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# MEDICAL COST AND OUT-OF-POCKET EXPENDITURE FOR PRETERM INFANTS: EVIDENCE FROM VIETNAM

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**Abstract.** Preterm birth is a leading cause of death in children under 5 years in low and middle income countries, and a major determinant of neonatal mortality and morbidity globally. The aim of this study was to assess the total cost of preterm infant treatment, as well as the financial contribution made by families in provincial and national hospitals. Cross-sectional medical and financial data were collected in one purposely chosen provincial, as well as in one purposely chosen national hospital. Cost data for all infants discharged from the two hospitals in 2017 were collected and analyzed. Average total medical cost per child was USD 1,643.52 in the national hospital and USD 668.94 in the provincial hospital. Mean medical out-of-pocket expenditure was USD 60 at the national hospital. No medical out of pocket expenditure was reported at the provincial hospital when parents complied with national health insurance policies. Substantial financial penalties were found for bypassing lower level facilities. Parents seeking care at specialized hospitals without medical authorization paid on average an additional USD 240, which corresponds to 111% of the average monthly wage in Vietnam.

**Keywords:** preterm infants, medical costs, out-of-pocket expenditure, Vietnam

## INTRODUCTION

According to World Health Organization (WHO), 15 million infants are born prematurely worldwide every year (WHO, 2018). Preterm birth, which is defined as childbirth occurring at less than 37 completed weeks of gestation, is a leading cause of death in children under 5 years in low and middle income coun-

tries, and a major determinant of neonatal mortality and morbidity globally (WHO, 2018). Children born prematurely have higher rates of cerebral palsy, sensory deficits, learning disabilities and respiratory illnesses compared with children born at term (WHO, 2018). The morbidities associated with preterm birth often extend to later life, resulting in considerable physical, psychological, economic and social costs (WHO, 2018).

There is a large literature dedicated to understanding the health costs associated with preterm births in high income settings. A systematic review of US data suggested an average cost of USD 203k for preterm infants born at 25 weeks of

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gestation, and costs between USD 70k and 100k for gestational ages <28 weeks (Zupancic, 2007). Evidence from the UK suggests that, compared to the full-term group, extreme preterm infants generated an additional societal cost of GBP 5,658 over a 12-month follow-up period (Petrou *et al*, 2006). Health service costs for preterm infants generally decrease with gestational age and birth weight, but this also depends on length of stay at health facilities as well as on the number of surgical procedures and respiratory treatments received by the infant (Petrou, 2003; Ringborg *et al*, 2006; Clements *et al*, 2007; Soilly *et al*, 2014).

Only few studies relating to preterm births in Vietnam have been published. A prospective cohort study of 1,709 women revealed that physically demanding work during pregnancy as well as intrauterine device removal less than 12 months before the current pregnancy were primary risk factors for a preterm birth (Younger *et al*, 1997). A cross-sectional study from Dong Anh District in 2014-2015 also found that antenatal depression, employment in the agricultural sector and domestic violence were associated with an increased risk of preterm birth (Toan *et al*, 2015).

From a health system perspective, Vietnam is an interesting setting to study the cost of preterm births. Even though all clinical expenditure incurred by preterm infants should be covered by the national health insurance in principle, this is not always the case in practice for two reasons: Firstly, health insurance will only cover 100% of the clinical cost at higher-level facilities where most premature babies are treated, if the child is referred to these tertiary hospitals by lower-level facility staff. Secondly, out-of-pocket payments may also arise when hospitals (specifically specialized hospitals) administer drugs or

provide services which are not covered by the national health insurance. To assess the total cost of preterm infant treatment, as well as the financial contribution made by families in provincial and national hospitals, we worked together with both a provincial and a national hospital in Vietnam in 2017, and extracted all medical and financial records for preterm infants treated during this period.

## MATERIALS AND METHODS

### Study design

This is a retrospective study that used secondary medical and financial data extracted from Vietnam National Children's Hospital and Thanh Hoa Provincial Pediatric Hospital.

### Health system settings

Under Vietnamese health insurance law enacted in 2008, all children under six years of age are automatically covered by national health insurance. In principle, this insurance covers all costs associated with premature births as long as parents seek treatment at their assigned facilities, and do not seek specialized (hospital) treatment without obtaining prior approval and referral from a basic health facility.

If a child is born prematurely, it is usually transferred from the delivery room to the pediatric ward for intensive care right after birth. Depending on the child health status, children may, upon consultation with the parents, be transferred to specialized hospitals. In such circumstances, preterm infants born in a community health center or district hospital are typically transferred to the provincial pediatric hospital. From a provincial pediatric hospital, children with several severe health conditions may be referred to the National Children's Hospital.

### Study setting

Two hospitals were purposively sampled for this study: Vietnam National Children's Hospital and Thanh Hoa Pediatric Hospital. Thanh Hoa Pediatric Hospital is the only public provincial pediatric hospital in Thanh Hoa Province. Vietnam National Children's Hospital is a national hospital (the first level) located in Hanoi City. It is a primary referral hospital for all 38 provinces of northern Vietnam, as well as a center for research, teaching, and postgraduate training regarding newborn diseases.

### Participants

A preterm child in this study was defined as an infant born alive before 37 weeks of gestation. We defined our target population as all infants discharged from the two hospitals between 1 January and 31 December 2017.

### Sample size and sampling method

The records for all preterm infants ( $n=261$ ) discharged from the Neonatal Care Unit of Thanh Hoa Pediatric Hospital in 2017 were selected. Due to the large number of cases, a random sample of infants ( $n=500$ ) was selected from all those discharged from the Neonatal Care Unit at the National Children's Hospital ( $n=800$ ) during 2017. This  $n=500$  target was chosen in order to be able to detect a mean difference in total cost between the two hospitals of at least 25% of the standard deviation of individual total costs with 90% power.

### Variables

**Outcome variables.** The primary outcome variable was the total numerical medical cost which were defined as the total amount invoiced by a hospital after the child was discharged from the hospital. The total direct medical cost was then divided into cost paid by national health

insurance and the out-of-pocket cost paid by parents. All cost data were extracted from the hospital records and converted to USD using an exchange rate of 1 USD=23.245 Vietnamese Dong (VND) (as of November, 2018).

**Covariates.** Social-demographic and clinical characteristics of premature infants were extracted from the hospital records including gender, ethnicity, place of residence, length of stay, weight at birth, gestational age, place of referral, transfer type, and referral type.

### Statistical analysis

Firstly, detailed statistics on total direct medical cost as well as costs per service category were generated. Secondly, we estimated the relative cost of being referred to a national rather than a provincial hospital for treatment using a series of linear regression models. The main independent variable of interest was a dichotomous variable for the child being treated at the national hospital, using the provincial hospital as a reference. In the adjusted model, we included the following covariates to account for potential differences in medical need: gender, ethnicity, place of residence, weight, and length of stay. Thirdly, we further divided the sample into four types of basic health system trajectories. Following this, we first estimate unadjusted associations with cost (mean cost differences), and then estimated how large the cost differences were adjusting on observable child characteristics. We used robust variance estimates to adjust for heteroskedasticity of residuals in the linear regression models.

We also looked directly at the relationship between transfer type and out-of-pocket expenditure in different referral groups. A transfer was considered as a proper transfer to a higher-level hospital

if the child had referral documents from a local registered facility or was admitted to the hospital as an emergency case.

All analyses were performed using the STATA statistical software package (Release 14; StataCorp, College Station, TX).

### Ethical considerations

The study was approved by the ethics committee of Vietnam National Children's Hospital (Approval Number: 166/BVNTW-VNCSKTE).

## RESULTS

After the data were cleaned, the final sample included 482 infants from the national hospital and 261 infants from the provincial hospital. Table 1 summarizes the main characteristics of study participants. Fifty-five point three percent of preterm infants were male in the Thanh Hoa Pediatric Hospital and 67% in Vietnam National Children's hospital. Most children belonged to the Kinh ethnic group and resided in rural areas. Gestational age at birth were relatively similar in the two hospitals, with about 55% of preterm infants born between week 32 and week 37, and less than 10% of infants were born prior to 28 weeks of gestation. No infant deaths were reported in the Thanh Hoa Pediatric Hospital; 9.8% of infants died in Vietnam National Children's Hospital. With regard to the length of stay in both hospitals, the majority of preterm infants were admitted for less than 14 days of treatment (75.5% in Thanh Hoa Pediatric Hospital and 46.7% in Vietnam National Children's Hospital). Most mothers were in the 20-34 year-old age group (81.6% in Thanh Hoa Pediatric Hospital and 82.8% in Vietnam National Children's Hospital).

Table 2 shows mean values and the proportions for the main cost categories

of the two hospitals. Average medical cost was about two and half times higher in the national than in the provincial hospital. In the national hospital, bed-days accounted for the largest share of the total cost while in provincial hospital the largest expense was the cost of drugs. The largest relative difference in cost was observed for medical supplies, which were almost 9 times more costly in the national than in the provincial hospital.

Table 3 shows a first set of regression results for total and out-of-pocket costs. After controlling for the child covariates displayed in Table 1, the estimated difference declined to USD 471.1 (95% CI: USD 322.1, 620.1;  $p < 0.001$ ). The primary cost-factor differing between the two hospitals was the average duration of stay (as already seen in Table 1), which accounted for about 50% of the drop between unadjusted and adjusted differences.

Columns 3 and 4 show differences for out-of-pocket expenditures. Rather remarkably, no (zero) out-of-pocket expenditure was reported for the provincial hospital. When we adjusted for child differences, this difference lowered to USD 48.8 (95% CI: USD 41.8, 55.7;  $p < 0.001$ ). Ethnicity, remoteness and length of stay had a significant impact on out-of-pocket costs. The Kinh ethnic group was also associated with an average out-of-pocket expenditure increase of USD 12.9 (95% CI: 21, 4.9;  $p < 0.05$ ). Residing in a rural area was associated with an increase of USD 13.3 (95% CI: 3.8, 22.8;  $p < 0.05$ ) compared to urban areas. Stays of more than 30 days were on average associated with an out-of-pocket expenditure increase of USD 82.7 (95% CI: 66, 99.3;  $p < 0.05$ ) compared to stays of less than 14 days.

Table 4 shows regression results for total costs and out-of-pocket costs by re-

Table 1  
Sociaodemographic and clinical characteristics of study participants.

Characteristics	Total	Thanh Hoa	National
		Pediatric Hospital N=261	Children's Hospital N=482
		<i>n</i> %	<i>n</i> %
Gender			
Male	462	139 (53.3)	323 (67)
Female	281	122 (46.7)	159 (33)
Ethnicity			
Kinh	674	230 (88.1)	444 (92.1)
Others	69	31 (11.9)	38 (7.9)
Place of residence			
Urban	163	40 (15.3)	123 (25.5)
Rural	580	221 (84.7)	359 (74.5)
Gestational age			
32-37 weeks	410	147 (56.3)	263 (54.6)
28-31 weeks	272	90 (34.5)	182 (37.8)
<28 weeks	61	24 (9.2)	37 (7.6)
Weight at birth			
≥2,500g	61	12 (4.6)	49 (10.2)
2,499-1,500g	422	166 (63.6)	256 (53.1)
1,000-1,499g	202	63 (24.1)	139 (28.8)
<1,000g	58	20 (7.7)	38 (7.9)
Death			
No	696	261 (100)	435 (90.2)
Yes	47	0 (0)	47 (9.8)
Length of stay			
<14 days	422	197 (75.5)	225 (46.7)
15-29 days	193	52 (19.9)	141 (29.2)
>30 days	128	12 (4.6)	116 (24.1)
Referral type			
From home to Thanh Hoa Pediatric Hospital	45	45 (17.2)	0 (0)
From health facility to Thanh Hoa Pediatric Hospital	216	216 (82.8)	0 (0)
From home to National Children's Hospital	42	0 (0)	42 (8.7)
From health facility to National Children's Hospital	440	0 (0)	440 (91.3)
Transfer type			
Proper	732	261 (100)	471 (97.7)
Improper	11	0 (0)	11 (2.3)
Mother's age			
<20 years old	53	25 (9.6)	28 (5.8)
20-34 years old	612	213 (81.6)	399 (82.8)
>35 years old	78	23 (8.8)	55 (11.4)

Table 2  
Medical direct costs in two hospitals (USD).

Type of costs	Thanh Hoa Pediatric Hospital. N=261, mean (%)	Vietnam National Children's Hospital. N=482, mean (%)
Total cost	668.9	1,643.5
Cost of bed-days	159.1 (23.8%)	515.1 (31.4%)
Cost of laboratory tests	94.1 (14.1%)	201.1 (12.2%)
Cost of surgery	119.4 (17.9%)	403.9 (24.6%)
Cost of medical supplies	18.9 (2.8%)	158.4 (9.6%)
Cost of drugs	249.9 (37.3%)	328.4 (20%)
Other costs	27.59 (4.1%)	36.64 (2.2%)

ferral group. Column 2 of Table 4 shows that the average total cost per infant transferred from a health facility to Thanh Hoa Pediatric Hospital was USD 262.5 (95% CI: 0.8-524.1;  $p < 0.05$ ) higher than those infants coming from home to Thanh Hoa Pediatric Hospital. The average total cost per infant seeking care directly from home to Vietnam National Children's Hospital, and those transferred from health facilities increased by USD 561 (95% CI: 61, 1061;  $p < 0.005$ ) and USD 1,252 (95% CI: 971.6, 1,532.4;  $p < 0.001$ ), respectively, compared to those coming from home to Thanh Hoa Pediatric Hospital.

After controlling for child characteristics, the total costs of infants transferred from a health facility to Vietnam National Children's Hospital were still the highest and generated an adjusted difference of USD 662 (95% CI: 455.1, 868.8;  $p < 0.001$ ) in comparison with infants seeking care from home at Thanh Hoa Pediatric Hospital. The adjusted differences for the group of infants coming from home to Vietnam National Children's Hospital and infants

transferred from health facilities to Thanh Hoa Pediatric Hospital were USD 376 (95% CI: 36.1, 716;  $p < 0.005$ ), and USD 198.4 (95% CI: 6.6, 390.3;  $p < 0.05$ ), respectively.

Results from the regression models for out-of-pocket costs are presented in Columns 3 and 4 of Table 4. Adjusting for other covariates, families of preterm infants coming from home to Vietnam National Children's Hospital paid an average of USD 75.1 as out-of-pocket costs (95% CI: 41.5, 108.7;  $p < 0.005$ ) and families with babies referred from a health facility to Vietnam National Children's Hospital paid an average of USD 47.2 in out-of-pocket expenditure (95% CI: 37.8, 56.6;  $p < 0.001$ ) more than families of infants seeking care directly from home to Thanh Hoa Pediatric Hospital.

Ethnicity, place of residence, and length of stay displayed statistically significant associations with out-of-pocket costs. The Kinh ethnic group was also associated with an average out-of-pocket expenditure increase of USD 11.9 (95% CI: 19.8, 4;  $p < 0.05$ ). Residing in rural areas was

Table 3  
Social-demographic and clinical characteristics predicting medical direct cost (USD, 2018).

Characteristics	Total cost			Out-of-pocket cost			
	Unadjusted regression coefficient (95% CI) (1)	<i>p</i> -value	Adjusted regression coefficient (95% CI) (2)	<i>p</i> -value	Unadjusted regression coefficient (95% CI) (3)	Adjusted regression coefficient (95% CI) (4)	<i>p</i> -value
Hospital							
Thanh Hoa Pediatric Hospital	(ref)		(ref)		(ref)	(ref)	
Vietnam National Children's Hospital	974.6 (810.8, 1,139)	<0.001	471.1 (322.1, 620.1)	<0.001	64.6 (57.9, 71.4)	48.8 (41.8, 55.7)	<0.001
Gender							
Male	(ref)		(ref)		(ref)	(ref)	
Female		0.428	-66.7 (-231.8, 98.4)			-1.8 (-9.1, 5.5)	0.634
Ethnicity							
Kinh	(ref)		(ref)		(ref)	(ref)	
Others		0.683	53.4 (-202.9, 309.8)			-12.9 (-21, -4.9)	0.002*
Place of residence							
Urban	(ref)		(ref)		(ref)	(ref)	
Rural		0.081	165 (-20.2, 350.1)			13.3 (3.8, 22.8)	0.006*
Length of stay							
<14 days	(ref)		(ref)		(ref)	(ref)	
15-29 days		<0.001	737.9 (566.7, 909.1)			9.4 (1.2, 17.6)	0.025*
>30 days		<0.001	2323 (1,982.8, 2,663.2)			82.7 (66, 99.3)	<0.001



Table 3 (Continued)

Characteristics	Total cost			Out-of-pocket cost				
	Unadjusted regression coefficient (95% CI) (1)	p-value	Adjusted regression coefficient (95% CI) (2)	p-value	Unadjusted regression coefficient (95% CI) (3)	p-value	Adjusted regression coefficient (95% CI) (4)	p-value
Weight			(ref)				(ref)	
>2,500g			102.1	0.391			5.28	0.607
1,500-2499g			(-131.6, 335.9)				(-14.8, 25.4)	
1,000-1499g			32.7	0.815			0.5	0.960
<1,000g			(-241.1, 306.6)				(-20.8, 21.9)	
			599.89	0.002			22	0.089
			(224, 975.7)				(-3.3, 47.3)	

\* $p < 0.05$ ; ref, reference group.

Average total cost in Thanh Hoa Pediatric Hospital (reference group) was USD 669. Average direct out-of-pocket cost in Thanh Hoa Pediatric Hospital (reference group) was USD 0 (zero).

associated with greater out-of-pocket costs (USD 15.9; 95% CI: 5.7, 26.1;  $p < 0.05$ ) compared to urban areas. In comparison with stays of less than 14 days, stays between 15-29 days and lasting longer than 30 days increased out-of-pocket costs by an average of USD 10.4 (95% CI: 2.3, 18.4;  $p < 0.05$ ), and USD 84.6 (95% CI: 68, 101.2;  $p < 0.05$ ), respectively.

Out of a total of 482 preterm infants admitted to the national hospital, 440 cases were referred from a lower-level health facility and 42 infants were going directly from home to the hospital.

Fig 1a shows the out-of-pocket costs of preterm babies being transferred from home to Vietnam National Children's Hospital classified by transfer type. Of the 42 infants who came from home to the national hospital, 8 cases were classified as improper and 34 cases as proper. The average out-of-pocket expenditure for the improper group was USD 214.3 which was significantly higher than proper group whose average expenditure was USD 42.9 for cases classified as proper ( $p < 0.001$ ).

Table 4  
Transfer groups predicting medical direct cost (USD).

Characteristics	Total cost			Out-of-pocket cost			
	Unadjusted regression coefficient (95% CI) (1)	p-value	Adjusted regression coefficient (95% CI) (2)	p-value	Unadjusted regression coefficient (95% CI) (3)	Adjusted regression coefficient (95% CI) (4)	p-value
<b>Transfer groups</b>							
From home to Thanh Hoa Pediatric Hospital	(ref)		(ref)		(ref)		
From health facility to Thanh Hoa Pediatric Hospital	262.5 (0.8, 524.1)	0.045	198.4 (6.6, 390.3)	0.043	0	1.3 (-6.1, 8.7)	0.737
From home to National Children's Hospital	561 (61, 1,061)	0.033	376 (36.1, 716)	0.03	75.6 (42.1, 109.1)	75.1 (41.5, 1,08.7)	<0.001
From health facility to National Children's Hospital	1252 (971.6, 1,532.4)	<0.001	662 (455.1, 868.8)	<0.001	63.6 (56.8, 70.4)	47.2 (37.8, 56.6)	<0.001
<b>Gender</b>							
Male	(ref)		(ref)		(ref)		
Female			-75.4 (-239.7, 88.9)	0.368		-1.2 (-8.5, 6)	0.736
<b>Ethnicity</b>							
Kinh	(ref)		(ref)		(ref)		
Others			35.2 (-221.3, 291.8)	0.788		-11.9 (-19.8, -4)	0.003*
<b>Place of residence</b>							
Urban	(ref)		(ref)		(ref)		
Rural			140 (-47.9, 328)	0.144		15.9 (5.7, 26.1)	0.002*

Table 4 (Continued)

Characteristics	Total cost			Out-of-pocket cost			
	Unadjusted regression coefficient (95% CI) (1)	p-value	Adjusted regression coefficient (95% CI) (2)	p-value	Unadjusted regression coefficient (95% CI) (3)	Adjusted regression coefficient (95% CI) (4)	p-value
Length of stay							
<14 days	(ref)		(ref)		(ref)	(ref)	
15-29 days		<0.001	719.8 (547.8, 891.7)		10.4 (2.3, 18.4)	10.4 (2.3, 18.4)	0.012*
>30 days		<0.001	2305 (1,959.9, 2,650)		84.6 (68, 101.2)	84.6 (68, 101.2)	0.012*
Weight							
>2,500g	(ref)		(ref)		(ref)	(ref)	
1,500-2,499g		0.352	110.4 (-122.5, 343.3)		4.20 (-15.9, 24.3)	4.20 (-15.9, 24.3)	0.682
1,000-1,499g		0.826	30.8 (-243.7, 305.3)		-0.6 (-22.1, 21)	-0.6 (-22.1, 21)	0.958
<1,000g		0.002	594.8 (219.6, 969.9)		21.2 (-4, 46.5)	21.2 (-4, 46.5)	0.099

$p < 0.05$ ; ref, reference group.

Average total cost in group "From home to Thanh Hoa Pediatric Hospital" (reference group) was USD 452. Average direct out-of-pocket cost in group "From home to Thanh Hoa Pediatric Hospital" (reference group) was USD 0.

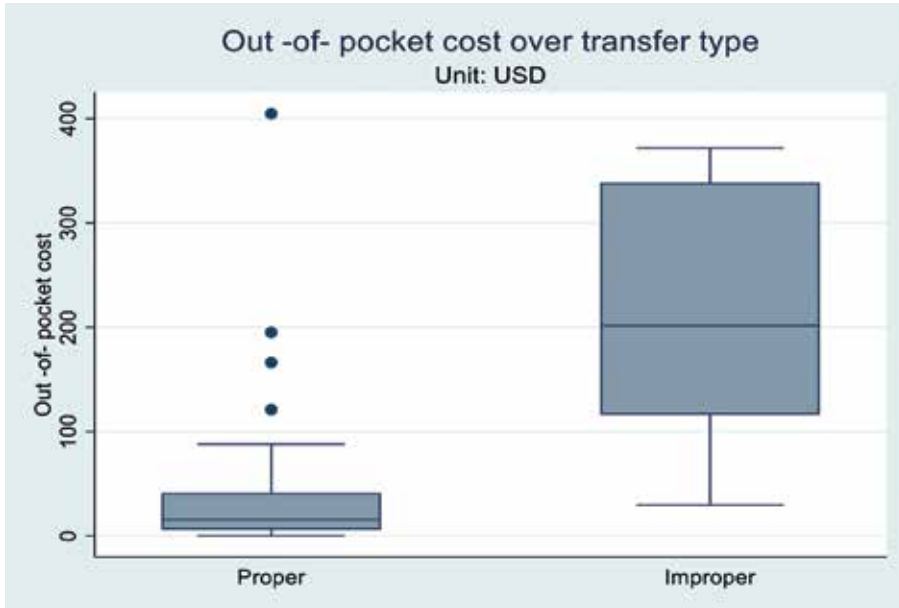


Fig 1a-Out-of-pocket costs for preterm infants transferred from home to Vietnam National Children’s Hospital by transfer classification (number of proper cases: 42; number of improper cases: 8).

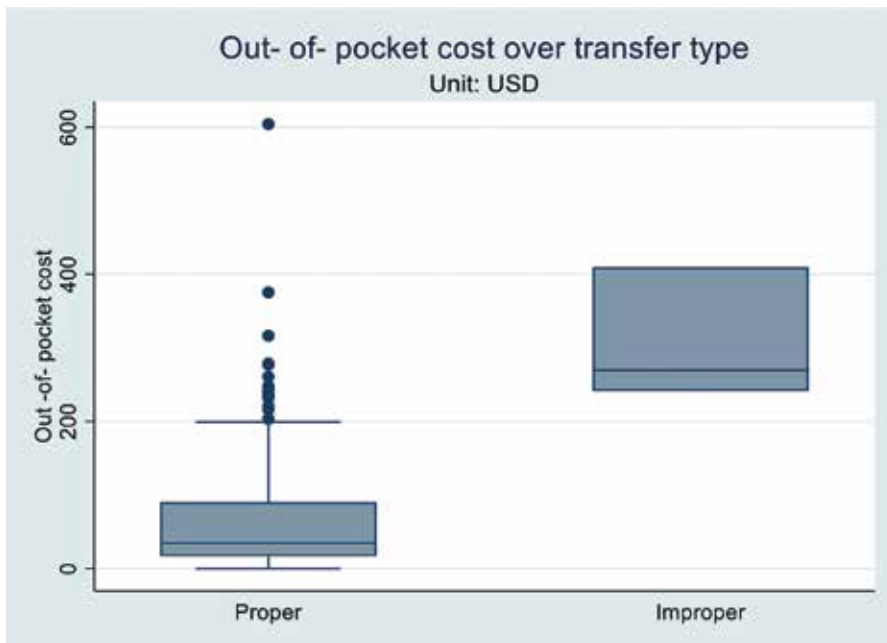


Fig 1b-Out-of-pocket costs for preterm infants transferred from a health facility to Vietnam National Children’s Hospital by transfer classification (number of proper cases: 437; number of improper cases: 3).

As seen in Fig 1b, of the 440 cases transferred from a health facility to Vietnam National Children's Hospital, only 3 cases were classified as improper. The average of out-of-pocket costs in the improper group was USD 307, compared to an average expenditure of USD 61.9 for the 437 cases who were transferred properly ( $p < 0.001$ ).

## DISCUSSION

Preterm birth does not only constitute a major medical challenge (Lockwood, 2002; Green *et al*, 2005), but it is also a potential threat for the immediate, short- and long-term physical, emotional and financial wellbeing of infants and their families. As we have shown in this study, preterm births also constitute a considerable financial burden to the health system. Our study has yielded several key findings.

Firstly, it is apparent from the literature and from our own findings that the primary driver of cost is gestational age. Infants born very prematurely require intensive care and tend to stay considerably longer in hospital (Petrou, 2003; Ringborg *et al*, 2006; Behrman and Butler, 2007; Russell *et al*, 2007; Blosky *et al*, 2010; Seaton *et al*, 2016). Secondly, and more importantly, from a health system perspective, the location of treatment appears to have major implications for both total and out-of-pocket expenditure. Mean total cost per child at the national hospital level was two and a half times higher than the mean cost observed at the provincial hospital.

About 50% of these differences were directly attributable to observable child characteristics in general, with an average substantially higher hospital stays for children treated in the national hospital. The remaining additional cost is likely to reflect both a larger number of tests, treat-

ment and services delivered and a higher cost per unit charged by the national hospital. This is even more apparent if the average cost per bed-day by each hospital is examined. In the provincial hospital, an average of USD 14.3 was charged per bed-day, while USD 23.6 was the average price per bed-day at the national hospital. This should not be taken as evidence that the national hospital is overcharging patients, but likely reflects differences in staffing, equipment, and general infrastructure costs at the higher-level facilities that need to be covered in order to be able to provide appropriate, high quality treatment for severe conditions.

This difference in cost is directly related to our third point. Our results suggest that the Vietnamese system is set up to provide relatively strong incentives for individuals to seek treatment at lower-level facilities prior to seeking care at provincial and national hospitals. According to Vietnam Health Insurance Law, children under 6 years old in Vietnam are fully covered by the national public health insurance as long as they are admitted in accordance with the correct procedure to public hospitals (Ministry of Justice, 2008). Proper admission into the health system requires that patients either arrive at higher-level hospitals with the appropriate referral order from a lower-level provider or as emergency case. While the classification of an emergency case may not always be obvious, health providers do clearly assess some transfers as inappropriate and higher co-payment. In our sample, the average additional co-payment borne out of an improper referral was about USD 240, which equates to 111% of the average monthly wage for a Vietnamese in 2018 (VnEconomy, 2018).

This study had several limitations. Firstly, the study was conducted in only

two hospitals. While these hospitals were purposely chosen to represent level I and level II facilities, they may not necessarily be representative of all hospitals of a similar level in the country. Secondly, we were not able to dig deeper into the cost per service such as service charge per patient per day or cost of basic investigations as the financial record we extracted did not provide a sufficient level of detail for such analysis. Thirdly, we were not able to capture the additional medical costs families may have incurred prior to being admitted to our study hospitals. Such costs could for example include direct medical costs in local hospitals such as physician charges and other professional fees. Future studies utilizing additional data sets linking hospital discharge with other databases which include vital statistics such as outpatient care, could provide a more detailed picture of these costs. Lastly, our study did not attempt to measure the indirect costs of premature birth including the cost of transport, accommodation, food, and days of work. It also did not attempt to quantify the social, psychological, or emotional costs to mothers and families.

In conclusion, the results presented in this study suggest that the average medical costs of preterm infants in Vietnam are substantial for the health system overall. Families complying with national health insurance policies seem to be relatively well protected from these (often very high) costs. Out-of-pocket costs were about six times higher for parents who bypassed lower-level facilities without acquiring the appropriate authorization.

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