

Prevention of Perioperative Hypothermia (PPH) Toolkit

REFERENCES

- Alderson P, Campbell G, Smith AF, Warttig S, Nicholson A, Lewis SR. Thermal insulation for preventing inadvertent perioperative hypothermia. *Cochrane Database Syst Rev*. 2014(6):CD009908. doi: 10.1002/14651858.CD009908.pub2.
- Andrzejowski J, Hoyle J, Eapen G, Turnbull D. Effect of prewarming on post-induction core temperature and the incidence of inadvertent perioperative hypothermia in patients undergoing general anaesthesia. *Br J Anaesth*. 2008;101(5):627-31.
- Andrzejowski JC, Turnbull D, Nandakumar A, Gowthaman S, Eapen G. A randomised single blinded study of the administration of pre-warmed fluid vs active fluid warming on the incidence of peri-operative hypothermia in short surgical procedures. *Anaesthesia*. 2010;65(9):942-945.
- AORN. Guideline for prevention of unplanned patient hypothermia. In: AORN, editor. *2017 Guidelines for Perioperative Practice*. Denver, CO: Association of periOperative Registered Nurses; 2018. p. 567-90.
- Balayssac, D., Pereira, B., Bazin, JE. et al. Warmed and humidified carbon dioxide for abdominal laparoscopic surgery: meta-analysis of the current literature. *Surg Endosc.* 2017;31:1. <https://doi.org/10.1007/s00464-016-4866-1>.
- Birch DW, Dang JT, Switzer NJ, Manouchehri N, Shi X, Hadi G, Karmali S. Heated insufflation with or without humidification for laparoscopic abdominal surgery. *Cochrane Database Syst Rev*. 2016;(10):CD007821.
- Birch DW, Manouchehri N, Shi X, Hadi G, Karmali S. Heated CO(2) with or without humidification for minimally invasive abdominal surgery. *Cochrane Database Syst Rev*. 2011;(1):CD007821.
- Borms SF, Engelen SL, Himpe DG, Suy MR, Theunissen WJ. Bair hugger forced-air warming maintains normothermia more effectively than thermo-lite insulation. *J Clin Anesth*. 1994;6(4):303-307.
- Caldwell JE, Heier T, Wright PM, et al. Temperature-dependent pharmacokinetics and pharmacodynamics of vecuronium. *Anesthesiology*. 2000;92(1):84-93.
- Campbell G, Alderson P, Smith AF, Warttig S. Warming of intravenous and irrigation fluids for preventing inadvertent perioperative hypothermia. *Cochrane Database Syst Rev*. 2015;(4):CD009891. doi: 10.1002/14651858.CD009891.pub2.
- Camus Y, Delva E, Cohen S, Lienhart A. The effects of warming intravenous fluids on intraoperative hypothermia and postoperative shivering during prolonged abdominal surgery. *Acta Anaesthesiol Scand*. 1996;40(7):779-82.
- DeRosier J, Stalhandske E, Bagian JP, Nudell T. Using health care Failure Mode and Effect Analysis: the VA National Center for Patient Safety's prospective risk analysis system. *Jt Comm J Qual Improv*. 2002;28(5):248-267, 209.

- Eberhart LH, Doderlein F, Eisenhardt G, et al. Independent risk factors for postoperative shivering. *Anesth Analg*. 2005;101(6):1849-57.
- Fossum S, Hays J, Henson MM. A comparison study on the effects of prewarming patients in the outpatient surgery setting. *J Perianesth Nurs*. 2001;16(3):187-94.
- Frank SM, Fleisher LA, Breslow MJ, et al. Perioperative maintenance of normothermia reduces the incidence of morbid cardiac events. A randomized clinical trial. *JAMA*. 1997;277(14):1127-34.
- Hall MJ, DeFrances CJ, Williams SN, Golosinskiy A, Schwartzman A. National Hospital Discharge Survey: 2007 summary. *Natl Health Stat Report*. 2010;(29):1-20, 24.
- Heier T, Caldwell JE. Impact of hypothermia on the response to neuromuscular blocking drugs. *Anesthesiology*. 2006;104(5):1070-1080.
- Hildebrand F, Giannoudis PV, van Griensven M, Chawda M, Pape HC. Pathophysiologic changes and effects of hypothermia on outcome in elective surgery and trauma patients. *Am J Surg*. 2004;187(3):363-371.
- Hooper VD, Chard R, Clifford T, et al. ASPAN's evidence-based clinical practice guideline for the promotion of perioperative normothermia: second edition. *J Perianesth Nurs*. 2010;25(6):346-65.
- Horn EP, Schroeder F, Gottschalk A, et al. Active warming during cesarean delivery. *Anesth Analg*. 2002;94(2):409-14, table of contents.
- Hynson JM, Sessler DI, Moayeri A, McGuire J, Schroeder M. The effects of preinduction warming on temperature and blood pressure during propofol/nitrous oxide anesthesia. *Anesthesiology*. 1993;79(2):219-228.
- Kitson AL, Rycroft-Malone J, Harvey G, McCormack B, Seers K, Titchen A. Evaluating the successful implementation of evidence into practice using the PARIHS framework: theoretical and practical challenges. *Implement Sci*. 2008;3:1.
- Kleimeyer JP, Harris AHS, Sanford J, et al. Incidence and risk factors for postoperative hypothermia after orthopaedic surgery. *J Am Acad Orthop Surg*. Aug. 30, 2018.
- Kurz A, Sessler DI, Lenhardt R. Perioperative normothermia to reduce the incidence of surgical-wound infection and shorten hospitalization. Study of Wound Infection and Temperature Group. *N Engl J Med*. 1996;334(19):1209-15.
- Lamb FJ, Rogers R. Forced-air warming maintains normothermia during orthotopic liver transplantation. *Anaesthesia*. 1995;50(8):745.
- Lenhardt R, Marker E, Goll V, et al. Mild intraoperative hypothermia prolongs postanesthetic recovery. *Anesthesiology*. 1997;87(6):1318-23.
- Madrid E, Urrútia G, Roqué i Figuls M, Pardo-Hernandez H, Campos JM, Paniagua P, Maestre L, Alonso-Coello P. Active body surface warming systems for preventing complications caused by inadvertent perioperative hypothermia in adults. *Cochrane Database Syst Rev*. 2016;(4):CD009016. doi: 10.1002/14651858.CD009016.pub2.

- Mahoney CB, Odom J. Maintaining intraoperative normothermia: a meta-analysis of outcomes with costs. *AANA J.* 1999;67(2):155-163.
- Michelson AD, MacGregor H, Barnard MR, Kestin AS, Rohrer MJ, Valeri CR. Reversible inhibition of human platelet activation by hypothermia in vivo and in vitro. *Thromb Haemost.* 1994;71(5):633-640.
- Ng SF, Oo CS, Loh KH, Lim PY, Chan YH, Ong BC. A comparative study of three warming interventions to determine the most effective in maintaining perioperative normothermia. Salazar F, Donate M, Boget T, et al. Intraoperative warming and post-operative cognitive dysfunction after total knee replacement. *Acta Anaesthesiol Scand.* 2011;55(2):216-22.
- Nieh HC, Su SF. Meta-analysis: effectiveness of forced-air warming for prevention of perioperative hypothermia in surgical patients. *J Adv Nurs.* 2016; 72(10):2294-314. doi: 10.1111/jan.13010. Epub 2016 May 31.
- Reynolds L, Beckmann J, Kurz A. Perioperative complications of hypothermia. *Best Pract Res Clin Anaesthesiol.* 2008;22(4):645-657
- Schmied H, Kurz A, Sessler DI, Kozek S, Reiter A. Mild hypothermia increases blood loss and transfusion requirements during total hip arthroplasty. *Lancet.* 1996;347(8997):289-92.
- Schmied H, Kurz A, Sessler DI, Kozek S, Reiter A. Mild hypothermia increases blood loss and transfusion requirements during total hip arthroplasty. *Lancet.* 1996;347(8997):289-292.
- Sessler DI, Schroeder M. Heat loss in humans covered with cotton hospital blankets. *Anesth Analg.* 1993;77(1):73-7.
- Sessler DI. Perioperative thermoregulation and heat balance. *Lancet.* 2016;387(10038):2655-64.
- Shaw CA, Steelman VM, DeBerg J, Schweizer ML. Effectiveness of active and passive warming for the prevention of inadvertent hypothermia in patients receiving neuraxial anesthesia: A systematic review and meta-analysis of randomized controlled trials. *J Clin Anesth.* 2017;38:93-104.
- Smith CE, Gerdes E, Sweda S, et al. Warming intravenous fluids reduces perioperative hypothermia in women undergoing ambulatory gynecological surgery. *Anesth Analg.* 1998;87(1):37-41.
- Stelman VM, Chae S, Duff J, Anderson MJ, Zaidi A. Warming of Irrigation Fluids for Prevention of Perioperative Hypothermia During Arthroscopy: A Systematic Review and Meta-analysis. *Arthroscopy.* 2018;34(3):930-42 e2.
- Stelman, V. M., Perkhounkova, Y. S., & Lemke, J. H. The gap between compliance with the quality performance measure "Perioperative Temperature Management" and normothermia. *Journal for Healthcare Quality: Official publication of the National Association for Healthcare Quality.* 2015;37(6):333-341. PMID: 24417607. doi: 10.1111/jhq.12063.
- Stelman, V. M., Schaapveld, A. G., Perkhounkova, Y., Reeve, J., & Herring, J. P. Conductive skin warming and hypothermia: An observational study. *AANA Journal.* 2017; 85(6), 461-268.

- Sultan P, Habib AS, Cho Y, Carvalho B. The Effect of patient warming during Caesarean delivery on maternal and neonatal outcomes: A meta-analysis. *Br J Anaesth*. 2015;115(4):500-510. doi: 10.1093/bja/aev325.
- Torossian A. Thermal management during anaesthesia and thermoregulation standards for the prevention of inadvertent perioperative hypothermia. *Best Pract Res Clin Anaesthesiol*. 2008;22(4):659-668.
- Vanni SM, Braz JR, Modolo NS, Amorim RB, Rodrigues GR, Jr. Preoperative combined with intraoperative skin-surface warming avoids hypothermia caused by general anesthesia and surgery. *J Clin Anesth*. 2003;15(2):119-25.
- Widman J, Hammarqvist F, Selldén E. Amino acid infusion induces thermogenesis and reduces blood loss during hip arthroplasty under spinal anesthesia. *Anesth Analg*. 2002;95(6):1757-1762.
- Winkler M, Akca O, Birkenberg B, et al. Aggressive warming reduces blood loss during hip arthroplasty. *Anesth Analg*. 2000;91(4):978-84.
- Woolnough MJ, Hemingway C, Allam J, Cox M, Yentis SM. Warming of patients during Caesarean section: a telephone survey. *Anaesthesia*;2009;64(1):50-3.
- Yokoyama K, Suzuki M, Shimada Y, et al. Effect of administration of pre-warmed intravenous fluids on the frequency of hypothermia following spinal anesthesia for Cesarean delivery. *J Clin Anesth*;2009;21(4):242-8.
- Zhang F, Wagner AK, Ross-Degnan D. Simulation-based power calculation for designing interrupted time series analyses of health policy interventions. *J Clin Epidemiol*. 2011;64(11):1252-1261.