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The Total Cost of the Sterilisation of Materials Used During Surgery for Postpartum Haemorrhage

Abstract

Objectives: The aim of this research paper is to determine the incomes and outgoings related to postpartum haemorrhage implementation for organisations which support prospective payment as the Diagnosis Related Groups (DRG) in United States. We have to take into account surgical costs associated with care provided for these specific patients. Among these costs, surgical acts have to be calculated in association with the sterilisation of materials which can be used more than once.

Research Design & Methods: Patients' evaluation has been held from data collected in obstetrical and sterilisation departments of a university hospital (in Paris), which provides surgical care. The research was based on data from 2014 and 2015. All estimated costs are seen from the hospital's point of view. Surgical care is provided according to the following acts: manual exploration of the uterus (uterine cavity), exploration with valve, hysterectomy, caesarean scar, vaginal packing or unpacking, hypogastrium (iliac vascular ligation), and repair of other organs, such as bladder and embolisation. We take into account the sterilisation of materials used during surgical acts, as well as the staff which was involved in this study.

Findings: 262 patients were taken care of with regard to postpartum haemorrhage, and 255 patient files were studied. Average age was 31.42 +/- 5.5 years old. The cost of surgical procedures goes from 275 EUR for uterus exploration to 875 EUR for hysterectomy. Cost per sterilisation cycle for material used during surgical procedures was about 100 E per cycle and about 33 E per act, no matter the nature of the act.

Implications / Recommendations: The sterilisation of medical devices used in these interventions represents a significant part of the fixed cost: 7.5% to 11.4%. These results make it possible to elaborate one or more future DRGs' "bleeding of the delivery".

Contribution / Value added: This study is an example showing that the current reforms do not favour the quality-of-care coverage. This can contribute to the strengthening and to the recognition of the coverage of postpartum haemorrhage as one of the first causes of maternal deaths, the reduction of which is a priority for public health, as well as a concern for the users. This study is also a contribution to managed care empowerment. Managed care helped to slow down the growth of health care expenditures.

Keywords: postpartum haemorrhage; managed care; DRG; healthcare expenditures; sterilisation of medical devices; cost of surgery

Article classification: research paper

JEL classification: I10; I12; I18

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Introduction

Managed care shifts power away from doctor to payers. For example, managed care contracts place limits on services, whereas a fee-for-service reimburses regardless of the doctor bills. From around 1983, managed care emerged as a market force that grew sharply until 1993. In regions where managed care secured a solid foothold, doctors were forced to compete for patients, putting economic pressure on them to change the way they practice. They now had incentives to consider less expensive medications, decline to provide services of a questionable value, and seek other cost-effective ways to provide care. This pitted payers against seeing a doctor who could provide a service for less money. Supply and demand for doctors had real meaning now. The advent of managed care fundamentally changed the marketplace of physicians by sharply reducing doctors' control over their practice and income (Simonet, 2014; Simonet, 2019).

Competition for patients is to be considered under the need to take care of patients according to quality standards, as well as the need for reducing mortality and morbidity in the public health area.

In public health, this is exactly the priority: to reduce maternal mortality (Ben Hmid et al., 2006; Direction et al., 2007; Kister, 2018a, 2018b, 2019). In France during the 1970s, to prevent morbidity and prenatal mortality, a political action was held. In 1998, a framework in multiple stages of obstetrical and neonatal cares was developed. Health care programmes – such as a perinatal plan – have been implemented during the second-generation Regional Health Organisation Plans (1999–2004) (Fr. *SROS II for schémas régionaux d'organisation sanitaire de deuxième génération*). The Law of August 9th, 2004, concerned a public health policy to provide public health aiming at maternal and prenatal issues. Until the Bill of April 27, 2004, issued by the Ministry of Health, perinatal morbidity and mortality was a major theme of regional health care organisation schemes of the third era (*SROS III: 2006–2011*) (Lernout,

2007; Chevreur et al., 2015; Bréchat, 2006). In 2002, maternal mortality rate was estimated to be at 9 to 13 deceases per 100 000 births (Direction, 2007; Subtil et al., 2004). About 50% of the deceases that occurred between 1996 and 1999 could be considered as preventable (Direction, 2007). The major consequences of maternal mortality is postpartum haemorrhage, with 17.3% of maternal mortalities (Subtil et al., 2004) as well as high blood pressure and embolism (Lévy et al., 2004). Surgery (d'Ercole et al., 2004) and embolisation (Pelage et al., 2004) is used to support postpartum haemorrhage (Saucedo, 2020; Saucedo et al., 2021; Morau et al., 2021; Deneux-Tharoux, 2017).

Knowing incomes and outgoings related to postpartum haemorrhage implementation is essential for health care organisations which do such activities and support prospective payment, known in France as the T2A. The T2A – as in the American Diagnosis Related Groups (DRGs), done in Medicare programme – financed each hospital stay for each French hospital (Segouin, 2006a; Segouin, 2006b; Sahraoui et al., 2006; Stępniewski, 2007; Bura Riviere, 2018; Guesdon-Caltero, 2020). If the T2A contributes to financing hospital stays, it is for each health care department to forecast incomes and outgoings (2005–1474 Bill Act from November 30th, 2005). Even though a maternal mortality decrease is a major public health aim, relative DRGs to postpartum haemorrhage do not exist (Deneux-Tharoux et al., 2017; Rossignol et al., 2021; Saucedo et al., 2020; Saucedo et al., 2021; Deneux-Tharoux et al., 2021). There is no health-and-economical study determining income for future DRGs-related “postpartum haemorrhage” (Morau, 2021). This income has to take into account surgical costs associated with care provided to these specific patients. Among these costs, surgical acts have to be calculated in association with the sterilisation of materials which can be used more than once. This study has been realised at the request of public hospital managerial staff and of the Ministry of Health; its purpose is to provide guidelines to those obstetricians in health care departments who

deal with postpartum haemorrhage and applied the T2A financing. The aim is to elaborate and follow up future DRGs' "postpartum haemorrhage" (Stępniewski & Bugdol, 2010).

Materials and methods

Patients' evaluation has been held from data collected in obstetrical and sterilisation departments of the Grand Hospital (a university hospital) providing surgical take care from 1st January, 2014, to 31st December, 2015. Materials used for embolisation acts can be applied only once. Only materials used during surgical acts can be applied more than once; this concerns those which are sterilised, and the associated cost of each material used more than once be studied (e.g. the sterilisation cost). An analysis of production costs has been realised based on the observation of real costs assumed by hospital. As a consequence, estimated costs will be seen from the hospital's point of view.

Material

Selection of health care hospitals

Study places have been searched based on the following criterium – it needed to be a public university hospital with surgical care during postpartum haemorrhage. Surgical care is provided according to the following acts: manual exploration of the uterus (uterine cavity), exploration with valve, hysterectomy, caesarean scar, vaginal packing or unpacking (supposed to be the same act), hypogastrium (iliac vascular ligation), and other organs' repair, such as bladder and embolisation. Hospitals could take into account the sterilisation of materials used during surgical acts, and the staff was involved in this study.

Based on these requirements, the Hôpital Lariboisière – Fernand Widal as well as the Assistance Publique – Hôpitaux de Paris (APHP) were selected for analysis.

Studied materials

Those have been used during surgeries on postpartum haemorrhage performed from 1st January, 2014, to 31st December, 2015.

Method

Standard costs method was used (Castiel, 2004, 2008), e.g. medical and paramedical staff concerned by each surgical act described materials used in a standard way during act realisation, as well as personnel present by a patient's side. Costs have been induced. Materials and goods used in operating theatres have to be considered as fixed costs. Staff cost is variable, because it depends on time used for each patient. Obstetricians, leaders, and nurses of operating theatres have meetings twice. They determined the materials used and the lengths of surgical acts, as well as which materials could be induced in a sterilisation process or used only once. Hourly cost of each staff category present in operating theatres was applied (the employer's cost). Increases in pay due to night work and/or Sunday work were taken into account based on each staff category (medical or paramedical personnel).

Costs analysis framework

Fixed costs

One can notice 10 different topics. Each item is related to quality and quantity: **1. Set-up** involves all items related to patient set-up in operating theatres (covers, bibs, pyjamas, etc.); **2. Debridement act** involves the use of antiseptic solution (Betadine®, compresses, etc.); **3. Dressing** involves dressing the medical team; **4. Draping** involves washing used on the operation area; **5. Materials used once** involve all materials used only once (manifolds, syringes, etc.); **6. Patient transportation** involves from anything concerning a move from a patient's room to operating theatres as well as the return to the room or the post-op recovery room, as well as the materials used during the very transportation

(pants, covers, gloves, etc.); **7. First disinfection** involves materials and disinfection goods used for materials which can be used again before the transportation to sterilisation department; **8. Anaesthesia** involves drugs used for anaesthesia; **9. Cleansing enema**, but only the one relating to the exploration with valve; **10. The sterilisation** for those materials which are used more than once.

Further, the price of each item is the price paid by the hospital. The total amount of these items makes the fixed cost: quantity x unit price sum for all items.

Variable costs

To appreciate variable costs, we created the hypothesis that regardless of the surgical act, staff on operating theatres is the same: when a patient goes to operating theatres for stopping haemorrhage, an act that will be made is unknown. Staff is here 24/7 and they do what is necessary. On the one hand, we looked into the act duration for each patient (the time of arriving and the time of departure in operating theatres). On the other hand, we looked into hourly costs (for hospital) for each category of staff that is present on operating theatres, including stretcher-bearers. It was not obvious to recognise the real wages of all the people present on operating theatres, which is why we included the average wage supported in this hospital for each category of staff. Based on this, we made the hypothesis as to 152 working hours per month for paramedical staff and 200 working hours per month for medical staff. Corrections were made when, for example, the surgeon was either a senior or a head resident. Weighting was made according to the staff's real arrangement. For example, obstetrician staff consists of three seniors and one head resident. Therefore, in this case, per one out of four acts, we assumed that surgeons' salary was the one of head resident, while per three out of four acts, surgeons' salary was the one of senior surgeon. More than this, for each staff category (medical and paramedical), bonuses wages were added for night work and/or

Sunday work: the date and time of arriving and the time of departure were known for each patient. The variable cost was calculated for each patient: the duration of an act multiplies by hourly cost for each staff category present in operating theatres. Stretcher-bearers' work could be considered as a fixed cost, because we made the hypothesis that this work lasts one hour (half an hour for going to operating theatres and half an hour for return). However, we considered this cost as variable: it can be made at night and/or on Sunday.

Another variable cost was included: the use of drugs as catecholamines or others, if it occurs.

Sterilisation

Costs framework was elaborated for sterilisation according to each surgical care during postpartum haemorrhage. It is also a retrospect study, because costs study were not previewed with regard to taking care of a patient. For each step of sterilisation, staff categories were specified (functions, working place), concrete roles of each one with human resources were discussed, and the used goods were explored, also for intervention places. Time was measured by two observers with the help of chronometer. The mean time was taken into account when differences between the two measures occurred. Costs were evaluated with regard of the employer. For each action, cost production and cost time were calculated. Cost time was appreciated in cost per minute. For each category of staff, monthly wage was provided by the employer or by the official scales of salary. As we did for the variable cost, night work and/or Sunday work was considered. Depreciation allowance for the sterilisation of equipments was calculated with straight line method of depreciation on the basis of only one machine (the more recent one, because we did not know the one used immediately for material sterilisation of each act). To induce the sterilisation cost, we assumed that one sterilisation cycle was made only for one material at a time; we took into account the theoretical maximal capacity for each machine, although it was not real; we induced

an average cost of a cycle for one material at a time. Then, we had to create a material basket (container) for the studied surgical act with regard to the theoretical sterilisation cost by a material.

Statistical analysis

The data issued from average differences analysed by t-Student with Epi Info 6.0, ENSP, France, tested at 5%.

Results

From 1st January, 2014, to 31st December, 2015, 262 patients were taken care of with regard to postpartum haemorrhage, and 255 patient files were studied. Average age, calculated at the date of arriving, was 31.42 +/- 5.5 years (n=255).

Surgical acts frequency

Surgical care is made according to the following acts: a manual exploration of the uterine cavity,

the exploration of the valve, hysterectomy, vaginal packing (and unpacking), hypogastrium (iliac vascular ligation), and embolisation. There are no caesarean scars and no other organs' repairs (e.g. the bladder's).

Embolisation made alone or coupled with another surgical act. Table 1 specifies the sharing out of distribution. Ninety-one patients got embolisation (35.7%). Among them, 23 got an additional surgical act, or they got a surgical act as the first action. That is to say that 68 patients got embolisation only. In total terms, 52 patients (20.4%) got a surgical act different from embolisation (for 29 patients, it was a surgical act alone). Therefore, the surgical intervention rate is low in postpartum haemorrhage.

Surgical acts costs

The average cost of surgical acts is provided in Table 2. One can notice that 12 patients got surgical act twice, or even a third one (for two patients only, it was unpacking).

Table 1. Surgeries distribution according to care strategies

	Hysterectomy	Ligation	Packing	Uterus explo.	Valve explo.	Embolisation	Total
Embolisation	2	0	3	5	13	68	91
Other act	3	3	7	3	13	0	29
Total	5	3	10	8	26	68	120

Source: own elaboration.

Table 2. Cost of surgical procedures in the care of postpartum haemorrhage (in euros) (n = 52)

	Hysterectomy	Ligation	Packing	Uterus explo.	Valve explo.
Age (years)	34.6 +/-6.02	37.7 +/-4.62	31.9 +/-4.98	29.63 +/-3.96	30.88 +/-5.22
Number (n)	5	3	10	8	26
Fixed costs:	422.22 (48.2%)	370.37 (61.6%)	403.94 (55.7%)	109.67 (39.9%)	122.9 (40.6%)
Variable costs:	452.84 (51.8%)	231.18 (38.4%)	321.59 (44.3%)	165.37 (60.1%)	179.58 (59.4%)
Total	875.06	601.55	725.53	275.04	302.48
Average length of act	2h21	1h30	1h51	0h47	1h00

Source: own elaboration.

Sterilisation

Three visits were paid to the sterilisation central service, with one such visit lasting half a day, as well as three talks with staff were held. We could not take into account data related to garbage and that related to labelling sterilised materials (the time necessary for labelling).

Sterilised surgical materials determination

Table 3 considers sterilised surgical materials used according to each included surgical act.

Sterilisation steps and costs per act (and per cycle) determination

For all steps, it was estimated that the hospital pharmacist used 5 minutes by cycle for validation, the head nurse used 5 minutes, too, for managing orders and for interventions' a follow-ups. The pharmacist spends 10 minutes more daily for managing problems observed in the course of the day.

Step 0: Materials used in operating theatres

Step 1: First disinfection in operating theatres (7 minutes for the nursing auxiliary and 30 minutes for the stretcher-bearers)

At the end of the surgical act, the used material is gathered by the nursing auxiliary (NA) of operating theatres; it is then put in a detergent bath (Hexanios G+R ®, Anios) (1 bag for 5 litres of water). The material details, date, and the time of beginning the first disinfection are noted. Two minutes are needed to fill the form. It takes fifteen minutes to dip materials in the detergent bath. At the end of this step, the form is completed with the ending time of disinfection; the NA empties the bath and gathers all materials in a container which is placed in a plastic bag (for protection) for transportation. The time for this is 5 minutes. Materials are sent on a patient cart to the Sterilisation Department by the NA, and then she/he returns to operating theatres. She/He goes through several operating theatres and collects materials for transportation. This takes one hour.

Step 2: The sterilisation process – Sterilisation Department

Taking care of materials is done instantly, if necessary, due to the increase of activity. The sterilisation process comprises the following 4 steps:

1. Receipt and check (4 minutes – NA)

Materials on receipt are verified both, on quantitative and qualitative basis, following sheet form, by NA; pre-disinfection is verified. That

Table 3. Identification of material which can be sterilised by the act of surgery

	Hysterectomy	Ligation	Packing	Uterus explo.	Valve explo.
Container «Delivery»					x
Container «Hysterectomy»	x				
Container «Stomach»	x	x	x		
Valves container					x
Cupule				x	x
Curette				x	x
Big cupule	x	x	x		
Pozzi's crowbar	x	x	x		
Needle case	x	x	x		
Leriche's valve	x	x	x		
Rochard's valve	x	x	x		

Source: own elaboration.

takes 4 minutes. Materials are disposed in washing baskets with optimal manner to optimise washing up. Baskets are put in washing machines. Time of beginning varies according to occupational rate of washing machines. Data put on form sheet are computerised. This engages follow up of sterilised materials in sterilisation department. All these actions take one hour.

2. *Washing up*

Three washing up process is used in the sterilisation department: hand washing (it is an exception, only used for materials which cannot be put in water for a long time), ultrasonic washing method (for materials which are difficult to wash), and washing by automatic machines with one or several chambers (T 840, Hamo-Steris). The materials used here are almost treated by washing machine in multi-chambers machine for 45 minutes. We included this machine for washing up in the cost evaluation. The NA computerises data for the follow-up of washing up: the material's name, the department, date and time, the washing machine used, the names of the people who did the washing up.

3. *Packaging and control (15 minutes for the NA and 50–90 minutes for a nurse depending on the surgical act)*

3.1. *Control*: each material is verified (working conditions, cleanliness, drying) at the end of washing up done by the NA. Drying can be carried on with medical oxygen (not observed and counted). The material is categorised. All these steps take 10 minutes.

3.2. *Packaging*: A nurse from the relevant department doing packaging. The nurse needs 20 minutes to prepare herself/himself: 15 minutes to undress in operating theatres, to go to the sterilisation department, and to dress her; 5 minutes to verify materials according to the surgical act, and to complete the form

of the follow-up. Packaging needs 10 more minutes for manual exploration of the uterus, i.e. up to 35 minutes for exploration with valve and up to 50 minutes for hysterectomy, packing, or hypogastrium (iliac vascular ligation). The nurse needs 5 more minutes to undress herself in the sterilisation area.

3.3. *Loading the sterilisation machine and data capture*: done by the NA during 5 minutes

4. *Sterilisation during 90 minutes* (Autoclave Matachana S1000 – 8 baskets)

Unloading sterilisation machines and controls (20 minutes – NA). Sterilised materials are waiting for cooling for about 30 minutes. During this time, the NA verifies sterilisation cycle parameters for 5 minutes. After material cooling, the NA compares the materials with those mentioned on the form. The NA proceeds to labelling and puts materials in baskets depending on the department. This takes 10 minutes. Data is computerised once again and distribution sheet is edited (5 minutes).

Step 3: Operating theatres return [30 minutes]

Sterilised material is put in the waiting area in the sterilisation department until a nurse comes from the operating theatre to pick up the sterilised materials. The waiting time varies from few minutes to several days, depending on the operating theatres' needs.

Table 4 presents the numbers of each material processed – theoretically – by the washing machine and the sterilisation machine.

Sterilisation costs are 1.75 EUR per act for manual exploration of the uterus (99.9 EUR per cycle), 14.02 EUR per act for exploration with valve (98.36 EUR per cycle), 31.73 EUR per act for hysterectomy (90.64 EUR per cycle), and 33.07 EUR per act for packing or vascular ligation (94.5 EUR per cycle). Tables 5–8 provide the calculus for material sterilisation used for each surgical act.

Table 4. The estimated number of items that can be handled by a cycle of a washing machine and a steriliser

Material (sterilised item)	Sterilised item volume estimation	Average items handled by cycle
Delivery container	Small container	16
Hysterectomy container	Big container	8
Stomach container	Big container	8
Valves container	Small container	16
Cupule	Small bag	200
Curette	Big bag	80
Big cupule	Big bag	80
Pozzi's crowbar	Big bag	80
Needle case	Big bag	80
Leriche's valve	Small container	16
Rochard's valve	Small container	16

Source: own elaboration.

Table 5. Cost per sterilisation cycle and by the act of manual exploration of the uterine cavity (EUR)

Cost by cycle	Units	Unit price	Total
Staff:			
Personnel NA:	2 h	10.83	21.66
Personnel nurse:	0.83 h	15.43	12.81
Personnel stretcher-bearer:	1 h	10.34	10.34
Personnel pharmacist:	0.08 h	43.55	3.63
Personnel head nurse:	0.08 h	31.56	2.63
Equipments:			
<i>Washing machine (Tunnel T 840, Hamo Steris)</i>			
Depreciation	1 cycle	19.95	19.95
Detergent	0.21 l	4.55	0.95
Lubricant	0.04 l	6.1	0.24
Electricity	9 kwh	0.05	0.45
Water	0.14 m3	4.07	0.57
Maintenance	1 cycle	9.48	9.48
<i>Autoclave 8 baskets (S1000, Matachana)</i>			
Depreciation	1 cycle	6.23	6.23
Electricity	20 kwh	0.05	1.00
Water	0.3 m3	4.07	1.22
Maintenance	1 cycle	1.92	1.92

Table 5 – continuation

Cost by cycle	Units	Unit price	Total	
First-disinfection realised at operating theaters (disinfectant)	1	0.15	0.15	
Dressing materials:				
Overall	1	3.46	3.46	
Forage cap	1	0.02	0.02	
Overshoes	1	0.15	0.15	
Overpants	1	3.02	3.02	
Soap	1	0.54	0.54	
Total per cycle:			99.87	
(2 items sterilised)				
Cost per material used	Units	Nb per cycle	Unit cost	Total
Cupule	1	200	0.50	1.181
Curette	1	80	1.25	11.813
				5.906
				11.813
				1.181
				1.181
Total sterilisation per act of exploration of the uterine cavity			1.75	

Source: own elaboration.

Table 6. Cost per a sterilisation cycle and by an act of exploration with valve (EUR)

Cost by cycle	Units	Unit price	Total
Staff:			
Personnel NA:	0.5 h	10.83	5.42
Personnel nurse:	1.75 h	15.43	27.00
Personnel stretcher-bearer:	1 h	10.34	10.34
Personnel pharmacist:	0.08 h	43.55	3.63
Personnel head nurse:	0.08 h	31.56	2.63
Equipments:			
<i>Washing machine (Tunnel T 840, Hamo Steris)</i>			
Depreciation	1 cycle	19.95	19.95
Detergent	0.21 l	4.55	0.95
Lubricant	0.04 l	6.1	0.24
Electricity	9 kwh	0.05	0.45
Water	0.14 m3	4.07	0.57
Maintenance	1 cycle	9.48	9.48

Table 6 – continuation

Cost by cycle	Units	Unit price	Total	
<i>Autoclave 8 baskets (S1000, Matachana)</i>				
Depreciation	1 cycle	6.23	6.23	
Electricity	20 kwh	0.05	1	
Water	0.3 m3	4.07	1.22	
Maintenance	1 cycle	1.92	1.92	
First-desinfection realised at operating theaters (disinfectant)	1	0.15	0.15	
Dressing materials:				
Overall	1	3.46	3.46	
Forge cap	1	0.02	0.02	
Overshoes	1	0.15	0.15	
Overpants	1	3.02	3.02	
Soap	1	0.54	0.54	
Total per cycle:			98.36	
(4 items, 50 minutes for packaging)				
Cost by material used	Units	Nb per cycle	Unit cost	Total
Cupule	1	200	0.49	1.181
Curette	1	80	1.23	11.813
Valves container	1	16	6.15	5.906
Delivery container	1	16	6.15	11.813
				1.181
				1.181
Total sterilisation per an act of exploration with valve			14.02	33.075

Source: own elaboration.

Table 7. Cost per a sterilisation cycle and by an act of hysterectomy (EUR)

Cost per cycle	Units	Unit price	Total
Staff:			
Personnel NA:	0.5 h	10.83	5.42
Personnel nurse:	1.25 h	15.43	19.29
Personnel stretcher-bearer:	1 h	10.34	10.34
Personnel pharmacist:	0.08 h	43.55	3.63
Personnel head nurse:	0.08 h	31.56	2.63
Equipments:			
<i>Washing machine (Tunnel T 840, Hamo Steris)</i>			
Depreciation	1 cycle	19.95	19.95
Detergent	0.21 l	4.55	0.95

Table 7 – continuation

Cost per cycle	Units	Unit price	Total	
Lubricant	0.04 l	6.1	0.24	
Electricity	9 kwh	0.05	0.45	
Water	0.14 m3	4.07	0.57	
Maintenance	1 cycle	9.48	9.48	
<i>Autoclave 8 baskets (S1000, Matachana)</i>				
Depreciation	1 cycle	6.23	6.23	
Electricity	20 kwh	0.05	1	
Water	0.3 m3	4.07	1.22	
Maintenance	1 cycle	1.92	1.92	
First-desinfection realised at operating theaters (disinfectant)	1	0.147	0.15	
Dressing materials:				
Overall	1	3.46	3.46	
Forage cap	1	0.02	0.02	
Overshoes	1	0.15	0.15	
Overpants	1	3.02	3.02	
Soap	1	0.54	0.54	
Total per cycle:			90.64	
(6 items, 50 minutes for packaging)				
Cost per material used	Units	Nb per cycle	Unit cost	Total
Cupule (big)	1	80	1.13	1.181
Rochard's valve	2	16	5.66	11.813
Leriche's valve	1	16	5.66	5.906
Stomach container	1	8	11.33	11.813
Pozzi's crowbar	1	80	1.13	1.181
Needle case	1	80	1.13	1.181
Total sterilisation per an act of hysterectomy			31.72	33.075

Source: own elaboration.

Table 8. Cost per a sterilisation cycle and by an act of vaginal packing (or unpacking) and vascular ligation (EUR)

Cost per cycle	Units	Unit price	Total
Staff:			
Personnel NA	0.5 h	10.83	5.42
Personnel nurse:	1.5 h	15.43	23.15
Personnel stretcher-bearer:	1 h	10.34	10.34
Personnel pharmacist:	0.0833	43.55	3.63
Personnel head nurse:	0.0833	31.56	2.63

Table 8 – continuation

Cost per cycle	Units	Unit price	Total	
Equipments:				
<i>Washing machine (Tunnel T 840, Hamo Steris)</i>				
Depreciation	1 cycle	19.95	19.95	
Detergent	0.21 l	4.55	0.95	
Lubricant	0.04 l	6.1	0.24	
Electricity	9 kwh	0.05	0.45	
Water	0.14 m3	4.07	0.57	
Maintenance	1 cycle	9.48	9.48	
<i>Autoclave 8 baskets (S1000, Matachana)</i>				
Depreciation	1 cycle	6.23	6.23	
Electricity	20 kwh	0.05	1	
Water	0.3m3	4.07	1.22	
Maintenance	1 cycle	1.92	1.92	
First-disinfection realised at operating theaters (disinfectant)	1	0.15	0.15	
Dressing materials:				
Overall	1	3.46	3.46	
Forage cap	1	0.02	0.02	
Overshoes	1	0.15	0.15	
Overpants	1	3.02	3.02	
Soap	1	0.54	0.54	
Total per cycle:			94.50	
(6 items, 50 minutes for packaging)				
Cost per material used	Units	Nb per cycle	Unit cost	Total
Cupule (big)	1	80	1.18	1.181
Rochard's valve	2	16	5.91	11.813
Leriche's valve	1	16	5.91	5.906
Stomach container	1	8	11.81	11.813
Pozzi's crowbar	1	80	1.18	1.181
Needle case	1	80	1.18	1.181
Total sterilisation per an act of packing or unpacking, and vascular ligation			33.08	33.075

Source: own elaboration.

Discussion

The used methodology allowed us to determine the costs of surgical acts in postpartum haemorrhage ($n = 52$): costs are from 275.04 EUR for manual exploration of the uterus ($n = 8$), 302.48 EUR for exploration with valve ($n = 26$), 601.55 EUR for vascular ligation ($n = 3$), 725.53 EUR for packing or unpacking ($n = 10$), and up to 875.06 EUR for hysterectomy ($n = 5$) (Castiel & Bréchat, 2008). The sterilisation of medical devices used in these interventions represents a significant part of the fixed cost: 7.5% to 11.4%. This cost is doubtless under the estimated in its component “variable Costs in staff” if one takes into account the database of the said cost accounting of the “TEACHING HOSPITAL of Angers” (author MSSPS, publisher DHOS): 145 EUR against 43 EUR in table 5. This can provide some explanation, partially by the fact that the time of unloading of the sterilisers and the control of the cycles and the sterilised articles varies according to the composition of the verified load; the accounted times correspond to the time of check of a load consisting exclusively of containers (or baskets).

The embolisation act is committed for 36% of postpartum haemorrhage. It is completed by a secondary surgical act for 25% of embolisations. The cheapest act is the uterine revision. It is also the fastest one to be performed. Because surgical practice is always joint, the observed patients' size is low by surgical act (Lernout, 2007). Elements of the “Strategy of care by the invasive methods” of the text of the recommendations from 2004 can be found (d'Ercole et al., 2004; Pelage et al., 2004)]. These results can give a trend in a domain which is still little explored (Segouin & Bréchat, 2006a; Jourdain, 2000).

Even if at the moment the cost of the sterilisation of medical devices in the public institutions of health is not often valued, it must be taken into account when calculating the costs of surgical activities (Stępniewski & Michałek, 2001). In the case of the care of post-partum haemorrhage, the cost of sterilisation was calculated following the example

of other participating services (or departments) (Rossignol, 2004). It is to be taken into account for quality acts as well as by the sanitary planning (Castiel, 1997).

These results were sent to the ministerial sponsors in order to elaborate and to follow-up one or more future DRGs' “bleeding of the delivery”. In 2012, it was not found in the last textbook of DRGs, updated 1st March, 2011¹. “Pathological pregnancies, the deliveries and the affections of the postpartum” appear in the major category of diagnosis n°14. Bleedings benefit from a level of severity of 3 on the scale of 4 for “bleeding during the delivery with anomaly of the coagulation”, “Other bleedings during the delivery” and “Bleeding during the delivery, without precision”². These 3 associated comorbidities (AC) can be taken into account if none of the major diagnoses from the list of 34 occurs³. Elements of supervision can be accounted, along with an average duration of stay (high and low border). This individually complex coding makes it possible to arrive at the DRGs. Therefore, receipts for postpartum haemorrhage under care in a public hospital can benefit from DRGs at the level of 5464–3331.64 EUR (DRGs 14Z02C – “Deliveries with major complications”) or 5308–5514.51 EUR (DRGs 14C02C – “Caesareans with major complications”). If a patient does not stay for a long time, receipts will come from DRGs at the level of 5307–4627.43 EUR (DRGs 14C02B – “Caesareans with other complications”) or of DRGs at the level of 5463–2532.95 EUR (DRGs 14Z02B – “Deliveries by vaginal childbirth with other complications”). If there is a hysterectomy, it will be DRGs at the level of 5309–5602.61 EUR (DRGs 14C03Z – “Deliveries by vaginal childbirth with other interventions”). If these receipts cover

¹ V. 11 of classification, V. 13.11c of grouping function, Bulletin Officiel n°2011/5 bis.

² Last textbook of grouping function, V. 13.11c, Bulletin Officiel n°2011/5 bis.

³ The list of DRGs, excluding the major-category list.

the costs of the calculated surgical acts, several remarks can be formulated.

In spite of the request of the Ministry of Health, this research did not press on the initial objective which was the elaboration and the follow-up of one (or) future DRGs' "bleeding of the delivery" or "postpartum haemorrhage". It raises the question of the transparency of the elaboration of the health policy and its financing, but also the legitimacy of the new governance and the credibility of the T2A-EPRD (Bréchat, 2010). The complexity of coding to arrive at the DRGs also raises the question of the investment of the department and the establishment to realise this coding. Financial constraints can urge the services or departments to cheat in order to benefit from DRGs better provided in euros, taking the risk of being controlled and sanctioned. Not considering evolutions of the practices according to the evolution of the T2A also risks discouraging professionals and managers in charge from investing in innovation, as embolisation of the bleeding of the delivery.

This study is an example showing that the current reforms do not favour the quality coverage of care (Bréchat, 2008). We find one of the two evolutions of the liberal thought in the space of the law conceived of by Koubi (2008): a service (or department) regardless of the quality of the provider for the "public" care, understood as an indefinite mass, which confirms the substitution of the customer to the user of public service (see also: Stepniewski & Bugdol, 2010). These evolutions must be considered in the European context and for all public services (Allouache, 1998). Nevertheless, the reduction of maternal mortality remains a priority of the public health. This study shows that the current reforms do not favour the production of the health, but, rather, the consumption of care (Evans, 1990).

This study is also an example illustrating that a lot of progress needs to be made in France concerning the consideration of the carbon tax, which is one of stakes in the health systems of the 21st century (Gray, 2011). Efforts must be

made with regard to the purchases of equipment, and our study can contribute to it.

This set can participate in the strengthening and in the recognition of the coverage of post-partum haemorrhage as one of first causes of maternal deaths, the reduction of which is a priority of public health and a concern of the users (Bréchat, 2010; Green, 2007).

Conclusion

The costs of surgical coverage care of postpartum haemorrhage can be calculated to give marks to the piloting and to the follow-up of these activities within the framework of the implementation of the T2A-EPRD and the business parks. They can also participate in the elaboration and in the follow-up of one (or more) future DRGs' "bleeding of the delivery".

They can especially integrate those of a health course or a capitation (Bréchat, 2016) which are less counterproductive fundings "for the health of the populations" than the T2A (Batifoulouier, 2017). The systems did this perform much better than those that stayed at the T2A (Castiel & Bréchat, 2019).

This study is a contribution to managed care empowerment. Managed care helped to slow down the growth of health care expenditures. As managed care grew, health care spending declined, and as managed care declined, health care expenditures rose. The managed care leads, for example, to the evaluation of costs for surgical coverage care of postpartum haemorrhage. Policymakers at the risk of the wrath of seniors would prioritise direct care, and it would be essential to know the costs of taking care of these patients. Another way is to coordinate doctors' efforts to answer the rising demand for healthcare and for physicians; in any case, the demand for physicians is rising faster than the supply, and it is already too late to try and produce all the doctors that would otherwise be needed today. If one really thought that the solution was more medical doctors (MDs), this should have started ten years ago. And it was

not the case. Therefore, the way to fill this gap is probably going to be through nurse practitioners and physician assistants, who are a lot quicker and easier to train than MDs are. It could also be beneficial to develop prevention and health pathways. Adopted managed care is another solution for producing more care for anything under supply control. Managed care is making the market more efficient under the constraints of knowing the real costs of intervention.

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