Published in final edited form as:
Am J Kidney Dis. 2008 October ; 52(4): 778–787. doi:10.1053/j.ajkd.2008.05.023.

Prevalence of Estimated GFR Reporting Among US Clinical Laboratories

Nancy A. Accetta, MHS, CHES, **Elisa H. Gladstone, MPH**, **Charles DiSogra, DrPH, MPH**, **Elizabeth C. Wright, PhD**, **Michael Briggs**, and **Andrew S. Narva, MD**
National Kidney Disease Education Program, National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health, Bethesda, MD and Field Research Corporation, San Francisco, CA

Abstract

Background—Routine laboratory reporting of estimated glomerular filtration rate (eGFR) may help clinicians detect kidney disease. The current national prevalence of eGFR reporting among clinical laboratories is unknown, thus the extent of the situation of laboratories not routinely reporting eGFR with serum creatinine (SCr) results is not quantified.

Design—Observational analysis.

Setting—National Kidney Disease Education Program survey of clinical laboratory conducted in 2006-7 by mail, Web, and telephone follow up.

Participants—A national random sample, 6,350 clinical laboratories, drawn from the Federal Clinical Laboratory Improvement Amendments database and stratified by six major laboratory types/groupings.

Predictors—Laboratory reports SCr results.

Outcomes—Reporting eGFR values along with SCr results.

Measurements—Percent of laboratories reporting eGFR along with reporting SCr, reporting protocol, eGFR formula used, and style of reporting cutoff values.

Results—Among laboratories reporting SCr, 38.4% report eGFR (physician offices, 25.8%; hospitals, 43.6%; independents, 38.9%; community clinics, 47.2%; health fair/insurance/public health, 45.5%; others, 43.2%). Physician office laboratories have a reporting prevalence lower than other laboratory types ($p < 0.001$). Among laboratories reporting eGFR, 66.7% do so routinely with all adult SCr determinations; 71.6% use the 4-variable Modification of Diet in Renal Disease Study equation; and 45.3% use the ">60 mL/min/1.73 m^2" reporting convention. Independent laboratories are least likely to routinely report eGFR, (50.6%, $p < .05$) and most likely to report only when specifically requested (45.4%, $p < 0.05$). High-volume laboratories across all strata are more likely to report eGFR ($p < 0.001$).

Address reprint requests to: Andrew S. Narva, MD, Director, National Kidney Disease Education Program, National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health, Two Democracy Plaza, Room 645, 6707 Democracy Boulevard, Bethesda, MD 20892-0001, 301-594-8864. E-mail: narvaa@niddk.nih.gov.

Financial Disclosure: None.

Limitations—Self-reporting by laboratories, Federal database did not have names of laboratory directors/managers (intended respondents), assumed accuracy of Federal database for sample purposes.

Conclusions—Routine eGFR reporting with SCr is not yet universal and laboratories vary in their reporting practices.

Index words

eGFR; laboratory reporting; serum creatinine; kidney disease

Early detection of chronic kidney disease (CKD) is critical to implementing preventive strategies, but early detection can be challenging due to the absence of symptoms. Serum creatinine has historically been used as a key measure of kidney function; however, kidney function is poorly inferred from serum creatinine alone because it is affected by multiple factors related to muscle mass, such as age, sex, race, and body size. Misinterpretation may also be a problem. A case study designed to test physician skills in interpreting serum creatinine results revealed a tendency to overestimate kidney function and therefore underestimate kidney disease.[1]

The National Kidney Disease Education Program (NKDEP), an initiative of the National Institutes of Health, recommends the use of estimated glomerular filtration rate (eGFR), instead of serum creatinine alone, to assess kidney function in adults over the age of 18. NKDEP and other organizations[2,3] encourage laboratories to estimate GFR using the Modification of Diet in Renal Disease (MDRD) Study equation[4] and routinely report eGFR with all serum creatinine determinations. This practice has been associated with improved physician recognition of CKD in the primary care setting[5] and in elderly patients.[6]

Laboratory reporting of eGFR appears to have increased over the past several years, possibly due to the inclusion of eGFR in clinical guidelines, an increase in the number of states with reporting mandates, and education efforts of various organizations. In 2003 and 2005, the College of American Pathologists (CAP), via its General Chemistry Survey, determined that 2.7% and 20.0% of respondents, respectively, reported an eGFR result based on serum or plasma creatinine measurement.[7] The CAP studies, however, included only laboratories that participate in the organization's proficiency testing program. While these data provide a helpful snapshot of eGFR use, and demonstrate that it has increased significantly among CAP proficiency testing participants, the CAP studies were not nationally representative of eGFR reporting and associated laboratory practices.

NKDEP designed a representative study to assess the prevalence of eGFR reporting in the United States (U.S.) and its territories, and to characterize reporting and related practices. The objective was to determine the extent to which laboratory practices are consistent with recommendations made by NKDEP and other organizations. NKDEP recommends that laboratories[8]: 1) use the 4-variable MDRD Study equation[4] to calculate the result, as it is useful for most patients and uses values that are easily accessible, 2) report eGFR with all serum creatinine determinations for adults, aged 18 and older, whenever appropriate and feasible, primarily for the purpose of flagging CKD for clinicians who may not have been thinking about impaired kidney function; 3) report eGFR values of 60 mL/min/1.73 m^2 (1.0 mL/s/1.73 m^2) or greater simply as "≥60 mL/min/1.73 m^2 (≥1.0mL/s/1.73 m^2)," not as an exact number, because inter-laboratory variation among, and imprecision of, creatinine assays and the estimating equation result in greater inaccuracies for eGFR values at 60 mL/min/1.73m^2 (1.0 mL/s/1.73 m^2) or greater [9]; 4) report serum creatinine to two decimal places (for mg/dL) to reduce rounding errors that may contribute to imprecision in eGFR[10].

Other study objectives were to generate data that provide a baseline useful for measuring the rate of adoption of eGFR reporting among U.S. laboratories, and gain insights into areas where NKDEP and others might strategically focus efforts to increase or improve eGFR reporting. Our hypothesis was that laboratories conducting relatively higher volumes of serum creatinine tests are more likely than lower-volume laboratories to report eGFR.

Methods

Study population and sampling

On November 22, 2005, NKDEP obtained the Clinical Laboratory Improvement Amendments (CLIA) database from the Centers for Medicare & Medicaid Services which includes all laboratories that hold or are seeking one of four types of certification required to perform laboratory tests on humans in the U.S. The file includes the laboratory/facility type (e.g., community clinic, hospital, etc.); testing specialties and sub-specialties; related annual test volumes; and other information. Of the nearly 200,000 laboratories in the CLIA database, we identified 20,532 that met the two inclusion criteria for this study: 1) possession of (or applying for) a Certificate of Compliance or Accreditation; and, 2) a specialty in chemistry, with a sub-specialty in routine chemistry testing.

These 20,532 laboratories represent the universe of those that could be reporting eGFR and constitute the sample frame for this study. A sample was designed to allow results to be generalized to U.S.-based clinical laboratories. The sample design maximized the precision of the estimated proportion of laboratories reporting eGFR for the national sample, as well as for six meaningful laboratory categories. The first four categories are those with the largest number of laboratories out of 27 unique types of laboratories/facilities identified in the CLIA database. The four categories, accounting for 84.6% of all those that met the inclusion criteria, are: physician office (7,627), hospital (6,574), independent (which traditionally conduct high test volumes) (2,174), and community clinic (986) laboratories. Samples were drawn from each of these four laboratory/facility types. The fifth category includes a small number of individual laboratories (28 in all) representing three laboratory types—public health (14), health fair (11), and insurance (3)—that account for 60.5% of the total volume of routine chemistry tests performed nationally. The 28 were combined to form a single group of “high-volume” laboratories, which would be examined separately. The sixth or “other” category represents the 3,143 laboratories from the remaining 20 laboratory/facility types. As a result, a total of six laboratory-type strata were created for sampling purposes. See Table 1 for brief descriptions of the different types of laboratories.

A minimum sample size was calculated for each of the six strata using a proportional sampling approach. Based on the 2005 CAP survey, the expected proportion of laboratories reporting eGFR was set to 0.20 and the desired level of precision set to ±2.0% with 95% confidence and corrected for each stratum’s finite size. Taking into account the design effect of the stratified sample (*deff*=1.24), the overall precision of the weighted national estimate was expected to provide a level of precision of ±1%. Planning for an 80% response rate, as per Office of Management and Budget requirement, the sample size randomly drawn from each of the sampled strata was: 1,599 physician office; 1,557 hospital; 1,125 independent; 751 community clinic; all 28 high-volume laboratories (a census of all three laboratory types, not a sample); and 1,290 others. The total sample was 6,350 laboratories.

Instrument development and data collection

NKDEP developed a ten-item questionnaire (Table 2) for both paper-and-pencil and Web administration modes. The questions are based, in part, on survey questions used by CAP and two state departments of health that were known to have asked laboratories about eGFR-

reporting practices. The paper-based instrument was pre-tested by laboratory professionals before implementation, and feedback was used to fine-tune the wording of questions and response selections. While NKDEP was most interested in determining an estimate for the prevalence of eGFR reporting, the survey also provided an opportunity to ask questions related to NKDEP's reporting-related recommendations (see introduction). The web version was pre-tested by communication professionals to ensure that it was easy-to-use. On October 20, 2006, a cover letter and questionnaire including a postage-paid return envelope were mailed to the sample of 6,350 clinical laboratories. Addressed to laboratory directors/managers, recipients were requested to either complete and return the paper questionnaire, or log on to NKDEP's website to access the electronic questionnaire. One week later, a reminder postcard was mailed to the entire sample.

The initial mailing and postcard yielded a response rate of approximately 30.0%. A telephone reminder call was fielded to all non-responders who had telephone numbers recorded in the sample database. During that telephone contact, if possible, survey data were directly collected by a trained interviewer to maximize response rates. This reminder/computer-assisted telephone interview data collection effort was fielded between January 16 and February 13, 2007. A total of 4,013 laboratories responded across all three modes (52.7% phone, 41.2 % mail, 6.1% Web). The overall survey response rate was 63.4% (range of 58.2% to 78.6% across laboratory types). The data from all modes were merged and prepared for analysis. The number of laboratories excluded from analyses due to missing data is noted in the relevant data tables.

Analysis

All analyses were conducted using SAS (version 9.1) PROC SURVEYFREQ. This procedure uses sampling weights and the finite population correction (FPC) to estimate the overall percents, the pooled variances and 95% confidence intervals. The FPC was used in estimating the variance within strata and the Rao-Scott chi-square test[11] was used to test for differences among the strata. P-values for comparisons among the first four strata were adjusted using the stepdown Bonferroni method (SAS PROC MULTTEST).[12] Note that 22 out of 28 possible responded in the public health/insurance/health fair stratum. Although a small n, confidence intervals are still shown for this group and are expectedly wide for all items. Serum creatinine volume quartiles were developed for each stratum to test the hypothesis that higher-volume laboratories are more likely than lower-volume laboratories to report eGFR. This study was implemented after receiving clearance from the U.S. Office of Management and Budget (OMB# 0925-0570).

Results

Serum creatinine reporting

Among laboratories performing routine chemistry tests for adult patients (Survey item 1), 63.8% report a serum creatinine result (Table 3). Serum creatinine reporting is highest among hospital (91.5%) and independent (70.7%) laboratories, and lowest among physician office (45.9%) and other (48.4%) laboratories. Differences for the percent reporting across strata were significant at a level of $p < 0.001$. When reporting serum creatinine in mg/dL (Survey item 2), 90.5% report the value with one or no decimal places, while the remaining 9.5% report to two decimal places (data not shown).

eGFR reporting

Among all laboratories that report serum creatinine, 38.4% calculate and report eGFR (Survey item 5) (Table 3). A statistical difference is seen across laboratory types ($p < 0.001$), with physician office laboratories, at 25.8%, the least likely to report eGFR when compared to hospital, independent, or community clinic laboratories ($p < 0.001$). When the annual volume

of serum creatinine tests (Survey item 4) is examined by quartile, as shown in Table 4, higher eGFR-reporting prevalence for laboratories at or above the median volume, compared to below the median, was significant for the overall, weighted estimates ($p < 0.001$) and most significant for physician office, hospital, and independent laboratories (all $p < 0.001$). Further, eGFR reporting prevalence varies across categories, even among the laboratories with the highest test volumes (top 5%, $p = 0.01$).

Protocol for reporting eGFR

The majority (66.7%) of eGFR-reporting laboratories do so with all measured serum or plasma creatinine determinations (Survey item 7). Alternatively, 25.0% report eGFR only when it is specifically requested, while 8.3% report for other reasons (e.g., with certain panels or profiles, for patients of a certain age, for outpatients) (Table 5). A comparison across all laboratory types shows a significant difference in the percentage of laboratories that routinely report eGFR with all determinations ($p < 0.001$). Independent laboratories are least likely (50.6%) to report eGFRs with all determinations and most likely (45.5%) to report eGFR when specifically requested. These estimates are significantly different from those for physician office ($p = 0.04$), hospital ($p < 0.001$), and community clinic ($p < 0.001$) laboratories.

Estimating equation and reporting convention

Almost three out of four laboratories (71.6%) use the 4-variable MDRD Study equation (Survey item 8), while another 14.3% use some other equation (e.g., 6-variable MDRD Study equation, Cockcroft-Gault). Some responding laboratories (14.1%) did not know which equation was being used (Table 5). Use of the MDRD Study equation ranged among laboratory types from 58.1% to 76.2% ($p < 0.001$). An eGFR reporting convention (Survey item 9) of ">60 mL/min/1.73 m^2 (1.0 mL/s/1.73 m^2)" when the result is greater than 60 is used by 45.3% of laboratories; however, 38.7% always report the exact numeric value. Another 5.5% use ">90 mL/min/1.73 m^2 (1.50mL/s/1.73 m^2)" when reporting (Table 5). Some (10.5%) respondents did not know the eGFR reporting convention being used. Differences in the reporting convention exist across laboratory types ($p < 0.001$). Community clinic laboratories are the least likely (28.3%) of all laboratory types to use ">60 mL/min/1.73 m^2 (1.0 mL/s/1.73 m^2)" when reporting..

Considering reporting eGFR

Among those laboratories not reporting eGFR, only 29.3% are currently considering reporting it while 58.8% are not considering doing so. Another 11.9% of respondents reported that they are unsure of their laboratory's consideration of reporting (Table 6). This is significantly different across laboratory types ($p < 0.001$). Hospital laboratories (38.4%) are more likely to be considering eGFR reporting than other laboratory types, while community clinic (16.4%) and physician office laboratories (19.8%) are least likely to be considering reporting eGFR.

Discussion

Estimated GFR is currently the clinical standard for assessing kidney function—for detecting early CKD, monitoring kidney function, and assessing the effectiveness of treatment plans. NKDEP, along with others in the kidney community, has encouraged widespread adoption of eGFR reporting with all determinations for those 18 and older, to facilitate earlier diagnosis and treatment of CKD. This is especially important in the primary care setting, where clinicians may routinely rely on alone to assess kidney function, or may not be thinking about kidney disease when they order a metabolic panel for a particular patient. A national estimate for the prevalence of eGFR reporting was not available before this research was conducted. This baseline study yielded findings that fall into three areas as discussed below.

The majority of laboratories are not reporting eGFR

Our findings indicate that more than half of serum creatinine-reporting laboratories are not reporting eGFR. We believe this is problematic, as it likely represents a tremendous number of missed opportunities to diagnose CKD. This is especially true for clinicians using independent laboratories, which, as a group, conduct exceptionally high routine chemistry test volumes and have the third-highest number of facilities that do routine chemistry, compared to the 26 other facility types in the CLIA database.

Improvements are necessary in laboratories already reporting eGFR

This study demonstrates that there is room for improvement in laboratories already reporting eGFR, as many of their practices are not consistent with the recommendations outlined above. For example, approximately 25.0% of eGFR-reporting laboratories do so only when specifically requested—that is, for clinicians already considering the possibility of kidney disease. Another concern is that only about half of independent laboratories report eGFR with all serum creatinine determinations. Again, given volumes of these laboratories, this may represent a significant number of missed opportunities to identify early CKD.

Accuracy of eGFR also is a challenge, as less than half of reporting laboratories (45.3%) and only 28.3% of laboratories in community clinics are using ">60 mL/min/1.73 m^2 (1.0 mL/s/1.73 m^2)" reporting convention. Reporting exact numbers may be problematic if clinicians and patients attempt to track decline in kidney function using eGFR results that are not valid. In addition, this study showed that virtually all eGFR results in the U.S. are calculated using serum creatinine determinations reported to one or no decimal places (Survey item 3, data not shown). NKDEP's Laboratory Working Group has called upon in vitro diagnostic companies to improve the precision of creatinine methods and develop instruments that report to two decimal places, both of which will improve the accuracy of eGFR determinations.

Estimated GFR reporting is more common in laboratories serving higher-risk patients and laboratories with relatively high test volumes

Stratum- and volume-level analyses of eGFR reporting yield two positive findings. Reporting is higher than the overall mean in hospital- and community clinic-based laboratories—facilities that commonly serve populations with high rates of CKD risk factors. In addition, for all laboratory categories, eGFR reporting prevalence is higher for laboratories with volumes above the median vs. below the median. Similarly, although the number of laboratories analyzed is relatively small, it appears that eGFR reporting prevalence is relatively high among the highest-volume laboratories overall (59.7%), and especially among laboratories in the independent (86.4%), other (75.0%), and hospital (64.1%) categories.

The study's limitations are those inherent to all research that relies upon "self-reporting" albeit across different modes. We expected respondents to be knowledgeable about their respective laboratory's practices and use their records to retrieve information about serum creatinine testing volume in 2005. Instead, we observed that a small percentage of respondents were unsure about the equation and reporting convention used by the laboratory and found that many respondents left the volume item blank. The latter hindered our ability to determine precise prevalence estimates for eGFR reporting by volume, although we did observe statistically significant differences in reporting prevalence for hospital and independent laboratories when we compared top- vs. bottom-half volumes. This limitation, of course, does not necessarily mean that survey results are inaccurate. Another possible limitation is that laboratories may have been more likely to respond to the survey if they reported serum creatinine than if they did not report serum creatinine.

Use of a previously existing database may present a second limitation, as any errors in the CLIA database would have carried through to impact the sampling design and study results. A third limitation, also associated with the database, was the absence of the names of laboratory directors and managers—our intended respondents. Our study correspondence was addressed to individuals with those or related titles, but it is unclear whether laboratory directors and managers were the individuals who actually completed the surveys/interviews. Completion of surveys by non-intended respondents may explain the cases where the lab indicated it "did not know" or didn't indicate the volume, as mentioned above.

Additional research questions that future investigations may address include reasons laboratories are not reporting eGFR; reasons laboratories are not considering reporting eGFR; and the actual percentage of serum creatinine results that are reported with an eGFR by laboratories that are known to serve high-risk populations.

This baseline study has produced a relatively precise estimate for the prevalence of eGFR reporting and associated practices among U.S. clinical laboratories during the end of 2006/ beginning of 2007. Results can be used in future investigations to estimate the rate of adoption of eGFR reporting overall as well as by laboratories most likely to serve people at highest risk for CKD.

Acknowledgements

We gratefully acknowledge the assistance of Anna Zawislanski, MPH, from the National Kidney Disease Education Program.

Support: This research was funded by the National Kidney Disease Education Program, National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health.

References

1. National Kidney Disease Education Program. Survey of Primary Care Providers' Knowledge and Practices Related to Kidney Disease: A Follow-Up Survey Report. August;2004
2. American Diabetes Association. Standards of medical care in diabetes—2007. Diabetes Care 2007;30 (Suppl 1):S4–S41. [PubMed: 17192377]
3. Levey AS, Coresh J, Balk E, Kausz AT, Levin A, Steffes MW, Hogg RJ, Perrone RD, Lau J, Eknoyan G. National Kidney Foundation practice guidelines for chronic kidney disease: Evaluation, classification, and stratification. Ann Intern Med 2003;139:137–147. [PubMed: 12859163]
4. Levey AS, Bosch JP, Lewis JB, Greene T, Rogers N, Roth D. A more accurate method to estimate glomerular filtration rate from serum creatinine: A new prediction equation. Modification of Diet in Renal Disease Study Group. Ann Intern Med 1999;130:461–470. [PubMed: 10075613]
5. Akbari A, Swedko PJ, Clark HD, Hogg W, Lemelin J, Magner P, Moore L, Ooi D. Detection of chronic kidney disease with laboratory reporting of estimated glomerular filtration rate and an educational program. Arch Intern Med 2004;164:1788–1792. [PubMed: 15364673]
6. Quartarolo JM, Thoelke M, Schafers SJ. Reporting of estimated glomerular filtration rate: Effect on physician recognition of chronic kidney disease and prescribing practices for elderly hospitalized patients. J Hosp Med 2007;2:74–78. [PubMed: 17427247]
7. Miller, G. Current status of reporting eGFR. College of American Pathologists. [September 14, 2007]. from: http://www.cap.org/apps/docs/disciplines/chemistry/current_status_reporting_egfr.pdf
8. National Kidney Disease Education Program. Information for Laboratory Professionals. [November 15, 2007]. from: www.nkdep.nih.gov/labprofessionals
9. Verhave JC, Baljé-Volkers CP, Hillege HL, Dezeeuw D, Dejong PEL. The reliability of different formulae to predict creatinine clearance. J Intern Med 2003;253:563–573. [PubMed: 12702034]
10. Myers GL, Miller WG, Coresh J, Fleming J, Greenberg N, Greene T, Hostetter T, Levey AS, Panteghini M, Welch M, Eckfeldt JH. National Kidney Disease Education Program Laboratory Working Group. Recommendations for improving serum creatinine measurement: A report from the

Laboratory Working Group of the National Kidney Disease Education Program. Clin Chem 2006;52:5–18. [PubMed: 16332993]

11. Rao JNK, Scott AJ. The Analysis of Categorical Data from Complex Surveys: Chi-Squared Tests for Goodness of Fit and Independence in Two-Way Tables. J Am Stat Assoc 1981;76:221–230.
12. Holm S. A simple sequentially rejective Bonferroni test procedure. Scan J Stat 1979;6:65–70.

Table 1

Descriptions of types of laboratory facilities

Stratum (n)	Description of type of laboratories	Why selected as a stratum
Physician office (7,627)	- Tests performed in physician office (PO) setting; results typically shared during visit - Practices are often small but can be quite large (2 or 3 to 200 providers) - May conduct only rapid tests or operate labs like those in hospitals	- Highest number of facilities that met inclusion criteria - Patient population with CKD risk factors (diabetes and hypertension)
Hospital (6,574)	- Tests performed include those needed in emergency situations and those done in high enough volume to warrant acquisition of necessary equipment - May be segmented by chemistry, pathology, other specialty divisions - Usually proportionate in size to the population it serves; generally used by all inpatients at particular hospital and many outpatients seen by physicians with offices in hospital - Send some tests to reference laboratories if demand is low	- Second-highest number of facilities that met inclusion criteria
Independent (2,174)	- Blood chemistry analyses and urinalyses are some of most frequently requested tests - Generally conduct high routine and specialty test volumes; often operate all day/week - Private, commercial facilities, including two largest national providers, Quest Diagnostics and LabCorp; at least 35 other companies exist - Also known as reference laboratories; most tests requested from POs and hospitals	- Third-highest number of facilities that met inclusion criteria
Community clinic (986)	- Labs that are on-site at community clinics - Labs perform tests on samples drawn from patients on site; some samples sent to reference labs for testing - Patients typically get results during follow-up visits	- Serve populations disproportionately affected by CKD risk factors - Fourth-highest number of facilities that met inclusion criteria (excluding CLIA's "other" category)
Health fair Insurance Public health (28)	- Health fair labs are set up as part of a health fair, health assessment, or health risk reduction program; can include lipid testing, measurement for prostate specific antigen, and comprehensive chemistry panels. Usually operated by a clinical lab, under special permit, and must follow strict procedural and management guidelines - Insurance labs perform tests required by insurance companies to determine whether to extend coverage or to pay a claim - Public health labs typically function to safeguard communities via monitoring communities for pathogens that spread via food/people/animals, testing to detect and monitor newly emerging infectious diseases, etc.	- Exceptionally high mean annual routine chemistry volumes (ranging from 524,460 to 1,658,704)
Other (3,143)	- Mix of remaining lab types: ambulatory surgery center, comprehensive outpatient rehabilitation facility, ancillary testing site in health care facility, end stage renal disease dialysis facility, health maintenance organization, home health agency, hospice, industrial, intermediate care facility for mentally retarded, mobile laboratory, pharmacy, school/student health service, skilled nursing facility/nursing facility, other practitioner, tissue band/ repositories, blood banks, rural health clinics, federally qualified health centers, ambulance, and other	- Catch all for remaining laboratories, including CLIA's "other" category

Table 2

Survey questions for NKDEP study to assess the prevalence of eGFR reporting

Item #	Question	Response choices
1	Does your lab report serum creatinine values for adults (18 and older)?	Yes No Not sure
2	How does your lab report serum creatinine values?	mg/dL μmol/L
3	To how many decimal places do you report the creatinine result?	None One Two
4	How many serum creatinine tests did your lab perform in 2005?	Fill in the blank
5	Does your lab EVER report estimated glomerular filtration rates (eGFR) with serum creatinine determinations?	Yes No Not sure
6	Is your lab currently considering reporting eGFR with serum creatinine determinations?	Yes No Not sure
7	Under what circumstances does your lab report eGFR?	With ALL measured serum or plasma creatinine determinations Only when specifically requested Other: please specify
8	Which estimating equation do you use for your reports?	4-variable MDRD 6-variable MDRD Cockcroft-Gault Not sure Other: please specify
9	When reporting eGFR, at what point do you assign a “greater than” (>) value?	60 mL/min/1.73 m^2 90 mL/min/1.73 m^2 Never (we always report an exact number) Other: please specify
10	Please indicate the ONE identifier you use for your lab when submitting your CMS-116 form (CLIA Application for Certification).	See list of 26 laboratory types at: www.cms.hhs.gov/cmsforms/downloads/cms116.pdf
11	For paper-based respondents: Enter the two-letter state or territory abbreviation where your lab is located (fill in the blank)	

Table 3

Serum creatinine (18 and older) and eGFR reporting for adults, by laboratory stratum

	Serum creatinine reporting			***eGFR reporting by labs reporting serum creatinine***		
Stratum	Yes %* (95% CI)	No % (95% CI)	Total (n)**	Yes %¥ (95% CI)	No % (95% CI)	Total (n)§
Physician office	45.9 (43.1 – 48.8)	54.1 (51.2 – 56.9)	1010	25.8 (22.1 – 29.6)	74.2 (70.4 – 77.9)	453
Hospital	91.5 (90.0 – 93.1)	8.5 (6.9 – 10.0)	1064	43.6 (40.7 – 46.5)	56.4 (53.5 – 59.3)	963
Independent	70.7 (67.8 – 73.7)	29.3 (26.3 – 32.2)	649	38.9 (35.1 – 42.7)	61.1 (57.3 – 64.9)	455
Community clinic	50.9 (47.5 – 54.3)	49.1 (45.7 – 52.5)	454	47.2 (42.4 – 51.9)	52.8 (48.1 – 57.6)	229
Health fair Insurance	50.0 (39.5 – 60.5)	50.0 (39.5 – 60.5)	22	45.4 (29.2 – 61.7)	54.5 (38.3 – 70.8)	11
Public health						
Other	48.4 (45.5 – 51.4)	51.6 (48.6 – 54.5)	803	43.2 (38.9 – 47.5)	56.8 (52.5 – 61.1)	382
Overall %***	63.8 (62.5 – 65.1)	36.2 (34.9 – 37.5)	4002	38.4 (36.6 – 40.2)	61.6 (59.8 – 63.4)	2493

* Does not include 9 labs that were not sure and 2 that refused to answer. P < 0.001 for comparison of the percent reporting creatinine over stratum.

** 2528 laboratories reported serum creatinine. This table excludes 35 labs that did not know or did not answer the question about eGFR. P < 0.001 for comparison of the percent reporting eGFR over stratum. P < 0.001 for pair wise comparisons of physician office lab (POL) to hospital, POL to independent, and POL to clinic; p = 0.2 for hospital to independent, p = 0.3 for hospital to clinic, and p = 0.1 for independent to clinic. Pair-wise comparisons are based on comparisons of the first 4 groups using the stepdown Bonferroni method.

*** Weighted percentage.

Table 4

eGFR reporting prevalence by serum creatinine test volume (2005), by laboratory strata

	Volume quartiles[@]						Top 5% volume laboratories	
Stratum	Quartile 1 % reporting eGFR (95% CI)	Quartile 2 % reporting eGFR (95% CI)	Quartile 3 % reporting eGFR (95% CI)	Quartile 4 % reporting eGFR (95% CI)	Total (n)[*]	p-value[**]	Yes %[§] (95% CI)	Total (n)
Physician office	22.4 (14.1 – 30.6)	15.3 (8.1 – 22.5)	27.6 (18.8 – 36.4)	43.7 (33.9 – 53.4)	344	< 0.001 < 0.001	31.6 (10.1 – 53.0)	19
Hospital	25.3 (19.6 – 30.9)	38.1 (31.9 – 44.4)	52.2 (45.5 – 59.0)	59.0 (52.9 – 65.1)	776	< 0.001 < 0.001	64.1 (49.7 – 78.5)	39
Independent	24.7 (17.2 – 32.3)	28.0 (20.3 – 35.6)	35.4 (26.7 – 44.1)	65.3 (57.5 – 73.2)	365	< 0.001 < 0.001	86.4 (73.3 – 99.4)	22
Community clinic	31.6 (20.7 – 42.5)	41.7 (31.4 – 52.0)	45.2 (34.1 – 56.4)	60.9 (50.5 – 71.3)	174	0.06 0.03	66.7 (38.6 – 94.8)	9
Health fair Insurance Public health	0.0	33.3 (3.3 – 63.4)	100	66.7 (36.6 – 96.7)	10	NA 0.09	0.0	1
Other	20.3 (12.3 – 28.2)	43.4 (33.8 – 53.1)	47.3 (37.4 – 57.2)	53.9 (44.2– 63.7)	300	< 0.001 0.001	75.0 (54.4 – 95.6)	16
Overall %[***]	24.1 (20.4 – 27.7)	31.9 (28.1 – 35.8)	42.8 (38.5 – 47.1)	55.6 (51.5 – 59.7)	1969	< 0.001 < 0.001	59.7 (51.0 – 68.5)	106

[@]Quartile definitions

Stratum	1st	2nd	3rd	4th
Physician office	< 1,100	1,100 – 3,099	3,100 – 9,999	≥ 10,000
Hospital	< 5,500	5,500 – 18,199	18,200 – 49,999	≥ 50,000
Independent	< 2,400	2,400 – 7,799	7,800 – 29,999	≥ 30,000
Community clinic	< 1,000	1,000 – 3,599	3,600 – 12,999	≥ 13,000
Health fair Insurance Public health	< 2,000	2,000 – 40,699	40,700 – 199,999	≥ 200,000
Other	< 1,800	1,800 – 7,099	7,100 – 42,999	≥ 46,000

[*] Volume not available for 524 laboratories.

[**] First p-value is for comparison of the 4 groups; second is for comparison of < median versus ≥median. Comparisons are made within each stratum and pooled over strata.

[§] P = 0.01 for comparison of percent yes over stratum (excluding health fair/insurance/public health category). Includes only labs with a volume in the top 5% for each stratum.

[***] Weighted percentage.

Table 5

Circumstances for eGFR reporting, estimating equation used, and reporting convention, by laboratory strata

	Circumstances for reporting**				Equation used***				Reporting convention****				
Stratum**	All % (95% CI)	When requested % (95% CI)	Other % (95% CI)	Total (n)*	4-variable MDRD % (95% CI)	Other % (95% CI)	Not sure % (95% CI)	Total (n)*	> 60 mL/min/1.73^2 % (95% CI)	> 90 mL/min/1.73^2% (95% CI)	Exact number % (95% CI)	Don't know % (95% CI)	Total (n)*
Physician office	65.8 (57.6 – 74.0)	25.4 (17.9 – 33.0)	8.8 (3.9 – 13.7)	114	70.4 (62.6 – 78.3)	13.9 (7.9 – 19.9)	15.7 (9.4 – 21.9)	115	36.2 (27.9 – 44.4)	5.2 (1.4 – 9.0)	46.6 (38.0 – 55.1)	12.1 (6.5 – 17.7)	116
Hospital	68.8 (64.7 – 72.9)	21.7 (18.1 – 25.4)	9.4 (6.8 – 12.0)	414	76.2 (72.4 – 79.9)	14.3 (11.2 – 17.4)	9.5 (6.9 – 12.1)	420	49.2 (44.8 – 53.6)	5.3 (3.3 – 7.2)	37.4 (33.1 – 41.7)	8.2 (5.7 – 10.6)	417
Independent	50.6 (44.3 – 56.8)	45.5 (39.2 – 51.7)	4.0 (1.5 – 6.4)	176	72.9 (67.3 – 78.4)	11.9 (7.8 – 15.9)	15.3 (10.8 – 19.7)	177	46.0 (39.8 – 52.6)	8.0 (4.6 – 1.3)	35.8 (29.8 – 41.8)	10.2 (6.4 – 14.0)	176
Community Clinic	79.2 (73.5 – 85.0)	17.9 (12.4 – 23.4)	2.8 (0.5 – 5.2)	106	58.1 (51.1 – 65.1)	16.2 (11.0 – 21.4)	25.7 (19.5 – 31.9)	105	28.3 (21.9 – 34.7)	9.4 (5.3 – 13.6)	50.0 (42.9 – 57.1)	12.3 (7.6 – 16.9)	106
Health fair Insurance Public health	100.0 (100.0 – 100.0)	0	0	5	80.0 (54.3 – 100)	0	20.0 (0.0 – 45.7)	5	60.0 (28.5 – 91.5)	0	40.0 (8.6 – 71.5)	0.0	5
Other	69.1 (62.9 – 75.3)	21.6 (16.1 – 27.1)	9.3 (5.4 – 13.2)	162	58.3 (51.7 – 64.9)	16.6 (11.6 – 21.5)	25.1 (19.3 – 31.0)	163	47.5 (40.8 – 54.2)	3.1 (0.8 – 5.4)	31.5 (25.2 – 37.7)	17.9 (12.8 – 23.0)	162
Overall % *****	66.7 (63.8 – 69.5)	25.0 (22.5 – 27.6)	8.3 (6.6 – 10.0)	977	71.6 (69.0 – 74.3)	14.3 (12.2 – 16.4)	14.1 (12.1 – 16.1)	985	45.3 (42.3 – 48.3)	5.5 (4.1 – 6.8)	38.7 (35.7 – 41.6)	10.5 (8.7 – 12.3)	982

* Circumstances for reporting: 992 laboratories answered that they report eGFR. This table excludes 1 laboratory that skipped the question, 8 that answered "do not know," and 6 that supplied answers that did not make sense; $p < 0.001$ for comparison over stratum. Pair-wise comparisons were calculated for reporting eGFR for all tests vs. when requested or other for the first 4 strata. $P = 0.04$ for independent comparison to physician office lab (POL), $p < 0.001$ for independent comparison to community clinic and to hospital. $P = 0.5$ for POL comparison to hospital, $p = 0.08$ for POL comparison to clinic, and $p = 0.08$ for hospital comparison to clinic.

** Equation used: This table excludes 7 laboratories that skipped the question; $p < 0.001$ for comparison over stratum.

*** Reporting convention: This table excludes 10 laboratories that skipped the question; $p = 0.001$ for comparison over stratum. Pair-wise comparisons were calculated for >60 vs. exact for the first 4 strata. $P = 0.004$ for clinic comparison to hospital, $p = 0.02$ for clinic comparison to independent, $p = 0.09$ for POL comparison to hospital, $p = 0.2$ for POL comparison to independent, $p = 0.6$ for POL comparison to clinic, and $p = 0.9$ for hospital comparison to independent.

**** Weighted percentage.

Table 6

Considering eGFR reporting, by laboratory strata (Among all who report serum creatinine and said no to eGFR reporting)

Stratum**	Yes % (95% CI)	No % (95% CI)	Not Sure % (95% CI)	Total (n)*
Physician office	19.8 (15.7 – 23.8)	68.4 (63.7 – 73.1)	11.9 (8.6 – 15.1)	329
Hospital	38.4 (34.6 – 42.3)	52.0 (48.1 – 55.9)	9.6 (7.2 – 11.9)	523
Independent	26.9 (22.5 – 31.3)	55.3 (50.3 – 60.2)	17.8 (14.0 – 21.6)	275
Community clinic	16.4 (11.4 – 21.4)	70.7 (64.5 – 76.8)	12.9 (8.4 – 17.5)	116
Health fair Insurance	16.7 (0.0 – 36.5)	66.7 (41.6 – 91.7)	16.7 (0.0 – 36.5)	6
Public health				
Other	28.8 (23.6 -34.1)	57.2 (51.5 – 63.0)	14.0 (9.9 – 18.0)	215
Overall %	29.3 (27.1 – 31.5)	58.8 (56.4 – 61.2)	11.9 (10.3 – 13.4)	1464

* 1511 labs answered that they did not report eGFR. 47 labs that did not answer the question are excluded from this table.

** $P < 0.001$ for comparison over stratum. Pair-wise comparisons for yes vs. no were calculated for the first 4 strata. $P < 0.001$ for comparison of physician office (POL) to hospital and hospital to clinic. $P = 0.04$ for comparison of POL to independent, POL to clinic, hospital to independent, and independent to clinic.

*** Weighted percentage