# Adherence to best practices for preventing perioperative hypothermia

## *Adesão às práticas recomendadas de prevenção da hipotermia perioperatória*

## *Adhesión a las prácticas recomendadas de prevención de la hipotermia perioperatoria*

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**ABSTRACT: Objective:** To verify the percentage of adherence to best practices for preventing hypothermia in the intraoperative period. **Method:** This is a cross-sectional, observational study with analysis of secondary data from 310 medical records of patients who underwent surgical procedures. A collection instrument based on the recommendations of national and international associations was used, whose data were analyzed using Microsoft Excel and EPI INFO 7 software. The study was approved by the Research Ethics Committee of the institution under Opinion No. 7.594.439. **Results:** There was a slight prevalence of men, comprising 50.32% (n=156) of the sample, mean age of 55 years (standard deviation [SD]=16.70), and mean body mass index (BMI) of 26.44. We verified a prevalence of 75.48% (n=234) of general anesthesia and 54.84% (n=170) of open surgeries, with mean anesthetic-surgical time of 210 minutes (SD=138). Thermal blanket was used in 79.68% (n=247) of patients and intraoperative temperature monitoring in 36.45% (n=113), while heated intravenous fluids and thermal mattress were used in 1.61% (n=5) of the sample. **Conclusion:** We identified adherence to the use of thermal blanket in 79.68% (n=247) of patients and intraoperative core temperature monitoring in 36.45% (n=113), which were the most adopted strategies to prevent perioperative hypothermia. In turn, heated intravenous fluids and thermal mattress were recorded in 1.61% (n=5) of the procedures. The analysis emphasizes normothermia as a quality indicator for best clinical outcomes, in such a way that investigating the rates of adherence to preventive measures becomes essential to support care planning and strengthen good practices in the perioperative period.

**Keywords:** Perioperative period. Hypothermia. Perioperative nursing. Surgery Department, Hospital. Intraoperative complications.

**RESUMO: Objetivo:** Verificar o percentual de adesão às práticas recomendadas de prevenção da hipotermia no período intraoperatório. **Metodologia:** Estudo observacional transversal, com análise de dados secundários de 310 prontuários de pacientes submetidos a procedimentos cirúrgicos. Utilizou-se um instrumento de coleta baseado nas recomendações de associações nacionais e internacionais, cujos dados foram analisados por meio dos *softwares Microsoft Excel* e *EPI INFO 7*. O estudo foi aprovado pelo Comitê de Ética em Pesquisa da instituição sob parecer nº 7.594.439. **Resultados:** Houve discreta prevalência do sexo masculino, sendo 50,32% (n=156) da amostra, média etária de 55 anos (DP=16,70) e índice de massa corporal (IMC) médio de 26,44. Observou-se 75,48% (n=234) de prevalência de anestesia geral e 54,84% (n=170) das cirurgias na técnica aberta, com tempo anestésico-cirúrgico médio de 210 minutos (DP=138). Utilizou-se manta térmica em 79,68% (n=247) dos pacientes e monitoramento térmico intraoperatório em 36,45% (n=113), já as soluções endovenosas aquecidas e o colchão térmico, em 1,61% (n=5) da amostra. **Conclusão:** O estudo identificou a adesão ao uso de manta térmica em 79,68% (n=247) dos pacientes e o monitoramento da temperatura central no intraoperatório em 36,45% (n=113), sendo estas as estratégias mais adotadas para prevenção da hipotermia perioperatória. Já as soluções endovenosas aquecidas e o colchão térmico foram registrados em 1,61% (n=5) dos procedimentos. A análise ressalta a normotermia como indicador de qualidade para melhores desfechos clínicos, por isso, investigar as taxas de adesão a medidas preventivas torna-se fundamental para subsidiar o planejamento assistencial e fortalecer boas práticas no período perioperatório.

**Palavras-chave:** Período perioperatório. Hipotermia. Enfermagem perioperatória. Centro cirúrgico. Complicações intraoperatórias.

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**RESUMEN:** **Objetivo:** Verificar el porcentaje de adhesión a las prácticas recomendadas para la prevención de la hipotermia en el período intraoperatorio. **Metodología:** Estudio observacional transversal, con análisis de datos secundarios de 310 historias clínicas de pacientes sometidos a procedimientos quirúrgicos. Se utilizó un instrumento de recolección basado en recomendaciones de asociaciones nacionales e internacionales, cuyos datos se analizaron mediante los softwares Microsoft Excel y EPI INFO 7. El estudio fue aprobado por el Comité de Ética en Investigación de la institución bajo el dictamen nº 7.594.439. **Resultados:** Se observó una discreta prevalencia del sexo masculino: 50,32% (n=156) de la muestra; edad media de 55 años (DE=16,70) e índice de masa corporal (IMC) medio de 26,44. Se observó 75,48% (n=234) de prevalencia de anestesia general y 54,84% (n=170) de las cirugías en la técnica abierta, con un tiempo anestésico-quirúrgico promedio de 210 minutos (DE=138). Se utilizó manta térmica en 79,68% (n=247) de los pacientes y monitoreo térmico intraoperatorio en 36,45% (n=113); en cambio, las soluciones endovenosas calentadas y el colchón térmico, en 1,61% (n=5) de la muestra. **Conclusión:** El estudio identificó la adhesión al uso de manta térmica en 79,68% (n=247) de los pacientes y el monitoreo de la temperatura central en el intraoperatorio en 36,45% (n=113), siendo estas las estrategias más adoptadas para la prevención de la hipotermia perioperatoria. Las soluciones endovenosas calentadas y el colchón térmico se registraron en 1,61% (n=5) de los procedimientos. El análisis destaca el normotermia como indicador de calidad para mejores desenlaces clínicos; por ello, investigar las tasas de adhesión a medidas preventivas se vuelve fundamental para fundamentar la planificación asistencial y fortalecer buenas prácticas en el período perioperatorio.

**Palabras clave:** Período perioperatorio. Hipotermia. Enfermería perioperatoria. Centro quirúrgico. Complicaciones intraoperatorias.

## INTRODUCTION

Perioperative hypothermia is defined by the North American Nursing Diagnosis Association (NANDA-I) as "susceptibility to an inadvertent drop in core body temperature below 36 Celsius (°C) that occurs from one hour prior to surgery to 24 hours after the procedure, which can compromise health" [free translation][1,2].

Some aspects constitute risk factors for perioperative hypothermia, especially the combination of general and local anesthesia, exposure to low temperatures in the operating room, body temperature below 36°C in the preoperative period, age extremes, American Society of Anesthesiologists (ASA) physical status classification higher than I, low body mass index (BMI), surgical technique, anesthetic-surgical time above 60 minutes, use of cold topical, intravenous, and inhalational fluids, large skin area exposure, major surgeries, and open or laparoscopic surgical technique with cavity exposure to cold carbon dioxide used for abdominal insufflation[1,2].

During the anesthetic-surgical procedure, several factors compromise physiological thermoregulation. Most anesthetics have vasodilating action and act in the central nervous system, especially in the hypothalamus, reducing the thresholds of thermoregulatory responses by 2 to 4°C. As a consequence, compensatory mechanisms, such as peripheral vasoconstriction and shivering thermogenesis, are activated at lower core temperatures than usual.

Heat loss in the intraoperative period occurs in three distinct phases. In the first hour of anesthesia, systemic vasodilation is observed, with rapid redistribution of heat from the central compartment to the body periphery, resulting in a sharp drop in temperature. Subsequently, linear temperature drop occurs due to the imbalance between metabolic heat production and its loss to the environment. Finally, homeostatic plateau occurs, when the reduced threshold for vasoconstriction activation is finally reached to support thermogenesis. However, this response occurs late and less effectively, as thermoregulatory mechanisms remain partially depressed by pharmacological action. At this time, the patient already presents with a degree of accentuated hypothermia[3–6].

Perioperative hypothermia is a recognized risk factor for multiple complications—such as changes in drug pharmacokinetics, increased bleeding, surgical site infection, pressure ulcers, and cardiovascular events. Its occurrence is directly related to the prolongation of the length of stay in the post-anesthesia care unit (PACU), increase in hospital stay, and increase in mortality in severe situations[2,7].

It is worth noting that perioperative hypothermia is preventable when adopting the best practices for this purpose. Major perioperative associations reinforce the importance of adherence to evidence-based normothermia maintenance strategies[2,8,9].

With regard to heating methods, these are classified into passive and active. Passive methods consist of reducing heat loss through thermal insulation, including the use of sheets, cotton blankets, and minimizing body exposure. In turn, active methods promote external heat transfer to the patient, especially the forced-air warming system, thermal blankets, circulating-water mattress and radiant heating, as well as the administration of heated intravenous fluids[2,8,9].

There is evidence that active methods have more effectiveness in maintaining normothermia when compared to exclusively passive methods, especially in procedures with prolonged duration. Regarding body temperature monitoring, the guidelines recommend continuous measurement in the intraoperative period, especially in procedures lasting 60 minutes or more. Methods for measuring temperature at central sites, such as esophageal, nasopharyngeal, or bladder, are considered more accurate for estimating core temperature, as established by the standards for basic anesthetic monitoring[2,8,9].

Other practices are also widely encouraged for temperature maintenance throughout the perioperative period, including searching for risk factors for hypothermia, promoting body preheating, removing wet clothing, increasing oxygen delivery in the postoperative period, paying attention to hemodynamic changes, and keeping the operating room warm. The systematic and combined adoption of these recommended measures constitutes an essential component in the prevention and early detection of inadvertent perioperative hypothermia[2,8,9].

Perioperative hypothermia can occur in more than 70% of surgical patients, especially in the intra- and postoperative phases, while its associated complications can affect up to 72% of patients. In certain clinical contexts observed in the literature, especially in studies whose authors analyzed patients without active heating intervention and with prolonged surgeries, the incidence of documented hypothermia was reported in up to 90% of cases, reflecting the importance of effective preventive strategies to maintain normothermia[10,11].

Despite characterizing a preventable event, these rates evidence low adherence to best practices and limited implementation of prevention strategies in many scenarios, which justifies the relevance of the present study. Authors of recent reviews highlight that, even in the face of robust evidence on the effectiveness of active heating and continuous temperature monitoring, its application remains heterogeneous among institutions.

This context is associated with barriers, such as insufficient availability of heating and temperature monitoring devices and financial restrictions for equipment acquisition and maintenance, as well as educational and organizational weaknesses, including absence of standardized protocols and gaps in the culture of perioperative safety and training of teams. Therefore, understanding the level of adherence to best practices is essential to support interventions aimed at improving the quality of care for surgical patients[7,10].

## OBJECTIVE

To verify the percentage of adherence to best practices for preventing hypothermia in the intraoperative period.

## METHODS

This is a cross-sectional, observational, epidemiological study, of a retrospective and documentary nature. Data were collected by analyzing electronic medical records of patients who underwent procedures in the surgical center of a large private hospital located in São Paulo, Brazil. The study population consists of patients who have previously undergone surgical procedures in the hospital where data were collected.

The sample size was determined by sample calculation for estimating proportions, initially considering infinite population, using the formula $n_0 = Z^2 \, x \, \frac{p(1-p)}{e^2}$, where "Z" corresponds to the value of the normal distribution for the adopted confidence level; "p," to the estimated proportion of the outcome; and "e," to the margin of error. Confidence level of 95% ($Z$=1.96), margin of error of 5% (e=0.05), and estimated proportion of 50% (p=0.5) were considered, resulting in $n_0$=384. Subsequently, the correction for finite population was applied using the formula $n = \frac{(N x \, n_0)}{(N+n_0-1)}$, considering a population of approximately 1,600 patients undergoing surgical procedures in the period of one month, corresponding to the average monthly volume of the institution. After correction, the sample size of 310 medical records of patients undergoing surgical procedures was obtained, and this number was considered for the study.

Medical records of adult and older adult patients of both sexes were included. They underwent elective or urgent surgeries in the specialties of general surgery, urology, gynecology, plastic, head and neck, orthopedics, vascular, otorhinolaryngology, thoracic, and neurology. The following medical records were excluded: those with incomplete information, from pediatric patients, cardiac and emergency surgeries, combined between specialties, and those lasting less than 60 minutes.

The collection began with the screening of medical records, according to the inclusion criteria. For each patient record included, an instrument prepared by the authors was completed based on the recommendations of associations that guide perioperative care, containing data on sample profile, anesthetic technique, surgical type and approach, procedure

time, perioperative temperature records, and normothermia maintenance measures adopted by the team.

The data collected on temperature variation were also obtained by information from electronic medical records, for which, in the preoperative and immediate postoperative periods (in PACU or intensive care unit [ICU]), the institution adopts a standardized axillary temperature measurement protocol, characterizing the peripheral method. In the intraoperative period, temperature monitoring follows the criteria of the anesthesiologist, and may include esophageal measurement, considered a central method.

It should be noted that the use of thermal blanket, esophageal thermometer, administration of heated intravenous fluids, and thermal mattress were the measures included in the analysis for maintaining normothermia adhered in the intraoperative period. Passive heating methods were not included due to the shortage of records in electronic medical records.

Data were analyzed using Microsoft Excel and EPI INFO 7 software. Quantitative variables were described by absolute number, percentage, mean, median, standard deviation, and maximum and minimum values. The research followed the ethical standards for research with human beings, with approval of the Ethics Committee of the institution under Opinion No. 7.594.439.

## RESULTS

Secondary data were collected from 310 (100%) patient records, according to inclusion criteria, and the following results were found: in Table 1, in which we characterize the clinical variables of surgical patients, there is a predominance of adults in relation to older adults, with 55.48% (n=172) of the patients aging between 18 and 59 years, 44.52% (n=138) of them aging 60 years or over, with a mean age of 55.96 years, and standard deviation of 16.7. As for sex, there was similarity between groups, with a slight prevalence of men, represented by 50.32% (n=156), compared to 49.68% (n=154) of women. Regarding BMI, the highest prevalence was of patients in the range classified as normal weight, with 41.93% (n=130), followed by 39.68% (n=123) classified as overweight, resulting in a mean BMI of 26.44, median of 25.71, and standard deviation of 4.64.

As for ASA classification, we verified a prevalence of ASA II patients (62.58%; n=194), followed by ASA I (25.16%; n=78), and ASA III (11.61%; n=36). Concerning comorbidities, 26.77% (n=83) of the patients reported absence of chronic diseases, 28.06% (n=87) reported dyslipidemia, 23.87% (n=74) reported hypertension, and 18.71% (n=58) reported psychiatric disorders.

According to Table 2, comprising data on the adopted anesthetic technique, there was a higher prevalence of intravenous general anesthesia, administered to 47.74% (n=148) of the patients. Balanced anesthesia was also expressive, given to 27.10% (n=84) of the patients, followed by the combined technique (general anesthesia with spinal anesthesia), administered to 7.74% (n=24) of the cases.

Regarding medical specialties, whose variables related to surgical procedures are described in Table 3, we observed a prevalence of orthopedic surgery, comprising 22.26% (n=69) of the patients, followed by general surgeries, accounting for 19.35% (n=60) of the cases, a result similar to the prevalence of plastic surgery, accounting for 19.03% (n=59) of patients. As for the surgical approach technique, open surgery prevailed, representing 54.84% (n=170) of the cases. The other approaches included laparoscopies, adopted in 17.10% (n=53) of the cases, followed by 16.13% (n=50) of endoscopic surgeries, and 6.77% (n=21) of robotic surgeries. We verified a predominance of elective surgeries, totaling 80.65% (n=250) compared to urgent ones, which totaled 19.35% (n=60) of the procedures.

Concerning surgical time and size, size-II procedures (43.55%; n=135) accounted for the highest frequency, followed by size I (24.19%; n=75), size III (20%; n=62), and size IV (12.26%; n=38). The mean time of anesthetic-surgical procedure was 210 minutes, with a median of 165 and standard deviation of 138 minutes, ranging from a minimum of 60 minutes to a maximum of 1,010.

In Graph 1, we present the percentage of adherence to the best practices for maintaining normothermia of patients in the intraoperative period. We observed a prevalence in the use of thermal blanket, which was used in 79.68% (n=247) of the patients, followed by the use of the esophageal thermometer, reported in 36.45% (n=113) of the cases. Conversely, thermal mattress and heated intravenous fluids presented a lower adherence rate, both used in 1.61% (n=5) of the patients. No preventive measures were adopted by the other 18.39% (n=57).

Finally, according to the variables presented in Table 4, the mean temperature in the preoperative period was 35.9°C, with a median of 36.0°C, standard deviation of 0.4°C, whose minimum and maximum values recorded corresponded to 34.3 and 37.5°C, respectively. During the intraoperative period, we observed a mean temperature of 36.0°C, median

**Table 1.** Clinical variables of patients seen at the surgical center of the study hospital – São Paulo, 2025.

| | n | % | Mean | Median | SD |
|---|---|---|---|---|---|
| **Age** | | | | | |
| 18–59 years | 172 | 55.48 | 55.96 | 56.50 | 16.70 |
| ≥60 years | 138 | 44.52 | | | |
| **Sex** | | | | | |
| Men | 156 | 50.32 | – | – | – |
| Women | 154 | 49.68 | – | – | – |
| **BMI** | | | | | |
| Underweight (<18.5) | 2 | 0.65 | 26.44 | 25.71 | 4.64 |
| Normal weight (18.5–24.9) | 130 | 41.93 | | | |
| Overweight (25.0–29.9) | 123 | 39.68 | | | |
| Obesity grade I (30.0–34.9) | 40 | 12.90 | | | |
| Obesity grade II (35.0–39.9) | 13 | 4.19 | | | |
| Obesity grade III (≥40.0) | 2 | 0.65 | | | |
| **ASA** | | | | | |
| ASA I | 78 | 25.16 | – | – | – |
| ASA II | 194 | 62.58 | – | – | – |
| ASA III | 36 | 11.61 | – | – | – |
| ASA IV | 2 | 0.65 | – | – | – |
| **Comorbidities** | | | | | |
| DLP | 87 | 28.06 | – | – | – |
| SAH | 74 | 23.87 | – | – | – |
| Psychiatric disorders | 58 | 18.71 | – | – | – |
| DM | 47 | 15.16 | – | – | – |
| Cardiovascular diseases | 45 | 14.52 | – | – | – |
| Endocrine diseases | 38 | 12.26 | – | – | – |
| Respiratory diseases | 26 | 8.39 | – | – | – |
| Obesity | 55 | 17.74 | – | – | – |
| Neurological diseases | 18 | 5.80 | – | – | – |
| Hematological and metabolic diseases | 17 | 5.48 | – | – | – |
| Cancer | 17 | 5.48 | – | – | – |
| Kidney and urological diseases | 14 | 4.52 | – | – | – |
| Gastrointestinal diseases | 11 | 3.55 | – | – | – |
| Rheumatic diseases | 5 | 1.61 | – | – | – |
| None | 83 | 26.77 | – | – | – |
| **Subtotal** | **595** | **191.92%** | | | |
| **Total** | **310** | **100%** | | | |

The sum of comorbidities and percentages exceeds the total sample (n=310/100%) due to the presence of multiple pathologies in the same individual.
BMI: Body mass index; ASA: American Society of Anesthesiologists. SD: Standard deviation; DLP: Dyslipidemia; SAH: Systemic arterial hypertension; DM: Diabetes mellitus.
Source: Prepared by the authors (2025).

**Table 2.** Anesthetic procedures in patients seen at the surgical center of the study hospital – São Paulo, 2025.

| Anesthetic techniques | n | % |
|---|---|---|
| Intravenous general anesthesia | 148 | 47.74 |
| Inhalational general anesthesia | 2 | 0.65 |
| Balanced anesthesia | 84 | 27.10 |
| Combined: general + spinal anesthesia | 24 | 7.74 |
| Combined: general + epidural anesthesia | 3 | 0.97 |
| Combined: sedation + spinal anesthesia | 18 | 5.81 |
| Combined: general + regional block | 17 | 5.48 |
| Combined: sedation + regional block | 7 | 2.26 |
| Combined: sedation + local anesthesia | 3 | 0.97 |
| Sedation | 4 | 1.29 |
| **Total** | **310** | **100** |

Source: Prepared by the authors (2025).

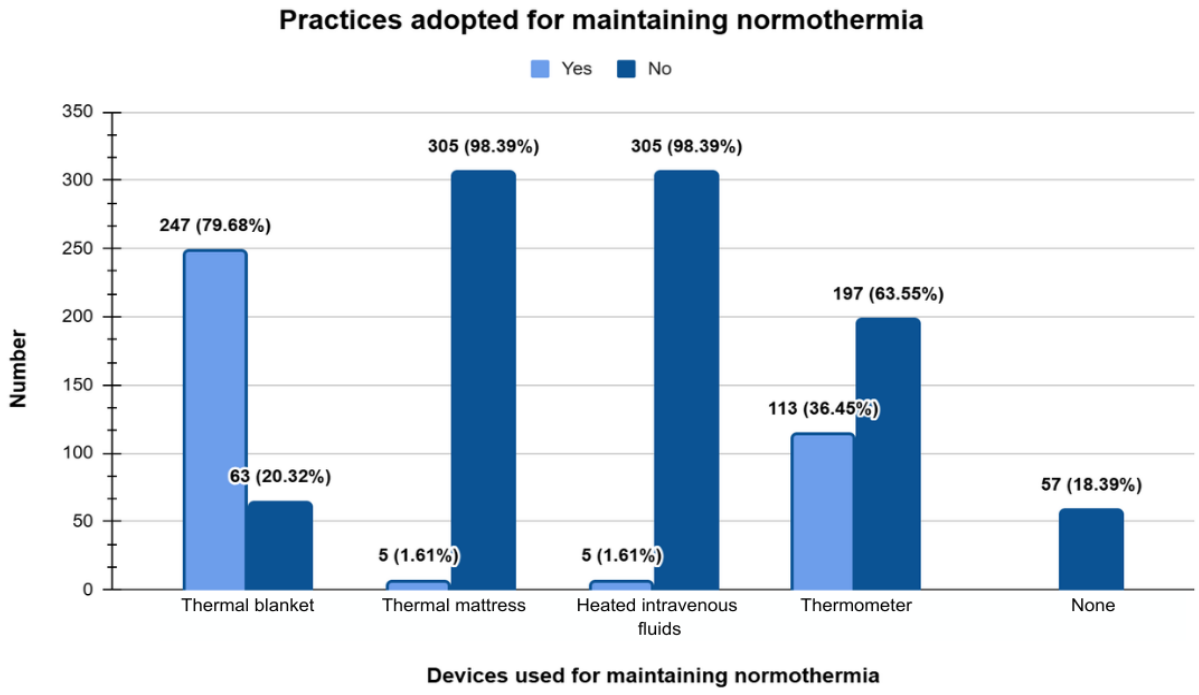
of 36.1°C, and standard deviation of 0.85°C, with temperatures ranging from 32.9 to 38.1°C. In turn, in the postoperative period, including patients referred to PACU or ICU, the mean and median temperature was 35.6°C and standard deviation of 0.75°C, with the minimum and maximum values of 33.0 37.9°C, respectively.

Regarding the type of thermal blanket, of the 247 used, 56.68% (n=140) were upper body blankets; 36.84% (n=91), lower body blankets; and 6.48% (n=16), underbody blankets. It is worth noting that, in the preoperative and in the immediate postoperative periods, 100% (n=310) of the patients had temperature recorded by axillary measurement, while in the intraoperative period, 63.55% (n=197) had no temperature monitoring record, and 36.45% (n=113) were monitored by esophageal measurement.

**Table 3.** Surgical variables applied to patients seen at the surgical center of the study hospital – São Paulo, 2025.

| | n | % | Mean (min) | Median (min) | SD (min) | Minimum (min) | Maximum (min) |
|---|---|---|---|---|---|---|---|
| **Specialties** | | | | | | | |
| General | 60 | 19.35 | – | – | – | – | – |
| Urology | 40 | 12.90 | – | – | – | – | – |
| Gynecology | 16 | 5.16 | – | – | – | – | – |
| Plastic | 59 | 19.03 | – | – | – | – | – |
| Orthopedics | 69 | 22.26 | – | – | – | – | – |
| Otorhinolaryngology | 20 | 6.45 | – | – | – | – | – |
| Vascular | 7 | 2.26 | – | – | – | – | – |
| Thoracic | 11 | 3.55 | – | – | – | – | – |
| Neurology | 17 | 5.48 | – | – | – | – | – |
| Head and neck | 11 | 3.55 | – | – | – | – | – |
| **Approaches** | | | | | | | |
| Open | 170 | 54.84 | – | – | – | – | – |
| Laparoscopic | 53 | 17.10 | – | – | – | – | – |
| Robotic | 21 | 6.77 | – | – | – | – | – |
| Arthroscopic | 16 | 5.16 | – | – | – | – | – |
| Endoscopic | 50 | 16.13 | – | – | – | – | – |
| **Classification** | | | | | | | |
| Elective | 250 | 80.65 | – | – | – | – | – |
| Urgency | 60 | 19.35 | – | – | – | – | – |
| **Duration of anesthetic-surgical procedure** | | | | | | | |
| Size I (up to 2 hours) | 75 | 24.19 | 210 | 165 | 138 | 60 | 1010 |
| Size II (from 2 to 4 hours) | 135 | 43.55 | | | | | |
| Size III (from 4 to 6 hours) | 62 | 20.00 | | | | | |
| Size IV (above 6 hours) | 38 | 12.26 | | | | | |
| **Total** | **310** | **100** | | | | | |

Source: Prepared by the authors (2025).




Source: Prepared by the authors (2025).

**Graph 1.** Adherence to the best practices for maintaining intraoperative normothermia by the multiprofessional team in the surgical center of the study hospital – São Paulo, 2025.

**Table 4.** Description of temperature variation in the perioperative period and use of devices to maintain normothermia in surgical patients seen at the study hospital – São Paulo, Brazil, 2025.

| | n | % | Mean (°C) | Median (°C) | SD (°C) | Minimum (°C) | Maximum (°C) |
|---|---|---|---|---|---|---|---|
| **Perioperative temperature variation** | | | | | | | |
| Temperature in the preoperative period | – | – | 35.9 | 36.0 | 0.40 | 34.3 | 37.5 |
| Temperature in the intraoperative period | – | – | 36.0 | 36.1 | 0.85 | 32.9 | 38.1 |
| Temperature in the postoperative period | – | – | 35.6 | 35.6 | 0.75 | 33.0 | 37.9 |
| **Types of thermal blanket** | | | | | | | |
| Upper | 140 | 56.68 | – | – | – | – | – |
| Lower | 91 | 36.84 | – | – | – | – | – |
| Underbody | 16 | 6.48 | – | – | – | – | – |
| **Type of thermometer in the preoperative period** | | | | | | | |
| Axillary | 310 | 100 | – | – | – | – | – |
| **Type of thermometer in the intraoperative period** | | | | | | | |
| Esophageal | 113 | 36.45 | – | – | – | – | – |
| No use | 197 | 63.55 | – | – | – | – | – |
| **Type of thermometer in the postoperative period** | | | | | | | |
| Axillary | 310 | 100 | – | – | – | – | – |
| **Total** | **310** | **100** | | | | | |

Source: Prepared by the authors (2025).

## DISCUSSION

Perioperative hypothermia is a frequent and clinically relevant complication in surgical procedures, especially when associated with risk factors linked to the patient and the conditions of invasive interventions, and may result in adverse outcomes[2].

Among the predisposing factors related to the patient, advanced age is recognized as a significant factor for the occurrence of perioperative hypothermia[7,12]. According to our analysis, within the respective age group, 69.56% (n=96) of older adults presented with peripheral body temperature below 36°C in the immediate postoperative period, while among adults this proportion was 63.37% (n=109). Considering the total sample of 310 patients, there was a global prevalence of 66.13% (n=205) that evolved with a peripheral body temperature below 36°C. This difference can be attributed to the reduction of thermoregulatory capacity in older adults, including lower muscle mass and impaired vasoconstrictor response[7,12].

Regarding the practices for maintaining normothermia in relation to age group, the use of thermal blankets was high in both groups, accounting for 76.16% (n=131) in adults and 84.06% (n=116) in older adults, while intraoperative temperature monitoring was 42.75% (n=59) in older adults and 31.39% (n=54) in adults.

When analyzing the ASA classification, among the 78 ASA I patients, 82.05% (n=64) used thermal blanket, 23.08% (n=18) had their temperature monitored during the anesthetic-surgical procedure, and 65.38% (n=51) presented with a peripheral temperature drop below 36°C in the postoperative period. In the ASA II group, composed of 194 patients, 78.86% (n=153) used thermal blanket and 36.60% (n=71) were monitored in the intraoperative period; 66.49% (n=129) evolved with a peripheral temperature drop. In turn, among the highest risk groups (ASA III and IV), of the 38 patients, 78.95% (n=30) used thermal blanket, 63.15% (n=24) had their temperature continuously monitored, and 65.79% (n=25) presented with peripheral temperature lower than 36°C in the postoperative period.

Thus, as per the findings according to the ASA classification, despite the high adherence to the use of thermal blanket in all groups—between 78.86% (n=153) and 82.05% (n=64)—the incidence of temperature drop in the postoperative period was 66.13% (n=205), regardless of anesthetic risk. Even in ASA III and IV patients, who presented higher frequency of intraoperative monitoring with esophageal thermometer, there was no significant reduction in the occurrence of temperature drop.

Considering these data, the proportion of patients who evolved with postoperative temperature drop was similar in all groups, partially opposing what is verified in the literature, according to which higher ASA classification is linked to a higher risk of thermoregulatory dysfunction due to the presence of comorbidities and lower physiological reserve[13]. It is also evident that the adoption of isolated measures, even when directed in a proportional way to the risk, is not always sufficient to ensure the maintenance of normothermia[12].

In this sense, the drop in body temperature is common even using preventive measures, which suggests, according to evidence from the literature, that the isolated adoption of active heating methods, when not employed in a combined and continuous manner throughout the perioperative period, may not be enough to prevent temperature drop. Moreover, the late onset of measures, such as the use of thermal blanket only after anesthetic induction, has reduced efficacy in the face of the rapid thermal redistribution promoted by anesthesia, which justifies the prevalence of body temperature drop in all ASA groups; hence, the maintenance of normothermia, according to the literature, seems to depend not only on the implementation of the thermal blanket, but on the early, continuous, and combined application of preventive methods throughout the perioperative period[12].

As for the anesthetic technique, the use of anesthetic drugs leads to redistribution of body heat and lack of thermoregulatory responses[11,14,15]. These mechanisms justify the hypothermia rates found in the present study, in which, of the 113 patients with continuous monitoring of intraoperative temperature, 69.91% (n=79) presented with intraoperative hypothermia, registering a minimum core temperature below 36.0°C. Of these patients, 79.74% (n=63) were given general anesthesia and 18.98% (n=15), the combined technique. In the immediate postoperative period, in turn, 66.13% (n=205) presented with a drop in peripheral body temperature below 36°C, of which 74.63% (n=153) were given general anesthesia and 23.07% (n=48), the combined technique, general anesthesia or sedation with spinal anesthesia.

These findings may be related to the variable adherence to measures to maintain normothermia such as the thermal blanket. That is, of the 234 patients who were given general anesthesia, 78.21% (n=184) used thermal blanket,

of which 60.86% (n=112) presented with a drop in peripheral temperature in the postoperative period. Among the 50 in which this resource was not used, almost the totality, i.e., 82% (n=41), presented with a drop in peripheral body temperature in the postoperative period. In turn, among the 72 patients who were given the combined technique, we verified high rates of adherence to the use of thermal blanket, accounting for 84.72% (n=61) of them; nonetheless, 65.57% (n=40) presented with peripheral temperature below 36°C in the postoperative period, which reinforces the prolonged impact of the combined technique on thermoregulatory mechanisms[14,16].

Thus, our results corroborate other studies, whose authors indicate a prevalence of hypothermia in about 75% of the patients who were given general anesthesia and around 50% of those who were given the combined technique[15], and the rate of occurrence of perioperative hypothermia at PACU admission was 77.8%[11].

Such results can also be verified, considering that the anesthetic effect of spinal anesthesia, unlike general anesthetics, takes about three hours to completely cease, prolonging the depression time of thermoregulatory actions. Therefore, according to the literature, there is a higher risk of developing inadvertent hypothermia when combined with general and local anesthetic techniques[14,16].

Certain surgical approaches may also offer a high risk of developing hypothermia—such as open surgeries with cavity exposure, which provide greater heat loss, and laparoscopies, due to the exposure of cavities to cold carbon dioxide used for abdominal insufflation[17].

These mechanisms justify the low peripheral temperature rates found in the different surgical approach techniques, in which, of the 170 patients undergoing open surgeries, 65.88% (n=112) presented with a drop in postoperative peripheral temperature below 36°C, a slightly higher rate when compared to those undergoing video surgeries, either laparoscopic or robotic, in which of the 74 patients, 60.81% (n=45) presented with low temperature when leaving the operating room.

Regarding the continuous temperature monitoring in the intraoperative period, this resource showed relatively low adherence in open surgeries, in which only 44.11% (n=75) of the patients had their temperature monitored in the operating room and, of these, 73.33% (n=55) presented with hypothermia throughout the surgery. In turn, in laparoscopic procedures, a thermometer was used in only 37.84% (n=28) of the patients, of which 60.71% (n=17) presented with intraoperative hypothermia. In endoscopic and arthroscopic techniques, adherence to thermometer in the intraoperative period was even lower, being used in only 20% (n=10) of the patients eligible to the endoscopic technique and none who underwent arthroscopy.

The thermal blanket presented good adherence rates, being used in 80.9% (n=137) of the patients undergoing open surgeries, in 82.43% (n=61) who underwent laparoscopies, in 76% (n=38) of those eligible to endoscopic surgeries, and 68.75% (n=11) of those eligible to arthroscopy.

The duration of the anesthetic-surgical procedure is a determining factor for the implementation of perioperative hypothermia prevention strategies. National and international guidelines recommend the adoption of preventive measures and the monitoring of body temperature in procedures lasting 60 minutes or more, considering the rapid fall in core temperature in the first hour of anesthesia, coupled with prolonged exposure to the surgical environment in thermoregulation[2,14,15]. In the present study, the characterization of the surgical time was presented by the classification of surgical size (I to IV), according to previously presented intervals. We observed high adherence to the use of thermal blanket in all sizes (79.68%, n=247), consisting in the preventive method with the highest adherence index in the collected sample. Authors of previous studies have shown that patients heated with the forced-air warming system took an average of 195 minutes to rewarm, while those in which cotton blanket was used took an average of 295 minutes. Thus, the forced-air warming system was the most effective heating method, justifying its use preferably in hypothermic patients, rather than passive heating methods[18].

However, continuous monitoring of core body temperature was observed by the esophageal thermometer in only 36.45% (n=113) of the anesthetic-surgical procedures, showing that 63.55% (n=197) of the patients were not adequately monitored during the intraoperative period. This finding is worrisome, evidencing a relevant gap in the care practice in the face of the current recommendations[2,14,15].

Among other best practices for preventing perioperative hypothermia, the infusion of heated intravenous fluids and the use of thermal mattress stand out. As per international guidelines, intravenous fluids and blood products should be administered heated whenever volumes greater than 500 mL are infused or when the infusion rate exceeds 1,000 mL/h[6,14,15,19]. Likewise, the thermal mattress is recognized as an effective active method in the prevention of hypothermia, as it covers

a large body area, favoring efficient heat transfer and minimizing thermal redistribution[19]. Despite the proven efficacy and scientific evidence, both strategies were little used in the sample of this study, being applied in only 1.61% (n=5) of the patients, evidencing the opportunity to expand the incorporation of these practices into the perioperative routine, aligning the provided care with the available evidence.

It is also noteworthy that perioperative hypothermia is associated with several relevant clinical repercussions. Nevertheless, despite the evidence about its risks, this complication is still undervalued in the surgical context, which reduces the adoption of some preventive practices by the teams, as evidenced in the verified results. Researchers point out that part of the surgical and anesthetic teams tend to consider hypothermia as a secondary event or of less clinical relevance, contributing to low adherence to best preventive practices. The lack of standardized institutional protocols, knowledge of their consequences by the teams, and adequate equipment for temperature monitoring, as well as the perception that hypothermia is an inevitable consequence of cold surgical environments, are factors that favor low adherence to recommendations[18].

Considering perioperative hypothermia as a preventable condition, adherence to best practices plays a key role in the quality of surgical care. Continuous monitoring of body temperature throughout the perioperative period is a fundamental practice, as it allows the early identification of temperature changes and supports timely clinical interventions to maintain normothermia[8,18]. Furthermore, authors of previous studies have shown that the use of active heating methods, such as thermal blanket and thermal mattress, and the infusion of heated intravenous fluids, have greater efficiency in temperature maintenance, especially when used in combination[18].

These interventions are broadly supported by scientific evidence and national and international guidelines, and should be incorporated into the care routine, considering that they represent strategies of high clinical impact capable of positively influencing surgical outcomes and patients' experience in the perioperative period[19]. In this sense, investigating the rates of adherence to preventive measures of perioperative hypothermia becomes essential to understanding the care reality and identifying critical points that hinder the consolidation of evidence-based care practices, aiming at supporting the formulation of strategies that favor the care for the surgical patient[18].

## CONCLUSION

In this study, we identified the most adopted strategies for preventing perioperative hypothermia in the intraoperative period, highlighting the use of thermal blanket in 79.68% (n=247) of patients and the monitoring of intraoperative core temperature by esophageal thermometer in 36.45% (n=113), which allow the early identification of temperature changes and support timely interventions for the maintenance of normothermia. Conversely, we verified a lower rate regarding the use of heated fluids and thermal mattress, which were recorded in only 1.61% (n=5) of the procedures.

The characteristics of the sample and surgical procedures demonstrated the presence of risk factors for hypothermia; however, despite evidence about its associated complications, this condition is often undervalued in the surgical context, which justifies the low adherence to some practices by the teams.

It should be noted that the present study has limitations, including the analysis of data restricted to the information recorded in the electronic medical records, which prevented the identification of undocumented practices that could be verified by direct observation. We also emphasize the institutional context as a study limitation, contemplating a private hospital with wide availability of material resources and infrastructure. These conditions may not reflect the reality of other health institutions, which often face budgetary constraints, scarcity of inputs, and absence of consolidated guidelines. Hence, the findings of this study should be interpreted with caution as to its applicability to different contexts, suggesting the performance of more similar research in different institutional realities.

Nevertheless, the data analysis contributes to increasing the knowledge of the practical application of care recommendations, emphasizing the importance of normothermia as an indicator of quality and safety, in order to contribute to better clinical outcomes. Therefore, investigating the rates of adherence to preventive measures of perioperative hypothermia becomes essential to support the planning of care processes and the strengthening of good practices in the perioperative environment.

## AUTHORS' CONTRIBUTIONS

SDM: Conceptualization, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. LL: Conceptualization, Data curation, Formal analysis,

Writing – original draft, Writing – review & editing. CRFI: Conceptualization, Writing – original draft, Writing – review & editing. SGL: Conceptualization, Writing – original draft, Writing – review & editing. MCG: Conceptualization, Formal analysis, Writing – original draft, Writing – review & editing. DMB: Conceptualization, Data curation, Formal analysis, Writing – review & editing. ESK: Conceptualization, Formal analysis, Writing – original draft, Writing – review & editing.

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## CONFLICT OF INTERESTS

The authors declare there is no conflict of interests.

## REFERENCES


1. North American Nursing Diagnosis Association (NANDA). Diagnósticos de enfermagem da NANDA Internacional: definições e classificação (2018-2020). 11a. ed. Porto Alegre: Artmed; 2018.
2. Associação Brasileira de Enfermeiros de Centro Cirúrgico, Recuperação e Centro de Material e Esterilização. Diretrizes de Práticas em Enfermagem Perioperatória e processamento de Produtos para Saúde. 8a ed. rev atual. São Paulo: SOBECC; 2021.
3. Chacón Abba R. Hipotermia perioperatoria. Rev Chil Anest. 2021;50(1):56-78. https://doi.org/10.25237/revchilanestv50n01-05
4. Vanni SMDA, Braz JRC. Hipotermia perioperatória: novos conceitos. Rev Bras Anestesiol. 1999;49(5):360-7.
5. Wittenborn J, Clausen A, Zeppernick F, Stickeler E, Meinhold-Heerlein I. Prevention of Intraoperative Hypothermia in Laparoscopy by the Use of Body-Temperature and Humidified CO2: a Pilot Study. Geburtshilfe Frauenheilkd. 2019;79(9):969-75. https://doi.org/10.1055/a-0903-2638
6. Cunha RGB, Guimarães SM, Schneider DS, Bongiorni GT. Revisão Integrativa: Hipotermia não intencional com a incorporação de evidências na prática clínica. Aletheia. 2020;53(1):13-28.
7. Rauch S, Miller C, Bräuer A, Wallner B, Bock M, Paal P. Perioperative Hypothermia – A Narrative Review. Int J Environ Res Public Health. 2021;18(16):8749. https://doi.org/10.3390/ijerph18168749
8. AORN Recommended Practices Committee. Recommended Practices for the Prevention of Unplanned Perioperative Hypothermia. AORN J. 2007;85(5):972-88. https://doi.org/10.1016/j.aorn.2007.04.015
9. American Society of Anesthesiologists. Standards for basic anesthetic monitoring [Internet]. Schaumburg: ASA; 2020 [accessed on July 29, 2025]. Available at: https://www.asahq.org/standards-and-practice-parameters/standards-for-basic-anesthetic-monitoring
10. Ji N, Wang J, Li X, Shang Y. Strategies for perioperative hypothermia management: advances in warming techniques and clinical implications: a narrative review. BMC Surg. 2024;24(1):425. https://doi.org/10.1186/s12893-024-02729-0
11. Oliveira RF, Lima IP, Gabiatti D, Nascimento ASM, Fuganti CCT. Desenvolvimento de protocolo clínico assistencial para prevenção e tratamento da hipotermia perioperatória. Rev Min Enferm. 2022;26. https://doi.org/10.35699/2316-9389.2022.40293
12. Hernández-Alcázar EJ, Ramírez-Tapia Y, Cuevas-Hernández A, Salas-Palomino I. Perioperative hypothermia: a systematic review. Rev Med Hosp Gen Mex. 2024;87(2):61-71. https://doi.org/10.24875/HGMX.23000071
13. Tan R, Chen Y, Yang D, Long X, Ma H, Yang C. Risk factors for postoperative hypothermia in non-cardiac surgery patients: a systematic review and meta-analysis. BMC Anesthesiol. 2025;25(1):223. https://doi.org/10.1186/s12871-025-03089-9
14. Ribeiro AF, Pereira E, Matias F, Azenha M, Macedo AL, Órfão MDR. Manutenção da normotermia perioperatória em Portugal–questionário de avaliação. RSPA. 2017;26(1):10-17. https://doi.org/10.25751/RSPA.10127
15. Oliveira TM, Aranha AL, Barbieri BM, Lopes AB, Fiorin BH. Ações de enfermagem no tratamento de hipotermia perioperatória: uma revisão de literatura. Res Soc Dev. 2022;11(8):e39911831193. https://doi.org/10.33448/rsd-v11i8.31193
16. Ribeiro E, Tabian Navarro N, Armede VCB, Rodrigues HS, Valle JPD, Duran ECM. Frequência de hipotermia não intencional no perioperatório de cirurgias eletivas. Rev SOBECC. 2016;21(2):68-74.
17. Chen H-Y, Su L-J, Wu H-Z, Zou H, Yang R, Zhu Y-X. Risk factors for inadvertent intraoperative hypothermia in patients undergoing laparoscopic surgery: A prospective cohort study. PLoS One. 2021;16(9):e0257816. https://doi.org/10.1371/journal.pone.0257816
18. Muniz GS, Teles NSB, Leitão IMTA, Almeida PC, Leitão MC. Hipotermia Acidental: Implicações para os cuidados de enfermagem no transoperatório. Rev SOBECC. 2014;19(1):79-86. https://doi.org/10.4322/sobecc.2014.009
19. Moysés AM, Trettene ADS, Navarro LHC, Ayres JA. Hypothermia Prevention During Surgery: Comparison Between Thermal Mattress And Thermal Blanket. Rev Esc Enferm USP. 2014;48(2):228-35. https://doi.org/10.1590/s0080-623420140000200005