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## Decreasing intraoperative delays with meaningful use of the surgical safety checklist

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**Background.** Purposeful completion (fidelity) more than simple adherence to items in the surgical safety checklist may improve operating room efficiency and patient safety. The purpose of this study was to evaluate intraoperative delays and correlate them with adherence and fidelity to the preincision surgical safety checklist.

**Methods.** Trained observers evaluated surgical safety checklist compliance during 3 observation periods from 2014–2016. Degree of adherence, checkpoint verbalization, fidelity, and meaningful completion were assessed. Delays were categorized as missing or malfunctioning equipment, staff error, and medication issues. Descriptive statistics, analysis of variance, logistic regression,  $\chi^2$  and Student t test were used to analyze results.

**Results.** Of the 591 cases observed, 19% (n = 110) had at least one documented, intraoperative delay. The majority of delays were related to missing (50%) or malfunctioning (30%) equipment. Compared with cases without delays, cases with delays did not have a different mean degree of adherence ( $96.3 \pm 7.6\%$  vs  $95.6 \pm 5.8\%$ ,  $P = .36$ ). Degree of fidelity was different between cases with and without delays (mean fidelity  $77.1 \pm 14.9\%$  vs  $80.5 \pm 7.14.2\%$ ,  $P = .03$ ).

**Conclusion.** The preincision SSC is a communication tool offering an opportunity to discuss potential concerns and anticipated intraoperative needs. Fidelity rather than adherence to the surgical safety checklist seems to diminish intraoperative delays. (Surgery 2017;160:XXX-XXX.)

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Surgical safety checklists (SSC) are instruments that have been promoted for the past decade to improve patient safety and decrease morbidity and mortality. Although some have questioned the effectiveness of checklists,<sup>1</sup> the preponderance of evidence supports their use.<sup>2</sup> Beyond decreasing immediate complications and adverse postoperative outcomes, SSCs have other benefits. Improved teamwork and communication in the operating room may be one mechanism that leads to better patient outcomes.<sup>3</sup> Appropriate performance of the SSC can find good catches<sup>4</sup> or near misses.<sup>5</sup> Although often perceived as time-consuming or redundant,<sup>6</sup> operating room (OR) efficiency also may be improved by the SSC.<sup>7</sup>

Adherence to the checklist and fidelity in its were studied previously at our institution.<sup>4,8,9</sup> Adherence to the checklist or “checking the box” is defined as simple completion of a checkpoint. Checklist

fidelity or meaningful its use is defined as purposeful completion of an item requiring intrateam communication beyond simple verbalization and is assessed for complex checkpoints. Both measures have improved over time due to multifaceted interventions,<sup>8</sup> but the impact of this progress on efficiency has not been studied. Checklists may increase operating room efficiency by improving the early communication and anticipation of intraoperative concerns between providers. We hypothesized that high adherence and fidelity to a pediatric, preincision, specific surgical safety checklist would lead to fewer intraoperative delays.

### Materials and Methods

#### Study setting and design

Children's Memorial Hermann Hospital is an academic, 234-bed children's hospital within the tertiary Memorial Hermann Hospital-Texas Medical Center. At Children's Memorial Hermann Hospital, 14 pediatric surgical specialties perform >6,000 operations annually. Since 2011, annual audits of our checklists and OR safety program have taken place. A safety council with members from all

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perioperative services and administration meets weekly to discuss safety issues, modify the checklist when needed, and implement the annual training of staff. Data from previous audits are reviewed with all staff as part of the yearly training. From 2014 to 2016, a prospective, observational study of pediatric OR delays was conducted. Observations and audits were conducted by medical students trained by local safety officers (K.T.A., M.B.K., K.T.). Approval by our institutional review board was sought, and annual checklist audits were deemed exempt because they were part of ongoing quality improvement (HSC-MS-15-0634).

### Sample

The cases observed for delays were a convenience sample across 8 primary pediatric surgical specialties performing elective, weekday pediatric operations. Services that had <10 observed cases were combined into the category "Other" and included burn surgery, dental procedures, fetal surgery, gastroenterology, oral and maxillofacial surgery, pulmonology surgery, and transplant surgery. Primary pediatric surgical specialties included cardiothoracic, otorhinolaryngology, general pediatric surgery, neurosurgery, ophthalmology, orthopedics, plastic and reconstructive surgery, and urology.

### Definitions

Adherence, fidelity, and delay were defined a priori. Adherence was specified as verbalization of a checkpoint. Fidelity was stated as meaningful completion of a checkpoint that requires inter-team communication and coordination above simple verbalization. Stating "antibiotics given" would satisfy adherence to the checkpoint for preincision administration of prophylactic antibiotics. Fidelity to the antibiotic checkpoint includes stating drug, dose, time given, and re-dose plan. To achieve fidelity for the equipment checkpoint, tools and supplies that could be reasonably anticipated to be used were required to be in the room, immediately outside the room, or a plan for retrieval discussed. For example, if fluoroscopy was needed for one portion of the case, staff needed to state that they might use it, when it might be needed, and/or when to call the technologist for it.

All observers were given and instructed how to use a guide to fidelity that detailed the specific requirements of fidelity for every item. Previous work provides further descriptions of fidelity.<sup>4</sup> An event was considered an intraoperative delay if it caused unanticipated postponement of surgical activity and occurred after preparation and draping but before dressings were placed at the end of the case. After data analysis, delays were categorized based on the observers' impression of the primary cause of the delay.

### Statistical analysis

Inter-rater reliability (Cohen's kappa) between student observers was established prior to collecting data for this study and evaluated for each year, because there were 3 different groups of observers during the 3 observation periods. As the number of checkpoints observed changed during the observation periods due to modification of the checklist, overall adherence and fidelity were calculated as the proportion of checklist items divided by the total number of items for that observation period. These proportions are described as degree of adherence and fidelity and are on a scale of 0% to 100%. Student *t* test and analysis of variance were used to compare the means of 2 groups and >2 groups (groups by year), respectively. Pearson's  $\chi^2$  was used to evaluate the association between delays, specialty, and year. Logistic regression was used to test for associations between predictive variables (degree of fidelity or adherence, duration of the case, specialty, and year of procedure) for

categorical outcomes (delay or no delay). Predictive variables were included in the full model if  $P < .2$  on univariate analysis. Linear regression was used for continuous outcome variables (degree of adherence and fidelity). All statistical analyses were performed using STATA 13.1 (College Station, TX).

### Results

A total of 591 cases were observed in their entirety (2014,  $n = 160$ ; 2015,  $n = 172$ ; 2016,  $n = 259$ ). In 8 specialties, >10 cases were observed. Cohen's kappa was >0.70 for all years (2014: 0.70, 3 observers; 2015: 0.70, 4 observers; 2016: 0.76, 4 observers). Adherence to the preincision checklist remained high during all study years but did decline slightly (Table 1). Degree of fidelity was poor but improved over time.

Multivariate linear regression revealed factors associated with increased fidelity: time taken to conduct the preincision checklist ( $P = .04$ ) and year of procedure ( $P < .01$ ). Specialty ( $P = .45$ ) and duration of the case ( $P = .06$ ) were not associated with differences in fidelity. The checklist took an average of 1 minute and 42 seconds to complete ( $102 \pm 42$  seconds). Although greater fidelity was associated with a greater time to complete the checklist (Fig 1), completion time of the checklist was not associated with delays (cases without delays had a mean time of  $101 \pm 41$  seconds; cases with delays had a mean time of  $106 \pm 45$  seconds,  $P = .25$ ).

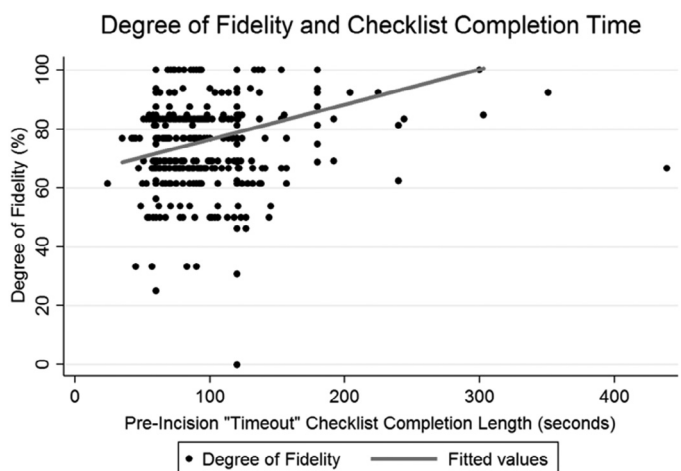
Almost one-fifth of cases had a documented intraoperative delay (18.6%, Table II). Surgical specialty was not predictive of delay ( $P = .37$ ). Combining all years, degree of adherence was not associated with delays (cases without delays had a mean degree of adherence of  $96.3 \pm 7.6\%$  vs cases with delays of  $95.6 \pm 5.8\%$ ,  $P = .36$ ). Degree of fidelity was associated with delays, with lesser fidelity correlating with increased likelihood of delay ( $P = .03$ ). Cases without delays had a mean degree of fidelity of  $80.5 \pm 14.3\%$  compared with cases without delays  $76.7 \pm 14.6\%$ .

**Table 1.**

Adherence and fidelity to preincision checkpoints during 3 observation periods

	2014	2015	2016	P value
Degree of adherence, mean $\pm$ SD	98.3 $\pm$ 3.1	95.8 $\pm$ 6.8	95.2 $\pm$ 9.0	<.01
Degree of fidelity, mean $\pm$ SD	73.1 $\pm$ 15.3	74.1 $\pm$ 12.2	88.0 $\pm$ 10.7	<.01

100% adherence means all checklist items were stated. 100% fidelity correlates to all checklist items completed meaningfully.



**Fig 1.** Each case is plotted on this scatter chart by degree of fidelity and duration of time it took to complete the checklist. Longer checklist times were associated with higher fidelity.

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