PICANet policy on PICUs lying outside the control limits of the mortality ratio funnel plots

Background – mortality ratios and funnel plots

PICANet is required by the Department of Health to report on the mortality outcomes of all children admitted for paediatric intensive care. The PICANet Clinical Advisory Group and Steering Group recommended that the mortality outcomes from each PICU be adjusted for the illness severity of the child at admission using Paediatric Index of Mortality 2 (PIM2) (Shann et al, 2003). PICANet reports the unadjusted mortality outcome from all PICUs and a mortality ratio based on the ratio of observed mortality in each PICU to the expected mortality calculated using PIM. The 2005 Annual report used the algorithm derived from the recently completed United Kingdom Paediatric Intensive Care Outcome Study. Previously PIM was used for risk-adjustment (Shann et al, 1997) and in the future PIM3 will be implemented (Straney et al, 2013).

Earlier work published by members of PICANet team (Parry et al, 1998) has highlighted the problems of attempting to rank PICUs on their annual mortality, whether unadjusted or adjusted. PICANet however, has also recognised the need to identify units which appear to have outcomes very different to other units. Consequently, in the 2004 and 2005 reports PICANet published a funnel plot of the observed to expected mortality ratio of individual PICUs. The funnel plots are constructed in such a way that there is an approximately 5% chance of a PICU falling outside the control limits if the distribution of the mortality ratios is random.

The mortality ratio is calculated for each PICU by dividing the observed number of deaths by the expected number of deaths calculated using the published PIM algorithm for each PICU. The mortality ratio is then plotted on the y-axis against the number of admissions to the PICU on the x-axis. In order to satisfy the condition that if the overall distribution of the mortality ratios is random there exists an approximately 5% chance of a PICU falling outside the control limits, then the upper and lower control limits constructed at an individual PICU level must represent not 95% confidence intervals, but 99.9% confidence intervals around a mortality ratio of 1 by number of admissions (Spiegelhalter, 2002). This is analogous to increasing the confidence interval (or significance level) when correcting for multiple comparisons in data containing numerous groups.

Data outliers

- A PICU whose mortality ratio lies outside of these control limits will be identified as having returned data that is markedly different to the other PICUs.
- It is important to note that a PICU lying outside the control limits is not sufficient evidence to suggest a PICU has either markedly higher or markedly lower mortality than the other PICUs, it merely indicates that the data they have returned is different to that of other PICUs.
- For those PICUs that do lie outside the control limits the principals of clinical governance should apply:
    - PICANet will raise the issue with the lead clinician of the PICU and the Trust Chief Executive

- PICANet will work with the PICU and the Trust, following the plan below until the issue is resolved.

In these circumstances, PICANet will:

i) Review the data to investigate whether there are data driven reasons for a PICU lying outside of the control limits (it is known that risk-adjustment tools can be unreliable when a PICU has a particularly high proportion of patients at either end of the bounds of the tool.)
ii) Review the data quality of the PICU. The quality of the data is the PICUs' responsibility. PICANet will provide feedback from PICU visits and central validation procedures. PICUs will be expected to check the quality of individual data items.
iii) Plot the data quality indicators over time to identify whether the anomaly can be traced to a certain data collection period.
iv) Plot the mortality ratio over time to identify whether the anomaly can be traced to a certain data collection period.
v) Plot the observed mortality over time to identify whether the anomaly can be traced to a certain data collection period.
vi) Plot the expected mortality over time to identify whether the anomaly can be traced to a certain data collection period.
vii) Investigate the primary reason for admission to the PICU. If the PICU has a markedly high proportion of some primary reason of admission to the PICU compared with other PICUs this may suggest further refinements to the risk-adjustment method are required.
viii) Produce a brief summary report of the above to be forwarded to the lead clinician and Chief Executive at the PICU concerned together with an invitation to meet in person to review the data with the PICANet team.

Where reference is made to the Chief Executive it is accepted that they may be represented by their clinical governance lead.

NOTE: Excess mortality in particular sub-groups of patients or associated with other aspects of service provision may be identified using different statistical methods. The process outlined above will be implemented wherever anomalous results/outliers are identified.

References:

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