ACQUISITION OF COST DATA FOR SURGERY AND INTENSIVE MEDICINE TO BE EMPLOYED FOR DRAFTING A DRGs HOSPITAL REIMBURSEMENT SYSTEM IN GREECE

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Abstract: We have attempted to acquire the necessary cost-data in the Operating Rooms (OR) and the Intensive Care Units (ICU), to be employed for a DRGs hospital reimbursement system in Greece. A representative group, including a Regional University Hospital, a Provincial Hospital on an island, and a Private Hospital in Athens, has formed the test-ground for the on-site data acquisition. The acquired data include Medical Equipment, Reagents, Consumables and Disposable Materials, Drugs, Man Power, Building Leasing and Infrastructure Maintenance expenditures, as the most important cost-components. Each cost component is broken down to a number of elementary and accessible fundamental economical figures such as purchase prices, expected equipment life etc. and they are correlated to the mean actual Department output. The task-force set-up invested about over 40 person-months to acquire, locate and collect, classify, process and present data in various forms, so that they become workable for the set purpose. The obtained data form a reliable base for drafting DRGs in Greece; however, there is an enormous discrepancy, between the high actual mean costs in the OR and the ICU, and the present relatively very low Health Insurance remuneration of the Hospitals.

Introduction

The Diagnosis Related Groups (DRG) system, developed initially at Yale University, has been adopted by most of the public in the EU. It seems inevitable that this will happen also in Greece, during the next few years, although this issue has not yet been publicly addressed.

However, a cardinal prerequisite for the adoption of a refined DRG system is the acquisition of health-care delivery related data, based upon the Greek real-word conditions. The later seems to be both, controversial and multifaceted, due mainly to the discrepancies between the conditions in the two major cities, Athens and Thessaloniki, the rest of the mainland, and the numerous islands.

Therefore, a medical procedure cost-capturing algorithm has been developed for the major Hospital Departments and Units [1]-[6]. The algorithm allows for an appropriate correlation of the major cost components, that is, first, the mean medical equipment cost contribution, second, the average building and infra-structure maintenance cost component, third, the approximate reagents and other material cost, fourth, the mean procedure related medication cost, and fifth, the weighted man-power cost, to any medical activity that can be selected out of a four-level Medical Procedures Classification and/or a three-level in vitro Laboratory test Classification.

The proposed algorithm, implemented on specific department-customized software-tools, allows for an efficient and realistic approximation of single-activity cost. This in turn will constitute the input data for the formation of an appropriate medical record, that is intrinsically, however latent, related to the costs caused and the expected reimbursement. Thus, the updating of the patient's relevant medical data, ignites when relevant, the corresponding revision of an implicitly associated financial record, that allows for a good approximation of the individual DRG-coded case-cost.

The system was tested within a representative group, including a Regional University Hospital, a Provincial Hospital on an island, and a Private Hospital in Athens, for the on-site data acquisition, and the obtained extended data will be presented.

Materials and Methods

In order for the estimation to become feasible each cost component was appropriately analyzed in a number of fundamental economical parameters (e.g. purchase prices, expected equipment life times, etc) that can be easily traced and entered into the system by any of the department's personnel, without being necessary for him / her to have special accounting skills, but merely good knowledge of the department's operational procedures. Once these parameters are filled the mean actual department output is estimated by entering into the system the frequency with which various medical procedures take place into the specific department.

The building and infra - structure maintenance cost is calculated by converting the approximate building value into a virtual annual rate. This rate, together with the maintenance personnel salaries, the overheads and

ISSN: 1727-1983

the outsourcing cost can be transformed into a hospital's maintenance cost per square meter.

Using the above features as inputs, the approximate mean cost contribution of each cost component in every medical procedure can be easily calculated using simple mathematical equations. The actual flow diagram of the developed procedure is demonstrated in the following figure (Figure 1).

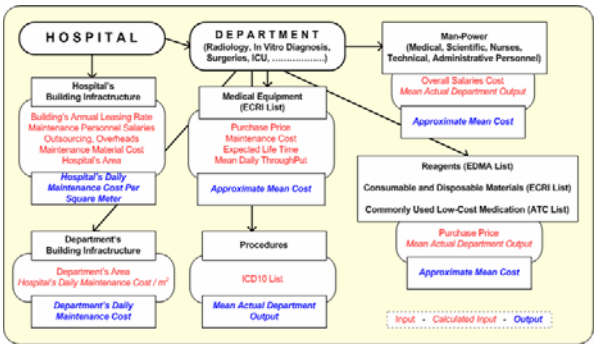

Figure 1: The flow diagram of the developed procedure.

Apart from this approximate mean cost contribution, a number of specific cost parameters are also determined for some of the procedures, when for example some high-cost medication or material is explicitly used for a medical procedure and cannot be included in the mean calculation. Such instances are for example the implantable pacemakers and the orthopedic implants that are used in specific surgical procedures.

Although all the above mentioned cost components contribute to all medical procedures, their contribution is most of the times not equal, depending mainly on the nature of the Hospital's Department / Unit in which the procedures take place. Thus, for the final cost estimation an array of weight factors, which are presently empirically determined, is introduced into the system.

Results

The task-force, set-up among graduating students on their final projects and/or on their six months on the job training and staff of our Department, invested about over 40 person-months to primary acquire, locate and collect, classify, process and present data in various forms, so that they become workable for the set purpose.

Over 500 operations covering all surgical specialties have been processed and evaluated and the ICU cycle has been evaluated for nine months. The obtained data were not usually complete, and they needed further processing.

A more detailed presentation of the various types of the acquired data is following. The presentation covers the most important cost components and their break-down if necessary.

Concerning the personnel cost component, the starting point for the public Hospitals was the official monthly salary lists of the Ministry of Health. Since the approach is of statistical and not an accounting nature, we do not need to take into account the individual pay-rolls of the employees, an approach that would be indiscrete and practically impossible.

The algorithm discriminates between Medical and other scientific Staff, Nurses, Technical and Administrative Personnel, and Auxiliary Personnel. The internal structure of each personnel category has also been taken into account. The overall salaries cost of a Department or a Unit is distributed over the service outcome, resulting in an elementary activity cost component. Distribution patterns can be defined and modified, according to the relevance of the locally performed activities.

By taking into account the approximate Medical and Nursing staff structure in the Operating Department, an hourly mean cost was calculated for each Operating Room (OR) that is presented in Table 1.

Table 1: An indicative hourly cost-basis for a mean virtual OR team.

Medical/Nurse Specialty	Cost/hour €
Surgeon A	21.90
Surgeon B	16.40
Resident	10.80
Anaesthesist A	18.33
Anaesthesist B	13.50
Anaesthesia Nurse	8.39
Instrumentariun Nurse	8.39
Management Nurse	8.39
Trainee Nurse	6.91
Total	**113.01**

By employing a similar approach for the involved personnel outside the OR, a break–down for the mean per patient cost-basis has also been estimated and is presented in Table 2.

Table 2: An indicative mean per patient cost-basis for the involved personnel outside the OR.

Medical/Nurse Specialty	Cost/patient €
Operating Room Head Nurse	2.41
Recovery Room Head Nurse	2.41
Recovery Room Nurses (2)	4.48
Ward & other Nurses (4)	8.96
Stretcher personnel (1)	9.21
Janitors (2)	12.28
Total	**39.75**

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A slightly modified and appropriately adapted approach was employed also for the private Hospital, however, only for the ICU, since the OR medical staff reimbursement in the private sector is based upon individually negotiated fees by case and not by salary. Therefore, the OR manpower cost statistical approach is indicative only for the Greek National Health System (ESY) Hospitals.

Concerning the estimation of the Medical Equipment mean cost contribution, the Equipment are, first, classified according to ECRI, second, the actual Medical Equipment item purchase price is transformed into a virtual daily leasing rate, and third, the actual maintenance cost is transformed into a virtual daily maintenance rate. Further, an expected mean life-time is assigned, a mean daily throughput or load factor is calculated, and finally an appropriate approximate mean elementary operational cost is then calculated. As an example, an indicative step by step calculation example of the mean per hour cost for an Operating Room Monitor is presented in Table 3.

Table 3: An indicative step by step calculation example of the mean per hour cost for an Operating Room Monitor.

DATEX COMPACT S5 Monitor (Registration Sheet)	
Installation Date	10-11-2003
Expected Service Duration	8 Years
Yearly service – hours required	11
Purchase Price	24 347.00 €
Yearly lost value	3 043.37 €
Daily lost value	11.53 €
Yearly maintenance cost	92.29 €
Daily maintenance cost	0.35 €
Total daily cost	11.88 €
Total hourly cost	**1.48 €**

The total equipment mean hourly operational cost is achieved by calculating the corresponding cost for all the equipment included in an Operation Room. This cost depends strongly on the type, the mission, and the location of the hospital that it belongs, and it constitutes an important measure for the technical support provided to the surgical team.

About 40 items are installed in an Operating Room. For all these items, according to the hospital inventory, a record was created including installation date, purchase price, expected Service duration (life) and the mean yearly service – hours required. Further, the yearly and daily lost value, the yearly and daily maintenance cost, and finally the total daily and hourly cost were calculated.

The variation of the equipment mean hourly operational cost among 10 different Operating Rooms, all belonging to a modern regional Hospital in Greece, and, thus, serving the most common Surgical Subspecialties, is presented in Figure 2. The Mean Value is 29.05 € and the corresponding Standard Deviation (SD) is 10.87 €. The equipment mean hourly operational cost of the corresponding Recovery Room is essentially lower than the one of the OR and is approximately 8.06 €.

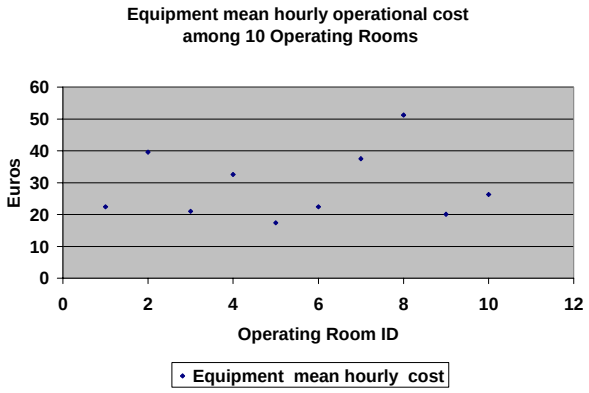

Figure 2: The variation of the equipment mean hourly operational cost among 10 different Operating Rooms serving the most common Surgical Subspecialties. The Mean Value is 29.05 € and the corresponding Standard Deviation (SD) is 10.87 €. The equipment mean hourly operational cost of the Recovery Room is 8.06 €.

Detailed data related to consumables, disposable and other material components used during an operation have been acquired, documented, and classified in 16 categories, covering all surgical subspecialties and the most frequent cases treated. The data cover 16 spread-sheets including several hundreds of materials, and their prices. The annual material cost is appropriately weighted and distributed to the actual output, i.e. the number of the performed operations. A summary of the documented surgical materials is presented in Table 4.

Table 4: Data related to consumables, disposable and other material components used during an operation.

Surgical Specialty	**Items Sets (#)**	**Surgical Specialty**	**Items Sets (#)**
Gen. Surgery	314	Cranial Surgery	13
Gen. Orthop.	88	Vascular Surgery	36
Osteosynthesis	205	ENT Surgery	17
Arthropl. Knee	136	Prothesis/Breast	5
Arthropl. Coxal	82	Prothesis/Testicles	1
Gastrointestinal	12	Neurosurgery	12
Aneurysm	4	Opthalmic Surg.	186

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Medication Cost can relatively easy be calculated since the Drugs are classified and priced by a National Authority. The algorithm and its implementations allows for and assists the discrimination between commonly used low-cost Medication resulting in approximated mean values for each Unit, and individually prescribed medium and high cost Medication, such as Antibiotics, Cytostatics, Antiviral Cocktails etc.

Both, personal and statistical mean contribution of Medication Cost can be calculated; however, in the Operating Room the main cost occurs from the anaesthesia agents (Table 4) and other related drugs, administered during the operation. Blood cost could also be an issue, in some blood intensive cases, such as Cardio-surgery.

Table 5: A typical alphabetical excerpt of the drugs spread-sheet employed to the calculation of a surgical case cost.

Product	Package	Qty	Price €
NIMBEXAMP 10ML X 2 MG / ML	1 BT : 5 AMP	10	299.66
NITROLINGUAL	1 INJ.SO.INF: 1 BT	4	21.58
NORCURON	1 BT: 10,00 AMP	16	245.41
NORCURON	1 BT: 10 VIALS	8	292.56
NOVAQUASOL A	1 CR.EXT.US : 1 TUB	2	2.16
OXYTOCIN/GAP	1 BT : 2 AMP	94	95.65
PENTOTHAL/ABBOTT	1 VIALS	77	137.94
PRIMPERAN	1 BT : 6 AMP	12	8.90
PROPOFOL / ABBOTT 20 ML	1 BT : 5 VIALS	14	204.05
PROPOFOL-LIPURO 100ML	1BT: 1 FLACON	30	437.25
PROPOFOL-LIPURO AMP	1 BT : 5 AMP	40	583.00

Concerning the estimation of the Building and Infra-Structure average leasing and maintenance cost, first, the actual approximate building value is transformed into a virtual annual leasing rate. Second, the actual maintenance personnel salaries and outsourcing cost is transformed into a virtual annual rate. Third, the annual energy, water, communication, and maintenance material costs are calculated. Finally, the actual Maintenance Equipment item purchase price is transformed into a virtual annual leasing rate.

A daily maintenance cost per quadrate meter is calculated. Weight factors for special Departments, as for example, ICU/CCU, Operating Rooms etc. are also determined.

Concerning the duration of the operations, the starting point was the recorded pre-anaesthesia and main operation times, as well as, the corresponding recovery times, for 535 various types of operations, covering General Surgery, Orthopedics, Maxillar Surgery, Cranial Surgery, Neurosurgery, Vascular Surgery, ENT Surgery, Ophthalmic Surgery, and Obstetrics / Gynaecology Surgery.

Two indicative examples demonstrating the variation of the duration of 24 different types of Neurosurgical Operations, and of 261 different types of Orthopedics and Maxillar Surgery Operations, as well as, the corresponding recovery times, are presented in Figures 3 and 4.

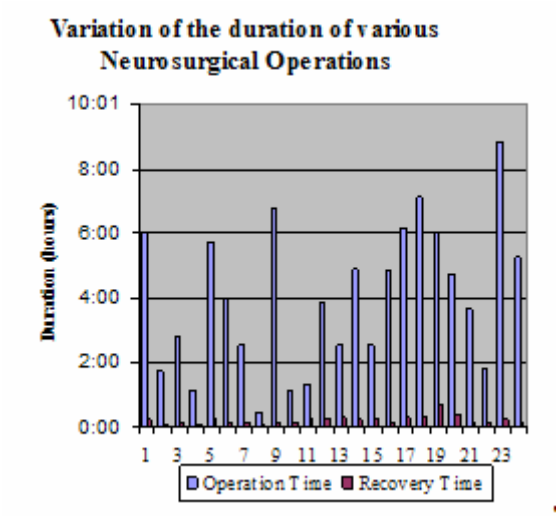

Figure 3: Variation of the duration of 24 different types of Neurosurgical Operations and of the corresponding recovery times.

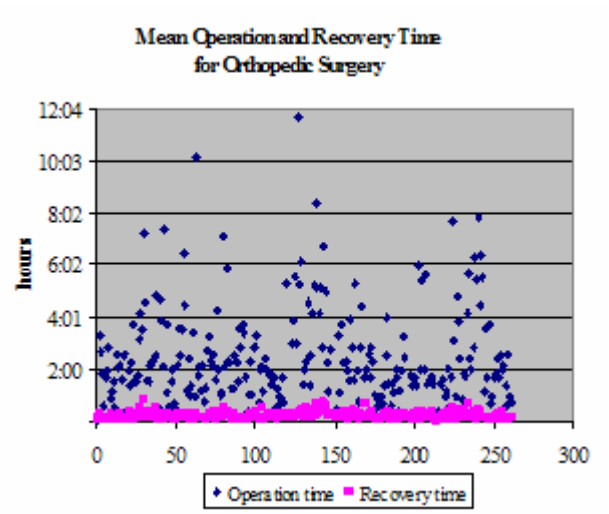

Figure 4: Variation of the duration of 261 different types of Orthopedics and Maxillar Surgery Operations and the corresponding recovery times.

After having completed the detailed presentation of the various types of the acquired data, covering the most important cost components, that is, Medical Equipment, Consumables and Disposable Materials, Drugs, Man Power, Building Leasing and Infrastructure Maintenance expenditures and their break-down, as well as, after having recorded the duration of numerous different types of Operations and the corresponding recovery times, it is relatively easy to combine the

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available data, in order to calculate the mean cost of an operation type. An example of the calculated single-case cost data for a typical laparoscopic cholocystectomy is presented in Table 6.

Table 6: Example of the acquired cost data and treatment duration for a typical laparoscopic cholocystectomy.

Mean Costs	**Euros (€)**
Human resources (surgical /others)	228.10
Surgical and other material	487.87
Anaesthesia factors & other drugs	79.71
Medical equipment employment	37.01
OR and Recovery occupation cost	12.36
Mean procedure duration	**min**
Pre-anaesthesia	35
Main operation	65
Recovery	15

We have calculated the mean cost for the above mentioned 535 different cases, classified within the most important surgical subspecialties. An indicative example, presenting the variation of the Calculated Cost for 52 different Urological Operations is presented in the following Figure 5.

The mean cost is 812.30 € however the Standard Deviation is very high, reaching the 728.69 €, an expected outcome, due to the very wide range of variation in severity and complication, among the various cases treated in a Hospital.

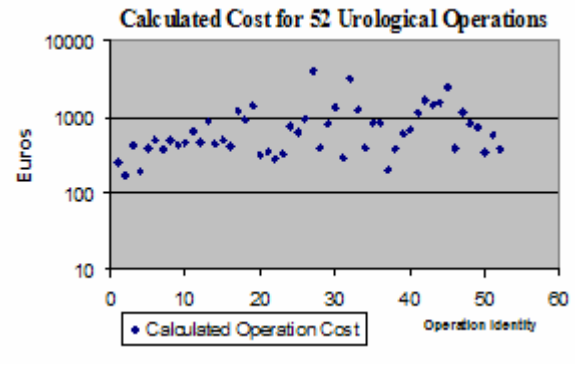

Figure 5: The variation of the Calculated Cost for 52 different Urological Operations. The mean cost is 812.30 € however the Standard Deviation is very high reaching the 728.69 €.

Concerning the Intensive Care Unit (ICU) cost calculation, the patient admission-release cycle has been evaluated for a period of nine months. The obtained data were not complete, and they needed further processing, in order to be fitted in the logic already described above.

However, as shown in the following example in Table 7, they could form a reliable starting point for drafting ICU/CCU related DRGs in Greece, after further verification in a larger and more representative, concerning the randomness, group of hospitals.

Table 7: Some indicative cost data for the ICU.

Mean Costs	**Euros (€)**
Mean fixed cost per day	120.00
Average variable cost per patient	1,651.00
Main sources of cost	**%**
Human resources	42.6
Supporting services	21.2
Drugs	16.7
Overheads	8.6
Disposables	5.1
Equipment employment	4.2

Conclusions

Comparing the calculated data for 535 Operations covering all specialties (Figure 6) with the official minimal and maximal nominal Reimbursement amounts for 107 frequent types of Operations (Figure 7), it becomes obvious that the calculation basis of the second set of data is entirely different.

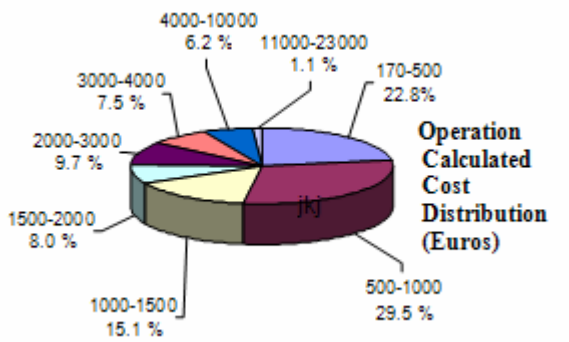

Figure 6: The Distribution in 8 cost classes of the Calculated Cost in Euros for 535 Operations covering all specialties.

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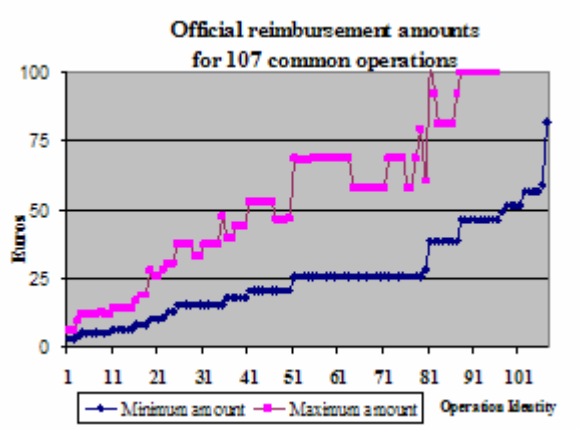

Figure 7: The official minimal and maximal nominal Reimbursement amounts for 107 frequent types of Operations.

There is an enormous discrepancy, between the high actual mean costs in the OR, and the relatively very low Health Insurance remuneration of the Hospitals. By special legal regulation [7], realistic pricing has been exceptionally assigned, to an indicative group, comprising of 14 high cost, mainly cardiovascular and arthroplastic operations, covered by the insurance of the patients. These pricing only is very close to our results.

Concerning the ICU, the official daily reimbursement amount per patient, hardly covers the mean fixed cost per day, since the usually very important average variable cost per patient remains uncovered.

These discrepancies lead to the planned creation of unavoidable debts for all public hospitals. Therefore, the data acquired according to our method, although not always complete, constitute a rather reliable base for drafting DRGs in Greece. In order to facilitate the optimal data acquisition in the public hospitals, appropriate Microsoft Visual Basic based software has been developed and is presented in another paper in this conference [8].

However, long term employment of the method and the supporting tools is required, in all types of public Hospitals in Greece, in order to create an adequately precise set of data, leading to a refined Hellenic DRGs System, and, thus, to the introduction of a more rational Hospital financing and reimbursement schema.

Acknowledgements

This work is part of a project co-funded by 75% from European Union and 25% from the Greek Government under the framework of the Education and Initial vocational Training Program "Archimedes".

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ISSN: 1727-1983