Developing a mobile clinical decision support tool for the management of diabetic nephropathy

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Diabetic nephropathy (DN) is a common and serious complication of diabetes mellitus. In the Western world, DN is the leading cause of end-stage renal disease (ESRD). According to the Hong Kong Central Renal Registry, 47% of patients undergoing dialysis treatment in the Hospital Authority suffered from DN. Early and vigorous treatment of DN will prevent or delay the development of end-stage DN.

The management of DN includes the detection of microalbminuria so that treatment can be started in the incipient stage of DN, control of blood sugar and control of blood pressure using angiotensin-converting-enzyme inhibitor or angiotensin II receptor blockers. The joint management of the family physician, the endocrinologist and the nephrologist is instrumental.

In practice, there are hurdles in the management of DN by the family physician. DN is a form of chronic kidney disease (CKD). The severity of the disease ranges from CKD stage 1, when renal function may be higher than normal due to glomerular hyperfiltration to CKD stage 5, when renal replacement therapy is required. For the treatment of early DN, metformin is the drug of choice. However, in patients with advanced renal failure, metformin is contraindicated for fear of inducing lactic acidosis. Similarly, some sulphonylurea drugs with predominantly renal excretion need to be used in a reduced dose with caution in patients with renal failure. For this reason, knowledge of renal function is of great importance.

Serum creatinine is the most commonly requested "renal function test" but it is not a sensitive measure of renal function. The widely accepted index is the estimated glomerular filtration rate (eGFR) based on the MDRD equation.

Unfortunately, the MDRD equations are rather complicated and even the "abbreviated" version involves exponential calculations which are not easy for clinicians. Ho and Ng reported the case of a 60-year-old diabetic housewife with a serum creatinine of 0.187 mmol/L. She was given glibenclamide and metformin for treatment. In fact, her eGFR was only 25 mL/minute and metformin was relatively contraindicated at such renal function. The long-acting sulphonylurea glibenclamide has to be used with caution under such circumstance [2].

Even if the physician has obtained the patient's eGFR, he still needs to stratify CKD into 5 stages according to the eGFR value and that involves some memorizing work. The subsequent management of diabetes mellitus and renal function is different for different stages of disease.

To assist healthcare providers in the management, it would be ideal if there is a tool to perform the calculation, stratify the disease staging and then list the suggested diabetes and renal disease management plans. Such "clinical decision support" tools do exist but they are very expensive and are usually available only in tertiary hospitals. They are designed to work in hospital workstations connected by a hospital intranet.

For a doctor in private practice, it is common that he needs to work in his private clinic as well as in hospitals. If a clinical decision tool is available, it would be ideal if it is a portable computer system so that he can carry it around different workplaces. Being a private nephrologist himself, the author undertook the task of developing a mobile computer system for clinicians. The computer needs to be portable, lightweight, inexpensive, quick to start ("boot up") and has a reasonably large screen, as many doctors have reached middle age or beyond with eyesight problems. For this reason, the "tablet PC" format would be preferable to the desktop computer and the author chose the iPad (iPad 1, 2 or the new iPad), which met all of these requirements.

To design the programme, the author set up the work flow so that the user just needs to enter a patient's age, gender, serum creatinine and race (default value as "non-African American" because majority of people in Hong Kong are Chinese or Caucasian). The iPad will then calculate the eGFR according to the MDRD equation, stratify the CKD staging (from stage 1 to 5) and list out the suggested plan for diabetics and renal disease management for the reference of the doctors. The programme was

Figure 1. Testing the programme.

Figure 2. Mastering the programme in 5 minutes.

subsequently complied into an Apple app which were then mounted to an iPad for testing.

With the strong computing power of the iPad, such calculations were virtually instantaneous. This final app was uploaded to the Apple store for users to download for free.

The app is called **"Diabetic Nephropathy Management Support"**. It is meant for use by healthcare providers only. It is very easy to use and in fact, a nurse takes only 5 minutes to master the programme.

The programme has other optional features such as calculation of BMI, but the user has to input body weight and the height as well.

The app is free for the medical profession. Interested colleagues can download from the Apple store free of charge. The app can be accessed by one of the three methods:

1. Go to Apple store, search for "diabetic nephropathy, management support"
2. Follow the link http://itunes.apple.com/us/app/ diabetic-nephropathy-management/id509986305? mt=8
3. Use the QR code (Figure 3)

This clinical tool was first introduced to doctors in the YTM community network in the scientific programme "Management of Diabetic Nephropathy" on 14 March, 2012 and the response was positive. (Figure 4)

Figure 3. The QR code for downloading the programme.

The video of the lecture is hosted on YouTube and readers can watch the video for more detailed information by following the link http://youtu.be/6vhShUXBIJM [3].

Future development

One suggestion after the launch seminar was that it would be more ideal to have an iPhone version as it would be easier for the doctors to carry them around the ward. The problem with the iPhone is the small size of its screen. For this reason, the author has redesigned the system and came up with an iPhone version which will be launched by the end of 2012 after beta testing. There was also an "air-print" button on the iPhone version so that the doctors can print out a hard copy of the contents.

The MDRD equation is used to estimate patient's GFR. Unfortunately, the MDRD equation is not fully validated for Chinese. There are projects to develop a similar equation for Chinese but they are not widely accepted yet [4]. If the equations are adopted in the future, there will be enhancement of the application in which the modified MDRD equation for Chinese will be used in Chinese patients.

Figure 4. Demonstrating the clinical tool in the scientific meeting.

Acknowledgement

References

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2. Ho CP, Ng WY. A diabetic patient with renal impairment, *HKMA CME Bulletin,* November 2009.
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Q&A

Answer these on page 15 or make an online submission at: www.hkmacme.org

Please indicate whether the following statements are true or false

1. The management of diabetic nephropathy is straightforward to family doctors.
2. Early and vigorous treatment of diabetic nephropathy will prevent or delay the development of end-stage DN.
3. Metformin is well tolerated in patients with advanced renal failure.
4. Clinical decision support tools are usually available only in primary healthcare providers.
5. The user of the clinical decision tool needs to enter a patient's age and gender only.
6. It is easy for an ordinary nurse to master the "Diabetic Nephropathy Management Support" app.
7. The "Diabetic Nephropathy Management Support" app is free for the medical profession.
8. The app can be downloaded in Apple App Store.
9. An iPhone version of "Diabetic Nephropathy Management Support" will be developed in future.
10. The MDRD equation is now fully validated for Chinese.

ANSWERS TO NOVEMBER 2012

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1. False	2. False	3. False	4. False	5. False
6. True	7. True	8. True	9. True	10. True