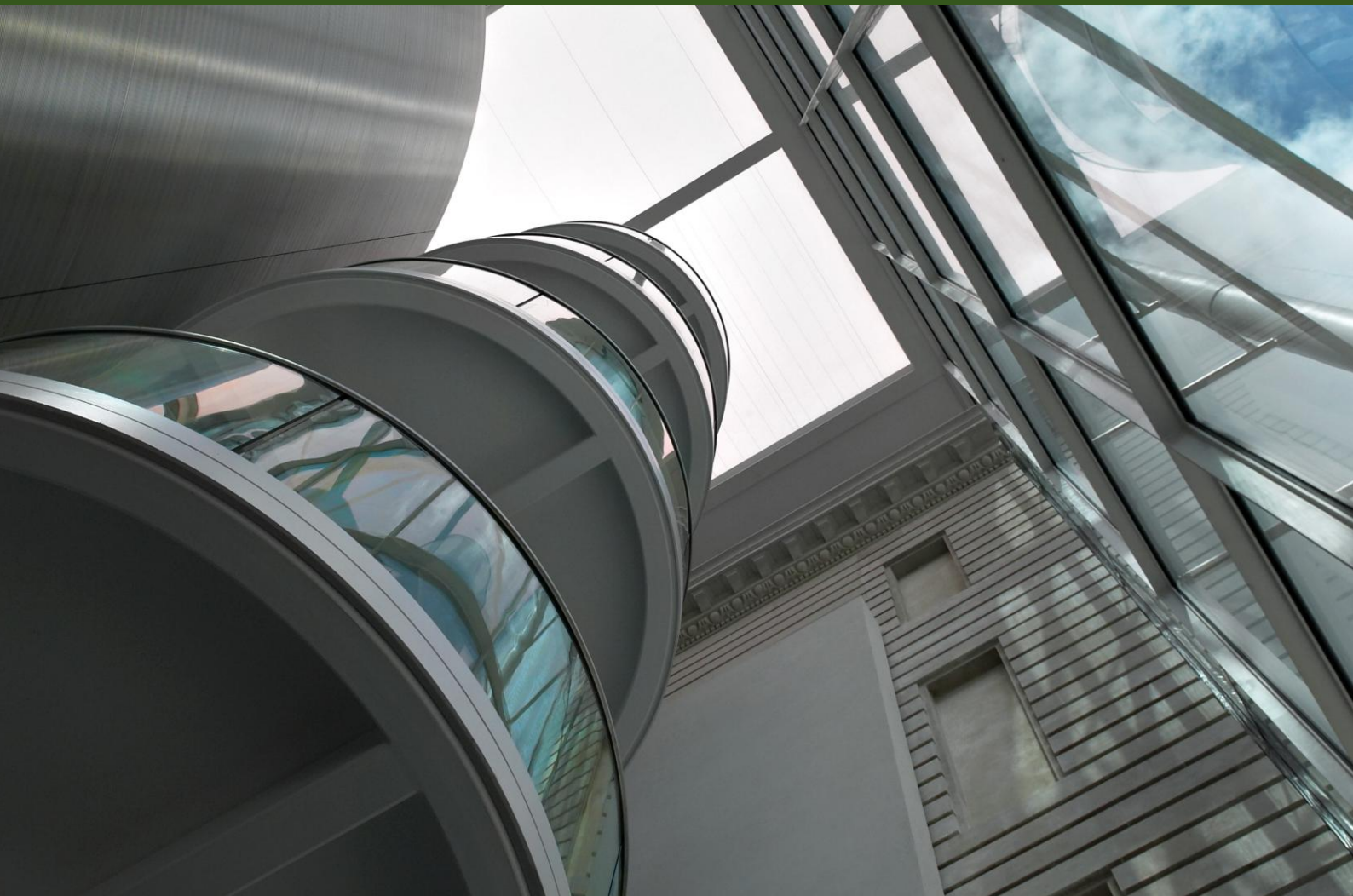


Elena Pizzo



**An estimate of costs and benefits of alternative methods
of delivery: an empirical analysis**

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AN ESTIMATE OF COSTS AND BENEFITS OF ALTERNATIVE METHODS OF DELIVERY: AN EMPIRICAL ANALYSIS

Elena Pizzo¹

Abstract[†]

The recent large increase in caesarean sections (CSs) in Europe seems not to be completely justified: CS is practiced independently of epidemiological reasons (physician's induction or mother's demand).

In Italy the introduction of epidural analgesia among the Essential Levels of Assistance (LEA) has been proposed with the hope that this will help to counteract the rise of CSs.

The work aims at analyzing the costs and benefits effectively involved in alternative methods of delivery- vaginal delivery (VD), with and without epidural analgesia, and planned caesarean.

The empirical analysis is conducted in an Italian hospital, where a wide range of individual variables are collected from clinical records, questionnaires and interviews.

A logistic regression is used to model the probability of the event "elective-CS" occurring as a function of women characteristics (clinical and socio-economic) to confirm that CS is widely performed for non-medical reasons (Signorelli, 1995).

A micro-costing analysis is used to evaluate the direct health costs of each delivery method, following an activity-based-costing approach. CS is on average more expensive than VD, but the difference is marginal taking into account the opportunity-cost of time during labour.

From a societal perspective we consider the implicit indirect costs (transport, medications, artificial feeding, time lost) and the benefits of each method.

The cost-effectiveness analysis shows that in general VD with analgesia is preferred both in terms of costs and benefits, but the final effect of its introduction is not clear: it could reduce inappropriate CSs, but also increase the costs due to complications.

Key words: cost-effectiveness, delivery, caesarean section (CS), vaginal delivery, epidural, STAI, CPQ

JEL codes: C13, H51, I10, I18

¹ Corresponding author: Imperial College Business School, Tanaka Building, South Kensington Campus, London SW7 2AZ, UK. Telephone (direct): +44 (0) 2075941233 e-mail: e.pizzo@imperial.ac.uk

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1. Introduction

In the last years Caesarean Section (CS) practice has registered a huge increase in all the European countries, but especially in Italy, where the 37.8% of CSs over all deliveries has overcome the appropriate rate of 10-15% suggested by the WHO (Istat, 2004).

In Italy there is also a strong variability in the use of CS, in particular in the Southern Regions, where demographic and logistic characteristics seem to explain the frequencies of CS practice.

The increase in CSs rates seems not to be justified: CS is practiced independently of health conditions or epidemiological reasons, but more often for physicians' induction or mothers' demand, because safer and less painful.

This tendency has certainly an impact in terms of equity and healthcare expenditure and new policies must be implemented to counteract the rise, suggesting alternative forms of delivery assistance.

The importance of safeguarding the woman's choice to control pain during labour, according to the National Committee of Bioethics and the National health plan, has been confirmed last 18 October 2006, by the National Committee of the Essential Levels of Assistance (LEA), with the approval of a document that underlines the essential role of analgesic procedures during delivery.

In 2007 the Italian Minister of Health has proposed the introduction of epidural analgesia not only to give to all women the possibility to reduce pain during labour, but also with the hope that this will help to counteract the caesarean section (CS) rates, reducing costs for the NHS.

New specific analgesic techniques has been developed and implemented to satisfy the women' desire to deliver with less pain.

The most recent scientific knowledge shows the advantages of the introduction of epidural analgesia during labour: the pain reduction determines a decrease of the metabolic needs and an increase of placenta perfusion with huge benefits for mother and child homeostasis (Bocci, 1995).

Despite epidural analgesia can be considered the *gold standard* in the reduction of pain during labour (Giron, 1996) for its reliability and efficacy, in Italy the diffusion of this practice is limited by social and cultural factors and by economic aspects.

Economic and logistic problems are an obstacle for the creation of anaesthesiology units in the obstetrics wards.

Moreover there is concern among physicians that analgesic methods may prolong labour length and increase the rate of operative deliveries.

A study conducted by Thorp (Thorp, 1993) refers an increment of urgent CSs after epidural analgesia, whereas an Austrian retrospective study shows that the use of epidural is correlated to instrumental deliveries, but CS frequencies are the same for deliveries that do not use analgesia (Ploekinger, 1995).

According to Torvaldsen (2006), children born with epidural analgesia have more problems at breastfeeding in the first week of life, and are the first to stop breastfeeding in the following months².

Epidural analgesia is not riskless and cannot be practiced in every occasion: besides the clinical condition for which it is not suggested, epidural can be performed by an anaesthetist and often when their cervix has dilated by about 5cm or 6cm.

According the Italian Obstetric Anaesthetists Association, in Italy only 20% of women have epidural, versus the 90% in USA, 70% in England and France and 38% in Spain. The differences registered in Italy may be due to the fact that this practice is not granted by the NHS and not reimbursed: only 4% of Italians gets epidural in public hospitals for free, the others must pay out of pocket in private sector (between € 800-1000).

From an economic perspective, if epidural would help to reduce CS rates in Italy, it is not clear which would be the impact in terms of costs for the NHS.

Caesarean section is more expensive if compared to a vaginal delivery and also the DRGs tariffs to reimburse hospitals are higher for CS³.

The main studies done on this issue refers to the American setting, which is extremely different from the Italian one (Petrou, Hendersen, 2001). Some studies show that there is a difference in costs between CS and VD, but it is marginal, and a policy aiming to reduce CS rates would not lead to significant savings (Malkin, 2001).

²The study has been conducted at the University of Sidney by Torvaldsen and colleagues on a sample of 1300 women. Over the 416 that have had epidural, 172 have had CS and only the 53% of babies born with epidural was breastfed at 24 weeks, versus the 75% of babies born without epidural.

³Generally the national DRG tariff to reimburse hospitals is higher for CS. In Veneto Region the tariff VD without complications is € 922,94, while CS may vary between € 2.197,78 and € 3.472,52 (respectively without and with complications).

Despite the debates, few studies have paid attention to the real cost of alternative methods of delivery – CS, VD with and without epidural analgesia- in the Italian framework.

This work aims at evaluating and comparing the differences in costs among the delivery methods. The results allow on a hand to understand if the DRGs tariffs truly represent the real cost of each practice and if differences are justified⁴ (in Lombardy VD and CS without complications have the same tariffs) and on the other hand to estimate the impact in terms of costs that epidural would have for NHS.

The aim of the study is extremely interesting if we take into account the new laws proposal and the increasing interest for the pain during labour.

We also analyse the impact in terms of benefits that each delivery method can have. It is well known that epidural analgesia reducing pain allows for a better perception of the birth experience and a higher ability to cope the situation.

According to the main literature an intervention with a higher cost is justified only if is necessary to grant a higher level of health status for the patient, avoiding risks and complications.

2. Materials and methods

The methodological approach used in the study is part of the methods used in cost analysis. It aims at determining all the activities done during the hospitalisation to evaluate the full cost of the alternative delivery methods.

An empirical analysis is done to evaluate the cost of different methods of delivery: vaginal delivery (VD) with and without epidural analgesia and caesarean section (CS). We evaluate the direct health costs, but also the indirect (health and not) costs and the outcomes of each procedure through direct administration of questionnaires to a sample of patients⁵.

We administered an anonymous questionnaire containing personal information about individual characteristics (age, origin, religion, civic status, education level,

⁴ The DRGs tariffs are defined at regional level, with appropriate weights, but they do not represent the real cost of interventions. The amount of the tariff DRG-371 (for CS) at national level in France, is almost twice if compared to the VD tariffs DRG-373. A study of Fabbri and Monfardini (2000) shows that these differences may induce to opportunistic behaviors in terms of clinical practice.

⁵ We administered an anonymous questionnaire containing personal information about individual characteristics (age, origin, religion, civic status, education level, profession, personal and family income), clinical information (pathologies during pregnancy, procreation method, number of check-up during pregnancy, tests done) and information about the delivery method.

profession, personal and family income), clinical information (pathologies during pregnancy, procreation method, number of check-up during pregnancy, tests done), information about the delivery method.

2.1. The setting and the sample of patients

The empirical analysis refers to a specific hospital of Veneto Region (the University hospital A.O. of Padua), where the frequencies of deliveries and the case-mix are sufficient to conduct a study with a significant sample.

The choice of this hospital instead of a hospital of local health organization (Asl) is due to the fact that epidural analgesia is practiced with a certain frequency.

The university hospital considered has a numerous staff and the constant presence of anaesthetists that can practice epidural in every moment (whereas in other hospitals there is a huge lack of anaesthetists and human resources).

The study refers to a sample of women that have given birth in the Obstetrics and Gynaecology unit of the A.O. hospital.

The women invited to complete the questionnaires have been selected consecutively among the patients hospitalised in three months time, reaching a sample of 250 women⁶.

The 80,4% of patients decided to comply, whereas 10% refused to be part of the study and 9,6% did not return the questionnaire⁷ (tab.1).

Tab. 1 Compliance to the study

<i>Compliance</i>	<i>patients</i>	<i>%</i>
Fulfilled	201	80,40%
Refused	25	10,00%
Not fulfilled	24	9,60%
TOTAL	250	100%

Source: our elaboration

⁶ The questionnaire has been administered after delivery, through direct interviews explaining the study aim, the data collection mechanisms and the fulfillment instructions. The questionnaires were left to the patients for the auto-fulfillment and collected the day after (or left in a box before the demission from the hospital). The questionnaire has been disposed also in English version for the strangers. The questionnaire was anonymous to increase the level of attendance of the answers, but through a codification we could match the data collected through questionnaires and the data from records.

⁷ In many cases patients did not completely fulfill the questionnaire because strangers with language problems, in other cases they fulfilled it only in part or they forgot to return it before exit.

All women have been considered eligible to the study and no restrictions have been made to the sample in terms of age, origin, race or number of deliveries.

Nevertheless, the presence of many foreigner women caused a reduction in the compliance rates due to language problems.

In tab.2 we show a summary of the women characteristics. In particular we can notice that average age at delivery, 32 years old, is quite high, confirming the average data referred to Italy of 31 years (ISTAT, 2006). The youngest mother delivers at 20 years old, the oldest at 46 years old.

Patients are mainly Italians (78%), followed by Rumanian (8%), Philippians and Moldavian (3%), and only in lower part Albanian or Moroccan (less than 1%) (tab.3). The prevalent religion is the Christian-catholic, followed by the Orthodox and Muslim (tab. 3).

Tab. 2 Patients age

Var	Observ.	Mean	Std. dev	Min	Max
<i>age</i>	208	32.6	5.09	20	46

Source: our elaboration

Tab. 3 Origin and religion

Origin	Freq.	Percent	Cum.
Albanian	3	1.43	1.43
Congolese	2	0.48	2.38
Philippine	7	3.33	5.71
Italian	165	78.57	84.29
Moroccan	4	1.90	86.19
Nigerian	4	1.90	90.48
Pakistani	1	0.48	90.95
Polish	1	0.48	91.43
Rumanian	17	8.10	99.52
Moldavian	6	2.38	100.00
Total	210	100.00	

Religion	Freq.	Percent	Cum.
N.R.	28	13.33	13.33
atheist	3	1.43	14.76
catholic	146	69.52	84.29
Christian	11	5.24	89.52
Evangelist	1	0.48	90.00
Islamic	1	0.48	90.48
Muslim	6	2.86	93.33
orthodox	14	6.67	100.00
Total	210	100.00	

Source: our elaboration

Women have a high level of education: more than 42% has a high school degree, the 30% has a graduation degree or a higher title (PhD), the 12% a university diploma or short graduation degree, only the 8% ended the study after secondary school and more than 1% at the primary school (tab. 4).

More than 32% of patients are employed; the 11% are home keepers or entrepreneurs, and the 8% unemployed or owners (tab. 5a).

Tab. 4 Level of education

Education	Freq.	Percent	Cum.
N.D.	10	4.76	4.76
Diploma	1	0.48	5.24
Primary	3	1.43	6.67
Laurea or higher (BA)	65	30.95	37.62
Laurea_br	24	11.43	49.05
Med_inf (secondary)	17	8.10	57.14
Med_sup (high school)	90	42.86	100.00
Total	210	100.00	

Source: our elaboration

Tab. 5a Professional condition

Profession	Freq.	Percent	Cum.
Not declared (N.D.)	10	4.78	4.78
Other	16	7.66	12.44
Autonomous	16	7.66	20.10
Home keeper	24	11.48	31.58
Manager	11	5.26	36.84
Unemployed	18	8.61	45.45
Professor	1	0.48	45.93
Employed	68	32.54	78.47
Entrepreneur	23	11.00	89.47
Nurse	1	0.48	89.95
Teacher	2	0.96	90.91
Musician	1	0.48	91.39
Worker (blue collar)	16	7.66	99.04
Student	2	0.96	100.00
Total	209	100.00	

Source: our elaboration

The 40% of patients has a personal income lower than € 15.000, the 24% earn between € 15.000 and € 30.000, the same percentage has no income and only the 1% has an income higher than € 50.000. The results are better if we consider the familiar income (tab. 5b).

Tab. 5b Yearly personal and familiar gross income

Income €	Personal		Family	
	Freq.	Percent	Freq.	Percent
0	40	22.10	8	4.85
<15000	72	39.78	23	13.94
15000-30000	44	44.31	56	33.94
30000-50000	22	12.15	42	25.46
> 50000	3	1.66	36	21.82
Total	165	100.00	165	100.00

Source: our elaboration

2.2. The frequencies of alternative delivery methods

The frequencies of the alternative delivery methods show that in this hospital the CS rate is very high: 42% of all deliveries are practiced with CS.

Elective CSs are the 26% over all deliveries, whereas only the 16% of CS are in emergency (tab.6).

Almost the 33% of induced deliveries and the 14% of deliveries practiced with epidural analgesia have complications that require emergency CS.

The registered rates of CS are higher if compared to the national average (about 37,8%).

Tab. 6 Frequencies of the alternative methods of delivery

<i>Delivery method</i>	<i>Freq.</i>	<i>Percent</i>	<i>Cum.</i>
CS_elective	54	25.84	25.84
CS_emergency	33	15.79	41.63
Vaginal	122	58.37	100.00
Total	209	100.00	

<i>CS</i>	<i>Freq.</i>	<i>Percent</i>	<i>Cum.</i>
CS_emerg	33	15.79	41.63
Induced	17	32.69	
Epidural	6	13.95	

Source: our elaboration

Such a high rate is certainly due to the case-mix⁸: the AO hospital has to deal with the most complex cases and may require emergency CSs very often. This partly confirms the results of a study that affirmed the importance of the case-mix as a factor that can explain the CS rates (Frost, Thomas, 2005). Nevertheless the value is still too high if we consider the CS rates registered in similar hospitals (A.O.) at national level (34,52%) and regional level (29,32%).

⁸ The A.O. treats all the most risky and complex cases, because the hospital is very specialized and has a neonatal center to assist babies with complications.

2.3. A model to estimate the probability of having a planned CS

The high rates of CSs seem not to be completely justified and were the initial stimulus to investigate which factors may explain such a practice.

We used a *logit* regression to model the probability of the event “planned CS” (*ces_el*) as a function of individual characteristics, clinical, social and economic factors.

The characteristics and factors considered are the following:

- Referring age at delivery (*age_rif*) calculated as the difference between the observed age and the average minimum age at delivery registered in the sample and at national level;
- Being foreigner (*foreigner*): woman not Italian; or being Italian (*Italian*);
- Having a previous CS (*ces_preg*);
- Number of pregnancy weeks over term (*gestaz*), calculated as the difference between the weeks of pregnancy observed and the 40th week;
- The expressed preference of the woman for a CS (*ces_pref*);
- The expressed preference of the woman for epidural analgesia (*epid_pref*);
- Presence of disease that may require a CS (*patol*);
- Attendance at delivery preparation courses (*corsi_prep*);
- Being catholic (*cattolica*);
- Being graduated (*laurea*) or having a diploma (*diploma*);
- Have a high degree of education (*titolo_stu*);
- Being unemployed (*no_job*);
- Being rich (*rich*): if woman gross income is equal or more than € 50.000 for year
- Have an autonomous job (*autonoma*);
- Being home keeper (*homekeeper*);
- Being not married (*no_married*).

The results of the model (Tab A.1 Appendix) show that the probability of having a planned CS increases with age: older women are more exposed to risks and complications that might require a CS. Moreover, getting pregnant in later age can be very difficult and expensive for older women that may require an assisted procreation: in these cases the baby is considered “precious” and planned CS is necessary to avoid complications.

The probability of having a planned CS increases if women have had a previous CS (to avoid complications), and if women express the desire of having a CS.

Even if CS should be practiced only for clinical reasons and not under mother request, in many cases an implicit agreement between the clinician and the patient is possible (especially if the doctor practices both in private sector and in the same hospital where the woman will deliver⁹).

The probability of a planned CS decreases before the 40th week of pregnancy.

An interesting result shows that being foreigner and unmarried decreases the probability of planned CS. The first result might be due to cultural reasons: some ethnic groups assign more value to pain during delivery and consider women more strength if they are able to manage this experience. In the second case, unmarried woman are more likely to be young and are probably not incurred in a previous CS before.

Co-morbidities or bad health conditions that may require CS are positively related with the probability of a planned CS, but are not significant.

Our results seem to confirm the results of another study done in different Italian hospitals and that show that, apart from few medical indications, CS is practiced for non clinical reasons (Osborn JF., Signorelli C., 1995).

3. Cost analysis

The cost analysis aims at evaluating the full cost of each alternative delivery method. We consider both the direct health costs (for delivery, surgical intervention, hospitalisation and in-stay) and from a broader perspective also the indirect costs (medications after delivery, complication costs, time lost, and caregivers' assistance). For each delivery method (vaginal with and without epidural analgesia and CS) we identify and assess the direct health costs due to the specific procedure (items, materials, pharmaceuticals, human resources and times, in-stay costs, diagnostic and laboratory tests, treatments and interventions), the direct health costs for complications (CS for urgency, obstetrics procedures, postpartum complications).

The evaluation of the direct health costs is done through a *micro-costing analysis*, with the identification, measurement and evaluation of each single cost item involved in the assistance process.

⁹ As explained in the previous chapter, doctors can have a real interest in practicing planned CS (financial incentives, logistic reasons, preventive practice, reduction of risks), but also woman can prefer CS because they think is painless.

This methodology, even if more laborious and less generalizable than a *gross-costing analysis*, gives a better and specific insight of the relation existing between the activities and the costs (Brouwer, Rutten, Koopmanschap, 2001).

The individuation and measurement of each cost item has been done through direct measurement, with accurate collection of data from clinical record or through direct interviews with physicians, nurses. We followed an *activity based costing* approach to evaluate all the activities performed during the in-stay.

We used administrative data and regional tariffs only for the daily pension cost¹⁰ and the laboratory tests because a micro-costing analysis would have been too expensive for the study aim. In tab.7 we show a sample of the laboratory analysis with tariffs used to evaluate the diagnostic exams.

Tab. 7 Tariffs (Tariffs Nomenclator Veneto Region 2006) (euro)

Cod.	Description	Tariff
H 90.65.3	GRUPPO SANGUIGNO ABO e Rh (D).	€ 8,55
H 90.65.4	GRUPPO SANGUIGNO ABO/Rh II controllo.	€ 5,65
90.62.2	EMOCROMO: Hb, GR, GB, HCT, PLT, IND. DERIV	€ 5,15
90.04.5	ALANINA AMINOTRANSFERASI (ALT) (GPT) [S/U].	€ 2,85
91.09.4	TOXOPLASMA ANTICORPI (E.I.A.).	€ 12,10
90.72.4	PROTEINA S LIBERA [P].	€ 10,80
90.72.5	PROTEINA S TOTALE [P].	€ 10,80
90.66.2	Hb - EMOGLOBINA [Sg/La].	€ 1,90
90.75.4	TEMPO DI PROTROMBINA (PT).	€ 2,85

Source: Tariffs Nomenclator Veneto Region 2006

The costs of pharmaceuticals and items used during delivery and in-stay is an average cost (including IVA-VAT) referred to the specific unit where the item is used (delivery room, surgery or unit).

In tab. 8 we show an example of the database that contains the hospital costs of a sample of drugs used in delivery room and in-stay.

Tab. 8 Database of the administrative costs of pharmaceuticals

Pharmaceutical Description	Deliv. room	In-stay
F15F110 METHERGIN IM IV 6F 1ML 0,2/MG/ML		
METILERGOMETRI	€ -	€ 0,22
F25A202 MIDAZOLAM IBI 5 MG/ ML F 1 ML	€ 0,34	€ 0,35
F15F420 MIOLENE FIALA 50 MG EV RITODRINA	€ 0,57	€ 0,57
F15F510 NALADOR FIALA 0,5 MG SULPROSTON	€ 11,14	€ 11,12
F24A520 NAROPINA 7,5 MG/ML POLYAMP DA 10 ML ROPIVA.	€ -	€ 11,81
F24A530 NAROPINA 10 MG/ML POLYAMP DA 10 ML ROPIVAC	€ -	€ 13,07
F02N430 NEO FURADANTIN 50 MG CPS NITROFURANTOINA	€ 0,05	€ 0,05

¹⁰ The pension costs consider only the costs for food and in-stay and not the health costs, as they have been already evaluated through ABC.

Through direct interviews and direct measurement we identified all the activities performed by each professional figure from the patient's admission (in labour or to book a planned CS) till her exit. For each activity we identified all the human resources involved, the time spent and the items used (tab. 9).

Tab. 9 Plan of the activities done during in-stay

<i>Activities</i>	<i>Prof. figure</i>	<i>q.ty</i>	<i>Minutes</i>
Clinical Record opening	nurse	1	15
Haematological blood test	nurse	1	5
Test-tube delivery	nurse	1	20
Trichotomy	nurse	1	5
Intravenous catheter insertion	nurse	1	5
Transfer to delivery room	OSS operator	1	10
Clinical record check	nurse	1	15
Transfer to bed	nurse	1	20
Sanitary activities, make bed	OSS operator	1	15
Position ice on the belly	OSS operator	1	2
VAS check up	nurse	1	60
Therapy administration	nurse	1	5
Check up	physician	1	10
	nurse	1	10
	trained nurse	1	10

Source: our elaboration

The unit cost for hour (with the total amount of wage in the year) of the human resources has been supplied by the administrative unit of the hospital: we identified the professional figures (gynaecologists, surgery staff, nurses, technicians, administrative staff) for each unit referred to delivery room, surgery room and obstetric units. The average cost for hour of each figure has been calculated as ratio between the wage and the number of hours worked in the year. The cost contains the basic wage and the extra time worked. In tab.10 we summarize the cost of human resources¹¹.

Tab. 10 Average cost for hour (a.c.h.) of human resources in delivery room and obstetric unit

<i>Obstétrical unit</i>	<i>clinic</i>	<i>division</i>	<i>a.c.h</i>
Health manager	75,92	71,86	€ 73,89
Health staff	26,17	26,22	€ 26,19
Non-health staff	21,48	21,26	€ 21,37
<i>Surgery- delivery room</i>	<i>clinic</i>	<i>division</i>	<i>a.c.h</i>
Health staff	26,22	26,19	€ 26,20
Non-health staff	20,79	20,87	€ 20,83

Source: our elaboration

¹¹ In the hospital there are two units that use the delivery and surgery room: the so called Clinic and the Division of Asl. All the physicians and nurses are often used in common, especially in the surgery room where there is a lack of nurses. The delivery room and surgery room are common to both the unit, but each one has a different in-stay unit. Seldom, some patients from division are sent to the clinic if there are no beds.

The identification and evaluation of the direct health costs born from the admission in hospital till discharge, has been done through a database. In the database, for each cost item we identify the consumption and the economic value to calculate the average cost for each delivery method. For each patient we collected all the useful data to determine the cost of hospitalisation, the in-stay, the time spent in delivery room during labour, in surgery room for CS (in the report we can find the hour the intervention started and ended and the human resources involved), the diagnostic tests and the pharmaceutical therapy (tab.11).

Tab. 11 Data collected from clinical records

Data collected from clinical records
Personal data
Hospitalisation data (admission data, type and length of in-stay)
Method of delivery and clinical indications
Delivery/intervention data (times, human resources involved)
Pharmacological therapy in delivery room/surgery
Pharmacological therapy during the in-stay
Diagnostic and laboratory tests
Barthel indexes

Source: our elaboration

The direct cost of human resources for each surgical intervention has been assessed through clinical report data: in the report we find the figures involved and the time spent.

For each professional figure we identified the cost for hour and for minute to assess the cost for each patient (tab.12).

Tab. 12 Costs of human resources for surgical intervention (euro)

Human resources	Nr. persons	Cost/hour	cost_min
Obstetrician-midwife	1	26,20	€ 0,44
Gynaecologist	1	73,89	€ 1,23
Special. STRUTT	2	26,20	€ 0,87
Surg. instruments physician	1	26,20	€ 0,44
Surg. instruments assistant	1	20,83	€ 0,35
Obstetrician assistant	1	20,83	€ 0,35
Anaesthetist	1	73,89	€ 1,23
Anaesthetist assistant	1		€ -
Nurse of surgery room	1	26,20	€ 0,44
Total	10	294,26	€ 5,34

Source: our elaboration

The human cost in surgery room may vary according to the intervention complexity from € 133,00 to € 534,00 but on average is € 287,00 (tab. 13).

Tab. 13 Cost of human resources during surgical intervention in surgery room (euro)

Variable	Obs	Mean	Std. Dev.	Min	Max
humanres_caesarean	63	287.6819	88.05121	133.5	534

Source: our elaboration

The cost of the diagnostic tests performed before and after delivery has been assessed using the regional tariffs. Some tests are done routinely, such as blood group and serologic tests (HiV, hepatitis) or control tests after delivery; in many cases some tests may check women conditions due to particular diseases (diabetes or complications).

The type and number of diagnostic tests have been collected from clinical report and evaluated with the correspondent tariff, to obtain a total cost for each patient.

The results show that there is no difference in costs due to the delivery method and the costs may vary between € 218,00 and € 291,00 (tab.14).

Tab. 14 Costs of diagnostic tests for each delivery method (euro)

Delivery method	Variable	Obs	Mean	Std. Dev.	Min	Max
Caesarean (all)	Cesarean	87	285.6437	79.83165	142	535
Planned CS	Ces_election	54	291.037	75.73862	142	535
Urgent CS	Ces_urg	33	276.8182	86.58791	142	473
CS after induction	Ces_induced	28	287.25	85.55294	142	473
CS after epidural	Ces_epidural	5	218.4	74.47684	142	312
Vaginal (all)	Vaginal	122	254.1721	87.27573	142	610
Spontaneous VD	Vag_spon	88	241.6818	75.5631	142	384
Induced VD	Vag_induced	34	286.5	106.6928	142	610
Epidural an. (all)	Epidural	41	280.6341	61.49421	142	430
Epid. followed by CS	Epid_ces	6	289.3333	35.75286	248	333
Epid. followed by VD	Epid_vag	37	280.1351	63.55145	142	430

Source: our elaboration

We assessed the costs for pharmaceuticals during labour, delivery and in-stay for each patient and we made an average for each delivery method (tab. 15).

The results show that the costs for drugs for a VD is on average € 33,00 (€ 31,00 in a natural delivery, € 33,00 with epidural and € 40,00 if induced).

The pharmaceutical cost for CS is on average € 44,00, but if we distinguish between elective and urgency CS, the second one costs on average € 65,00.

Tab. 15 Costs of pharmaceuticals for each method of delivery (euro)

Delivery method	Variable	Obs	Mean	Std. Dev.	Min	Max
Caesarean (all)	Cesarean	80	44.11413	67.5696	2.97	560.4
Planned CS	Ces_election	53	33.3917	31.71712	8.87	232.4
Urgent CS	Ces_urg	27	65.16185	105.6702	2.97	560.4
Vaginal (all)	Vaginal	91	33.07282	72.06698	1.91	441.22
Spontaneous VD	Vag_spon	64	31.19063	74.80935	1.91	441.22
Epid. followed by VD	Epid_vag	29	33.15104	65.58399	3.1	337.76
Epid. followed by CS	Epid_ces	6	38.77833	38.35647	7.15	98.18
Induced VD	Vag_induced	29	40.84748	65.11087	3.21	337.76
CS after induction	Ces_induced	15	84.372	136.5887	2.97	560.4

Source: our elaboration

If we take into account the length of in-stay for each delivery method, a VD may require a minimum stay of three days up to ten days. The difference in length of stay between natural, induced and delivery with epidural is of one day, whereas CS requires a longer stay (tab.16).

Tab. 16 Average days of in-stay for each delivery method

Delivery method	Variable	Obs	Mean	Std. Dev.	Min	Max	AO_ Italy	AO_ Veneto
Vaginal (all)	Vaginal	88	5.170	1.655.514	3	11	4.41	4.33
Induced VD	Vag_induced	26	5.846	205.314	4	11	5.27	5.03
Spontaneous VD	Vag_spon	62	4.887	1.380.245	3	10	3.56	4.03
Epidural an. (all)	Epidural	38	5.684	1.645.719	4	10	.	.
Epid. followed by CS	Epid_ces	6	6.666	1.861.899	5	9	.	.
Epid. followed by VD	Epid_vag	32	5.05	1.565.763	4	10	.	.
Caesarean (all)	Cesarean	78	6.294	1.020.682	4	9	7.07	7.24
Planned CS	Ces_election	52	6.230	.6749113	5	9	6.20	6.20
Urgent CS	Ces_urg	26	6.423	1.501.282	4	9	7.55	8.28

Source: our elaboration

The length of stay has a great impact in term of cost that is generally represented by the postpartum assistance.

The cost of the activities done by the human resources during the in-stay has been assessed through the identification of all the activities done during the hospitalisation: a distinction has been done between the activities done only once (clinical report start, transfer from/to delivery room, checkout), and the activities done every day (food administration, check-up, drugs administration, controls). There are some activities that may vary with the number of diagnostic tests done (blood injections, check of

results), the pharmacological therapy, and the delivery method (for CS women must wear specific tights, or due particular therapy).

In tab.17 we show the costs for the in-stay for each delivery method, including the human resources costs and materials used.

Tab. 17 Costs of in-stay activities (euro)

Activities	Vaginal	Caesarean
Daily activities	€ 15,28	€ 60,70
Una tantum	€ 89,56	€ 197,26
Variable activities		
Blood tests		€ 4,16
Inser/rem phlebo		€ 2,18

Source: our elaboration

For each patient we estimated the in-stay costs taking into account the length of stay registered in the clinical report, the treatments done and other variable costs.

The results show that on average the cost for in-stay is quite high for CS: especially if practiced on urgency -a CS cost almost € 604,00- whereas the VD cost on average €177,00 (tab.18). The in-stay for a woman who had epidural analgesia without complications costs € 183,00, but if after epidural an emergency CS is required, the costs of in-stay can raise up to € 612,00.

Tab. 18 Average cost for in-stay (euro)

Delivery method	Variable	Obs	Mean	Std. Dev.	Min	Max
Caesarean (all)	Cesarean	79	592.8608	64.34876	457	760
Planned CS	Ces_election	53	587.2642	42.27254	510	756
Urgent CS	Ces_urg	26	604.2692	94.87109	457	760
Vaginal (all)	Vaginal	90	177.6333	32.29862	136	297
Spontaneous VD	Vag_spon	62	172.6129	27.14162	136	277
Induced VD	Vag_induced	28	188.7500	39.85402	151	297
Epidural an. (all)	Epidural	39	249.4872	164.0232	151	755
Epid. followed by CS	Epid_ces	6	612.1667	111.7666	513	755
Epid. followed by VD	Epid_vag	33	183.5455	29.13663	151	260

Source: our elaboration

To evaluate the cost of the surgical intervention for the CS, we identified all the activities done during the intervention, the human resources involved, the health material used and the time spent.

Some activities are done before and after the intervention (room preparation and cleaning) and are standard, whereas other may vary with the length of the intervention. The staff costs that do not change with the time of intervention are € 50,91 where as the costs that vary with the length of surgery are almost € 5,34 for minute (tab.12). In tab.19 we show the costs of activities and materials used for the different delivery methods. The material used during intervention is standard and does not require particular variations, so the cost for resources consumption is almost € 480,00 for each patient.

Tab. 19 Costs of variable activities (euro)

Activities-Cost items	Cost
Activities in surgery room for CS	€ 50,91
Variable activities for CS (surgery length)	€ 5,34 / min
Standard activities for vaginal delivery	€ 26,19
Materials for vaginal delivery	€ 103,81
Material used for CS (standard)	€ 480,00
Pharmaceuticals-drugs costs	For patient
Episiotomy	€ 118,33
Epidural analgesia	€ 75,00
Surgery room utilization	€ 154,00
Delivery room utilization	€ 118,00

Source: our elaboration

The cost for human resources and the material used in delivery room has been assessed in the same way and is respectively of € 26,19 and € 103,81.

The cost of the drugs used during CS (fentanest, bupivacain, electrolytic solution) is included in the pharmaceutical costs, as the consumption varies with the length of intervention and the type of patient (the quantities are reported in clinical report).

For the VD with episiotomy, the evaluation of the cost of human resources, drugs and pharmaceuticals has been done separately, with the identification of the staff involved, the activities and the material consumption.

The episiotomy requires the presence of a physician and a nurse, it lasts on average 20-30 minutes and it is performed with local analgesia (lidocain). The full cost for episiotomy is almost € 118,33 and it is the same with or without analgesia.

Epidural analgesia, if required by the patients, is actually at hospital charge, so we must carefully analyse the costs involved. The human resources involved (anaesthetists

and nurse) cost about € 24,00, whereas the material (Thuoy, analgesia) costs € 51,35, for a total cost of € 75,00.

The anaesthesiology consultation that the patient must do before epidural or in case of CS costs on average € 12,30.

The use of the surgery room and delivery room is almost € 154,00 for surgical intervention and € 118,00 for vaginal delivery¹².

The full cost including drugs, materials, diagnostic tests, in-stay, assistance during delivery and hospitalisation, epidural or episiotomies) has been added of almost 20% to take into account the general indirect costs (structure costs, services, administrative costs)¹³.

We show the average total cost of each delivery method, without considering the general costs and with the 20% of general costs (tab. 20-a-b).

Tab. 20-a Total costs on average for each delivery method, without general costs

Delivery method	Variable	Obs	Mean	Std. Dev.	Min	Max
Caesarean (all)	Cesarean	87	1858.69	225.5636	1073.18	2288.99
Planned CS	Ces_election	54	1884.243	151.9097	1244.57	2268.49
Emergency CS	Ces_urg	33	1816.876	309.2113	1073.18	2288.99
Vaginal (all)	Vaginal	114	856.7704	117.2811	651.16	1228.16
Spontaneous VD	Vag_spon	84	836.6865	102.5845	651.16	1217.45
Induced VD	Vag_induced	30	913.0056	137.9763	651.16	1228.16
Epidural an. (all)	Epidural	42	1076.11	339.8024	766.58	2149.415
Epid. followed by VD	Epid_vag	36	944.8581	77.44268	766.58	1098.81
Epid. followed by CS	Epid_ces	6	1863.622	191.2882	1562.159	2149.415

Source: our elaboration

Tab. 20-b Total cost on average without labour, with general costs (euro)

Delivery method	Variable	Obs	Mean	Std. Dev.	Min	Max
Caesarean (all)	Cesarean	87	2230.428	270.6763	1287.816	2746.788
Planned CS	Ces_election	54	2261.092	182.2916	1493.484	2722.188
Emergency CS	Ces_urg	33	2180.251	371.0535	1287.816	2746.788
Vaginal (all)	Vaginal	114	1028.125	140.7373	781.392	1473.792
Spontaneous VD	Vag_spon	84	1004.024	123.1015	781.392	1460.94
Induced VD	Vag_induced	30	1095.607	165.5716	781.392	1473.792
Epidural an. (all)	Epidural	42	1291.332	407.7629	919.896	2579.298
Epid. followed by VD	Epid_vag	36	1133.83	92.93121	919.896	1318.572
Epid. followed by CS	Epid_ces	6	2236.347	229.5459	1874.591	2579.298

Source: our elaboration

¹² Surgery room and delivery room are dedicated, so there are no other units using them, and the costs can be divided only for the interventions done in each one.

¹³ The choice of this percentage is not casual, but has been suggested by the Administrative unit, even if a deep analysis of the Accounting report is required to calculate the data in a more accurate way.

The results show that CS is more expensive if compared to VD, especially when practiced in emergency.

Nevertheless, if we consider the minimum and maximum values of each method, the costs may vary a lot, and in some cases they can be the same or in some extreme cases the VD can be more resource consuming than CS (in the range between € 1.287,81 and € 1.473,79).

A vaginal delivery with epidural costs on average € 1133,83 when no complications occur, so a bit more than VD, but it can reach € 2.579,29 if complications occur and an emergency CS is finally required.

If we consider the assistance that patients receive from the admission in hospital and during all the labour length, the costs may differ a lot (tab. 20-c,d).

From the admission in hospital till the delivery the patient may spend many hours in labour, during which the nurses and physicians must give all the possible assistance.

From the data in the clinical reports we can see that during this time the midwife, the gynaecologist and nurses assist the patient, administer drugs (oxitocyn, prepydil) and visit her at regular intervals.

Nurses and midwives are always present during labour and assist the patient at least for 20 minutes every hour, whereas the gynaecologists visit her at least for 5 minutes for a total costs of almost € 15,00 for hour.

For each patient we can calculate the cost of assistance during labour in delivery room collecting data from the clinical report (time of arrival, first visit, baby born hour). If we consider also this component of costs in the total cost of delivery the full cost of VD increases.

In tab 20-c we show that including the cost of assistance during labour the full cost of a CS in urgency increases on average of € 280,00 up to € 822,00, VD cost increases of € 138,00 and € 163,00 with induction, up to € 378,00 in the worst cases¹⁴.

The cost of VD with epidural increases of almost € 200,00, from € 160,00 to € 300,00 for VD and up to € 555,00 if CS is required.

¹⁴ Induction through prepydil may prolong the length of delivery and induce dystocia.

Tab. 20-c Total cost on average with labour assistance, without general costs (euro)

Delivery method	Variable	Obs	Mean	Std. Dev.	Min	Max
Caesarean (all)	Cesarean	87	1947.003	314.9965	1073.18	2974.014
Planned CS	Ces_election	54	1884.243	151.9097	1244.57	2268.49
Urgent CS	Ces_urg	33	2049.701	459.2576	1073.18	2974.014
Vaginal (all)	Vaginal	114	972.3639	147.362	689.04	1543.21
Spontaneous VD	Vag_spon	84	945.1707	126.9762	689.04	1343.61
Induced VD	Vag_induced	30	1048.505	174.1596	758.37	1543.21
Epidural an. (all)	Epidural	42	1242.382	427.2574	811.25	2612.425
Epid. followed by VD	Epid_vag	36	1077.627	102.1708	811.25	1343.61
Epid. followed by CS	Epid_ces	6	2230.909	236.1529	1966.63	2612.425

Source: our elaboration

Tab. 20-d Total cost on average with labour assistance and general costs (euro)

Delivery method	Variable	Obs	Mean	Std. Dev.	Min	Max
Caesarean (all)	Cesarean	87	2336.404	377.9958	1287.816	3568.817
Planned CS	Ces_election	54	2261.092	182.2916	1493.484	2722.188
Urgent CS	Ces_urg	33	2459.641	551.1092	1287.816	3568.817
Vaginal (all)	Vaginal	114	1166.837	176.8344	826.848	1851.852
Spontaneous VD	Vag_spon	84	1134.205	152.3714	826.848	1612.332
Induced VD	Vag_induced	30	1258.206	208.9916	910.044	1851.852
Epidural an. (all)	Epidural	42	1490.858	512.7089	973.5	3134.91
Epid. followed by VD	Epid_vag	36	1293.153	122.605	973.5	1612.332
Epid. followed by CS	Epid_ces	6	2677.091	283.3835	2359.956	3134.91

Source: our elaboration

3.1. The opportunity cost of an emergency team

The hospital selected for this study is characterised by the constant presence of human resources and anaesthetists that can assist the patients in every moment, both during night and, in the week-end and holidays¹⁵.

Nevertheless we must consider the option that in some hospitals the presence of human resources might not be constant, but limited during week time with lack of assistance in moments where it is more required. Because the delivery event cannot be planned the chance to practice epidural is limited, as not always the staff is available.

The opportunity of having a team that can assist women 24 hours over 24 during VD and can offer epidural is an opportunity cost that must be taken into account comparing the alternative methods of delivery.

The evaluation of the cost of a team has been done from the cost data already collected and can be estimated in almost € 152,46 for hour and € 3.659,04 in the 24 hours.

¹⁵ In the hospital there is a sufficient number of physicians, and medicine students that can substitute the structured personal.

If we consider also the presence of an anaesthetist to practice epidural the cost rises to € 226,35 for hour and € 5.432,40 in the 24 hours.

These data are useful if compared with the cost of a team required for a planned CS, as they show the difference of cost between alternative procedures. As already reported the cost for the human resources during planned CS is very high and reaches € 294,26 for hour.

3.2. The indirect costs and the private costs

In the study we assess not only the direct health costs, but also costs not directly referred to the delivery event.

In particular we take into account the costs due to the possibility of breastfeeding, the costs to go back to hospital to remove the stitches (for episiotomies or for CS), the private costs for private care or the cost for caregivers assistance (husband, parents, relatives).

We considered also the costs for the examinations during pregnancy and the prenatal diagnostic tests (amniocentesis, ECG).

All the information to assess the private and indirect costs has been collected through questionnaires (tab.21). Some questions aimed at calculating the eventual indirect costs due to delivery, such as the cost for artificial milk, for postpartum care. We asked women to quantify the caregivers time: in the questionnaire they must say if they will need assistance (paying or for free), who will assist them, how many hours for day, if the caregivers will change their activities, if they will lose days of job and leisure time, and how many.

Tab. 21 Data collected through clinical records

<i>Individual data:</i>
age, origin place, citizen, social-civic status
<i>Social and economic data:</i>
religion, level of education, profession, income (individual, familiar)
<i>Clinical data:</i>
disease during pregnancy, previous deliveries, prenatal diagnosis, week of preg., weeks worked, delivery method, breastfeeding
<i>Preference:</i>
preferred delivery, willingness to pay
<i>Indirect costs:</i>
home assistance, caregivers assistance, time lost

Source: our elaboration

In tab.22 we show the frequencies of breastfeeding after delivery for each method. Women that delivered with VD breastfeed in the 92% of cases, whereas women those have had CS only in the 75.6%: CS reduces the possibility to breastfeed of 20% in compared to VD. Moreover, compared to planned CS, the probability of breastfeeding after an emergency CS is lower (71,88% instead of 78%), because the less organization that characterised the emergency intervention makes more difficult to attach the baby at the mother's breast in the following two hours.

Tab. 22 Breastfeeding frequencies

Delivery method	Variable	Freq. Patients breastfeeding	Total patients	Percentage of woman breastfeeding
	All	168	197	85.28
Caesarean (all)	Cesarean	62	82	75.61
Planned CS	Ces_election	39	50	78.00
Urgent CS	Ces_urg	23	32	71.88
Vaginal (all)	Vaginal	106	115	92.17
Epidural an. (all)	Epidural	34	35	97.14
Total respond.	Total	209		100.00

Source: our elaboration

The natural breastfeeding can be considered a benefit index, because it has lot of advantages both for the mother and the baby.

Numerous studies show the potential positive effects of breastfeeding for mother's health: it reduces the risk of breast and ovarian cancer, the risk of osteoporosis; it increases the possibility of physical recovery postpartum. Some epidemiological studies show that maternal milk contributes to a better grew and development of the baby and reduces the risk of a wide number of acute and chronic diseases¹⁶.

Moreover, breastfeeding has not only individual benefits, but produces social and economic advantages for the society, reducing the costs for medical expenditure, the absence from work of parents due to babies' diseases.

The direct economic benefits for the family are significant too: considering the actual market prices of artificial milk, we estimate that feeding a baby in the first 6 months of life (exclusive period of breastfeeding suggested by the WHO) costs on average almost € 412,62 (it may vary between € 142,00 and € 690,00)¹⁷. The cost for artificial feeding

¹⁶ American Academy of Pediatrics workgroup on breastfeeding. Breastfeeding and the use of human milk. Paediatrics 1997;100:1035.

¹⁷ In Italy there are many brands of milk on the market and the prices vary a lot, so we considered a sample of 22 from the most used product in Italy (from Humana, Milupa, Miltina, Mellin, Beba Nestlè, Coop). For the evaluation

in the first year is on average € 907,00, but can reach also € 1.520,00 (tab. 23), confirming the results of a previous study conducted by Bonati (1998)¹⁸.

Tab. 23 Costs for artificial feeding (euro)

Period	Mean	min	max
6 months	412.62	141.75	691.74
1 year	907.11	311.65	1520.73

Source: our elaboration

To evaluate the transport costs incurred by husband and relatives to visit the patient during the in-stay, we considered the location of the patient's living place to evaluate the travel distance from the hospital. The evaluation has been done applying the petrol cost born to travel every day of in-stay from home to hospitals (tab.24). In the same way we evaluated the transport costs to go to the hospital to remove the stitches after the surgery (tab.25).

Tab. 24 Transport costs for visits (euro)

Variable	Obs	Mean	Std. Dev.	Min	Max
C_trasp_visits					
Total	201	15.50642	27.17254	0	180
Caesaren Section	83	24.54373	37.88223	0	180
Vaginal Delivery	118	9.149661	12.55659	0	65.5
Epidural Analgesia	36	11.64778	13.0009	0	65.5

Source: our elaboration

Tab. 25 Transport costs to remove stitches (euro)

Variable	Obs	Mean	Std. Dev.	Min	Max
C_trasp_rimo					
Caesarean Section	83	4.064458	6.025272	1	30
Vaginal Delivery	118	1.945085	2.671052	0	14.92

Source: our elaboration

The cost of the home care after delivery has been included in the questionnaire by the patient and corresponds to the monthly wage paid (tab. 26). In this case the data must

we considered the daily dose of milk in grams that a baby must have in the different periods of life, as suggested by the pediatric association, and the total quantity for each period (first weeks, first month and next) has been evaluated using the price of the correspondent artificial milk for kg.

¹⁸ The Italian study conducted in 1998 estimated that the financial cost for artificial feeding in the first year of life is almost € 780,00. See Bonati M., Vivarelli P., Brunetti M. (1998). *Il costo economico del non allattamento al seno*. Quaderni ACP; 6:10.

be normalized with respect to the personal and familiar income, as generally, women with higher income can pay more for assistance. The same applied for the profession, as it can have a different impact on the length of assistance: self-employed women are more time flexible than employed women.

Tab. 26 Costs for assistance in the postpartum (euro)

Variable	Obs	Mean	Std. Dev.	Min	Max
C_assistance					
Tot	190	93.42105	213.9237	0	1000
Caesarean Section	76	124.3421	255.0155	0	1000
Ces_elec	46	139.1304	250.7573	0	800
Ces_urg	30	101.6667	264.0805	0	1000
Vaginal	114	72.80702	179.7417	0	1000
Vag_no alg	78	81.41026	188.1401	0	1000
Epidural	36	54.16667	160.9681	0	800

Source: our elaboration

In the postpartum the 28% of women will be assisted by the husband, 21% by parents and 5% by other people (tab.27). The 46% of women will not ask for assistance.

The costs for the days of job lost by caregivers have been quantified using the monthly wage, from which we determined the daily cost (tab. 28-a,b).

Tab. 27 Caregivers' assistance in the postpartum

Caregiver	Freq.	Percent.	Cum.
Any	96	45.93	45.93
Other	10	4.78	50.72
Parent	44	21.05	71.77
Husband/partner	59	28.23	100.00
Total	209	100.00	

Tab. 28-a Average days of job lost by caregivers

Variable	Obs	Mean	Std. Dev.	Min	Max
Gg_persi					
Total	105	1.504762	2.981107	0	15
Caesarean (all)	44	1.590909	3.060006	0	10
Ces_elec	30	2.1	3.487416	0	10
Ces_urg	14	.5	1.400549	0	5
Vaginal	61	1.442623	2.946889	0	15
Vag_no alg	39	1.153846	2.18293	0	9
Epidural	22	1.954545	3.969854	0	15

Source: our elaboration

Tab. 28-b Costs of job lost by caregivers (euro)

Variable	Obs	Mean	Std. Dev.	Min	Max
C_Gglav_perso					
Tot	209	54.24097	203.3153	0	2045.45
Caesarean (all)	87	46.23824	150.5343	0	909.090
Ces_elec	54	66.91919	184.712	0	909.090
Ces_urg	33	12.39669	49.88717	0	227.272
Vaginal	122	59.94784	234.2522	0	2045.45
Vag_no alg	85	42.19251	151.6189	0	818.181
Epidural	37	100.7371	358.2517	0	2045.45

Source: our elaboration

In the questionnaires patients reported also the monthly hours of leisure time lost by the caregivers. In tab.29 we show the average amount of hours lost for each delivery method: CS requires more assistance if compared to VD.

Tab. 29 Average of monthly hours of leisure time lost by caregivers

Variable	Obs	Mean	Std. Dev.	Min	Max
TI_lost					
Tot	206	27.23301	53.71664	0	240
Caesarean (all)	84	29.28571	58.16026	0	240
Ces_elec	51	34.11765	61.194	0	240
Ces_urg	33	21.81818	53.17745	0	240
Vaginal	122	25.81967	50.62976	0	240
Vag_no alg	85	22.94118	50.20964	0	240
Epidural	37	32.43243	51.66158	0	180

Source: our elaboration

For the evaluation of the leisure time we used as proxy the hourly salary for the marginal hours of job (overtime work), assuming that leisure time could be spent at work. We increased of 35% the hourly salary and we multiplied it for the hour of time lost reported. We calculated it only for the first month for convenience, but we could extend the analysis for the following months (tab.30).

Tab. 30 Average cost of the monthly time of leisure lost by caregivers (euro)

Variable	Obs	Mean	Std. Dev.	Min	Max
C tl_mese					
Tot	60	113.2528	168.2455	0	715.9091
Caesarean (all)	25	116.2159	203.6371	0	715.9091
Ces_elec	15	138.0114	215.8928	0	715.9091
Ces_urg	10	83.52272	189.9954	0	596.5909
Vaginal	35	111.1364	140.8458	0	477.2727
Vag_no alg	21	112.5	144.4475	0	477.2727
Epidural	14	109.0909	140.624	0	477.2727

The time lost by husband is not considered

In tab.31 we report the total private and indirect costs borne by patients and their relatives due to the delivery event.

Tab. 31 Total indirect and private costs (euro)

Variable	Obs	Mean	Std. Dev.	Min	Max
Tot_costs	185	760.2428	842.2415	120.55	6565.63
Caesarean (all)	75	875.6392	909.6488	120.55	3905.197
Ces_elec	46	1006.736	997.1797	156.5	3905.197
Ces_urg	29	667.6926	718.1571	120.55	2669.306
Vaginal (all)	110	681.5634	787.5897	191.35	6565.63
Vag_spon	75	630.5672	571.146	191.35	2927.241
Epidural	35	790.841	1122.76	246	6565.63

Source: our elaboration

3.3. A model to estimate the delivery costs factors

To understand which factors may impact more on the delivery total cost, we used a model to estimate the delivery cost as a function of women characteristics, such as age, origin, level of education, profession, health conditions, and as a function of interventions and procedures used during the hospitalisation.

To estimate the delivery cost we used a statistic regression that consider the dependent variable *tot_cdir* representing the total cost of delivery (only health costs), as a function of the following explicative variables:

- *age_rif*, the difference between the age observed and the minimum age at delivery in the sample and in Italy;
- *deg_ref*, the difference between the days of in-stay observed and the minimum length;
- *foreigner*, dummy with value one if the mother is not Italian;
- *laurea* and *diploma* dummy with value one if the women is graduated o has a diploma;
- *no_job* dummy with value one if the woman is not employed;
- *ces_preg* dummy with value one if the woman had a previous CS;
- *patol* dummy with value one if the woman has disease;
- *gestaz* is the difference between the observed week of pregnancy and the 40th week;
- *ces_urg* or *ces_el* dummy with value one if the woman had CS in urgency or planned CS;

- *indpil* dummy with value one if the woman has been induced during labour;
- *episio* dummy with value one if the woman has had episiotomy;
- *epid* dummy with value one if the woman has had epidural analgesia;

The results of the model show that the factors that impact more on the delivery cost are the “*deg_rif*”, the incremental days of in-stay that the patient spends in hospital with respect to the minimum number of days (Tab. A2 in appendix).

The planned caesarean section and the emergency caesarean increases the costs of delivery of almost € 825,00 and € 998,00. Epidural analgesia and episiotomy, even if in a marginal way, can increase the average cost of delivery up to € 120,00.

The individual characteristics of the patients, especially the social and economic factors are not significant to determine the full cost of delivery.

4. Measures of mothers’ satisfaction and effectiveness of delivery

4.1. If women could choose, which delivery method would they prefer?

In the questionnaire we asked patients to state which delivery method they would have preferred (between VD without analgesia, VD with epidural and planned CS), if they could have chosen, motivating the answer.

In tab. 32 we show a synthesis of the preferences with respect to each delivery method. The results show that in general more than a half of the interviewed women would have a VD with epidural analgesia, the 27% would not have epidural and 12% would prefer CS.

Tab. 32 Preferred delivery method

delivery_pref	Freq.	Percent	Cum.
N.R.	14	6.70	6.70
Caesarean section	25	11.96	18.66
Epidural	112	53.59	72.25
Vaginal	58	27.75	100.00
Total	209	100.00	

Source: our elaboration

If we analyse the data taking into account the type of delivery that the woman have really had, the results seem to be more significant (tab. 33).

Women who had a VD, in the 36% of cases would have the same delivery, the 56,5% would have VD but with analgesia, and only 2,5% would have a CS.

Only one half of the women that did not have epidural would like to have it, but the other half has not been satisfied of delivery and would like to deliver without analgesia.

Women who had epidural followed by a natural delivery would repeat the same experience in the 78,39% of the cases, because they have had a great experience, but the 9,3% of them would not have epidural because of the further complications occurred.

Women who had CS after epidural would have epidural again in the 66% of cases¹⁹, or would prefer elective CS in the 16% of the cases, but any of them would have a VD without analgesia.

Women who had CS in general still prefer it in the 25,3% of cases, but the 49,4% would prefer a natural delivery with analgesia to feel less pain, and only the 16% of them would prefer a VD without analgesia.

Tab. 33 Preferred delivery method (with respect to the delivery experience had)

<i>Delivery experience</i>	<i>VAGINAL (all)</i>			<i>Vaginal without analgesia</i>		
Delivery_pref	Freq.	Percent	Cum.	Freq.	Percent	Cum.
N.R.	6	4.92	4.92	6	6.31	6.32
Caesarean section	3	2.46	7.38	1	1.05	7.37
Epidural analgesia	69	56.56	63.93	44	46.32	53.68
Vaginal analgesia (no ep)	44	36.07	100.0	44	46.32	100.0
Total	122	100.00		95	100.00	

<i>Delivery experience</i>	<i>EPIDURAL ANALGESIA</i>			<i>Epidural followed by VD</i>			<i>Epidural followed by CS</i>		
Delivery_pref	Freq.	Percent	Cum.	Freq.	Percent	Cum.	Freq.	Percent	Cum.
N.R.	2	4.65	4.65	1	2.70	2.70	1	16.67	16.67
Caesarean section	4	9.30	13.95	3	8.11	10.81	1	16.67	33.33
Epidural analgesia	33	76.74	90.70	29	78.38	89.19	4	66.67	100.0
Vaginal analgesia (no ep)	4	9.30	100.0	4	10.81	100.00			
Total	43	100.00		37	100.00		6	100.0	

<i>Delivery experience</i>	<i>CAESAREAN (all)</i>			<i>Urgent_CS</i>			<i>Planned_CS</i>		
Delivery_pref	Freq.	Percent	Cum.	Freq.	Percent	Cum.	Freq.	Percent	Cum.
N.R.	8	9.05	9.05	6	11.11	11.11	2	6.06	6.06
Caesarean section	22	25.29	34.48	19	35.19	46.30	3	9.09	15.15
Epidural analgesia	43	49.43	83.91	20	37.04	83.33	23	69.70	84.85
Vaginal analgesia (no ep)	14	16.09	100.00	9	16.67	100.00	5	15.15	100.00
Total	87	100.00		54	100.00		33	100.00	

Source: our elaboration

¹⁹ The value is not much significant because the sample is very small.

If we distinguish the type of CS, women who had an urgent CS are more willing to do it again with respect to women who had a planned CS (35% in the first case and only 9% in the second), because they know that the procedure was important to save their life or the baby's one.

The 16% of women who had an emergency CS would like to have a VD without analgesia: part of them had complications after epidural.

Finally, women who had a planned CS would do it again in the 9% of cases, and would prefer VD in the 85%: they think VD is a more natural way of having a baby and it allows a shorter recovery. The 69,7% of them would have epidural analgesia.

4.2. Patient wellbeing, pain, anxiety and childbirth perception

The delivery event differs from the other healthcare interventions (therapies and surgical operations) because it does not improve or worsen the quality of life of the patients and it is not intended to modify a pre-existent health status.

Delivery can certainly have some repercussions in physical terms on women: if during CS fibro-adenomas or cysts can be removed she will benefit from the delivery, but if delivery have some complications her health status can get worse (such as depression, incontinence, uterine injuries, or hysterectomy in the worst cases).

Changes in the quality of life due to delivery are limited to the labour period, the delivery moment and the postpartum period. Nevertheless, these changes are temporal and can often be solved in few days, thus the classical instruments generally used in the economic evaluations used (such as QALYs, EuroQol (EQ-5D) and the questionnaires SF_36 o SF_12 (Jomeen and Colin, 2005) are not useful.

A first index of women clinical status before and after delivery is given by the Barthel index (Mahoney and Barthel, 1965). The index consists of 10 dimensions and for each dimension it assigns points from 0 to 10 to physical conditions, such as the ability to walk, eat, dress. The final scores can vary from 0 to 100 (where 0 is the higher disability and 100 is the perfect health status).

We collected the Barthel index measures from clinical reports; results are reported in tab. 34.

Results show that the patients admitted in hospital in labour (spontaneous VD) have a Barthel index on average quite low if compared to other women, and this is due to the

physic pain that they are feeling, but they register better results when they are discharged from hospital.

Women asking for epidural analgesia enter with a very low index and this seems to justify the need of epidural to reduce the pain. Vaginal delivery with operative procedure has low index at entrance, but the higher scores at the exit. The same good results at discharge are reported for induced VD; it presents good scores also at admission, because the woman will start to suffer only after induction. The CS has high Barthel scores at admission if the intervention is planned, and low scores when practiced in emergency. In both the cases the scores at discharge are the lowest in the Barthel scheme.

Tab. 34 Barthel index at entrance and exit for each delivery method

<i>Delivery method</i>	<i>Entrance</i>	<i>Exit</i>
Vaginal with epidural	66	95
Vaginal _induced	77	98
Vaginal _spontan	62	94
Planned caesarean	96	88
Urgent caesaren	78	89

Source: our elaboration

According to the main literature, the instrument used to evaluate the impact of delivery on woman's well being must be clinical and psychological instruments.

The psychological determinants that may give information about the maternal status may be synthesized by the following variables: anxiety, pain perception, maternal satisfaction of the delivery event. The level of psychological and social stress, associated to anxiety, can cause risks on the obstetric condition of the mother and the wealth of the baby.

Anxiety is linked to a higher perception of the labour and the delivery (Waldenstrom, 1999) and to an increasing probability of postpartum depression (Mckee, 2001; Da Costa, Larouche, Dritsa and Brender, 2000).

In woman's perception of pain during labour there is a qualitative difference between pain in a sufferance context with lack of help, and the pain in a comfortable context, with aims and strategies direct to contrast the pain, as epidural.

For the delivery event the evaluation of the patient's well being must be done through anonymous questionnaires that can value the clinical and psychological dimension, and the changes of such dimension due to the delivery.

The instruments used to this aim are: S.T.A.I. (state-trait anxiety inventory) Form Y (Scale A-B) (Spielberger and Gorusch, 1970) and Italian Questionnaire of Pain-Q.U.I.D. (Questionario Italiano del Dolore) before delivery (to estimate psychological aspects of anxiety and pain not confounded by the fear and the concern for the next delivery), S.T.A.I. and C.P.Q. (Childbirth Perception Questionnaire) two days after delivery to understand the maternal satisfaction due to the delivery method.

The questionnaires, administered by specialized personnel, have been analysed to calculate indexes of women well being for each delivery method.

The preliminary results of the analysis refer to the results of the postpartum C.P.Q. questionnaires, administered to almost 133 patients (66% of the sample)²⁰.

The questionnaire is divided into three parts and aims at evaluating the woman satisfaction with respect to three different dimensions: the physical and sexual satisfaction during pregnancy, labour and delivery, the satisfaction of the childbirth experience and the satisfaction of the interaction with the partner²¹.

In tab. 35 we show the results of the CPQ questionnaires for each delivery method.

The results show that the women that have had CS have lower scores of physical satisfaction than women that delivered naturally.

Probably, women that have CS may feel worst because of the abdominal injury and the stitches (the same can be said for women that have had episiotomies and have lower scores).

Epidural analgesia seems not to have impacts on physical satisfaction, because the values are the same than women that delivered without analgesia.

The satisfaction of the delivery event seems to be very low for woman that have had CS, because the indexes are 21 over 52, but comparing CS in emergency and election the first one has better results (probably the women that live the labour event felt to be more active and present for the delivery).

²⁰ The analysis is not completed because the sample of women has been selected in a limited temporal interval and too recent, to administer the questionnaire after two months. A new survey is taking place and the results will be published soon.

²¹ The first section of the questionnaire refers to the physical and sexual dimension and consists of 5 questions to understand if women were embarrassed of her aspect during pregnancy, labor and delivery, if she thinks that it will have an impact in her future life and relationship. The second section of the questionnaire refers to the satisfaction of the delivery method and the behavior during delivery, the ability to control pain, the self-esteem. The third section consists of 9 questions in which we ask woman to give a value of the interaction she had with the partner during pregnancy, the labor time and the delivery, which impact delivery will have on the relationship and the impact that the baby will have on their relationship (see appendix).

Women that had VD are on average more satisfied, especially if they could reduce the pain thanks to epidural (the index for VD is 29,2 without epidural and 31,7 with epidural).

The same results have been registered for the third dimension of satisfaction: women that had epidural are more satisfied of the interaction with the partner (for VD the partner can assist the woman during delivery, but this is not allowed during CS) and they are more faithful with respect to their future relationship and the impact that the baby will have on it.

Tab. 35 Maternal satisfaction of delivery event (CPQ) for each dimension

Delivery method	<i>Physical_sexual dimension sat.</i>	<i>Child_birth event dimension sat.</i>	<i>Partner_rel dimension sat.</i>	<i>Total satisfaction</i>
Caesarean (all)	7.596774	21.35484	12.04839	41.16129
Caesarean_elect	8	18.15385	11.23077	37.64103
Ces_urg	6.913043	26.78261	13.43478	47.13043
Vaginal	9.169014	29.25352	15.85915	54.09859
Episiotomy	8.725806	29.79032	16.22581	54.53226
Epidural	8.916667	31.70833	16.91667	56.70833
TOTAL	8.43609	25.57143	14.08271	48.06767

Source: our elaboration

Overall, the possibility to deliver with less pain during labour seems to grant better scores of satisfaction than other delivery methods, both for the physical and sexual dimensions, both for the delivery event and the relationship with the partner (tab.36).

Tab. 36 Total satisfaction

<i>Total satisfaction</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
Caesarean section	62	21.35484	17.57345	1	80
Caesarean_elect	39	18.15385	17.98755	1	80
Caesarean_urg	23	26.78261	15.43404	26	77
Vaginal	71	29.25352	15.2729	22	93
Episiotomy	62	29.79032	14.0581	28	88
Epidural	24	31.70833	14.44172	32	93

Source: our elaboration

The Q.U.I.D. and S.T.A.I. questionnaires have been administered to a sample of more than 100 patients, but we just provide some preliminary results, as the data collection

is still going on. The selection criterion for these two tests are very strictly and they must be repeated at least after two months to evaluate the changes, so the study need of a significant sample of participants to get the first significant results ²².

However, preliminary results show that there are no significant differences in the pain dimensions after delivery among the alternative delivery methods.

Before delivery there is no significant difference in pain perception among women having alternative methods of delivery, even if those delivering with epidural analgesia have the highest scores (this would justify the demand of analgesia).

Two days after delivery the pain perception increases in all the patients: those who had epidural have the lowest scores, followed by those who had CS (because they are still treated with an analgesic bolus to limit the pain of the surgery intervention), whereas those who had vaginal delivery without epidural are those suffering more.

The results two months after delivery show that the difference in pain among vaginal, epidural and caesarean are not significant.

No significant results are found also for the anxiety dimension, measured with the S.T.A.I. Y-form questionnaire.

The only dimension that varies significantly is the state-A anxiety: women having vaginal delivery without epidural analgesia have the lowest anxiety score both before and after delivery; those having epidural have the highest anxiety before delivery; anxiety decreases after vaginal delivery both with and without epidural, but it increases after CS.

²² For these instruments the sample must be composed only by Italian patients, with an age of 22-42 years old, at first delivery and with a natural prognosis of pregnancy. The questionnaires must be administered before delivery after two days and at least after two months after delivery. The sample selection principles and the administration methods can be a limit, because they can give problems both for the patients recruitment and compliance (many patients decide to leave the study after so many months), both for the collection of data (it requires a long time) and the elaboration of the results (the first results are available after months).

5. Cost-effectiveness analysis

For each delivery method we can build cost-effectiveness ratios and make a comparative analysis using the costs and the effectiveness data obtained so far (tab.37). A first index of cost-effectiveness (*COST/CPQ*) has been calculated comparing the total costs (*Mean T_Cost*) of each delivery method with the total average score from the *Childbirth Perception Questionnaire* (*CPQ_tot*).

A second index of effectiveness is represented by the possibility to breastfeed after delivery: we compare the total average cost and the probability to breastfeed (*%br_feed*) to calculate a second index of cost-effectiveness (*Cost/breast*).

The results of cost-effectiveness analysis in each case show that VD is preferred to CS, because it allows better indexes of effectiveness and less costs. VD with epidural analgesia is still preferred to CS, but the indexes of cost-effectiveness on average are not as good as for VD without analgesia because epidural can have complications and end up in urgent CS, with worst results both in terms of costs and benefits for women.

Tab. 37 Cost-effectiveness indexes for each delivery method

<i>Delivery</i>	<i>COST/CPQ</i>	<i>MeanT_cost</i>	<i>CPQ_tot</i>	<i>% br_feed</i>	<i>COST/brest</i>
Caesar_tot	54,84	2.257,40	41.16129	75,61	€ 29,86
Caes_el	59,60	2.228,00	37.38462	78,00	€ 28,56
Caes_urg	48,90	2.304,89	47.13043	71,88	€ 32,07
Vaginal_tot	21,61	1.170,01	54.17	92,56	€ 12,64
Vag_no epid	21,13	1.107,85	52,42	90,59	€ 12,22
Epidural	22,90	1.321,07	56.70833	95,24	€ 13,87
Epid_vag	22,59	1.302,97	57,69	97,22	€ 13,40
Epidur_no epis	18,40	1.149,69	62,50	97,14	€ 11,84
Vaginal_no epis	18,72	905,56	48,37	97,17	€ 9,32

Source: our elaboration

6. Results and conclusions

Despite the debates few studies have paid attention to the real cost of alternative delivery methods, vaginal delivery with and without analgesia and caesarean section.

This study allows for a better knowledge of the real costs of alternative delivery methods and their differences in the Italian framework.

The results show that in general CS is more expensive if compared to VD, but the difference is marginal in case of complications or if we consider the opportunity cost of time during labour.

On a hand this is useful to highlight the differences in terms of costs between the alternative procedures, and on the other hand to compare the real costs of the intervention to the correspondent DRGs tariffs.

The results of the study show that in general the real costs of delivery are rather similar to the tariffs (tab.38). Comparing the costs of each intervention with the correspondent DRGs tariff we can see if tariffs cover the real costs and if eventual differences are justified: the costs seem to be aligned with the regional tariffs, but in many cases planned CS can give positive profit margins and induce opportunistic behaviours (according to Fabbri and Monfardini, 2000).

In fact, if we consider the labour assistance and we compare the total costs of CS and VD with the correspondent tariffs the difference is marginal. On average, when the tariff is higher than the cost, the CS has a positive margin of almost € 223,00 that can reach € 1.124,00 and loss of no more than € 776,00 in the worst cases. The vaginal delivery, in the best situation can have a positive margin of almost € 234,00, but on average the cost is not covered by the tariff for almost € 49,42, reaching huge lost of € 620,00 in the most complex cases.

Tab. 38 Full costs and DRGs tariffs (taking into account assistance during labour)

	<i>Without general costs</i>			<i>With general costs</i>		
	<i>min</i>	<i>max</i>	<i>average</i>	<i>min</i>	<i>max</i>	<i>average</i>
Caesarean	1073,18	2974,01	1974,00	1.287,81	3.586,81	2.336,40
DRG 371	2197,78	2197,78	2197,78	2.197,78	2.197,78	2.197,78
Difference	1124,60	-776,23	223,78	909,97	-1.389,03	-138,62
Vaginal	689,04	1543,21	972,36	826,84	1.851,85	1.166,83
DRG 373	922,94	922,94	922,94	922,94	922,94	922,94
Difference	233,90	-620,27	-49,42	96,10	-928,91	-243,89

Taking into account the general costs (20% of total), the average cost of each type of delivery are not covered by tariffs, for € 138,00 the CS and € 244,00 the VD.

In general CS may give higher positive margin with respect to VD and lower costs: these results are quite astonishing if we consider that CS is a surgical procedure and for this reason should be more resource consuming.

Despite this, we must keep in mind that VD, even if it is a natural event, consumes lot of resources too, especially in terms of staff time during labour.

This aspect should be carefully investigated, especially if we think at the lack of nurses in many hospitals.

The elective CS allows for a more efficient organization of human resources, materials and spaces, avoiding congestion. Moreover CS can be practiced in more convenient times, avoiding week end, night hours and holidays, where there is a lack of staff.

The assessment of the real costs of each delivery method is useful to estimate the potential saving that a reduction of inappropriate CS rates would cause.

In tab.39 we show the savings in cost terms that we could obtain reducing the rate of CS to the rate registered in the same type of hospital in Italy (31,34%) and Veneto Region (26,95%)²³.

We chose to consider this rate instead of the 20% suggested by the WHO, to take into account the higher complexity that characterises the hospital of our study.

If we consider the deliveries practiced last year in the A.O., over a total of 3.994 deliveries, almost 34% have been done with CS, and in clinic the rates reaches the 42%.

If we assume that the inappropriate CS can be done vaginally with epidural, and we reduce the rates of CS to 31.34% e 26.95% we could save respectively € 186.327,00 or € 258.922,00 (tab. 39).

Moreover, if we consider the case in which the more expensive CS are replaced by VD that cost less, in the best hypothesis we could save between € 336.622,44 and € 467.774,04 (tab. 40). If we consider the worst hypothesis, in which the less expensive CSs are substituted with the most expensive VD with epidural, we would increment the costs from € 22.878 to € 31.791.

²³ The percentage of the CS delivery rates are available at the Minister of Health website: <http://ministerosalute.it/datisis.jsp>

Tab. 39 Potential savings from CS rates reduction (euro)

	Taking into account labour assistance costs			Without labour assistance costs		
	min	max	average	min	max	Average
Caesarean	1.244,57	2.268,49	1.884,24	1.244,57	2.268,49	1.884,24
31%	287.495,67	524.021,19	435.259,44	287.495,67	524.021,19	435.259,44
27%	399.506,97	728.185,29	604.841,04	399.506,97	728.185,29	604.841,04
Epidural	811,25	1.343,61	1.077,63	766,58	1.098,81	944,85
31%	187.398,75	310.373,91	248.931,84	177.079,98	253.825,11	218.260,35
27%	260.411,25	431.298,81	345.918,27	246.072,18	352.718,01	303.296,85
Diff 31%	- 100.096,92	- 213.647,28	- 186.327,60	- 110.415,69	- 270.196,08	- 216.999,09
Diff 27%	- 139.095,72	- 296.886,48	- 258.922,77	- 153.434,79	- 375.467,28	- 301.544,19

Source: our elaboration

Tab. 40 Savings hypothesis (euro)

	Taking into account labour costs		Without labour costs	
	31%	27%	31%	27%
Worst hypothesis	22.878,24	31.791,84	-33.670,56	-46.788,96
Best hypothesis	-336.622,44	-467.774,04	-346.941,21	-482.113,11
On average	-186.327,60	-258.922,77	-216.999,09	-301.544,19

Source: our elaboration

The results show that the introduction of epidural analgesia among LEA would certainly have a strong impact in economic terms, but the final effect is not clear. Epidural may reduce the number of inappropriate CSs, but it may also prolong labour and increase the number of CS practiced on emergency, increasing the costs due to complications.

From a societal perspective we consider also the implicit indirect costs due to the delivery event (transport costs, medications, cost for artificial milk, time lost by caregivers) and the impact in terms of benefits that each delivery method can have on patients.

Epidural analgesia reducing pain during labour seems to allow a better perception of the childbirth event and a higher ability to manage this experience.

The opportunity to deliver with less pain gives higher results in terms of women satisfaction, both for the physical and sexual dimensions, both for the delivery event and the relationship with the partner. The cost-effectiveness analysis shows that in general VD with analgesia is preferred both in terms of costs and benefits, but in many cases epidural analgesia can end up in CS, with worst results.

In conclusion we think that the preliminary results presented in the study must be considered, especially with refer to the last law proposals that are addressed towards a higher attention for pain during labour.

Despite the implementation of the study has been complex and required the collaboration of many professional figures, we think that its extension and validation can give useful data, actually not available, on the real costs of medical practice in Italy.

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Appendix – The models results

Tab. A.1 Logit model results for the probability of a CS in election

	(1)	(3)	(4)	(5)	(6)	(7)	(9)
COEFFIC.	ces_el	ces_el	ces_el	ces_el	ces_el	ces_el	ces_el
age_rif	0.139**	0.128**	0.112*	0.124**	0.115*	0.115*	0.116*
	(0.0558)	(0.0569)	(0.0600)	(0.0565)	(0.0610)	(0.0605)	(0.0613)
foreigner	-1.214	-1.191	-1.651*	-1.340*	-1.633*	-1.670**	-1.637*
	(0.749)	(0.751)	(0.844)	(0.765)	(0.845)	(0.848)	(0.846)
diploma	-0.322	-0.346	-0.958	-0.222	-1.006	-0.951	-0.974
	(0.661)	(0.667)	(0.712)	(0.681)	(0.727)	(0.711)	(0.728)
no_job	0.170	0.120	0.0401	0.184	0.0328	0.0425	0.0160
	(0.514)	(0.519)	(0.563)	(0.523)	(0.562)	(0.562)	(0.561)
ces_preg	3.540***	3.595***	3.413***	3.459***	3.426***	3.385***	3.393***
	(0.611)	(0.624)	(0.626)	(0.607)	(0.629)	(0.633)	(0.636)
patol	0.373	0.359	0.604	0.459	0.590	0.595	0.564
	(0.536)	(0.538)	(0.581)	(0.542)	(0.583)	(0.582)	(0.583)
gestaz	-0.395***	-0.397***	-0.324**	-0.382***	-0.323**	-0.323**	-0.323**
	(0.120)	(0.120)	(0.132)	(0.120)	(0.132)	(0.133)	(0.133)
laurea	-0.592	-0.737	-0.933	-0.408	-0.986	-0.893	-0.953
	(0.687)	(0.715)	(0.705)	(0.704)	(0.726)	(0.717)	(0.738)
no_married	-1.321*	-1.358*	-1.398*	-1.289*	-1.403*	-1.382*	-1.384*
	(0.754)	(0.754)	(0.812)	(0.775)	(0.808)	(0.816)	(0.813)
homekeeper	-0.872	-0.906	-0.142	-0.692	-0.160	-0.128	-0.167
	(0.835)	(0.835)	(0.896)	(0.866)	(0.895)	(0.898)	(0.895)
rich		0.511				-0.179	-0.0901
		(0.594)				(0.668)	(0.681)
ces_pref			2.563***		2.668***	2.607***	2.649***
			(0.671)		(0.758)	(0.694)	(0.783)
epid_pref				-0.703	0.166		0.148
				(0.449)	(0.544)		(0.546)
Constant	-3.643***	-3.490***	-3.165***	-3.202***	-3.265***	-3.188***	-3.246***
	(1.101)	(1.104)	(1.126)	(1.139)	(1.175)	(1.127)	(1.173)
Observ.	207	204	207	207	207	207	204
R-squared	.	.	.	.	.	.	.

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
STATA 10 version results

- <i>age_rif</i> : Referring age at delivery calculated as the difference between the observed age and the average minimum age at delivery registered in the sample and at national level;
- <i>foreigner</i> : women not Italian
- <i>diploma, laurea</i> : if woman has a diploma/laurea
- <i>no_job</i> : if woman does not work
- <i>ces_preg</i> : if woman has had previous CS
- <i>patol</i> : Presence of disease that may require a CS
- <i>gestaz</i> : number of pregnancy weeks over term as the difference between the weeks of pregnancy observed and the 40th week;
- <i>laurea</i> : if woman is graduated
- <i>homekeeper</i> : if woman is homekeeper (dummy)
- <i>rich</i> : if woman income >= 50.000 euros
- <i>ces_pref</i> : if woman expressed preference for a CS
- <i>epid_pref</i> : if woman expressed preference for epidural
- <i>no_married</i> : Being not married (dummy)

Tab. A.2 Regression model results

reg tot_cdir deg_rif age_rif laurea ces_pregr patol gestaz ces_urg ces_el epid foreigner no_job episio

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
COEFFICIENT	tot_cdir	tot_cdir	tot_cdir	tot_cdir	tot_cdir	tot_cdir	tot_cdir	tot_cdir
deg_rif	69.93*** (10.55)	70.35*** (10.63)	66.96*** (10.86)	64.72*** (10.92)	64.35*** (10.89)	63.91*** (11.02)	63.33*** (11.02)	61.71*** (11.02)
ces_urg	999.8*** (42.86)	1004*** (43.36)	1002*** (43.35)	1111*** (65.43)	1121*** (65.62)	1123*** (65.95)	1123*** (65.91)	1115*** (65.81)
ces_el	844.1*** (39.89)	854.2*** (41.35)	840.4*** (42.62)	948.8*** (64.84)	961.2*** (65.24)	962.3*** (65.51)	961.3*** (65.47)	924.2*** (69.26)
epid	103.4*** (38.23)	103.4*** (38.44)	110.1*** (38.60)	106.2*** (38.58)	115.2*** (38.99)	115.4*** (39.10)	111.1*** (39.27)	112.8*** (39.12)
age_rif		-1.971 (2.935)	-1.527 (2.994)	-0.597 (3.081)	1.240 (3.332)	1.318 (3.350)	1.021 (3.358)	0.960 (3.345)
patol			54.77 (38.53)	58.04 (39.03)	63.22 (39.09)	62.92 (39.20)	64.51 (39.20)	69.46* (39.17)
gestaz			-8.763 (9.653)	-7.439 (9.675)	-7.975 (9.656)	-8.029 (9.681)	-9.416 (9.755)	-9.983 (9.721)
episio				127.9** (56.83)	135.9** (56.95)	137.7** (57.40)	132.1** (57.57)	129.2** (57.36)
foreigner					56.28 (39.46)	54.94 (39.81)	67.59 (41.37)	62.68 (41.32)
laurea						-8.926 (29.95)	-16.35 (30.66)	-20.59 (30.65)
no_job							-36.82 (33.02)	-42.93 (33.11)
ces_preg								73.95 (46.69)
Constant	821.3*** (26.79)	841.8*** (43.41)	826.2*** (44.63)	712.7*** (69.03)	666.1*** (76.21)	669.0*** (77.02)	692.2*** (79.73)	700.2*** (79.56)
Observations	199	197	196	193	193	193	193	193
R-squared	0.863	0.864	0.865	0.867	0.868	0.868	0.869	0.871

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
STATA 10 version results

- *age_rif*, the difference between the age observed and the minimum age at delivery in the sample and in Italy
- *deg_ref*, the difference between the days of in-stay observed and the minimum length
- *foreigner*, dummy with value one if the mother is not Italian
- *laurea* and *diploma* dummy with value one if the women is graduated o has a diploma
- *no_job* dummy with value one if the woman is not employed
- *ces_preg* dummy with value one if the woman had a previous CS
- *patol* dummy with value one if the woman has disease
- *gestaz* is the difference between the observed week of pregnancy and the 40th week
- *ces_urg* or *ces_elez* dummy with value one if the woman had CS in urgency or planned
- *epid* dummy with value one if the woman has had epidural analgesia
- *episio*, dummy with value one if the woman has had episiotomy

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Imperial College Business School
Tanaka Building
South Kensington Campus
London SW7 2AZ
United Kingdom

T: +44 (0)20 7589 5111
F: +44 (0)20 7594 9184

www.imperial.ac.uk/business-school