Research Article

The Impact of Anaesthesiology Service Accreditation on the Incidence of Postoperative Hypothermia: A Time Series Study

Juliana Thomaz Menck[1*], Rohnelt Machado de Oliveira[2], Júlio Cezar Uili Coelho[3], Ana Carolina Locatelli Stunitz[4]

[1]Department of Anesthesiology, Federal University of Paraná, Paraná, Brazil, [2]Department of Anesthesiology, Federal University of Paraná, Paraná, Brazil, [3]Department of Surgery, Nossa Senhora das Graças Hospital, Curitiba, Paraná, Brazil, [4]Department of Anesthesiology, Nossa Senhora das Graças Hospital, Curitiba, Paraná, Brazil

Corresponding author:
Juliana Thomaz Menck, Department of Anesthesiology, Federal University of Paraná, Paraná, Brazil, E-mail: juliana_menck@hotmail.com
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Abstract

Background: Hospital and medical subspecialties accreditation programs evaluate institutions based on predetermined quality standards. Several indicators can be used to measure the quality of health.

Aim: This study aimed to evaluate the effect of accreditation on postoperative hypothermia rate in an anesthesiology department.

Methods: This was a longitudinal, observational and retrospective study, with an interrupted time series design. The temperatures of patients in post-anesthetic recovery were analyzed between January 2021 and February 2023 with three cycles of plan-do-study-act interventions being carried out during this period. Mild and moderate hypothermia rates and monthly temperature means were evaluated using linear regression graphs to verify possible shifts in variables or trends.

Results: The data were collected from 20,149 participants. It was observed an increase in level (0.3 degrees, P<0.01) and in trend (0.2 degrees per month, P=0.02) in monthly temperature mean along the accreditation program. The rate of moderate hypothermia fell by a mean of 3.6% per month (P<0.01) getting close to zero (P=0.03). Mild hypothermia was initially more resistant but showed a significant downward trend after the third intervention cycle decreasing by 9% per month (P=0.01).

Conclusion: This study shows a beneficial effect of accreditation on postoperative hypothermia rate in an anesthesiology service.

Keywords: Accreditation; Hypothermia; Time-series

Introduction

Accreditation is a program that evaluates organizations based on pre-established quality standards. Hospitals worldwide seek accreditation, usually voluntarily, to improve patient care and safety [1]. The same is true for medical specialty services, such as anesthesiology, whose improvements increase the institution's credibility.

However, measuring quality in health is difficult. Several indicators have been proposed in anesthesiology services, but the extent to which these metrics are directly related to anesthesia and whether improving these parameters brings real benefits is still under discussion. Anesthetic care is often monitored through indicators collected in the immediate postoperative period, such as the incidence of pain, nausea, and vomiting [2]. The rate of hypothermia is also important, but many hospitals have no protocols or policies for managing perioperative temperature. Thus, this parameter needs to be effectively improved, as does the data collection itself to avoid underreporting [3].

The implementation of an accreditation program in our anesthesiology service resulted in interventions aimed at improving hypothermia rates in the Post-Anesthetic Care Unit (PACU). Disseminating the data for anesthesiologists is not necessarily associated with an improved parameter, which has led us to implement more continuous and multifaceted evaluation cycles [4]. This study aimed to determine whether the implementation of an accreditation program in the anesthesiology department changes the incidence of postoperative hypothermia.

Materials and Methods

This was a longitudinal, observational and retrospective study, with an Interrupted Time Series (ITS) design. It was performed in accordance with the Declaration of Helsinki and was approved by the Research Ethics Committee of the Department of Health Sciences of the University under CAAE no. 66887123.5.0000.0102 (plataformabrasil.saude.gov.br, approved on March 2, 2023). It also received approval from the Research Ethics Committee of the co-participating institution under CAAE no. 66887123.5.3001.0269 (plataformabrasil.saude.gov.br, approved on April 10, 2023). The study followed

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the recommendations of the Standards for Quality Improvement Reporting Excellence (SQUIRE) guideline, a tool obtained from the Equator Network [5].

Our anesthesiology service is part of a private hospital and currently has a team of 20 anesthesiologists working in approximately 700 to 1,000 small, medium and large operations a month. The search for an accreditation program occurred voluntarily in September 2020, in the context of high surgical demand after the COVID-19 pandemic and due to the need to restructure our service to improve patient care and safety. The implementation was carried out with the Qualisa Management Institute (IQG), using the Qmentum international accreditation model.

We initially focused on collecting data about the indicators. Body temperature was measured on all patients referred to the PACU using an axillary thermometer (skin temperature sensor compatible with a Mindray multiparameter monitor). These data were already routinely collected by physicians, nurses or technicians as part of the mandatory vital signs checklist in the immediate postoperative period. The data were registered in each patient's medical record and monthly tables were generated for analysis of hypothermia rates by the anesthesiology department. This collection, which used to be manually reported in physical records, started to be reported in electronic medical records (Tasy/Philips management system) after January 2021, which clearly showed the underreporting of hypothermia cases. Reducing this rate and correctly measuring the temperature became the focus in subsequent meetings with the IQG team. A continuous study and action plan called the Plan-Do-Study-Act (PDSA) cycle was structured, a well-known concept in business that had been increasingly used in healthcare quality management. The tool promotes iterative changes, i.e., it is a four-stage cycle that is repeated: planning the change, executing it, analyzing the results, and acting on the necessary changes in a new cycle. This working mechanism is widely used in programs focused on better quality indices, being particularly important in complex environments such as hospitals [6].

The first PDSA cycle took place in June 2021, and subsequent cycles and interventions have been based on the analysis and study of the results of the previous one (Table 1). The anesthesiology service accreditation certificate was obtained in September 2021, after the second cycle, and the third cycle took place several months later, in December 2022.

The monthly incidence of hypothermia (<36°C) in the immediate postoperative period and the relative mild (34°C to 35.9°C), moderate (30°C to 33.9°C), and severe (<30°C) hypothermia rates from August 2020 to February 2023 were calculated. This classification was based on the IQG manual produced in partnership with the Brazilian Society of Anesthesiology. In addition, the mean monthly temperature was determined and all measurements were collected both when the patient entered (first measurement) and left (last measurement) the PACU [7]. The objective was to include all patients who went to the PACU of the hospital's general operating room during the period analyzed, so no sample calculation was necessary. Value or behavior changes in these variables over time were studied in association with the interventions carried out during the service accreditation process to check whether they resulted in the expected positive impact.

Table 1: Plan-do-study-act intervention cycles.

Cycles	Plan	Do	Study	Act
First cycle (June/2021)	Focus on general guidelines and monitoring	-Warming the PACU -Controlling air conditioning -Using a thermometer in the perioperative period	Moderate hypothermia improvement. No mild hypothermia changes	Many patients are admitted to the operating room with hypothermia. Focus on the preoperative period
Second cycle (September/2021)	Improve preoperative warming	Commitment to keeping the admission room warm and having blankets available for patients	No improvement in mild hypothermia data	Need for improving active patient warming in the intraoperative period
Third cycle (December/2022)	Improve intraoperative warming	Purchase forced-air warming devices	First improvement in mild hypothermia rates at the PACU	Encourage the use of intraoperative forced-air warming

Statistical analysis

The data was organized into a monthly time series. The mean temperatures and hypothermia rates before and after the first intervention were compared using a T-test. In addition, level and trend changes were quantified over time using ITS regression models in order to analyze the results in conjunction with the interventions. Regression model coefficients add up as time passes, resulting in a mean monthly increase or decrease over the period. Autocorrelation was assessed using the Durbin-Watson test, and corrected when necessary, using the Cochrane-Orcutt method. The results are presented in figures and tables, and the analyses were carried out using the R software, always at a 5% significance level.

Results

After changing to electronic data collection, we found out that hypothermia rates were underreported between August and December 2020 (normothermia rate went from 95% to 7% in the month following the change). Therefore, as the data were not reliable, they were not included in the ITS analysis. The pre-accreditation period analyzed comprehended January to May 2021.

A total of 25,492 surgeries were performed between January 2021 and February 2023, including elective and emergency surgeries. The data of 20,149 patients (79%) were complete, therefore being included in the study. The other patients were excluded. Six variables were quantified over this 26-month period, including mean temperature in the first and last measurements and the rate of mild and moderate hypothermia in the first and last measurements. No cases of severe hypothermia were observed over this period.

The results showed an increased mean monthly temperature after June 2021, when the interventions began (from 35°C to 35.3°C, P<0.01). In addition, the rate of moderate hypothermia decreased from 7.5% to 1.3% in the first measurement (P<0.01), while the rate of mild hypothermia increased from 80.3% to 86% (P<0.001) (Table 2).

The analysis of the linear regression models showed the following results:

Mean monthly temperature in the first measurement: A significant level change was observed in September 2021 (an increase of 0.3 degrees compared to what would be expected with the previous trend, P<0.01). In addition, a trend change was observed in December 2022, when temperatures began to increase by 0.2 degrees per month (P=0.02) (Figure 1).

Moderate hypothermia in the first measurement: Prior to June 2021, this rate decreased by a mean of 1.3% per month (P<0.001). Then, a level increase of 8.6% immediately occurred after the first intervention (P<0.001), along with a greater downward trend in this rate, which began to fall by a mean of 3.6% per month (P<0.01). After the second intervention, in September 2021, a significant level decrease close to zero (P=0.03) and a tendency for this rate to stabilize by the end of the analysis period (P<0.001) were observed (Figure 2).

Mild hypothermia in the first measurement: A significant trend change was only seen in December 2022, after the third PDSA cycle, when the rate of mild hypothermia started to decrease by 9% per month (P=0.01) (Figure 3).

The mean temperature and moderate and mild hypothermia rates showed no significant level or trend changes in the last measurements after the interventions.

Table 2: Mean temperature and hypothermia rates in the two measurements.

Characteristics	01/2021 to 05/2021, N=5*	06/2021 to 02/2023, N=21*	*P*-value†
Temperature at first measurement	35.0 (0.2)	35.3 (0.1)	<0.01
Temperature at last measurement	36.0 (0.1)	36.0 (0.1)	0.45
Mild hypothermia rate at first measurement	80.3 (1.4)	86.0 (6.2)	<0.001
Mild hypothermia rate at last measurement	29.8 (5.7)	36.3 (8.3)	0.07
Moderate hypothermia rate at first measurement	7.5 (2.5)	1.3 (2.4)	<0.01
Moderate hypothermia rate at the last measurement	0.3 (0.3)	0.1 (0.1)	0.25

Note: *Mean (standard deviation), †Welch's t-test

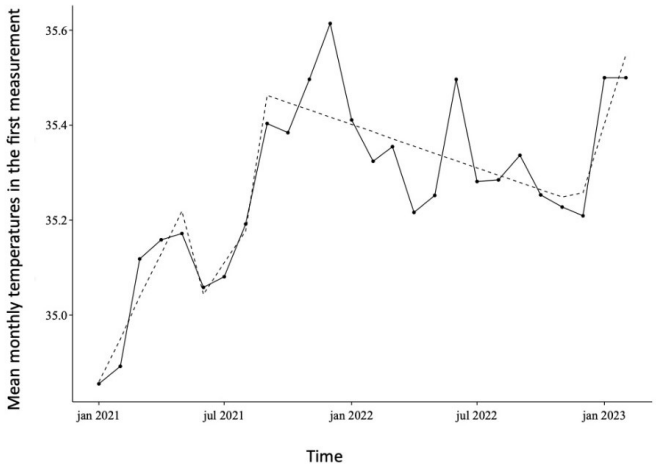

Figure 1. Linear regression for mean monthly temperatures in the first measurement.

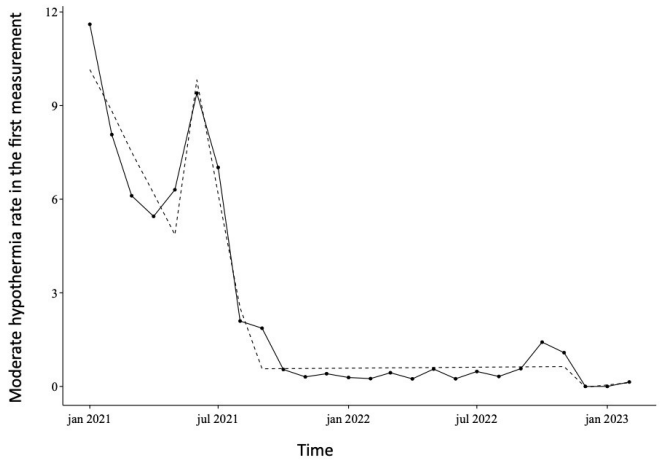

Figure 2. Linear regression for the rate of moderate hypothermia in the first measurement.

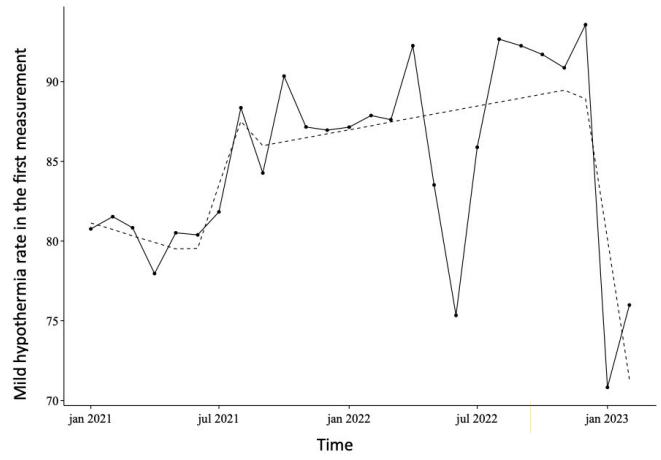

Figure 3. Linear regression for the rate of mild hypothermia in the first measurement.

Discussion

Improving data collection is the first step for changing any indicator. Reliable data improves staff engagement in the process and ensures that interventions are focused to areas of genuine need. Thus, changing the collection method to spreadsheets automatically generated from electronic medical records was essential to start improving our service [2]. The normothermia rate decreased from 95% in December 2020 to 7% in January 2021, showing significant underreporting of patients with temperatures below 36°C. Hypothermia cases previously depended on the PACU team to specifically record the event, which probably only happened with more serious cases or those patients who attracted more attention.

Time series are studies that analyze quantitative data and their distribution over time. Its graphical analysis shows trends, seasonality or any factor that could interfere with the measurement of interest. They are very important in epidemiological and public health studies. Although randomized clinical trials are considered the gold standard, ITS are a strong tool for analyzing the impact of health interventions in situations that evaluate larger populations, historical data, or where it is not possible to have a control group [8]. A study that critically evaluated the methodology of several ITS showed that simple data analysis before and after the intervention using the T-test is subject to biases, thus it recommends the use of regression techniques as the most appropriate statistical method [9]. We believe it is better to analyze the two results together, as the information provided by the two tests is important and, if interpreted correctly, complements one another [10].

After the beginning of the accreditation interventions, the mean temperature upon PACU admission increased, which led to significantly decreased moderate hypothermia values. However, it was insufficient to improve mild hypothermia since this rate increased at the amount over the period analyzed, showing a migration of patients between the two classifications. The analysis of regression techniques complements this result. The first two PDSA cycles, whose interventions were more focused at improving patient monitoring and care and attention to room temperature, were particularly important in reducing the rates of moderate hypothermia, keeping them close to zero. However, mild hypothermia was more resistant, with positive changes only seen after December 2022, when forced-air warming systems were available in all operating rooms. The third PDSA cycle also led to a trend in mean temperature change, which increased again by 0.2°C per month, highlighting the importance of active heating devices in the intraoperative period.

A more detailed analysis of each intervention showed moderate hypothermia rates increased by 8.6% right after the first PDSA cycle, which may reflect greater case reporting due to data collection by PACU team. However, a significant trend change occurred over the same period, bringing the rates of moderate hypothermia close to zero over a short time. This corroborates the positive effect of strategies aimed at guiding and educating the staff [11,12].

Pre-warming the patients, which was analyzed in the second PDSA cycle, may prevent body temperature decreases by reducing heat redistribution to the periphery after anesthetic induction. Some studies showed that the use of forced-air warming before the procedure reduced the incidence of intraoperative hypothermia [13]. Our study reports a positive level change in the mean monthly temperature and a negative level

change in the rates of moderate hypothermia after September 2021 due to the availability of more blankets to patients and the increased temperature of the pre-surgical admission room [14,15]. Although we found this beneficial association, it was not possible to collect the patients' preoperative temperatures automatically; thus, we cannot confirm whether the intervention increased these values as desired.

The third PDSA cycle aimed to increase the temperature with active intraoperative heating. However, due to economic or bureaucratic difficulties at the hospital, it was only possible in December 2022. A guideline published in England by the National Institute for Health and Care Excellence (NICE) in 2008, revised in 2016, recommends the use of forced-air warming in the intraoperative period, and a 2016 Cochrane review that analyzed 67 randomized controlled clinical trials associated the use of these devices with increased body temperature and decreased hypothermia complications, such as cardiovascular events and surgical site infections [16,17]. Many studies also report that this type of heating is more effective than passive methods such as cotton blankets. Those were the most used tool in our service as they were less expensive, which would explain the positive effect after the third intervention cycle [18,19].

The temperatures collected at PACU discharge, called last measurement variables, showed no significant changes over the period analyzed. This indicates that, although the first cycle focused on warming the PACU, the interventions in this study were more centered on managing intraoperative hypothermia, resulting in warmer patient discharges from the operation room.

All these changes were part of a restructuring of the anesthesiology service implemented during the accreditation process, which had a positive impact on postoperative hypothermia rates. It includes not just the improvements in the monitoring and more advanced equipment, but also educational and organizational status. Studies analyzing hospital accreditation programs have presented conflicting results. Although some reported positive outcomes, most reviews emphasize that the existing studies are heterogeneous, mostly observational, and many present low evidence levels [20,21]. A randomized clinical trial carried out in South Africa in 2003, widely cited in the literature for its methodology, found better compliance measures in accredited hospitals than in control hospitals [22-24]. However, no positive association was found when analyzing seven out of eight quality indicators, including patient satisfaction. Only a slight improvement in the nurses' perception of quality was observed. Some publications also analyzed the accreditation of subspecialties, suggesting it helped improve health quality by focusing more on the professional [25]. Anesthesiology accreditation is strongly recommended in World Health Organization guidelines, and many metrics can be used in the evaluation [26,27]. An article published in 2012 states that good quality indicators should be created to optimize interventions, provide feedback to the team, and measure service improvements, which were contemplated in our study with the measurement of postoperative hypothermia [2].

This study has some limitations. The data automatically generated in tables did not include the total number of surgeries by month. This collection failure of 5,343 participants (21%) refers to those who did not have their temperature measured or registered in their medical records. This may be due to postoperative patients admitted to the Intensive Care Unit (ICU), small children who did not allow the axillary thermometer to be positioned correctly, and incorrectly typed or missing records, especially in night and weekend shifts, where correct recording was less supervised. Patients eligible for postoperative ICU admission may be at greater risk of hypothermia due to more complex and longer surgeries, but they also tend to receive more attention regarding their temperature from anesthesiologists, which is also true in pediatric anesthesia [28]. Therefore, due to the difficulty in obtaining exact information on the population with unmeasured data, we cannot state that the hypothermia rate found in the study represents all of our patients [29]. ITS is considered a quasi-experimental method and does not have the same strength of association as a randomized clinical trial. In addition, it was not possible to include intraoperative temperature values in the analysis. These data would require individual collection from each patient's records, which was unfeasible due to the large number of participants. Other anesthetic quality indicators, such as postoperative pain, nausea and vomiting, although analyzed by the accreditation program, were not included in this study. These parameters did not undergo major interventions by the service, and the PDSA cycle was only implemented to control hypothermia.

Although our analysis is restricted to a single quality indicator, the accreditation had a beneficial effect on reducing postoperative hypothermia in the service. It's important to notice that this is a populational study, so there's no intention to individualize the results. There is no other study in the literature that address the specific management of hypothermia along the anesthesiology accreditation process, especially with this large number of participants. Many other parameters still need to be assessed, not only regarding the immediate postoperative period but also on possible organizational, cultural, professional and economic changes in the institution.

Conclusion

Accreditation programs in health sector are more common each day. It's essential to pursuit quality for all hospital areas as also to find reliable ways of measuring it. This study concludes that implementation of an accreditation program reduces the incidence of postoperative hypothermia in the anesthesiology department.

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