Postpartum length of stay and newborn health: a cost-effectiveness analysis

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Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
The effect of length of stay (LOS) following birth was assessed. In particular, LOS shorter than 48 hours for vaginal delivery and 96 hours for Caesarean delivery were compared with LOS greater than these thresholds.

Type of intervention
Primary prevention.

Economic study type
Cost-effectiveness analysis.

Study population
The population comprised all newborns born in Washington State between 1989 and 1990 that were recorded on the RAND Birth Event Record Database (BERD). The database did not include births that occurred in military hospitals, multiple births, or newborns under 2,500 g. Cases with extensive missing data were not included in the study.

Setting
The setting was secondary care. The economic study was carried out in the USA.

Dates to which data relate
The effectiveness and cost data were collected between 1989 and 1990. The price year was 2000.

Source of effectiveness data
The effectiveness data were derived from a single study.

Link between effectiveness and cost data
The costing was carried out retrospectively using the same sample of patients as that used in the effectiveness study.

Study sample
The authors did not report that power calculations were carried out to ensure a sufficiently large sample to rule out the influence of chance. From the eligible cases in the RAND BERD, the authors excluded newborns who were transferred to another facility on discharge, newborns with estimated stays of less than 5 hours (due to coding errors) and newborns whose birth certificate was missing. They also excluded vaginally-delivered newborns with stays longer than 2 nights and Caesarean section newborns with stays longer than 4 nights, as these stays were insufficient to be affected by the LOS mandate. This left a sample size of 113,147 cases available for analysis. This sample was appropriate for the clinical study question since it included newborns whose LOS was likely to have been affected by the LOS mandate.
Study design
The analysis used a historical case series. The data on the cases were taken from the RAND BERD, which recorded births throughout Washington, USA. The participants were followed for the duration of their LOS.

Analysis of effectiveness
The primary health outcome was the change in the probability of newborn mortality. This was estimated by regression, where the probability was one if the newborn died during the neonatal period. The primary explanatory variable was LOS (in hours). LOS was estimated using the known hour of the birth and the number of nights stayed, along with assumptions about discharge.

The authors controlled for the influences of the marital status of the mother, her Medicaid status, whether she was multiparous, whether she was younger 18 years of age, the newborn's gender, and the newborn's race.

The authors stratified the sample by mode of delivery in order to control for vaginal or Caesarean birth.

To predict the impact of LOS on infant mortality, the authors measured the actual estimated LOS, and the LOS expected if all mothers and newborns used at least the time allowed under the LOS mandate.

Effectiveness results
The coefficients from the logistic regression were as follows:

- estimated LOS, -0.026 (standard error 0.009; p=0.004; 95% confidence interval, CI: -0.044 - -0.008);
- infant male, 0.456 (standard error 0.310; p=0.142; 95% CI: -0.152 - 1.063);
- mother and/or father Hispanic, -0.491 (standard error 0.539; p=0.363; 95% CI: -1.548 - 0.566);
- mother and/or father black, 0.416 (standard error 0.613; p=0.498; 95% CI: -0.786 - 1.618);
- mother married, 0.061 (standard error 0.387; p=0.876; 95% CI: -0.698 - 0.819);
- mother on Medicaid, 0.703 (standard error 0.355; p=0.048; 95% CI: 0.008 - 1.398);
- mother multiparous, 0.286 (standard error 0.336; p=0.394; 95% CI: -0.372 - 0.945);
- mother younger than 18 years of age, 1.142 (standard error 0.647; p=0.401; 95% CI: -0.725 - 1.812).

The mean increase in estimated LOS to conform with the LOS mandate was 15 hours.

The mean predicted probability of neonatal death fell from 0.039% using the estimated actual LOS to 0.025% when assuming an increased LOS.

Clinical conclusions
The authors did not draw clinical conclusions independently from the cost conclusions.

Modelling
A logistic regression model was used to predict the impact of changes in LOS on the probability of newborn mortality.

Measure of benefits used in the economic analysis
The authors estimated the number of lives saved from increased LOS by considering the change in the predicted probability of death, and the estimated life-years gained per life saved. A base-case discount rate of 3% was used to
discount the benefits. A sensitivity analysis explored the impact of using 0% and 5% discount rates.

**Direct costs**
The costs were estimated from a societal perspective. The three categories of cost considered were hospital input, physician labour and postdischarge professional care. The authors did not generate a single point estimate, but instead defined a range between which they expected the costs to fall. This gave them an upper and lower bound analysis. The costs were estimated using actual data taken from surveys, a randomised controlled trial and administrative records. The unit costs were reported separately. The quantity of resources was measured for postpartum stays between 1989 and 1990. The price year was 2000. The authors did not discount the costs, as the costs of increased postpartum LOS were incurred within the first few weeks after birth.

**Statistical analysis of costs**
The 95% cost-effectiveness ratios were developed using bootstrapping with 1,000 samples. A statistical analysis was performed using Stata software (version 7.0).

**Indirect Costs**
Although the authors reported that a societal perspective was adopted, it was unclear whether any indirect costs were included in the analysis.

**Currency**
US dollars ($).

**Sensitivity analysis**
The nature of the cost analysis was such that the lower and upper bound estimates for all cost categories provided a form of sensitivity analysis.

**Estimated benefits used in the economic analysis**
The authors did not report the estimated benefits independently from the costs (see Synthesis of Costs and Benefits).

**Cost results**
For the lower bound analysis, the mean projected increase in the total direct medical costs was $84 (standard deviation 75; 25th percentile 3; 75th percentile 130).

For the upper bound analysis, the mean projected increase in the total direct medical costs was $401 (standard deviation 359; 25th percentile 18; 75th percentile 593).

**Synthesis of costs and benefits**
The incremental cost per discounted life-year gained was $19,800 (95% CI: 11,600 - 61,300) for the lower bound analysis and $94,800 (95% CI: 55,200 - 286,800) for the upper bound analysis.

The results were moderately sensitive to an indicator for mode of delivery. The results were very sensitive to the definition of the time period over which newborn deaths were considered, and the discount rate.

**Authors' conclusions**
The authors concluded that "at hospitals that do not experience additional capacity costs as a result of increased LOS (length of stay), lengthening short postpartum stays seems to be more cost-effective than many common health
interventions”.

CRD COMMENTARY - Selection of comparators
The authors aimed to assess the benefits of lengthening postpartum LOS. To this end, they compared the impact on neonatal probability of death of two durations of stay (estimated actual LOS and LOS given the LOS mandate). These comparators were well justified and were well timed, given the introduction of the LOS mandate.

Validity of estimate of measure of effectiveness
The study used a historical case series, which provided data for a logistic regression model. This was appropriate for the study question. A before-and-after study relative to the introduction of the mandate may have been carried out to provide the two study groups. This may have increased the extent to which the results reflect actual practice. The study sample was representative of the study population. The authors made every effort to discuss the significance of, and to control for potential confounding factors. They also provided an in-depth discussion of the potential impact of factors they could not control for. The control for confounding factors gives this study high internal validity. The authors did not account for the health and well-being of the mother, such as reduced anxiety. This may mean that the study under estimated the true benefit of the mandate.

Validity of estimate of measure of benefit
The authors estimated discounted life-years gained as a result of the mandate. This was a natural choice of benefit. They thought that the cost per quality-adjusted life-year gained would not be much higher than the cost per life-year gained, and therefore did not make quality adjustments. This decision was made explicitly and was well justified.

Validity of estimate of costs
The authors reported that a societal perspective was adopted, but it was unclear whether any indirect costs were included in the analysis. The authors provided a thorough estimation of the direct costs. They highlighted some costs that they did not estimate, such as the postdischarge care provided by the mother, family and friends, and usefully hypothesised the impact of this on the results. The unit costs were reported separately and the price year was reported. These facts enhance the reproducibility of the results obtained.

Other issues
The authors made appropriate comparison of their cost-effectiveness results with the results from other analyses concerned with interventions for newborns. However, there was no comparison with studies that examined the costs and benefits of LOS specifically. The issue of generalisability was addressed through a valuable discussion on the pertinence of the results in other institutions that do not experience additional capacity costs. The results were not presented selectively and the conclusions accurately reflected the scope of the study. A number of limitations were presented, which concentrated on reasons why the analysis may have underestimated the cost-effectiveness of increased LOS.

Implications of the study
The authors recommended that, at hospitals that do not experience additional capacity costs, increased LOS might be more cost-effective than other common health interventions. The authors appear to have been in favour of the LOS mandate. No areas for further work were explicitly stated, although some may be inferred from the discussion of the study limitations.

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Other publications of related interest

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