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Estimates of the Cost and Length of Stay Changes that can be Attributed to One-Week Increases in Gestational Age for Premature Infants

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Abstract

Objective—To estimate the potential savings, both in terms of costs and lengths of stay, of one-week increases in gestational age for premature infants. The purpose is to provide population-based data that can be used to assess the potential savings of interventions that delay premature delivery.

Data—Cohort data for all births in California in 1998–2000 that linked vital records data with those from hospital discharge abstracts, including those of neonatal transport. All infants with a gestational age between 24 and 37 weeks were included. There were 193,167 infants in the sample after deleting cases with incomplete data or gestational age that was inconsistent with birth weight.

Methods—Hospital costs were estimated by adjusting charges by hospital-specific costs-to-charges ratios. Data were aggregated across transport into episodes of care. Mean and median potential savings were calculated for increasing gestational age, in one-week intervals. The 25th and 75th percentiles were used to estimate ranges.

Results—The results are presented in matrix format, for starting gestational ages of 24–34 weeks, with ending gestational ages of 25 to 37 weeks. Costs and lengths of stay decreased with gestational age from a median of $216,814 (92 days) at 24 weeks to $591 (2 days) at 37 weeks. The potential savings from delaying premature labor are quite large; the median savings for a 2 week increase in gestational age were between $28,870 and $64,021 for gestational ages below 33 weeks, with larger savings for longer delays in delivery. Delaying deliveries <29 weeks to term (37 weeks) resulted in savings of over $122,000 per case, with the savings being over $206,000 for deliveries <26 weeks.

Conclusions—These results provide population-based data that can be applied to clinical trials data to assess the impacts on costs and lengths of stay of interventions that delay premature labor. They show that the potential savings of delaying premature labor are quite large, especially for extremely premature deliveries.

Keywords

Neonatal care; NICU; health care costs; prematurity; preterm

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INTRODUCTION

Medical and technological advances in the care of infants have resulted in dramatic reductions in neonatal mortality, especially for low birth weight (<2500g) and very low birth weight (<1500g) infants.[1,2] While birth weight specific survival has improved markedly, rates of prematurity and extreme prematurity have remained relatively stable over time. While many interventions have been tried, until recently there was relatively little that could be done to prevent premature labor.[3] However, the recent report that 17 alpha-hydroxyprogesterone caproate therapy significantly increased gestation in mothers who had had a previous preterm birth gives hope that other successful therapies may be in the offing.[4]

While clinical trials can demonstrate effectiveness, the very large variations in the costs of care for premature infants can result in substantial uncertainty about the cost-effectiveness of interventions.[5] Even trials with hundreds of infants will not have very many infants of any given weight or gestational age at birth. Clinical trials are further biased because they tend to occur in large academic medical centers which tend to have better outcomes than other hospitals.[6] This will affect the neonatal cost estimates because most extremely premature infants die in the first few days. Thus, having population-based estimates with large samples would provide a better basis for estimating the cost-effectiveness of any successful perinatal intervention to prevent or delay premature labor. Gilbert et al. reported neonatal costs by week of gestation for all births in California for 1996.[7] But, they only reported the mean and median costs, with no information about the distribution of costs at each week of gestation. The purpose of this study is to provide population-based estimates of the costs of neonatal care by week of gestation and use information on the distributions of costs to provide plausible ranges on the potential shifts in costs that may arise as a result of interventions that delay premature labor. These are provided for both neonatal costs and neonatal lengths of stay.

METHODS

Following approval of this study by the Stanford University Institutional Review Board and the California Department of Health and Human Services Committee for the Protection of Human Subjects, linked data were obtained for the 1998 – 2000 California birth cohorts. These data link the California Office of Statewide Health Planning and Development (OSHPD) infant hospital discharge summaries to the infant vital statistics data (birth and death certificate data). Infant hospital discharge summaries included the delivery hospital discharge summary and those of any subsequent inter-hospital transfers.

The linkage algorithm employed by OSHPD in creating the linked cohort data file is highly accurate.[8] Over ninety-nine percent of the infant discharge abstracts were successfully linked with the infant birth certificates. These data were also successfully linked to the infant's discharge abstract from the receiving hospital for 99% of the infants who were transferred to another hospital.

The hospital discharge abstracts were the source of information on hospital charges and lengths of stay. Reabstracting studies have found that all of these data elements are reliably coded in the OSHPD discharge data.[9] The death certificate was the source of information on the period of survival.

For this study we limited the observations to those infants with a reported gestational age <38 completed weeks. We also deleted all observations with a birth weight <500g given the limited viability of these infants and significant inter-hospital variation in decisions to resuscitate these infants.

Checking the Accuracy of Gestational Age

Gestational age was estimated in completed weeks from the last menstrual period (LMP) reported on the birth certificate. Because there are known accuracy issues for the LMP, we used the much more accurately reported birth weight to identify cases where the reported gestation was likely to be in error.[10,11] First, we required all surviving infants to have remained in hospital to a corrected age of at least 34 completed weeks. Any surviving infant who was discharged with a corrected age less than 34 completed weeks was assumed to have an error in the reported gestation and excluded from the study. Second, we used the California fetal growth curves to identify outlier gestational ages.[12] The study by Williams and colleagues reported separate fetal growth curves for singleton males, singleton females, and multiple births.[12] For each of these groups, we considered the reported gestational age from the birth certificate to be in error if the birth weight was less than the 10th percentile of the fetal growth curve for two weeks earlier. For example, for male singleton infants with a birth certificate gestational age of 28 weeks, we used the 10th birth weight percentile for 26 weeks (574g). Any 28 week male singleton infant with a birth weight <574g was considered an outlier and dropped from the analysis. Similarly, we considered the reported gestational age to be in error if the birth weight was more than the 90th percentile of the fetal growth curve for two weeks later. For example, for female singleton infants with a birth certificate gestational age of 28 weeks, we used the 90th birth weight percentile for 30 weeks (2113g). Any 28 week female singleton with a birth weight >2113g was considered an outlier and deleted.

Computation of Hospital Costs and Length of Stay

Length of Stay—The total length of stay (total inpatient hospital days) was computed as the total number of hospital days until first discharge to home or death. This total incorporated any inter-hospital transfers that may have occurred. In some instances, length of stay information was missing from the hospital discharge summary. Cases that did not include complete hospital stay information were excluded.

Hospital Costs—Most hospital charges represent a significant mark-up over actual costs, and these mark-ups vary greatly across hospitals.[13] To provide a more accurate view of the actual costs, the charges for each hospital stay were multiplied by a hospital-specific cost-to-charge ratio derived from annual hospital financial data compiled by OSHPD.[14] Ideally, this adjustment of charges to estimated costs would be done using department-specific cost-to-charge ratios as this yields more accurate estimates of costs.[13] Unfortunately, the OSHPD discharge data only report total hospital charges, not department-specific charges. Once charges were converted to costs, they were adjusted by the consumer price index to reflect December 2003 levels.[15]

Total adjusted hospital costs were computed as the sum of adjusted inpatient hospital costs for the birth hospitalization and any subsequent hospitalizations (transfers) prior to the infant being discharged home for the first time or prior to death if the infant died prior to being discharged. In some instances, total adjusted costs could not be accurately computed due to missing data. Some hospitals (particularly Kaiser hospitals) do not regularly report hospital charges in the OSHPD discharge summaries. Cases with missing cost data and cases involving multiple hospitalizations (for example, inter-hospital transfers) that did not include complete hospital charge data for each relevant hospitalization were excluded from our analyses.

Cost Outliers

Through an examination of the distributions of infant adjusted costs, several cases with outlying/improbable adjusted-cost per day values were identified and excluded from our analyses. We excluded any case with an adjusted cost per day in excess of $10,000. We also excluded cases (survivors) with an adjusted cost per day of less than $100. Surviving infants with a birth weight less than 1500g were excluded if adjusted costs per day were less than $400. Surviving infants with birth weights between 1500g and 1999g were excluded if adjusted costs per day were less than $250. Infants who died and had a total hospital stay that exceeded one day were excluded if adjusted costs per day were less than $400.

Analysis

All infants in the sample were sorted ascendingly by week of gestational age. Descriptive statistics were calculated for costs and lengths of stay, by week of gestation for 24 to 37 completed weeks, for all infants and for only those infants who survived to hospital discharge. We then calculated the expected changes in costs and lengths of stay for delays in premature delivery, by week. To do this we assumed that, for any delay in delivery, the expected cost and length of stay would be equal to those for other infants of the gestation being shifted to. Since there is some uncertainty around how expected costs and lengths of stay would shift, we used the 25th and 75th percentiles of the cost and length of stay distributions to create ranges for use in sensitivity analyses. The lower value of the range of potential cost savings was defined as:

$$S_L = 25^{th}\ \text{percentile}\ \text{Cost}_I - 75^{th}\ \text{percentile}\ \text{Cost}_S$$

Where Cost_I is the cost distribution of the lower gestational age that is the baseline, and Cost_S is the cost distribution of the higher gestational age that the delivery was shifted to. Similarly, the upper value of the range of potential cost savings was defined as:

$$S_U = 75^{th}\ \text{percentile}\ \text{Cost}_I - 25^{th}\ \text{percentile}\ \text{Cost}_S$$

This same method was used to create the intervals for lengths of stay.

Since the costs and lengths of stay of premature infants are quite sensitive to survival, we also repeated all of the analyses after excluding those infants who died. All data management and statistical analyses were conducted using SAS Statistical Analysis System software.[16]

RESULTS

There were a total of 264,870 cases in the linked data with a gestational age between 24 and 37 completed weeks. We deleted 354 cases with a birth weight <500g. 33,296 cases were deleted due to incomplete cost or length of stay information, or if they were identified as having a non-creditable cost estimate. A total of 38,054 cases were deleted because they failed the gestational age criteria described above. The resulting final sample was 193,167 infants.

Table 1 reports the distributions of costs by week of gestation for 24 to 37 weeks. In addition to the mean and median, the table reports the 5th, 25th, 75th and 95th percentiles of the cost distributions. Costs decrease rapidly as gestation increases and the distributions of costs are very large.

Table 2 reports the same information as table 1 for the distributions of length of stay by week of gestation. Again, lengths of stay decreases rapidly as gestation increases.

Table 3 reports the estimates of how changes in gestation affect neonatal costs. This table is just the upper right triangle of a matrix. The rows represent the starting gestation, and the columns are the gestation to which the delivery was hypothetically delayed. Each cell of the table reports the mean and median cost savings, and the range estimated as described in the methods above. For example, we estimated that shifting a delivery from 25 weeks to 29 weeks

(2nd row, 5th column) would result in a mean and median savings of $117,737 and $118,334, respectively. The estimated range of this estimate is (−$9,987, $242,865).

Table 4 reports reductions in lengths of stay in the same format as table 3.

Appendix Tables A-1, A-2, A-3, and A-4 repeat the analyses for all four of the above tables after excluding infants that died.

DISCUSSION

This analysis provides summaries of the neonatal costs and lengths of stay by week of gestation from a large, population-based dataset. These data provide more reliable information on which to base estimates of the cost-effectiveness of interventions to prevent or delay premature labor than can be obtained from the relatively small samples of randomized controlled trials. Further, because these data were population-based, they were not subject to any bias with respect to the types of hospitals or providers that are frequently present in clinical trials. In addition to providing information on the mean and median costs and lengths of stay, we also reported detailed information about their distributions, which makes it possible to estimate confidence intervals and conduct sensitivity analyses.

In Tables 3 and 4 we have reported the point estimates of how the mean and median costs and lengths of stay change with shifts in gestational age. These tables relied on the assumption that infants with delayed deliveries will have cost (lengths of stay) distributions similar to those of infants who naturally deliver at those gestations. Given that there is no available information to test the validity of this assumption, it will need to be tested when there are sufficient data available from cases where delivery is successfully delayed. This assumption does have strong face validity, given that the underlying cause of the high costs (lengths of stay) of very premature infants is physiologic development. Unless the interventions to delay delivery somehow alter the time driven fetal development, using other cases of similar gestational ages should result in unbiased estimates of the neonatal costs (lengths of stay) of infants with delayed deliveries.

There are many possible ways to estimate distributions or choose values for sensitivity analyses. In Tables 3 and 4 we report ranges based on a specific method. There are other possible ways to do this and we have provided information in tables 1 and 2 that will allow individual investigators to use other methods. We want to be very explicit that what we have reported are not traditional 95% confidence intervals. The lower bounds that we report include many negative values. These are not entirely implausible, given that increasing gestation reduces mortality risk. We know from results not reported that almost all of the very low birth weight deaths occurred within the first few days after delivery, with over 75% of them occurring within the first two days. Delaying premature delivery has a compound effect on the resulting neonatal costs; it almost certainly reduces costs for those infants who would have survived anyway, but it also markedly increases the costs for those infants who would have died in the first few days of life and now survive with long neonatal hospitalizations.

Although the current study makes a significant contribution to the documentation of hospital costs associated with premature delivery, there are several limitations to this report. First, as mentioned previously, some hospitals in California (primarily Kaiser hospitals) do not report charges in the hospital discharge abstracts. As a result, all infant hospitalizations with missing data were excluded. Second, it is difficult to accurately derive hospital costs from hospital charges because hospital charges reflect different markups for different services. The methodology we employed of converting charges to costs by applying a hospital-level cost to charge ratio has some error, but is a standard and accepted method for converting hospital charges to costs.[13] While these are clearly limitations, we do not believe that these limitations

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had a meaningful affect on the results or conclusions. Given that the cases with missing cost estimates had similar distributions of length of stay (not reported), it is unlikely that the cases with missing cost data had patterns of care that were dramatically different from those that remained in the sample.

As we acknowledged in the methods section, there are significant data quality issues with the gestational age reported on the birth certificate. Within the limits of the methods available to secondary data studies, we tried to screen out those observations with reported gestations that were clearly inconsistent with other information in the record, especially birth weight. We relied on birth weight as a primary screen for gestational age estimates because multiple data quality studies have found that it is reported correctly on the birth certificate with very high levels of accuracy.[11,12] Given the large number of infants (14%) we excluded for having clearly inaccurate reported gestational age, it is possible that our analyses included observations where the gestational age was in error. Further, in results not shown above, about two thirds of the discrepancies between gestational age and birth weight indicated that the reported gestational age was too low for the recorded birth weight. Thus, in addition to adding variance to our results, there may be some bias in our results. Since we removed the cases where reported gestation was clearly in error, any remaining errors in gestation should be relatively small (≤2 weeks). Further, the amount of systematic bias should be small relative to the overall reported costs and lengths of stay.

In conclusion, these results provide population-based data that can be applied to clinical trials data to assess the impacts on costs and lengths of stay of interventions that delay premature labor. They show that the potential savings of delaying premature labor are quite large, especially for extremely premature deliveries. Thus, it is likely that interventions to delay or prevent premature delivery will be cost-effective unless they are extremely expensive.

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Appendix Tables

Table A-1

Distribution of Costs of Neonatal Care By Gestational Age and Survival, 24 to 37 Completed Weeks, All Births in California 1998–2000.

Gestational Age (completed weeks)	Survival/ Death	N	Mean (US $)	Std. Dev. (US $)	Median (US $)	5th % ile (US $)	25th % ile (US $)	75th % ile (US $)	95th % ile (US$)
24	Survivors	325	297,627	147,900	268,747	130,906	208,773	342,164	601,195
24	Non-survivors	161	71,036	126,060	24,324	3,461	9,072	66,544	404,684
25	Survivors	523	272,730	142,284	235,123	115,026	171,607	325,906	563,499
25	Non-survivors	155	101,296	205,710	33,770	4,142	12,233	104,163	460,275
26	Survivors	663	222,425	124,617	196,774	93,401	143,675	263,046	428,374
26	Non-survivors	93	102,219	145,265	42,162	4,466	15,143	140,212	416,658
27	Survivors	812	186,894	108,252	156,905	74,997	119,756	224,361	398,244
27	Non-survivors	88	96,754	136,227	41,182	5,812	13,768	104,162	391,362
28	Survivors	1,028	149,101	100,267	124,060	54,355	86,741	180,725	318,263
28	Non-survivors	63	97,495	137,045	45,140	6,581	12,897	120,949	352,271
29	Survivors	1,171	115,975	107,363	90,405	41,199	62,029	138,210	268,853
29	Non-survivors	55	112,094	211,379	44,107	4,601	12,536	98,703	578,145
30	Survivors	1,491	92,662	84,463	68,314	29,926	45,954	107,396	233,805
30	Non-survivors	65	97,912	133,766	45,491	4,904	17,617	101,836	382,475
31	Survivors	1,943	65,963	58,723	49,102	20,649	33,181	76,952	165,819
31	Non-survivors	52	161,210	248,990	44,332	1,061	9,268	198,776	887,196
32	Survivors	2,754	45,710	51,174	32,628	13,560	21,447	51,411	123,207
32	Non-survivors	45	71,011	115,664	28,128	452	8,803	65,190	351,237
33	Survivors	4,657	29,677	44,378	20,216	6,628	12,662	33,490	75,350
33	Non-survivors	62	65,282	110,775	25,057	225	7,537	71,121	216,262
34	Survivors	14,480	10,167	22,648	1,928	262	556	12,830	39,291
34	Non-survivors	61	97,710	200,330	15,821	414	5,033	87,149	440,375
35	Survivors	25,007	5,751	20,060	843	247	463	4,411	24,566
35	Non-survivors	70	97,412	197,203	21,936	418	8,858	85,718	517,689
36	Survivors	44,829	3,359	18,567	674	239	421	1,280	14,192
36	Non-survivors	93	44,840	72,587	15,490	829	7,577	41,581	182,308
37	Survivors	92,336	1,966	11,145	591	230	387	945	6,282
37	Non-survivors	85	67,758	128,644	22,702	466	6,249	73,355	283,910

Infants with a birth weight <500g and infants with a gestational age that was inconsistent with birth weight were deleted.

Costs converted to December 2003 levels by the U.S. Consumer Price Index.

Table A-2

Distribution of Lengths of Stay of Neonatal Care by Gestational Age and Survival, 24 to 37 Completed Weeks, All Births in California 1998–2000

Gestational Age (completed weeks)	Survival/ Deaths	N	Mean (days)	Std. Dev. (days)	Median (days)	5th % ile (days)	25th % ile (days)	75th % ile (days)	95th % ile (days)
24	Survivors	325	109.6	31.6	104	77	91	119	159
24	Non-survivors	161	16.9	33.6	5	1	1	17	65
25	Survivors	523	101.7	30.2	96	68	82	112	157
25	Non-survivors	155	21.0	37.5	7	1	2	23	93
26	Survivors	663	89.6	27.7	85	61	73	99	130
26	Non-survivors	93	27.5	49.8	9	1	3	29	163
27	Survivors	812	80.0	30.0	73	52	63	90	126
27	Non-survivors	88	25.6	45.3	11	1	2	24.5	126
28	Survivors	1,028	68.6	23.1	63.5	45	53	78	105
28	Non-survivors	63	24.9	37.0	14	1	3	31	85
29	Survivors	1,171	57.9	27.7	53	36	43	64	98
29	Non-survivors	55	27.5	49.1	13	1	3	25	187
30	Survivors	1,491	48.8	23.3	44	30	36	55	85
30	Non-survivors	65	25.5	36.3	13	1	3	32	90
31	Survivors	1,943	38.5	17.6	34	22	27	44	69
31	Non-survivors	52	37.2	55.0	13.5	1	2	47.5	185
32	Survivors	2,754	28.3	16.5	24	15	19	33	54
32	Non-survivors	45	20.3	32.2	9	1	1	18	88
33	Survivors	4,657	19.3	14.5	16	7	11	23	40
33	Non-survivors	62	17.2	28.9	9	1	1	19	47
34	Survivors	14,480	7.4	9.3	4	1	2	10	23
34	Non-survivors	61	26.9	53.1	6	1	1	27	123
35	Survivors	25,007	4.7	7.2	2	1	2	5	15
35	Non-survivors	70	25.8	54.0	6.5	1	1	21	144
36	Survivors	44,829	3.3	5.6	2	1	1	3	10
36	Non-survivors	93	12.2	37.2	5	1	1	11	29
37	Survivors	92,336	2.6	4.1	2	1	1	3	5
37	Non-survivors	85	14.4	23.9	5	1	2	14	58

Infants with a birth weight <500g and infants with a gestational age that was inconsistent with birth weight were deleted.

Table A-3 and Table A-4 can be found in the Figures and Tables section.

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Table 1

Distribution of Costs of Neonatal Care By Gestational Age, 24 to 37 Completed Weeks, All Births in California 1998–2000.

Gestational Age (completed weeks)	N	Mean (US $)	Std. Dev. (US $)	Median (US $)	5th % ile (US $)	25th % ile (US $)	75th % ile (US $)	95th % ile (US $)
24	486	222,563	176,785	216,814	6,418	65,342	307,390	557,607
25	678	233,538	174,431	207,002	10,950	127,081	302,956	554,079
26	756	207,637	133,225	186,649	27,736	131,247	257,635	428,374
27	900	178,080	114,389	150,304	41,036	110,776	219,493	396,760
28	1,091	146,121	103,372	122,628	46,290	81,979	179,624	319,227
29	1,226	115,801	113,927	88,668	37,108	60,091	137,069	272,251
30	1,556	92,882	87,025	68,074	28,889	44,741	107,277	240,665
31	1,995	68,446	71,934	49,099	19,916	32,952	77,273	175,153
32	2,799	46,117	52,889	32,615	13,175	21,357	51,569	125,702
33	4,719	30,145	46,028	20,228	6,549	12,622	33,850	77,294
34	14,541	10,535	26,616	1,963	262	557	12,895	39,702
35	25,077	6,007	23,058	847	247	464	4,484	24,975
36	44,922	3,444	18,930	676	239	421	1,290	14,397
37	92,421	2,027	11,963	591	230	388	946	6,359

Infants with a birth weight <500g and infants with a gestational age that was inconsistent with birth weight were deleted.

Costs converted to December 2003 levels by the U.S. Consumer Price Index.

Table 2

Distribution of Lengths of Stay of Neonatal Care by Gestational Age, 24 to 37 Completed Weeks, All Births in California 1998–2000

Gestational Age (completed weeks)	N	Mean (days)	Std. Dev. (days)	Median (days)	5th % ile (days)	25th % ile (days)	75th % ile (days)	95th % ile (days)
24	486	78.9	54.3	92	1	18	112	147
25	678	83.3	46.6	89	2	68	107	154
26	756	82.0	37.3	82.5	6	68	98	130
27	900	74.7	35.6	72	11	59	88	126
28	1,091	66.0	26.2	62	42	52	77	105
29	1,226	56.5	29.7	52	35	42	64	98
30	1,556	47.8	24.5	43	28	35	55	85
31	1,995	38.5	19.5	34	22	27	44	70
32	2,799	28.2	16.9	24	14	19	33	54
33	4,719	19.3	14.8	16	7	11	23	40
34	14,541	7.4	9.9	4	1	2	10	23
35	25,077	4.7	7.8	2	1	2	5	16
36	44,922	3.3	5.9	2	1	1	3	10
37	92,421	2.6	4.2	2	1	1	3	5

Infants with a birth weight <500g and infants with a gestational age that was inconsistent with birth weight were deleted.

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Table 3

Estimates of the Reduction in Neonatal Costs Associated with 1 Week Increases in Gestational Age: Mean, Median, and Ranges. Estimated From 1998–2000 California Data.

Gestational Age (completed weeks)	To 25 Weeks (US $)	To 26 Weeks (US $)	To 27 Weeks (US $)	To 28 Weeks (US $)	To 29 Weeks (US $)	To 30 Weeks (US $)	To 31 Weeks (US $)	To 32 Weeks (US $)	To 33 Weeks (US $)	To 34 Weeks (US $)	To 35 Weeks (US $)	To 36 Weeks (US $)	To 37 Weeks (US $)
24	−10,975 9,812 (−237,613, 180,308)	14,926 30,165 (−192,293, 176,143)	44,483 66,510 (−154,151, 196,614)	76,442 94,186 (−114,282, 225,410)	106,762 128,146 (−71,727, 247,299)	129,681 148,740 (−41,935, 262,648)	154,117 167,715 (−11,930, 274,437)	176,446 184,198 (13,773, 286,033)	192,418 196,586 (31,493, 294,768)	212,028 214,851 (52,447, 306,832)	216,556 215,967 (60,859, 306,926)	219,118 216,138 (64,052, 306,968)	220,536 216,223 (64,396, 307,002)
25		25,901 20,353 (−130,553, 171,709)	55,458 56,697 (−92,412, 192,180)	87,417 84,374 (−52,543, 220,977)	117,737 118,334 (−9,987, 242,865)	140,657 138,928 (19,804, 258,215)	165,092 157,903 (49,809, 270,004)	187,421 174,386 (75,512, 281,599)	203,393 186,773 (93,232, 290,334)	223,003 205,039 (114,186, 302,399)	227,531 206,155 (122,598, 302,492)	230,094 206,326 (125,791, 302,534)	231,511 206,410 (126,135, 302,568)
26			29,557 36,345 (−88,246, 146,859)	61,517 64,021 (−48,377, 175,656)	91,836 97,981 (−5,822, 197,544)	114,756 118,575 (23,970, 212,894)	139,192 137,550 (53,975, 224,683)	161,520 154,034 (79,678, 236,278)	177,492 166,421 (97,397, 245,013)	197,103 184,686 (118,352, 257,078)	201,631 185,802 (126,763, 257,171)	204,193 185,973 (129,957, 257,213)	205,611 186,058 (130,301, 257,247)
27				31,959 27,676 (−68,849, 137,514)	62,279 61,637 (−26,293, 159,402)	85,199 82,230 (3,499, 174,752)	109,635 101,206 (33,503, 186,541)	131,963 117,689 (59,207, 198,137)	147,935 130,076 (76,926, 206,871)	167,546 148,341 (97,880, 218,936)	172,073 149,457 (106,292, 219,029)	174,636 149,629 (109,486, 219,072)	176,053 149,713 (109,830, 219,106)
28					30,320 33,960 (−55,090, 119,533)	53,239 54,554 (−25,298, 134,883)	77,675 73,529 (4,707, 146,672)	100,004 90,012 (30,410, 158,268)	115,976 102,399 (48,129, 167,003)	135,586 120,665 (69,084, 179,067)	140,114 121,781 (77,496, 179,161)	142,676 121,952 (80,689, 179,203)	144,094 122,036 (81,033, 179,237)
29						22,920 20,594 (−47,186, 92,328)	47,356 39,569 (−17,181, 104,117)	69,684 56,052 (8,522, 115,712)	85,656 68,439 (26,241, 124,447)	105,267 86,705 (47,196, 136,512)	109,794 87,821 (55,607, 136,605)	112,357 87,992 (58,801, 136,647)	113,774 88,076 (59,145, 136,681)
30							24,436 18,975 (−32,531, 74,325)	46,764 35,458 (−6,828, 85,921)	62,737 47,845 (10,891, 94,655)	82,347 66,111 (31,846, 106,720)	86,875 67,227 (40,258, 106,813)	89,437 67,398 (43,451, 106,856)	90,855 67,483 (43,795, 106,890)
31								22,329 16,483 (−18,617, 55,916)	38,301 28,870 (−898, 64,651)	57,911 47,136 (20,057, 76,715)	62,439 48,252 (28,469, 76,809)	65,001 48,423 (31,662, 76,851)	66,419 48,507 (32,006, 76,885)
32									15,972 12,387 (−12,493, 38,947)	35,583 30,652 (8,461, 51,012)	40,110 31,768 (16,873, 51,105)	42,673 31,940 (20,067, 51,148)	44,090 32,024 (20,411, 51,182)
33										19,610 18,265 (−274, 33,292)	24,138 19,381 (8,138, 33,386)	26,701 19,553 (11,332, 33,428)	28,118 19,637 (11,676, 33,462)
34											4,528 1,116 (−3,926, 12,432)	7,090 1,287 (−733, 12,474)	8,508 1,372 (−389, 12,508)

Infants with a birth weight <500g and infants with a gestational age that was inconsistent with birth weight were deleted.

Costs converted to December 2003 levels by the U.S. Consumer Price Index.

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Table A-3

Estimates of the Reduction in Neonatal Costs Associated with 1 Week Increases in Gestational Age: Mean, Median, and Ranges. Estimated From 1998–2000 California Data, Survivors Only.

Gestational Age (completed weeks)	To 25 Weeks (US $)	To 26 Weeks (US $)	To 27 Weeks (US $)	To 28 Weeks (US $)	To 29 Weeks (US $)	To 30 Weeks (US $)	To 31 Weeks (US $)	To 32 Weeks (US $)	To 33 Weeks (US $)	To 34 Weeks (US $)	To 35 Weeks (US $)	To 36 Weeks (US $)	To 37 Weeks (US $)
24	24,896 33,624 (−117,132, 170,557)	75,202 71,973 (−54,273, 198,489)	110,733 111,842 (−15,588, 222,408)	148,526 144,687 (28,048, 255,424)	181,651 178,342 (70,564, 280,135)	204,964 200,433 (101,377, 296,210)	231,664 219,645 (131,822, 308,983)	251,916 236,119 (157,362, 320,718)	267,950 248,531 (175,284, 329,502)	287,459 266,819 (195,943, 341,608)	291,876 267,904 (204,363, 341,701)	294,268 268,073 (207,493, 341,743)	295,660 268,156 (207,829, 341,777)
25		50,306 38,349 (−91,439, 182,230)	85,836 78,218 (−52,754, 206,150)	123,629 111,064 (−9,118, 239,165)	156,755 144,718 (33,397, 263,877)	180,068 166,809 (64,211, 279,952)	206,767 186,022 (94,655, 292,724)	227,020 202,495 (120,196, 304,459)	243,053 214,908 (138,117, 313,244)	262,563 233,196 (158,777, 325,349)	266,979 234,280 (167,196, 325,442)	269,372 234,449 (170,326, 325,485)	270,764 234,533 (170,662, 325,518)
26			35,531 39,869 (−80,686, 143,290)	73,324 72,715 (−37,050, 176,305)	106,449 106,369 (5,466, 201,017)	129,762 128,460 (36,279, 217,092)	156,461 147,673 (66,723, 229,865)	176,714 164,146 (92,264, 241,600)	192,747 176,559 (110,186, 250,384)	212,257 194,847 (130,845, 262,490)	216,674 195,931 (139,264, 262,583)	219,066 196,100 (142,395, 262,625)	220,458 196,184 (142,730, 262,659)
27				37,793 32,845 (−60,969, 137,621)	70,919 66,500 (−18,454, 162,332)	94,232 88,591 (12,359, 178,407)	120,931 107,803 (42,804, 191,180)	141,184 124,277 (68,345, 202,915)	157,217 136,689 (86,266, 211,699)	176,727 154,977 (106,926, 223,805)	181,143 156,062 (115,345, 223,898)	183,536 156,231 (118,475, 223,940)	184,928 156,314 (118,811, 223,974)
28					33,125 33,654 (−51,469, 118,696)	56,439 55,746 (−20,656, 134,771)	83,138 74,958 (9,789, 147,544)	103,390 91,432 (35,330, 159,279)	119,424 103,844 (53,251, 168,063)	138,933 122,132 (73,911, 180,169)	143,350 123,217 (82,330, 180,262)	145,742 123,386 (85,460, 180,304)	147,135 123,469 (85,796, 180,338)
29						23,313 22,091 (−45,367, 92,256)	50,012 41,304 (−14,923, 105,028)	70,265 57,777 (10,618, 116,763)	86,298 70,190 (28,539, 125,548)	105,808 88,478 (49,199, 137,653)	110,224 89,562 (57,618, 137,746)	112,617 89,731 (60,749, 137,789)	114,009 89,815 (61,084, 137,822)
30							26,699 19,213 (−30,998, 74,215)	46,952 35,686 (−5,457, 85,950)	62,985 48,098 (12,464, 94,734)	82,495 66,387 (33,124, 106,840)	86,911 67,471 (41,543, 106,933)	89,304 67,640 (44,673, 106,975)	90,696 67,724 (45,009, 107,009)
31								20,253 16,474 (−18,230, 55,505)	36,286 28,886 (−308, 64,290)	55,796 47,174 (20,351, 76,395)	60,212 48,259 (28,771, 76,489)	62,605 48,428 (31,901, 76,531)	63,997 48,511 (32,237, 76,564)
32									16,033 12,412 (−12,043, 38,749)	35,543 30,700 (8,617, 50,855)	39,959 31,785 (17,036, 50,948)	42,352 31,954 (20,166, 50,990)	43,744 32,037 (20,502, 51,024)
33										19,510 18,288 (−168, 32,933)	23,926 19,373 (8,251, 33,027)	26,319 19,542 (11,382, 33,069)	27,711 19,625 (11,717, 33,102)
34											4,416 1,085 (−3,854, 12,367)	6,809 1,253 (−724, 12,409)	8,201 1,337 (−388, 12,443)

Infants with a birth weight <500g and infants with a gestational age that was inconsistent with birth weight were deleted.

Costs converted to December 2003 levels by the U.S. Consumer Price Index.

Table 4

Estimates of the Reduction in Length of Stay Associated with 1 Week Increases in Gestational Age: Mean, Median, and Ranges. Estimated From 1998–2000 California Data.

Gestational Age (completed weeks)	To 25 Weeks (days)	To 26 Weeks (days)	To 27 Weeks (days)	To 28 Weeks (days)	To 29 Weeks (days)	To 30 Weeks (days)	To 31 Weeks (days)	To 32 Weeks (days)	To 33 Weeks (days)	To 34 Weeks (days)	To 35 Weeks (days)	To 36 Weeks (days)	To 37 Weeks (days)
24	−4.4 3 (−89, 44)	−3 9.5 (−80, 44)	4.2 20 (−70, 53)	12.9 30 (−59, 60)	22.4 40 (−46, 70)	31.1 49 (−37, 77)	40.5 58 (−26, 85)	50.7 68 (−15, 93)	59.6 76 (−5, 101)	71.5 88 (8, 110)	74.2 90 (13, 110)	75.6 90 (15, 111)	76.4 90 (15, 111)
25		1.3 6.5 (−30, 39)	8.6 17 (−20, 48)	17.2 27 (−9, 55)	26.8 37 (4, 65)	35.4 46 (13, 72)	44.8 55 (24, 80)	55.1 65 (35, 88)	64 73 (45, 96)	75.8 85 (58, 105)	78.6 87 (63, 105)	80 87 (65, 106)	80.7 87 (65, 106)
26			7.2 10.5 (−20, 39)	15.9 20.5 (−9, 46)	25.5 30.5 (4, 56)	34.1 39.5 (13, 63)	43.5 48.5 (24, 71)	53.8 58.5 (35, 79)	62.7 66.5 (45, 87)	74.5 78.5 (58, 96)	77.2 80.5 (63, 96)	78.7 80.5 (65, 97)	79.4 80.5 (65, 97)
27				8.7 10 (−18, 36)	18.2 20 (−5, 46)	26.9 29 (4, 53)	36.3 38 (15, 61)	46.5 48 (26, 69)	55.4 56 (36, 77)	67.3 68 (49, 86)	70 70 (54, 86)	71.4 70 (56, 87)	72.2 70 (56, 87)
28					9.5 10 (−12, 35)	18.2 19 (−3, 42)	27.6 28 (8, 50)	37.8 38 (19, 58)	46.7 46 (29, 66)	58.6 58 (42, 75)	61.3 60 (47, 75)	62.8 60 (49, 76)	63.5 60 (49, 76)
29						8.7 9 (−13, 29)	18 18 (−2, 37)	28.3 28 (9, 45)	37.2 36 (19, 53)	49.1 48 (32, 62)	51.8 50 (37, 62)	53.2 50 (39, 63)	53.9 50 (39, 63)
30							9.4 9 (−9, 28)	19.6 19 (2, 36)	28.5 27 (12, 44)	40.4 39 (25, 53)	43.1 41 (30, 53)	44.6 41 (32, 54)	45.3 41 (32, 54)
31								10.3 10 (−6, 25)	19.1 18 (4, 33)	31 30 (17, 42)	33.7 32 (22, 42)	35.2 32 (24, 43)	35.9 32 (24, 43)
32									8.9 8 (−4, 22)	20.8 20 (9, 31)	23.5 22 (14, 31)	24.9 22 (16, 32)	25.6 22 (16, 32)
33										11.9 12 (1, 21)	14.6 14 (6, 21)	16 14 (8, 22)	16.7 14 (8, 22)
34											2.7 2 (−3, 8)	4.2 2 (−1, 9)	4.9 2 (−1, 9)

Infants with a birth weight <500g and infants with a gestational age that was inconsistent with birth weight were deleted.

Table A-4

Estimates of the Reduction in Length of Stay Associated with 1 Week Increases in Gestational Age: Mean, Median, and Ranges. Estimated From 1998–2000 California Data, Survivors Only.

Gestational Age (completed weeks)	To 25 Weeks (days)	To 26 Weeks (days)	To 27 Weeks (days)	To 28 Weeks (days)	To 29 Weeks (days)	To 30 Weeks (days)	To 31 Weeks (days)	To 32 Weeks (days)	To 33 Weeks (days)	To 34 Weeks (days)	To 35 Weeks (days)	To 36 Weeks (days)	To 37 Weeks (days)
24	7.9 8 (−21, 37)	20 19 (−8, 46)	29.6 31 (1, 56)	41.1 40.5 (13, 66)	51.8 51 (27, 76)	60.8 60 (36, 83)	71.1 70 (47, 92)	81.3 80 (58, 100)	90.3 88 (68, 108)	102.3 100 (81, 117)	105 102 (86, 117)	106.4 102 (88, 118)	107.1 102 (88, 118)
25		12.1 11 (−17, 39)	21.7 23 (−8, 49)	33.2 32.5 (4, 59)	43.9 43 (18, 69)	52.9 52 (27, 76)	63.2 62 (38, 85)	73.4 72 (49, 93)	82.4 80 (59, 101)	94.4 92 (72, 110)	97.1 94 (77, 110)	98.5 94 (79, 111)	99.2 94 (79, 111)
26			9.6 12 (−17, 36)	21 21.5 (−5, 46)	31.7 32 (9, 56)	40.8 41 (18, 63)	51.1 51 (29, 72)	61.3 61 (40, 80)	70.3 69 (50, 88)	82.2 81 (63, 97)	84.9 83 (68, 97)	86.3 83 (70, 98)	87.1 83 (70, 98)
27				11.5 9.5 (−15, 37)	22.2 20 (−1, 47)	31.2 29 (8, 54)	41.6 39 (19, 63)	51.7 49 (30, 71)	60.7 57 (40, 79)	72.7 69 (53, 88)	75.4 71 (58, 88)	76.8 71 (60, 89)	77.5 71 (60, 89)
28					10.7 10.5 (−11, 35)	19.8 19.5 (−2, 42)	30.1 29.5 (9, 51)	40.2 39.5 (20, 59)	49.2 47.5 (30, 67)	61.2 59.5 (43, 76)	63.9 61.5 (48, 76)	65.3 61.5 (50, 77)	66 61.5 (50, 77)
29						9.1 9 (−12, 28)	19.4 19 (−1, 37)	29.5 29 (10, 45)	38.5 37 (20, 53)	50.5 49 (33, 62)	53.2 51 (38, 62)	54.6 51 (40, 63)	55.3 51 (40, 63)
30							10.3 10 (−8, 28)	20.5 20 (3, 36)	29.5 28 (13, 44)	41.4 40 (26, 53)	44.1 42 (31, 53)	45.5 42 (33, 54)	46.3 42 (33, 54)
31								10.2 10 (−6, 25)	19.1 18 (4, 33)	31.1 30 (17, 42)	33.8 32 (22, 42)	35.2 32 (24, 43)	35.9 32 (24, 43)
32									9 8 (−4, 22)	21 20 (9, 31)	23.7 22 (14, 31)	25.1 22 (16, 32)	25.8 22 (16, 32)
33										12 12 (1, 21)	14.7 14 (6, 21)	16.1 14 (8, 22)	16.8 14 (8, 22)
34											2.7 2 (−3, 8)	4.1 2 (−1, 9)	4.8 2 (−1, 9)

Infants with a birth weight <500g and infants with a gestational age that was inconsistent with birth weight were deleted.