

## Why multidisciplinary clinics should be the standard for treating chronic kidney disease

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Received: 24 May 2012 / Revised: 28 May 2012 / Accepted: 29 May 2012 / Published online: 4 July 2012  
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**Abstract** In adults, strong evidence indicates that slowing progression of chronic kidney disease (CKD) requires an integrated, multidisciplinary approach. In children, however, this approach has not been studied. This editorial commentary to the study by Ajarmeh et al in this volume of *Pediatric Nephrology* highlights how a dedicated, multidisciplinary team of physicians, nurses, pharmacists, dieticians, social workers and clinic data managers slowed the progression of CKD in children to a remarkable degree. We discuss the strengths and limitations of the study and its cost implications, as well as the issue of determining the optional complement of physicians and allied health care professionals in such clinics. Our calculations indicate that the additional costs of such clinics would be recovered in one year, even if the progression

of CKD were to be delayed by 1 year in only 2% of affected children. Here, we call on the international pediatric nephrology community to establish guidelines for forming multidisciplinary clinics throughout the world.

**Keywords** Chronic kidney disease · Children · Dialysis · Health care costs · Anemia · Growth and nutrition · Blood pressure · Disease progression · Hospitalization

Chronic kidney disease (CKD) is a disease with multiple complications that worsen with progression [1]. Managing adults with CKD requires a careful, integrated approach to all comorbidities and complications. In 1997, the National Kidney Foundation Kidney Disease Outcome Quality Initiative (NKF KDOQI) introduced evidence-based clinical practice guidelines for all stages of CKD and its complications [2–5]. We now have guidelines for nutrition [6], anemia [7], and bone metabolism specific to children [8]. There is good evidence that meeting these guidelines when managing CKD can improve outcomes, even survival rates [9]. Interventions such as ACE inhibition and strict blood pressure control can substantially slow the progression of CKD [10].

At the same time, we know that a multidisciplinary approach is required to lessen the impact of future cardiovascular disease in these patients [11]. We also know that social integration (measured as independent living, occupational and vocational training, living with a partner) is poor in adults with childhood-onset of CKD [12]. Should it therefore not be standard to have children and adults treated by a multidisciplinary team of nurses or nurse practitioners, pharmacists, dieticians, social workers, and physicians, ideally a combination of pediatric nephrologists, perhaps pediatric urologists, pediatric cardiologists, and possibly psychiatrists?

A recent systematic review of the multidisciplinary model of care for adults with CKD not on dialysis clearly

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highlights the benefits of such an approach [13]. Both randomized trials found that health information, patient education, telephone-based support, and aid of a support group slowed disease progression [14]. Most of the data supporting this concept come from case–control studies, but none found it to be cost-ineffective [15].

### Multidisciplinary clinics for children with chronic kidney disease

Most centers caring for children with CKD have some multidisciplinary features, but few studies have evaluated the beneficial effects of a comprehensive, multidisciplinary approach to this disease. In one case–control study, 20 children with CKD stages 2 through 4 receiving the standard of care were compared with 24 historical controls treated in a dedicated multidisciplinary CKD clinic. Children in the multidisciplinary clinic met more of the KDOQI guidelines after beginning dialysis than did children receiving standard care [16]. To this study we can gladly add that of Salma Ajarmeh and her colleagues on the effect of a multidisciplinary care clinic on 125 children with CKD in this issue of *Pediatric Nephrology* [17]. The results of these children were compared with those of 73 historical controls with CKD. The multidisciplinary approach improved calcium, hemoglobin, and albumin concentrations, and most impressively, in a mean annualized estimated glomerular filtration rate (eGFR) slope of  $+0.5 \text{ mL/min/1.73 m}^2$ , reversing the trend in controls, who had a mean slope of  $-4.0 \text{ mL/min/1.73 m}^2$ . The improved hemoglobin concentrations will also have improved the outcomes, as indicated by the North American Pediatric Renal Transplant Cooperative Study (NAPRTCS) database [18, 19]. Interestingly, blood pressure was not significantly better controlled. The study did not utilize 24-h ambulatory blood pressure monitoring, a powerful tool for slowing progression of CKD, as established by the Escape trial [10]. However, most Canadian provinces do not fund ambulatory blood pressure monitoring, despite the overwhelming evidence supporting its use, not only in CKD, but also in hypertension and cardiovascular disease in general [20].

Dedicated additional funding was the key to establishing the multidisciplinary CKD clinic. Furthermore, the province of British Columbia provided an infrastructure with a centralized renal disease registry and a clinic data manager. It is unclear whether this is a full-time clinic data manager position. In the field of pediatric nephrology, the power of databases is perhaps most apparent in the success of the Renal Transplant Cooperative Study cited above [21]. The government of the province of British Columbia and the Provincial Renal Agency should be congratulated for funding the Patient Records, Outcome and Management Information System (PROMIS). The impressive improvement in the eGFR

should convince other government and funding agencies to implement similar approaches, because the data show that dialysis costs could be deferred as a result of slowing the progression of CKD. The substantial savings in dialysis costs from following similar strategies, including early referral, have also been highlighted in studies of adults, although substantial gaps remain in what we know about slowing this disease [22].

### Limitations and cost savings

The study presented by Ajarmeh and colleagues has several limitations, mostly arising from the study design. In *Pediatric Nephrology* (and elsewhere), there are several examples of prospective studies with negative results, despite preliminary studies with strong positive results. A larger, multicenter randomized approach would have a stronger impact. As pediatric nephrologists, we have to move toward a culture of multicenter, randomized trials to persuade governments and funding agencies to invest in databases and adequately funded multidisciplinary care teams for children with CKD.

Costs are of paramount importance. Dialysis is one of the most expensive treatments. When calculating the total costs of dialysis to society, to the approximately US\$97,000 (€78,000) of direct costs (for children it usually costs much more [23]), must be added the indirect costs of gas, automobile maintenance, driver or attendant, meal expenses, and so on, which average US\$20,855 (€16,770) in adults annually [24]. The authors expect the total per-child cost of dialysis to exceed 194,000 US dollars (156,000 Euros) per year, as most children receive 4–6 treatments per week, and monitoring is much more intensive, all of which adds to travel costs.

As pediatricians, we must collaborate with health economists to control costs. For instance, compared with conventional in-center hemodialysis, home nocturnal hemodialysis provides about three times as many treatment hours and improves clinical and biochemistry factors, all at a 20% cost-saving [25]. It is one thing to establish that an intervention, such as multidisciplinary care, improves clinical outcomes, but it is quite another to show substantial savings by delaying the need for renal replacement therapy. If dialysis can be deferred in 5 of 125 patients per year, the US \$970,000 (€780,000) in savings will easily offset the extra costs of the extended health-care team (nurse up to a maximum of \$95,940/year (€76,393) including benefits (\$41.17/h, € 33.10/h), social worker \$95,917/year (€77,130; \$41.71/h, €33.54/h), pharmacist \$107,921 ((€ 86,782; \$44.99/h, €33.54/h) dietician \$84,128 (€67,649; \$36.57/h, €29.41/h), and a data manager \$46,929 (€37,736; \$20.37/h, €16.38/h), totaling \$429,897.21; €345,690.54). Thus, the savings

achieved by delaying progression of CKD in even 2% of the children in this Canadian study would fund all the allied health-care workers needed for such a multidisciplinary team.

### Future directions

The pediatric nephrology community should develop guidelines and standards for creating an optimal multidisciplinary team to manage children and adolescents with CKD. Apart from nurses or nurse practitioners, pharmacists, dieticians, social workers, and pediatric nephrologists, for whom the appropriate number of full-time equivalents (FTEs) per patient would have to be defined, addressing the social rehabilitation and the higher cardiovascular risk of these patients should be emphasized. In Germany, the Kuratorium für Heimdialyse, the major funding agency for pediatric renal replacement institutions, requires similar centers to have a ratio of one psychosocial professional for every six patients with end-stage renal disease [26]. In London, Ontario, with more than 200 children with CKD stage 2 and higher, we have no psychologist and only 0.2 FTE of social work and dietician positions.

The variability of pediatric nephrologists also varies widely, even within a country. In Canada, the number of pediatric nephrologists in the provinces ranges from zero to 0.87/100,000 children (average, 0.48; standard deviation, 0.29) [27]. Given the PROMIS registry mentioned above, we can assume that Ajarmeh and colleagues identified all children with CKD in British Columbia, which has 4,400,000 people (as of the 2011 census), 1,144,015 of them children. In Canada, 26% of the population is less than 18 years of age; thus, the overall complement of physicians is 0.17/100,000 children, and that of allied health-care professionals is 0.09/100,000 children.

The appropriate and optimal complement of providers in a specialized care center is unknown. Administrative data, such as admission rates, might help determine the ratio of allied health-care professionals per 100,000 children, which is associated with acceptable minimal outcomes and which can serve as a minimum standard for health-care funding. Canada is challenged by a small population of only 33,476,688 over a vast land mass (2011 census), and distance to a pediatric nephrology center clearly affects the outcome of renal replacement therapy [28].

A really important remaining question is whether there should just be a multidisciplinary or rather a multispecialty approach. It would really be important to include a pediatric cardiologist in the multidisciplinary team. Cardiovascular morbidity and mortality form the single most important survival factor in these patients, especially in view of the high prevalence of vascular media calcifications,

cardiomyopathy, and arrhythmias in these patients [11]. Multispecialty, multiple-site life-course studies of pediatric renal and cardiovascular disease and its epigenetic factors are essential for accurately determining the risk of exposures and to identify vulnerable sub-populations [29]. There is a need for the development of quality improvement translational efforts to close the gap between science and practice and to enhance evidence-based care to improve outcomes. This is particularly important for this first generation of long-term survivors of childhood CKD [29, 30]. Especially, given that children with special health-care needs comprise 12% of all children, but require more than half of pediatric health-care dollars, there is a real need to improve their access to preventive and early care [29]. The benefits of a multidisciplinary health care program have also been demonstrated in children with chronic cardiac disease, with a significant impact on both the frequency of hospitalizations and the length of stay [31]. The benefits of including cardiologists in the long-term care of pediatric cancer survivors at risk of long-term cardiomyopathy due to toxic chemotherapy effects provided an excellent example of multispecialty clinical care [32, 33]. It should be pointed out that the growing cohort of pediatric cancer survivors forms one of the most important reasons for the increase of CKD in children [34].

### Conclusion

Ajarmeh and colleagues' study reveals that multidisciplinary care for children and adolescents with CKD stages 3 through 5 can slow the progression of renal dysfunction to a remarkable degree. Their team of two pediatric nephrologists, a specialized renal nurse, a dietician, a pharmacist, a social worker and a clinic data manager, were able to significantly improve calcium, albumin, and hemoglobin concentrations for the 125 CKD patients they evaluated. There is the second, much larger study to clearly show that multidisciplinary care improved health outcomes in this population. We agree with the authors that this multidisciplinary approach is clinically valuable and cost-effective and should indeed become the international norm. We suggest augmenting this team further by regular involvement of pediatric cardiologists.

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