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Brief report

Decreasing contamination of the anesthesia environment

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Until recently, anesthetists have focused on antibiotic administration and normothermia but have paid less attention to contamination in the anesthesia environment and its impact on surgical site infections. We implemented a simple intervention and tested its effect on anesthetic environment contamination between procedure start and finish. Of the baseline cases, 46% reached a critical predefined threshold of contamination compared with 12% of the intervention cases. A small behavioral change dramatically lowered contamination in the anesthesia environment.

Though progress has been made, surgical site infections (SSIs) as a subset of hospital-acquired infection continue to have great impact on health care cost and patient morbidity.[1] Until recently, little attention has been focused on the impact of the anesthesia environment on SSIs. In 2008, Loftus et al[2] demonstrated the increase in contamination of the anesthesia environment between the start and end of a case. Furthermore, a contamination threshold of 100 colonies per surface area sampled (CPSS) carried a >50% probability of obtaining a positive stopcock culture, which then was associated with an increased mortality and trend toward increased hospital-acquired infection. Based on our observation of the variability of anesthetists' attention to the anesthesia environment and lack of a demonstrated effective approach, our hypothesis is that a simple structured intervention could impact the contamination of the anesthesia environment between case start and end.

METHODS

Using contamination data from a prior study of our baseline practice,[2] results from a small intervention pilot, a significance level of .05, and power of 80%, we calculated a sample size of 45 cases for each group. After institutional review board approval and waiving of the requirement for written informed consent, we then selected 54 current practice first morning cases with minimum expected case durations of 2 hours and general anesthesia as the planned technique. Five sites within the anesthesia environment were cultured for CPSS counts (adjustable pressure limiting valve, oxygen control knob, anesthetic agent control dial, drawer pulls to the first and second drawers in the anesthesia equipment cart, which were separate from the anesthesia machine). To establish a reproducible baseline, these sites were sampled following disinfection with alcohol (with a minimum drying time of 2 minutes) prior to anesthesia personnel entering the room. At the conclusion of the case, these same sites were cultured again. Blood agar plates were incubated for 48 hours prior to bacterial colony counting as previously described.[2]

The intervention involved brief training of a small subset of anesthesia providers (14 certified registered nurse anesthetists, 2 anesthesia residents, 4 anesthesia staff medical doctors).

The training included the following.

1. Education: our goals were to determine whether a simple intervention could lead to decreased contamination in the anesthesia environment. Various sites of the anesthesia environment would be cultured after case completion.
2. The anesthesia equipment cart was to be kept clean. No used items were to go back to the top of this cart, and a placard was placed on the cart top stating "clean hands only" as a reminder to perform hand hygiene prior to handling materials on the cart.
3. The surface of the anesthesia machine was designated as the working surface for materials used during the current case. A separate container placed on the anesthesia machine (as per usual practice) was provided for clearly contaminated items (eg, laryngoscope blades).

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Table 1
Percentage of cases and sites reaching the contamination threshold of 100 colonies per surface area sampled

Study Group	Case count	CPSS ≥100 case count	% cases CPSS ≥100	*P* value	Site count (precase CPSS ≤50)	CPSS ≥100 site count	% sites CPSS ≥ 100	*P* value
Baseline	54	25	46	.001	239	35	15	.001
Intervention	51	6	12		245	8	3	

CPSS, colonies per surface area sampled.

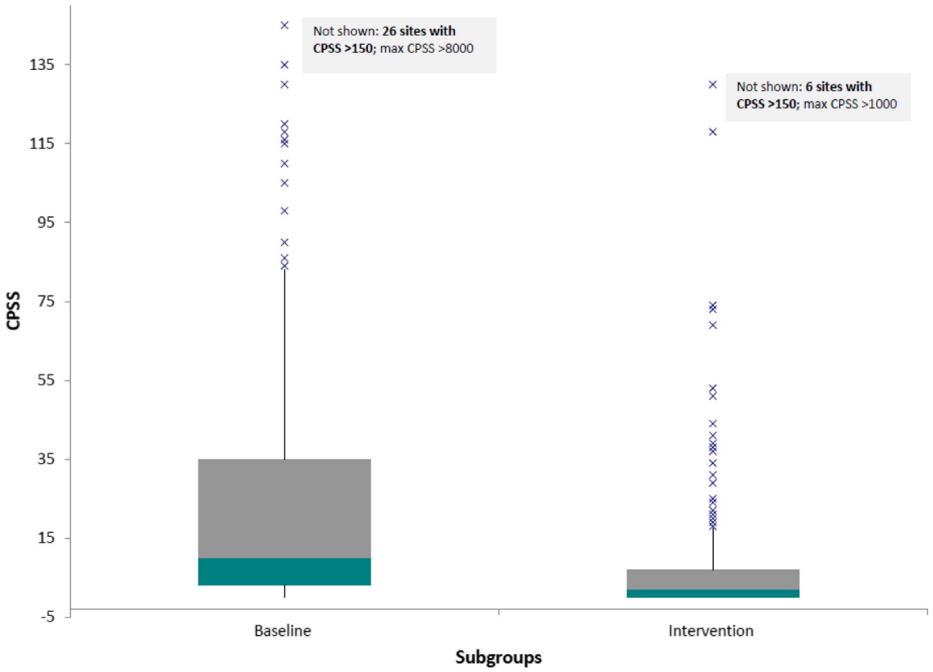

Fig 1. Distribution of colony counts per surface area sampled (CPSS) between baseline and intervention groups.

4. After known contamination, the contaminated sites were to be wiped with an ammonium chloride–based commercially available wipe. In practice this meant one wiping of the touched portions of the anesthesia environment in the period of relative decreased workload after induction and initial charting. This was most commonly a once per case event.

We then repeated the culturing on 51 similar cases using intervention providers who were made aware of the case inclusion by the clean hands placard on top of the anesthesia equipment cart.

At the conclusion of the intervention period we interviewed the study participants using an unstructured survey.

Primary and analyzed outcomes were cases with any site CPSS ≥100 and total sites with CPSS ≥100 before and after intervention. Any site with ≥50 CPSS on the precase sample was omitted from our analysis. Therefore, 31 of 270 individual sites in the baseline cases and 9 of 255 individual sites in the intervention cases were omitted. One intervention site was omitted when the agar plate was dropped. Results are displayed as total numbers, fraction in percentages, median, range, and first and third quartiles.

Baseline and intervention differences were analyzed with χ^2 tests for frequency of samples with CPSS ≥100.

Asymptotic Wilcoxon rank-sum tests (computing exact conditional *P* values and quartiles) for unpaired samples were used to analyze changes between baseline and intervention and generate confidence intervals for assumption of nonequality. Statistical results are shown as the change in location shift with confidence intervals and the corresponding *P* value.

RESULTS

There were 25 of 54 baseline cases (46%) and 6 of 51 intervention cases (12%) that had at least 1 site ≥100 CPSS ($P < .001$). There were 35 of 239 baseline sites (15%) versus 8 of 245 intervention sites (3%) that had ≥100 CPSS ($P < .001$) (Table 1). The magnitude and significance of the results were not different whether or not omitted sites were included. CPSS were different by the rank-sum test between baseline and intervention (difference in location was 6; 95% confidence interval, 3-8; $P < .001$) (Fig 1).

CONCLUSIONS

A small, structured intervention along with attention to a clean anesthesia environment can dramatically affect the amount of contamination in the anesthesia environment over the course of a case. A common response from the anesthetists involved was that the changes in workflow were minimal and the added action of wiping down the touched surfaces after induction was easily incorporated into the work flow.

This study is limited because of the fact that the providers were aware that they were involved in a quality improvement project and therefore may have performed better just because of that (Hawthorne effect). In some ways this strengthens the argument in favor of adopting our simple changes because we did not have to script every action, but rather our changes plus a heightened conscious and subconscious awareness lead to highly effective behaviors on the part of our study anesthetists.