NICU-Volume and VLBW-Infant Mortality: Effect of Volume versus Quality Cut-offs

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Introduction

Recent publications postulated that the introduction of a minimum volume load for NICUs should improve quality of care. However, these studies used preset cut-off levels (n>50 VLBW infant/year, e.g.) for NICU intergroup comparisons.

They identified:

- high variation of mortality rates (by a factor of 3) between units of comparable size.
- a soft volume-outcome relationship (explained less than 10% variation of VLBW-mortality).
- no precise volume threshold for unit shut-down.

Hypothesis: Quality-driven strategies for NICU shut-downs have major beneficial effects on overall outcome compared to volume-driven approaches.

Aim and Methods

Aim of the study: To investigate changes in mortality rates when NICUs closings are based on either volume load or outcome quality.

Methods: Mortality data of VLBW infants were abstracted from recent publications (Vermont-Oxford Network: 285 centers with 22,382 infants; NRW neonatal register (Germany): 66 centers with 3,959 infants).

Modeling:

- stepwise center exclusion using either volume load (in steps of 5 infants/year) or outcome quality (in steps of 0.05 mortality rate)
- calculation of the overall mortality rate after randomly allocating infants from closed down units to one remaining center.
- random allocation was repeated 1000 times per step giving a precise estimate (mean and SD) of resulting standardized mortality.
- a 10% effect on mortality with volume size was assumed.

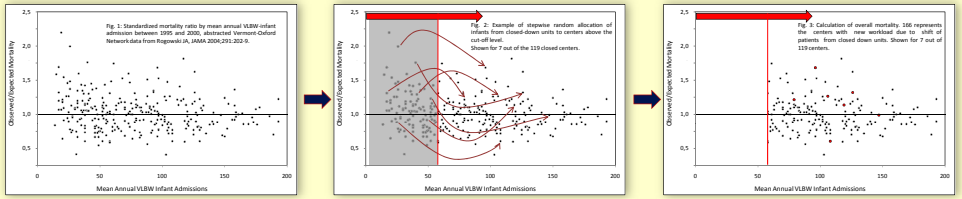

Figure 1-3: Modeling of overall mortality after stepwise exclusion of centers using volume load strategy, random allocation was repeated 1000 times per step giving mean and SD. Here shown for a cut-off level of 60 annual VLBW infant admissions.

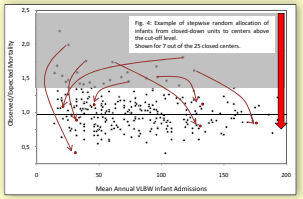

Figure 4: Modeling of overall mortality using quality strategy with cut-off level mortality=1.4.

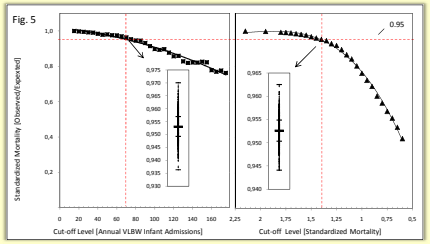

Figure 5: Mortality rates versus strategies used minimum number of VLBW infants (Fig. 5a) versus outcome quality (Fig. 5b)

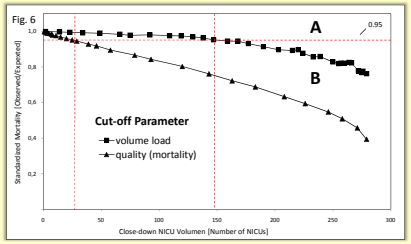

Figure 6: Standardized mortality versus closed-down number of NICUs using A: volume strategy (5% improvement of overall mortality by closing 147 (52%) of all NICUs) and B: quality strategy (5% improvement of overall mortality by closing 25 (9%) of all NICUs)

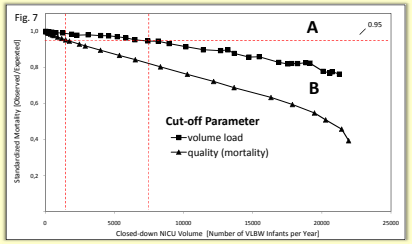

Figure 7: Standardized mortality versus closed-down number of VLBW-infants transfer/year using A: volume strategy (5% improvement of overall mortality by transfer of more than 6483 (29%) of all infants) and B: quality strategy (5% improvement by transfer of 1468 (7%) of all infants)

Results

- Quality-based strategies are considerably more effective in improving VLBW outcome when compared to volume-based strategies.
- Volume based strategy needs to close more than 52% of the units (representing 29% of VLBW infants) to achieve a 5% improvement, the maximum effect was limited to 24%.
- Quality based strategy achieves a 5% improvement by only closing 9% of the units (7% of VLBW infants), maximum effect is 61%.
- Using data from the NRW neonatal register showed similar results.

Conclusion

- This study shows for the first time that volume-based cut-offs alone are not appropriate to decrease VLBW mortality significantly.
- Volume cut-offs and quality indicators should be combined.
- This approach can be used also for parameters of morbidity (NEC, BPD, ROP) and is suitable to identify thresholds for either volume or quality parameters for given improvement in quality of care.

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