Supplementary Appendix

This appendix has been provided by the authors to give readers additional information about their work.

Supplement to: Inker LA, Eneanya ND, Coresh J, et al. New creatinine- and cystatin C–based equations to estimate GFR without race. N Engl J Med. DOI: 10.1056/NEJMoa2102953

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Supplemental Methods

A. Development of equations to estimate GFR and evaluation of their performance compared to measured GFR

Chronic Kidney Disease-Epidemiology Collaboration (CKD-EPI)

CKD-EPI is a research group funded by the National Institute of Diabetes, Digestive and Kidney Disease (NIDDK) to address challenges in the study and care of CKD, including development and validation of improved GFR estimating equations by pooling data from research studies and clinical populations (hereafter referred to as "studies"). The design and studies have been previously described and are briefly reviewed here.[1-3] Full information can be found here https://www.tuftsmedicalcenter.org/research-clinical-trials/institutes-centers-labs/chronic-kidney-disease-epidemiology-collaboration/overview

The first and last authors are co-directors of CKD-EPI. They drafted the first draft and subsequent revisions with the participation of a subgroup of the authors (Crews, Coresh, Eneanya, Grams, Gutierrez and Powe). Hocine Tighiouart performed the analyses under the direction of the first and last authors. The remainder of the writing group reviewed the near to final draft and provided input. All authors approved the final version. The first, fourth, and last authors take responsibility for all the analyses and directed the development and validation of the GFR estimating equations. Drs. Coresh and Selvin and analyst Dan Wang directed the NAHANES analyses.

Data sources

The institutional review boards of all participating institutions approved each study and Tufts Medical Center's institutional review board approved the current analysis.

Collaborators provided data from research studies and clinical populations. **Figure S1** and **Table S2** shows the division of these studies into development and external validation for the CKD-EPI 2009 creatinine ($eGFR_{cr}$) equation, CKD-EPI 2012 cystatin C ($eGFR_{cys}$) and creatinine-cystatin C equations ($eGFR_{cr\text{-}cys}$) and the CKD-EPI 2021 equations described here. GFR was measured using urinary or plasma clearance of exogenous filtration markers (**Table S1**). For development of new equations, we used existing development populations: CKD-EPI 2009 for $eGFR_{cr}$ (**Table S6,** 10 studies, 8254 participants) and CKD-EPI 2012 for $eGFR_{cys}$ and $eGFR_{cr\text{-}cys}$ (**Table S7,** 13 studies, 5352 participants). For external validation of all equations, we used a new population (CKD-EPI 2021) consisting of CKD-EPI 2012 external validation studies and new studies (**Table S8** 12 studies, 4050 participants). Separately, for external validation of $eGFR_{cr}$, we also used CKD-EPI 2009 external validation population, as it is larger than CKD-EPI 2021. Race was self-reported by participants in most studies (**Table S3**).

Information on race and ethnicity groups were provided in the original study data. In our past work, we had explored use of 2-level variable for race (Black vs. White and other) and as a 4-level variable (Black, Asian, Native American and Hispanic vs. White and other). Our main publications and equations used in practice included the 2-level variable as we had insufficient representation from the other groups to have definitive results and our analyses within these small sample sizes did not demonstrate large effects.[4] Categorization of racial groups in this study was consistent with previous studies. We recognize the broad diversity within racial groups and in future studies, categorization can reflect this important concept.

Laboratory methods

Methods for measurement and standardization of creatinine, cystatin C and GFR have been previously reported. [1,2,5,6,7] We calibrated serum creatinine assays or measured serum creatinine on the Roche enzymatic method (Roche-Hitachi P-Module instrument with Roche Creatininase Plus assay, Hoffman-La Roche, Ltd., Basel, Switzerland), traceable to National Institute Standardized Technology (NIST) creatinine standard reference material 967.[7] We calibrated serum cystatin C assays or measured serum cystatin C on the Siemens Dade Behring Nephelometer, traceable to International Federation for Clinical Chemists (IFCC) Working Group for the Standardization of Serum Cystatin C and the Institute for Reference Materials and Measurements (IRMM) certified reference materials.[8,9]

Development and Validation of Equations

Our goal was to compare the current approach to guideline-recommended CKD-EPI creatinine, cystatin C and creatinine-cystatin C equations (hereafter referred to as "current equations"), to two new approaches for GFR estimation that do not require race (hereafter referred to as "new equations")[1,2].

Current models: As we have previously described, CKD-EPI equations are modeled using least squares linear regression to relate log transformed measured GFR to log-transformed filtration markers, age, sex and race with two slope splines for creatinine and cystatin C[1,2]. The splines are two phase linear splines on the log scale. For creatinine, the knot is at 0.7 mg/dl for women and 0.9 mg/dl for men. For cystatin, the knot is at 0.8 mg/l. The mathematical form of the joint model that estimates log transformed mGFR from log serum creatinine, log serum cystatin, age, sex and race is

$$\begin{aligned}\log(\text{mGFR}) &= \log\mu + \alpha_1 \log\{\min(\text{Scr}/\kappa, 1)\} + \alpha_2 \log\{\max(\text{Scr}/\kappa, 1)\} \\ &\quad + \beta_1 \log\{\min(\text{Scys}/0.8, 1)\} + \beta_2 \log\{\max(\text{Scys}/0.8, 1)\} \\ &\quad + \{\log(\lambda) \times \text{Age}\} + \{\log(\psi) \times \text{Female}\} + \{\log(\phi) \times \text{Black}\} + \epsilon \qquad (1) \\ &= f(\text{Scr}, \text{Scys}, \text{Age}, \text{Female}, \text{Black}; \theta)\} + \epsilon\end{aligned}$$

The knot point κ for serum creatinine is set to 0.7 if female and 0.9 if male. In log transformed models, $\log\mu$ is the intercept, α_1 and α_2 are the coefficients for log serum creatinine below and above the serum creatinine knot point; β_1 and β_2 are the coefficients for log serum cystatin C below above the serum cystatin C knot point. In addition, $\log(\lambda)$ is the coefficient for age, $\log(\psi)$ is the coefficient for female and $\log(\phi)$ is the coefficient for Black race. Further, Female = 1 if the person is female and 0 otherwise; Black = 1 if the person is a Black individual and 0 otherwise. In the final equation, the symbol θ represents the full set of parameters $(\mu, \alpha_1, \alpha_2, \kappa, \beta_1, \beta_2, \lambda, \psi, \phi)$.

Table S2 shows the variables included in the current regression models based serum creatinine without serum cystatin C, serum cystatin C without serum creatinine, and serum creatinine and serum cystatin jointly:

1. The CKD-EPI 2009 Creatinine model includes coefficients for the two creatinine splines, age, sex and race.
2. The CKD-EPI 2012 Cystatin C model includes coefficients for the two cystatin C splines, age, and sex
3. The CKD-EPI 2012 Creatinine-Cystatin C model includes coefficients for the two creatinine splines, the two cystatin C splines, age, sex and race

Each of these models can be expressed in the framework of **Equation 1**, where the coefficients $\beta_1$and $\beta_2$are set to 0 for the CKD-EPI 2009 creatinine model, the coefficients α_1, α_2,and ϕ are set to 0 for the CKD-EPI 2012 serum cystatin model, and all coefficients are included for the CKD-EPI 2012 creatinine-cystatin C model. The remaining non-zero coefficients differ between the models as needed to provide least squares estimation of $\log(\mathrm{mGFR})$.

For the purposes of computing estimated GFR, the regression expression on the right hand side of equation (1) is exponentiated, leading to estimating equations of the form:

$$\mathrm{eGFR} = \mu \times \min\left(\frac{\mathrm{Scr}}{\kappa}, 1\right)^{\alpha_1} \times \max\left(\frac{\mathrm{Scr}}{\kappa}, 1\right)^{\alpha_2} \times \min\left(\frac{\mathrm{Scys}}{0.8}, 1\right)^{\beta_1} \times \max\left(\frac{\mathrm{Scys}}{0.8}, 1\right)^{\beta_2} \times \lambda^{\mathrm{Age}} \times \psi\,[\text{if female}] \times \phi\,[\text{if black}].$$

New approaches for GFR estimation that do not require specification of race New race-free approaches were required for creatinine and creatinine-cystatin C equations, but not for the cystatin C equation since the current version of this equation already excludes race. **Table S2** shows the models for these alternative approaches.

1. The first new approach used the same coefficients for the intercept, age, sex and creatinine as in the current equations, but removed the Black race coefficient in computing eGFR; thus the eGFR value for non-Black was assigned to Black individuals.
2. The second new approach was to develop new equations using the same form as the current equations, but without the inclusion of race as an explanatory variable.

Since all equations were developed by the CKD-EPI research group, we refer to them only by filtration marker(s) (eGFRcr, eGFRcys or eGFRcr-cys) and demographic factors in their development (age, sex, and race [ASR], age and sex [AS]). We use the term non-Black (NB) to refer to ASR equations in which the Black race coefficient is removed for computing eGFR.

Assessment of accuracy

Development dataset: We assessed bias (or systematic error) in race groups as the mean of the difference between log mGFR and log eGFR model fit using root mean square error on the logarithmic scale.[1,2] Bias is the systematic error, or average deviation, between the eGFR and the mGFR and can occur in either direction. The presence of a bias in one group in the development dataset implies that the equation was not fit well to that group. We also show bias on the natural scale as the median of the difference between mGFR and eGFR. This can be expressed in units of GFR (ml/min per 1.73 m^2), the same units as are used in practice, thus helping with clinical interpretability. As in past publications, we use mGFR-eGFR to reflect the role of mGFR as the dependent variable in the regression models, in which residuals correspond to mGFR-eGFR.

Validation dataset: In the validation dataset, we assessed accuracy as bias on the natural scale, the interquartile range (IQR) of the difference between mGFR and eGFR, as well as agreement between eGFR and mGFR. IQR is a measure of the precision of the eGFR around mGFR. Agreement combines both bias and precision. We show agreement as the percentage of estimates within 30% different from measured GFR (P_{30}) and as agreement of eGFR to mGFR categories using guideline recommended CKD GFR (G) stages (< 30, 30-44, 45-59, 60-89 and > 90 ml/min/1.73m^2)[10,11]. P_{30} of 80-90% is considered acceptable for GFR evaluation for many clinical settings and P_{30} of $\geq$ 90% would be optimal; these values correspond to approximately 65% and > 70%

agreement of eGFR to mGFR categories, respectively.[10] 1-P_{30} corresponds to large errors that may be clinically significant and both P_{30} and 1-P_{30} have been widely used to define accuracy of current equations.[10]

Confidence intervals were calculated by bootstrap methods using 2000 replicating samples. In addition, we focused on differential bias between racial groups because it could lead to systematic differences in treatment for the same mGFR level.

We assessed performance in subgroups: eGFR (as defined above), age (<40, 40-≤65 and > 65 years), sex, body mass index (BMI) (≤25, 25-≤30, and ≥30 kg/m^2).

Sensitivity analyses

1. Weighted proportions of Black individuals in the development dataset To evaluate the impact of proportion of Black individuals included in the development data on the observed performance of GFR estimates, we conducted a weighted data analysis. In the weighted data analyses, we varied the weights assigned to Black individuals from 0% to 100%. This was accomplished by calculating weights for Black individuals equal to the ratio of the target population proportion of Black individuals to the proportion of Black individuals in the current dataset and the converse for the non-Black individuals. For example, for a target population proportion of 13%, if the development proportion Black individuals was 32%, we used a weight of 13%/32%=0.41 for Black individuals and 87%/68%= 1.28 for non-Black individuals. These weights were used in the regression model to derive weighted regression coefficients and standard errors. For data presentation, we focused on weights that leads to a proportion of Black of 0% and 100%, as the two extremes to see the greatest impact, and on weights that leads to a proportion of Black of 13%, which is the population of self-identified adult Black persons in the United States, and weights that leads to a proportion of Black of 50% for consideration of equality. In evaluating performance in validation population, we also weighted that population similarly.

2. Calibration of GFR methods In the validation dataset, we calibrated GFR measurement methods to urinary clearance of iothalamate, the method used in the development datasets[1,2] based on a systematic comparison of all methods (**Table S1**)[12-14]. In the validation dataset, two methods are used: plasma clearance of iohexol (9 studies) and urinary clearance of EDTA (2 studies).
   Calibration is required for the former method but not for the latter method. As in a past publication, we increased plasma clearance of iohexol by 5% to calibrate for differences to urinary clearance of iothalamate.[3,15]

3. Comparisons to equations for adults developed by other research groups. Several other research groups have developed equations to estimate GFR from creatinine, cystatin C or the combination. None include a race term, but none included Black individuals in their model development. [16-20] In the validation dataset, we compared the CKD-EPI equations to those from these research groups. This is a fair comparison as the CKD-EPI equations were not developed in this validation dataset.

B. Estimation of prevalence of chronic kidney disease in the United States

The National Health and Nutrition Examination Survey (NHANES) is a cross-sectional, multistage, stratified, clustered probability samples of the civilian, non-institutionalized population of the U.S. The study population for this analysis was limited to 4563 participants who were 20 years and older from 1999-2000 and 2001-2002 surveys who had completed the examination in the mobile examination center, and were not missing serum creatinine or cystatin C measurements **(Table S4).**[21,22] Methods are similar to previous reports.[23-26] Measured GFR was not available in NHANES.

As previously reported, serum creatinine was measured using a kinetic rate Jaffe method and re-calibrated to standardized creatinine measurements obtained in at the Cleveland Clinic Research Laboratory (Cleveland, OH).[27] Cystatin C was measured using a particle-enhanced immunonephelometric assay (N Latex Cystatin C; Dade Behring, Deerfield, IL) with a coefficient of variation of 5%[23-26]. GFR was estimated using the equations described above. Albuminuria was defined as albumin-to-creatinine ratio (ACR) $\geq$30 mg/g in a spot urine sample.[23,28] Repeated measurements, obtained in 1,241 NHANES 1988-1994 participants approximately 2 weeks after the original examination were used to estimate the persistence of albuminuria.[28] CKD was defined as persistent albuminuria or eGFR <60 ml/min/1.73 m^2[29]. CKD GFR stages were classified according to eGFR.[10] We also used the same methods to analyze NHANES 1999-2018 participants with creatinine data (N=49,015) to confirm that limiting the analysis to individuals with cystatin C data did not change the inferences (data not shown).

Analyses were performed incorporating the sampling weights to obtain unbiased estimates from the complex NHANES sampling design using Stata (Version 15.1, StataCorp, College Station, TX). Standard errors for all estimates were obtained using the Taylor series (linearization) method following NHANES recommended procedures and weights.[30-32] Confidence intervals for prevalence estimates for CKD stages incorporating persistence data on of albuminuria were made using bootstrap methods implemented in Stata. Prevalence estimates were applied to the 2019 U.S. Census of 246.6 million adults people greater than 20 years of age to obtain estimates of the number of individuals with CKD in the U.S.

Figures and Tables

Figure S1: Flow diagram of the CKD-EPI development and validation datasets

Legend: The flow diagram shows the evaluation of studies and participants included in the development and validation of the 2009, 2012 and 2021 CKD-EPI equations.[1,2] The dark gray shaded boxes show the three main datasets included in the analyses presented in the analysis. The light gray shaded box indicates a dataset used in a secondary analysis. Squares represent addition or removal of studies. Circles represent removal of subset of studies. Dashed lines indicate when studies or participants were removed. Solid lines indicate when studies were added.

The green shaded area shows the creatinine development and validation studies. A more detailed figure showing the development of those studies was previously published.[1] The yellow shaded area depicts the transition from the studies included in the creatinine datasets to those included in the development and validation of the 2012 cystatin C and creatinine-cystatin C equations. The blue shaded area depicts the studies included in the new 2021 external validation dataset.

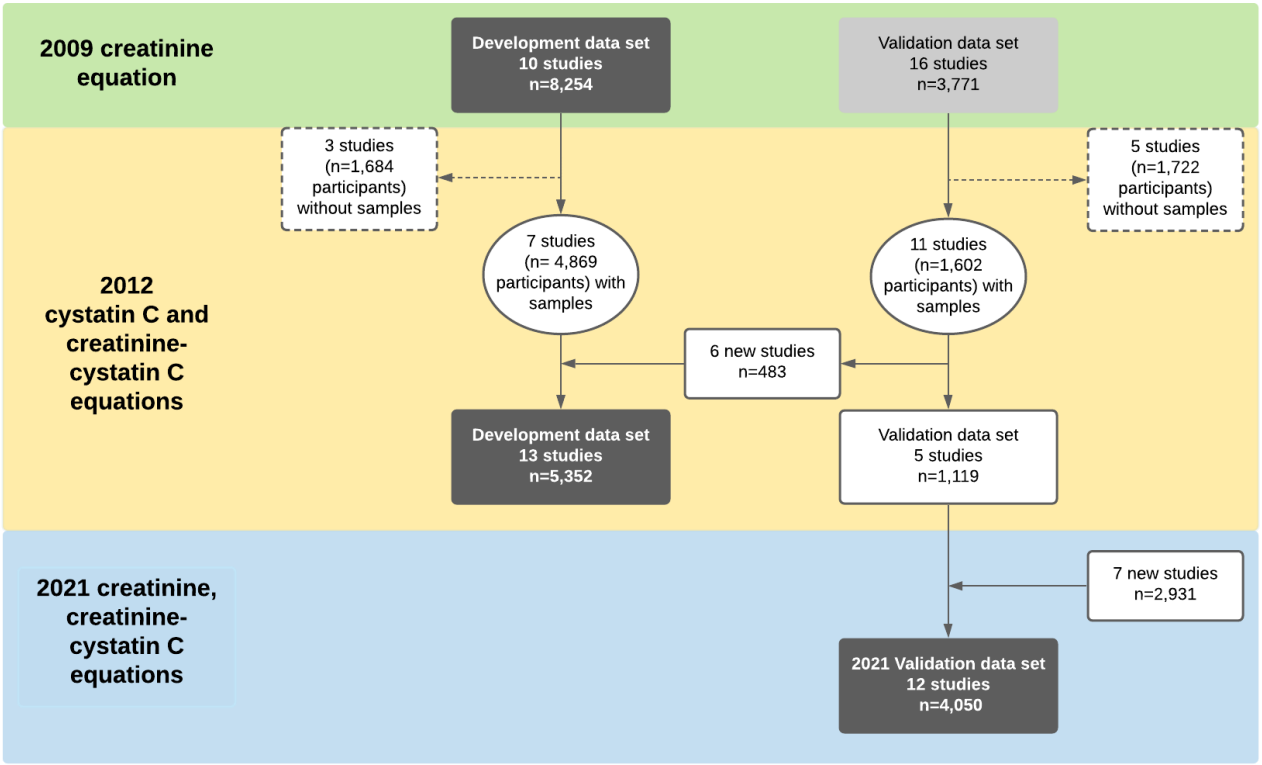
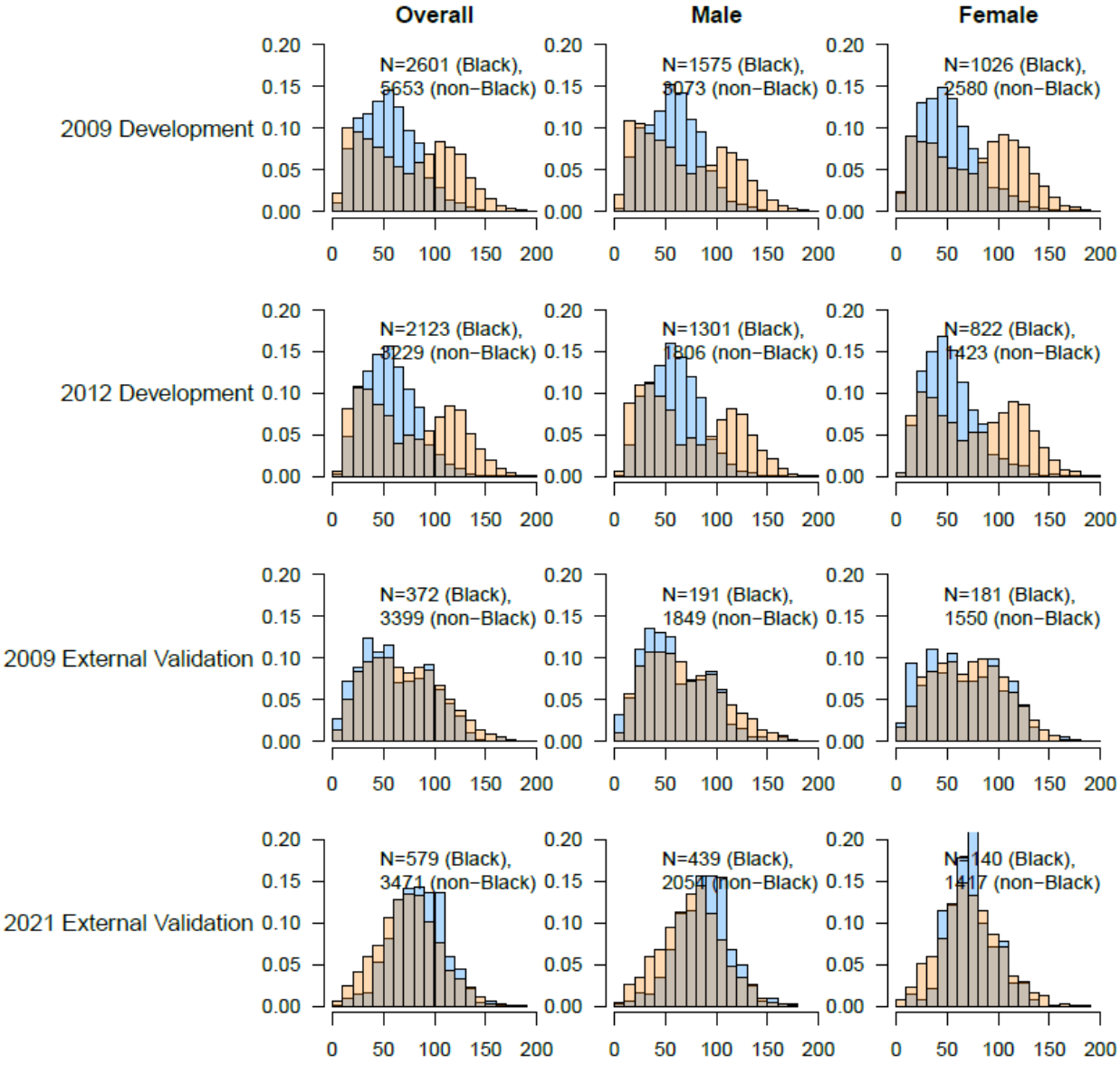


Figure S2: Distribution of measured GFR and age by sex and race groups for the development and validation datasets

a. Distribution of measured GFR



b. Distribution of age

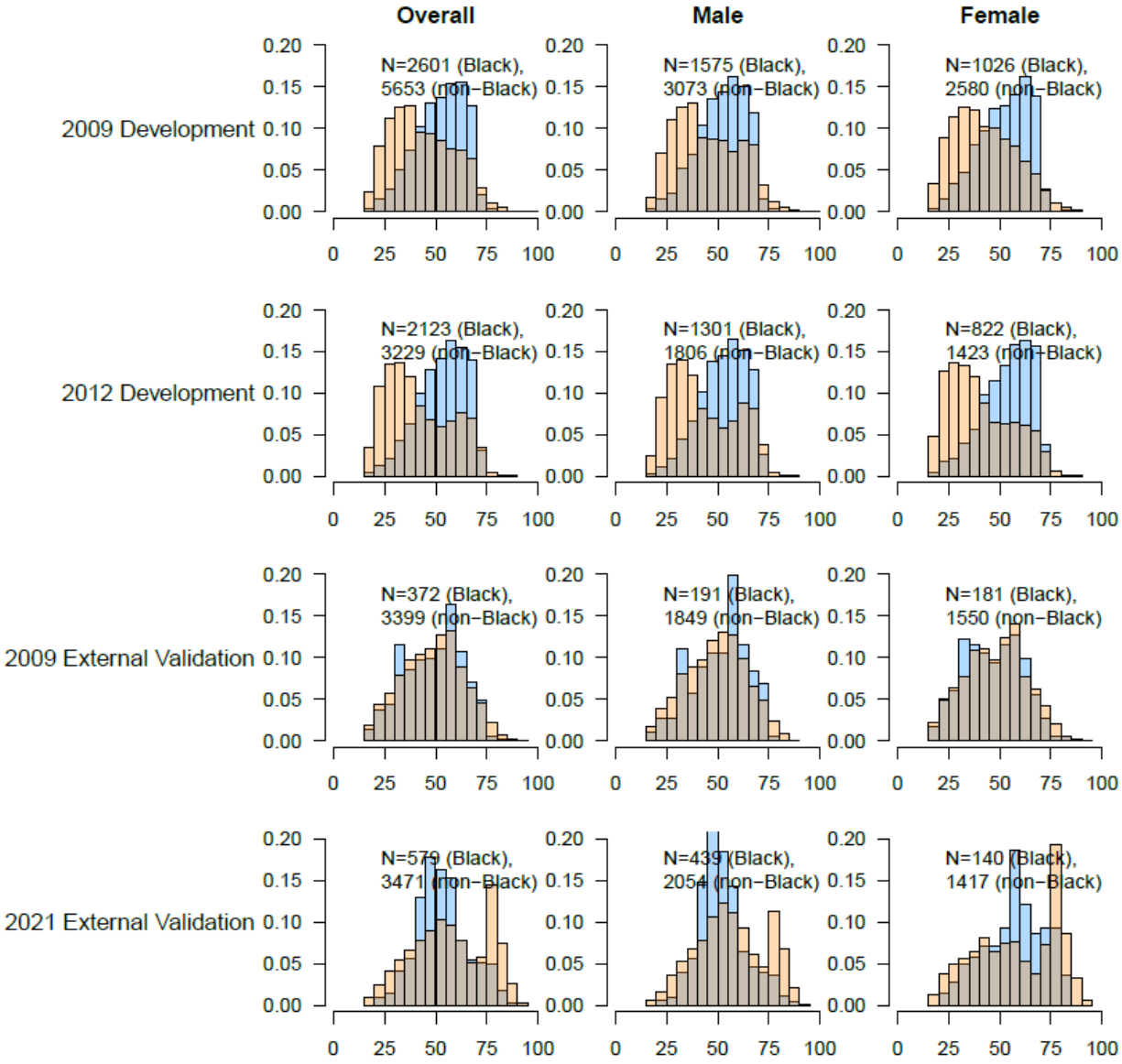
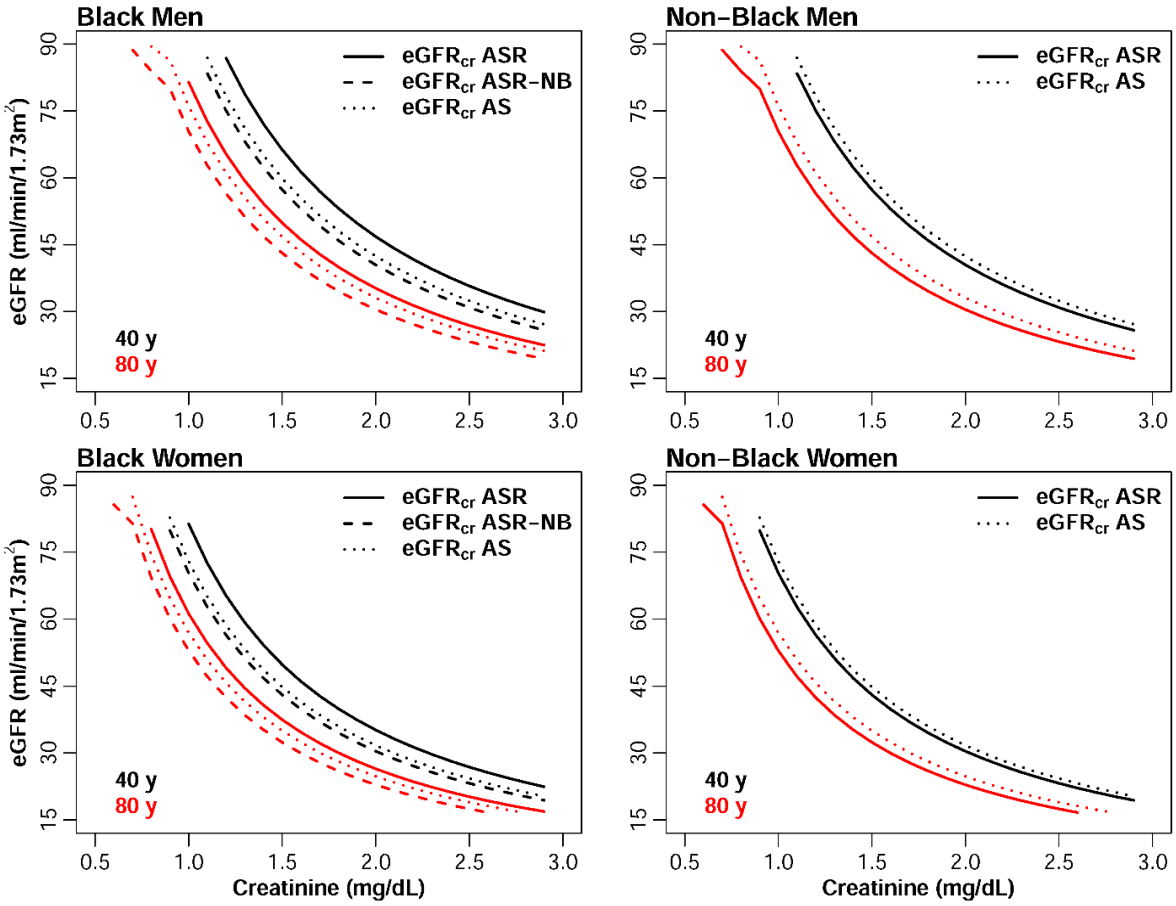


Figure S3: Estimated GFR using current and new equations for simulated patients

ASR, refers to the current CKD-EPI equation which included age, sex and race as demographic factors. NB, refers to the new equation presented in this manuscript where the term for Black race is removed in the computation of the eGFR value. AS refers to the new equation refit using only creatinine, age and sex. Cr, creatinine, Cys, cystatin C; y, age

a. Creatinine



b. Creatinine-Cystatin C

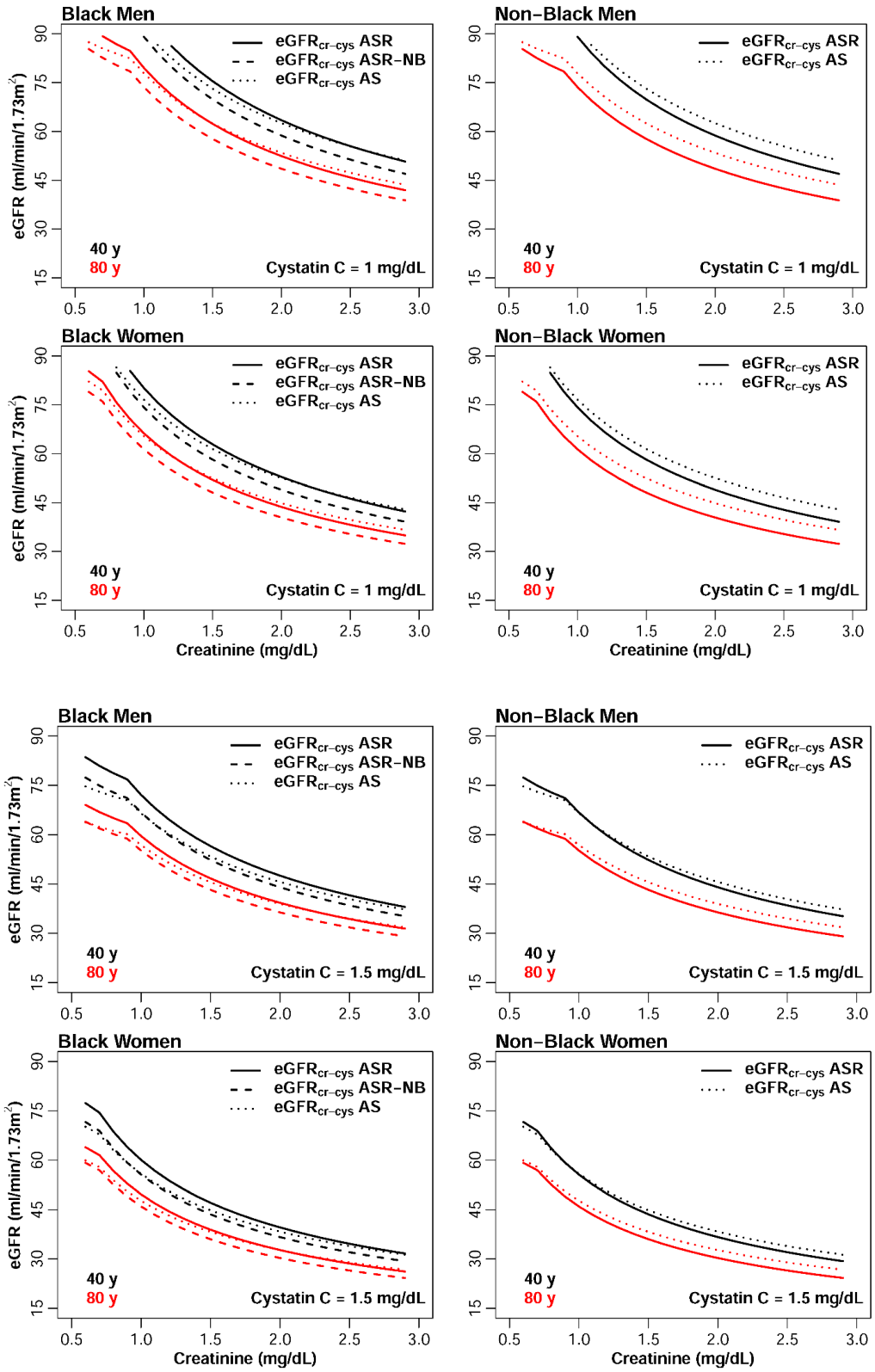


Figure S4: Comparison of measured vs estimated GFR by race groups across alternative GFR estimating equations in development dataset

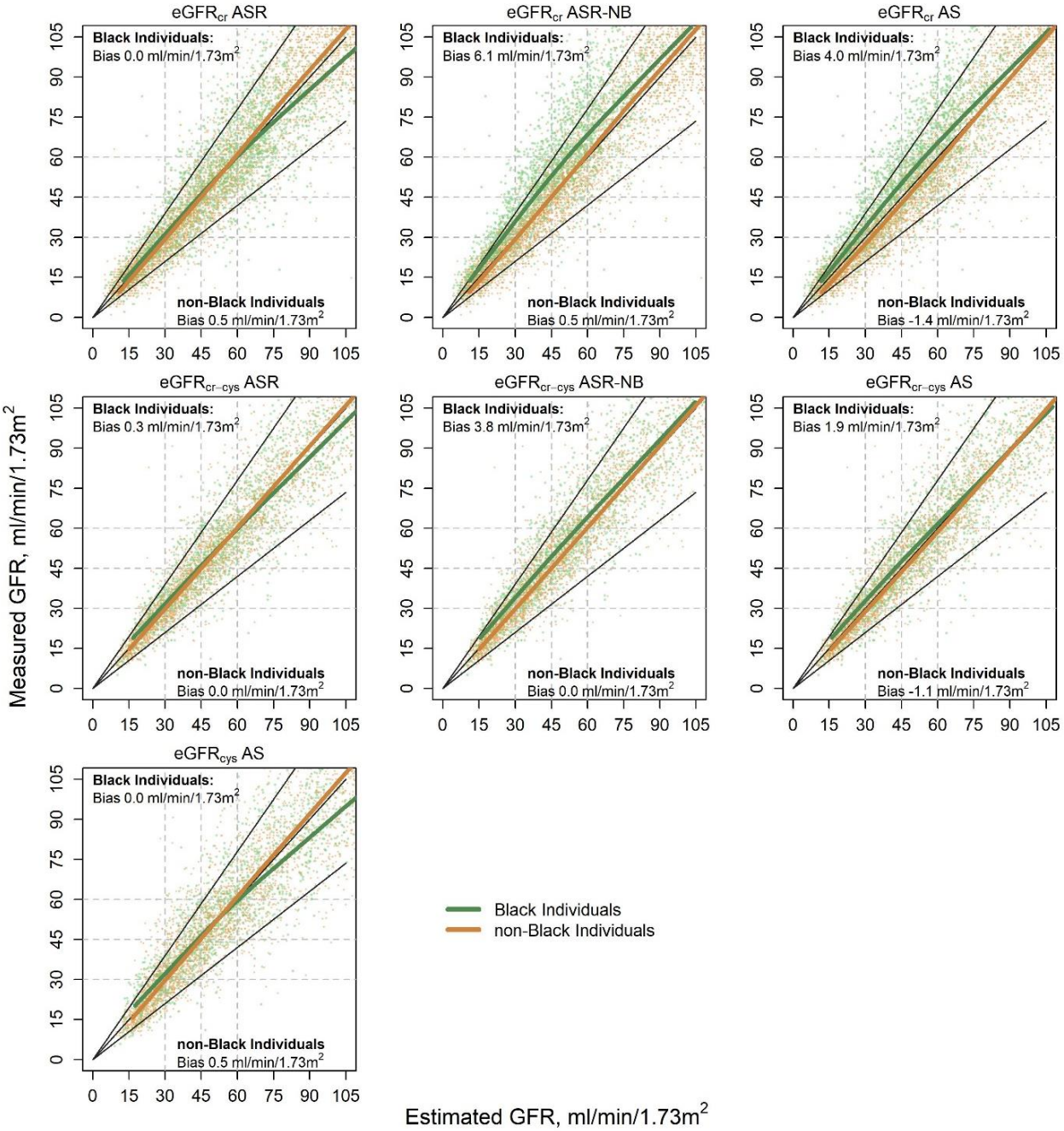


Figure S5: Performance for weighted blended AS equations in 2009 and 2012 development datasets
Top panel: Bias as measured as the difference between measured and estimated GFR and units are in ml/min per 1.73 m^2. Bottom panel: Accuracy as measured by 1- P_{30} or the percentage of estimates greater than 30% of measured GFR. The vertical bars indicate 95% confidence intervals. The dotted black line represents the difference in the GFR equation performance between race groups.
Cr, creatinine. Cys, cystatin C.

The numbers in the x axis refer to the proportion of Black individuals in the development dataset. The 2009 development and 2012 development include 31% and 40% respectively (indicated as *). These correspond to the new AS equation. To demonstrate the impact of proportion of Black individuals included in the development dataset, we weighted the population for values of 0, 13 (representing the proportion of Blacks in the current US population), 50 and 100% Blacks.

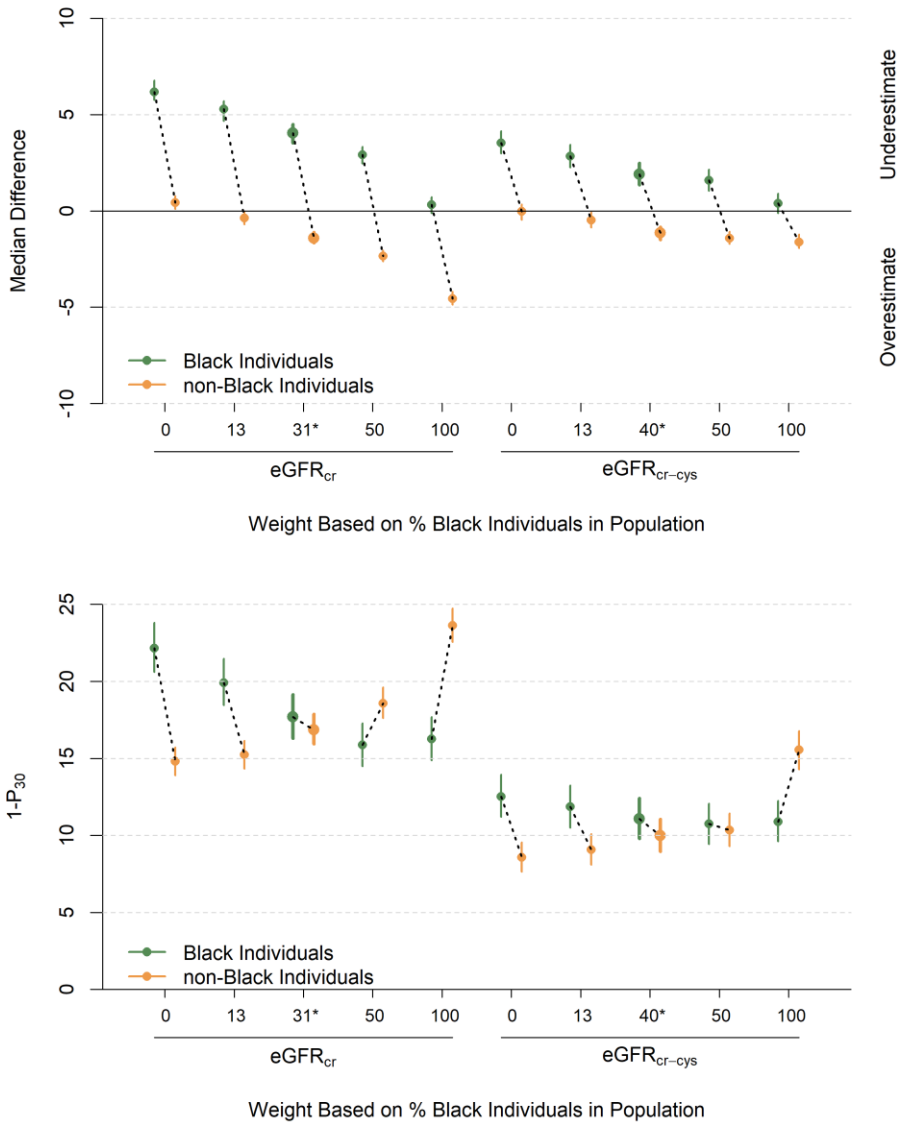


Figure S6: Performance of Current and New Equations compared to directly measured GFR in the 2021 Validation Dataset, Overall and by Race Groups

Top panel: Bias as measured as the difference between measured and estimate GFR and units are in ml/min per 1.73 m^2. Bottom panel: Accuracy as measured by 1- P_{30} or the percentage of estimates greater than 30% of measured GFR. The equations are referred to by filtration marker(s) (eGFRcr, eGFRcys or eGFRcr-cys) and the demographic factors included in equation development (age, sex, and race [ASR] or age and sex [AS]). The current equations are the eGFRcr (ASR), eGFRcys (AS) and eGFRcr-cys (ASR). Non-Black (NB) refers to equations in which Black race is removed in computation. The vertical bars indicate 95% confidence intervals. The dotted black line represents the difference in the GFR equation performance between race groups.

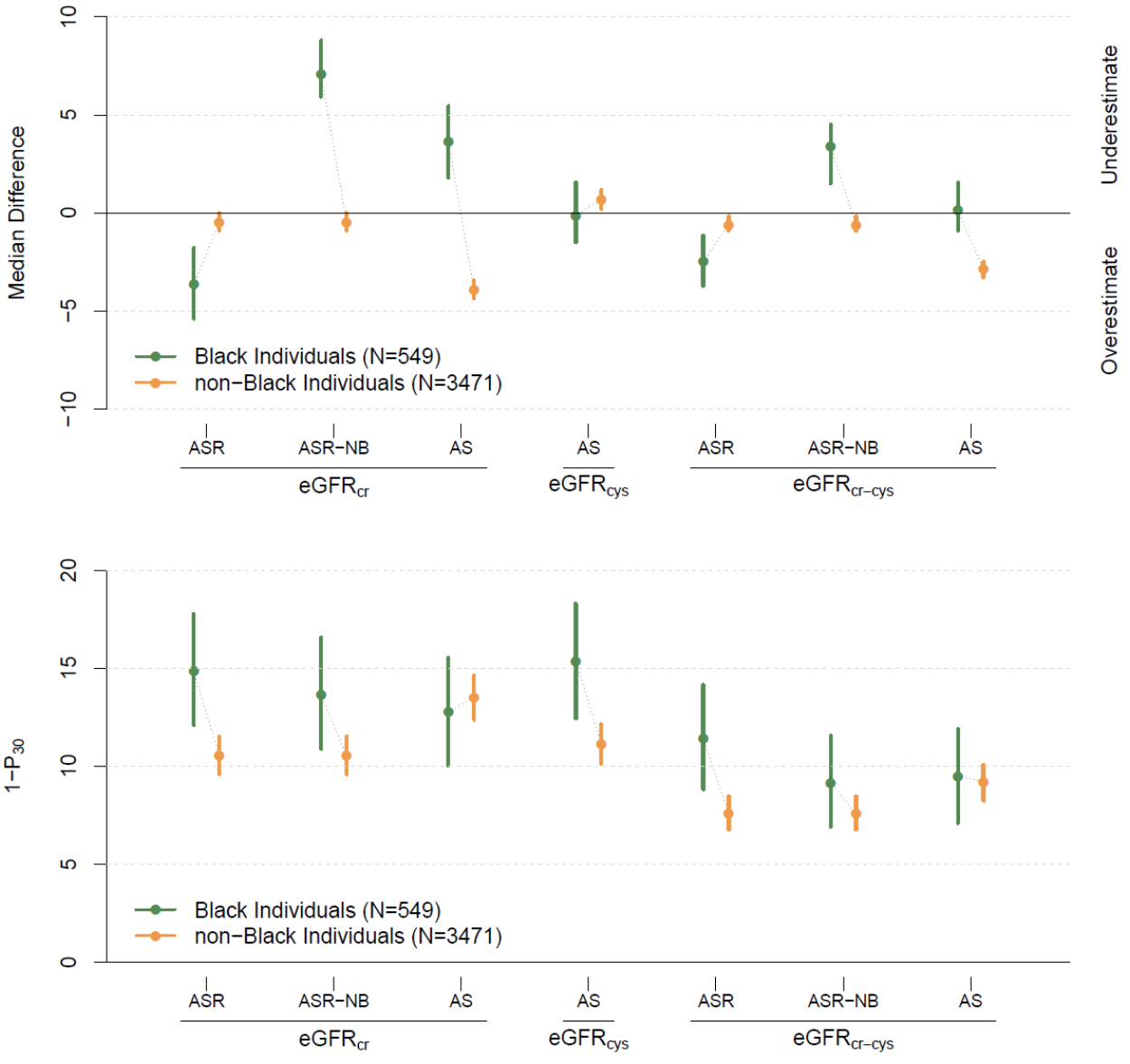


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Figure S7: Comparison of measured vs estimated GFR by race groups across alternative GFR estimating equations in the 2021 validation dataset, calibrated for possible variation in mGFR measurement methods

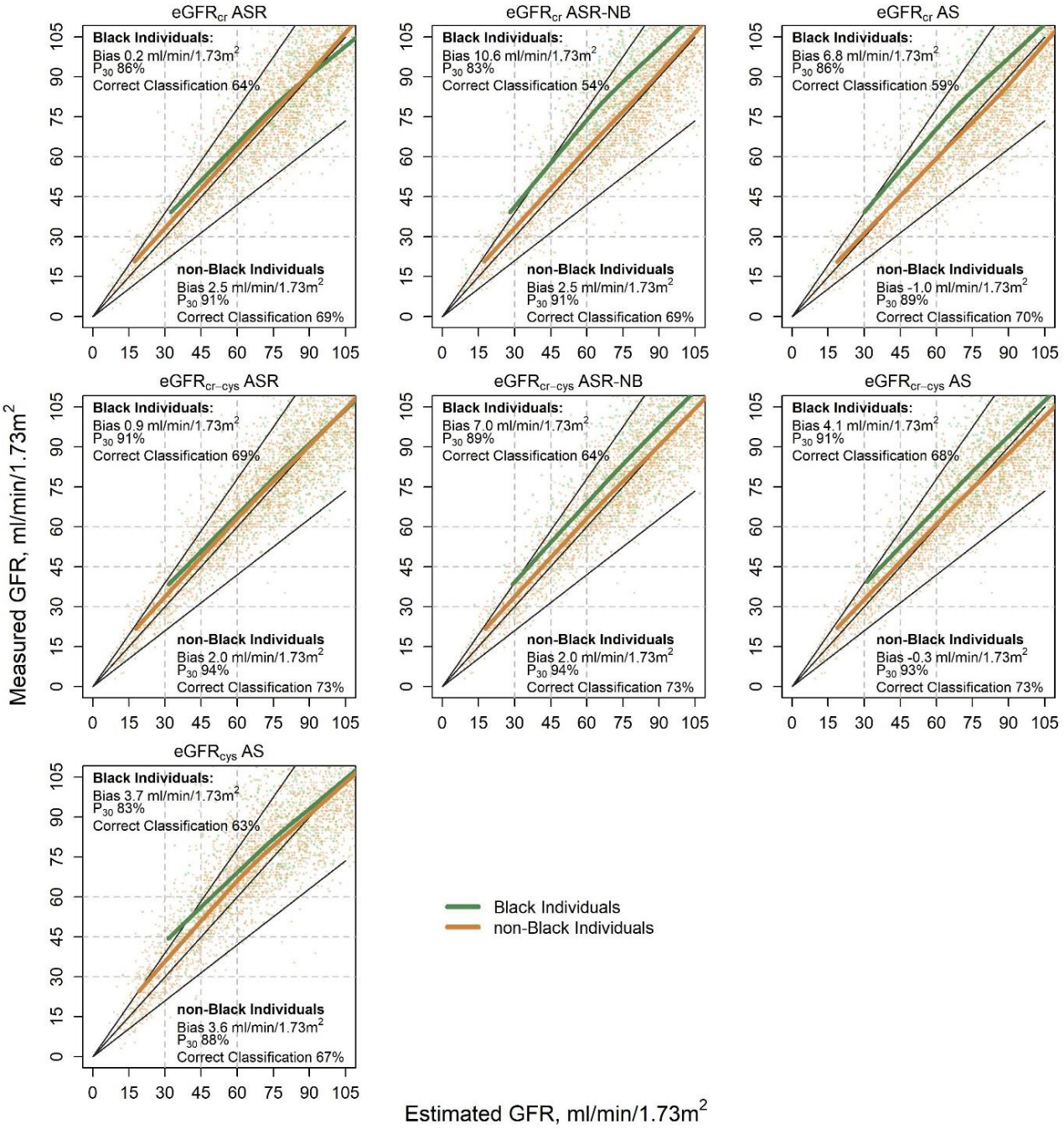


Figure S8: Performance of Current and New Equations compared to directly measured GFR in the 2021 Validation Dataset, Overall and by Race Groups, calibrated for possible variation in mGFR measurement methods

Top panel: Bias as measured as the difference between measured and estimate GFR and units are in ml/min per 1.73 m^2. Bottom panel: Accuracy as measured by 1- P_{30} or the percentage of estimates greater than 30% of measured GFR. The equations are referred to by filtration marker(s) (eGFRcr, eGFRcys or eGFRcr-cys) and the demographic factors included in equation development (age, sex, and race [ASR] or age and sex [AS]). The current equations are the eGFRcr (ASR), eGFRcys (AS) and eGFRcr-cys (ASR). Non-Black (NB) refers to equations in which Black race is removed in computation. The vertical bars indicate 95% confidence intervals. The dotted black line represents the difference in the GFR equation performance between race groups.

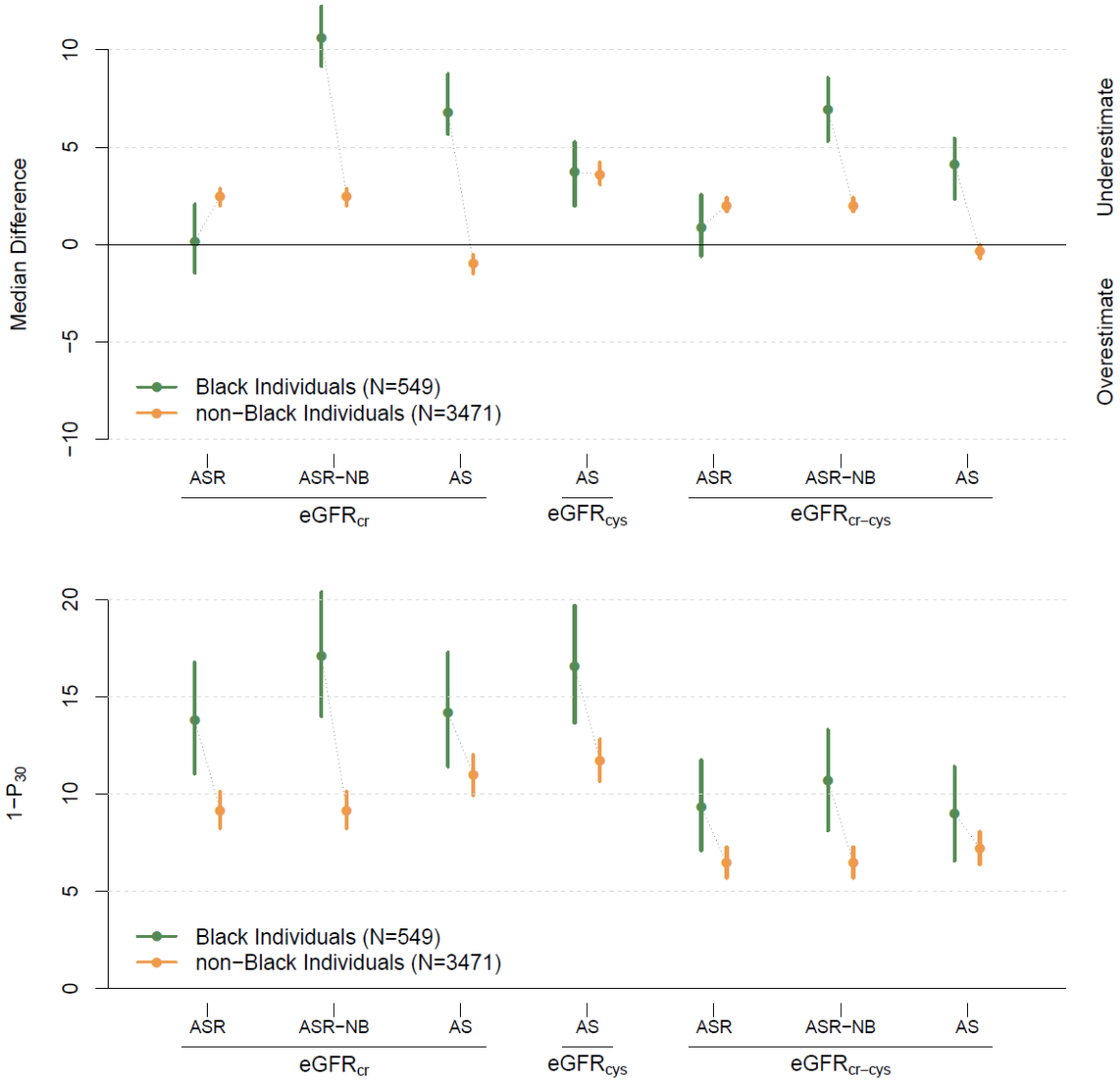


Figure S9: Performance for weighted blended AS eGFR equations in 2021 validation dataset
Top panel: Bias as measured as the difference between measured and estimated GFR and units are in ml/min per 1.73 m^2. Bottom panel: Accuracy as measured by 1- P_{30} or the percentage of estimates greater than 30% of measured GFR. The vertical bars indicate 95% confidence intervals. The dotted black line represents the difference in the GFR equation performance between race groups.
Cr, creatinine. Cys, cystatin C

The numbers in the x axis refer to the proportion of Black individuals in the development dataset. The 2009 development and 2012 development include 31% and 40% respectively (indicated as * on the figures). These correspond to the new AS equation. To demonstrate the impact of proportion of Black individuals included in the development dataset, we weighted the population for values of 0, 13 (representing the proportion of Blacks in the current US population), 50 and 100% Blacks.

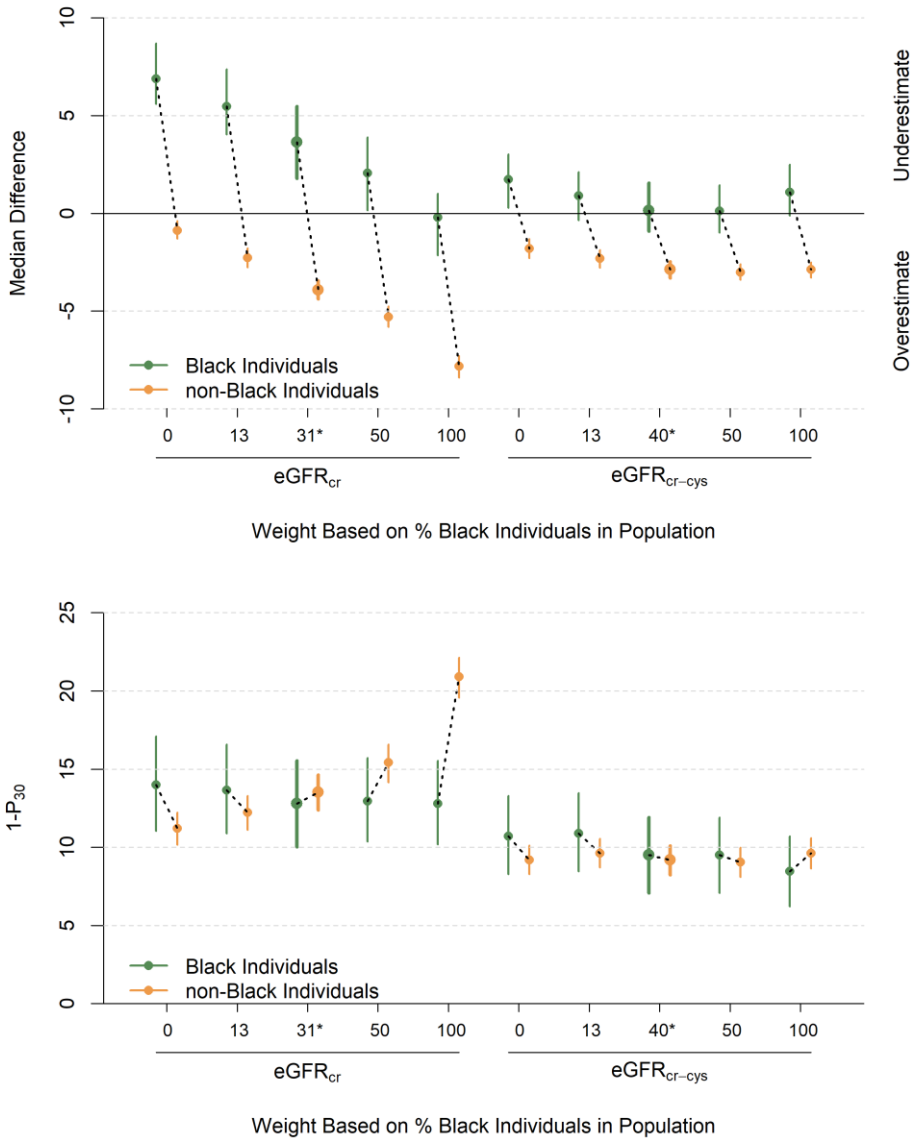
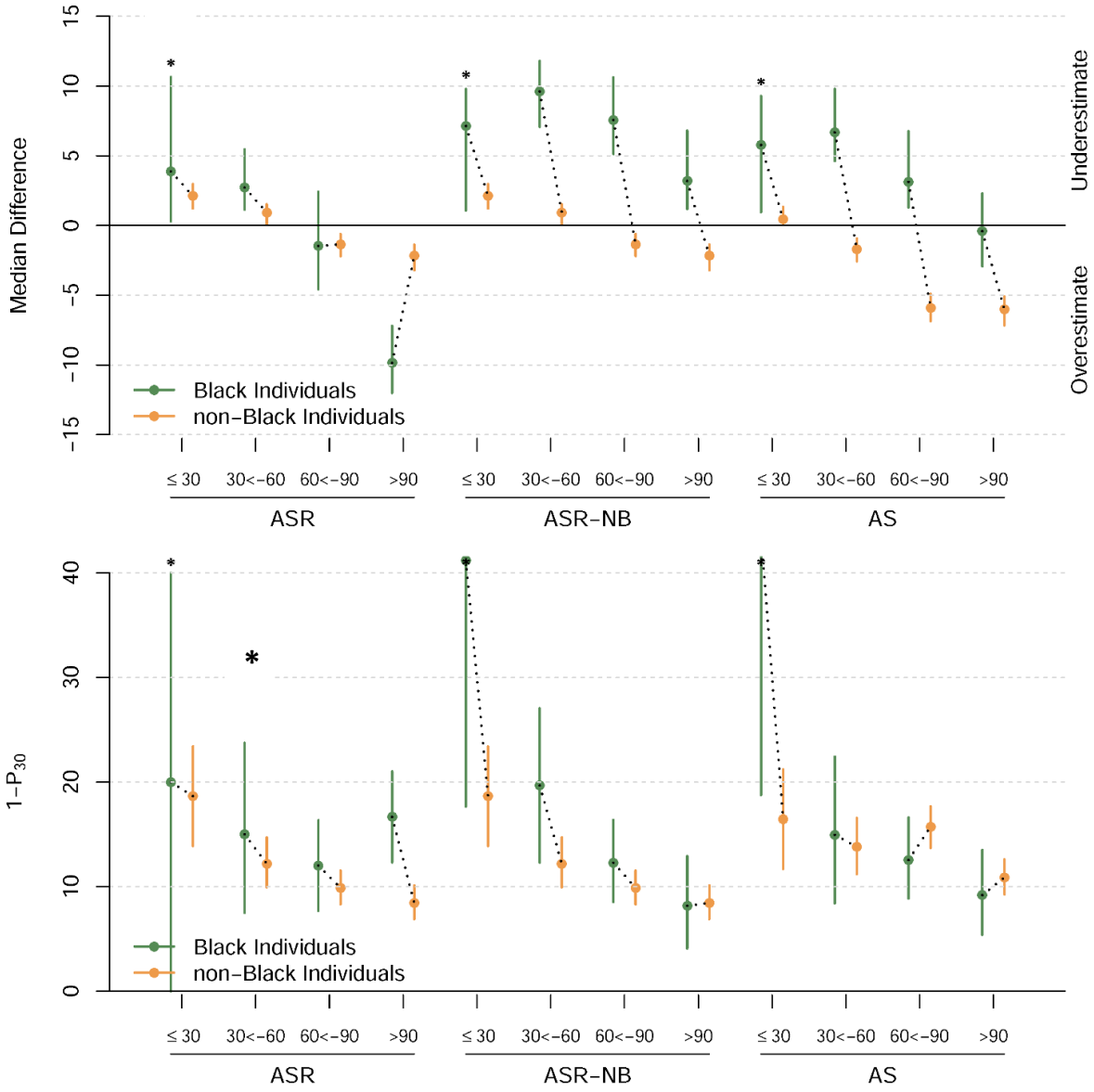


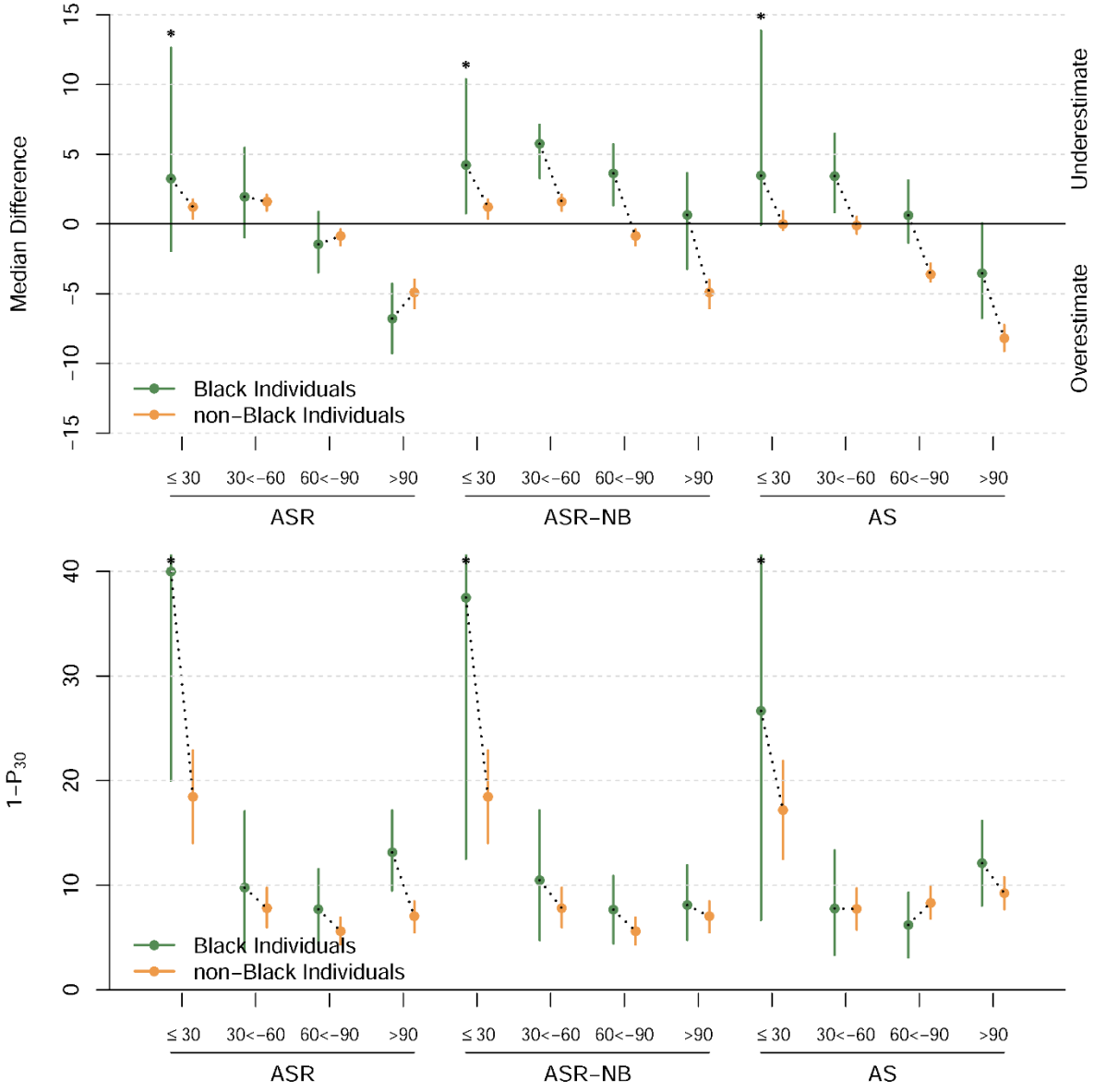
Figure S10: Performance for current vs new equations in 2021 and 2009 validation datasets in subgroups as defined by eGFR, age, sex, and BMI

Legend: Top panel: Bias as measured as the difference between measured and estimated GFR and units are in ml/min per 1.73 m^2. Bottom panel: Accuracy as measured by 1- P_{30} or the percentage of estimates greater than 30% of measured GFR. The vertical bars indicate 95% confidence intervals. The dotted black line represents the difference in the GFR equation performance by race.
*indicates sample size for subgroups with less 100 people and results are unreliable.
eGFR stages (< 30, 30-59, 60-89 and > 90 ml/min/1.73m^2), age (<40, 40-≤65 and > 65 years), sex, body mass index (BMI) (≤25, 25-≤30, and ≥30 kg/m^2). eGFR was defined separately for each equation.
ASR, refers to the current CKD-EPI equation which included age, sex and race as demographic factors.
NB, refers to the new equation presented in this manuscript where the term for Black race is removed from the computation of the eGFR value. AS refers to the new equation refit using only creatinine, age and sex. Cr, creatinine, Cys, cystatin C; y, age. Units for GFR are ml/min per 1.73 m^2.

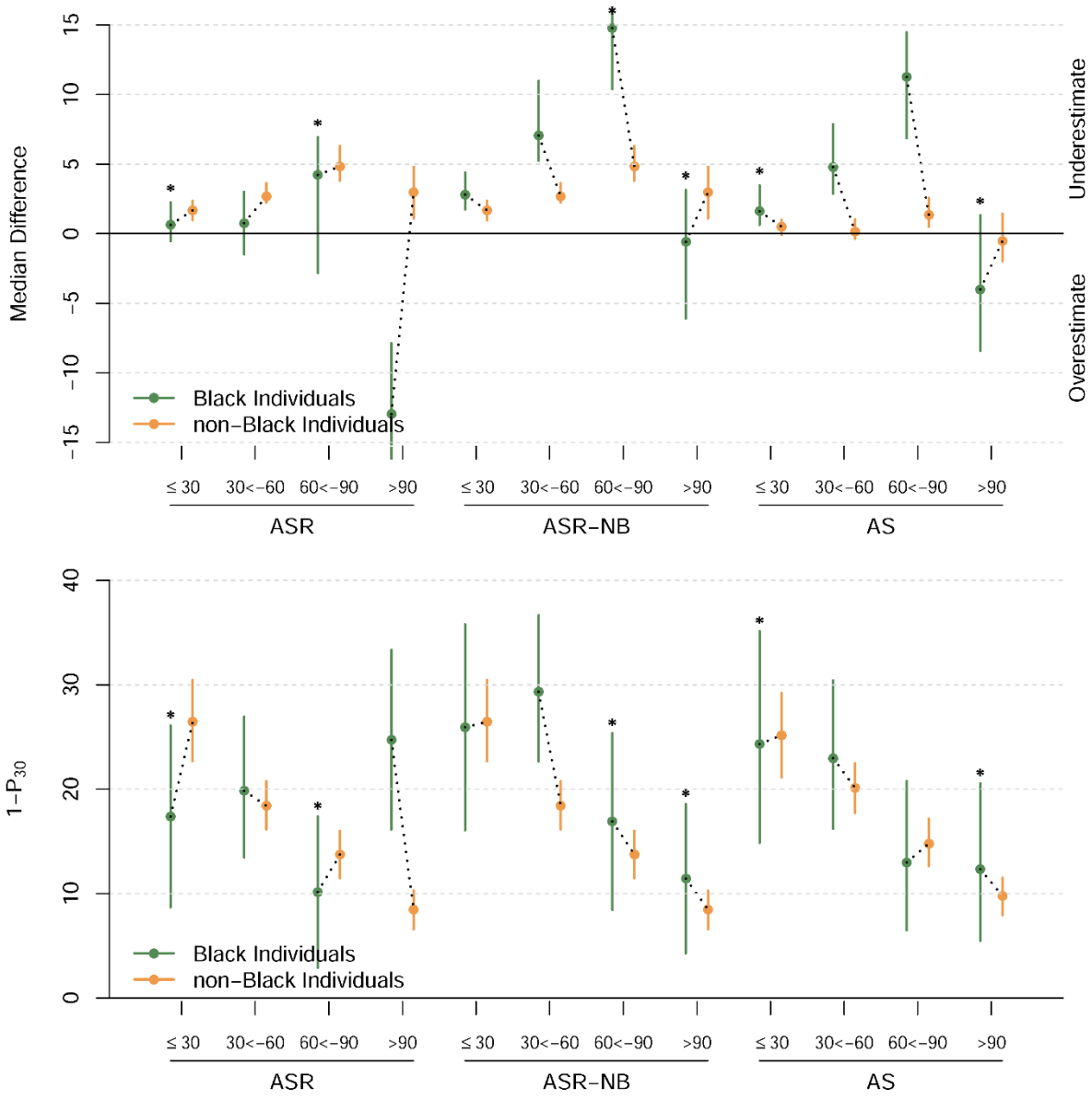
a. Performance of eGFR creatinine by eGFR subgroups in 2021 external validation



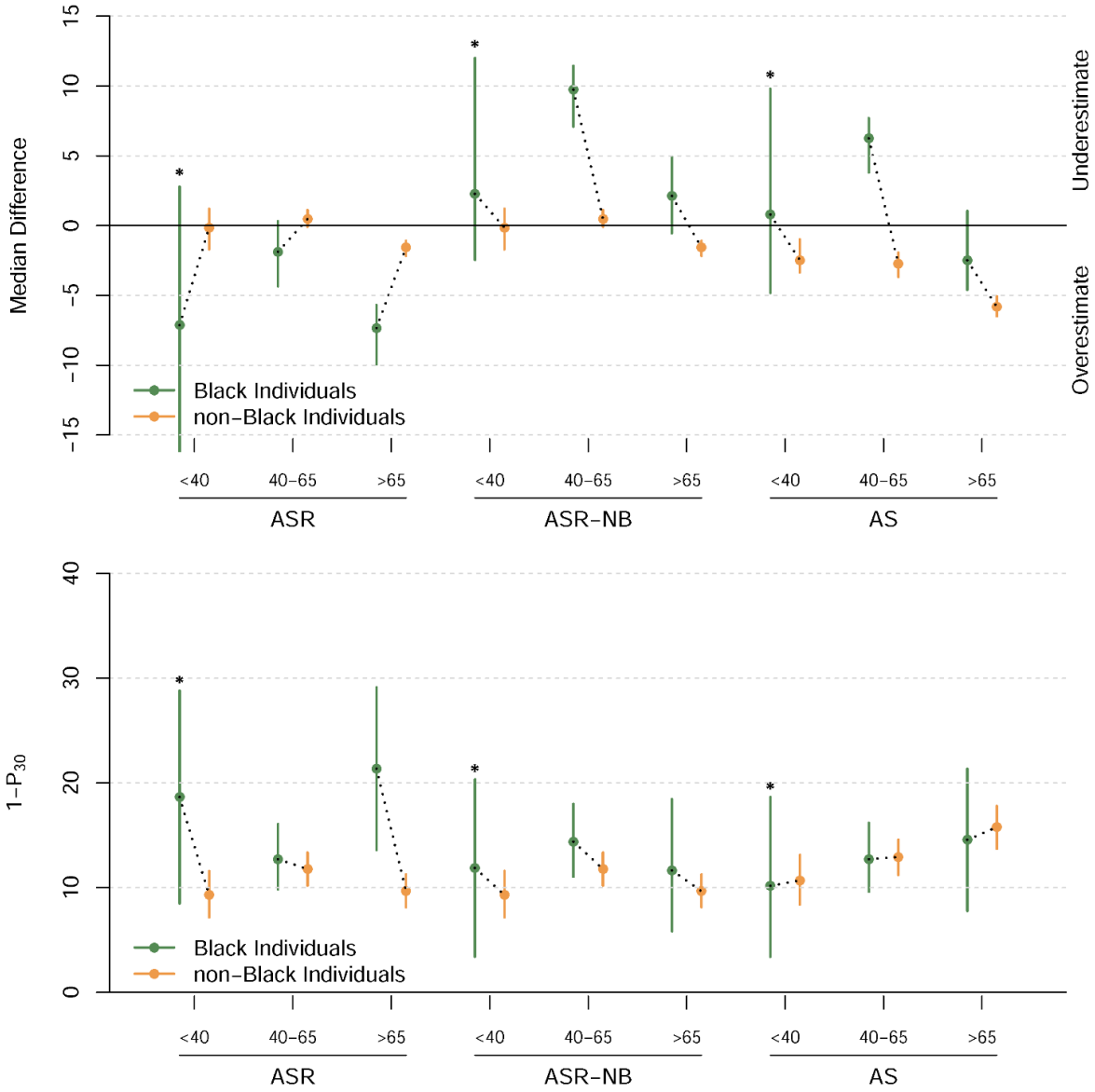
b. Performance of eGFR creatinine-cystatin C by eGFR subgroups in 2021 external validation



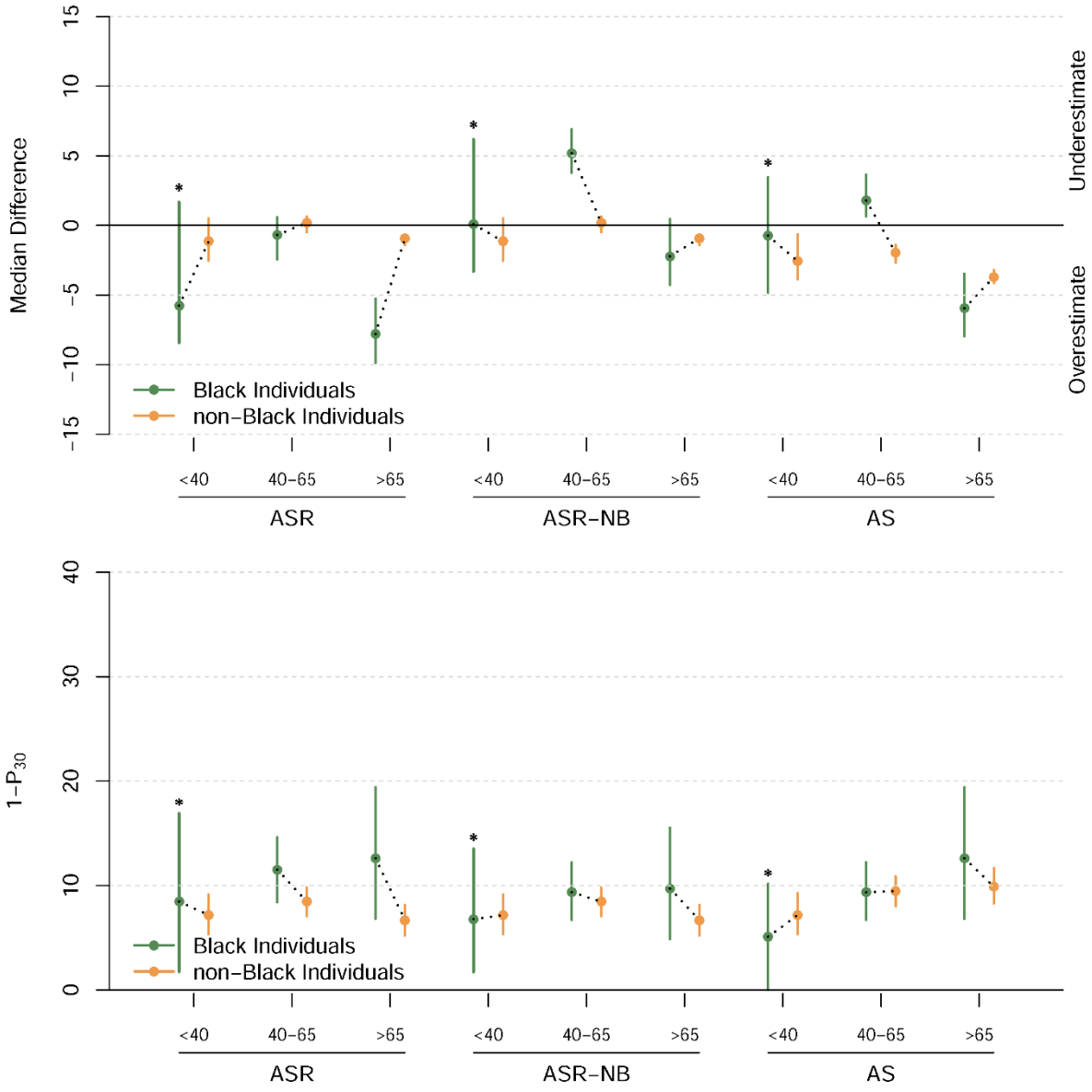
c. Performance of eGFR creatinine by eGFR subgroups in 2009 external validation



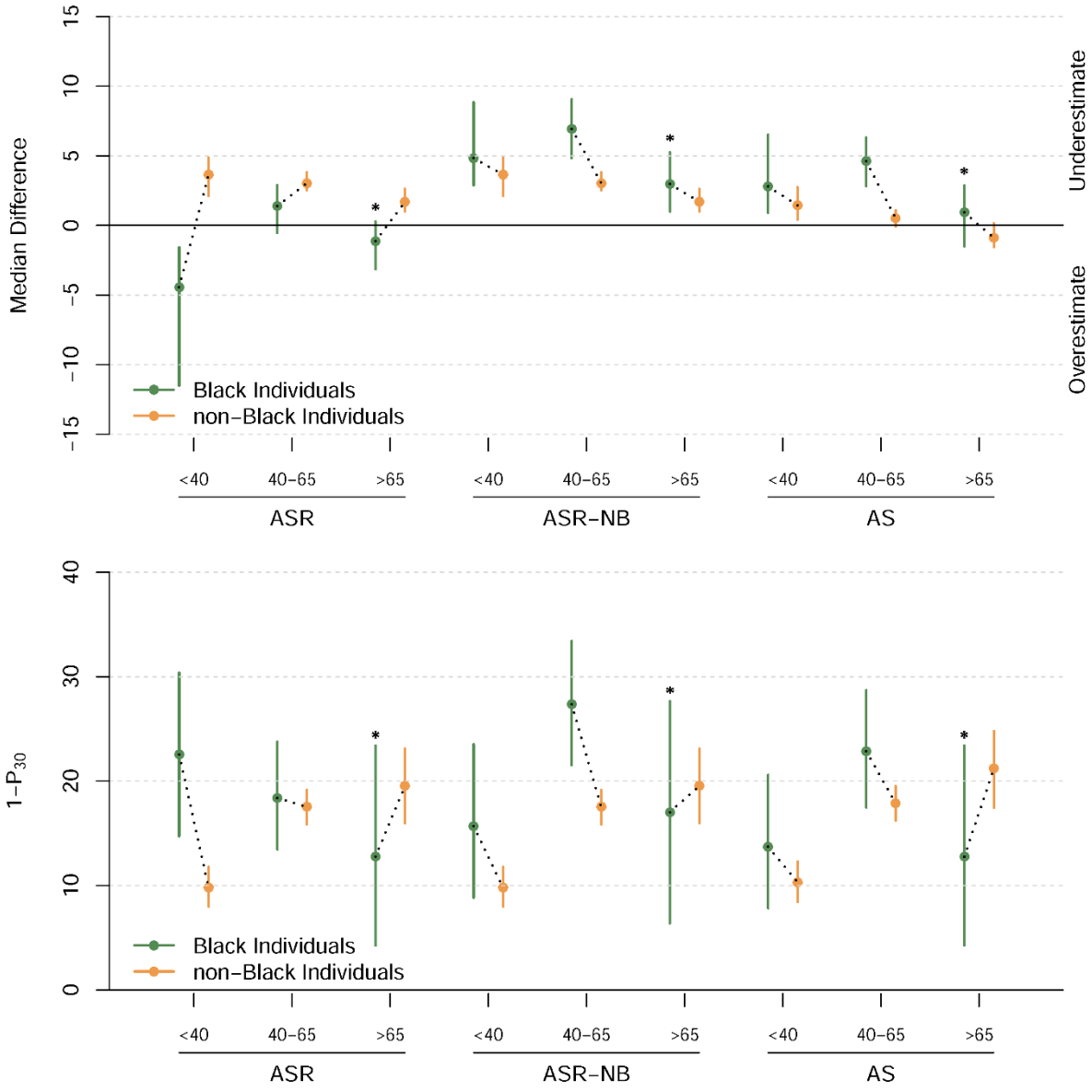
d. Performance of eGFR creatinine by age subgroups in 2021 external validation



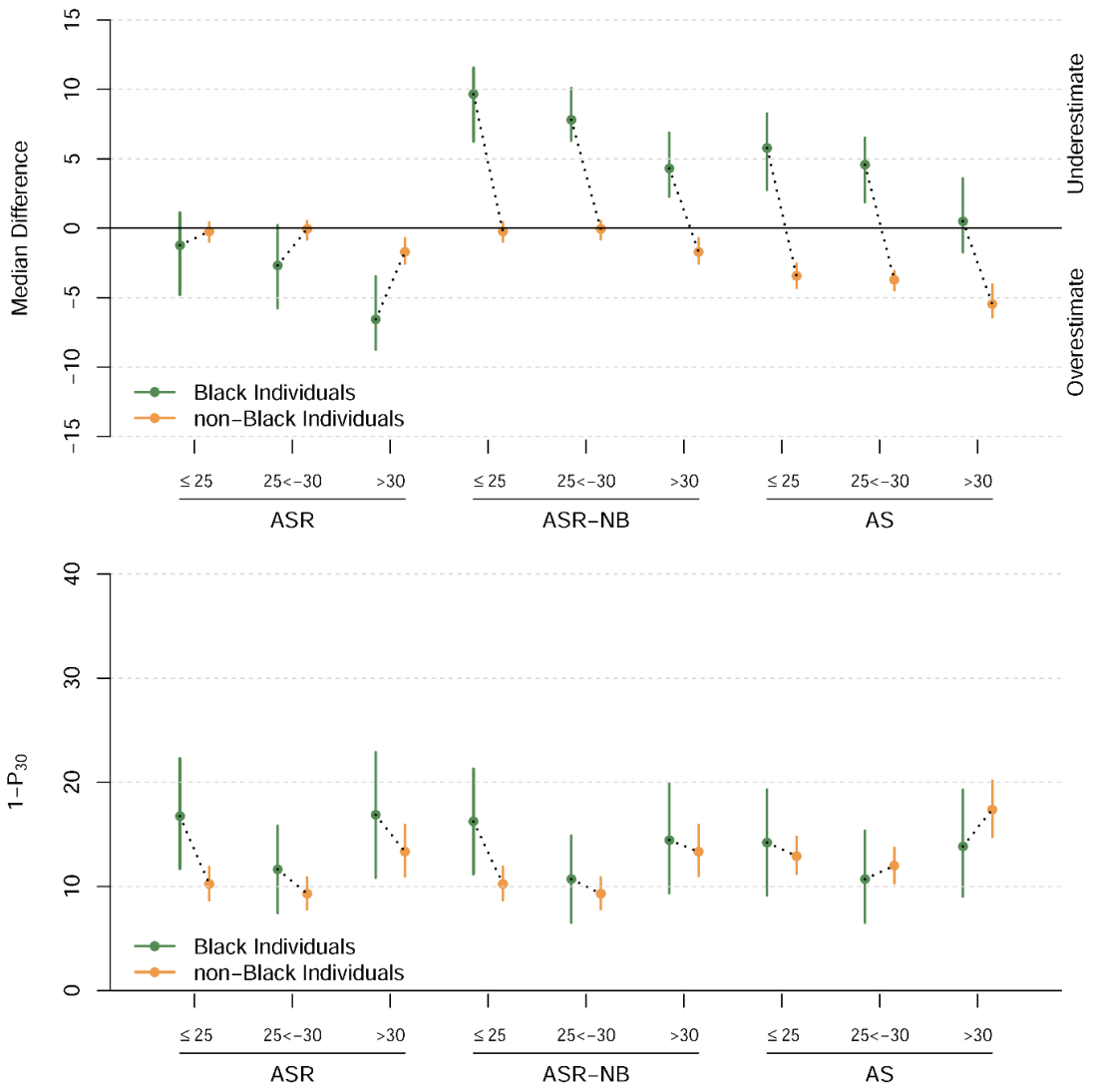
e. Performance of eGFR creatinine-cystatin C by age subgroups in 2021 external validation



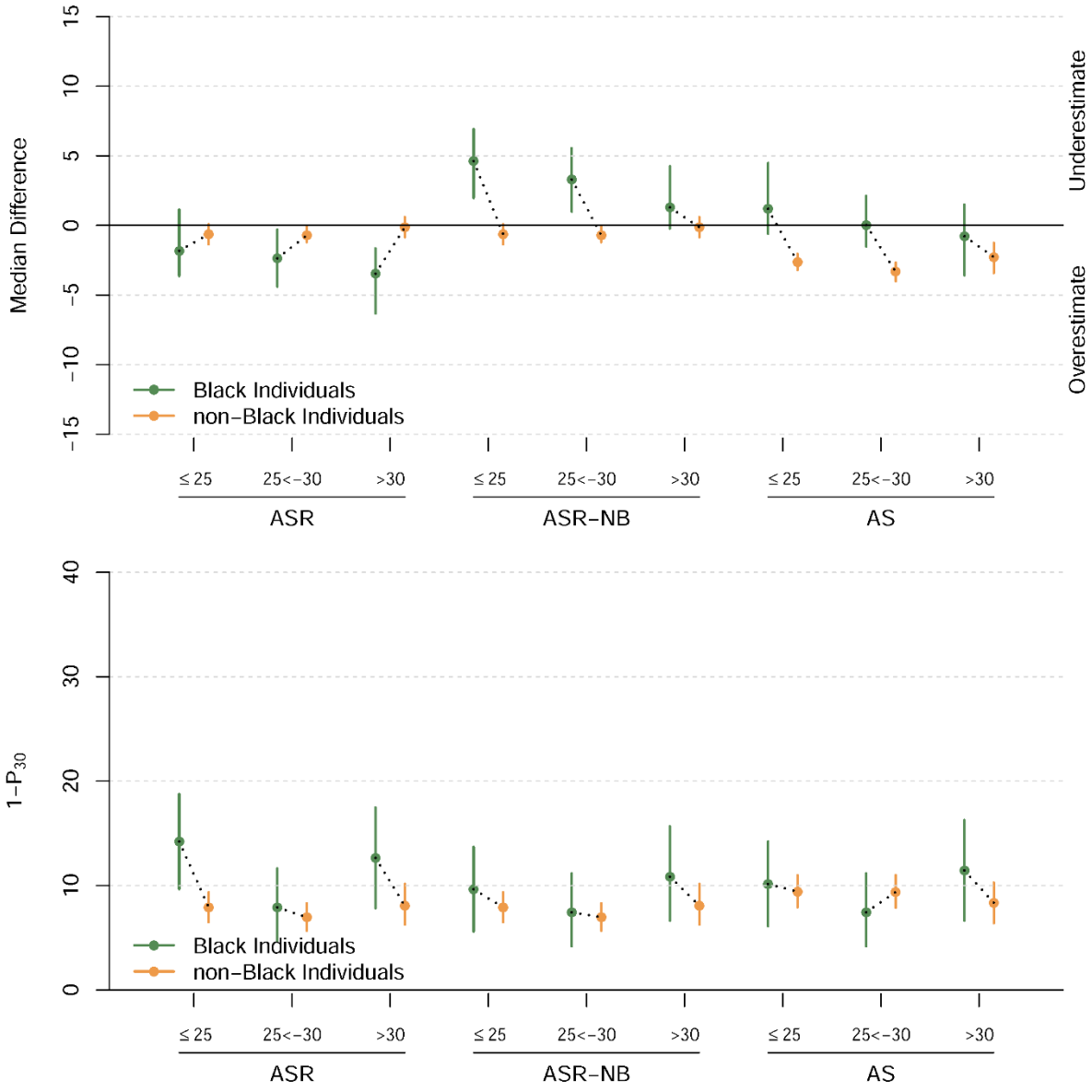
f. Performance of eGFR creatinine by age subgroups in 2009 external validation



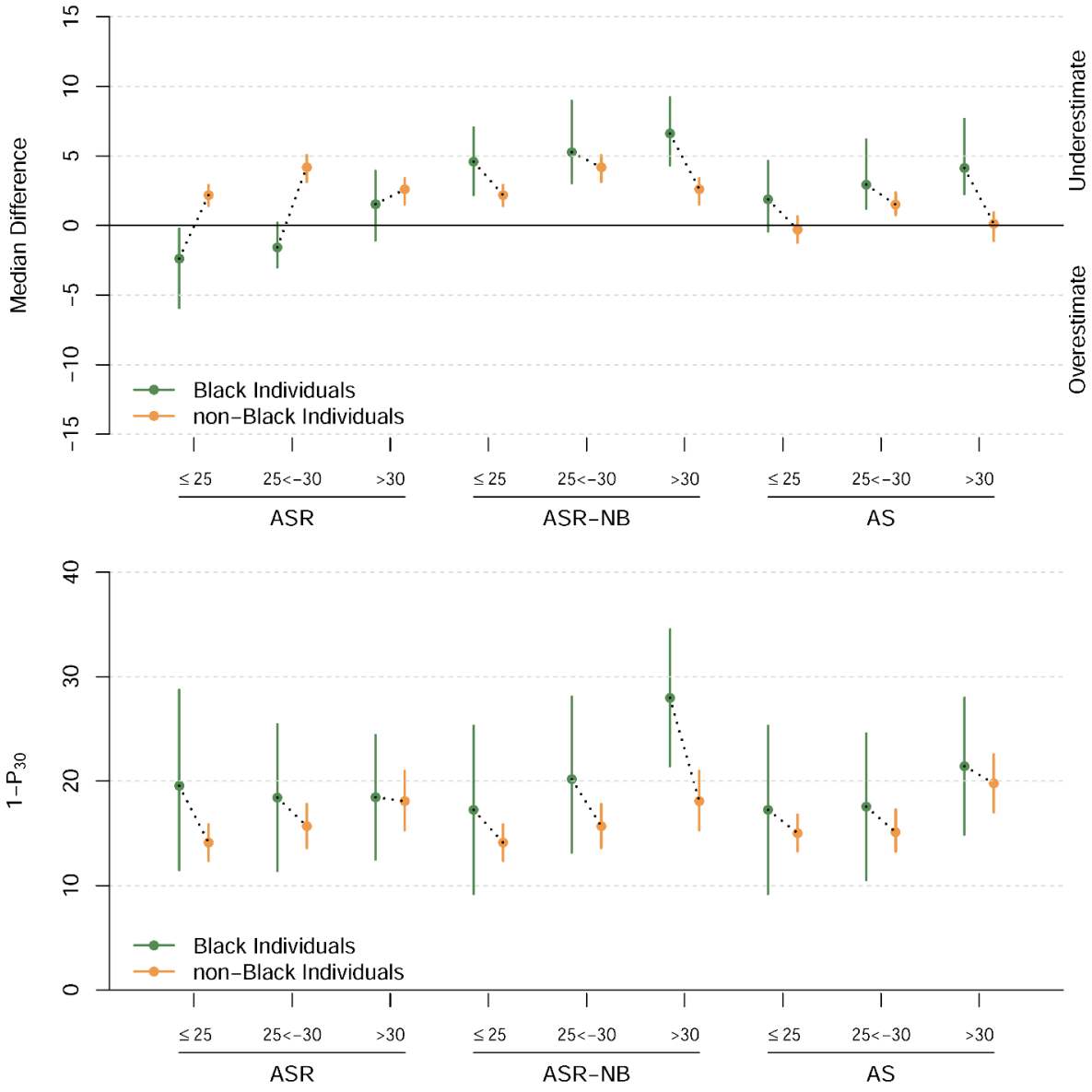
g. Performance of eGFR creatinine by BMI subgroups in 2021 external validation



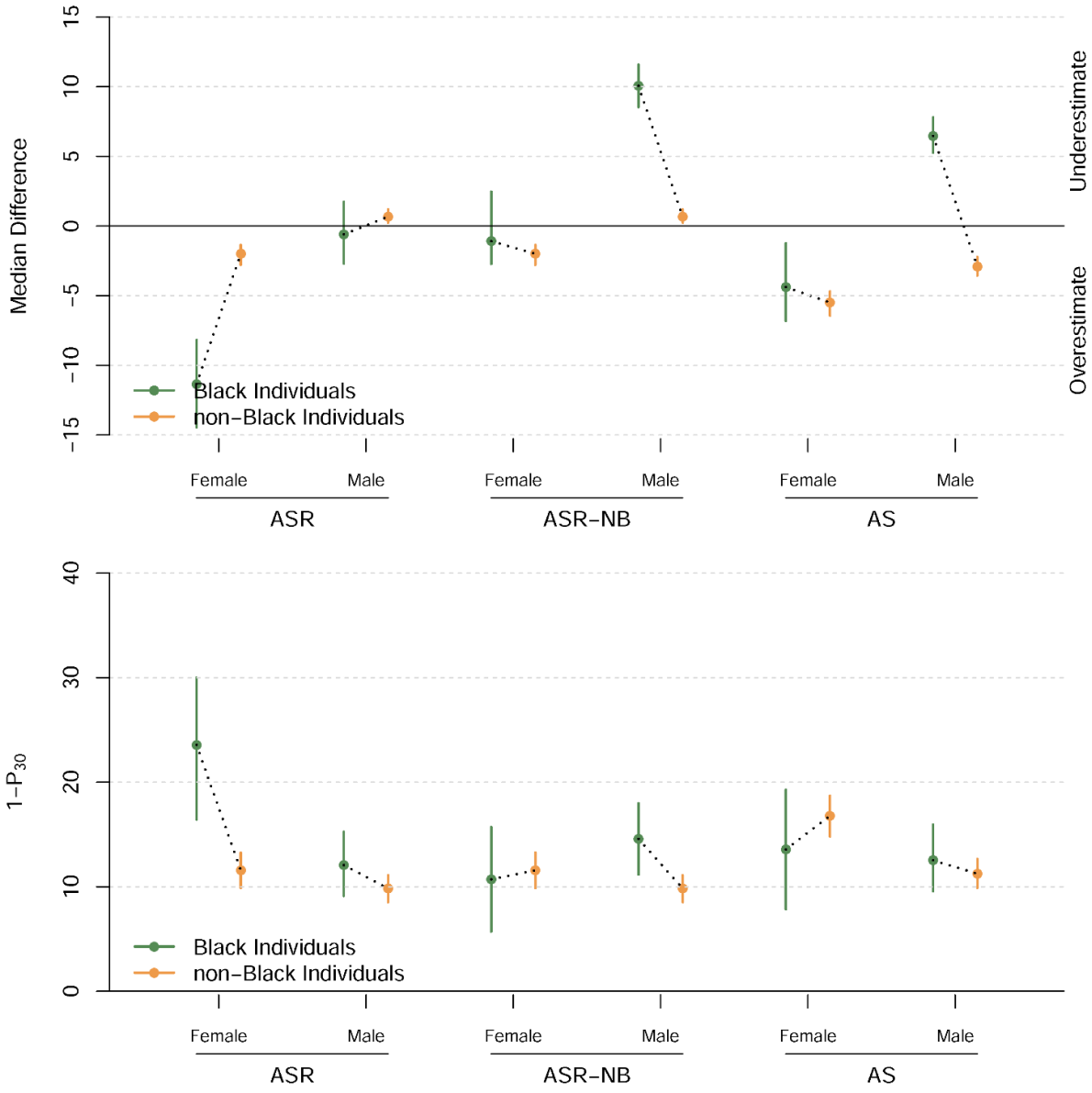
h. Performance of eGFR creatinine-cystatin C by BMI subgroups in 2021 external validation



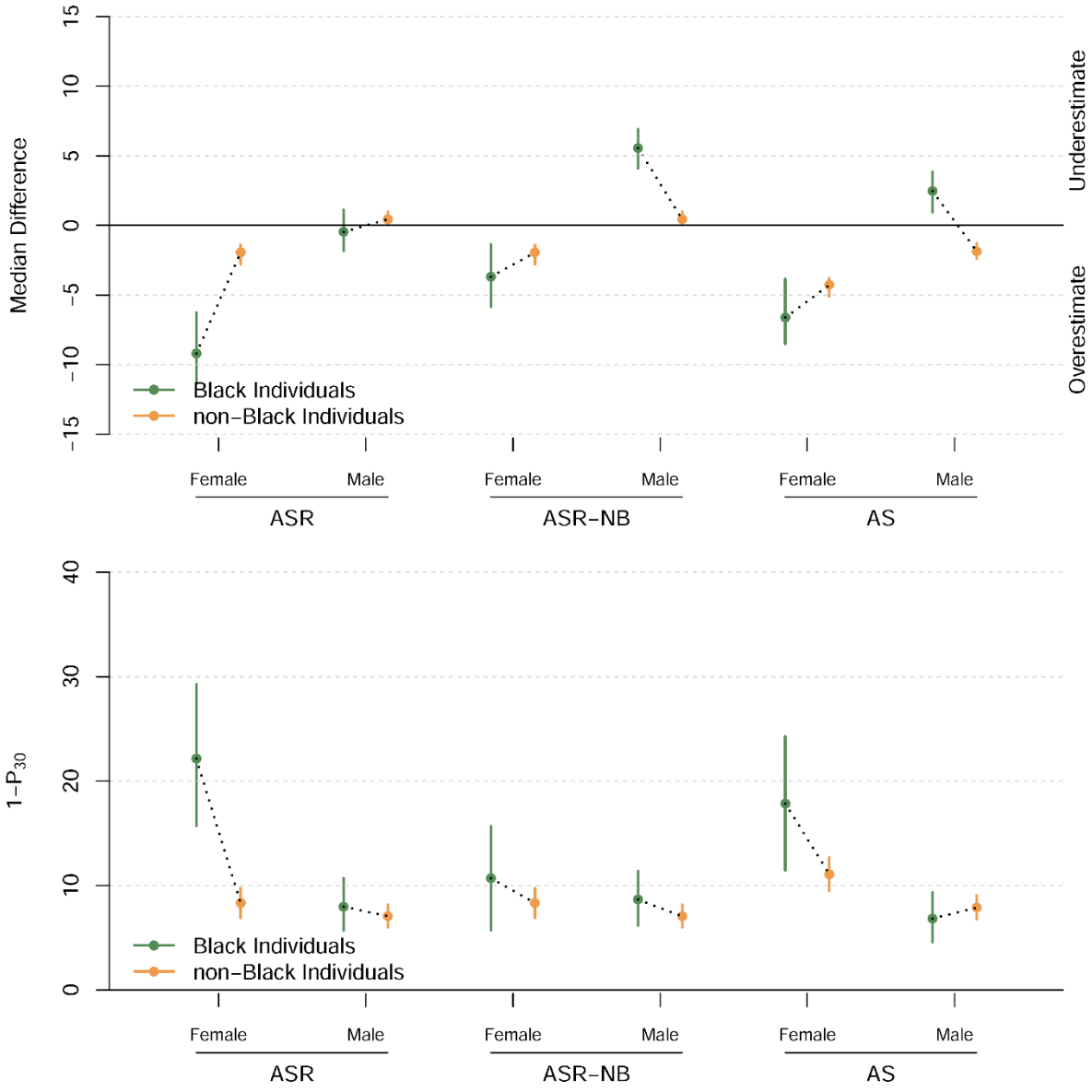
i. Performance of eGFR creatinine by BMI subgroups in 2009 external validation



j. Performance of eGFR creatinine by sex subgroups in 2021 external validation



k. Performance of eGFR creatinine-cystatin C by sex subgroups in 2021 external validation



I. Performance of eGFR creatinine by sex subgroups in 2009 external validation

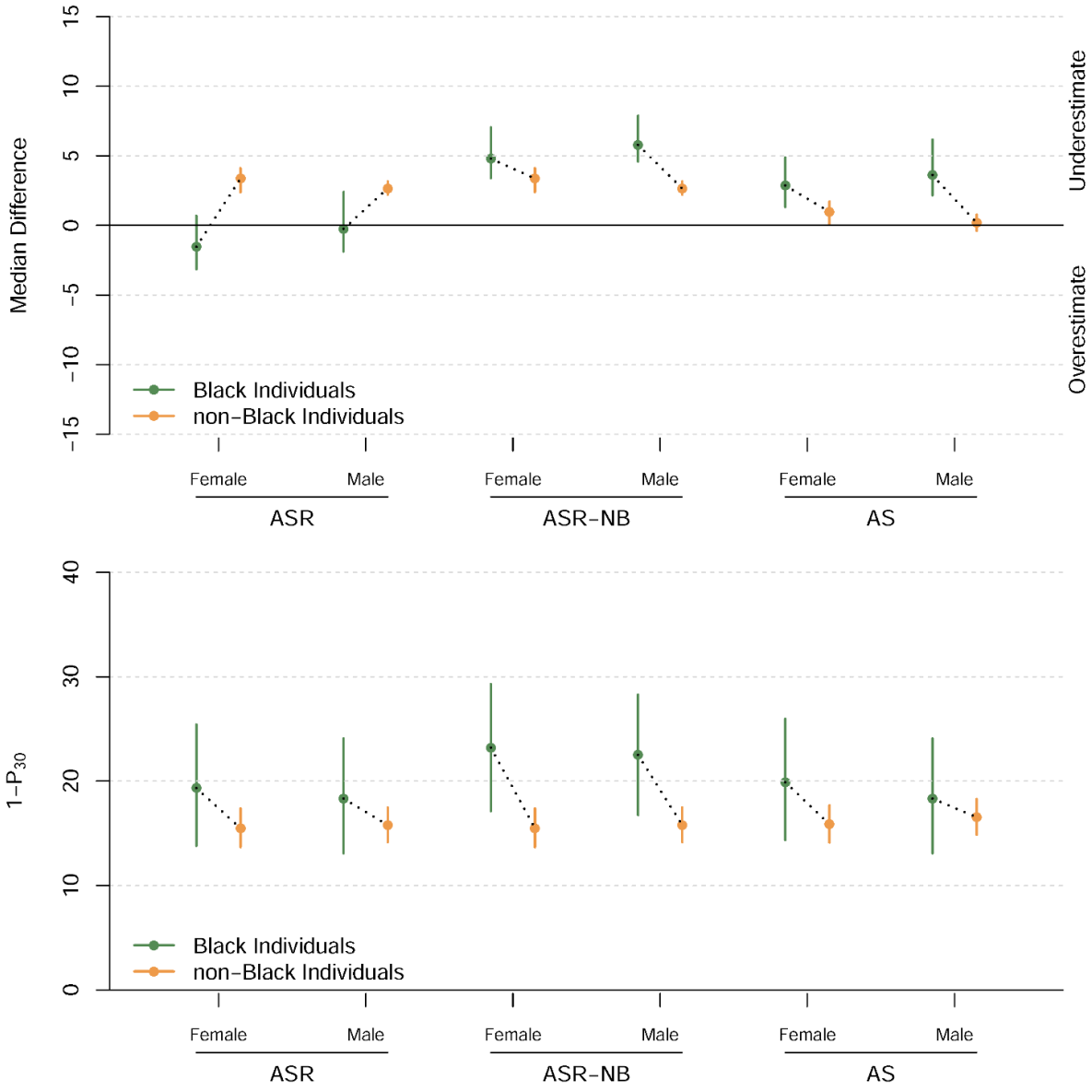
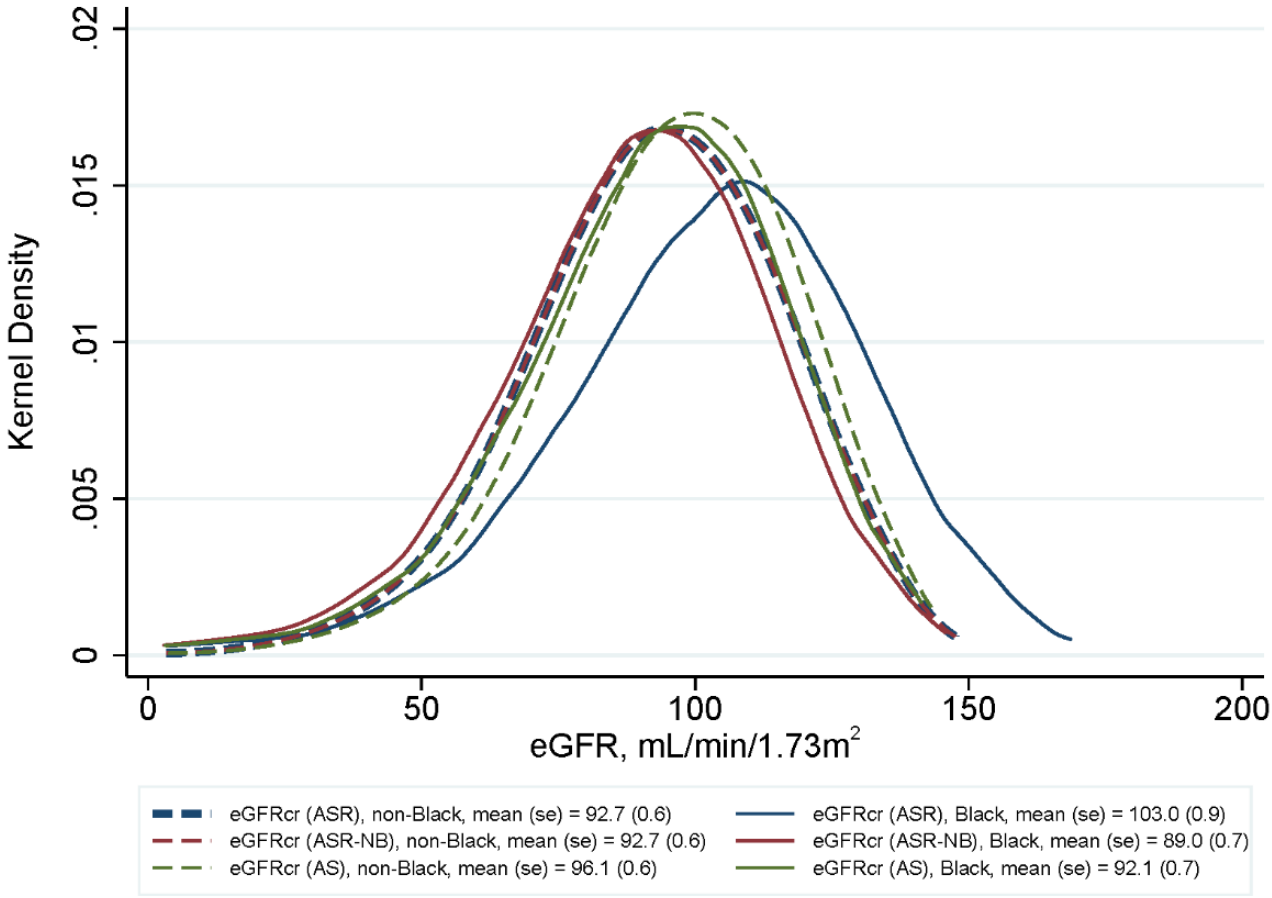


Figure S11: Distribution of the estimated glomerular filtration rate (eGFR) equations as calculated in National Health and Nutrition Examination Survey (NHANES 1999-2002)

a. Distribution of eGFR creatinine equations



b. Distribution of eGFR cystatin C and creatinine-cystatin C equations

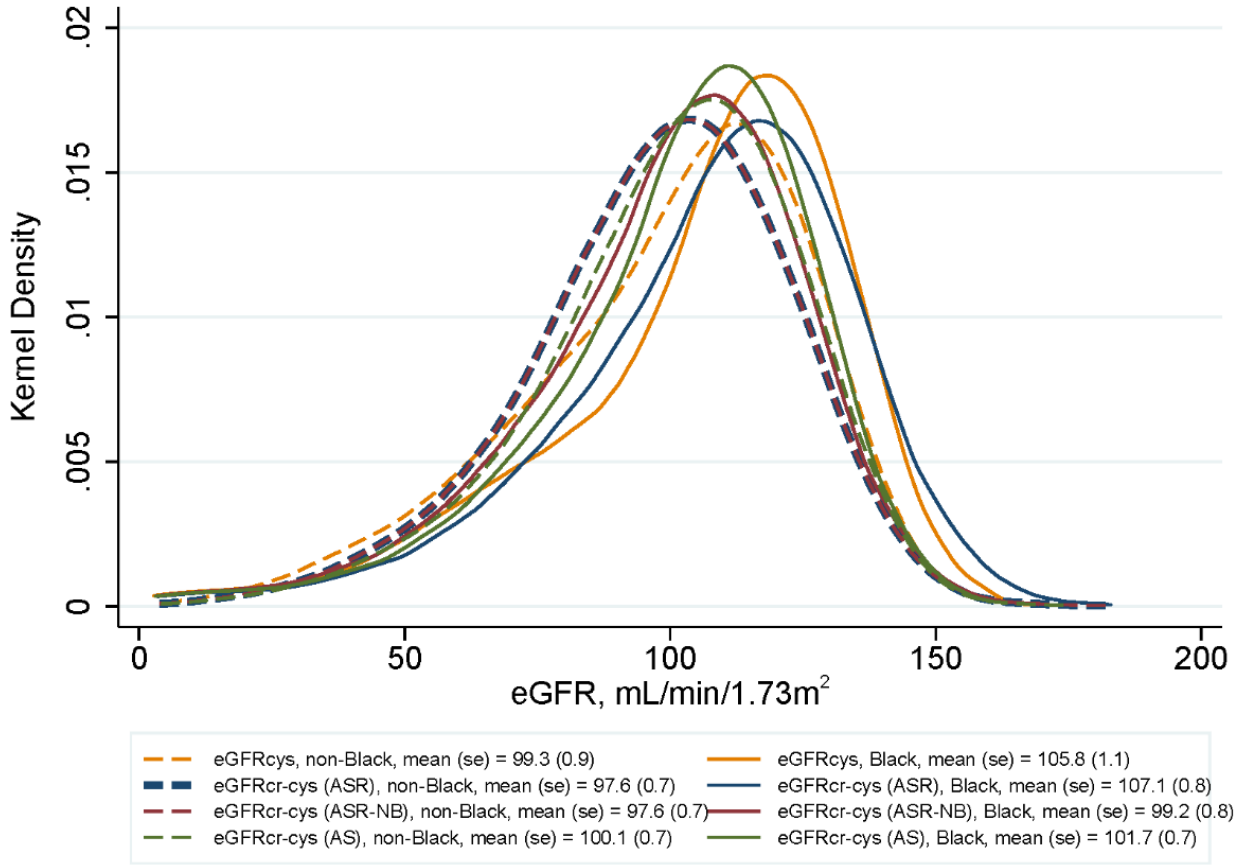


Table S1: Methods to measure GFR in each study in the 2009 and 2012 development and 2021 External Validation Datasets

Study	**Datasets**		
	2009 Creatinine Development	2012 Cystatin C Development	2021 External Validation
AASK[33]	Urinary clearance of iothalamate	Urinary clearance of iothalamate	-
MDRD[34]	Urinary clearance of iothalamate	Urinary clearance of iothalamate	-
DCCT[35]	Urinary clearance of iothalamate	Urinary clearance of iothalamate	-
DRDS[36]	Urinary clearance of iothalamate	-	-
CSG[37]	Urinary clearance of iothalamate	Urinary clearance of iothalamate	-
CRIC[38]	Urinary clearance of iothalamate	Urinary clearance of iothalamate	-
CCF[39]	Urinary clearance of iothalamate	Urinary clearance of iothalamate	-
Mayo[40]	Urinary clearance of iothalamate	Urinary clearance of iothalamate	-
CRISP[41]	-	Urinary clearance of iothalamate	-
Groningen[42]	-	Urinary clearance of iothalamate	-
RASS[43]		Urinary clearance of iothalamate	Plasma clearance of iohexol*[12]
AGES[44]	-	-	Plasma clearance of iohexol*[12]
STENO[45-48]	-	-	Plasma clearance of ^{51}Cr-EDTA
UMN Donor	-	-	Plasma clearance of iohexol*[12]
Lund[49]	-	-	Plasma clearance of iohexol*[12]
HIV[50]	-	-	Plasma clearance of iohexol*[12]
MACS[51]	-	-	Plasma clearance of iohexol*[12]
PERL[52]	-	-	Plasma clearance of iohexol*[12]
MESA[53]	-	-	Plasma clearance of iohexol*[12]
ALTOLD[54]	-	-	Plasma clearance of iohexol*[12]
NephroTest[55]	-	-	Plasma and urinary clearance of ^{51}Cr-EDTA

Abbreviations: MDRD Study, Modification of Diet in Renal Disease Study; AASK, African American Study of Kidney Diseases and Hypertension; DCCT, Diabetes Control and Complications Trial; DRDS, Diabetic Renal Disease Study; CSG, Collaborative Study Group: Captopril in Diabetic Nephropathy Study; CRIC, Chronic Renal Insufficiency Cohort Study; CCF, Cleveland Clinic Foundation; MACS, Multicenter Aids Cohort Study; PERL, Preventing Early Rental Loss in Diabetes; CCF, Cleveland Clinic Foundation; MESA, Multi-Ethnic Study of Atherosclerosis; ALTOLD, Assessing Long Term Outcome of Living Kidney Donors; CRIC, Chronic Renal Insufficiency Cohort Study; AGES, Age, Gene/Environment Susceptibility-Reykjavik Study; UMN, University of Minnesota; RASS, Renin Angiotensin System Study, ^{51}Cr-EDTA, ^{51}Cr-ethylenediaminetetraacetic acid

* Calibrated to urinary clearance of iothalamate by reducing the assigned value of other methods by 5%, based on a systematic comparison of all methods. See supplemental methods for additional details

Table S2: Equations to estimate GFR with their filtration markers and demographics, and datasets used for their development and validation

Equations	Predictors used in model fitting		Demographics used in computation of eGFR	Datasets	
	Filtration Markers	Demographics used in model development		Development Dataset	Validation Dataset
eGFRcr (ASR) *(current)*	Creatinine	Age, Sex, Race	Age, Sex, Race	2009 Development	2021 Validation
eGFRcr (ASR-NB) *(new)*	Creatinine	Age, Sex, Race	Age, Sex	2009 Development	2021 Validation
eGFRcr (AS) *(new)*	Creatinine	Age, Sex	Age, Sex	2009 Development	2021 Validation
eGFRcys (AS) *(current)*	Cystatin C	Age, Sex	Age, Sex	2012 Development	2021 Validation
eGFRcr-cys (ASR) *(current)*	creatinine, cystatin C	Age, Sex, Race	Age, Sex, Race	2012 Development	2021 Validation
eGFRcr-cys (ASR-NB) *(new)*	creatinine, cystatin C	Age, Sex, Race	Age, Sex	2012 Development	2021 Validation
eGFRcr-cys (AS) *(new)*	creatinine, cystatin C	Age, Sex	Age, Sex	2012 Development	2021 Validation

Abbreviations: eGFR, estimated glomerular filtration rate; eGFRcr, estimating GFR using creatinine; eGFRcys, estimating GFR using cystatin c; eGFRcr-cys, estimating GFR using creatinine and cystatin c; ASR, age, sex and race; ASR-NB, age, sex and race, non-black

Table S3: Race group ascertainment by study

Study	Race/ethnicity groups identified in cohort	Ascertainment and notes	Reference
MDRD	F04Q10: race/population group White Black Hispanic Asian Native American Pacific islander Other Unknown	Self-identified, No definition provided	Case Form 1[1]
AASK	All African American	Over the phone or chart review	Case Form 16, 45, 51[2]
DCCT	Q: Predominant Race/Ethnicity White, not of Hispanic Origins Black, not of Hispanic Origins Hispanic Asian, or Pacific Islander Native American or Alaskan Native	Self-identified in Medical History and Physical Examination Form	Case Form 002.4[3]
DRDS	Identified through Pima Indian tribal heritage	Must be ≥1/2 Pima Indian to participate in study	Inclusion criteria[4]
CSG	Q: Race Caucasian (not Hispanic) Hispanic Black Oriental American Indian Polynesian/Filipino Other, Specify	Self-identified in baseline demographic forms	Case Form[5]
CRIC	Q: Using the categories below, what do you consider to be your racial background? (check yes/no) American Indian/Alaskan Native Asian/Asian American Black/African American Native Hawaiian/Other Pacific Islander White/Caucasian	Race was Self-Identified in Demographic Information Form	Case Form[6]

	Q: If Asian/Asian American, do you consider yourself to be (check all that apply) Chinese East Indian/South Asian Japanese Filipino Korean Southeast Asian Other Don't know Q: If Black or African American, do you consider yourself to be (check all that apply) American African Haitian Jamaican Cuban Puerto Rican Dominican Other Caribbean Island Central/South American Other Don't know If you checked Hispanic/Latino, do you consider yourself to be (check all that apply) Mexican American/Mexican Central American South American Puerto Rican Cuban Dominican Spaniard or Portuguese Other Don't Know		
CCF CKD/Donor	Race categories in * White Black Hispanic Asian Native American	Self-identified	Clinical Population
Mayo CKD/Donor	Race categories in * White Black Hispanic	Self-identified from patient registration	Clinical Population

	Asian Native American		
CRISP	Q4. Race/population (circle one) Caucasian African American Asian Hispanic Native American Pacific Islander Unknown Other	Race was identified on the Registration Form at the participant's first clinical visit during baseline	Case Form 25[7]
Groningen	Race categories in * White Black	Self-identified	Clinical Population
RASS	Race categories in * Caucasian Black	Self-identified	
STENO	Race categories in * White	Self-reported and noted in electronic medical record	Clinical Population
UMN Donor	Race categories in * White AA/Black Asian Indian LatinX/Hispanic American Indian/Alaskan Indian	Self-identified	Clinical Population
Lund	White	Race not obtained - Swedish population	Clinical Population
HIV	Q: Race: White Black Native American Asian Japanese Asian Chinese Asian other Other Q: Ethnicity: Hispanic non-Hispanic	Self-identified on the Health Screening Visit Flow Sheet	Case Form[8]
MACS	Q: Which of the following best describes your racial background? White, Non-Hispanic White, Hispanic Black, Non-Hispanic Black, Hispanic	Self-identified	Demographics questionnaire[9]

	American Indian or Alaskan Native Asian or Pacific Islander Other (write in option)		
PERL	Q: Ethnicity Hispanic or Latino Non-Hispanic or Non- Latino Prefer Not to answer Q: Race (Please select all that apply) American Indian or Alaska Native Asian Native Hawaiian or Other Pacific Islander African American or Black White Unknown or not reported Prefer not to answer	Self-identified	Case form[10]
MESA	Q: Are you Spanish/Hispanic/Latino? If yes: Mexican, Chicano, Mexican-American Dominican Puerto Rican Cuban Q: Which of the following best describes you? African-American or Black Asian Chinese Filipino Japanese Korean Vietnamese Asian Indian Caucasian or White Native Hawaiian or other Pacific Islander Guamanian or Chamorro Samoan Micronesia Tahitian American Indian or Alaska Native Did not identify	As part of the study design, approximately 38% of the recruited participants are white, 28% African-American, 22% Hispanic, and 12% Asian, predominantly of Chinese descent. Race was identified as self-report on the Screening/Recruitment form. Separate questions for Hispanic other groups, and if respondent names a Spanish/Hispanic/Latino group instead of the race classification question, wording for interviewers to state that "Some Hispanics also identify themselves with one of these other groups"	Screening/Recruitment form[11]

AGES	White	Race not obtained – Icelandic population	Clinical Population
ALTOLD	Q: Ethnicity White Black Hispanic Asian Native American Other	Race was identified on Screening Visit form	Case Form[12]
NephroTest	Race categories in * White Black Asian	Self-identified	Clinical Population
DNA	Race categories in * White Black Hispanic Asian Native American	Self-identified	Clinical Population
Baylor	Race categories in * White Black Asian Native American	Self-identified	Clinical Population

* Race categories in the dataset provided to CKD-EPI

1. The National Institute of Diabetes and Digestive and Kidney Diseases. Modification of Diet in Renal Disease, Index of Forms. https://repository.niddk.nih.gov/media/studies/mdrd/Forms/MDRD_Forms.pdf. Accessed 2021.
2. The National Institute of Diabetes and Digestive and Kidney Diseases. African American Study of Kidney Disease and Hypertension Cohort Study, Index of Forms. https://repository.niddk.nih.gov/studies/aask-cohort/forms/. Accessed 2021.
3. Diabetes Control and Complications Trial. Baseline Medical History and Physical Examination Form. In: Inker LA, ed1987. Personal Communication.
4. Nelson RG, Bennett PH, Beck GJ, et al. Development and progression of renal disease in Pima Indians with non-insulin-dependent diabetes mellitus. Diabetic Renal Disease Study Group. New England Journal Medicine 1996;335:1636-42.
5. Collaborative Study Group: Captopril in Diabetic Nephropathy Study. Baseline Medical Inventory. In: Inker LA, ed1987. Personal Communication
6. The National Institute of Diabetes and Digestive and Kidney Diseases. Chronic Renal Insufficiency Cohort Study, Index of Forms, Demographic Information. https://repository.niddk.nih.gov/media/studies/cric/forms/demographic_information.pdf. Accessed 2021.
7. The National Institute of Diabetes and Digestive and Kidney Diseases. Consortium for Radiologic Imaging Studies of Polycystic Kidney Disease, Index of Forms, Registration Form. https://repository.niddk.nih.gov/media/studies/crisp1/Forms/CRISP_1_Forms/registration.pdf. Accessed 2021.
8. Evaluation of the Performance of GFR Estimating Equations in HIV Positive Patients. Health Screening Visit Flow Sheet. In: Inker LA, ed2009. Personal Communication.
9. Multicenter AIDS Cohort Study. Demographic Form. https://statepi.jhsph.edu/macs/Questionnaires/S2-3forms/v01_s2-3.pdf

10. Preventing Early Rental Loss in Diabetes. In: Inker LA, Couture SJ, ed2021. Personal Communication
11. The Multi-Ethnic Study of Atherosclerosis Study. Screening and Recruitment Form. https://www.mesa-nhlbi.org/PublicDocs/010101-011231/MESABaselineExamForms/screener.pdf. Accessed 2021.
12. The National Institute of Diabetes and Digestive and Kidney Diseases. Assessing Long Term Outcomes in Living Kidney Donors, Forms. https://repository.niddk.nih.gov/studies/altold/. Accessed 2021.

Table S4: Baseline characteristics, National Health and Nutrition Examination Survey

	Overall	Non-Black	Black
Unweighted N	4563	3728	835
Mean (SE) serum creatinine, mg/dL	0.90 (0.01)	0.89 (0.01)	1.00 (0.02)
Mean (SE) age, year	45.99 (0.40)	46.31 (0.45)	43.36 (0.68)
20-44, % (SE)	51.5 (1.3)	50.7 (1.4)	58.3 (2.2)
45-64, % (SE)	31.7 (1.2)	31.9 (1.4)	30.0 (1.8)
65-80, % (SE)	16.8 (0.6)	17.4 (0.7)	11.7 (1.0)
Female, % (SE)	52.2 (1.1)	51.8 (1.2)	55.8 (2.9)
PIR tertile, % (SE)			
Tertile 1	16.9 (1.4)	15.5 (1.7)	27.8 (2.5)
Tertile 2	27.9 (1.5)	27.7 (1.6)	29.7 (2.0)
Tertile 3	47.7 (1.5)	49.7 (1.8)	31.9 (3.0)
Missing	7.5 (0.9)	7.1 (1.0)	10.6 (1.2)
Education, % (SE)			
<High school	6.8 (0.5)	6.8 (0.6)	6.7 (1.0)
High school degree	42.1 (1.7)	40.7 (1.9)	53.8 (2.0)
>High school degree	51.1 (1.7)	52.5 (1.9)	39.5 (2.2)
Self-reported hypertension, % (SE)	26.4 (1.2)	25.1 (1.2)	36.9 (3.0)
Diabetes, % (SE)	8.4 (0.5)	7.8 (0.6)	13.3 (1.5)
Mean (SE) urine ACR, mg/g, log10 scale	0.89 (0.01)	0.87 (0.01)	0.99 (0.03)
<30, % (SE)	89.7 (0.7)	90.4 (0.7)	84.6 (1.5)
30-<300, % (SE)	8.6 (0.7)	8.1 (0.7)	12.3 (1.5)
≥300, % (SE)	1.7 (0.2)	1.5 (0.3)	3.1 (0.5)

NHANES 1999-2002 adults (age 20+), with complete data of age, sex, race, serum creatinine and cystatin C. We also used the same methods to analyze NHANES 1999-2018 participants with creatinine data (N=49,015) to confirm limiting the analysis to individuals with cystatin C data did not change the inference

SE, standard error; PIR, poverty income ratio

Table S5: Race ascertainment in NHANES and Chronic Kidney Disease-Prognosis Consortium

Cohorts	Race/ethnicity groups identified in cohort	Ascertainment and notes	Reference
NHANES 1999-2002	Race-ethnicity variable: RIDRETH1 Mexican-American Other Hispanic Non-Hispanic White Non-Hispanic Black Other Race – Including Multi-Racial	In this analysis, 'RIDRETH1 Race/Ethnicity' was used to identify black vs. non-black. Non-Hispanic black was called 'black' and all other race/ethnicity was called 'non-black'. Race-ethnicity This race/ethnicity variable is derived by combining responses to questions on race and Hispanic origin. Respondents who self-identified as "Mexican American" were coded as such (i.e., RIDRETH1=1) regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity would result in code "2, Other Hispanic" in the RIDRETH1 variable. All other non-Hispanic participants would then be categorized based on their self-reported races: non-Hispanic white (RIDRETH1=3), non-Hispanic black (RIDRETH1=4), and other non-Hispanic race including non-Hispanic multiracial (RIDRETH1=5).	NHANES link[1]

1. National Health and Nutrition Examination Survey. 1999-2000 Data Documentation, Codebook, and Frequencies. DEMO https://wwwn.cdc.gov/Nchs/Nhanes/1999-2000/DEMO.htm

Table S6: Characteristics of the creatinine 2009 development and internal validation dataset by study

	MDRD[34]			AASK[33]	DCCT[35]			DRDS[36]
	Overall	Black	Non-Black	Black (Overall)	Overall	Black	Non-Black	Non-Black (Overall)
N	1628	197 (12.1%)	1431 (87.9%)	1807 (100%)	1176	38 (3.2%)	1138 (96.8%)	190 (100%)
Age, years	50.6 (12.7)	48.9 (12.0)	50.8 (12.8)	54.0 (10.5)	28.7 (5.7)	29.3 (5.4)	28.6 (5.7)	41.2 (10.9)
<40	370 (22.7%)	53 (26.9%)	317 (22.2%)	179 (9.9%)	1176 (100%)	38 (100.0%)	1138 (100.0%)	84 (44.2%)
40-65	1046 (64.3%)	132 (67.0%)	914 (63.9%)	1356 (75.0 %)	0 (0.0%)	0 (0.0%)	0 (0.0%)	106 (55.8%)
>65	212 (13.0%)	12 (6.1%)	200 (14.0%)	272 (15.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Female	645 (39.6%)	84 (42.6%)	561 (39.2%)	644 (35.6%)	541 (46.0%)	17 (44.7%)	524 (46.1%)	110 (57.9%)
BMI, kg/m2	27.2 (4.7)	28.7 (5.0)	27.0 (4.6)	30.6 (6.7)	24.5 (3.0)	24.1 (2.4)	24.5 (3.0)	34.3 (8.0)
<20	58 (3.6%)	3 (1.5%)	55 (3.8%)	42 (2.3%)	47 (4.0%)	1 (2.6%)	46 (4.0%)	0 (0.0%)
20-<25	510 (31.3%)	45 (22.8%)	465 (32.5%)	301 (16.7%)	655 (55.7%)	24 (63.2%)	631 (55.5%)	18 (9.5%)
25-<30	649 (39.9%)	76 (38.6%)	573 (40.0%)	611 (33.8%)	418 (35.5%)	12 (31.6%)	406 (35.7%)	39 (20.5%)
≥30	411 (25.3%)	73 (37.1%)	338 (23.6%)	853 (47.2%)	56 (4.8%)	1 (2.6%)	55 (4.8%)	133 (70.0%)
Diabetes	99 (6.1%)	22 (11.2%)	77 (5.4%)	0 (0.0%)	1176 (100%)	38 (100%)	1138 (100%)	159 (83.7%)
Kidney donor candidates	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Measured GFR, ml/min/1.73m^2	39.8 (21.2)	43.6 (21.4)	39.2 (21.1)	57.3 (23.6)	124.0 (20.5)	124.6 (21.3)	124.0 (20.5)	118.2 (28.7)
<30	621 (38.1%)	60 (30.5%)	561 (39.2%)	250 (13.8%)	1 (0.1%)	0 (0.0%)	1 (0.1%)	0 (0.0%)
30-<60	747 (45.9%)	91 (46.2%)	656 (45.8%)	765 (42.3%)	3 (0.3%)	0 (0.0%)	3 (0.3%)	3 (1.6%)
60-<90	226 (13.9%)	44 (22.3%)	182 (12.7%)	639 (35.4%)	29 (2.5%)	2 (5.3%)	27 (2.4%)	31 (16.3%)
≥90	34 (2.1%)	2 (1.0%)	32 (2.2%)	153 (8.5%)	1143 (97.2%)	36 (94.7%)	1107 (97.3%)	156 (82.1%)
Creatinine, mg/dL	2.14 (1.11)	2.28 (1.24)	2.12 (1.09)	1.70 (0.81)	0.76 (0.13)	0.78 (0.17)	0.76 (0.13)	0.67 (0.17)

	CSG[37]			CRIC[38]			CCF CKD[39]		
	Overall	Black	Non-Black	Overall	Black	Non-Black	Overall	Black	Non-Black
N	399	32 (8.0%)	367 (92.0%)	669	289 (43.2%)	380 (56.8%)	1037	169 (16.3%)	868 (83.7%)
Age, years	34.1 (7.6)	37.2 (9.8)	33.8 (7.3)	54.9 (13.4)	54.9 (13.1)	54.8 (13.7)	54.3 (15.4)	54.8 (14.3)	54.2 (15.7)
<40	298 (74.7%)	14 (43.8%)	284 (77.4%)	112 (16.7%)	46 (15.9%)	66 (17.4%)	195 (18.8%)	28 (16.6%)	167 (19.2%)
40-65	101 (25.3%)	18 (56.3%)	83 (22.6%)	373 (55.8%)	166 (57.4%)	207 (54.5%)	575 (55.5%)	105 (62.1%)	470 (54.2%)
>65	0 (0.0%)	0 (0.0%)	0 (0.0%)	184 (27.5%)	77 (26.6%)	107 (28.2%)	267 (25.8%)	36 (21.3%)	231 (26.6%)
Female	186 (46.6%)	17 (53.1%)	169 (46.1%)	307 (45.9%)	143 (49.5%)	164 (43.2%)	438 (42.2%)	83 (49.1%)	355 (40.9%)
BMI, kg/m2	25.2 (4.1)	27.5 (6.8)	25.0 (3.8)	31.7 (7.7)	33.5 (7.5)	30.3 (7.5)	28.4 (6.3)	30.2 (7.1)	28.0 (6.1)
<20	21 (5.3%)	1 (3.1%)	20 (5.5%)	21 (3.1%)	7 (2.4%)	14 (3.7%)	56 (5.4%)	5 (3.0%)	51 (5.9%)
20-<25	204 (51.1%)	12 (37.5%)	192 (52.3%)	100 (15.0%)	26 (9.0%)	74 (19.5%)	282 (27.2%)	36 (21.3%)	246 (28.3%)
25-<30	137 (34.3%)	12 (37.5%)	125 (34.1%)	190 (28.4%)	66 (22.8%)	124 (32.6%)	341 (32.9%)	52 (30.8%)	289 (33.3%)
≥30	37 (9.3%)	7 (21.9%)	30 (8.2%)	358 (53.5%)	190 (65.7%)	168 (44.2%)	358 (34.5%)	76 (45.0%)	282 (32.5%)
Diabetes	399 (100%)	32 (100%)	367 (100%)	302 (45.1%)	136 (47.1%)	166 (43.7%)	249 (24.0%)	69 (40.8%)	180 (20.7%)
Kidney donor candidates	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Measured GFR, ml/min/1.73m^2	76.9 (32.0)	58.8 (26.1)	78.5 (32.0)	49.6 (21.4)	47.9 (20.6)	50.9 (21.9)	34.6 (28.1)	27.4 (26.6)	36.0 (28.2)
<30	19 (4.8%)	6 (18.8%)	13 (3.5%)	123(18.4%)	66 (22.8%)	57 (15.0%)	625 (60.3%)	131 (77.5%)	494 (56.9%)
30-<60	108 (27.1%)	9 (28.1%)	99 (27.0%)	361 (54.0%)	144 (49.8%)	217 (57.1%)	211 (20.4%)	16 (9.5%)	195 (22.5%)
60-<90	145 (36.3%)	12 (37.5%)	133 (36.2%)	151 (22.6%)	69 (23.9%)	82 (21.6%)	144 (13.9%)	12 (7.1%)	132 (15.2%)
≥90	127 (31.8%)	5 (15.6%)	122 (33.2%)	34 (5.1%)	10 (3.5%)	24 (6.3%)	57 (5.5%)	10 (5.9%)	47 (5.4%)
Creatinine, mg/dL	1.26 (0.40)	1.44 (0.44)	1.25 (0.39)	1.73 (0.59)	1.88 (0.65)	1.62 (0.52)	2.90 (1.80)	3.76 (2.00)	2.74 (1.71)

	CCF Donors[39]			Mayo CKD[40]	Mayo Donors[40]		
	Overall	Black	Non-Black	Overall (Non-Black)	Overall	Black	Non-Black
N	457	63 (13.8%)	394 (86.2%)	318 (100.0%)	573	6 (1.0%)	567 (99.0%)
Age, years	41.8 (10.1)	38.2 (10.1)	42.3 (10.0)	53.2 (14.5)	41.4 (11.2)	42.8 (18.6)	41.4 (11.1)
<40	191 (41.8%)	36 (57.1%)	155 (39.3%)	60 (18.9%)	256 (44.7%)	NS	253 (44.6%)
40-65	266 (58.2%)	27 (42.9%)	239 (60.7%)	183 (57.6%)	303 (52.9%)		300 (52.9%)
>65	0 (0.0%)	0 (0.0%)	0 (0.0%)	75 (23.6%)	14 (2.4%)		14 (2.5%)
Female	280 (61.3%)	37 (58.7%)	243 (61.7%)	125 (39.3%)	330 (57.6%)	NS	329 (58.0%)
BMI, kg/m2	27.2 (4.3)	27.8 (3.9)	27.1 (4.3)	28.8 (6.2)	27.8 (5.3)	30.9 (2.7)	27.8 (5.3)
<20	14 (3.1%)	1 (1.6%)	13 (3.3%)	10 (3.1%)	16 (2.8%)	NS	16 (2.8%)
20-<25	136 (29.8%)	13 (20.6%)	123 (31.2%)	79 (24.8%)	161 (28.1%)		161 (28.4%)
25-<30	187 (40.9%)	30 (47.6%)	157 (39.9%)	116 (36.5%)	235 (41.0%)		232 (40.9%)
≥30	120 (26.3%)	19 (30.2%)	101 (25.6%)	113 (35.5%)	161 (28.1%)		158 (27.9%)
Diabetes	0 (0.0%)	0 (0.0%)	0 (0.0%)	22 (6.9%)	0 (0.0%)	NS	0 (0.0%)
Kidney donor candidates	457 (100.0%)	63 (100.0%)	394 (100.0%)	0 (0%)	573 (100.0%)	6 (100.0%)	567 (100.0%)
Measured GFR, ml/min/1.73m^2	106.0 (18.4)	103.8 (18.4)	106.3 (18.4)	48.5 (25.2)	101.2 (16.5)	99.0 (18.5)	101.2 (16.5)
<30	0 (0.0%)	0 (0.0%)	0 (0.0%)	83 (26.1%)	0 (0.0%)	NS	0 (0.0%)
30-<60	2 (0.4%)	1 (1.6%)	1 (0.3%)	134 (42.1%)	0 (0.0%)		0 (0.0%)
60-<90	78 (17.1%)	13 (20.6%)	65 (16.5%)	76 (23.9%)	150 (26.2%)		148 (26.1%)
≥90	377 (82.5%)	49 (77.8%)	328 (83.3%)	25 (7.9%)	423 (73.8%)		419 (73.9%)
Creatinine, mg/dL	0.83 (0.16)	0.89 (0.17)	0.82 (0.16)	1.72 (0.97)	0.84 (0.16)	0.88 (0.12)	0.84 (0.16)

Abbreviations: MDRD Study, Modification of Diet in Renal Disease Study; AASK, African American Study of Kidney Diseases and Hypertension; DCCT, Diabetes Control and Complications Trial; DRDS, Diabetic Renal Disease Study; CSG, Collaborative Study Group: Captopril in Diabetic Nephropathy Study; CRIC, Chronic Renal Insufficiency Cohort Study; CCF, Cleveland Clinic Foundation; GFR, glomerular filtration rate; BMI, body mass index; SD, standard deviation; Scr, serum creatinine, NS, number too small for the group or subgroup to present descriptive data. To convert GFR from mL/min/1.73 m2 to mL/s/m2, multiply by 0.0167. To convert serum creatinine from mg/dL to µmol/L, multiply by 88.4.

Table S7: Characteristics of the cystatin 2012 development and internal validation dataset by study

	MDRD[34]			AASK[33]	CRIC[38]		
	Overall	Black	Non-Black	Black (Overall)	Overall	Black	Non-Black
N	1046	102 (9.8%)	944 (90.2%)	1647 (100.0%)	653	283 (43.3%)	370 (56.7%)
Age, years	51.5 (12.5)	50.4 (11.7)	51.6 (12.6)	53.9 (10.5)	54.9 (13.5)	54.9 (13.1)	54.8 (13.8)
<40	215 (20.6%)	25 (24.5%)	190 (20.1%)	168 (10.2%)	115 (17.6%)	47 (16.6%)	68 (18.4%)
40-65	660 (63.1%)	68 (66.7%)	592 (62.7%)	1211 (73.5%)	345 (52.8%)	153 (54.1%)	192 (51.9%)
>65	171 (16.4%)	9 (8.8%)	162 (17.2%)	268 (16.3%)	193 (29.6%)	83 (29.3%)	110 (29.7%)
Female	408 (39.0%)	44 (43.1%)	364 (38.6%)	592 (35.9%)	301 (46.1%)	140 (49.5%)	161 (43.5%)
BMI, kg/m2	27.1 (4.4)	28.8 (5.1)	26.9 (4.3)	30.7 (6.7)	31.7 (7.7)	33.5 (7.5)	30.3 (7.6)
<20	40 (3.8%)	3 (2.9%)	37 (3.9%)	38 (2.3%)	21 (3.2%)	7 (2.5%)	14 (3.8%)
20-<25	327 (31.3%)	25 (24.5%)	302 (32.0%)	269 (16.3%)	98 (15.0%)	25 (8.8%)	73 (19.7%)
25-<30	431 (41.2%)	34 (33.3%)	397 (42.1%)	555 (33.7%)	185 (28.3%)	65 (23.0%)	120 (32.4%)
≥30	248 (23.7%)	40 (39.2%)	208 (22.0%)	785 (47.7%)	349 (53.5%)	186 (65.7%)	163 (44.1%)
Diabetes	60 (5.7%)	15 (14.7%)	45 (4.8%)	0 (0.0%)	294 (45.0%)	133 (47.0%)	161 (43.5%)
Kidney donor candidates	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Measured GFR, ml/min/1.73m^2	33.1 (14.2)	35.6 (15.4)	32.8 (14.1)	57.1 (23.4)	49.8 (21.5)	48.1 (20.5)	51.0 (22.1)
<30	479 (45.8%)	38 (37.3%)	441 (46.7%)	223 (13.5%)	120 (18.4%)	64 (22.6%)	56 (15.1%)
30-<60	532 (50.9%)	57 (55.9%)	475 (50.3%)	705 (42.8%)	351 (53.8%)	141 (49.8%)	210 (56.8%)
60-<90	34 (3.3%)	7 (6.9%)	27 (2.9%)	584 (35.5%)	148 (22.7%)	68 (24.0%)	80 (21.6%)
≥90	1 (0.1%)	0 (0.0%)	1 (0.1%)	135 (8.2%)	34 (5.2%)	10 (3.5%)	24 (6.5%)
Creatinine, mg/dL	2.34 (1.09)	2.55 (1.24)	2.32 (1.07)	1.71 (0.82)	1.73 (0.59)	1.88 (0.65)	1.62 (0.52)
Cystatin C, mg/L	2.08 (0.69)	2.02 (0.78)	2.09 (0.68)	1.46 (0.61)	1.61 (0.52)	1.65 (0.55)	1.57 (0.50)

	DCCT[35]			CSG[37]			CRISP[41]		
	Overall	Black	Non-Black	Overall	Black	Non-Black	Overall	Black	Non-Black
N	985	27 (2.7%)	958 (97.3%)	285	23 (8.1%)	262 (91.9%)	197	21 (10.7%)	176 (89.3%)
Age, years	28.7 (5.7)	29.2 (5.5)	28.7 (5.7)	34.0 (7.8)	36.1 (10.9)	33.8 (7.5)	33.5 (7.8)	34.2 (8.9)	33.5 (7.7)
<40	985 (100%)	27 (100%)	958 (100%)	210 (73.7%)	10 (43.5%)	200 (76.3%)	145 (73.6%)	13 (61.9%)	132 (75.0%)
40-65	0 (0.0%)	0 (0.0%)	0 (0.0%)	75 (26.3%)	13 (56.5%)	62 (23.7%)	52 (26.4%)	8 (38.1%)	44 (25.0%)
>65	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Female	450 (45.7%)	10 (37.0%)	440 (45.9%)	126 (44.2%)	11 (47.8%)	115 (43.9%)	117 (59.4%)	16 (76.2%)	101 (57.4%)
BMI, kg/m2	24.5 (3.0)	23.9 (2.2)	24.5 (3.0)	25.8 (5.6)	26.4 (8.7)	25.7 (5.3)	26.1 (5.3)	26.7 (5.3)	26.1 (5.3)
<20	37 (3.8%)	1 (3.7%)	36 (3.8%)	42 (14.8%)	3 (13.0%)	39 (14.9%)	15 (7.6%)	1 (4.8%)	14 (8.0%)
20-<25	557 (56.6%)	18 (66.7%)	539 (56.3%)	94 (33.1%)	9 (39.1%)	85 (32.6%)	78 (39.6%)	6 (28.6%)	72 (40.9%)
25-<30	343 (34.8%)	8 (29.6%)	335 (35.0%)	98 (34.5%)	7 (30.4%)	91 (34.9%)	69 (35.0%)	10 (47.6%)	59 (33.5%)
≥30	48 (4.9%)	0 (0.0%)	48 (5.0%)	50 (17.6%)	4 (17.4%)	46 (17.6%)	35 (17.8%)	4 (19.1%)	31 (17.6%)
Diabetes	985 (100%)	27 (100%)	958 (100%)	285 (100%)	23 (100%)	262 (100%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Kidney donor candidates	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Measured GFR, ml/min/1.73m^2	123.6 (19.5)	121.6 (21.3)	123.7 (19.5)	71.8 (32.7)	67.1 (38.9)	72.2 (32.2)	95.2 (23.4)	102.1 (26.4)	94.4 (23.0)
<30	1 (0.1%)	0 (0.0%)	1 (0.1%)	36 (12.6%)	4 (17.4%)	32 (12.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
30-<60	1 (0.1%)	0 (0.0%)	1 (0.1%)	72 (25.3%)	8 (34.8%)	64 (24.4%)	7 (3.6%)	0 (0.0%)	7 (4.0%)
60-<90	21 (2.1%)	2 (7.4%)	19 (2.0%)	94 (33.0%)	5 (21.7%)	89 (34.0%)	87 (44.2%)	8 (38.1%)	79 (44.9%)
≥90	962 (97.7%)	25 (92.6%)	937 (97.8%)	83 (29.1%)	6 (26.1%)	77 (29.4%)	103 (52.3%)	13 (61.9%)	90 (51.1%)
Creatinine, mg/dL	0.76 (0.13)	0.82 (0.16)	0.76 (0.13)	1.38 (0.64)	1.42 (0.78)	1.37 (0.63)	0.93 (0.21)	0.92 (0.18)	0.93 (0.21)
Cystatin C, mg/L	0.74 (0.10)	0.75 (0.13)	0.74 (0.10)	1.33 (0.61)	1.42 (0.73)	1.32 (0.60)	0.94 (0.17)	0.87 (0.13)	0.95 (0.17)

	Mayo CKD[40]			Mayo Donor[40]	CCFP CKD[39]		
	Overall	Black	Non-Black	Nonblack (Overall)	Overall	Black	Non-Black
N	203	1 (0.5%)	202 (99.5%)	50 (100%)	88	7 (8.0%)	81 (92.0%)
Age, years	55.2 (16.0)	NS	55.2 (16.0)	41.3 (10.5)	53.7 (13.3)	55.4 (12.9)	53.6 (13.4)
<40	39 (19.2%)		39 (19.3%)	19 (38.0%)	12 (13.6%)	NS	11 (13.6%)
40-65	103 (50.7%)		102 (50.5%)	30 (60.0%)	58 (65.9%)		53 (65.4%)
>65	61 (30.1%)		61 (30.2%)	1 (2.0%)	18 (20.5%)		17 (21.0%)
Female	91 (44.8%)	NS	91 (45.1%)	34 (68.0%)	33 (37.5%)		29 (35.8%)
BMI, kg/m2	29.5 (6.9)	NS	29.5 (6.9)	28.4 (5.7)	28.4 (6.3)	28.2 (4.8)	28.4 (6.5)
<20	7 (3.5%)		7 (3.5%)	1 (2.0%)	4 (4.6%)	NS	4 (4.9%)
20-<25	44 (21.7%)		44 (21.8%)	14 (28.0%)	23 (26.1%)		21 (25.9%)
25-<30	73 (36.0%)		73 (36.1%)	20 (40.0%)	32 (36.4%)		28 (34.6%)
≥30	79 (38.9%)		78 (38.6%)	15 (30.0%)	29 (33.0%)		28 (34.6%)
Diabetes	37 (18.2%)	NS	37 (18.3%)	0 (0.0%)	18 (20.5%)	NS	18 (22.2%)
Kidney donor candidates	0 (0.0%)	NS	0 (0.0%)	50 (100%)	0 (0.0%)	NS	0 (0.0%)
Measured GFR, ml/min/1.73m^2	51.0 (29.2)	NS	50.9 (29.3)	100.5 (16.2)	53.1 (31.1)	52.9 (33.5)	53.1 (31.1)
<30	63 (31.0%)		63 (31.2%)	0 (0.0%)	20 (22.7%)	NS	18 (22.2%)
30-<60	59 (29.1%)		59 (29.2%)	0 (0.0%)	33 (37.5%)		31 (38.3%)
60-<90	56 (27.6%)		55 (27.2%)	12 (24.0%)	27 (30.7%)		25 (30.9%)
≥90	25 (12.3%)		25 (12.4%)	38 (76.0%)	8 (9.1%)		7 (8.6%)
Creatinine, mg/dL	1.62 (1.17)	NS	1.62 (1.17)	0.68 (0.16)	1.68 (1.15)	1.52 (1.12)	1.69 (1.15)
Cystatin C, mg/L	1.76 (0.81)	NS	1.76 (0.81)	0.93 (0.15)	1.69 (0.93)	1.49 (0.73)	1.70 (0.94)

	CCFP Donor[39]			Groningen[42]			Groningen Donors[56]	RASS[43]		
	Overall	Black	Non-Black	Overall	Black	Non-Black	Nonblack (overall)	Overall	Black	Non-Black
N	96	10 (10.4%)	86 (89.6%)	29	1 (3.4%)	28 (96.6%)	34 (100%)	39	1 (2.6%)	38 (97.4%)
Age, years	42.9 (11.9)	36.2 (10.2)	43.7 (11.8)	40.9 (14.4)	NS	40.9 (14.7)	51.9 (12.7)	24.2 (5.0)	NS	23.9 (4.8)
<40	38 (39.6%)	NS	31 (36.1%)	17 (58.6%)		17 (60.7%)	6 (17.7%)	39 (100%)		38 (100%)
40-65	57 (59.4%)		54 (62.8%)	12 (41.4%)		11 (39.3%)	22 (64.7%)	0 (0.0%)		0 (0.0%)
>65	1 (1.0%)		1 (1.2%)	0 (0.0%)		0 (0.0%)	6 (17.7%)	0 (0.0%)		0 (0.0%)
Female	48 (50.0%)	NS	44 (51.2%)	17 (58.6%)	NS	16 (57.1%)	13 (38.2%)	15 (38.5%)	NS	15 (39.5%)
BMI, kg/m2	26.4 (4.2)	26.5 (3.5)	26.4 (4.3)	24.4 (3.3)	NS	24.5 (3.3)	26.3 (4.2)	25.5 (3.6)	NS	25.5 (3.6)
<20	6 (6.3%)	NS	6 (7.0%)	2 (6.9%)		2 (7.1%)	1 (2.9%)	0 (0.0%)		0 (0.0%)
20-<25	34 (35.4%)		29 (33.7%)	16 (55.2%)		15 (53.6%)	12 (35.3%)	19 (48.7%)		19 (50.0%)
25-<30	36 (37.5%)		34 (39.5%)	10 (34.5%)		10 (35.7%)	13 (38.2%)	16 (41.0%)		15 (39.5%)
≥30	20 (20.8%)		17 (19.8%)	1 (3.5%)		1 (3.6%)	8 (23.5%)	4 (10.3%)	NS	4 (10.5%)
Diabetes	3 (3.1%)	NS	3 (3.5%)	5 (17.2%)	NS	5 (17.9%)	0 (0.0%)	39 (100%)	NS	38 (100%)
Kidney donor candidates	96 (100%)	NS	86 (100%)	0 (0.0%)	NS	0 (0.0%)	34 (100%)	0 (0.0%)	NS	0 (0.0%)
Measured GFR, ml/min/1.73m^2	102.1 (18.3)	102.8 (11.6)	102.0 (19.0)	81.6 (33.1)	NS	81.9 (33.6)	102.8 (19.3)	143.0 (18.6)	NS	142.4 (18.5)
<30	0 (0.0%)	NS	0 (0.0%)	3 (10.3%)		3 (10.7%)	0 (0.0%)	0 (0.0%)		0 (0.0%)
30-<60	1 (1.0%)		1 (1.2%)	4 (13.8%)		4 (14.3%)	0 (0.0%)	0 (0.0%)		0 (0.0%)
60-<90	22 (22.9%)		21 (24.4%)	9 (31.0%)		8 (28.6%)	11 (32.4%)	0 (0.0%)		0 (0.0%)
≥90	73 (76.0%)		64 (74.4%)	13 (44.8%)		13 (46.4%)	23 (67.7%)	39 (100%)		38 (100%)
Creatinine, mg/dL	0.82 (0.16)	0.93 (0.14)	0.81 (0.15)	1.12 (0.78)	NS	1.14 (0.80)	0.89 (0.15)	0.77 (0.14)	NS	0.77 (0.14)
Cystatin C, mg/L	0.84 (0.11)	0.81 (0.10)	0.85 (0.11)	1.42 (0.70)	NS	1.41 (0.71)	0.98 (0.14)	0.76 (0.07)	NS	0.76 (0.07)

Abbreviations: MDRD Study, Modification of Diet in Renal Disease Study; AASK, African American Study of Kidney Diseases and Hypertension; DCCT, Diabetes Control and Complications Trial; CSG, Collaborative Study Group: Captopril in Diabetic Nephropathy Study; CRIC, Chronic Renal Insufficiency Cohort Study; CCF, Cleveland Clinic Foundation; GFR, glomerular filtration rate; BMI, body mass index; SD, standard deviation, NS, number too small for the group or subgroup to present descriptive data. To convert GFR from mL/min/1.73 m2 to mL/s/m2, multiply by 0.0167. To convert serum creatinine from mg/dL to µmol/L, multiply by 88.4.

Table S8: Characteristics of the 2021 validation dataset by study

	AGES[44]	RASS[43]			UMN Donor		
	Nonblack (Overall)	Overall	Black	Non-Black	Overall	Black	Non-Black
N	805 (100%)	211	5 (2.4%)	206 (97.6%)	288	10 (3.5%)	278 (96.5%)
Age, years	80.0 (4.0)	32.6 (9.0)	NS	32.5 (9.0)	40.4 (12.5)	37.3 (14.2)	40.5 (12.4)
<40	0 (0.0%)	161 (76.3%)		157 (76.2%)	144 (50.0%)	NS	138 (49.6%)
40-65	0 (0.0%)	50 (23.7%)		49 (23.8%)	139 (48.3%)		135 (48.6%)
>65	805 (100%)	0 (0.0%)		0 (0.0%)	5 (1.7%)		5 (1.8%)
Female	450 (55.9%)	109 (51.7%)	NS	106 (51.5%)	186 (64.6%)	6 (60.0%)	180 (64.8%)
BMI, kg/m2	27.3 (4.2)	25.8 (3.7)	NS	25.8 (3.7)	26.6 (3.8)	23.9 (3.5)	26.7 (3.8)
<20	19 (2.4%)	0 (0.0%)		0 (0.0%)	9 (3.1%)	NS	8 (2.9%)
20-<25	221 (27.5%)	98 (46.5%)		96 (46.6%)	90 (31.3%)		85 (30.6%)
25-<30	385 (47.8%)	84 (39.8%)		81 (39.3%)	135 (46.9%)		131 (47.1%)
≥30	180 (22.4%)	29 (13.7%)		29 (14.1%)	54 (18.8%)		54 (19.4%)
Diabetes	83 (10.4%)	211 (100%)	NS	206 (100%)	0 (0.0%)	NS	0 (0.0%)
Kidney donor candidates	0 (0.0%)	0 (0.0%)	NS	0 (0.0%)	288 (100%)	NS	278 (100%)
Measured GFR, ml/min/1.73m^2	62.4 (16.5)	128.1 (18.9)	NS	128.2 (19.1)	93.8 (13.8)	96.1 (19.4)	93.7 (13.6)
<30	28 (3.5%)	0 (0.0%)		0 (0.0%)	0 (0.0%)	NS	0 (0.0%)
30-<60	286 (35.5%)	0 (0.0%)		0 (0.0%)	3 (1.0%)		3 (1.1%)
60-<90	458 (56.9%)	0 (0.0%)		0 (0.0%)	114 (39.6%)		110 (39.6%)
≥90	33 (4.1%)	211 (100%)		206 (100%)	171 (59.4%)		165 (59.4%)
Creatinine, mg/dL	1.00 (0.37)	0.77 (0.14)	NS	0.77 (0.14)	0.79 (0.15)	0.72 (0.15)	0.80 (0.15)
Cystatin C, mg/L	1.19 (0.38)	0.77 (0.10)	NS	0.77 (0.10)	0.78 (0.11)	0.74 (0.14)	0.78 (0.11)

	HIV[50]			MACS[51]			STENO[45-48]
	Overall	Black	Non-Black	Overall	Black	Non-Black	Overall (Non-Black)
N	200	104 (52.0%)	96 (48.0%)	691	235 (34.0%)	456 (66.0%)	245 (100%)
Age, years	47.8 (8.2)	47.3 (8.8)	48.3 (7.6)	52.5 (8.7)	50.0 (7.0)	53.8 (9.1)	42.5 (9.1)
<40	26 (13.0%)	16 (15.4%)	10 (10.4%)	41 (5.9%)	11 (4.7%)	30 (6.6%)	110 (44.9%)
40-65	169 (84.5%)	86 (82.7%)	83 (86.5%)	600 (86.8%)	218 (92.8%)	382 (83.8%)	134 (54.7%)
>65	5 (2.5%)	2 (1.9%)	3 (3.1%)	50 (7.2%)	6 (2.6%)	44 (9.7%)	1 (0.4%)
Female	55 (27.5%)	36 (34.6%)	19 (19.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	85 (34.7%)
BMI, kg/m2	26.6 (5.9)	27.1 (6.0)	26.2 (5.8)	26.4 (4.7)	27.1 (5.6)	26.0 (4.1)	24.0 (3.3)
<20	15 (7.5%)	8 (7.7%)	7 (7.3%)	26 (3.8%)	8 (3.4%)	18 (4.0%)	20 (8.2%)
20-<25	65 (32.5%)	30 (28.9%)	35 (36.5%)	272 (39.4%)	94 (40.0%)	178 (39.0%)	147 (60.0%)
25-<30	84 (42.0%)	45 (43.3%)	39 (40.6%)	278 (40.2%)	81 (34.5%)	197 (43.2%)	66 (26.9%)
≥30	36 (18.0%)	21 (20.2%)	15 (15.6%)	115 (16.6%)	52 (22.1%)	63 (13.8%)	12 (4.9%)
Diabetes	16 (8.0%)	9 (8.7%)	7 (7.3%)	102 (18.6%)	48 (26.8%)	54 (14.6%)	245 (100%)
Kidney donor candidates	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Measured GFR, ml/min/1.73m^2	87.0 (25.7)	87.2 (27.6)	86.8 (23.6)	95.9 (21.1)	95.4 (21.7)	96.2 (20.8)	71.8 (31.0)
<30	3 (1.5%)	2 (1.9%)	1 (1.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	19 (7.8%)
30-<60	25 (12.5%)	15 (14.4%)	10 (10.4%)	37 (5.4%)	14 (6.0%)	23 (5.0%)	69 (28.2%)
60-<90	87 (43.5%)	43 (41.4%)	44 (45.8%)	231 (33.4%)	72 (30.6%)	159 (34.9%)	87 (35.5%)
≥90	85 (42.5%)	44 (42.3%)	41 (42.7%)	423 (61.2%)	149 (63.4%)	274 (60.1%)	70 (28.6%)
Creatinine, mg/dL	1.17 (0.41)	1.23 (0.45)	1.12 (0.36)	1.00 (0.26)	1.08 (0.29)	0.95 (0.23)	1.37 (0.80)
Cystatin C, mg/L	1.06 (0.39)	1.04 (0.42)	1.08 (0.36)	0.99 (0.28)	1.01 (0.31)	0.99 (0.26)	1.41 (0.66)

	Lund CKD[49]	Lund Donor[49]	PERL[52]		
	Non-Black (Overall)	Non-Black (Overall)	Overall	Black	Non-Black
N	343 (100%)	7 (100%)	489	57 (11.7%)	432 (88.3%)
Age, years	57.8 (15.6)	49 (10.3)	51.4 (11.0)	46.0 (10.2)	52.1 (10.9)
<40	46 (13.4%)	NS	86 (17.6%)	18 (31.6%)	68 (15.7%)
40-65	182 (53.1%)		360 (73.6%)	38 (66.7%)	322 (74.5%)
>65	115 (33.5%)		43 (8.8%)	1 (1.8%)	42 (9.7%)
Female	167 (48.7%)	5 (71.4%)	163 (33.3%)	20 (35.1%)	143 (33.1%)
BMI, kg/m2	25.6(5.5)	26 (2)	29.4 (5.9)	30.1 (6.8)	29.3 (5.8)
<20	39 (11.4%)	NS	11 (2.3%)	3 (5.4%)	8 (1.9%)
20-<25	139 (40.5%)		106 (21.9%)	11 (19.6%)	95 (22.2%)
25-<30	112 (32.7%)		166 (34.3%)	17 (30.4%)	149 (34.8%)
≥30	53 (15.5%)		201 (41.5%)	25 (44.6%)	176 (41.1%)
Diabetes	66 (19.2%)		489 (100%)	57 (100%)	432 (100%)
Kidney donor candidates	0	NS	0 (0.0%)	0 (0.0%)	0 (0.0%)
Measured GFR, ml/min/1.73m^2	63.6 (32.6)	88.4 (18.2)	68.0 (17.0)	66.7 (15.3)	68.2 (17.2)
<30	68 (19.8%)	NS	4 (0.8%)	1 (1.8%)	3 (0.7%)
30-<60	96 (28%)		163 (33.3%)	17 (29.8%)	146 (33.8%)
60-<90	96 (28%)		277 (56.7%)	36 (63.2%)	241 (55.8%)
≥90	83 (24.2%)		45 (9.2%)	3 (5.3%)	42 (9.7%)
Creatinine, mg/dL	1.50 (1.1)	0.99 (0.24)	1.12 (0.30)	1.26 (0.36)	1.10 (0.29)
Cystatin C, mg/L	1.58 (0.8)	1.02 (0.25)	1.15 (0.33)	1.13 (0.35)	1.15 (0.32)

	MESA[53]			ALTOLD[54]			NephroTest[55]		
	Overall	Black	Non-Black	Overall	Black	Non-Black	Overall	Black	Non-Black
N	294	139 (47.3%)	155 (52.7%)	164	4 (2.4%)	160 (97.6%)	313	25 (8.0%)	288 (92.0%)
Age, years	70.7 (8.6)	69.5 (8.6)	71.8 (8.5)	44.1 (11.4)	NS	44.2 (11.3)	58.6 (14.7)	55.6 (10.8)	58.8 (15.0)
<40	0 (0.0%)	0 (0.0%)	0 (0.0%)	61 (37.2%)		59 (36.9%)	38 (12.1%)	2 (8.0%)	36 (12.5%)
40-65	92 (31.3%)	52 (37.4%)	40 (25.8%)	99 (60.4%)		98 (61.3%)	159 (50.8%)	17 (68.0%)	142 (49.3%)
>65	202 (68.7%)	87 (62.6%)	115 (74.2%)	4 (2.4%)		3 (1.9%)	116 (37.1%)	6 (24.0%)	110 (38.2%)
Female	140 (47.6%)	70 (50.4%)	70 (45.2%)	107 (65.2%)		105 (65.6%)	90 (28.8%)	3 (12.0%)	87 (30.2%)
BMI, kg/m2	29.7 (5.4)	30.6 (5.8)	28.9 (4.9)	26.7 (4.2)	NS	26.8 (4.2)	25.9 (4.4)	24.6 (3.6)	26.1 (4.5)
<20	3 (1.0%)	1 (0.7%)	2 (1.3%)	1 (0.6%)	NS	1 (0.6%)	22 (7.0%)	2 (8.0%)	20 (6.9%)
20-<25	47 (16.0%)	16 (11.5%)	31 (20.0%)	62 (38.0%)		60 (37.7%)	117 (37.4%)	13 (52.0%)	104 (36.1%)
25-<30	124 (42.2%)	55 (39.6%)	69 (44.5%)	65 (39.9%)		63 (39.6%)	119 (38.0%)	8 (32.0%)	111 (38.5%)
≥30	120 (40.8%)	67 (48.2%)	53 (34.2%)	35 (21.5%)		35 (22.0%)	55 (17.6%)	2 (8.0%)	53 (18.4%)
Diabetes	73 (24.8%)	47 (33.8%)	26 (16.8%)	0 (0.0%)		0 (0.0%)	72 (23.0%)	5 (20.0%)	67 (23.3%)
Kidney donor candidates	0 (0.0%)	0 (0.0%)	0 (0.0%)	164 (100%)	NS	160 (100%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Measured GFR, ml/min/1.73m^2	72.6 (18.8)	74.2 (19.7)	71.2 (17.9)	96.1 (14.3)	NS	95.7 (14.3)	35.4 (17.7)	41.2 (21.9)	34.8 (17.3)
<30	2 (0.7%)	2 (1.4%)	0 (0.0%)	0 (0.0%)		0 (0.0%)	130 (41.5%)	9 (36.0%)	121 (42.0%)
30-<60	66 (22.5%)	26 (18.7%)	40 (25.8%)	0 (0.0%)		0 (0.0%)	151 (48.2%)	12 (48.0%)	139 (48.3%)
60-<90	172 (58.5%)	82 (59.0%)	90 (58.1%)	47 (28.7%)		47 (29.4%)	28 (9.0%)	3 (12.0%)	25 (8.7%)
≥90	54 (18.4%)	29 (20.9%)	25 (16.1%)	117 (71.3%)		113 (70.6%)	4 (1.3%)	1 (4.0%)	3 (1.0%)
Creatinine, mg/dL	0.94 (0.34)	0.99 (0.43)	0.89 (0.23)	0.79 (0.15)	NS	0.79 (0.15)	2.44 (1.18)	2.61 (1.39)	2.43 (1.16)
Cystatin C, mg/L	1.03 (0.33)	1.01 (0.35)	1.06 (0.30)	0.80 (0.12)	NS	0.80 (0.12)	2.01 (0.75)	1.78 (0.75)	2.02 (0.74)

Abbreviations: MACS, Multicenter Aids Cohort Study; PERL, Preventing Early Rental Loss in Diabetes; CCF, Cleveland Clinic Foundation; MESA, Multi-Ethnic Study of Atherosclerosis; ALTOLD, Assessing Long Term Outcome of Living Kidney Donors; CRIC, Chronic Renal Insufficiency Cohort Study; AGES, Age, Gene/Environment Susceptibility-Reykjavik Study; UMN, University of Minnesota; GFR, glomerular filtration rate; BMI, body mass index; SD, standard deviation, NS, number too small for the group or subgroup to present descriptive data. To convert GFR from mL/min/1.73 m2 to mL/s/m2, multiply by 0.0167. To convert serum creatinine from mg/dL to µmol/L, multiply by 88.4.

*No Donors was assumed

Table S9: Characteristics of the 2009 validation dataset by study

	Baylor[57]			STENO[45-48]	RASS[43]		
	Overall	Black	Non-Black	Nonblack (Overall)	Overall	Black	Non-Black
N	708	47 (6.6%)	661 (93.4%)	245 (100%)	235	5 (2.1%)	230 (97.9%)
Age, years	53.7 (11.0)	48.6 (12.7)	54.0 (10.8)	42.5 (9.1)	31.7 (9.0)	NS	31.6 (9.1)
<40	68 (9.6%)	12 (25.5%)	56 (8.5%)	110 (44.9%)	185 (78.7%)		181 (78.7%)
40-65	535 (75.6%)	31 (66.0%)	504 (76.3%)	134 (54.7%)	50 (21.3%)		49 (21.3%)
>65	105 (14.8%)	4 (8.5%)	101 (15.3%)	1 (0.4%)			
Female	321 (45.3%)	27 (57.5%)	294 (44.5%)	85 (34.7%)	121 (51.5%)	NS	118 (51.3%)
BMI, kg/m2	28.6 (6.5)	28.5 (6.4)	28.6 (6.5)	24.0 (3.3)	25.8 (3.7)	NS	25.8 (3.7)
<20	35 (5.1%)	4 (9.1%)	31 (4.8%)	20 (8.2%)			
20-<25	174 (25.3%)	11 (25.0%)	163 (25.4%)	147 (60.0%)	109 (46.4%)		107 (46.5%)
25-<30	227 (33.0%)	13 (29.6%)	214 (33.3%)	66 (26.9%)	94 (40.0%)		91 (39.6%)
≥30	251 (36.5%)	16 (36.4%)	235 (36.6%)	12 (4.9%)	32 (13.6%)		32 (13.9%)
Diabetes	177 (25.0%)	16 (34.0%)	161 (24.4%)	245 (100%)	235 (100%)		230 (100%)
Transplant recipient	708 (100%)	47 (100%)	661 (100%)	0 (0%)	0 (0.0%)	NS	0 (0.0%)
Kidney donor candidates	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	NS	0 (0.0%)
Measured GFR, ml/min/1.73m^2	59.2 (27.6)	64.7 (28.4)	58.9 (27.5)	71.8 (31.0)	129.5 (19.4)	NS	129.6 (19.5)
<30	81 (11.4%)	3 (6.4%)	78 (11.8%)	19 (7.8%)	0 (0.0%)		0 (0.0%)
30-<60	323 (45.6%)	21 (44.7%)	302 (45.7%)	69 (28.2%)	0 (0.0%)		0 (0.0%)
60-<90	202 (28.5%)	15 (31.9%)	187 (28.3%)	87 (35.5%)	0 (0.0%)		0 (0.0%)
≥90	102 (14.4%)	8 (17.0%)	94 (14.2%)	70 (28.6%)	235 (100%)		230 (100 %)
Creatinine, mg/dL	1.43 (0.62)	1.30 (0.46)	1.44 (0.63)	1.48 (0.76)	0.82 (0.14)	NS	0.82 (0.14)

	Groningen[42]			Groningen Donors[56]	Interdiabetes[58]		
	Overall	Black	Non-Black	Nonblack (Overall)	Overall	Black	Non-Black
N	422	4 (0.9%)	418 (99.1%)	43 (100.0%)	16	1 (6.3%)	15 (93.8%)
Age, years	48.4 (13.1)	NS	48.5 (13.1)	51.0 (12.0)	23.9 (5.7)	NS	23.3 (5.2)
<40	113 (26.8%)		110 (26.3%)	8 (18.6%)	16 (100%)		15 (100%)
40-65	278 (65.9%)		277 (66.3%)	29 (67.4%)	0 (0.0%)		0 (0.0%)
>65	31 (7.4%)		31 (7.4%)	6 (14.0%)	0 (0.0%)		0 (0.0%)
Female	189 (44.8%)	NS	187 (44.7%)	19 (44.2%)	3 (18.8%)	NS	3 (20.0%)
BMI, kg/m2	25.8 (4.4)	NS	25.9 (4.4)	26.8 (4.2)	25.2 (2.7)	NS	25.0 (2.6)
<20	33 (7.8%)		33 (7.9%)	1 (2.3%)	0 (0.0%)		0 (0.0%)
20-<25	155 (36.7%)		153 (36.6%)	14 (32.6%)	9 (56.3%)		9 (60.0%)
25-<30	164 (38.9%)		162 (38.8%)	17 (39.5%)	6 (37.5%)		5 (33.3%)
≥30	70 (16.6%)		70 (16.8%)	11 (25.6%)	1 (6.3%)		1 (6.7%)
Diabetes	56 (13.3%)	NS	56 (13.4%)	0 (0.0%)	16 (100%)		15 (100%)
Transplant recipient	365 (86.5%)	NS	362 (86.6%)	2 (4.7%)	0 (0.0%)	NS	0 (0.0%)
Kidney donor candidates	0 (0.0%)	NS	0 (0.0%)	43 (100%)	0 (0.0%)	NS	0 (0.0%)
Measured GFR, ml/min/1.73m^2	55.9 (23.5)	NS	56.0 (23.6)	102.2 (19.3)	149.4 (21.6)	NS	148.3 (21.8)
<30	50 (11.9%)		49 (11.7%)	0 (0.0%)	0 (0.0%)		0 (0.0%)
30-<60	209 (49.5%)		208 (49.8%)	0 (0.0%)	0 (0.0%)		0 (0.0%)
60-<90	126 (29.9%)		124 (29.7%)	14 (32.6%)	0 (0.0%)		0 (0.0%)
≥90	37 (8.8%)		37 (8.9%)	29 (67.4%)	16 (100%)		15 (100%)
Creatinine, mg/dL	1.44 (0.57)	NS	1.44 (0.56)	0.85 (0.16)	0.80 (0.11)	NS	0.80 (0.11)

	CCFP CKD[39]			CCFP Donor[39]			CRIC[38]		
	Overall	Black	Non-Black	Overall	Black	Non-Black	Overall	Black	Non-Black
N	103	9 (8.7%)	94 (91.3%)	96	10 (10.4%)	86 (89.6%)	298	127 (42.6%)	171 (57.4%)
Age, years	51.9 (14.3)	49.7 (16.8)	52.1 (14.2)	42.9 (11.9)	36.2 (10.2)	43.7 (11.8)	56.8 (11.1)	57.2 (10.6)	56.5 (11.5)
<40	17 (16.5%)	NS	15 (16.0%)	38 (39.6%)	NS	31 (36.1%)	33 (11.1%)	14 (11.0%)	19 (11.1%)
40-65	68 (66.0%)		62 (66.0%)	57 (59.4%)		54 (62.8%)	203 (68.1%)	87 (68.5%)	116 (67.8%)
>65	18 (17.5%)		17 (18.1%)	1 (1.0%)		1 (1.2%)	62 (20.8%)	26 (20.5%)	36 (21.1%)
Female	37 (35.9%)		32 (34.0%)	48 (50.0%)		44 (51.2%)	112 (37.6%)	52 (40.9%)	60 (35.1%)
BMI, kg/m2	28.1 (6.2)	28.4 (5.1)	28.0 (6.4)	26.4 (4.2)	26.5 (3.5)	26.4 (4.3)	31.1 (6.1)	32.9 (6.3)	29.8 (5.7)
<20	5 (4.9%)	NS	5 (5.3%)	6 (6.3%)	NS	6 (7.0%)	3 (1.0%)	0 (0.0%)	3 (1.8%)
20-<25	31 (30.1%)		28 (29.8%)	34 (35.4%)		29 (33.7%)	49 (16.4%)	13 (10.2%)	36 (21.1%)
25-<30	34 (33.0%)		30 (31.9%)	36 (37.5%)		34 (39.5%)	90 (30.2%)	34 (26.8%)	56 (32.8%)
≥30	33 (32.0%)		31 (33.0%)	20 (20.8%)		17 (19.8%)	156 (52.4%)	80 (63.0%)	76 (44.4%)
Diabetes	20 (19.4%)	NS	20 (21.3%)	3 (3.1%)	NS	3 (3.5%)	161 (54.0%)	68 (53.5%)	93 (54.4%)
Transplant recipient	15 (14.6%)	NS	13 (13.8%)	0 (0.0%)	NS	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Kidney donor candidates	0 (0.0%)	NS	0 (0.0%)	96 (100%)	NS	86 (100%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Measured GFR, ml/min/1.73m^2	52.2 (30.7)	52.4 (32.4)	52.2 (30.7)	102.1 (18.3)	102.8 (11.6)	102.0 (19.0)	49.7 (19.8)	49.6 (18.9)	49.8 (20.6)
<30	25 (24.3%)	NS	22 (23.4%)	0 (0.0%)	NS	0 (0.0%)	47 (15.8%)	17 (13.4%)	30 (17.5%)
30-<60	39 (37.9%)		37 (39.4%)	1 (1.0%)		1 (1.2%)	174 (58.4%)	79 (62.2%)	95 (55.6%)
60-<90	29 (28.2%)		26 (27.7%)	22 (22.9%)		21 (24.4%)	63 (21.1%)	27 (21.3%)	36 (21.1%)
≥90	10 (9.7%)		9 (9.6%)	73 (76.0%)		64 (74.4%)	14 (4.7%)	4 (3.2%)	10 (5.9%)
Creatinine, mg/dL	1.79 (1.22)	1.65 (1.44)	1.80 (1.22)	0.87 (0.17)	1.00 (0.16)	0.86 (0.16)	1.80 (0.58)	1.88 (0.59)	1.74 (0.57)

	CRISP[41]			DNA Donors			DNA CKD		
	Overall	Black	Non-Black	Overall	Black	Non-Black	Overall	Black	Non-Black
N	198	21 (10.6%)	177 (89.4%)	109	19 (17.4%)	90 (82.6%)	209	61 (29.2%)	148 (70.8%)
Age, years	33.6 (7.8)	34.2 (8.9)	33.5 (7.7)	41.5 (11.1)	35.9 (9.1)	42.7 (11.1)	53.4 (13.8)	51.8 (13.6)	54.1 (13.9)
<40	145 (73.2%)	13 (61.9%)	132 (74.6%)	48 (44.0%)	13 (68.4%)	35 (38.9%)	32 (15.3%)	9 (14.8%)	23 (15.5%)
40-65	53 (26.8%)	8 (38.1%)	45 (25.4%)	61 (56.0%)	6 (31.6%)	55 (61.1%)	137 (65.6%)	42 (68.9%)	95 (64.2%)
>65	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	40 (19.1%)	10 (16.4%)	30 (20.3%)
Female	118 (59.6%)	16 (76.2%)	102 (57.6%)	70 (64.2%)	12 (63.2%)	58 (64.4%)	111 (53.1%)	34 (55.7%)	77 (52.0%)
BMI, kg/m2	26.1 (5.3)	26.7 (5.3)	26.0 (5.3)	28.8 (5.9)	31.5 (6.8)	28.2 (5.6)	30.5 (6.8)	32.9 (6.7)	29.6 (6.7)
<20	15 (7.6%)	1 (4.8%)	14 (7.9%)	2 (1.8%)	0 (0.0%)	2 (2.2%)	5 (2.4%)	0 (0.0%)	5 (3.4%)
20-<25	79 (39.9%)	6 (28.6%)	73 (41.2%)	30 (27.5%)	4 (21.1%)	26 (28.9%)	40 (19.1%)	5 (8.2%)	35 (23.7%)
25-<30	69 (34.9%)	10 (47.6%)	59 (33.3%)	33 (30.3%)	2 (10.5%)	31 (34.4%)	61 (29.2%)	16 (26.2%)	45 (30.4%)
≥30	35 (17.7%)	4 (19.1%)	31 (17.5%)	44 (40.4%)	13 (68.4%)	31 (34.4%)	103 (49.3%)	40 (65.6%)	63 (42.6%)
Diabetes	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (1.0%)	0 (0.0%)	2 (1.4%)
Transplant recipient	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Kidney donor candidates	0 (0.0%)	0 (0.0%)	0 (0.0%)	109 (100%)	19 (100%)	90 (100%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Measured GFR, ml/min/1.73m^2	95.2 (23.4)	102.1 (26.4)	94.3 (23.0)	104.0 (19.3)	105.4 (16.0)	103.7 (20.0)	39.2 (28.6)	35.1 (28.2)	41.0 (28.6)
<30	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	107 (51.2%)	33 (54.1%)	74 (50.0%)
30-<60	7 (3.5%)	0 (0.0%)	7 (4.0%)	1 (0.9%)	0 (0.0%)	1 (1.1%)	47 (22.5%)	15 (24.6%)	32 (21.6%)
60-<90	88 (44.4%)	8 (38.1%)	80 (45.2%)	24 (22.0%)	2 (10.5%)	22 (24.4%)	40 (19.1%)	9 (14.8%)	31 (21.0%)
≥90	103 (52.0%)	13 (61.9%)	90 (50.9%)	84 (77.1%)	17 (89.5%)	67 (74.4%)	15 (7.2%)	4 (6.6%)	11 (7.4%)
Creatinine, mg/dL	0.98 (0.20)	0.95 (0.23)	0.98 (0.20)	0.83 (0.20)	0.91 (0.20)	0.81 (0.20)	2.66 (1.82)	3.35 (2.24)	2.37 (1.54)

	NephroTest CKD[55]			NephroTest Donor[55]			Lund CKD[49]	Lund Donor[49]
	Overall	Black	Non-Black	Overall	Black	Non-Black	Non-Black	Non-Black
N	313	25 (8.0%)	288 (92.0%)	382	43 (11.3%)	339 (88.7%)	387 (100.0%)	7 (100.0%)
Age, years	58.6 (14.7)	55.6 (10.8)	58.8 (15.0)	44.9 (12.5)	40.1 (11.6)	45.5 (12.5)	57.1 (15.5)	49.0 (10.3)
<40	38 (12.1%)	2 (8.0%)	36 (12.5%)	143 (37.4%)	22 (51.2%)	121 (35.7%)	56 (14.5%)	NS
40-65	159 (50.8%)	17 (68.0%)	142 (49.3%)	217 (56.8%)	21 (48.8%)	196 (57.8%)	210 (54.3%)	
>65	116 (37.1%)	6 (24.0%)	110 (38.2%)	22 (5.8%)	0 (0.0%)	22 (6.5%)	121 (31.3%)	
Female	90 (28.8%)	3 (12.0%)	87 (30.2%)	215 (56.3%)	23 (53.5%)	192 (56.6%)	187 (48.3%)	
BMI, kg/m2	25.9 (4.4)	24.6 (3.6)	26.1 (4.5)	25.5 (4.3)	26.4 (4.5)	25.4 (4.2)	25.6 (5.4)	26.0 (2.0)
<20	22 (7.0%)	2 (8.0%)	20 (6.9%)	22 (5.8%)	1 (2.3%)	21 (6.2%)	45 (11.6%)	
20-<25	117 (37.4%)	13 (52.0%)	104 (36.1%)	164 (42.9%)	15 (34.9%)	149 (44.0%)	154 (39.8%)	
25-<30	119 (38.0%)	8 (32.0%)	111 (38.5%)	149 (39.0%)	19 (44.2%)	130 (38.4%)	129 (33.3%)	
≥30	55 (17.6%)	2 (8.0%)	53 (18.4%)	47 (12.3%)	8 (18.6%)	39 (11.5%)	59 (15.3%)	
Diabetes	72 (23.0%)	5 (20.0%)	67 (23.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	78 (20.2%)	NS
Transplant recipient	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	44 (11.4%)	NS
Kidney donor candidates	0 (0.0%)	0 (0.0%)	0 (0.0%)	353 (92.4%)	43 (100.0%)	310 (91.5%)	0 (0.0%)	NS
Measured GFR, ml/min/1.73m^2	35.4 (17.7)	41.2 (21.9)	34.8 (17.3)	96.2 (14.4)	95.9 (14.2)	96.3 (14.5)	61.4 (31.9)	88.4 (18.2)
<30	130 (41.5%)	9 (36.0%)	121 (42.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	78 (20.2%)	NS
30-<60	151 (48.2%)	12 (48.0%)	139 (48.3%)	2 (0.5%)	0 (0.0%)	2 (0.6%)	124 (32.0%)	
60-<90	28 (9.0%)	3 (12.0%)	25 (8.7%)	133 (34.8%)	13 (30.2%)	120 (35.4%)	102 (26.4%)	
≥90	4 (1.3%)	1 (4.0%)	3 (1.0%)	247 (64.7%)	30 (69.8%)	217 (64.0%)	83 (21.5%)	
Creatinine, mg/dL	2.44 (1.18)	2.61 (1.39)	2.43 (1.16)	0.88 (0.15)	0.95 (0.16)	0.87 (0.15)	1.45 (1.22)	0.85 (0.25)

Abbreviations: CCF P, Cleveland Clinic Foundation Prospective; CKD, Chronic Kidney Disease; CRIC, Chronic Renal Insufficiency Cohort; CRISP, Consortium for Radiologic Imaging Studies of Polycystic Kidney Disease; DNA, Dallas Nephrology Associates; Inter Diabetes, International Diabetic Nephropathy Study Group [GFR
measures performed at the same centers as the RASS clinical sites, since it only includes 16 participants, it is grouped with RASS for the remainder of the analyses]; RASS, Renin Angiotensin System Study; GFR, glomerular filtration rate; BMI, body mass index; SD, standard deviation; Scr, serum creatinine. To convert GFR from mL/min/1.73 m2 to mL/s/m2, multiply by 0.0167. To convert serum creatinine from mg/dL to µmol/L, multiply by 88.4.

Table S10: Current and new CKD-EPI equations for estimating GFR on the natural scale expressed for specified sex, serum creatinine or serum cystatin C

Coefficients	Sex	Serum Creatinine (mg/dL)	Serum Cystatin C (mg/L)	Equation
CKD-EPI creatinine equation				
ASR, current	Female	≤0.7		GFR= 144 x $(Scr/0.7)^{-0.329}$ x 0.9929^{Age} x 1.159 [if Black]
		>0.7		GFR= 144 x $(Scr/0.7)^{-1.209}$ x 0.9929^{Age} x 1.159 [if Black]
	Male	≤0.9		GFR= 141 x $(Scr/0.9)^{-0.411}$ x 0.9929^{Age} x 1.159 [if Black]
		>0.9		GFR= 141 x $(Scr/0.9)^{-1.209}$ x 0.9929^{Age} x 1.159 [if Black]
ASR-NB, new	Female	≤0.7		GFR= 144 x $(Scr/0.7)^{-0.329}$ x 0.9929^{Age}
		>0.7		GFR= 144 x $(Scr/0.7)^{-1.209}$ x 0.9929^{Age}
	Male	≤0.9		GFR= 141 x $(Scr/0.9)^{-0.411}$ x 0.9929^{Age}
		>0.9		GFR= 141 x $(Scr/0.9)^{-1.209}$ x 0.9929^{Age}
AS, new	Female	≤0.7		GFR= 143 x $(Scr/0.7)^{-0.241}$ x 0.9938^{Age}
		>0.7		GFR= 143 x $(Scr/0.7)^{-1.200}$ x 0.9938^{Age}
	Male	≤0.9		GFR= 142 x $(Scr/0.9)^{-0.302}$ x 0.9938^{Age}
		>0.9		GFR= 142 x $(Scr/0.9)^{-1.200}$ x 0.9938^{Age}
CKD-EPI cystatin C equation 2012				
AS, current			≤0.8	GFR= 133 x $(Scys/0.8)^{-0.499}$ x 0.9962^{Age} x 0.932 [if Female]
			>0.8	GFR= 133 x $(Scys/0.8)^{-1.328}$ x 0.9962^{Age} x 0.932 [if Female]
CKD-EPI creatinine-cystatin C equation				
ASR, current	Female	≤0.7	≤0.8	GFR= 130 x $(Scr/0.7)^{-0.248}$ x $(Scys/0.8)^{-0.375}$ x 0.9952^{Age} x 1.08 [if Black]
			>0.8	GFR= 130 x $(Scr/0.7)^{-0.248}$ x $(Scys/0.8)^{-0.711}$ x 0.9952^{Age} x 1.08 [if Black]
		>0.7	≤0.8	GFR= 130 x $(Scr/0.7)^{-0.601}$ x $(Scys/0.8)^{-0.375}$ x 0.9952^{Age} x 1.08 [if Black]
			>0.8	GFR= 130 x $(Scr/0.7)^{-0.601}$ x $(Scys/0.8)^{-0.711}$ x 0.9952^{Age} x 1.08 [if Black]
	Male	≤0.9	≤0.8	GFR= 135 x $(Scr/0.9)^{-0.207}$ x $(Scys/0.8)^{-0.375}$ x 0.9952^{Age} x 1.08 [if Black]
			>0.8	GFR= 135 x $(Scr/0.9)^{-0.207}$ x $(Scys/0.8)^{-0.711}$ x 0.9952^{Age} x 1.08 [if Black]
		>0.9	≤0.8	GFR= 135 x $(Scr/0.9)^{-0.601}$ x $(Scys/0.8)^{-0.375}$ x 0.9952^{Age} x 1.08 [if Black]
			>0.8	GFR= 135 x $(Scr/0.9)^{-0.601}$ x $(Scys/0.8)^{-0.711}$ x 0.9952^{Age} x 1.08 [if Black]
ASR-NB, new	Female	≤0.7	≤0.8	GFR= 130 x $(Scr/0.7)^{-0.248}$ x $(Scys/0.8)^{-0.375}$ x 0.9952^{Age}
			>0.8	GFR= 130 x $(Scr/0.7)^{-0.248}$ x $(Scys/0.8)^{-0.711}$ x 0.9952^{Age}
		>0.7	≤0.8	GFR= 130 x $(Scr/0.7)^{-0.601}$ x $(Scys/0.8)^{-0.375}$ x 0.9952^{Age}
			>0.8	GFR= 130 x $(Scr/0.7)^{-0.601}$ x $(Scys/0.8)^{-0.711}$ x 0.9952^{Age}
	Male	≤0.9	≤0.8	GFR= 135 x $(Scr/0.9)^{-0.207}$ x $(Scys/0.8)^{-0.375}$ x 0.9952^{Age}
			>0.8	GFR= 135 x $(Scr/0.9)^{-0.207}$ x $(Scys/0.8)^{-0.711}$ x 0.9952^{Age}
		>0.9	≤0.8	GFR= 135 x $(Scr/0.9)^{-0.601}$ x $(Scys/0.8)^{-0.375}$ x 0.9952^{Age}
			>0.8	GFR= 135 x $(Scr/0.9)^{-0.601}$ x $(Scys/0.8)^{-0.711}$ x 0.9952^{Age}
AS, new	Female	≤0.7	≤0.8	GFR= 130 x $(Scr/0.7)^{-0.219}$ x $(Scys/0.8)^{-0.323}$ x 0.9961^{Age}
			>0.8	GFR= 130 x $(Scr/0.7)^{-0.219}$ x $(Scys/0.8)^{-0.778}$ x 0.9961^{Age}
		>0.7	≤0.8	GFR= 130 x $(Scr/0.7)^{-0.544}$ x $(Scys/0.8)^{-0.323}$ x 0.9961^{Age}
			>0.8	GFR= 130 x $(Scr/0.7)^{-0.544}$ x $(Scys/0.8)^{-0.778}$ x 0.9961^{Age}
	Male	≤0.9	≤0.8	GFR= 135 x $(Scr/0.9)^{-0.144}$ x $(Scys/0.8)^{-0.323}$ x 0.9961^{Age}
			>0.8	GFR= 135 x $(Scr/0.9)^{-0.144}$ x $(Scys/0.8)^{-0.778}$ x 0.9961^{Age}
		>0.9	≤0.8	GFR= 135 x $(Scr/0.9)^{-0.544}$ x $(Scys/0.8)^{-0.323}$ x 0.9961^{Age}
			>0.8	GFR= 135 x $(Scr/0.9)^{-0.544}$ x $(Scys/0.8)^{-0.778}$ x 0.9961^{Age}

CKD-EPI, Chronic Kidney Disease Epidemiology Collaboration. To convert GFR from mL/min/1.73 m^2 to mL/s/1.73 m^2, multiply by 0.0167. Serum creatinine is expressed in mg/dl. Serum cystatin C is expressed in mg/L. To convert serum creatinine from mg/dL to µmol/L, multiply by 88.4.

** The CKD-EPI Creatinine Age, Sex, Race Equation (2009), that we developed previously,[1] can be expressed as a single equation 141 X $\min(Scr/k,1)^{\alpha}$ X $\max(Scr/k,1)^{-1.209}$ 0.9929^{age} X 1.018 [if female] X 1.159 [if Black] where Scr is serum creatinine k is 0.7 for females and 0.9 males, α is -0.329 for females and -0.411 for males, min indicates the minimum of Scr/k or 1, max indicates the maximum of Scr/k or 1

** The CKD-EPI Creatinine Age, Sex Equation (2021) can be expressed as a single equation 142 X $\min(Scr/k,1)^{\alpha}$ X $\max(Scr/k,1)^{-1.200}$ 0.9938^{age} X 1.012 [if female] where Scr is serum creatinine, k is 0.7 for females and 0.9 males, α is -0.241 for females and -0.302 for males, min indicates the minimum of Scr/k or 1, max indicates the maximum of Scr/k or 1

** The CKD-EPI Cystatin C Age, Sex Equation (2012), that we developed previously,[2] can be expressed as a single equation 133 X $\min(Scys/0.8,1)^{-0.499}$ X $\max(Scys/0.8,1)^{-1.328}$ X 0.9962^{age} X 0.932 [if female] where Scys is serum cystatin C

** The CKD-EPI Creatinine-Cystatin C Age, Sex, Race Equation (2012), that we developed previously,[2] can be expressed as a single equation 135 X $\min(Scr/k,1)^{\alpha}$ X $\max(Scr/k,1)^{-0.601}$ X $\min(Scys/0.8,1)^{-0.375}$ X $\max(Scys/0.8,1)^{-0.711}$ X 0.9952^{age} X 0.969 [if female] X 1.08 [if Black] where Scr is serum creatinine Scys is serum cystatin C, k is 0.7 for females and 0.9 males, α is -0.248 for females and -0.207 for males, min indicates the minimum of Scr/k or 1, max indicates the maximum of Scr/k or 1.

** The CKD-EPI Creatinine-Cystatin C Age, Sex Equation (2021) can be expressed as a single equation 135 X $\min(Scr/k,1)^{\alpha}$ X $\max(Scr/k,1)^{-0.544}$ X $\min(Scys/0.8,1)^{-0.323}$ X $\max(Scys/0.8,1)^{-0.778}$ X 0.9961^{age} X 0.963 [if female] where Scr is serum creatinine Scys is serum cystatin C, k is 0.7 for females and 0.9 males, α is -0.219 for females and -0.144 for males, min indicates the minimum of Scr/k or 1, max indicates the maximum of Scr/k or 1
All equations were developed by the CKD-EPI research group.

Table S11 Estimated GFR using current and new equations for simulated patients at different ages, sex and creatinine or cystatin C levels. Panel a: creatinine levels; Panel b: creatinine and cystatin C equations

a. Creatinine

Race groups	**Age**		**50 years**				**75 years**			
	Creatinine (mg/dl)		**0.6**	**1**	**1.5**	**2**	**0.6**	**1**	**1.5**	**2**
Black	men	eGFRcr (ASR) *(current)*	135	101	62	44	113	84	52	37
		eGFRcr (ASR-NB) *(new)*	117	87	53	38	98	73	45	32
		eGFRcr (AS) *(new)*	117	92	56	40	101	79	48	34
	women	eGFRcr (ASR) *(current)*	123	76	46	33	103	63	39	27
		eGFRcr (ASR-NB) *(new)*	106	66	40	28	89	55	34	24
		eGFRcr (AS) *(new)*	109	69	42	30	94	59	36	26
NonBlack	men	eGFRcr (ASR) *(current)*	117	87	53	38	98	73	45	32
		eGFRcr (ASR-NB) *(new)*	117	87	53	38	98	73	45	32
		eGFRcr (AS) *(new)*	118	92	56	40	101	79	48	34
	women	eGFRcr (ASR) *(current)*	106	66	40	28	89	55	34	24
		eGFRcr (ASR-NB) *(new)*	106	66	40	28	89	55	34	24
		eGFRcr (AS) *(new)*	109	69	42	30	94	59	36	26

Abbreviations: eGFRcr, estimated glomerular filtration rate creatinine equation; A, age; S, sex; R, race; Non-Black (NB) refers to equations in which Black race is removed

b. Creatinine- Cystatin C equations

Cys, mg/L	Race groups	Age		50 years				75 years			
		Creatinine (mg/dl)		0.6	1	1.5	2	0.6	1	1.5	2
1	Black	men	eGFRcr-cys (ASR) *(current)*	106	92	72	61	94	81	64	54
			eGFRcr-cys (ASR-NB) *(new)*	98	85	67	56	87	75	59	50
			eGFRcr-cys (AS) *(new)*	98	88	70	60	89	79	64	54
		women	eGFRcr-cys (ASR) *(current)*	98	76	60	50	87	68	53	45
			eGFRcr-cys (ASR-NB) *(new)*	91	71	56	47	81	63	49	41
			eGFRcr-cys (AS) *(new)*	92	74	59	51	84	67	54	46
	NonBlack	men	eGFRcr-cys (ASR) *(current)*	98	85	67	56	87	75	59	50
			eGFRcr-cys (ASR-NB) *(new)*	98	85	67	56	87	75	59	50
			eGFRcr-cys (AS) *(new)*	98	88	70	60	89	79	64	55
		women	eGFRcr-cys (ASR) *(current)*	91	71	56	47	81	63	49	41
			eGFRcr-cys (ASR-NB) *(new)*	91	71	56	47	81	63	49	41
			eGFRcr-cys (AS) *(new)*	92	74	59	51	84	67	54	46
1.5	Black	men	eGFRcr-cys (ASR) *(current)*	80	69	54	45	71	61	48	40
			eGFRcr-cys (ASR-NB) *(new)*	74	64	50	42	66	57	44	37
			eGFRcr-cys (AS) *(new)*	72	64	51	44	65	58	47	40
		women	eGFRcr-cys (ASR) *(current)*	74	57	45	38	66	51	40	34
			eGFRcr-cys (ASR-NB) *(new)*	68	53	42	35	61	47	37	31
			eGFRcr-cys (AS) *(new)*	67	54	43	37	61	49	39	33
	NonBlack	men	eGFRcr-cys (ASR) *(current)*	74	64	50	42	66	57	44	37
			eGFRcr-cys (ASR-NB) *(new)*	74	64	50	42	66	57	44	37
			eGFRcr-cys (AS) *(new)*	72	64	51	44	65	58	47	40
		women	eGFRcr-cys (ASR) *(current)*	68	53	42	35	61	47	37	31
			eGFRcr-cys (ASR-NB) *(new)*	68	53	42	35	61	47	37	31
			eGFRcr-cys (AS) *(new)*	67	54	43	37	61	49	39	33

Abbreviations: eGFRcr, estimated glomerular filtration rate creatinine equation; eGFRcys, estimated glomerular filtration rate cystatin C equation; eGFRcr-cys, estimated glomerular filtration rate creatinine equation; A, age; S, sex; R, race; Non-Black (NB) refers to equations in which Black race is removed

Table S12: Performance of current and new creatinine GFR estimating equations in development dataset

a. 2009 development dataset

Equation	Log GFR scale		GFR scale
	Bias	**RMSE**	**Bias**
Overall			
eGFRcr (ASR) *(current)*	0.000 (-0.005, 0.005)	0.236 (0.229, 0.242)	0.40 (0.14, 0.66)
eGFRcr (ASR-NB) *(new)*	0.046 (0.041, 0.051)	0.249 (0.243, 0.256)	2.31 (2.06, 2.65)
eGFRcr (AS) *(new)*	0.000 (-0.005, 0.005)	0.244 (0.238, 0.251)	0.28 (0.01, 0.52)
Black			
eGFRcr (ASR) *(current)*	0.000 (-0.009, 0.009)	0.243 (0.232, 0.254)	-0.04 (-0.61, 0.53)
eGFRcr (ASR-NB) *(new)*	0.146 (0.136, 0.155)	0.283 (0.274, 0.293)	6.10 (5.70, 6.61)
eGFRcr (AS) *(new)*	0.091 (0.081, 0.1)	0.258 (0.248, 0.268)	4.04 (3.54, 4.49)
Non-Black			
eGFRcr (ASR) *(current)*	0.000 (-0.006, 0.006)	0.232 (0.225, 0.241)	0.52 (0.25, 0.84)
eGFRcr (ASR-NB) *(new)*	0.000 (-0.006, 0.006)	0.232 (0.225, 0.240)	0.52 (0.25, 0.84)
eGFRcr (AS) *(new)*	-0.042 (-0.048, -0.036)	0.238 (0.230, 0.247)	-1.41 (-1.65, -1.11)

Bias on the log scale is computed as mean of the difference between log measured and log estimated GFR. Bias on the natural scale is computed as the median of the difference between measured and estimated GFR. RMSE, root mean square error, is a measure of model fit and computed on the log scale. Abbreviations: eGFRcr, estimated glomerular filtration rate creatinine equation; A, age; S, sex; R, race; Non-Black (NB) refers to equations in which Black race is removed

b. Performance of new eGFRcr (AS) equation weighted for proportion of Black individuals in the 2009 development dataset

Equation	Log GFR scale		GFR scale
	Bias	RMSE	Bias
Overall			
eGFRcr (AS) (current population of 31%) *(new)*	0.000 (-0.005, 0.005)	0.244 (0.238, 0.251)	0.28 (0.01, 0.52)
Weighted			
eGFRcr (AS-0%)	0.000 (-0.005, 0.005)	0.232 (0.224, 0.240)	0.43 (0.09, 0.77)
eGFRcr (AS-13%)	0.000 (-0.005, 0.005)	0.239 (0.231, 0.246)	0.35 (0.07, 0.61)
eGFRcr (AS-50%)	0.000 (-0.005, 0.005)	0.246 (0.239, 0.253)	0.28 (-0.01, 0.58)
eGFRcr (AS-100%)	0.000 (-0.005, 0.005)	0.238 (0.227, 0.250)	0.32 (-0.11, 0.74)
Black			
eGFRcr (AS) (current population of 31%) *(new)*	0.091 (0.081, 0.1)	0.258 (0.248, 0.268)	4.04 (3.54, 4.49)
Weighted			
eGFRcr (AS-0%)	N/A	0.289 (0.279, 0.299)	6.17 (5.75, 6.77)
eGFRcr (AS-13%)	0.124 (0.115, 0.134)	0.273 (0.264, 0.284)	5.28 (4.67, 5.71)
eGFRcr (AS-50%)	0.062 (0.053, 0.071)	0.248 (0.238, 0.259)	2.92 (2.46, 3.33)
eGFRcr (AS-100%)	0.000 (-0.009, 0.009)	0.238 (0.228, 0.250)	0.32 (-0.12, 0.73)
Non-Black			
eGFRcr (AS)(current population of 31%) *(new)*	-0.042 (-0.048, -0.036)	0.238 (0.230, 0.247)	-1.41 (-1.65, -1.11)
Weighted			
eGFRcr (AS-0%)	0.000 (-0.006, 0.006)	0.232 (0.224, 0.240)	0.43 (0.11, 0.78)
eGFRcr (AS-13%)	-0.019 (-0.025, -0.013)	0.233 (0.225, 0.241)	-0.38 (-0.69, -0.06)
eGFRcr (AS-50%)	-0.062 (-0.068, -0.056)	0.245 (0.237, 0.254)	-2.34 (-2.62, -2.06)
eGFRcr (AS-100%)	N/A	0.269 (0.261, 0.278)	-4.56 (-4.86, -4.2)

Bias on the log scale is computed as mean of the difference between log measured and log estimated GFR. Bias on the natural scale is computed as the median of the difference between measured and estimated GFR.
RMSE, root mean square error, is a measure of model fit and computed on the log scale.
Abbreviations: eGFRcr, estimated glomerular filtration rate creatinine equation; A, age; S, sex; R, race; NB, Non-Black; Weighted, weighted for proportion of Black population

c. Performance of current and new creatinine-cystatin C GFR estimating equations in the 2012 cystatin C development dataset

Equation	Log GFR scale		GFR scale
	Bias	**RMSE**	**Bias**
Overall			
eGFRcys (AS) *(current)*	0.000 (-0.006, 0.006)	0.224 (0.217, 0.231)	0.31 (-0.07, 0.59)
eGFRcr-cys (ASR) *(current)*	0.000 (-0.005, 0.005)	0.195 (0.188, 0.202)	0.09 (-0.14, 0.33)
eGFRcr-cys (ASR-NB) *(new)*	0.031 (0.025, 0.036)	0.201 (0.194, 0.207)	1.60 (1.32, 1.92)
eGFRcr-cys (AS) *(new)*	0.000 (-0.005, 0.005)	0.197 (0.191, 0.204)	0.04 (-0.27, 0.33)
Black			
eGFRcys (AS) *(current)*	-0.004 (-0.014, 0.006)	0.235 (0.225, 0.244)	0.04 (-0.34, 0.52)
eGFRcr-cys (ASR) *(current)*	0.000 (-0.009, 0.009)	0.204 (0.195, 0.214)	0.25 (-0.29, 0.76)
eGFRcr-cys (ASR-NB) *(new)*	0.077 (0.069, 0.086)	0.218 (0.210, 0.228)	3.76 (3.30, 4.18)
eGFRcr-cys (AS) *(new)*	0.036 (0.027, 0.044)	0.208 (0.199, 0.217)	1.89 (1.34, 2.47)
NonBlack			
eGFRcys (AS) *(current)*	0.003 (-0.005, 0.01)	0.216 (0.208, 0.226)	0.50 (0.01, 0.96)
eGFRcr-cys (ASR) *(current)*	0.000 (-0.006, 0.006)	0.188 (0.180, 0.199)	0.04 (-0.24, 0.30)
eGFRcr-cys (ASR-NB) *(new)*	0.000 (-0.006, 0.006)	0.188 (0.180, 0.199)	0.04 (-0.24, 0.30)
eGFRcr-cys (AS) *(new)*	-0.023 (-0.03, -0.017)	0.191 (0.182, 0.201)	-1.15 (-1.50, -0.84)

Bias on the log scale is computed as mean of the difference between log measured and log estimated GFR. Bias on the natural scale is computed as the median of the difference between measured and estimated GFR. RMSE, root mean square error, is a measure of model fit and computed on the log scale.
Abbreviations: eGFRcr, estimated glomerular filtration rate creatinine equation; eGFRcys, estimated glomerular filtration rate cystatin C equation; eGFRcr-cys, estimated glomerular filtration rate creatinine equation; A, age; S, sex; R, race, Non-Black (NB) refers to equations in which Black race is removed

d. Performance of new eGFRcr-cys (AS) equation weighted for proportion of Black individuals in the 2012 development dataset

Equation	Log GFR scale		GFR scale
	Bias	RMSE	Bias
Overall			
eGFRcr-cys (AS) (current population of 40%) *(new)*	0.000 (-0.005, 0.005)	0.197 (0.191, 0.204)	0.04 (-0.27, 0.33)
Weighted			
eGFRcr-cys (AS-0%)	0.000 (-0.005, 0.005)	0.187 (0.178, 0.198)	-0.03 (-0.46, 0.32)
eGFRcr-cys (AS-13%)	0.000 (-0.005, 0.005)	0.191 (0.183, 0.200)	-0.06 (-0.38, 0.26)
eGFRcr-cys (AS-50%)	0.000 (-0.005, 0.005)	0.199 (0.192, 0.205)	0.05 (-0.19, 0.34)
eGFRcr-cys (AS-100%)	0.000 (-0.005, 0.005)	0.200 (0.191, 0.208)	0.39 (-0.03, 0.90)
Black			
eGFRcr-cys (AS) (current population of 40%) *(new)*	0.036 (0.027, 0.044)	0.208 (0.199, 0.217)	1.89 (1.34, 2.47)
Weighted			
eGFRcr-cys (AS-0%)	N/A	0.222 (0.213, 0.232)	3.52 (2.98, 4.15)
eGFRcr-cys (AS-13%)	0.058 (0.049, 0.067)	0.216 (0.207, 0.225)	2.85 (2.25, 3.45)
eGFRcr-cys (AS-50%)	0.029 (0.02, 0.037)	0.205 (0.196, 0.215)	1.59 (1.04, 2.16)
eGFRcr-cys (AS-100%)	0.000 (-0.008, 0.008)	0.200 (0.191, 0.209)	0.39 (-0.12, 0.89)
Non-Black			
eGFRcr-cys (AS)(current population of 40%) *(new)*	-0.023 (-0.03, -0.017)	0.191 (0.182, 0.201)	-1.15 (-1.50, -0.84)
Weighted			
eGFRcr-cys (AS-0%)	0.000 (-0.006, 0.006)	0.187 (0.178, 0.198)	-0.03 (-0.46, 0.34)
eGFRcr-cys (AS-13%)	-0.009 (-0.015, -0.002)	0.188 (0.179, 0.199)	-0.47 (-0.85, -0.09)
eGFRcr-cys (AS-50%)	-0.029 (-0.035, -0.022)	0.193 (0.184, 0.203)	-1.43 (-1.71, -1.07)
eGFRcr-cys (AS-100%)	N/A	0.220 (0.212, 0.229)	-1.61 (-1.93, -1.22)

Bias on the log scale is computed as mean of the difference between log measured and log estimated GFR. Bias on the natural scale is computed as the median of the difference between measured and estimated GFR. RMSE, root mean square error, is a measure of model fit and computed on the log scale.
Abbreviations: eGFRcr, estimated glomerular filtration rate creatinine equation; eGFRcys, estimated glomerular filtration rate cystatin C equation; eGFRcr-cys, estimated glomerular filtration rate creatinine equation; A, age; S, sex; R, race; Weighted, weighted for proportion of Black population

Table S13: Performance in validation dataset

a. Performance in 2021 Validation dataset for equations for current vs new equations

Equation	Bias	IQR	P_{30}	RMSE
Overall				
eGFRcr (ASR) *(current)*	-0.8 (-1.2, -0.3)	17.0 (16.2, 17.6)	88.8 (87.8, 89.8)	0.192 (0.187, 0.197)
eGFRcr (ASR-NB) *(new)*	0.4 (0.0, 0.8)	16.8 (16.0, 17.6)	89.0 (88.0, 90.0)	0.196 (0.191, 0.202)
eGFRcr (AS) *(new)*	-3.1 (-3.5, -2.6)	17.5 (16.7, 18.1)	86.6 (85.5, 87.6)	0.201 (0.196, 0.206)
eGFRcys (AS) *(current)*	0.6 (0.1, 1.0)	18.0 (17.3, 18.7)	88.2 (87.2, 89.2)	0.209 (0.203, 0.215)
eGFRcr-cys (ASR) *(current)*	-0.7 (-1.1, -0.4)	15.3 (14.7, 16.0)	91.9 (91.1, 92.7)	0.172 (0.167, 0.176)
eGFRcr-cys (ASR-NB) *(new)*	-0.2 (-0.5, 0.2)	15.1 (14.6, 15.7)	92.2 (91.4, 93.0)	0.173 (0.168, 0.178)
eGFRcr-cys (AS) *(new)*	-2.5 (-2.9, -2.1)	15.8 (15.2, 16.3)	90.8 (89.9, 91.6)	0.177 (0.172, 0.182)
Black				
eGFRcr (ASR) *(current)*	-3.7 (-5.4, -1.8)	22.8 (20.0, 24.7)	85.1 (82.2, 87.9)	0.205 (0.194, 0.217)
eGFRcr (ASR-NB) *(new)*	7.1 (5.9, 8.8)	21.4 (18.1, 23.3)	86.4 (83.4, 89.1)	0.232 (0.218, 0.246)
eGFRcr (AS) *(new)*	3.6 (1.8, 5.5)	21.6 (18.3, 23.6)	87.2 (84.5, 90.0)	0.211 (0.199, 0.224)
eGFRcys (AS) *(current)*	-0.1 (-1.5, 1.6)	22.8 (20.9, 24.7)	84.6 (81.7, 87.6)	0.225 (0.209, 0.241)
eGFRcr-cys (ASR) *(current)*	-2.5 (-3.7, -1.2)	20.3 (18.5, 21.9)	88.6 (85.8, 91.2)	0.189 (0.177, 0.200)
eGFRcr-cys (ASR-NB) *(new)*	3.4 (1.5, 4.5)	19.7 (17.8, 21.2)	90.8 (88.4, 93.1)	0.195 (0.182, 0.208)
eGFRcr-cys (AS) *(new)*	0.1 (-0.9, 1.6)	20.1 (18.5, 22.0)	90.5 (88.1, 92.9)	0.190 (0.178, 0.203)
Non-Black				
eGFRcr (ASR) *(current)*	-0.5 (-0.9, 0.0)	16.1 (15.5, 16.8)	89.5 (88.5, 90.4)	0.190 (0.184, 0.195)
eGFRcr (ASR-NB) *(new)*	-0.5 (-0.9, 0.0)	16.1 (15.5, 16.8)	89.5 (88.5, 90.4)	0.190 (0.184, 0.195)
eGFRcr (AS) *(new)*	-3.9 (-4.4, -3.4)	16.7 (16.0, 17.4)	86.5 (85.4, 87.6)	0.199 (0.194, 0.205)
eGFRcys (AS) *(current)*	0.7 (0.2, 1.2)	17.2 (16.5, 18.0)	88.9 (87.9, 89.9)	0.206 (0.200, 0.214)
eGFRcr-cys (ASR) *(current)*	-0.6 (-0.9, -0.2)	14.5 (13.9, 15.2)	92.4 (91.5, 93.2)	0.169 (0.163, 0.174)
eGFRcr-cys (ASR-NB) *(new)*	-0.6 (-0.9, -0.2)	14.5 (13.9, 15.2)	92.4 (91.5, 93.2)	0.169 (0.163, 0.174)
eGFRcr-cys (AS) *(new)*	-2.9 (-3.3, -2.5)	15.4 (14.7, 16.0)	90.8 (89.9, 91.8)	0.174 (0.169, 0.180)

Abbreviations: eGFRcr, estimated glomerular filtration rate creatinine equation; eGFRcys, estimated glomerular filtration rate cystatin C equation; eGFRcr-cys, estimated glomerular filtration rate creatinine equation; A, age; S, sex; R, race; Non-Black (NB) refers to equations in which Black race is removed; IQR, interquartile range

Bias is computed as the median of the difference between measured and estimated GFR. IQR, interquartile range, is computed as the difference between the 25th and 75th percentiles. Units for bias and IQR are ml/min per 1.73 m^2. P_{30} is a measure of accuracy and is computed as percent (%) of estimates within than 30% of the measured GFR; RMSE, root mean square error, is a second measure of accuracy and computed on the log scale.

b. Performance in 2021 Validation Dataset for equations adjusting for possible variation in GFR measurement methods

Equation	Bias	IQR	P_{30}	RMSE
Overall				
eGFRcr (ASR) *(current)*	2.2 (1.7, 2.7)	17.3 (16.6, 18.0)	90.2 (89.3, 91.0)	0.193 (0.188, 0.199)
eGFRcr (ASR-NB) *(new)*	3.3 (2.9, 3.7)	17.3 (16.6, 17.9)	89.7 (88.7, 90.6)	0.202 (0.197, 0.208)
eGFRcr (AS) *(new)*	-0.1 (-0.5, 0.2)	17.6 (16.9, 18.3)	88.5 (87.5, 89.5)	0.196 (0.191, 0.202)
eGFRcys (AS) *(current)*	3.6 (3.1, 4.2)	18.2 (17.5, 18.8)	87.6 (86.6, 88.6)	0.219 (0.213, 0.226)
eGFRcr-cys (ASR) *(current)*	1.9 (1.6, 2.3)	15.1 (14.5, 15.7)	93.1 (92.4, 93.9)	0.175 (0.170, 0.180)
eGFRcr-cys (ASR-NB) *(new)*	2.5 (2.1, 2.9)	15.3 (14.6, 15.9)	92.9 (92.1, 93.7)	0.179 (0.174, 0.184)
eGFRcr-cys (AS) *(new)*	0.0 (-0.3, 0.4)	15.4 (14.7, 16.1)	92.5 (91.7, 93.3)	0.175 (0.170, 0.180)
Black				
eGFRcr (ASR) *(current)*	0.2 (-1.5, 2.1)	22.7 (19.8, 25.0)	86.2 (83.2, 88.9)	0.202 (0.190, 0.214)
eGFRcr (ASR-NB) *(new)*	10.6 (9.2, 12.2)	22.5 (19.5, 24.5)	82.9 (79.6, 86.0)	0.257 (0.243, 0.272)
eGFRcr (AS) *(new)*	6.8 (5.7, 8.8)	21.9 (19.3, 24.9)	85.8 (82.7, 88.6)	0.229 (0.215, 0.243)
eGFRcys (AS) *(current)*	3.7 (2.0, 5.3)	22.8 (20.8, 24.5)	83.4 (80.3, 86.4)	0.236 (0.219, 0.253)
eGFRcr-cys (ASR) *(current)*	0.9 (-0.6, 2.6)	20.8 (18.8, 22.5)	90.7 (88.3, 92.9)	0.189 (0.177, 0.202)
eGFRcr-cys (ASR-NB) *(new)*	7.0 (5.3, 8.6)	20.2 (18.3, 22.1)	89.3 (86.7, 91.9)	0.213 (0.200, 0.228)
eGFRcr-cys (AS) *(new)*	4.1 (2.3, 5.5)	21.0 (18.9, 22.6)	91.0 (88.6, 93.4)	0.200 (0.187, 0.214)
Non-Black				
eGFRcr (ASR) *(current)*	2.5 (2.0, 2.8)	16.7 (15.9, 17.4)	90.8 (89.9, 91.8)	0.192 (0.186, 0.197)
eGFRcr (ASR-NB) *(new)*	2.5 (2.0, 2.8)	16.7 (15.9, 17.4)	90.8 (89.9, 91.8)	0.192 (0.186, 0.197)
eGFRcr (AS) *(new)*	-1.0 (-1.5, -0.5)	16.8 (16.1, 17.6)	89.0 (88.0, 90.1)	0.190 (0.185, 0.196)
eGFRcys (AS) *(current)*	3.6 (3.1, 4.2)	17.5 (16.7, 18.2)	88.3 (87.2, 89.3)	0.216 (0.209, 0.223)
eGFRcr-cys (ASR) *(current)*	2.0 (1.7, 2.4)	14.3 (13.8, 15.0)	93.5 (92.7, 94.3)	0.172 (0.167, 0.178)
eGFRcr-cys (ASR-NB) *(new)*	2.0 (1.7, 2.4)	14.3 (13.8, 15.0)	93.5 (92.7, 94.3)	0.172 (0.167, 0.178)
eGFRcr-cys (AS) *(new)*	-0.3 (-0.7, 0.0)	14.8 (14.1, 15.4)	92.8 (91.9, 93.6)	0.170 (0.165, 0.176)

Abbreviations: eGFRcr, estimated glomerular filtration rate creatinine equation; eGFRcys, estimated glomerular filtration rate cystatin C equation; eGFRcr-cys, estimated glomerular filtration rate creatinine equation; A, age; S, sex; R, race; Non-Black (NB) refers to equations in which Black race is removed; IQR, interquartile range

Bias is computed as the median of the difference between measured and estimated GFR. IQR, interquartile range, is computed as the difference between the 25th and 75th percentiles. Units for bias and IQR are ml/min per 1.73 m^2. P_{30} is a measure of accuracy and is computed as percent (%) of estimates within than 30% of the measured GFR; RMSE, root mean square error, is a second measure of accuracy and computed on the log scale.

c. Performance in 2021 Validation Dataset for equations weighted for proportion of Black individuals in the development dataset

Equation	Bias	IQR	P_{30}	RMSE
Overall				
eGFRcr (AS) *(new)*	-3.1 (-3.5, -2.6)	17.5 (16.7, 18.1)	86.6 (85.5, 87.6)	0.201 (0.196, 0.206)
Weighted				
eGFRcr (AS-0%)	-0.9 (-1.3, -0.4)	16.5 (15.8, 17.2)	88.8 (87.7, 89.8)	0.193 (0.187, 0.199)
eGFRcr (AS-13%)	-1.4 (-1.9, -1.0)	17.3 (16.5, 18.0)	87.6 (86.5, 88.6)	0.198 (0.193, 0.203)
eGFRcr (AS-50%)	-2.1 (-2.8, -1.2)	19.2 (17.9, 20.1)	85.8 (84.3, 87.4)	0.205 (0.198, 0.212)
eGFRcr (AS-100%)	-0.2 (-2.2, 1.0)	20.5 (18.1, 22.8)	87.2 (84.4, 90.0)	0.195 (0.183, 0.206)
eGFRcr-cys (AS) *(new)*	-2.5 (-2.9, -2.1)	15.8 (15.2, 16.3)	90.8 (89.9, 91.6)	0.177 (0.172, 0.182)
Weighted				
eGFRcr-cys (AS-0%)	-1.8 (-2.3, -1.3)	15.8 (15.1, 16.3)	90.8 (89.9, 91.8)	0.175 (0.170, 0.180)
eGFRcr-cys (AS-13%)	-2.0 (-2.4, -1.6)	16.0 (15.4, 16.6)	90.2 (89.3, 91.1)	0.178 (0.173, 0.183)
eGFRcr-cys (AS-50%)	-1.6 (-2.3, -0.9)	17.3 (16.2, 18.4)	90.7 (89.4, 92.0)	0.181 (0.174, 0.188)
eGFRcr-cys (AS-100%)	1.1 (-0.1, 2.4)	19.2 (17.2, 21.2)	91.5 (89.1, 93.7)	0.186 (0.174, 0.198)
Black				
eGFRcr (AS) *(new)*	3.6 (1.8, 5.5)	21.6 (18.3, 23.6)	87.2 (84.5, 90.0)	0.211 (0.199, 0.224)
Weighted				
eGFRcr (AS-0%)	6.9 (5.6, 8.7)	21.4 (18.2, 23.5)	86.0 (82.9, 88.9)	0.233 (0.220, 0.247)
eGFRcr (AS-13%)	5.5 (4.0, 7.4)	21.7 (18.3, 23.6)	86.4 (83.4, 89.1)	0.222 (0.209, 0.236)
eGFRcr (AS-50%)	2.1 (0.2, 3.9)	21.1 (18.3, 23.6)	87.0 (84.3, 89.6)	0.204 (0.192, 0.216)
eGFRcr (AS-100%)	-0.2 (-2.1, 1.0)	20.5 (18.2, 23.0)	87.2 (84.5, 89.8)	0.195 (0.183, 0.206)
eGFRcr-cys (AS) *(new)*	0.1 (-0.9, 1.6)	20.1 (18.5, 22.0)	90.5 (88.1, 92.9)	0.190 (0.178, 0.203)
Weighted				
eGFRcr-cys (AS-0%)	1.7 (0.3, 3.0)	20.6 (18.8, 22.1)	89.3 (86.7, 91.7)	0.197 (0.184, 0.211)
eGFRcr-cys (AS-13%)	0.9 (-0.4, 2.1)	20.5 (18.8, 22.3)	89.1 (86.5, 91.5)	0.195 (0.182, 0.208)
eGFRcr-cys (AS-50%)	0.1 (-1.0, 1.5)	20.0 (18.3, 21.8)	90.5 (88.1, 92.9)	0.188 (0.176, 0.200)
eGFRcr-cys (AS-100%)	1.1 (-0.1, 2.5)	19.2 (17.3, 21.4)	91.5 (89.3, 93.8)	0.186 (0.174, 0.198)
Non-Black				
eGFRcr (AS) *(new)*	-3.9 (-4.4, -3.4)	16.7 (16.0, 17.4)	86.5 (85.4, 87.6)	0.199 (0.194, 0.205)
Weighted				
eGFRcr (AS-0%)	-0.9 (-1.3, -0.4)	16.5 (15.8, 17.2)	88.8 (87.8, 89.8)	0.193 (0.187, 0.198)
eGFRcr (AS-13%)	-2.3 (-2.8, -1.8)	16.5 (15.8, 17.3)	87.8 (86.7, 88.9)	0.194 (0.189, 0.200)
eGFRcr (AS-50%)	-5.3 (-5.8, -4.8)	16.7 (16.1, 17.5)	84.6 (83.4, 85.9)	0.206 (0.200, 0.212)
eGFRcr (AS-100%)	-7.8 (-8.4, -7.3)	16.9 (16.2, 17.6)	79.1 (77.9, 80.4)	0.223 (0.217, 0.230)
eGFRcr-cys (AS) *(new)*	-2.9 (-3.3, -2.5)	15.4 (14.7, 16.0)	90.8 (89.9, 91.8)	0.174 (0.169, 0.180)
Weighted				
eGFRcr-cys (AS-0%)	-1.8 (-2.3, -1.3)	15.8 (15.1, 16.3)	90.8 (89.9, 91.7)	0.175 (0.170, 0.180)
eGFRcr-cys (AS-13%)	-2.3 (-2.8, -1.9)	15.7 (15.1, 16.4)	90.4 (89.5, 91.3)	0.176 (0.171, 0.181)
eGFRcr-cys (AS-50%)	-3.0 (-3.4, -2.6)	15.1 (14.5, 15.7)	91.0 (90.0, 91.9)	0.174 (0.169, 0.179)
eGFRcr-cys (AS-100%)	-2.9 (-3.3, -2.5)	14.8 (14.0, 15.4)	90.4 (89.4, 91.4)	0.180 (0.174, 0.186)

Weighted, weighted for proportion of Black population; IQR, interquartile range. Bias is computed as the median of the difference between measured and estimated GFR. IQR, interquartile range, is computed as the difference between the 25th and 75th percentiles. Units for bias and IQR are ml/min per 1.73 m^2. P_{30} is a measure of accuracy and is computed as percent (%) of estimates within than 30% of the measured GFR; RMSE, root mean square error, is a second measure of accuracy and computed on the log scale.

d. Performance in 2021 validation dataset of alternative GFR estimating equations developed by other research groups

Equation	Filtration Maker	Bias	IQR	P_{30}	RMSE
Overall					
FAS 2016 (AS)[16]	Cr	2.6 (2.2, 3.1)	17.0 (16.2, 17.7)	89.4 (88.4, 90.3)	0.201 (0.196, 0.207)
LM 2011 (AS)[17]	Cr	7.0 (6.4, 7.4)	16.8 (16.2, 17.3)	88.3 (87.3, 89.2)	0.220 (0.214, 0.225)
EKFC 2020 (AS)[18]	Cr	3.0 (2.5, 3.4)	16.3 (15.6, 16.9)	87.8 (86.8, 88.8)	0.323 (0.302, 0.344)
FAS 2017 (A)[20]	Cys	2.6 (2.2, 3.0)	18.9 (18.1, 19.4)	85.6 (84.5, 86.7)	0.228 (0.221, 0.236)
CAPA 2014 (A)[19]	Cys	1.9 (1.5, 2.4)	17.8 (17.1, 18.4)	86.7 (85.7, 87.8)	0.219 (0.212, 0.225)
FAS 2017 (AS)[20]	Cr-Cys	3.0 (2.4, 3.4)	16.1 (15.6, 16.6)	91.6 (90.7, 92.5)	0.190 (0.184, 0.196)
Avg of LMR CAPA 2011 (AS)	Cr-Cys	4.0 (3.6, 4.4)	15.0 (14.4, 15.7)	92.8 (91.9, 93.6)	0.187 (0.182, 0.192)
Black					
FAS 2016 (AS)[16]	Cr	8.3 (6.6, 9.6)	19.2 (17.0, 21.8)	86.5 (83.8, 89.3)	0.222 (0.209, 0.234)
LM 2011 (AS)[17]	Cr	13.4 (12.3, 14.8)	20.6 (18.6, 22.4)	79.8 (76.3, 83.1)	0.276 (0.262, 0.290)
EKFC 2020 (AS)[18]	Cr	9.1 (7.7, 10.6)	19.8 (17.8, 22.3)	85.0 (82.0, 87.9)	0.264 (0.236, 0.293)
FAS 2017 (A)[20]	Cys	3.3 (2.2, 5.1)	22.6 (19.9, 24.7)	85.0 (82.0, 87.8)	0.227 (0.212, 0.242)
CAPA 2014 (A)[19]	Cys	3.4 (2.2, 5.2)	24.2 (21.4, 25.9)	81.7 (78.4, 84.8)	0.244 (0.228, 0.260)
FAS 2017 (AS)[20]	Cr-Cys	6.7 (5.3, 7.9)	19.1 (16.9, 20.8)	90.8 (88.4, 93.1)	0.199 (0.188, 0.210)
Avg of LMR CAPA 2011 (AS)	Cr-Cys	8.4 (7.0, 10.2)	20.1 (18.1, 22.1)	88.6 (86.0, 91.0)	0.222 (0.210, 0.235)
Non-Black					
FAS 2016 (AS)[16]	Cr	1.8 (1.5, 2.2)	16.5 (15.8, 17.2)	89.8 (88.9, 90.8)	0.198 (0.191, 0.204)
LM 2011 (AS)[17]	Cr	5.8 (5.4, 6.3)	15.8 (15.2, 16.6)	89.7 (88.6, 90.7)	0.209 (0.203, 0.215)
EKFC 2020 (AS)[18]	Cr	2.1 (1.6, 2.6)	15.6 (14.8, 16.4)	88.2 (87.2, 89.3)	0.332 (0.309, 0.355)
FAS 2017 (A)[20]	Cys	2.5 (1.9, 3.0)	18.5 (17.6, 19.2)	85.7 (84.6, 86.9)	0.229 (0.220, 0.237)
CAPA 2014 (A)[19]	Cys	1.7 (1.3, 2.1)	17.0 (16.2, 17.8)	87.6 (86.5, 88.6)	0.214 (0.208, 0.222)
FAS 2017 (AS)[20]	Cr-Cys	2.4 (1.9, 2.9)	15.6 (15.0, 16.2)	91.7 (90.8, 92.7)	0.188 (0.181, 0.195)
Avg of LMR CAPA 2011 (AS)	Cr-Cys	3.5 (3.1, 3.9)	14.2 (13.4, 14.8)	93.5 (92.7, 94.3)	0.180 (0.175, 0.186)

mGFR, measured glomerular filtration rate (ml/min/1.73m2); LM, Lund-Malmo; CAPA, Caucasian and Asian Pediatric and Adult; FAS, Full-Age Spectrum; EKFC, European Kidney Function Consortium; Avg of LMR, is the average between Lund-Malmo and Caucasian and Asian Pediatric and Adult equations; Cr, creatinine, Cys, cystatin C, A, age; S, sex; R, race; IQR, interquartile range.

Bias is computed as the median of the difference between measured and estimated GFR. IQR, interquartile range, is computed as the difference between the 25th and 75th percentiles. Units for bias and IQR are ml/min per 1.73 m^2. P_{30} is a measure of accuracy and is computed as percent (%) of estimates within than 30% of the measured GFR; RMSE, root mean square error, is a second measure of accuracy and computed on the log scale.

e. Performance in 2009 external validation dataset of current vs new creatinine equations

Equation	Bias	IQR	P_{30}	RMSE
Overall				
eGFRcr (ASR) *(current)*	2.6 (2.2, 3.0)	17.1 (16.4, 17.9)	84.0 (82.9, 85.2)	0.251 (0.242, 0.261)
eGFRcr (ASR-NB) *(new)*	3.2 (2.7, 3.8)	17.2 (16.4, 17.9)	83.6 (82.6, 84.8)	0.254 (0.245, 0.263)
eGFRcr (AS) *(new)*	0.9 (0.4, 1.3)	17.2 (16.4, 18.0)	83.5 (82.3, 84.6)	0.249 (0.240, 0.259)
Black				
eGFRcr (ASR) *(current)*	-0.8 (-2.0, 0.7)	15.8 (12.9, 18.5)	81.2 (77.2, 85.2)	0.245 (0.222, 0.267)
eGFRcr (ASR-NB) *(new)*	5.3 (4.6, 7.0)	16.4 (14.0, 18.6)	77.2 (72.8, 81.5)	0.273 (0.253, 0.293)
eGFRcr (AS) *(new)*	3.3 (2.2, 4.7)	16.1 (13.8, 18.1)	80.9 (76.9, 84.9)	0.252 (0.231, 0.272)
Non-Black				
eGFRcr (ASR) *(current)*	2.9 (2.4, 3.4)	17.3 (16.5, 18.0)	84.3 (83.1, 85.6)	0.252 (0.242, 0.262)
eGFRcr (ASR-NB) *(new)*	2.9 (2.4, 3.4)	17.3 (16.5, 18.0)	84.3 (83.1, 85.6)	0.252 (0.242, 0.262)
eGFRcr (AS) *(new)*	0.5 (0.1, 1.0)	17.4 (16.5, 18.1)	83.8 (82.5, 85.0)	0.249 (0.239, 0.260)

Abbreviations: eGFRcr, estimated glomerular filtration rate creatinine equation; A, age; S, sex; R, race; Non-Black (NB) refers to equations in which Black race is removed; IQR, interquartile range

Bias is computed as the median of the difference between measured and estimated GFR. IQR, interquartile range, is computed as the difference between the 25th and 75th percentiles. Units for bias and IQR are ml/min per 1.73 m^2. P_{30} is a measure of accuracy and is computed as percent (%) of estimates within than 30% of the measured GFR; RMSE, root mean square error, is a second measure of accuracy and computed on the log scale.

f. Performance in 2012 external validation dataset of current vs new creatinine, cystatin and creatinine-cystatin C equations

Equation	Bias	IQR	P_{30}	RMSE
Overall				
eGFRcr (ASR) *(current)*	3.9 (3.1, 4.7)	15.4 (14.3, 16.5)	87.3 (85.3, 89.2)	0.224 (0.213, 0.235)
eGFRcr (ASR-NB) *(new)*	4.1 (3.3, 5.1)	15.5 (14.4, 16.7)	87.2 (85.3, 89.2)	0.226 (0.215, 0.237)
eGFRcr (AS) *(new)*	2.0 (1.3, 2.8)	15.3 (14.3, 16.3)	87.5 (85.5, 89.5)	0.217 (0.205, 0.230)
eGFRcys (AS) *(current)*	3.3 (2.3, 4.4)	16.4 (14.8, 17.7)	85.8 (83.7, 87.8)	0.234 (0.219, 0.250)
eGFRcr-cys (ASR) *(current)*	3.8 (3.1, 4.5)	13.4 (12.3, 14.4)	91.5 (89.8, 93.0)	0.189 (0.178, 0.201)
eGFRcr-cys (ASR-NB) *(new)*	3.9 (3.3, 4.6)	13.5 (12.4, 14.4)	91.6 (89.9, 93.2)	0.189 (0.178, 0.201)
eGFRcr-cys (AS) *(new)*	2.4 (1.5, 3.2)	13.0 (11.9, 14.2)	92.4 (90.8, 93.9)	0.183 (0.171, 0.197)
Black				
eGFRcr (ASR) *(current)*	3.3 (-0.7, 4.9)	10.2 (4.8, 14.5)	90.0 (76.7, 100.0)	0.194 (0.145, 0.242)
eGFRcr (ASR-NB) *(new)*	8.1 (6.2, 11.3)	11.8 (5.0, 17.9)	86.7 (73.3, 96.7)	0.266 (0.210, 0.325)
eGFRcr (AS) *(new)*	6.4 (3.4, 9.3)	10.6 (5.7, 16.2)	83.3 (70.0, 96.7)	0.228 (0.176, 0.279)
eGFRcys (AS) *(current)*	-3.2 (-7.1, 0.2)	9.9 (6.2, 21.8)	76.7 (60.0, 90.0)	0.259 (0.182, 0.332)
eGFRcr-cys (ASR) *(current)*	-0.9 (-3.3, 2.4)	9.4 (5.4, 16.8)	86.7 (73.3, 96.7)	0.187 (0.135, 0.242)
eGFRcr-cys (ASR-NB) *(new)*	2.6 (0.6, 5.8)	10.2 (5.3, 17.4)	90.0 (80.0, 100.0)	0.189 (0.142, 0.234)
eGFRcr-cys (AS) *(new)*	0.5 (-2.0, 4.4)	8.7 (5.3, 18.2)	96.7 (90.0, 100.0)	0.186 (0.139, 0.236)
Non-Black				
eGFRcr (ASR) *(current)*	3.9 (3.1, 4.9)	15.6 (14.5, 16.8)	87.2 (85.3, 89.2)	0.225 (0.213, 0.236)
eGFRcr (ASR-NB) *(new)*	3.9 (3.1, 4.9)	15.6 (14.5, 16.8)	87.2 (85.3, 89.2)	0.225 (0.213, 0.236)
eGFRcr (AS) *(new)*	1.8 (1.1, 2.6)	15.4 (14.4, 16.3)	87.6 (85.7, 89.4)	0.217 (0.204, 0.230)
eGFRcys (AS) *(current)*	3.5 (2.6, 4.7)	16.4 (14.9, 17.7)	86.0 (83.9, 88.0)	0.233 (0.218, 0.249)
eGFRcr-cys (ASR) *(current)*	4.0 (3.3, 4.8)	13.5 (12.5, 14.4)	91.6 (89.9, 93.3)	0.189 (0.178, 0.201)
eGFRcr-cys (ASR-NB) *(new)*	4.0 (3.3, 4.8)	13.5 (12.5, 14.4)	91.6 (89.9, 93.3)	0.189 (0.178, 0.201)
eGFRcr-cys (AS) *(new)*	2.4 (1.5, 3.2)	13.0 (12.0, 14.2)	92.3 (90.7, 93.9)	0.183 (0.171, 0.196)

Abbreviations: eGFRcr, estimated glomerular filtration rate creatinine equation; eGFRcys, estimated glomerular filtration rate cystatin C equation; eGFRcr-cys, estimated glomerular filtration rate creatinine equation; A, age; S, sex; R, race; Non-Black (NB) refers to equations in which Black race is removed; IQR, interquartile range

Bias is computed as the median of the difference between measured and estimated GFR. IQR, interquartile range, is computed as the difference between the 25^{th} and 75^{th} percentiles. Units for bias and IQR are ml/min per 1.73 m^2. P_{30} is a measure of accuracy and is computed as percent (%) of estimates within than 30% of the measured GFR; RMSE, root mean square error, is a second measure of accuracy and computed on the log scale.

Table S14: Agreement and disagreement between mGFR and eGFR categories

Equation	Black Individuals			Non-Black Individuals		
	Agreement, % (CI)	eGFR too high (upward), % (CI)	eGFR too low (downward), % (CI)	Agreement, % (CI)	eGFR too high (upward) % (CI)	eGFR too low (downward) % (CI)
eGFRcr (ASR) *(current)*	63.2 (59.3, 67.1)	14.9 (12.0, 17.7)	21.9 (18.6, 25.3)	68.5 (67.0, 70.1)	14.0 (12.8 ,15.2)	17.5 (16.2, 18.7)
eGFRcr (ASR-NB) *(new)*	59.2 (55.2, 63.2)	33.5 (29.7, 37.4)	7.3 (5.1, 9.4)	68.5 (67.0, 70.1)	14.0 (12.8, 15.2)	17.5 (16.2, 18.7)
eGFRcr (AS) *(new)*	61.8 (57.9, 65.8)	27.3 (23.7, 30.9)	10.9 (8.3, 13.4)	66.7 (65.1, 68.2)	9.0 (8.0, 9.9)	24.3 (22.9, 25.8)
eGFRcys (AS) *(current)*	62.5 (58.6, 66.5)	21.4 (18.1, 24.8)	16.1 (13.1, 19.1)	66.1 (64.5, 67.7)	19.3 (18.0, 20.6)	14.6 (13.5, 15.8)
eGFRcr-cys (ASR) *(current)*	67.9 (64.1, 71.7)	13.6 (10.8, 16.4)	18.5 (15.3, 21.6)	70.8 (69.3, 72.4)	13.4 (12.3, 14.5)	15.8 (14.5, 17.0)
eGFRcr-cys (ASR-NB) *(new)*	66.5 (62.6, 70.3)	22.6 (19.2, 26.0)	10.9 (8.3, 13.4)	70.8 (69.3, 72.4)	13.4 (12.3, 14.5)	15.8 (14.5, 17.0)
eGFRcr-cys (AS) *(new)*	68.4 (64.6, 72.2)	16.6 (13.6, 19.6)	15.0 (12.1, 17.9)	70.2 (68.6, 71.7)	10.1 (9.1, 11.1)	19.7 (18.4, 21.0)

Shown is agreement was ascertained between measured GFR and estimated GFR using guideline recommended CKD GFR (G) stages < 30, 30-44, 45-59, 60-89 and > 90 ml/min/1.73m^2.

Abbreviations: mGFR, measured GFR; eGFRcr, estimated glomerular filtration rate creatinine equation; eGFRcys, estimated glomerular filtration rate cystatin C equation; eGFRcr-cys, estimated glomerular filtration rate creatinine equation; A, age; S, sex; R, race; NB, Non-Black; CI, confidence interval

Table S15: Prevalence of total CKD and CKD stages, defined with eGFR and persistent ACR, overall and stratified by race groups

	Overall			Non-Black			Black		
	Unweighted N	**Weighted N**, millions**	**Prevalence, % (SE)***	**Unweighted N**	**Weighted N**, millions**	**Prevalence, % (SE)***	**Unweighted N**	**Weighted N**, millions**	**Prevalence, % (SE)***
eGFRcr (ASR) *(current)*	1179	29.6	12.0 (0.6)	948	25.2	11.7 (0.9)	231	4.6	14.3 (1.1)
Stage 1	111	7.3	3.0 (0.4)	84	5.8	2.7 (0.7)	27	1.6	4.9 (0.9)
Stage 2	254	5.4	2.2 (0.2)	200	4.6	2.1 (0.4)	54	0.9	2.9 (0.5)
Stage 3a	526	11.1	4.5 (0.3)	439	9.8	4.6 (0.4)	87	1.2	3.7 (0.4)
Stage 3b	200	4.3	1.7 (0.1)	166	3.8	1.8 (0.2)	34	0.4	1.4 (0.3)
Stage 4	88	1.5	0.6 (0.1)	59	1.1	0.5 (0.1)	29	0.4	1.4 (0.3)
eGFRcr (ASR-NB) *(new)*	1251	30.5	12.4 (0.6)	948	25.2	11.7 (0.9)	303	5.6	17.8 (1.3)
Stage 1	101	7.0	2.8 (0.4)	84	5.8	2.7 (0.7)	17	1.2	3.8 (0.7)
Stage 2	245	5.6	2.3 (0.2)	200	4.6	2.1 (0.4)	45	1.1	3.6 (0.7)
Stage 3a	581	11.7	4.8 (0.3)	439	9.8	4.6 (0.4)	142	2.0	6.2 (0.6)
Stage 3b	226	4.5	1.8 (0.1)	166	3.8	1.8 (0.2)	60	0.8	2.4 (0.3)
Stage 4	98	1.6	0.7 (0.1)	59	1.1	0.5 (0.1)	39	0.6	1.8 (0.3)
eGFRcr (AS) *(new)*	1089	26.9	10.9 (0.6)	823	22.0	10.2 (1.0)	266	5.2	16.3 (1.2)
Stage 1	135	7.8	3.2 (0.4)	114	6.6	3.1 (0.8)	21	1.2	3.9 (0.8)
Stage 2	238	5.2	2.1 (0.2)	186	4.1	1.9 (0.3)	52	1.2	3.9 (0.7)
Stage 3a	461	9.0	3.6 (0.3)	343	7.4	3.4 (0.3)	118	1.7	5.3 (0.4)
Stage 3b	176	3.7	1.5 (0.1)	134	3.2	1.5 (0.2)	42	0.5	1.7 (0.3)
Stage 4	79	1.2	0.5 (0.1)	46	0.8	0.4 (0.1)	33	0.5	1.5 (0.3)
eGFRcys (AS) *(current)*	1277	33.0	13.4 (0.7)	1047	28.6	13.3 (1.0)	230	4.5	14.2 (1.3)
Stage 1	121	6.6	2.7 (0.4)	89	5.2	2.4 (0.7)	32	1.6	5.0 (1.0)
Stage 2	189	5.1	2.1 (0.3)	148	4.4	2.0 (0.4)	41	0.8	2.4 (0.5)
Stage 3a	511	12.2	4.9 (0.4)	428	11.0	5.1 (0.5)	83	1.1	3.5 (0.6)
Stage 3b	303	6.1	2.5 (0.2)	268	5.5	2.6 (0.2)	35	0.5	1.5 (0.3)
Stage 4	153	3.1	1.3 (0.2)	114	2.6	1.2 (0.2)	39	0.6	1.8 (0.3)
eGFRcr-cys (ASR) *(current)*	1174	29.8	12.1 (0.6)	955	25.5	11.9 (1.0)	219	4.3	13.6 (1.2)
Stage 1	120	7.0	2.8 (0.4)	90	5.5	2.6 (0.7)	30	1.6	5.1 (0.9)
Stage 2	221	5.3	2.2 (0.3)	172	4.5	2.1 (0.4)	49	0.8	2.5 (0.5)

Stage 3a	504	10.9	4.4 (0.4)	427	9.9	4.6 (0.4)	77	1.0	3.1 (0.4)
Stage 3b	207	4.1	1.7 (0.2)	181	3.8	1.7 (0.2)	26	0.4	1.1 (0.2)
Stage 4	122	2.4	1.0 (0.1)	85	1.9	0.9 (0.2)	37	0.5	1.7 (0.3)
eGFRcr-cys (ASR-NB) *(new)*	1199	30.1	12.2 (0.6)	955	25.5	11.9 (0.9)	244	4.7	14.7 (1.2)
Stage 1	113	6.8	2.8 (0.4)	90	5.5	2.6 (0.7)	23	1.4	4.4 (0.9)
Stage 2	220	5.5	2.2 (0.3)	172	4.5	2.1 (0.4)	48	1.0	3.1 (0.6)
Stage 3a	520	11.1	4.5 (0.3)	427	9.9	4.6 (0.4)	93	1.2	3.7 (0.3)
Stage 3b	222	4.3	1.7 (0.2)	181	3.8	1.7 (0.2)	41	0.5	1.7 (0.3)
Stage 4	124	2.4	1.0 (0.1)	85	1.9	0.9 (0.2)	39	0.6	1.8 (0.3)
eGFRcr-cys (AS) *(new)*	1107	28.0	11.4 (0.6)	881	23.7	11.0 (1.0)	227	4.4	13.9 (1.2)
Stage 1	134	7.6	3.1 (0.4)	108	6.2	2.9 (0.8)	26	1.5	4.6 (0.9)
Stage 2	213	5.0	2.0 (0.2)	162	4.1	1.9 (0.4)	52	1.0	3.0 (0.5)
Stage 3a	459	9.4	3.8 (0.3)	380	8.4	3.9 (0.4)	79	1.0	3.2 (0.4)
Stage 3b	183	3.8	1.5 (0.1)	150	3.3	1.5 (0.2)	33	0.4	1.4 (0.3)
Stage 4	118	2.2	0.9 (0.1)	81	1.7	0.8 (0.1)	37	0.5	1.7 (0.3)

* SE from bootstrap

** Weighted N was based on 2019 US population estimation.

CKD stage:

Stage 1: eGFR≥90 & persistent ACR≥30 (50.9 % of the proportion of individuals with ACR between 30-299 and eGFR ≥ 90, and 100% of those with ACR≥300 and eGFR≥90)

Stage 2: eGFR 60-89 & persistent ACR≥30 (75.0% of the proportion of individuals with ACR between 30-299 and eGFR between 60-89, and 100% of those with ACR≥300 and eGFR between 60-89)

Stage 3a: eGFR 45-59

Stage 3b: eGFR 30-44

Stage 4: eGFR<30

Abbreviations: eGFRcr, estimated glomerular filtration rate creatinine equation; eGFRcys, estimated glomerular filtration rate cystatin C equation; eGFRcr-cys, estimated glomerular filtration rate creatinine equation; A, age; S, sex; R, race; Non-Black (NB) refers to equations in which Black race is removed

Table S16: Prevalence of KDIGO GFR stages, overall and stratified by race

	Overall			Non-Black			Black		
	Unweighted N	**Weighted N**, millions**	**Prevalence, % (SE)***	**Unweighted N**	**Weighted N**, millions**	**Prevalence, % (SE)***	**Unweighted N**	**Weighted N**, millions**	**Prevalence, % (SE)***
eGFRcr (ASR) *(current)*									
≥90 ml/min/1.73 m^2	1673	144.6	58.6 (1.3)	1313	122.4	57.0 (1.3)	360	22.9	72.2 (1.5)
60-<90 ml/min/1.73 m^2	2076	85.2	34.5 (1.2)	1751	77.6	36.1 (1.3)	325	6.8	21.3 (1.3)
45-<60 ml/min/1.73 m^2	526	11.1	4.5 (0.3)	439	9.8	4.6 (0.4)	87	1.2	3.7 (0.4)
30-<45 ml/min/1.73 m^2	200	4.3	1.7 (0.1)	166	3.8	1.8 (0.2)	34	0.4	1.4 (0.3)
<30 ml/min/1.73 m^2	88	1.5	0.6 (0.1)	59	1.1	0.5 (0.1)	29	0.4	1.4 (0.2)
eGFRcr (ASR-NB) *(new)*									
≥90 ml/min/1.73 m^2	1529	139.3	56.5 (1.3)	1313	122.4	57.0 (1.3)	216	16.6	52.1 (1.9)
60-<90 ml/min/1.73 m^2	2129	89.5	36.3 (1.2)	1751	77.6	36.1 (1.3)	378	11.9	37.4 (1.9)
45-<60 ml/min/1.73 m^2	581	11.7	4.8 (0.3)	439	9.8	4.6 (0.4)	142	2.0	6.2 (0.6)
30-<45 ml/min/1.73 m^2	226	4.5	1.8 (0.1)	166	3.8	1.8 (0.2)	60	0.8	2.4 (0.3)
<30 ml/min/1.73 m^2	98	1.6	0.7 (0.1)	59	1.1	0.5 (0.1)	39	0.6	1.8 (0.3)
eGFRcr (AS) *(new)*									
≥90 ml/min/1.73 m^2	1903	156.2	63.3 (1.4)	1638	137.3	63.9 (1.5)	265	18.6	58.5 (1.7)
60-<90 ml/min/1.73 m^2	1944	76.6	31.0 (1.3)	1567	66.2	30.8 (1.4)	377	10.5	32.9 (1.7)
45-<60 ml/min/1.73 m^2	461	9.0	3.6 (0.3)	343	7.4	3.4 (0.3)	118	1.7	5.3 (0.4)
30-<45 ml/min/1.73 m^2	176	3.7	1.5 (0.1)	134	3.2	1.5 (0.2)	42	0.5	1.7 (0.3)
<30 ml/min/1.73 m^2	79	1.2	0.5 (0.1)	46	0.8	0.4 (0.1)	33	0.5	1.5 (0.3)
eGFRcys (AS) *(current)*									
≥90 ml/min/1.73 m^2	2117	171.7	69.6 (1.4)	1677	147.8	68.8 (1.5)	440	24.4	76.7 (1.7)
60-<90 ml/min/1.73 m^2	1479	53.6	21.7 (1.1)	1241	48.0	22.4 (1.2)	238	5.2	16.5 (1.4)
45-<60 ml/min/1.73 m^2	511	12.2	4.9 (0.4)	428	11.0	5.1 (0.5)	83	1.1	3.5 (0.6)
30-<45 ml/min/1.73 m^2	303	6.1	2.5 (0.2)	268	5.5	2.6 (0.2)	35	0.5	1.5 (0.3)
<30 ml/min/1.73 m^2	153	3.1	1.3 (0.2)	114	2.6	1.2 (0.2)	39	0.6	1.8 (0.3)
eGFRcr-cys (ASR) *(current)*									

≥90 ml/min/1.73 m^2	2032	169.1	68.6 (1.3)	1602	144.8	67.4 (1.4)	430	24.8	77.9 (1.3)
60-<90 ml/min/1.73 m^2	1698	60.1	24.4 (1.1)	1433	54.5	25.4 (1.2)	265	5.1	16.1 (0.9)
45-<60 ml/min/1.73 m^2	504	10.9	4.4 (0.4)	427	9.9	4.6 (0.4)	77	1.0	3.1 (0.4)
30-<45 ml/min/1.73 m^2	207	4.1	1.7 (0.2)	181	3.8	1.7 (0.2)	26	0.4	1.1 (0.2)
<30 ml/min/1.73 m^2	122	2.4	1.0 (0.1)	85	1.9	0.9 (0.2)	37	0.5	1.7 (0.3)
eGFRcr-cys (ASR-NB) *(new)*									
≥90 ml/min/1.73 m^2	1952	167.4	67.9 (1.3)	1602	144.8	67.4 (1.4)	350	22.7	71.6 (1.4)
60-<90 ml/min/1.73 m^2	1745	61.5	24.9 (1.1)	1433	54.5	25.4 (1.2)	312	6.7	21.2 (1.2)
45-<60 ml/min/1.73 m^2	520	11.1	4.5 (0.3)	427	9.9	4.6 (0.4)	93	1.2	3.7 (0.3)
30-<45 ml/min/1.73 m^2	222	4.3	1.7 (0.2)	181	3.8	1.7 (0.2)	41	0.5	1.7 (0.3)
<30 ml/min/1.73 m^2	124	2.4	1.0 (0.1)	85	1.9	0.9 (0.2)	39	0.6	1.8 (0.3)
eGFRcr-cys (AS) *(new)*									
≥90 ml/min/1.73 m^2	2225	179.2	72.7 (1.1)	1824	155.5	72.4 (1.2)	401	23.8	74.8 (1.2)
60-<90 ml/min/1.73 m^2	1578	52.0	21.1 (1.0)	1293	45.9	21.4 (1.0)	285	6.0	18.9 (1.0)
45-<60 ml/min/1.73 m^2	459	9.4	3.8 (0.3)	380	8.4	3.9 (0.4)	79	1.0	3.2 (0.4)
30-<45 ml/min/1.73 m^2	183	3.8	1.5 (0.1)	150	3.3	1.5 (0.2)	33	0.4	1.4 (0.3)
<30 ml/min/1.73 m^2	118	2.2	0.9 (0.1)	81	1.7	0.8 (0.1)	37	0.5	1.7 (0.3)

* SE from bootstrap

** Weighted N was based on 2019 estimated population

KDIGO, Kidney Disease Improving Global Outcomes; SE, standard error

Abbreviations: eGFRcr, estimated glomerular filtration rate creatinine equation; eGFRcys, estimated glomerular filtration rate cystatin C equation; eGFRcr-cys, estimated glomerular filtration rate creatinine equation; A, age; S, sex; R, race; Non-Black (NB) refers to equations in which Black race is removed

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