2024

Refining Successful Implementation Strategies for the Surgical Safety Checklist in High-Income Contexts: Results of an International Mixed Methods Study

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Cover Page Footnote
The authors would like to thank the study participants for their time, invaluable perspectives, and continued commitment to improving surgical safety.

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This research is available in Patient Experience Journal: https://pxjournal.org/journal/vol11/iss1/12
RESEARCH

Refraining Successful Implementation Strategies for the Surgical Safety Checklist in High-Income Contexts: Results of an International Mixed Methods Study

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ABSTRACT

The WHO Surgical Safety Checklist (SSC) continues to show inconsistent success in reducing surgical complications in high-income settings. Previous implementation research identified potential barriers and facilitators to success, but it primarily consists of qualitative studies with small sample sizes in limited geographic areas. We conducted a multi-country mixed-methods study of barriers and facilitators to SSC implementation to better inform policies and practices for improving SSC buy-in and use to maximize its impact. This convergent parallel mixed-methods study utilized survey and interview data from surgical team members practicing in five countries. Survey data were analyzed using χ² analysis or Fisher’s exact test for categorical variables and McNemar’s test to analyze differences between related groups for dichotomous variables. Interview data underwent inductive coding followed by thematic analysis for predominant themes common across the study countries. The study resulted in 2,032 survey responses and 51 interviews. Facilitators to success included having influential multi-disciplinary champions from surgery, anesthesiology, and nursing; using a distributed leadership process to promote ownership across all surgical team members; and providing education on the “why” of the checklist. Practitioners found patient safety metrics (e.g., wrong side surgery) more relevant than clinical outcome measures (e.g., surgical mortality) to assess SSC success. Finally, auditing for process engagement was felt to promote more meaningful use than auditing for checklist completion. Our international examination of barriers and facilitators to successful SSC implementation has identified more specific guidance for high-income settings that integrate people, data, and processes.

Keywords: Quality of care, Patient-centered care, Implementation, Surgical safety

1. Background

Approximately 313 million surgical procedures take place worldwide each year.1 Sixty percent of these operations occur in countries with high levels of per capita health expenditures, including the United States, Canada, and the United Kingdom.2 Studies have found that post-operative complications occur in up to 20% of surgeries in these high-income settings.3,4 Post-operative complications significantly increase care costs, and are associated with long-term physical and mental health consequences for patients.5,6 To address this, in 2008, the World Health Organization (WHO) released the first Surgical Safety...
Checklist (SSC) aimed at reducing post-surgical complications. The SSC was designed to improve surgical team adherence to evidence-based surgical safety practices by facilitating team communication and point-of-care reminders of necessary tasks at three critical points during surgery: before anesthesia, before the incision, and before leaving the operating room.

The pivotal 2008 global SSC pilot study found that checklist use reduced surgical morbidity and mortality while also increasing patient safety-related practices. Following this, the SSC was rapidly adopted in more than 130 countries. Many institutions and surgery and anesthesia professional societies adopted the checklist without considering the best implementation strategies in different settings. Subsequent studies evaluating large-scale checklist implementation revealed variable success in reducing surgical complications across high-income settings. Further research revealed high levels of organizational SSC adoption alone did not correlate with improved surgical outcomes; clinical end user staff needed to buy-in to the SSC tool to ensure fidelity and achieve improvements in patient outcomes.

There is ongoing debate among health administrators, nurses, anesthesiologists, and surgeons in high-income settings about the SSC’s usefulness and questions as to why some contexts achieve higher performance. Stakeholders at sites where the checklist had failed to achieve its promise identified formidable SSC implementation challenges yielding low uptake including a lack of perceived relevance to the local context and resistance to change as well as confusion around the timing of and roles involved in checklist processes. Alternatively, where the SSC flourished, users identified several strategies that facilitated SSC adoption. These include the use of designated checklist champions, providing education and checklist training, audits and feedback, checklist modification to the local context and pilot testing to incorporate frontline staff feedback. These studies with SSC stakeholders are limited, given they primarily use qualitative study designs with small sample sizes from few hospitals in a single location.

Despite consensus in the literature on the facilitators to successful SSC implementation, these concepts are broad, and continued variation in checklist performance indicates that sites struggle to make them actionable. In this study, we present a mixed-methods analysis of barriers and facilitators to SSC implementation across multiple high-income countries to provide more actionable insights for checklist implementers. Ultimately, our objective is to inform policies and practices that will improve buy-in and fidelity of SSC use in these settings to maximize its impact on patient safety in surgery.

2. Methods

2.1. Study design and setting

This cross-sectional, convergent parallel mixed-methods study utilized survey and interview data. The survey was developed and distributed as part of a larger parent study to develop a toolkit to facilitate SSC adaptation, implementation, and utilization in high-income settings. Survey data were collected across five high-income countries: the United States, Canada, the United Kingdom, Australia, and New Zealand, which were selected because of their similar resource availability and differing degrees of checklist utilization. Key informant interviews were performed within the same five countries to explore the survey findings in more detail and contextualize the findings. This study was reviewed and approved by the Boston University Medical Campus and Boston Medical Center Institutional Review Board (IRB#H-38776) and the University of Calgary’s Conjoint Health Research Board (REB18-0511).

2.2. Study sample

Survey respondents included the active membership for 14 surgery, nursing, and, anaesthesiology professional societies. Interviewees included clinical and non-clinical health administrators and surgical team members recruited using purposive sampling from a subset of survey respondents who were willing to participate in a follow-up interview. We also used non-probability discriminative snowball sampling.
by asking interviewees to direct us to colleagues who may be interested in discussing their SSC experiences. This allowed us to incorporate additional perspectives not already captured through the survey and ensure all professional groups and study countries were represented through the data. Survey respondents and interviewees were contacted via an email explaining the study and inviting participation. An electronic consent form preceded the online survey, while verbal consent was obtained before each interview. Interviews of each informant type continued until little-to-no new information was learned in subsequent interviews. Three study authors reviewed the interview data as it was being collected to determine the point of saturation.

2.3. Data collection

The survey used in this study is described elsewhere. A 43-question, online survey was distributed between February and October 2019. A mix of nominal, Likert-scale, and free-text questions assessed respondents’ views on SSC content and utility within that person’s organization. Data were collected and managed using the University of Calgary’s REDCap survey system.

Key informant interviews were performed between July 2019 and February 2020. A semi-structured interview guide was developed for this study and included topics such as checklist (1) processes, (2) leaders, (3) implementation barriers and facilitators, and (4) effectiveness (Supplement 1). The interview guide was pilot tested several times with field-based specialists and health administrators in the target demographic to ensure 1) question interpretability and understanding, 2) questions were eliciting the intended information, and 3) interviews could be completed in approximately 60 minutes. Interviews were conducted in-person, via Zoom, or via telephone by two members of the study team. All interviews were audio-recorded and transcribed.

2.4. Analysis

Survey data were analyzed using $\chi^2$ analysis or Fisher’s exact test for categorical variables and McNemar’s test to analyze differences between related groups for dichotomous variables, such as the “choose all that apply” survey questions. Statistical significance for all tests was set at a p-value less than or equal to 0.05. For these analyses, Likert and 3-point scale answers were divided into three categories: Disagreement (all responses of strongly disagree and disagree), Neutral (all responses of neutral) and Agreement (all responses of agree and strongly agree). All quantitative analyses were performed using SPSS, version 26 (IBM).

Qualitative data underwent inductive coding followed by a hybrid thematic analysis. All transcripts were initially inductively coded by a single member of the study team to allow codes to organically emerge from the data. Across-case analyses were then conducted to identify codes spanning multiple study countries and to generate themes. The predominant themes resulting from the across-case analyses were subsequently compared to common SSC facilitators previously identified through the literature and memos were created to document ongoing analysis. All qualitative analyses were completed using NVivo 12 (QSR International).

3. Results

The study resulted in 2,032 survey responses (a 1.01% response rate assuming full distribution to society members) and 51 interviews. Most survey respondents practiced in the United States (69.7%) and identified as nurses (51.4%), while most interviewees practiced in Australia or New Zealand (23.5% each) and were surgeons or anesthesiologists (29.4% each). Table 1 provides a demographic profile of all study participants. We interlace our survey and interview findings herein and compared them to the five facilitators that the extant literature consistently associated with successful SSC implementation. These include 1) use of designated checklist champions, 2) providing checklist education and training, 3) audits and feedback, 4) checklist modification to fit the local context, and 5) pilot testing to incorporate frontline staff feedback.

3.1. Use of designated checklist champions

Twenty-two of the 51 (43%) interviewees mentioned the importance of checklist leaders or champions during SSC implementation. Interviewees consistently felt that having multidisciplinary champions from surgery, anesthesiology, and nursing was critical to obtaining buy-in from all surgical team members and improving fidelity with checklist processes. Further, having champions who were well-known senior clinicians was viewed as particularly effective in maximizing buy-in among peers. One interviewee said:

“…The medical co-director of the surgical division, the head of anesthesia…and the heads of the 17 different surgical departments were involved… and
Table 1. Participant demographics.

<table>
<thead>
<tr>
<th>Country</th>
<th>Survey Respondents n (%)</th>
<th>Interviewees n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>53 (2.6)</td>
<td>12 (23.5)</td>
</tr>
<tr>
<td>Canada</td>
<td>449 (22.1)</td>
<td>11 (21.6)</td>
</tr>
<tr>
<td>New Zealand</td>
<td>40 (2.0)</td>
<td>12 (23.5)</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>33 (1.6)</td>
<td>7 (13.7)</td>
</tr>
<tr>
<td>USA</td>
<td>1323 (65.1)</td>
<td>9 (17.6)</td>
</tr>
<tr>
<td>Left blank</td>
<td>134 (6.6)</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>2032</td>
<td>51</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>Survey Respondents n (%)</th>
<th>Interviewees n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>1433 (70.5)</td>
<td>28 (54.9)</td>
</tr>
<tr>
<td>Male</td>
<td>456 (22.4)</td>
<td>20 (39.2)</td>
</tr>
<tr>
<td>Prefer not to disclose / Left blank</td>
<td>143 (7.0)</td>
<td>3 (5.9)</td>
</tr>
<tr>
<td>Total</td>
<td>2032</td>
<td>51</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Professional Group</th>
<th>Survey Respondents n (%)</th>
<th>Interviewees n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anesthesiologist</td>
<td>355 (17.5)</td>
<td>15 (29.4)</td>
</tr>
<tr>
<td>Anesthesiologist Assistant</td>
<td>7 (0.3)</td>
<td>0</td>
</tr>
<tr>
<td>Clinical Health Administrators</td>
<td>67 (3.3)</td>
<td>2 (3.9)</td>
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<tr>
<td>Non-Clinical Health Administrators</td>
<td>211 (10.4)</td>
<td>6 (11.8)</td>
</tr>
<tr>
<td>Nurse</td>
<td>968 (47.6)</td>
<td>13 (25.5)</td>
</tr>
<tr>
<td>Nurse Anesthetist</td>
<td>16 (0.8)</td>
<td>0</td>
</tr>
<tr>
<td>Other role</td>
<td>134 (6.6)</td>
<td>0</td>
</tr>
<tr>
<td>Surgeon</td>
<td>160 (7.9)</td>
<td>15 (29.4)</td>
</tr>
<tr>
<td>Left blank</td>
<td>114 (5.6)</td>
<td>0</td>
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<tr>
<td>Total</td>
<td>2032</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Years of Practice</th>
<th>Survey Respondents n (%)</th>
<th>Interviewees n (%)</th>
</tr>
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<tr>
<td>0-5 years</td>
<td>134 (6.6)</td>
<td>6 (11.8)</td>
</tr>
<tr>
<td>6-10 years</td>
<td>182 (9.0)</td>
<td>8 (15.7)</td>
</tr>
<tr>
<td>11-19 years</td>
<td>383 (18.9)</td>
<td>14 (27.5)</td>
</tr>
<tr>
<td>20 or more years</td>
<td>1014 (49.9)</td>
<td>23 (45.1)</td>
</tr>
<tr>
<td>Left blank</td>
<td>319 (15.7)</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>2032</td>
<td>51</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of Institution</th>
<th>Survey Respondents n (%)</th>
<th>Interviewees n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Care Hospital</td>
<td>1600 (78.7)</td>
<td>35 (68.6)</td>
</tr>
<tr>
<td>Ambulatory Surgical Center</td>
<td>242 (11.9)</td>
<td>4 (7.8)</td>
</tr>
<tr>
<td>Other type of hospital</td>
<td>73 (3.6)</td>
<td>2 (3.9)</td>
</tr>
<tr>
<td>Left blank</td>
<td>117 (5.8)</td>
<td>10 (19.6)</td>
</tr>
<tr>
<td>Total</td>
<td>2032</td>
<td>51</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hospital Size (Number of Beds)</th>
<th>Survey Respondents n (%)</th>
<th>Interviewees n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fewer than 200 beds</td>
<td>411 (20.2)</td>
<td>5 (9.8)</td>
</tr>
<tr>
<td>Greater than or equal to 200 beds</td>
<td>1120 (55.1)</td>
<td>21 (41.2)</td>
</tr>
<tr>
<td>I am unsure</td>
<td>43 (2.1)</td>
<td>0</td>
</tr>
<tr>
<td>Not Applicable / Left blank</td>
<td>458 (22.5)</td>
<td>25 (49)</td>
</tr>
<tr>
<td>Total</td>
<td>2032</td>
<td>51</td>
</tr>
</tbody>
</table>

because there were clinical leaders who were known to their own departments...the implementation went much more smoothly.” (Anesthesiologist, AUS)

When multiple champions were not an option, interviewees overwhelmingly agreed that a single champion needed to be a surgeon. This was likely because surgeons were considered the “key leader” of the surgical team and because surgeons were the profession most frequently cited as being resistant to checklist processes. One nurse explained:

“For implementation...get your surgeon champion, that was the first thing that we needed. We knew that if it was just going to be nurses teaching surgeons there might not be as big a positive response, so it was very important for us to find a good surgeon champion who is able to talk to all our different surgeons.” (Nurse, USA)

3.2. Checklist education and training

Most survey respondents (66%) and interviewees (65%) reported receiving specific education on the SSC before or during its implementation. However, 35% of interviewees could not remember receiving any formal SSC training or education, and more than one-quarter (27.6%) of survey respondents felt that they received inadequate education or training. Hardcopy educational materials (46.7%) and
in-person education sessions, such as grand rounds presentations or professional in-services, (43%) were commonly noted approaches by survey respondents. Interviewees also mentioned that videos during orientation were an effective tool.

Interviewees discussed that education and training were frequently completed separately by profession, with nurses receiving the most training. Survey results appear to confirm this with 41.8% of surgeons and anesthesiologists reporting inadequate training on the checklist compared to 22.9% of nurses (p<0.001). When asked what forms of education and training were the most effective, both survey respondents and interviewees noted the importance of conducting more interdisciplinary team-based training. Sixty-two percent of survey respondents felt that team-based training was one of the most helpful strategies used to increase meaningful checklist implementation. One interviewee exemplified this: “...this whole silo teaching, we had teaching for anesthesia...surgeons...nurses, but that’s not how we function; we function together as a theatre team.” (Anesthesiologist, NZ) Interviewees also discussed simulation training and demonstration of a well-performed checklist process as effective strategies:

“I think it’s [simulation] much more effective because you’re trying to do an operation and you don’t know some of the information that someone else knows...and the pressure...you’re sweating even though it’s a simulation. You learn well that way.” (Surgeon, NZ)

When asked how educational sessions could be improved, interviewees from all five countries responded that more emphasis on SSC history, why it was introduced, and its importance would help improve buy-in and achieve a greater sense of contextual relevance. One surgeon mentioned:

“I remember in the beginning people thinking... ‘What are we doing this for?’ So, I did a little education on why I thought this was important. ...people... once they understand the reasoning behind it, I think they really do buy into it.” (Surgeon, USA)

Interviewees also pointed to the importance of being supplied with data-supported explanations and real-world examples as part of effective educational sessions. One surgeon stated:

“... I think doctors are always convinced by statistics...if you could show that it’s reduced the incidents of wrong side surgery, then doctors will really stand up and take notice of it.” (Surgeon, NZ)

3.3. Use of audit and feedback

Nearly half (45%) of survey respondents and 76% of interviewees reported using audit and feedback interventions to promote checklist use within their institution. Most survey respondents (55.7%) felt it was one of the most effective strategies to encourage meaningful use. Interviewees noted both prospective in-person audits and retrospective chart audits were used primarily to assess checklist completion rates. While interviewees felt completion audits facilitated use, they also felt auditing surgical team members’ engagement level with checklist processes would be more impactful. For example:

“... having someone come through and audit and paying particular attention to...are you covering each of the five, six, seven points on the form, scoring you on whether you are actually standing still and listening...it does remind people that this is not just a checklist for the sake of ticking a box.” (Surgeon, NZ)

The degree to which audit feedback was provided to surgical team members varied greatly across institutions. A few interviewees described providing or receiving “on-the-spot” coaching during an audit, while others reported having performance data compiled and shared publicly within their organization. Others did not recall ever receiving feedback. In terms of sustaining performance, feedback was most often provided during the initial SSC implementation, but regularly stopped once the checklist was perceived to be fully implemented. Interviewees stated:

“As far as I’m concerned...the job’s done, we use the checklist...we used to audit the use of the checklist...but I’m not aware that those things are still ongoing.” (Anesthesiologist, UK)

Finally, when asked for measures of checklist effectiveness, interviewees most frequently cited patient safety metrics (e.g., wrong side/site surgeries), not metrics associated with clinical outcomes (e.g., surgical mortality rate). Nearly 9-of-10 (88%) survey respondents indicated the SSC positively impacted institutional patient safety. Similarly, 86% of respondents felt it positively impacted team communication. Interviewees echoed these findings and while they did not cite specific data, they anecdotally discussed the intangible effects of improving surgical team communication and flattening historical operating room hierarchies:

“Why has it worked? ...it’s primarily about making people talk to one another and share information, not...
just during the checklist phase but at other phases as well... It’s really hard to prove all that stuff, but that’s what I see.” (Anesthesiologist, NZ)

3.4. Checklist modification to fit the local context

More than half (58%) of survey respondents reported using a modified version of the WHO’s SSC in their institution. Moreover, 69% of respondents felt these modifications were effective. Forty-one of 51 (80.4%) interviewees also described using a modified checklist version, and nearly half (48.8%) also felt the modifications were effective. Interviewees further described content modifications that added checklist items related to local issues (e.g., specimen handling) or modified wording to better reflect the local spoken language. For example:

“...if things come up on safety briefs, or...at M and M meetings and there are things that we could try to standardize on the checklists then we tried to add it.” (Anesthesiologist, UK).

Many organizations also developed specialty-specific checklists for ophthalmology and obstetrics, as the surgical procedures in these fields were unique. However, interviewees emphasized the need to balance local modifications with simplicity. It was felt the longer and more complex the checklist became, the harder it was for people to stay engaged:

“...the people responsible for patient safety...their goal should be to improve (checklist) compliance rather than adding to the complexity... I think they need to refocus...define what role it plays in the overall safety brief and how to make sure that it’s done properly.” (Surgeon, AUS)

Checklist implementation teams also made process modifications to better integrate the SSC into existing workflows. The most common process modification identified was the addition of a morning huddle, or briefing, where all surgical cases were reviewed. Surgical team members noted that discussing the case equipment needs and potential issues at the beginning of the day helped ensure these were addressed in advance and prevented OR delays:

“We have a pre-operative...huddle, which happens at the beginning of the day...that is run by the surgeon. It involves introductions, a summary of cases on the list, any specific equipment that might be needed or important issues to be considered, and...opportunity for anyone to contribute around those things.” (Surgeon, NZ)

Several key informants described that shifting from a single process leader to a distributed leadership model improved engagement and buy-in across surgical team members. At a minimum, these decentralized leadership models encouraged shared leadership responsibilities between the anesthesiologist and the surgeon. In New Zealand, anesthesiology, surgery, and nursing all shared leadership responsibilities. One interviewee described this by saying:

“...we made it very clear that the anesthesiologist should lead the sign in, the surgeon should lead the time out, and the nurse should lead the sign out. And that’s improved ownership and it’s improved engagement from the team.” (Anesthesiologist, NZ)

3.5. Piloting and incorporating frontline staff feedback

Few (11.8%) interviewees identified pilot testing as part of the SSC implementation process. Of those who commented, some reported pilot testing a modified version of the checklist that was reintroduced after initial checklist implementation failure. All interviewees who reported pilot testing the checklist offered that end users had an opportunity to provide feedback. This resulted in greater buy-in and a sense of ownership over the checklist from those stakeholders:

“...when we were trying to introduce it to try and get buy-in from the various different personnel. You would bring them in and say, ‘Which bits did you find useful? Which bits are you not happy with?’... That was quite a prolonged process trying to involve all the members of the team to the theatre nurses, the anesthetists and the surgeons.” (Surgeon, UK)

Few interviewees reported ongoing opportunities for staff to provide continuous feedback once initial checklist implementation was considered complete.

These findings add to the prior literature on SSC implementation facilitators as outlined in Table 2 by providing additional guidance and examples to help sites prioritize strategies most likely to result in successful checklist implementation.

4. Discussion

The impact of the WHO SSC on patient safety and clinical outcomes continues to be highly variable across settings more than a decade after its introduction.\textsuperscript{11,38,39} Research has acknowledged the importance of SSC implementation in achieving intended
Our data suggest that having multiple champions and facilitators to improve buy-in and fidelity with checklist processes. However, our study demonstrates that surgical systems in many high-income countries struggle to effectively implement these facilitators and continue to experience inconsistent buy-in and meaningful checklist use. This study is, to our knowledge, the largest international mixed-methods study assessing the barriers and facilitators to successful SSC implementation and use in high-income settings. While several findings of interest emerged from this research, we focus on three key areas that were most frequently addressed in the data: 1) use of designated champions, 2) education and training, and 3) audit and feedback.

Our data suggest that having multiple champions from different professional groups was the most effective model in securing SSC buy-in across team members. This corresponds with previous findings that implementation efforts led by a multi-disciplinary team are associated with higher implementation success rates. Our study subjects confirmed that the use of multidisciplinary champions was associated with improved buy-in and engagement across all professions. While some interviewees discussed the importance of having senior clinicians serve in the champion role, there were more specific mentions of clinicians who were well known to, or had good relationships with, their peers. This is consistent with other research and illuminates the importance of informal leadership in innovation dissemination, specifically when organizational change is a goal of the innovation, as is the case with the SSC. The historically siloed nature of the nursing, anesthesia, and surgical professions makes implementing practice change across these groups challenging. Each

### Table 2. Refined implementation strategies for the SSC.

<table>
<thead>
<tr>
<th>Facilitator</th>
<th>Previously Identified Activities</th>
<th>New Guidance</th>
</tr>
</thead>
</table>
| Use of designated checklist champions⁵,⁶,²²       | • A single person serves as checklist implementation leader (can be clinician or health administrator)  
  • One person from each surgical team specialty promotes implementation  
  • A single multi-disciplinary team leads the implementation of the checklist | • Having influential multi-disciplinary champions from surgery, anesthesia, and nursing is ideal  
  • If having only one champion, this should be a surgeon well-respected by their peers  
  • Conduct a network analysis to identify influential informal leaders to serve as champions |
| Providing specific education and training on the  | • Webinars, in-person trainings, videos, on-site coaching, bulletins, etc.                      | • Education should focus on the history of the SSC, the rationale for including checklist items, and highlighting relevance to the local context  
  • Offer continuing medical education (CME) credits  
  • Tailor trainings for each discipline  
  • Explain background and relevance of SSC to local context  
  • Provide training on communicating with resistant team members | checklist ⁶,²²–²⁴                                                                 |
| Use of audit and feedback ¹⁸,²²,²⁴–²⁷            | • Observational audits with immediate correction and feedback  
  • Retrospective chart audits with performance data reported back to physicians  
  • Audits with performance data posted for other clinicians to see  
  • Use of outcome measures determined to be most important for the local context | • Emphasize checklist effectiveness on patient safety metrics rather than clinical outcomes  
  • Audit for level of engagement in processes instead of completion |
| Modification of the checklist to fit the local    | • Change checklist items based on local OR practices  
  • Create specialty-specific checklists  
  • Change timing of checks or team member responsible for checks based on local workflows | • Consider a distributed leadership model that allows all professional groups to have ownership over a part of the checklist processes ⁴,¹⁴,¹⁶,¹⁸,²⁴ |
| Pilotling and incorporating frontline staff feedback ¹⁴,¹⁶,²⁴ | • Testing the checklist in a subset of operating rooms before rolling it out to the entire hospital  
  • Asking for feedback from surgical team members on results  
  • Incorporate feedback from surgical team members in checklist modifications | • Develop mechanisms for SSC end users to provide continuous feedback and offer suggestions for improving checklist processes ¹⁴,¹⁶,²⁴ |

Features, outcomes, and identified facilitators to improve buy-in and fidelity with checklist processes. However, our study demonstrates that surgical systems in many high-income countries struggle to effectively implement these facilitators and continue to experience inconsistent buy-in and meaningful checklist use. This study is, to our knowledge, the largest international mixed-methods study assessing the barriers and facilitators to successful SSC implementation and use in high-income settings. While several findings of interest emerged from this research, we focus on three key areas that were most frequently addressed in the data: 1) use of designated champions, 2) education and training, and 3) audit and feedback.

Our data suggest that having multiple champions from different professional groups was the most effective model in securing SSC buy-in across team members. This corresponds with previous findings that implementation efforts led by a multi-disciplinary team are associated with higher implementation success rates. Our study subjects confirmed that the use of multidisciplinary champions was associated with improved buy-in and engagement across all professions. While some interviewees discussed the importance of having senior clinicians serve in the champion role, there were more specific mentions of clinicians who were well known to, or had good relationships with, their peers. This is consistent with other research and illuminates the importance of informal leadership in innovation dissemination, specifically when organizational change is a goal of the innovation, as is the case with the SSC. The historically siloed nature of the nursing, anesthesia, and surgical professions makes implementing practice change across these groups challenging. Each
discipline has their own distinct training, culture, and professional networks, which may lead to differences in the degree to which an innovation may be adopted.\textsuperscript{8,14,20,21,44}

Multiple informal networks exist within organizations, which often transcend formal professional boundaries.\textsuperscript{40} Leaders of informal networks do not always correspond to an official leadership position within the organization, but prior authors have demonstrated that network leaders can be more effective at eliciting practice change across an organization compared to a formal organizational leader.\textsuperscript{40} For example, a study aiming to improve physician promotion of vaginal birth after the first C-section saw an 11.9% decrease in the number of C-sections performed in hospitals where network leaders were recruited to be champions of the practice change versus the 12 comparison hospitals that used traditional leadership to introduce a policy and practice change.\textsuperscript{40} In preparation for implementing improvement initiatives, like the SSC, hospitals and surgical centers should consider conducting a network analysis to identify informal leaders who would make effective champions for different stakeholder groups.

Consistent with the extant literature,\textsuperscript{16,22–24} interviewees and survey respondents felt that receiving formal checklist-specific education or training was a critical factor in facilitating buy-in and engagement with checklist processes. However, they also reported there needed to be more education on the SSC’s “why” rather than the “how.” Our data indicates that understanding the SSC history, as well as the rationale behind why specific items were included, would help clinicians better understand SSC relevance to their practice and assist with buy-in. Implementation literature suggests that improving this sense of relevance and buy-in is critical for sustaining the practices and results of an organizational change over time.\textsuperscript{17,19,41,45}

Finally, consistent with previous studies,\textsuperscript{18,22,24–27} our data suggest that auditing checklist use was perceived to be a facilitator of successful implementation and use, but current auditing practices may not use the best metrics to promote the SSC’s effectiveness in a high-income context. The initial pilot study that resulted in the SSC’s rapid, global adoption focused on the checklist’s ability to impact clinical outcomes, such as reducing surgical-related mortality.\textsuperscript{7} However, our data show that surgical team members consider the value of the checklist primarily as it relates to patient safety and adherence to evidence-based practices rather than clinical outcomes. This is likely due, in part, to the relatively low rates of surgical mortality and other adverse clinical outcomes (e.g., surgical site infections [SSIs]) in high-income contexts compared to low and middle-income contexts. Patient safety metrics are more likely to provide observable, clinically-significant results that can be immediately identified, captured, and quantified in the OR setting.

The individual versus organizational nature of patient safety and clinical outcome metrics may also play a role in the perceptions of which checklist impact metrics hold the greatest value. For example, a wrong-sided surgery metric is very personal to a clinician and directly attributable to surgical team performance. However, adverse clinical events, such as SSIs and mortality, vary in how they are defined and often occur several days after a surgical procedure. This makes it more challenging to attribute the event to the surgery and easier for the surgical team to distance their performance from these negative outcomes. It is important to assess the checklist’s impacts on metrics most relevant to surgical team members in these contexts to improve the SSC’s relevance. Creating a shared interest between stakeholder groups in achieving a broader organizational goal or mission is frequently cited as critical for the successful implementation of interdisciplinary initiatives in health care and other complex organizations, such as the Department of Defense.\textsuperscript{40}

This study has several limitations. First, despite efforts to solicit survey responses across all professional groups and study countries, the survey data was heavily skewed toward the United States and nurses. In response, we focused on recruiting interviewees from the study countries and professions with less representation in the survey sample. Second, 55% of survey respondents were from hospitals with more than 200 beds. These hospitals are more likely to have additional staff and resources available to implement improvement projects such as the SSC; smaller facilities may face additional challenges underrepresented here. Third, there is the potential for interviewer confirmation bias that may affect the information quality collected during key informant interviews. To minimize this risk, both interviewers conducted the first four interviews together, providing feedback on the delivery of the questions immediately following the conclusion of each interview and coming to consensus on rephrasing. Fourth, despite efforts to recruit interviewees with a range of attitudes toward the SSC, most of our final study sample had positive SSC viewpoints. Therefore, barriers to implementation in organizations with poor SSC adoption may not have
been uncovered. Finally, while our study captures a broad range of perspectives across multiple high-income settings, it is not a comprehensive assessment of implementation strategies or their perceived effectiveness. It is also unlikely that any single strategy will independently improve implementation success; the degree to which these strategies interact and are impacted by organizational context is unknown. Future research should investigate this area to improve claims about generalizability across organizational and international settings. Additionally, this study focused on organizational actions to improve SSC implementation. The broader health policy environment is also likely a significant factor in the success of the SSC at scale. Future research should also more thoroughly examine the correlation between different state and national health systems and the success of SSC implementation to assist policymakers in identifying political barriers and facilitators.

5. Conclusion

The SSC’s purpose “is to reinforce accepted safety practices and foster better communication and teamwork between clinical disciplines.” Our international examination of barriers and facilitators to successful SSC implementation has identified more actionable guidance for high-income settings with the goal of achieving this purpose. Ultimately, success will be determined based on how well organizations meet the challenge of integrating people, data, and processes. Pulling these pieces together will help improve safety and create a more patient-centered experience for the approximately 188 million patients receiving surgical care in these settings each year.

Acknowledgements

The authors would like to thank the study participants for their time, invaluable perspectives, and continued commitment to improving surgical safety.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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