Understanding your NCAA Report

This guide sets out and explains the different types of analyses that you will find in your Quarterly NCAA Reports.

There is also a video guide to your NCAA Report available on File Exchange.

If you have any questions about this guide or your Quarterly Reports please contact NCAA:

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Number and rate of cardiac arrests

Explaining Rate Graphs
These graphs look at the number and rate of team visits during the period of the report.
This is a bar graph. It shows the number of team visits each month.

Red is in-hospital cardiac arrests and blue is pre-hospital cardiac arrests.

The black line shows the average number of reported cardiac arrests attended by the team over that reporting period. In this example the average is 12.
Each month you report on the number of 2222 calls received. This graph shows what percentage of those have been recorded as part of NCAA.

The red dot shows the rate. Ideally each red point should be on 100. i.e. 100% of 2222 calls are recorded as team visits in NCAA.

The grey vertical line shows the 95% confidence interval.
Each month you report the number of hospital admissions.

This graph shows the rate/number of cardiac arrests per 1,000 hospital admissions.

To give an example, this graph shows that in June 2013 the rate of cardiac arrests per 1,000 hospital admissions is approximately 1.6.
This graph presents the reported number of in-hospital cardiac arrests attended by the team per 1,000 hospital admissions.
As with the previous rate graphs data points plotted are displayed with a 95% confidence interval shown as the vertical line through each data point.

The values plotted are an estimate of the true underlying value because they are based on a certain sized sample of data.

The true value will most likely lie somewhere along the vertical line of the confidence interval.
A large sample of data provides a more accurate estimate of the value. Hence, the confidence interval will become a narrower (shorter) vertical line.

The confidence interval, therefore, gives an indication of how accurately the value has been estimated. A 95% confidence interval means that 95% of the time we would expect the true value to lie along the vertical line.
Bar and trend graphs

Understanding bars and trends
This is a bar graph. It shows the percentage of team visits in each category.

Red bars are for your hospital.

The blue bar is the equivalent for the whole of NCAA.

The categories are along the x-axis and the percentage is shown on the y-axis.

The number on the top of each bar shows the number of team visits in each category.
This is a trend graph.

All trend graphs show one variable (shown on the y-axis) plotted over time (shown on the x-axis).

The numbers along the bottom give you the sample size (the total number of team visits) that has been used to calculate the value each quarter.
The grey area shows the 95% confidence interval for each point. There is always an amount of uncertainty around each calculation and we can be 95% certain that the true values lies in the grey area.

The red line shows data for your hospital.

The blue line shows data for the whole of NCAA.
This trend graph shows the percentage of cardiac arrests attended by the team that were male patients plotted over time.

In the first example in April-June 2012 approximately 45% of a total of 36 Team Visits were male patients.

Whereas in the second example in October-December 2013 around 60% of 22 Team Visits were male patients.
Outcome flow

Reviewing your outcome data
This is an outcome flow.

All percentages shown in this flow are calculated from the overall number of individuals shown at the top of the flow.
This section shows the outcome percentages at the end of resuscitation.

Number of individuals 108

Reason resuscitation stopped

Dead 60 (55.6%)
Alive 48 (44.4%)
Missing 0 (0.0%)

Status at discharge from your hospital

Dead 88 (81.5%)
Survival to hospital discharge 20 (18.5%)
Patient still in your hospital 0 (0.0%)
Missing 0 (0.0%)
This section shows the outcome percentages at discharge from your hospital.

Number of individuals 108

Reason resuscitation stopped

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Stratified analyses

Understanding grouped comparisons
Stratified analyses provide grouped comparisons on specific outcome variables.

This stratified analyses shows favourable neurological outcome by age. Each point shows that outcome for a group of patients (shown on the x-axis).

For example...about 27% of individuals aged 16-64 years have a favourable neurological outcome in this hospital.
The vertical red line is the 95% confidence interval. We can be 95% confident that the true value is in this range.

The confidence interval is wide as it is based on only 15 individuals.
iii) Favourable neurological outcome (% individuals)

The value for this hospital is very similar to the value for NCAA.

The confidence interval for NCAA is narrow as it is based on a large number of individuals.
There were no individuals aged 0-15 years in this report, so there is no result for your hospital.

Also, if the sample size is less than five there will be no result plotted; as the sample size is too small.
Funnel plots and risk adjusting
Understanding why we risk adjust
This is a funnel plot.
Along the x axis is the number of individuals.
Along the y-axis is what we call the ratio of observed to predicted survival.

To understand the observed to predicted survival we must first consider why we risk adjust...
Why do we risk-adjust?
Why do we risk-adjust?

• To ensure **fair** comparison across hospitals
Why do we risk-adjust?

- To ensure fair comparison across hospitals
- To ensure fair comparison over time within a single hospital (e.g. your trended data)
Understanding risk-adjusted comparative analyses

- Why do we risk-adjust?
- The NCAA risk models
The NCAA risk models

- NCAA risk models predict:
  - the number of patients who will achieve ROSC >20 mins
  - the number of patients who will survive to hospital discharge
The NCAA risk models

- Characteristics used in the models:
  - Age
  - Gender (only for ROSC >20 mins)
  - Length of stay in hospital prior to arrest
  - Reason for admission to/attendance at/visit to hospital
  - Location of arrest
  - Presenting/first documented rhythm
  - Interactions between location of arrest and presenting/first documented rhythm

These are the factors of each arrest that you cannot control and these are the characteristics that we need to take into account.
The NCAA risk models

• Assign each patient a probability of survival

Using these characteristics we calculate a probability of survival for each individual.
The NCAA risk models

- Assign each patient a probability of survival

This patient has a predicted survival of 0.8, that’s an 80% chance of surviving. This individual may be young, with a shockable rhythm and may have arrested in the ICU.
The NCAA risk models

- Assign each patient a probability of survival

In contrast, this patient has been predicted only a 10% chance of survival. Possibly an older patient with a non-shockable rhythm who arrested in the ward.
The NCAA risk models

- Assign each patient a probability of survival

\[
\begin{align*}
0.3 & + 0.8 & + 0.2 & + 0.5 & + 0.6 & + 0.1 \\
= & 2.5
\end{align*}
\]

- Add these to get the predicted number of survivors

We then add all of these together to get the predicted number of survivors. So for this group of 6 patients, we predict that 2.5 of them will survive.
The NCAA risk models

- Assign each patient a probability of survival
- Add these to get the predicted number of survivors

\[0.3 + 0.8 + 0.2 + 0.5 + 0.6 + 0.1 = 2.5\]

- Compare to the observed number of survivors

We are now able to compare this to the observed number of survivors, this is the actual number of individuals who do survive.
The NCAA risk models

- Assign each patient a probability of survival
- Add these to get the predicted number of survivors

\[0.3 + 0.8 + 0.2 + 0.5 + 0.6 + 0.1 = 2.5\]

- Compare to the observed number of survivors

\[\checkmark \checkmark \checkmark = 3\]

Where we assigned each patient a probability of survival using their characteristics, we then added these to get the predicted number of survivors for the whole group. And then we look at what the actual or observed number of survivors was.
The NCAA risk models

- Ratio of observed to predicted survival

\[
\frac{\text{observed}}{\text{predicted}} = \frac{3}{2.5} = 1.2
\]

Our ratio of observed to predicted survival is the observed (or actual) number of survivors divided by the predicted number of survivors. In this case 3 divided by 2.5, giving us a ratio of 1.2.
Returning to our funnel plot...if a point falls on the comparator line where the ratio equals 1, this means that observed survival is the same as the predicted survival.
If a point is below the comparator line (where the ratio is below one), the observed survival is less than we predicted.
If a point is above the comparator line (where the ratio is above one), the observed survival is more than we predicted.
These funnel plot lines are similar to confidence intervals. They show how confident we are about the calculated ratio for all NCAA Hospitals.
The funnel plot lines are wider where the number of individuals are small as we can be less certain about our calculations when the sample size is small.
The funnel plot lines are narrower where the number of individuals are large as we can be more certain about our calculations when the sample size is large.
We expect 95% of hospitals to lie within the dashed funnel plot lines.
For those hospitals who appear between the funnel lines, it may be worth looking at your data, especially if you appear here in consecutive reports.
Hospitals who appear outside the funnel at the top of the plot where observed survival is greater than predicted, should look at your data to see if your patients differ from the rest of NCAA.
For hospitals who appear outside the funnel at the bottom of the plot, where observed survival is less than predicted, we will inform you of this when we send you your report and will suggest that this should be investigated.
Distribution plot
Plotting predicted probability
This is a distribution plot.
Here on the x-axis is the predicted probability of survival.
And on the y-axis, the percentage of individuals.
The red bars show data for your hospital. Let’s take the first red bar only.

This shows that 22% of individuals for your hospital have been assigned a predicted probability of survival of between 0 and 5%.
The blue line, shows the equivalent for all hospitals in NCAA.

Taking the first point only, in NCAA, 25% of individuals... 

...have a predicted survival of between 0 and 5%. As you can see very similar to the red bar.
This is an example of a hospital where the red bars follow the blue line closely whose distribution of individuals is very similar to the whole of NCAA.
This is an example of a hospital where the distribution of individuals (red bars) does not closely match NCAA (the blue line). This is something you should look out for.

This will show you how your individuals differ from NCAA in terms of their predicted probability of survival.
Calibration plot

Understanding calibration
This is a calibration plot.
Along the x axis is the predicted probability.
The y-axis is the observed or actual percentage survival.
The red line is the data for this hospital.
We split the individuals from this hospital into 5 groups. The way we do this is to first...
order the individuals by their predicted probability of survival as shown here.
And then we split them into five groups with equal numbers of individuals. If you have small number of team visits we may use fewer than five groups.
Each of these groups gets its own point on the plot.
Let's take this group of individuals as an example. This group has a predicted survival of approximately 45%.

i.e. we predict that 45% of individuals in this group will survive.
For this group we know that roughly 43% actually did survive, this is the observed percentage survival.
When we say that 43% of individuals in your hospital survived we know that this will be have been affected by chance variation so we also calculate the 95% confidence interval. We can be 95% confident that the true observed percentage survival is in this range.
The diagonal line through the plot is where the observed survival equals the predicted survival.
Observed survival is lower than predicted survival

Below this line is the area of the plot where observed survival is less than we predicted.
And above this line is the area of the plot where observed survival is greater than we predicted.
The dark blue line is the same analysis for all hospitals in NCAA.
This is an example of a calibration plot where the red line for your hospital follows the diagonal line and the blue NCAA line.

We expect the blue NCAA line to sit nicely on the diagonal where observed survival equals the predicted survival. This is where a typical hospital’s red line would also sit.
And on this calibration plot, the red line does not follow the diagonal line at all.
These four groups of patients sit far from the diagonal in the area of the plot where observed survival is less than we predicted.
In particular for this group of patients, the 95% confidence interval does not cross the diagonal.

This means that the observed survival is significantly less than we predicted for this group of patients.
Exponentially-weighted moving average plot

(EWMA)
This is an EWMA plot.

EWMA plots are particularly useful for hospitals with small numbers of arrests. Similar to trended data, these graphs show historical data as well as current data.
This date range is the date range from the start to the finish of the plot.
This line splits the plot into historical and current data.
To the left of the vertical line is the historical data. This is everything up to the period of time covered by the report.
To the right is the current data covered by this report.
These numbers tell you how many patients there are in the current reporting period.
The two most important parts of an EWMA are the red line for observed survival and the blue line for predicted survival.

Blue shading indicates control limits around the predicted survival (similar to the funnel shaped lines in the funnel plots).
This is an example of an EWMA plot where the observed survival is consistently similar to predicted and this would be a typical EWMA for most hospitals.
This EWMA however shows a hospital where the observed survival (red line) is significantly worse than the predicted survival (the blue line). This is significant since the red line is outside the shaded area so we can be very confident that survival is worse than predicted.

Observed survival also seems to be consistently worse than predicted survival, in fact as the EWMA builds up to the final few patients, the difference is getting stronger. This is something that may prompt an investigation into the data.
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Supported by Resuscitation Council (UK) and ICNARC