

process.^{11,13} Most institutions use a checklist because it is a safety measure; however, meaningful use of the checklist is highly variable. Furthermore, checklist adoption, acceptance, and adherence may differ between surgical subspecialties and between surgeons caring for adults versus children. Checklists are not always designed for pediatric patients and may have irrelevant components if used for both adult and pediatric patients. Workflow can be negatively affected by an irrelevant checklist. Therefore, a positive perception of the SSC is paramount to its success.

Since the hallmark WHO report,⁴ the majority of studies show that checklists improve patient safety and outcomes in adults. However, researchers have not adequately investigated the effect of SSCs in the pediatric population. The current investigators designed a survey to assess safety knowledge, attitudes, and perceptions of North American pediatric surgeons and to specifically gauge the “buy-in” of the American Pediatric Surgical Association (APSA) membership on checklists. To support understanding of surgical checklists, the investigators conducted a literature review aiming to summarize the current data on the utility of SSCs in both adult and pediatric surgery.

METHODS

Study Design

All active APSA members were e-mailed an invitation asking them to participate in a survey on SurveyMonkey. The survey was developed by the APSA Quality and Safety Committee to measure patient safety attitudes and perceptions of the membership. It collected demographic information and practice setting and asked surgeons whether they functioned in any formal leadership, education, or safety roles within their hospital. This report focuses on checklist-specific survey content. Questions were designed to quantify surgeon participation in the preinduction, preincision, and postoperative debriefing checklists and measure surgeons' attitudes about the effectiveness of checklists using Likert scales. Respondents had the opportunity to elaborate on certain survey questions with open-ended responses. APSA members were encouraged to participate in the survey with 2 follow-up reminder e-mails over a 3-week interval.

Variables and Data Analysis

The current investigators performed standard frequency analyses for surgeons' responses regarding whether checklists exist in their hospital and to summarize surgeons' beliefs about whether checklists improve patient safety. They tested associations between surgeon characteristics (years since fellowship, practice setting, leadership/safety/educational roles) and attitudes toward the SSC using a chi-square test for categorical variables and Kruskal-Wallis test for continuous variables. Likert scale responses were dichotomized into agree/strongly agree versus neutral/disagree/strongly disagree. A *P* value < 0.05 was statistically significant.

The authors analyzed open-ended response questions using content analysis to enhance understanding of quantitative findings. The content analysis method is a systematic data coding and analysis procedure¹⁴⁻¹⁶ that allocates specific quotes from respondents into a code structure that is developed through an iterative process. The codes are then used to group the data into representative themes. The investigators selected specific quotes to illustrate the broader themes, and these are noted in italics. Four separate reviewers (including an expert in qualitative research) evaluated the open-ended responses and formed consensus on the themes that emerged.

Literature Review

In addition to the survey, we conducted a literature search to identify systematic reviews of safety checklists in surgery and studies focusing on checklists in the pediatric surgical population. The online databases Medline, Embase, and PubMed were searched using the terms “surgical checklists” AND “systematic review,” “safety checklists” AND “systematic review,” “surgical safety checklists” AND “systematic review,” “pediatric surgery,” “checklist,” AND “systematic review,” and “children's surgery,” “checklist,” AND “systematic review.” Studies were limited to those that focused on surgery/perioperative checklists, were written in the English language, and were peer-reviewed and included an abstract.

RESULTS

Demographics and Other Respondent Characteristics

A total of 928 APSA members received the survey, and 353 responded (38% response rate). The majority of respondents operate primarily within a children's hospital, 49.7% freestanding and 38.1% within an adult medical center. Most respondents were in an academic (65.3%) or mixed (25.3%) practice, with only 9.4% in private practice. The majority of respondents (56.7%) self-reported holding leadership positions at their institutions (eg, chair or division chief), with 43.4% in education and 21.0% in safety positions. The median number of years since completion of pediatric surgery fellowship was 13 (range, 0–32 years).

Practice and Attitudes Surrounding SSC

Most respondents (93.6%) reported compliance with SSCs at their institution, but only 54.7% felt that checklists improve patient safety. Respondents most consistently reported doing the preincision checklist (83.8% of respondents stated that they do it all of the time), followed by the preinduction checklist (79%), and then the postoperative debriefing checklist (29%). The majority of respondents (54.5%) agreed strongly that the checklists improve operating room communication, but only 35.6% agreed that they prevent harm and 24.1% that they benefit every case. Only 62.6% agreed strongly that they would want it used in their own child's operation. Being

Table 1. Associations between Surgeon Characteristics and Attitudes toward Surgical Safety Checklists

	Believe Checklist Improves Patient Safety [n (%)]	P	Strongly Agree Would Want Checklist Used on Own Child [n (%)]	P
Type of practice				
Mixture of private practice with academic/teaching affiliation	39 (48.2)	0.4	40 (62.5)	0.86
Predominantly academic	119 (56.9)		115 (63.2)	
Predominantly private practice	16 (53.3)		12 (57.1)	
Type of hospital				
Children's hospital within an adult medical center	65 (53.3)	0.97	67 (63.8)	0.5
Children's unit within an adult tertiary care hospital	16 (50)		14 (51.9)	
Community hospital with pediatric commitment	3 (60)		3 (100)	
Freestanding children's hospital	89 (56)		82 (63.1)	
Positions held				
Leadership position	76 (57.6)	0.4	72 (64.3)	0.63
No leadership position	103 (52.8)		97 (57.4)	
Education position	54 (53.5)	0.76	51 (60)	0.55
No education position	125 (55.3)		118 (63.8)	
Safety position	36 (73.5)	0.004	39 (84.8)	0.0006
No safety position	143 (51.4)		130 (58)	

in a safety position was the only respondent characteristic correlated with believing that checklists improve patient safety or wanting the checklist used in one's own child's operation (Table 1).

In the open-ended questions, several themes emerged to explain a lack of enthusiasm for SSCs/handoffs:

1) Checklists are too long and contain information that is not relevant to the current case. Three respondents had these comments:

“Checklists only work if they are short. So many checklists are filled with useless info. As a pilot, I use a checklist when I fly. It encourages safety by being short, simple, and to the point.”

“There are generic elements to all surgical procedures that have some applications in the generic checklists currently available. What would be far more effective would be computer generated checklists SPECIFIC for the procedure scheduled.”

“Safety checklist has become too encompassing beyond safety issues so that safety factors are getting lost in the long checklist, which has become another form to complete.”

2) Checklists result in mindlessness as opposed to mindfulness and can distract from thoughtful patient care as described by these 4 respondents:

“All this devotion to checklists and process has become a form of fetishism, and often is a distraction from the task at hand.”

“The surgical checklist is highly ineffective in modern Western hospitals. This was shown, but ignored, in the original paper. It is a meme, a trend, and a fad. It does not actually improve real mindfulness, and often distracts from it.”

“People sometimes go through the motions but don't really pay attention.”

“Like any checklist, it is used with varying degrees of a mechanical/begrudging fashion.”

3) Surgeons want to see data proving that checklists prevent adverse events. As 2 surgeons stated:

“There may be one case in 10,000 in which it makes a difference. I personally haven't seen it.”

“Of the tools that are available, none have led to new systems that demonstrably decrease error or improve safety.”

In contrast to the negative comments summarized above, some surgeons saw some utility in the checklist depending on the situation.

“It was my practice to discuss the more complicated cases at the beginning of the day to identify the need for additional anesthesia/nursing/surgical care or unusual equipment. Current safety lists may have influenced some groups to use a similar practice. However, for most routine cases, the safety lists (required for all cases) add little or nothing to the case or safety of the patient.”

“It has improved patient safety in SOME cases.”

Many other respondents voiced strong support for SSCs as illustrated by these 3 respondents:

“SSC has definitely improved OR [operating room] safety. NO wrong side procedures, NO wrong procedures since it was introduced and adopted. Also caught several 'near misses,' also improved timeliness of preop antibiotics.”

"I have been trying for years to implement a safety checklist."

"It has become hard-wired and is an improvement."

Literature Review

The investigators identified 34 manuscripts, of which 11 met inclusion criteria and were reviewed in detail. Only 2 studies address pediatric surgery patients,^{17,18} and the remainder focus on the adult literature. The first pediatric surgery study, by MacDonald and Sevdalis,¹⁷ systematically reviews 20 studies of patient safety interventions including the SSC. The authors note that pediatric cardiothoracic surgery account for the majority of the children's safety literature. Fifteen studies (75%) use a checklist tool as part of their safety intervention; however, only 5 studies use checklists as their primary safety intervention. The 5 checklist-oriented studies evaluate checklist adherence and perioperative patient safety, but none assess the rate of complications, and only 1 addresses the near misses as a result of checklist adherence.

The second pediatric surgery study, a systematic review, by Lagoo and colleagues,¹⁸ evaluates the effectiveness and meaningful use of pediatric SSCs and their implementation strategies. The authors include 26 studies, all of which are cross-sectional or cohort studies. They rate 6 of them as poor overall. Of the 20 studies rated fair or good, only 16 evaluate SSCs in the operating room or perioperative setting. Three studies measure the effectiveness of checklists on morbidity and mortality with mixed results; one of these is primarily in adults with a small pediatric component. Four studies assess parental involvement in SSCs. Nine studies evaluate compliance with checklists, 11 studies investigate the implementation of checklists, and 8 studies assess attitudes related to checklist use and the effect of SSCs on safety culture. Table 2 summarizes the results of the pediatric surgery-specific checklist studies written in the English language.

Review of the Adult Surgical Literature on Checklists

The adult literature yielded 9 systematic reviews that met the inclusion criteria, and these are reviewed here in more detail starting with oldest to newest.^{11,19-26} Unlike the majority of the pediatric surgery literature, several of these studies did evaluate the effect of checklists on morbidity and mortality. It is important to note that many of the individual studies included in each systematic review overlap those included in the other reviews, as would be expected. Therefore, there is some redundancy between systematic reviews. Table 3 (Supplemental Digital Content, available at <http://links.lww.com/PQ9/A43>) shows a summary of the results.

DISCUSSION

For nearly a decade, checklist implementation has been a surgical safety initiative around the world. Since the

landmark 2009 *NEJM* report showing a decrease in deaths and surgical complications after the implementation of the WHO's SSC in 8 different hospitals,⁴ numerous studies evaluate the role of checklists in surgery. The *NEJM* report by Haynes et al.⁴ has been challenged, and some studies show that SSCs cause no reduction in morbidity and/or mortality.^{21,27} However, the majority of studies show that checklists improve patient outcomes, teamwork, and communication. This national survey of APSA members shows that pediatric surgeons are skeptical about the value of SSCs. The current investigators sought to understand why such skepticism exists and how to make the SSC a more meaningful safety tool for their pediatric patients.

In the current survey, the authors found that the majority of pediatric surgeons believe that checklists improve operating room communication. Both the pediatric and adult literature support this notion; checklists are one tool used to facilitate better communication in surgical settings and are shown to improve operating room teamwork.^{11,28} In 1 study of all root cause analyses submitted to the Joint Commission on Accreditation of Healthcare Organizations, communication is the most common root cause of sentinel event wrong-site surgeries.²⁹ Ideally, good communication is efficient. In the current survey, several pediatric surgeons express opinions that the checklist is too long or contained elements that are irrelevant to a particular case. A checklist that contains too many elements may be thought to inhibit effective communication. As 1 pediatric surgeon said, "Like any checklist, it is used with varying degrees of a mechanical/begrudging fashion." Acceptance of the checklist as an important safety tool means realizing that not all checklist items will benefit every patient, but all patients will benefit from some portion of the checklist. Customizing the checklist to pediatric general surgical patients should be a goal, but maintaining a routine set of items ensures that communication is standardized.

Across several studies in both the adult and pediatric literature, staff perception is noted to play a large role in the acceptance and successful adoption of checklists. To maximize its safety benefit, those people designing and using the checklist need to be engaged in the process. Some pediatric surgeons surveyed express support for the checklist and it is becoming "hard-wired" as an expected part of surgery. Perceived ownership of the checklist varies. Having an organizational culture of safety that begins with executive leadership can help foster an environment where the introduction of a checklist is well received. The onus for completing a checklist may be driven by hospital administration to satisfy a Joint Commission requirement but, ideally, is most closely overseen by leadership within the operating room who may be more "in touch" with the day-to-day use of the checklist. The investigators did note that being in a safety position is the only surgeon characteristic that correlates with believing that checklists improve patient safety or wanting the checklist used in

Table 2. Pediatric Surgical Studies on Checklists Used in the Operating Room

Study	Context/ Location	Volume	Type of Checklist	Measures of Checklist Compliance and Adherence			Participant Feedback	Measures of Effect on Outcomes	Balancing Measures	Salient Points/Conclusions
				Completion rates	Adherence	Time-outs				
Khoshbin et al. ³⁹	OR, CH, Toronto, Canada	391 Preoperative huddles or time-outs	9-point CL	Compliance audit: completion rates of 64.1% for huddles and 99.1% for surgical time-outs	No	The perception of safety in the OR improved, but only among nurses.	No	No	Structured communication tools encourage teamwork and patient safety.	
Norton and Range ⁴⁰	OR, CH, Boston, MA	30 procedures audited	3-part WHO SSC modified for pediatrics	Regular audits: 80–90% compliance	None	“Overwhelmingly positive”	Outcomes noted in terms of “near miss” situations identified at each CL phase.	None	CL use has improved teamwork, communication, and adherence to process measures.	
Avansino et al. ⁴⁰	OR, CH, Seattle, Wash.	129 survey audits over 1 year of operations	Modified WHO procedural CL	Statistically significant increase in compliance over a 12-month period	No	Surgeons responded more favorably than anesthesiologists; both responded more favorably than OR staff.	No	No	High levels of compliance can be achieved and sustained with a procedural checklist, but perceptions of checklist efficacy vary.	
Levy et al. ⁴¹	OR, CH, Houston, Tex.	142 operations	Modified WHO SSC	100% compliance with preincision CL; adherence was poor	No	Poststudy survey: surgeons deemed most responsible for CL completion	No	No	Despite 100% documented completion of the preincision CL, there was a lack of CL implementation fidelity; may be due to poor implementation and dissemination.	
Low et al. ⁴²	Pediatric ambulatory surgery center, Seattle, Wash.	12 months of observation	CL created for 4 perioperative phases	100% compliance	None	The team valued the checklists as a component of patient safety.	None	No increase in turnover times or OR efficiency	Reproducible model, multiple perioperative CLs, high degree of staff engagement, no decrease in OR efficiency	
Corbally and Tierney ⁴³	OR, CH, Dublin, Ireland	42 patients/operations	3-stage WHO SSC; parents participated in each stage	No	No	All staff felt that parental involvement in the SSC improved patient safety.	100% of surgeons felt parental involvement did not add to the complexity of the process.	Both parents and staff welcomed parental involvement in SSC and felt that it improved patient safety.		
Jenkins et al. ³⁶	OR, 27 sites in developing countries	15,049 operations	Modified WHO SSC for congenital heart surgery, also implemented a broad safety strategy that included use of CL, practice bundles, and team-based practice	No	Significant decrease in risk-adjusted in-hospital mortality and major infection	Not reported		No	Broad safety strategy, which included a CL, improved mortality, and infection rates in developing countries.	
Putnam et al. ²⁸	OR, CH, Houston, Tex.	873 operations	Modified WHO SSC	Significant improvement in CL adherence over 2 years	No	Safety attitudes questionnaire showed improvements in all 5 domains (safety culture, teamwork, speaking up, safety rounds, and other aspects of the safety culture).	No	No	Strategic, multifaceted approach to perioperative safety significantly improved CL adherence. Successful CL implementation requires efforts to change the safety culture, stakeholder buy-in, and sustained efforts over time.	

(Continued)

Table 2. (Continued)

Study	Context/ Location	Volume	Type of Checklist	Measures of Checklist Compliance and Adherence			Participant Feedback	Measures of Effect on Outcomes	Balancing Measures	Salient Points/Conclusions
				Compliance ranged	No	Yes				
Urbach et al. ²⁷	130 hospitals in Ontario, Canada; only 7% of patients were aged 0–17 y	215,711 operations; data taken in 3-month periods before and after adoption of an SSC	Canadian Patient Safety Institute CL, WHO SSC, or a unique CL devised by the hospital	Compliance ranged 91–100%	No		No significant reduction in No operative mortality after CL implementation and no reductions in risks of surgical complications, emergency department visits, or hospital readmissions within 30 days after discharge		Majority of patients were adults. Implementation of surgical safety checklists was not associated with significant reductions in operative mortality or complications.	
Montgomery et al. ³³	OR, CH, Glasgow, United Kingdom	114 operations	Modified WHO SSC, created as a group effort	Compliance improved from 90% to 100%; adherence improved from 51% to 77%.	No	Surgical pause perceived as a time-consuming process; feedback suggested that a poster reduced the time to complete the CL	No		By engaging with OR staff to create an acceptable CL poster, CL adherence can be improved.	
Wyrick et al. ⁴⁴	OR, CH, Little Rock, Ark.	390 operations	Debrief portion of the WHO SSC	Process measure compliance (surgical wound classification) increased.	No		No		Implementation of a multifaceted approach (including education) improved accuracy of 1 component of the debrief CL.	
Norton et al. ⁴⁵	OR staff, CH and satellite campuses, Boston, Mass.	196 surveys	Pediatric surgical safety CL	No	Yes, survey about staff's perception of patient safety mostly positive		Some perceived the CL as overbearing.		The majority of the surgical staff felt the CL improved patient safety in the perioperative environment.	
O'Leary et al. ³⁵	Pediatric surgery admissions in 116 hospitals, Ontario, Canada	14,458 operations	3-phase modified WHO SSC	> 98% compliance postimplementation	No		No significant difference in the odds of perioperative complications, no differences in measures of health care utilization		Implementation of SSCs for pediatric surgery was not associated with a reduction in the proportion of children who had perioperative complications.	
Putnam et al. ³⁷	OR, CH, Houston, Tex.	1,346 CL performances	Modified WHO SSC	Adherence to the preincision CL improved but preincision CL fidelity decreased; adherence to preinduction CL decreased; adherence to debriefing CL remained unchanged	No		No, but good catches were identified during 16% of preincision CL performances		A well-performed preincision CL resulted in numerous good catches (including process issues, medication issues, and safety issues).	

CH, children's hospital; CL, checklist; OR, operating room.

Table 3. Systematic Reviews of Adult Studies on Surgical Safety Checklists

Systematic Review	No. Studies Included	Purpose of Review	Type of Checklist	Measures of Checklist Compliance and Adherence	Participant Feedback	Measures of Effect on Outcomes	Balancing Measures (ie, Decreased OR Efficiency)	Salient Points/Conclusions
Borchard et al. ¹⁹	22	To assess the effectiveness of, staff compliance with, and critical factors for the successful implementation of CLs	SURPASS, WHO SSC, JC UP, or an adaptation of the WHO SSC or JC UP	12–100% overall CL compliance; mean 75%; 91% compliance for “time-out”	Not included	RR of mortality with the use of a CL was 0.57 (95% CI, 0.42–0.76), RR for any complications 0.63 (95% CI, 0.58–0.67), RR for SSI 0.62 (95% CI, 0.53–0.72)	Not addressed	Highly variable compliance rate for checklists suggests that “accompanying measures” are necessary for highly effective CL implementation. Safety CLs improve both perceived and observed teamwork and communication in the OR.
Russ et al. ¹¹	20	To determine whether safety CLs improve teamwork and communication in the OR	WHO SSC, CL adapted from the JC UP, or CL developed locally	No	CLs improved communication, strengthened the “team feeling” in the OR, increased discussion of critical events, made team members more familiar with each other, improved decision making, led to better inter-professional coordination and assignment of tasks, and caused fewer delays due to miscommunications.	No	Not addressed	Safety CLs improve both perceived and observed teamwork and communication in the OR.
McDowell and McComb ²⁰	23	To gather evidence regarding compliance in conducting CL briefings, outcomes of briefings, and surgical team members’ perceptions toward the use and efficacy of CL briefings	Variable: WHO SSC, modified WHO SSC, SURPASS, or an institution-specific CL	> 95% rate of compliance	Overall positive responses for team introductions and team communication and awareness of patient-centered information, team awareness, and sense of improvement in overall safety	CL briefings helped prevent error events during procedures and reduced postoperative complications and also decreased the number of potential intraoperative incidents.	Not addressed	Support for CL in terms of decreased error events and complications and overall positive perception of CL use and its effect on teamwork and patient safety
Gillespie et al. ²¹	7	To assess the risk of complications (including wound infection, blood loss, pneumonia, and unplanned return to the operating room) and mortality	WHO SSC, JC UP, or an adaptation of the WHO SSC or JC UP	Not specifically reported but “variable”	Not included	When CLs were used, there was a reduction in any major complication, wound infections, and elevated blood loss. No significant reduction in mortality, pneumonia, or unplanned return to the OR	Not addressed	CLs are associated with a reduction in overall complications in surgical patients but not in mortality.
Howell et al. ²²	4	To perform a systematic review of interventions (including CLs) used to reduce adverse events in surgery	WHO SSC or SURPASS	Not reported	Not included	3 studies showed a reduction in adverse events. One study showed a reduction in mortality rates when CLs were used.	Not addressed	SSCs (and care pathways) were the strongest evidence-based interventions used to reduce adverse events in surgery.

(Continued)

Table 3. (Continued)

Systematic Review	No. Studies Included	Purpose of Review	Type of Checklist	Measures of Checklist Compliance and Adherence	Participant Feedback	Measures of Effect on Outcomes	Balancing Measures (ie, Decreased OR Efficiency)	Salient Points/Conclusions
Treadwell et al. ²³	33	To summarize experience with surgical CL use and efficacy for improving patient safety	WHO SSC (majority), SURPASS, CL based on JC UP	Variable, from 80–100%, but, while compliance with checklist use was high, adherence was often poor	Successful implementation was attributed to having a local champion, good training/staff understanding, support from upper management, a modifiable CL, distribution of responsibility and the feeling of ownership by team members, a step-wise implementation process that was open to feedback, and enhanced communication and teamwork.	< 50% WHO SSC studies reported improved health outcomes and reductions in complications. Multiple studies reported decreased surgical complications and SSIs. A few studies noted improved safety processes; 1 study noted a decrease in mortality, and 1 study identified multiple near misses.	Challenges to efficient workflow (especially during emergency procedures)	CLs have been widely adopted and are generally associated with improved health outcomes. However, they may be only part of a multifaceted strategy to improve care; not all CLs are beneficial, and reporting bias exists. There are also many barriers to successful implementation.
Patel et al. ²⁴	16 (including 2 pediatric: Avansino et al. ⁴⁰ and Levy et al. ⁴¹)	To systematically analyze published literature to assess the use of the WHO Surgical Safety Checklist and its effect on patient safety (in different surgical specialties)	WHO SSC	Highly variable (26–97%)	Overall, feedback was that CL items were important and that CLs result in improved communication between team members, allowing for more efficient patient care, a positive atmosphere, and better teamwork.	Individual studies showed a reduction in mortality, complication rate (including SSIs), adverse events, and unplanned reoperations. Only 1 study found no significant change in morbidity or mortality.	Not addressed	Surgical CLs have been shown to significantly improve postoperative patient outcomes. Compliance is needed.
Bergs et al. ²⁵	18	To review the qualitative evidence (barriers and facilitators) related to implementation of SSCs	Not reported	Not reported	Staff's perception of the CL and patient safety affected their willingness to use the CL.	No	Concerns about legal implications, patient perception, time efficiency, and workflow adjustments	Implementation problems are multifactorial. SSC implementation requires change in perception of the CL and patient safety in general and also requires workflow adjustment. Critical and skeptical of findings supporting use of CLs. Discouraged the data as "suboptimal" quality. Concluded that many benefits associated with CLs were due to "temporal changes, confounding factors, and publication bias"
De Jager et al. ²⁶	25 (most excluded patients below the age of 16 or 18 y)	To examine the effects of the SSC on postoperative outcomes	WHO SSC or an adaptation of the WHO SSC	"Reported compliance to the checklist was not scrutinized"	Not included	Majority of the studies showed a decrease in complication and postoperative mortality rates. Reduced mortality was even more pronounced in developing countries.	Not addressed	

CL, checklist; JC UP, Joint Commission Universal Protocol; OR, operating room; SURPASS, Surgical Patient Safety System; SSI, surgical-site infection.

one's own child's operation. As the systematic study by Berg et al.²⁵ states, "The motivation for implementing an SSC differs between health care providers and hospital management." In the Boston Children's study, feedback from surgeons, anesthesiologists, and nursing staff is "overwhelmingly positive,"³⁰ and this may have been due to participant engagement in the initiation of the checklist. After a first pilot test, feedback resulted in changes to improve the second version. Participant involvement in the creation and modification of the checklist can be beneficial but is not enough. Implementation of the checklist needs to be done thoughtfully. Repeatedly, it is seen that effective implementation strategies incorporate education and in-service training that addresses the concerns expressed by staff.^{25,30} As many studies have shown, when implemented well, checklists improve the safety culture.^{23,25,31,32}

Clearly, there is a difference between checklist compliance (participants did the checklist), adherence (participants did all the parts of the checklist as it was designed), and fidelity (participants did the checklist with intent and meaning). Multiple studies show that checklist adherence is lower than compliance.^{23,33} In the pediatric literature, SSC compliance has been good in most studies. Not all elements of the checklist are being done routinely, however, perhaps because the checklist is too lengthy. The current study found that pediatric surgeons surveyed do use SSCs regularly, but that compliance is best with the preinduction and preincision, and that the postoperative debriefing checklist is much less common. It would be interesting to know why this is the case among the surgeons surveyed. It may be easier to overlook a less formal postoperative debriefing than a more formal time-out. It may be because the lead surgeon or the lead anesthesiologist or both are not always both present at the end of the case to lead the debriefing. It may be due to a lack of institutional awareness of the potential benefits of the debriefing.³⁴ The relevance of the postoperative debriefing may also be a factor. If the debriefing contains elements that pertain to the transition of care of the patient leaving the operating room, it represents a key moment of team communication. However, if it contains only a review of wound classification and name of the case, it may be less valued as a component of patient safety. Better education on the benefits of doing all 3 parts of the SSC as it is designed is needed to make the debriefing an essential part for pediatric surgeons.

In the current survey, the authors found that pediatric surgeons express concern about the checklist being done in a mindlessly. When the operating room team does not embrace checklists or uses them improperly, they can have a negative effect on team dynamics.¹¹ When used properly, checklists strengthen the "team feeling" in the operating room, increase discussion of critical events, improve decision making, and lead to better inter-professional coordination and assignment of tasks.¹¹ One theme noted in the comments is the concern that the mindless use of

the checklist can distract from thoughtful patient care. "Going through the motions" and not paying attention to the components of the checklist can detract from its utility and can contribute to surgeons' skepticism about its benefit. By contrast, thoughtful use of the checklist can result in "good catches" or "near misses," which will ultimately improve patient safety.

This survey shows that pediatric surgeons question the checklist's ability to prevent adverse events. Although the majority of the pediatric literature on checklists does not address effects on complications and mortality, the adult literature shows that checklists reduce both.¹⁹⁻²⁶ A recent retrospective study from Ontario showed no reduction in perioperative complications when SSCs were used in pediatric patients.³⁵ In one of the other few studies that address outcomes in pediatric surgical patients, there is no significant decrease in morbidity or mortality, except in developing countries when a broad safety strategy that includes practice bundles and team-based practice is employed.³⁶ In the pediatric population, perhaps a better measure of outcome success would be to look at the ability of the checklist to prevent errors and identify "near misses" or "good catches." As suggested by Putnam et al.,³⁷ meaningful use or good catches may be a more appropriate metric for checklist effectiveness. Wrong-site surgery is unacceptable but exceedingly rare. Still, current site-verification protocols could have prevented only two-thirds of the wrong-site surgery examined cases. Many protocols involve considerable redundancy without clear added benefit.³⁸ A preincision checklist that includes site verification and pertinent radiological imaging, and has engaged participants, is a more efficient way of confirming the correct surgical site. Other good catches including identification of medication issues and allergies and confirmation of the availability of essential implants or blood products can have safety implications for a pediatric patient. As 1 pediatric surgeon responded to the survey, "SSC has definitely improved OR safety. NO wrong side procedures, NO wrong procedures since it was introduced and adopted. Also caught several 'near misses,' also improved timeliness of preoperative antibiotics." The effect of the SSC can be measured by its ability to prevent harm before it happens.

This study has several limitations. The survey questions were selected based on what the APSA Quality and Safety Committee subcommittee deemed important to evaluate checklists in pediatric surgery. The response rate was only 38%, which may reflect a lack of interest in or support for checklist use among the APSA membership. The majority of respondents reported holding leadership positions at their institutions, and those in leadership positions may be more likely to support a checklist because of the belief that it improves the safety culture. In general, those who responded to the survey are more likely to be involved in patient safety initiatives, so the survey likely overestimates pediatric surgeons' enthusiasm for checklists.

Despite being driven by Centers for Medicare and Medicaid Services and the WHO to use them, belief in SSCs among pediatric surgeons is lacking. Checklists are often implemented as part of a multi-step process to improve care. Studies show that safety attitudes and staff engagement affect successful implementation, adherence, and fidelity of the SSC. The current survey results support this. Checklists work, but only if surgeons believe in them and are engaged. Those surgeons who believe in the safety culture understand why SSCs are important. Clearly, there needs to be more education to get pediatric surgeons on board with checklists and to get them involved in the development and implementation of checklists for the pediatric surgical patients. Their “buy-in” is essential to their effective use, and the current survey shows that an alarming number of pediatric surgeons have not “bought in.” In the pediatric setting, investigators should judge the effectiveness of a checklist on its ability to foster teamwork, good communication, and improve the safety culture. With pediatric patients, the SSC can certainly prevent errors, but its benefit may not be in its direct effect on patient outcomes. When compared with adults, the pediatric adverse and “never” event rates are very low. Therefore, using complications and mortality rates as a checklist metric is unrealistic. At a time when quality improvement is at the forefront of health care, and when the Children's Surgery Verification program is beginning to set expectations for pediatric surgical care in the United States, one must look to safety initiatives that have shown promising results to be the foundation of surgical care for children. Checklists are such an initiative. One must continually engage in such safety efforts when seeking to provide better, safer care for the patient population.

DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

REFERENCES

- Gawande A. *The Checklist Manifesto: How to Get Things Right*. New York, N.Y.: Metropolitan Books of Henry Holt and Co.; 2011.
- World Alliance for Patient Safety. Safe surgery saves lives: second global patient safety challenge. Available at http://www.who.int/patientsafety/safesurgery/knowledge_base/SSSL_Brochure_final-Jun08.pdf. Accessed May 10, 2017.
- WHO surgical safety checklist. Available at http://www.who.int/patientsafety/safesurgery/tools_resources/SSSL_Checklist_final-Jun08.pdf. Accessed May 10, 2017.
- Haynes AB, Weiser TG, Berry WR, et al.; Safe Surgery Saves Lives Study Group. A surgical safety checklist to reduce morbidity and mortality in a global population. *N Engl J Med*. 2009;360:491–499.
- CMS.gov. ASC quality reporting. 2017. Available at <https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/ASC-Quality-Reporting/>. Accessed May 10, 2017.
- World Health Organization. New scientific evidence supports WHO findings: a surgical safety checklist could save hundreds of thousands of lives. 2011. Available at http://www.who.int/patientsafety/safesurgery/checklist_saves_lives/en/index.html. Accessed May 15, 2017.
- Takala RS, Pauniah SL, Kotkansalo A, et al. A pilot study of the implementation of WHO surgical checklist in Finland: improvements in activities and communication. *Acta Anaesthesiol Scand*. 2011;55:1206–1214.
- Helmiö P, Blomgren K, Takala A, et al. Towards better patient safety: WHO Surgical Safety Checklist in otorhinolaryngology. *Clin Otolaryngol*. 2011;36:242–247.
- Böhmer AB, Wappler F, Tinschmann T, et al. The implementation of a perioperative checklist increases patients' perioperative safety and staff satisfaction. *Acta Anaesthesiol Scand*. 2012;56:332–338.
- Haynes AB, Weiser TG, Berry WR, et al.; Safe Surgery Saves Lives Study Group. Changes in safety attitude and relationship to decreased postoperative morbidity and mortality following implementation of a checklist-based surgical safety intervention. *BMJ Qual Saf*. 2011;20:102–107.
- Russ S, Rout S, Sevdalis N, et al. Do safety checklists improve teamwork and communication in the operating room? A systematic review. *Ann Surg*. 2013;258:856–871.
- Reames BN, Scally CP, Thumma JR, et al. Evaluation of the effectiveness of a surgical checklist in Medicare patients. *Med Care*. 2015;53:87–94.
- Singer SJ, Molina G, Li Z, et al. Relationship between operating room teamwork, contextual factors, and safety checklist performance. *J Am Coll Surg*. 2016;223:568–580.e2.
- Glaser BG, Strauss AL. *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Chicago, Ill.: Aldine; 1967.
- Bradley EH, Curry LA, Devers KJ. Qualitative data analysis for health services research: developing taxonomy, themes, and theory. *Health Serv Res*. 2007;42:1758–1772.
- Krippendorff K. *Content Analysis. An Introduction to its Methodology. The Sage Commtext Series*. London, United Kingdom: Sage Publications; 1980.
- Macdonald AL, Sevdalis N. Patient safety improvement interventions in children's surgery: a systematic review. *J Pediatr Surg*. 2017;52:504–511.
- Lagoo J, Lopushinsky SR, Haynes AB, et al. Effectiveness and meaningful use of paediatric surgical safety checklists and their implementation strategies: a systematic review with narrative synthesis. *BMJ Open*. 2017;7:e016298.
- Borchard A, Schwappach DL, Barbir A, et al. A systematic review of the effectiveness, compliance, and critical factors for implementation of safety checklists in surgery. *Ann Surg*. 2012;256:925–933.
- McDowell DS, McComb SA. Safety checklist briefings: a systematic review of the literature. *AORN J*. 2014;99:125–137.e13.
- Gillespie BM, Chaboyer W, Thalib L, et al. Effect of using a safety checklist on patient complications after surgery: a systematic review and meta-analysis. *Anesthesiology*. 2014;120:1380–1389.
- Howell AM, Panesar SS, Burns EM, et al. Reducing the burden of surgical harm: a systematic review of the interventions used to reduce adverse events in surgery. *Ann Surg*. 2014;259:630–641.
- Treadwell JR, Lucas S, Tsou AY. Surgical checklists: a systematic review of impacts and implementation. *BMJ Qual Saf*. 2014;23:299–318.
- Patel J, Ahmed K, Guru KA, et al. An overview of the use and implementation of checklists in surgical specialties—a systematic review. *Int J Surg*. 2014;12:1317–1323.
- Bergs J, Lambrechts F, Simons P, et al. Barriers and facilitators related to the implementation of surgical safety checklists: a systematic review of the qualitative evidence. *BMJ Qual Saf*. 2015;24:776–786.
- de Jager E, McKenna C, Bartlett L, et al. Postoperative adverse events inconsistently improved by the World Health Organization Surgical Safety Checklist: a systematic literature review of 25 studies. *World J Surg*. 2016;40:1842–1858.
- Urbach DR, Govindarajan A, Saskin R, et al. Introduction of surgical safety checklists in Ontario, Canada. *N Engl J Med*. 2014;370:1029–1038.
- Putnam LR, Levy SM, Sajid M, et al. Multifaceted interventions improve adherence to the surgical checklist. *Surgery*. 2014;156:336–344.
- Sentinel events: approaches to error reduction and prevention. *Jt Comm J Qual Improv*. 1998;24:175–186.
- Norton EK, Rangel SJ. Implementing a pediatric surgical safety checklist in the OR and beyond. *AORN J*. 2010;92:61–71.
- Haugen AS, Softeland E, Eide GE, et al. Impact of the World Health Organization's Surgical Safety Checklist on safety culture in the

- operating theatre: a controlled intervention study. *Br J Anaesth*. 2013;110:807–815.
32. Lee SL. The extended surgical time-out: does it improve quality and prevent wrong-site surgery? *Perm J*. 2010;14:19–23.
 33. Montgomery K, Khan I, Thomson K, et al. Improving the practice of the World Health Organisation's surgical pause checklist at a tertiary paediatric surgical unit. *Scott Med J*. 2016;61:88–91.
 34. Bartz-Kurycki MA, Anderson KT, Abraham JE, et al. Debriefing: the forgotten phase of the surgical safety checklist. *J Surg Res*. 2017;213:222–227.
 35. O'Leary JD, Wijeyesundera DN, Crawford MW. Effect of surgical safety checklists on pediatric surgical complications in Ontario. *CMAJ*. 2016;188:E191–E198.
 36. Jenkins KJ, Castañeda AR, Cherian KM, et al. Reducing mortality and infections after congenital heart surgery in the developing world. *Pediatrics*. 2014;134:e1422–e1430.
 37. Putnam LR, Anderson KT, Diffley MB, et al. Meaningful use and good catches: more appropriate metrics for checklist effectiveness. *Surgery*. 2016;160:1675–1681.
 38. Kwaan MR, Studdert DM, Zinner MJ, et al. Incidence, patterns, and prevention of wrong-site surgery. *Arch Surg*. 2006;141:353–357; discussion 357.
 39. Khoshbin A, Lingard L, Wright JG. Evaluation of preoperative and perioperative operating room briefings at the Hospital for Sick Children. *Can J Surg*. 2009;52:309–315.
 40. Avansino JR, Javid P, Katz C, et al. Implementation of a standardized procedural checklist in a children's hospital. *Am J Surg*. 2011;201:660–665.
 41. Levy SM, Senter CE, Hawkins RB, et al. Implementing a surgical checklist: more than checking a box. *Surgery*. 2012;152:331–336.
 42. Low DK, Reed MA, Geiduschek JM, et al. Striving for a zero-error patient surgical journey through adoption of aviation-style challenge and response flow checklists: a quality improvement project. *Paediatr Anaesth*. 2013;23:571–578.
 43. Corbally MT, Tierney E. Parental involvement in the preoperative surgical safety checklist is welcomed by both parents and staff. *Int J Pediatr*. 2014;2014:791490.
 44. Wyrick DL, Smith SD, Dassinger MS. Implementation of the World Health Organization checklist and debriefing improves accuracy of surgical wound class documentation. *Am J Surg*. 2015;210:1051–1054; discussion 1054.
 45. Norton EK, Singer SJ, Sparks W, et al. Operating room clinicians' attitudes and perceptions of a pediatric surgical safety checklist at 1 institution. *J Patient Saf*. 2016;12:44–50.