



## Consensus Statement | Surgery

# Development of an Enhanced Recovery After Surgery Surgical Safety Checklist Through a Modified Delphi Process

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## Abstract

**IMPORTANCE** Enhanced Recovery After Surgery (ERAS) guidelines and the World Health Organization Surgical Safety Checklist (SSC) are 2 well-established tools for optimizing patient outcomes perioperatively.

**OBJECTIVE** To integrate the 2 tools to facilitate key perioperative decision-making.

**EVIDENCE REVIEW** Snowball sampling recruited international ERAS users from multiple clinical specialties. A 3-round modified Delphi consensus model was used to evaluate 27 colorectal or gynecologic oncology ERAS recommendations for appropriateness to include in an ERAS SSC. Items attaining potential consensus (65%-69% agreement) or consensus ( $\geq 70\%$  agreement) were used to develop ERAS-specific SSC prompts. These proposed prompts were evaluated in a second round by the panelists with regard to inclusion, modification, or exclusion. A final round of interactive discussion using quantitative consensus and qualitative comments was used to produce an ERAS-specific SSC. The panel of ERAS experts included surgeons, anesthesiologists, and nurses within diverse practice settings from 19 countries. Final analysis was conducted in May 2022.

**FINDINGS** Round 1 was completed by 105 experts from 18 countries. Eleven ERAS components met criteria for development into an SSC prompt. Round 2 was completed by 88 experts. There was universal consensus ( $\geq 70\%$  agreement) to include all 37 proposed prompts within the 3-part ERAS-specific SSC (used prior to induction of anesthesia, skin incision, and leaving the operating theater). A third round of qualitative comment review and expert discussion was used to produce a final ERAS-specific SSC that expands on the current WHO SSC to include discussion of analgesia strategies, nausea prevention, appropriate fasting, fluid management, anesthetic protocols, appropriate skin preparation, deep vein thrombosis prophylaxis, hypothermia prevention, use of foley catheters, and surgical access. The final products of this work included an ERAS-specific SSC ready for implementation and a set of recommendations to integrate ERAS elements into existing SSCs.

**CONCLUSIONS AND RELEVANCE** The SSC could be modified to align with ERAS recommendations for patients undergoing major surgery within an ERAS protocol. The stakeholder- and expert-generated ERAS SSC could be adopted directly, or the recommendations for modification could be applied to an existing institutional SSC to facilitate implementation.

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## Key Points

**Question** Can modifications be made to the World Health Organization's Surgical Safety Checklist to optimize its use in patients undergoing surgery within an enhanced recovery after surgery protocol?

**Findings** This consensus statement used expert-derived consensus using a modified Delphi process to identify enhanced recovery after surgery topics that could be appropriately addressed within the context of a modified surgical safety checklist.

**Meaning** These findings suggest that an enhanced recovery after surgery surgical safety checklist could be implemented in place of an existing surgical safety checklist, with a goal of improving adherence with the individual tools to improve outcomes.

## + Supplemental content

Author affiliations and article information are listed at the end of this article.

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## Introduction

Enhanced Recovery After Surgery (ERAS) guidelines and the World Health Organization (WHO) Surgical Safety Checklist (SSC) are well-established tools for optimizing perioperative patient outcomes.<sup>1-9</sup> There are more than 20 rigorously produced and endorsed ERAS guidelines covering a wide spectrum of elective and emergent surgical care.<sup>10</sup> The SSC, first introduced in 2009, is now used in more than 75% of procedures globally.<sup>11</sup> Both tools have demonstrated consistent associations with improved surgical safety and outcomes, particularly within colorectal and gynecologic surgery, where ERAS is best-studied.<sup>12-14</sup>

ERAS guidelines often consist of upwards of 20 items designed to be implemented as a care bundle. The level of adherence correlates with outcomes.<sup>15-20</sup> Similarly, the original WHO SSC has 22 procedural checkpoints and conversations prompts that, despite a demonstrated mortality benefit, are variably implemented in practice.<sup>21-24</sup> We sought to integrate the 2 tools within an ERAS SSC to optimize perioperative decision-making for teams using ERAS protocols.

## Methods

We used a 3-round modified Delphi process.<sup>25</sup> This study is reported following the Standards for Quality Improvement Reporting Excellence (SQUIRE) reporting guideline. The University of Calgary Conjoint Health Research Ethics Board provided an exemption from institutional review board review, since participants in the development of this checklist are not, themselves, the focus of research but rather are collaborators in recommendation development.<sup>26</sup> Consensus was defined a priori as at least 70% agreement among participant experts. ERAS experts were recruited via snowball sampling. No quotas were defined; however, additional purposive sampling was used to encourage representative participation from surgeons (gynecologic, colorectal, and others), anesthesiologists, and nurses as well as to encourage participation from practitioners in low- and middle-income countries. Invitation letters were sent by email from the study team. A maximum of 2 reminders were sent once initial contact was made for each round, and invitees were encouraged to share the survey link with other ERAS experts. No incentives or compensation was offered. All experts were given the option to be identified as contributors. All respondents who completed round 1 and provided valid contact information were invited to participate in round 2. No new experts were sought once the first round was complete (March 2022). Survey data from participants who completed round 1 but did not provide valid contact information were included in the analysis of the first round, but these experts were not invited to participate in subsequent rounds.

Consensus was reached after 3 rounds: 2 primarily quantitative survey rounds (using Qualtrics survey software) and 1 virtual convening with an option for noncontemporaneous participation. Each survey round underwent pilot acceptability and fidelity testing with 5 to 10 ERAS experts prior to dissemination. In the first round (February to March 2022), invited experts were asked to assess each current colorectal and gynecologic oncology ERAS recommendation topic (combined where duplication existed) to determine appropriateness for SSC inclusion (presented as 5 preoperative, 12 intraoperative, and 10 postoperative ERAS topics). Experts were provided and encouraged to reference guidance from the WHO SSC Adaptation Guide.<sup>27</sup> Agreement for inclusion was indicated using a 5-point Likert scale and was dichotomized such that 4, indicating should address, and 5, indicating must address were collapsed and given equal weight toward consensus to include. Free-text comments were solicited. The results of round 1 were used to create specific ERAS SSC prompts reflecting the topic areas reaching consensus for inclusion ( $\geq 70\%$  agreement) or nearing consensus (65%-69% agreement) for consideration. There were no missing inclusion data, since respondents were encouraged to complete each topic prior to moving on within the survey.

In the second round (March to April 2022), participant experts who completed round 1 were invited to evaluate the novel ERAS SSC prompts and the original WHO SSC prompts. The level of agreement from round 1 was indicated, and experts were given the option to suggest including or

excluding the topic-derived prompt within an ERAS SSC. Each proposed prompt was assigned to 1 of the original time points from the WHO SSC (ie, sign-in, timeout, or debrief). A 4-point Likert scale gave experts the option to exclude items from the ERAS SSC, include the item as proposed, include it but modify content, and include but move within the SSC. Free-text comments were again solicited. Consensus to include was an unweighted summation of include the item as proposed, include it but modify content, and include but move, and respondents' suggestions to either modify the content or move the recommendation to another section of the ERAS SSC were considered alongside the free-text comments provided.

For the final round (May 2022), a virtual convening of a selection of experts reviewed the qualitative results and summative quantitative review of provided comments. Final consensus was reached, and an ERAS SSC was produced.

## Results

Round 1 was completed by 105 ERAS experts from 19 countries (39 gynecologists or gynecologic oncologists, 24 surgeons, 15 anesthesiologists, 13 nurses, and 14 individuals with other or unspecified specialties). One hundred experts indicated their country of residence, with 90 participants working in high-income countries and 10 participants working in low- or middle-income countries, as defined by World Bank.<sup>28</sup> The use of snowball sampling prevented calculation of response rate or characterization of nonrespondents. Experts reported high rates of ERAS use, with 74% reporting they always used an ERAS protocol, if an appropriate protocol existed, and all participants engaged in active clinical care reported always using a surgical safety checklist (**Table**).

In the first round, experts were presented with 27 ERAS topics (eg, prehabilitation, prevention of nausea and vomiting, and thromboprophylaxis) and 6 topics met criterion for development into an SSC prompt ( $\geq 70\%$  agreement to include) while 5 additional topics neared consensus (65% to 69% agreement to include) (**Box**). Participants provided 293 free-text comments that were used to create the proposed ERAS SSC prompts for the selected topics that were assessed in round 2.

Round 2 was completed by 88 of 100 experts from round 1 with valid contact information (88% response rate). There was consensus to include all 37 proposed prompts within the ERAS-specific SSC (**Figure 1**; eAppendix 1 in **Supplement 1**). There were 282 comments reviewed and categorized:

**Table. Expert Familiarity With ERAS and the Surgical Safety Checklist**

Question	Respondents, No./total No. (%)
Do you use ERAS protocols for any of your patients?	
Yes, always when an appropriate ERAS protocol exists	78/105 (74)
Yes, I sometimes use ERAS protocols	3/105 (3)
I use an institution-specific care bundle in the spirit of ERAS	14/105 (13)
I rarely use ERAS protocols	2/105 (2)
I never use ERAS protocols	0
I am not currently engaged in clinical practice	33/105 (3)
Did not respond	5/105 (5)
Do you use a Surgical Safety Checklist for any of your patients?	
Yes, I always use the WHO SSC	45/105 (43)
Yes, I always use an institution-specific SSC	48/105 (46)
Yes, I use a procedure-specific SSC	3/105 (3)
I do not always use an SSC	0
I am not currently engaged in clinical practice	4/105 (4)
Did not respond	5/105 (5)

Abbreviations: ERAS, Enhanced Recovery After Surgery; SSC, surgical safety checklist; WHO, World Health Organization.

236 comments were item-specific, 23 comments related to general content, and 23 comments related to implementation. A third round of quantitative and qualitative comment review and interactive discussion was used to produce a final ERAS SSC intended for patients undergoing surgery within an ERAS protocol (Figure 2). For users wishing to modify an existing institutional SSC, there is expert-derived consensus on additional items to consider for inclusion: analgesia strategies, nausea prevention, appropriate fasting, fluid management, anesthetic protocols, appropriate skin preparation, deep vein thrombosis prophylaxis, hypothermia prevention, use of foley catheters, and surgical access.

## Discussion

The ERAS SSC is a consensus-built modification that incorporates evidence-based ERAS components relevant to the operative setting. The WHO SSC is a powerful communication tool used in operating rooms worldwide. Most institutions use a modified version of the original WHO SSC; adaptation can improve the SSC but also risks degrading the utility of the checklist.<sup>29</sup> There are a number of modified SSCs that have been tailored to specific procedures,<sup>30</sup> institutions,<sup>31</sup> and situations.<sup>32</sup> By relying on the rigor through which ERAS recommendations are developed, this checklist remains focused on clinical impact.<sup>33</sup>

The ERAS SSC is a tool that can be used to improve teamwork and encourage a shared mental model in keeping with the principles of enhanced recovery. Most new ERAS-related topics are addressed through conversation prompts rather than procedural checkpoints, eg, "what is the opioid-sparing analgesia plan?" rather than "has an epidural been placed?" Conversation prompts within the SSC may promote better teamwork than procedural checks.<sup>34</sup> These additions may allow teams to capitalize on the pause points of the checklist for the efficient sharing of the ERAS mental model with new team members, even those unfamiliar with ERAS. In addition to grounding teams in the principles of enhanced recovery, the use of an ERAS SSC also has the potential to improve adherence with the evidence-based tenets of ERAS by helping to ensure that specific process measures key to ERAS management are performed. Greater adherence to ERAS protocols has been associated with incremental reduction in complications, length of stay, and improved 3-year survival outcomes for nonmetastatic colorectal resections.<sup>14-20,35</sup> It is hoped that by using the SSC, which is already integrated into the workflow of many operating rooms, the ERAS SSC coprioritizes intraoperative safety and perioperative recovery.

When used well, the WHO SSC has a demonstrated association with the clinical outcomes addressed within it but is not associated outcomes that are not directly addressed (eg, deep vein thrombosis prophylaxis).<sup>12</sup> With this in mind, the ERAS SSC was designed to ensure that discussions addressing specific issues important to a patient's recovery are discussed at 3 defined, critical points in perioperative care. This new checklist has introduced new elements critical to patient safety and optimal recovery. Novel discussion around pain management in the safety checklist could be used to promote opioid-sparing strategies.<sup>36,37</sup> An expanded debrief includes anesthesiologists in postoperative care planning. The conversation prompts were again designed such that all team members understand the plan of care. Unnecessary foley catheter and nasogastric tubes can be

### Box. Enhanced Recovery After Surgery Topics for Surgical Safety Checklist Consideration From Round 1

#### Consensus to include (≥70%):

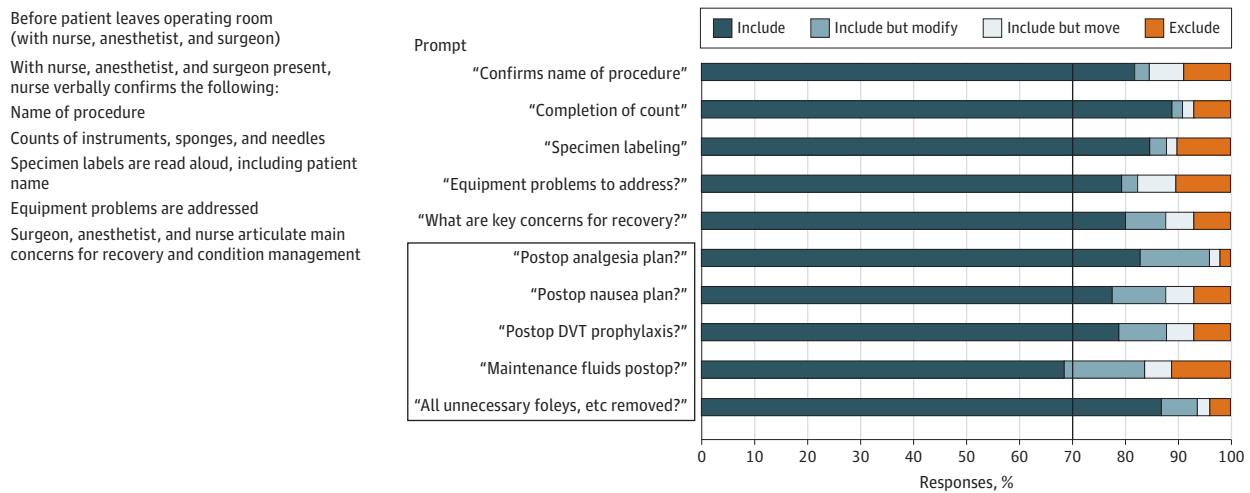
- Antimicrobial prophylaxis and skin preparation
- Thromboprophylaxis
- Postoperative analgesia
- Prevent hypothermia
- Intraoperative fluids and electrolytes
- Management of nausea and vomiting

#### Potential consensus (65-69%):

- Preoperative fasting and carbohydrate load
- Urinary drainage
- Postoperative fluid and electrolytes
- Surgical access (open vs minimally invasive)
- Standard anesthesia protocol

removed prior to patients awakening, and necessary catheters can be left in place to avoid future reinsertion (eg, after consideration of locoregional analgesia use). The ERAS SSC is intended to work across institutions using ERAS protocols to maximize the efficacy of both the SSC and the ERAS recommendations. This consensus-built ERAS SSC is the first tool designed to enhance the synergistic effect of both ERAS and the SSC. The collaboration of ERAS experts from a wide range of clinical practices in 19 countries helps to ensure its generalizability.

Figure 1. Sample Round 2 Results of Enhanced Recovery After Surgery Surgical Safety Checklist Generation For Items Before Patient Leaves Operating Room



DVT indicates deep vein thrombosis.

Figure 2. Consensus-Derived Enhanced Recovery After Surgery Surgical Safety Checklist

## ERAS Surgical Safety Checklist

Before induction of anaesthesia	Before skin incision	Before patient leaves operating room
<p><b>Has the patient confirmed his/her identity, site, procedure, and consent?</b></p> <input type="checkbox"/> Yes	<p><input type="checkbox"/> Confirm all team members have introduced themselves by name and role</p> <p><input type="checkbox"/> Confirm the patient's name, procedure, and where the incision will be made</p>	<p><b>Nurse verbally confirms:</b></p> <input type="checkbox"/> The name of the procedure
<p><b>Is the site marked?</b></p> <input type="checkbox"/> Yes <input type="checkbox"/> Not applicable	<p><b>Has appropriate antibiotic prophylaxis been given within the last 60 minutes?</b></p> <input type="checkbox"/> Yes <input type="checkbox"/> Not applicable	<input type="checkbox"/> Completion of instrument, sponge and needle counts
<p><b>Is anesthesia machine and medication check complete?</b></p> <input type="checkbox"/> Yes	<p><b>Anticipated Critical Events</b></p> <p><b>To surgeon:</b></p> <input type="checkbox"/> What are the critical or non-routine steps? <input type="checkbox"/> How long will the case take? <input type="checkbox"/> What is the anticipated blood loss?	<input type="checkbox"/> Specimen labeling (read specimen labels aloud, including patient name)
<p><b>What is the patient's NPO status?</b></p> <p><b>Does the patient have a:</b></p> <p>Known allergy?</p> <input type="checkbox"/> No <input type="checkbox"/> Yes	<p><b>To anesthetist:</b></p> <input type="checkbox"/> Are there any patient-specific concerns? <input type="checkbox"/> What is the plan for intraoperative fluid management?	<input type="checkbox"/> Whether there are any equipment problems to be addressed
<p>Difficult airway or aspiration risk?</p> <input type="checkbox"/> No <input type="checkbox"/> Yes, and equipment/assistance available	<p><b>To nursing team:</b></p> <input type="checkbox"/> Are there equipment issues or any concerns?	<p><b>To Surgeon, Anesthetist, and Nurse:</b></p> <p><b>What are the key concerns for recovery and management of this patient?</b></p> <input type="checkbox"/> What is the postoperative analgesia plan? Any contraindications to NSAIDs?
<p>Risk of &gt;500mL blood loss?</p> <input type="checkbox"/> No <input type="checkbox"/> Yes, two IVs/central access and fluids planned?	<p><b>Is essential imaging displayed?</b></p> <input type="checkbox"/> Yes <input type="checkbox"/> Not applicable	<input type="checkbox"/> What is the postoperative nausea prevention plan? Any contraindications to early feeds?
<p><b>What is the opioid-sparing analgesia plan?</b></p> <p><b>What is the warming and temperature monitoring plan?</b></p> <p><b>What DVT prophylaxis is planned or in place?</b></p> <p><b>What antibiotics and skin prep have been requested?</b></p> <p><b>Is the appropriate surgical equipment available?</b></p> <input type="checkbox"/> Yes		<input type="checkbox"/> What is the postoperative DVT prophylaxis plan? <input type="checkbox"/> What are expected ongoing maintenance fluid requirements? <input type="checkbox"/> Have all unnecessary drains, NGs, foleys been removed?
<p><b>Does the patient need to void or foley required?</b></p>		

Based on the WHO Surgical Safety Checklist, © World Health Organization 2009. All rights reserved.

## Limitations

This study has some limitations. One study limitation in our ERAS SSC development process is that the ERAS experts used only the colorectal and gynecologic oncology guidelines to build consensus, although the topics that emerged apply within most ERAS guidelines. The ERAS SSC is an expansion of the WHO SSC, and checklist fatigue is a risk if used inappropriately. Therefore, this checklist should not replace an institutional checklist for non-ERAS procedures. Indeed, many of the discussion points may be irrelevant, for example, in minor surgical procedures. Experts were selected to have experience with ERAS protocols, and therefore, most participants were from high-income settings. The potential impact of both the SSC and ERAS may be greatest in lower-resource settings, where uptake of both is typically lower.<sup>38</sup> The recent publication of the first ERAS guideline for use in primary and secondary hospitals in low- and middle-income countries suggests a potential opportunity to introduce an ERAS SSC in such settings.<sup>39</sup>

## Conclusions

The SSC and ERAS guidelines can engage multidisciplinary teams; the ERAS SSC is designed as a tool to facilitate seamless communication and safer surgery. This can be used as a stand-alone tool, or recommendations can be used to modify an institution's existing SSC to better address key facilitators to enhanced patient recovery. The evidence supports their use independently and the next steps must determine how best to translate this evidence into practice for health care teams in the operating room.

## ARTICLE INFORMATION

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**Author Contributions:** Drs Pilkington and Brindle had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

**Concept and design:** Pilkington, Nelson, Cauley, Ljungqvist, Oodit, Brindle.

**Acquisition, analysis, or interpretation of data:** Pilkington, Nelson, Cauley, Holder, Molina, Oodit, Brindle.

**Drafting of the manuscript:** Pilkington, Ljungqvist, Brindle.

**Critical revision of the manuscript for important intellectual content:** All authors.

**Statistical analysis:** Pilkington, Brindle.

**Administrative, technical, or material support:** Nelson, Cauley, Holder, Molina.

**Supervision:** Nelson, Cauley, Ljungqvist, Oodit, Brindle.

**Conflict of Interest Disclosures:** Dr Nelson reported receiving grants from Pfizer and personal fees from Glaxo Smith Kline, AstraZeneca, 3M, and Abbott outside the submitted work; and serving as treasurer for the Enhanced Recover After Surgery (ERAS) Society during the conduct of the study. Dr Cauley reported receiving non-financial support from fees from Olympus and Boston Scientific and that her spouse receives research support from



Seimens Healthcare outside the submitted work. Dr Ljungqvist reported serving as founder and past president for the ERAS Society during the conduct of the study; receiving personal fees from Nutricia, Encare, Medtronic Fresenius-Kabi, BBraun, Pharmacosmos, and Vitaflo and owning stock in Encare outside the submitted work. Dr Oodit reported receiving personal fees from Pangeamed outside the submitted work. Dr Brindle reported serving as the secretary of the ERAS Society during the conduct of the study. No other disclosures were reported.

**Group Information:** Members of the ERAS Checklist Collaborative are provided in [Supplement 2](#).

**Data Sharing Statement:** See [Supplement 3](#).

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#### SUPPLEMENT 1.

eAppendix. Additional Round 2 Results

#### SUPPLEMENT 2.

The ERAS Checklist Collaborative

#### SUPPLEMENT 3.

Data Sharing Statement