Workshop 3: Patient safety and mHealth/big data/hand held services

CRAB™: Big Scale – Routine Data as First Alert

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• To use standard, common datasets to monitor outcomes and reduce variation
• To identify avoidable problems and root causes and take remedial action
• To do so with minimal impact on clinical time, and reduce avoidable cost
• To do so at scale
Big data: the OBJECTIVES

CRAB™: using big data without losing sight of the individual patient:

• A safety and quality monitoring system, designed to give doctors, nurses, hospitals & external assessors detailed visibility on clinical performance from patient-level data

• Identify good practice & danger zones based on clinical variation in practice that would not appear in statistical analysis.

• Provide audit of outcomes which beyond mortality to review underlying issues of morbidity and avoidable harm.

• Interpret headline SMR figures - explaining or validating outliers as well as pointing to root cause.
CRAB™ in Surgery

How it works

- Individual risk prediction of risk of mortality and complication for each patient having an operation.
  - Improves effectiveness of mortality and morbidity review
  - Identify those deaths where improvements in care potentially could have been made
  - Identification the successes (high-risk patients with a successful outcome): learn from what we did well!
CRAB™ in Surgery

Benefits

- A very accurate quality outcome measure: the Observed/Expected ratio (O/E ratio) (4x more accurate than SMR)
- Allows performance to be monitored over time and early detection of variation
- Works with very small numbers, so a sensitive early warning mechanism
CRAB™ in Surgery

Benefits

• Looks at complications:
  - Find the underlying causes of avoidable deaths
  - Find those areas which may not have resulted in death but where care nonetheless poor: complications are expensive – so we can improve quality whilst reducing avoidable cost!
The bigger picture: causes of variation in outcome are multifactorial. It’s not just about the surgeon!

Looking at complications (risk-adjusted) gives a detailed understanding of where the problem lies:

– **Surgeon and anaesthetist**
  - Problem with technique
  - Appropriate prophylactic measures (eg thromboprophylaxis, antibiotics)
  - Appropriate post-operative management (eg pain control, fluid balance)
The bigger picture: causes of variation in outcome are multifactorial. It’s not just about the surgeon!

Looking at complications (risk-adjusted) gives a detailed understanding of where the problem lies:

- **Supporting staff**
  - Nursing staff (eg mobilisation, pain relief, fluid balance)
  - Medical staff (eg fluid balance, appropriate response to deterioration)
  - Para-medical (eg physiotherapy provision)
The bigger picture: causes of variation in outcome are multifactorial. It’s not just about the surgeon!

Looking at complications (risk-adjusted) gives a detailed understanding of where the problem lies:

- **Supporting facilities**
  - Appropriate ward
  - Appropriate theatre
  - ITU/HDU provision

- **Appropriate procedure for particular surgeon**
- In addition by examination of the surgical success the best care pathway can be identified
CRAB™ Medical: finding evidence of avoidable harm across hospital care

Key triggers indicating problems in nursing & ward-based care

• Decubitus ulcer
• Shock/cardiac arrest
• Unplanned admission to ITU
• Acute kidney injury
• Abnormal electrolyte levels
• Falling haemoglobin
• Hospital acquired pneumonia
• Septicaemia
• Clostridium difficile infection

• The combination of multiple triggers for a patient greatly increases the risk of death or serious avoidable harm
CRAB™ Medical
Number of GTT triggers vs. mortality risk %: Overall organisation
Clinical Performance is more than mortality rates

• The previous slide is impossible mathematically and suggests an external cause: *us*

• The great majority of hospital deaths are to be expected

• The potentially avoidable ones are in those patients with harm events caused by *us*

• These are generally not disease specific

• The patients with 4 or more triggers hold the clue
  – Detectable by the percentage of patients with 4 or more triggers
  – Death may be avoided if a higher level of care is invoked
  – …Although harm may still be caused
Clinical Performance is more than mortality rates

• The mortality rate of patients with 4 or more triggers is a very sensitive measure of overall ward based care

  – **Wide** variation in the UK, Europe, USA, Australia and New Zealand

  – Those institutions aspiring to zero harm can
    - Reduce these rates significantly
    - Reduce complications
    - Reduce costs and litigation
    - Reduce avoidable death
CRAB™ is used worldwide, with consistently very high degree of accuracy

CRAB™ around the world

- **Sourced originally from the UK**
  - Used by a range of high-reputation University Teaching Hospitals and other organisations around the UK
  - Applied by UK national authorities (Ministry of Health, Hospitals Inspectorate and Regulatory Bodies)

- **Worldwide application**
  - Exclusive international benchmarking: world’s largest surgical referential dataset of its kind covering >40 countries
  - Fully cross-referenced and tested to work on international datasets. Advisory work & clinical reviews across Europe, USA, Middle East & S.E Asia

**CRAB™ accuracy**

<table>
<thead>
<tr>
<th>SURGICAL</th>
<th>CRAB predicted value</th>
<th>Manually collected actual value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality¹</td>
<td>3.92%</td>
<td>3.99%</td>
</tr>
<tr>
<td>Morbidity²</td>
<td>27%</td>
<td>26.2%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MEDICAL: Trigger Variables</th>
<th>Relationship to ICD10</th>
<th>Sensitivity (range per variable)</th>
<th>Specificity (range per variable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decubiti, Vitamin K, Naloxone, Flumazenil, Glucagon, Dextrose, Troponin, MRSA, C.Diff, Wound infection, VRE, Sepsis</td>
<td>Single code relationship</td>
<td>97.9 - 100</td>
<td>98.7 - 100</td>
</tr>
<tr>
<td>Patient fall, Change in procedure, Remove/damage organ</td>
<td>Multiple diagnostic &amp; operative codes</td>
<td>93.1 – 97.1</td>
<td>92.7 – 97.8</td>
</tr>
<tr>
<td>Shock/Cardiac arrest, DVT/PE, Complication, Abrupt Medication Stop, High INR, Transfusion, Abrupt fall in hgb, Urea/Sodium/Potassium, Hypoglycaemia, N.Pneumonia</td>
<td>Multiple diagnostic codes</td>
<td>89.9 – 96.4</td>
<td>90.1 – 94.1</td>
</tr>
<tr>
<td>Lack response to EWS, Unplanned escalation</td>
<td>Complex diag. &amp; op. codes with episode of care</td>
<td>87.3 – 93.2</td>
<td>90.6 – 93.2</td>
</tr>
<tr>
<td>Readmission, Escalation, Readmission to ITU, Return to Theatre</td>
<td>Episode of care</td>
<td>96.9 – 99.0</td>
<td>97.5 – 98.9</td>
</tr>
</tbody>
</table>

Notes: 1. 10yr collaborative national mortality outcomes research study of emergency general surgical patients across UK; 2. Independent validation of CRAB predictive accuracy of trauma & orthopaedic patients by Karolinska Hospital, Stockholm, Sweden