What is audit?

- In the paper *Principles for Best Practice in Clinical Audit*, NICE defined clinical audit as
- "A quality improvement process that seeks to improve patient care and outcomes through systematic review of care against explicit criteria and the implementation of change. Aspects of the structure, processes, and outcomes of care are selected and systematically evaluated against explicit criteria. Where indicated, changes are implemented at an individual, team, or service level and further monitoring is used to confirm improvement in health care delivery."

How should audit be conducted?

The case mix program

icnarc intensive care national audit & research centre

25 Years and counting...

case mix programme

Hospitals that have had problems with patient care.

Comparison of different units

- **Why?**

- Some units may have problems with the way they are run or their staffing or their equipment and resources.
- They may also have problems with how they select patients for critical care.
- Other units may have particularly good structures that allow them to give excellent care. How they do this should be shared with other units.

Why. 2

- If a unit is dysfunctional then this will probably not be recognised by the staff working in that unit.
- Without evidence that a unit is clearly underperforming then it is really unlikely that they would get additional resources to improve.

How can you compare different units

- Crude mortality rates
- Adjusted mortality rates adjusted by how sick the patients are
- External reviews
- Staff safety surveys

What kind of things might effect the chances of surviving critical care?

What kind of things might effect the chances of surviving critical care?

- Demographics- Age and sex
- Previous health and frailty
- The disease that has resulted in critical care admission
- The degree of physiological derangement
- Chance and randomness

What is SMR and how to we work it out?

$$\text{SMR} = \frac{\text{O (Observed number of deaths)}}{\text{E (Expected number of deaths)}}$$

Clearly we can measure the number of deaths in a unit.
The expected number of deaths is based on a prediction model, with the ICNAC coding model this prediction is based on the ages, diagnoses and physiological derangement of the patients being admitted.
The model is based on outcome data collected over many hundreds of thousands of patients.
Exactly how the model is calculated is not published and has been subject to multiple changes. In part these have been needed because the outcomes of critically ill patients have improved over the years

Statistical Significance of SMR

- **How can you know whether an SMR of 1.32 indicates that there are *significantly* more deaths than were expected? Conceptually, if the observed number of deaths is equal to the expected number, the SMR would have a value of 1.0. So the statistical test for the significance of SMR is whether it is different from 1.0. To gauge statistical significance of SMR, we must first calculate the 95% confidence interval for the SMR. If the 95% C.I. excludes the value, "1.0," it may be considered statistically significant.**
- **In this example there are 35 deaths and the expected number of deaths is 26.5.**

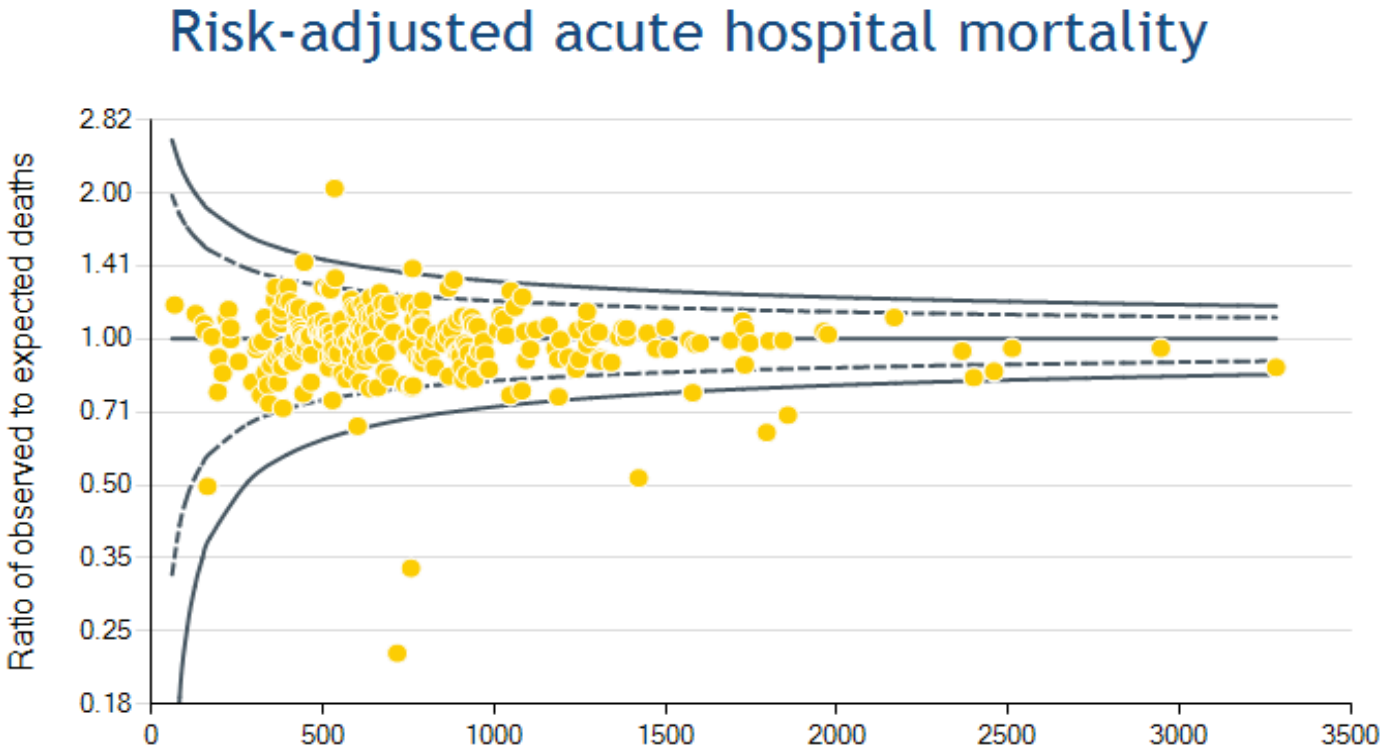
  The 95% Confidence Interval is equal to 1.96 times the standard error of the estimate.

  95% C.I. = 1.96 x s.e.SMR
- **The standard error for the SMR is calculated as follows:**

  s.e.SMR = (Square Root of O) / E For this example = (Square Root of 35) / 26.5
  = 5.92 / 26.5
  = 0.22339

- **1.96 x s.e.SMR = 0.438 (95% confidence interval, plus or minus)**
  1.32 - 0.438 = 0.88 (lower limit of 95% confidence interval)
  1.32 + 0.438 = 1.76 (upper limit of 95% confidence interval)
- **As you can see, in our example, the 95% confidence interval of the SMR does include the value "1.0," indicating that the observed number of deaths in De Baca County is not *statistically significantly* higher than the expected number of deaths.**

Is the SMR significantly different from the expected mortality?



ICNARC presents the SMR for each unit (ratio of observed to expected deaths) as a funnel plot. The X axis shows the number of patients in the unit and the Y axis the SMR. The lines show two and three standard deviations for the SMRs (95% and 99.8% CIs). The CI get narrower with larger numbers of patients in the unit. More cases reduce the confidence intervals as previous slide

How did we get to where we are now?

How has this been done in the past

- Apache II (Acute physiological and chronic health evaluation)- Physiological variables- some blood tests and observations, combined with the patient's age and some chronic health conditions. This is described below and there is also a link to an on line calculator here:
- https://www.mdcalc.com/apache-ii-score
- https://en.wikipedia.org/wiki/APACHE_II

Relationship between Apache score and outcome

APACHE II score	Hospital mortality (%)	
	Non-operative	Post-operative
0-4	4	1
5-9	6	3
10-14	12	6
15-19	22	11
20-24	40	29
25-29	51	37
30-34	71	71
>35	82	87

Data from Knaus *et al.* APACHE: Acute Physiology and Chronic Health Evaluation

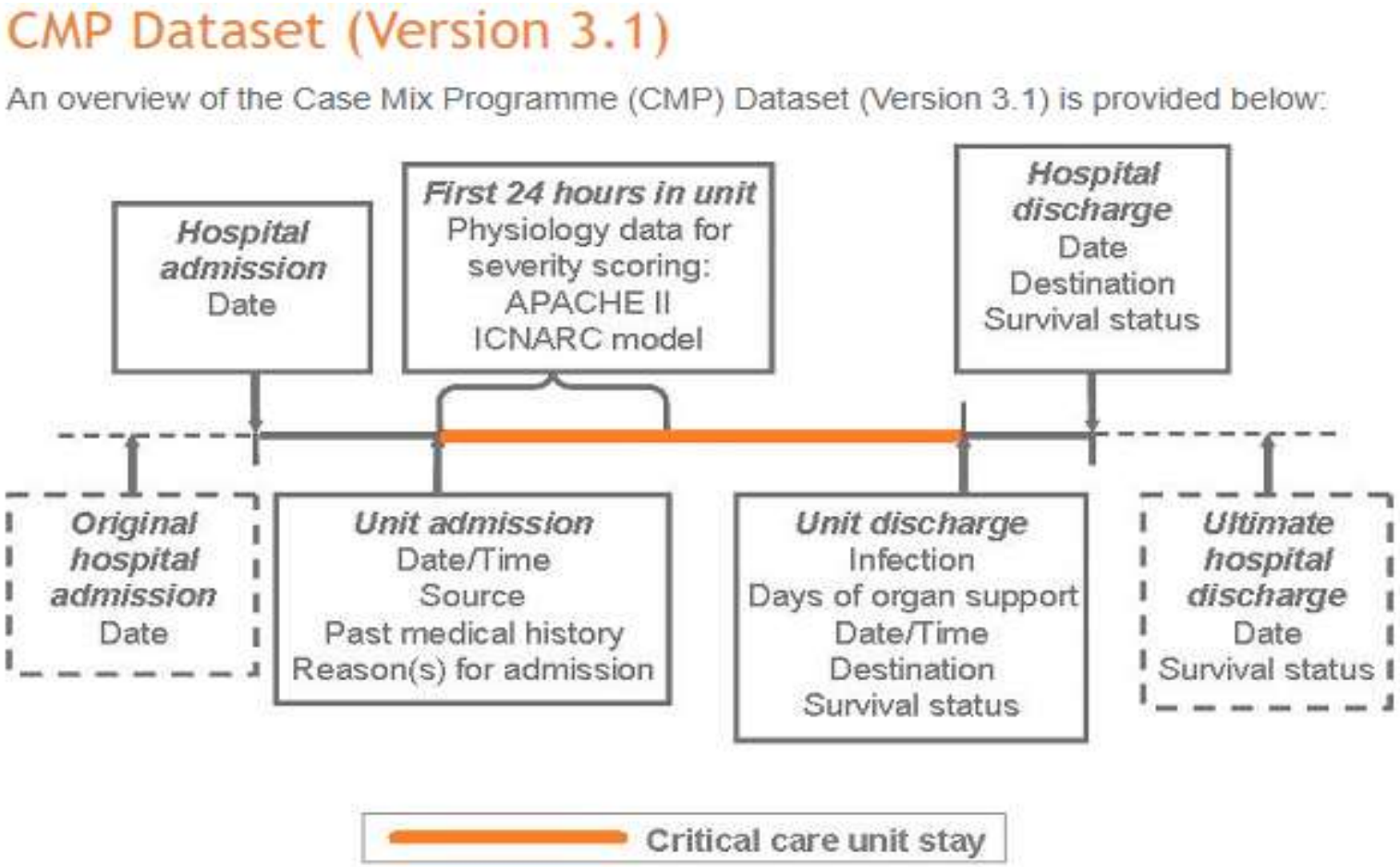
History of the Case Mix Program 1.

- **Intensive care evolved from enthusiastic staff setting up units in individual hospitals from the 1950s.**
- **In 1973 a group of colleagues set up the Intensive Care Society in the UK, one of the aims of this society was to share best practice.**
- **In the late 1980s the society started to use the Apache II tool to try to compare outcomes between critical care units in the UK.**
- **This lead to the setting up of 'ICNARC' (Intensive Care National Audit and Research Centre) to collect outcome data from different critical care units in the UK. This developed from Apache II scoring to the Case Mix Program**

History of the Case Mix Program 2.

- **The best model for predicting patient mortality**
- By 2007, after several years of work to establish the best risk prediction model, using over 200,000 admissions in the CMP Database, the ICNARC model was completed to compliment and exceed the APACHE II model.
- We continue to seek improvements to both the ICNARC and APACHE II models, which are regularly recalibrated to CMP data. The vastly increased quantity of data amassed has enabled even greater accuracy of analysis.
- **One of the largest critical care databases in the world**
- In 2013 the CMP passed the milestone of 1.5 million patients recorded on its database.
- Providing regular analysis for participants and collaborative research, this unique wealth of accurate data is invaluable for improving management of health services and future plans for intensive care provision.

Data that are collected in the CMP



ICNARC Coding Method (ICM) Guide Last updated: April 2018

ICM Structure:

The resulting hierarchical structure is composed of the following five tiers:

Type: has the admission had surgery for the condition being coded?

System: which body system is involved?

Site: which anatomical site(s) within the body system are involved?

Process: what physiological or pathological process is involved?

Condition: what is the condition being coded?

Type: *Non-surgical* - ***2***
System: *Respiratory* - ***1***
Site: *Lungs* – ***4***
Process: *Infection* – ***27***
Condition: *Bacterial pneumonia* – ***1***

The full code for bacterial pneumonia is therefore **2.1.4.27.1**

There are often multiple ways of classifying a condition- most common in our unit is that head injuries can be found under ‘trauma’ or ‘neurology’. The mortality weighting is the same.

Conditions affecting multiple body systems:

Some conditions can be seen to affect multiple body systems, and therefore can be found in the ICM via multiple paths through the tiers, e.g. myasthenia gravis can be viewed either as a respiratory condition and coded:

Type: *Non-surgical* - ***2***
System: *Respiratory* - ***1***
Site: *Neuro-muscular junction disorders causing respiratory failure* - ***8***
Process: *Inflammation* – ***28***
Condition: *Myasthenia gravis* – ***1***

Code: **2.1.8.28.1**

or as a musculoskeletal condition and coded:

Type: *Non-surgical* - ***2***
System: *Musculoskeletal* - ***10***
Site: *Muscles or connective tissue* - ***3***
Process: *Congenital or acquired deformity or abnormality* – ***8***
Condition: *Myasthenia gravis* – ***3***

Code: **2.10.3.8.3**

Where a condition can be coded via multiple paths through the tiers, the weighting in the predicted risk of acute hospital mortality will always be the same, regardless of which path is selected.

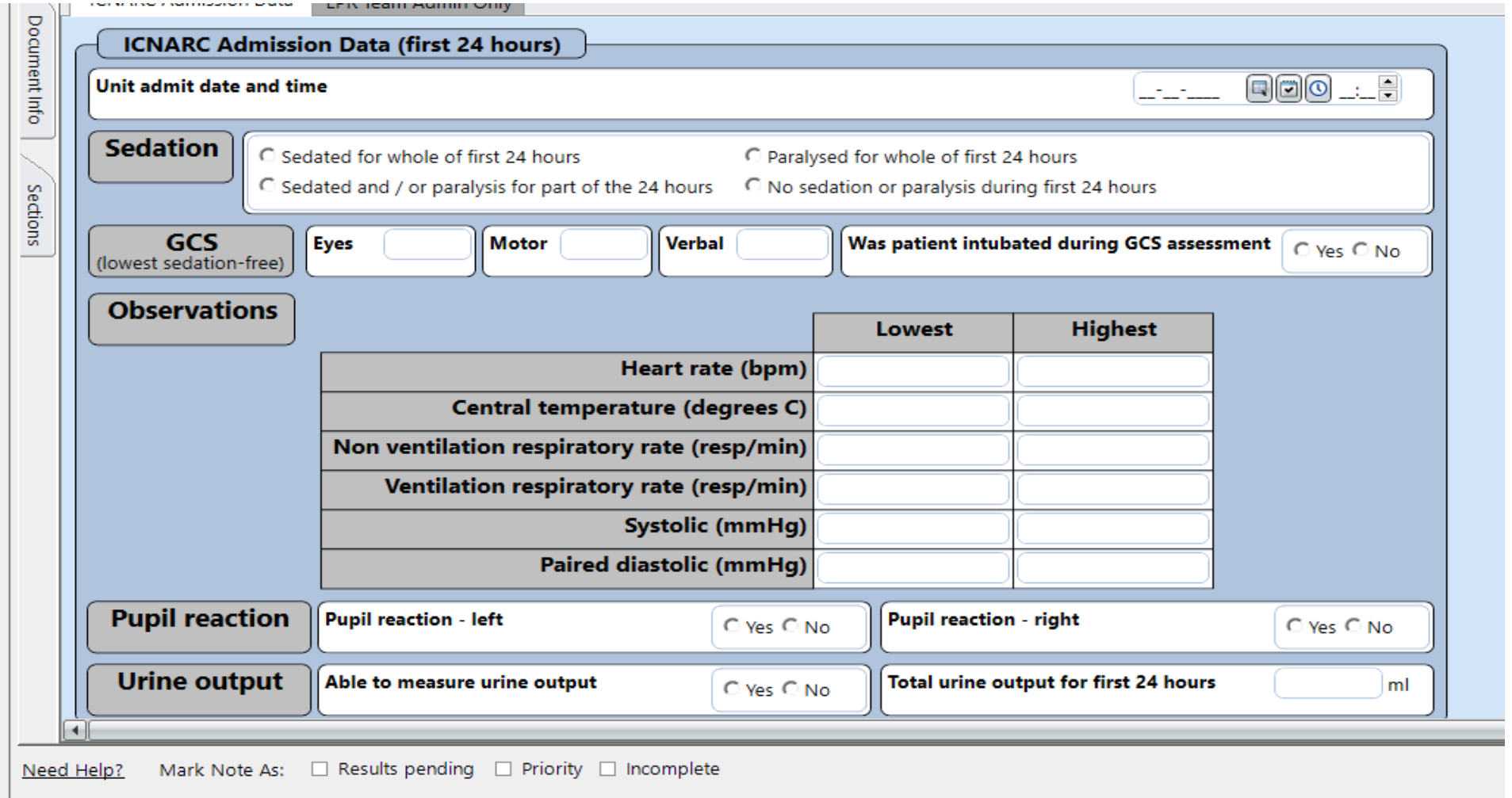
Primary, secondary and ultimate reasons for admission, past medical conditions and dependency

SUMMARY OF STAY

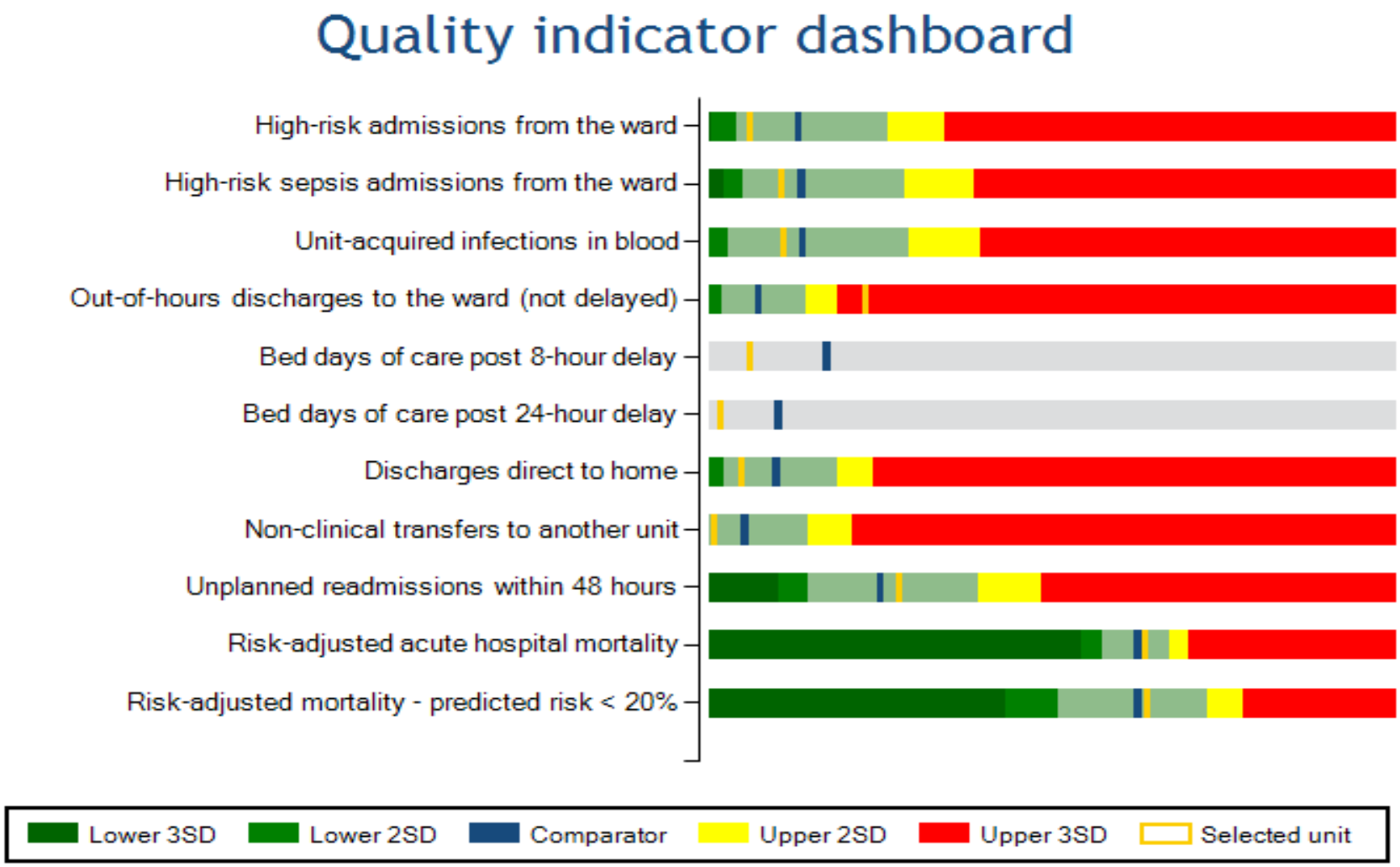
Admitting critical care Consultant	
ICNARC Information	○ Click here to view ICNARC website
ICNARC – Primary reason for admission	
ICNARC – Secondary reason for admission	
ICNARC – Ultimate reason for admission	
ICNARC - Other condition in past medical history	
ICNARC past medical condition	☐ None ☐ Biopsy proven cirrhosis ☐ Portal hypertension ☐ Hepatic encephalopathy ☐ Very severe cardiovascular disease ☐ Severe respiratory disease ☐ Home ventilation ☐ Chronic renal replacement therapy ☐ HIV/AIDS ☐ Steroid treatment... ☐ Radiotherapy ☐ Chemotherapy ☐ Metastatic disease ☐ Acute myelogenous/lymphocytic leukaemia or multiple myeloma ☐ Chronic myelogenous/lymphocytic leukaemia ☐ Lymphoma ☐ Congenital immunohumoral or cellular immune deficiency state ☐ Other...
Dependency prior to admission	○ Able to live without assistance ○ Some (minor/major) assistance ○ Total assistance with daily activities
Summary of critical care stay	

d Help? Mark Note As: ☐ Results pending ☐ Priority ☐ Incomplete ☐ E&M Calculation ☐ Charge Capture

Physiological data recorded in the first 24 hours of admission.



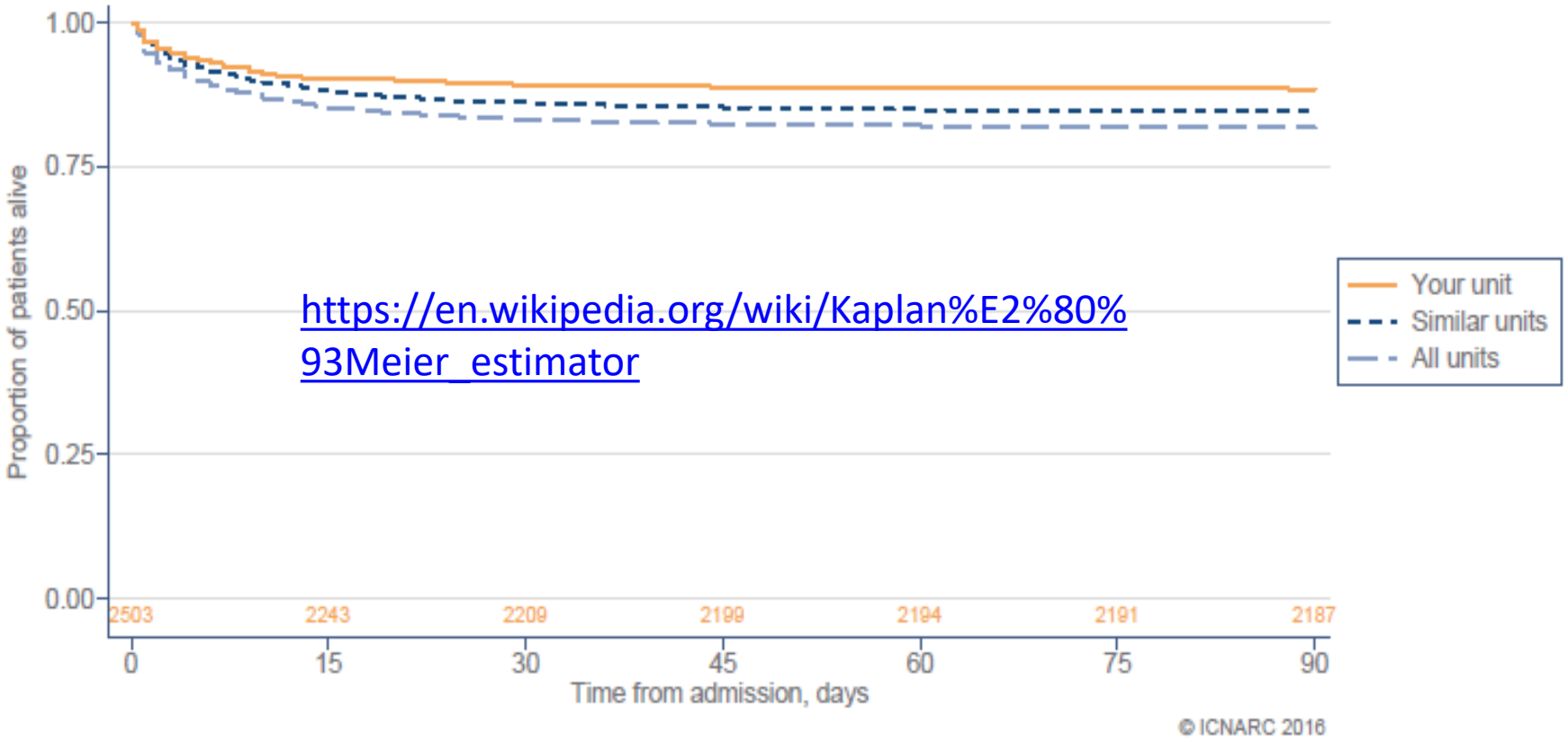
The ICNARC report



Salford Royal Hospital, Critical Care Directorate

case mix programme

Kaplan-Meier survival plot

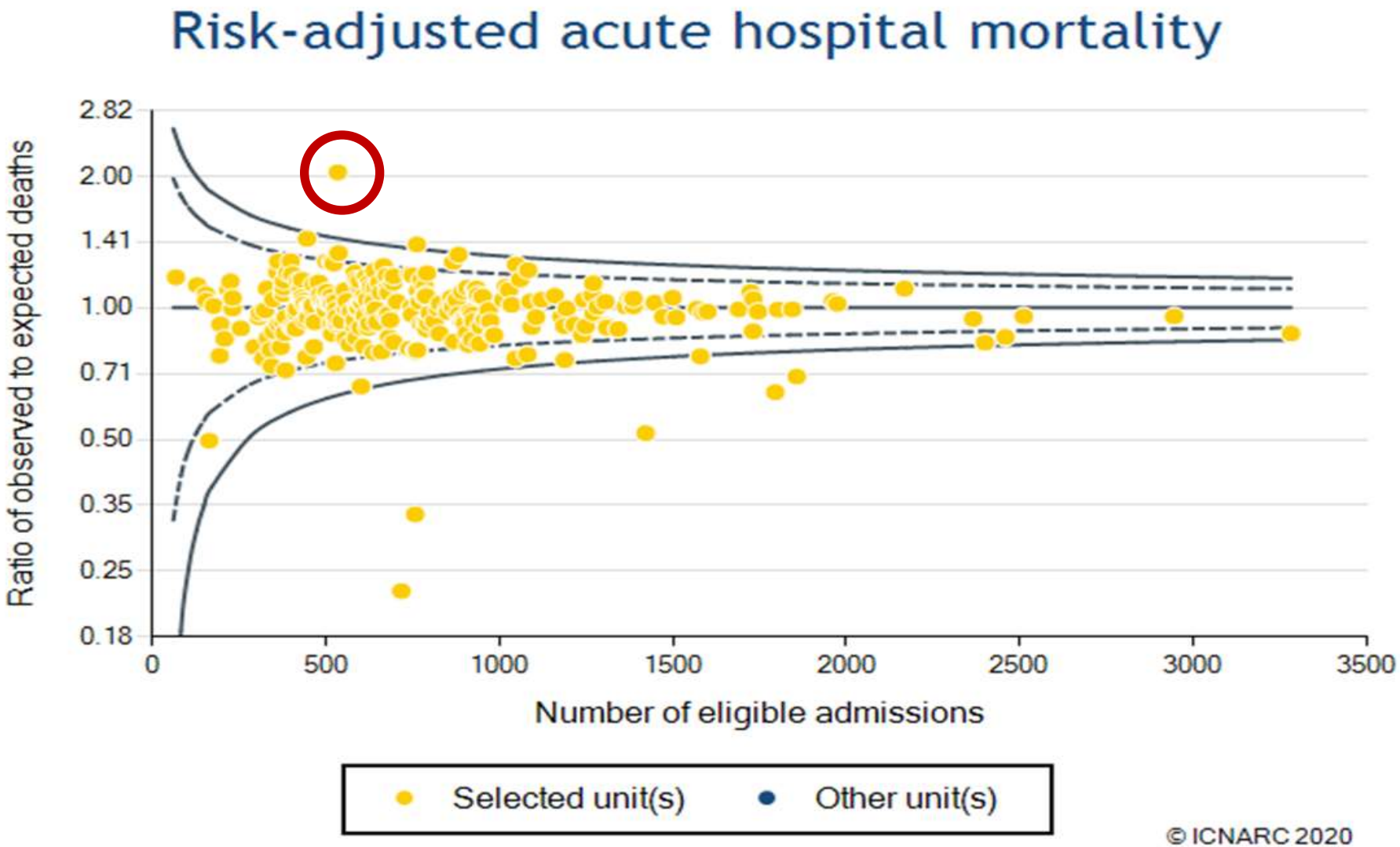


https://en.wikipedia.org/wiki/Kaplan%E2%80%93Meier_estimator

Explanation

- The Kaplan-Meier survival plot shows the proportion of patients that remain alive by the number of days following admission to the critical care unit
- The numbers at the foot of the figure are the numbers of patients that remain 'at risk' (i.e. have not died or been lost to follow-up) for your unit at that time point
- Patients that were discharged from acute hospital before 90 days are assumed to have survived to 90 days

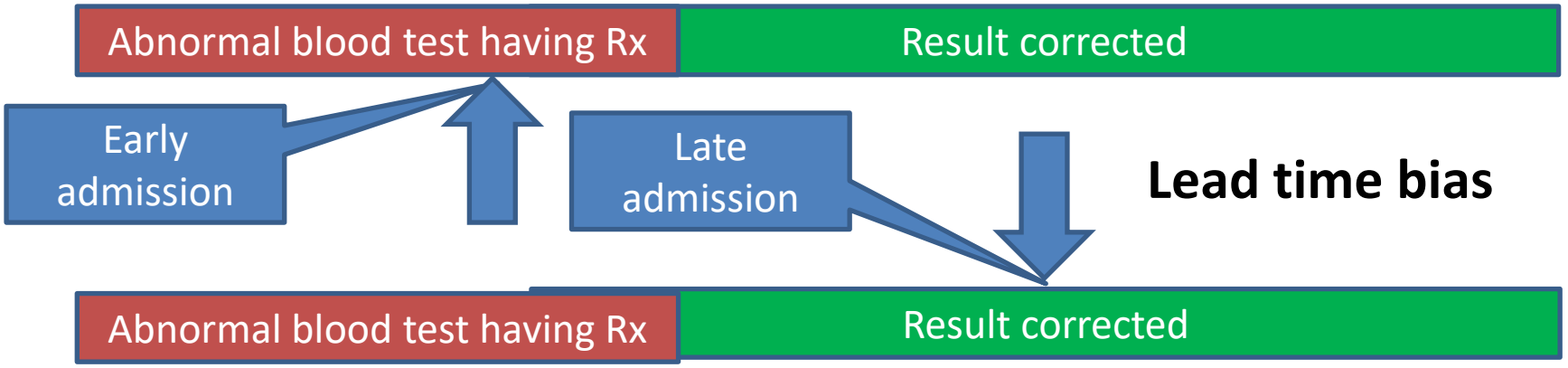
What do you do if you are an outlier?



This is a big deal and it's best not to be here!

- Robust data collection would be most likely to stop you being here- hence your help in data collection.
- If you are here then will require a detailed review of all the deaths to look to see if they were correctly coded and what preventable factors there were.
- There should also be a review of the case selection and if patients are being admitted when they have no reasonable chance of survival.
- There should be an external lead for the process as the colleagues working in the unit will probably not be able to see what the problems are as they will have worked with them for so long.
- The senior management must be involved as if there is a real problem then there will be major changes and costs involved.
- Many times the resolution to this problem is to improve the coding of the patients, hence it's good to get this right before there is a problem
- There should also be a review of the coding if the unit is better than the control limits but I guess that this won't always be done.

Comparisons between different units- problems and solutions- apples and pears and lead time bias



Other roles for ICNARC

- Research activity- in part associated with the Case Mix Data Base
- For example- research on the effect on mortality of transferring patients out of hours
- Also from central coordinating role in critical care- e.g. the 65 trial
- Rapid reporting on ICU activity in a crisis
- Critical care activity around Covid-19.