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Employer-Sponsored Plan Expenditures for Infants Born Preterm

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Abstract

BACKGROUND—Care for infants born preterm or with major birth defects is costly. Specific estimates of financial burden for different payers are lacking, in part because use of administrative data to identify preterm infants and costs is challenging.

METHODS—We used private health insurance claims data and billing codes to identify live births during 2013 and calculated first-year expenditures for employer-sponsored health plans for infants born preterm, both overall and stratified by major birth defects.

RESULTS—We conservatively estimated that 7.7% of insured infants born preterm accounted for 37% of $2.0 billion spent by participating plans on the care of infants born during 2013. With a mean difference in plan expenditures of ~$47 100 per infant, preterm births cost the included plans an extra $600 million during the first year of life. Extrapolating to the national level, we projected aggregate employer-sponsored plan expenditures of $6 billion for infants born preterm during 2013. Infants with major birth defects accounted for 5.8% of preterm births but 24.5% of expenditures during infancy. By using an alternative algorithm to identify preterm infants, it was

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Dr Grosse conceptualized and conducted the analysis contained in this report, interpreted the data, and led the writing of the initial manuscript and revised versions; Drs Waitzman and Yang conceptualized the analysis contained in this report, interpreted the data, and critically revised the manuscript for intellectual content; Dr Abe participated in the conceptualization of the analysis and critically revised the manuscript for intellectual content; Dr Barfield interpreted the data and critically revised the manuscript for intellectual content; and all authors approved the final version and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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revealed that incremental expenditures were higher: $78 000 per preterm infant and $14 billion nationally.

CONCLUSION—Preterm births (especially in conjunction with major birth defects) represent a substantial burden on payers, and efforts to mitigate this burden are needed. In addition, researchers need to conduct studies using linked vital records, birth defects surveillance, and administrative data to accurately and longitudinally assess per-infant costs attributable to preterm birth and the interaction of preterm birth with major birth defects.

Approximately 1 in 10 US infants are born preterm (<37 completed weeks' gestation), [1] with high costs of neonatal hospitalizations.[2–4] Each year's cohort of preterm births incurred an incremental lifetime societal cost of $26.2 billion in 2005 dollars, including $16.9 billion in health care costs.[5] In addition, the medical costs of prematurity to employers[6] and Medicaid have also been assessed.[7] Estimates of the added cost of preterm birth to employer-sponsored health plans can be used to demonstrate to employers the financial benefit of preterm birth prevention.

Our objectives with this analysis were (1) to estimate the financial impact on US employer-sponsored plans of medical care for infants born preterm during 2013 (both overall and among infants with and without major birth defects), and (2) review potential biases in estimates of per-infant incremental expenditures for preterm versus nonpreterm births from analyses in which stand-alone claims data are used to ascertain preterm birth and estimate health care expenditures. Because infants with birth defects are more likely to be born preterm[5, 8] and have elevated use of health care, [9, 10] we excluded infants with malformations to provide a lower-bound estimate of the burden of preterm birth. Finally, although record linkage in studies in which researchers use vital records data are the gold standard for economic assessments of preterm birth, [5] administrative databases are often used to estimate health care costs, and it is important to understand their limitations.

METHODS

Data Source

We analyzed data from the Truven Health Analytics MarketScan Commercial Research Database, a nationwide sample of private health plans provided through employers with data for tens of millions of individuals with employer-sponsored insurance (ESI). We accessed MarketScan data via Treatment Pathways 4.0, an online analytic platform; our analysis was restricted to plans with prescription drug coverage, which include ~75% of all MarketScan enrollees. This platform does not enable linkages between infant and maternal records.

Inclusion Criteria

We used 2 distinct approaches to identify a cohort of newborn infants with a presumed birth hospitalization during the 2013 calendar year. One approach included all infants with both a diagnosis-related group (DRG) code of 789 to 795 in the principal diagnosis field for an inpatient admission and a diagnosis code of V30 to V39 to indicate a live birth associated with the same discharge; in addition, they had no claims or enrollment date before the first inpatient claim with a neonatal DRG. In the other approach, we excluded the 790 DRG code, which refers to “extreme immaturity or respiratory distress syndrome, neonate.” The justification for that exclusion is that infants with respiratory distress syndrome (RDS) may be enrolled in a covered plan after diagnosis rather than at birth. In both approaches, we tracked services and expenditures for 12 months after the first claim.

Identifying Preterm Infants

To identify infants coded for preterm birth (gestational age <37 weeks), we used the presence of International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes 765.00 to 765.28 on the first neonatal hospital discharge. Those codes, together with others for term low birth weight (LBW) births, are used to bill for services relating to “disorders relating to short gestation and low birth weight” (Supplemental Table 3). All other newborns were presumed to be nonpreterm. In previous studies, researchers indicated that the above ICD-9-CM codes are highly specific, with a positive predictive value of at least 90%.[11, 12] However, the sensitivity is much lower (between 45% and 80%) and is particularly low for infants born at 35 or 36 weeks' gestation.[12, 13] Consequently, only a subset of infants born preterm are coded as preterm.

By using a list of ICD-9-CM codes for selected major birth defects (Supplemental Table 4), infants who had 1 or more inpatient claims with any of the selected codes or ≥2 claims in any setting at least 7 days apart were classified as having a major birth defect. Billing codes for major birth defects in a single claim have a low positive predictive value (typically 50% to 70%).[11, 14, 15] We calculated incremental expenditures for preterm birth, both overall and excluding infants with major birth defects.

Outcomes and Sensitivity Analysis

We calculated net plan expenditures (reimbursements to providers by plans) during the first 12 months of life, regardless of duration of enrollment. We reported all expenditures and expenditures associated with inpatient services. In addition, we reported total allowable charges after adjudication by the health plan, which consists of 2 parts: the plan payment and the expected out-of-pocket payment by beneficiaries.

As a sensitivity analysis, we restricted the primary analysis sample to infants with continuous enrollment for 12 months.

National Estimates

The aggregate additional expenditures by US employers on infancy care associated with preterm birth during 2013 were extrapolated from the study estimates by adjusting for the ratio of all births covered by ESI to the number of births in the data source. In 2013, private payers were responsible for 1 808 809 of 3 899 668 hospitalizations with a neonatal DRG code (789–795) (Health Care Utilization Project, Agency for Healthcare Research and Quality).[16] In 2013, 93.4% of children aged <6 years with private health insurance had ESI coverage.17[*] Those estimates imply 1 746 901 neonatal admissions were covered nationally

[*]In 2013 47.3% of children aged <6 years had private health insurance (Table 102) and 44.2% had employer-sponsored health insurance (Table 103).[17]

by ESI during 2013. We used the ratio of this number to the number of neonatal admissions in our analytic sample to extrapolate employer-sponsored plan expenditures to the national level.

RESULTS

The number of infants with first neonatal hospitalizations during the 2 approaches in 2013 were 180 787 (with the 790 DRG code) and 173 649 (excluding the 790 DRG code as an inclusion criterion). The number of insured infants with preterm billing codes were 17 795 (9.8%) in the first approach and 13 426 (7.7%) in the second approach. Of the 7138 infants who had a 790 DRG code, virtually all (98%) also had an ICD-9-CM diagnosis code for RDS. The percentage of infants with an inpatient diagnosis of RDS was 4.4% of 180 787 infants in the first approach by using the 790 DRG code to ascertain neonates and 0.9% of the 173 649 infants in the second approach. The latter estimate is consistent with population-based neonatal RDS prevalence estimates of 1.2%.[18, 19] Consequently, we treated the second approach as the primary analysis.

Per-Infant Expenditures

By using the second approach, mean net plan expenditures for infants classified as preterm were $54 873 compared with $7774 for nonpreterm infants, a mean difference of $47 099 (Table 1).

Under the first approach, with an approximately fourfold higher RDS prevalence, mean net plan expenditures were $85 962 for preterm infants and $7942 for nonpreterm infants, a difference of $78 019 per infant (Table 1).

In a sensitivity analysis restricted to the 42% of infants with 12 months of continuous enrollment, per-child expenditures for the year were similar to those reported above (S.D.G., unpublished observations).

Mean inpatient expenditures accounted for 89% to 92% of overall net plan expenditures for preterm infants compared with 61% to 62% for nonpreterm infants (S.D.G., unpublished observations). Total mean allowable charges (ie, expected total payments to providers) per child were slightly higher than plan payments for infants coded as preterm (ie, expected out-of-pocket payments) by $1883 to $2158 in absolute terms and 2.5% to 3.4% in relative terms; for other infants, total costs were higher by $961 to $1354, or 12.4% to 17.0% in relative terms (Table 1).

As is generally the case with health care expenditures, median expenditures (the payment for the average child) were considerably lower than mean expenditures (the average payment for all children in the group). The median was closer to the mean for the nonpreterm group than for the preterm birth group, which reflects a more skewed distribution of costs in the latter.

Aggregate Infant Spending and Attributable Preterm Birth Spending

The aggregate plan expenditures variable is the product of mean expenditures during the first 12 months by the number of infants. For 173 649 infants in the second approach, aggregate expenditures were ~$2.0 billion, of which ~$740 million (37.2%) were incurred by 7.7% of infants coded as preterm (Table 1). In the first approach, aggregate expenditures for the cohort of 180 787 infants were ~$2.9 billion, of which ~$1.5 billion (or 54.2% of total infant expenditures) were incurred by the 9.8% of infants classified as preterm.

The number of hospital deliveries in this study was ~10% of the 1 746 901 deliveries covered nationally by ESI during 2013.

Aggregate expenditures during infancy attributable to preterm births in the second approach were ~$632.4 million (the product of the incremental expenditure for preterm infants [$47 099] and the number of infants coded as preterm [*n* = 13 426]). The national estimate of aggregate spending by employer-sponsored plans on medical care during infancy associated with preterm birth during 2013 was $6.3 billion in 2014 dollars in that approach. Aggregate preterm-attributable expenditures according to the first approach were ~$14 billion.

Per-Infant Expenditures Associated With Birth Defects

In the primary analysis (in which the second approach to identify newborns was used), infants with major birth defects comprised 6.5% of infants coded as preterm compared with 2.3% of infants not coded as preterm. Mean expenditures for infants who did not meet the algorithm for confirmed major birth defects were 6.6 times higher for those born preterm: $42 620 vs $6450. The incremental expenditure associated with preterm birth among those without major birth defects was $36 171 (Table 2). The latter figure multiplied by the number of preterm infants without major birth defects (12 401) yields a lower-bound attributable expenditure for preterm birth among participating plans of $528.5 million, which is 16.5% lower than the primary estimate of $632.4 million. The mean expenditures for preterm infants with major birth defects ($226 840) is 3.5 times greater than for infants with major birth defects not coded as born preterm ($63 939). Preterm infants with major birth defects accounted for 27.5% of all expenditures for preterm infants.

DISCUSSION

In this study, we confirm previous findings that preterm birth is costly to US private health plans and employers.[5, 6, 20] The estimates in this study relate to plan expenditures. Average payments by private health plans substantially exceed those of public payers, including Medicare and Medicaid.[21] Estimates of average per-child Medicaid expenditures for preterm and/or LBW infants born during 2009 were only one-third as high as for infants in employer-sponsored plans.[6, 7] Unlike the authors of a 2006 Institute of Medicine (IOM) report, [5] we did not include costs of pregnancy and delivery care or medical care after infancy, and therefore our medical cost estimates are partial. Furthermore, our estimates do not address societal costs, which include nonmedical services and lost economic production. Preterm birth is costly, and efforts to reduce its occurrence have large potential benefits.

We estimated an aggregate cost to US employer-sponsored plans of between $6 billion and $14 billion for infant care attributable to preterm birth during 2013. The difference between the 2 estimates reflects the differential inclusion of infants with a DRG code for RDS, representing 0.9% and 4.4% in the second and first approaches, respectively. Because the former estimate is consistent with population-based neonatal RDS prevalence estimates of 1.2%, [18, 19] we believe that it is closer to a representative cohort of privately insured newborns enrolled from birth. Conversely, the second cohort might have been enriched with infants with RDS. Consequently, we suspect that the aggregate economic impact of preterm birth on employer-sponsored health plans is likely to be much closer to the lower-bound estimate of $6 billion than the upper-bound estimate of $14 billion.

Our lower-bound estimate of $6 billion for the US employer insurance burden of preterm birth may appear low relative to a March of Dimes estimate of $12 billion in 2011 dollars.[6] However, that estimate included both maternity and infant care costs; infant care costs alone were just over $10 billion.[6] It also included costs to families as well as costs to employer plans, although out-of-pocket expenditures by enrollees raised incremental expenditures in the current study by just 2%. Additionally, the comparison group was restricted to “healthy” term infants, whose mean expenditure in 2013 and 2014 dollars[22] was 39% lower than the average expenditure for nonpreterm infants in the current study. Finally, the March of Dimes estimate included both LBW and preterm infants.[6] Conversely, we directly estimated numbers of privately-insured infants who were coded as preterm rather than using estimates of preterm births indirectly derived from vital records. Aggregate cost estimates calculated by using the same ascertainment methods both to identify affected persons and to estimate per-person costs are preferred.[23]

Also, for the first time, we have quantified the overlap of medical costs during infancy for major birth defects and preterm birth. A recent analysis found that excluding hospital codes for preterm birth would reduce US birth defect–related hospital cost estimates by approximately one-fifth.[10] More than one-quarter (27.5%) of total expenditures for infants born preterm were incurred by the 6.5% of preterm infants with major birth defects. It also appears that the cost of shorter gestation is higher for infants with major birth defects. In Australia, each additional completed week of gestation was found to reduce mean cost during the first year of life by 10% and 27% for infants with and without severe neonatal morbidity, respectively.[24] Prevention of the synergistic combination of birth defects and preterm birth may yield higher cost savings.

Our estimates have limitations. First, MarketScan Commercial data are a convenience sample of the US population with ESI that over-represents states in the South and underrepresents states in the West, which have the highest expenditures.[25] The average expenditures for preterm infants in the South were 12% less than the sample mean, and in the West they were 32% greater than the sample mean. Therefore, the unweighted expenditures likely underestimate expenditures for US ESI plans.

The most serious study limitation is the inability to reliably ascertain preterm birth in administrative databases. The ICD-9-CM diagnosis codes used to identify infants born preterm were developed to code diseases for purposes of reimbursement, not for surveillance of risk factors such as preterm birth. In particular, infants who are born at 35 to 36 weeks’ gestation and do not require additional hospital care are less likely to be coded as preterm and also have much lower hospital days than infants who are coded as preterm, similar to those born at term. Among infants who are relatively healthy, the association of preterm birth with increased expenditures is lower than it is among those with severe neonatal morbidity.[24] The implication is that the estimates of per-child expenditures associated with preterm birth (especially late preterm birth) may be substantially overstated by using stand-alone administrative databases. On the other hand, the incomplete sensitivity of the ICD-9-CM codes for ascertaining preterm births does not bias aggregate estimates of expenditures; rather, the aggregate estimates are conservative because they do not include any incremental health care cost for late preterm infants who are not coded as preterm.

Overstatement of expenditures for late preterm infants identified by using billing codes with stand-alone administrative databases relative to actual expenditures for all late preterm infants is illustrated by a comparison of published estimates from 2004 to 2005 MarketScan Commercial claims data[26] and linked California vital records and hospital discharge data from 1998 to 2000.[2] According to the MarketScan analysis, late preterm infants (33–36 weeks' gestation) had 12.6 times higher mean expenditures for the birth hospitalization than term infants.[26] In the California analysis, the mean cost of birth hospitalizations when pooling gestational ages 33 to 36 weeks was 3.3 times higher than for infants with a gestational age of 37 weeks.[2] The latter analysis, which used reliable estimates of gestational age in combination with linked administrative data, yields credible estimates of hospitalization costs by gestational age.

Not surprisingly, the average per-child expenditures reported in this study by using stand-alone claims data are higher than the per-child cost estimates reported by the IOM committee on the basis of an analysis of linked birth certificate and administrative health care data.[5] The average medical cost for all preterm infants during the birth year in the IOM study was $29 041 in 2005 dollars, [5] which, adjusted for 2013 and 2014 medical prices, [22] is equivalent to $35 527. Applying the gestational age composition of 2013 births[1] to the stratified cost estimates in the IOM report[5] yields a birth year cost estimate for 2013 births of $37 868. Part of the difference between this latter figure and the lower-bound estimate of $47 099 per infant in the current study is due to the difference between expenditures by employer-sponsored plans and population-level costs. An even more important contribution, however, is the lower likelihood that preterm infants without complications are coded as preterm. Consequently, the average expenditure for all infants born preterm is presumably lower than the estimates reported here.

The limitations of administrative health care databases can be remedied through the use of record linkages with nonadministrative databases (including vital records and birth defects surveillance systems) to validate diagnoses.[27] Accurate estimates of per-child costs associated with preterm birth based on record linkage of administrative data with US vital records have been published.[2, 5] A linkage of databases in New South Wales, Australia, has also generated estimates of the impact of preterm birth on health care costs during infancy and the first 6 years of life.[24, 28] Similarly, linked databases have been used to assess health care use and costs for infants and young children with birth defects.[9]

Updated estimates of the preventable cost of prematurity could be used to project cost savings to health care payers and society from interventions that reduce the number of infants born preterm. Such estimates ideally should be specific to the outcomes of interventions. For example, suppose it were possible to delay threatened preterm labor by 1 week. How much would health care payers save for each infant whose gestational age was raised from 36 to 37 weeks? To answer that question, analyses of cost differences by single weeks of gestational age based on reliable obstetric estimates[1] are needed.[2] The present findings, which are limited to administrative data and billing codes, are too crude to be used for that purpose.

CONCLUSIONS

In the current study, we make 3 contributions. First, we provide conservative, lower-bound estimates of the financial impact of preterm birth on US employer-sponsored health plans. Second, we call attention to the synergistic interaction of preterm birth and major birth defects. Infants born with serious birth defects incur much higher costs if they are also born preterm. Third, we identify inherent limitations with the use of standalone administrative databases for research on prematurity and suggest an alternative research approach based on the exploitation of record linkages of administrative health care data with data containing validated estimates of gestational age.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations

DRG	diagnosis-related group
ESI	employer-sponsored insurance
ICD-9-CM	International Classification of Diseases, Ninth Revision, Clinical Modification
IOM	Institute of Medicine
LBW	low birth weight
RDS	respiratory distress syndrome

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What's Known on This Subject

Preterm infants often incur high medical costs. Lifetime medical costs for US infants born preterm in 2005 were $17 billion higher than for other infants. Birth defects were associated with $9 billion in hospital costs during infancy in 2013.

What This Study Adds

Employer-sponsored health plans in the United States paid at least $6 billion extra for infants born preterm during 2013, one-quarter of which was associated with the 6% of preterm infants who had major birth defects.

TABLE 1

Net and Total Plan Expenditures During First Year of Life, MarketScan Commercial Database (2013–2014)

	N	Expenditure Type	Mean, $	Median, $	Aggregate Net Expenditures, $	Percent of Total Expenditures
Excluding 790 DRG as inclusion criterion for cohort						
Preterm	13 426	Net	54 873	16 669	736 727 449	37.2
		Total	56 756	18 609		
		OOP	1883	1941		
Nonpreterm	160 223	Net	7774	4365	1 245 562 711	62.8
		Total	8735	5104		
		OOP	961	739		
Preterm minus nonpreterm	—	Net	47 099	12 304	—	—
		Total	48 021	13 506		
		OOP	922	1202		
All infants	173 649	Net	11 416	4524	1 982 290 162	100.0
		Total	12 448	5281		
		OOP	1032	757		
Including 790 DRG as inclusion criterion for cohort						
Preterm	17 795	Net	85 962	28 044	1 529 691 121	54.2
		Total	88 119	30 145		
		OOP	2158	2101		
Nonpreterm	162 992	Net	7942	4369	1 294 560 700	45.8
		Total	9296	5139		
		OOP	1354	770		
Preterm minus nonpreterm	—	Net	78 019	23 675	—	—
		Total	78 823	25 006		
		OOP	814	1331		
All infants	180 787	Net	15 961	4630	2 824 251 821	100.0
		Total	17 005	5402		
		OOP	1094	771		

Net plan expenditures are the direct reimbursements by health plans. Total plan expenditures are the total allowable payments including expected OOP payments. 790 DRG is “extreme immaturity or respiratory distress syndrome, neonate.” OOP, out of pocket; —, not applicable.

TABLE 2

Net Plan Expenditures During First Year of Life, Stratified by the Presence of Major Birth Defects, MarketScan Commercial Database (2013–2014) Primary Analysis Cohort (First Approach)

	N	Mean, $	Median, $	Aggregate, $	Percent of Total Expenditures
Preterm with MBD	893	226 840	73 738	202 568 433	10.2
Preterm without MBD	12 401	42 620	14 948	528 533 100	26.7
Net difference with MBD	—	184 220	58 790	—	—
Nonpreterm with MBD	3691	63 939	13 074	235 998 923	11.9
Nonpreterm without MBD	156 532	6450	4317	1 009 562 526	50.9
Net difference with MBD	—	57 489	8756	—	—
Net difference preterm versus term with MBD	—	162 910	60 664	—	—
Net difference preterm versus term without MBD	—	36 171	10 630	—	—

Net plan expenditures are the direct reimbursements to providers by plans, excluding payments by enrollees. MBD, major birth defects; —, not applicable.