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Socioeconomic Disparities in Chronic Kidney Disease

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CKD is a national public health problem that afflicts persons of all segments of society. Although racial/ethnic disparities in advanced CKD including dialysis-dependent populations have been well established, the finding of differences in CKD incidence, prevalence, and progression across different socioeconomic groups and racial and ethnic strata has only recently started to receive significant attention. Socioeconomics may exert both interdependent and independent effects on CKD and its complications and may confound racial and ethnic disparities. Socioeconomic constellations influence not only access to quality care for CKD risk factors and CKD treatment but may mediate many of the cultural and environmental determinants of health that are becoming more widely recognized as affecting complex medical disorders. In this article, we have reviewed the available literature pertaining to the role of socioeconomic status and economic factors in both non-dialysis-dependent CKD and ESRD. Advancing our understanding of the role of socioeconomic factors in patients with or at risk for CKD can lead to improved strategies for disease prevention and management.

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Key Words: Poverty, Chronic kidney disease, Disparities, Socioeconomics, End-stage renal disease

Introduction

CKD is a growing public health problem that has become recognized globally as an important cause of premature morbidity and mortality.¹⁻³ Disparities in CKD may be related to many factors such as socioeconomic status (SES), gender, and race/ethnicity.⁴⁻⁶ Rostand and colleagues⁷ brought national attention to this issue for the first time in the early 1980s when they reported a 4-fold higher race-specific risk for developing ESRD among blacks in Jefferson County, AL, in comparison with their white counterparts. A consistently higher rate of ESRD has subsequently been noted among other racial/ethnic groups over the last 30 years.^{8,9} It should be noted that these high rates of ESRD occur despite similar or even lower prevalence rates of early-stage CKD, reinforcing the need to better understand the multiple factors that conspire to influence progression to ESRD.^{9,10} The excess rate of ESRD among minorities not only levies a personal toll on affected families and communities, but the excess prevalence of ESRD accounts for nearly a

third of the \$45 billion (Medicare and non-Medicare) a year in US ESRD costs alone.⁹

Although disparities in CKD prevalence and progression have generally been thought to be a function of racial/ethnic, gender, or genetic differences influencing the prevalence and/or control of CKD risk factors, such as diabetes and hypertension, the role of the social environment and economic conditions has recently gained greater attention as an important element in the pathway from CKD risk to the development and complications of CKD and ESRD.¹¹ Indeed, the social environment has been cited as a key determinant in the persistence of health inequities in the United States. Despite our recognized standing as a world leader in health technology and medical care, the United States ranks near last in preventable deaths among developed nations.¹² Dr Steven Schroeder, former president of the Robert Wood Johnson Foundation, argued that “since the less fortunate are disproportionately affected by actionable social determinants of health, we must focus on this population to improve the health of the American and concentrate our strategies on health behaviors, social factors, health care, and the environment.”¹³ This serves as a clear directive to establish greater social equity as part of a broad strategy to improve health outcomes among many vulnerable populations.

Theoretic Framework for Adverse Socioeconomic Status and Kidney Disease

Socioeconomically disadvantaged populations across the globe exhibit a disproportionate burden of CKD often complicated by the inability to receive evidence-based care leading to suboptimum clinical outcomes.^{2,14} A basic understanding of the vulnerabilities of the disadvantaged populations will facilitate the adaptation and adoption of the necessary policies to support kidney disease treatment and prevention guidelines.² Moreover, the World Health Organization has identified 3 key tenets to improve health at a global level that each reinforce the impact of socioeconomic factors: (1) improve the conditions of daily life, (2) tackle the inequitable distribution of power, money, and resources—the structural drivers of

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those conditions of daily life—globally, nationally, and locally, and (3) develop a workforce trained in the social determinants of health and raise public awareness about the social determinants of health.¹⁵ The increasing impact of social factors and health behaviors has contributed to the growing CKD epidemic positioning the nephrology community to lead the charge and deal with the challenge of providing quality care in the setting of contrasting financial and public health policies to control costs.¹⁶ A conceptual framework emphasizing the importance of socioeconomic factors as a mediator of key CKD prevention and treatment pathways highlights its vast impact on the CKD epidemic (Fig 1). The figure shows that many of the determinants of CKD, such as obesity, diabetes, hypertension, and endothelial dysfunction, and chronic inflammation, neurohormonal activation, and oxidative stress may have their foundation in socioeconomic deprivation and its outcroppings or extensions. These include, but are not limited to discrimination and segregation, substandard living conditions, limited quality health care to the uninsured or underinsured, limited health literacy, poor educational systems, and chronic stress that result in measureable and quantifiable pathologic factors that contribute to and enhance the development of CKD and eventually to ESRD and premature mortality.^{4,9,17-20}

Socioeconomic Class and Key Determinants of Health Values

The World Health Organization Commission on Social Determinants of Health has found that poor health of low-income persons is directly related to the social gradient in health within and across countries caused by the unequal distribution of power, income, goods, and services, globally and nationally.¹⁵ Importantly, they have noted that unequal and unfair social policies, poor economic arrangements, and bad politics conspire to cause much of the health inequity in the world. This has been seen dramatically for many years in infectious disease morbidity and mortality and now more recently in chronic diseases such as cardiovascular disease, diabetes, CKD, and others.²¹ Table 1 highlights the influence of socioeconomic class including income on the context of patient specific needs, values, and preferences. An individual's SES may actually considerably affect one's perception of seemingly mundane matters such as food, education, language, and time. Indeed, although these concepts may be apparent and easily recognizable in other social disciplines, their presence and implications may be lost or concealed to many in the medical arena. Therefore, an understanding of how SES may influence world views

is critical for health professionals to truly understand the diverse patients they care for and how to better connect with them to optimize the effectiveness of traditional health strategies and recommendations.

Socioeconomic Status and Non-Dialysis-Dependent CKD

Several studies have highlighted a strong association between SES and the incidence, prevalence, and complications of CKD.²²⁻³² In an analysis of over 14,000 adults in the third National Health and Nutrition Examination Survey III, we found the presence of poverty, defined as less than 200% federal poverty level (FPL), was associated with a 35% greater odds of prevalent microalbuminuria and a 78% greater odds of prevalent macroalbuminuria.²² However, after adjusting for age, sex, race, education, obesity, hypertension, diabetes, reduced estimated glomerular filtration rate (eGFR), and medication use, the odds of prevalent microalbuminuria was less robust but still significant (18%; $P < .05$), but the association with macroalbuminuria was

no longer significant. Importantly, even after multiple statistical adjustments, racial/ethnic differences in macroalbuminuria were more apparent among the subset of less affluent study participants than in those greater than 200% FPL.²² Similarly, albuminuria was found to be associated with lower self-reported annual household income in over 22,500 adult participants of 45 years and older in the Reasons for Geographic and Racial Differences in Stroke Study, where Crews and others²³ also found that after multiple adjustments, the self-reported annual household income less than

\$20,000/y vs more than \$75,000/y had a 1.34 greater odds of albumin to creatinine ratio of 30 to 300 mg/g and 2.36 odds of albumin to creatinine ratio more than 300 mg/g for all participants, and the relationship was more robust for blacks than whites, suggesting that the effect of SES may be a determinant of racial disparities in albuminuria.

An analysis from the baseline examination data of the Jackson Heart Study assessed CKD status (albuminuria or eGFR <60 mL/min/1.73 m²) in over 3400 African American adults living in the Tri-County region of the Jackson, MS, metropolitan area, and found that high SES participants (family income at least 3.5 times the FPL or having at least 1 undergraduate degree) were associated with a 41% lower odds of prevalent CKD than their less affluent counterparts.²⁵ In a cohort of nearly 2500 community-dwelling black and white adults aged 30 to 64 years residing in Baltimore City, MD, stratified by SES (household income $<125\%$ FPL or higher). Crews and colleagues²⁶ found that low SES was independently

CLINICAL SUMMARY

- Socioeconomic factors influence not only access to high-quality care for the treatment of CKD and its risk factors, but they may also mediate biological, cultural, and environmental determinants that impact CKD.
- Socioeconomic factors may also influence epigenetic changes and factors associated with progression of CKD to ESRD and its complications, including early death.
- Evidence-based initiatives to mitigate the effects of socioeconomic deprivation extend from using social media and local networks to increased CKD awareness and to primary intervention strategies aimed at addressing risk factors for CKD among vulnerable communities and high-risk individuals.
- Understanding the vulnerabilities of disadvantaged populations will facilitate the global adaptation and adoption of CKD treatment and prevention guidelines

Figure 1. Conceptual model of the inter-relationship between socioeconomic deprivation and CKD.

associated with a 59% greater odds of CKD prevalence after adjusting for demographics, insurance status, and comorbid disease, but there was no difference by race. However, when stratified by race, low SES was associated with CKD in African Americans, but not in whites, suggesting that the role of SES to CKD may differ across racial/ethnic groups.

Similar to CKD prevalence, an increase in CKD incidence has also been associated with adverse SES. An assessment of CKD incidence among 5490 white and black residents with hypertension or diabetes enrolled in the Atherosclerosis Risk in Communities Study found that blacks had an increased risk for CKD compared with whites, of which 10% was explained by poorer access to health care and more than 60% by demographic, socioeconomic, lifestyle, and clinical factors.²⁴

An evaluation of a cross-sectional sample of US adults that included over 16,000 adults who participated in the National Health and Nutrition Examination Survey 1999 to 2006 found in adjusted analyses that uninsured adults with non-dialysis-dependent CKD were 40% less likely to be treated for their hypertension and 55% less likely to be receiving recommended therapy with angiotensin inhibitors compared with those with insurance coverage.²⁷ The uninsured cohort was also more likely to be younger than 50 years (62.8% vs 23.0%, $P < .001$) and nonwhite (58.7% vs 21.8%, $P < .001$) compared with their insured counterparts.²⁷ These findings reinforce some of the key pathways through which SES may mediate CKD progression and the public burden of ESRD. In addition, based on a Beck Depression score, low SES as determined by unemployment and low income and lower quality and satisfaction with life

Table 1. Socioeconomic Class and Values of Key Determinants of Health

Patient Needs	Poverty	Middle Class	Wealth
Food	Key question: Did you have enough? Quantity important.	Key question: Did you like it? Quality important.	Key question: Was it presented well? Presentation important.
Education	Valued and revered as abstract but not as reality.	Crucial for climbing the success ladder and making money.	Necessary tradition for making and maintaining connections.
Destiny	Believes in fate. Cannot do much to mitigate chance.	Believes in choice. Can change future with good choices now.	Noblesse oblige.
Language	Casual register. Language is about survival.	Formal register. Language is about negotiation.	Formal register. Language is about networking.
Family Structure	Tend to be matriarchal.	Tends to be patriarchal.	Depends on who has money.
World View	Sees the world in terms of local settings.	Sees the world in terms of national settings.	Sees the world in terms of international view.
Time	Present most important. Decisions made for the moment based on feelings or survival.	Future most important. Decisions made against future ramifications.	Traditions and history most important. Decisions made partially on the basis of tradition and decorum

Adapted with permission from Payne and Blair.⁷⁰

scale scores among 628 African Americans with hypertension and CKD were independently and significantly associated with a greater degree of depression, an important co-existing condition in persons with CKD.²⁸

The impact of individual or household income vs community poverty level on CKD outcomes is not clear. To investigate this issue, McClellan and colleagues³² reported data from over 22,000 participants in the Reasons for Geographic and Racial Differences in Stroke cohort study in the Southeast United States, finding household income (<\$15,000) vs community poverty ($\geq 25\%$ of the community households were below the FPL), and found that household income, but not community poverty, was independently associated with CKD (eGFR 10-59 mL/min/1.73 m²) prevalence. They also found that adjusting for household income attenuated but did not fully account for the higher CKD prevalence in blacks compared with whites.

In summary, although low SES was strongly associated with albuminuria in unadjusted analyses, after adjusting for multiple factors such as demographic, clinical, and laboratory variables, the association was much more modest. In contrast, SES remained strongly associated with CKD as defined by reduced eGFR (<60 mL/min/m²) even after adjusting for multiple factors (Table 2).

Socioeconomic Status and ESRD

Similar to non-dialysis-dependent CKD, several studies have highlighted a strong association between SES and the incidence, prevalence, and complications of ESRD.³³⁻³⁷ In an analysis of 79,943 black and white participants in the Southern Community Cohort Study, Lipworth and others³³ found that low income (income less than vs more than \$15,000) was associated with a 50% increased risk of ESRD and that the 3.5-fold increase in black-white ESRD incidence was attenuated, but not eliminated, after controlling for known risk factors in a cohort closely matched by socioeconomics. Like low income, homelessness might affect ESRD risk. Hall and colleagues³⁴ also examined time to ESRD and death in over 15,000 urban and mostly poor adults (73% with annual income <\$15,000) with CKD using a public health safety net system and found that racial/ethnic minorities had a 2.2- to 4.0-fold higher risk of progression to ESRD compared with white persons with CKD, which was not explained by lower relative mortality, which could increase their likelihood of progressing to ESRD. In addition to many urban adults with low SES being more likely to be underinsured or uninsured, they also are at greater risk of homelessness. When Hall and coworkers re-examined this urban and mostly poor cohort, they found that 858 adults were homeless. The homeless group was younger, disproportionately male, and uninsured and not only did they suffer from far higher rates of depression and substance abuse compared with adults with stable housing ($P < .001$) but also over a follow-up period of nearly 3 years had a 80% crude and 28% adjusted higher risk of ESRD or death, suggesting that homeless adults with CKD had increased CKD morbidity and mortality.³¹

Of 86,588 adults younger than 65 years in the National Kidney Foundation's Kidney Early Evaluation Program

that screened persons at risk for CKD (history of diabetes or hypertension or family history of CKD), Jurkovitz and colleagues³⁸ found that uninsured participants were 82% (adjusted) more likely than privately insured participants to die and 72% (adjusted) more likely to develop ESRD. Thus, the lack of insurance, which is more common among low SES persons, is an independent risk factor for early death and ESRD in this high-risk population.³⁸ Although health insurance was associated with improved survival in this cohort, having a primary care provider or nephrologist did not affect the risk of survival, suggesting the need to explore the connection between insurance, primary care access, and outcomes in persons at high risk of or with CKD.³⁰

The impact of income on outcomes for patients with ESRD, who are largely relieved of structural and insurance barriers to care because of the Medicare ESRD program, is poorly understood. In a cohort of over 3000 ESRD patients, Garg and others³⁵ reported that higher neighborhood income was associated with decreased mortality and an increased likelihood of placement on the kidney transplant waiting list. The presence of private insurance coverage in addition to Medicare improved rates of listing for transplantation in a graded manner but had no effect on socioeconomic disparities in mortality, suggesting that greater health benefits can attenuate financial barriers to transplantation in low-income patients.³⁵ The effects of low SES could also be mediated through structural barriers to care. Although an assessment of distance from patient residence to transplant center did not predict placement on the transplant waitlist in over 35,000 subjects in ESRD Network 6 (Georgia, North Carolina, or South Carolina), increasing neighborhood poverty was associated in a graded manner with greater likelihood of decreased placement on the transplant waitlist for all patients, but the effect was even greater in blacks than in whites.³⁶ When Volkova and coworkers³⁷ explored the contribution of neighborhood poverty to racial disparity in ESRD incidence by examining census tract-level neighborhood poverty in over 34,000 patients in ESRD Network 6, they found that census tract was strongly associated with higher ESRD incidence for both blacks and whites. Increasing levels of census tract poverty was associated with a greater disparity in ESRD rates between blacks and whites, whereas census tracts with lesser poverty had more similar ESRD rates by race, suggesting an interaction between race and poverty.³⁷

In summary, low SES was strongly associated with risk for ESRD progression and or death even after adjusting for multiple factors such as demographic, clinical, and laboratory variables suggesting a strong link between social and economic deprivation and progression to severe kidney disease and premature death (Table 3).

Socioeconomic Status and Genetic Risk Factors

Among 736 African Americans participating in the Cardiovascular Health Study, who were older than 65 years, a low income (<\$8000/y vs >\$35,000/y) was associated with a 3-fold greater odds of prevalent CKD assessed by cystatin C or serum creatinine-based eGFR, whereas there was no association between genetic African ancestry and CKD, suggesting a strong influence of social and

Table 2. Selected Studies of Socioeconomics and CKD

Condition	Participants	Key Findings	References
Albuminuria	~14,000 Adults in national survey (NHANES)	<200% FPL was associated with a 35% greater odds of microalbuminuria (18% adjusted, $P < .05$) and 78% greater odds of macroalbuminuria (NS after adjusted)	Martins et al ²²
Albuminuria	22,500 White and black adults ≥ 45 years in the Southeast United States (REGARDS cohort study)	After multiple adjustments, persons with self-reported annual household income <\$20,000/y vs >\$75,000/y had a 1.34 greater odds of ACR of 30-300 mg/g and 2.36 odds of ACR >300 mg/g.	Crews et al ²³
CKD prevalence (albuminuria or eGFR <60)	3430 African American adults in Tri-County region of Jackson, MS	Family income ≥ 3.5 times FPL or at least 1 undergraduate degree was associated with a 41% lower odds of CKD vs less affluent counterparts	Bruce et al ²⁵
CKD prevalence	2500 Community-dwelling black and white adults aged 30-64 years residing in Baltimore City, MD	After adjusting for demographics, insurance status, and comorbid disease, household income <125% vs $\geq 125\%$ of FPL was associated with 59% greater adjusted odds of CKD. In stratified analyses, the association was noted in African Americans but not in whites.	Crews et al ²⁶
CKD prevalence (eGFR <60)	736 African Americans >65 years at multiple sites across the nation	Income <\$8000/y vs >\$35,000/y was associated with a 3 times greater odds of CKD. There was no association between genetic African ancestry and kidney function	Peralta et al ³⁹
CKD incidence	5490 White and black residents with diabetes or hypertension at multiple sites across the nation	Blacks had increased risk for CKD compared with whites; 10% was explained by lesser access to health care and over 60% was explained by demographic, socioeconomic, lifestyle, and clinical factors.	Evans et al ²⁴
Blood pressure control in CKD	Over 16,000 adults in a national survey NHANES 1999-2006	Uninsured persons with non-dialysis-dependent CKD were 40% less likely to be treated for their hypertension compared with insured persons.	Hall et al ²⁷
CKD prevalence (eGFR 10-59)	628 African American adults at multiple sites across the nation	Low SES as determined by unemployment and low income associated with a greater degree of depression	Fischer et al ²⁸
CKD prevalence (eGFR 10-59)	~22,000 Black and white adults ≥ 45 years in the Southeast United States (REGARDS)	Household income (<\$15,000) but not community poverty ($\geq 25\%$ of the community households below FPL) was independently associated with CKD	McClellan et al ³²

Abbreviations: ACR, albumin to creatinine ratio; eGFR, estimated glomerular filtration rate in mL/min/1.73 m²; FPL, federal poverty level; KEEP, National Kidney Foundation Kidney Early Evaluation Program; NHANES, National Health and Nutrition Examination Survey; NS, nonsignificant; REGARDS, Reasons for Geographic and Racial Differences in Stroke Study; SES, socioeconomic status.

Table 3. Selected Studies of Socioeconomics and ESRD

Condition	Participants	Key Findings	References
Risk of ESRD	79,943 Black and white participants in the Southern Community Cohort Study	Income less than vs more than \$15,000 was associated with a 50% increased risk of ESRD. A 3.5-fold increase in black-white ESRD incidence was markedly attenuated, after controlling for known risk factors in a SES-matched cohort	Lipworth et al ³³
Risk of ESRD or death	15,000 Urban, mostly poor adults with CKD in the San Francisco Community Health Network	In this low SES cohort (73% < \$15,000/y), racial/ethnic minorities had a 2.2- to 4.0-fold higher risk of progression to ESRD compared with white persons with CKD	Hall et al ³⁴
Risk of ESRD or death	15,000 Urban, mostly poor adults with CKD in the San Francisco Community Health Network	In this low SES cohort (73% < \$15,000/y), a subgroup of 858 homeless persons followed over ~3 years, had a 80% crude and 28% adjusted higher risk of ESRD or death vs adults with stable housing. They also had higher rates of depression and substance abuse ($P < .001$).	Hall et al ³¹
Risk of ESRD or death	86,588 Adults <65 years in a national CKD screening program (KEEP)	Uninsured participants with or at risk for CKD were 82% (adjusted) more likely than privately insured participants to die and 72% (adjusted) more likely to develop ESRD.	Jurkovitz et al ³⁸
Risk of death	138,331 Adults <65 years in a national CKD screening program (KEEP)	The lack of having a primary care provider or nephrologist was not associated with increased risk for death in persons with or at risk for CKD (unlike being uninsured—ref ³⁹)	Saab et al ³⁰
Risk of death or placed on transplant list	3000 ESRD patients	Higher neighborhood income was associated with decreased mortality and an increased likelihood of placement on the kidney transplant waiting list.	Garg et al ³⁵
Risk of placement on the transplant waitlist	35,000 ESRD patients in Network 6 (Georgia, North Carolina, or South Carolina)	Distance from patient residence to transplant center did not predict placement on the transplant waitlist. Increasing neighborhood poverty was associated with greater likelihood of decreased placement on the transplant waitlist, and the effect was even greater in blacks than in whites	Patzer et al ³⁶
Risk of ESRD	34,000 Patients in ESRD Network 6 (Georgia, North Carolina, or South Carolina)	Neighborhood poverty (census tract level) was strongly associated with higher ESRD incidence for both blacks and whites. Increasing levels of census tract poverty was associated with a greater disparity in ESRD rates between blacks and whites, suggesting an interaction between race and poverty	Volkova et al ³⁷

(Continued)

Table 3. Selected Studies of Socioeconomics and ESRD (Continued)

Condition	Participants	Key Findings	References
Risk of ESRD incidence, kidney transplant waiting list, and kidney transplantation	408,535 Adults aged 20 to 64 years from national administrative data set (Medicaid)	Low-income nonelderly adults covered by states with Medicaid broader coverage (closer to the projected impact of ACA) had a 1.8% lower ESRD incidence for each additional 10% of the low-income nonelderly population covered by Medicaid. There was also a reduction in gaps to access to care between those with private insurance and those with expanded Medicaid in access to peritoneal dialysis, kidney transplant waiting list, and kidney transplantation.	Kurella-Tamura et al ⁵⁸

Abbreviations: FPL, federal poverty level; KEEP, National Kidney Foundation Kidney Early Evaluation Program; NHANES, National Health and Nutrition Examination Survey; REGARDS, Reasons for Geographic and Racial Differences in Stroke Study; SES, socioeconomic status.

environmental factors.³⁹ Although African ancestry alone has not been shown to increase the risk of CKD, recent studies have identified that persons with 2 allelic variants of the *APOL1* gene that is particularly prevalent in African Americans is associated with increased risk of progression to ESRD in the presence of CKD, such as hypertension, diabetes, and HIV-related CKD, and focal glomerulosclerosis.⁴⁰⁻⁴² These *APOL1* gene variants are associated with protection of trypanosomiasis and are most highly prevalent in Western Africa where they are estimated to have developed 4000 years ago, well before the original migration of humans from Africa to Europe, but well before the transatlantic slave trade leading to the high prevalence in African Americans.⁴³ Importantly, socioeconomic stresses can lead to neurohormonal and/or epigenetic changes that could adversely affect CKD⁴⁴ and CKD risk factors, such as blood pressure, metabolic pathways, oxidative stress, inflammatory mediators, and/or other signaling factors.⁴⁵⁻⁴⁸ Given the emerging evidence of epigenetic alterations contributing to CKD and ESRD risk,^{44,49} it is conceptually plausible that socioeconomic depravity can contribute not only to societal and health system-level inequities in care leading to adverse outcomes (Fig 1) but also to epigenetic changes that can influence the expression of CKD and CKD risk factor genes and signaling factors (Fig 2). The reversible nature of the epigenetic changes⁵⁰ gives a unique opportunity to halt or even reverse socioeconomic-induced epigenetic disease processes through targeted social interventions or to create targeted interventions to attenuate the biologic alteration of low SES while social changes, which often take generations to occur, are being implemented.

Conclusion

The increasing rates of poverty and exposure to adverse social determinants of health, both in the United States and globally, are reaching a level of crisis.^{13,51} The nephrology community and related stakeholders should unite in a strategic effort to address the clinical, financial, and public policy issues that will enable the delivery of appropriate CKD care to low socioeconomic and other vulnerable patient populations.¹⁶ The Affordable Care Act (ACA) has dramatically increased the number of low-income nonelderly adults eligible for insurance coverage including Medicaid⁵² and may have favorable overarching consequences on mitigating previous disparities. A recent survey from Barcellos and colleagues⁵³ found that lower income persons (100%-250% FPL) in comparison with higher income persons (≥400% FPL) were 31% less likely to score above the median on ACA knowledge and 54% less likely to score above the median on health insurance knowledge, suggesting that low SES can adversely affect understanding of the ACA and may limit its success. In addition to extending health insurance coverage, the ACA of 2010 allowed introduction of bundled payments for a range of services, proposed the creation of accountable care organizations, and established the Centers for Medicare and Medicaid Innovation to test new care delivery and payment models aimed to improve quality of care and contain costs with many of the demonstration programs being introduced in the

* As well as neurohormonal changes

Figure 2. Conceptual model of socioeconomic influences on epigenetic changes.

nephrology community.^{54,55} The implications of ACA for CKD are substantial given the tremendous role that the nephrology community has played in piloting key ACA demonstration programs.^{54,56,57} To gain a sense of the potential impact of extending health insurance coverage, Kurella-Tamura and others⁵⁸ found that low-income non-elderly adults covered by states with Medicaid broader coverage (closer to the projected impact of ACA) had a significant decrease in ESRD incidence (1.8% for each additional 10% of the low-income nonelderly population covered by Medicaid) and a reduction in gaps to access to care between those with private insurance and those with Medicaid in access to peritoneal dialysis, kidney transplant waiting list, and kidney transplantation. The ACA may set the stage for not only more available care but also more structured medical care systems that can help improve kidney outcomes.⁵⁹ However, education of the potential benefits of the ACA directed toward lower income persons will need to be enhanced.⁵³

An important challenge for the nephrology community and the broader medical community is to rethink how we might improve each element that affects the health outcomes we are trying to achieve and not just those limited to a procedure or prescription. Increased awareness of social and environmental factors that contribute to CKD disparities must be followed by cost-effective policies to improve CKD/ESRD prevention and care, especially in the setting of increasing diversity and increasing disparities in wealth and educational attainment.^{4,9,59-61} As health care providers, we can directly address many of the factors crucial for closing the CKD/ESRD disparities gap, and although other factors may seem beyond our reach, we should not turn a blind eye to those elements of institutionalized racism entrenched within the fabric of our society, such as social injustice and human indifference.^{11,60} Examples of evidence-based initiatives to mitigate untoward effects of socioeconomic deprivation include expanding awareness of CKD in vulnerable communities and high-risk individuals such as through the

National Kidney Foundation Early Evaluation Program or mobile clinics⁶²⁻⁶⁵ and implementing strategies to increase health literacy even among low educational groups with or at risk for CKD using videos and/or novellas,^{66,67} social support such as social networks,¹⁹ and primary intervention strategies including the use of lay health workers and patient navigators to address CKD and CKD risk factors ranging from diabetes to childhood chronic diseases.^{62,65,68,69} Finally, we should not miss the opportunity to learn important lessons as we strive to advance the necessary policies to improve social welfare and health outcomes as the existence of health inequities provides unique, unrecognized opportunities for understanding biologic, environmental, sociocultural, and health care system factors that can lead to improved clinical outcomes.^{4,5,9,59,60}

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