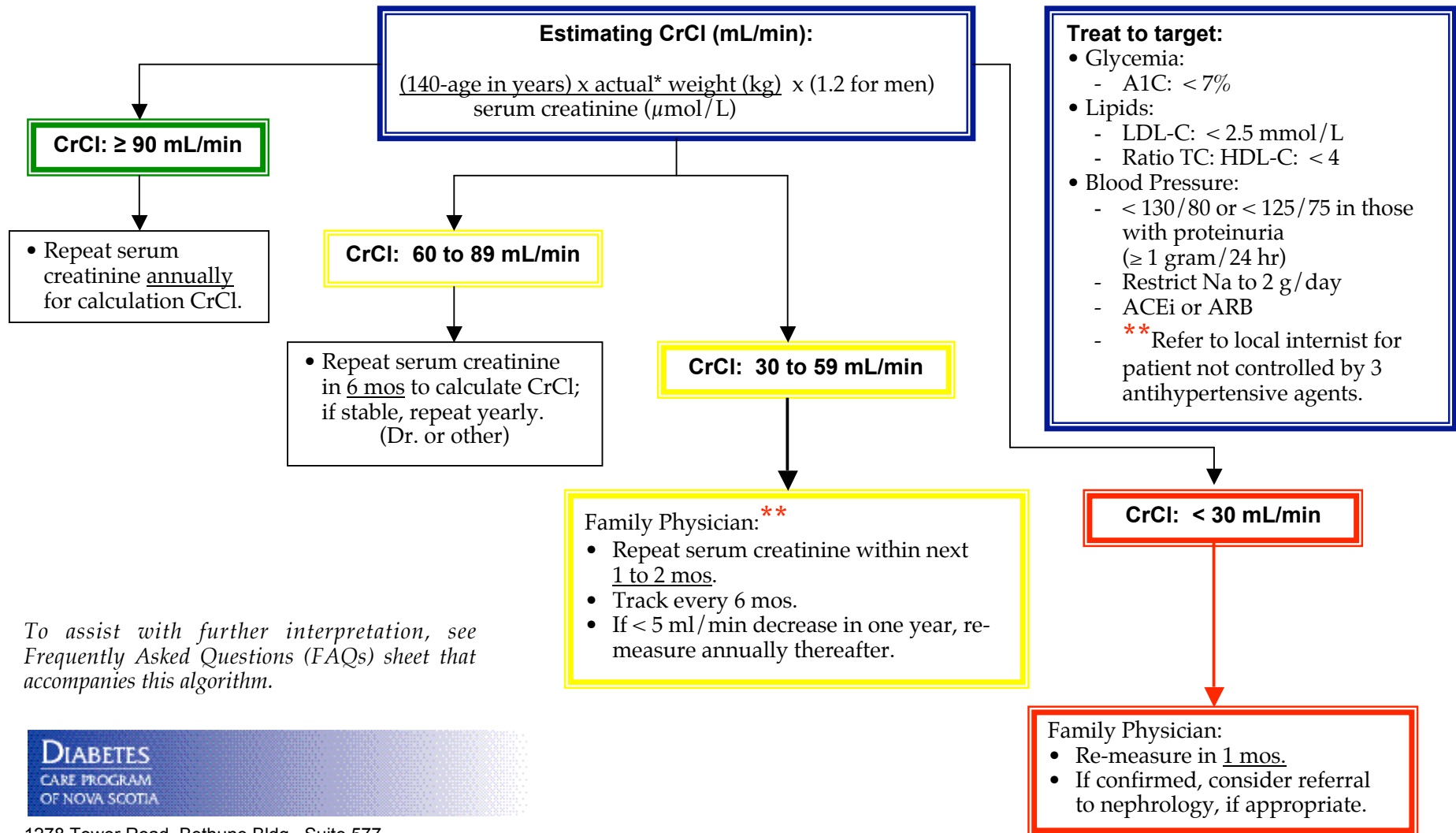


Interpreting and Acting on Estimated Creatinine Clearance (CrCl) Using the Cockcroft-Gault Formula

Assess: Blood Pressure, Serum Creatinine, Urinalysis (for proteinuria), Lipid Profile, and A1C



To assist with further interpretation, see Frequently Asked Questions (FAQs) sheet that accompanies this algorithm.

DIABETES
CARE PROGRAM
OF NOVA SCOTIA

1278 Tower Road, Bethune Bldg., Suite 577
Halifax, NS B3H 2Y9
Website: www.diabetescareprogram.ns.ca

Frequently Asked Questions (FAQs)

Use of Estimating Equations for Creatinine Clearance (CrCl) such as the Cockcroft-Gault Formula

What should the patients be told by Diabetes Centre staff about their specific CrCl values?

The Diabetes Centre should provide the results to the family/referring physician who can then interpret and explain these to the patient in the proper context of other health considerations. If a patient asks about his/her results, it may be appropriate to say, "We have conducted routine tests to assess your kidneys. It appears that you may have a decrease in your kidney function that may or may not be related to your diabetes. Your doctor will explain what these results mean to you."

Note: Those with values < 60 mL/min confirmed over a three-month period have what is now being called "Chronic Kidney Disease" or CKD. This is the most appropriate terminology to describe noted changes.¹

At any point, are their other actions (other than the treat to target) that should be taken with any of the CrCl values?

It should be the responsibility of the family/referring physician to determine the best course of action as it relates to other medications such as NSAIDs.

In the case of Metformin, the following guidelines may be helpful:

CrCl > 60 mL/min:	Up to maximum daily allowance.
CrCl 30 to 60 mL/min:	Up to 1 gram per day.
CrCl < 30 mL/min:	Metformin should be discontinued.

Are there any grounds where immediate referral to a nephrologist is warranted?

The decision to refer should be made by the family/referring physician as other conditions may warrant an earlier referral (e.g., anemia, acidosis, etc.). The following guidelines should be considered:

- CrCl < 30 mL/min measured on at least 2 occasions.
- Atypical features: hematuria, systemic disease, rapidly rising Cr, or increased Cr $> 30\%$ after ACEi or ARB.
- Nephrotic syndrome: > 3.5 g/day proteinuria with or without low albumin, increased cholesterol, edema, or hypertension.

Would the estimate of Creatinine Clearance using the Cockcroft-Gault formula be more accurate if it were based on ideal body weight as opposed to actual?

Determining ideal body weight is not an exact science; this too is at best an estimate based on Metropolitan Life Tables (1983) and does not consider age or body type.

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¹ Levey AS, Eckardt KU, Tsukamoto Y, et al. Definition and classification of chronic kidney disease: a position statement from Kidney Disease: Improving Global Outcomes (KDIGO). *Kidney International*. 2005;67:2089–2100.

The Cockcroft-Gault, as a worst-case scenario, will provide an overestimate of CrCl. It is more important to see how function changes over time than to make a decision on a single value. Periodic estimates using the Cockcroft-Gault formula will help determine the rate of progression. Expected rate of progression in patients with Chronic Kidney Failure, as measured by decrease in GFR (CrCl), is 4-6 mL/min/year. This decrease is much higher than that seen in the “normal” population with an expected loss of 1 mL/min/year after the age of 30. (Keeping this in mind, average clearances of 90-100 mL/min are expected in healthy elderly people.)

There is another estimating equation that has also been used to calculate CrCl that does not require weight as part of the formula. It is the MDRD (Modification of Diet in Renal Diseases) equation, which has three derivations—one with five variables, one with four variables, and one with three variables. The three variable formula has been validated in subjects with kidney disease. In general, however, the MDRD formula has been found to underestimate the CrCl. There are currently global renal initiatives underway to develop a new formula.

When would a 24-hour urine collection be recommended?

Studies have shown that patients under-collect in up to 30% of cases and over-collect in about 10 – 20% of cases. For these reasons, as well as the inconvenience associated with the collection, less 24-hour urine tests are being ordered. A 24-hour urine, however, is still a valuable test to help quantify proteinuria. (Proteinuria is a strong risk factor for cardiovascular events and progression of kidney disease.) It is becoming more common to see random urine samples done to quantify albumin and protein excretion (albumin to creatinine ratio [ACR]), while estimating equations like the MDRD and Cockcroft-Gault are being used to calculate creatinine clearance.

Should estimating equations be used in special populations such as pregnant women and children/adolescents with diabetes?

The use of estimating equations to calculate CrCl in children and during pregnancy is not straightforward. In children, a study done in 2003 (Pierrat A. *Kidney International*) found that the Cockcroft-Gault formula was accurate for children > age 12. However, a study just published in June 2005 (Filler, et al. *Kidney International*) found that compared to DTPA renal scans, the Cockcroft-Gault was not accurate.

In pregnancy, few studies have been done. One study published in 1994 (Quadri, et al. *American Journal of Kidney Disease*) found excellent correlation between the Cockcroft-Gault formula (using the prepregnancy weight) and 24-hour urine CrCl in 95 women from the first trimester to postpartum. However, the KDIGO working group discusses that estimating equations (both MDRD and Cockcroft-Gault) are imprecise with low creatinine values, and this could lead to misclassification in children and pregnant women.

So, in pregnancy, one would favor the use of 24-hour collection. In children, seek the opinion of a Pediatric Nephrologist to see if they use 24-hour urine or nuclear medicine GFR.

Acknowledgement

The DCPNS would like to acknowledge and thank Dr. Steven Soroka, Nephrologist, QEII Health Sciences Centre, Halifax, Nova Scotia for his assistance in the preparation of the this FAQ sheet and the algorithm – “Interpreting and Acting on Estimated Creatinine Clearance (CrCl) Using the Cockcroft-Gault Formula.” We would also like to thank the many reviewers for their comments and suggestions.

We would like to thank Sanofi-Aventis for providing financial support, through an unrestricted educational grant, to print this handout.