National Confidential Enquiry into Patient Outcome and Death

ACUTE KIDNEY INJURY (AKI)

Alistair Douglas

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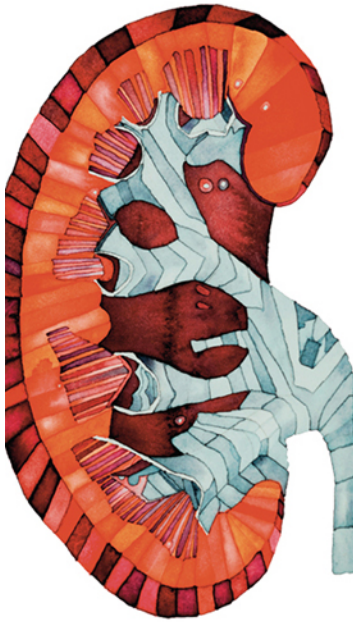
NCEPOD

Tayside – Dundee and Perth



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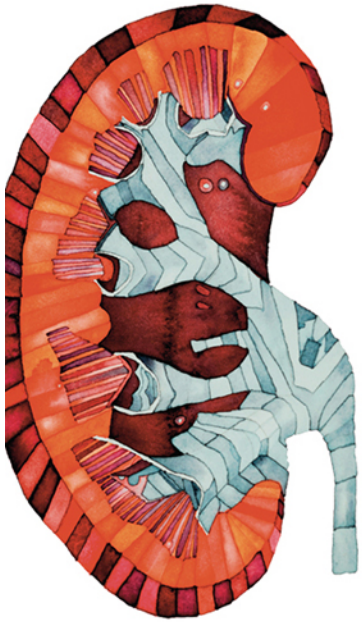
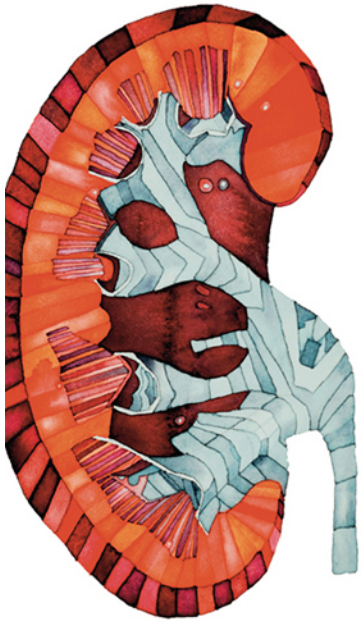
Unknown unknowns



- There are known knowns. These are things we know that we know. There are known unknowns. That is to say, there are things that we know we don't know. But there are also unknown unknowns. There are things we don't know we don't know.

Donald Rumsfeld

Knowing what might go wrong...



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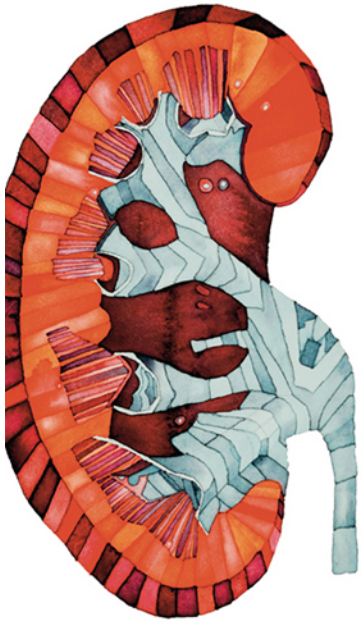
Reduces the chance of error



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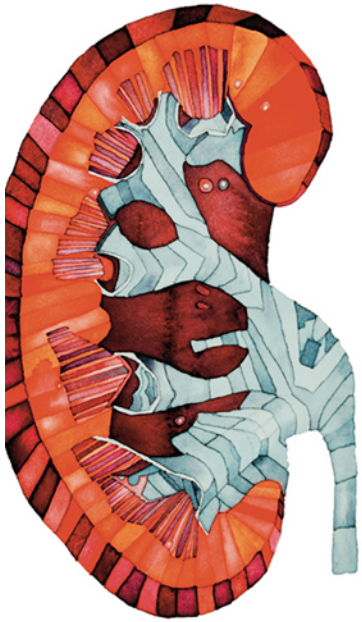
AKI - Outline



- Why AKI is relevant to all Internal Medicine Specialists
- Why change from ARF to AKI?
- The classification of AKI
- Simple approach to managing AKI
  - Known knowns
- Common mistakes and how to avoid them
  - Unknown unknowns?

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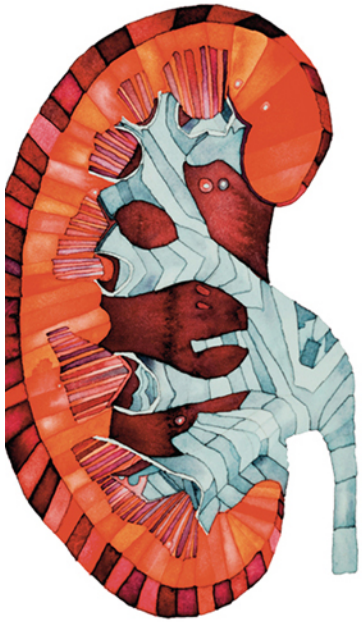
AKI - Outline



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Why AKI is relevant

- AKI is common
  - Estimated AKI incidence in hospital is 3-7% (historical ARF definitions)
  - RIFLE criteria suggest true incidence 18-20%
- Most AKI does not need a Nephrologist
  - Only 1% require dialysis
- AKI is associated with increased length of stay and mortality

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AKI is Common

- Dundee Acute Medical Unit
- All patients audited over 4 month period in 2007
- n = 3850
- 707 (18%) had AKI
- 19 (0.5%) required dialysis

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Most AKI will occur in General Internal Medicine

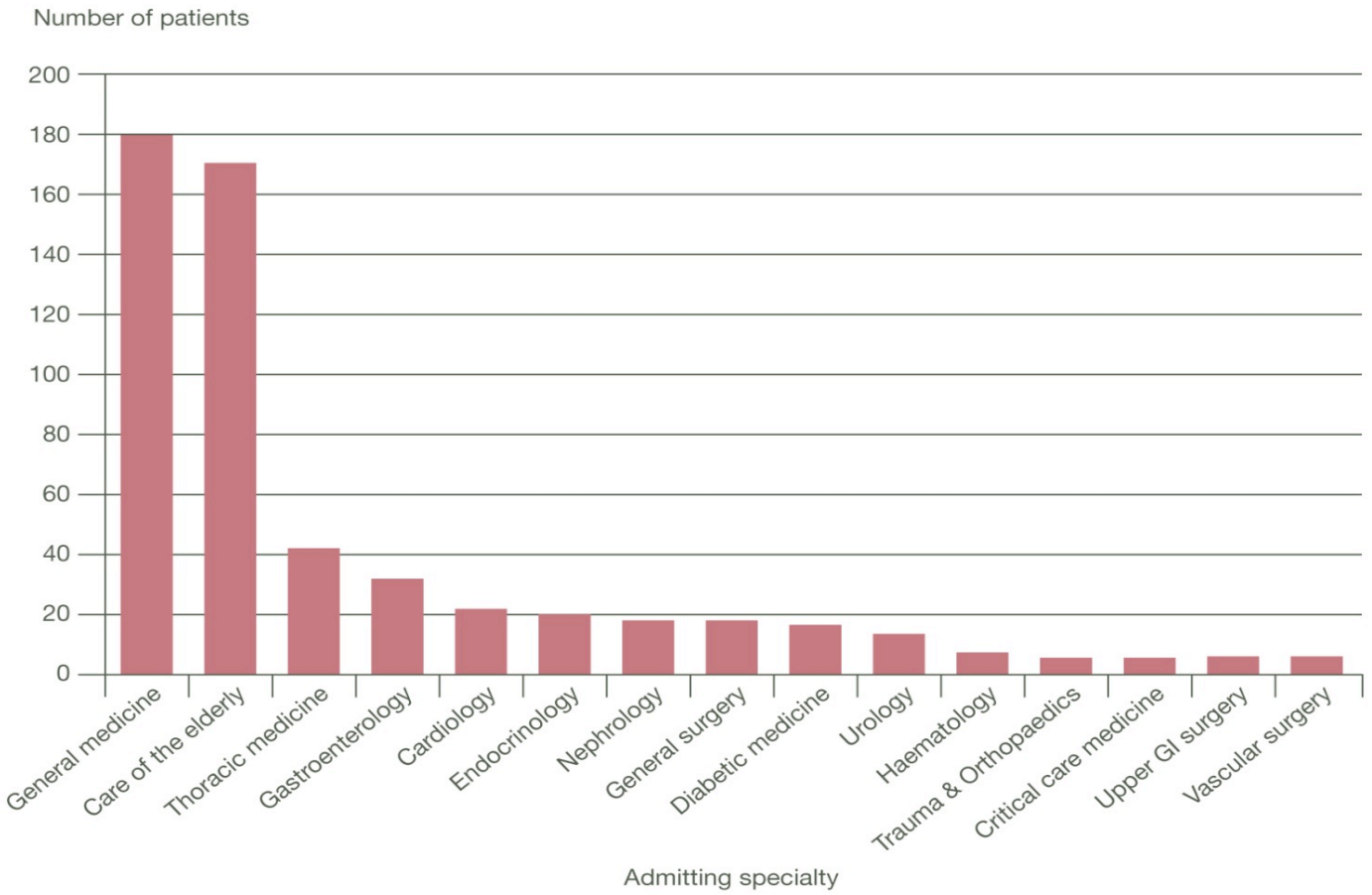
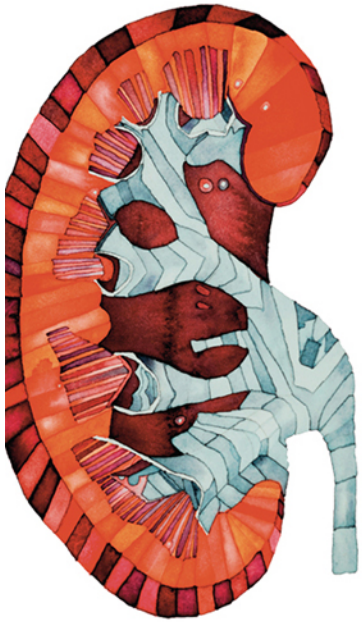
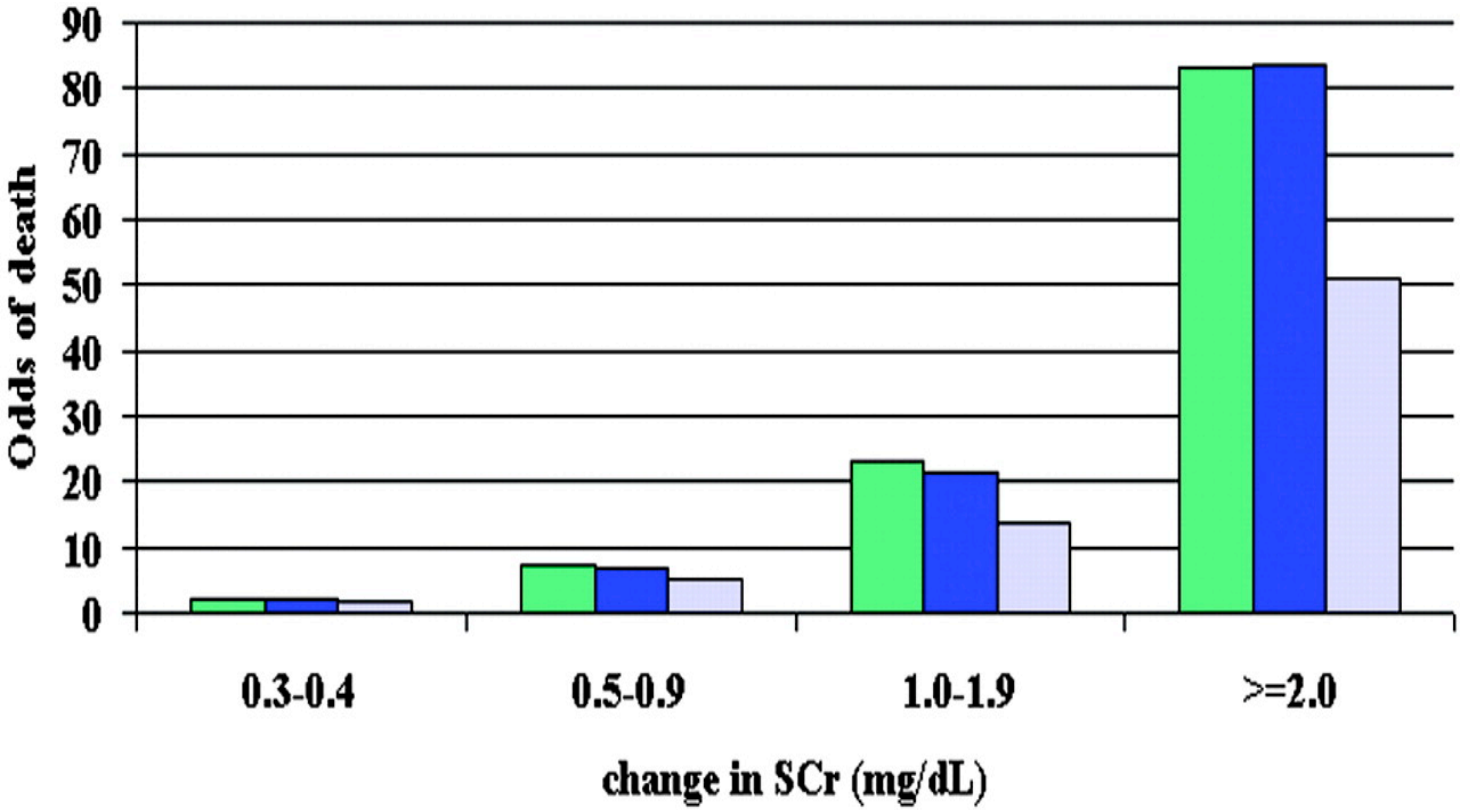


Figure 3.2 Specialties of admitting consultants

AKI and outcome

National Confidential Enquiry into Patient Outcome and Death





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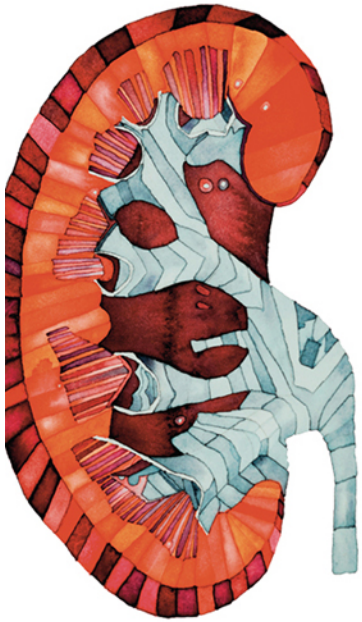
Chertow GM *et al.* J Am Soc Nephrol 2005; 16: 3365-3370

2 patients with pneumonia



- Patient 1
- Age 73
- Orientated
- Resp rate 25/min
- SaO2 95% (air)
- BP 110/70
- Urea 4.9 mmol/L

- Patient 2
- Age 73
- Orientated
- Resp rate 25/min
- SaO2 95% (air)
- BP 110/70
- Urea 9.8 mmol/L

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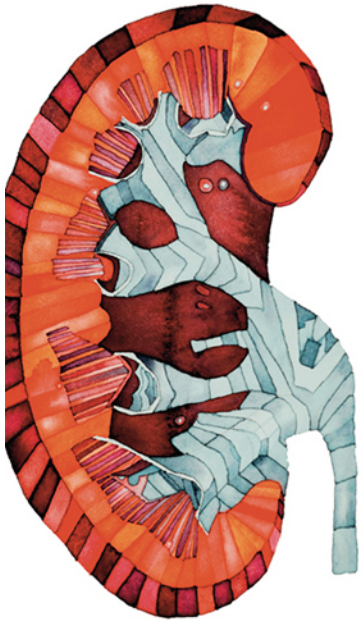
2 patients with pneumonia



- Patient 1
- Age 73
- Orientated
- Resp rate 25/min
- SaO2 95% (air)
- BP 110/70
- Urea 4.9 mmol/L
- CURB65 = 1

- Patient 2
- Age 73
- Orientated
- Resp rate 25/min
- SaO2 95% (air)
- BP 110/70
- Urea 9.8 mmol/L
- CURB65 = 2

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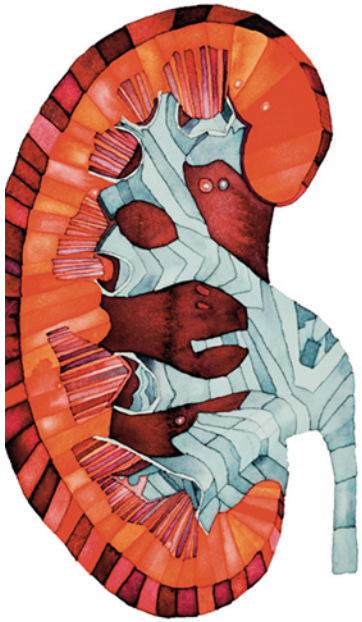
2 patients with pneumonia



- Patient 1
- Age 73
- Orientated
- Resp rate 25/min
- SaO2 95% (air)
- BP 110/70
- Urea 4.9 mmol/L
- CURB65 = 1
- 30 day mortality ?

- Patient 2
- Age 73
- Orientated
- Resp rate 25/min
- SaO2 95% (air)
- BP 110/70
- Urea 9.8 mmol/L
- CURB65 = 2

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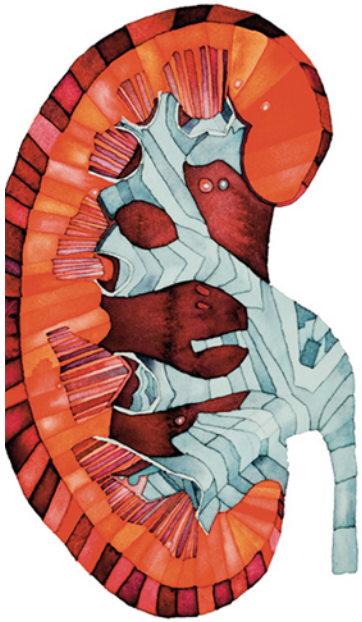
2 patients with pneumonia



- Patient 1
- Age 73
- Orientated
- Resp rate 25/min
- SaO2 95% (air)
- BP 110/70
- Urea 4.9 mmol/L
- CURB65 = 1
- 30 day mortality 3%

- Patient 2
- Age 73
- Orientated
- Resp rate 25/min
- SaO2 95% (air)
- BP 110/70
- Urea 9.8 mmol/L
- CURB65 = 2

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2 patients with pneumonia

- Patient 1
- Age 73
- Orientated
- Resp rate 25/min
- SaO2 95% (air)
- BP 110/70
- Urea 4.9 mmol/L
- CURB65 = 1
- 30 day mortality 3%

- Patient 2
- Age 73
- Orientated
- Resp rate 25/min
- SaO2 95% (air)
- BP 110/70
- Urea 9.8 mmol/L
- CURB65 = 2
- 30 day mortality 7%

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2 patients with pneumonia

- Patient 2
- Age 73
- Urea 9.8 mmol/L
- Creatinine 81 umol/L
- CURB65 = 2
- 30 day mortality 7%

- Patient 3
- Age 73
- Urea 9.8 mmol/L
- Creatinine 162 umol/L
- CURB65 = 2
- 30 day mortality ?

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2 patients with pneumonia

- Patient 2
- Age 73
- Urea 9.8 mmol/L
- Creatinine 81 umol/L
- CURB65 = 2
- 30 day mortality 7%

- Patient 3
- Age 73
- Urea 9.8 mmol/L
- Creatinine 162 umol/L
- CURB65 = 2
- 30 day mortality 18-36%

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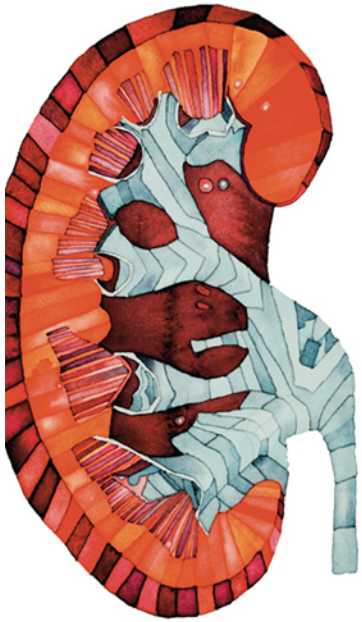
AKI - Outline



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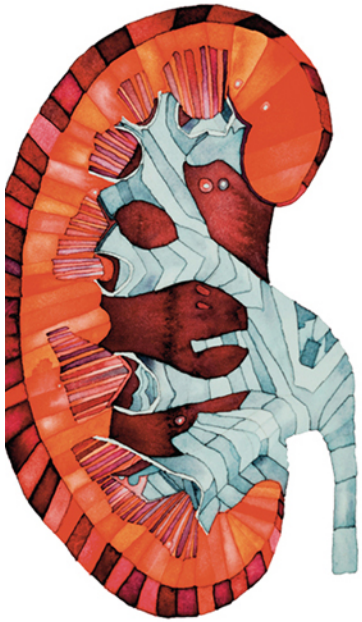
Change in Terminology



Chronic Renal Failure is now

Chronic Kidney Disease (CKD)

Stage (1, 2,) 3a, 3b, 4, 5

Acute Renal Failure is now

Acute Kidney Injury (AKI)

Grade 1, 2 or 3

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Why change?

- Question: What is your definition of Acute Renal Failure?

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Why change?

- Question: What is your definition of Acute Renal Failure?
- Answer: ?

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Why change?

- Previously no agreed definition of ARF
- Many different values of absolute or relative change in creatinine and/or urine output used in studies.
- Increasing recognition that incremental changes in renal function predict outcome

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Why change?

- New system to permit risk stratification
- Facilitates comparison studies of intervention and outcome

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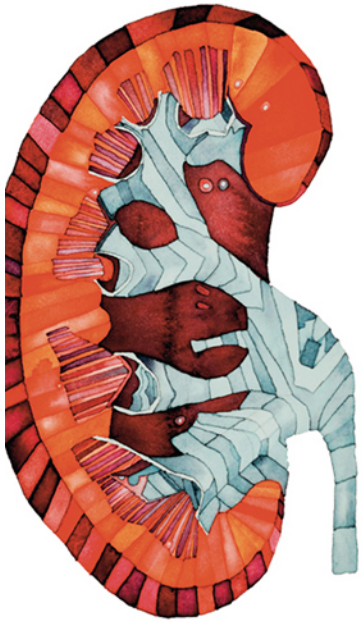
AKI - Outline



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RIFLE Classification

- **R**isk
- Injury
- **F**ailure
- ***L**oss of function > 4 weeks*
- ***E**ndstage kidney disease*

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- Kellum JA, Levin N, Bouman C, et al. Developing a consensus classification system for acute renal failure. Curr Opin Crit Care (2002) 8:509–514

RIFLE

- **RIFLE** classification agreed in 2002 (Acute Dialysis Quality Initiative)
- Based on defined changes in serum creatinine/ urine output
- Validated in > 200,000 patients

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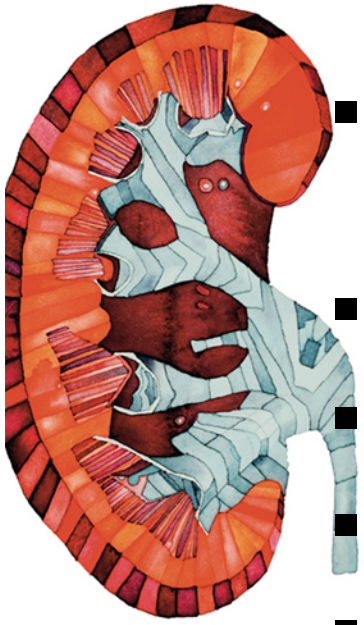
AKI Network (AKIN)



- AKIN amended RIFLE classification in 2007
- Risk = **AKI stage 1**
- Injury = **AKI stage 2**
- Failure = **AKI stage 3**
- *Stage 3 includes the previous Loss and Endstage groups*

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Mehta RL, Kellum JA, Shah SV, et al. Acute Kidney Injury Network: report of an initiative to improve outcomes in acute kidney injury. Crit Care (2007) 11:R31

AKI *simplified*

- Stage 1
  - Creatinine increased by 26.4 umol/L
  - *or urine output <40 ml/hr x 6 hrs*
- Stage 2
  - Creatinine increased x 2
  - *or urine output <40 ml/hr x 12 hrs*
- Stage 3
  - Creatinine increased x 3 or >354 umol/L or dialysis
  - *or urine output <25 ml/hr x 24 hrs*

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AKI *for dummies*

- Stage 1
  - –Creatinine >120
- Stage 2
  - –Creatinine doubled or >240
- Stage 3
  - –Creatinine trebled or >360

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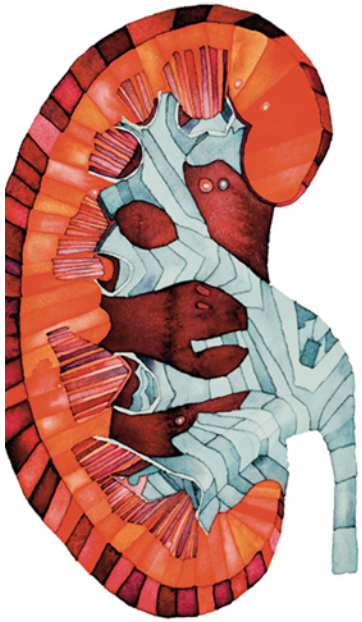
AKI - Outline



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Detective story

- A man is found dead lying at the bottom of a cliff. He has a rope around his neck. He has been stabbed 12 times. He has been shot in the chest. He has an empty bottle of diazepam in his pocket. His blood alcohol level is very high and postmortem reveals subarachnoid haemorrhage, myocardial infarction, pancreatitis and metastatic lung cancer.
- Question: Why did he die?

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Detective story

- A man is found dead lying at the bottom of a cliff. He has a rope around his neck. He has been stabbed 12 times. He has been shot in the chest. He has an empty bottle of diazepam in his pocket. His blood alcohol level is very high and postmortem reveals subarachnoid haemorrhage, myocardial infarction, pancreatitis and metastatic lung cancer.
- Question: Why did he die?
- Answer: Cigarette smoking

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Detective story – multiple factors

- Cigarette smoking caused
  - Lung cancer...
  - He became depressed and alcoholic...
  - He lost his job...
  - He borrowed money and gambled...
  - He could not pay his debts and borrowed from the Mafia...
  - And so on.....

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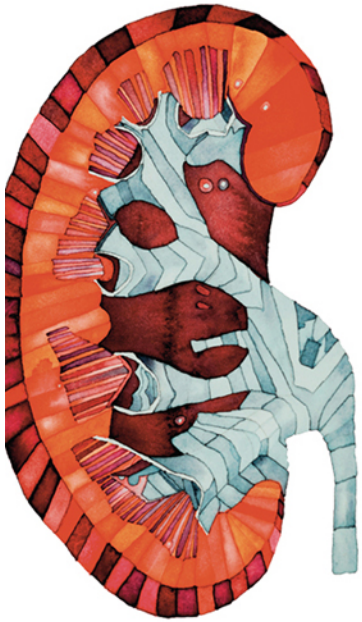
Internal Medicine must defend the kidneys from multiple attackers



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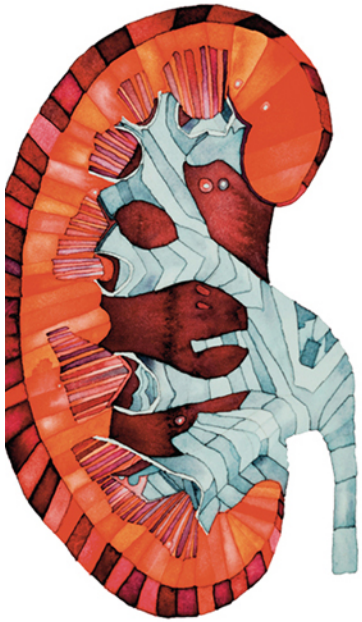

An 86 year old lady is known to have a serum creatinine of 125 µmol/l. She is taking enalapril for hypertension, metformin for type 2 diabetes and naproxen for rheumatoid arthritis. She develops right upper quadrant pain, vomiting, fever, and jaundice. She is found to be dehydrated, hypotensive and pyrexial. She is given coamoxiclav, metronidazole and gentamicin and has an abdominal CT scan..

Question: How many attackers (risk factors for AKI) are there?

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An 86 year old lady is known to have a serum creatinine of 125 µmol/l. She is taking enalapril for hypertension, metformin for type 2 diabetes and naproxen for rheumatoid arthritis. She develops right upper quadrant pain, vomiting, and jaundice. She is found to be dehydrated, hypotensive and pyrexial. She is given coamoxiclav, metronidazole and gentamicin and has an abdominal CT scan.

Answer: 12 (minimum!)

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AKI: causes

Liano et al, 1996

National Confidential Enquiry into Patient Outcome and Death

Acute tubular necrosis	45%
Prerenal	21%
Acute on chronic Kidney injury	13%
(Total	79 %)
Obstructive	10%
Glomerulonephritis (primary & secondary)	3%
Acute tubulo-interstitial nephritis	2%
Vasculitis	1.5%
Vascular	1%
Other	3.5%

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The simple approach

Pre-Renal (very common)

Has the patient got an adequate BP or cardiac output?

Renal (less common)

Have we poisoned the kidney?

Is there a primary renal cause?

Post- Renal (common)

Is there obstruction to the urine flow?

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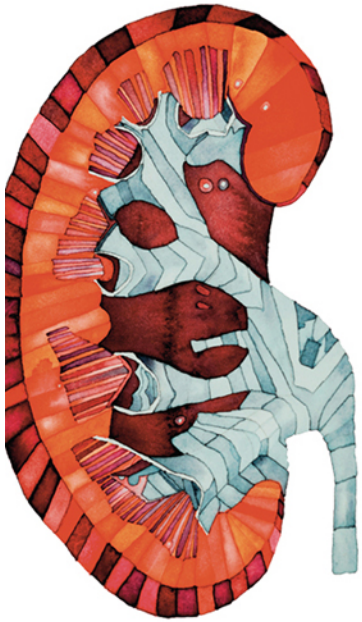
But we make mistakes



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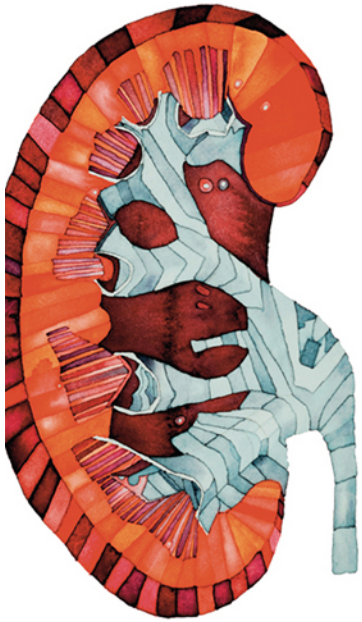
AKI - Outline



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National Confidential Enquiry into Patient Outcome and Death

Adding Insult to Injury

A review of the care of patients who died in hospital with a primary diagnosis of acute kidney injury (acute renal failure).

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WHO OPERATES WHEN? II

The 2003 Report of the National Confidential Enquiry into Perioperative Deaths

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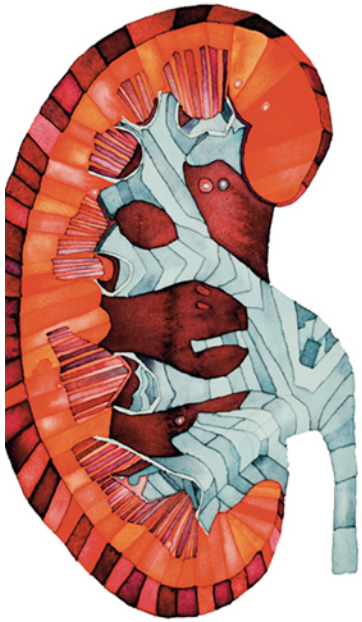
NCEPOD 2005 Report

An Acute Problem?

Recommendations
An Acute Problem (2005)



1. Training must be provided for junior doctors in the recognition of critical illness and the immediate management of fluid and oxygen therapy in these patients.
2. Consultants must supervise junior doctors more closely and should actively support juniors in the management of patients rather than only reacting to requests for help.
3. Junior doctors must seek advice more readily. This may be from specialised teams e.g. outreach services or from the supervising consultant.

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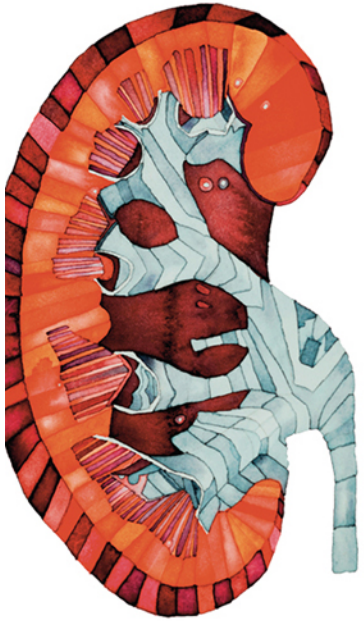
Emergency Admissions:
A journey in the right direction?

A report of the National Confidential Enquiry
into Patient Outcome and Death (2007)

Recommendation Emergency Admissions

Trainees need to have adequate training and experience to recognise critically ill patients and make clinical decisions. This is an issue not only of medical education but also of ensuring an appropriate balance between a training and service role; exposing trainees to real acute clinical problems with appropriate mid-level and senior support for their decision making.

Primary aim



To examine the process of care of patients who died in hospital with AKI, in order to identify remediable factors in the care received by these patients

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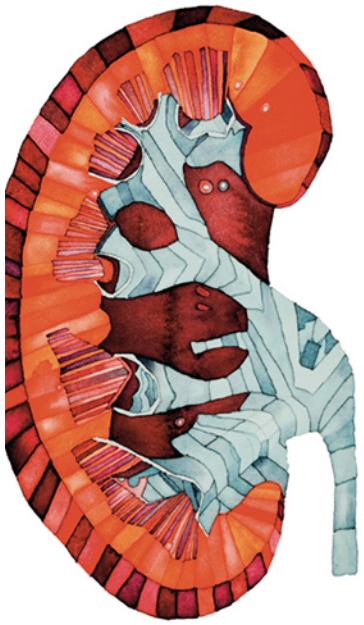
Patient sample



Inclusion criteria

- Patients aged 16 years or older
- Coded for a diagnosis of AKI (or ARF)
- Who died in hospital between January 1st 2007 and March 31st 2007 inclusive

Exclusion criteria

- Patients already on RRT
- Admission was for palliative care

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Demographics

- 974 patients suitable for study
- 90% acute medical admissions
- 88% AKI on admission
- 54% had evidence of CKD

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Study population

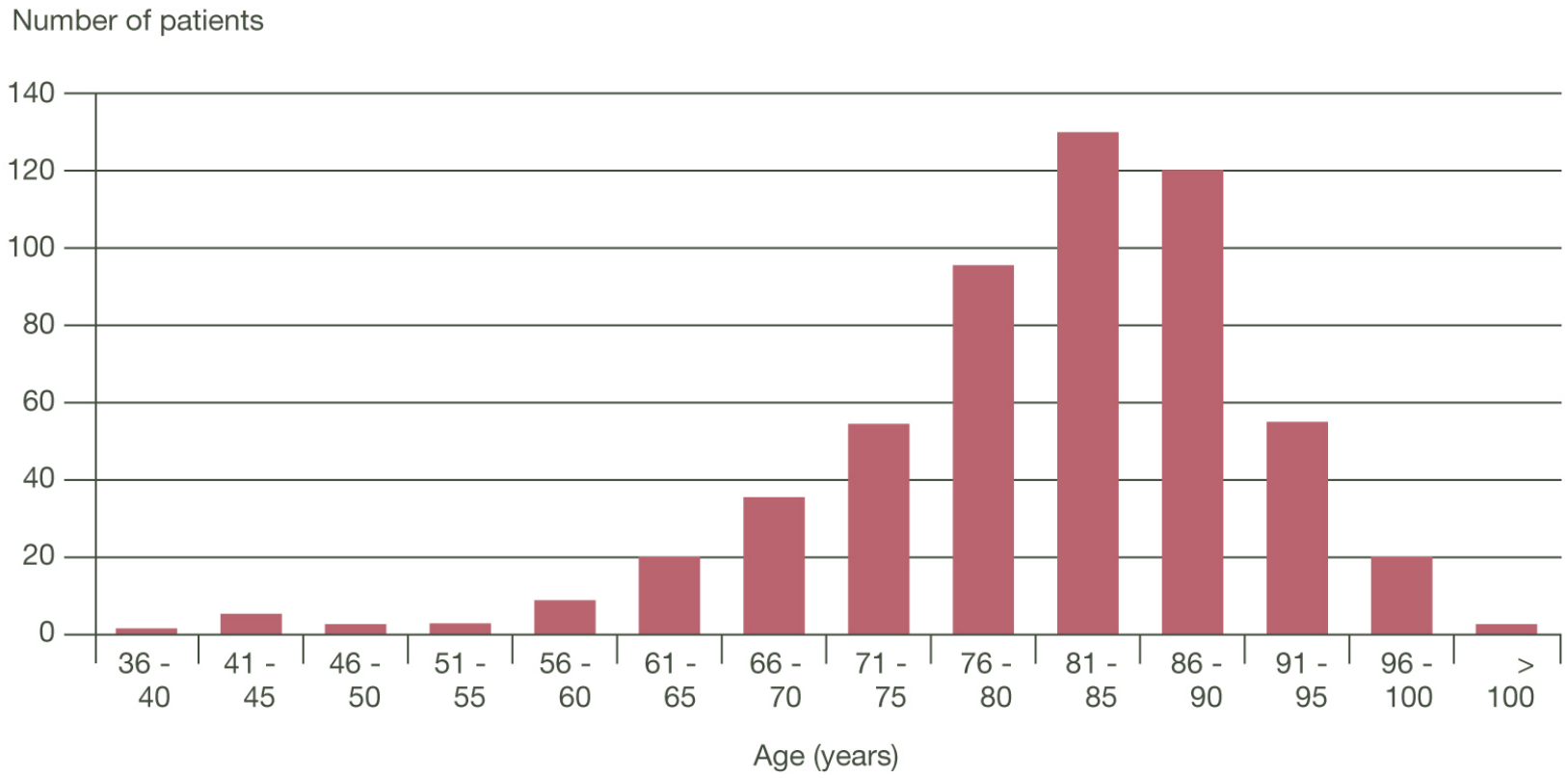


Figure 3.1 Age distribution of study population

Elderly population - median age of 83

Case study

An elderly patient was admitted with a history of dyspnoea and AKI. Their past medical history included congestive cardiac failure and diabetes for which the patient was taking metformin. Initial investigations showed a white cell count of 25: ABG showed pH 6.98 and base excess -25. The patient was treated as LVF with diuretics and CPAP. They died 12 hours after admission.

Case study

An elderly patient was admitted with a history of dyspnoea and AKI. Their past medical history included congestive cardiac failure and diabetes for which the patient was taking metformin. Initial investigations showed a white cell count of 25: ABG showed pH 6.98 and base excess -25. The patient was treated as LVF with diuretics and CPAP. They died 12 hours after admission.

This was an example of poor management and complete failure to recognise the likelihood of sepsis and/or lactic acidosis.

Missed complications

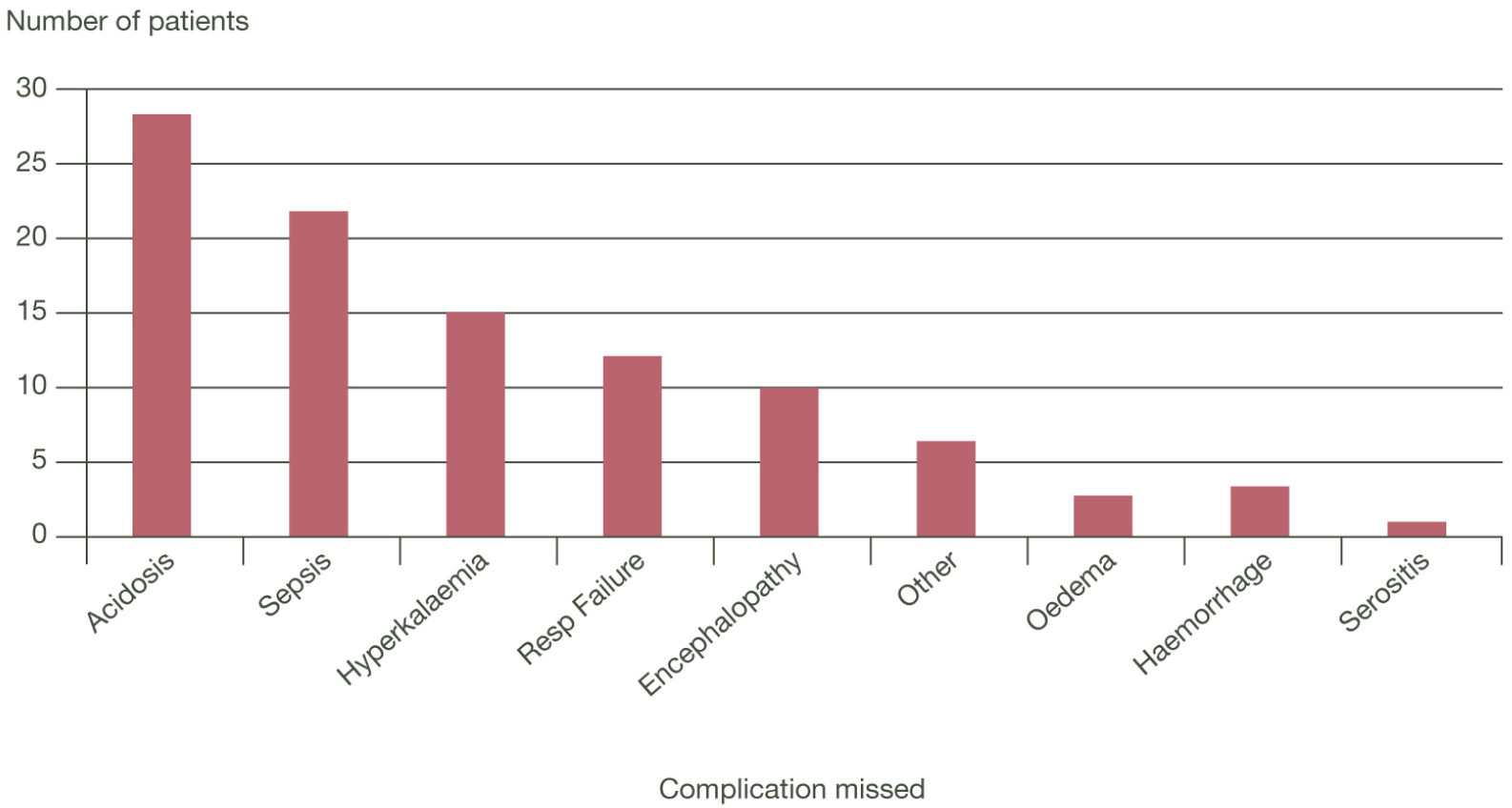


Figure 4.4 Missed complications – advisors' opinion in the 55 cases highlighted in Table 4.13

Missed complications

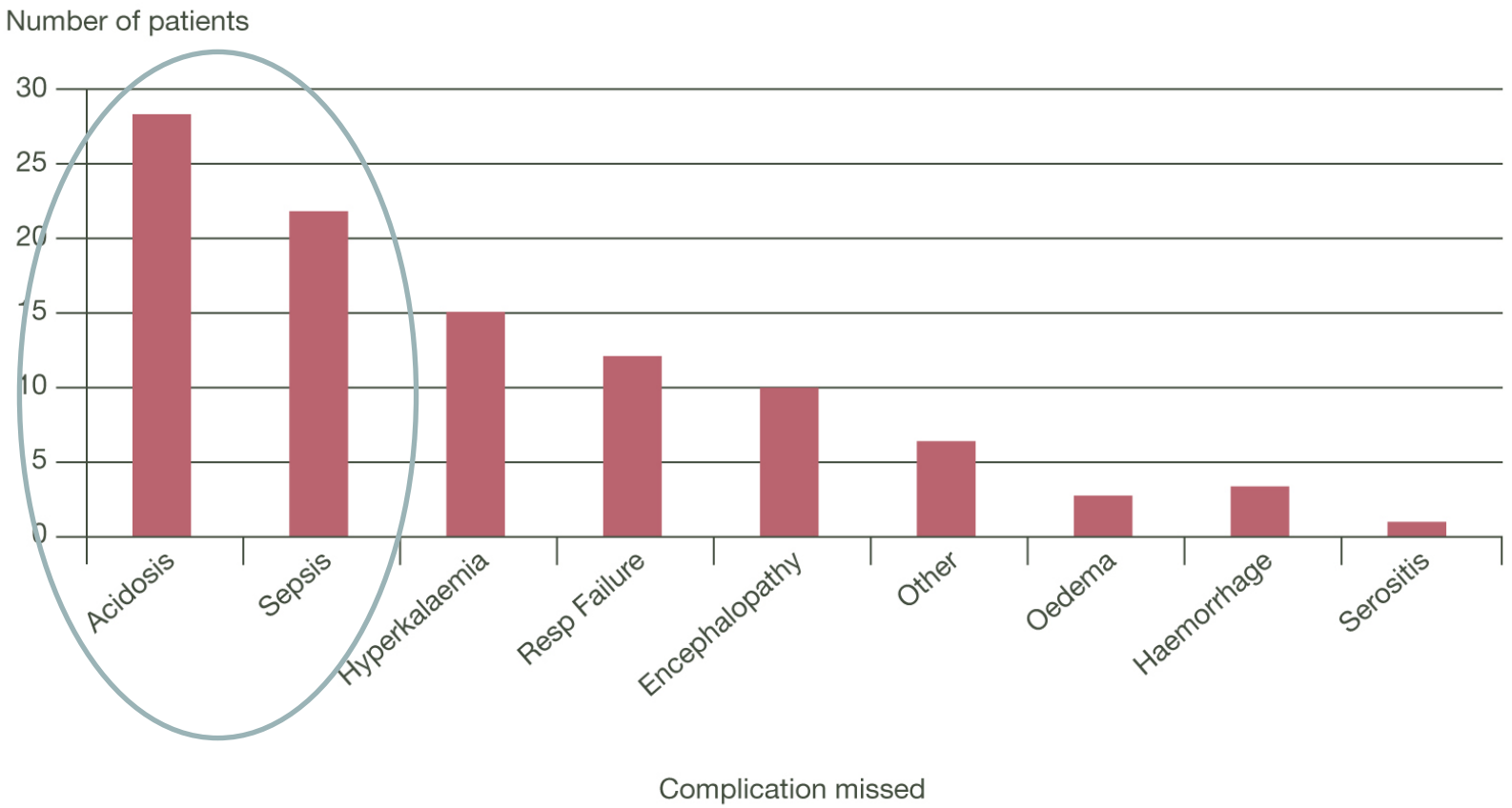


Figure 4.4 Missed complications – advisors' opinion in the 55 cases highlighted in Table 4.13

Case study

An elderly patient was admitted with a history of lethargy and confusion. They were found to have AKI (urea 62, creatinine 668.) They were treated with volume resuscitation and discontinuation of potential nephrotoxins. A urinary catheter was inserted which drained 200 mls initially and nothing thereafter. Twenty four hours after admission renal function had worsened and the patient had their first Consultant review. An ultrasound was ordered which was performed later that day and showed bilateral hydronephroses. The patient suffered a fatal cardiac arrest before a nephrostomy could be organised.

Case study

An elderly patient was admitted with a history of lethargy and confusion. They were found to have AKI (urea 62, creatinine 668.) They were treated with volume resuscitation and discontinuation of potential nephrotoxins. A urinary catheter was inserted which drained 200 mls initially and nothing thereafter. Twenty four hours after admission renal function had worsened and the patient had their first Consultant review. An ultrasound was ordered which was performed later that day and showed bilateral hydronephrosis. The patient suffered a fatal cardiac arrest before a nephrostomy could be organised.

The delay in recognising the importance of anuria and organising the ultrasound may have contributed to the patients death in a potentially reversible case of AKI.

Omitted investigations

Table 5.2 Omitted investigation of AKI – Advisors' opinion

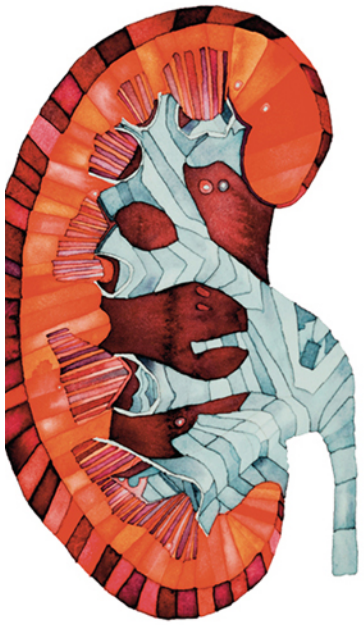
Omitted from investigations	Number of patients
Ultrasound	94
Acid base balance	83
Volume status	76
Urinalysis	73
Early warning score	57
Sepsis recognition	48
Biochemistry	33
Other	18
TPR	16
Immunology	10
CT	5
Radioisotopes	1
Renal biopsy	1
Total	**515**

Omissions in AKI management

Table 5.6 Omissions in AKI management- advisors' opinion

Omitted from management	Number of patients
Correction of hypovolaemia	85
Biochemistry	62
Fluid	54
Urine output	51
Other	46
Cessation of nephrotoxic drugs	36
Medications altered to Renal doses	32
Urinary Catheter	28
Daily weight chart	23
TPR	21
Central venous pressure	20
Cessation of diuretics	18
Administration of diuretics	15
Review by nutrition team	15
Antibiotics	10
Interventional radiology	3
Total	**519**

Key findings



- 33% of patients had inadequate investigations
- 29% had inadequacies in clinical management
- Poor recognition of acute illness, hypovolaemia and sepsis

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Case study

An elderly patient was admitted with a chest infection. There were significant comorbidities – type 2 Diabetes, ischaemic heart disease, LV dysfunction, CKD, COPD, morbid obesity. Renal function deteriorated despite good medical care. The Consultant discussed treatment options with the patient and next of kin. After several discussions the patient decided that they did not wish to undergo dialysis and subsequently died peacefully.

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Early recognition of deterioration allowed the patient to take part in decision making about treatment options. They commented that this represented excellent care of a dying patient.

Case study

An elderly patient was admitted from home following severe vomiting and diarrhoea. They had significant cardiorespiratory co-morbidity but was self caring and able to live independently with their spouse. On admission a diagnosis of AKI secondary to volume depletion was made. Despite resuscitation the biochemistry did not improve and no urine was passed. There was no discussion with the patient about likely outcomes and appropriate treatments. Over the next 24 hours the patient became more drowsy and hypotensive. A decision not to escalate care was taken following discussion with their spouse and a palliative care plan put in place. On that day an ultrasound (that had been requested on admission) revealed bilateral hydronephroses. The patient died later that day.

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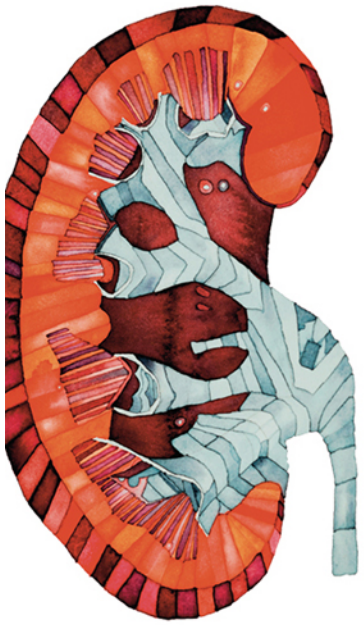
The decision not to escalate care had been made without a full assessment and that hydronephrosis was an easily reversible cause of AKI. Furthermore, no effort had been made to discuss treatment options with the patient when they were competent.

Recommendations: Assessment



- Initial clerking for all emergency patients should include an AKI risk assessment
  - *or should all emergency medical admissions be suspected to have AKI?*
- All emergency patients should have electrolytes checked on admission and appropriately thereafter
  - *including acid-base status*
- Urinalysis should be performed on all emergency admissions

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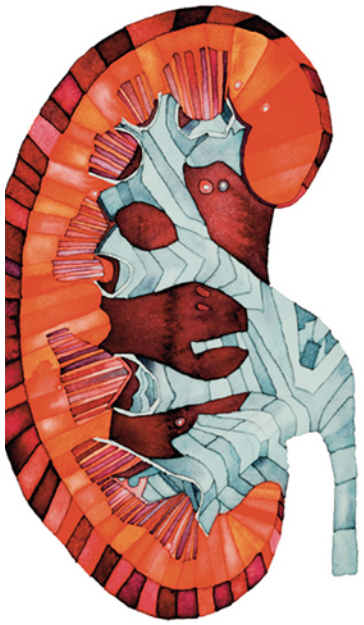
Recommendations: Management



- All acute admissions should receive adequate senior reviews (with a consultant review within 12 hours of admission)

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Conclusion

- Education and Practice
  - Illness severity
  - Risk of AKI
  - Precipitants
  - Early management

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In the UK

- 98% of hospitals have Acute Medical Assessment Units
- Specialists in Acute Internal Medicine (AIM)
- Society for Acute Medicine (SAM) since 2000 – now 1000 members
- AIM recognised as full specialty in 2010

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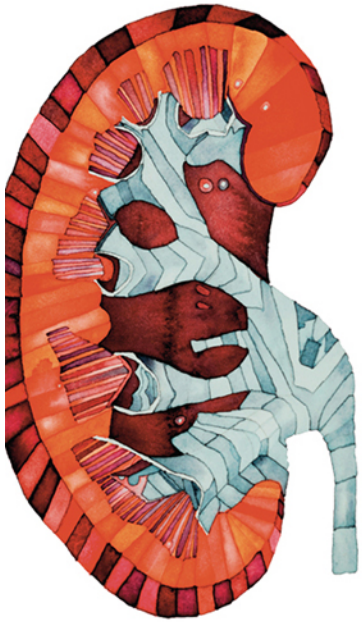
In Dundee



- 31 bed Assessment Unit
- 6 bed Critical Care Unit (inotropes, NIV, dialysis etc)
- 15 bed Short Stay Unit (72 hours)
- 5 Consultants, 4 rounds per day
- 11,000 admissions per year
- Ambulatory Care Unit 1000-1800
- Patients from ER (25%) and direct from General Practitioner

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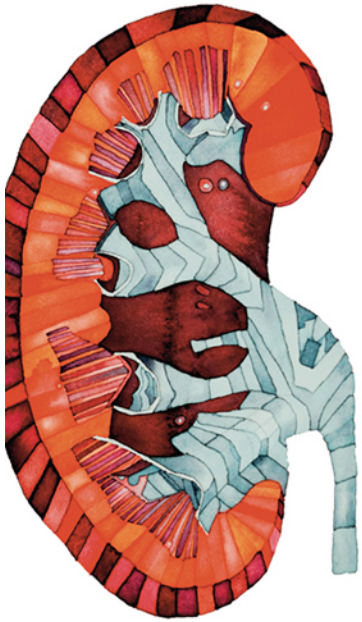
In the UK



- Acute Kidney Injury Care Initiative
  - NHS Kidney Care (DH sponsored)
  - Stakeholders from different organisations
    - Physicians, Surgeons, Nephrologists, Intensivists
  - Identify the challenges and propose solutions
  - Education and training

Core Competencies Document

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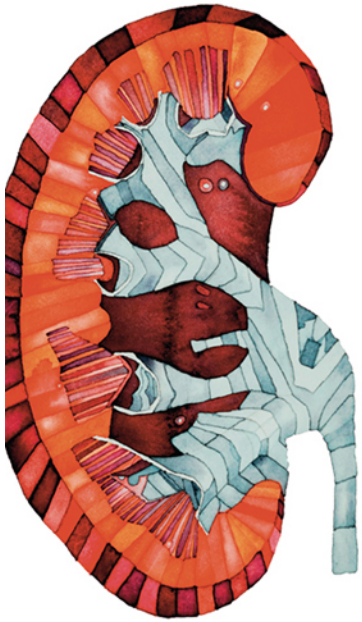
AKI - Summary



- Why AKI is relevant to all Internal Medicine Specialists
- Why change from ARF to AKI?
- The classification of AKI
- Simple approach to managing AKI
  - Known knowns
- Common mistakes and how to avoid them
  - Unknown unknowns?

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AKI

Thank you

Any Questions?

www.ncepod.org.uk

www.renal.org/pages/pages/guidelines/current/arf.php

www.acutemedicine.org.uk

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