Indicators and criteria for efficiency and quality in public hospitals: A performance evaluation model

Indicators and criteria for efficiency and quality in public hospitals: a performance evaluation model

Abstract: In many countries, the public sector is currently characterized by the need to improve its performance. The implementation of performance measurement systems is essential to generate better results, especially in the public health sector. In healthcare practice, clinical indicators are part of a performance measurement system, and are a way of assessing the quality of care by investigating the frequency of specific results. Through a clinical audit process, this study aims to define the criteria and key performance indicators for minimally invasive endovascular surgical treatment. This type of treatment is chosen because aortic pathologies are an important European issue in cardiovascular surgery. A model of criteria and indicators used in a large public Italian hospital was constructed in order to assess the level of performance achieved with this service.

Keywords: healthcare organization; evaluation model; key performance indicators; efficiency; quality improvement; performance assessment; health services; new public management; internal audit; healthcare costs.

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1 Introduction

In many countries, public organizations are characterized by the need to improve their performance. As a result, over time, many scholars have tried to develop theories and models that could help public managers to gain competitiveness, efficiency, and effectiveness. In the early 1980s, the theory of New Public Management (NPM) pushed towards the introduction and implementation of practices and tools of the private firms to increase the performance of public administrations.

Since the first appearance, one of the key principles of the NPM was the performance indicators use for assessing the production processes and

the quality of public services (Dunleavy and Hood, 1994). Measurement systems, and subsequent results evaluation, are the first steps to allow the organization to trigger improvement processes (Leblanc, 2018). "*Performance measurement*" identifies the information- and data-collection process adopted by the organizations, useful to assess aspects and activities (Maestrini et al., 2017). While "*performance evaluation*" means checking whether an action has achieved the desired effects, that is, expressing a judgment on the deviation that normally occurs between objectives and results (John and Eeckhout, 2018).

The complexity level of the activities, the constant setting change, the growing needs of citizens are just some of the main issues that afflict public organizations. Their first concern is the requirement to solve these issues in order to adopt adequate performance measurement systems. Furthermore, these issues are even more evident in the public health organizations (Rechel et al., 2018); hospitals around the world began reporting and monitoring indicator data to improve the quality of care (Chiu et al., 2007). A large number of quality indicators are defined with reference to the structure, processes and outcomes in order to guide the improvement processes of quality in health care (Linton et al., 2020). The positive impact of monitoring indicator data on the quality of care, and consequently on the patient, has been widely demonstrated in scientific studies (De Vos et al., 2009). Nevertheless, the benefits of using

performance indicators are not limited to improving the quality of care. Many authors suggest the performance measurement systems adoption in public health organizations improves accountability systems, making hospitals more transparent for internal and external stakeholders, such as physicians, nurses, patients, policy-makers, and citizens (Mullen, 2004; De Vos et al., 2009). Consequently, methodologies that make measurable the actions implemented by health professionals have become common practices in health organizations (Smith et al., 2009). However, even though the use of indicators brings benefits in terms of better performance, developing indicators and collecting data implies an important administrative burden for both hospitals and healthcare professionals. Therefore, it is necessary to make a careful evaluation of which indicators use and which implementation strategy is optimal.

The international literature in the management field recommends to better identify the so-called Key Performance Indicators (KPIs). KPIs are a limited number of measures can be representative of a complex phenomenon. KPIs depend on the nature of the activities, the type of organization and its strategy. They are especially useful to assess and measure difficult-to-quantify processes such as healthcare quality (Hani et al. 2010).

In the healthcare contexts, performance assessment is a critical issue for the identification and the development of best practices in order to

improve outcomes for patient, for this reason, KPIs are more and more incorporated into healthcare management systems. The right identification of the KPI represents one of the most important issue in the process of quality monitoring (Morris and Bailey, 2014). A single indicator is not able to grasp a very broad concept such as the quality of care which requires a multidimensional approach. Many authors have therefore suggested the development of multi-dimensional performance measurement systems, as reported in the next section of this article.

The present study, through a clinical audit process, aims to define the criteria and KPIs for minimally invasive endovascular surgical treatment. Auditing can be defined as a proactive approach for assessing weaknesses and strengths in performance and offer continuous improvement of operational activities (Fuller 1997, p. 165). For assessing the level of performance achieved in minimally invasive endovascular surgical treatment, a model composed of criteria and KPIs in a large public Italian hospital was developed.

The remainder of the paper is structured as follows. The first section deals with the topic of performance measurement in healthcare, emphasizing the need to develop a multidimensional approach. The following section focus on the invasive endovascular surgical treatment to explain the rational of the study. A specific paragraph on the objectives and sub-objectives of the research anticipates the methodology used and

the results obtained. The paper ends with the conclusion and future directions.

2 Performance measurement system in the public health sector

As mentioned in the first section, NPM takes inspiration from the private sector to introduce explicit measures of performance in public organizations, shifting the focus on outputs rather than input and bureaucratic rules.

However, the adoption of business logics in the public sector is not simple. McNulty and Ferlie (2002) studying the introduction of a business process re-engineering in British hospitals, were skeptical about the benefit of this private practice for public organizations if not properly implemented. Other studies are in accordance with this theory (Williams et al., 1993; Ferlie and Steane, 2002). Consequently, even if performance measurement is universally recognized as an indispensable aspect for improving the quality of public services, the problem is how the assessment process, certainly complex, should be managed. The implementation of effective performance measurement systems becomes an important managerial challenge for public organizations. Setting goals, allocating resources, defining indicators, assigning responsibilities, implementing information system, as well as building a reward system are

some of the aspects should be taken into account. According to Moullin (2017), the main characteristics of a performance measurement system are: i) balanced set of indicators; ii) indicators consistent with the decision makers needs; iii) improved staff involvement; iv) definition of measure and indicators; v) definition of outcome and process measures; vi) affordable prices; vii) definition of organizational strategy; viii) focus on continuous improvement.

The issue of the performance multidimensionality is no less problematic. Since the 90s, it has been recognized that organizational success is a multi-dimensional concept and, thus, the different performance aspects should be monitored (Emmanuel et al. 1990; Exposito and Sanchis-Llopis, 2018). In addition, key performance aspects need to be monitored over time and from one organization to another, as different stakeholders pay attention to different performance aspects as well. To give an idea, in the health sector patients are naturally more interested in clinical outcomes, while clinical staff deepens the process of care (e.g. waiting times, service delivery process) and administrative staff prefers to control the trend of the outputs measures (e.g. bed occupancy, costs for the length of stay). For the achievement of acceptable levels of performance in each abovementioned aspects, it is necessary to manage all organizational activities. To overcome the rising dissatisfaction of traditional performance measurement systems, several approaches to

assess multi-dimensional performance measures have been developed. The most used are: the performance measurement matrix (Keegan et al., 1989); the performance pyramid system (Lynch and Cross, 1991), the balanced scorecard (Kaplan and Norton, 1992); the performance prism (Neely et al., 2002). All these frameworks recognize performance as a multi-dimensional concept. Moreover, Braithwaite et al. (2017) identify the three main dimensions of a healthcare organization's performance, which are: efficiency, patient safety, and quality of care. This latter is considered the most important for hospitals (Burstin et al. 2016); as a result, a performance measurement system should be focused on the quality of care measures.

Brown (1996) classifies the performance creation process into four phases: input, process, output, and outcome. Inputs concern the available resources. Process concerns how resources are used. Results of the process identify the outputs, and the way the results are satisfactory expresses the outcomes. These phases are sequentially and by cause-effect relationships interconnected: how a first phase is carried out has an impact on the next phase and so on. Brown's performance approach can also be easily applied to the identification of the hospital care quality (Schreyer, 2012) and for each phase it is possible to identify indicators of efficiency and effectiveness.

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This study identifies criteria and KPIs in order to measure efficiency and effectiveness for each phase of minimally invasive endovascular surgical treatment. Findings can be useful for healthcare professionals and managers to improve quality of care and performance.

3 Scientific rationale

Healthcare management tries to categorize correct KPIs which provide practical and valuable information regarding a range of activities. These indicators are essential for any medical and scientific audit procedure.

This study uses criteria and KPIs for minimally invasive endovascular surgical treatment. The treatment was selected for our research because aortic pathologies are one of the most widespread diseases of the cardiovascular system in EU (ESC, 2014; ISTAT, 2017; Pratesi et al., 2016; Speziali et al., 2015). In Italy, where this study was carried out, the Society of Vascular and Endovascular Surgery reports about 84,000 people suffering from abdominal aortic aneurysms and 27,000 cases are added each year (Pratesi et al., 2016; Speziali et al., 2015). Replace an aneurysm can be carried out in two ways: traditional surgery (open repair) or using an endovascular prosthesis with a minimally invasive procedure.

'EndoVascular Abdominal Aortic Repair' (EVAR) and 'Thoracic Endovascular Aortic Repair' (TEVAR) are procedures to substitute

traditional surgery, and decrease surgical and post-surgical risks (Wadhwani et al., 2018).

Among various scientific articles, Powell et al., (2017) have shown how minimally invasive cardio-surgical treatment is related with a 66.7% decrease in perioperative mortality, complication rate and hospitalizations compared to traditional medical procedure.

Recently, technical progress, screening programs and recommendations for minimally invasive surgery, have led to an increased economic burden on the healthcare system due to an increase in cardio-surgical procedures (ESC, 2014; Pratesi et al., 2016; Speziali et al., 2015).

In the Italian context, the use of abdominal thoracic aorta prostheses (ICD9-CM: 39.71, 39.73, 39.79) increased in 2017 compared to 2016. Cost monitoring reveals an augment in vascular prosthesis procedures causing a 10% raise in costs and 75% raise in budget compared to 2016. This increase is partly explained by the use of a custom-made system which is less cheap than the standard. Moreover, for custom-made systems, the prices of medical devices are higher than the Diagnosis-Related Group tariff rate which applies to all hospitalization costs. In the light of the increases in activity and price of surgical devices, a clinical audit was planned to collect more data.

4 Aims of the study

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In order to evaluate if the recommendation for minimally invasive endovascular surgical treatment was appropriate in the hospital context, a model based on criteria and KPIs was identified.

The principal aim was split into three sub-aims:

1. Identify in the literature appropriate guidelines for the treatment of abdominal and thoracic aortic aneurysm;
2. Verify whether the indication for minimally invasive treatment by EVAR and TEVAR is evidence-based;
3. Appraise the performance of minimally invasive treatments EVAR and TEVAR.

Findings should be useful to steer professionals in prescribing the best patient care, causing a positive effect both for patients with regard to quality of care and for the healthcare organization with regard to funds.

5 Methodology

5.1 Study plan

Two main steps characterized the methodology.

In the first step a Systematic Literature Review (SLR) was performed. National and international guidelines were recognized with the PubMed search engine. The keywords: ‘Abdominal Aortic Aneurysm’, ‘Thoracic Aortic Aneurysm’, ‘Endovascular Aortic / Aneurysm Repair’; ‘Thoracic

Endovascular Aortic / Aneurysm' and limits constraints of language (English and Italian), document type (practice guidelines), publication year (last 3 years) and object of the study (humans) were used as inclusion criteria. Later, the guidelines were assessed taking into account the criteria defined by Grilli et al., (2000). After the evaluation process carried out by health professionals, the '*Guidelines on the diagnosis and treatment of aortic diseases of the European Society of Cardiology*' (ESC, 2014) was evaluated as the best protocol. In addition, to ensure pertinence in the Italian health system '*Patologia aneurismatica dell'aorta infrarenale, aneurismi viscerali e aneurismi periferici*' (Pratesi et al., 2016) and '*Trattamento delle patologie dell'aorta toracica e toraco-addominale*' (Speziali et al., 2015) guidelines were also taken into account.

In the second step, the criteria and indicators selected in the SLR were used on a sample identified considering diverse open-access health sources accessible in the health system.

STATA statistical software version 14.0 was used to record and process data.

5.2 Population

Surgery registry, medical device registry (GE4) and medical records were the sources used to collect data.

The inclusion criteria for the sample selection were as follows:

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- Adults with a suggestion for elective or urgent surgical treatment;
- Patients undergoing an endovascular graft implant operation (ICD9-CM: 39.71, 39.73, 39.79), classified by aneurysm size, type of graft and surgical unit.

Considering a 90% confidence interval with a margin of error of ± 10% the sample was identified. 53 out of 160 patients were considered eligible. The global prevalence of aortic aneurysm in screened populations has ranged largely from 1.1 to 5.2% (Ashton et al., 2002; Stather et al., 2014; Darwood et al., 2012(a); Darwood et al., 2012(b); Svensjö et al., 2011; Benson et al., 2016; Grøndal et al., 2015; Wanhainen et al., 2016). In Italy the prevalence is higher than the average values and is around 9% (Rahimi, 2019). Thus, the magnitude of the sample has valid statistical numerosity, and the results are generalizable.

6 Results and Discussion

6.1 Sub-objective 1: Criteria and key performance indicators

In order to achieve the first sub-aim, an SLR was performed. In terms of evidence-based recommendations, 9 criteria, of which 5 connected to the abdominal area and 4 to the thoracic area were identified in Table 1.

Table 1. Criteria for evaluating the indication for the minimally invasive EVAR and TEVAR

ABDOMINAL AREA - EVAR

Title

Criterion 1: Patients enrolled for Abdominal Aortic Aneurysm (AAA) treatment with favorable anatomy and a High Surgical Risk (HSR) due to perioperative complications undergo EVAR surgery (ESC, 2014; Pratesi et al., 2016).	(No. of patients with indication for AAA surgery, HSR and favorable anatomy) / (No. of patients undergoing EVAR surgery with indication for AAA, HSR and favorable anatomy)
Criterion 2: Patients enrolled for AAA treatment with favorable anatomy and a medium or low risk due to perioperative complications undergo EVAR or OPEN surgery (ESC, 2014; Pratesi et al., 2016).	(No. of patients with indication for AAA surgery, medium or low surgical risk and favorable anatomy) / (No. of patients undergoing EVAR surgery with indication for AAA, medium or low surgical risk and favorable anatomy)
Criterion 3: Patients enrolled for AAA treatment with NO favorable anatomy for EVAR undergo OPEN surgery. If the risk of perioperative complications is high, medical therapy is indicated (ESC, 2014; Pratesi et al., 2016).	(No. of patients with indication for AAA surgery and NO favorable anatomy for EVAR) / (No. of patients undergoing EVAR surgery with indication for AAA)
Criterion 4: Patients enrolled for broken or symptomatic AAA with favorable anatomy undergo EVAR surgery if the risk of perioperative complications is high and the structure is adequate (min 50 surgery per year) (ESC, 2014; Pratesi et al., 2016).	(No. of patients with indication for broken or symptomatic AAA, HSR and favorable anatomy) / (No. of patients undergoing EVAR surgery with indication for broken or symptomatic AAA and HSR)
Criterion 5: Patients enrolled for broken or symptomatic AAA with NO favorable anatomy for EVAR undergo OPEN surgery (ESC, 2014; Pratesi et al., 2016).	(No. of patients with indication for broken or symptomatic AAA and No favorable anatomy for EVAR) / (No. of patients undergoing EVAR surgery with indication for broken or symptomatic AAA)
THORACIC AREA - TEVAR	
Criterion 6: Patients with chronic dissection associated with connective tissue disorders, aneurysm > 5.5cm and without severe comorbidity undergo OPEN surgery (ESC, 2014; Speziali et al., 2015).	(No. of patients with indication for Abdominal Thoracic Aorta Aneurysm (ATA), aneurysm > 5.5cm and without severe comorbidity) / (No. of patients undergoing TEVAR surgery with indication for ATA)
Criterion 7: Patients with ATA associated with connective tissue disorders and aneurysm > 6cm or less if associated with Marfan or LoyezDietz pathology are subjected to OPEN surgery (ESC, 2014; Speziali et al., 2015).	(No. of patients with indication for ATA associated with connective tissue disorders and aneurysm > 6cm or less if associated with Marfan or LoyezDietz pathology) / (No. of patients undergoing TEVAR surgery with indication for ATA)
Criterion 8: Patients with ATA associated with connective tissue disorders and aneurysm > 6cm or	(No. of patients with a high perioperative risk and indication for ATA associated with connective tissue disorders and aneurysm >

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less if associated with Marfan or LoyezDietz pathology, are subjected to TEVAR surgery if there is a high perioperative risk (ESC, 2014; Speziali et al., 2015).	6cm or less if associated with Marfan or LoyezDietz pathology) / (No. of patients undergoing TEVAR surgery with HSR and indication for ATA)
Criterion 9: Patients with an abdominal or traumatic thoracic aortic aneurysm, saccular aneurysms, or post-operative pseudoaneurysms are subjected to TEVAR surgery (ESC, 2014; Speziali et al., 2015).	(No. of patients with indication for ATA associated with traumatic or aneurysm > 6cm or saccular aneurysms, or post-operative pseudoaneurysms) / (No. of patients undergoing TEVAR surgery with indication for ATA)

As for the KPIs to evaluate the performance of minimally invasive EVAR and TEVAR, the following five indicators were identified:

1. Intraoperative mortality: (No. of patients who died during EVAR or TEVAR) / (No. of patients with indication for EVAR or TEVAR);
2. Average duration of hospitalization (days);
3. Average duration of surgery (minutes): End - Start operation;
4. Type of anesthesia (general or local): (No. of patients with indication for EVAR or TEVAR procedure under general or local anesthesia) / (No. of patients with indication for EVAR or TEVAR);
5. Average of stay duration in intensive care unit (days).

6.2 Sub-objective 2: Criteria for EVAR and TEVAR procedures

A sample of 53 eligible patients was identified using the inclusion criteria. The patients undergoing minimally invasive EVAR comprised 51% (96% male, 4% female). Seventy-seven per cent of participants were

in the age group 60-79 years. The size of the aneurysm was ≥ 5cm in 78% of cases, of which 71% of participants (age group 60-79 years) were male. As for TEVAR, 47% of patients underwent treatment. Males comprised a total of 72%, in age groups 40-59 years (28%) and 60-79 years (44%).

To achieve sub-aim 2, criteria reported in Table 1 were used. The results classified by abdominal and thoracic area are shown below.

Abdominal area

Criterion 1: 60% of patients with favourable anatomy and HSR, underwent EVAR. The residual 40% did not meet the criteria for EVAR, as in two cases it was not possible to find data and in two other cases the CT Angiography (CTangio) was not favourable to the surgical intervention.

Criterion 2: 100% of patients with favourable anatomy and medium-low surgical risk underwent EVAR.

Criterion 3: 8% of patients with no favourable anatomy and HSR underwent EVAR.

Criterion 4: 100% of patients with aneurysm of the broken or symptomatic abdominal aorta, favourable anatomy and HSR underwent EVAR.

Criterion 5: No patient with aneurysm of the broken or symptomatic abdominal aorta, no favourable anatomy and HSR underwent EVAR.

Thoracic area

Criterion 6: No patient with chronic dissection associated with connective tissue disorders, aneurysm > 5.5 cm, no severe comorbidity and no favourable anatomy, underwent TEVAR.

Criterion 7: No patient with ATA associated with connective tissue disorders and aneurysm > 6 cm or less if associated with Marfan or LoyezDietz pathology, underwent TEVAR.

Criterion 8: All patients with ATA associated with connective tissue disorders and aneurysm > 6 cm or less if associated with Marfan or LoyezDietz pathology and HSR, underwent TEVAR.

Criterion 9: 80% of patients with saccular aneurysms, or post-operative pseudoaneurysms underwent TEVAR.

6.3 Sub-objective 3: Performance evaluation of minimally invasive EVAR and TEVAR procedures

The following tables show the KPIs results and present the discussion of them.

Indicator 1 reveals that intraoperative mortality was 0%.

Indicator 2 shows the average duration of hospitalization. The DH-average in days was 8 [3-19] in EVAR, and 11 [4-25] in TEVAR. The overall result of both procedures was 9 days [3-25] (Table 2).

Table 2. DH-average classified into surgery, graft type and operating unit

ICD9-CM CLASSIFICATION	GRAFT TYPE *	Cardiac Surgery Unit				Vascular surgery Unit				TOTAL			
		n	DH-average	Max	Min	n	DH-average	Max	Min	n	DH-average	Max	Min
39.71	CMD	1	9	9	9					1	9	9	9
	CMD+STD					2	12	12	11	2	12	12	11
	STD	1	6	6	6	23	7	19	3	24	7	19	3
		2	8	9	6	25	8	19	3	27	8	19	3
39.73	CMD	1	4	4	4					1	4	4	4
	CMD+STD	1	7	7	7	3	19	25	9	4	16	25	7
	STD	16	11	21	6	4	11	23	5	20	11	23	5
		18	10	21	4	7	14	25	5	25	11	25	4
39.79	STD					1	10	10	10	1	10	10	10
						1	10	10	10	1	10	10	10
	TOTAL	20	10	21	4	33	9	25	3	53	9	25	3

** CMD: Custom made, CMD+STD: Custom Made + Standard, STD: Standard*

The DSI-average in minutes was 03:31 [01:45-07:05] in for EVAR, and 03:32 [01:40-06:40] in TEVAR. The overall result of both procedures was 03:30 [01:40-07:05] (Table 3).

Table 3. DSI-average classified into surgery, graft type and operating unit

ICD9-CM CLASSIFICATION	GRAFT TYPE *	Cardiac Surgery Unit				Vascular surgery Unit				TOTAL			
		n	DSI average	Max	Min	n	DSI average	Max	Min	N	DSI average	Max	Min
39.71	CMD	1	03:00	03:00	03:00					1	03:00	03:00	03:00
	CMD+STD					2	0	06:35	06:35	2	06:35	06:35	06:35
	STD	1	03:20	03:20	03:20	23	0	07:05	01:45	24	03:24	07:05	01:45
		2	03:10	03:20	03:00	25	03:33	07:05	01:45	27	03:31	07:05	01:45
39.73	CMD	1	02:25	02:25	02:25					1	02:25	02:25	02:25
	CMD+STD	1	05:10	05:10	05:10	3	0	06:05	03:26	4	04:47	06:05	03:26
	STD	16	03:25	06:05	01:45	4	0	06:40	01:40	20	03:20	06:40	01:40
		18	03:27	06:05	01:45	7	0	06:40	01:40	25	03:32	06:40	01:40
39.79	STD					1	0	02:40	02:40	1	02:40	02:40	02:40
						1	0	02:40	02:40	1	02:40	02:40	02:40
	TOTALE	20	03:25	06:05	01:45	33	0	07:05	01:40	53	03:30	07:05	01:40

* CMD: Custom made, CMD+STD: Custom Made + Standard, STD: Standard

EVAR used local anesthesia at 92% of times and TEVAR used local anesthesia at 0% of times, and the procedures used general anesthesia 33% and 67% of times respectively. The overall result of both procedures was

23% in the case of local anesthesia and 68% in general anesthesia. This information was missing for 33% cases in EVAR and for 20% cases in the TEVAR. Overall missing data was 9% (Table 4).

Table 4. Type of anesthesia classified into surgery, graft type and operating unit

ICD9-CM CLASSIFICATION	GRAFT TYPE *	Cardiac Surgery Unit						Vascular surgery Unit						TOTAL	
		General		Local		n.a		General		Local		n.a		n	%
		n	%	n	%	n	%	n	%	n	%	n	%		
39.71	CMD		0,00%			1	1,90%		0,00%		0,00%		0,00%	1	1,90%
	CMD+STD		0,00%				0,00%	1	1,90%		0,00%	1	1,90%	2	3,80%
	STD	1	1,90%				0,00%	10	18,90%	11	20,80%	2	3,80%	24	45,30%
		1	1,90%	0	0,00%	1	1,90%	11	20,80%	11	20,80%	3	5,70%	27	50,90%
39.73	CMD	1	1,90%				0,00%		0,00%		0,00%		0,00%	1	1,90%
	CMD+STD	1	1,90%				0,00%	3	5,70%		0,00%		0,00%	4	7,50%
	STD	15	28,30%			1	1,90%	4	7,50%		0,00%		0,00%	20	37,70%
		17	32,10%	0	0,00%	1	1,90%	7	13,20%		0,00%		0,00%	25	47,20%
39.79	STD		0,00%				0,00%		0,00%	1	1,90%		0,00%	1	1,90%
			0,00%	0	0,00%		0,00%		0,00%	1	1,90%		0,00%	1	1,90%
	TOTAL	18	34,00%	0	0,00%	2	3,80%	18	34,00%	12	22,60%	3	5,70%	53	100%

** CMD: Custom made, CMD+STD: Custom Made + Standard, STD: Standard*

The last indicator showed no differences. Indeed, DICU-average was 1 day [0-4] for both procedures and no substantial differences in the type of EVAR or TEVAR procedure were identified (Table 5).

Table 5. DICU-average classified into surgery, graft type and operating unit

ICD9-CM CLASSIFICATION	GRAFT TYPE *	Cardiac Surgery Unit				Vascular surgery Unit				TOTAL			
		n	DICU-average	Max	Min	n	DICU-average	Max	Min	n	DICU-average	Max	Min
39.71	CMD	1	1	1	1					1	1	1	1
	CMD+STD					2	4	4	3	2	4	4	3
	STD	1	1	1	1	23	0	2	0	24	0	2	0
		2	1	1	1	25	1	4	0	27	1	4	0
39.73	CMD	1	1	1	1					1	1	1	1
	CMD+STD	1	1	1	1	3	2	3	1	4	2	3	1
	STD	16	1	3	1	4	2	2	1	20	1	3	1
		18	1	3	1	7	2	3	1	25	1	3	1
39.79	STD					1	0	0	0	1	0	0	0
						1	0	0	0	1	0	0	0
	TOTAL	20	1	3	1	33	1	4	0	53	1	4	0

* CMD: Custom made, CMD+STD: Custom Made + Standard, STD: Standard

These results made it possible to evaluate the percentage using ICU. In particular, access to ICU after surgical intervention was 66% procedures in total; 19% and 47% respectively for EVAR and TEVAR procedures (Table 6).

Table 6. ICU using after surgical intervention classified into surgery, graft type and operating unit

ICD9-CM CLASSIFICATION	GRAFT TYPE *	ICU using (NO)	ICU using (YES)	TOTAL
39.71	CMD	0%	2%	2%
	CMD+STD	0%	4%	4%
	STD	32%	13%	45%
		32%	19%	51%
39.73	CMD	0%	2%	2%
	CMD+STD	0%	8%	8%
	STD	0%	38%	38%
		0%	47%	47%
39.79	STD	2%	0%	2%
		2%	0%	2%
	TOTAL	34%	66%	100%

* CMD: Custom made, CMD+STD: Custom Made + Standard, STD: Standard

Brown et al. (2012) and Rayner et al. (2020) state that a minimally invasive procedure compared to the open repair solution, demonstrates a decrease in hospitalization duration, medical procedure duration, ICU hospitalization as well as full exclusion of intraoperative mortality. Our study confirms these findings. The benefits need to be measured in terms of life expectancy, quality of life and complications, although they may appear in the short-term. In fact, a lengthy time period is required in order to assess the effectiveness of surgical repair of an aneurysm and whether it prevents following access to the emergency room and/or hospitalization.

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7. Conclusions

Public organizations are constantly aiming at higher levels of efficiency and quality of services provided. This reflects two issues currently affecting most developed countries: on the one hand, citizen demands and requirements for qualitatively and quantitatively better services; and on the other, cuts in public funding. These two issues mean that the use of available resources has to be optimized in order to provide services capable of effectively responding to the needs of society. The introduction of indicators and performance measurement systems can help public organizations to achieve this goal (Rouag and Stejskal, 2017). Because they are extremely complex, this is particularly true for healthcare organizations (Fanelli et al., 2017).

A development of indicators for health system, patient care as well as specific illnesses, is a result of a better knowledge of organizational and safety issues. Nowadays, these indicators are gathered by managerial health division, and an audit process is often built up to extend a range of measures (Doktorchik, et al., 2020).

The process of upgrading needs permanent checks so that healthcare can be assessed (Alexey et al., 2019). This study provides insights for public health organizations by developing and implementing effective performance measurement systems in order to improve the quality of care.

Title

We opted to investigate minimally invasive endovascular surgical procedures because they illustrate how complex the performance process is for healthcare entities in terms of economic burden and quality of results.

The present findings and its benefits for both patient and health care organizations, may provide a basis for the informed choice and proper use of minimally invasive treatment.

Principal strengths and weaknesses of the study are as follows:

- The characteristics of patients undergoing a minimally invasive surgical procedure reflect most of the findings of the literature reviewed (Brown et al., 2012; Corio et al., 2013; Cheng et al., 2010; Patel et al., 2018). An indication for minimally invasive procedure is that it is appropriate for older patients in poor health and with an aneurysm larger than 5 cm. In our sample there is a prevalence of males in the age group 60-79 years for EVAR and in the age groups 40-59 and 60-79 years for TEVAR. Patients undergoing both procedures suffer severe co-morbidities in 87% of cases.

- The positive outcomes of the minimally invasive treatment quantified in terms of costs, generate huge savings for the National Health Service. These could be invested in prevention campaigns aimed at reducing the rate of cardiovascular disease.

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- The indicators for measuring the performance of minimally invasive procedures may be useful for professionals as a baseline for the creation of a domestic register in order to monitor process and outcomes over time.

Our findings show in fact that continuous monitoring and recording in a domestic database would be extremely useful.

The rate of patient surgical risk represents a piece of crucial information for correctly recommend minimally invasive treatment. The absence of a score as a reference index makes it difficult to collect information. It would be useful to use a single score for the surgical risk assessment and, for this purpose, the EuroScore tool could be considered. To date, however, academic literature notes that this tool is rarely used in the field of clinical care (Patel et al., 2018; Corio et al., 2013).

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