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Health Insurance Expenditure of Premature Infants Hospitalized in the Neonatal Intensive Care Unit

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= Abstract =

신생아중환자실에 입원한 미숙아의 건강보험 비용

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목 적: 본 연구의 목적은 2007년 우리나라의 43개 종합전문요양기관의 신생아 중환자실에 입원한 미숙아(출생체중 2,500 g 미만 혹은 재태기간 37주 미만)의 건강보험급여 비용을 분석하기 위함이다.

방 법: 건강보험심사평가원에서 제공한 전국 43개 종합전문요양기관의 주상병 상병코드 p07 (단기임신과 저체중 출산과 관련된 장애)와 제 1부상병명에 따른 건강보험 청구건수와 이에 따른 건강보험급여와 입원기간 자료를 이용하여 신생아중환자실에 입원한 미숙아의 건강보험 급여의 비용을 출생체중, 재태기간, 그리고 미숙아 질환으로 분류하여 서술통계 분석하였다.

결 과: 2007년 43개 종합전문 요양기관에서 상병코드 p07로 청구된 총 보험급여 건수는 7,102건으로 약 314억의 건강보험급여가 지급되었다. 9.2%가 극단적 저체중 출산아(<999 g) 혹은 극단적 미숙아(<28주 재태기간)를 주상병으로 신청하였고, 약 74억원(총 건강보험급여의 23.6%)이 지급되었다. 평균 입원 기간은 극단적 저체중출산아의 경우 청구건수 당 40.5일, 극단적 미숙아의 경우 39.7일이었다. 평균 일일 입원비용은 극단적 미숙아가 295,000원으로 가장 높았고, 극단적 저체중아의 입원비용이 270,162원으로 두 번째로 높았다. 미숙아의 신생아중환자실 입원비용 중 건강보험급여로 지급된 청구건수당 비용이 1세미만 아동의 입원비용중 건강보험급여로 지급된 금액보다 10배 높았고 입원기간도 17일 더 길었다. 부상명중에서 가장 많이 보고된 미숙아의 질환으로는 호흡곤란증이었으며, 총 건강보험급여 중 27.3% (약 85억원)가 지급되었고, 평균 입원기간은 38일이었다.

결 론: 우리나라 1세미만 아동의 입원과 관련된 건강보험급여비 청구건수 중에서 미숙아와 관련된 건강보험급여비 청구건수는 1.3%에 해당함에도 불구하고 지급된 건강보험급여비는 전체 1세미만 아동 건강보험급여 지급액의 13.3%를 차지하였다. 이는 미숙아출생과 관련되어 지출되는 건강보험급여가 불균등하게 많으며 따라서 효과적인 건강보험비용을 절약하기 위해서는 미숙아 출생의 예방과 신생아중환자실에서의 조기퇴원 중재법이 개발되어야 할 것을 제안한다.

Key Words: premature infant, neonatal intensive care unit, health insurance expenditures

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Introduction

During the past two decades, there has been a dramatic increase in the survival rate of premature infants (<37 weeks gestational age), particularly very premature infants (<32 weeks) or very low birth weight (VLBW) infants (<1,500 g) in both Korea and the U.S. (Bae, 2002; Ananth et al., 2005). This dramatic increase is largely attributed to advanced life-support equipment in the neonatal intensive care unit (NICU) such as high frequency oscillatory ventilators and cardiopulmonary monitoring systems (Kim, 2002). Smaller infants, who are more dependent on life-support equipment for survival, remain longer in the NICU (Kim, 2002). With the use of high-technology devices and prolonged hospitalization in the NICU, medical costs associated with premature birth have been of significant public health concern.

In the U.S., about 12.7% of infants are born prematurely, although within this group there are substantial race/ethnic disparities (Martine et al., 2007). The rate of African American premature births in 2004 was 17.8% while that of Caucasian was 12% and Asians 10.4%. When infants are defined by birth weight, about 7.9% of all infants are born with a low birth weight (LBW) (<2,500 g). However, 13.5% of African American infants are born with LBW. According to the report of the Korea National Statistical Office, 9,258 (2.1%) infants (out of all 451,514 live births in 2007 in Korea) were born prior to 35 weeks gestational age (no data available on the number of infants born <37 weeks), and 14,187 (3.1%) infants were born with LBW. Compared to the rate of premature infant births in the U.S., a much smaller percentage of infants are born prematurely or with a LBW in Korea.

Prematurity, whether defined by gestational age or birth weight, is associated with significant neonatal hospital costs (Ringborg et al., 2006; Rogowski, 1999, Rogowski, 2003). In 2005, the U.S. spent $16.9 billion for medical care for premature infants ($33,200 per premature infant) (Behrman & Butler, 2006). A total $ 26.2 billion was spent for all health care service including medical treatment, early intervention, and special education ($51,600 per premature infant).

Costs by gestational ages and birth weights reported in detail that hospital costs for infants born at 25 weeks averaged $202,700, decreasing to $2,600 for infants born at 36 weeks and $1,100 for 38 weeks infants (Gilbert et al., 2003; Phibbs & Schmitt, 2006). Costs for infants born with birth weights of 500 700 g averaged $224,000, decreasing to $4,300 for infants with a birth weight of 2,250~2,500 g (Gilbert et al., 2003; Cuevas et al, 2005). Thus, costs of infant hospitalization decrease exponentially with advancing gestational age and increasing birth weight. In the U.S., 8% of all infant hospitalizations were associated with a diagnosis of preterm birth/LBW. However, costs for these infant hospitalizations totaled $5.8 billion which were 47% of the costs for all infant hospitalizations (Russell et al, 2007). Indeed, preterm/LBW infants are a high-cost population.

In addition to the initial high cost of infant

hospitalization in the NICU, premature birth continues to be associated with considerable long-term health care costs, including medical, developmental, and special educational costs (Petrou et al., 2003; Clements et al., 2007). During the first year of life, the mean hospital cost of an infant born at <28 weeks gestational age is estimated to be $22,798, while infants born at 28 31weeks gestational age $18,654. This relatively high cost of hospitalization of premature infants continues through the first 10 years of life as well (Petrou, 2005). To assess the economic impact of premature-birth health care, costs incurred after NICU discharge should be included.

In Korea, the current national health insurance system covers all medical fees for children under six years of age except several items that HIRA has not approved. Although hospital costs associated with premature birth are all paid by national health insurance, no data on health insurance hospital costs analyzed by premature infant's birth weight or gestational age are available in Korea. Information on the hospital costs paid by health insurance is important in assessing the impact of increasing premature infant births, the costs of providing appropriate treatment for these infants, and evaluating the cost-effectiveness of treatment. Thus, the purpose of this study is to estimate health insurance hospital costs of premature infants admitted in an NICU in Korea in 2007. The results of this study will provide a foundation for health policy and planning for a health care system budget associated with preterm infant birth.

Materials and Methods

1. Study design

A cross-sectional descriptive study was designed to estimate the hospital costs paid by national health insurance for premature infants hospitalized in 43 tertiary hospital NICUs in Korea during the period of January through December in 2007.

2. Source of Data

Data were obtained from the Health Insurance Review and Assessment Service (HIRA). The HIRA is responsible for conducting a review of medical fee claim submitted by health care providers (institutions) and evaluating the appropriateness of health care services provided to beneficiaries. The National Health Insurance Corporation (NHIC) then reimburses the medical care institutions based on the notice from HIRA about the review result.

A primary diagnosis of P07 (disorders related to short gestation and low birth weight) defined by the Korean Classification Disease (KCD) Code (version 2002) was used to retrieve data for the study. The P07 code includes most infants hospitalized with a birth weight of less than 2,499 g or born prior to 37 weeks' gestation (259 days). However, infants born with LBW due to slow fetal growth and fetal malnutrition (P05) were not included because those infants are likely to experience with different medical problems from that of typical premature infants do. The KCD P07 can

further be classified into subgroups: (1) P071, infants born with a birth weight of less than 999 g (extremely low birth weight (ELBW) infant), (2) P072, infants born with a birth weight between 1,000 and 2499 g (other low birth weight infant (LBW)), (3) P073, infants born prior to 28 weeks (<196 days) (extreme immature infant (EI)), and (4) P074, infants born between 28 and 37 weeks (196~259 days) (other preterm infants (PT)). The KCD guideline recommends using the infant's birth weight as a primary KCD code. However, only 33.4% of infants studied were diagnosed with their weights for the primary KCD code and 66.6% of infants were diagnosed with their gestational ages.

Data obtained are presented aggregated total hospital costs and length of stays (LOS) by both primary KCD codes (P01, P02, P03, and P074) and various secondary KCD codes including respiratory distress related codes, sepsis code and congenital anomaly code and so on. Neither identification nor individual information on diagnosis and hospital costs was available. Hospital costs paid by health insurance indicate the amount that the HIRA have determined to pay to the medical care institutions based on the medical fee claims.

Medical care institutions are categorized as tertiary hospitals, general hospitals, hospitals or clinics depending on their scales of operation and the number of beds. There are 43 tertiary hospitals, including national, public, and academic medical centers, inclusive of those that provide maternity and newborn intensive care services. A total 1,216 beds in 178 NICUs are available in Korea. Of these, 553 beds (45.5%) are provided by 43 tertiary hospitals.

3. Data analysis:

Descriptive statistics were used to calculate costs and LOS by four primary diagnosis (EBLW, LBW, EI, PT) for all infants. In addition, the costs of premature infants were compared with total hospital costs for infants (<1 year of age). Selected complications were also described by costs and LOS. All data management and statistical analyses were conducted using the SPSS 14.0 (Chicago, IL).

Results

1. Hospital Costs Paid by Health Insurance

In 2007, a total of 7,102 medical fee claims associated with premature infants was reviewed and 31.4 billion Korean won was determined to reimburse by HIRA. A total of 565,380 medical claims was reviewed in relation to infants' (<1 year of age) hospitalization in 2007, only 7,102 (1.3%) of claims were related to premature infants. A total of 236 billion won was reimbursed in response to claims for all infant hospitalization, however, 13.3% were associated with premature infant hospitalization. The mean hospital cost awarded per claim for premature infant was 4,415,000 won, compared with 416,000 won for all infant hospital costs which is as much as 10 times. The average days of LOS per claim for premature infant was 23.2 days, which was 4 times that of all infants, which was 6.3 days (Table 1).

When examined by four subgroups, both

ELBW and EI infants account for 9.2% of total claims and 7.4 billion (23.6%) was spent for those two groups of preterm infants. The EI infants (<28weeks) were most expensive with 11,710,000 won awarded per claim, indicating a costly hospitalization that may reflect a prolonged NICU hospital and an intense use of resources during hospitalization. The mean hospital cost per claim was lowest for PT infants (28~37weeks) as 3,495,000 won. Mean LOS per claim was longer for both ELBW infants (<999 g) and EI infants (<28 weeks) than other infants groups, as 40.5 and 39.7 days, respectively (Table 1).

2. Selected Complications of Premature Infants

Several common medical complications of premature infantsrespiratory distress syndrome (RDS), bronchopulmonary displasia (BPD), sepsis, intraventricular hemorrhage (IVH), congenital anomaly, jaundice, and maternal factorswere selected to compare their corresponding hospital costs to each other. Only 36.3 % of infants studied were diagnosed with one of the selected complications as a secondary diagnosis while 44.8% used P070~P073 as a secondary diagnosis. For example, an infant was diagnosed with his birth weight code for a primary diagnosis, and then, again diagnosed with gestational age code as a secondary diagnosis and vice versa. Thus, 2,574 (36.3%) medical fee claims were analyzed to estimate hospital costs by selected neonatal complications.

RDS (34.0%) was the most commonly assigned secondary diagnosis for premature infants, and jaundice (27.7%) was second. BPD (1.2%) and IVH (0.5%) were not often diagnosed for premature infants. Sepsis was a

Table 1. Distribution of Health Insurance Hospital Costs by Primary Diagnosis

Classification	Medical Fee Claim	Hospital costs (in thousands won)		LOS (days)		Mean cost per day (won)
	n (%)	sum (%)	mean per claim	sum (%)	mean per claim	
ELBW (<999 g)	373 (5.3%)	4,086,193 (13.0%)	10,954	15,125 (9.2%)	40.5	270,162
LBW (1,000~2,499 g)	1,995 (28.1%)	8,406,158 (26.8%)	4,214	47,326 (28.8%)	23.7	177,622
EI (<28 weeks)	282 (3.9%)	3,302,440 (10.5%)	11,710	11,194 (6.8%)	39.7	295,188
PT (28~37 weeks)	4,452 (62.7%)	15,561,378 (49.6%)	3,495	90,770 (55.2%)	20.4	171,437
All premature infant	7,102 (100%)	31,356,169 (100%)	4,415	164,415 (100%)	23.2	190,714
All infants (<1 year of age)	565,380	235,646,915	416	3,569,350	6.3	66,020

Abbreviations : ELBW, extremely low birth weight; LBW, low birth weight; EI, extremely immaturity; PT, premature infant; LOS, length of stay

secondary diagnosis for 13.9% of premature infants assigned with selected complications, and maternal factors, such as premature rupture of membrane and hypertension, were secondary diagnosis for 15.4% (Table 2).

The mean cost per claim was highest for infants with BPD (13,939,000 won), followed by infants with RDS (9,775,000 won). Interestingly, the mean cost per claim for ELBW infants with sepsis (13,012,000 won) was as high as that for infants diagnosed with RDS (13,119,000 won). Although a small number of infants was diagnosed with BPD, EI infants with BPD cost 30,951,000 won per claim, the highest cost per claim among all complications (Table 2).

Among neonatal complications selected, average LOS of infant was longest for infants with BPD (59.4 days), and followed by those with RDS (38.0 days) and those with sepsis (37.8 days). Mean cost per day was highest for infants with RDS (252,000 won), while the lowest cost per day was for infants with jaundice (112,000won) (Table 3).

Discussion

This is the first study that uses nationally representative data to provide estimates of costs paid by health insurance for medical treatment during initial NICU hospitalization for prematurely born infants. The study quantifies the vastly disproportionate health insurance hospital costs that are associated with infants born prematurely or LBW: 13.3% of all infant (<1 year of age) hospitalization costs are spent for 1.3% medical fee claims related to premature infants initial hospitalization. Mean hospital costs for premature/LBW were 10 times higher compared with those for all infants, and were 17 days longer compared to average hospitalizations for all infants. Marked disparate ex-

Table 2. Total Number of Claims and Mean Costs per Claim for Selected Complications

(cost in thousand won)

Complication	ELBW		LBW		EI		PT		Total	
	claim	cost per claim	claim	cost per claim	claim	cost per claim	claim	cost per claim	claim n (%)	cost per claim
RDS	69	13,119	137	7,388	77	12,667	593	5,929	876 (34.0)	9,775
BPD	10	9,562	8	10,517	3	30,951	10	4,729	31 (1.2)	13,939
Sepsis	20	13,012	29	3,976	1	10,120	308	2,754	358 (13.9)	6,581
IVH	1	4,480	10	3,699	1	7,215	39	3,907	13 (0.5)	3,803
Congenital anomaly	9	9,335	34	2,818	1	7,939	144	2,781	188 (7.30)	4,978
Jaundice	1	12,660	140	1,638	-	-	571	1,450	712 (27.7)	1,544
Maternal factor	4	8,316	62	3,031	4	12,450	326	1,755	396 (15.4)	6,388

Abbreviations : RDS, respiratory distress syndrome; BPD, bronchopulmonary displasia; IVH, intraventricular hemorrhage

Table 3. Mean LOS and Mean Costs per Day for Selected Complications

(cost in thousand won and LOS in days)

Complication	ELBW		LBW		EI		PT		Total	
	LOS	cost per day	LOS	cost per day	LOS	cost per day	LOS	cost per day	LOS	cost per day
RDS	46.9	280	34.5	214	43.9	289	26.8	224	38.0	252
BPD	50.2	191	43.5	244	111.0	278	32.8	144	59.4	214
Sepsis	54.3	240	24.2	165	52.0	195	20.6	134	37.8	184
IVH	10.0	448	23.0	161	31.0	233	23.2	168	21.8	187
Congenital anomaly	36.0	259	16.7	170	50.0	159	18.8	149	23.8	184
Jaundice	67.0	189	14.5	113	-	-	13.0	111	13.8	112
Maternal factor	38.3	217	21.3	142	45.3	275	16.3	108	30.3	186

Abbreviations : LOS, length of stays; RDS, respiratory distress syndrome; BPD, bronchopulmonary dysplasia; IVH, intraventricular hemorrhage

penses for premature/LBW infants are attributed to intensive care and treatment for acute and chronic conditions in the NICU (Kim, 2002). As expected, respiratory complications were the most prevalent and costly diagnosis for premature/LBW infants. The cost for RDS and BPD complications accounted for 28.7% of the total hospital costs spent for premature/LBW infants. The result may suggest that treatments of respiratory problems should be focused to save efficiently premature infant related hospital costs.

Although hospitalization for infants <28 weeks or <999 g accounted for only 9.2% of all premature/LBW infant hospitalization, these infants accounted for approximately one quarter (23.6%) of total preterm infant hospitalization costs in 2007. Mean hospital costs for these groups of infants were three times as much as those for premature/LBW infants. It is important to note that relatively high hospital costs for very small premature infant demonstrate the public health impact of these infants. Since the rate of premature infant birth and the rate of survival of very small premature infants has been steadily increasing in Korea over the past several years, premature infant hospital costs are expected to continue to increase in the future (Bae, 2002). An increased costs incurred during premature infant hospitalization can be a financial burden to the national health care budget and may result in an increased health insurance fees in a society. The results of this study might assist health policy planners and health care providers in their attempts to project future health care avenues for costs containment.

The results of this study provide only the costs incurred during initial NICU hospitalizations for premature/LBW infants in Korea. However, to assess the economic impact of premature infant birth, the long-term cost for

rehospitalization of premature/LBW infants after NICU discharge and in-direct cost should all be considered. The high rates of rehospitalizaiton of premature infants, high utilization rates of follow-up clinics for neurodevelopmental problems, and medications should be added when calculating health costs related premature infant birth (Clements et al, 2007). In addition, indirect costs, uncovered costs related to the birth of a premature infant can also be calculated for travel time, parking, meals, employment status (time off), child care for siblings.

A future study is warranted to investigate the indirect costs related to premature infant birth along with direct hospital costs to better understand the economical impact of premature birth on the family and society. A longer LOS in the NICU was reported in smaller/younger infants and was consequently related to increased hospital costs. This information further emphasizes that an intervention to reduce hospital stay of those infants needs to be developed and implemented in clinical settings. The costs data spent for sepsis complications associated with premature birth may provide an insight into investigating preventive intervention for sepsis, so that significant hospital costs can be efficiently saved.

This study has several limitations. First, since data for this study were obtained from only 43 tertiary hospitals (42.6% out of the total number of NICU beds available in Korea), they may not reflect the precise costs of all premature infants born in Korea in 2007. Since infants who expired during hospitalization were not excluded in the study (information of expiration was not available), the estimate of hospital costs could be inaccurate. Because the dataset did not include accurate individual infant's birth weight nor gestational ages the hospital costs could not be graduated more detail. Data on birth statistics reported by the Korea National Statistical Office also provide information by certain intervals of gestational age, for example, the total birth of infants born between 36 weeks and 39 weeks. The number of premature infant born at 37 weeks gestational age cannot accurately be estimated.

Conclusions

The study results present a national estimate of health insurance hospital costs associated with premature infant care in Korean NICUs. Hospital cost associated with premature infants composes a substantial portion of the cost of hospital care for all infant hospitalizations. As the rate of premature infant birth is increasing and smaller and younger infants will continue to survive, the economic impact of premature birth will be likely to increase in the future. The results of this study might provide valuable cost information to health policy planners and hospitals as a reference for dealing with prematurity.

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