GFR+

Impact of clinical decision support on renally cleared drug dosing in elderly hospitalised patients.

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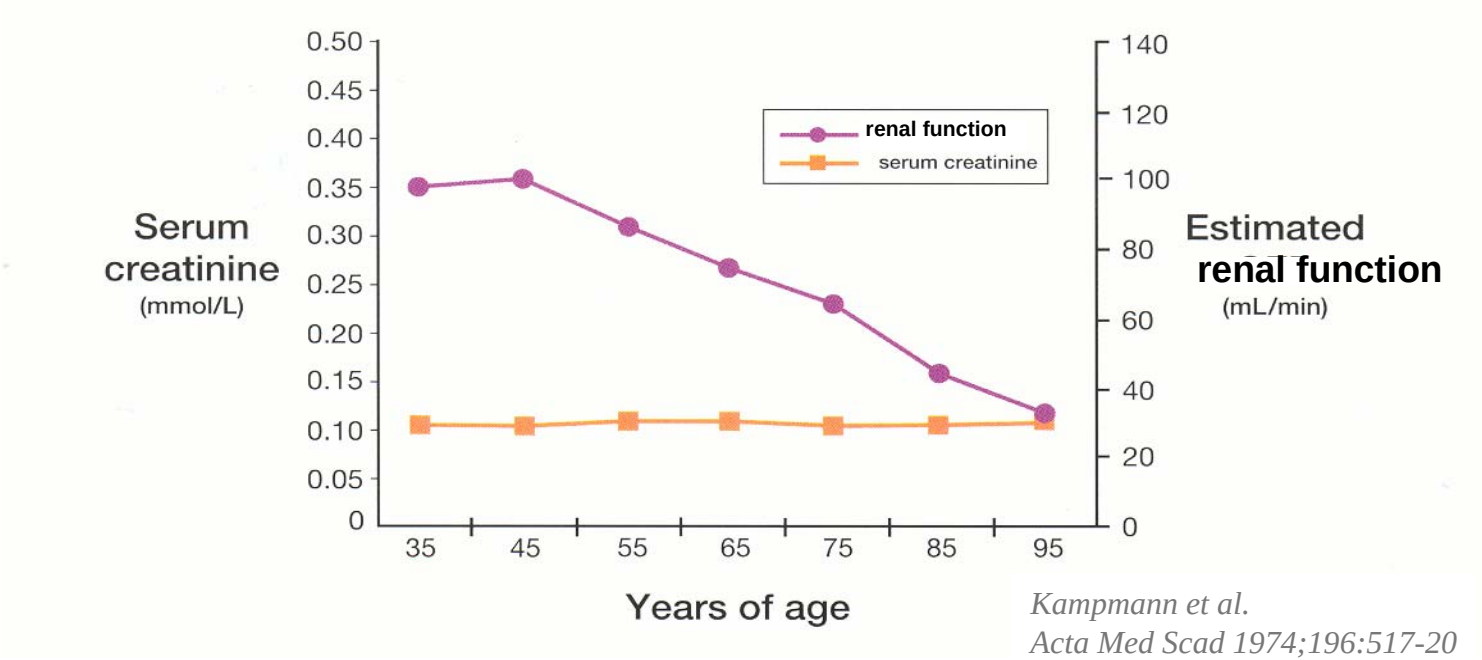
The Problem.

• lack of recognition of age-related decline in kidney (renal) function in hospital patients
• clinical culture revolves around using serum creatinine as a marker of renal function, which is very misleading in the elderly

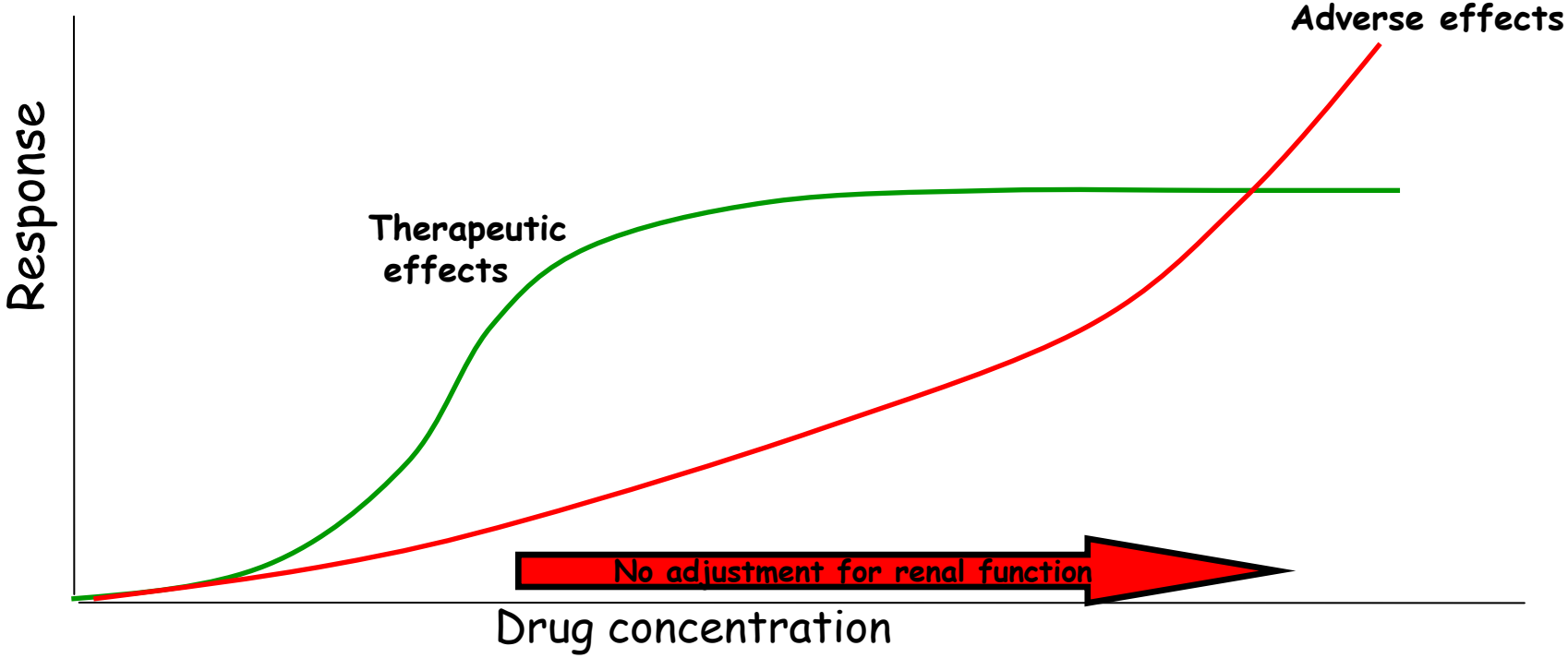


Kampmann et al.
Acta Med Scad 1974;196:517-20

• many key drugs excreted from the body via kidneys (renally cleared)
•the dose of these drugs needs to be decreased according to the decreasing renal function
•not being done in older patients with key drugs in particular (enoxaparin, gentamicin) - identified via death review audit process

The Problem.

•by not appropriately decreasing the dose when renal function is impaired, the patient inadvertently receives an overdose. The drug concentrations build up in the body, increasing the likelihood of adverse drug events.



•this causes a 2-fold increase in the rate of adverse drug events

Corsonello A et al. Arch Int Med 2005; 165: 790-5.

•adverse drug events are associated with a two-fold increase in mortality rate, increased length of hospital stay of 1.91 days, and an extra US$2262 per patient

Classen DC et al. JAMA 1997; 277: 301-6

Existing literature: Dosage adjustment in patients with renal impairment

Cantu et al. Am J Hosp Pharm 1992;49:2944-8.

- 169 inpatients with GFR<40 of which 60 patients were prescribed a renally cleared drug requiring dose adjustment
- 45% of renally cleared drugs too high
- on average 2.5 times higher than recommended dose
- prescribers notified of excessive dosing changed the dose 80% of the time

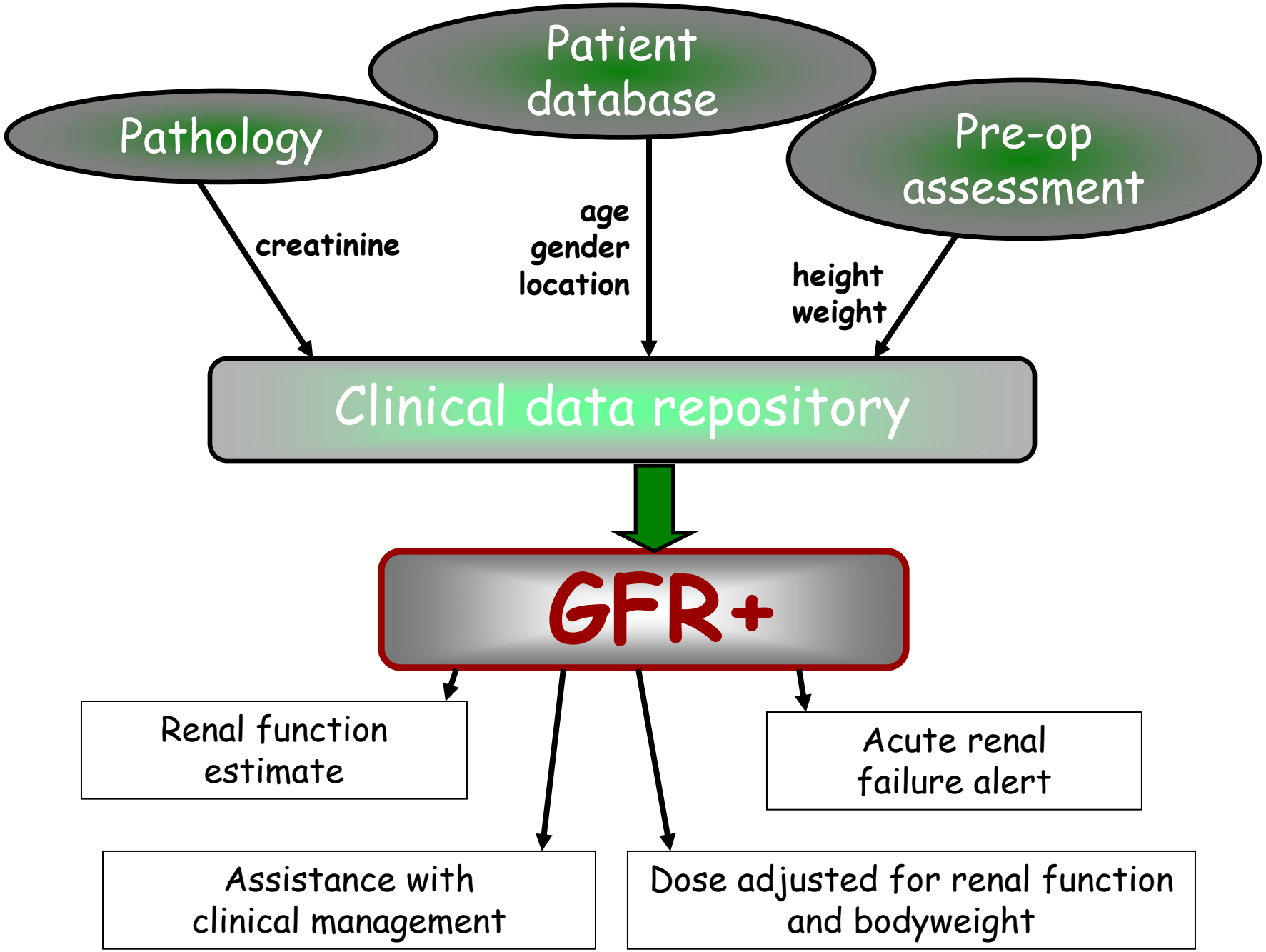
Formula required for estimation of patients renal function

- modified version of the Cockroft-Gault formula, using the lesser of ideal or actual weight, serum creatinine capped at a minimum of 60 mmol/l.

$$\textbf{Renal function (ml/min)} = \frac{(140 - \textbf{age}) \times \textbf{weight} \times k \text{ (x 0.85 if female)}}{\text{serum } \textbf{creatinine}}$$

Methodology

- clinical decision support module developed (GFR+). See next slide
- dosing guidelines developed with adjustment incorporated for renal function and body weight
- drugs included enoxaparin, gentamicin, metformin, ACE inhibitors, digoxin, vancomycin
- dosing and drug management data collected on 500 patients on renally cleared drugs before introduction of GFR+ to assess baseline
- GFR+ introduced to prescribers via academic detailing
- a further 500 patients were assessed and prescribing accuracy compared to baseline as well as drug management during episodes of acute renal failure


Patient database
Pathology
Pre-op assessment
creatinine
age
gender
location
height
weight
Clinical data repository
GFR+
Renal function estimate
Acute renal failure alert
Assistance with clinical management
Dose adjusted for renal function and bodyweight

Inpatient Renal Function - Microsoft Internet Explorer

http://rghapps.rgh.sa.gov.au/apps/gfr/RenalFunction.aspx

Current Inpatient Renal Function, Cardiology Unit

GFR+ Calculator — For patients with no renal function assessment, record height and weight into the GFR+ calculator.

Cardiology Unit | Ward, Name

Patient	Ward	GFR Values (ml/min)					Most Recent GFR (ml/min)	Renal Impairment
2								
CRILLY - 614025	2 - 08	24 26/05/2005	26 27/05/2005	26 30/05/2005	8 11/07/2005		8 12/07/2005	Severe >50% Decrease
5								
ALVEY - 594712	5 - B13	18 06/07/2005	16 07/07/2005	17 08/07/2005	17 11/07/2005		16 12/07/2005	Severe
DOBRIVOJEVIC - 621184	5 - B12	20 05/07/2005	21 07/07/2005	21 08/07/2005	20 09/07/2005		20 11/07/2005	Severe
SMITH - 555555	5 - B27	36 07/07/2005	44	41	42		47	
EDGAR - 515012	5 - B24	54						
HEALEY - 504647	5 - B20							
KAVANAGH - 523199	5 - B21							
RODDA - 624533	5 - B28	61 03/07/2005						
SOUTHALL - 573376	5 - B25							
WARNER - 525956	5 - B16	12 07/07/2005						
WEBB - 528643	5 - B26	25 07/07/2005						
CG								
HOMES - 548821	CG -							
HH								
TURNER - 535784	HH -							

RGH GFR+ Calculator - Microsoft Internet Explorer provided by RGH - Daw Park

http://rghapps.rgh.sa.gov.au/apps/gfr/GFRplus.aspx?Patient_ID=552227&Time_Period=3

GFR+ Calculator - Using optimised version of Cockroft/Gault equation

Inpatients Clear Help

Name: **SMITH, JOHN** MRI **555555** OB: **15/11/1919**

Patient Search

Age: 85 years

Weight: 56 kg

Height: 170 cm

cm / feet and inches

Serum Creatinine: 0.067 mmol/L (101 days ago)

Female / Male

Remember Height and Weight

Calculate GFR

GFR **47** ml/min

Choose The Drug

Top >>

ACE Inhibitors
Allopurinol
Digoxin
Enoxaparin (Prophylaxis)
Enoxaparin (Treatment)
Gentamicin
Lithium
Metformin
Vancomycin

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RGH GFR+ Calculator - Microsoft Internet Explorer provided by RGH - Daw Park

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Address http://rghapps.rgh.sa.gov.au/apps/gfr/GFRplus.aspx?Patient_ID=552227&Time_Period=3 Go Links Customize Links Free Hotmail

GFR+ Calculator - Using optimised version of Cockroft/Gault equation

Inpatients Clear Help

Name: **John Smith** MRN **555555** DOB: **15/11/1919**

Patient Search

Age: 35 years

Weight: 56 kg

Height: 170 cm

(•) cm ( ) feet and inches

Serum Creatinine: 0.067 mmol/L
101 days ago

(•) Female ( ) Male

☐ Remember Height and Weight

Calculate GFR

GFR **47** ml/min

Choose The Drug

Top >>

- ACE Inhibitors
- Allopurinol
- Digoxin
- Enoxaparin (Prophylaxis)
- Enoxaparin (Treatment)
- Gentamicin
- Lithium
- Metformin
- Vancomycin

Enoxaparin (Treatment)

35mg s/c twice daily

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Enoxaparin Treatment Doses

Dosing Frequency

Dosing frequency is maintained at twice daily for all patients. Once daily dosing is generally discouraged in order to avoid peaks that may be associated with bleeding, although it may be a necessary option for patients receiving home based therapy being administered by RDNS nurses.

Doses are rounded up to the nearest 5mg in order to accomodate the commercially available pre-filled syringes (Clexane©). For doses lower than 60mg the 60 mg syringe will have to be used for all doses except 20mg and 40mg. The 20mg and 40mg pre-packed syringes do not have markings that allow their use for any other doses.

Commencing Warfarin

Continue enoxaparin treatment for at least 24 hours after the patients returns their first therapeutic INR.

Anti-Xa Monitoring

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Address http://rghapps.rgh.sa.gov.au/apps/gfr/GFRplus.aspx?Patient_ID=522846 Go Links Customize Links Free Hotmail

GFR+ Calculator - Using optimised version of Cockroft/Gault equation

Inpatients Clear Help

Name **Bill Jones** MRN: **555556** DOB: **25/10/1923**

REPATRIATION GENERAL HOSPITAL DAW PARK

Patient Search

Age: 91 years

Weight: 90 kg

Height: 180 cm

cm feet and inches

Serum Creatinine: 221 µmol/L today

Female Male

Remember Height and Weight

Calculate GFR

GFR 20 ml/min

Choose The Drug

Top >>

ACE Inhibitors
Allopurinol
Digoxin
Enoxaparin (Prophylaxis)
Enoxaparin (Treatment)
Gentamicin
Lithium
Metformin
Vancomycin

Severe Renal Impairment

The estimated GFR is less than 30ml/min

The following drugs should only be used with caution, if at all:

- Acyclovir
- Allopurinol
- Gabapentin
- Lithium
- Metformin
- Morphine
- Spironolactone (pending potassium)
- Venlafaxine

Highlights drugs to be avoided if patient has severe renal impairment

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Start Inbox - Mi... GFR+ pos... Presentati... BSL mana... GFR manu... GFR+ scr... RGH GFR... 15:43

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Address http://rghapps.rgh.sa.gov.au/apps/gfr/GFRplus.aspx?Patient_ID=585543 Go Links Customize Links Free Hotmail

GFR+ Calculator - Using optimised version of Cockroft/Gault equation

Inpatients Clear Help

Name: **Bill Jones** MRN: **555556** DOB: **25/10/1923**

Patient Search

Age: 36 years

Weight: 55 kg

Height: 145 cm

cm feet and inches

Serum Creatinine: 0.083 mmol/L
4 days ago

Female Male

Remember Height and Weight

Calculate GFR

GFR **26** ml/min

Choose The Drug

Top >>

- ACE Inhibitors
- Allopurinol
- Digoxin
- Enoxaparin (Prophylaxis)
- Enoxaparin (Treatment)
- Gentamicin
- Lithium
- Metformin
- Vancomycin

Gentamicin

200mg STAT dose intravenously

Further doses ONLY after 24 hour trough level known

Extended interval dosing (one dose every 2 days or more) may be required for this patient.

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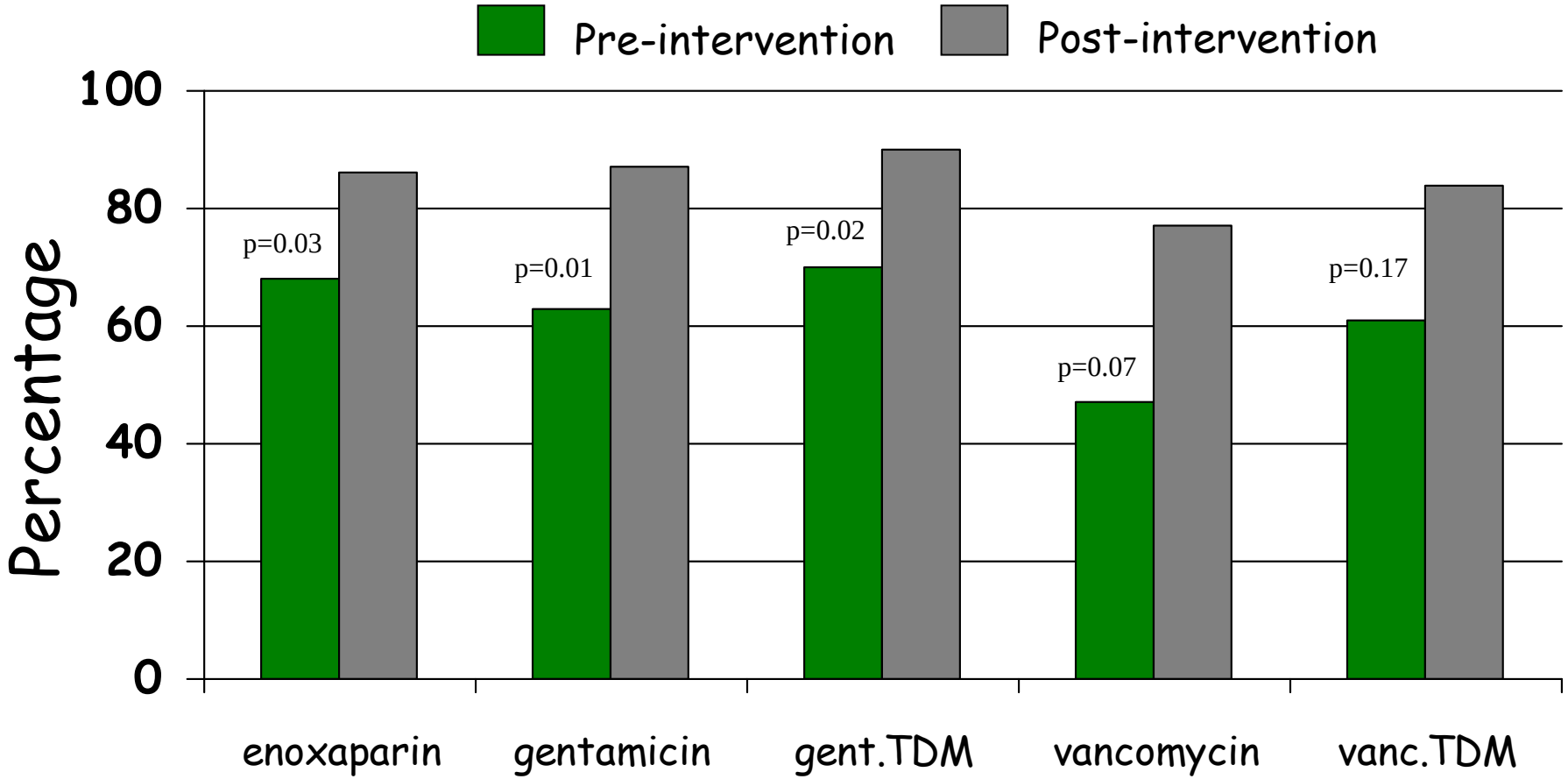
Improvement in prescribing of renally cleared drugs.



- frusemide was more likely to be held after the intervention (19% versus 31%, p<0.01).
- during episodes of acute renal failure, renally cleared drugs (ACE inhibitors, metformin, digoxin, frusemide) were held on 38% of instances in the pre-intervention period versus 62% post-intervention (p=0.01).

Discussion

- likely to lead to improved patient safety and outcomes
- extremely positive reception from medical staff
- apart from dose adjustment for renal clearance and weight, also possible to focus on different issues for different drugs:

✓ improving gentamicin dosing by extending the dosing interval during renal impairment rather than decreasing the dose

✓ encouraging appropriate drug monitoring

✓ encouraging maximisation of ACE inhibitor doses for heart failure

✓ building a general awareness of drug issues related to renal function