Acute kidney injury
Common, harmful, treatable
Dr Richard Fluck
NHS Outcomes Framework Summary

Domain 1: Preventing people from dying prematurely

Domain 2: Enhancing quality of life for people with long-term conditions

Domain 3: Helping people to recover from episodes of ill health or following injury

Domain 4: Ensuring people have a positive experience of care

Domain 5: Treating and caring for people in a safe environment and protecting them from avoidable harm
”One in five emergency admissions to hospital will have AKI”

”AKI is 100 times more deadly than MRSA infection”

”Around 20 per cent of AKI cases are preventable”

”costs of AKI to the NHS are £434-620m pa”
‘reducing avoidable death, long-term disability and chronic ill health...’

- VTE prevention: estimate 25,000 deaths pa

Data derived from: Hospital Episode Statistics Annual Report, DoH VTE Prevention Programme 2010 and Selby et al 2012
Incidence of AKI is increasing

AKI not requiring dialysis

Dialysis-requiring AKI


* Per 100,000 person years

Hsu RK et al. *JASN* 2013;24:37-42

* Per million person years
Patients with AKI do not die from uraemia

Bi-directional relationship of AKI and CKD

1 million patients with baseline assessments of serum creatinine and proteinuria

CKD and proteinuria increase risk of AKI

<table>
<thead>
<tr>
<th>Baseline renal function</th>
<th>Rate ratio for hospital admission with AKI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>eGFR &gt;60</td>
<td>1.0</td>
</tr>
<tr>
<td>eGFR 45-59.9</td>
<td>2.3</td>
</tr>
<tr>
<td>eGFR 30-44.9</td>
<td>5.6</td>
</tr>
<tr>
<td>eGFR 15-29.9</td>
<td>13</td>
</tr>
</tbody>
</table>

*non-proteinuric group shown; similar pattern seen across all levels of proteinuria

James MT et al. Lancet 2010; 376: 2096-2103

233,803 hospitalised patients aged over 67

AKI increased risk of ESKD by 13 fold

Ishani A et al. JASN 2009; 20: 223-228
NCEPOD report published in 2009

- Poor assessment of risk factors for AKI and acute illness
- Delays in recognising AKI
- Most patients with AKI are not cared for by nephrologists
- Post admission AKI avoidable in 21%
- ‘Good’ care in <50% cases
Study population

Figure 3.1 Age distribution of study population

Elderly population - median age of 83
Admitting specialty

Figure 3.2 Specialties of admitting consultants
Key findings

- Only 50% of AKI care considered good
- Poor assessment of risk factors
- Unacceptable delay in recognition of post-admission in AKI in 43%
- 22 patients died with a primary diagnosis of post-admission AKI which was predictable and avoidable
- Complications missed (13%), avoidable (17%) or badly managed (22%)
Conclusion

- Systematic failings in AKI
- Failures in:
  - Recognition and management of AKI
  - Recognition and management of complications
  - Referral and support
- Failures in recognition of the acutely ill
At present systems are being developed *ad hoc*. A national group should be established to develop agreed standards for e-alert systems recognising the need for some system-dependent local flexibility.
Support for implementing the NICE clinical guideline on acute kidney injury (CG169)
• Identifying acute kidney injury in patients with acute illness
• Identifying acute kidney injury in patients with no obvious acute illness*
• Assessing risk factors in adults having iodinated contrast agents and in adults having surgery
• Ongoing assessment of patients in hospital
• Detecting acute kidney injury
• Identifying the cause(s) of acute kidney injury
  • Urinalysis*
  • Ultrasound
• Managing acute kidney injury
  • Relieving urological obstruction*
  • Pharmacological management*
  • Referring for renal replacement therapy*
  • Referring to nephrology
  • Information and support for patients and carers

* not a KPI, but considered a key issue by the guideline development group
Risk factors: adults

- Chronic kidney disease (or history of)
- Diabetes
- Heart failure
- Sepsis
- Hypovolaemia
- Age 65 years or over
- Use of drugs with nephrotoxic potential (for example, NSAIDs, ACE inhibitors)
- Use of iodinated contrast agents within past week
- Oliguria
- Liver disease
- Limited access to fluids, e.g. via neurological impairment
- Deteriorating early warning scores
- Symptoms or history of urological obstruction
Detecting AKI

- Investigate for AKI when risks factors are present
- Compare serum creatinine with the patient’s baseline

<table>
<thead>
<tr>
<th>Detect AKI using (p)RIFLE, AKIN, KDIGO criteria:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum creatinine</td>
</tr>
<tr>
<td>Serum creatinine</td>
</tr>
<tr>
<td>Urine output</td>
</tr>
</tbody>
</table>

- Urine output $< 0.5$ml/kg/hour for more than 8 hours in children and young people
- In children and young people – a 25% or greater fall in eGFR
Adults: ongoing hospital assessment

- Use early warning scores (track and trigger systems) (CG50)
- Ensure there is a system in place to recognise and respond to oliguria <0.5ml/kg/hour (if not part of early warning score)
- Continue to monitor serum creatinine regularly in all patients with, or at risk, of acute kidney injury
Managing AKI

- Pharmacological management
- Relieving urological obstruction
- Referral
- Information and support for patients and carers
## Referral

### Nephrology:
Discuss AKI management with a nephrologist/paediatric nephrologist as soon as possible (and within 24 hours) if one of the following is present:

<table>
<thead>
<tr>
<th>Potential diagnosis requiring specialist treatment (for example, vasculitis or glomerulonephritis)</th>
<th>AKI with no clear cause</th>
<th>Inadequate treatment response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complications associated with AKI</td>
<td>Stage 3 AKI</td>
<td>eGFR is less than &lt; 30 ml/min/1.73 m² after AKI episode</td>
</tr>
<tr>
<td>Patients with renal transplant and AKI</td>
<td>CKD stage 4 or 5</td>
<td></td>
</tr>
</tbody>
</table>

### Renal replacement therapy:
Refer adults, children and young people **immediately** for RRT if any of the following are not responding to medical management:

| Hyperkalaemia | Metabolic acidosis | Symptoms or complications of uraemia such as pericarditis or encephalopathy | Fluid overload +/- pulmonary oedema |
Acute Kidney Injury Programme Board NHS England
The House of Care

Outcome: Organisational and Clinical Processes
Enabling Person Centred Coordinated Care

Components:
- Risk stratification
- Information and technology
- Guidelines and national audits
- Evidence based practice and protocols
- Service structure and planning

Outcome: Informed and engaged patients and carers
Components:
- Activation
- Self management
- Technology
- Peer support
- Information
- Effective contacts
- Carers

Outcome: Health and Care Professionals working in partnership with patients, carers and each other
Components:
- Integration
- Culture
- Technology
- Care Navigation
- Effective contacts

Outcome: Effective Commissioning
Components:
- Needs Assessment and Planning
- Joint commissioning
- Service User and Public Involvement
- Contracting
- Procurement
- Evaluation
The steering group

- Provide governance and strategy to the project
- Responsible for communication to stakeholders
- Be accountable for the deliverables
- Supported by the programme manager
- Review of the project budget
- Provide leadership to the work streams
Work streams

• Chair and deputy
• Co-opted membership agreed by the management team
• Develop project plan with support of programme manager

• Delineate scope
• Provide timelines and objectives
• Identify evidence and best practice
• Develop tools
• Provide research and development focus
• Ensure equity and transparency in approach - e.g. paediatric dimension
On going professional groups

**ACB scientific committee**
- Met July 2013
- Biochemists, nephrologists and software providers
- Initial algorithm and minutes available online

**Renal Association guidelines committee**
- Due to meet October 2013
- Nephrologists, ICU, general medicine

AKI work streams - Programme board plan

- Patient level tools
  - Risk
  - Definition & E-alert
  - Education
  - Interventions

Toolkit for local usage
AKI care bundle

- Introduced to assessment units in 2011
- Targets systematic improvements in basic elements of care
- Consistent with intranet guidelines
Combination of IT and human algorithms
Based on AKIN serum creatinine criteria only (now KDIGO)
Selects baseline from up to 12 months previously, disregards 48hr timeframe

Serum creatinine measured

In-patient location?
(renal ward and dialysis unit excluded)

Creatinine >1.5x ‘ideal’ creatinine (measured from reverse eGFR)

Authoriser vets results; selects true baseline and inputs to AKI calculator

No AKI, result not flagged

Report issued: AKI stage 1

Report issued: AKI stage 2

Report issued: AKI stage 3

Selby NM et al CJASN 2012; 7(4): 53
Components of the Educational Toolkit

- Large group
- Teaching
- Ward based
- E-learning
Educational outcomes

• 457 clinicians surveyed (319 at baseline, 138 post intervention)

• Improvements seen in self-reported indicators:
  (Combined data from RDH and UHL)
  ✦ Confidence levels
    50% vs. 68%, p<0.001
  ✦ Independent initiation of investigation and treatment
    48% vs. 64%, p=0.002
  ✦ Awareness of local AKI guidelines
    25% vs. 64%, p<0.001

• Improvements in knowledge scores in junior doctors (F1/F2)

Xu G, Westacott R, Baines R, Selby NM, Carr S. Submitted QJM
AKI work streams

Quality improvement project

Implementation

Pathfinder

Registry & audit

Primary care

Secondary care
Objectives

• Lead implementation across England - need for coordination and globalisation
• Reduce burden of illness related to AKI
• Provide patient level tools for improved management
• Establish a national Registry
• Initiate and lead QI

• April 2014 Workstream meeting
• October 2014 National Launch meeting
The safety thermometer - a place for AKI?

### Table 2: NHS Safety Thermometer summary results

The following table summarises the national percentage of patient assessments which showed each of the four harms and which showed none of the harms – ‘harm free’ - for the period from October 2012 to October 2013 based on the number of records shown in Table 1.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>92.0%</td>
<td>92.3%</td>
<td>92.4%</td>
<td>92.3%</td>
<td>92.1%</td>
<td>92.4%</td>
<td>92.2%</td>
<td>92.4%</td>
<td>92.7%</td>
<td>92.8%</td>
<td>93.0%</td>
<td>93.2%</td>
<td>93.4%</td>
</tr>
<tr>
<td>Pressure Ulcers - All</td>
<td>5.4%</td>
<td>5.3%</td>
<td>5.2%</td>
<td>5.5%</td>
<td>5.6%</td>
<td>5.4%</td>
<td>5.6%</td>
<td>5.5%</td>
<td>5.2%</td>
<td>5.1%</td>
<td>5.0%</td>
<td>4.8%</td>
<td>4.7%</td>
</tr>
<tr>
<td>Pressure Ulcers - New</td>
<td>1.2%</td>
<td>1.2%</td>
<td>1.2%</td>
<td>1.3%</td>
<td>1.3%</td>
<td>1.3%</td>
<td>1.2%</td>
<td>1.2%</td>
<td>1.2%</td>
<td>1.1%</td>
<td>1.1%</td>
<td>1.1%</td>
<td>1.1%</td>
</tr>
<tr>
<td>Fail with Harm</td>
<td>1.0%</td>
<td>1.0%</td>
<td>1.0%</td>
<td>0.9%</td>
<td>1.0%</td>
<td>0.9%</td>
<td>0.9%</td>
<td>1.1%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>1.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Catheters &amp; UTIs</td>
<td>1.2%</td>
<td>1.1%</td>
<td>1.0%</td>
<td>1.0%</td>
<td>1.0%</td>
<td>1.0%</td>
<td>1.0%</td>
<td>1.0%</td>
<td>0.9%</td>
<td>1.0%</td>
<td>1.0%</td>
<td>1.0%</td>
<td>0.9%</td>
</tr>
<tr>
<td>Catheters &amp; New UTIs</td>
<td>0.6%</td>
<td>0.5%</td>
<td>0.5%</td>
<td>0.5%</td>
<td>0.5%</td>
<td>0.5%</td>
<td>0.5%</td>
<td>0.5%</td>
<td>0.5%</td>
<td>0.5%</td>
<td>0.5%</td>
<td>0.5%</td>
<td>0.5%</td>
</tr>
<tr>
<td>New VTEs</td>
<td>0.8%</td>
<td>0.7%</td>
<td>0.7%</td>
<td>0.7%</td>
<td>0.7%</td>
<td>0.6%</td>
<td>0.6%</td>
<td>0.5%</td>
<td>0.5%</td>
<td>0.5%</td>
<td>0.5%</td>
<td>0.5%</td>
<td>0.5%</td>
</tr>
<tr>
<td>All Harms</td>
<td>8.1%</td>
<td>7.7%</td>
<td>7.6%</td>
<td>7.7%</td>
<td>7.9%</td>
<td>7.6%</td>
<td>7.8%</td>
<td>7.6%</td>
<td>7.3%</td>
<td>7.2%</td>
<td>7.0%</td>
<td>6.8%</td>
<td>6.6%</td>
</tr>
<tr>
<td>New Harms</td>
<td>3.5%</td>
<td>3.4%</td>
<td>3.3%</td>
<td>3.3%</td>
<td>3.4%</td>
<td>3.2%</td>
<td>3.3%</td>
<td>3.1%</td>
<td>3.0%</td>
<td>2.8%</td>
<td>2.8%</td>
<td>2.7%</td>
<td></td>
</tr>
<tr>
<td>Patient Assessments</td>
<td>175,199</td>
<td>178,853</td>
<td>177,561</td>
<td>185,338</td>
<td>188,901</td>
<td>192,085</td>
<td>208,444</td>
<td>206,849</td>
<td>204,397</td>
<td>202,214</td>
<td>201,030</td>
<td>201,167</td>
<td>194,284</td>
</tr>
<tr>
<td>Organisations</td>
<td>559</td>
<td>587</td>
<td>605</td>
<td>618</td>
<td>648</td>
<td>665</td>
<td>715</td>
<td>738</td>
<td>749</td>
<td>780</td>
<td>788</td>
<td>784</td>
<td>725</td>
</tr>
</tbody>
</table>

Note: a patient may have all, some, one, or none of the harms, so the percentages may not add up to 100%.
Local IT

- Pathology IT: iLab
- Results reporting: iCM

- Functionality limited:
  - Delta check
  - Compare current value with a calculated field

- No options to change programming
- No response from company to work collaboratively
Educational programme

- Collaboration between Royal Derby Hospital and University Hospitals Leicester
- Joint funding from East Midlands HIEC
- Initiated April 2011

Project team
- Prof Sue Carr (project lead)
- Dr Nick Selby (project lead)
- Dr Rachel Westacott
- Dr Richard Baines
- Dr Nitin Kolhe
- Dr Gang Xu
- Dr Salman Riaz
- Joanne Kirtley
- James Trew

Winner of BMJ ‘Excellence in Education’ Award 2013
Impact on standards of basic care

- Cases note audit of 306 pts.
  - 132 cases baseline
  - 156 cases post intervention
    - 77 in 2012 audit, 79 in 2013 audit
    - Equal numbers in each AKI stage

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>2012</th>
<th>2013</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid balance assessed</td>
<td>36.4%</td>
<td>66.2%</td>
<td>79.7%</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Medication review</td>
<td>71.1%</td>
<td>-</td>
<td>88.4%</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Renal imaging (AKI 2 &amp; 3)</td>
<td>45.3%</td>
<td>54.2%</td>
<td>71.0%</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Nephrology referral (AKI 3)</td>
<td>37.8%</td>
<td>56.5%</td>
<td>78.9%</td>
<td>p&lt;0.001</td>
</tr>
</tbody>
</table>
Impact on patient outcomes

- n=8411
- Unadjusted 30-day mortality:
  - Sep10-Feb11: 23.7%
  - Mar11-Aug11: 20.8%
  - Sep11-Feb12: 20.8%
  - Mar12-Aug12: 19.5%

  Chi square for trend p=0.006

- No differences in LoS or rate of renal recovery

Selby NM. Curr Opin Nephrol Hypertens. 2013 in press

<table>
<thead>
<tr>
<th></th>
<th>Cox regression</th>
<th>Hazard ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sep10-Feb11</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mar11-Aug11</td>
<td>0.9</td>
<td>0.79-1.0</td>
</tr>
<tr>
<td></td>
<td>Sep11-Feb12</td>
<td>0.87</td>
<td>0.77-0.99</td>
</tr>
</tbody>
</table>
Weekend versus weekday AKI

Crude mortality:
- Weekday: 20.4%
- Weekend: 24.9%

*p<0.001*
Working with primary care: ’Community acquired’ AKI accounts for two-thirds of cases

Selby NM et al CJASN 2012; 7(4): 53
AKI prevention project

- Project team:
  - Nephrologists
  - GPs
  - Pharmacists

- Measure outcomes:
  - Educational outcomes
  - Patient acceptability
  - Admission rates and outcomes for patients with community acquired AKI

- Raise profile of AKI
- Embed ‘sickday’ rules for high-risk patients
- Education for primary care practitioners
- Empower patients to react to acute illness
- Develop an educational ‘toolkit’
- Patient-held information cards
CKD and AKI ARID - serial creatinine results

Serial creatinine values: AKI versus control

* p<0.001

n=298
Conclusion

• AKI represents a significant patient safety

• It is harmful

• It is common

• Management could be better - lives saved, reduced disease burden and reduced resource utilised