Original article: Organizational features in the healthcare environment

Fee payment system for nursing performance: an operational proposal through the use of I.C.A. (Indexes of Complexity of Assistance) methodology

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Abstract. *Background and Aim of the Study:* The objective of this study is to demonstrate the feasibility of a possible fee system based on the performance of the nursing function, validating the theoretical and methodological assumption of an economic analysis for nursing. *Method:* The I.C.A. Methodology (Indexes of Complexity of Assistance) was chosen as a system able to produce the reading, in an economic sense, of nursing performance to a sufficiently accurate degree, by its use of "assistance settings" and "nursing assistance plans". For the planning of assistance, the Nursing Interventions Classification (NIC) was used, as it is a validated and shared language. For the cost of each single operation/intervention and recovery, the "weight intervention" algorithm of the I.C.A. methodology was used. This research project was carried out in the form of a pilot study which investigated a sample of 30 patients, and a multi-center cross-sectional and observational retrospective study conducted on a sample of 135 patients coming from three Region of Liguria Hospitals. *Results:* The study was concerned with 165 cases. It highlighted 65 D.R.G.s, of which 17 were selected, containing comprehensively 61 cases. The results obtained confirm that it is possible to use this proposed approach to calculate the direct and indirect costs of nursing activity, and that it is also possible to compare it to the present D.R.G. system. *Conclusions:* It is necessary to create a multidisciplinary payment system for a patient's care. This must be able to monitor the whole treatment process, and therefore all of the activities carried out for the patient's benefit. The present D.R.G. system is not able to register the care provided by nursing services.

Key words: fees, analysis of costs, and traceability of nursing care

Introduction

Health services economics today constitute, more than ever, for all health services practitioners, an essential analytical tool for understanding the mechanisms which regulate the health services system from a clinical administration point of view. This serves to develop responsible behavior, guarantee a more appropriate use of the resources needed, and meet health needs[1].

The main goal of this study was to show the feasibility of a possible fee system for nursing activities by using the theory and the methods of an economic analysis.

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[1] Cavaliere B., Manzoni E. and Piu F. "Innovazione e Governance delle Professioni Sanitarie. Scenari di sviluppo per una sanità a misura d'uomo" [Innovation and Governance of the Health Professions: Development scenarios for health services on a human scale], Casa Editrice Ambrosiana, 2015

Secondary goals were: to define the necessary elements to determine the fee, to produce specific indicators for the cost of nursing assistance, to identify a useful methodology for the definition of a cost based on the assignation and customization of care, and to identify through this study a useful and user-friendly classification system.

Bibliographic research was undertaken based on this research question. The period of investigation dated from January 2000 to June 2016. No restrictions related to language were applied, as the research brought to light many works in many different languages other than English and Italian with abstracts in English. The articles highlighted in the PubMed research bibliography are eighty-one in number. The abstracts of these were read, and then the complete text was requested for twenty-nine of these articles. Among the twenty-nine, no study appeared which analyzed a fee system for nursing services.

In the articles analyzed, nursing assistance and that of the health professionals is always seen as an indirect cost that derives from medical activity and is measured by the hour. The operational and quality aspect of the activity is never faced, along with their related complexity.

Method

Instruments used

- The integrated system for the measurement of the complexity of assistance with a methodology which uses assistance complexity indexes (I.C.A.)[2], and a multi-dimensional driver which uses process indicators specific to the health services professions and able to produce an economic reading of performance.
  I.C.A. methodology uses a "dictionary of activities" to build a multidimensional driver. This is composed of three elements:
  o Categories: The structure chosen for the study consists of nine categories of need (respira-

tion, feeding, hydrating, urinary and intestinal elimination, hygiene, movement, rest and sleep, circulatory function, and a safe environment and communication interaction) and two process categories (therapeutic procedures and diagnostic procedures);
  o Operations/interventions: 495 nursing intervention acts are included;
  o The "weight" of the intervention is represented by an algorithm which the I.C.A. methodology uses to determine the relative complexity of each single intervention on a five level scale going from one to five, where five represents the highest level.
- The Intervention Cost Index algorithm is derived by using the I.C.A. methodology's "intervention weight" to determine the analytic cost of the operations/interventions.
- The Nursing Interventions Classification (N.I.C.) was created by a research group at the University of Iowa in the United States[3].

The study was divided into two phases:
- Pilot Study: Experimentation of the study protocol on a small scale, to verify the feasibility of the project, define the size of the study sample, and better contribute to the improvement of the measurement and archiving of the data collected.
- Multi-centric Study: The demonstration, using the determining of fees, of the feasibility of the study's hypothesis.

To determine the Intervention Cost Index, the average hourly cost of nursing personnel in 2014 was chosen. This was provided by the Region of Liguria, and was seen to be equal to € 23,64[4].

Participants

Pilot Study – Retrospective Cross-sectional Observation Study
The sampling carried out to decide the elements

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[2] Cavaliere B. Sistema integrato di misurazione della complessità assistenziale [Integrated System to Measure the Complexity of Assistance] , Management infermieristico, 2006, 2, 13-22

[3] McCloskey J. & Bulechek G. Classificazione degli interventi infermieristici NIC [Classification of Nursing Interventions, NIC], Milano, Ambrosiana, 2007
[4] The data provided by the Regione Liguria came from its Ligurian Health Services structures through the use of a ledger sent to the management administration of each single entity.

for the sample was of a non-probability type with representative elements.

The representative elements were selected from within a population which the researcher felt was coherent with the research's objectives.

A sample of thirty patients was chosen:
o Fifteen from medicine and oncology;
o Fifteen from surgery.

Thirty hospital medical records were analyzed for each Operational Unit. Fifteen of these were then selected by using their "entry diagnosis" as a representative element for the patients, hospitalized between September 1, 2015 to November 31, 2015.

Pilot Study – Retrospective Cross-sectional Observation Study

The sample size was calculated taking into account the number of beds in the three hospital structures:
o ASL 5 Spezzino: 612[5];
o ASL 3 Genovese: 681[5];
o Ente Ospedaliero – Ospedali Galliera [Hospital]: 414[5].

The total number of beds in the three structures numbered 1707.

Having hypothesized on the use of a population of 3000 people for the study's sampling, the number of the significant sample needed to be 135 patients from the three Regione Liguria hospitals. The 45 hospital records collected from each hospital were selected by simple randomized sampling.

ASL 5 Spezzino [La Spezia]: The operational units involved were the surgery, medicine and emergency care areas. Each provided 15 hospital records from January 1, 2016 to March 31, 2016.

ASL 3 Genovese [Genoa]: The operational units involved were the medicine, cardiology, and surgery areas. Each provided 15 hospital records from September 1, 2015 to December 31, 2015.

Ente Ospedaliero – Ospedali Galliera [Galliera Hospital]: The operational units involved from April 1, 2016 to May 31, 2016, were surgery (providing 12

records), internal medicine (20 records) and emergency care (13 records).

Analysis of the Data

The data collected from the assistance programs in the pilot study and the multi-center study were analyzed by the use of STATA 14/SE[6] software.

Statistical analyses carried out on the sample were: distribution by sex, distribution of the sample based on age and days in the hospital, distribution based on Diagnosis Related Group (DRG), and the comparison of DRG and the length of stay in the hospital.

Statistical analysis carried out for each single DRG analyzed the most important information extrapolated from the data, done by the use of the applicative ICAcode© (I.C.A. methodology)[7].

The following were calculated:
- Delta: DRG number – Nursing Assistance Cost;
- Average daily cost for nursing assistance and days of hospital stay;
- Average daily cost for nursing assistance;
- Average daily cost for nursing assistance: Average, Standard Deviation, Interquartile 1st and 3rd (25th P - 75st P), and Median.

Results

Pilot Study

DRGs with a frequency greater than or equal to two cases were analyzed to observe any variations and/or similarities.

The DRGs analyzed and compared were the following:
o DRG 290: Thyroid operations (11 cases);
o DRG 395: Abnormalities in red blood cells in patients over 17 years of age (2 cases);
o DRG 404: Lymphoma and non-acute leukemia without CC (4 cases);
o DRG 420: Fever of unknown origin in patients over 17 years of age without CC (3 cases).

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[5] Bed situation and patient numbers at the Ligurian hospital entities, ASL, IRCCS, Enti Ospedalieri Liguri (2014 2016), Attachment 7, https://www.galliera.it/files/documenti/piano-strategico-2014-2016/allegato 7.

[6] Statistical software – www.stata.com
[7] Software distributed by Bit Italia

The analysis of the assistance scheduling grouped together in DRGs allowed for the analysis of the assistance scheduling for the recovery event, highlighting the following parts: assistance for the operation/ intervention, operational time, the frequency of intervention by the nursing staff, the cost index for the operation and its total cost (the frequency of nursing intervention multiplied by the operation's cost index).

Table 1 shows an example of nursing assistance scheduling for the recovery event.

Example: Diagnosis Related Group (DRG) 290– Thyroid Operations.

Table 2 shows the difference between the value attributed to the actual Diagnosis Related Group (DRG) 290 System and the total cost of nursing assistance. The discussion remains open regarding the value, called "delta", shown in column five. This value is contained in the actual fee or represents an incremental cost for care.

By observing the eleven cases, we note that for the same length of stay (3 days), the cost of the recovery event can vary from a minimum of € 318.46 to a maximum of € 623.69. The variation in daily cost is due to assistance scheduling (the sum of the interventions undertaken), for which the presence of co-morbidity in the patient can be a factor.

Table 3 shows that the average daily cost for nursing assistance, with reference to the Diagnosis Related Group (DRG) 290 System, can vary from a minimum of €106.15 to a maximum of €207.89.

Table 1

Planning assistance	Time intervention (minutes)	Frequency nursing interventions	Cost index intervention (€)	Cost total interventions (€)
Maintenance of access to veins	10	4	5,23	20,92
Intravenous administration of drugs	15	10	8,26	82,6
Subcutaneous administration of drugs	10	3	5,12	15,36
Monitoring of vital parameters	10	9	5,12	46,08
Oral administration of drugs	15	5	8,08	40,4
Administration of analgesics	20	5	11,69	58,45
Preparation for surgery	30	1	19,56	19,56
Laboratory tests at patient's bedside	15	2	8,76	17,52
Monitoring of liquids	20	3	11,45	34,35
Management of nausea	20	4	10,78	43,12
Bladder catheterization	15	1	9,09	9,09
Management of urinary elimination	10	2	5,61	11,22
Bathing	20	1	9,88	9,88
Assistance for self care	20	3	10,34	31,02
Care of the surgical cut	15	1	8,25	8,25
Dressing / Undressing	15	1	7,56	7,56
Wound care	15	2	8,93	17,86
Help in sleeping	15	4	8,26	33,04
Pain management	30	9	11,68	105,12
Management of the environment	30	1	15,51	15,51
Assistance upon admittance	20	1	10,1	10,1
Improvement of security	15	1	8,26	8,26
Documentation	15	10	7,08	70,8
Identification of risks	50	1	28,1	28,1
Reduction of anxiety	30	1	17,2	17,2
Infection control	20	1	11,47	11,47
Promotion of physical activity	30	2	16,51	33,02
Environmental management: well-being	15	1	6,55	6,55
Cost nursing assistance event recovery (€)		812,41		

Table 2

	Recovery days	Cost DRG 290	Nursing assistance cost for DRG 290	Difference
1° Case	4	€ 3340	€ 812,41	€ 2527,59
2° Case	3	€ 3340	€ 623,69	€ 2716,31
3° Case	3	€ 3340	€ 594,73	€ 2745,27
4° Case	3	€ 3340	€ 584,76	€ 2755,24
5° Case	3	€ 3340	€ 532,16	€ 2807,84
6° Case	3	€ 3340	€ 507,27	€ 2832,73
7° Case	3	€ 3340	€ 489,16	€ 2850,84
8° Case	3	€ 3340	€ 477,05	€ 2862,95
9° Case	3	€ 3340	€ 471,47	€ 2868,53
10° Case	3	€ 3340	€ 470,46	€ 2869,54
11° Case	3	€ 3340	€ 318,46	€ 3021,54

Table 3

	Recovery days for nursing care	Average daily cost
1° Case	4	€ 203,10
2° Case	3	€ 207,89
3° Case	3	€ 198,24
4° Case	3	€ 194,92
5° Case	3	€ 177,39
6° Case	3	€ 169,09
7° Case	3	€ 163,05
8° Case	3	€ 159,01
9° Case	3	€ 157,16
10° Case	3	€ 156,82
11° Case	3	€ 106,15

Table 4

Average	Standard deviation	Interquartile 1st and 3rd (25th P - 75st P)	Median
€ 172,07	€ 29,23	€ 157,16 - € 198,24	€ 169,51

Figure 1 shows the variation on the average daily cost for DRG 290 amounts to €101.74.

Table 4 shows how the average daily cost for nursing assistance has been analyzed in detail.

The pilot study shows that the elements which contribute to the determination of the cost of assistance scheduling are:

- The sum of the "intervention cost indexes" with regards to the frequency in which they are carried out;
- The length of the hospital stay;
- The complexity of the assistance given to the patient;
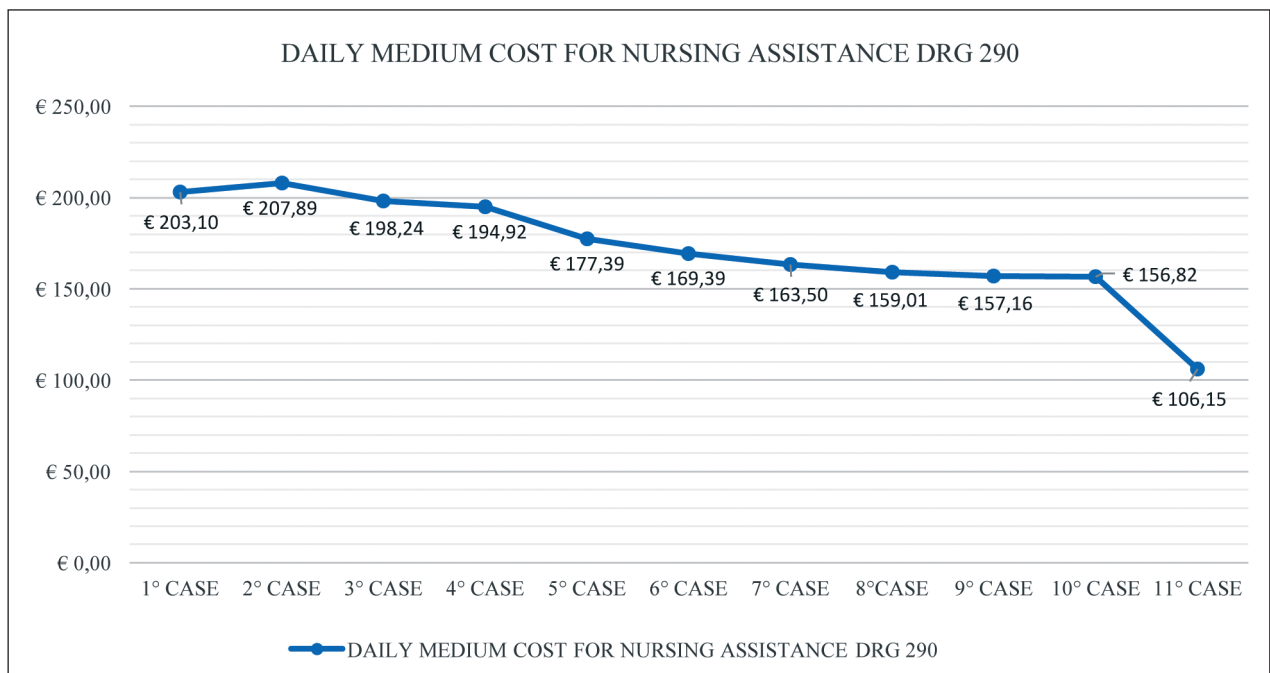- The appropriateness of the interventions carried out.

Figure 1.

Multi-Center Study

DRGs with a frequency greater than or equal to three cases were analyzed to observe any variations or similarities.

The DRGs analyzed and compared are as follows:
o DRG 127: Heart failure and shock (12 cases);
o DRG 87: Pulmonary edema and respiratory failure (10 cases);
o DRG 174: Gastro-intestinal hemorrhaging with CC (6 cases);
o DRG 118: Heart pacemaker substitution (4 cases);
o DRG 152: Minor operations on the small and large intestine with CC (4 cases);
o DRG 201: Other hepatobiliary or pancreas operations (4 cases);
o DRG 75: Major operations on the chest (3 cases);
o DRG 121: Cardiovascular diseases with acute myocardial infarction and major complications, discharged alive (3 cases);
o DRG 143: Chest pains (3 cases);
o DRG 160: Hernia operations, with the exception of inguinal and femoral hernias, in patients over 17 years of age without CC (3 cases);
o DRG 172: Malignant neoplasms of the digestive system with CC (3 cases);
o DRG 569: Major operations on the large and small intestine with CC with greater gastrointestinal diagnosis (3 cases);

o DRG 570: Major operations on the large and small intestine with CC without greater gastro-intestinal diagnosis (3 cases).

The analysis of the assistance scheduling grouped together in DRGs allowed for the analysis of the assistance scheduling for the recovery event, highlighting the following parts: assistance for the operation/intervention, operational time, the frequency of intervention by the nursing staff, the cost index for the operation and its total cost.

Example: Diagnosis Related Group (DRG) 127 - Heart Failure and Shock.

Table 5 shows the difference between the value attributed to the Diagnosis Related Group (DRG) 127 System and the total cost of nursing assistance for a patient hospitalized for heart failure and shock.

In the first case the asterisk* indicates that the DRG has a threshold value of 21 days of hospital stay. The final cost of the DRG must bear in mind the five days of stay that extend beyond the threshold. As a result, the fee calculated for DRG 127 amounts to € 3,052, to which the €179 (the cost for days of hospital stay beyond the threshold) for the five days must be added, bring the total to € 3,947.

Table 6 shows the average daily cost for nursing assistance for DRG 127- Heart Failure and Shock.

Observing the fourth case, with its ten days of hospital stay, the scheduling of assistance has an average daily cost of € 86.63. In contrast, the eleventh case with only five days of stay, shows that the scheduling of assistance reached an average daily cost of € 205.46.

Table 5

	Recovery days	Cost DRG 127	Nursing assistance cost for DRG 127	Difference
1° Case	26*	€ 3052,00 + € 895 (€ 179 x 5 gg fuori soglia) = € 3947	€ 3836,57	€ 110,43
2° Case	12	€ 3052,00	€ 2133,23	€ 918,77
3° Case	11	€ 3052,00	€ 1832,59	€ 1219,41
4° Case	10	€ 3052,00	€ 866,31	€ 2185,69
5° Case	8	€ 3052,00	€ 1513,39	€ 1538,61
6° Case	7	€ 3052,00	€ 1288,04	€ 1763,96
7° Case	7	€ 3052,00	€ 1183,85	€ 1868,15
8° Case	7	€ 3052,00	€ 1127,38	€ 1924,62
9° Case	6	€ 3052,00	€ 1154,79	€ 1897,21
10° Case	6	€ 3052,00	€ 1091,47	€ 1960,53
11° Case	5	€ 3052,00	€ 1027,29	€ 2024,71
12° Case	5	€ 3052,00	€ 819,06	€ 2232,94

Table 6

	Recovery days	Average daily cost for nursing care
1° Case	26	€ 147,56
2° Case	12	€ 177,77
3° Case	11	€ 166,60
4° Case	10	€ 86,63
5° Case	8	€ 189,17
6° Case	7	€ 184,00
7° Case	7	€ 169,12
8° Case	7	€ 161,05
9° Case	6	€ 192,46
10° Case	6	€ 181,91
11° Case	5	€ 205,46
12° Case	5	€ 163,81

Table 7

Average	Standard deviation	Interquartile 1st and 3rd (25th P - 75st P)	Median
€ 168,79	€ 30,29	€ 161,74 - € 187,88	€ 165,55

Figure 2 shows the variation of the average daily cost for DRG 127 is € 118.83.

Table 7 shows the analysis of the average daily cost for nursing assistance.

The analysis of the data regarding the multi-center study shows – as in the case of the pilot study – that the deviation in the final fee for assistance depends on the sum of each single intervention inserted in the as-sistance schedule for each patient (which may be due to the presence of comorbidity in the patient, or his/her lack of autonomy in daily life) and the duration of his/her recovery (days of hospital stay).

Conclusion

Pilot Study

The pilot study sample was composed of thirty cases. The sampling was distributed across the Diagnosis Related Group (DRG) system with 14 different DRGs.

The pilot study rejected ten DRGs with less than two cases, and analyzed the four DRGs which had more than two cases.
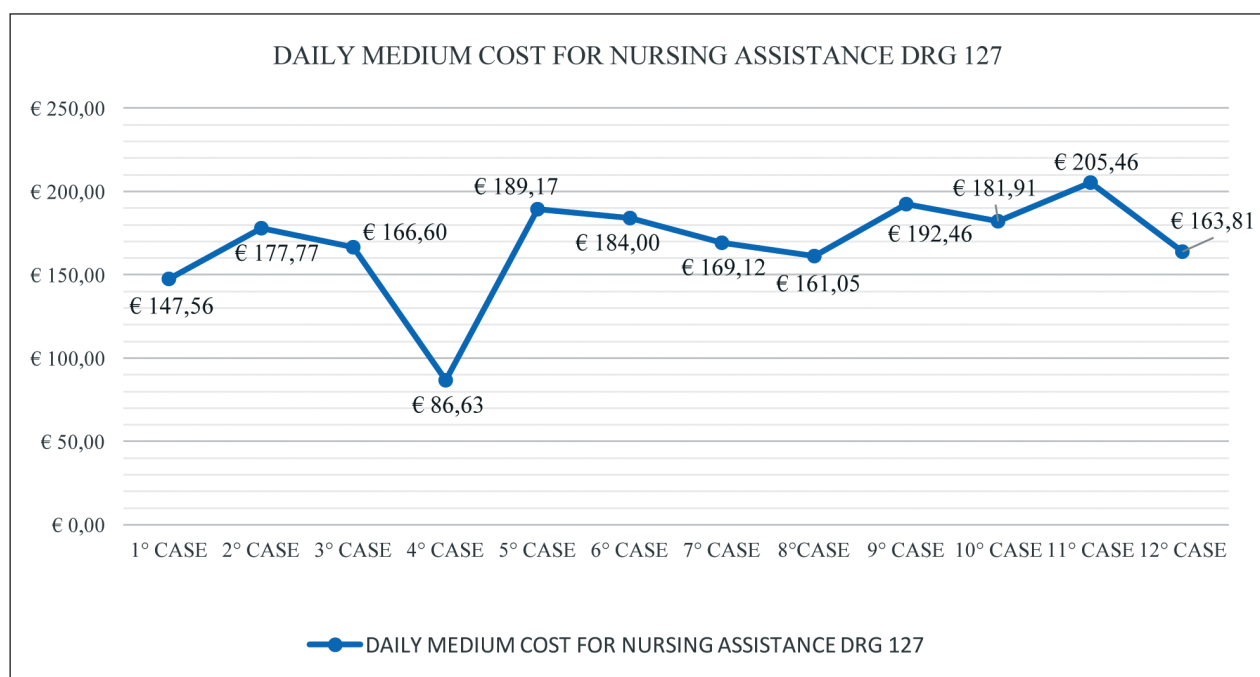
Figure 2.

Multi-center Study

The multi-center study sample was composed of 135 cases. The sampling was distributed across the Diagnosis Related Group (DRG) system with 65 different DRGs.

The multi-center study rejected DRGs with less than three cases, and analyzed the thirteen DRGs which had more than three cases.

The results obtained by the two studies have allowed us to confirm that it is possible − by using the proposed approach − to calculate the direct and indirect costs of nursing activities, and also compare them with the present DRG system to analyze specific characteristics. In fact, a highly significant correlation has emerged ($p<0.001$) between nursing costs and the length of hospital stay, which is equal to 0.8923. The present system misses important elements which serve for a correct fee structure for care, as, for example, the autonomous activities of health professionals.

It is important to underline that a DRG doctor cannot completely realize the quality and quantity dimension of nursing care. In particular, understanding of the quality aspect is completely lacking.

It would be advantageous to create a monitoring and fee system that respects the multi-disciplinary aspect when taking charge of a patient. And so, we should be speaking of a DRG for the patient which takes into consideration the whole process of patient care, and therefore all the necessary provisions of service required.

Discussion

The advantages of this study can be seen in the relevance of the subject. It allows for a better definition of the nursing profession (of the health services professions) and would simplify the creation of investment plans that guarantee adequate care for patients. Up till today, the calculation of the fees can be seen to be partial, in that it is exclusively designed to pick up the service of doctors with a reduced "Time" item for health service professionals.

We feel that this study has amply demonstrated that time as a single variable is no longer sufficient to nurture the fee system that is presently employed. For this reason, we feel that it is important to propose the creation of a permanent national observation unit for the health profession. This could work in synergy with the present National Commission for Essential Levels of Assistance (L.E.A.) analogously with the present D.R.G and/or Delisting sub-groups which are, at present, intended to make the system adequate and applicable. Its structure should guarantee the creation of local, regional, and national data flows with figures dedicated to the creation of systems of traceability for nursing services (health service professionals). This would permit validation with regards to the standardization of assistance interventions. On a national scale this would enable the application of the "intervention cost index" across the whole of Italian territory.

The activation of a pilot plan at regional level would be auspicious. The plan should be able to define the roles, the necessary skills, and the organization structures which would accommodate them.

The pilot study activity could be made concrete by the creation of standardized packages (Assistance Settings) able to define the best practice for nursing services to guarantee the length of hospital stay. These would improve the setting of fees both in terms of daily cost as in the overall recovery event.

In a second phase, it would be useful to insert into the present DRG system, specific DRGs for nursing assistance related to autonomous activities (which up to now have not been registered by the DRG system). An improvement of the calculation of DRG fees is also to be desired, as today only the size of the collaborative activities of the health service professionals is noted.

This must be able to overcome the simple and generic time variable (only the "Minute" entry for the health professions appears in today's DRG) with greater traceability based on the type of operation/intervention connected to a specific outcome.

This study also proposes another and very important question which can find an adequate response only by carrying out the phases discussed above. The costs of nursing care represented in this work − as presented in the example of the case shown in Table 1, equal to € 812.41 (including nursing assistance costs for the recovery stage) − is a fee that derives from the actual D.R.G. shown in Table 2. Further possible hypotheses

can plan for an increased value of the fee itself. At present, the data in our possession does not allow us to formulate an adequate decision which could be taken up for further in-depth studies.

Limits

The limits of this study can be seen in three factors:
- The cases analyzed have been classified by the Diagnosis Related Group (DRG) because it is the only instrument present on Italian territory.
- The fee should be calculated on a national scale. The cost of standard nursing assistance of the recovery event should be analyzed respecting the main principles of "good practice" and guarantee required and safe outcomes.
- The following costs should be analyzed on a national scale:
  o Health services material and material from other sources;
  o Equipment used (maintenance and depreciation);
  o Transfers (for indirect services for the patient);
  o Indirect representation of the costs of productive factors attributed to the production unit, but not directly used in the production of each individual service (for example: cleaning, utilities, electrical consumption, etc.).

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