Original Article

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The Cost Analysis of Preterm Infants from a NICU of a State Hospital in Istanbul

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Abstract

Objective: The objective of this study was assessment of hospital costs of 211 preterm babies admitted to NICU in a 12-month period.

Methods: Preterm babies with gestational age 28-37 GW hospitalized in Dr. L. Kırdar Kartal Research and Training Hospital NICU between November 1st, 2006 to October 31st, 2007 were included in this retrospective study. The financial records of the babies were plotted and investigational, interventional, consumable costs, drugs and ancillary costs were determined. The average daily cost of a preterm has been determined. Group I and II consisted of babies with gestational ages 37-33 GW and 32-28 GWs respectively. The length of stay, ventilation duration and costs of each group were compared.

Findings: The mean birth weight was 1689±497 gr. The mean length of hospital stay was 13.6±13.4 days. Hundred and four (49,5%) patients were found to be ventilated. The median ventilation day was 3 days. We found a statistically significant relation between length of hospital stay, ventilation duration, presence of intervention, RDS, sepsis and hospital costs. The mean total hospitalization cost and the daily cost of a preterm was determined as $4187 and $303 respectively. The highest intensive care costs of preterm neonates were found to be paid for interventional procedures, followed by NICU personnel salary and ancillary costs. Between two groups statistically significant difference was found for length of stay, duration of ventilation, interventional and consumable costs (*P*=0.014, *P*=0.019, *P*=0,001, *P*=0.03 respectively).

Conclusion: Strategies for prevention of prematurity and early weaning from mechanical ventilation may shorten length of hospital stay leading to decreased NICU costs.

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Key Words: NICU; Hospital Costs; Cost Analysis; Preterm Infant

Introduction

With the recent advances in neonatal intensive care, the chance of survival of very low birth weight (VLBW) infants have increased. This improvement in life expectancy of preterm neonates is nevertheless accompanied by increased length of stay in hospital leading to increased hospitalization costs. The intensive care costs constitute a large portion of whole hospital budgets worldwide [1-3]. Neonatal intensive care for VLBW infants is considered among the most costly hospital admissions. Accounting for about 10% of total pediatric expenses, intensive care of

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VLBW infants is regarded as one of the most expansive components of pediatric health care[2,4].

Because of the continued increasing demand and resource consumption, the organization of neonatal intensive care units (NICU) deserve much attention everyday. In an era of financial scrutiny and growing demands for limited healthcare resources especially in developing countries, hospital cost analysis would help to develop new strategies for reduction of expenses and facilitate optimum provision of health services[4,5]. A few studies have evaluated the cost analysis of neonatal intensive care in Turkey. Due to the paucity of literature data on the subject in our region, this retrospective study was undertaken. The objective of this study was assessment of hospital costs of 211 preterm babies admitted to NICU in a 12 month-period.

Subjects and Methods

This retrospective, study was carried out at Dr. Lütfi Kırdar Kartal Research and Training Hospital, one of the largest tertiary care referral state hospitals on the Asian side of Istanbul, with a NICU of 25 beds. Seven beds are equipped with non-invasive monitorization devices and mechanical ventilation. Two hundred and eleven preterm babies with gestational age of 28-37 gestational weeks (GW) hospitalized in NICU between November 1st, 2006 to October 31st, 2007 were included in the study. All eligible neonates from the nursery, with gestational ages of 28-37 GWs who were admitted to NICU during the study period were included. The outpatient born preterms and neonates with cardiac or surgical disorders who had to be operated or hospitalized in another department were excluded.

The study was approved by the Research Ethics Committee. By retrospective evaluation of medical records, demographic and clinical features were recorded. The financial records of the hospital from computerized system were plotted and investigational, interventional, consumable costs, drugs and ancillary costs were determined. By evaluation of the whole data, the average daily cost of a preterm has been determined. The entire costs of invasive procedures applied to the baby, oxygen treatment and mechanical ventilation, intravenous and nutritional therapies; whole medical equipment used for the interventions; laboratory tests and other investigational imaging techniques; incubator therapy and intensive care were defined under headings as interventional, consumable, investigational and ancillary costs respectively.

The establishment cost of the NICU like electricity, water supply, heating, sterilization, telephone and other services were determined by dividing the number of NICU beds to total hospital beds and multiplied by the total hospital expenses. The babies were grouped into 2 as: Group I with gestational age 37-33 GW and Group II with gestational age 32-28 GWs. The costs of each group were compared.

Statistical calculations were performed with SPSS 13.0 statistics program for Windows. Besides standard descriptive statistical calculations (frequencies, mean and standard deviation), one way ANOVA was used in the comparison of groups, and Chi square test was performed during the evaluation of qualitative data. Statistical significance level was established at $P<0,05$.

Findings

Of the 211 preterm babies, 115 (54.5%) preterms with 37-33 GWs and 96 (45.5%) with 32-28 GWs were included in the study. The mean birth weight was found to be 1689±497 gr. The mean length of hospital stay was 13.6±13.4 days. Hundred and four patients were found to be ventilated totally 435 days. The median ventilation duration was 3 days (Table 1). Regarding whole group of preterms included, we found a statistically significant relation between length of hospital stay, ventilation duration, presence of inter-vention, RDS, sepsis and hospital costs (Table 2).

The annual cost for the whole preterms were found to be 1 076 150 Turkish Liras (TL) (=883 535 US$). The mean total hospitalization cost of

Table 1: The characteristics of preterm babies included in the study

Characteristics		Number of patients (n): 211
Gestational age (weeks)	**37-33**	n=115 (54.5%)
	32-28 GW	n=96 (45.5%)
Female/male ratio		0.97
Average (SD) birth weight (g)		1689 (497)
RDS		70 (33.2%)
Surfactant treatment		57 (27%)
Ventilation support		104 (49.5%)
Median ventilation time (min-max)		3 days (1-57)
Median length of hospital stay (min-max)		9 days (1-80)
Total ventilation days		435

SD: Standard Deviation

a preterm was determined as TL 5 099.00 ($4187). The daily cost of a preterm was found to be TL 369.00 ($303). The highest cost of intensive care of preterm neonates was found to be paid for interventional procedues followed by NICU personnel salary and ancillary costs (Table 3). The characteristics of the neonates in Group I and II are presented in Table 4. Between the two groups, statistically significant difference was found for length of stay, duration of ventilation, interventional and consumable costs (*P*=0.014, *P*=0.019, *P*=0,001, *P*=0.03 respectively) (Table 4).

Discussion

Due to recent technological and pharmacological advances in perinatal and neonatal care, the neonatal and perinatal mortality has dramatically decreased. Although such advances have improved life expectancy of very premature babies, unfortunately they have come at a high financial cost[6,7]. Factors like limited healthcare sources, widespread poverty and lack of medical insurance pose further problems in developing countries[8]. The estimation of costs of neonatal intensive care and the costs of a single patient may help organize the sources for optimal NICU organization. In this study our objective was to determine the hospital costs of preterms hospitalized in NICU.

When we compare our results of intensive care cost per preterm of $4187 and daily cost per preterm of $303 to those of the international literature, differences and similarities have been observed. In the study of Kırkby S et al[9], in which the intensive care costs of 32-34 GW preterms were evaluated, the mean cost of a preterm was found to be $31 000; whereas Narang et al[6] from India found a mean cost of $5438 for babies less than 1000g. In the study of Akman et al[7] from Turkey, evaluating the effects of perinatal factors on the duration and cost of hospitalization for preterm infants, the mean cost per preterm hospitalized in NICU was found to be $4345. This wide range of NICU costs may be explained by many factors. Firstly, the studies were conducted in different years and geographical regions with different inflation rates. Secondly different charging of personnel salary, consumables and the

Table 2: Analysis of factors in relation to total hospital costs among all preterms included

Vriables		*P*- value
Length of stay (days, median)	9	0.001
Ventilation duration (days, median)	3	0.001
Intervention [n (%)]	101 (47.8)	0.003
RDS [n (%)]	70 (33.2)	0.002
Sepsis [n (%)]	35 (16.6)	0.001

Table 3: The distribution of neonatal intensive care costs

Type of intensive care cost	Amount (US Dollars) (%)
Establisment cost of NICU	
Annual NICU expanses (for preterms)	473 955 US$
Running costs of NICU	409 580
Interventional costs	128 408 (31.4)
Personnel salary	85 182(20.8)
Ancillary costs	82 382 (20.1)
Consumable costs	39 795 (9.7)
Drugs	38 180 (9.3)
Laboratory/investigational costs	35 633 (8.7)

other expenses may be another explanation for this discrepancy. Drug and consumable costs may differ among NICUs depending on many factors like birthweight, disease severity and NICU treatment policies [10].

In pevious studies mean cost of a baby in NICU was reported to be inversely related to the week of gestation and birth weight[11,12]. In the study of Powel et al[13], gestational age, respiratory difficulty, birth weight, infections and metabolic problems were found to be predictive factors of time of hospital discharge. Navarrate et al[14] reported that infected children in intensive care units had an excess of hospital stay of 9.6 days justifying the introduction of infection control programs. In our study, supporting these literature data, we found a statistically significant relation between length of stay, ventilation duration, presence of intervention, RDS, sepsis and neonatal intensive care cost. These findings obviously show that in order to lower the costs of neonatal intensive care, prevention of extreme prematurity is essential and conducting new strategies for early termination of mechanical ventilation and for infection control should be the major goals.

Geitona M et al[3] from Greece reported that personnel costs accounted for 59.9% of all resources consumed, followed by enteral/parenteral feeding (16.14%) and pharmaceutical expenses (11.1%). In the study of Narang et al[6] personnel salary constituted 55% of NICU costs. The personnel salary costs have been reported to range between 45-70% of the total costs in other studies[15]. The highest component of cost of NICU in our study was found to be composed of interventional costs followed by personnel salary and ancillary costs.

Many studies have reported that NICU costs are closely related to gestational age, severity of illness and the need for mechanical ventilation. Similar to these findings we found a statistically significant difference regarding length of stay, ventilation duration, interventional and consumable costs between the two groups with gestational ages of 33-37 GW and 28-32 GW respectively. Narang A et al reported that while the mean cost for a baby with a birth weight

Table 4: Comparison of characteristic data of Group I and II

Varaible	Group I n=115	Group II n=96	*P*-value
Female/male ratio	59/56	46/50	
Birth weight (gr) [Mean (SD)]	1955 (124)	1370 (279)	
RDS [n (%)]	14 (12.1)	56 (58.3)	0.01
Sepsis [n (%)]	15 (13.04)	20 (20.8)	0.03
Length of stay (days)	12.04	15.58	0.014
Ventilation duration (days)	1.11	3.34	0.019
Intervention [n (%)]	29 (25.2)	72 (75)	0.05
Interventional cost (US$)	423	1022	0.001
Consumable cost (US$)	162	479	0.004
Total cost (US dollars)	1525	2575	0.3

<1000g was $3866, the cost increased to $5483 if the baby was ventilated. They found that mechanical ventilation in babies <1000g increased NICU costs by 1.6 [6]. The finding that RDS was more often encountered among our babies with lower gestational ages leading to increased ventilation duration and length of hospital stay which eventually caused higher interventional and consumable costs was not surprising.

In the study of Geitona M et al [3] from Greece, regarding the reimbursement of hospital costs of neonates, it was reported that underpayment by social security funds was evident except for SGA and VLBW newborns. A study from India showed that the cost of NICU care to the family was nearly one fourth of the actual running cost to the unit[6]. In contrast with literature, we found that the costs of preterms with public health insurance were entirely paid by the government. In a developing country like ours, with annual birth rate of nearly 1.4 million, the total reimbursement of neonatal intensive care costs of the people with public health insurance by the government is an important public health issue.

Although the results of this study may form the basis for the implementation of new strategies for cost reduction in NICUs in Turkey, it has some limitations. First of all, the results represent the data of the local population of preterm babies hospitalized in our hospital's NICU and may not reflect the whole population. Secondly inclusion of extremely premature babies would give a more precise data about the costs of preterm newborns. Since the study was retrospectively designed, the cost of medical errors was not taken into consideration which would probably affect the actual hospitalization cost.

Conclusion

Neonatal intensive care is expensive. Regionalization of perinatal health care and prevention of prematurity and RDS are among the most effective means of decreasing NICU costs. Additional strategies like optimum use of antenatal steroids, prevention of asphyxia and sepsis, implementing less aggressive, gentle ventilation techniques with early weaning strategies from mechanical ventilation may further decrease the need for mechanical ventilation and shorten length of hospital stay leading to decreased NICU costs.

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Conflict of Interest: None

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