FAQs About the Glomerular Filtration Rate

This article is the twelfth of a series about Chronic Kidney Disease and its management based on the new National Kidney Foundation guidelines. If you missed previous articles in this series, log onto the IHS website. Archived issues of The IHS Provider *may be found from the Clinical Support Center's page.*

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Now that the equation to estimate the glomerular filtration rate (GFR) is built into the new Resource and Patient Management System (RPMS) lab software patch, providers are asking questions about the GFR listed on the lab results.

Why have the estimated GFR listed on the chemistry panel in RPMS?

GFR results give providers an estimate of functioning renal mass. In addition, providers can identify, assess and monitor the stage of kidney disease and provide care based on that stage.

What is the glomerular filtration rate (GFR)?

True GFR is the actual glomerular filtration rate measured by inulin clearance, a cumbersome procedure performed only for research purposes. GFR measures functioning renal mass and filtering capacity of the kidneys. Listed in units of mL/min/1.73 m^2, (normalized for body surface area) the GFR is the sum of the rates of all filtering nephrons in the kidneys (roughly one million nephrons/kidney). Nephrons that have been scarred or damaged no longer contribute to the filtering capability of the kidneys.

What is a normal GFR?

This varies depending on the reference used. In young, healthy, hydrated adults, inulin clearance measurements showed means of 127 mL/min/1.73 m^2 for males and 118 mL/min/1.73 m^2 for females (with a standard deviation of about 20 mL/min/1.73m^2). In general, GFR declines with age by about 1 mL/min/1.73 m^2 per year after age 30.

What is the difference between GFR and creatinine clearance?

Creatinine clearance performed with a 24-hour urine is an approximation of the glomerular filtration rate. Creatinine comes from muscle metabolism and is released at a fairly constant rate. It is freely filtered across the glomeruli and is not reabsorbed or metabolized by the kidney. However, a small amount of creatinine is secreted into the filtrate in the proximal tubules, adding to the amount excreted by the kidneys. As kidney function (GFR) declines, less creatinine is filtered, yet the secretion continues. The amount of creatinine in the urine is a combination of filtration and secretion of creatinine, not filtration alone. As a result, creatinine clearance tends to overestimate kidney function.

Why use an equation to estimate GFR?

Estimating GFR using prediction equations is cost effective. Twenty-four hour urine collections are not required, making it easier for all involved. Note that all prediction equations are "predictions." The bias, precision, and accuracy of these equations have an effect. The Modification of Diet in Renal Disease (MDRD) equation provides the best prediction of GFR for the most people. However, the equation is less useful in people who are extremely malnourished or overnourished.

Which GFR equation is used in RPMS?

The abbreviated MDRD equation is used.

$$\text{Estimated GFR (mL/min/1.73 m}^2\text{)} = 186 \times (\text{Scr})^{-1.154} \times (\text{age})^{-0.203} \times (0.742 \text{ if female}) \times (1.21 \text{ if African-American})$$

There are several variations of the MDRD equation. The recommended equation uses only age, gender, race, and serum creatinine as variables. Fortunately these variables are readily available through RPMS at the time serum creatinine is reported. This is the same GFR calculator used on the National Kidney Foundation and National Kidney Disease Education Program websites. There is marginal improvement when albumin and serum urea nitrogen are included in the calculation, but it is not felt that the burden of including additional variables is worth the minimal improvement in results.

Why is the new abbreviated MDRD formula better than the Cockcroft-Gault Equation?

The MDRD equation is more accurate and precise. Published in 1975, the Cockcroft-Gault equation was derived to predict creatinine clearance from serum creatinine based on 249 Canadian males (veterans) ages 18 - 92. The MDRD equations were derived to predict glomerular filtration rate from serum creatinine based on 1628 males (60%) and females with known kidney disease.

Why should we use GFR instead of just looking at serum creatinine?

Equations that estimate GFR from serum creatinine are more accurate when assessing kidney function than serum creatinine alone. For example, a 70 year old woman's serum creatinine is 1.2 mg/dL. Depending on your lab's "normal" ranges for serum creatinine, that is either at the high end of normal or just above the upper limits of normal. Let's say this woman weighs 72 kg. Using the Cockcroft-Gault equation, her estimated creatinine clearance is 49 mL/min/1.73 m^2. Using the abbreviated MDRD equation; her estimated GFR is 47 mL/min/1.73 m^2. Regardless of the prediction equation used, the estimate indicates a reduction in kidney function that is not easily ascertained from serum creatinine alone.

What does "normalized" GFR mean?

The estimated GFR produced by the MDRD equation is "normalized" for body surface area. The term "normalized" means that two people of different sizes may have the same GFR per 1.73m^2 (body surface area or BSA) but their actual GFRs may be different. A 100 kg man with a normalized GFR of 90 mL/min/1.73 m^2 may have a measured GFR of 150 mL/min because he has 2.4 m^2 of BSA, while a 55 kg woman also with a normalized GFR of 90 mL/min/1.73 m^2 may have a measured GFR of 70 mL/min because she has only 1.4 m^2 of BSA. Normalizing allows us to compare a variable, GFR, which varies with body size, between people of different body sizes.

The prediction equation for GFR was developed as a result of the Modification of Diet in Renal Disease study, an National Institutes of Health funded study on nutrition and kidney disease. For detailed information on validation studies, please look at: *http://www.kidney.org/professionals/doqi/kdoqi/p5_lab_g4.htm*.