

# Prevention and Control of Trichotomy Infection in the Elderly Surgical Patient

*An Umbrella Review*



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### ABSTRACT

**Introduction:** The World Health Organization creates norms and guidelines for the adoption of good practices in health care that are provided to the surgical patient. In order to prevent and control infections associated with health care, the nurse must follow the guidelines for preparing the surgical patient for success. These infections can be particularly harmful to the elderly person given their vulnerability. The preoperative preparation, includes the trichotomy as one of the interventions to be performed, however, is one of the most controversial interventions that has caused in clinical practice, by the potential risk of infection in the surgical patient.

**Aim:** To investigate the need for trichotomy, or removal of hair, in the preparation of the skin of the surgical patient, clarifying which is the most appropriate technique in the prevention of infection.

**Methodology:** we conducted an umbrella review. The documentary research followed the consultation of bibliographic sources in the Cumulative Index to Nursing & Allied Health (CINAHL) and Public/Publisher Medline (PubMed) databases. The researched articles were grouped in a time horizon between 2011 and

2020. After data extraction, a narrative analysis was performed.

**Results:** We found 40 articles from which 8 were selected.

**Conclusion:** Trichotomy should be avoided by increasing the risk of infection of the surgical site. Innovative haircut and vacuum technologies can help in hair removal, mitigating the risk of contaminating the surgical incision. The timing of the trichotomy is not consensual among researchers.

**Keywords:** Hair Removal, Nursing, Perioperative Care, Infection Control, High-Cost Technology.

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#### Introduction

The improvement of quality in patient care beyond the techniques used and the purposes for which they are intended is evidenced by the importance of prevention and control of infection in surgeries. Over the years, the World Health Organization (WHO) has been concerned with providing quality, infection-free care through best practices for infection prevention and control. Guidelines for infection prevention and control are issued throughout the world, and are a cornerstone in assessing the quality of healthcare provided in any nation<sup>1</sup>.

Infection Prevention and Control (ICP) is a practical, evidence-based approach. According to the WHO the goal is to prevent patients and healthcare workers from being harmed by preventable infections<sup>2</sup>. Surgical Site Infections (SSI) can cause morbidity and even mortality<sup>3</sup> and it impair not only the patient's quality of life, but also have a negative economic impact. It increases the patient's length of stay in the hospital and incurs extra costs in healthcare. SSI are responsible for a significant burden of health care spending, depending on the type of surgery and the severity of the infection<sup>4</sup>. However, up to 60% of ILC have been estimated to be preventable and their risk minimized if best practices were applied in the preoperative period<sup>5</sup>.

For every 100 hospitalized patients, 7 in developed countries and 15 in developing countries will acquire at least one nosocomial infection<sup>1</sup>. Surgical site infection (SSI) is the most common type of nosocomial infection in developing countries, affecting more than 1/3 of patients who undergo a surgical procedure. Although the incidence is much lower in developed countries, it remains the second most common type of nosocomial infection in Europe and the United States<sup>1</sup>. The incidence rate of SSI ranges from 2 to 15%, depending on several factors, including the type of surgery. In the most recent prevalence survey conducted by the European Centre for Disease Surveillance and Control (ECVDC), CLI accounted for 18% of Healthcare Associated Infections (HCAI)<sup>5</sup>.

The infection of the surgical site, according to the definition of the Centers for Disease Control and

Prevention, consists of an infection that appears in the surgical site or close to the surgical incision during the first 30 days or even a year with the placement of an implant<sup>5</sup>. It is one of the postoperative complications that arise associated with risk factors related to the patient (age, obesity and underlying disease), the quality of the surgical procedure (duration, technique and type), as well as the microorganisms involved (number, virulence)<sup>5</sup>.

Success in preventing infection of the surgical site in the patient depends on several basic measures, such as: preoperative preparation, using, among other measures, trichotomy or hair removal and antibiotic prophylaxis, intraoperative procedure and postoperative care. Trichotomy is one of the phases contemplated in the preoperative preparation, it consists of the removal of hair for better visualization and accessibility to the surgical site<sup>5</sup>.

#### *Surgical Preparation*

The surgical patient needs specific care taking into account the surgical technique to which he/she will be subjected. That is, a set of cares that are given in the pre, intra and postoperative periods, being called perioperative nursing care<sup>6</sup>.

One of the preoperative care is the preparation of the skin that, according to the same author, has as objective the reduction of the preexisting bacteria. The activity of the "barber surgeons", whose interventions motivated high mortality rates, has been maintained for centuries, without worrying about the infection issues, disappointing an incalculable number of lives<sup>7</sup>.

The surgical patient is the one who is admitted to a health unit to undergo a surgical intervention. Usually, the patient undergoing surgery must go through certain preoperative preparation steps to help control and prevent infection. The research will focus on the preoperative period, a phase in which specific interventions are performed to prepare the patient, being the trichotomy one of the preoperative interventions.

In medicine, trichotomy is defined as the shaving or removal of hair from an area of the body, usually before a surgery or similar intervention. Throughout the article, we can find the term trichotomy or hair removal when reference is made to the need to prepare the patient for the surgical act.

### Prevention measures

In 2002, National Surgical Infection Prevention, NSIP, implemented preventive measures to control surgical infection, especially antibiotic selection, antibiotic administration time (taking into account the duration of surgery), maintenance of body temperature, oxygenation, glycemia and correct performance of trichotomy, which demonstrated a general decrease in surgical infections<sup>8</sup>.

For the Directorate General of Health (2015), the interventions to be implemented to prevent surgical infection are: Perform a 2% chlorhexidine bath, administer antibiotic surgical prophylaxis, avoid trichotomy, maintain normothermia ( $\geq 35.5^{\circ}$ ) and maintain glycemia  $< 180$  mg/dl. The "intervention bundle" presents unit of time and space, in the sense that all interventions take place at a specific time and place<sup>9</sup>.

Thus, the following objectives were defined for this article:

- To determine the need for trichotomy in the preparation of the surgical patient's skin;
- Clarify which is the safest technique in the context of preparing the skin of the surgical patient;
- Determine the influence of the techniques on the infection rate of the surgical site

### Methodology

To carry out this study, systematic literature reviews were revised, also called umbrella reviews<sup>10</sup>. The research was started in September 2020. The published works were grouped in a time horizon of the last ten years, that is, between 2011 and 2020. Their analysis was carried out, seeking a relationship with the issue of initial research, with the aim of determining the practices that must be followed in order to ensure the prevention and control of infection in the surgical site.

The documentary research followed a rational process of consultation of bibliographic sources in the databases Cumulative Index to Nursing & Allied Health (CINAHL) and Public/Publisher Medline PubMed - indexed for MEDLINE.

### Review question

In view of the GDH intervention beams and the measures taken by the NSIP, the questions are asked. But does this surgical preparation presuppose trichotomy? Is there a need for it in our daily practice? The lack of any consensus on this matter led us to reflect on this reality and led us to the central question that guides our research. What is the influence of the trichotomy technique and the moment it is performed, for the preparation of the skin of patients who will undergo surgery, in the rate of infection of the surgical site?

Evidence-based practice proposes that clinical problems that arise in care practice, teaching or research, be broken down and then organized. In accordance with the method for the elaboration of the research question recommended by Joana Briggs Institute, the PI(C)O strategy was used, which represents an acronym for Population, Intervention, (Comparison) and Outcomes. The formulation of the question thus uses the PI(C)O method in an attempt to obtain an answer about the need for trichotomy (Intervention) in surgical patients (Population) in order to prevent and control infection (Outcomes). We excluded the comparison d research question, as it was not suitable for our research and it is not mandatory in the PI(C)O method<sup>11</sup>.

### Inclusion criteria

In order to select the manuscripts that answered the question, the following inclusion criteria were established: articles reviewed by experts, with full text, articles written in Portuguese, English and Spanish and finally articles that contained in the abstract the following expressions: Hair removal or Trichotomy; Perioperative; Infection prevention.

Thus, and in order to operationalize the empirical analysis of the selected articles, the following key concepts of research were defined: Removal of hair, Perioperative and Prevention of infection. From the results obtained in the different databases, the articles were selected in a first stage through the reading and analysis of the titles, followed by the reading of the respective abstracts, choosing them according to the inclusion criteria. Ultimately, the articles were read in their entirety, with emphasis on the subject under study, from the abstract.

Data collection and analysis

Two independent researchers did the analysis and selection of the articles. A third investigator resolved the disagreements.

The following data were extracted: author/year, study objective, results, and conclusions. A narrative analysis was performed.

Selection criteria

Articles reviewed by experts, with full text, articles written in Portuguese, English and Spanish and finally articles that contained in the abstract the following expressions: Hair removal or Trichotomy; Perioperative; Infection prevention. The research process is schematically presented in table 1.

Table 1: Research process

<b>Data bases</b>	CINAHL and PubMed - indexed for MEDLINE	
<b>Descriptors and Boolean Operators</b>	Hair removal AND Perioperative AND Infection prevention	
<b>Limiters</b>	- [2011-2019] - Reviewed by experts - Available in the on-line library collection	
<b>Full text search</b>	- hair removal - perioperative - infection prevention	
<b>Articles found</b>	40	
<b>Selected article after reading</b>	Title	15
	Abstract	10
	Full	10

Out of a total of 40 articles found in the databases, 23 were initially excluded by reading the title, 2 because they were repeated, 1 because they were not accessible by the available databases, lastly 6 are not systematic literature review studies. Of the remaining 10 articles, the full text of the selected articles was read and found to be the answer to the research question.

Based on the final sample of the selected articles, a distributed analysis of these articles was carried out, directed, essentially, to a quality, according to a quality scale of Joanna Briggs Instituto (JBI) <sup>12</sup>. The articles were classified according to the criteria defined in the

quality scale of Joanna Briggs, to allow the critical evaluation and synthesis of these different forms of evidence to assist in clinical decision-making in the health area. Table 1 is the result of the evaluation of the articles analyzed in this work, which contains the listed articles and the classification that each one obtains according to the evaluation carried out by the JBI guidelines. The assigned Y, N, U and NA symbols correspond in the respective order to "Yes", "No", "Unclear" and "Not Applicable".

Table 2: Results of the evaluation of the articles, according to the JBI Quality Scale (2020).

Articles	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Total
1	Y	Y	Y	Y	NA	U	N	N	NA	Y	Y	72.2%
2	Y	Y	Y	Y	Y	N	NA	Y	NA	Y	Y	88.8%
3	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	NA	90%
4	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	NA	90%
5	Y	Y	Y	U	U	Y	N	U	NA	Y	NA	72.2%
6	Y	Y	Y	Y	Y	Y	N	Y	NA	Y	NA	88.8%
7	Y	Y	Y	Y	Y	Y	U	Y	NA	Y	NA	94.4%
8	Y	Y	Y	Y	Y	Y	N	Y	N	N	NA	70%

Yes (Y) = 1 value | No (N) = 0 value | Unclear (U) = 0.5 value | Not Applicable (NA) = NA

The sum of these references is translated and classified into categories in which Grade A corresponds to articles with a high level of quality 12 and articles with Grade E are those with gaps and with a low level of quality for the study in question.

Of the sample obtained in this work, the 8 articles, most of them stand out in grade A and grade B, that is, overall good quality (table 2).

Table 3: Quality Scale according to Joanna Briggs Institute (2020).

Artigos	Authors & Year	Title	Grade
1	Spencer M, Barnden M, Johnson HB, Fauerbach LL, Graham D, Edmiston CE 2018	Perioperative hair removal: A review of best practice and a practice improvement opportunity. J Perioper Pract.	C
2	Gómez-Romero FJ, Fernández-Prada M, Navarro-Gracia JF 2017	Prevention of Surgical Site Infection: Analysis and Narrative Review of Clinical Practice Guidelines	B
3	Leaper D, Ousey K. 2015	Evidence update on prevention of surgical site infection	A
4	Broekman MLD, van Beijnum J, Peul WC, Regli L. 2011	Neurosurgery and shaving: what's the evidence?	A
5	Tokarski AT, Blaha D, Mont MA, et al. 2014	Perioperative Skin Preparation	C
6	Sebastian S. 2012	Does Preoperative Scalp Shaving Result in Fewer Postoperative Wound Infections When Compared With No Scalp Shaving?	B
7	Edmiston CE, Leaper DJ, Barnes S, et al. 2019	Revisiting Perioperative Hair Removal Practices.	A
8	Corby M, Meller C, Park S. 2018	Does perioperative skin preparation reduce surgical site infection?	C

## Result

Presentation of the diagram (PRISMA), with the selection process of the studies (re-financing of the research results until it reaches the final body).

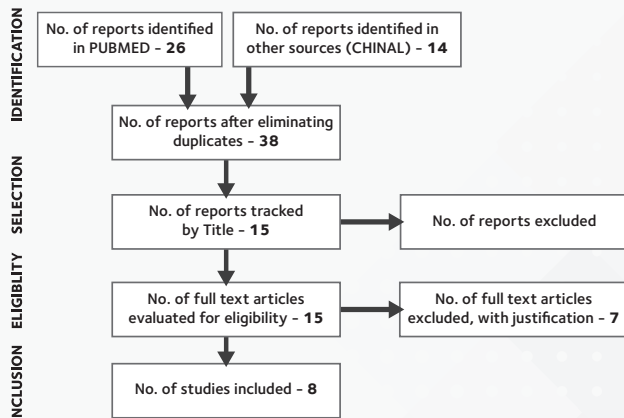


Figure 1: PRISMA flowchart of the article selection process.

The results of the research conducted are presented in chart 2, where the results obtained from the analysis of the articles are summarized. Afterwards, a critical analysis is made in order to create answers to our question.

## Discussion

Healthcare-related infections are defined as those infections that had no evidence that they were present or incubating during the period of admission to health care and whose most likely origin was health activity resulting from an adverse reaction or the presence of an infectious agent<sup>14</sup>. The same authors also clarify that infections of the surgical site are a type of infections associated with health care that occur after a surgical intervention, in an area of the body where the surgery was performed, involving the skin, tissues and organs or implanted material, revealing themselves as a combination of signs and symptoms that translate into an infectious process<sup>14</sup>.

The surgical site infection classification system according to the Centers for Diseases Control (CDC) that summarizes the following description: superficial incision, deep incision or organ/space incision, and states that the presence of infection should be identified using both the patient's clinic and laboratory findings and may include the presence of at least one of the following characteristics: pus, pain, edema or redness<sup>13</sup>. They also mention that infections of the surgical site affect a large percentage of patients, and can result in delayed wound healing and consecutively

increased length of hospital stay, unnecessary pain and in extreme cases death as already mentioned by other authors<sup>13</sup>.

There are, all over the world, different trichotomy practices<sup>17</sup>. For example, the CDCs referred to in the study by the same author recommend that the hair should not be removed in the preoperative period unless the hair around the incision site interfered with the operation. If there is the presence of long and dense hair at the incision site, according to the same authors, it should be performed immediately before the surgery and only, if strictly necessary<sup>17</sup>. The trichotomy of a patient before surgery has been perennial in the preparation of the surgical skin for decades<sup>18</sup>.

Currently, three preoperative trichotomy methods are used. The first method is the use of a blade to perform the trichotomy, where a sharp blade passes over the patient's skin to cut the hair near the skin surface. The second method of trichotomy is the method where the hair is cut by hair cutting machines, which have fine teeth (leaving the hair about one millimeter long). Finally, the last method is based on chemical trichotomy, where the hair dissolves through contact with depilatory creams after 15 to 20 minutes of contact, this method is not without risks, because of the allergic reactions that can occur.

Although it is still used in several places, trichotomy with lamina can cause microscopic skin ruptures and can be considered unnecessary for many surgical procedures, especially for surgeries related to neurosurgery, in the head area<sup>16</sup>.

Studies comparing trichotomy with a razor with a depilatory machine have concluded that there are significant statistical changes in the incidence of infections of the surgical site when the trichotomy is performed with a razor, where there is a significant increase in cases of infection compared to trichotomy performed with a cutting machine.

Comparing the trichotomy with the knife performed on the day of surgery and using the same method, the studies showed that the incidence of infections of the surgical site was slightly higher in patients who underwent trichotomy with a knife on the day of surgery, although these results were minimal, so these results cannot be classified as significant<sup>21</sup>.

Trichotomy should be performed as close as possible to the time of surgery to minimize the number of bacteria that may colonize any solution of skin continuity

Table 4: Main results and conclusions of studies included.

Author / Year	Objective	Result	Conclusion
Spencer et al. (2018) <sup>13</sup>	Determine the most appropriate and efficient method of trichotomy for the reduction of infection in the surgical site.	A 10-year prospective sentinel study with 62,939 wounds in 1980 showed that the lowest risk of surgical wound infection was associated with no depilation; <ul style="list-style-type: none"> <li>The trichotomy technique is fundamental to obtain the best</li> <li>Some organizations recommend that the trichotomy be performed outside the operating room and immediately before surgery;</li> <li>Cleaning of the hair cut after the trichotomy with adhesive tape versus with a machine for cutting and aspiration of hair, for deposit.</li> </ul>	Studies point out that the best practice will be the absence of trichotomy in the surgical patient. However, in case of need, studies show that trichotomy can be an improved and more efficient alternative when using the hair cutting system with aspiration to reservoir.
Gómez-Romero et al. (2017) <sup>14</sup>	Describe the evidence as-signed in the most up-to-date clinical practice guidelines on preventive measures to avoid Surgical Site Infection (SSI), taking into consideration all phases of the surgical process	The Clinical Practice Guides of health organizations of several countries involved in this study expose the main preventive measures divided into 3 phases (Preoperative, perioperative and postoperative) with the evaluation of the quality of evidence and the degree of recommendation that each one gives them;  Only the WHO Practical Clinical Guide makes recommendations for all points, while HICPAC (USA) or CPSI (Canada) omits sufficient recommendations in the preventive measures of the perioperative and postoperative phases.	The Clinical Practice Guides recommend not to perform a trichotomy, if necessary an electric shaver with a disposable head should be used on the same day as the surgery (SHEA, NICE (National Institute for Health and Care Excellence), NHSS, MSSSI) or 2 hours in advance of surgery (CPSI).  The WHO recommends non trichotomy.
Leaper & Ousey (2015) <sup>15</sup>	Include in the guidelines for Surgical Site Infection Prevention (SSI) the results of new research and systematic literature reviews, if appropriate.	Compliance with guidelines (involving appropriate hair removal, rational antibiotic prophylaxis, and proper maintenance of perioperative normothermia and glycemic control) should minimize potentially preventable infection associated with medical care.	Trichotomy together with other preoperative procedures seems to make little sense. Changes in preventive measures may have resource implications, increased costs, and increased risk of injury.
Broekman et al. (2011) <sup>16</sup>	Understand if the commonly used trichotomy technique is based on evidence and its impact on the infection and/or complications of the surgical wound.	There are no significant differences in infection rates among patients who performed trichotomy versus those who did not perform trichotomy before neurosurgical procedures.  In some studies, there is even some evidence that trichotomy can even increase the infection rate in neurosurgical procedures.	There is no evidence to support the trichotomy technique routinely.  Further studies are needed that are designed to provide more evidence for preoperative recommendations on the technique of trichotomy.
Tokarski et al. (2014) <sup>17</sup>	Determine the role of preoperative skin cleansing and which is the right time. Define the best agent for the surgical preparation of the skin.  Indicate the method and the most appropriate time for the removal of hair in the surgical context.  Establish the recommendations in case of skin lesions, in the surgical site.	The removal of hair should be done through the trichotomy, as opposed to the shaving blade. This procedure should be done close to the surgical procedure;  Surgeons and assistants should wash their hands mechanically with an antiseptic agent for 2 minutes, with no clear differences between the various agents;  The preoperative cleaning is fundamental, the bath is recommended, preferably the night before the surgery;  According to the studies performed, the best agent in the preoperative preparation is the alcoholic Chlorohexidine.	There is no significant difference in the infection rate, using or not the trichotomy in hair removal.  The best evidence shows that trichotomy should not be used routinely.
Sebastian (2012) <sup>18</sup>	Determine the difference between shaving or not shaving the scalp before skull surgical procedures.	The removal of scalp hair, before performing cranial surgical procedures, does not bring benefits to the surgery, nor reduces the risk of infections of the operative site, and may even increase, due to skin lesions.	Trichotomy should be used if the removal of hair is requested (surgeons) and should be performed within the operating room.
Edmiston et al. (2019) <sup>19</sup>	Describe the basic structure of human hair and the potential for it to become contaminated.  Discuss the origins and current policy recommendations for perioperative depilation.  Discuss the evidence for different types of epilation.  Identify the challenges and solutions for preoperative skin preparation and depilation	Shaving (with a razor) carries a higher risk of infection than conventional trichotomy.  There is little supporting evidence on the cut compared to no hair removal and subsequent effects on surgical site infections	Innovative haircut and vacuum technologies can help remove hair, mitigating the risk of contaminating the surgical incision.  When removal is considered absolutely necessary, it is preferable to cut the hair rather than cut with a razor, in order to reduce skin lesions and the risk of bacterial colonization and subsequent infection of the surgical site.
Corby et al. (2018) <sup>20</sup>	Determine whether preoperative trichotomy, the time at which the trichotomy is performed, and the different methods of trichotomy result in fewer infections of the surgical site than failure to perform.	There was no statistical difference in the Prevention of surgical site infection rate between the two groups (submitted to trichotomy and not submitted to trichotomy)  The best available evidence indicates that the hair removal routine should not be performed if it is purely to prevent infection of the surgical site: Routine preoperative bath with antiseptic solutions is not recommended.	The ideal methods of skin preparation to reduce head and neck surgical site infection is not depilation, or if absolutely necessary, pre-surgical removal should be performed immediately before the surgery by cutting trichotomy

caused by the performance of the trichotomy<sup>15</sup>. These authors justify that the trichotomy should be performed as close to the surgery as possible, since the perioperative nurse will be able to identify the real need for it taking into account the surgery in question<sup>15</sup>. It is also necessary to take care of the trichotomy already in the operating room because it may cause contamination and minimize the time of appearance and colonization of new bacteria<sup>15</sup>.

More studies that are recent still innovate in the practice of trichotomy. In particular, with the device used, "this innovation has demonstrated that the new technology will potentially transform this practice, reducing the time needed to cut and clean the hair and significantly reduce the microbial load associated with cut loose hair", with the use of the device with aspiration of hair to a reservoir<sup>13</sup>.

A recent study demonstrated that the use of the vacuum suction device resulted in a significant reduction in the total time needed to cut and clean the residual hair that contaminates the operating field compared to standard practice (eliminating the need to physically remove the scattered hair, which can harbor a significant microbial load, within the surgical field)<sup>19</sup>. Innovative haircut and vacuum technologies can help remove hair more safely by eliminating the dispersion of hair fibers around the incision site, mitigating the risk of hair contaminating the surgical incision<sup>19</sup>.

Prevention and control of infection is a crucial part of patient safety and is a fundamental requirement of the quality of health care, assuming a particular preponderance in recent years. This concern of healthcare providers in the area of infection prevention and control is very important, for both patients and their relatives, who want to feel safe and confident about the healthcare they receive.

## Conclusion

Trichotomy is one of the measures performed in the pre-surgical patient, but increasingly questionable in its applicability in clinical practice. It is emphasized that this procedure is based on the specificity of the surgery to be performed, the patient's situation and the surgeon's criteria.

This review aimed to answer the question: What is the influence of the technique and the time of performing trichotomy, for the preparation of the skin of patients who will undergo surgery, on the rate of infection of the surgical site? In view of the results obtained, and

presented, through the systematic review of the literature it was possible to obtain the following conclusions:

- In the possibility of not performing a trichotomy, it is preferable for the patient to be submitted to the surgical technique without it;
- If the need to perform a trichotomy is verified, it should be performed by hair cutting machine instead of using the blade.

The timing of the trichotomy is also not consensual since the differences observed regarding the infection rates of the surgical site are not statistically significant to affirm the exact time for its performance.

Although there is low statistical significance, several authors mention that it should be performed as close as possible to the surgery, however, others defend that it should not be performed inside the operating room because of the risk of soiled.

## Implications for clinical practice

This review allowed the authors of the article to analyze the preventive measures implemented in the preparation of the surgical patient, in several health services, in Europe and in America, revealing in a general way that the interventions in the preparation of the surgical patient's skin, in this case the trichotomy, is not a unanimous decision, nor rigorous. It depends on the surgeon, the surgical act, the specificity of the surgery and the clinical situation of the patient. Future research on this topic and studies in this area with samples of patients in surgical context will be an asset for the consensus of surgical activities in preoperative preparation and for the improvement of care provided to the surgical patient.



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