to glomerular filtration rate in the evaluation of patients with diabetic nephropathy.

Development of approach

The publication of 'Sustainable and tenable Renal Health Model: a Latin American proposal of classification, programming and evaluation' in 2005 included a model outline, a classification methodology and a tool for monitoring patients [7] (Fig. 2). The classification consolidated the proposed stages of the NKF [20] with two other variables: proteinuria and degree of hypertension in the patient. At that time, we thought that indicators other than the eGFR might be needed to evaluate the extent of kidney damage. The eGFR requires the application of formulas to estimate glomerular filtration to classify stages I–V. The eGFR can be calculated using the Cockcroft–Gault [21], Modification in Diet in Renal Disease [22] or Schwartz's [23] formulas. Reliable and consistent calibration of serum creatinine testing is critical to avoid variation in the value of serum creatinine, which can significantly affect high values of eGFR. There is an ongoing debate about using an eGFR of $<60\,\text{ml/min}/1.73^2$ as the cut-off value to diagnose CKD. The addition of albuminuria appears to enhance the predictive value for both diagnosis and prognosis.

In addition, the classification includes the degrees of blood pressure using the recommendations of the 'Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure for Adults aged 18 years or over' [24] by which a letter (A–F) is assigned to blood pressure ranges. We have adopted this classification for the greater weight it gives to systolic pressure and its closer association with cardiovascular events.

The third variable we included in the classification is a three-level scale of the level of albumin in 24 h urine defined as 1 = <30 mg (microalbuminura); 2 = 30–300 mg and 3 = >300 mg.

The following is an example of the application of this classification: a man aged 40 years with a history of type 2 diabetes mellitus, eGFR $50\,\text{ml/min}/1.73\,\text{m}^2$, blood pressure of 160/100 mmHg and albuminuria level

Figure 4 Regression and Remission Progress Notes

Regression and remission progress notes

Puerto RICO MEDICAL CENTER UNIVERSITY HOSPITAL NEPHROLOGY SECTION DEPARTMENT OF MEDICINE Date: ______	Patient's Name ______ Age ______ Sex ______ Record No. ______ am/pm Visit: ______ I ______ F

Birth Wt	Current Wt	B/P	Pulse	T =
Diagnosis:		Subjective:		
Pain	Pain Rx	Objective:		
Medications		Laboratories		

*Assesment CKD Progression ______ Yes ______ No ______ SP ______ FP ______ No P

B.M. Brenner Progression Factors	Results & Plan of Action	Progression Factors	Plan of Action
1. Activity of underlying disease		12. CO2 combining power	
2. Persistent proteinuria		13. Obesity	
3. BP		14. Smoking	
4. BS		15. Uric acid	
5. Protein Diet		16. Renal calculi	
6. PTH		17. UTI	
7. Ca x P		18. BPH	
8. Anemia		19. Cysts	
9. CVD, LVH		20. Renal Cell CA	
10. PO4		21. Hydronephrosis	
11. Lipids		22. Obstruction	

Physician Signature ______ Lic # ______

*SP: Slow Progression No P: No Progression
FP: Fast Progression

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Patient clinical information including low birth weight and the risk factor associated with CKD are identified. For each factor there is an established clinical goal, also known as the benchmark, and an Action Plan is set for the control of each progression factor.

of 500 mg/24 h would be diagnosed with CKD stage 3, grade E, level 3, secondary to type 2 diabetes mellitus.

The classification by itself would have no purpose without an orderly and logical method for patient monitoring. We have used a descriptive term for the proposed tool: the 'Systematic Approach for Management of Chronic Kidney Disease' or SAM-CKD for short. It utilizes the three components that constitute the proposed classification, that is, stage of CKD according to eGFR, degree of blood pressure, and albuminuria level. By adding other measures of significant comorbidity we were able to develop the 'Follow-up and Evaluation Chart' (Fig. 3) that generates a prognostic tracking tool we call the 'Progression and Remission Progress Notes'.

The 'Follow-Up and Evaluation Chart' allows an orderly and logical tracking of patients in clinical practice over time. Specifically, it captures the rate of change of eGFR and serum creatinine at each visit. The rate of change allows the clinician to classify a patient's status into stable, slow or rapid (fast) progression of CKD. The data from the Follow-up and Evaluation Chart is used to develop the third component of the SAM-CKD, which we call the 'Regression and Remission Progress Notes' (Fig. 4).

In addition to the patient's medical information, including low birth weight, the risk factors associated with CKD progression as summarized by Brenner [25] are added to the regression and remission notes. For each factor, a clinically relevant benchmark is established [25], and an action plan is established for the control of each progression factor. The central goal is to ensure that all risk factors are managed to achieve an outcome close to the established clinical goals. We believe that, with these controls and with a systematical and logical follow-up, the clinician can minimize the impact of most risk factors and optimize the chances of reducing CKD progression and the very high cardiovascular complications rate.

Conclusion

The Systematic Approach to the Management of Chronic Kidney Disease (SAM-CKD) that we have proposed is a clinical tool designed to integrate current knowledge into a systematic, outcome oriented, tool that should be used both in clinical practice of individual nephrology and in the multidisciplinary team that cares for patients with CKD in daily practice. We believe that it will help better manage this multifactorial condition and its attendant cardiovascular complications.

With evidence suggesting a rising incidence rate and a dwindling per capita ratio of practicing nephrologists, other clinically trained members of the team will take on more responsibilities. Tools designed to systematize the workflow of the team have become essential to achieving the clinical and public health goals for CKD management and, if adopted universally, will allow comparison of effectiveness across programs.

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References and recommended reading

Papers of particular interest, published within the annual period of review, have been highlighted as:
- • of special interest
- •• of outstanding interest

Additional references related to this topic can also be found in the Current World Literature section in this issue (pp. 000–000).

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