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## SCIENTIFIC ARTICLE

# Indication of preoperative tests according to clinical criteria: need for supervision

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### KEYWORDS

Medical examinations;  
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### Abstract

**Background and objectives:** The indiscriminate order for additional tests on pre-anesthetic evaluation is common in clinical practice, which entails additional costs and the possibility of false-positive results. The aim of this study was to analyze whether preoperative tests in elective surgeries are ordered according to clinical criteria and assess the unnecessary costs for the institution.

**Methods:** Evaluation of preoperative investigations in adult patients undergoing elective non-cardiac surgery. Tests were ordered by surgeons according to the Anesthesia Service protocol. Demographic data, physical status, comorbidities, and type of ordered supplementary examination were evaluated. The tests performed were compared with the indicated tests. The cost of screening was based on Datasus' table.

**Results:** 1063 patients were evaluated. It was found that 41.9% of the tests performed on patients classified as ASA-I were not indicated. In ASA II group, 442 tests (17.72%) were made unnecessarily. The ordered percentages of blood count, creatinine, coagulation profile, chest X-ray, and ECG were high in groups ASA I–II. Only 40 (5.25%) of the examinations made in ASA III group were not indicated. In ASA IV group, 22.5% of the required tests were not performed. We highlight an annual saving of 13% (R\$ 1923.13) if tests were done according to the protocol.

**Conclusions:** Preoperative tests are not always ordered according to clinical criteria, which results in higher costs for the institution.

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## Introduction

Preoperative evaluation is the fundamental basis for managing surgical patient and it may reduce risks and contribute to a better surgical outcome.<sup>1</sup> In this context, we highlight the clinical history and physical examination, which in most cases are responsible for disease diagnosis.<sup>2</sup>

The selection of preoperative laboratory tests (specific or imaging tests) should be performed as a complementary measure to the clinical suspicion. The indiscriminate and routine testing is unnecessary and involves, besides the additional cost for the institution,<sup>3</sup> the possibility of false-positive results,<sup>4</sup> with more or less serious consequences for patients.

This research was conducted with the aim of analyzing whether preoperative tests in elective surgeries are ordered according to clinical criteria and evaluate the costs of these so-called "routine" tests for the institution.

## Methods

After approval by the Human Research Ethics Committee, under the number 1059/2009/SC, and obtaining the written informed consent, the preoperative tests ordered for adult patients undergoing non-cardiac elective surgery were prospectively evaluated over a period of one year. The institution routine prescribes the preoperative examinations ordered by surgeons, according to the protocol given by the Anesthesiology Service. In the pre-anesthetic evaluation (PAE), anesthesiologists completed for this research a specific form that included patient demographics, physical status, existing comorbidity, and type of supplementary examination ordered by the surgeon. The tests (ordered by the surgeon) were compared with tests indicated according to the institution protocol.

The costs for each exam were based on the unified table of Datasus. Results are expressed as absolute frequency (relative frequency or percentage).

## Results

A total of 1063 patients were evaluated, whose demographics and physical condition according to the American Society of Anesthesiologists (ASA) are shown in Table 1. Among patients, there was a higher prevalence of females, aged between 41 and 65 years, Caucasian, and ASA I–II.

Table 2 shows the protocol for ordering preoperative tests established by the anesthesiology team of the institution, according to the ASA physical status, comorbidities and type of surgery to be performed.

The correlation of ASA physical status classification with the exams is shown in Fig. 1. The high percentages of complete blood count, creatinine, coagulation profile, chest X-rays, and ECG ordered in patients ASA I–II draw attention.

Fig. 2 shows the type of preoperative examination ordered according to age. The emphasis is on the high percentage of exams ordered in patients up to 40 years.

The type of preoperative examination ordered according to the number of comorbid conditions is shown in Fig. 3. Even in patients without comorbidity, additional tests were widely ordered.

**Table 1** Demographics and ASA physical status.

	n (%)
<b>Sex</b>	
Male	387 (36.4)
Female	647 (60.9)
Not registered	29 (2.7)
<b>Age (years)</b>	
18-40	355 (33.4)
41-65	429 (40.3)
Over 65	117 (11.0)
Not registered	162 (15.3)
<b>Ethnicity</b>	
White	916 (86.2)
Black	37 (3.5)
Yellow	16 (1.5)
Mixed	25 (2.4)
Not registered	69 (6.4)
<b>ASA</b>	
I–II	842 (79.2)
III	152 (14.3)
IV	13 (1.2)
Not registered	56 (5.3)

Fig. 4 shows the ordering of preoperative tests according to age and comorbidities. In general, it can be seen that the ordering pattern is repeated, even when young and healthy patients are compared to patients over 40 years of age with or without comorbid conditions.

Realization and indication of complementary tests were compared according to the institution protocol. Costs and number of tests performed and indicated in the PAE were compared (Tables 3–6). It was found that 41.9% of tests performed in patients classified as ASA I were not indicated (Table 3). In patients classified as ASA II, 442 tests (17.72%) were made without necessity (Table 4). Regarding patients classified as ASA III, only 40 (5.25%) of the performed tests were not indicated by the protocol. However, in patients classified as ASA IV, there were fewer ordered tests than recommended and 16 (22.5%) required tests were not made (Table 4).

Table 7 shows the total cost of the performed tests compared to the total cost of the indicated tests, regarding patients in general. We emphasize an annual savings of 13% if the tests were done according to the protocol established by the institution.

## Discussion

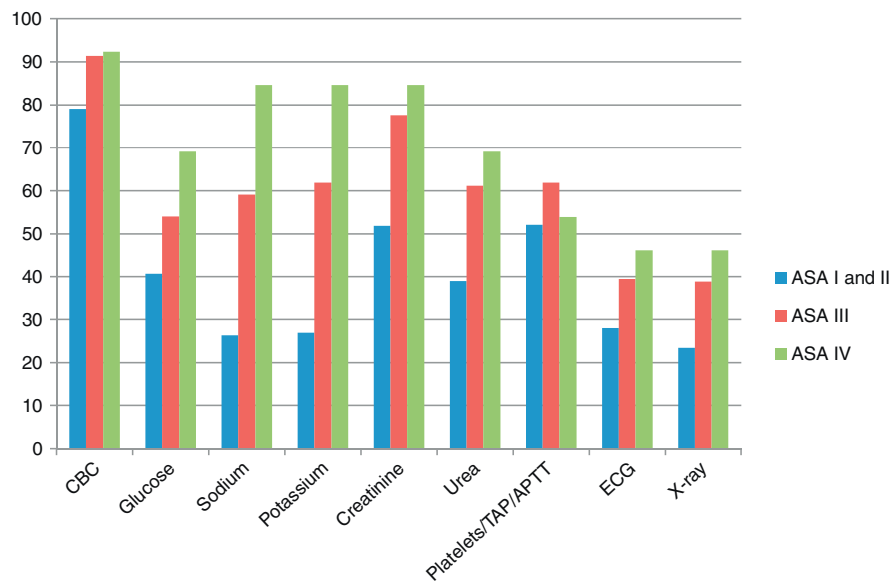
In this study, the outstanding fact is that the preoperative laboratory tests ordered by the surgeon did not follow the protocol recommended by the department of anesthesiology; that is, the ordering does not meet the clinical criteria and, therefore, the cost of these tests is 13% higher for the institution.

Considered as a complementary part of the pre-anesthetic evaluation, preoperative tests confirm and document conditions that may affect the course of anesthesia and postoperative period.<sup>4-7</sup> Thus, anesthesiologists

**Table 2** Protocol of the institution for ordering preoperative tests.

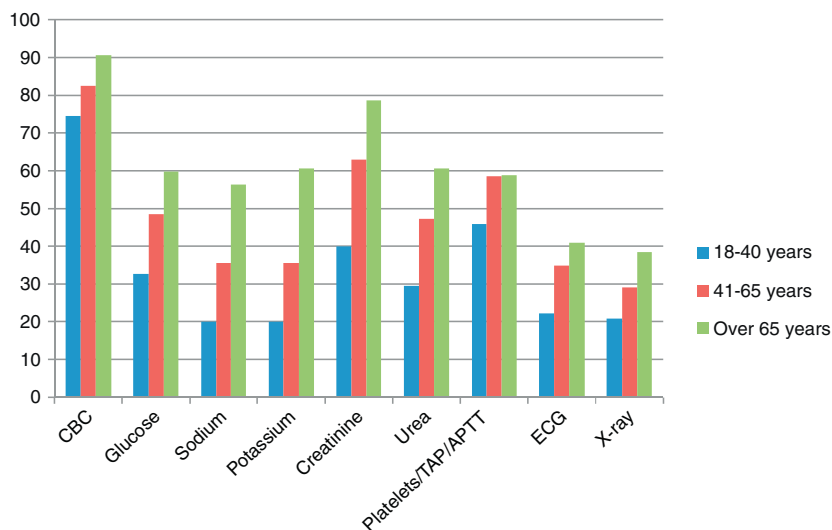
	Hematocrit	Platelets/TAP/APTT	Glucose	Creatinine	Electrolytes	Chest X-rays	ECG
[1]	×						
[2]	×	×					
[3]	×						×
[4]	×	×					×
[5]	×		×	×	×	×	×
[6]	×					×	×
[7]	×	×		×			×
[8]	×		×	×		×	×

- [1], Patient ASA I, <40 years, surgery without loss.
- [2], Patient ASA I, <40 years, surgery with loss and/or bleeding disorder.
- [3], Patient ASA I or II, >40 years, surgery without loss.
- [4], Patient ASA I or II, >40 years, surgery with loss and/or bleeding disorder.
- [5], Heart disease and/or diabetes and/or nephropathy.
- [6], Pulmonary disorder.
- [7], Liver disorder.
- [8], Age >60 years.



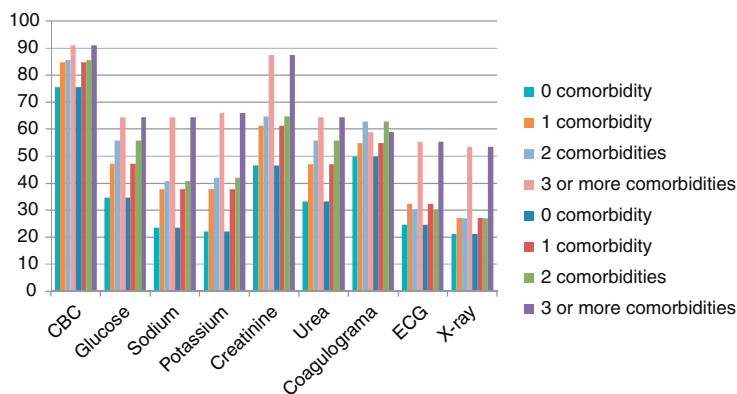
	CBC	Glucose	Sodium	Potassium	Creatinine	Urea	Platelets/TAP/APTT	ECG	X-ray
ASA I and II	78.979	40.618	26.316	26.96	51.9	38.955	52.138	28.029	23.397
ASA III	91.447	53.947	59.211	61.842	77.632	61.184	61.842	39.474	38.816
ASA IV	92.308	69.231	84.615	84.615	84.615	69.231	53.846	46.154	46.154

**Figure 1** Preoperative tests ordered according to the ASA physical status classification.



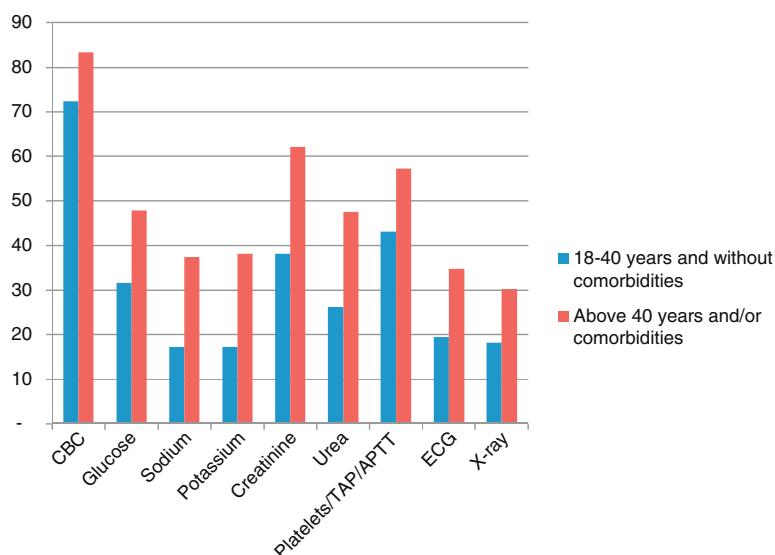
	CBC	Glucose	Sodium	Potassium	Creatinine	Urea	Platelets/TAP/APTT	ECG	X-ray
18-40 years	74.648	32.676	20	20	40	29.577	45.915	22.254	20.845
41-65 years	82.517	48.485	35.664	35.664	62.937	47.319	58.508	34.965	29.138
Over 65 years	90.598	59.829	56.41	60.684	78.632	60.684	58.974	41.026	38.462

Figure 2 Preoperative tests ordered according to age.



	CBC	Glucose	Sodium	Potassium	Creatinine	Urea	Coagulation	ECG	X-ray
0 comorbidity	75.468	34.644	23.408	22.034	46.442	33.146	49.813	24.719	21.161
1 comorbidity	84.756	47.256	37.805	37.805	61.28	46.951	54.878	32.317	27.134
2 comorbidity	85.517	55.862	40.69	42.069	64.828	55.862	62.759	30.345	26.897
3 or more comorbidities	91.071	64.286	64.286	66.071	87.5	64.286	58.929	55.357	53.571

Figure 3 Preoperative tests ordered according to the number of comorbidities.



	18-40 years and without comorbidities	Above 40 years and/or comorbidities
CBC	72	83.3
Glucose	32	47.9
Sodium	17	37.4
Potassium	17	38.1
Creatinine	38	62.2
Urea	26	47.6
Platelets/TAP/APTT	43	57.2
ECG	19	34.7
X-ray	18	30.2

**Figure 4** Preoperative tests ordered according to age and number of comorbidities.

**Table 3** Comparison between quantity and cost of tests ordered and recommended by the institution's protocol for patients classified as ASA I.

ASA I = 249	Unit cost	Performed test		Indicated test		Total saved	
		<i>n</i>	Total cost	<i>n</i>	Total cost	<i>n</i>	Total cost
Hematocrit	R\$ 4.11	186	R\$ 764.46	249	R\$ 1023.39	-63	-R\$ 258.93
Urea	R\$ 1.85	104	R\$ 192.40	43	R\$ 79.55	61	R\$ 112.85
Creatinine	R\$ 1.85	99	R\$ 183.15	43	R\$ 79.55	56	R\$ 103.60
Glucose	R\$ 1.85	54	R\$ 99.90	14	R\$ 25.90	40	R\$ 74.00
Sodium	R\$ 1.85	14	R\$ 25.90	40	R\$ 74.00	-26	-R\$ 48.10
Potassium	R\$ 1.85	116	R\$ 214.60	40	R\$ 74.00	76	R\$ 140.60
TAP	R\$ 2.73	126	R\$ 343.98	1	R\$ 2.73	125	R\$ 341.25
TTPA	R\$ 5.77	91	R\$ 525.07	1	R\$ 5.77	90	R\$ 519.30
ECG	R\$ 5.15	68	R\$ 350.20	71	R\$ 365.65	-3	-R\$ 15.45
Chest X-rays	R\$ 9.50	25	R\$ 237.50	11	R\$ 104.50	14	R\$ 133.00
Total		883	R\$ 2937.16	513	R\$ 1835.04	370	R\$ 1102.12

**Table 4** Comparison between quantity and cost of tests ordered and recommended by the institution's protocol for patients classified as ASA II.

ASA II = 591	Unit cost	Performed test		Indicated test		Total saved	
		<i>n</i>	Total cost	<i>n</i>	Total cost	<i>n</i>	Total cost
Hematocrit	R\$ 4.11	481	R\$ 1976.91	591	R\$ 2429.01	-110	-R\$ 452.10
Urea	R\$ 1.85	308	R\$ 569.80	238	R\$ 440.30	70	R\$ 129.50
Creatinine	R\$ 1.85	307	R\$ 567.95	238	R\$ 440.30	69	R\$ 127.65
Glucose	R\$ 1.85	218	R\$ 403.30	145	R\$ 268.25	73	R\$ 135.05
Sodium	R\$ 1.85	145	R\$ 268.25	205	R\$ 379.25	-60	-R\$ 111.00
Potassium	R\$ 1.85	272	R\$ 503.20	205	R\$ 379.25	67	R\$ 123.95
TAP	R\$ 2.73	307	R\$ 838.11	3	R\$ 8.19	304	R\$ 829.92
TTPA	R\$ 5.77	229	R\$ 1321.33	3	R\$ 17.31	226	R\$ 1304.02
ECG	R\$ 5.15	159	R\$ 818.85	305	R\$ 1570.75	-146	-R\$ 751.90
Chest X-rays	R\$ 9.50	68	R\$ 646.00	119	R\$ 1130.50	-51	-R\$ 484.50
Total		2494	R\$ 7913.70	2052	R\$ 7063.11	442	R\$ 850.59

**Table 5** Comparison between quantity and cost of tests ordered and recommended by the institution's protocol for patients classified as ASA III.

ASA III = 152	Unit cost	Performed test		Indicated test		Total saved	
		<i>n</i>	Total cost	<i>n</i>	Total cost	<i>n</i>	Total cost
Hematocrit	R\$ 4.11	130	R\$ 534.30	152	R\$ 624.72	-22	-R\$ 90.42
Urea	R\$ 1.85	96	R\$ 177.60	90	R\$ 166.50	6	R\$ 11.10
Creatinine	R\$ 1.85	83	R\$ 153.55	90	R\$ 166.50	-7	-R\$ 12.95
Glucose	R\$ 1.85	69	R\$ 127.65	77	R\$ 142.45	-8	-R\$ 14.80
Sodium	R\$ 1.85	77	R\$ 142.45	71	R\$ 131.35	6	R\$ 11.10
Potassium	R\$ 1.85	86	R\$ 159.10	71	R\$ 131.35	15	R\$ 27.75
TAP	R\$ 2.73	87	R\$ 237.51	0	R\$ -	87	R\$ 237.51
TTPA	R\$ 5.77	64	R\$ 369.28	0	R\$ -	64	R\$ 369.28
ECG	R\$ 5.15	48	R\$ 247.20	100	R\$ 515.00	-52	-R\$ 267.80
Chest X-rays	R\$ 9.50	21	R\$ 199.50	70	R\$ 665.00	-49	-R\$ 465.50
Total		761	R\$ 2348.14	721	R\$ 2542.87	40	-R\$ 194.73

**Table 6** Comparison between quantity and cost of tests ordered and recommended by the institution's protocol for patients classified as ASA IV.

ASA IV = 13	Unit cost	Performed test		Indicated test		Total saved	
		<i>n</i>	Total cost	<i>n</i>	Total cost	<i>n</i>	Total cost
Hematocrit	R\$ 4.11	12	R\$ 49.32	13	R\$ 53.43	-1	-R\$ 4.11
Urea	R\$ 1.85	8	R\$ 14.80	10	R\$ 18.50	-2	-R\$ 3.70
Creatinine	R\$ 1.85	9	R\$ 16.65	10	R\$ 18.50	-1	-R\$ 1.85
Glucose	R\$ 1.85	7	R\$ 12.95	10	R\$ 18.50	-3	-R\$ 5.55
Sodium	R\$ 1.85	10	R\$ 18.50	10	R\$ 18.50	0	R\$ -
Potassium	R\$ 1.85	6	R\$ 11.10	10	R\$ 18.50	-4	-R\$ 7.40
TAP	R\$ 2.73	8	R\$ 21.84	1	R\$ 2.73	7	R\$ 19.11
TTPA	R\$ 5.77	6	R\$ 34.62	1	R\$ 5.77	5	R\$ 28.85
ECG	R\$ 5.15	3	R\$ 15.45	12	R\$ 61.80	-9	-R\$ 46.35
Chest X-rays	R\$ 9.50	2	R\$ 19.00	10	R\$ 95.00	-8	-R\$ 76.00
Total		71	R\$ 214.23	87	R\$ 311.23	-16	-R\$ 97.00

**Table 7** Comparison between quantity and cost of tests ordered and recommended by the institution's protocol.

Tests	Unit cost	Performed test		Indicated test		Total saved	
		<i>n</i>	Total cost	<i>n</i>	Total cost	<i>n</i>	Total cost
Hematocrit	R\$ 4.11	856	R\$ 3518.16	1063	R\$ 4368.93	-207	-R\$ 850.77
Urea	R\$ 1.85	523	R\$ 967.55	400	R\$ 740.00	123	R\$ 227.55
Creatinine	R\$ 1.85	541	R\$ 1000.85	400	R\$ 740.00	141	R\$ 260.85
Glucose	R\$ 1.85	361	R\$ 667.85	255	R\$ 471.75	106	R\$ 196.10
Sodium	R\$ 1.85	505	R\$ 934.25	339	R\$ 627.15	166	R\$ 307.10
Potassium	R\$ 1.85	345	R\$ 638.25	339	R\$ 627.15	6	R\$ 11.10
TAP	R\$ 2.73	557	R\$ 1520.61	5	R\$ 13.65	552	R\$ 1506.96
TTPA	R\$ 5.77	407	R\$ 2348.39	5	R\$ 28.85	402	R\$ 2319.54
ECG	R\$ 5.15	290	R\$ 1493.50	512	R\$ 2636.80	-222	-R\$ 1143.30
Chest X-rays	R\$ 9.50	125	R\$ 1187.50	221	R\$ 2099.50	-96	-R\$ 912.00
Total		4510	R\$ 14,276.91	3539	R\$ 12,353.78	971	R\$ 1923.13

seek to increase patient safety regarding adequate perioperative care, better use of available resources, reduced delays and cancellations of surgeries, and positive contribution to greater satisfaction of patients, relatives, and health team.<sup>3,6,8,9</sup>

Studies show that in the absence of any clinical indication, the likelihood of finding an abnormality in laboratory tests, electrocardiogram, and chest X-ray is significantly small.<sup>3,4,7,8,10</sup> When the history and physical examination are considered paramount as prime determinants in the indication of preoperative tests, it is noted that 60–70% of laboratory tests routinely performed are not really necessary.<sup>4</sup>

In order to rationalize the indication of preoperative tests in elective surgeries, evidence-based guidelines have been published<sup>11–13</sup> and, although studies are emphatic about non testing without specific clinical indication,<sup>4,6,14–18</sup> the routine of preoperative tests ordering is still common in daily practice.<sup>3</sup>

Contrary to what the literature recommends, this study showed that the ordering of preoperative tests does not follow strict criteria and is done indiscriminately for young patients without comorbidities.

Although the costs of preoperative tests adopted in this research are not those actually expended by the institution, and therefore it should be carefully analyzed, we cannot fail to note the significant cost of tests ordered indiscriminately. In the current context, this cost is not negligible and becomes an important factor in the increase of annual hospital budgets.<sup>3,10,19</sup> From this point of view, an indication of clinical tests is debatable, particularly in healthy patients, as the results may add more risks than benefits. Authors even suggest that in young and healthy patients undergoing minor surgery the preoperative examinations should be abolished.<sup>19</sup> Taking this approach into account, by eliminating unnecessary tests in a hospital in England, the annual savings would be £50,000.<sup>19</sup> In Brazil, the annual savings in just one medium-sized hospital is estimated at R\$157,536.84, according to a previous study.<sup>10</sup>

Table 7 shows that if the preoperative tests were ordered according to the protocol established by our institution, the annual savings would be 13%. Furthermore, it can be inferred that this economy could be even greater if the basics and

more updated principles of evidence-based medicine be applied to update the protocol adopted by the institution. In other words, it is necessary that, in addition to the supervision of existing routines, a constant update of the protocols be performed. It should be noted that although the data are objective about the lack of parameters in the ordering of additional tests, these results should be interpreted with caution, as the size of surgeries was not included as an evaluation criterion in this study.

From this research data, the point to be highlighted is the inadequacy of the institution model, which does not allow the anesthesiologist to order the tests required to plan his anesthesia. Similarly, anesthesiologists must not transfer the responsibility of ordering tests to surgeons. The responsibility of the medical act is not transferable.

Data from this study suggest the need for constant supervision of protocols used in clinical practice, as well as awareness of the importance of preoperative period as a factor of hospital cost reduction and satisfaction of patients and their relatives. The sequence of events, from the preparation of facilities and logistics services, material of preoperative tests ordering, and how the patient can do these tests is an important and necessary step in order to offer a quality medicine for someone who trusts his life to us.

In conclusion, preoperative tests are not always ordered within clinical criteria, resulting in increased cost for the institution.

## Conflicts of interest

The authors declare no conflicts of interest.

## References

1. Van Klei WA, Moons KG, Rutten CL, et al. The effect of outpatient preoperative evaluation of hospital inpatients on cancellation of surgery and length of hospital stay. *Anesth Analg*. 2002;94:644–9.
2. Miller RD, Lars EI, et al. *Miller's anesthesia*, vol. 1, 7th ed., premium ed. Philadelphia: Churchill Livingstone; 2010. p. 1001–66.

3. Correll DJ, Bader AM, Hull MW, et al. Value of preoperative clinic visits in identifying issues with potential impact on operating room efficiency. *Anesthesiology*. 2006;105:1254–9.
4. Mathias LA, Guaratini AA, Gozzani JL, et al. Preoperative exams: a critical analysis. *Rev Bras Anesthesiol*. 2006;56:658–68.
5. Munro J, Booth A, Nicholl J. Routine preoperative testing: a systematic review of the evidence. *Health Technol Assess*. 1997;1:1–62.
6. Pasternak RL, Arens JF, Caplan RA, et al. (Task Force on Preanesthesia Evaluation)—Practice advisory for preanesthesia evaluation: a report by the American Society of Anesthesiologists. *Anesthesiol*. 2002;96:485–96.
7. Apfelbaum JL, Connis RT, Nickinovich DG, et al. (Task Force on Preanesthesia Evaluation)—Practice advisory for preanesthesia evaluation: an updated report by the American Society of Anesthesiologists. *Anesthesiol*. 2012;116:522–38.
8. Ferschl MB, Tung A, Sweitzer B, et al. Preoperative clinic visits reduce operating room cancellations and delays. *Anesthesiol*. 2005;103:855–9.
9. Hepner DL, Bader AM, Hurwitz S, et al. Patient satisfaction with preoperative assessment in a preoperative assessment testing clinic. *Anesth Analg*. 2004;98:1099–105.
10. Issa MR, Isoni NF, Soares AM, et al. Preanesthesia evaluation and reduction of preoperative care costs. *Rev Bras Anesthesiol*. 2011;61:60–71.
11. Garcia-Miguel FJ, Serrano-Aguilar PG, Lopez-Bastida J. Preoperative assessment. *Lancet*. 2003;362:1749–57.
12. Larocque BJ, Maykut RJ. Implementation of guidelines for preoperative laboratory investigations in patients scheduled to undergo elective surgery. *Can J Surg*. 1994;37:397–401.
13. Nardella A, Pechet L, Snyder LM. Continuous improvement, quality control, and cost containment in clinical laboratory testing: effects of establishing and implementing guidelines for preoperative tests. *Arch Pathol Lab Med*. 1995;119:518–22.
14. Fischer SP. Cost-effective preoperative evaluation and testing. *Chest*. 1999;115:596–100.
15. Oliveira AR, Mendes FF, Oliveira M. Outpatient preoperative evaluation and clients' satisfaction. *Rev Bras Anesthesiol*. 2003;53:83–8.
16. Halaszynski TM, Juda R, Silverman DG. Optimizing postoperative outcomes with efficient preoperative assessment and management. *Crit Care Med*. 2004;32:S76–86.
17. Mendes FF, Mathias LA, Duval Neto GF, et al. Impact of preoperative outpatient evaluation clinic on performance indicators. *Rev Bras Anesthesiol*. 2005;55:175–87.
18. Perez A, Planell J, Bacardaz C, et al. Value of routine preoperative tests: a multicentre study in four general hospitals. *Br J Anaesth*. 1995;74:250–6.
19. Johnson RK, Mortimer AJ. Routine pre-operative blood testing: is it necessary? *Anaesthesia*. 2002;57:914–7.