Figure 2: Probability of *Legionella* Positivity by Monochloramine Level

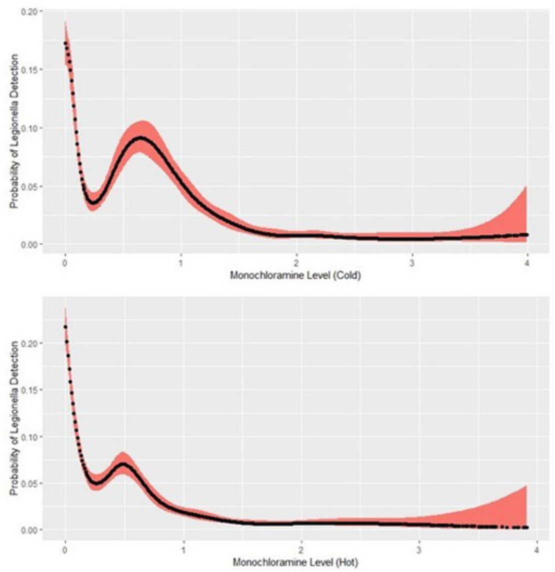
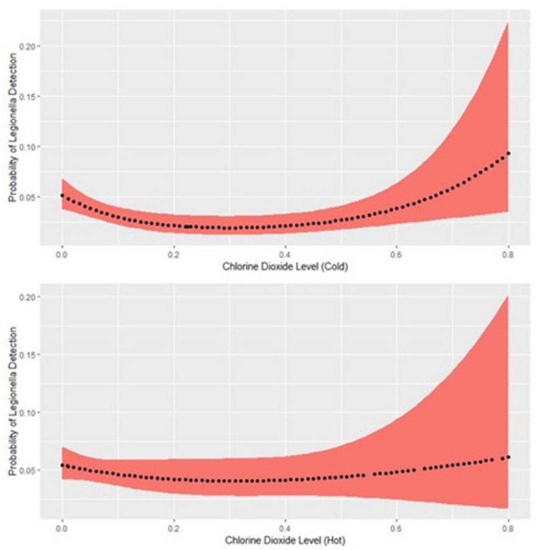


Figure 3: Probability of *Legionella* Positivity by Chlorine Dioxide Level



Disclosures. **All authors:** No reported disclosures.

1231. *Legionella* Variability From Routine Environmental Testing Across All Veterans Health Administration (VHA) Medical Facilities

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Background. VHA *Legionella* prevention policy requires quarterly testing of potable water samples, for its 170 medical facilities ("stations") distributed across the United States. We modeled the variability in *Legionella* positivity rates by location structure and by time to understand *Legionella* prevalence and distribution across VHA nationwide. Our goal was to understand when, where and why variations in *Legionella* positivity happens across VHA facilities.

Methods. Data from quarterly water samples from sinks and showers from 2015 through 2017 and for which complete information was reported were used for the model. A multi-level Bayesian logistic regression model was run in R version 3.5.1. The hierarchical location group levels consisted of room nested within floor, within building, within station, within region. The time group-level effects included quarter nested within year. Variabilities within groups were estimated as standard deviation (SD) on the log-odds scale.

Results. Among 138,553 samples, there was little seasonal effect (SD: 0.32) in *Legionella* positivity based on the quarter in which they were sampled. The largest variability in *Legionella* positivity occurred at the station level (SD: 2.38), with substantial variation at the building level also (SD: 1.85). The 5% of stations most likely to be positive for *Legionella* represented only 7.5% of total samples but accounted for 39.7% of all positive samples. The 5% of stations least likely to be positive for *Legionella* represented 10.4% of total samples, but only had 2 positive samples.

Conclusion. Buildings with the highest probability for *Legionella* positivity are clustered together within stations. We saw no major seasonal variations in *Legionella* positivity across facilities. We were able to better predict stations with higher positivity as well as lower overall positivity for *Legionella* water sampling. The observed dominant station-level effects could be due to overarching influences such as a single water source and suggests approaches at this level can impact *Legionella* control. These results demonstrate a mechanism for understanding the distribution and probability of *Legionella* and can inform prevention practices and future policy.

Disclosures. **All authors:** No reported disclosures.

1232. Potential Health and Cost Outcomes of Optimized Statistical Process Control Use for Surgical Site Infection Surveillance

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Background. Surgical site infections (SSIs) are common (160,000–300,000 per year in the United States) and costly ($6,000–$25,500 per event) healthcare-associated infections with potentially lethal outcomes (2.1%–6.7% mortality rate). A prior analysis by our group suggested that statistical process control (SPC) can detect SSI outbreaks earlier than traditional epidemiological surveillance methods. This study aimed to quantify the potential impact of SPC surveillance on patient outcomes (prevented SSIs and deaths) and healthcare costs.

Methods. We retrospectively analyzed 30 SSI outbreaks occurring over a period of 8 years in a network of 50 community hospitals from the Southeastern United States. We applied 24 control chart variations, including 2 optimized for SSI surveillance, 6 with expert-defined pre-outbreak baselines (used in our pilot study), 4 with lagged rolling baselines (idem), and 12 common practice ones (using rolling baselines with no lag or fixed baselines). The charts used procedure-specific data from either the outbreak hospital or the entire network to compute baseline SSI rates. We calculated the average SSI rates during, before and after the outbreaks, and the months elapsed between SPC and traditional detection. We then used these values to estimate the number of SSIs that could have been prevented by SPC, and corresponding deaths avoided and cost savings (Figure 1).

Results. Optimized charts detected 96% of the outbreaks earlier than traditional surveillance, while pilot study and common practice charts did so only 65% (58%) of the time (Figure 2). Optimized charts could potentially prevent 15.2 SSIs, 0.64 deaths, and save $226,000 in excess care costs per outbreak. Overall, charts using network baselines performed better than those relying on local hospital data. Commonly used variations were the least effective, but were still able to improve on traditional surveillance (Figure 3).

Conclusion. SPC methods provide a great opportunity to prevent infections and deaths and generate cost savings, ultimately improving patient safety and care quality. While common practice SPC charts can also speed up outbreak detection, optimized SPC methods have a significantly higher potential to prevent SSIs and reduce healthcare costs.

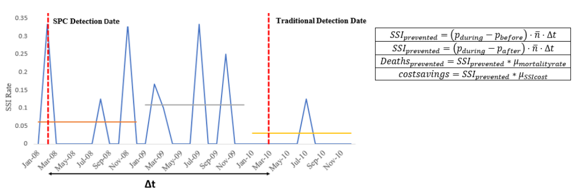

Figure 1. Example calculation of prevented SSI and related outcomes for one hospital. Left graph shows the SSI rate over time (blue). Overlaid horizontal lines represent the average SSI rate before (orange), during (gray), and after (yellow) the outbreak. SPC and traditional surveillance detection dates are depicted in red dashed lines, while their difference in months is represented by Δt (black arrow). Right inset shows the equations used to estimate prevented SSI cases (using average pre- or post-outbreak SSI rates), deaths (using average SSI mortality rate of 3.9%), and cost savings (using average cost per SSI of $13,212).

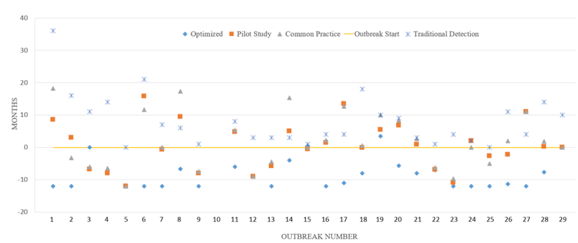

Figure 2. Outbreak-specific SPC and traditional detection relative to outbreak onset (months). For each outbreak, the plot shows the month difference between outbreak detection by optimized (diamonds), pilot study (squares), and common practice (triangles) charts relative to the estimated outbreak onset. The horizontal line represents the estimated outbreak onset date. Negative values indicate detection prior to the outbreak onset, and positive values represent the converse. Also shown are the number of months between outbreak onset and traditional detection dates (crosses).

Outcome Measure	Optimized Charts	Pilot Study Charts	Common Practice Charts	Optimized – Non-optimized
Prevented SSIs	**15.2** (10.7 – 19.7)	**6.7** (5.6 – 7.7)	**6.1** (5.2 – 7.1)	**9** (5 – 12)
Prevented Deaths	**0.64** (0.22 – 1.32)	**0.28** (0.12 – 0.52)	**0.26** (0.11 – 0.47)	**0.4** (0.1 – 0.8)
Cost Savings	**$ 226,000** (64,000 – 503,000)	**$ 100,000** (34,000 – 197,000)	**$ 92,000** (31,000 – 181,000)	**$131,000** (31,000 – 314,000)

Figure 3. SPC effectiveness. Estimates of prevented SSIs, deaths, and cost savings per outbreak by chart type. Values given as average and (in parenthesis) 95% confidence intervals or minimum and maximum. Also shown is the average difference in outcomes between optimized charts and non-optimized charts (pilot study and common practice charts).

Disclosures. **All authors:** No reported disclosures.

1233. Surveillance Quality Correlates with SSI Rates in Prosthetic Hip and Knee Surgery: A Call to Action to Adjust Reporting of SSI rates

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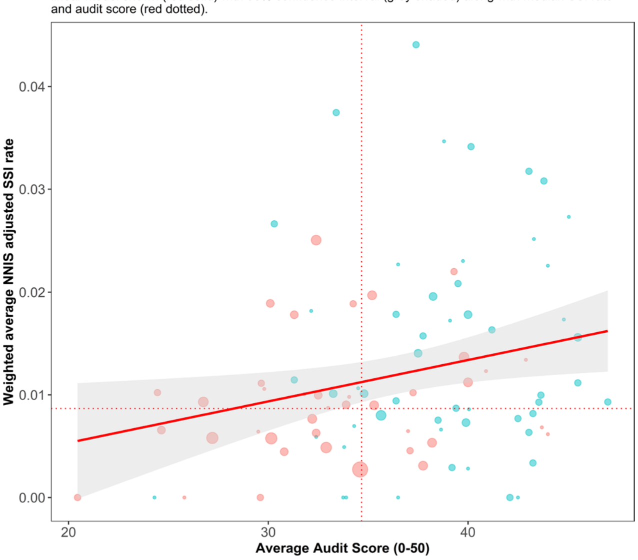
Background. Surgical site infections (SSIs) are rather infrequent following knee and hip surgery, but can have profound consequences for the patient. SSI data from a large network of Swiss hospitals has routinely been collected in a nationwide SSI surveillance system since 2009. The aim of the study was to investigate whether SSI rates are correlated with the quality of surveillance.

Methods. We calculated the weighted mean NNIS adjusted infection rates for hip and knee surgeries for the years in which audits occurred in each hospital. The 50-point score per audit is an amalgamation of quantitative and qualitative information from both structured interviews and a random selection of reviewed patient records, including (amongst others) an evaluation of completeness of medical documentation, follow-up, data quality, and training.

Results. The analysis included 30'696 knee and hip surgeries from 92 hospitals (excluding those institutions with <50 procedures in the audit year), with median infection rate 1% (IQR [1–2%]) and median audit score 35 (IQR [32–39]). The Figure plots the NNIS adjusted infection rate against audit score along with the linear fit (solid red) and 95% confidence intervals (gray). There is large variability in rates and scores, with a noticeable increasing trend (P = 0.01). Using the median of both metrics to divide the plot into 4 quadrants, those hospitals in the lower left quadrant have both low infection rates and low audit scores (predominantly private hospitals), whereas those in the upper right quadrant have both higher SSI rates and audit scores (mostly public hospitals). Those in the lower right quadrant represent the ideal situation with both low rates and high-quality surveillance.

Conclusion. In this national surveillance of nosocomial SSI hip and knee infections, there was a wide range of SSI rates and surveillance quality, with discernible clustering of hospital types. Those hospitals with low infection rate correlated with low-quality audit scores. Surveillance systems without routine evaluation of validity may underestimate the true incidence of SSIs. Audit quality should be taken into account when interpreting SSI rates, perhaps by infection rates for those hospitals with lower audit scores.

Figure: Average audit score plotted against weighted average NNIS adjusted infection rate per hospital for knee and hip surgery
Bubble sizes proportional to number of surgeries; type of hospital - private (pink), public (blue); linear model shown (red solid) with 95% confidence interval (grey shaded) along with median SSI rate and audit score (red dotted).



Disclosures. **All authors:** No reported disclosures.

1234. Mental Models of Surgical Site Infection Prevention Among Surgical Technicians and Nurses

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Background. Surgical site infections (SSI) are common and costly. Institutions have implemented complex prevention bundles to reduce SSI, but adherence remains challenging. Understanding clinicians' mental models related to SSI prevention can help develop strategies to improve adherence.

Methods. We conducted focus groups with surgical clinicians at a tertiary care center. We used constructs from behavior change theories to analyze responses and identify relevant themes for SSI prevention.

Results. We had 19 participants (10 nurses, 9 surgical technicians) in 4 focus groups. We found the following SSI prevention challenges: (1) emphasis on rapid patient turnover, which impairs ability to complete all required infection control tasks; (2) OR crowding and traffic, with increased risk to sterile technique breaks; (3) poor compliance with OR attire, including wearing scrubs outside of the hospital; (4) inadequate OR cleaning between cases; (5) lack of emphasis on post-discharge wound care instructions. The following beliefs were commonly expressed: (1) belief that some SSI are inevitable, due to increased complexity and duration of surgical procedures in a referral center; (2) perceived lack of knowledge and training on OR sterile technique among medical and nursing students; (3) perceived incorrect techniques for applying skin preps among surgical residents, and, occasionally, attendings; (4) fear and hesitancy to bring up OR irregularities if individual involved is perceived as having a "difficult personality," irrespective of social hierarchy; (5) feeling overwhelmed by too many requirements for SSI prevention, which frequently change; (6) belief that some policies originate from outside influences and are not relevant to frontline clinicians; (7) frustration to receiving SSI performance feedback that is not individualized and lacks actionable items; (8) feeling "blamed" for having SSI without knowing "how to fix it"; (9) belief that training rigor and dedication to patient care have decreased over time, and are lax among younger generations. Representative quotes categorized according to behavior change constructs are shown in Table 1.

Conclusion. Addressing clinicians' perceptions of SSI prevention may help improve adherence to the process and reduce SSI incidence.

Table 1. Representative quotes depicting mental models of SSI prevention among surgical nurses and technicians, grouped by constructs from behavior change theories (Theoretical Domains Framework)

Domain	Quote
Capability	
Skills	"I think …technique with prepping…it's a learned skill. And your preceptor or teacher or the previous resident, … are they technically doing it well?"
Knowledge	"…we're a teaching hospital, so there's always new people, which is great, but .. everybody has varying levels of knowledge and stuff about sterile technique. So that's kind of where come in to try to watch all these people and make sure everything's OK." "I feel like especially med students or nursing students, like operating room isn't necessarily covered a whole lot… Like it takes a while to understand, and they don't understand it, so you got to watch them like a hawk."
Memory, attention, and decision processes	"And there's always situations where, you know, there's a lot of people in the room. And it's hard to keep everybody … keep them all from breaking sterile technique, paying attention to everybody…" "And another thing is, if you want to introduce an initiative, introduce your initiative, but don't do another one three days later… give people a chance to adjust to one before you bring out another one. "Like for a while, it seemed like there were ten things happening every week. Not just with SSIs but like with everything. …it's just like overwhelming." "Because you're trying to take care of a patient, and you've got 4,000 checklists that you're supposed to remember to do."
Behavioral regulation	"…somebody is contaminating or not being sterile, like we all would give feedback in the moment, most of the time, you know." "If the other people, like the residents or the surgeons listen to us about it is, you know, another question."
Opportunity	
Social influences	"Yeah, because there's some physicians where they'll be like, well, tell me what other people are doing, maybe I can start doing it. You know, … a lot of people are open to change"
Environmental context and resources	"You know, I think some of the barriers for us is just that everybody wants you to speed everything up all the time, and like speed up turnovers, and speed up this and speed over that, you know, to make things more efficient. And I think … sometimes it can affect, you know, SSI. […] "I was thinking about traveling on the interstate, everybody's going 80 and so its 70 or whatever." "I don't think the rooms sometimes get as clean as they should because we're in a hurry, or you're rushing to finish a case, and you're trying to get instruments out of the room, and you've got lots of traffic." "… and then sometimes surgeons won't wait, and they'll just start prepping when you're still doing other things." "I think sometimes, with any of the changes that we have, they could be rolled out better… I don't think, when we do some of these initiatives, that all the key players are on the same page."
Motivation	
Social and Professional Role	"I think occasionally, the rules that come from an outside source or come from people who are not on the frontline can be difficult for us because we are there every day and see how things should work …So being given a rule that we have to follow makes it difficult to do our job sometimes when we don't necessarily feel like it should be enacted."
Beliefs about capabilities	" Yeah. It becomes kind of a circus. *[OR crowding]* And it's like, I'm only one person, and I can only watch it so many times."
Optimism (Skepticism)	"…just situations where we're doing huge multiservice cases where, you know, you're working down below on somebody, you're working up top on the abdomen, or it's a trauma, you know. Like there's just situations where no matter what you do, there's going to be breaks in sterile techniques, I guess." "You're getting the patient in the middle of the night from [Hospital X or Y] with … that nobody wants to deal with, so they just say, << oh, we can't, you guys need to take the patient.>> And it's like, obviously, the outcome of that is not going to be great, but, you know, we still have to take the patient. So I think that when you look at the statistics for our hospital, I don't think they're always very indicative of what's actually happening."
Beliefs about consequences	"We wouldn't be having this discussion if Medicare still paid for our infections."