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# GLOMERULAR FILTRATION RATE INFORMATION SHEET

## INTRODUCTION

The Glomerular Filtration Rate (GFR) is the best overall measure of renal function. There are a range of methods to determine the GFR:

- Estimate of GFR (eGFR) by CKD-EPI formula. This is reported with all requests for serum creatinine. See eGFR Limitations and Interpretation for further information.
- Estimate of Creatinine Clearance by the Cockcroft and Gault equation (which requires patient age, sex, weight or height, and serum creatinine). This estimate of GFR is recommended for drug dosing decisions (on-line calculator).
- Measurement of Creatinine Clearance (which requires a serum creatinine measurement and a 24 hour urine collection). This is the least reliable method for routine use but may be valuable in extremes of body composition where the estimation formulae above are less reliable.
- Formal GFR Measurement with radionuclide injection and timed serum sampling. This is the gold standard but is time-consuming and expensive. This testing is available if required from the St Vincent's Hospital Nuclear Medicine Department. For inpatients this is usually requested by a renal physician.

## eGFR USING CKD-EPI FORMULA

(on-line calculator - from Kidney Health Australia).

The CKD-EPI formula has varying coefficients depending on the sex and serum creatinine of the patient as shown below. Note there are additional versions for Black Americans, but these are NOT recommended for use in Australian Aboriginals.

## FEMALES

If serum creatinine less than (or equal to) 62 umol/L

$eGFR\ (mL/min/1.73m^2) = 144 \times ((S.Cr \times 0.0113) / 0.7))^{-0.329} \times 0.993^{Age}$

If serum creatinine greater than 62 umol/L

$eGFR\ (mL/min/1.73m^2) = 144 \times ((S.Cr \times 0.0113) / 0.7))^{-1.209} \times 0.993^{Age}$

## MALES

If serum creatinine less than (or equal to) 80 umol/L

$eGFR\ (mL/min/1.73m^2) = 141 \times ((S.Cr \times 0.0113) / 0.9))^{-0.411} \times 0.993^{Age}$

If serum creatinine greater than 80 umol/L

$eGFR\ (mL/min/1.73m^2) = 141 \times ((S.Cr \times 0.0113) / 0.9))^{-1.209} \times 0.993^{Age}$

## eGFR BY CKD-EPI: NOTES

- eGFR using the CKD-EPI equation is reported with all requests for serum creatinine on patients 18 years of age and older
- The results are expressed relative to a standard body surface area of 1.73 $m^2$ to allow for different body sizes. The units are mL/min/1.73$m^2$
- This is a recommendation of the peak renal and pathology bodies in Australia (Johnson SW, Jones GRD et al MJA 2012;197:226-8)
- The formula is named after the Chronic Kidney Disease Epidemiology Collaboration

## eGFR - IMPORTANT LIMITATIONS

- The accuracy of the eGFR is only about +/- 30%
- The equation is only valid in persons 18 years of age or older
- eGFR equations should not be used in pregnancy
- The use of the eGFR in patients on dialysis is inappropriate and will give misleading results
- The use of eGFR in patient with very acute renal failure will over-estimate the true GFR due to delays in creatinine accumulation in the blood
- The formula has been validated in Aboriginals and is suitable for use in most racial groups
- Results may be inaccurate in patients with extremes of body composition (eg very lean, obese, muscular, paraplegia, amputation, muscle disease)
- Results may be less accurate in patients with severe liver disease
- Results may be less accurate in patients with exceptional dietary intake (eg vegetarian diet, high protein diet, creatine supplements)
- Drug Dosing information in Australia (eg MIMS, Australian Medicines Handbook, Therapeutic Guidelines) is based on Cockcroft and Gault estimates of creatinine clearance. Cockcroft and Gault is recommended for drug dosing decisions. The results of eGFR provide a guidance, especially in persons of average build, but calculation of the creatinine clearance is preferred

## eGFR: INTERPRETATION

The estimate of GFR can be used for identification of moderate to severe decrease in renal function and as a staging tool for Chronic Kidney Disease (CKD).

- **eGFR >90 mL/min/1.73m2 - Normal GFR**
- e**GFR 60 - 90 mL/min/1.73$m^2$ - Mild decrease in GFR**
  - Likely to be normal for age except in younger adults. In our population the eGFR falls at a rate of about 0.5 mL/min/year.
  - Patients with elevated serum creatinine or increase in serum creatinine over time should be further investigated.
  - Note this value for eGFR does not exclude mild acute or chronic kidney disease which may be detected by rising serum creatinine and urea, proteinuria or haematuria or damaged kidneys seen on imaging studies.

- **eGFR 30 - 60 mL/min/1.73m$^2$ - Moderate decrease in GFR**
  - Two or more results in this range indicates stage 3 CKD
  - Monitoring for rapid progression may be indicated
  - Assessment and management of cardiovascular risk factors indicated in CKD
  - Dose adjustment of some drugs may be indicated
  - Stage 3 is subdivided into stage 3a (45 - 59 mL/min/1.73m$^2$) and stage 3b (30-44mL/min/1.73m$^2$)
  - Note that results between 45 and 60 mL/min/1.73m$^2$ (stage 3a) are common in patients over 75 years of age.
- **eGFR 15 - 29 mL/min/1.73m$^2$ - Severe decrease in GFR**
  - Two or more results three months apart indicates stage 4 CKD.
  - Monitoring for rapid progression may be indicated.
  - Identification and treatment of precipitating factors required.
  - Dose adjustment of some drugs may be indicated.
  - Review by renal physician indicated.
- **eGFR <16 mL/min/1.73m$^2$ - End-stage kidney failure**
  - Stage 5 CKD if persistent
  - Dose adjustment of some drugs may be indicated
  - Review by renal physician is indicated

## eGFR USING MDRD FORMULA

The GFR can be estimated from the patient's age, sex and serum creatinine using the MDRD formula as follows:

eGFR (mL/min/1.73m$^2$) = 175 x [Serum Creatinine (umol/L) x 0.0113]$^{-1.154}$ x Age(years)$^{-0.203}$ (x 0.742 if female)

For further information and clinical action plans see the Kidney Health Australia website **(Welcome - The National Kidney Foundation)**