Cost of Medical and Nursing Actions to the Intensive Care Unit.

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ABSTRACT

Aim of this study: Was the calculation of the cost of the most common medical and nursing procedures to the intensive care unit.

Design/methods: Data were collected from 60 patients for 166 days of hospitalization. The study's duration was about 5 months and the data collection started at 1/6/2005 and finished at 13/11/2005. The procedures which had been calculated were: the pressure ulcer care, the arterial line placement, the peripheral and central venous line placement, patient transportation for CT, the bronchoaspiration, the receipt of arterial blood gases, sputum and urine, the tracheostomy tube`s change, the Levin`s and the Swan-Ganz catheter placement. The statistical analyses were performed with SPSS 13 and x2 tests.

Results: The patients had an average age of 53.62years. The cost of the procedures were found: central venous line placement 67.03±29.18 euro, arterial line placement 3.92±0.18 euro, tracheostomy tube`s change 17.23±0.33 euro, bronchoaspiration 3.32±0.03 euro, patient transportation for CT 0.49±0 euro, receipt of arterial blood gases 1.6±0 euro, sputum`s reception 3.46±0.56 euro, reception of urine 1.26±0.43 euro, pressure ulcer care 8.48±0.28 euro, peripheral venous line placement 1.71±0.28 euro, Levin`s placement 5.81±0.62 euro και placement of Swan-Ganz 265.94±0.86 euro.

Conclusions: The study show the cost of the most common medical and nursing procedures to an intensive care unit and the relation that the cost has with the experience of the health care providers.

Key words: Cost, experience, Pressure ulcer care, Bronchoaspiration, arterial blood gases, Arterial line, Peripheral line, Transportation for CT, Levin, Swan-Ganz

Introduction

The cost of Intensive Care Units (I.C.U.) can be separated in direct expenses for their function and in indirect expenses (Arthur, 1979, Health technology, 2003). The Sanders appreciated that for the Massachusetts general hospital of Boston the direct expenses (equipment, etc) constituted the 65%, while the 35% constituted the indirect expenses (general expenses, cleanness etc) (Sanders, 1983, Health technology, 2003). The direct expenses include regularly and variable charges. The constant expenses do not depend from the number of nursing patients and include the expenses of manufacture, renovation, purchase and maintenance of equipment (Arthur, 1979, Health technology, 2003). The variable expenses depend from the volume of the provided health care services. Certain variable expenses, as the wage of professionals of health care are constants for a concrete volume of patients and they change when the number of patients exceeds the expected. Other variable expenses, as the "consumable" equipment and oxygen, depend directly from the number of the heavily suffering that nurses in an I.C.U. (Arthur, 1979, Health technology, 2003). Data collected from I.C.U. showed that the 50-80% of the direct expenses is for personnel, mainly for hospitalization (Sanders, 1983, Civetta, 1973, Griner, 1971, McCleave, 1977). On average, I.C.U. patients require three times more time for hospitalization from the patients that nurses in general departments (Russell, 1979).

Aim

The aim of the study was to calculate the cost (in Euros) of the most common actions that are realized in daily base in the I.C.U., reporting so the absolute cost of an action, as the related one with various parameters as the specialization of professionals of health care and the gravity of situation of the patient.

Material and Method

The sample of the study was constituted by 60 patients, 43 were men (71.67%) and 17 women (28.33%), that were imported for hospitalization in the general Academic ICU of KAT in time period of 166 days (1 June 2005-13 November 2005). Criteria of exclusion of patients from the study did not exist.

It was calculated the cost of the following actions: the pressure ulcer care, the arterial line placement, the peripheral and central venous line placement, patient transportation for CT, the bronchoaspiration, the receipt of arterial blood gases, sputum and urine, the tracheostomy tube`s change, the Levin`s and the Swan-Ganz catheter placement.

For the collection of data it was used a form of recording that included the demographic elements of patient, the measurement`s system of gravity of illness of patients, the materials that are required for an action, the number of efforts that became in order an action to be achieved and also who professional of health care participated in the process. In all the patients was calculated the gravity of their illness with the systems APACHE II (Knaus, 1985) and SAPS II (Le Gall, 1993). All the data were collected from their files and from the electronic systems of his continuous follow-up, according to the guidelines that are described in the articles of growth of original systems. The data collected only at the duration of morning shift.

The cost of the actions has been calculated according to the tariffs that were given by the office of supplies of hospital and has been included the tax of added value 19%.

The statistical analysis of data was done by the statistical parcel of SPSS 13. It was used the descriptive statistics and the statistical control of x^2.

Results

The mean age of patients was 53.6±3.33 years (mean±standard error). The 63.2% of patients were imported for medical reasons, without surgery, the 13.2% after programmed surgery and the 23.5% after urgent operation. The patients were separated depending on the diagnosis at the import in five categories: injuries (usually after car accidents) with percentage 35%, patients for follow-up after urgent surgery with percentage 40%, vascular cerebral episodes with percentage 15%, cardiac failure with percentage 6.67% and craniocerebral injury in percentage 3.33%. The gravity of illness of patients was found with the APACHE II = 16.52±0.31 and with the SAPS II =46.37±0.73. The mean time of recording of patients was 18.6±2.86 days with minimal one (1) day of hospitalization and maximum sixty four (64).

In Table I is given the number of medical-nursing actions that were recorded at the duration of study.

The materials that were used were recorded and they were cost per action they are:

- Placement of central line: a flagon of anesthetic (xylocaine 2%), one pair sterilized gloves, a 5 ml syringe, a set central venous access simple or silver in proportion the needs of patient, two needles for syringe of size of 18 G and 25 G, a lancet No 11, flagon heparin, suture of skin (2-0 or 3-0) with the surgery tool, set that includes gauzes for dressing and transparent template, a sterilized top, a mask, a cap and a sterilized field.
- Placement of arterial line: an arterial catheter or intravenous catheter 18-20G, a Tesoplast (transparent sticker for stabilization of the catheter), solution of Normal Solid 500 ml, a pair sterilized gloves and flagon heparin.
- Change of tracheostomy tube: a pair sterilized gloves, a mask, two blades of surgical knife No 15 and No11, a flagon anesthetic (xylocaine 2%), a 5 ml syringe, set transcutaneous tracheostomy, sterilized gauzes, an aspiration catheter, suture silk 3-0 or 4-0 and two needles 18 G and 27 G.
- Bronchoaspiration: a box or bag of aspiration, a conjunctive pipe of aspiration, a sterilized catheter of aspiration with interrupted control, a pair sterilized gloves and 10 ml N / S 0.9%.
- Transport patient except I.C.U. for computed tomography: the only thing that was needed in every case was a bottle of oxygen.
- Reception of blood gases: a 2.5 or 5 ml syringe, a needle 20G, a syringe 1-2 ml and 5000 units heparin.
- Reception of samples for cultivation. For bronchial excretions needed an appliance of collection of excretions, a tube of aspiration and a pair sterilized gloves. For collection of urine were necessary a box for collecting the urine, a pair sterilized gloves and a 20 ml syringe.
- Pressure ulcer care: various types of covers in reference with the anatomic place of the pressure ulcer, one Seas orb soft filler, one purilon gel, sterilized gauzes, a pair sterilized gloves, ampoule of Normal Solid 10ml.
- Placement of venous catheter: an intravenous catheter and a cover (Opsite).
- Levin`s placemen: an 60 ml syringe, gel xylocaine 2%, an one-use box and a nasogastric tube.

- Placement of catheter Swan - Ganz: a pair sterilized gloves, a sterilized field, a 20 ml syringe, a set Swan - Ganz, set transcutaneous import and 3 way stop cock.

In the above action it could not be calculated the cost that was required for antiseptic solution because each time was used a concrete quantity and no all the packing, the no sterilized gloves and the gauzes that needed each time in order an action to be realized.

- The table I shows the number of medical-nursing actions, the "absolute" and the mean cost of an action. The absolute cost is the cost which was calculated with the materials that were mentioned before and the medium cost is the cost that was calculated with moreover materials that were used. In certain cases because lack of materials, were used less materials so that exists decreased cost.

The arterial line placement became from doctor (69.83%), while in percentage 3.17% participated also nurse. At the second case there was important statistical difference in the cost of the action (P<0.001). The placement of peripheral line was realized by doctor at 70%, while only in the 30% of cases was participated nurse. In this case did not exist statistically important difference in the cost (P=0.12). Moreover the bronchoaspirations executed at 28.15% from physiotherapist, 34.5% from nurses and 37.35% from doctor. There was not found statistically important difference in the cost of bronchoaspirations depending on who made them. The ill`s transport outside ICU for computed tomography, or for other diagnostic examinations became always in cooperation of doctor and nurse. The reception of sample (blood, sputum and urine) was realized at 85.47% from doctors, 11.96% from physiotherapists and 2.57% from doctor and nurse together. It was not observed important statistical difference (P=0.02). The pressure ulcers that were created and developed in the heavily suffering patients were cared exclusively by the nurses and at the duration of morning care. The fourth degree`s pressure ulcers that needed surgical care did not exist. The placement of central line, Levin`s catheter, the change of traheostomy tube and the placement of catheter Swan - Ganz became exclusively in cooperation of doctor and nurse.

As it is presented in Table II for the successful completion of concrete action they were needed more from one effort, while other times certain action was not completed ever. This is the main cause that the cost of this action is not fixed, but varies proportionally the additional materials that were used.

In urgent and threatening for patients' situations was not observed important statistical difference in the cost of interventionist processes that became.

In effort of combination the cost of an action and the gravity of illness of patient, which was calculated with Apache II score and Saps II score was not found important statistical difference. The sex and the age of patients did not play any role in the cost of recorded medical-nursing action.

Discussion

In the examination of literature for the exact cost of the déjà mentioned medical-nursing actions were not found results apart from the placement of central venous lines and the process of tracheostomy tube.

It has become international priority in our days the control of cost of care of health. The cost that is required for the function of an ICU amounts in the 28% of total cost of the hospital (Critical Care in the united states, 1992, American medical Association council, 1999).

The Halpern et al (2004) in study that made and lasted from 1985 to 2000, recorded that the total number of hospitals in the USA were decreased at 8.9% (from 6.032 in 5.494), while the hospitals that offer intensive treatment were decreased at 13.7% (from 4.150 in 3.581). The total number of beds in hospitals with ICU was decreased at 26.4% (from 889.600 in 654.400) in contrast to the beds in the ICU that were increased at 26.2% (from 69.300 in 87.400). The cost of function per day of beds of intensive treatment was increased at 126% (from 1.185$ in 2.674$). Even if the total cost of ICU in the USA was increased at 190.4% (19.1-55.5 billion dollars) the government owned budget for the sector of health was decreased at 5.4%.

The Warren et al (2004) in their study were focused in the education of doctors with a 24 months program in the process of import of central venous lines. In the study existed two teams of observation. In the one participated educated doctors with the particular seminar and in other not specialized. The result was that the specialized doctors had less complications in the placement of central venous lines and the cost was decreased from 1.573.000$ in 1.036.000$. This study proves that the specialization of professionals of health decreases the cost of health care 13. The cost related with the infections and the complications that were presented in the central venous catheters was between 3.700$ and 56.167$ (Dimick, 2001, Digiovine, 1999, Arnow, 1993).

The Kinsella et al (2008) calculated that the cost of placement of central venous line in the USA is 130.26$. In this sum has been calculated also the radiograph of thorax which is ordered in order to certify the correct place of catheter.

The Knudsen et al (1999) in the Durham of USA calculated the cost for 13 tracheostomies, which were calculated 1323.92$. The prices were calculated with prices that carried out in July 1999.

The Hakellis et al (1996) studied 30 patients who developed 45 ulcers. The mean cost of treatment, including long-term care and hospital costs, was $2,731 per ulcer; excluding hospital costs, the mean cost of treatment was $489 per ulcer. The mean cost of treatment per patient was $4,647; excluding hospital costs, the mean treatment cost was

$1,284 per patient. Eighty percent of the total cost of pressure ulcer treatment was generated by the 4% of patients who required hospitalization for their pressure ulcers.

Twenty six studies computed the cost per ulcer healed from $US910 to $US2179. For a hypothetical managed-care plan, the difference between the least and most cost-effective modalities was $US1.9 million for pressure ulcers. Observed differences were generally attributable to variances in outcomes and cost differences related to frequency of dressing changes. Pressure ulcer care took place in inpatient care settings. Physician visit frequencies were once every four weeks for pressure ulcers. Wound sizes ranged from 2.5cm2 to 5.6cm2 for pressure ulcers. All patients with pressure ulcers required pressure relief, nutritional support and incontinence management. Costs per patient healed were lowest for pressure ulcers with hydrocolloids and highest with saline gauze (this is a manpower issue). (Kerstein et al, 2001).

It is remarkable a study that was conducted in the home care setting to compare healing rates and costs of two different dressings for pressure ulcers: the gauze and tape dressing and the transparent moisture vapor permeable dressing (MVP). Each wound was randomly assigned to either a gauze dressing or a MVP dressing. Initial ulcer grade (Shea criteria) and measurements were determined at the start of treatment and weekly for an eight-week period. Photographs of the wound were taken at the beginning and end of treatment. The same protocol for irrigating the wound and relieving pressure was followed for both dressing groups. The mean (eight-week) labor and supply cost per ulcer using the MVP was $845, while that for gauze treatments was $1359, p less than 0.05 (Wilcoxon rank sum test). The cost difference for grade III ulcers was not significant in the two dressing groups. (Sebern, 1986)

A retrospective research design was used to describe the costs incurred by an 830-bed, long-term care facility to treat 81 pressure ulcers over a one-year period following implementation of a research-based, skin care protocol. The total cost for the study period was $30,079 with 73% of these expenditures attributable to nursing care. Mean cost of treatment was $3.74/pressure ulcer/day, which was a reduction from the $5.35/pressure ulcer/day cost prior to implementation of the skin care protocol. (Frantz et al, 1995).

The Alterescu (1981) examined in a three-month, retrospective study 75 patients with pressure ulcers. The average cost of treatment per day was $80.42. The average total variable cost per patient was $1,300.37. The average variable cost for treatment of a patient admitted for an ulcer was $3,746.03, while the average variable cost for treatment of patients admitted for other reasons was $621.02.

A European cost-effectiveness study has been conducted using published clinical trial data from multinational studies on chronic venous leg ulcers and pressure sores. Data relevant to UK chronic wound management practice have been extracted and are presented here. A total of 15 pressure sore studies involving 519 wounds, and 12 leg ulcer studies involving 843 ulcers were used in a pooled analysis. The study objectives included the calculation of comparative costs in pound sterling for three different treatment protocols for each wound type. The protocols have been adapted for UK clinical practice in both hospital and community settings and are based on primary dressings and nurse time costs, wound cleansing and debridement, the use of fillers, and compression as appropriate. The focus of the study has been the cost-effectiveness comparison (as measured by cost per healed wound) of two modern dressings - Granuflex(R) hydrocolloid dressing and Apligraf(R) skin replacement - and traditional gauze dressings in the treatment of venous leg ulcers and, in the case of pressure sores, comparison of Granuflex(R) Comfeel(R) hydrocolloid dressings and traditional saline gauze dressings. The choice of dressings studied was dictated by the available published literature. The construction of treatment protocols and assumptions on treatments otherwise missing from published papers has been achieved through the use of an expert panel. Results show Granuflex(R) to be 50% more cost-effective, at 422 pounds per healed wound, than Comfeel(R) (643 pounds) and 500% more so than saline gauze (2548 pounds) in the treatment of pressure sores. Granuflex(R) at 342 pounds was also more cost-effective than gauze (541 pounds) or Apligraf(R) (6741 pounds) in the treatment of venous leg ulcers. These data will provide a valuable adjunct to published clinical evidence, offering further information upon which cares can base their choice of wound dressing. (Harding et al, 2000).

Bennet et al (2004) estimated the annual cost of treating pressure ulcers in the UK. The cost of treating a pressure ulcer varies from Θ1,064 (Grade 1) to Θ10,551 (Grade 4). Costs increase with ulcer grade because the time to heal is longer and because the incidence of complications is higher in more severe cases. The total cost in the UK is Θ1.4–Θ2.1 billion annually (4% of total NHS expenditure). Most of this cost is nurse time. The cost per day for ulcer grade I was 38 pounds, for grade II 42 pounds and for grades III and IV 50 pounds.

Conclusions

The study showed the cost of most common medical-nursing actions in ICU. Also it was proved, via the data, that there is cross-correlation between the cost of an action and the specialization of the professionals of health. The no specialized physicians and nurses used more materials and they increased the cost that was required for an interventionist process.

LITERATURE

1. American Medical Association Council on Long Range Planning and Development in cooperation with the Council on Constitution and Bylaws, and the Council on Ethical and Judicial Affairs. Policy Compendium. Chicago: American Medical Association, 1999: H-425.0, H-440.9.
2. Alterescu V. The financial costs of inpatient pressure ulcers to an acute care facility. Decubitus. 1989 Aug;2(3):14-23.
3. Arnow PM, Quimosing EM, Beach M. Consequences of intravascular catheter sepsis. Clin Infect Dis 1993; 16:778–784.
4. Arthur D. Little, Inc., "Planning for General Medical and Surgical Intensive Care Units: A Technical Assistance Document for Planning Agencies, prepared for the U.S. Department of Health, Education, and Welfare, publication No.(HRS) 79-14020 (Washington, DC: U.S. Government Printing Office, 1979).
5. Bennett G, Dealey C, Posnett J. The cost of pressure ulcers in the UK. Age and Ageing 2004; 33: 230–235.
6. Civetta, J. M., 'The Inverse Relationship between Cost and Survival. Res. 14(3):265, 1973.
7. Critical care in the United States: coordinating intensive care resources for positive cost-effective patient outcomes. Anaheim, Calif: Society of Critical Care Medicine, 1992; 18.
8. David K. Warren, MD; Jeanne E. Zack, BSN; Jennie L. Mayfield, MPH; Alexander Chen, MD; Donna Prentice, MSN; Victoria J. Fraser, MD; and Marin H. Kollef, MD, FCCP. The Effect of an Education Program on the Incidence of Central Venous Catheter-Associated Bloodstream Infection in a Medical ICU. Chest 2004; 126; 1612-1618.
9. Digiovine B, Chenoweth C, Watts C, et al. The attributable mortality and costs of primary nosocomial bloodstream infections in the intensive care unit. Am J Respir Crit Care Med 1999; 160:976–981.
10. Dimick JB, Pelz RK, Consunji R, et al. Increased resource use associated with catheter-related bloodstream infection in the surgical intensive care unit. Arch Surg 2001; 136:229–234.
11. Frantz RA, Bergquist S, Specht J. The cost of treating pressure ulcers following implementation of a research-based skin care protocol in a long-term care facility. Adv Wound Care. 1995 Jan-Feb;8(1):36-45.
12. Griner, P. F. and Liptzin, B., "Use of the Laboratory in a Teaching Hospital: Implications for Patient Care, Education, and Hospital Costs, Ann. Intern. Med. 1971 Aug; 75(2):157-63.
13. Halpern, Neil A. MD, FCCM; Pastores, Stephen M. MD, FCCM; Greenstein, Robert J. MD. Critical care medicine in the United States 1985-2000: An analysis of bed numbers, use and costs [Feature Articles]. Critical Care Medicine:Volume 32(6)June 2004pp 1254-1259.
14. Harding K, Cutting K, Price P. The cost-effectiveness of wound management protocols of care. Br J Nurs. 2000 Oct;9(19 Suppl):S6, S8, S10 passim.
15. HEALTH TECHNOLOGY CASE STUDY 28 Intensive Care Units (ICUs) Clinical Outcomes, Costs, and Decision making. 2003; 23: 38-53.
16. Kerstein, Morris D.; Gemmen, Eric; van Rijswijk, Lia; Lyder, Courtney H.; Phillips, Tania; Xakellis, George; Golden, Katharine; Harrington, Catherine. Cost and Cost Effectiveness of Venous and Pressure Ulcer Protocols of Care. Disease Management & Health Outcomes. 9(11):651-636, 2001.
17. Kinsella S, Young N. Ultrasound-Guided Central Line Placement as Compared with Standard Landmark Technique: Some Unpleasant Arithmetic for the Economics of Medical Innovation. Value Health. 2008 Jul 18.
18. Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II: A severity of disease classification system. Crit Care Med 1985, 13:818.
19. Le Gall JR, Lemeshow S, Saulnier F. A new Simplified Acute Physiology Score (SAPS II) based on a European/ North American multicenter study. JAMA 1993, 270: 2957-2963.
20. McCleave, D. J., Gilligan, J. E., and Worthley, L. I. G., "The Role and Function of an Australian Intensive Care Unit, Crit. Care Med. 5(5):245, 1977.
21. NW Knudsen, MW Sebastian, RA Perez-Tamayo, WL Johanson and SN Vaslef. Intensive care unit procedures: cost savings and patient safety. Crit Care 1999; 158: 546-551.
22. Russell, L. B., "Intensive Care, ch. 3 in Technology in Hospitals: Medical Advances and Their Diffusion (Washington, DC: The Brookings Institution, 1979).
23. Sanders, C. A., "Hospital Management of Critical Care I, presentation at the National Institute of Health Consensus Development Conference, Critical Care Medicine, Mar. 8, 1983.
24. Sebern MD. Pressure ulcer management in home health care: efficacy and cost effectiveness of moisture vapor permeable dressing. Arch Phys Med Rehabil. 1986 Oct;67(10):726-9.
25. Xakellis GC, Frantz R. The cost of healing pressure ulcers across multiple health care settings. Adv Wound Care. 1996 Nov-Dec;9(6):18-22.

Table I: Cost medical-nursing actions

ACTION	SUM (N)	BLANK COST (EURO)	COST (EURO)
CENTRAL VENOUS LINE PLACEMENT	250	66.29	67.03±29.18
ARTERIAL LINE PLACEMENT	500	3.81	3.92±0.18
TRACHEOSTOMY TUBE`S CHANGE	150	16.56	17.23±0.33
BRONCHOASPIRATION	500	3.31	3.32±0.03
PATIENT TRANSPORTATION FOR CT	300	4.95	0.495±0
RECEIPT OF ARTERIAL BLOOD GASES	500	1.6	1.6±0
SPUTUM`S RECEIPTION	500	2.05	3.46±0.56
URINE`S RECEIPTION	500	0.8	1.26±0.43
PRESSURE ULCER CARE	500		8.48±0.28
PERIPHERAL VENOUS LINE PLACEMENT	300	1.62	1.71±0.28
LEVIN PLACEMENT	150	5.32	5.81±0.62
SWAN-GANZ CATHETER PLACEMENT	100	260.54	265.94±0.86

Table II

ACTION	N EFFORTS	EMERGENCY
CENTRAL VENOUS LINE PLACEMENT	2,6±0,29	2% YES
ARTERIAL LINE PLACEMENT	2,3±0,2	19% YES
TRACHEOSTOMY TUBE`S CHANGE	1,1±7,1	NO
BRONCHOASPIRATION	1±0,8	63.7% YES
BLOOD GASES	1,6±0,2	34% YES
RECEIPT OF SAMPLES	1,3±0,3	18.8% YES
PRESSURE ULCER CARE	1±0,1	NO
PERIPHERAL VENOUS LINE PLACEMENT	2±0.1	21.05% YES