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Increasing compliance with the World Health Organization Surgical Safety Checklist—A regional health system's experience

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Abstract

BACKGROUND: In 2009, NorthShore University HealthSystem adapted the World Health Organization Surgical Safety Checklist (SSC) at each of its 4 hospitals. Despite evidence that SSC reduces intraoperative mistakes and increase patient safety, compliance was found to be low with the paper form. In November 2013, NorthShore integrated the SSC into the electronic health record (EHR). The aim was to increase communication between operating room (OR) personnel and to encourage best practices during the natural workflow of surgeons, anesthesiologists, and nurses. The purpose of this study was to examine the impact of an electronic SSC on compliance and patient safety.

METHODS: An anonymous OR observer selected cases at random and evaluated the compliance rate before the rollout of the electronic SSC. In June 2014, an electronic audit was performed to assess the compliance rate. Random OR observations were also performed throughout the summer in 2014. Perioperative risk events, such as consent issues, incorrect counts, wrong site, and wrong procedure were compared before and after the electronic SSC rollout. A perception survey was also administered to NorthShore OR personnel.

RESULTS: Compliance increased from 48% (n = 167) to 92% (n = 1,037; $P < .001$) after the SSC was integrated into the electronic health record. Surgeons (91% vs 97%; $P < .001$), anesthesiologists (89% vs 100%; $P < .001$), and nurses (55% vs 93%; $P < .001$) demonstrated an increase in compliance. A comparison between risk events in the pre- and post-rollout period showed a 32% decrease ($P < .01$). Hospital-wide indicators including length of stay and 30-day readmissions were lower. In a survey to assess the OR personnel's perceptions of the new checklist, 76% of surgeons, 86% of anesthesiologists, and 88% of nurses believed the electronic SSC will have a positive impact on patient safety.

CONCLUSIONS: The World Health Organization SSC is a validated tool to increase patient safety and reduce intraoperative complications. The electronic SSC has demonstrated an increased compliance rate, a reduced number of risk events, and most OR personnel believe it will have a positive impact on patient safety.

In 2008, the World Health Organization (WHO) published the "Safe Surgery Saves Lives" guidelines identifying multiple recommended practices to ensure the safety of surgical patients.[1] This publication unveiled the WHO Surgical Safety Checklist (SSC), a 19-item comprehensive checklist designed to reduce the rate of major surgical complications and mortality via a systematic approach to safely navigate a patient through an operating room (OR) encounter. Soon after the checklist was released, an international comprehensive study demonstrated a reduction in mortality rates from 1.5% to .8% and inpatient complications from 11.0% to 7.0% after the implementation of the SSC.[2] Since the release of this high impact study, a multitude of institutions have reported their experience implementing an SSC.[3–6]

In a few short years since the inception of the WHO SSC, approximately 3,900 hospitals in 122 countries have adapted some form of the SSC.[7] The medical community was inspired by the impressive results of early adapters, especially considering the perceived straight forward implementation of the checklist. If pilots have been using a preflight checklist for decades, why can't the same concept be applied in the OR? Unfortunately, as the SSC has become more widely adapted, several institutions have been unable to reproduce the dramatic gains in patient safety.[8] The theories for this are plentiful; however, a few common themes tend to be described in the literature. The failure of an SSC to improve surgical patient outcomes is typically attributed to poor compliance with the items on the list,[9–12] a lack of "buy-in" among the OR personnel,[13] and/or an ineffective rollout strategy.[14]

Although a vast amount of data suggests that a properly implemented SSC reduces preventable mistakes in the OR, there is little known as to how to implement the checklist most effectively to avoid these potential pitfalls. We hypothesized that a technological solution would be the ideal approach to maximize the compliance rate and ultimate effectiveness of the WHO SSC at our institution. In 2009, NorthShore University HealthSystem first adapted the WHO SSC at each of its 4 hospitals. The checklist was implemented according to the WHO guidelines as a paper form that traveled with the patient throughout the surgery encounter; however, a formal evaluation in the summer of 2013 indicated an unacceptably low compliance rate. This study aimed to examine the impact of a new SSC integrated into the electronic health record (EHR) on compliance and patient safety.

Methods

Study design

This retrospective cohort study took place between March 2013 and October 2014 at our institution. Before November 2013 (pre-rollout), a paper WHO SSC was used in the OR. In November 2013 (post-rollout), a multidisciplinary team of surgeons, anesthesiologists, nurses, and trainers launched the electronic SSC at 4 NorthShore hospitals. The primary outcomes measured before and after rollout included the compliance rate for the first column of the checklist (all items to be completed before the induction of anesthesia, excludes timeout and sign out), identified surgical risk events, and hospital wide quality indicators.

Data collection

Between July and October 2013, an anonymous observer was randomized to different ORs to evaluate the compliance rate of the paper WHO SSC (n = 167). Compliance was defined as 100% completion and documentation of the first column of the WHO SSC before the induction of anesthesia. In February 2014, 3 months following the initial rollout of the new electronic SSC, a perceptions survey was administered to OR personnel. During the following summer, in June 2014, an electronic audit was performed to assess the compliance rate of the electronic SSC from data residing in the EHR (n = 1,037). At this same time, a second round of randomized OR observations were also performed and lasted throughout the summer 2014 (n = 50). In September 2014, perioperative risk events, such as consent issues, incorrect counts, wrong site, and wrong procedure were compared before and after the electronic SSC rollout.

Integration into the electronic health record

Starting in the spring 2013, a multidisciplinary team of surgeons, anesthesiologists, nurses, and software developers initiated a weekly meeting to plan the implementation of the new electronic checklist. The team identified several goals for the new checklist:

(1) Increase communication between OR personnel.
(2) Allow collaboration between the surgical team and ambulatory services unit while being physically located in separate areas of the hospital.
(3) Leverage the EHR to autopopulate the WHO SSC for certain data points, such as patient allergies and pregnancy test results.

(4) Encourage best practices during the natural workflow of surgeons, anesthesiologists, and nurses.

Several systematic changes were implemented to improve the checklist. First, the WHO SSC was integrated into Epic (Epic Systems Corporation, Madison, WI), the EHR used at NorthShore. The responsibilities of the checklist were divided between the surgeon, anesthesiologist, and nurse. Because the EHR can monitor in real-time the status of each individuals checklist responsibilities, we were able to design a barrier to prevent the patient from entering the OR until all SSC-related items were complete. The OR status board underwent a design upgrade that displayed an "S", "A", "N", and "R"; each letter respectively stands for "Surgeon", "Anesthesiologist", "Nurse", and "Room". To proceed with transporting the patient into the OR, every letter must be dropped from the OR status board. The intention behind this concept was to allow coordination among the surgical team regarding the status of the individualized checklist responsibilities.

The surgeon was required to complete the preoperative workflow for the SSC within 24 hours of surgery. This included entering a preoperative note and reviewing several items about the planned surgery. The anesthesiologist had to declare readiness to begin the case and attest that all equipment is in working order. The nurse responsibilities for the WHO SSC were divided between the nurse in the ambulatory services unit and the circulating nurse; however, ultimately, the circulating nurse had to verify all information was correct. These responsibilities included reviewing the surgeon's note matches the OR schedule, the patient's consent form matches the OR schedule, among other items.

Clinical decision support (CDS) was also built into the new electronic SSC. Examples of CDS include autopopulating the patient's allergies, consent form, history and physical, surgeon's preoperative note, among other items so they are automatically able to be reviewed and signed off. Before this, a major setback identified for the paper form was that it required the nurse to constantly search for items located deep within the EHR. Furthermore, because the circulating nurse and surgeon were rarely in the same physical location before a case, this required the nurse to repeatedly check the EHR for the surgeon's preoperative note. Without the note, the nurse specific responsibilities could not be completed. Using CDS, our team was able to autopopulate many relevant items for the WHO SSC, so they are easily accessible for the surgical team and ready for sign off.

Implementation

The new electronic SSC went live at NorthShore hospitals in November 2014. The multidisciplinary team responsible for the rollout anticipated the critical importance of a smooth transition. This was not only important to maintain patient safety but also to maximize the chance of OR personnel "buy-in" to the new system. In the months before the implementation, regular meetings were held to inform all OR personnel of the upcoming changes. Not only was every staff member properly trained on the new WHO SSC workflow in the EHR but it was also explained why management believed this would improve patient safety. During the rollout, many issues were anticipated; however, even with months of planning, there were still some growing pains in the first few weeks. Fulltime Epic trainers were staffed in the OR for the first 2 weeks after the rollout, and several meetings were required to reconcile minor technical glitches. Nevertheless, the overall rollout was deemed a success, and the new system has remained stable over the upcoming year.

Results

Compliance

During the pre-rollout period, compliance was evaluated by random OR observations and was assessed to be 48% overall (n = 167). Surgeons, anesthesiologists, and nurses demonstrated varying levels of compliance. Several of the items that were ultimately the responsibility of the nurse were also dependent on other personnel and tended to have the lowest compliance rate. For example, reconciling the surgeon's preoperative note and the OR schedule was only performed in 68% of cases observed (Table 1). In addition, several items were found to have a low compliance rate because they were not documented until after the case. During the pre-rollout phase of this study, WHO SSC paper forms were collected at the end of an OR encounter, and the compliance rate was assessed. This compliance rate was measured to be above 90% but was believed to be artificially high due to the fact that a paper form SSC could be completed after the case. The pre-rollout random observations confirmed this was the case.

During the post-rollout period, nearly every single available metric relating to compliance was improved. The overall compliance rate increased from 48% (n = 167) to 92% (n = 1,037; $P < .001$) as evidenced by the electronic audit performed in June 2014. Surgeons (91% vs 97%; $P < .001$), anesthesiologists (89% vs 100%; $P < .001$), and nurses (55% vs 93%; $P < .001$) demonstrated an increase in compliance (Fig. 1). Furthermore, the compliance rate was assessed by hospital, time of day, day of the week, and surgical specialty, and nearly, all metrics maintained statistically significant improvement (Table 2). Randomized OR observations performed during the summer in 2014 demonstrated a 100% compliance rate (N = 50).

Outcomes

A comparison between risk events in the pre- and post-rollout periods showed a 32% decrease (106 vs 67; $P < .01$;

Table 1 WHO SSC compliance rate: line item detail by responsibility

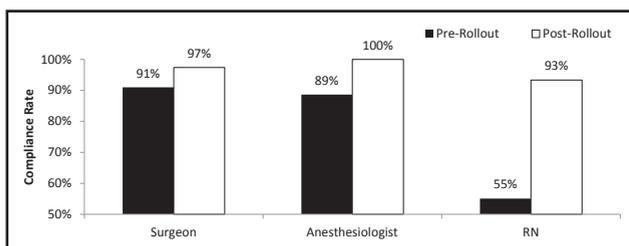| Specialty	Item on the WHO Surgical Safety Checklist	Pre-rollout (n = 167)	Post-rollout (N = 1,037)
S	PreOp note	93%	98%
	Site and side confirmed and marked	93%	98%
	Procedure with patient	93%	98%
	Consent complete and accurate	93%	98%
	H and P complete	93%	98%
	Consent and preop note reconciled	93%	98%
	Diagnostic/Radiology results are available in OR	92%	98%
	VTE prophylaxis ordered	92%	97%
A	Anesthesia machine and equipment check	89%	100%
	Anesthesia pre op patient evaluation.	88%	100%
	Potential for blood loss requiring blood products	88%	100%
N	Does patient have a known allergy	99%	100%
	Isolation precautions needed	99%	100%
	Pregnancy test	99%	99%
	Currently on anticoagulant	98%	99%
	Glucose checked for diabetic patients	99%	99%
	Does patient have implants or pacemaker	99%	99%
	Blood products available	97%	99%
	Reconcile consent and schedule	84%	98%
	Reconcile consent and preop	68%	95%

This table compares the pre-rollout vs post-rollout compliance per line item on the SSC. Items are divided by responsibility.

A = anesthesiologist; N = Nurse; OR = operating room; S = Surgeon; SSC = Surgical Safety Checklist; VTE = venous thromboembolism; WHO = World Health Organization.

Fig. 2). Issues related to an incorrect consent form identified at the time of surgery decreased 35%, or from 79 events to 51 events year over year. Incorrect documentation risk events, such as an incorrect OR schedule, decreased 41% from 17 events to 10 events. Never events, including the placement of an incorrect implant or wrong site procedure, although rare at our institution, decreased or remained unchanged after the new electronic WHO SSC was implemented. Hospital-wide indicators such as postoperative venous thromboembolism, surgical site infections, and in hospital mortality were lower after the implementation of the new electronic SSC. In both the years before and after the rollout of the electronic SSC, 30-day readmissions after any surgery were 13%. The median length of stay was 3.2 days and 3.1 days for the pre- and post-rollout periods, respectively.

OR personnel perceptions

Three months after the initial rollout of the new electronic SSC, a survey was administered to all OR personnel. When asked whether the new electronic SSC will have a positive impact on patient safety compared with the paper form, 76% of surgeons (N = 58), 86% of anesthesiologists (N = 7), and 88% of nurses (N = 66) believed that it would (Table 3). There was strong agreement that the electronic SSC will increase compliance with items on the list (84%), that it was more convenient than the paper form (85%), and in general, the OR staff were satisfied with the technological solution (83%).

Comments

Although many institutions report positive data regarding the use of an SSC, several recent examples in the literature have been shared that do not experience the same gains in patient safety. Although our institution was an early adapter of the WHO SSC, our evaluated compliance rate was unacceptably low at 48% during the pre-rollout period. Other institutions have reported similar experiences with a low compliance rate. Biffl et al performed an evaluation of the compliance rate for the WHO SSC at 10 hospitals in Colorado. After evaluation, suboptimal compliance was found with only 71% of observers reporting active participation by physicians; 9% reported that "the majority did not pay attention"; and 4% reported that the team was "just going through the motions".[10] In another case, Sendhofer et al reported their findings for a single hospital in Austria after the implementation of an SSC. Interestingly, the authors reported a high level of use of the SSC at 99.2% of cases; however, they found over time the completion rate

Figure 1 Compliance rate by role in the OR.

Table 2 Compliance rate pre-rollout and post-rollout of the electronic WHO SSC

Specialty	Pre-rollout		Post-rollout	
	Compliance	n	Compliance	n
Overall compliance	47.9%	167	91.9%	1,037
Hospital				
Hospital#1	52.3%	44	96.5%	346
Hospital#2	61.9%	42	96.8%	252
Hospital#3	29.4%	34	81.4%	204
Hospital#4	44.7%	47	88.9%	235
Day of week				
Monday	39.3%	28	92.7%	151
Tuesday	53.8%	13	90.0%	200
Wednesday	50.0%	44	93.4%	181
Thursday	40.5%	37	92.7%	260
Friday	53.7%	41	91.0%	245
Case start time				
7am–12pm	48.6%	105	92.5%	464
12pm–4pm	47.2%	53	93.6%	377
4pm–7am	44.4%	9	87.2%	196
Specialty				
Anesthesia	100.0%	4	91.7%	12
Cardiovascular	100.0%	1	90.5%	21
General	52.2%	46	89.2%	186
Neuro	25.0%	8	91.2%	57
Obstetrics/gynecology	20.0%	10	81.1%	74
Opthalmology	50.0%	4	92.2%	64
Orthopedic	39.6%	48	89.5%	181
Otolaryngology	83.3%	12	96.4%	56
Plastic	50.0%	16	96.2%	26
Thoracic	50.0%	4	100.0%	22
Urology	50.0%	10	95.1%	123
Vascular	25.0%	4	100.0%	15
Other	—	—	95.5%	200

Compliance was defined as 100% completion of all required fields on the WHO Checklist form.

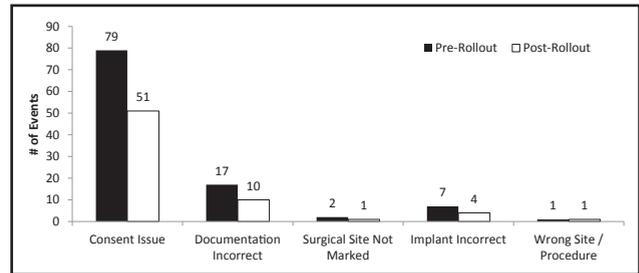SSC = Surgical Safety Checklist; WHO = World Health Organization.

Figure 2 Perioperative risk events. This figure compares the number of perioperative risk events in the year before the rollout of the electronic WHO SSC with the year after the rollout of the electronic WHO SSC.

SSC. Another issue was identified pertaining to the logistics of completing the checklist. The OR team is typically located in different physical locations before the patient arriving in the OR. In order for all individuals to successfully complete the paper checklist, this required constant monitoring in the EHR. Owing to these reasons, we believed that integrating the WHO SSC into the EHR would be an ideal solution to improve compliance and ultimately patient safety. The EHR is already an integral part of the natural workflow for all OR personnel; therefore, integrating the WHO SSC into the EHR and autopopulating items seemed logical. This conclusion was also reached by doctors surveyed in a study performed by de Vries et al in the Netherlands. When asked to give suggestions to improve the logistics and content of the SSC, 45% of interviewed physicians suggested integrating the checklist into existing hospital information systems.[15]

In early 2015, a retrospective analysis of 64,981 Michigan patients at 29 hospitals was performed by Reames et al[14] to evaluate the effectiveness of the "Keystone Surgery Program". The Keystone Surgery program was implemented in 2008 and consisted of a checklist-based intervention designed to reduce preventable mistakes in the OR. The authors performed a comparative analysis of Michigan hospitals that implemented the Keystone Surgery Program and those that did not. Interestingly, the authors found that the checklist-based quality improvement initiative did not affect rates of adverse surgical outcomes in patients undergoing general surgery at Michigan hospitals. In a separate study, Reames et al[8] investigated the effectiveness of a surgical checklist in 1,002,241 Medicare patients using Medicare claims data for Michigan patients between 2006 and 2011. The authors concluded that the Keystone Surgery Program was not associated with improved outcomes in 30-day mortality, intraoperative complications, reoperations, or readmissions. The authors offer two possible explanations for the unimpressive results of the Keystone Surgery Program. First, adherence to the Surgical Care Improvement Program process measures may not be strongly associated with improved outcomes, or second, that the Surgical Care Improvement Program measures are effective, but implementation of the program was not effective in increasing compliance. We believe that many institutions may lack

decreased from 81.7% to 60.6% and 53.2% during the first year after implementation. The authors suggest that although implementation is critical, constant supervision and leadership is required to maintain compliance and accuracy.[9] Sparks et al[11] reported similar findings at a tertiary care center in Texas. In their study, completion rates were high for the checklist at 84.5%; however, the authors noted accuracy was poor at 54.1%.

At our institution, after the initial randomized OR observations were performed, several deficiencies were identified with the paper form system. First, when the patient was first brought into the OR, the nurse concurrently had to balance many responsibilities in addition to completing the paper form for the WHO SSC. If an item was unable to be completed before the patient entering the OR, it was often left blank until there was sufficient time, typically resulting in the WHO SSC being completed following the surgery. This method is contrary to the concept as outlined in the WHO guidelines and defeats the purpose of requiring an

Table 3 Perceptions survey administered to OR personnel

Question	Overall (n = 131) No, the paper form was better	Yes	Surgeon (n = 58) No, the paper form was better	Yes	Anesthesiologist (n = 7) No, the paper form was better	Yes	Nurse (n = 66) No, the paper form was better	Yes
In your opinion, will the electronic version of the WHO Surgical Safety Checklist increase patient safety?	18%	82%	24%	76%	14%	86%	12%	88%
In your opinion, will the electronic version of the WHO Surgical Safety Checklist increase compliance with the items contained on the list?	16%	84%	22%	78%	0%	100%	12%	88%
Is the electronic version of the WHO Surgical Safety Checklist more convenient than the paper form?	15%	85%	21%	79%	0%	100%	11%	89%
In general, are you happy with the switch to the electronic WHO Surgical Safety Checklist from the paper form?	17%	83%	28%	72%	0%	100%	9%	91%

OR = operating room; WHO = World Health Organization.

an adequate implementation strategy but more importantly also have not optimized the workflow required to use an SSC most effectively.

We feel strongly that a sophisticated technological solution may be the best method to improve compliance with the checklist, garner buy-in from OR staff, and to meaningfully improve patient outcomes. We recognize this approach requires many months of planning, a significant investment of time and energy, and an experienced multi-disciplinary team; however, in our experience it has resulted in better outcomes than the alternative less integrated approaches. Although this technological approach may not be feasible for every institution, we strongly believe that our positive experience can be replicated at many institutions and are currently drafting a technical paper to be used as a guideline for building a customized SSC into any EHR.

Although our findings are quite positive regarding an electronic SSC, there are several limitations to this study that are important to address. First, as with any study pertaining to hospital wide quality indicators, it is difficult to draw a direct causative effect that the improvements were due to the changes implemented from the electronic WHO SSC alone. Over this same time period for example, there were other quality improvement initiatives ongoing, such as a task force to reduce the incidence of surgical site infections. Another limitation of this study was the inherent limitations in the electronic audit of the EHR too assess compliance. In theory, it is possible for a case to be measured as compliant if the time the patient is documented to enter to OR is incorrect. For instance, if a nurse completes the checklist while the patient is in the OR and already under anesthesia, then afterward registers that the patient entered the OR, this would be displayed as a compliant case. It was for this reason that we performed the second round of randomized OR observations, which demonstrated a compliance rate of 100%. Therefore, we think this risk is minimal; however, a more robust electronic audit may need to be developed.

Conclusions

Although a vast amount of data suggests that a properly implemented SSC reduces preventable mistakes in the OR, there is little known as to how to implement the checklist most effectively. Many institutions have shared their experience with implementing an SSC, and shortfalls are typically attributed to poor staff buy-in, poor compliance, or a negligible effect on patient outcomes. We hypothesized integrating the WHO SSC into the EHR would significantly increase compliance and ultimately improve patient outcomes. After integration, the overall compliance rate increased from 48% to 92%. Surgeons, anesthesiologists, and nurses all demonstrated a significant increase in compliance. Perioperative risk events were significantly lower following integration.

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