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**"AN ANALYSIS OF HOSPITALIZATION COSTS:**  
**THE CASE OF AZIENDA OSPEDALIERA DI PADOVA"**

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*“Volere è potere...”*



## **Abstract**

Since 1992 New Public Management inspired managerial principles in public health firms and the introduction of accounting systems and costing methodologies met the requirement of greater efficiency and transparency in all public sector. The need to identify the “true” cost of health care delivering lead to developing always more accurate costing processes. Patient Level Costing represents the deepest degree of health care cost accounting methods. This study undertakes an analysis of hospitalization costs through a Patient Costing approach in Azienda Ospedaliera di Padova which is a highly complex and specialized public hospital firm. AOP sends hospitalization costs data to a network of hospital companies which pools economic and health information in order to create standard costs and to perform benchmarking activity.

**Keywords:** Azienda Ospedaliera di Padova – Patient Costing – Hospitalization – Standard costs



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## Introduction

The official birth of the Italian National Health System dates back to the radical 1978 reform that introduced universal access to health care implementing Article 32 of the Italian Constitution which guarantees the “right to health” of all individuals. The Italian health system was then repeatedly reformed: the end of the so-called “First Republic” (1992), characterized by the misuse of public resources and episodes of fraudulent behaviour among party politicians, demanded for greater efficiency and transparency in Italian public administrations; the call for the “managerialisation” of the Italian public sector became more or less inevitably part of a more general moral drive for the “cleaning up” of the whole public domain<sup>1</sup>. Therefore, since that year, New Public Management (NPM) principles inspired healthcare reforms in Italy and, more precisely, decentralization, quasi-market and managerialism. The last principle introduced in healthcare companies managerial concepts and tools typical of private enterprises in order to ensure a more effective and efficient use of resources; that is, healthcare organizations needed budgeting and new accounting systems for planning and controlling purposes. Accounting systems and costing methodologies play a key role to produce reliable costs data in order to strategically manage healthcare operations, producing high quality services and, at the same time, containing healthcare public expenditure. After the 1998-1999 reform and the last phase of fiscal federalism, the National Health System appears as a system of Regional Health Services and is organized into three levels: national, regional and local level. The national level ensures the general and fundamental principles of the Italian healthcare system while the regional health institutions work for guaranteeing the delivery of a basic benefit package (Livelli Essenziali di Assistenza – LEA) through a network of local health enterprises called “ASLs” (Aziende Sanitarie Locali”) and public and private accredited hospitals. The first chapter is an introduction and an overview over the Italian National Health System: initially the historical steps that led to the establishment of the NHS in 1978 and the main reforms since 1992 are described; later on, the thesis concerns the organizational structure and a summary of both public and private healthcare expenditure, comparing Italy with EU countries. A particular focus is given to the financing framework and DRGs classification; the debate around the weighted capitation and standard costs system close the first part. The second chapter concerns the “cycle” of management decisions and the main control tools used for planning and controlling purposes (budget, analytical accounting, reports and indicators

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<sup>1</sup> Panozzo F. (2000). Management by decree. Paradoxes in the reform of the Italian public sector, Scand. J. Mgmt.

system). Afterwards it deals with costing methodologies in the healthcare sector: it describes the difference between Top-down and Bottom up approach and then it gives a particular focus on the methodologies Activity-Based Costing, Time-Driven Activity-Based Costing and, finally, Patient Costing. The third chapter presents an overview over the organizational and economic structure of Azienda Ospedaliera di Padova, analysing its financial situation and the delivering of hospital care. Padua Hospital, hereinafter AOP, is a public corporation born on January 1<sup>st</sup> 1995, following the divestiture of Local Health Trust ULSS 21, in which the former Civil Hospital was included. The AOP is recognised as a Highly Specialised Hospital of National Importance and it is identified by the Regional Community Health Plan 2012-2016 as a “hub-centre” for the Province of Padua. Moreover the AOP is for the University of Padua the reference healthcare organization for the development of the functions of teaching and researching of the School of Medicine. Finally, the last chapter describes the Patient Costing analysis performed during an internship experience in the AOP Planning and Control Unit. The project was a long process divided in several phases: first of all, before starting the work, a meeting between all the AOP P&C Unit was arranged; during that meeting the work to be carried out was planned and then it was divided between all the staff involved. Thereafter the phase of collecting and managing the data began: this stage was useful to get an overview of all the "production process" of the Hospital of Padua and to understand the complexity of AOP. After this phase of data collection, the analysis continued loading data in the “CSO” software, an evolved data base used for costing each episode of hospitalization: the data loading process in the “CSO” software was a complicated procedure that required support from IT staff. Once the cost for single patient episode is obtained, data can be aggregated in various way depending on the analysis to perform. Therefore the final stage of the whole process has been the analysis of the results obtained: the study paid main attention over the costs of patients discharged by an Operating Unit and some DRGs costs of production. Every year, Azienda Ospedaliera di Padova send hospitalization costs data to an organization called N.I.San. (Italian-Health-Network) which is basically a network of about 24 companies that pool the economic and health information in order to create technical and economic standards and to perform benchmarking activity among all the companies involved.

# 1. Introduction to the Italian National Health System

## 1.1 Historical background

The Italian health system, since the Second World War to date, has gone from an incipient form of social security, supported by state and religious charity, to the social insurance model and, after a brief transition period, to the National Health Service. The historical evolution of the NHS can be mainly divided into three phases:

1. Insurance and charitable phase (from the unification of Italy up to the mid-60s);
2. Full mutuality phase ( from mid-60s up to 1977);
3. Health System phase (after the 1978 Reform with the establishment of the “SSN”, Law N. 833/1978);

In the period going from the unification of Italy (1861) and the beginning of the fascist regime (1920s) the Italian health care system was characterized by several structures sponsored by the Catholic Church, old charitable institutions and other autonomous mutual aid associations for artisans and workers and independent no profit structures. Then employers and employee became the main responsible for financing the health care system since they contributed a percentage of their salary to work related health insurance funds. This kind of insurance since it was financed by contributions paid by the workers themselves and their employers caused that the right to health protection was therefore not related to being a citizen but being employee (or family member of the employee) and this produced many cases of failure to health coverage. In the fascist period (1922-1943) for the first time the right to hospital care for the needy was introduced and some improvements towards mandatory health care insurance for workers were also provided with for example the introduction in 1925 of the National Institute for Local Authority Employees (Istituto Nazionale Assistenza Dipendenti Enti Locali (INADEL)). Later on (1942-1943), the National Institute for Civil Servants (Ente Nazionale Previdenza e Assistenza Dipendenti Statali (ENPAS)) and the National Institute for Disease Control (Istituto Nazionale per l'Assicurazione Contro le Malattie (INAM)) were established: they were the two major institutions for social insurance and health care for respectively the public and private sector employees. In 1958 the Ministry of Health was created and in 1968 some public institutions enabled to provide hospital care as autonomous entities (enti ospedalieri) were constituted. In the early 1970s the Italian health care system was still characterized by nearly 100 health insurance funds each of them with its own regulation and procedures; therefore this

structure was affected by organizational fragmentation, unnecessary duplication of services, bureaucratization and a strong growth of expenditure. Moreover the insurance funds' large deficits caused a financial crisis which forced the government to take action abolishing health insurance funds, transferring the responsibility for managing hospitals to the region and finally in 1978 the NHS was established.

The 1978 Reform created the NHS introducing universal health-care coverage for Italian citizens and those legally residing in Italy implementing Article 32 of the Italian Constitution which sanctions the “right to health” of all individuals<sup>2</sup>. The health reform law, one of the most advanced at that time, was based on the following principles:

- universality of the right to health care for all people and all forms of the disease, without discrimination, limits of time and costs;
- global delivery of services to individuals and to the community: public hygiene services and veterinary, diagnostic services, treatment and rehabilitation, integration with social services, etc;
- uniqueness of the administration of services by the “USL”, as opposed to the multiplicity of bodies deputies before the reform: municipalities, provinces, regions, state, health insurers, hospitals;
- equality of citizens with respect to the health needs and uniformity of treatment in all areas of the country;
- democracy, participation and control over the management of health, through the election of local administrators of the USL;
- decentralization of tax and spending decisions.

Law 833/1978 radically changed the system and represented the first major health-care reform in the post-Second World War period. The SSN was not fully implemented until the 1980s

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<sup>2</sup> Art.1 Law N. 833/1978: "The Republic protects health as a fundamental right and interest of the community through the National Health Service. Protection of physical and mental health must respect the dignity and freedom of the human person. The National Health System shall comprise all of the functions, facilities, services and activities for the promotion, maintenance and recovery of physical and mental health of the entire population regardless of individual or social conditions and in a manner ensuring the equality of citizens against the service (...)"

Art. 32 Italian Constitution: The Republic protects health as a fundamental right of the individual and collective interest, and guarantees free medical care to the indigent. No one can be forced to a specific medical treatment unless required by law. The law can not under any circumstances violate the limits imposed by the respect of the human person.

through substantial unification and harmonization of regulations, information systems and procedures that derived from several independent health providers; it was still characterised by some weaknesses such as the lack of financial control by the central government over expenditure, the over-politicization of SSN organizations, the frequent conflicts between the three political tiers of government, the lack of specific management systems and expertise to run health-care organizations. Therefore after the 1978 reform there were mainly three subsequent legislative improvements:

- 1992 - 1995 Reform (Decree 502/1992, Law No. 724/1994), which introduced elements of "managed competition" through the "managerialism process" (the so-called "aziendalizzazione");
- Decree 446/1997 and 1998 – 1999 Reform (Law No. 419/1998, Decree 229/1999): these legislative interventions transformed the SSN in a system of Regional Health Services funded with taxes (IRAP and IRPEF);
- Federalism (art. 10 Law No. 133/1999, Decree 56/2000, Law No. 42/2009, Decree 68/2011, Constitutional law 3/2001 and recent amendment of July 2014).

Despite the second reform of the NHS was on the policy agenda since a long time, it was not implemented before 1992; in that year the country's main governing parties collapsed due to several corruption scandals, including a major one concerning the regulation of pharmaceuticals. In addition, due to a period of economic crisis and a high level of public debt, Italy had lost the confidence of financial markets and thus needed a series of reforms to reduce public spending: so in this scenario the new reform of the SSN was quickly approved. It included four main components:

1. *Regionalization*
2. *Managerialism*
3. *Quasi-market for specialist care*
4. *Opting-out of the NHS (this last component was repealed in 1993)*

#### *1. Regionalization*

The institutional structure was reorganised reducing the powers of the national tier of the SSN in favour of the 19 regions and 2 autonomous provinces. The 1992 legislation introduced the idea of 'basic benefit packages' (Livelli Essenziali di Assistenza – LEA): basically they are the set of all benefits, services and activities that citizens have the right to obtain from the NHS; these services must be guaranteed to all citizens and on the whole national territory, regardless

of income and place of residence, in times appropriate to the clinical conditions<sup>3</sup>. The reform strengthened the regions' fiscal autonomy and responsibility and also gave them more organizational powers. According to this new model, the national government should define LEA and ensure that regions received adequate resources to deliver it. On the other hand regions were called to ensure the nationally guaranteed services, and would have to use their own resources if they were unable to do so due to inefficiencies or if they wanted to provide additional services beyond those specified in the national basic package. In addition the 1992 Reform included other interventions aimed at:

- redesigning health service supply systems and the boundaries of ASLs;
- detaching larger and more specialized hospitals from ASLs;
- designing new systems to pay providers;
- defining accreditation systems for both public and private providers;
- giving providers guidelines on their organizational arrangements.

To conclude this first point, it has to be said the 1992 reform made the regions the main owners of the health system; the constitutional changes approved in 2001 (Constitutional Law N. 3/2001) confirmed and enhanced these arrangements

## *2. Managerialism, the so-called "aziendalizzazione"*

The 1992 reform initiated the process of "managerialism", a process formally ended in 1995 with the appointment of general managers as heads of SSN organizations, namely the ASLs and AOs, but constantly evolving because it requires a new and different cultural orientation of the management and all the staff. The managerialism was inserted in the context of New Public Management emerged in the United Kingdom under the Prime Minister Margaret Thatcher who played the functional role of "policy entrepreneur" and drove changes in public management policy in such areas as organizational methods, civil service, labor relations, expenditure planning, financial management, audit, evaluation, and procurement. During this period the local health authorities "USLs" (literally "local health units") and some hospitals were transformed in public firm changing their name in "ASL" and "AO" and their management was made compulsory appointing general managers with a university degree and with management experience selected from a list of potential candidates identified by each region. General managers of ASLs (literally "local health enterprises"), now have a five years contract and they can be dismissed by the Region and they are responsible for electing the Health and Administrative directors within ASLs (and in most regions, also the Directors for Social Care).

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<sup>3</sup> Mapelli V.(2012), Il sistema sanitario italiano, Il Mulino.

As firms, ASLs and AOs were called to introduce new management functions such as cost accounting, budgeting, strategic planning, need assessment and quality control. Moreover an accrual accounting system was introduced aimed at measuring organizations' economic viability and tracking their assets and liabilities in order to back up the traditional financial accounting system which is used to plan the expenditure and measure the financial performance. Regarding the accounting structure, up to 2011 across Regions there were still substantial differences with respect to accrual accounting systems. After the Decree No 118/2011 uniform accounting standards were introduced to all public health-care organizations across all the Italian country.

### *3. Quasi-market for specialist care*

The quasi-market mechanism in the health system provides a distinction between purchasers (e.g. ASL) and providers (e.g. bodies which provide hospital care). Moreover this kind of structure is based on:

1. complete freedom for patients to choose any SSN provider (even outside their region) without any prior authorization;
2. inclusion in the market of accredited private organizations which created a fair competition between public and private providers;
3. introduction of a fee-for-service payment system for out-patient care and inpatient hospital care, the last based on DRG classification system<sup>4</sup>.

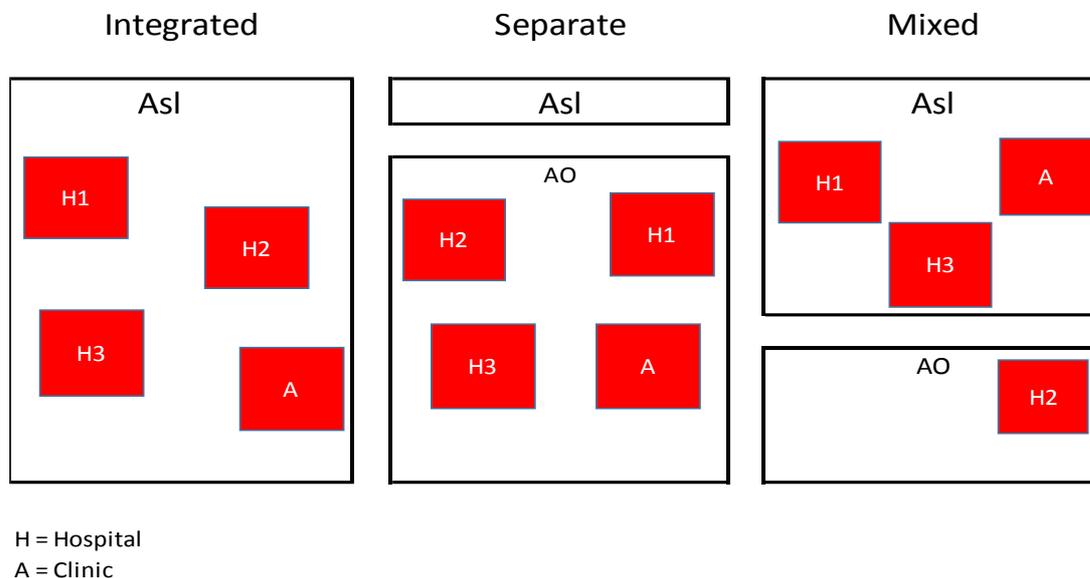
The 1992-1993 health reform has granted to major hospitals in possession of certain requirements the chance to be recognized as "independent" from ASLs thus constituting new types of health corporations. Hospitals lacking the necessary requirements have remained within the ASLs while enjoying greater management autonomy. Three different models of ASLs were then created: "integrated" ASLs, "separate" ASLs and "mixed" ASLs. "Integrated" ASLs are those deriving from Law No 833 / 1978 and are characterized by the presence of all hospitals within the local health enterprise: hospitals are then considered as "factories" and they were subject to the direct management of the ASLs. At the other extreme the most characteristic example is that of the Lombardy model that has a complete separation of hospitals by local health enterprises and therefore responds fully to the need to separate providers (AOs) from

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<sup>4</sup> The Diagnosis-Related-Group (DRG) system will be deeply explained later on; however it is basically a system that allows to classify all patients discharged from a hospital into homogeneous groups for absorption of resources committed. This aspect makes it possible to economically quantify that consumption of resources and thus remunerate each episode of hospitalization. One of the purpose of the system is to monitor and control the health care costs.

purchasers (ASL) and is the necessary condition for creating a system of competition between public and private accredited hospitals. Mixed Asl are those who continue to keep within them some hospitals but at the same time there is a company that has taken legal personality.

Figure 1 Institutional types of ASLs



#### 4. Opting out

The “Opting out” measure, which however has been repealed in 1993, was designed to give patients the possibility to opt-out the SSN; citizens would have continued to pay taxes for the SSN but at the same time they would have received a voucher to use in the private insurance market.

As described before one of the 1992 reform’s main purpose was to create a health care competitive market with public and private providers both players of this “game”.

The third most important reform was introduced in 1999 by the Law No 229/1999 which tried to reverse the pro-market orientation of the previous reform; it remarked the universal character of the SSN system and the health care as a citizen’s right. The government wanted also to limit attempts by some regions to deviate from the national model and to control the private sector. The main measures of the reform were:

- regulation of the medical profession: doctors had to choose between two options for private practice: intra-moenia or extra-moenia. If they choose the intra-moenia private practice, doctors had to use SSN facilities and they were controlled by their independent hospitals or ASLs. Only intra-moenia doctors could have access to senior management positions (e.g. being a department director). The other option was to practise

independently and outside (extra-moenia) the SSN facilities; such doctors could not have access to senior management positions and they received lower salaries;

- participation of municipalities in the revocation procedure and evaluation of the general managers and the development of health policies;
- greater involvement of local communities in the planning of social and health services;
- citizen participation in the planning and evaluation of activities to implement the “Charter of the Services”;
- revision of tariffs for providers and moreover it was determined when and how to activate the social and health districts to enhance the territorial activities.

There are still a lot of different opinions around the meaning and impacts of the 1990s reform of the health care system. According to Taroni<sup>5</sup> the quasi-market system were short lived due to regional policies that limited the extent of competition between providers through caps and targets for each provider and other funding arrangements. Fattore, Petrarca and Torbica<sup>6</sup> found that competition is stronger between different regions, with significant flows of resources coming from to the south to the north and the centre of Italy. Moreover the increased centralization of decision-making at regional level weakened the managerialism since the degrees of autonomy of SSN organizations was reduced.

The last phase of the evolution of the National Health System is related to the fiscal federalism, which was initially introduced by the 2001 constitutional reform and it is still a very debated argument. This significant reform wanted to redesign the Italian’s fiscal system in order to give more power and responsibility to regions but the law 3/2001 did not provide accurate details about its implementation which would also have affected the health care system.

A further step was the Law No 42/2009 which regulated the composition of revenues for sub-national levels of government and established an Equalization Fund aimed at ensuring provision of a minimum standard of health services to those regions with a too low tax income. The new financing system outlined the computation of standard costs in order to determine the standard need at the regional and national level; standard costs should be set at the level of average service costs of the best Italian performing regions.

The last relevant decree dealing with the health care sector was the so-called Balduzzi decree in 2012 which modernized the SSN on several levels. The basic benefit package (LEA) was

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<sup>5</sup> Taroni F (2011). Politiche sanitarie in Italia. Il futuro del SSN in una prospettiva storica. Roma, Il pensiero Scientifico Editore.

<sup>6</sup> Fattore G., Petrarca G., Torbica A (2014). Traveling for care: inter-regional mobility for aortic valve substitution in Italy. Health Policy.

significantly revised for the first time since 2001 and regarding the private professional activities of SSN doctors, specialists were incentivised to work within SSN facilities. It was decided to reorganize the primary care and a set of policies to contain pharmaceutical costs were debated.

## **1.2 Organizational overview**

Following the Britain NHS's model, born in the 1948, the structure of the "SSN" is currently organized into three main levels (national, regional and local).

### *1. National level*

The Ministry of Health is currently organized into three independent Departments:

- Department of Public Health and Innovation, which comprises the directorates of Prevention, Health and Biomedical research, European and International relationships, Communication and institutional relations
- Department of Planning and Organization of the SSN which comprises the directorate of Health-care planning, Health statistics and information system, Health professions and SSN human resources, Medical devices pharmaceutical service and safety of care
- Department of Veterinary Care, Food Safety and Collegial Organs for Health Protection which comprises the directorates of Veterinary care and pharmaceutical, Food and nutrition safety and lastly the Collegial organs for Health Production.

Moreover the Ministry is supported in its functions by several permanent agencies such as the ISS (The National Institute of Health), AGENAS (the National Agency for Regional Health Services), CCM (The National Centre for Disease Prevention and Control), AIFA ( The National Authority for pharmaceutical regulation. Finally two other important bodies which support the Ministry in its functions are the National Health Council and the State-Regions Conference.

The main instrument for national level health-care planning is the National Health Plan (NHP) which defines the LEA, the criteria for ensuring that the financing of regional health care is adequate to guarantee the LEA, the criteria for resource allocation of regional funds across the individual ASLs, the economic sustainability and the criteria for adapting national goals with the epidemiological features and health needs of regional populations

## *2. Regional level*

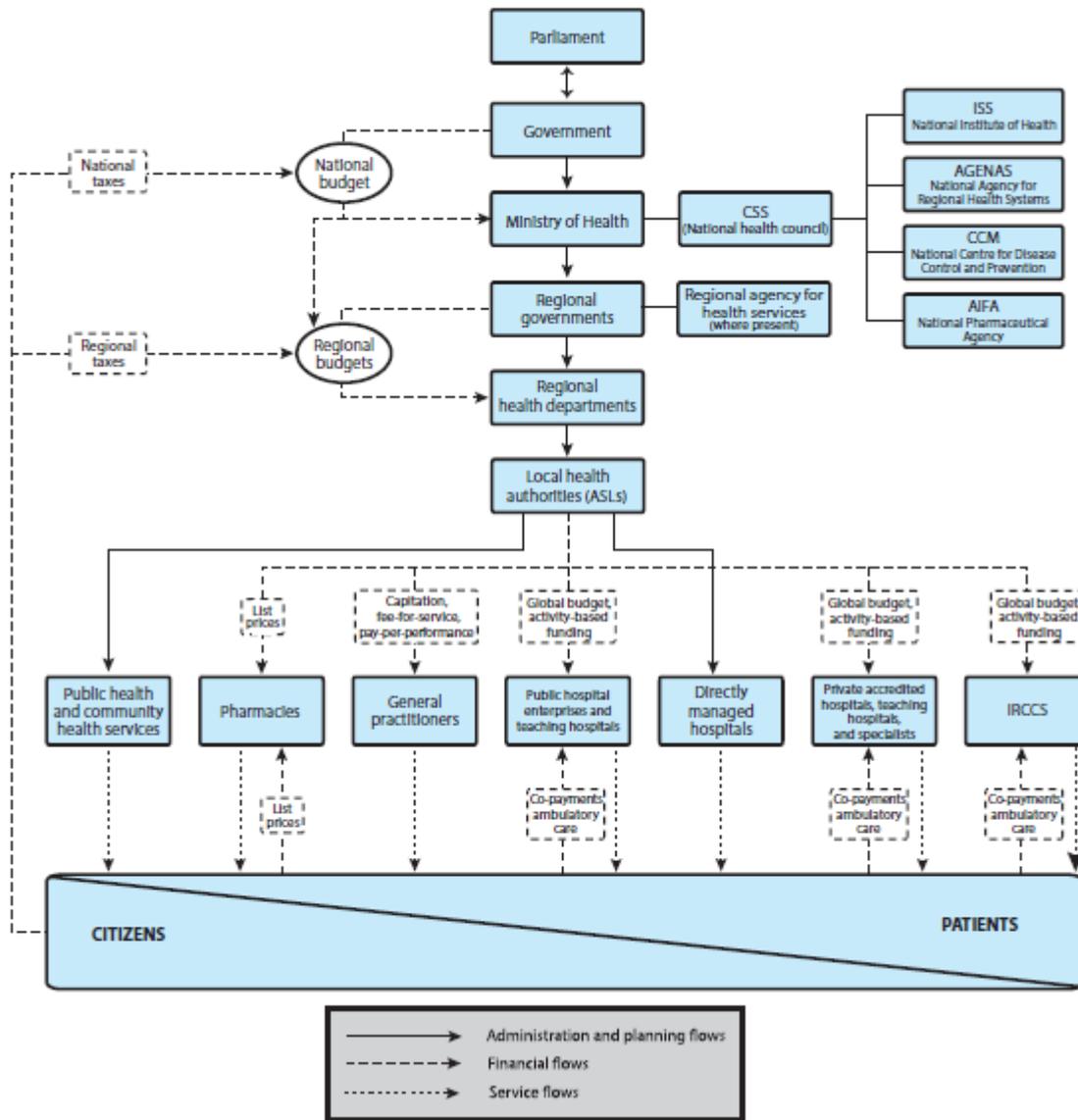
Regions share their planning and financing functions with the national government in the State-Region Conference and they are responsible for delivering health care services through their regional health care systems. Moreover their legislative functions include general principles and organization of the regional health care system, the criteria for financing public and private health care providers. Finally Regions draft the Regional Health Plan which defines the criteria for authorizing and accrediting public and private health care providers, monitoring the quality of their care, coordinating health and social care through a Standing Conference for Regional Health and Social Care Planning, managing ASLs and AOs by defining their geographical boundaries, allocating resources to them.

## *3. Local level*

The responsibility for the delivery of services rests on the ASLs, which are institutions defined on a geographical and on a population size base. These Local Health Authorities provide primary and secondary care in a territory which is divided into Districts; each district cover approximately a population of 60.000 inhabitants. Moreover health care can be either delivered directly by the ASLs through the hospitals they own or by public hospital enterprises, the AOs (Aziende Ospedaliere), or hospitals owned by other ASLs, or by accredited private hospitals . In the latter case, the ASLs work as purchasers of services in a quasi market system. It is up to the individual regions to choose whether to adopt a purchaser-provider separation. The level of planning of ASLs generally is based on the Managing Board, which performs long-term strategic planning and monitoring and the Department Directors, which draft the budget for medium.

The regionalization process which took place after the 1992 Reform has transferred full jurisdiction to the regions with respect to goal setting and planning and as a result they have been experimenting different organizational and funding models. Most regions use an “ASL-centred template”: in this model each ASL acts as both provider and as purchaser of services from a limited number of AOs. This model reflects a quasi-market and, depending on tariffs, ASLs might be penalized if resident patients demand for care from providers other than theirs. Few regions in Italy adopt a “region-centred template” where most purchasing concentrates at regional level and ASLs most of the time act as providers. In Italy, Lombardy is the only region that has carried out a complete split between purchasers and providers; most hospitals are AOs and ASLs buy services from public and private providers while the region has more a regulatory function.

Figure 2 Overview over the organization of the Italian health-care system

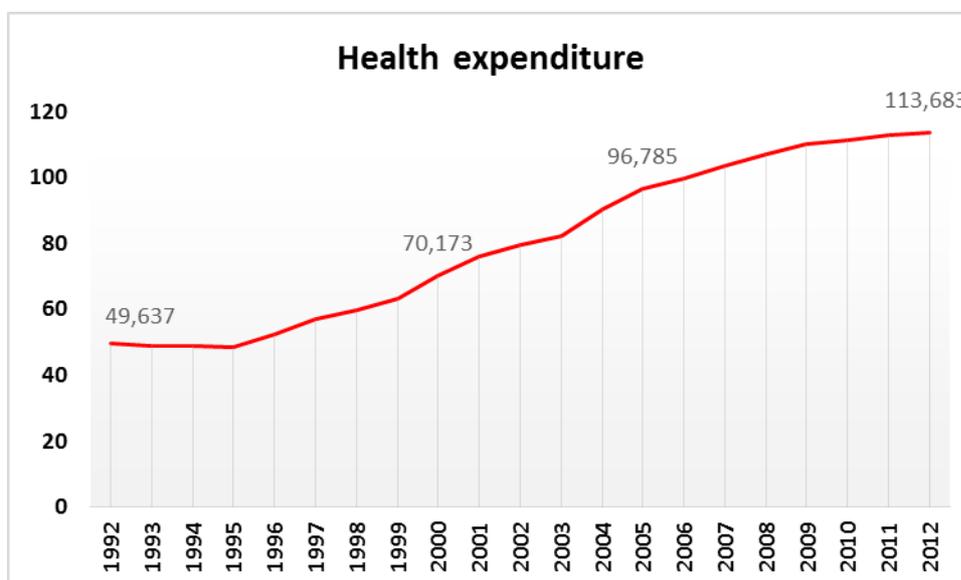


Source: Italy-Health system Review (2014)

### 1.3 Health care spending

Since 1992 up to 2012 in absolute terms the Italian health spending showed an increasing trend (Ministry of Health data). From 1992 the health expenditure increased up to 113 million (2012).

Figure 3 Health care expenditure in absolute terms (Euro)



Source: Ministry of Health data

According to the “WHO health for all”<sup>7</sup> database in 2014, which is the last available year, the total health expenditure was 9.25% of Italian GDP, slightly below the EU average of 9.45%.

Table 1 Trends in health expenditure in Italy and EU as a share (%) GDP (1995-2014)

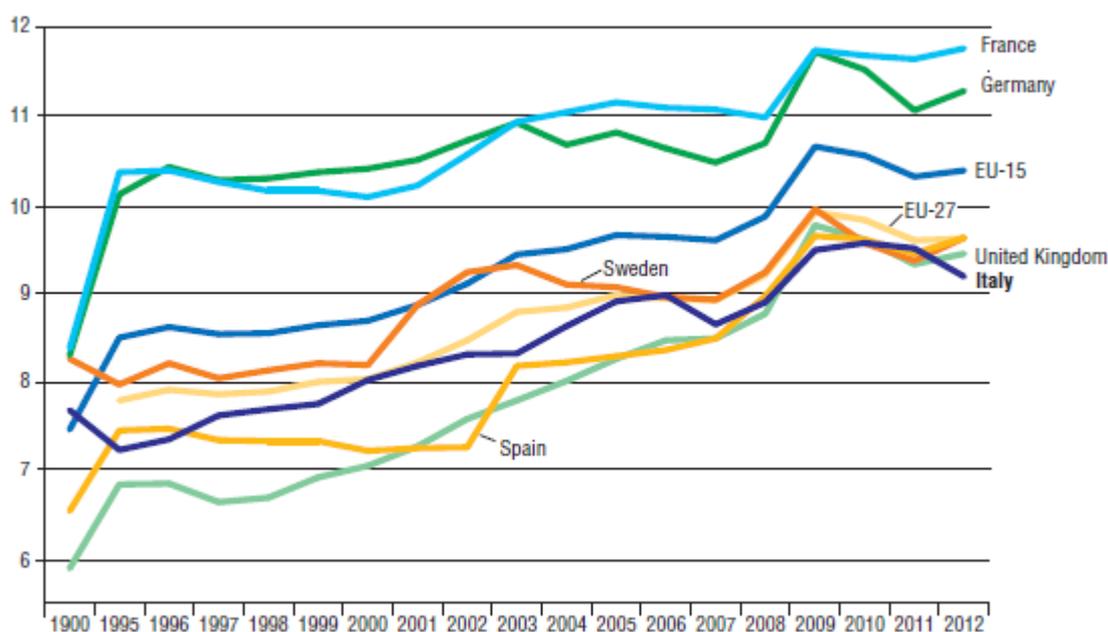
	1995	2000	2005	2009	2010	2011	2012	2013	2014
<b>Italy</b>	7,1	7,91	8,71	9,41	9,42	9,27	9,28	9,22	9,25
<b>EU</b>	7,55	7,87	8,76	9,67	9,56	9,48	9,51	9,5	9,45

Source: WHO Health for All database, 2016

The figure below shows Italy’s position with regard to health care expenditure as a percentage of GDP of a section of Western European countries from 1990 to 2012. During this period Italy was one of the lowest countries regarding the health expenditure together with Spain and the United Kingdom.

<sup>7</sup> The data are compiled from various sources, including a network of country experts, WHO/Europe’s technical programmes and partner organizations, such as agencies of the United Nations system, the statistical office of the European Union (EUROSTAT) and the Organisation for Economic Cooperation and Development. HFA-DB is updated twice a year.

Figure 4 Trends in health expenditure as a share (%) of GDP in Italy and selected countries (1990-2012)



Source: WHO health for All, 2014

The total health-care spending is mainly represented by the public sector (76% in 2014 ): the italian public expenditure in health care over the total health expenditure is near the EU average. Northern countries such as Denmark, Norway, Sweden, Netherlands are those that have a higher percentage while Spanish and Portuguese public system have the lowest.

Table 2 Public health expenditure over the total health expenditure (1995-2014)

	1995	2000	2005	2009	2010	2011	2012	2013	2014
<b>Italy</b>	70,76	72,09	76,31	76,99	77,04	75,14	75,34	75,59	75,61
Spain	72,18	71,62	72,37	75,72	75,07	73,86	71,73	71,49	70,88
Portugal	62,62	67,75	70,06	68,73	68,71	66,55	64,03	65,24	64,82
France	79,69	79,38	77,99	77,54	77,51	77,03	77,16	77,08	78,21
Germany	81,42	79,17	76,13	76,38	76,22	75,99	76,07	76,75	76,99
Uk	83,86	79,58	80,85	83,21	83,53	83,15	82,91	83,31	83,14
Denmark	82,52	83,86	84,48	85,04	85,13	85,3	85,76	85,3	84,76
Netherlands	71,04	63,08	69,48	86,5	86,69	86,31	86,52	87,07	87
Sweden	86,65	84,89	81,16	81,5	81,51	84,72	84,35	84	84,03
Norway	84,23	82,49	83,54	84,57	84,7	84,48	84,9	85,24	85,49
Finland	71,69	71,26	73,81	74,94	74,5	74,94	75,72	75,46	75,31
EU	76,92	75,49	75,46	76,72	76,68	76,05	75,79	76,1	76,23

Source: WHO Health For All database, 2016

Although out-of-pocket spending at around 21% of health spending has not increased too much in recent years, it remains relatively high compared with other western European countries such as France (6%), Germany (13%) and United Kingdom (10%), although still well below some other southern European countries such as Portugal (27%).

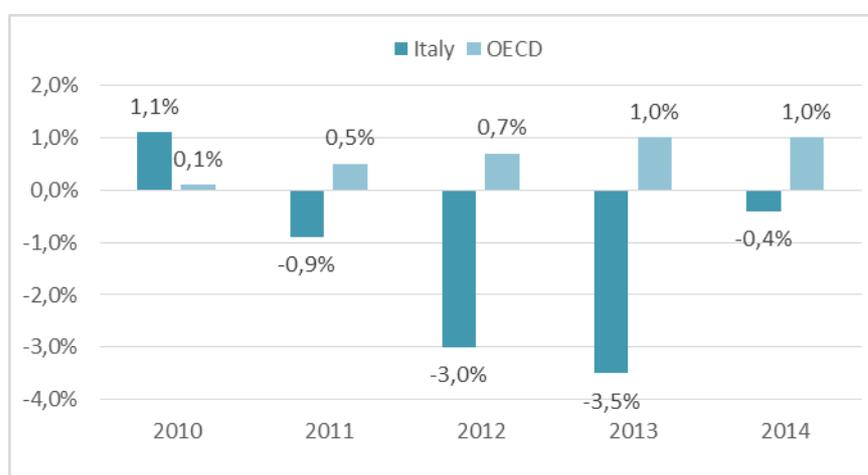
Figure 5 Out of Pocket health expenditure over the total health expenditure (1995-2014)

	1995	2000	2005	2009	2010	2011	2012	2013	2014
<b>Italy</b>	26.86	25.34	20.74	19.69	19.52	20.96	20.91	20.64	21.19
Spain	23.54	23.58	21.25	18.97	20.24	20.71	22.54	23.47	23.99
Portugal	23.92	22.58	22.02	23.26	23.3	25.16	27.4	26.38	26.84
France	7.6	7.1	7.08	7.5	7.45	6.69	6.51	6.35	6.34
Germany	9.96	11.83	13.99	13.56	13.75	13.78	13.83	13.2	13.2
Uk	10.91	10.99	9.49	8.85	9.61	9.3	9.46	9.55	9.73
Denmark	16.3	14.67	14.05	13.17	13.19	12.82	12.44	12.89	13.36
Netherlands	9.64	8.98	7.65	5.26	5.27	5.42	5.42	5.23	5.22
Sweden	13.34	13.77	16.41	16.11	16.01	13.36	13.77	14.09	14.06
Norway	15.22	16.72	15.66	14.59	14.49	14.64	14.18	13.86	13.61
Finland	22.65	22.32	20.07	18.72	19.31	18.81	18.04	18.19	18.23
EU	17.35	17.63	16.77	16.07	16.18	16.29	16.47	16.51	16.68

Source: WHO Health For All database, 2016

Since 2010 in OECD countries per capita health spending has increased slowly and the share of GDP allocated to health spending has been on average 8.9% (2013). But in Italy, according to OECD health statistics, the per capita health expenditure has contracted in the period between 2011 and 2014.

Figure 6 Annual growth per capita health spending (2010-2014)



Source: OECD Health Statistics, 2015

The figure below shows the regional variation of the per capita health-care expenditure up to 2012. Looking to the data from 1990 to 2012, in general northern regions were above the national average while southern regions were below: this is partly due to the different age structure of the population, with some regions having more elderly citizens and such differences are also taken into account in the allocation of resources that each regions should have in order to guarantee the LEA. However public health expenditure tends to be lower in less affluent and less economically developed regions.

*Table 3 Per capita health-care spending (in Euro) in Italy's regions (1990-2012)*

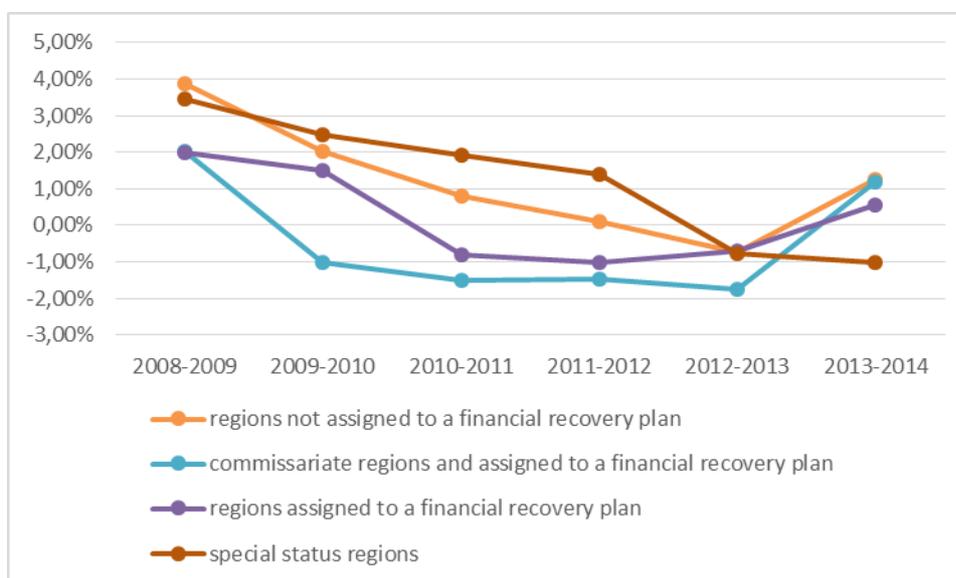
	1990	1995	2000	2005	2009	2010	2011	2012
<b>North</b>	<b>753</b>	<b>904</b>	<b>1321</b>	<b>1738</b>	<b>1951</b>	<b>1983</b>	<b>2031</b>	<b>2042</b>
Piedmont	688	828	1300	1661	1883	1903	1897	1914
Valle d'Aosta	756	875	1392	1829	2076	2170	2236	2224
Lombardy	709	868	1185	1573	1766	1813	1872	1870
A.P. Bolzano	722	995	1589	2059	2134	2183	2234	2259
A.P. Trento	731	907	1318	1722	2044	2088	2209	2229
Veneto	746	861	1249	1609	1769	1788	1782	1823
Friuli Venezia Giulia	730	868	1234	1650	1958	1979	2076	2095
Liguria	841	957	1342	1837	2026	2006	2043	1983
Emilia R	856	975	1282	1699	1906	1920	1926	1983
<b>Centre</b>	<b>794</b>	<b>883</b>	<b>1253</b>	<b>1685</b>	<b>1870</b>	<b>1868</b>	<b>1878</b>	<b>1886</b>
Tuscany	788	891	1240	1647	1919	1899	1914	1945
Umbria	766	865	1251	1629	1807	1806	1841	1850
Marche	834	886	1237	1544	1744	1795	1793	1800
Lazio	788	891	1283	1919	2011	1971	1965	1950
<b>South</b>	<b>669</b>	<b>762</b>	<b>1138</b>	<b>1633</b>	<b>1789</b>	<b>1798</b>	<b>1799</b>	<b>1801</b>
Abruzzo	724	761	1281	1729	1757	1743	1751	1773
Molise	678	776	1145	2033	2072	2070	2037	2035
Campania	692	743	1150	1670	1747	1719	1710	1692
Puglia	671	783	1109	1515	1751	1772	1731	1730
Basilicata	603	707	1071	1505	1753	1796	1818	1816
Calabria	586	721	1130	1423	1741	1719	1697	1686
Sicily	700	747	1054	1559	1666	1688	1717	1727
Sardinia	695	860	1163	1632	1826	1874	1932	1951
<b>Italy</b>	<b>730</b>	<b>840</b>	<b>1208</b>	<b>1648</b>	<b>1825</b>	<b>1836</b>	<b>1850</b>	<b>1859</b>
<b>Coefficient of variation (%)</b>	9.5	9.8	10.0	10.1	7.7	8.1	9.3	9.3

*Source: Armeni & Ferré, 2013, using Ministry of Health and Finance data*

In the last years the region's health spending was put under strict control after a few regions resulted in considerable deficits. The government introduced a special regime for overspending

regions: since 2007, 8 out of twenty-one regions have adopted “financial recovery plans” (Piani di Rientro) aimed to address the structural determinants of costs.

Figure 7 Current health expenditure (percentage variation)



Source: Agenas (2008-2014)

#### 1.4 Financing system in health care

Historically the allocation of resources for the NHS in Italy has been a source of contention between the national government and the regions and it is possible to identify three main different phases relating to the SSN’s funding structure:

- 1978-1991: the NHS was financed only by the national budget;
- 1992-2000: a gradual fiscal decentralization took place and the regional financial responsibility increased;
- since 2001, the focus is on fiscal federalism according to a path launched from 2013 (according to the Decree 68/2011 implementation of Law 42/2009).

The financial responsibility today is shared between the State and regions but the different regions contribute to the necessary withdrawal measure depending on their fiscal capacity. Currently, the NHS is funded by an annual budget called "National Health Fund ", despite its formal abolition in 2001. The NHF, which represents the national expenditure requirements in order to ensure the LEAs, it is defined by the so called “Legge di stabilità”<sup>8</sup> (literally “Stability

<sup>8</sup> In Italy, as finance law is generally defined as the ordinary law of the Italian government to adjust the economic policy of the country for three years through public finance and fiscal policy measures. Often called generically as "economic measures" or "" Stability Law", is regularly published in the Official Gazette of the Italian Republic.

Law”) and it is funded by both national and regional sources. Since 2000 it is negotiated and defined for three years in the State-Regions Conference ("Pact for Health"). The main sources of the public health care system are:

- “IRAP”: it is an earmarked corporate tax on the value added companies<sup>9</sup> and on the salaries paid to public sector employees.
- “Addizionale IRPEF”: it is a regional surcharge on the national income tax (IRPEF) and it is applied by regions on a regressive or progressive basis depending on income brackets.
- VAT: a fixed proportion of national value-added tax revenue is used to finance the national equalization fund which is used by the State to provide sufficient resources to those regions unable to guarantee the core health benefit package (LEA).

Table 4 Distribution of main sources of health financing, 2012

Sources of financing	% of total financing
IRAP and additional IRPEF	35
VAT and other excise taxes (Decree Law n. 56/2000)	47
Other transfers from public and private organizations	9
Health organizations' revenue and other income	3
National Health Fund and Restricted National Funds	4
Other	2
Total	100

Source: Armeni & Ferré (2013), using Ministry of Health and Finance data

The heterogeneity in term of regional economic development, size and age of population affects the allocation of resources to the regions therefore since 1997 the regional financial requirement is computed through a weighted capitation system that takes into account the current demand for health services, age, geographical distribution, social deprivation and health condition of the population based on the mortality rate. The formula below is the one used to calculate the regional financial requirement

$$R_j = P_j * k_{ij} * E_n$$

<sup>9</sup> The tax base is set at 3.9% of value-added produced by a company and regions have the flexibility to raise the level by 0.92% depending on the industry.

Table 5 Components of the weighted capitation formula

<i>R</i>	<i>Financial requirement of region “j”</i>
<i>P</i>	<i>Population size in region “j”</i>
<i>k</i>	<i>Indicator of health-care needs “i” in region “j”; it is calculated multiplying the age composition of the regional population for national weights derived from the national health care consumption for drugs, specialist care and hospital admissions. They are based on consumptions recorded through the hospitals discharge register and the health insurance card. (if k=1, simple capitation)</i>
<i>E</i>	<i>National pro-capita expenditure</i>

Before the formula is applied the National Health Fund is divided into three macro-levels of assistance that are the “community health care” (district-level, 51% of NHF), “hospital health care” (44%) and “public health service and preventive medicine” (5%). After the computation of each regional financial requirement, the balance of inter-regional mobility is taken into account. The allocation of resources is then proposed at the national level and they represents the amount needed to guarantee the LEAs; however regions are free to reallocate the funds received since every region is responsible for the organization and delivery of health services within its jurisdiction.

A more recent development still debated to improve the efficiency of the allocation of resources between regions was introduced by the Decree 68/2011 within the contest of fiscal federalism (Law N. 42/2009); the Legislative Decree no. 68/11 has identified the standard cost (necessary to calculate the standard requirements of regional expenditure) with the "per capita standard health expenditure", measured by a per capita weighted (by age) average of the cost registered in 3 reference regions (benchmark). 3 Regions benchmarks are identified in a shortlist of five among those listed by the Ministry of Health as eligible (in accordance with the provision of LEA with a balanced budget) and with high standards of quality, appropriateness and efficiency synthesized in a IQE (indicator for quality and efficiency).

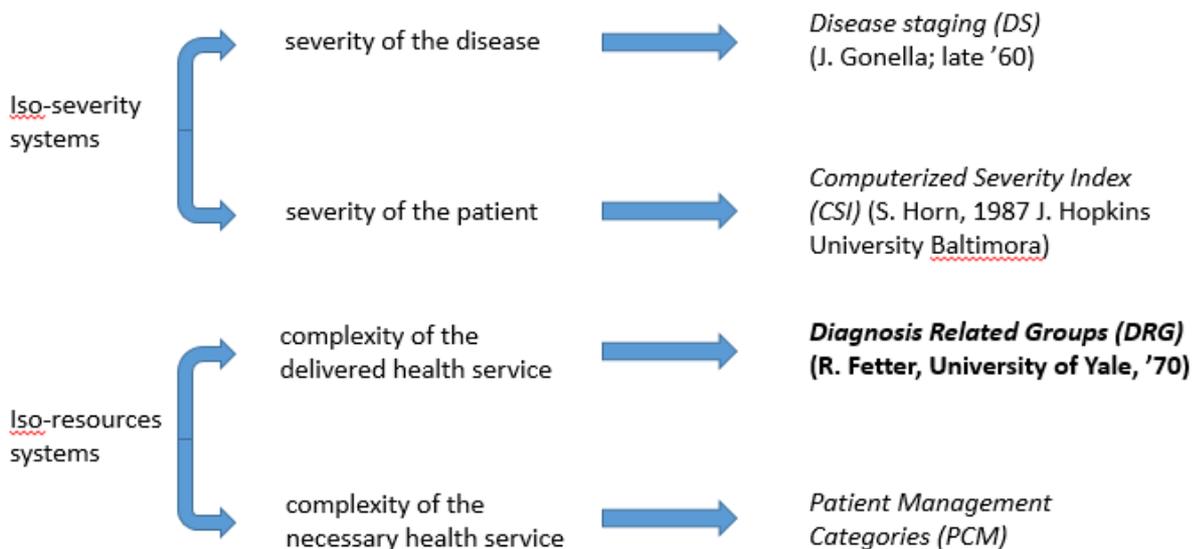
For each Region, per capita standard health expenditure is multiplied by the weighted regional population, getting to the regional standard health requirements. The sum of the standard regional health needs must be equal to standard national health requirements to provide the LEA, fixed by agreement between the State and the Regions in respect of the public finance constraints. However the standard cost is now a multiplicative constant of the weighted

population, so it is irrelevant for the allocation of funds and to stimulate the efficiency of the Regions; it would be different if the standard cost of the health service (e.g. hospitalizations costs multiplied by the standard quantity of admissions) or for the treatment of a disease would be calculated.

### 1.5 The Drg system for financing the ASLs/AOs

The hospital care financing structure is based on a system where hospitals are remunerated on the basis of health services provided according to pre-determined and all-inclusive fees for each hospitalization; this is aimed at reducing production costs and ensuring appropriateness in the resource's provision and use. The system of Diagnosis-Related Groups (DRG) introduced by Robert Fetter and colleagues from Yale University in 1980 is the best known of the classification systems in iso-resources groups and it proposes to build homogeneous groups of patients from informations contained in the hospital discharge form. The main objective of the DRG classification is to identify end-groups of patients who have a reasonably similar resource consumption, not necessarily identical. Each DRG is characterized by a certain "length of stay" and by an average cost of treatment. These two characters allow to assign a relative weight to each DRG.

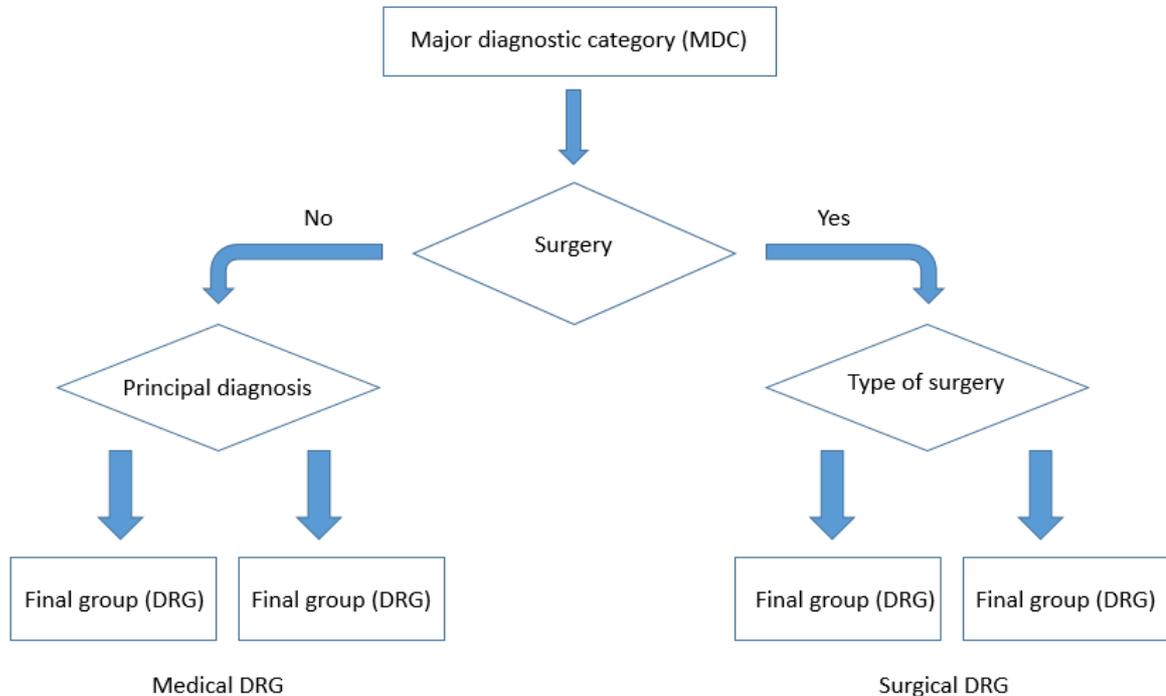
Figure 8 Some classification systems of admissions to acute care hospitals.



Since 2009 the hospitalization's category are based on the system ICD-9-CM and therefore they are classified according to 538 Drg and 25 Mdc (Major diagnostic categories). Initially, patients

are assigned to a MDC, and are then classified differently depending on whether or not they require a surgical procedure and / or a diagnostic and therapeutic invasive procedure.

Figure 9 Allocation process to a DRG of a given admission



The DRGs were used for the first time in the USA for the Medicare program to determine prospectively the amount of financing of hospitals. The Prospective Payment System (PPS) provides that every year a hospital receives ex-ante funding equal to the total costs (as defined according to DRG tariffs) which would face if it were a case-mix of patients equal to that of the previous year. The main feature that needs to be highlighted is that the actual costs for each hospital admission no longer have any relationship with the extent of its funding, as this is completely defined in advance and it is based on national average values (adjusted for the labor cost in the operational area of the hospital, for its urban or rural location, etc). The following are other elements that characterize the PPS:

- the unit of payment is the dismissal (admission treated within a particular DRG);
- in pure PPS, the tariff of each DRG is calculated by multiplying an average cost per discharge at the national level for the weight  $w$  assigned to DRGs (weight that expresses the complexity of hospitalization in terms of resources used and may be considered as a price index)

$$t_i = C * w_i$$

Where  $w_i = c_i/c_m$

- “C” refers to all the discharges recorded in the year while the average cost  $c_m$  and the cost for each DRG  $c_i$  are cost indexes that relate to a significant sample of the discharges made during the year
- outliers (i.e. those cases which exceed the average cost and / or the average hospital stay for a certain DRGs) are paid according to the actual costs.

The aim of the prospective funding DRG tariffs was to create a sort of yardstick competition (Schleifer, 1991)<sup>10</sup> that would have promoted efficiency, pushing hospitals to support costs that do not exceed the tariffs, and quality because, being all structures remunerated with the same tariff for each DRG, each structure is encouraged to increase the quality of health care services offered in order to attract demand for admissions. The DRG system still involves some issues and financial risks, mainly due to the considerable diversity of the case-mix of patients treated in different hospitals; therefore there are "winning hospitals", ie those that treat patients relatively inexpensive and that achieve an operating surplus, and "losers hospitals", characterized by a very expensive case mix that make operating deficit ( this is the so-called “lottery effect” in the health-care market). In order to minimize these risks then hospitals can be encouraged to adopt strategies aimed at:

- reducing the average quality of health care services offered
- not treating, transferring in other hospitals or dismissing particular types of patients
- increasing the number of admissions
- offering a higher quality of services to more profitable patients (i.e. those that, for a given DRG, have lower actual costs)

The advent of the DRG has set itself the primary objective of reducing unnecessary health spending, but this resulted in the following, unwanted effect: if the previous system based on funding by the cost per day of hospitalization tended to protract the hospitalization of a patient more than necessary, since a longer hospitalization corresponded to greater revenues, now the trend is to accelerate the resign, since each day of hospitalization in more than necessary is in charge of the hospital.

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<sup>10</sup> When a regulatory authority is able to set prices or rates by tying prices of a firm to the cost structure of other realities and vice versa, the mechanism is called yardstick competition. In this case, as shown by A. Schleifer (A theory of yardstick competition, in "Rand Journal of Economics", 1985), the company which has a less efficient cost structure is encouraged to achieve the standards of the others. The risk facing the less efficient it is to see oneself imposed a price that will not allow it to make a profit based on its current system of cost.

## 1.6 The debate around the weighted capitation system and standard costs

The "Pact for health 2014-2016" confirmed as the standard cost method for the calculation of the regional financial requirements; so what changes is the method of calculating the capitation but this raises some perplexities. The method of apportionment of the national fund is based on an "allocative formula" which, as described before, must take into account three variables: the resident population in the region concerned, an indicator for the health needs of the population and an average pro-capita expenditure (capitation). This is aimed at achieving two main goals: equality, guaranteeing all citizens the same rights and the same opportunity to access to essential services, and efficiency, allocating resources on average needed (standard) to produce good quality services. The Decree 68/2011 attributes to the concept "standard cost" the meaning "standard per capita expenditure", calculated on the model of some more efficient regions. In general, however, the standard cost can also be understood as (a) the standard cost per unit of product (health service) or (b) as a standard cost of treatment by type of disease. According to Mapelli<sup>11</sup>, in general it is possible to identify five different methods for calculating the regional requirement:

1. Simple capitation
2. Weighted capitation
3. Per capita expenditure based on the most efficient regions
4. Analytical capitation based on standard costs and standard quantity
5. Capitation adjusted for diagnosis

The first two methods are basically the ones explained in the previous section while the third is explained in the Decree 68/2011 and is strongly debated. In this method, the standard cost is represented by the average weighted expenditure of three regions (out of 5) considered as benchmark taking into account financial parameters (balanced budget), social parameters and quality of services.

Defining as:

- $E_i^{(w)}$  = per capita weighted expenditure of region "i"
- $Pop_i$  = population in region "i"
- $Pop$  = national population
- $Pop^{(w)}$  = weighted regional population
- $SC$  = standard cost

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<sup>11</sup> Mapelli V. (2014). Monitor 36. Dentro al Patto per la salute: riflessioni e proposte per definire la quota capitaria. Roma, Agenas.

- $RSR$  = regional standard requirement
- $NR$  = national requirement

It can be shown that the regional funding based on the standard cost calculated as the per capita expenditure based on the most efficient regions is exactly the same as that determined by the allotment criterion of weighted population; the standard cost is therefore irrelevant for the allocation of funds and to improve the efficiency of the Regions. Hence the choice of the benchmark regions is insignificant and therefore is on the population weights that ones must focus his attention. In the formulas below it is shown what it was just said.

$$\text{Standard cost } SC = \frac{\sum_{i=1}^3 E_i^{(w)} Pop_i}{\sum_{i=1}^3 Pop_i}$$

$$\text{Regional standard requirement } RSR = \frac{SC * Pop_i^{(w)}}{\sum_{i=1}^3 SC * Pop_i^{(w)}} = \frac{Pop_i^{(w)}}{Pop}$$

$$\text{Regional funding } F_i = RSR * F = \frac{Pop_i^{(w)}}{Pop} * F$$

The fourth method considers the standard cost as a cost per unit of output and identifies the regional requirements as the product between standard costs for health services and per capita quantities of the various types of health services. The method is called “analytic” because it calculates the unit cost for the health service and also needs the quantity of health benefits for each patient; so is a method that requires a lot of informations and allows the calculation of the standard value of the final product in health care that is the health service (for example, the cost of hospitalization). The effect of this method is that it could be considered a posteriori the effective provision of LEAs: nowadays, is assigned to the regions a comprehensive and indistinct funding per capita that they are free to spend at their discretion. With the analytical method, knowing in advance the cost and quantity of the services it is possible to realize that a region provides a low quantity of health services of certain types because the costs are high or because there are excesses of health consumption in other sectors. Obviously the method presents several difficulties both as regards the number and quality of informations needed and also with respect the method of calculation the cost of health services; however, as it has been

verified in some studies<sup>12</sup>, in the medium term the method tends to converge the costs and the demand for regional health services to the national standard value, reducing waste and the unnecessary consumption of health services. Finally, the fifth method (capitation adjusted for diagnosis) is emerging in those countries (such as Switzerland, the Netherlands, Germany) that have adopted a universal insurance system but with freedom of choice of insurer (public or private). In these countries in addition to traditional weights as the age, the capitation is also weighted with the diagnosis of current or past illnesses. Obviously this is a method that requires large amounts of data (Big Data) but which reflects, better than the others, the principles of equity and efficiency: on the one hand it takes into account regional differences in the prevalence rates of the disease and at the same time it sets a standard treatment cost for illnesses that would ensure efficient and inclusive treatments of LEAs.

The capitation method requires public facilities to receive a fixed amount per patient, and this can lead, in the light of a principle of cost rationalization, to prefer, for a given DRG, "less expensive" patients. The capitation system can distract providers from the main objective of the health facilities, which is to guarantee universal care, targeting healthier individuals.

A system that seems to improve the principle "better health outcomes delivered at lower cost" is that of the bundled payment. Bundled payment, also known as episode-based payment, is defined as the reimbursement of health care providers (such as hospitals and physicians) on the basis of expected costs for clinically-defined episodes of care. It has been described as "a middle ground" between fee-for-service reimbursement (in which providers are paid for each service rendered to a patient) and capitation (in which providers are paid a "lump sum" per patient regardless of how many services the patient receives). Bundled payments have been proposed in the health care reform debate in the United States as a strategy for reducing health care costs, especially during the Obama administration.

A value-based bundled payment has four essential components:

1. Covers care for a medical condition over a full cycle of care; this means that a bundled payment should compensate providers for all the drugs, devices, tests, materials, facilities and services required to treat a given patient. By contrast a Drg-based system reimburses only for inpatient episodes or procedures and does not incorporate the full range of services needed to achieve good outcomes over a complete care cycle;

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<sup>12</sup> Mapelli V. (2009) La perequazione degli standard sanitari delle Regioni, in Arachi G., Mapelli V., Zanardi A., Prime simulazioni del sistema di finanziamento e di perequazione di Regioni e Comuni previsto dal ddl sul federalismo fiscale, mimeo, Roma.

2. Contingent on risk adjusted outcomes, including a set of outcomes that matter to patients in order to eliminates the concern in previous fixed price contracts that providers will cut costs in ways that could affect patient health or that they prefer to treat healthier and simpler patients;
3. Payment is based on the cost of efficient and effective care, not past charges. The methodology TDABC (Time Driven Activity Based Cost) allows providers to measure true patient-level treatment costs. This method is based on a two-step approach and first a team of clinicians and administrators maps all the steps (clinical and administrative) used during a complete cycle of care identifying all the resources used and as well as the time spent at each step. After this first step the finance staff estimate the cost per available minute of each type of resources; it is then possible to accurately calculate the time-based total treatment cost;
4. Specified limits of responsibility for unrelated care needs and catastrophic events. Bundle payments do not include the costs incurred for care unrelated to the specific medical condition covered by the bundle; therefore the responsibility of providers is limited and the bundle price need not to include a risk premium to protect providers against unforeseen high costs from catastrophic episodes of care;

## 2. Management Control in Health Care Organizations

### 2.1 The “cycle of management control

After the National Law No 502/1992<sup>13</sup> public healthcare companies have adopted specific programming, monitoring and controlling tools which are typical of the management control. Generally management control can be defined as the process which identifies the objectives that the company intends to achieve and verifies the compliance of management with the goals set in the planning phase, in order to permit their achievement with the maximum effectiveness and efficiency.<sup>14</sup> According to Anthony and Young in particular there are three different types of programming and controlling intended as a single business function<sup>15</sup>:

- strategic planning
- directional control
- operational control.

Strategic planning is defined as the process by which the business goals and the main guidelines are identified. Directional control deals with the implementation of the strategies and the achievement of the purposes and then its main function is to develop company's programmes efficiently and effectively. The operational control verifies that tasks are executed. The two authors in particular propose a management control model that is based mainly on four cyclical phases shown in the figure below (planning, budget formulation, execution of activities and measurement; reporting and evaluation). According to this model, the process does not end with the four phases but feeds itself dynamically correlating with the external environment. In fact, in each of the four phases there is the connection with the external information that reflects the relation that binds the programming system and the internal control with the external environment (Region, other healthcare organizations, etc.). As said, the model considers four steps:

1. *Programming*: for public health organizations this first stage coincides with the preparation of the strategic three-year plan and the guidelines for the budget formulation;

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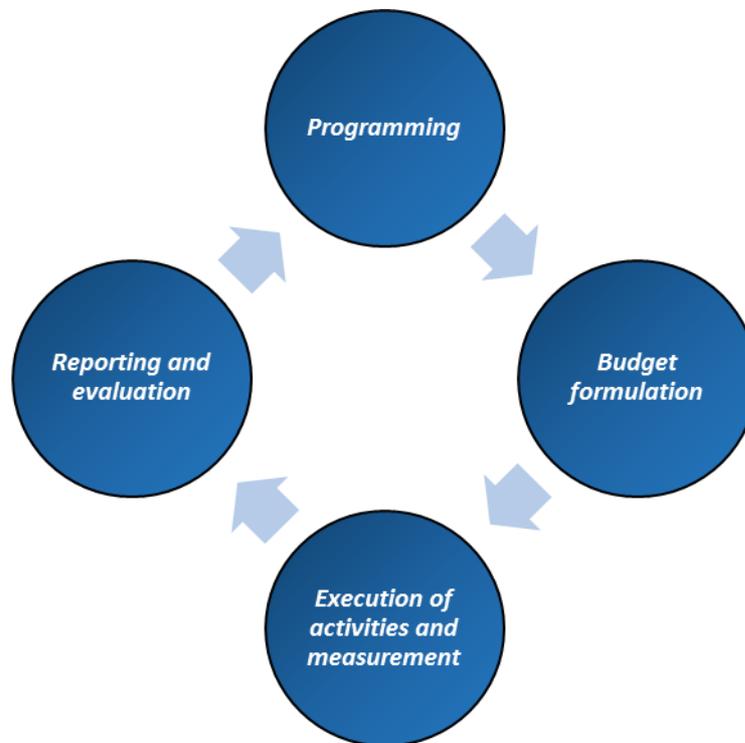
<sup>13</sup> In Italian Regions, National Law 502/1992 was then implemented by Regional Laws: for example, in Veneto, the Regional Law No 55/1994 was the one that introduced managerial principles in public healthcare organizations.

<sup>14</sup> Ceruzzi P., Sorano E. (2013), *Il controllo di gestione nelle aziende sanitarie ai tempi dell'armonizzazione contabile*, IPSOA.

<sup>15</sup> Anthony R.N., Young D.W. (1992), *Controllo di gestione per gli enti pubblici e le organizzazioni non profit*, McGraw-Hill, Milano

2. *Budget formulation*: it is essentially a negotiation between the centres of responsibility and the upper levels of the health corporation; it provides for the definition of the output to be carried out in the year of budget and resources required;
3. *Execution of activities and measurement*: at this stage the activities are carried out and intermediate objectives are monitored;
4. *Reporting and evaluation*: this fourth and final phase concludes the planning and control cycle and allows to check the achievements of the results with the consequent redefinition of policies and guidelines for the next cycle. At this stage the reasons (endogenous and exogenous) which led to certain results are also analysed.

*Figure 10 The cycle of management control*



*Source: (Anthony R.N., Young D.W)*

## 2.2 Budget in health care organizations

The budget is an operational instrument of planning and control for the centres of responsibility and to these centres, qualitative and quantitative targets and related current and investment resources are assigned<sup>16</sup>. The budget is therefore a document which describes, in quantitative terms, the future program of business management and thus represents the translation into operational terms of the choices made during the planning phase. During the budgeting process then the outputs of the health care organization are defined (activities, performance, services) as well as the inputs (physical and financial resources). In general, therefore during the budget the different corporate bodies define the use and allocation of available resources, the objectives that each of them has to reach and finally analyse the differences between targets and achievements. The main parts involved in the process are:

- *the strategic board* (general manager, health director, managing director) which basically acknowledge the regional guidelines and translates them into implementation plans and also defines the plan of centres of responsibility;
- *the managers of responsibility centres* who formulate the budget proposal related to their responsibility centre, participating in all stages of the decision-making process aimed at defining the objectives and the resources to be allocated;
- *the management control office* which is the operating unit with the technical support function to the management of the budget process. More precisely it has the task of managing the information flows, support the process of formulation of budget proposals and compilation of the budget tabs.

It is important to highlight that the goals are tied with the ultimate objective of a health organization (health protection) and then, during the budgeting process, they are not always related to the cost-efficiency of the activities. However in general it is possible to identify a scheme divided into five main stages:

1. *estimating demand for health services* which is the starting point for implementing all the other phases of programming;
2. *budgeting of responsibility centres*: at this stage, for each centre of responsibility, health care services are defined in quantitative and qualitative terms as well as the physical and financial resources necessary. During this phase emerges the difficulty of trying to estimate as much as possible precisely the volumes of health services needed to meet the demand but in some cases (e.g. emergency room) is rather difficult; moreover the health care services must be valued economically, and some can be estimated through

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<sup>16</sup> Zavattaro F. (1993), Il budget: una risposta alla crescita di complessità del sistema sanitario, Mecosan.

the classifications (e.g. " Nomenclature tariffario") while for other types of health care services ad hoc processes are built.

3. *verification of the financial and economic compatibility and compliance with planned targets*: in this step the available resources and the resources required by the various responsibility centres are compared and also production schedules of health services are set and they are aimed at making the health care organization able to achieve the required objectives and to calculate the associated costs, the latter based on standards of production.
4. *negotiation of the budget proposals*: in this phase there is the comparison between the General Management and the heads of the various responsibility centres on the need to develop certain activities that require the use of additional resources (monetary, human, material).
5. *formulation of the overall budget of the company*: this is based on the different budgets of the various responsibility centres and it generally divided into the Economic Budget, the Financial Budget and the Assets Budget. The first, which is similar to an income statement, summarizes the costs and planned revenues; the second is usually divided into the sources and uses of budget and cash flow budget and it is essential to check the company's ability to obtain the financial resources necessary for carrying out the activity. The last highlights the breakdown of assets, liabilities and shareholders' equity at the end of the budget period.

### **2.3 Reporting and indicators system**

The process of planning and control provides that the cost accounting system is complemented by an information system designed to provide periodic information on its activities and on services via a reporting system through which, in the form of periodic inspection reports, all accounting and non-accounting information useful for the verification of results is represented. The report recipients can be both parties outside (e.g. the Region) and inside (strategic direction, the various heads of responsibility centres) the health care organization.

The activity of management control in a healthcare company aims at achieving a system of indicators that allows the comparison between objectives and achievements. The use of health indicators has been introduced by Decree 502/1992 and with reference to a healthcare organization one can distinguish four categories of indicators:

1. *Demand and accessibility indicators*: measure the availability of services and the real possibility of access to them;

2. *Resource indicators*: measure the availability of specific inputs and measure the resources used, both in monetary and physical terms;
3. *Activity indicators*: measure the activities and services provided distinguishing them by type and by type of user;
4. *Outcome indicators*: relate the activities to the inputs used in order to express the degree of achievement of objectives through the services provided.

In the table below some examples of indicators (described in the Ministerial Decree 24<sup>th</sup> July 1995 and then in the Ministerial Decree 12<sup>th</sup> December 2001) are listed

*Figure 11 Examples of indicators in healthcare organizations*

Type of indicators	Examples
<b>Demand and Accessibility indicators</b>	<ul style="list-style-type: none"> <li>• Hospitalization rate</li> <li>• Average waiting time between the request and the execution of a medical examination</li> <li>• (N. of beds/Resident Pop.)*1000</li> </ul>
<b>Resource indicators</b>	<ul style="list-style-type: none"> <li>• Cost of medical staff / N. of hospital discharges</li> <li>• Cost of nursing staff / N. of hospital discharges</li> <li>• Cost of drugs / N. of hospital discharges</li> </ul>
<b>Activity indicators</b>	<ul style="list-style-type: none"> <li>• Utilization rate of beds</li> <li>• Average hospital stay</li> <li>• Weekly working hours of operating rooms</li> </ul>
<b>Outcome indicators</b>	<ul style="list-style-type: none"> <li>• N. of patients died within 30 days / tot. treated patients</li> <li>• N. of cases of hospital infections / N. of patients discharged</li> <li>• N. of caesareans / N. of births</li> </ul>

## 2.4 Analytical accounting

The accounting system of a healthcare enterprise can focus on two main different aspects:

1. the analysis of the external operations, i.e. those operations in which the company acquires inputs and then gives the products of its “business”;
2. the analysis of internal operations, i.e. those operations related to the technical and organizational combination of inputs in order to obtain products or services.

The first requirement is satisfied by the general ledger system, which monitor the trading activity of the company with the external environment and highlights the achievement of balanced budgets. On the other hand analytical accounting (known also as managerial accounting) supports the general accounts by providing information on the consumption of resources allocated for specific units or used to obtain a product or service. The regulatory obligation to maintain cost accounting for healthcare companies was introduced by Legislative Decrees n. 502/1992 and n. 517/1993 and was confirmed by the State - Regions Conference in 2005. The managerial accounting system is an accounting tool designed to produce information about the costs and revenues of the healthcare organizations with respect to specific detection objects (cost centres, types of health care services, projects, etc.) aimed at analysing production factors (personnel, technology, services, etc.) which are used to obtain services. The information produced by the system is used both for controlling purposes, as it allows to verify the achievement of the objectives, but also to plan future actions. So an effective management control requires an accurate analytical accounting of costs or, more precisely, of costs centers that can be identified within the corporate system.

Cost centers are ideally represented as accounting aggregates where direct and indirect costs are allocated. A cost centre could be defined as an unit, recognized in the charts of accounts, for which relevant expenses and revenues are accumulated<sup>17</sup>. The concept of a cost centre is closely related to the concept of responsibility centre; the latter constitutes a group of individuals who have the responsibility for performing some tasks<sup>18</sup> and moreover in a responsibility centre there is a leader which is the main responsible for the decisions undertaken. The cost centre is basically a subset of a responsibility centre and has the following characteristics: homogeneity of activities and services; specificity of competences and

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<sup>17</sup> Gottlieb J.A. (1989), Healthcare Cost Accounting: practice and applications, Healthcare Financial Management Association, Westchester, IL.

<sup>18</sup> Finkler A. (1994), Cost Accounting for Health Care Organizations. Concept and Applications, New York, ASPEN

processes; significance from an economic and technical profile<sup>19</sup>. Then it can happen that a responsibility centre is made up of several cost centres, while a single cost centre can not refer to two different responsibility centres. Moreover the cost centres are generally classified in<sup>20</sup>:

- *final cost centres*: these units refer to services that directly contribute to the organization's purpose and activities addressed to external clients; these centres relate to inpatient services (inpatient admissions, day hospital, day surgery) and also to outpatient services, etc;
- *intermediate cost centres*: in these centres are carried out activities addressed to external as well as support activities for the final performance centres; some examples are represented by the testing laboratory or radiology;
- *Auxiliary cost centres*: in these units services for final performance cost centres are produced; some examples are cooking and laundry services.
- *Overhead cost centers*: these centers relate to the structural costs that are divided into general and administration tasks (General Management, Administrative services, Technical services, etc).

From a logical point of view the analytical accounting system can be represented as a double-entry matrix: on the horizontal axis inputs are organized by nature (services, consumer goods, personal) while on the vertical axis are identified cost centers representing the allocation of resources<sup>21</sup>.

Figure 12 "Structure" of analytical accounting system

	Cost centre 1	Cost centre 2	Cost centre 3	Cost centre 4
Services				
Consumer goods				
Staff				

It is possible to identify a general model of analytical accounting which consider the following steps:

<sup>19</sup> Ceruzzi P., Sorano E. (2013), Il controllo di gestione nelle aziende sanitarie ai tempi dell'armonizzazione contabile, IPSOA.

<sup>20</sup> Ceruzzi P., Sorano E. (2013), Il controllo di gestione nelle aziende sanitarie ai tempi dell'armonizzazione contabile, IPSOA.

<sup>21</sup> G.Casati (1996), Manuale di contabilità direzione nelle aziende sanitarie, Ed. Egea.

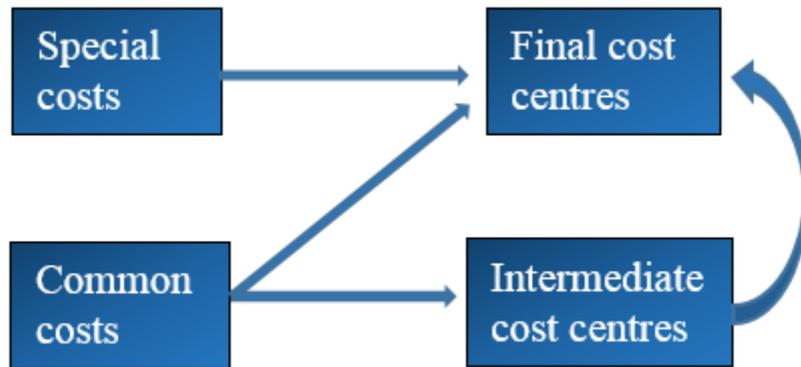
- Analysis of the organizational structure and the definition of the plan of cost centers;
- Plan of inputs;
- Allocation of resources' costs used by the cost centers;
- Allocation of costs to final costs centers;
- measuring the volume of production conducted in the final centers;
- computation of unit output costs.

The costs of individual inputs (staff, consumer goods, etc.) are allocated to the cost centres directly when that particular cost centre is the only direct user of that particular resource. This structure then identifies a system of costs distinguishing between special and common costs. The special costs are generated by the consumption of inputs which are used exclusively in the performance of an activity aimed at obtaining a specific product or service. Their assignment to the cost centre is based on objective and verifiable criteria. The common costs are generated by the consumption of inputs that contribute to the performance of several activities aimed at obtaining different products / services. Their assignment to the cost centre is through arbitrary allocation criteria; these costs are therefore always indirect. Referring to a hospital the cost of physician and nurses who work steadily in a particular ward can be defined as special costs while electricity costs or other staff working in several wards are included in the category of common costs. Therefore in the process of cost allocation<sup>22</sup> in the various cost centres, the allocation of common costs is less intuitive than the one of special costs. In addition, the complexity of the procedure is also enhanced since some common costs are first allocated to intermediate centres and then to the final centres. Thus there is the need to identify the criteria and reference models for costs allocation especially between intermediate and final cost centres.

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<sup>22</sup> It is important to remark that, however, the process of allocation is the same also for revenues in the various centres.

Figure 13 The process of costs allocation among intermediate and final costs centres



The literature identifies three major costs allocation models:

1. *the direct method*: it considers the direct allocation of the costs of the various intermediate centres to the final centres to which they are related. The weakness of this method is that it does not take into account that there may be also relations between the intermediate cost centres;
2. *the step down method*: it presents a higher level of complexity than the previous model and has the objective to overcome the weakness of the direct allocation model by providing a sequence of successive allocations between intermediate and final cost centres. The weak point of this method is that the method considers only unilateral relationships between cost centres without considering the mutual relations of services.
3. *the reciprocal allocation method*: this method works with a “waterfall” allocation of costs between the various centres, but also considers the mutual allocation of costs for the services between the various centres also providing bidirectional allocations.

## 2.5 Accounting vs economic costing methodologies

Before starting an overview of costing methodologies used in health care organizations, it is useful beforehand to make the differences clear between accounting and economic costing approaches. A first difference relies on the perspective from which decisions and evaluations are made. Economists try to assess the impact of any decision more from a societal perspective and therefore the economic evaluation of a health care service is based on welfare economics; accountants have an organizational perspective and therefore economists and accountants could

apply different costing methodologies<sup>23</sup>. They also use different concept of costs: the formers measure costs for financial and reporting purposes and therefore they basically measure costs by the historical outlay of funds which is practically the cost of acquisition of a product. Health care services are then estimated by a cost allocation process which encompasses direct and indirect costs. From an economic point of view, the cost of resources absorbed by patients during their treatment is considered as “opportunity cost”, i.e. the cost of the resources that they could have used if they would not have needed a treatment of care. Since economic evaluation are based on a societal perspective, economist may include in costs calculations some additional costs which are not considered in cost accounting reports; in addition some items, such as informal care or buildings/equipment after their accounting lifetime may not have an accounting value: therefore it is not possible to calculate the “true costs” and accounting costs are reasonable estimates of economic costs<sup>24</sup>. Furthermore economic costs which consider opportunity costs, require a deep knowledge of the social welfare function but unfortunately economists have not yet implemented a feasible way to estimate it. Therefore even if one may consider the opportunity costs as the “true cost”, the calculation of it can be very hard and time consuming while on the other hand accounting costs can be estimated relatively cheaply and quickly.

## **2.6 Identification of the costing methodology**

During the process of choosing the right methodology for costing a particular service one must keep in mind that there is no a universally accepted costing methodology. Selecting the appropriate method to estimate the unit cost of a service depends on several variables: type of service, the reason for costing that particular service, the economical feasibility of cost calculation, the quality of the data, the time horizon, etc. To different purposes (e.g. pricing, tax report, management control, etc.) different cost concepts and different costing methodologies correspond. However the decision problem and more precisely the intended use of cost information is what determines the methodology that analysts should take into account. In this chapter the focus is on accountings methods to evaluate a particular health service. The process of selecting the appropriate costing methods encompasses basically four major steps<sup>25</sup>:

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<sup>23</sup> Brouwer W. (2001). Costing in economic evaluation. In Drummond M., McGuire A., Economic evaluation in Health care. Merging theory with practice, Oxford University Press.

<sup>24</sup> Finkler A., Ward M., Baker J. (2007). Essential of Cost accounting for Health Care Organizations. 3<sup>rd</sup> ed. Newyork, Jones & Barnett Learning.

<sup>25</sup> Mogyorosy Z., Smith P. (2005), The main methodological issues in costing health care services. A literature review, HealthBasket project, University of York

1. *Portraying the decision problem and defining the purpose of costing* such as pricing new services for an internal market, cost comparison between different providers, identifying areas of cost reduction / cost containment, etc. In this first step the perspective of the study may affect the decision problem, therefore the analysts should make clear if the costing process is for example from a patient or provider perspective and moreover the time horizon affects as well the costing procedure since the nature of some costs may change in the long period.
2. *Identification of health services* to be evaluated since costing studies could focus on the cost of a particular service (surgery, GP visits), the cost of a treatment episode (e.g. outpatient visits, inpatient DRG, etc.), the annual total costs of particular services, etc. This second step will substantially determine the kind of cost information needed.
3. *Identification and classification of resource items* in order to clarify which are all the relevant costs for the service delivered. For example identifying all the direct and indirect costs which can be allocated in the calculation of the health service may not be straightforward. A clinical pathway could help to highlight all the relevant resource items and ,moreover, the information needed depends also on the selection of the appropriate unit measure.
4. *Measurement the resource utilisation:* basically the choice of the approach to select the resource consumption measurement depend on the aim of the cost analysis and the availability of the data. On one hand there is the direct measurement of costs at patient level through a bottom up approach. On the other hand the top-down approach is based on larger and aggregated databanks (national, regional level) which could be easier and less expensive to implement but at the same time the quality of the unit cost estimate could be affected. Therefore the process of measuring the resource utilisation implies a trade-off between the level of detail of the cost information and the cost to obtain it. Some of the international costing guidelines (e.g. NHS Costing Manual) recommend a mixed approach (Top-down and Bottom-up) for costing health care services.

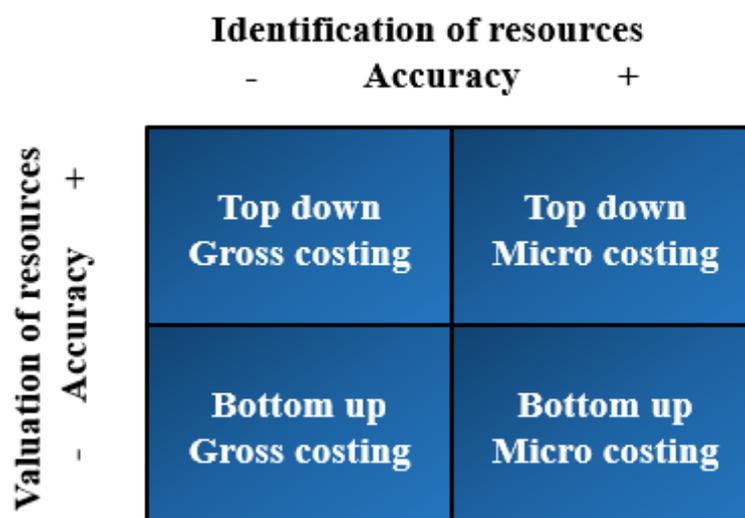
## 2.7 Top-down vs bottom-up approach to costing

In order to evaluate the cost of a health care service in general it is possible to distinguish between a “Top-down approach” and a “Bottom up approach”. The former approach to costing an health care service first calculates the total cost of that particular service at a broad level such as at the whole organisation, single hospital or department level and then it disaggregates the total cost to a more specific level such as at the patient level depending on the availability of the data. This process of disaggregation of the total cost can be done through several steps; first of all allocating the total cost to the cost centres and then dividing the cost allocated to each cost centre down to the patient level on a number of unit basis (e.g. patient treated) for each cost centre. On the other hand a bottom up approach is based on records of resource utilisation at the patient or individual service level. In general a top-down approach is associated with the gross costing method and the bottom-up with micro-costing. An important cause for methodological differences concerns the level of accuracy that is addressed. The level of accuracy is determined by the identification of cost components (gross costing versus microcosting) and valuation of cost components (top down versus bottom up costing). In gross costing cost components are defined at a highly aggregated level (e.g. inpatient days only), whereas in microcosting all relevant cost components are defined at the most detailed level). In the top down approach cost components are valued by separating out the relevant costs from comprehensive sources (e.g. annual accounts), resulting in average unit costs per patient. In the bottom up approach cost components are valued by identifying resource use directly employed for a patient, resulting in patient specific unit costs<sup>26</sup>. The Bottom up microcosting methodology is considered as the gold standard since it allows to identify all relevant costs at the individual patient level and this leads to the most accurate costs estimates. The problem of this kind of methodology is that relies on appropriate hospital information systems and this could affect its feasibility. The Top-Down microcosting identify all relevant costs but these costs are evaluated for average patients and in this way this method does not traces costs directly to the specific patient who incur in that cost. However since the Bottom-Up methodology is the one that should be applied but it is lengthy and expensive, it may be more feasible its application only to those cost components that have a greater impact on total costs.

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<sup>26</sup> Tan S. (2009). Microcosting in Economic Evaluations. Issues of accuracy, feasibility, consistency and generalizability, Optima Grafische Communicatie, Rotterdam

Figure 14 The level of accuracy at the identification and valuation of cost



Source: Tan S. (2009)

With respect to microcosting methodologies, the gross costing method is more feasible since it considers cost elements at a high degree of aggregation. Often the only component of cost identified is the inpatient day and bottom up gross costing identifies the cost elements for each individual patient while Top Down gross costing consider the cost component per average inpatient days. The gross costing method is inaccurate since it does not trace costs directly to specific cost components; to give an example suppose that inpatient hospital stay is the only cost component considered and then suppose that the analyst faces the situation of evaluating the cost differences between stroke patients undergoing different kinds of treatments (e.g. thrombolysis treatment and conservative treatment). Considering inpatient hospital days as the only cost component implies that the cost differences between the two groups of patients can be explained only through differences in the number of hospital days and therefore it is not possible to analyse more relevant cost differences due to for example different consumption of medications. A study<sup>27</sup> conducted in the Netherlands in representative general hospitals tried to determine the differences in the total cost estimate of health care service using cost components of top down microcosting or bottom up gross costing instead of the bottom up microcosting. Total cost estimates used as illustrations were determined for appendectomy, normal delivery, stroke and acute myocardial infarction in 2005 using bottom up microcosting, top down microcosting and (bottom up) gross costing. This study considered the hospital perspective and all direct (diagnostic procedure, medications, labour, inpatient stay, devices) and indirect

<sup>27</sup>Tan S. (2009). Microcosting in Economic Evaluations. Issues of accuracy, feasibility, consistency and generalizability, Optima Grafische Communicatie, Rotterdam

(general expenses, administration, registration, energy, maintenance, insurance, etc) costs encountered from hospital admission to discharge of the patient. Regarding the methodologies adopted and compared must be specified that:

- The bottom up microcosting was implemented identifying patient specific resource use and hospital specific unit costs;
- The top down microcosting was characterised by the identification of patient specific resource use and national tariffs as unit costs;
- The gross costing was carried out by the classification of resource use of inpatient days only and hospital specific unit costs

The estimates according to the top down and gross costing were generally higher than bottom up estimates. The statistical analysis evidenced that top down microcosting can be a strong alternative to bottom up microcosting but this seems to differ between health care services and on the other hand gross costing might be a weak alternative to bottom up microcosting. Even though bottom up microcosting is generally considered as the gold standard methodology for costing health care services but it is very time consuming and relies on accurate and detailed data. Therefore this study suggests that it might be an option for estimating health care services to apply this kind of methodology to those cost components that have a greater impact on the total costs (i.e. labour and inpatient stay).

Figure 15 Total cost estimates of bottom up micro costing, top down micro costing and gross costing (Euro)

	Bottom up microcosting	Top down microcosting	Gross costing
<b>Appendectomy</b>	<b>1,796</b>	<b>2,025</b>	<b>2,278</b>
Diagnostic procedures + medications	166	173	} 1,662
Labour	856	757	
Inpatient stay + devices	376	755	
Overheads	397	340	616
<b>Normal delivery</b>	<b>634</b>	<b>711</b>	<b>718</b>
Diagnostic procedures + medications	58	18	} 506
Labour	397	475	
Inpatient stay + devices	32	55	
Overheads	147	163	212
<b>Stroke</b>	<b>6,264</b>	<b>7,235</b>	<b>12,154</b>
Diagnostic procedures + medications	271	537	} 7,605
Labour	1,163	729	
Inpatient stay + devices	3,138	4,217	
Overheads	1,691	1,752	4,549
<b>Acute myocardial infarction</b>	<b>5,338</b>	<b>5,738</b>	<b>10,842</b>
Diagnostic procedures + medications	774	771	} 7,256
Labour	698	660	
Inpatient stay + devices	3,588	3,417	
Overheads	278	890	3,586

Source: Tan S. (2009)

## 2.8 Activity Based Costing

The Activity Based Costing (ABC) is a cost accounting system developed in Anglo-Saxon countries to cope with the obsolescence of traditional accounting systems with respect to changes in business management techniques, in production technology, in organizational models and in the competitive environment. It represents a micro costing/bottom-up approach and the fundamental principle of the ABC is that activities consume resources and the services or products are the result of that activities. It is a product cost calculation system that rather than relying on cost centres it is based on the concept of activity. It is still a full costing methodology but it considers that the consumption of resources in the production process is not only linked to the volume of production, but to a large extent depends on the activity, not necessarily and exclusively related with the same volumes production<sup>28</sup>. Therefore, activities are the fundamental subject of cost to consider: for example if 1000 units of a product “A” and

<sup>28</sup> Collini P. (2009). Analisi dei costi. Un approccio orientato alle decisioni, Franco Angeli, Milano.

100 units of “B” are produced, a traditional system would assign the product A a share of indirect costs up to 10 times those consumed by B, although it is not shown that the indirect activities needed to produce product “A” were 10 times higher than the ones used to produce “B”. Product “B” could be a product (e.g. a health service in the case of a healthcare organization) much more complex to achieve and it may ask for more support activities. The ABC system considers necessary to identify on one hand the extent to which the final products absorb activities (identification of activity drivers) and on the other to what extent the activities require resources (resource driver) thus allowing to obtain more accurate systems in the allocation of indirect costs to the final object of cost. In general, it is possible to identify four main steps to proceed with the Activity Based Costing:

1. Identification of the major activities taking place in an organization used to produce an health care service;
2. Assigning costs to activity pools through resource drivers;
3. Determining the cost driver for each activity (activity drivers);
4. Assigning the costs of activities to products according to their individual demands through the activity drivers.

A fundamental step of the Activity Based Costing is the identification of cost drivers both in the phase of cost allocation to activities (resource drivers) and to final cost objects (activity drivers). Since cost drivers depend on the cause that has generated the cost this implies that there is the need to identify an activity hierarchy. In a health care organization the hierarchy between activities reflects the clinical pathway that the patient follows in the organization during his/her period of care. Since the aim of an ABC model is to give as much as possible an accurate cost for a patient in hospital, it has been possible to identify the following hierarchy of costs and activities<sup>29</sup>:

- Activities (costs) at “patient” level;
- Activities (costs) at “day of hospitalization” level;
- Activities (costs) at “ (surgical) operation” level;
- Activities (costs) at “department” level;
- Activities (costs) at general support” level;

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<sup>29</sup> Cinquini L., Miolo P., Pitzalis A., Campanale C. (2007). Il costo dell’intervento chirurgico in laparoscopia mediante l’activity-based costing, Mecosan

Table 6 Activities in the hierarchical model

Hierarchy levels	Activities/Costs
Patient level	Admission to department
	Admission to hospital
	SDO Registration (SDO = Hospital Discharging Record)
Stay in hospital day level	Nursing care (depending on how severe the patient's condition is)
	Medical care
	Meals
	Laundry service
Operational level	Surgery room usage
	Surgical process
	Laundry service for operation
	Sterilization for operation
	Laboratory tests cost and physician visits
Department level	Internal Logistic
	Material orders management
	Department housekeeping services
	Legal controversies in medical activities and insurance management
	Maintenance to medical equipment
	Medical Department controls
	Legal activities for departments
General support level	Human Resources management
	Supplies and procurement management
	Reporting management
	Budget management

Source: Cinquini L., Miolo P., Pitzalis A., Campanale C. (2007)

In the selection of activities it is still important to remember that: a) the activities must be relevant therefore they must absorb a significant share of resources; b) the activities must be significant, i.e. they must be constituted by a series of actions which take a specific output; c) the activities must be, as much as possible, characterized by a unique activity driver, i.e. there must be a parameter that combines the activity costs and cost objects that require the performance.

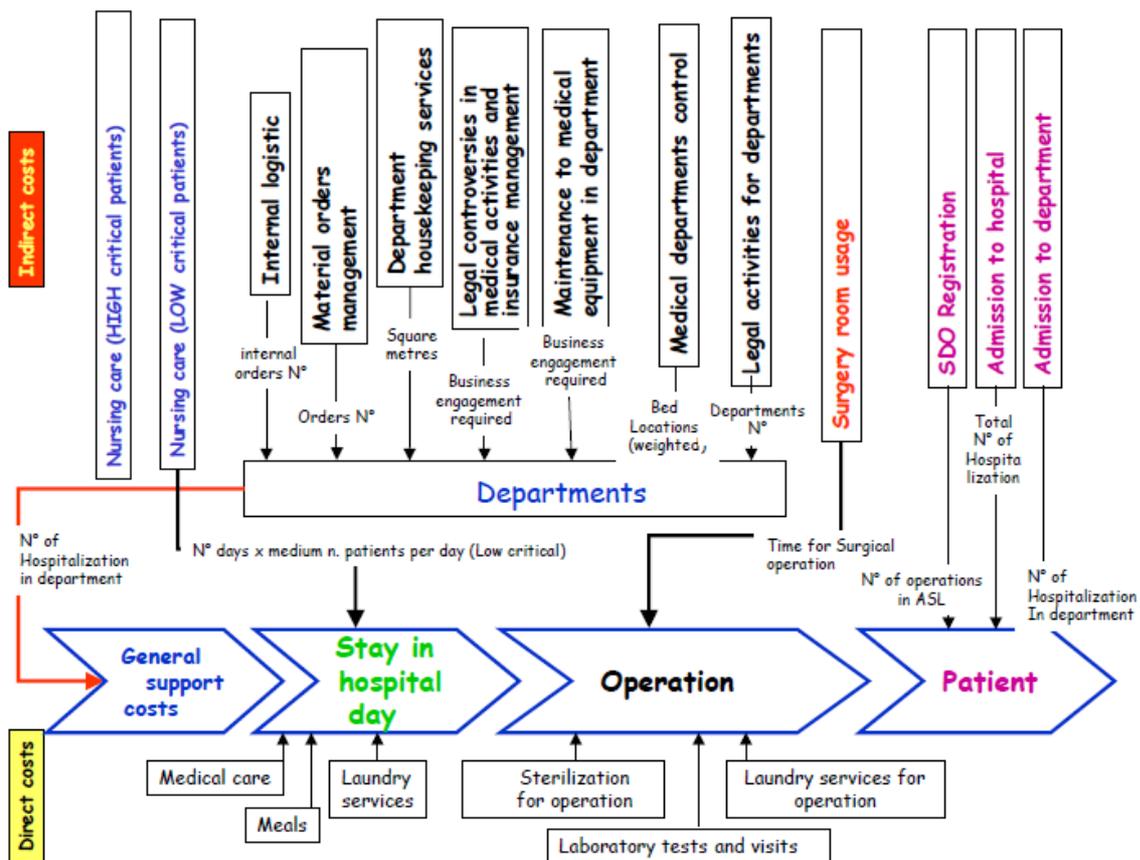
A process can be built using one or more of the following criteria for the identification of relevant activities:

- direct detection by those who take part in the activities, through compilation of periodic reports where the time devoted to each activity is indicated;
- external monitoring: it is in such a case that the detector following for a period of reasonable time the actions of those who carry out the activities, determines the importance and relevance of each activity for the analysis;

- subjective estimate: in this case through interviews individuals will be asked to provide a percentage estimate of the average time dedicated to each activity.

A critical stage, once identified the activities, is to select the appropriate drivers to share the cost of the activities and cost objects (activity drivers). It is possible to distinguish between the following drivers that have an increasing degree of accuracy: a) *Transaction driver*: these parameters refer to the frequency of a phenomenon and therefore they share the costs to a given cost object on the basis of the repetition in time of a benchmark activity; b) *Duration driver*: they allocate costs on the basis of the duration of the activity for the object of cost; c) *Intensity driver*: they give a more detailed information since they also indicate the quality of resources spent in a given activity depending for example on the severity and how critically ill is the patient. The figure below shows an example of a clinic pathway in a laparoscopy surgery: as shown the indirect costs are assigned to main activities on the basis of specific identified activities drivers.

Figure 16 Connections in the hierarchical model

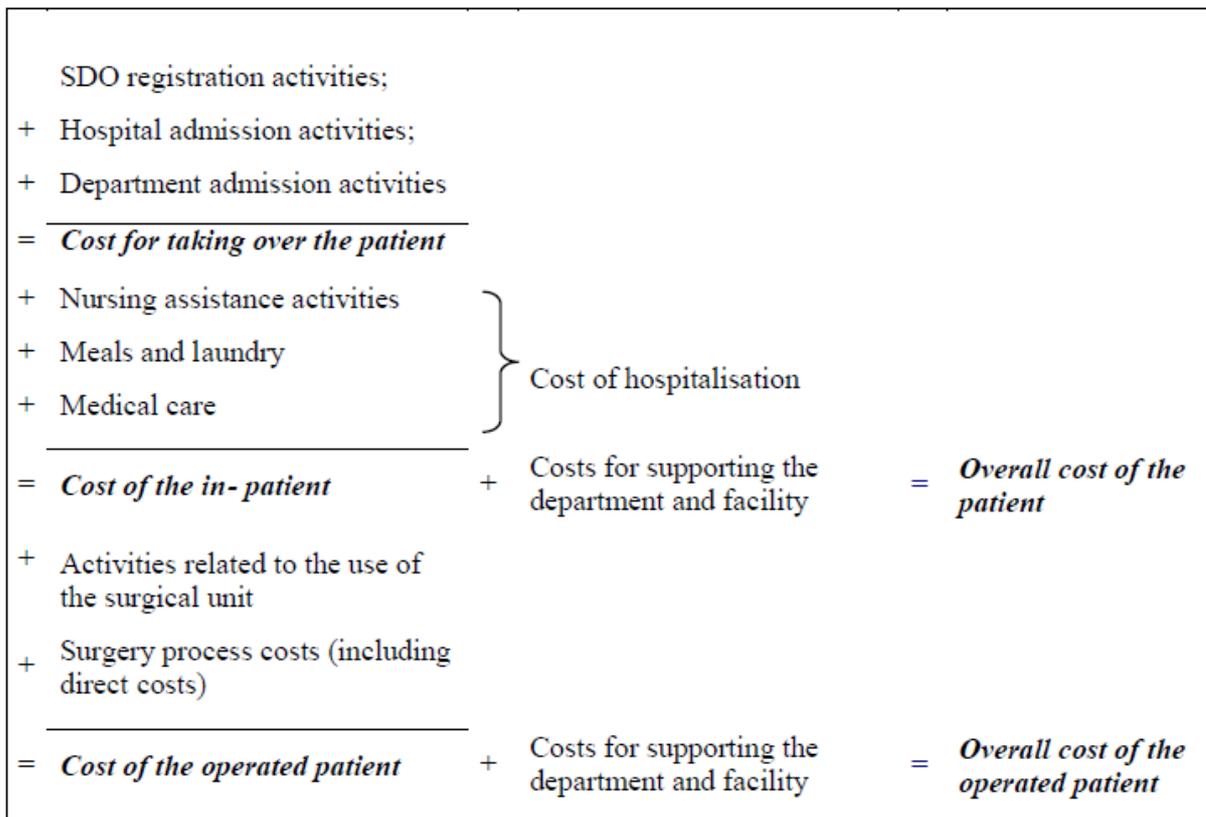


Source: Cinquini L., Miolo P., Pitzalis A., Campanale C. (2007)

Following the example of the laparoscopic surgical process also the cost configurations are based on a hierarchical model and therefore it is possible to identify:

- *the cost for taking over the patient*: It includes all the costs of direct activities to manage the patient's entry in the hospital and its leaving at the time of discharge;
- *the cost of in-patient*: includes in addition to the costs of taking over the patient (the previous configuration) also all costs related to the management of the patient's hospitalization, taking into account the duration of it;
- *the overall cost of the patient*: this cost is the sum of the cost of the in-patient and all other costs associated with any indirect activity (i.e. activities in support of the department and facility);
- *cost of the operated patient*: this includes for example all the activities related to the use of the surgical unit and the surgery process costs.
- *the overall cost of the operated patient*: finally this last cost configuration is obtained summing up the cost of the operated patient and the all costs for supporting the department and facility.

Figure 17 Cost configurations



Source: Cinquini L., Miolo P., Pitzalis A., Campanale C. (2007)

## 2.9 Time-Driven Activity-Based Costing

As described in the previous paragraph the ABC is a costing methodology where resource costs are allocated to products based on activities consumption. Therefore managers have a greater overview of the organizational processes and this allow them to reduce costs of non-value added activities improving the efficiency of processes: this model of proceeding for developing organizational processes is also referred as Activity Based Management (ABM). Nevertheless the ABC methodology has the potential disadvantage that the high time and cost to estimate and maintain it, through re-interviews and re-surveys, has been a major barrier to widespread ABC adoption<sup>30</sup> and especially on a large scale basis is not easy to implement. Therefore a simplified version of the ABC developed by Kaplan and Anderson is the Time Driven Activity Based Costing which in the process of evaluating all the resources used by the patient during his period of care it requires that providers estimate only two parameters at each process step: the cost of each of the resources used in the process and the quantity of time the patient spends with each resource<sup>31</sup>. Therefore TDABC starts identifying different departments, their cost and their practical capacity and then it calculates the cost per time unit dividing the total cost by the practical capacity (the practical capacity is the amount of time each employee can work without unoccupied time). As last step costs are allocated to the final cost object by multiplying the cost per time unit by the time that is necessary to accomplish the activity.

An important element that has to be stressed is that TDABC focus on how long it takes to complete one unit of an activity (e.g. the time required to register one patient) and also it estimates the resource demand by a simple time equation. Therefore this kind of approach points out some specific advantages since time equation create more cost transparency than a traditional ABC system.

*Table 7 ABC and TDABC steps comparison*

ABC	TDABC
1. Identify the different overhead activities;	1. Identify the various resource groups (departments);
2. Assign the overhead costs to the different activities using a resource driver;	2. Estimate the total cost of each resource group;
3. Identify the activity driver for each activity;	

<sup>30</sup> Kaplan R., Anderson S. (2004), Time-driven activity-based costing. Harvard Business Review.

<sup>31</sup> Kaplan R., Porter M. (2011). How to Solve The Cost Crisis in Health Care, Harvard Business Review.

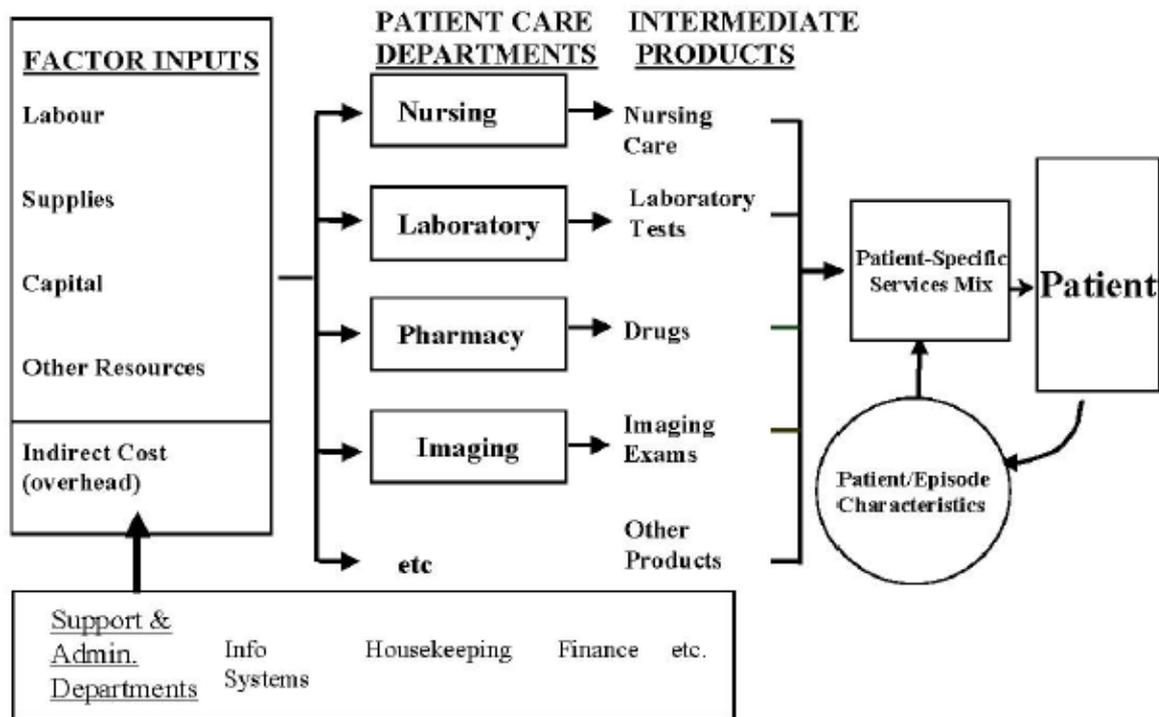
ABC	TDABC
	3. Estimate the practical capacity of each resource group (e.g. available working hours, excluding vacation, meeting and training hours);
4. Determine the activity driver rate by dividing the total activity costs by the practical volume of the activity driver;	4. Calculate the unit cost of each resource group by dividing the total cost of the resource group by the practical capacity;
5. Multiply the activity driver rate by the activity driver consumption to trace costs to orders, products or customers.	5. Determine the time estimation for each event, based upon the time equation for the activity and the characteristics of the event;
	6. Multiply the unit cost of each resource group by the time estimate for the event.

## 2.10 Patient Costing

Patient costing, sometimes known also as Case costing or Clinical Costing, is a specific healthcare costing methodology which is based on an Activity-Based Costing model and it is aimed at estimating the actual cost of care delivered to each service recipient (the patient). Therefore Patient costing is an accounting method that captures the full cost of specific procedures in episode of care by calculating all direct and indirect costs. The starting point in order to develop good cost data deals with the identification and the understanding of the context in which patient-specific costs are generated<sup>32</sup>. The hospital production function model shown in the figure below illustrates how a hospital uses a number of inputs (labour, equipment, etc.) in order to deliver health care services (x-ray, laboratory tests, nursing services, etc.) to the patients; a deep analysis through the identification of all the costs of the services provided and the distribution of these costs to each patient allow to reflect the cost of care delivered.

<sup>32</sup> Ministry of Health and Long-Term Care (2008), Ontario Guide to Case Costing

Figure 18 Hospital Production Function model



Source: Ontario Guide to Case Costing (2008)

The patient characteristics drive the specific mix of intermediate products produced by several departments (e.g. Nursing, Pharmacy, etc.) which in turn consume services from other departments (overhead or support and administration departments) that do not directly contribute to the production of patient care; the goal of the Case Costing methodology is then to allocate total hospital costs ( not only those related to direct patient care but also overhead functional centres) to single patients within a determined costing period. The overall process of Patient Costing consists of four main steps:<sup>33</sup>

*The first step* is basically the one described before and it is the process of identification of all resources incurred in the hospital that are necessary for the products to be costed (episodes of care) and moreover it includes the alignment of the timing of producing them with the timing of incurring their costs; this step involves therefore the manipulation of the costs recorded in the general ledger system and then it ends with the partitioning into overhead and final costs centres.

*The second step* regards the allocation of all overhead costs to final costs centres using direct consumption data or allocation criteria. For example in the Canadian guidelines to Patient

<sup>33</sup> IHPA (2014), Australian Hospital Patient Costing Standards, Version 3.1.

Costing<sup>34</sup> the standard method for indirect cost allocation is the Simultaneous Equation Allocation Methodology (SEAM); this methodology works through a series of linear algebraic equations and it has been shown to be one of the best approaches used to solve the problem of “reciprocal service allocation” between overhead cost centres.

*The third step* entails the allocation of the final cost centres into product categories (inpatient (or admitted) patient “products”, outpatient (or non-admitted) “products”, emergency department patient products, teaching and training products, etc.) but since final cost centres often do not fit entirely within a product category it is necessary to apportion them across more than one using for example data deriving from surveys ( e.g. medical staff in a cost centre uses x% of their time on admitted patient, y% on non-admitted patient and z% on teaching, training and research) or direct consumption data (e.g. x% of laboratory test are for admitted patients, y% for non-admitted patients, etc.).

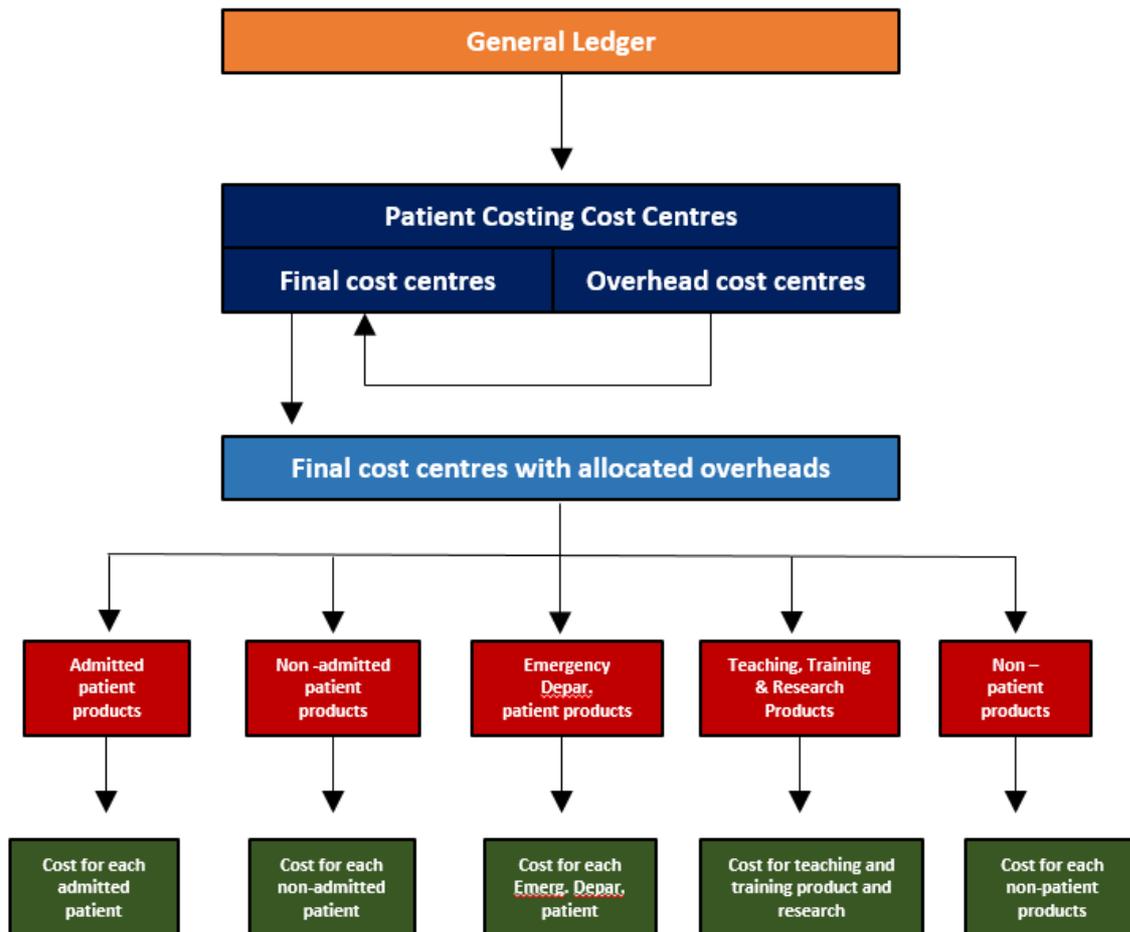
Finally *the fourth step* includes, within each product category, the allocation of costs in final cost centres to end-classes which are represented by individual patient (e.g. an admitted patient episode). The allocation process is complex and where is possible it should be based on actual resource consumption (e.g. time spent with an individual patient). If it is not possible to retrieve the information regarding the actual usage of the resource then a method that best approximates actual usage should be used. Other examples of methodologies which could be adopted are<sup>35</sup>:

- *Estimated average usage*: it is based on actual data gathered for a sample of patients from which an average is calculated. If even one sample of data is not available, then the estimates should be obtained from the clinical staff who work in the area concerned.
- *Using activity information as a proxy for specific patient level resource information*: for example ward stock drugs could be allocated on the basis of bed days/hours spent on the ward.

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<sup>34</sup> CIHI (2011), Canadian Patient Cost Database Technical Document: MIS Patient Costing Methodology.  
<sup>35</sup> Healthcare Financial Management Association, Acute health clinical costing standards 2016/2017

Figure 19 Overview over the Patient Costing process



Source: Australian Hospital Patient Costing Standards, Version 3.1

Patient-level cost data enables healthcare organizations to understand how costs are built up allowing to analyse them at the deepest level. The need to produce reliable and consistent costing data rely on the application of recognized best practice guidance (Standards) which reflect the methodologies and processes used to derive individual patient costs information; the application of the Standards when implementing Patient Costing allows the comparison between healthcare organizations following the same criteria. Just to give some examples at the international level<sup>36</sup>, in England the Healthcare Financial Management Association (HFMA) developed the *Acute Clinical Costing Standards* and the *Mental Health Clinical Costing Standards* as reference manual for applying Patient Level Costing. In Canada the Canadian Institution for Health Information (CIHI) have adopted the *MIS Standards* in order to collect “case cost” information and to make health service organizations to be able to measure and compare their resource utilization across the country. Moreover the *Australian Hospital Patient Costing Standards* have been implemented during a significant health reform in 2011 which

<sup>36</sup> The Italian case will be deeply analyzed in Chapter 4.

also established the Independent Hospital Pricing Authority (IHPA) as an independent government agency charged with receiving cost data from jurisdiction via the National Hospital Data Collection (NHCDC). The compliance with the Australian Standards of all healthcare organizations involved allows the IHPA to determine the National Efficient Price (NEP) for public hospital services.

Figure 20 CIHI and IHPA Patient Costing Manuals



Source: CIHI (2011) and IHPA (2014)



### 3. An Overview over Azienda Ospedaliera di Padova

#### 3.1 Mission, vision and values of AOP

As stated in the Corporate Deed adopted in 2014, the AOP has defined its mission that is aimed at ensuring basic healthcare for the communities in the Padua area and providing highly complex and high-technology healthcare at provincial, regional, national and international level [...] <sup>37</sup>. Moreover the AOP develop collaborative relationships with healthcare companies, territorial health trusts and other parties (e.g. volunteers) aimed at realizing continuity of care and monitoring the course of the patient before, during and after hospitalization, in full awareness of the centrality of the citizen / user in the system. Its vision is aimed at meeting the demand for high-complexity health by ensuring a high scientific level [...]. <sup>38</sup>

Moreover the healthcare values and principles that guide the strategic planning of its activities are <sup>39</sup>:

- *People at the Core* which reflects the ability of the “company system” to place people (healthcare users and providers) at the core of its actions creating an organisation of “People Caring for People”;
- *Fairness* which identify the goal of guaranteeing equal and timely need-based opportunities for access to healthcare;
- *Quality of the care provided* characterized by the promotion of care paths that are founded on the best scientific evidence;
- *Quality of administration* based on the principles of legality, transparency, confidentiality, good performance, effectiveness, efficiency and economy;
- *Education and Training* since the AOP is the primary site for specific School of Medicine and Surgery teaching programmes and also the AOP promotes and invests in the ongoing staff training system in order to maintain and develop the professional knowledge;
- *Research and Innovation* at a clinical level implementing diagnostic, curative and technological advancement processes and at a managerial level developing new organisational models;

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<sup>37</sup> Azienda Ospedaliera di Padova (2014), Art. 4 Corporate Deed.

<sup>38</sup> Azienda Ospedaliera di Padova (2013), White Book.

<sup>39</sup> Azienda Ospedaliera di Padova (2014), Art 5 Corporate Deed

- *Ethics* recognising the importance of ethical problems relating to clinical practice, experimentation and organisation;
- *Transparency* based on the visibility and clarity of relations both internal and external in order to facilitate widespread monitoring of the performance of institutional functions and the use of public resources;
- *Sustainability* developing management policies mindful of environmental, economic and organisational issues in line with the principles of equal opportunities and combatting discrimination of any kind

### 3.2 Organizational structure

The Corporate Deed highlights the AOP's organization which is divided into Departments, Complex Operating Units (UOC), Simple Departmental Operative Units (UOSD) and Simple Operating Units (UOS):

- *Departments*: basically they are coordination structures and at the organizational level they are above the Operating Units. In fact each Complex Operational Unit (UOC) and Simple Department Operative Unit (UOSD) pertains to a Structural Department. The AOP structural setting provides Structural Departments, Functional Departments and Inter-company (structural and functional) Departments. *Structural Departments* are those formed by the aggregation of at least three UOCs that are similar under the activity profile or the human and technological resources. *Functional Departments* aggregates UOC and UOSD that, although belonging to different structural departments, contribute to the achievement of specific strategic and transversal business objectives. The duration of the functional department is related to a project that identifies goals to achieve in a defined time. The *Intercompany Departments*, established on the basis of specific agreements reached with other companies, is a department that aggregates UOCs and UOSDs from different Companies / Institutions of the Regional Health Social Service and is aimed at achieving specific goals within a defined time.
- *Complex Operational Units (UOC)*: they are organizational structures internal to the department, with responsibility for the budget, exercising management functions and producing services identified as priorities by the regional or company planning. It is possible to distinguish between Hospital UOC and Non-hospital UOC. The former are those related to the clinical area while the latter are the operating units related to the Professional, Technical and Administrative area;

- *Simple Departmental Operative Unit (UOSD)*: the UOSDs are internal structures to the department with responsibility for the budget to which is assigned the responsibility of management of human, structural, technical and financial resources.
- *Simple Operating Units (UOS)*: they are internal structures to the UOC without budget responsibilities to which it some management responsibility for the human, structural, technical and financial resources is assigned.

At the top of the organizational chart of the AOP there are the institutional bodies which are the *General Manager*, the Board of Advisors and the *Council of Management* (which actually is considered as a collegial body and therefore it will be described later on together with the Council of Health).

- The *General Manager*, which is appointed by the President of the Regional Government in agreement with the Dean of the University of Padua, is the body which all the powers of management and the AOP's legal representation compete to. The General Director is responsible for achieving the objectives assigned by the Regional Government and the correct and economic management of the resources available to the AOP. The General Manager is assisted by the Health Director and the Administrative Director through a delegation system.
- The is appointed by the General Manager and remains in office for three years. It consisted of five members (recently downsized to three), including two appointed by the Region, one designated by the Ministry of Health, one by the Ministry of Finance and one from the Permanent Conference for Health and Social Health Regional Planning. It is up to the the control of administrative and accounting regularity and the control function of the compliance with the law of the management.

The General Manager together with the *Health and Administrative Managers* composes the General Management which retains the powers of definition of strategic goals and programs and the verification and control of the results achieved.

The Health Manager is appointed by the General Director and chairs the Health Area of the AOP; he/she is head of the Council of Health and is a member of the Council of Management and he/she can be considered as the link between the strategic and operational levels directly involved in assistance.

The Administrative Manager is appointed by the General Manager and preside over the administrative services of the AOP governing the economic and financial side of the AOP; it is also a member of the Council of Management.

The organizational structure provide also some collegial bodies in order to ensure the unified and coordinated action of the AOP's government. These are:

- *The Council of Management*: it is the collegial body that ensures to the General Management support for the government and planning of technical and health activities, for the use and development of human resources and the evaluation of the results achieved with respect to the clinical goals, etc. The Council of Management comprises: a) The General Manager; b) The Health Manager; c) The Administrative Manager; d) One manager of the Medical Management; e) One structural department manager for each area .
- *The Council of Health*: it provides mandatory non-binding opinions to the General Manager for technical and health activities and related investments.

Regarding the Departments the AOP is structured into two main areas: the hospital area and V the non-hospital area, but there also are a number of structural and functional inter-company departments. The organization is based on models of aggregation of similar activities thus eliminating duplication in work processes. Therefore the aggregation of the UOC / UOSD has therefore taken place for example for large homogeneous areas for sharing of resources and care pathways (e.g., medical area, surgical area, etc.)

In the figures below the AOP organization chart and the list of the structural, functional and inter-company departments (with its UOC and UOSD) help to understand the complexity of the organization structure of this healthcare organization. Looking at the bottom of the organization chart from the left to the right there are the structural departments, the functional departments, the inter-company structural departments and finally the inter-company functional departments of the hospital area. Regarding the non-hospital area there are only structural departments represented by the Department of general administrative services, the Department of resources for technical and IT services, the Department of material and financial resources and finally in the centre of the organization chart as a coordination structure there is the Department of Staff services.



In the following tables some examples of the list of the AOP Departments both for the Hospital and Non-hospital area are reported with the related UOC and UOSD.

*Table 8 Company structural department - Medicine*

<b>COMPANY STRUCTURAL DEPARTMENT - MEDICINE</b>
UOC Andrology and Reproductive Medicine
UOC Dermatology
UOC Dietetics and Clinical Nutrition
UOC ...
UOSD Coagulopathies
UOSD Hypertension
UOSD Thrombotic and Haemorrhagic Diseases
UOSD ...

*Table 9 company structural department - Surgery*

<b>COMPANY STRUCTURAL DEPARTMENT - SURGERY</b>
UOC General Surgery 1
UOC Hepatobiliary Surgery and Liver Transplants
UOC Kidney and Pancreas Transplant Surgery
UOC ...
UOSD Spine Surgery
UOSD Endocrine Surgery
UOSD Minimally Invasive Surgery
UOSD ...

*Table 10 Company Structural Department - Relation with the territory*

<b>COMPANY FUNCTIONAL DEPARTMENT – RELATIONS WITH THE TERRITORY</b>
UOC Acceptance and First Aid
UOC Acceptance and Pediatric First Aid
UOC Geriatrics
UOC ...

*Table 11 Company Structural Department - Coordination Of The Organizational And Technological Support To Biomedical Research*

<b>COMPANY FUNCTIONAL DEPARTMENT – COORDINATION OF THE ORGANIZATIONAL AND TECHNOLOGICAL SUPPORT TO BIOMEDICAL RESEARCH</b>
UOC Pathological Anatomy
UOC Pharmacy
UOC Laboratory Medicine
UOC ...
UOSD Projects and Clinical research

Table 12 Inter-Company Structural Department - Mental Health

<b>INTER-COMPANY STRUCTURAL DEPARTMENT – MENTAL HEALTH</b>
UOC Psychiatry AOP

Table 13 Inter-Company Structural Department – Transfusion Medicine

<b>INTER-COMPANY STRUCTURAL DEPARTMENT – TRANSFUSION MEDICINE</b>
UOC Transfusion Medicine AOP
UOSD Transplant Immunology AOP

Table 14 Inter-Company Functional Department - Rehabilitation Hospital-Territory

<b>INTER-COMPANY FUNCTIONAL DEPARTMENT – REHABILITATION HOSPITAL-TERRITORY</b>
UOC Recovery and Functional Rehabilitation AOP
UOC Recovery and Functional Rehabilitation (ULSS 16)

Table 15 Inter-Company Functional Department – Drug Policies

<b>INTER-COMPANY FUNCTIONAL DEPARTMENT – DRUG POLICIES</b>
UOC Pharmacy AOP
UOC Hospital Pharmacy (ULSS 16)
UOC Territorial Pharmacy (ULSS 16)

**NON - HOSPITAL AREA**

Table 16 Company Structural Department – General Administrative Services Department

<b>COMPANY STRUCTURAL DEPARTMENT – GENERAL ADMINISTRATIVE SERVICES DEPARTMENT</b>
UOC General and Legal Affairs
UOC Hospital Administrative Department
UOC Relations with the University and Training
UOC Human Resources

Table 17 Company Structural Department – Resources For Technical And It Services

<b>COMPANY STRUCTURAL DEPARTMENT – RESOURCES FOR TECHNICAL AND IT SERVICES</b>
UOC Tender Management and Technical Area Contracts
UOC Real Estate and Systems Management
UOC Information Technology
UOC ...

Table 18 Company Structural Department – Material And Financial Resources

COMPANY STRUCTURAL DEPARTMENT – MATERIAL AND FINANCIAL RESOURCES
UOC Accounting and Financial Statements
UOC Logistic Management
UOC Freelance and Binding Loans
UOC ...

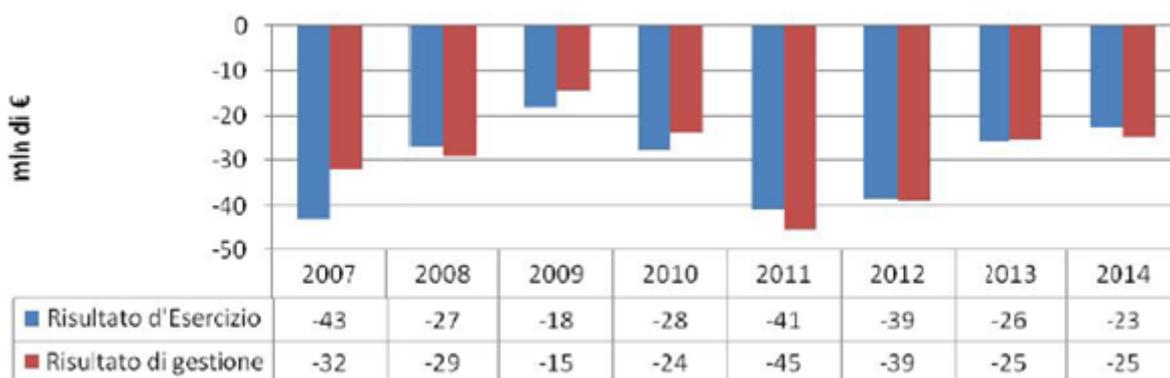
Table 19 Company Structural Department – Staff Services

COMPANY STRUCTURAL DEPARTMENT – STAFF SERVICES
UOC Communication and Relations with Citizens
UOC Planning and Management Control
UOC Quality and Accreditation
UOC ...

### 3.3 Economic and financial overview

The period 2013-2014 have recorded an improvement in the operating income compared to previous years. The result for the year 2014 amounted to - € 22.8 million (the lowest loss after 2009) and the same trend was confirmed by the operating result, which includes the operating income net of financial and extraordinary operations.

Figure 21 Azienda Ospedaliera di Padova: Operating result and Operating income (2008-2014)



Source: AOP Performance plan 2015-2017

The planned result, even if improved, has been strongly negative, so admitting the structural nature of the income loss for the AOP.

Figure 22 Azienda Ospedaliera di Padova: Planned result

	<b>2013</b>	<b>2014</b>	<b>2015</b>
Risultato pianificato	-38.700.000 euro	-34.400.000 euro	-28.667.000 euro

Source: Social accountability report

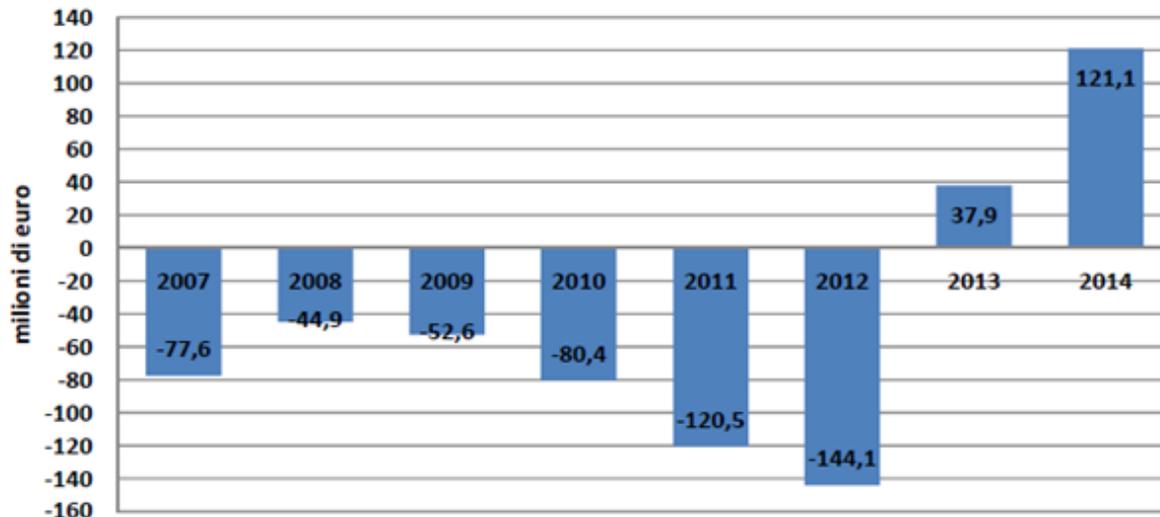
The reasons for the negative results have been identified in the modalities and amounts of the AOP financing system and in particular in the imbalance between tariffs and cost of production<sup>40</sup>. For example regarding this aspect, the AOP has a high production of high specialized activities whose costs are not fully covered by the tariff system. An example is the organ transplant activity in which the AOP presents a volume of operations that place it among the leading Italian hospitals. Moreover the standard cost recently developed by N.I.San. (Italian Health Network) regarding the comparison between the average hospitalization costs and the average value of the tariffs had shown that on average, the tariff covers the 63% of the costs of the hospitals analysed and with the growth of the hospitalization complexity the tariff becomes less coherent with respect to the cost of production.

The shareholder's equity highlighted a clear improvement after reaching value of -144 million euro in 2012, going back to positive figures from 2013 approximately 38 million euro in 2013 and a further improvement in 2014 up to the value of 121 million euro. This improvement is due in part from coverage by the Region of past losses leading to a recapitalization of the assets, but mainly from disbursement of the tranche of Decree 35/2013 which was aimed at repaying part of the debts of public administrations.

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<sup>40</sup> Azienda Ospedaliera di Padova (2015). Social accountability report.

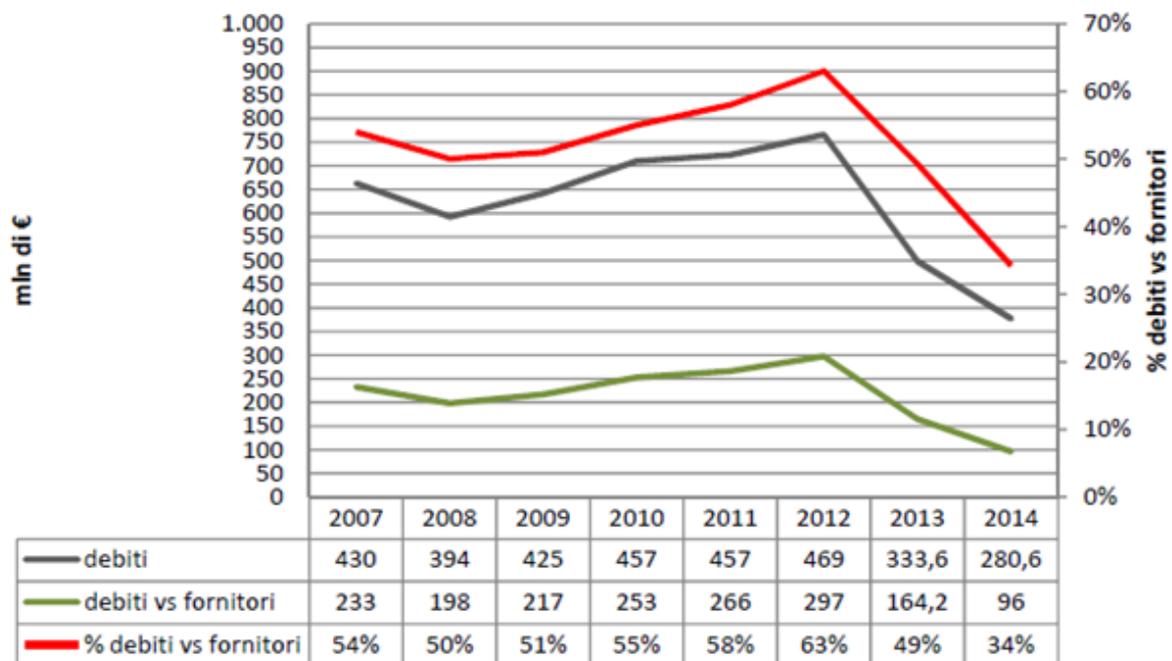
Figure 23 Azienda Ospedaliera di Padova: “Shareholder’s equity”



Source: Social accountability report

The financial situation of indebtedness had an increasing trend until 2012 while in 2013 the situation improved as a result of new legislations (e.g. Decree 35/2013) which allowed the AOP to have more liquidity to pay part of debts to suppliers that had already expired. The financial situation for 2014 revealed total debts of almost 280.6 million euro and more precisely debt to suppliers of approximately 96 million euro.

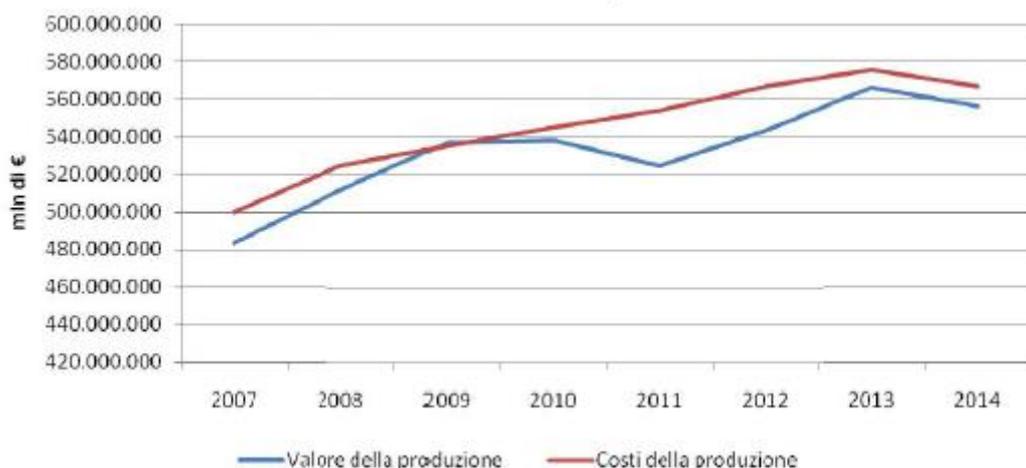
Figure 24 Debts of Azienda Ospedaliera di Padova



Source: Social accountability report

Finally looking to the value of production it decreased in 2011 and then started to grow again the following year, also due to the increase in the tariffs of hospitalizations and in 2013, for the increase of the contributions received. In 2014 there was again a decrease in revenues due in part to the reduction of tariffs of specialist health services.

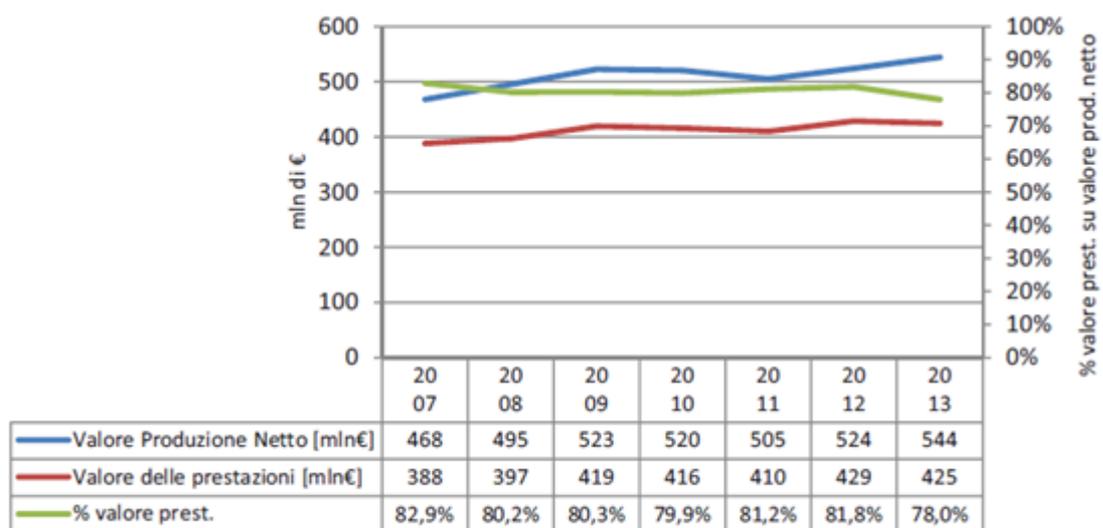
Figure 25 Revenues and Costs trends of Azienda Ospedaliera di Padova



Source: Social accountability report

### 3.4 The delivering of hospital care

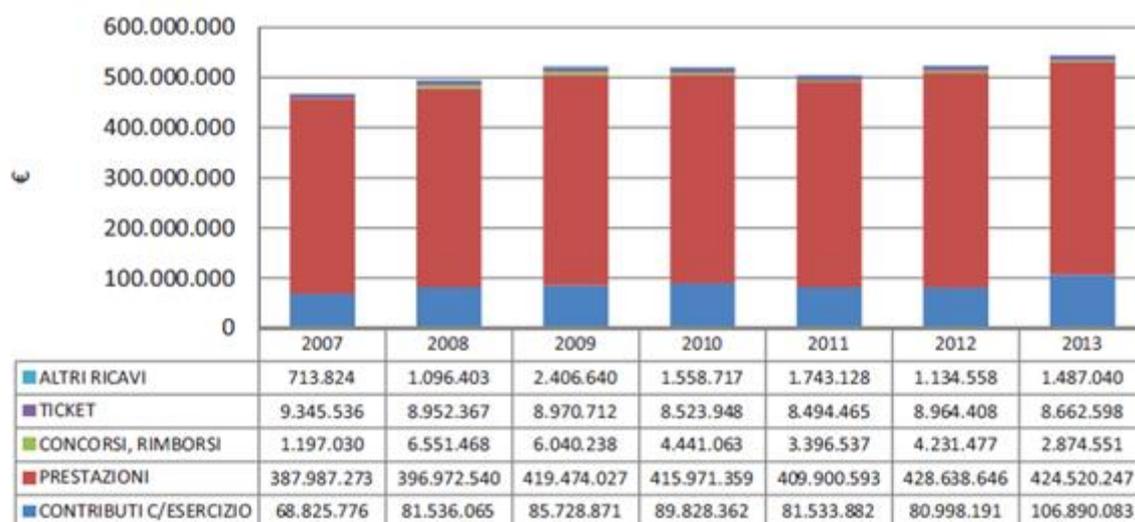
Figure 26 Value of the services provided with respect to the Net value of production of AOP



Source: Performance Plan (2015-2017)

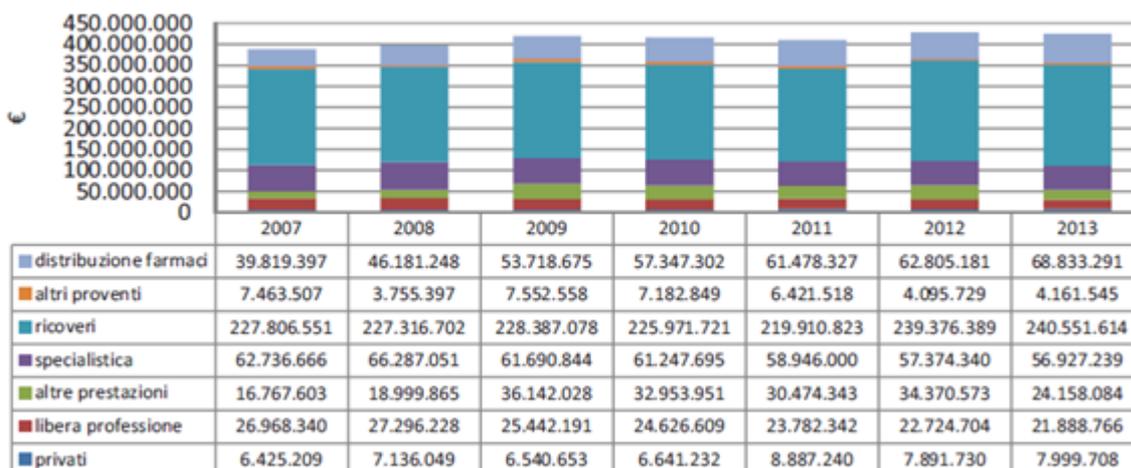
Focusing on the AOP economic activity, most of the value of the net production derives from the services provided (about 80%). The graph above shows the trend in the value of production from 2007 to 2013<sup>41</sup>. The value of the services compared to the total value decreased until 2010 due to the sustained increase of the contributions received, while in subsequent years grew due to the gradual contraction of the same contributions, except for the 2013. The absolute value of the services provided, however, altogether increased until 2009, then decreased of 10 million in total in the following two years, and grew again in 2012.

Figure 27 Net Value of Production



Source: Performance Plan 2015-2017

Figure 28 Value of Net services

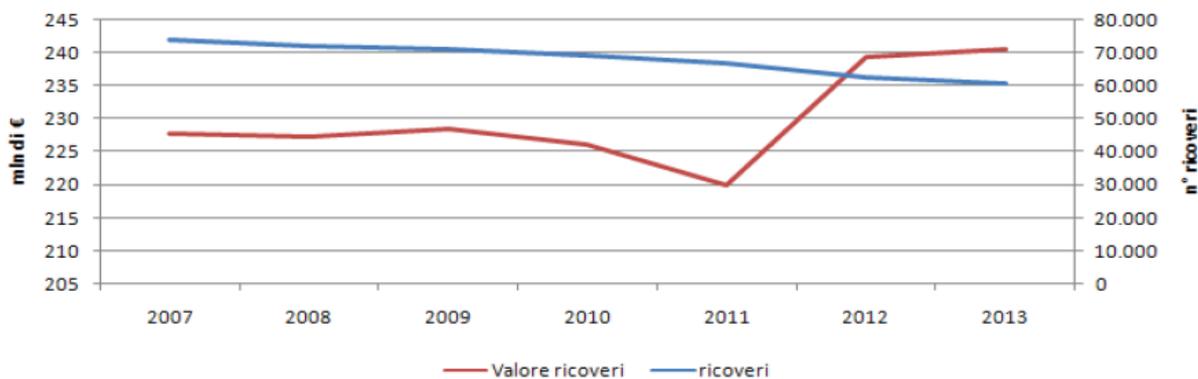


Source: Performance Plan (2015-2017)

<sup>41</sup> Azienda Ospedaliera di Padova (2015), Performance Plan (2015-2017)

By the trend of the number and value of the AOP's hospital admissions it is possible to observe that the value has reduced significantly in 2011, but then rose again in 2012, despite the continued and progressive reduction of hospitalizations, due to the increase of tariffs established by the Veneto Region.

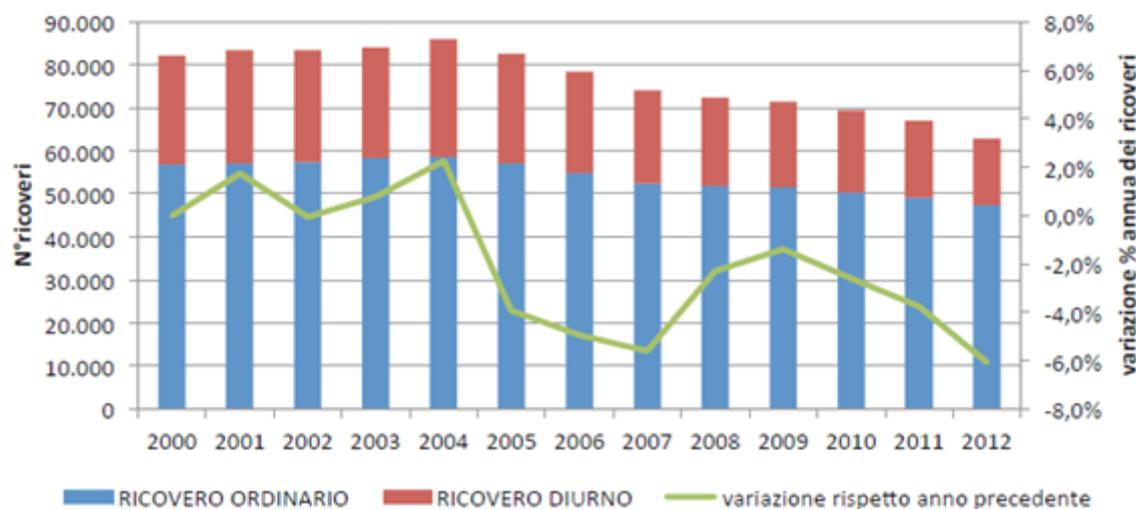
Figure 29 Number and value of hospitalization in the Azienda Ospedaliera di Padova



Source: Performance Plan (2015-2017)

In the period 2004-2012 the number of hospitalizations decreased and the reduction was 23,128 units, accounting for 26.9%. The reduction was equally distributed between ordinary hospitalizations and day hospitals; however, for the latter the reduction in relative terms was much higher (44%, because of the lower total number).

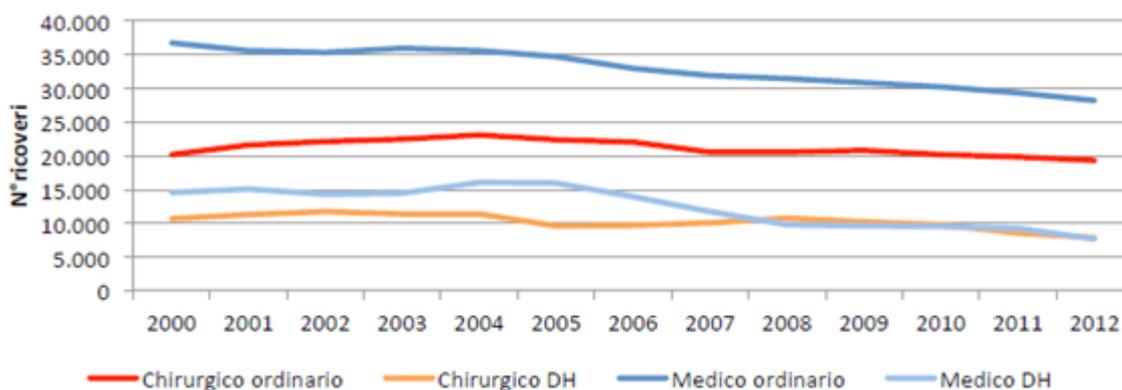
Figure 30 Hospitalization trends in the Azienda Ospedaliera di Padova



Source: Social accountability report

With reference to the same period (2004-2012) it is possible to observe that the reduction has occurred in the surgical area, but especially in the medical area (-30.6%) and in both cases the reduction has interested in homogeneous measure both the ordinary and day-hospital cases.

Figure 31 Hospitalization trends in AOP considering type and regime



Source: Social accountability report

Finally in order to conclude the analysis some data about the number of hospitalizations, the total value per year and the average value with reference to the period 2007-2013 are reported. As said before the number of hospitalizations showed a decreasing trend but on the other hand the average value increased, thanks to the increase in the importance of high complexity cases.

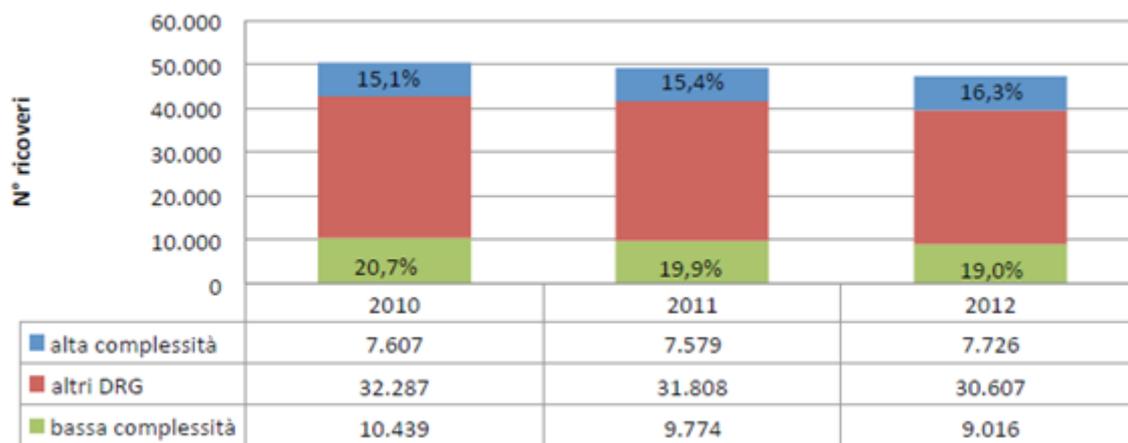
Figure 32 Number, Value and Average value of hospitalizations (2007 - 2013)

	2007	2008	2009	2010	2011	2012	2013
N. ricoveri	74.115	72.411	71.400	69.536	66.925	62.861	60.866
Valore ricoveri (mln €)	228	227	228	226	220	239	241
Valore medio ricovero	€ 3.074	€ 3.139	€ 3.199	€ 3.250	€ 3.286	€ 3.808	€ 3.952

Source: Social accountability report

As a matter of fact in the years 2010-2012 high complexity inpatient admissions increased from 15,1% to 16% with respect to the total admissions. On the other hand the number of low complexity inpatient admissions was higher than that of high complexity (in 2012 19,0% vs 16,3%) but however the trend of low-complexity inpatient admissions decreased (from 20.7% in 2010 to 19.0% in 2012)

Figure 33 Complexity distribution of hospitalization in Azienda Ospedaliera di Padova



Source: Social accountability report



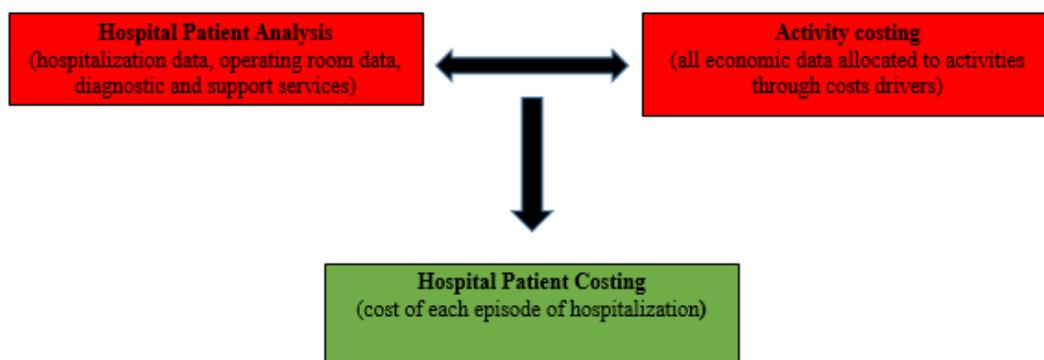
## 4. An Analysis of Hospitalization Costs

### 4.1 Analysis of hospitalization costs: a Hospital Patient Costing approach

The analysis related to costs of hospitalizations of Azienda Ospedaliera di Padova is based on data referring to year 2014 and it is an application of the Patient Costing methodology also called Hospital Patient Costing or Clinical Costing. The process is basically the result of the connection of two main phases: the Hospital Patient Analysis (HPA) (or analysis of production) and the Activity Costing; the final product of the analysis is then the cost per episode of hospitalization.

- *Hospital Patient Analysis (HPA)*: it identifies the clinical path of each episode of hospitalization and it is based on hospital discharge records, operating room data and diagnostic and support services data;
- *Activity Costing*: at this stage economic data, i.e. costs relating to each diagnosis and treatment unit (drugs, health services, staff, etc.) identified through the analytical accounting system, are allocated to the "activities" through cost drivers;

Figure 34 The process of Hospital Patient Costing



The last step of the process is basically the one that links the two phases and allocates costs to each episode of hospitalization using different cost drivers<sup>42</sup>.

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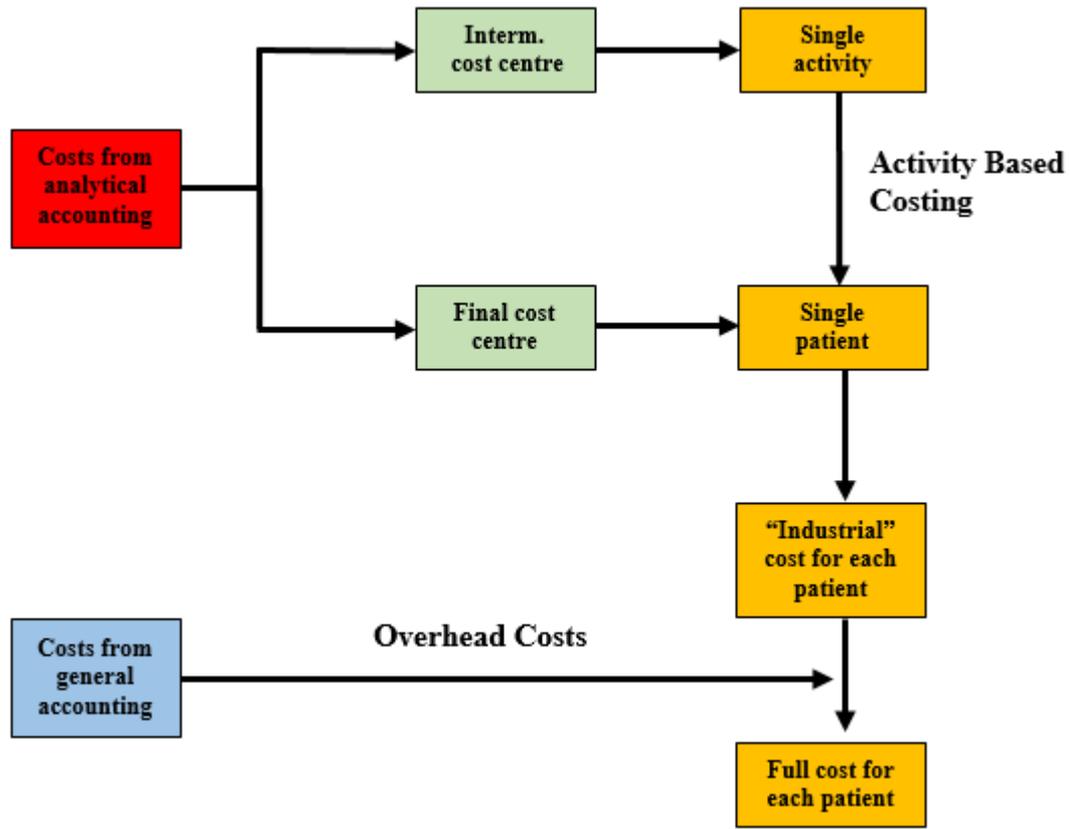
<sup>42</sup> The final process of costs allocation is performed by a software named "CSO" (Controllo Strategico Ospedaliero – Hospital Strategic Control) which will be described later on.

As mentioned before, the data required for starting the analysis were:

- on the organizational side: responsibility centre plan and cost centre plan;
- on the activity side:
  1. *Hospitalizations data*: single-patient data of the following activities: inpatient activity, based on hospital discharge records (SDO – Schede di Dimissione Ospedaliera), ER short stay observation (OBI – Osservazione Breve Intensiva) and outpatient complex health services (PAC – Prestazioni Ambulatoriali Complesse);
  2. *Operating room data*: they refer to the information related to a surgical procedure (e.g. surgical procedure code, starting/ending time of the surgical procedure, surgical team code, etc.) and are pulled out from the Operating Room Registry;
  3. *Diagnostic and support services data*: data about diagnostic services for outpatients, inpatients and those relating to the Emergency Room. Data do not take into account records concerning OBI and PAC since they are already included in the “Hospitalization data”;
- on the costs side:
  4. *Costs data*: related to costs of drugs, health care services, medical and surgical devices, depreciation of health equipment and maintenances, cleaning and laundry services;
  5. *Staff data*: data related to the costs of all the AOP human resources (medical staff, nurses, healthcare assistants, administrative staff, etc.)

The figure below describes the general process of the model used: costs from analytical accounting are divided between intermediate and final cost centres. Afterwards intermediate costs centre are allocated to each activity and then, through an Activity-Based approach, down to each single patient. Final cost centre are directly allocated to each single patient. At this step, the result is the “industrial” cost for each single patient. Once overhead costs, coming from the general accounts, are allocated the “full costs” for each patient is obtained.

Figure 35 The process of cost allocation in Hospital Patient Costing



## 4.2 Data management process

In this paragraph each of the data set listed above will be described as to:

- its role in the whole analysis,
- its content,
- the main issues that had to be solved in order to actually use the data.

Before starting to describe the data set, it is necessary to remind that the methodology used is an analysis based on analytical accounting where costs, divided between final and intermediate cost centres, are distributed through a step down approach first of all to all centres and then the intermediate are allocated to the final ones.

Table 20 Examples of final and intermediate cost centres

Code	Final cost centres	Code	Intermediate cost centres
200	MEDICINA NUCLEARE 1	10601	MAL. INFETT. SZ 1 P
300	TOSSICOLOGIA FORENSE E ANTIDOPING	10801	CH. GEN. SZ DEG.
700	ANGIOLOGIA	11001	CH. PLASTICA SZ DEG.
800	MICROBIOLOGIA E VIROLOGIA	11101	NEUROCHIR. DEGENZA

Code	Final cost centres
1300	ANATOMIA E ISTOLOGIA PATOLOGICA - CLOPD
1500	ANATOMIA PATOLOGICA 2
1602	ANAT PATOLOG SRAG CITODIAGN
2400	SERVIZIO AMBULATORIALE
2700	MEDICINA DELLO SPORT
3200	RADIOLOGIA
3300	ISTITUTO RADIOLOGIA
3700	COORDINAMENTO MALATTIE RARE
3800	NEURORADIOLOGIA

Code	Intermediate cost centres
11202	CLI. ORTOPEDICA SZ DEG.
11401	CLI MEDICA 1 SZ DEG.
11708	CLI. NEUROLOGICA SZ DEG.
11802	PED. DEGENZA 2
11803	PED. DEGENZA 3
11804	PED. D.H.
11901	CLI. O.R.L. SZ DEG.
15901	CLI.CH.GEN. 3 DEG.
12602	NEFROLOGIA SZ DEGENZE

### a) Hospitalization data

The main activity data set to retrieve is the hospitalization one. Most of the data were collected from the Discharge Patient Record using a business intelligence & visualization software “Qlikview” used by AOP Planning & Control Unit.

Each record refers to a case of hospitalization: for year 2014, 59814 records related to hospital discharge records (SDO).

Two other activities were added, because of their similarity to hospitalizations:

- The activity of the Short Stay Observation (O.B.I.), which is a ward of the Emergency Room with a limited number of monitored beds, with possibility of at most 24 hour stay. This unit is aimed at assessing clinical cases, arriving in the emergency room daily, which manifest a clinical picture that may not require a hospitalization. This work has the dual purpose of avoiding unnecessary hospital admissions in specialist wards for patients as well as inappropriate and potentially hazardous discharge. In 2014 this activity generated 9592 records related to short stay observations (OBI);
- The outpatient complex health services (PAC). These are outpatient activities that once required an hospitalization. Thanks to organizational improvements and under pressure for decreasing the hospitalization rate, the multiple health investigations needed by these patients are now performed in a single day, avoiding the patient to be admitted for the night. These procedures, that can be complex such in the case of cataract, inguinal hernia, chemotherapy, were offered to 6027 in 2014.

The table below provides an example of the data included in a Hospital discharge record in order to highlight what kind of information was necessary to retrieve. This multiplicity of data

serves both to build the patient's path, and then properly allocate costs, both to calculate the drivers.

*Table 21 Hospitalization data: information contained in a hospital discharge record*

Hospital Discharge Record	Example
DRG code	548
Amount related to the DRG tariff	17604
Amount charged to the user	
Date of admission	01/01/2014
Budget unit of admission	12902 (U.C.I.C.)
Date of the first patient transfer	03/01/2014
Budget unit of the first patient transfer	12900 (CARDIOLOGIA)
Date of the second patient transfer	10/01/2014
Budget unit of the second patient transfer	12810 (CARDIOCHIRURGIA T.I.P.O.)
Date of the third patient transfer	
Budget unit of the third patient transfer	
Date of the fourth patient transfer	
Budget unit of the fourth patient transfer	
Date of the fifth patient transfer	
Budget unit of the fifth patient transfer	
Date of the sixth patient transfer	
Budget unit of the sixth patient transfer	
Date of discharge	14/01/2014
Budget unit of discharge	12810 (CARDIOCHIRURGIA T.I.P.O.)
number of inpatient days	13
Code related to the kind of inpatient stay (1= ordinary-standard; 2 = ordinary-outliers; 3 = ordinary - 0-1 days; 4= DH standard; 5 = Pac ; 6=OBI)	1
Patient died ( 1= yes; 0 = no)	1
First Aid ( 1 = patient admitted through FA; 0 = otherwise)	1
Payor ( 1= if the patient is payor; 0 = otherwise)	0
Medical record code	1_2014_00000067
City of residence code	28060
Date of birth	01/08/1930

Hospital Discharge Record	Example
Code of Diagnosis 1	41401 (ATEROSCLEROSI CORONARICA DI ARTERIA CORONARICA NATIVA)
Code Diagnosis 2	99811 (EMORRAGIA COMPLICANTE UN INTERVENTO)
Code of Diagnosis 3	4821 (POLMONITE DA PSEUDOMONAS)
Code of Diagnosis 4	03849 (ALTRE SETTICEMIE DA MICRORGANISMI GRAM-NEGATIVI)
Code of Diagnosis 5	44489 (EMBOLIA E TROMBOSI DI ALTRE ARTERIE)
Code of Diagnosis 6	
Code of surgical/diagnostic procedure 1	8856 (ARTERIOGRAFIA CORONARICA CON CATETERE DOPPIO)
Budget unit of surgical/diagnostic procedure 1	12900 (CARDIOLOGIA)
Date of surgical/procedure 1	02/01/2014
Code of surgical/diagnostic procedure 2	3612 (BYPASS AORTOCORONARICO DI DUE ARTERIE CORONARICHE)
Budget unit of surgical/diagnostic procedure 2	12800 (CARDIOCHIRURGIA)
Date of surgical/procedure 2	10/01/2014
Code of surgical/diagnostic procedure 3	3961 (CIRCOLAZIONE EXTRACORPOREA AUSILIARIA PER CHIRURGIA A CUORE APERTO)
Budget unit of surgical/diagnostic procedure 3	12800 (CARDIOCHIRURGIA)
Date of surgical/procedure 3	10/01/2014
Code of surgical/diagnostic procedure 4	3403 (RIAPERTURA DELLA SEDE DI TORACOTOMIA RECENTE)
Budget unit of surgical/diagnostic procedure 4	12800 (CARDIOCHIRURGIA)
Date of surgical/procedure 4	10/01/2014
Code of surgical/diagnostic procedure 5	8856 (ARTERIOGRAFIA CORONARICA CON CATETERE DOPPIO)
Budget unit of surgical/diagnostic procedure 5	12900 (CARDIOLOGIA)

Hospital Discharge Record	Example
Date of surgical/procedure 5	02/01/2014
Code of surgical/diagnostic procedure 6	3995-EMODIALISI
Budget unit of surgical/diagnostic procedure 6	12600 (NEFROLOGIA 2)
Date of surgical/procedure 6	14/01/2014
Hospital unit code	50901

Even if based on a computerized system, these data were not perfect and required checks and corrections for example the phase of controlling budget units dates and codes related to patient transfers among budget units (a budget unit basically identifies for example a ward) was the more problematic in term of data management. In particular, data collected from “Qlik” were often filled out incorrectly; some records had the code of the budget unit of a patient transfer which coincided with the code of the budget unit of the previous/successive transfer; moreover the code of the budget unit of the last transfer of the patient had to coincide with the code of the budget unit from which the patient was discharged. Another important check on hospitalization data concerned the progressivity of transfers dates: any date of a transfer had to be next to that of the previous transfer. However, these problems was related only to hospital discharge records data since episodes of care related to OBI and PAC do not consider transfers among budget units because the patient is not admitted.

#### **b) Diagnostic and support services data**

Not all the treatment and diagnostic procedures are performed by the Department which has the patient in charge. Diagnostic services especially are required from Diagnostic Units that can be considered as service centres:

- “Laboratory”, “Microbiology” and “Pathological anatomy” for blood and other laboratory tests;
- “Radiology” e “Neuroradiology” for imaging;
- various other units for specialized consultations.

Each record referred to diagnostic and support services data for inpatients, outpatients or ER. Total records were 61324 for the year 2014. The following table identifies information required for the analysis.

Table 22 Diagnostic and support services data: information used for the analysis

Health services	Example
Hospital unit code providing the service	50901
Responsibility centre code providing the service	3900 (MEDICINA DI LABORATORIO)
Identification of the service provided ( PS= service provided for Firs Aid unit; I = service provided for inpatients; E: service provided for outpatients	E
Hospital unit code requiring the service	50901
Responsibility centre code requiring the service	3900 (MEDICINA DI LABORATORIO)
Regional code of the service provided	90.62.2-EMOCROMO: Hb, GR, GB, HCT, PLT, IND. DERIV., F. L..
Number of services provided	101111
Amount of the tariff related to the service provided	414443,39

### c) Operating room data

Operating room data were useful for two main reasons:

- To allocate correctly costs of the operating room on each patient, thanks to the connection between the surgical register and the hospital discharge record (in fact many patients do not even pass for the operating room while others come back several times during the same hospitalization);
- to allocate costs on the basis of objective drivers such as the number of people in attendance or the duration of a surgical procedure.

Each record refer to a surgical procedure carried out during the patient hospitalization period and total records with respect to year 2014 were 48996. The information required for the analysis are listed in the table below.

Table 23 Operating room data: information of a surgical procedure

Information of a surgical procedure	Example
medical record code	1_2014_00005256
date of the surgical procedure	30/01/2014
surgical unit code who performed the surgical procedure	011208 (CLI. ORTOPEDICA SR OPERATORIO)

Information of a surgical procedure	Example
number of surgeons	2
starting time of the session for surgeons	9:10:00
ending time of the session for surgeons	9:35:00
anesthesiology unit code	15800
number of anesthetists	1
starting time of the session for anesthetists	8:30:00
ending time of the session for anesthetists	9:35:00
operating block code	051100 (P.O. 1E - ORTOPEDIA)
number of nurses	1
number of healthcare assistants	1
starting time of the session for nurses/healthcare assistant	8:10:00
ending time of the session for nurses/healthcare assistant	10:00:00

The main issues addressed managing the operating room data referred to the starting/ending time of the surgical procedure, the starting/ending time of the session of anaesthesiologists and nurses/healthcare assistants. More precisely the overall structure (shown in chronological order) related to a surgical procedure with respect to the starting/ending time of the session of each worker is:

1. starting time of the session for nurses/health care assistant;
2. starting time of the session for anaesthesiologists;
3. starting time of the session for surgeons;
4. ending time of the session for surgeons/ anaesthesiologists <sup>43</sup>;
5. ending time of the session for nurses/health care assistant.

Therefore data were managed in order to check out that for each surgical procedure the timing structure were followed. In those records where it was not the case, records have been filled out using an average time computed with respect to a similar surgical unit. For example if for a surgical procedure addressed by the surgical unit “Plastic surgery” the starting time of the session for the anaesthesiologist was recorded, incorrectly, before the starting time of the session for nurses/healthcare assistants, the record has been corrected using the average starting time of the session of the anaesthesiologist with respect to the starting time of the session of the

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<sup>43</sup> During the data management process, it was considered that the ending time of the session of the anesthetist coincided with the ending time of the session of the surgeon since data was very often filled out incorrectly.

nurse/healthcare assistant calculated on the basis of all surgical procedures performed by the surgical unit “plastic surgery”. Another important check that has been done relates to the correspondence between the data on hospital discharge records and operating room registry data: in particular we checked that all cases in which the patient had been operated during the hospitalization period (not in cases of Day Hospital) were actually present in the hospital discharge records.

#### **d) Goods and services cost data**

The Activity Costing phase identifies the process where costs are firstly retrieved from the management accounting system and then allocated to the activities through costs drivers. Costs data concern costs related to:

- Drugs;
- Medical and surgical devices;
- Health services;
- Kitchen services;
- Cleaning and laundry services;
- depreciation of buildings and technical equipment and maintenances;

Any other cost, besides human resources costs dealt with in the following paragraph, has been considered as general costs (see paragraph on overhead costs).

The table below identifies the information required in order to perform the analysis: basically resources costs of each analytical cost centre<sup>44</sup> were allocated to the activities performed by that analytical centre. Moreover other additional information were required in order to load data in the “CSO” software and then allocate the costs to each episode of hospitalization.

*Table 24 Good and services costs data: information required*

Information required	
Responsibility centre code	e.g. 10800
Responsibility centre name	e.g. General Surgery
Responsibility centre hospital unit	50901
Hospital unit name	AO Padova
Firm code	901
Cost type	e.g. drugs

<sup>44</sup> Basically an analytical centre is a subset of each responsibility centre: for example the responsibility centre “General Surgery” (identified through the code 010800) is composed by the analytical centre “General Surgery – ward” (code 010801) and “General Surgery – operating room “ (code 010805).

Information required	
Accrued cost	It identifies the total cost of for example drugs for the General Surgery
cost for ordinary hospitalization activity	
cost for DH, DS activity	
cost for patients hospitalized in intensive care	
cost for operating room activity	
cost for performances of invasive cardiology	
cost for "guardia interdivisionale" (doctor on-call)	
Costs for inpatients activity	
costs for ER activity	
costs for outpatients activity	
costs for the "territorial" activities	e.g. in the case of drugs, the "territorial activities" identify the direct distribution of medicines to patients not admitted
costs related to overhead costs of the firm	

Costs data were collected at analytical centre level and then assigned to the activities on the base of the main activity performed by that particular analytical centre (identified by the so-called activity centre). If the cost of an analytical centre could be attributed to more than one activity, then a cost driver was used to share the cost. For example to share the cost of a particular analytical centre which “performs activities” for both outpatients and inpatients the cost driver used has been the percentage of revenues deriving from outpatients/inpatients activities of that particular analytical centre. Moreover if a cost centre “performs activity” both for ordinary hospitalizations and Day Hospitals, the cost was shared using as a cost driver the number of days of hospital stay (splitted between ordinary hospitalizations and Day Hospital). The table below shows the main AOP activity centres types, the related main activity performed by each activity centre and the driver used to allocate costs.

*Table 25 AOP activity centres types, main activity performed and driver used to allocate costs*

Activity centre type	Main activity	Driver
Ambulatorio	Outpatients activity + Inpatients activity	Revenues for outpatient /inpatient activity
Culle	Ordinary hospitaliz. activity	
Day Hospital	DH activity	
Degenza Ordinaria	Ordinary hospitaliz. activity + Day Hospital activity	Days of hospital stay (O.H. or D.H.)
Dozzinanti	Ordinary hospit. activity	

Activity centre type	Main activity	Driver
Equipe professionale	Outpatients activity + Inpatients activity	Revenues for outpatient /inpatient activity
Laboratorio	Outpatients activity + Inpatients activity	Revenues for outpatient /inpatient activity
Piastra ambulatoriale	Outpatients activity + Inpatients activity	Revenues for outpatient /inpatient activity
Piastra Operatoria	Operating room activity	
Pronto Soccorso	Emergency Room activity	
Segreteria	Outpatients activity + Inpatients activity	Revenues for outpatient /inpatient activity
Servizio Amministrativo	Activity related to overhead costs of the firm	
Servizio Operatorio, Ambulatorio	Operating room activity	
Servizio Sanitario	Activity related to overhead costs of the firm	
Sr Rianimazione	Intensive care activity	
Sub Intensiva	Ordinary hospit. activity	
Terapia Intensiva	Intensive care activity	
Terapia Intensiva fittizia	Intensive care activity	
Terapia Semintensiva	Ordinary hospit. activity	

Considering the case of the responsibility centre “General Surgery” and the related analytical centres

- “General Surgery - ward”
- “General Surgery – operating room”,

the analytical centre “General Surgery – ward” (considered as the activity centre type “ordinary hospital stay”) identifies costs related to both “ordinary hospitalization activity” and “day hospital activity” so that costs have been allocated through a cost driver which in this case was the number of days of total hospital stay splitted between “ordinary hospitalization” and “Day hospital”. On the other hand the analytical centre “General Surgery – operating room” identifies costs related only to the “operating room activity” and therefore the whole cost of that analytical centre have been totally allocated to the “operating room activity”.

Table 26 Example of cost of drugs allocation in the General Surgery

Analytical centre	Activity centre type	Total cost for drugs for ward	Cost of ordinary hospitalization activity	% of O.H activ.	Cost of DH activity	% of DH activ.	Cost of operating room activity
General Surgery - ward	ordinary hospital stay	363740	356466	98%	7275	2%	-
General Surgery – operating room	operating room service	180	-	-	-	-	180

Another example could be the analytical centre “ Laboratory - diagnosis and study of rare diseases” which is assigned to the activity centre “Laboratory” and performs activity both for inpatients and outpatients and therefore the cost has been shared between “outpatients activity” and “inpatients activity” using as cost driver the percentage of revenues deriving from the inpatient and outpatient activities.

Table 27 Example of cost of medical and surgical devices allocation in the a.c. " Laboratory - diagnosis and study of rare disease"

Analytical centre	Activity centre	Total cost for medical and surgical devices	Cost for inpatients activity	% of inpatient activity revenues	Cost outpatients activity	% of outpatients activity revenues
Laboratory-diagnosis and study of rare diseases	Laboratory	10850	10144	93%	705	7%

Then for all costs related to drugs, health services, medical and surgical devices, depreciation and maintenances the process of costs allocation was basically the same. After analytical centre costs have been allocated to the activities, costs related to the same responsibility centre have been summed up in order to get the whole costs at each responsibility centre level (e.g. the total cost for drugs of the responsibility centre “General Surgery” )

After the ratio used to allocate costs has been described, the steps for cost allocation of drugs, medical and surgical devices, health services, depreciation and maintenances are now presented.

### Allocation of drugs costs

The total value of the cost of medicines taken from the AOP Income statement was initially adjusted with the cost for drugs purchases for other health companies (i.e. "IOV" Oncology Institute of Veneto and "ULSS 16", Local Health and Social care Unit).

*Table 28 Total cost of drugs - adjusted*

	2014
Total cost of drugs	97.249.904
Purchases for IOV and ULSS 16	- 6.787.340
Total costs of drugs - adjusted	90.462.564

Later on, the value has been divided between the total cost to allocate to the hospital Responsibility Centers and the total cost for the "territorial activities". In fact an important and increasing amount of hospital drug costs are aimed at providing patients with drugs to be taken at home. These costs cannot be charged on the hospitalization cost and must therefore be labelled as "territorial activities" in order to leave them out from the analysis.

For each analytical centre the cost related to the "wards" have been allocated directly to the various activities or using a cost driver depending on the activity centre assigned to each analytical centre. Then as a final step costs of analytical centres have been summed up in the corresponding responsibility centre.

### Allocation of medical and surgical devices costs

The costs considered are those related to for example In-vitro diagnostic devices, other medical devices and prosthetic devices<sup>45</sup>. As for drugs, costs have been firstly adjusted discarding purchases for "IOV" and "ULSS 16".

*Table 29 Total cost of medical and surgical devices - adjusted*

	2014
Total cost of medical and surgical devices	72.965.839
Purchases for IOV and ULSS 16	1.998.085
Total cost of medical and surgical devices - adjusted	70.967.754

<sup>45</sup> in the AOP Income statement these costs are those related to: "d-d.m. diagnostici in vitro-ivd", "p-dispositivi medici altro", "q-disp. protesici impiantabili", "qa-d.m. impiantabili attivi".

The process of cost allocation for medical and surgical devices was very similar to the process of cost allocation of drugs among activities. Initially costs related to each analytical centre have been assigned directly to the activities or using the cost drivers described before (i.e. the percentage of revenues for inpatients or outpatients activities or the percentage of ordinary hospitalizations or Day hospital). Finally, costs assigned to the various activities for each analytical centre have been summed up in order to get the cost for each responsibility centre.

Allocation of health services costs

Costs for health services provided by other firms are those related for example to medical transportation, outsourced nursing services and other services. Costs of each analytical centre have been allocated to the activities using a process similar to those described before, based on the main activity performed by the activity related to the each analytical centre. Then the cost of each analytical center have been summed up and assigned to the related responsibility centre.

Allocation of depreciation and maintenances

For each analytical centre, costs categories considered were:

- depreciation of buildings;
- depreciation of medical equipment;
- depreciation of other equipment (ambulances; office machines; etc.);
- depreciation of software;
- Maintenances services.

As before, costs assigned to each analytical centre have been allocated to the different activities based on the activity centre type; then costs have been summed up identifying the total cost of the related responsibility centre. In the table below the total costs related to drugs, medical and surgical devices, health services, depreciation and maintenances, cleaning and laundry services are listed. Cost related to cleaning and laundry service have been totally allocated to the “activities related to overhead costs of the firm”, in lack of an acceptable driver such as square metres.

*Table 30 Costs allocated to the activities*

Costs	Amount allocated
Drugs	46.561.610
Medical and surgical devices	70.925.284

Costs	Amount allocated
Health services	2.627.084
Amortization and maintenances	17.612.606
Kitchen services	8.600.234
Cleaning and laundry services	10.343.361
<b>Tot.</b>	<b>156.670.179</b>

#### d) Staff costs data

Staff costs refer to the categories listed below:

- AOP employees;
- other health companies employees temporarily working for AOP (ULSS16 employee only regarding some responsibility centre);
- AOP non – employees, such as “borsisti non sanitari” (see table below);
- university employees under collaboration agreement with AOP;
- “SAI” which are private practitioners working “by the hour” for outpatients services only.

For our purposes different personnel categories have been fit into the following categories:

- Employee medical staff;
- Non-employee medical staff (e.g. medical graduate students);
- Other employee graduate staff (e.g. biologists, chemists, etc);
- Other non-employee graduate staff (e.g. other graduate student);
- Employee nursing staff;
- Non-employee nursing staff;
- Employee technical and health staff (e.g. laboratory staff);
- Non-employee technical and health staff (e.g. other laboratory staff);
- Employee health care assistants;
- Non-employee health care assistants;
- Employee administrative staff;
- Non-employee administrative staff;
- Other employee staff;
- Other non-employee staff.

Table 31 Staff costs categories considered for the analysis

Dipendenti AOP	Dipendenti ULSS16
<b>ALTRO PERSONALE DIPENDENTE</b> Personale vigilanza ispezione Dirigenti tecnici Dirigenti professionali Comparto professionali	<b>PERSONALE AMMINISTRATIVO DIPENDENTE</b> Comparto amministrativi
<b>ALTRO PERSONALE LAUREATO DIPENDENTE</b> Dirigenti non medici	<b>PERSONALE INFERMIERISTICO DIPENDENTE</b> Personale infermieristico
<b>PERSONALE AMMINISTRATIVO DIPENDENTE</b>	<b>PERSONALE OTA/OSS/AUSILIARIO DIPENDENTE</b> Comparto tecnici OTAA/OSS
	<b>PERSONALE TECNICO SANITARIO DIPENDENTE</b>

Dirigenti Amministrativi Comparto amministrativi	Tecnici sanitari
<b>PERSONALE INFERMIERISTICO DIPENDENTE</b> Personale infermieristico	<b>Universitari</b>
<b>PERSONALE MEDICO DIPENDENTE</b> Medici	<b>ALTRO PERSONALE DIPENDENTE</b> Personale vigilanza ispezione Dirigenti tecnici
<b>PERSONALE OTA/OSS/AUSILIARIO DIPENDENTE</b> Comparto tecnici OTAA/OSS	<b>ALTRO PERSONALE LAUREATO DIPENDENTE</b>  Dirigenti non medici
<b>PERSONALE TECNICO SANITARIO DIPENDENTE</b> Tecnici sanitari Tecnici riabilitativi	<b>PERSONALE AMMINISTRATIVO DIPENDENTE</b> Dirigenti Amministrativi  Comparto amministrativi
<b>Non dipendenti AOP</b>	<b>PERSONALE INFERMIERISTICO DIPENDENTE</b> Personale infermieristico
<b>ALTRO PERSONALE LAUREATO NON DIPENDENTE</b> Borsisti Collaboratori Coord. e Continuat.	<b>PERSONALE MEDICO DIPENDENTE</b>  Medici
<b>ALTRO PERSONALE NON DIPENDENTE</b> Borsisti non sanitari Collaboratori Coord. e Continuat. Non sanitari	<b>PERSONALE OTA/OSS/AUSILIARIO DIPENDENTE</b> Comparto tecnici
<b>SAI AOP</b>	<b>PERSONALE TECNICO SANITARIO DIPENDENTE</b> Tecnici sanitari  Tecnici riabilitativi
<b>PERSONALE MEDICO NON DIPENDENTE</b>	

For each category of staff, Full Time Equivalent has been considered: one FTE is equivalent to one person working full-time (8 hours a day) for a working year, which is quantified on average in 220 days of work (365 days excluding Saturdays, Sundays, various vacation and holidays). For example, a project that "costs" 10 FTE over a period of one year, employs 10 full time people in the period of one year, or 20 part-time people for the period of one year, or 20 full-time people for the period of 6 months. Then, for every responsibility centre, another information required for staff costs data was the "number of hours clocked in" by each category of staff.

Before allocating cost of each category of staff cost of every responsibility centre, staff costs have been assigned to activities centre in order to identify the "main activity" performed and then allocate costs using cost drivers (see Table 25).

Table 32 Staff data: information required

Information required	
Responsibility centre code	e.g. 10800
Responsibility centre name	e.g. General Surgery
Responsibility centre hospital unit	50901
Hospital unit name	AO Padova
Firm code	901
Cost type	e.g. doctors
Accrued cost	It identifies the total cost of for example doctors for the General Surgery
Number of operators (only for staff costs)	For staff costs it identifies the FTE (Full Time Equivalent)
Number of hours clocked in (only for staff costs)	
cost for ordinary hospitalization activity	
cost for DH, DS activity	
cost for patients hospitalized in intensive care	
cost for operating room activity	
cost for performances of invasive cardiology	
cost for "guardia interdivisionale" (doctor on-call)	
Costs for inpatients activity	
costs for First Aid activity	
costs for outpatients activity	
costs for the "territorial" activities	
costs related to overhead costs of the firm	

The table below shows the example of the Heart-surgery responsibility centre: to each type of cost category, the related activity centre has been assigned.

Table 33 Some Heart Surgery activity centres

Type of resource		Category	Activity centre
Dip. AOP	Medici	PERS. MEDICO DIP.	Degenza Ordinaria
Dip. AOP	Comparto amministrativi	PERS. AMM. DIP.	Degenza Ordinaria
Dip. AOP	Dirigenti non medici	ALTRO PERS. LAUREATO DIP.	Degenza Ordinaria
Dip. AOP	Personale infermieristico	PERS. INF. DIP.	Ambulatorio
Dip. AOP	Personale infermieristico	PERS. INF. DIP.	Degenza Ordinaria
Dip. AOP	Personale infermieristico	PERS. INF. DIP.	Day Hospital
Dip. AOP	Personale infermieristico	PERS. INF. DIP.	Segreteria
Dip. AOP	Tecnici sanitari	PERS. TECNICO SANITARIO DIP.	Servizio Operatorio

Type of resource		Category	Activity centre
Dip. AOP	Comparto tecnici	PERS. OTA/OSS/AUSILIARIO DIP.	Ambulatorio
Dip. AOP	OTAA/OSS	PERS. OTA/OSS/AUSILIARIO DIP.	Ambulatorio
Non Dip. AOP	Borsisti	ALTRO PERS. LAUREATO NON DIP.	Degenza Ordinaria
Non Dip. AOP	Borsisti non sanitari	ALTRO PERS. NON DIP.	Degenza Ordinaria
Universitari	Medici	PERS. MEDICO DIP.	Degenza Ordinaria
Universitari	Comparto amministrativi	PERS. AMM. DIP.	Degenza Ordinaria
Universitari	Comparto tecnici	PERS. OTA/OSS/AUSILIARIO DIP.	Degenza Ordinaria

Finally for those activities centres which perform more than one “main activity” costs for each type of category have been allocated through extra-system information, such as the shift plan of each clinical unit, or, in the lack of this organizational information, using some cost drivers (calculated on the base of the revenues deriving from each “main activity” of each responsibility centre) as done during the process of allocation of costs of drugs, health services, etc. Clearly this second method is less reliable because it assumes that more profitable activities requires higher costs, that is not always true. In the table below an example of the costs allocation of the responsibility centre “General Medicine” is presented.

Table 34 Cost allocation of "General Medicine"

	TOT	Ordinary hospitalization activity	DH, DS activity	Inpatients activity	First Aid activity	Outpatients activity
Revenues	4.472.073,72	4.386.766,51	8.000,00	9.496,56	-	67.810,65
%		0,9809	0,0018	0,0021	-	0,0152
Cost allocated						
Employee administrative staff	69.116,33	68.990,51	125,82	-	-	-
Employee nursing staff	1.202.786,85	1.134.111,41	3.684,77	7.983,57	-	57.007,10
Employee medical staff	1.150.272,03	1.128.329,97	2.057,70	2.442,63	-	17.441,73
Employee health care assistants	343.865,24	342.748,40	1.116,84	-	-	-

### e) Overhead costs

After all indirect costs have been allocated, the Activity Costing phase ends identifying the amount of overhead costs: first of all the Hospital total costs are computed and they are represented by the difference between “Financial statement production costs” and other expenses such as “refunds to staff for private practice” and “other expenses for third parties”. Finally the amount of overhead costs is calculated as the difference between “Hospital total costs” and the total amount of costs allocated during the Activity Costing process.

Table 35 Amount of overhead costs

<b>Financial statement production costs</b>		<b>€</b>	<b>561.298.513</b>	<b>%</b>
	- Refunds to staff for private practice	€	18.003.082	3%
	- expenses for third parties	€	2.542.672	0.1%
<b>Hospital total costs</b>		<b>€</b>	<b>540.752.759</b>	<b>96%</b>
	- costs for drugs, health services, etc. already allocated	€	156.670.179	28%
	- staff costs already allocated	€	240.268.045	43%
<b>Overhead costs</b>		<b>€</b>	<b>143.814.535</b>	<b>25%</b>

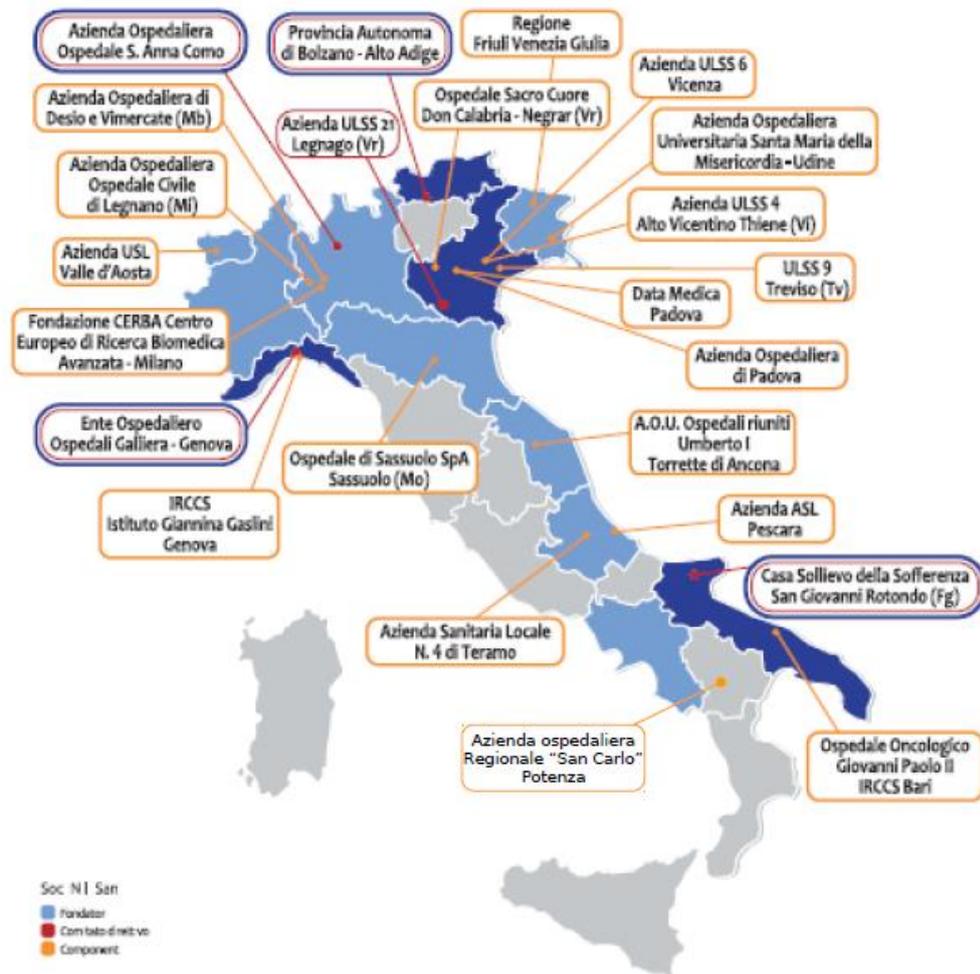


## 5. Results, Data Utilization and Preliminary Remarks

### 5.1 Preliminary remarks

Every year Azienda Ospedaliera di Padova sends hospitalization costs data to an organization called N.I.San. (Italian-Health-Network<sup>46</sup>) which is basically a network of about 24 health companies that pool the economic and activity data to create indicators designed to serve as economic and technical standards. N.I.San. collects data about costs of hospitalization continuously since 2009 and in seven years of analysis 3.758.211 episodes of hospitalization have been studied.

Figure 36 Healthcare firms adhering to N.I.San.



The determination of costs for each specific episode of hospitalization is made by every company that participates in the Network; for reasons of homogeneity, all companies follow

<sup>46</sup> <http://www.costistandard.com/>

the HPC methodology and in the data management process they follows some guidelines provided by the Network. The tool used by every firm to elaborate and then collect hospitalization costs data is the “CSO” software: this kind of software is a management system specifically designed for the allocation of costs to the individual patient, that becomes the "building block" of the analysis. The methodology used by the CSO software allows to analyse the totality of the healthcare company (with respect to hospitalizations and to costs); in order to compute the cost of every single episode, the software needs information deriving from the Hospital clinical records (hospital discharge records, operating room registry data and diagnostic and support services) and those relating to costs of drugs, health services, depreciations and other expenses. Then the system allows, through some economic reports, to perform various analysis related to the single episode of hospitalization: once grouped according to the chosen variable (the DRG, the discharge Unit, ...), the average of costs of the selected hospitalizations gives the information required, such as the cost of a single DRG, of a specific Operating Unit of the hospital, etc.

Moreover this kind of analysis allows to:

- identify the total cost of each responsibility centre;
- define the actual cost of production and the actual full cost for each specific case of hospitalization;
- compare N.I.San.’s benchmarks with actual cost of each responsibility centre (DRGs, etc.) in order to define indicators of variances. “N.I.San. benchmarks” are basically average costs computed on all costs data deriving from the firms adhering to the Network. More precisely, if an analysis must be done on discharged patients of a surgical ward, the benchmark is calculated on the basis of a "virtual" surgery who discharged the same case-mix of patients.

## **5.2 Analysis of results**

After these preliminary information, the aim of the research is to show what kind of analysis can be performed applying patient level costing; the work proceeds with a “Top-Down” approach: first of all an AOP Operating Unit is analysed; than the focus is on the costs of hospitalization of some DRGs and finally the study ends showing what kind of costs heterogeneity can be found “inside” the same DRG. Moreover, the comparison between “costs of productions” and “regional tariffs” is performed among all the cases analysed.

- Analysis of an Operating Unit: the example of "General Surgery"

The benchmark is calculated among the companies belonging to N.I.San., considering the same DRGs produced from a "virtual" surgery that dismisses the same case mix of patients. Starting from a reading of non-economic data it is possible to note that this operating unit has discharged 1361 patients, of which 950 (69,8%) have been operated. The average age turned out to be lower than the benchmark N.I.San. (57.3 vs. 58.9). Even the days of hospitalization are slightly lower than the benchmark (9582 vs 10215) while, on the other hand, the number of days in intensive care are higher (476 vs 326). Looking instead to the economic data, it is possible to note that the full cost amounts to euro 7.702.703 with a negative difference of about 826000 euro compared to the "Tariffato DRG" (the total amount of revenues from tariffs); however comparing the production costs with the "Tariffato DRG" the analysis shows that those are lower and, instead, full costs are higher than total tariffs due to the amount of overhead costs. In addition, data show that the full cost of the benchmark is higher than the tariffs and therefore it is possible to conclude that in general tariffs do not cover the costs of this operating unit.

Figure 37 Analysis over patients discharged by the Operating Unit "General Surgery"

	Dati effettivi	Benchmark	Scostam.(Bench-effettivi) in valore assoluto in %	
Età media	57,3	58,9	1,7	2,9
GG. totali di ricovero	9.582	10.215	633	6,2
GG. in reparto	9.106	9.888	782	7,9
GG. in intensiva	476	326	-150	-45,9

<b>Dimessi:</b>	<b>1.361</b>
<b>Operati:</b>	<b>950</b>
<b>% Operati:</b>	<b>69,8 %</b>

Totale	Medici	Infermieri	Altro Personale	Farmaci	Presidi
	Dati effettivi	Benchmark	Scostam.(Bench-effettivi) in valore assoluto in %		
Degenza	2.053.400,75	2.824.684,88	771.284,13	27,3	
Rianimazione	582.209,91	748.579,33	166.369,42	22,2	
UCIC	610,67	697,19	86,51	12,4	
Terapia Intensiva neonatale	0,00	270,97	270,97	100,0	
Interventi chirurgici in s.o.	2.233.102	2.706.638,50	473.536,3	17,5	
Prest. invasive di area cardiol.	8.111	11.397,50	3.286,1	28,8	
Laboratorio e Anat. patologica	264.784	398.715,08	133.930,6	33,6	
Radiodiagnostica e Med. nucl.	309.551	177.599,93	-131.950,7	-74,3	
Prestazioni da altre u.o.	352.348	492.175,58	139.827,8	28,4	
<b>TOTALE COSTI DI PRODUZIONE</b>	<b>5.804.015</b>	<b>7.360.758,95</b>	<b>1.556.743,5</b>	<b>21,1</b>	
Quota costi comuni	1.898.688	1.879.041,70	-19.646,2	-1,0	
<b>TOTALE COSTI PIENI</b>	<b>7.702.703</b>	<b>9.239.800,64</b>	<b>1.537.097,3</b>	<b>16,6</b>	
<b>TOTALE TARIFFATO DRG</b>	<b>6.876.072</b>				
<b>RISULTATO ECONOMICO</b>	<b>-826.631</b>				
Risultato ec. in % sul tariffato	-12,02				

Source: CSO output

- Analysis of a single DRG costs: the examples of DRG 290 “Thyroid procedures” and DRG 494 “Laparoscopic cholecystectomy without exploration of the common bile duct without CC”

The system calculates the costs of a single DRG as the average cost, for each input, of all the patients that were dismissed with that DRG. This analysis allow to identify which are the main categories of cost (medical staff, nursing staff, drugs, medical and surgical devices, etc.) that contribute to build up the full cost of a DRG and moreover it is possible to verify if costs are covered by tariffs. With regard to DRG 290, the Hospital of Padua, in the analyzed year, recorded 1098 cases related representing, therefore, a medium-high percentage of hospitalization episodes; moreover, all patients (1096) of this DRG have undergone a surgical intervention. Average values of the DRG 290 show that the average days of hospitalization were 2.6 and occurred all in the same unit, therefore without transfers to other wards.

Figure 38 Analysis of DRG 290 costs

N. dimessi		1098		N. Operati in S.O. **		1096		Età media		51	
Totale	Media	BenchMark	Fattore produttivo								
	GG. di ric.	Costi Totali	Personale medico	Personale infermierist.	Altre Fig. professionali	Farmaci	Presidi san./chir.	Altri Costi			
<b>Degenza</b>											
Unità di dimissione *	2,6	600,7	279,4	179,7	68,1	45,6	21,5	6,4			
Rianimazione	0,0	24,5	5,2	9,7	1,5	4,1	2,6	1,4			
UCIC	0,0	2,2	0,5	1,0	0,1	0,2	0,2	0,1			
Ter. Int. Neonatale	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0			
Degenza in altri reparti	0,0	1,2	0,5	0,5	0,1	0,1	0,0	0,0			
Guardia interdivisionale	0,0	0,0	0,0								
<b>Totale degenza</b>	<b>2,6</b>	<b>628,0</b>	<b>285,3</b>	<b>190,7</b>	<b>69,8</b>	<b>49,9</b>	<b>24,4</b>	<b>7,9</b>			
<b>Prestazioni chirurgiche</b>											
Chirurgia		209,3	170,1	0,0	0,0	0,1	26,1	12,9			
Anestesia		351,5	351,5	0,0	0,0	0,0	0,0	0,0			
Blocco		981,7	0,0	310,4	89,4	51,4	507,8	22,6			
Altre U.O.		3,6	0,3	0,0	0,0	0,6	2,1	0,6			
P.I.A.C.		5,3	0,2	0,3	0,2	0,2	4,1	0,3			
<b>Totale prestazioni chirurgiche</b>		<b>1.551,3</b>	<b>522,1</b>	<b>310,7</b>	<b>89,6</b>	<b>52,3</b>	<b>540,2</b>	<b>36,3</b>			
<b>Servizi</b>											
Laboratorio e Anat. patologica		41,1	7,6	1,0	13,5	0,1	16,7	2,2			
Radiodiagnostica e Med. nucl.		55,7	12,6	6,5	15,9	2,3	6,1	12,3			
Prestazioni da PS		0,0	0,0	0,0	0,0	0,0	0,0	0,0			
Servizi da altre u.o.		62,4	14,1	17,2	11,6	0,8	12,1	6,6			
<b>Totale Servizi</b>		<b>159,1</b>	<b>34,3</b>	<b>24,7</b>	<b>40,9</b>	<b>3,2</b>	<b>34,9</b>	<b>21,1</b>			
<b>TOTALE COSTI DI PRODUZIONE</b>		<b>2.338,4</b>	<b>841,7</b>	<b>526,2</b>	<b>200,4</b>	<b>105,4</b>	<b>599,5</b>	<b>65,3</b>			
<b>QUOTA COSTI COMUNI</b>		<b>765,0</b>									
<b>TOTALE COSTI PIENI</b>		<b>3.103,4</b>									
<b>TARIFFA REGIONALE</b>		<b>2.742,9</b>									

Source: CSO output

Looking at economic data, the total average cost with respect to inputs of production (medical staff, drugs, etc.) was 628 euro for the ward costs: medical and nursing staff accounted for the higher percentage. The main costs are however those related to the surgery operation: 1551 euro divided almost equally between doctors, surgery devices and other costs. Diagnostic

services requested from other units amount to 159 euro. The average full cost of DRG 290 was 3103, 361 euro higher than the related tariff (2742).

Finally the figure below compares total actual costs with respect to the benchmark: only medical and surgical devices costs had a total value higher than the benchmark (658.243 vs 532.466).

Figure 39 Comparison between actual costs of inputs with respect to the benchmark

	Costi effettivi	Benchmark	Differenza di benchmark
Personale medico	924.152,28	1.055.635,59	131.483,3
Personale infermieristico	577.779,73	922.832,29	345.052,6
Altre figure profess.	220.011,15	371.033,02	151.021,9
Farmaci	115.679,70	150.915,74	35.236,0
Presidi sanitari/chirurgici	658.243,52	532.466,13	-125.777,4
Altri costi alberghieri e vari	71.719,22	445.744,25	374.025,0
<b>TOTALE COSTI PRODUZIONE</b>	<b>2.567.585,59</b>	<b>3.478.627,02</b>	<b>911.041,4</b>

Source: CSO output

Therefore we can conclude that the economic loss caused by DRG 290 is not due to inefficiency of the Clinical Departments that treat these patients, since a comparison with the other participants to the network shows lower costs than the benchmark. Probably the problem dwells in an underestimation of the reimbursement tariff.

As to DRG 494, the patients dismissed were 518 and almost all of them (506) undergone a surgical procedure; the average age was of 53 years and admitted patients were hospitalized on average for 1,9 days. Looking to economic data, total average costs were 507 euro: medical staff accounted for around 36% while nursing staff for around 22% with respect to the total cost of hospital stay. Concerning the other inputs, drugs accounted for 18% and medical and surgical devices for 10% of the total cost.

In this case as well the main cost is related to the surgery: 1224 euro that sum up the costs of the Surgery Unit (979 euro), the costs of the Anesthesiology Unit (180 euro) and the costs of using the Operating Theatre (668 euro).

Compared to the previous case, the cost due to diagnostic service was higher: 58 euro for Lab tests, 154 euro for imaging, 45 euro for other specialists consultations.

Figure 40 Analysis of DRG 494 costs

N. dimessi		518		N. Operati in S.O. **		506		Età media		53	
Totale	Media	BenchMark	Fattore produttivo								
		GG. di ric.	Costi Totali	Personale medico	Personale infermierist.	Altre Fig. professionali	Farmaci	Presidi san./chir.	Altri Costi		
<b>Degenza</b>											
Unità di dimissione *		1,9	498,3	181,3	106,5	61,3	92,1	52,9	4,2		
Rianimazione		0,0	4,3	0,9	1,7	0,2	0,6	0,4	0,5		
UCIC		0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		
Ter. Int. Neonatale		0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		
Degenza in altri reparti		0,0	4,7	1,5	1,8	0,9	0,3	0,2	0,1		
Guardia interdivisionale			0,0	0,0							
<b>Totale degenza</b>		<b>1,9</b>	<b>507,3</b>	<b>183,7</b>	<b>110,0</b>	<b>62,4</b>	<b>93,1</b>	<b>53,4</b>	<b>4,7</b>		
<b>Prestazioni chirurgiche</b>											
Chirurgia			373,0	221,4	0,0	0,1	1,6	107,3	42,6		
Anestesia			179,7	179,7	0,0	0,0	0,0	0,0	0,0		
Blocco			668,5	0,0	213,1	59,8	42,6	328,3	24,7		
Altre U.O.			3,0	0,3	0,0	0,0	0,5	1,8	0,5		
P.I.A.C.			0,0	0,0	0,0	0,0	0,0	0,0	0,0		
<b>Totale prestazioni chirurgiche</b>			<b>1.224,2</b>	<b>401,4</b>	<b>213,1</b>	<b>59,9</b>	<b>44,7</b>	<b>437,4</b>	<b>67,7</b>		
<b>Servizi</b>											
Laboratorio e Anat. patologica			58,5	10,9	1,4	19,1	0,1	23,8	3,2		
Radiodiagnostica e Med. nucl.			153,8	35,9	17,3	43,9	6,9	15,7	34,2		
Prestazioni da PS			1,5	0,5	0,6	0,2	0,0	0,1	0,0		
Servizi da altre u.o.			45,0	10,2	12,4	8,4	0,6	8,7	4,8		
<b>Totale Servizi</b>			<b>258,8</b>	<b>57,4</b>	<b>31,7</b>	<b>71,6</b>	<b>7,6</b>	<b>48,3</b>	<b>42,2</b>		
<b>TOTALE COSTI DI PRODUZIONE</b>			<b>1.990,3</b>	<b>642,5</b>	<b>354,7</b>	<b>193,8</b>	<b>145,4</b>	<b>539,1</b>	<b>114,7</b>		
<b>QUOTA COSTI COMUNI</b>			<b>651,1</b>								
<b>TOTALE COSTI PIENI</b>			<b>2.641,4</b>								
<b>TARIFFA REGIONALE</b>			<b>3.094,2</b>								

Source: CSO output

Finally, in this case as well, total actual costs are lower than the benchmark. However, looking for efficiency improvements we can underline that the cost of drugs were higher than the benchmark: the figure below highlights that the variance was around 22.548 euro. Even if aware that the total cost is a unique mix of different kind of inputs, and that it can be tricky to compare a single one, we can try to deepen the analysis as to the use of drugs in this unit.

Figure 41 Comparison between actual costs of inputs with respect to the benchmark

	Costi effettivi	Benchmark	Differenza di benchmark
Personale medico	332.840,26	357.868,53	25.028,3
Personale infermieristico	183.756,53	240.325,14	56.568,6
Altre figure profess.	100.410,42	107.582,60	7.172,2
Farmaci	75.310,45	52.761,97	-22.548,5
Presidi sanitari/chirurgici	279.269,26	362.897,10	83.627,8
Altri costi alberghieri e vari	59.394,89	143.872,05	84.477,2
<b>TOTALE COSTI PRODUZIONE</b>	<b>1.030.981,81</b>	<b>1.265.307,39</b>	<b>234.325,6</b>

Source: CSO output

- Analysis of two different surgical procedures within a same DRG: the example of “DRG 481 - Bone Marrow transplant”

To show the diversity of production costs that can be found within the same DRG, two different main surgical procedures (called, for simplification, the procedure "A" and procedure "B") related to "DRG 481- bone marrow transplant " are now described. This example shows that, especially in high complexity cases, it is crucial to “go down” to a level of detail more specific than an analysis that considers the totality of the costs of each DRG class. The first case considers a sample of 10 patients. In this example the average number of days of hospital stay was 25, all in the unit of discharging. Average total cost of production was 10.744 which, with respect to the regional tariff, accounted for 27%. On the other hand, the case of procedure “B” had 8 patients; the average number of days of hospital stay was 55,8 (45,7 days in the unit of discharging, 3 days in intensive care and 7,1 in other wards). Average total costs of production were 25.662 and in this case they accounted for 62% with respect to the regional tariff. Main differences of production costs between procedure “A” and procedure “B” are represented by average total costs of hospitalization(3.875 vs 11.567) and average total costs of health services (6.331 vs 13.391).

Figure 42 Analysis of DRG 481 costs: procedure "A"

N. dimessi		N. Operati in S.O. **		Età media					
10		2		12					
Totale	Media	Benchmark	Fattore produttivo						
		GG. di ric.	Costi Totali	Personale medico	Personale infermierist.	Altre Fig. professionali	Farmaci	Presidi san./chir.	Altri Costi
<b>Degenza</b>									
Unità di dimissione *	25,6	3.875,1	995,8	1.232,4	106,5	1.450,0	70,8	19,5	
Rianimazione	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
UCIC	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
Ter. Int. Neonatale	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
Degenza in altri reparti	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
Guardia interdivisionale	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
<b>Totale degenza</b>	<b>25,6</b>	<b>3.875,1</b>	<b>995,8</b>	<b>1.232,4</b>	<b>106,5</b>	<b>1.450,0</b>	<b>70,8</b>	<b>19,5</b>	
<b>Prestazioni chirurgiche</b>									
Chirurgia	146,0	74,1	0,0	0,0	3,5	65,7	2,7		
Anestesia	44,0	44,0	0,0	0,0	0,0	0,0	0,0		
Blocco	346,2	0,0	186,1	45,4	13,5	89,6	11,5		
Altre U.O.	1,8	0,2	0,0	0,0	0,3	1,1	0,3		
P.I.A.C.	0,0	0,0	0,0	0,0	0,0	0,0	0,0		
<b>Totale prestazioni chirurgiche</b>	<b>538,0</b>	<b>118,2</b>	<b>186,1</b>	<b>45,4</b>	<b>17,3</b>	<b>156,4</b>	<b>14,5</b>		
<b>Servizi</b>									
Laboratorio e Anat. patologica	3.447,9	397,6	68,2	1.023,1	3,2	1.735,8	220,0		
Radiodiagnostica e Med. nucl.	291,9	54,4	37,3	76,3	12,9	41,5	69,5		
Prestazioni da PS	0,0	0,0	0,0	0,0	0,0	0,0	0,0		
Servizi da altre u.o.	0,0	586,1	713,8	480,9	34,3	502,6	273,9		
<b>Totale Servizi</b>	<b>6.331,3</b>	<b>1.038,2</b>	<b>819,3</b>	<b>1.580,2</b>	<b>50,4</b>	<b>2.279,8</b>	<b>563,4</b>		
<b>TOTALE COSTI DI PRODUZIONE</b>	<b>10.744,3</b>	<b>2.152,2</b>	<b>2.237,8</b>	<b>1.732,1</b>	<b>1.517,7</b>	<b>2.507,0</b>	<b>597,4</b>		
QUOTA COSTI COMUNI	3.514,8								
TOTALE COSTI PIENI	14.259,2								
TARIFFA REGIONALE	39.758,7								

Source: CSO output

Figure 43 Analysis of DRG 481 costs: procedure "B"

N. dimessi		8		N. Operati in S.O. **		1		Età media		8	
Totale		Media		BenchMark		Fattore produttivo					
		GG. di ric.	Costi Totali	Personale medico	Personale infermierist.	Altre Fig. professionali	Farmaci	Presidi san./chir.	Altri Costi		
<b>Degenza</b>											
Unità di dimissione *	45,7	6.165,2	1.706,0	2.221,8	184,6	1.983,9	34,8	34,2			
Rianimazione	3,0	1.741,4	255,9	799,0	89,4	263,1	179,9	154,2			
UCIC	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0			
Ter. Int. Neonatale	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0			
Degenza in altri reparti	7,1	3.660,9	205,8	1.108,5	700,7	1.329,6	127,6	188,6			
Guardia interdivisionale		0,0	0,0								
<b>Totale degenza</b>	<b>55,8</b>	<b>11.567,5</b>	<b>2.167,6</b>	<b>4.129,3</b>	<b>974,8</b>	<b>3.576,6</b>	<b>342,2</b>	<b>377,0</b>			
<b>Prestazioni chirurgiche</b>											
Chirurgia		146,6	145,8	0,0	0,0	0,6	0,0	0,2			
Anestesia		45,3	45,3	0,0	0,0	0,0	0,0	0,0			
Blocco		510,4	0,0	291,1	55,1	16,5	129,5	18,2			
Altre U.O.		1,1	0,1	0,0	0,0	0,2	0,7	0,2			
P.I.A.C.		0,0	0,0	0,0	0,0	0,0	0,0	0,0			
<b>Totale prestazioni chirurgiche</b>		<b>703,5</b>	<b>191,3</b>	<b>291,1</b>	<b>55,1</b>	<b>17,3</b>	<b>130,1</b>	<b>18,6</b>			
<b>Servizi</b>											
Laboratorio e Anat. patologica		6.864,3	721,3	139,0	2.008,5	6,8	3.546,7	442,0			
Radiodiagnostica e Med. nucl.		400,0	73,6	50,0	102,8	18,0	59,2	96,4			
Prestazioni da PS		0,0	0,0	0,0	0,0	0,0	0,0	0,0			
Servizi da altre u.o.		0,120,7	1.385,7	1.687,4	1.136,8	81,2	1.188,2	647,5			
<b>Totale Servizi</b>		<b>13.391,0</b>	<b>2.180,5</b>	<b>1.876,4</b>	<b>3.248,1</b>	<b>106,0</b>	<b>4.794,1</b>	<b>1.185,9</b>			
<b>TOTALE COSTI DI PRODUZIONE</b>		<b>25.662,0</b>	<b>4.539,5</b>	<b>6.296,8</b>	<b>4.278,0</b>	<b>3.699,8</b>	<b>5.266,4</b>	<b>1.581,5</b>			
QUOTA COSTI COMUNI		8.394,9									
TOTALE COSTI PIENI		34.056,9									
TARIFFA REGIONALE		41.388,9									

Source: CSO output

- Analysis of two different surgical procedures within DRG 191 - pancreas, liver & shunt procedures w cc

This final analysis consider two different procedures within the same Drg 191 in order to show differences in costs of production and that there might be often the case that tariffs do not cover costs due to different surgical procedures undergone by patients that are recorded in the same “class” of hospitalization. Procedure “A” considers 21 patients discharges with an average age of 69 years and all of them have been operated. On average the total number of hospital stays was 36 days and this led to a total cost of 12.388 euro in term of inputs ( medical staff costs, nursing staff, etc.). Total costs of production were 26.690 and overhead costs 8.731 and this caused a negative economic result of 12.300 with respect to the regional tariff (23.120). Considering the case of patients that have undergone procedure “B”, on average they were hospitalized for a period of 35 days, leading to a total costs in term of inputs of 22.534. Patients discharged were 21 with an average age of 57 years. Average full costs were even higher than the previous case (44.465) and this caused a negative economic result of 21.252 euro with respect to the regional tariff (21.252).



### 5.3 Data utilisation

Whenever cost analysis is performed it is important to point out the limitations of the methodologies applied but also what might be the future developments with respect to data utilisations. As previously analysed, a patient costing approach allows to compare the actual costs of DRGs with the related tariffs and also to perform “unbundling” analysis through the computation of analytical costs; basically they show the amount of inputs (how much is the cost of the medical staff, drugs, etc.) and related activities (how much is the cost for intensive care, for the operating room, etc.) that contribute to the cost of a particular DRG in order to show how actual costs are built up. The analysis compared cost values to N.I.San’s benchmarks: they are based on huge amount of data since they are computed on hospitalization costs of a pool of healthcare companies. When large data set are collected from different systems and by many subjects and pooled together, the methodology applied to gather those cost information is really important. Therefore, what must be implemented is the approach that allows data collection among hospital firms in order to compute as much as possible reliable data for benchmarking and planning purposes. The models that should be taken as reference are, for example, the experiences of the “Canadian Institute of Health Information” (CIHI), the “Independent Hospital Pricing Authority” in Australia and “Healthcare Financial Management Association” in England: they published “best practice” guidelines (Standards), recognized at national level, which describe methodologies and processes to derive individual patient costs information and to allow comparisons between healthcare organizations among the whole country. In Italy, N.I.San is a spontaneous network of companies and it does not have a specific manual ( as the ones analysed at the international level) which shows, for example, clear guidelines on the drivers chosen to allocate the costs; this would ensure a greater degree of homogeneity between companies adhering to the network with respect to the methodologies applied. However, nowadays, this network is the only that gather and use, for benchmarking activities, Patient Costing information. An institutional project by the Ministry of Health called “IT.DRG<sup>47</sup>” begun in 2011 with the aim (among others) of calculating a weighting system for the absorption of resources of each DRG; however, to date, the project has not produced its results. Finally, since on average tariffs are not able to fully fund hospital costs of production and therefore the balance of the budget largely depends on funding granted for specific functions, i.e. for mere balancing reasons<sup>48</sup>, developing Patient Costing might represents a starting point for calculating

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<sup>47</sup> <http://drgit.agenas.it>

<sup>48</sup> Bernardini C., Battaglia G. (2015). I sistemi di finanziamento regionali delle Aziende Sanitarie e Ospedaliere, Fiaso, Crea Sanità.

better tariffs. However this kind of approach is still not easy to perform and requires to be improved: for example Patient level costing data are used by AOP for some scientific research but not yet for budgeting purposes.



## Conclusions

The analysis performed is the result of a project developed during an internship period in the Planning and Control Unit of AOP; this study took several steps and, after all management and loading processes, the final product has been the single hospitalization event; then the analysis focused on some of its possible aggregation (Operating Units, DRGs, etc) evaluating costs of production and variances with tariffs. The analysis of single episode of hospitalization allows an insight of the main activity of a hospital firm in order to improve an efficient and transparent use of resources and to fill the production capacity. This experience in-field allowed me to draw some conclusions about the activity performed and the approach adopted. Patient costing focuses cost analysis on the single hospitalization event, requiring accurate and trustworthy information in order to manage a higher degree of costs allocation processes compared to traditional costing approach; this kind of costing methodology analyses all the hospitalization production activity of a health care firm and therefore the amount of data to be managed is huge and quite complex, especially in a highly specialized hospital firm as Azienda Ospedaliera di Padova. Moreover, even if nowadays data rely on computerized system, they required many checks, corrections and even IT support. The complexity of the analysis, the large and specific amount of information needed and the great number of allocation processes increase the subjectivity of the analysis, which might affect the results. This is even more true when such analysis are performed by different companies and so by many “actors” in order to calculate a benchmark. A solution to address this problem can be the use of common guidelines as said before, but also Networks of healthcare firms and group-works are a good starting point to compare methodologies and to correct mistakes in the procedures. In Italy, there is still the need to follow the international examples in order to produce recognized “best practice guidelines” to perform Patient Level Costing and to starting good benchmarking activities between health care organizations.

Even if the project was a long process and it was characterized by a multiplicity of drivers used in order to allocate costs data as well as possible, in Azienda Ospedaliera di Padova’s framework patient level costing information are not used yet for budgeting purposes and this means that there still a lot of work for implementing this kind of methodology for planning and controlling purposes. Since this approach relies on accurate and specific patient level data, information systems still need to be adjusted. AOP’s IT systems already allow to allocate operating room cost to each patient thanks to the connection between the operating room register and the hospital discharge record; this let to assign costs through objective driver such

as the number of people working during a surgical procedure or its duration. With respect to diagnostic and support services data, I foresee a possible improvement in the short period. At present data are collected based on the Responsibility Centre that requires the diagnostic service, but AOP IT systems already provide specific information on the single patient. Using single-patient data would transform the cost of diagnostic from indirect cost to direct cost, improving the analysis accuracy and allowing the allocation of costs to individual patient (e.g. laboratory and radiology costs). What should be implemented is the allocation of drugs resources that are still indirect costs for individual patients. Computerized therapies would allow accurate information gathering, making possible to directly allocate drugs cost down to patient level.

I spent almost six month working in the Planning and Control Unit of Azienda Ospedaliera di Padova; I choose to start this project and to undertake an internship in a hospital firm in order to see in the flesh a highly specialized and, at the beginning, almost unknown environment for me. The analysis led me to evaluate all the “hospitalization production function” of AOP and step by step my economical background needed to be compensated by basic clinical knowledge in order to understand AOP hospitalization processes: this goal was reached working side by side with AOP P&C staff that bring me to compensate my lack of knowledge of this new environment. Finally, this period allowed me to understand how deep is the link between economical analysis in health care firms and clinical expertise in order to deeply understand medical procedures and then produce reliable cost analysis.

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