Acute Kidney Injury
Adding Insult to Injury

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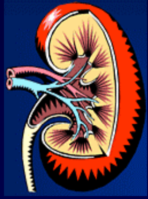
NATIONAL CONFIDENTIAL ENQUIRY INTO PATIENT OUTCOME AND DEATH



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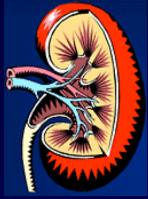
2. Comments on the NCEPOD report
3. Additional suggestions



Why worry about AKI?

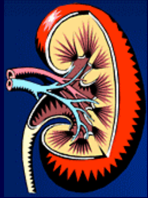
"Acute kidney injury, mortality, length of stay, and costs in hospitalized patients"

19,982 pts admitted to academic medical centre in SF

9,205 pts with >1 creatinine results

Rise in creatinine	Multivariable OR (hospital mortality)
≥ 0.3 mg/dl (26.4 μmol/L)	4.1
≥ 0.5 mg/dl (45 μmol/L)	6.5
≥ 1.0 mg/dl (90 μmol/L)	9.7
≥ 2.0 mg/dl (180 μmol/L)	16.4

Chertow et al. JASN 2005; 16:3365-3370



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"Acute kidney injury, mortality, length of stay, and costs in hospitalized patients"

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Rise in creatinine	Multivariable OR (hospital mortality)	Increase in length of stay
≥ 0.3 mg/dl (26.4 μmol/L)	4.1	
≥ 0.5 mg/dl (45 μmol/L)	6.5	3.5 d (3.6 d)
≥ 1.0 mg/dl (90 μmol/L)	9.7	5.4 d (5.8 d)
≥ 2.0 mg/dl (180 μmol/L)	16.4	7.9 d (9 d)

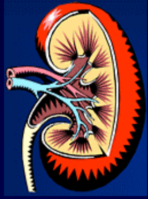
Chertow et al. JASN 2005; 16:3365-3370

AKI classification

(**A**cute **K**idney **I**njury **N**etwork - international working group of Nephrologists and Critical Care Physicians, founded in 2002)

Stage	Creatinine criteria	Urine output
1	**↑ serum creatinine of ≥0.3 mg/dl (26.4 μmol/L)** **or** 1.5 – 2 fold increase from baseline	<0.5ml/kg/hr for > 6hr
2	2 – 3 fold rise of serum creatinine from baseline	<0.5ml/kg/hr for >12 hrs
3	> 3 fold rise of serum creatinine from baseline **or** serum creatinine ≥4.0 mg/dl (>354 umol/L) with an acute rise of at least 0.5 mg/dl (44 umol/L) **or** treatment with RRT	<0.3ml/kg/hr x 24hr or anuria x 12 hr

Mehta R et al. Crit Care 2007;11(2):R31



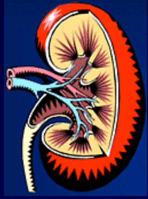
Impact of AKI

Correlation between AKI classification and outcome

22,303 adult patients admitted to 22 ICUs in UK and Germany between 1989–1999 with ICU stay ≥24 hours

	No AKI 65.6%	AKI I 19.1%	AKI II 3.8%	AKI III 12.5%
Mean age	60.5	62.1	60.4	61.1
ICU mortality	10.7%	20.1%	25.9%	49.6%
Hospital mortality	16.9%	29.9%	35.8%	57.9%

Ostermann et al, Critical Care 2008;12:R144



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ICU mortality	10.7%	20.1%	25.9%	49.6%
Hospital mortality	16.9%	29.9%	35.8%	57.9%
Length of stay in ICU (median)	2 d	5 d	8 d	9 d

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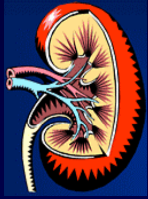
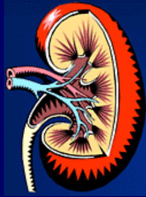


Why worry about AKI?

Significant impact on outcome

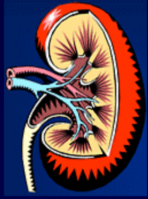
- Hospital mortality / post-discharge mortality
- Resources: length of stay (ICU/hospital)
referrals / tests / treatment
- Patient morbidity: acute complications
dysfunction of other organs
risk of CKD / ESRF



Impact of AKI

Ischemic Kidney

Local production of inflammatory mediators
- cytokines (TNFa, IL-1), chemokines (IL-8, MCP-1)
- complement activation products
- platelet activating factor (PAF)
- metabolites of arachidonic acid
- reactive oxygen species (ROS)



Impact of AKI on other organs

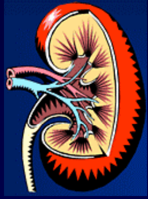
Organ cross-talk

Inflammation and cytokine release in ischaemic AKI

→ increased pulmonary vascular permeability

→ increased cardiac apoptosis
(bi-directional cardio-renal syndrome)

Emerging evidence that AKI not only occurs in association with failure of other organs but also leads to dysfunction of other organs



Impact of AKI – long term outcomes

Risk of CKD

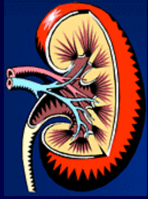
Increasing evidence that episodes of AKI leave permanent renal damage

“Long-term prognosis after AKI requiring RRT”

206 ICU patients with RRT for AKI
Single centre in Geneva

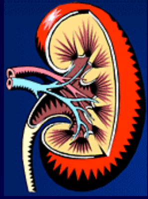
90 day survival:	46%	
3 years post ICU:	60/206	(29.1%): alive
	25/60	(41.7%): new CKD
	9/60	(15%): ESRD, on dialysis

Triverio et al. NDT 2009



Impact of AKI – long term outcomes

Triverio et al. NDT 2009



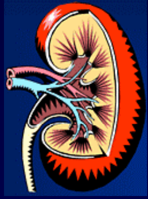
Impact of AKI – long term outcomes

"Long-term risk of mortality and other adverse outcomes after AKI: A systematic review and meta-analysis"

48 studies, 47,017 patients with AKI (varying criteria)
Length of follow-up: 6 months – 17 years

AKI associated with:
- increased risk of CKD
- increased risk of CV event
- increased long-term mortality

Coca S et al, Am J Kidney D, June 2009



Impact of AKI - Resources

“Patient flow from critical care to renal services: a year-long survey in a critical care network”

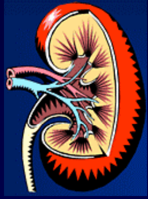
Prospective service evaluation in 11 hospitals in North East and Cumbria between March 05 – Feb 06
(3 hospitals with on-site renal unit)

Results:
542 pts on RRT, 129 still on RRT when discharged from ICU

Period of single-organ renal support pre-discharge:

Hospitals with renal service:	median 2 days	[1 – 17]
Hospitals without renal service:	median 3.5 days	[1 – 5]

Wright et al, QJM 2008

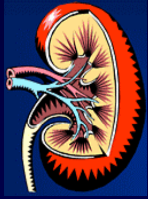


NCEPOD report

Aims:

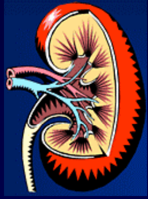
To improve diagnosis, prevention and management of AKI

To facilitate organisational changes relevant to the treatment of AKI



NCEPOD Report – General comments

- Identifies a major gap in management of AKI among NHS hospitals in UK
- Includes useful recommendations
- Serious organisational and resource implications



NCEPOD report

Methodology

- Case notes coded for “Acute renal failure”

  But: no standard criteria

  probably different degrees

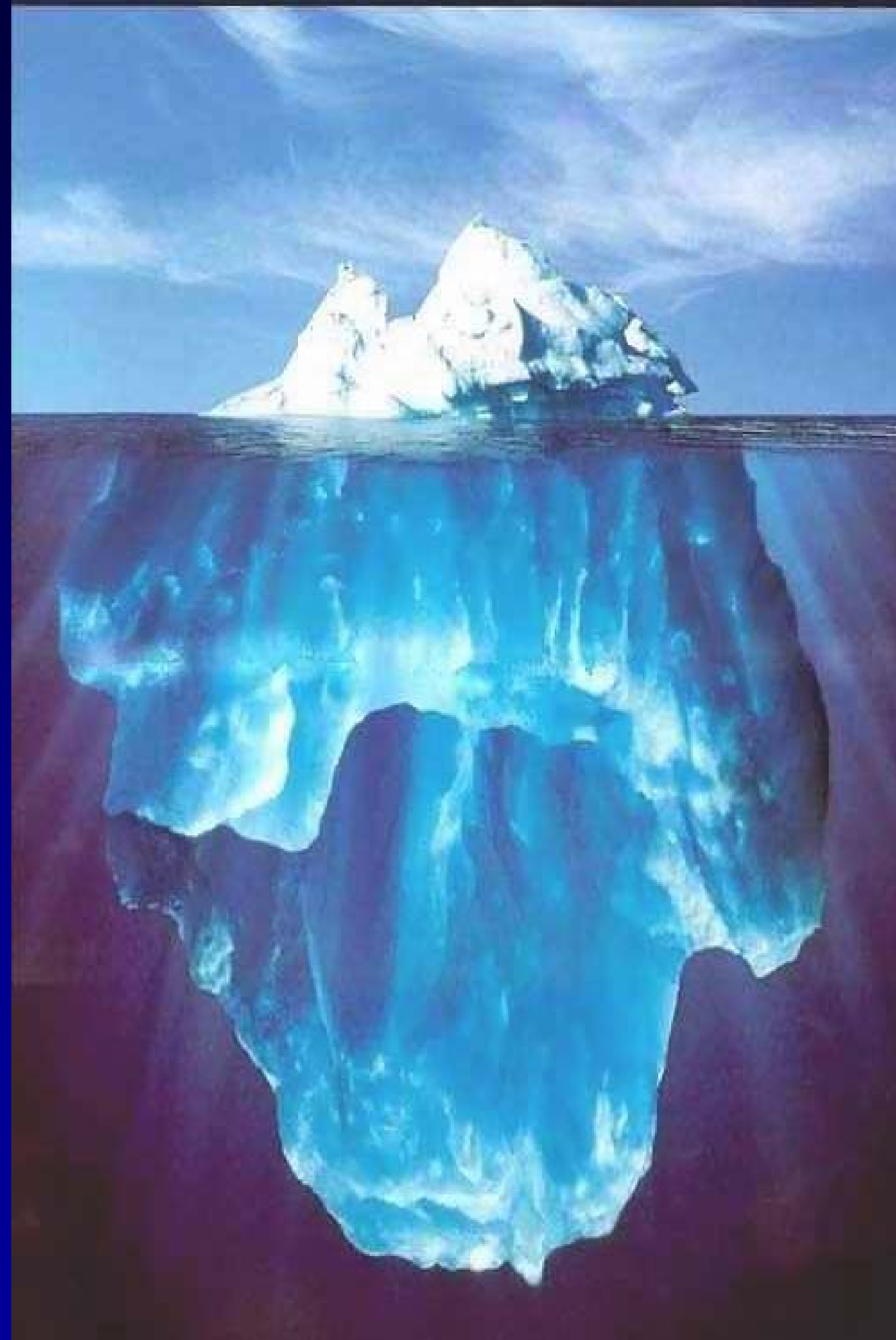
- Only outcome assessed: Hospital mortality

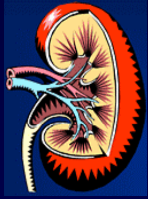
AKI

NCEPOD report

AKI

- not recognised
- not coded for
- didn't die in hospital





NCEPOD – additional suggestions

- Need for education of all specialties and grades about serious implications of even minor changes in renal function

- More research into key areas of AKI in parallel with implications of recommendations:

  Incidence of AKI in UK hospitals

  Management of AKI in UK

- Some recommendations in NCEPOD report need clarification related to stage of AKI

  (ie. need for level 2/3 care for all degrees of AKI?)

AKI