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## Educational Intervention with Visual Cues to Increase Compliance with Postoperative Warming

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Educational Intervention with Visual Cues to Increase Compliance with Postoperative Warming

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June 26, 2022

Author Note

This doctoral project is dedicated to my wife and children, Rizpah, Patrick, and Gabrielle, who went on this journey with me every step of the way. In addition, I would like to dedicate this doctoral project to the memory of my mother, Juliana Domingo. She started this journey with me but passed away before my completion. I would like to thank my doctoral project chair, Dr. Denise Dawkins, and my program advisor, Dr. Lisa Walker-Vischer. Thank you for believing in me and supporting me along this journey. I would also like to thank my SJSU 2022 Spring Cohort classmates. Thank you for being so generous and supportive. I would like to thank the PACU RNs from KP Richmond that took part in this project. You took the time to listen and improve the outcomes of our patients. Finally thank you to my big sister, Marites Williamson, for always believing in me and supporting me through my failures and triumphs.

### Abstract

Millions of operations are performed annually in the United States. However, postoperative hypothermia still affects surgical patients who are not thermoregulated and can occur among them during the postoperative period. Postoperative warming compliance rates across countries and institutions are generally poor (Koh et. al, 2021). Therefore, the focus of the DNP project was to assess how providing education on postoperative warming and providing visual cues to the PACU RNs would increase postoperative warming compliance. The PACU RN participants were provided postoperative warming education with visual cues. Specifically reviewed with the PACU RNs was taking the patient's temperature, connecting the patient to a forced air warming device if hypothermic, and documentation. A three month pre- and post-chart review was done to obtain the baseline data on PACU RN compliance. A Social Science Statistics Fisher Exact Test Calculator and Microsoft Excel was utilized to perform all data analysis. Results revealed an averaged increase of 85.6% postoperative warming compliance rate that was a statistically significant improvement ( $p < 0.05$ ) after the intervention with the PACU RNs. Postoperative warming education with visual cues helped improve postoperative warming compliance in the PACU. The project showed how essential education is to remind PACU RNs the dangers of hypothermia and what measures are needed to prevent postoperative hypothermia.

*Keywords:* postoperative hypothermia, forced warm air, electronic medical records, PACU, normothermia

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## Educational Intervention with Visual Cues to Increase Compliance with Postoperative Warming

**Chapter 1: Introduction**

Hypothermia, a condition that affects an individual's core temperature, affects 70% of surgical patients. Hypothermia occurs when a human's core temperature falls to 36°C/96.8°F or less (Bu et al., 2019). Hypothermia results in vasoconstriction of the subcutaneous tissue. As a result of the vasoconstriction, the wound site is more prone to surgical site infections (SSI) (Mason et al., 2017). Furthermore, Mason et al. (2017) have stated that hypothermia has also been shown in vitro to have a detrimental effect on the host's ability to mount an immune response, thereby decreasing leucocytes' ability to migrate and produce antibodies, and phagocytose. Researchers have demonstrated that postoperative hypothermic patients were at an increased risk for SSIs. Their findings show the importance of utilizing forced air warming (FAW) devices in maintaining normothermia and preventing SSIs. FAW devices are warming devices that blow warm, regulated air onto the patient to maintain core temperature.

Postoperative hypothermia affects patients who are not thermoregulated during their preoperative, intraoperative, and postoperative stay. Lack of thermoregulation can allow a patient's temperature to drop to 36 °C/96.8°F or less, and postoperative hypothermia can affect multiple recovery phases. The causes of postoperative hypothermia result from a combination of anesthesia-induced impairment of thermoregulatory control, the cool perioperative environment, and various surgical factors that promote excessive heat loss (Kim, 2019). As a result of postoperative hypothermia, postoperative patients are at greater risk for cardiovascular complications, blood loss, the need for blood transfusions, and higher SSI rates. In addition, postoperative hypothermia can alter drug metabolism, delay recovery, decrease patient comfort

and satisfaction, and increase hospital costs (Kim, 2019). Such complications can be detrimental to the patient's recovery and health.

## **Background**

### **Surgical Site Infections and Hypothermia**

According to the International Journal of Surgery, 40 to 50 million major surgeries are performed annually in the USA (Dobson, 2020). With advances in surgical and anesthetic techniques, and improvements in perioperative care, surgery in the U.S. is routine. However, there are still unintended outcomes that result from surgery. The Center for Disease Control and Prevention (CDC) defines a SSI as an infection that occurs after surgery in the part of the body where the surgery took place and can be superficial or, more seriously, involving tissues under the skin, organs, or implanted material (CDC, 2010). SSIs are now the most common and costly of all hospital-acquired infections, accounting for 20% of all hospital-acquired infections (Ban, et al., 2016). SSIs have unfortunately led to additional pain, suffering, and additional treatment for postoperative patients. SSIs can increase the lengths of stay for surgical patients in hospitals, drive up costs, and have raised the rate of mortalities among postoperative patients. Thus, to counter SSIs, the CDC created various measures intended to decrease SSIs. These measures are known as SSI bundles.

Of the multiple interventions within the bundles meant to prevent SSIs, the prevention of hypothermia is a simple measure often missed by healthcare providers within the perioperative phases of care. Mild peri-operative hypothermia has been shown to increase the risk of surgical wound infection, bleeding, impaired cardiac function, the need for extended postanesthetic observation time, shivering and discomfort due to feeling cold (Tywold, 2019). Utilizing a

thermometer, forced warm air device, and documenting temperature can help the nurse to maintain normothermia of the patient and avoid experiencing hypothermia. Despite the availability of tools to prevent hypothermia, postoperative hypothermia still commonly occurs putting patient's recovery at risk. It is reported that the prevalence of perioperative hypothermia is in between 50-90% among patients and that that 70% of the patients who undergo surgery are affected by postoperative hypothermia (Aldemir et al., 2021). Postoperative hypothermia can lead to cardiovascular complications, blood loss, SSIs, alter drug metabolism, delay recovery, decrease patient comfort, and increase hospital costs.

### **Purpose of the Doctoral Project**

The focus of the DNP project was to assess how providing education on postoperative warming and providing visual cues to the PACU RNs would increase postoperative warming compliance. The outcomes were evaluated by comparing PACU RN postoperative warming compliance rates before and after implementing the interventions. By conducting the DNP project, we can assess how providing education on postoperative warming and providing visual cues to the PACU RNs would increase postoperative warming compliance.

## **Theoretical Framework**

### **Malcolm Knowle's Theory of Adult Learning Principles**

Malcolm Knowle's theory of adult learning principles was the guiding theory for this quality improvement project. Knowle's Theory of Adult Learning is also known as andragogy, the art and science of helping adults learn (Western Governors University, 2020).



As discussed below, there are six principles utilized to facilitate learning. Applying the six principles assumes that greater learning takes place in adults than if one does not utilize these principles (Twaddell, 2019). The six andragogy principles are:

Principle 1. Adults need to know and understand why they should learn something for themselves.

Principle 2. Adults have a deep need to be self-directing.

Principle 3. Adults have a greater volume and different quality of experience than children.

Principle 4. Adults become ready to learn when they experience a need to know or be able to perform in their life situations to perform more effectively and satisfyingly.

Principle 5. Adults enter into a learning experience with a task-centered or problem-centered orientation to learning.

Principle 6. Adults are motivated to learn by both extrinsic and intrinsic motivators.

### **Application of the Andragogy Principles to Educate PACU RNs**

The goal was to increase the PACU RN's postoperative warming compliance by applying the andragogy principles to the PACU RN's learning of the postoperative warming process. PACU RN's have the responsibility to advocate for the postoperative patient. PACU RNs are advocates for their patients during the postoperative phase of care. Understanding the need for normothermia translates into actions to ensure normothermia postoperatively.

However, PACU RNs must be taught the proper guidelines of maintaining normothermia in order for them to understand what measures to treat postoperative hypothermia. Additionally,

a PACU RN must be taught the appropriate interventions to correct hypothermia in a patient, and how to properly document the situation in the hospital's electronic medical records (EMR) system.

Educating the PACU RN on postoperative hypothermia maintains its importance. PACU RNs are assumed to have a complete comprehension of postoperative warming procedures. Individually reviewing the PACU RN's knowledge of hypothermia, the use of FAW devices, and proper EMR documentation provides a baseline to assess and clarify any deficits in practice for the PACU RNs.

While assessing the PACU RN's knowledge of postoperative hypothermia, providing education can refresh or even add to their knowledge. Providing this education can clarify any confusion about assessment, warming, or documentation.

The importance of preventing postoperative hypothermia must be made clear when educating PACU RNs on postoperative hypothermia. Hypothermia increases patients' susceptibility to perioperative wound infections (or SSIs) by causing vasoconstriction and impaired immunity (Allen & Jacofsky, 2017). Stressing the importance of dangers due to hypothermia can better facilitate the PACU RN's attention to the matter.

Finally, as adult learners, PACU RNs are motivated to learn when they understand the necessity for their patient's recovery. Understanding the PACU RNs role as a patient advocate and the possible complications that a patient may experience from postoperative hypothermia can stimulate both the extrinsic and intrinsic motivations of the PACU RNs.

## Chapter 2: Literature Review

### SSI Bundles

Surgical site infection bundles were originally conceived through a joint effort by the Centers for Medicare and Medicaid Services (CMS) and the Centers for Disease Control (CDC) (Rosenberger et al., 2011). SSI bundles were meant to form consistent compliance with infection control measures since SSIs are a frequently reported nosocomial infection. It has been noted by Khan et al. (2017) that SSIs occur in 2-5% of surgical patients, and are the second most common type of nosocomial infection. Thus, the implementation of SSI bundles under the CMS and CDC's Surgical Infection Prevention (SIP) Project was introduced in 2002.

Several years later, in 2006, the Specifications Manual for National Inpatient Quality Measures (in short, the Specifications Manual) was composed by the Surgical Care Improvement Project (SCIP) (2011). SCIP emerged from SIP to provide a standard form of quality measures to unify documentation and track various care standards, including SSIs. The Specification Manual noted ten measures to decrease SSIs. These ten evidence-based measures aimed to improve surgical outcomes, ranging from receiving antibiotic medications one hour before surgery to clipping hair of the surgical site. SCIP infection measure INF-10 specifically addresses surgical patients with perioperative temperature management among the ten measures. Postoperative temperature management correlates with INF-10 (surgery patients with perioperative temperature management), and is one of the SSI bundle measures used to decrease SSIs. It states that perioperative temperature must be maintained preoperatively, intraoperatively, and postoperatively.

Surgical site infections continue to occur in multiple surgeries in the United States; for example, SSIs have an incidence of 2 to 5% in patients undergoing surgery complicating

approximately 300,000 to 500,000 surgeries per year, and costing the healthcare systems upward of \$1.6 billion (Mukagendaneza et al, 2019). Too many patients' recovery is at risk because of SSIs. In addition, SSIs are too costly to where hospitals must pay for the patient's entire treatment without any reimbursement from CMS.

SSI bundle measures were implemented to decrease the incidence of postoperative SSIs. In an article by D'Souza and Ivaska (2020), it was pointed out that there are still facilities having difficulties with SSIs. SSI bundles originating from SCIP measures have had a limited impact on SSI rates across facilities. This limited impact has led to the creation of a bundled approach utilizing current evidence-based strategies. This new bundled approach includes the prevention of hypothermia as one of the measures. Normothermia should be maintained throughout the patient's entire perioperative stay. However, postoperative patients appear to be the most vulnerable to becoming hypothermic.

### **Interventions to Treat Postoperative Hypothermia**

Postoperative hypothermia (a temperature less than 36 °C/96.8°F) hinders the recovery of postoperative patients. Hypothermia can occur in 20% of patients in the postoperative period (Mendoza et al., 2019). Those receiving general or regional anesthesia and those exposed during surgery have a higher incidence of becoming hypothermic postoperatively. Specifically, anesthetics inhibit the vasoconstriction mechanism responsible for maintaining temperature (Watson, 2018). Due to the incidence of postoperative hyperthermia, various methods are in place to maintain normothermia in postoperative patients. Maintaining perioperative normothermia is considered a mainstay of perioperative care as it minimizes the risk of SSIs, other infectious diseases, and cardiovascular events, postoperatively (Yamada et al., 2020). The most common methods used to maintain normothermia in postoperative patients include:

- Warmed irrigation and fluids.
- Passive warming.
- Resistance heating (RH) devices.
- Forced-warming (FAW) devices.

Of all the methods, RH and FAW devices have been the most effective methods for maintaining normothermia in postoperative patients. In a randomized single-blinded study, John et al. (2016) compared perioperative hypothermia in patients receiving RH versus those receiving FAW, and found a significantly higher rate of hypothermia occurring at the end of surgery in patients in the RH group. The study concluded that FAW is more effective than posterior surface resistive heating. Additionally, a study by Okoué et al. (2018) also found that FAW systems are the most effective method for hypothermia prevention.

### **Forced Air Warming**

Forced air warming is a commonly used and effective method to treat postoperative hypothermia. FAW works by forcing warmed air through a tube to an inflatable blanket, and the blanket inflates, thereby conveying warm air to the patient. FAW devices work like a big hair dryer sending warm air into an air mattress, which transfers warmth to the patient. As a result, the patient can be warmed continuously, and their temperature can be maintained consistently. In a study on the effectiveness of FAW for the prevention of perioperative hypothermia in surgical patients, Neih and Su (2016) concluded that FAW prevents perioperative hypothermia more effectively than either passive insulation or circulating-water mattresses. This finding supports the claim that FAW devices are especially beneficial to postoperative hypothermic patients.

Forced air warmers can be regulated and controlled, and they are easy to use. Additionally, a single warming blanket can be transferred during each patient's phase of care perioperatively. However, there has been a concern about wasted heat from FAW devices which escapes near the floor and rises to potentially contaminate the sterile field (Augustine, 2017). This finding has caused some hesitation about using FAW devices during surgery. However, a more recent study revealed that airflow caused by forced air warming is well counteracted by downward laminar airflow from the ceiling, and thus less likely to cause surgical field contamination in the presence of sufficient laminar airflow. (Shirozu et al., 2018). This research counters concerns that FAW airflow causes airborne bacteria to contaminate the surgical field and reinforces the safe usage of FAW devices.

### **Postoperative Warming Compliance**

There are multiple tools available to prevent hypothermia within all phases of care perioperatively. Everything from FAW devices to warm intravenous fluids, and thermal blankets. In addition, it is highly noted that perioperative hypothermia is associated with coagulopathy, increased SSIs, delayed drug metabolism, prolonged recovery, and shivering. The postoperative warming resources and knowledge are intended to raise the awareness of the perioperative staff in maintaining patient normothermia. Despite the tools to prevent hypothermia and warnings of hypothermia's adverse effects, hypothermia still occurs more often than necessary. In addition, a study in France hypothesized that the rate of hypothermic patients admitted to the PACU remain high (around 50%) (Alfonsi et. al, 2019). Barriers noted against normothermia compliance were limited normothermia equipment, a lack of standards on preventing postoperative hypothermia, and a lack of training on the prevention of postoperative hypothermia.

### **A Gap in Practice-RNs Not Meeting Benchmark**

The failure to postoperatively warm patients falls upon the PACU RNs. PACU RNs immediately see the postoperative patient upon arrival from surgery. Standard practice notes that patients arriving in the PACU are to have their temperature immediately assessed. If the patient arrives to the PACU with a temperature less than 36°C/96.8°F, the PACU RN is to document the temperature, connect the patient to the FAW device, reassess the temperature, and document interventions and results in the EMR. Despite the PACU RNs understanding of the postoperative warming process, there are missed opportunities to warm the patient postoperatively. As a result of the hypothermia, patient recovery is delayed and can lead to an SSI. This failure to warm postoperative patients may be caused by PACU RNs forgetting to warm the patient in the PACU, or adequately document in the EMR.

These failed opportunities to maintain normothermia during the postoperative phase of care has raised concerns. Alfonsi et al. specifically noted this concern when they found that despite the data supporting active warming during surgery and the availability of FAW devices, the prevalence of perioperative hypothermia remained highly variable from one health facility to another, ranging from 4% to more than 70% (2019). Specifically, at Kaiser Richmond, the postoperative warming compliance last year was 67%. This left 33% (See Figure 1) of the postoperative patients at Kaiser Richmond inadequately warmed.

## **Chapter 3: Methods**

### **Design**

A quality improvement (QI) project framework incorporating a cohort study design following Malcolm Knowle's Theory of Adult Learning Principles was used to implement an intervention to improve PACU RN postoperative warming compliance rates. The focus of the

DNP project was to assess how providing education on postoperative warming and providing visual cues to the PACU RNs would increase postoperative warming compliance. The education included presenting a PowerPoint (see table 4) on postoperative warming (how to properly take a temporal temperature, recognize a hypothermic temperature, utilize a FAW device to warm a hypothermic patient, and document in the Kaiser EMR properly) to the participating PACU RNs. Education was provided during January 2022 at various sessions to capture the entire PACU staff. The visual cues (a rotating message pen and a hypothermia reminder card) were supplied to the PACU RNs and posted in the PACU bays to increase postoperative warming awareness and compliance. The project was designed to collect quantitative data and utilize descriptive statistics for assessment.

### **Participants**

The observation was with the registered nurses of the PACU at Kaiser Richmond. There are 22 registered nurses on staff for the PACU. Most of the PACU RNs are full time employees working 40 hours a week. There are some part time RNs of the PACU and a few Per-Diem RNs. Of the 22 RNs in the PACU, 20 participated in the project. The remaining two were not available during the month of January due to illness and Per-Diem unavailability.

### **Setting**

The DNP project took place at the PACU of the Kaiser Permanente Richmond Medical Center. The PACU at the Richmond Medical Center consists of 15 recovery room bays and one isolation room. At peak times, when all six operating rooms are functioning at capacity, approximately 500 surgeries are performed monthly. However, during the observation one of the operating rooms was under construction. The medical center's various surgical specialties



include bariatric, cardiology, dentistry, gastroenterology, general surgery, gynecology, ears, nose, and throat (ENT) surgery, maxillofacial, ophthalmology, orthopedic, plastics, podiatry, urology, and vascular services. The Kaiser Richmond Medical Center is an adult facility and no pediatric procedures are performed at this location.

### **Data Collection**

The baseline data was derived from the KP Weekly Summary & Process Improvement report. The report provided the compliance percentages and baseline of surgeries to put everything into perspective. Compliance in postoperative warming is based upon the PACU RNs properly taking the patient's temperature upon arrival to the PACU, connecting the patient to the FAW device if they are hypothermic, and properly documenting in the EMR. Noting the temperature, connecting the FAW device if the patient is hypothermic, and reassessment of the temperature are the required documentation in the EMR to qualify as compliant.

The baseline established from the report showed that in October 2021, there were 415 surgeries performed at Kaiser Richmond, then in November 2021, there were 378, and in December 2021, there were 408 surgeries. During that time, October 2021 presented with only one of the four (25%) postoperative hypothermia patients being warmed and properly documented. November 2021 showed that only one of the three (33%) postoperative hypothermia patients was warmed and properly documented. Finally, December 2021 presented with zero of the two (0%) postoperative hypothermia patients being warmed and properly documented. Table 3. shows the postoperative warming baseline.

Once a three-month baseline of the PACU RN postoperative warming compliance was established, the intervention (postoperative warming education and distribution of visual cues) was conducted. The intervention was performed within January 2022. After the intervention

was conducted for the month with the PACU RNs, their postoperative warming compliance was evaluated. Postoperative warming compliance of the PACU RNs was assessed monthly for three months after the intervention to determine if any change in postoperative warming compliance occurred.

The post data was derived from the number of surgeries performed during the months of January, February, and March of 2022. These three months were the months observed after the intervention was provided. The breakdown for the number of surgeries performed at Kaiser Richmond from January through March 2022 was that in January 2022, there were 371 surgeries performed. In February 2022, there were 357 performed, and in March 2022, there were 402 surgeries performed. In addition to the number of surgeries performed during the three months after surgery, the percentage of postoperative warming compliance was also obtained for the months after the intervention. January 2022 showed a 75% post operative warming compliance, February 2022 showed a 100% post operative warming compliance, and March 2022 showed a 82% post operative warming compliance (see Table 4.).

### **Procedures**

Educational sessions were conducted throughout January 2022. Multiple sessions were conducted with the goal of capturing of the majority of the PACU RNs at Kaiser Richmond. In addition, the visual cues were distributed to the department and provided to the PACU RNs at Kaiser Richmond during January 2022. A bright yellow visual cue card was placed at each PACU bay patient monitor. On the card, the initials "T?W?D", abbreviated for temperature, warming, and documentation, was written in bold as a reminder for the PACU RNs to note the patient's temperature, warm the patient if hypothermic, and document the temperature and interventions.

A rotating message pen was given as an additional reminder for each PACU RN who attended the PowerPoint presentation on postoperative hypothermia. The rotating message pen provided four messages that can be advanced by clicking the pen. The four messages are:

- Upon patient arrival to the PACU don't forget
- To take the temperature
- To warm the patient
- To document.

Before January, communication was established with the PACU manager and staff that the education sessions on postoperative hypothermia would be conducted during January 2022. Also, assistance from the PACU unit assistant was recruited to compose the yellow visual cue cards for all 15 PACU bays. Finally, communication with the Greeting Pen Company was established to order the rotating message pens for the project.

Once a three-month baseline of the PACU RN postoperative warming compliance was established, the intervention (postoperative warming education and distribution of visual cues) was conducted. The intervention was performed during the month of January 2022. After the intervention was conducted for the month with the PACU RNs, then evaluation of the PACU RN's compliance began. Postoperative warming compliance of the PACU RNs was assessed monthly for three months after the intervention to determine if there was any change in postoperative warming compliance.

## **Analysis**

In utilizing the Social Science Statistics Fisher Exact Test Calculator (seen in Table 5), a Pre-Postop warming education group and a Post-Postop warming education group was composed and compared to a Compliant postop warming group and a Non-Compliant postop warming group. Two hypothermic patients were properly warmed by the PACU RN prior to the education, while 22 hypothermic patients were properly warmed by the PACU RN after the education. Seven hypothermic patients were not properly warmed by the PACU RN prior to the education, while only five hypothermic patients were not properly warmed by the PACU RN after their education. From this data, the Fisher exact test statistic value was 0.0025 and the result was significant at  $p < 0.05$ .

## **Chapter 4: Results**

### **Results**

The results of the project showed that in January 2022, 12 of the 15 postoperative hypothermic patients were properly warmed which reflected that 75% of the postoperative hypothermic patients were correctly warmed. In February 2022, there was only one postoperative hypothermic patient who was warmed correctly, reflecting 100% compliance with postoperative warming. In March 2022, nine out of 11 postoperative hypothermic patients were properly warmed, which reflected 82% postoperative warming compliance. This improvement in postoperative warming compliance happened after the educational intervention was performed in January 2022. Prior to the intervention, the PACU's postoperative warming compliance was at its highest at 33%. Table 6 visually shows the improvement in postoperative warming compliance after the implementation of the postoperative warming intervention.

## **Chapter 5: Discussion**

### **Implications of Project**

Completion of this project suggests that an educational intervention with visual cues increased PACU RN compliance with postoperative warming. Nabizadeh-Gharghozar et al. (2021) stated that providing knowledge and skill improvement during nursing education is an essential prerequisite for care quality improvement. The education of the PACU staff at Kaiser Richmond and the utilization of a cue card and rotating message pen helped reinforce the postoperative warming interventions. The education and visual cues helped remind the PACU RNs to take the patient's temperature immediately upon arriving to the PACU, warm the patient if they are hypothermic ( $<36^{\circ}\text{C}/96.8^{\circ}\text{F}$ ), and document in the EMR. As a result, postoperative warming compliance increased and normothermia improved among the postoperative hypothermic patients.

### **Sustainability**

In order to sustain compliance measures must be done to continuously educate the PACU RNs on maintaining patient normothermia. An annual in-service on normothermia and postoperative warming is recommended to sustain postoperative warming concepts at the forefront of postoperative care. Also recommended are clarifications on postoperative warming in the EMR to clarify the PACU RN requirements when documenting. Guidelines and documentation need to be provided if the PACU RN is considered non-compliant for not warming a normothermic patient. In addition, clarification needs to be provided on the duration of documentation for a patient that reaches normothermia.

Another recommendation to sustain postoperative warming compliance is an update to the EMR requiring the PACU RN to enter a temperature before charting any other additional information. In some facilities, this is called a "Hard Stop," which requires data entry before proceeding. Doing so may increase the PACU RN's consciousness of postoperative warming, interventions to treat postoperative hypothermia, and improve compliance in EMR documentation.

### **Limitations**

Limitations noted from the project included being unable reach all 22 PACU RNs. One RN was on medical leave, and one was a Per Diem RN whose work availability did not coincide with the education in January 2022. Also, the PACU RNs had specific questions about the EMR documentation during the education. The education showed the PACU RNs where to document in the EMR. However, the PACU RNs had particular questions on the EMR, such as how long to record the patient's postoperative temperature after normothermia is reached, which was not foreseen. Another limitation was that the observation only lasted for three months. A more extended observation would better picture the PACU RN staff maintaining compliance. Finally noted among the limitations was that in February 2022, there was only one hypothermic case and that patient was properly warmed and documented. As a result of the one patient, compliance for that month was skewed due to the small subject size for February 2022.

### **Chapter 6: Conclusion**

In conclusion, the postoperative warming education and visual cues appeared to help improve the postoperative warming compliance of the PACU RNs at Kaiser Richmond. Providing the education and visual cues supports the saying "Knowledge is power." By providing the PACU RNs information on the importance of maintaining normothermia, they are

more inclined to improve patient outcomes. Maintaining normothermia can facilitate for better surgical outcomes of the patient. However, further assessments are necessary to assess the consistency of the PACU RNs postoperative warming compliance. Providing follow-up education, feedback on postoperative warming compliance and adjustments to the EMR, just may be the interventions necessary in maintaining compliance of postoperative warming.

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Appendix

Table 1. Variables and Operational Definitions

Data Variable Table Worksheet

Variable Name	Operational Definition	Aggregate or individual data	Independent or Dependent	Level of measurement
PACU RN's compliance (DV)	Documentation if the PACU RN treats the hypothermia with FAW. Measurement: The compliance (or noncompliance) of the PACU RN connecting the postoperative hypothermic patient to a FAW for hypothermia.	Individual data	Dependent	Nominal
Patient's contraction of SSI (DV)	The incidence of SSI in postoperative patients who were hypothermic.	Individual data	Dependent	Nominal
Postoperative temperature of postoperative patients (IV)	Normothermic patients (36.5-37.5° C); Hypothermic patients (36.0° C and below) Measurement: Patients who are hypothermic will be recorded.	Individual data	Independent	Ratio

Aggregate data = data that cannot be traced back to an individual participant. Results from the combination of data pertaining to a group of patients, i.e. a monthly fall rate or CLABSI percentage.

Individual data = data from a single participant, i.e. race, age, diagnosis, response to treatment, etc.

The above refer to the form in which you will receive the data.

**Table 2. Monthly Data Sheet**

Postoperative Warming After Intervention			
	Month/Year	Month/Year	Month/Year
Number of Surgeries at KP Richmond			
Post-OP Warming Ratio of Compliant to Non-Compliant Intervention			
Post-Op Compliant Percentage			

**Table 3. Postoperative Warming Baseline**

Postoperative Warming Before Intervention			
	October 2021	November 2021	December 2021
<b>Number of Surgeries at KP Richmond</b>	415	378	408
<b>Post-OP Warming Ratio of Warmed to Hypothermic Patients</b>	1:4	1:3	0:2
<b>Post-Op Warming Percentage</b>	25%	33%	0%

**Table 4. Postoperative Warming After Intervention**

<b>Postoperative Warming After Intervention</b>			
	<b>January 2022</b>	<b>February 2022</b>	<b>March 2022</b>
<b>Number of Surgeries at KP Richmond</b>	317	352	402
<b>Post-OP Warming Ratio of Warmed to Hypothermic Patients</b>	12:15	1:1	9:11
<b>Post-Op Warming Percentage</b>	75%	100%	82%

**Table 5. Postoperative warming compliance results**

<b>Results</b>			
	<i>Pre-Postop warming re-education</i>	<i>Post-Postop warming re-education</i>	<i>Marginal Row Totals</i>
<i>Compliant postop warming</i>	2	22	24
<i>Non Compliant postop warming</i>	7	5	12
<i>Marginal Column Totals</i>	9	27	36 (Grand Total)

The Fisher exact test statistic value is 0.0025. The result is significant at  $p < .05$ .



**Table 6. Postoperative warming compliance percentages from September 2021-March 2022**

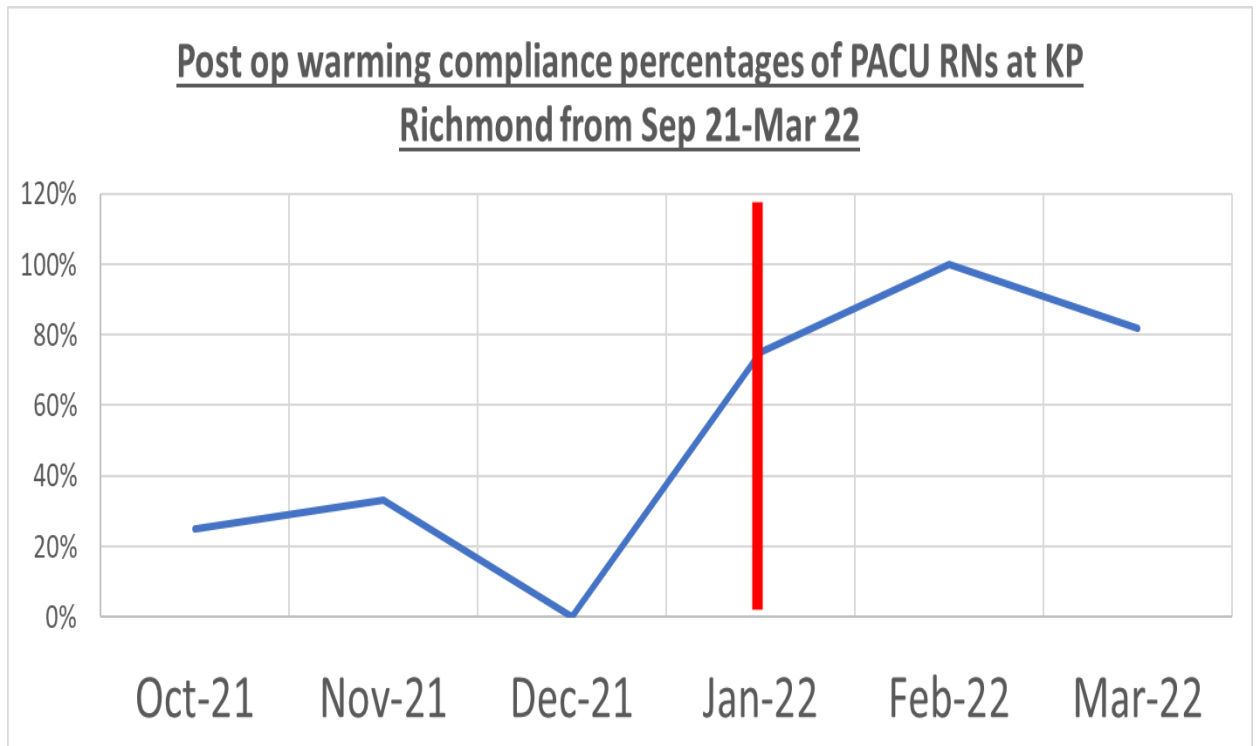


Figure 1. Current percentage of Kaiser Richmond PACU postoperative warming

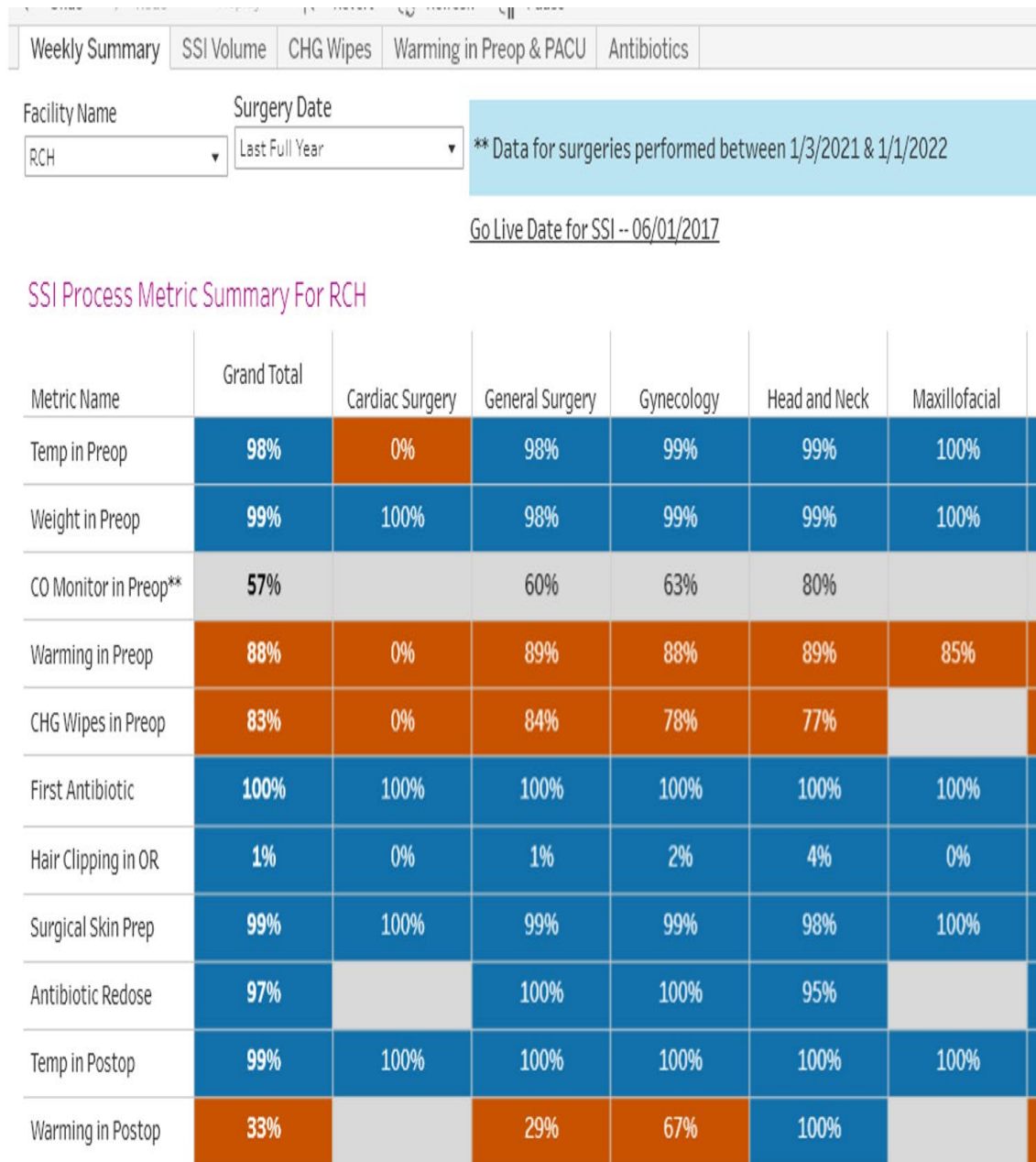


Figure 2. Education Checklist

[Type here]

Name: \_\_\_\_\_  
Date: \_\_\_\_\_

Postoperative warming PACU RN review checklist			
Hypothermia= <36°C	Reviewed: Yes/No	Staff Initial	Coordinator Initial
Temporal thermometer <ul style="list-style-type: none"> <li>• Function</li> <li>• Usage</li> <li>• Cleaning</li> </ul>			
Bair Hugger <ul style="list-style-type: none"> <li>• Function</li> <li>• Components                             <ul style="list-style-type: none"> <li>-On/Off</li> <li>-Temperature Select</li> <li>-Hose</li> <li>-Blanket</li> </ul> </li> <li>• Cleaning</li> </ul>			
Healthconnect <ul style="list-style-type: none"> <li>• Postoperative temperature</li> <li>• Connection to FAW device</li> <li>• Re-assessment after 15 minutes</li> </ul>			

Student Name/Signature: \_\_\_\_\_

Coordinator Name/Signature: \_\_\_\_\_

Figure 3. TWD Cue card and Message pen

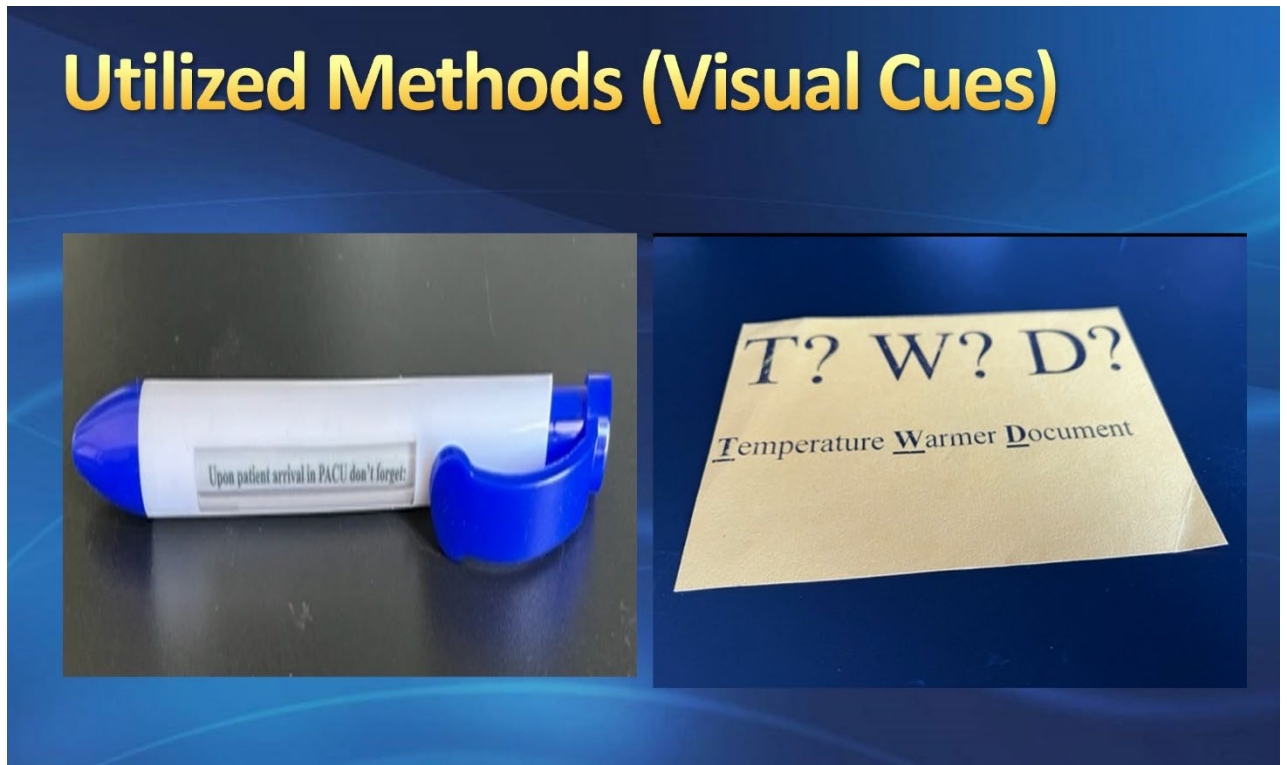
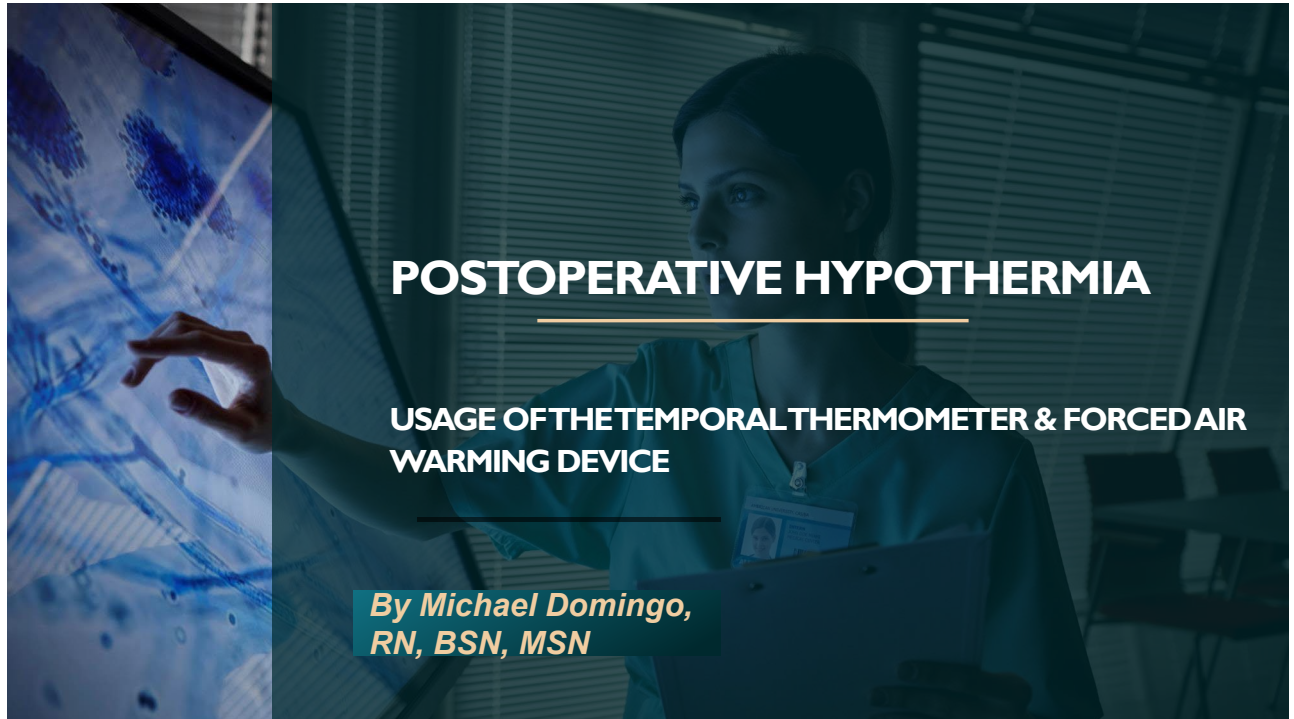


Figure 4. Postoperative Warming Teaching PowerPoint



## LESSON OBJECTIVES

### UPON COMPLETION OF THIS TOPIC STUDENTS SHOULD BE ABLE TO:

1. Know when to expect hypothermia in postoperative patients
2. How to identify hypothermia in postoperative patients
3. Discuss methods to treat postoperative hypothermia
4. How to use a temporal thermometer
5. How to use a forced air warming unit

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2

## POSTOPERATIVE HYPOTHERMIA

Postoperative hypothermia affects patients who are not thermal regulated during their preoperative, intraoperative, and postoperative phases.

- Lack of thermoregulation can allow patient's temperature to drop to 36 °C or less.
- Hypothermia = 36 °C or less
- Postoperative hypothermia can affect multiple phases of recovery.



3

## HOW POSTOPERATIVE HYPOTHERMIA OCCURS?

Postoperative hypothermia results from a combination of:

- Anesthesia-induced impairment of thermoregulatory control
- Cool perioperative environment
- Various surgical factors that promote excessive heat loss (Kim, 2019)

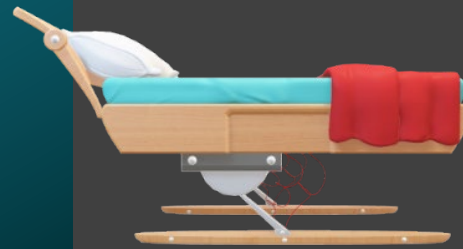


4

## POSTOPERATIVE HYPOTHERMIA EFFECTS ONTO PATIENTS

Postoperative hypothermia can cause:

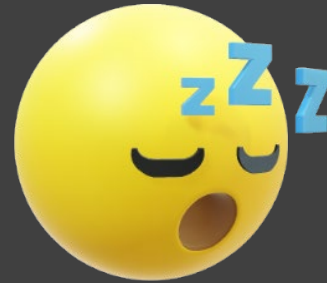
- Increased risk of cardiovascular complications
- Blood loss
- Need for blood transfusions
- Higher surgical site infection (SSI) rates
- Alter drug metabolism
- Delayed recovery



5

## WHICH PATIENTS ARE MORE PRONE TO POSTOPERATIVE HYPOTHERMIA?

- Neonates
- Prolonged anesthesia
- Open body cavities
- Not monitored

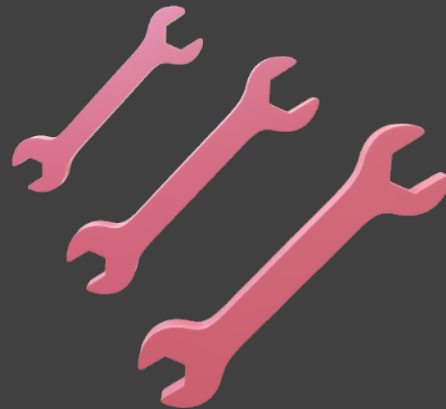


6

## HOW IS POSTOPERATIVE HYPOTHERMIA TREATED?

The most common methods used to assert normothermia in postoperative patients include:

- Warmed irrigation and fluids.
- Passive warming.
- Resistance heating (RH) devices.
- Forced-warming (FAW) devices.



7



**LET'S REVIEW:**

1. What temperature is the starting point that classifies a patient as hypothermic?

- a) <43 C
- b) <36 C
- c) <32 C
- d) <30 C

Answer = <36 C



9

**LET'S REVIEW:**

2. Postoperative hypothermia results from a combination of:

- a) Anesthesia- induced impairment of thermoregulatory control
- b) Cool perioperative environment
- c) Various surgical factors that promote excessive heat loss
- d) All of the above

Answer= d) All of the above



11

**LET'S REVIEW:**

3. T/F? Postoperative hypothermia can cause:  
Increased risk of cardiovascular complications  
Blood loss  
Need for blood transfusions  
Higher surgical site infection (SSI) rates  
Alter drug metabolism  
Delayed recovery

TRUE



13

**LET'S REVIEW:**

4. Which patients are more prone to postoperative hypothermia?

- a) Neonates
- b) Prolonged anesthesia
- c) Open body cavities
- d) Not monitored
- e) All of the above

Answer=e) All of the above



15

**LET'S REVIEW:**

5. Which of the 4 preferred methods to treat postoperative hypothermia is most commonly used?

- a) Resistance heating (RH) devices.
- b) Forced air warming (FAW) devices.
- c) Passive warming
- d) Warmed fluids/irrigation

Answer=a) Resistance heating (RH) devices &b) Forced air warming (FAW) devices



## HOW TO USE A TEMPORAL THERMOMETER



18

## HOW TO USE A FORCED AIR WARMING UNIT (BAIR HUGGER)



28

# HOW TO DOCUMENT IN HEALTHCONNECT

