

Cost Analysis of Parenteral Nutrition in Neonatal and Pediatric Care in German Hospitals

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Background

- Parenteral nutrition (PN) is critical for neonatal care and for infants who are unable to tolerate oral or enteral feeding during this important growth period.
- PN for neonates and children is highly complex and differs from PN for adults.
- In general, two mechanisms to deliver PN are available: commercial standard solutions or in hospital compounded individualized admixtures. Commercial standard solutions are mainly available for adults and children older than two years.
- At present, little is known about the clinical and pharmaceutical practice of pediatric parenteral nutrition in different European countries. Exceptional cases exist in France and UK, where commercial standard solutions for neonates are available.

Objective

- The purpose of this study was to create a model to assess the total costs of PN therapy for neonates, infants and children using formulations manufactured in-hospital—either in a hospital pharmacy or in the ward.

Material and Method

- Face-to-face and telephone interviews of healthcare professionals (physicians, pharmacists and nurses) in 12 hospitals across 4 EU countries (Belgium, France, Germany, and UK) were conducted in 2010 to collect resource use, including nutrients, staff time, equipment and supplies for the patient groups: newborns (pre-term and term babies with different weight groups); infants (< 2 years excluding newborns); and children (between 2 and 18 years). Additional information was collected via literature review.
- A cost model connecting resource use information with publicly listed prices from government websites and published literature was constructed using Microsoft Excel to generate estimated total costs for a PN bag in each of the 4 mentioned countries.
- This model was piloted in 3 German hospitals, which together treat a total of 1,183 patients annually (637 neonates and 546 infants and children) with 13,038 used bags (8,680 for neonates in the ICU, 469 for neonates on the ward, 2,769 for paed in the ICU, 1,120 for paed on the ward).

Organization of the hospital production

- 96% of the 13,038 pediatric PN bags in Germany were compounded in the hospitals and 4% were industrially manufactured.
- 40% of the in-hospital compounded bags were produced in the pharmacy and 60% on the ward.

Cost analysis

- Fixed and variable costs were taken into account to determine the cost of producing an in-hospital formulation. Variable costs depended on the type of formulation and included the costs of the raw materials, nutrients or supply items. Fixed costs included bacteriology control or depreciation of equipment and facilities.
- Costs were calculated from country specific list prices without discounts, data from interviews and official statistics.

Material and Method (cont'd)

Cost analysis (cont'd)

- Cost of nutrients** were calculated on the basis of the required volume of all substances for the bag size by multiplying individual costs by their volume concentration.
- Costs of supplies** are the costs of disposables (bags, bottles, needles, swabs, etc.), garments (sterile gloves, disposable headwear, etc.) and antiseptics.
- Equipment costs:** depreciation was calculated linearly over the previous 5 years for installation and devices (laminar flow hood/bench, compounder, infusion pump isolator). Equipment was weighted by the percentage of time used for the production of pediatric parenteral nutrition. Maintenance costs are included in total equipment costs.
- Wage costs:** time spent by each category of personnel to produce the nutritive preparations (prescription, preparation for compounding, installation/connection) was recorded. Time requirements were combined with the average costs of the personnel involved in the above mentioned activities.

Results

Costs per PN bag

- The cost of individualized admixtures increased with the body weight of the patient. The average cost for feeding neonates was €64.05. Total average cost for infants was €92.70 and €124.54 for children.
- Wage costs accounted for 54% of total costs in the neonate group, nutrients were 28%, and 15% were supplies. The remaining 2% of total costs related to installation and device costs. Cost differences between pharmacy and ward compounding were due to higher nurse workload. For infants, nutrients represent 50% of the total costs per bag, wage costs 38%, supplies 10% and installation and device costs were 2%. Comparable percentages were seen with the cost structure for a PN bag for children (See Figure 1 & Table 1)

Table 1. Average total costs per in-hospital compounded PN unit and total costs per patient

	Cost components				Total costs per unit (€)	Total costs per patient (€)
	Nutrients	Supplies	Installations and devices	Wage costs		
Average total costs						
Neonates	18.06 (28%)	9.64 (15%)	1.55 (2%)	34.81 (54%)	64.05	747.51
Infants	46.70 (50%)	9.64 (10%)	1.55 (2%)	34.81 (38%)	92.70	370.80
Children	78.54 (63%)	9.64 (8%)	1.55 (1%)	34.81 (28%)	124.54	1,120.83
Pharmacy compounding						
Neonates	18.06 (28%)	9.51 (15%)	2.22 (4%)	33.03 (53%)	62.81	732.35
Infants	46.70 (51%)	9.51 (10%)	2.22 (3%)	33.03 (36%)	91.46	365.84
Children	78.54 (63%)	9.51 (8%)	2.22 (2%)	33.03 (27%)	123.30	1,109.67
Ward compounding						
Neonates	18.06 (28%)	9.72 (15%)	1.11 (2%)	35.99 (55%)	64.88	757.61
Infants	46.70 (50%)	9.72 (10%)	1.11 (1%)	35.99 (39%)	93.53	374.11
Children	78.54 (62%)	9.72 (8%)	1.11 (1%)	35.99 (29%)	125.36	1,128.28

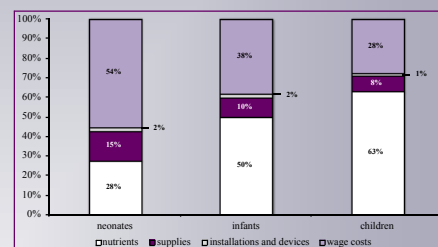
Possible rounding differences due to callulation in Microsoft Excel 2010

Costs per case

- The length of parenteral nutrition for neonates depends on their weight, and generally treatment becomes shorter with increasing birth weight. For preterm neonates < 1000g, PN days averaged 26 days. Neonates with a birth weight > 2500g received PN for approximately 1 week. The average treatment duration across all neonates of differing weights was 11 days. Infants < 2yrs received PN for 4 days; children between 2 and 18yrs received PN for 9 days.
- Total average treatment costs were € 747.51 for neonates, € 370.80 for infants < 2yrs and € 1,120.83 for children between 2 and 18yrs.

Results (cont'd)

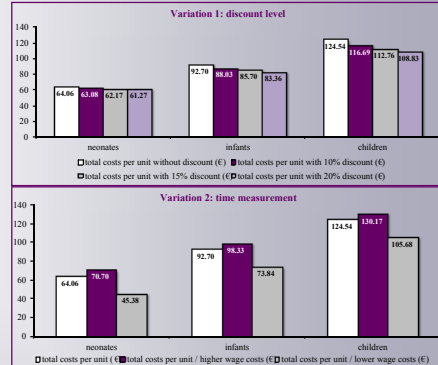
Figure 1: Percentage of the cost components



Sensitivity analyses

- One-way sensitivity analyses were performed to test the impact of different levels of discount rates off list prices and staff time to prepare compounded PN on PN cost estimates.
- The first sensitivity analyses varied discount rates (variation 1), assuming discounts of either 0, 15 or 20% of total nutrition component costs. The total costs per bag varied for neonates €63.08 (10%), €62.17 (15%) and €61.27 (20%); for the infants €88.03 (10%), €85.70 (15%), €83.36 (20%) and for the children €116.69 (10%), €112.76 (15%) and €108.83 (20%).
- The second sensitivity analysis varied the time required for PN preparation (variation 2), was derived from interviews, and represents the lowest and highest quoted minutes to prepare compounded PN (37 and 109 minutes). Costs per bag for infants when increasing personnel time ranged between €70.70 (neonates), €98.33 (infants) and €130.17 (children). Lower personnel time: total costs per neonate bag €45.38, for infants €73.84 and for children €105.68.

Figure 2: Sensitivity analyses



Conclusion & Discussions

- Our study estimated that the costs of PN therapy for pediatrics ranged from €64.05 to €124.54 in German hospitals.
- We found that a significant proportion of the total cost of PN was due to staff time. Depending on patient group, staff time accounts for 28%–54% of total costs.
- Ready prepared PN could increase medical staff time for patient-related activities by reducing staff time spent on compounding.

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Additional literature with the authors