Predictive factors for surgical site infection in general surgery

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Background. *Global parameters, such as wound class, the American Society of Anesthesiologists' physical classification score, and prolonged operative time, have been associated with the risk of surgical site infection (SSI). We hypothesized that additional risk factors for SSI would be identified by controlling for these parameters and that deep and organ/space SSI may have different risk factors for occurrence.*
Methods. *A retrospective review was performed on general and vascular surgical patients who underwent an operation between June 2000 and June 2006 at a single institution. Patients with SSI were matched with a case-control cohort of patients without infection (no SSI) according to age, sex, ASA score, wound class, and type of operative procedure. Data were analyzed using bivariate and regression analyses.*
Results. *Overall, 10,253 general surgical procedures were performed during the 6-year period; 316 patients (3.1%) developed SSI. In all, 300 patients with 251 superficial (83.6%), 22 deep (7.3%), and 27 organ/space (9%) SSIs were matched for comparison. Multivariate logistic regression analysis identified previous operation (odds ratio [OR], 2.4; 95% confidence interval [CI] = 1.6–3.7), duration of operation ≥75th percentile (OR, 1.8; 95% CI = 1.2–2.8), hypoalbuminemia (OR, 1.8; 95% CI = 1.1–2.8), and a history of chronic obstructive pulmonary disease (OR, 1.7; 95% CI = 1.0–2.8) as independent risk factors for SSI. Only hypoalbuminemia (OR, 2.9; 95% CI = 1.4–6.3) and a previous operation (OR, 2.0; 95% CI = 1.0–4.4) were significantly associated with deep or organ/space infections.*
Conclusions. *These results demonstrate additional factors that increase the risk of developing SSI. Deep and organ/space infections have a different risk profile. This information should guide clinicians in their assessment of SSI risk and should identify targets for intervention to decrease the incidence of SSI. (Surgery 2008;144:496-503.)*

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Surgical site infection (SSI) is 1 of the most common complications after an operation, and it has been reported to vary between 2.1% and 7%.[1] These infections result in an increase in morbidity, duration of hospital stay, health-care expenses, and mortality.[2-4] Current efforts are underway to decrease SSI by implementing process measures that have been demonstrated to decrease the risk of SSI.[2,5,6] Compliance with these process measures, however, has not been associated consistently with a reduction in SSI.[7,8] Therefore, accurate identification of parameters that impact the development of SSI is a necessary step to decrease the incidence and avoid the ill effects associated with SSI.

The National Nosocomial Infection Surveillance (NNIS) study identified wound class, American Society of Anesthesiologists' (ASA) physical classification score, and prolonged operative time as parameters associated with risk of developing SSI.[9] Within each defined parameter is a range of risk that likely is influenced by other factors that may be possible to modify through dedicated intervention.

Identifying factors that influence SSI risk has the potential to help direct resources to decrease the incidence of SSI. We hypothesized that additional risk factors for SSI would be identified by comparing patients with SSI with a matched case-control cohort of patients without SSI to control for known risk factors, such as wound class, ASA risk score, and type of operative procedure. We also investigated whether deep and organ/space

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infections, which have a greater morbidity and mortality than superficial SSI, had a different risk profile. Additional parameters were identified that are potential targets for future interventions.

METHODS

Patients 18 years of age or older who underwent a general or a vascular surgical operation between June 2000 and June 2006 at MetroHealth Medical Center, which is a public tertiary care and teaching hospital, comprised the study population. SSI was identified by a search of the medical records database using ICD-9 codes. Patients who developed SSI had their medical records reviewed retrospectively. SSI was categorized based on standard definitions.[8] Superficial infection was defined as an infection of the surgical site that occurred within 30 days after the operation and involved the skin or subcutaneous tissue. Deep infection was defined as infection of the surgical site that occurred within 30 days after operation and involved the fascial and muscle layers. Organ/space infection was defined when an SSI that occurred within 30 days after operation involved any part of the anatomy (eg, organs or spaces) beneath the incision.[8]

In all, 50 discrete variables were assessed, which included demographics, comorbid diseases, preoperative and intraoperative variables, the type of operative procedure, and information regarding the SSI. Comorbid diseases were determined to be present when such a diagnosis was present in the medical record at the time of the index operation. Data regarding previous operations and the use of prior incision site for the current operation were collected. Intraoperative data were collected from the operating room information system (Surgical Information Systems, Alpharetta, Ga). This information included ASA risk score, wound classification, type and duration of operation, and estimated operative blood loss. Operations were categorized into 5 discrete groups for comparison. Operations that exceeded the referenced 75th percentile for that procedure were considered prolonged.

We developed a reference group of patients without SSI (No SSI) for comparison This case-control cohort was created by matching a patient with SSI to the next patient in the database without an SSI using the following variables: age ± 5 years, sex, ASA risk score, wound class, and type of operation. Patients who could not be matched (n = 16) were excluded from additional analysis. Some continuous variables were categorized for comparison (eg, hemoglobin ≤ 10 g/dL, serum albumin ≤ 3.4 mg/dL, and estimated blood loss ≥ 500 mL); continuous data are presented as mean ± SD.

Data were analyzed using SPSS statistical software (SPSS Inc., Chicago, Ill). Discrete variables were compared using chi-square analysis or the Fisher exact test. Continuous variables were compared using an unpaired, 2-tailed Student t-test. Differences were considered significant at P less than or equal to .05. Variables with a P value of less than or equal to .10 on bivariate analysis were retained for multivariate analysis using a backward stepwise logistic regression model to predict the risk of developing SSI. This study was approved by the MetroHealth Medical Center Institutional Review Board.

RESULTS

In all, 10,253 general and vascular operations were performed over 60 months. Of those, 5,929 ambulatory operations were performed, which included patients who stayed less than 24 h (57.8%), 2919 inpatient procedures (28.5%), and 1,405 operations on patients who were admitted the same day (13.7%). The average ASA score for these patients was 2.6 ± 0.9. Operations were most commonly classified as clean (n = 6,395, 62.4%) or clean-contaminated (n = 2,224, 21.7%).

In all, 300 patients met the inclusion criteria for SSI and were matched adequately for comparison. The mean age for SSI patients was 56.3 ± 14.3 years. In all, 193 women and 107 men participated in this study. The demographic and patient characteristics of this group are listed in Table I. In all, 251 patients (83.6%) developed superficial SSI, 22 patients (7.3%) had deep SSI, and 27 patients (9%) had organ/space infection. SSI was more common in patients with ASA 2 and 3 risk scores (38% and 50%, respectively) and those with clean and clean-contaminated wound class (62% and 28%, respectively; Table II). The mean ASA score for all SSI patients was 2.6 ± 0.7. Patients who developed deep and organ/space infection (n = 49) had a greater mean ASA score (3.0 ± 0.7) than patients with superficial SSI (P < .002) and were less likely to have a clean wound class (32.7% vs 67.7% with superficial SSI, P < .001). Deep and organ space SSI was more commonly present among patients who had gastrointestinal operations (71.4%). Most of these patients had operations on the large intestine (71%, n = 74).

The case-control cohort (No SSI) had characteristics similar to the SSI group (Table III). Bivariate analysis identified 8 preoperative variables that were significantly more common among patients

Table I. Characteristics of patients with surgical site infection (n = 300)

Variables	n	*Percent*
Age (years, mean ± SD)	56.3 ± 14.3	—
Female	193	64.4
ASA score		
I	11	3.6
II	114	38
III	150	50
IV	25	8.3
Wound Classification		
Clean	186	62
Clean-contaminated	84	28
Contaminated	11	3.7
Dirty/Infected	19	6.3
Type of Procedure		
Gastrointestinal*	116	38.7
Hernia repair†	58	19.3
Vascular	49	16.3
Breast	39	13
Extra-abdominal‡	38	12.7
Risk Factors		
History of smoking	159	53
History of previous operation	150	50
Current operation through a previous incision	96	32
Diabetes mellitus	91	30
Excessive alcohol use	84	28
Peripheral vascular disease	80	27
Chronic pulmonary obstructive disease	71	24
Congestive cardiac failure	66	22
Infection at a remote site	43	14
History of cancer	27	9
History of anticoagulation use	26	9
Renal failure	25	8
Hepatic disease	17	6
History of steroid use	15	5
History of chemotherapy or radiation	2	1
History of skin disorder at incision site	1	0.3

*Gastrointestinal = Stomach, small and large intestine, or pancreas, biliary tract.
†Hernia = Inguinal, umbilical, or ventral hernias.
‡Extra-abdominal = Skin and soft tissue or thyroid.

who developed SSI (Table IV). Hypoalbuminemia, a low hemoglobin, excessive alcohol use, and history of a previous operation were identified as significant risk factors associated with developing deep and organ/space SSI (Table V).

Multivariate logistic regression analysis identified a history of previous operation (odds ratio [OR], 2.4; 95% confidence interval [CI] = 1.6–3.7), prolonged operative time (OR, 1.8; 95% CI = 1.2–2.8), hypoalbuminemia (OR, 1.8; 95% CI = 1.1–2.8), and history of chronic obstructive pulmonary disease (OR, 1.7; 95% CI = 1.0–2.8) was significantly associated with the development of SSI. Multivariate analysis identified hypoalbuminemia (OR, 2.9; 95% CI = 1.4–6.3) and history of previous operation (OR, 2.0; 95% CI = 1.0–4.4) as risk factors for deep and organ/space infection.

DISCUSSION

The NNIS study has identified 3 risk factors—ASA score, wound class, and prolonged operative time—as predictive of the development of SSI.[1] Considerable variability, however, exists in the rate of SSI when using this predictive model.[10,11] Recent studies have indicated that the NNIS risk index is not sufficiently accurate and may need to be modified.[9,10,12] This observation prompted us to evaluate a large population of general and vascular surgical patients at a single institution for additional risk factors that could be targeted to prevent SSI.

Our results identified the history of a previous operation, prolonged operative time, hypoalbuminemia, and a history of chronic obstructive pulmonary disease as major risk factors that affect the development of SSI when we corrected for ASA score, wound classification, and type of procedure. Other factors found to be significant on bivariate analysis included a history of congestive cardiac failure, excessive alcohol use, operation through a previous incision, infection at a remote site, and a low preoperative hemoglobin.

Recent studies have identified history of a previous operation as a risk factor for SSI among patients who underwent colorectal operations.[13,14] Gastrointestinal procedures comprised the most common type of procedure performed in our patients. Half of the patients in the current study had a history of previous operation, and 64% of these patients had their operation performed through a previous incision site. In our study, 74% of patients who developed more complicated SSI (deep and organ/space infection) had a gastrointestinal operation, and 71% of these operations involved the large bowel. A previous operation may serve as a surrogate for a more difficult operation, which can also be associated with prolonged operative time. This observation can affect wound class particularly if contamination occurs during the procedure. Conducting the operation through a previous incision may predispose to SSI because the scar has decreased vascularity and may be affected by previous incisional complications (although we did not examine this parameter). One strategy to reduce SSI may be to

Table II. Comparison of patients with superficial and deep/organ space infections

Variables	*Percent with superficial SSI* (n = *251*)	*Percent with deep/organ space SSI* (n = *49*)	P *value*
Age (years, mean ± SD)	55.3 ± 14.2	61.3 ± 13.9	.007
Female	64.9	61.2	.366
ASA Score			.002
I	4.4	0	
II	41	22.4	
III	49.8	51	
IV	4.8	26.5	
Wound Classification			<.001
Clean	67.7	32.7	
Clean-contaminated	25.1	42.9	
Contaminated	2.4	10.2	
Dirty/infected	4.8	14.3	
Type of Procedure			<.001
Gastrointestinal*	33.1	71.4	
Hernia repair†	21.9	6.1	
Vascular	16.3	16.3	
Breast	14.7	0	
Extra-abdominal‡	13.9	6.1	
Risk Factors			
Low albumin (≤3.4mg/dL)	23.5	51	.001
Low hemoglobin (≤10g/dL)	16.7	38.8	.001
Excessive alcohol use	31.1	12.2	.004
History of previous operation	46.6	67.3	.006
Current operation through a previous incision	29.9	42.9	.050

*Gastrointestinal = Stomach, small and large intestine, pancreas, or biliary tract.
†Hernia = Inguinal, umbilical, or ventral hernias.
‡Extra-abdominal = Skin and soft tissue or thyroid.

avoid using a previous incision when possible, especially if the prior incision had been infected.

Previous studies have assessed the influence of prolonged operative time as a risk factor for SSI.[15] Prolonged operative time may be an indicator of more advanced disease, reoperative operation, or difficulties encountered intraoperatively. Operative time is often related to increased blood loss, which can contribute to tissue hypoxemia. A long operation also exposes the incision to desiccation, which may increase the likelihood of incisional contamination. The use of a laparoscopic approach has been demonstrated to decrease the incidence of SSI significantly after cholecystectomy and colon resection.[9,16] Unfortunately, minimally invasive approaches may not be possible in all situations. Although the incidence of superficial SSI has been decreased by the use of minimally invasive approaches, the incidence of deep and organ/space infection remains unchanged.[17] This observation implies that other parameters also influence the development of deep and organ/space infections.

Hypoalbuminemia can be associated with hepatic dysfunction, protein-calorie malnutrition, and an active acute-phase response. A low serum albumin concentration was found in 24% of patients with superficial SSI and in 51% of those with deep and organ/space infections. A large study from the National Surgical Quality Improvement Project has demonstrated that low serum albumin is associated with an increased risk of SSI in patients who undergo general and vascular surgical operations.[18] Patients with oropharyngeal or upper gastrointestinal tract cancers frequently have hypoalbuminemia; preoperative correction of hypoalbuminemia using supplemental nutrition improves mortality and reduces postoperative complications.[19] In contrast, correction of hypoalbuminemia using supplemental intravenous albumin does not improve mortality in critically ill patients.[20] The strategy of using supplemental albumin prior to operation has not been tested specifically as a perioperative maneuver to decrease SSI. Selective patients who require major elective procedures may benefit from attempts to improve their nutritional status prior to operative intervention.

Multivariate analysis identified chronic obstructive pulmonary disease (COPD) as another

Table III. Characteristics of patients with SSI and no SSI

Variables	*SSI (n = 300)*	*No SSI (n = 300)*	P *value*
Age (years, mean ± SD)	56.3 ± 14.3	56.6 ± 14.2	.839
Female	193	197	.399
ASA Score			.992
I	11	12	
II	114	112	
III	150	152	
IV	25	24	
Wound Classification			.976
Clean	186	190	
Clean-contaminated	84	80	
Contaminated	11	12	
Dirty/infected	19	18	
Type of Procedure			.924
Gastrointestinal*	116	115	
Hernia repair†	58	58	
Vascular	49	51	
Breast	39	39	
Extra-abdominal‡	38	37	

*Gastrointestinal = Stomach, small and large intestine, pancreas, or biliary tract.
†Hernia = Inguinal, umbilical, or ventral hernias.
‡Extra-abdominal = Skin and soft tissue or thyroid.

Table IV. Bivariate analysis of patients with SSI and No SSI

Variables	*Percent with SSI*	*Percent with No SSI*	P *value*
History of previous operation	50	31	<.001
Prolonged operation	52	34	<.001
Congestive cardiac failure	22	12	.002
Excessive alcohol use	28	38	.010
Current operation through a previous incision	32	23	.013
Infection at a remote site	14	8	.013
Low hemoglobin (≤10g/dL)	23	14	.021
Low albumin (≤3.4mg/dL)	38	27	.022
Chronic obstructive pulmonary disease	24	17	.068
Estimated blood loss ≥500mL	16	11	.074

parameter that increased the risk of superficial SSI. Patients with COPD have lower tissue oxygen delivery and decreased physiologic reserve. Oxidative-mediated mechanisms for microbial killing are compromised profoundly, and tissue oxygenation is impaired.[21] The absence of an effect of COPD on the incidence of deep and organ/space SSI suggests that additional risk factors, such as wound class and ASA score, may be more important for the development of these complications.

Table V. Bivariate analysis of patients with deep/organ space SSI and superficial SSI

Variables	*Percent with deep/organ space SSI*	*Percent with superficial SSI*	P *value*
Low albumin (≤3.4mg/dL)	51	24	.001
Low hemoglobin (≤10g/dL)	39	17	.001
Excessive alcohol use	12	31	.004
History of previous operation	67	47	.006
Current operation through a previous incision	43	30	.050
Estimated blood loss ≥500mL	25	15	.095

Deep and organ/space SSI is associated with a greater mortality than superficial infection. Like superficial SSI, hypoalbuminemia and a previous operation significantly increased the risk of deep and organ/space SSI. Patients who developed these infections were older, had a greater ASA risk score, and were more likely to have microbial contamination of the incision during operation. The persistence of hypoalbuminemia and a prior operation as risk factors in these patients suggests that they are exceedingly important factors that impact the development of all types of SSI. The lack of significance of a prolonged operative time and COPD in patients with deep and organ/space SSIs could also be because of the smaller sample size in this group.

Our study has several limitations. It was retrospective and had a relatively small sample size, particularly in the subset of patients with deep and organ/space SSI. We did not collect data on other measures demonstrated to affect the incidence of SSI, such as the use of perioperative antimicrobial prophylaxis, method and timing of hair removal, skin preparation, and the adequacy of mechanical bowel preparation.[22-24] Although we abide by the current recommendations for these measures routinely, it is possible that our results were affected by individual or system errors. We also did not routinely collect measurements of patient body temperature, glycemic control, oxygenation, or the use of intraoperative transfusions. We attempted to minimize the confounding effects of these variables by using a matched case-control cohort. Data regarding the microbiology of the SSI were not examined, and it is possible that recently reported

increases in antimicrobial resistance may have reduced the effectiveness of standard perioperative antimicrobials.

The results of this study suggest that preoperative risk factors in addition to those traditionally associated with SSI can be identified and are important to recognize. Deep and organ/space infections have a different risk profile. This information should guide clinicians in their assessment of SSI risk and should identify other targets for intervention to decrease the incidence of SSI. Additional research to assess the validity of these observations is needed to determine their relative importance and to assess the effectiveness of proposed interventions.

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DISCUSSION

Dr Hiram C. Polk Jr (Louisville, Ky): This was a nice paper. It is one of many I think we will see that shows the extreme power of contemporary data schemes that allow you to make comparisons that you just couldn't have done by hand before. There is much also to value in this paper because it talked about deep wound infections and intraspace infection that is excluded from most papers. And while the numbers are small here, it is a really good part of this.

The problem with COPD is it is a variable for somebody that has mild forms, severe forms. You can imagine that is a continuous variable and you need to account for that.

Given all the publicity that NSQIP has used about an albumen of 2.0, I think the observation that an albumin of 3.8 is a cut point for this group of people is really, really important, so we don't have to go to the extremes that the V.A. has talked about, we can examine now lesser degrees of hypoalbumin and realize they are highly significant.

I do have a question of Dr Malangoni. How did you follow the discharge data? How did you get the post-op infections that occurred in these people? Are you sure you got them all? That has been the will of the wisp for the short term hospitalization now for about 15 years, and finding that out from the doctors' records is really important.

I found the deep versus superficial infection a really intriguing inquiry—again, albumin, low hemoglobin, alcohol, pre-op through the same incision.

I think that also sets up a little bit of the suggestion made last year about an apgar score for surgery after an operation is done. We are pretty good with the preoperative surgical time-out. I think the post-op surgical briefing to reassess where you have been and say we did lose more blood, did it last longer than expected, maybe we had better keep a closer eye on this patient is a big part of it. And I would encourage you, Dr Malangoni, to go ahead and perhaps try some of the bigger, even more robust databases to see if these points are confirmed. I bet they are. And I particularly think the data about the deep wound infection is really new and not previously known.

Dr Mark A. Malangoni (Cleveland, Ohio): Dr Polk, thank you for your comments. I think your question about following the postoperative course of the operations is extremely important. We only follow these infections out to 30 days, as does the CDC, so we did not follow any prosthetic-related infections that might occur beyond 30 days. But we did use our electronic medical record which incorporates outpatient visits to allow us to follow these patients for that period of time. I appreciate your comments about the need for using large databases to confirm or refute what information we have found on our small database, and we hope to be able to do that in the future.

Dr William G. Cheadle (Louisville, Ky): I congratulate both Drs Haridas and Malangoni on a very interesting and comprehensive study of a single institutional experience identifying these risk factors. You found that previous or long operation, low albumin, and COPD out of 50 discreet variables were significantly associated with SSI, and this occurred even when you controlled for ASA class, wound classification, and the type of procedure.

Your overall SSI rate of 3% including 10,000 patients over six years is certainly laudable, although your use of ICD-9 codes in a retrospective fashion likely underestimates superficial incision SSI, but not certainly necrotizing fasciitis or deep tissue space infection. Identification of these additional risk factors that are amenable to risk reduction certainly will be helpful to us all and especially the hospital bottom line as the era of no pay for these complications is ushered in.

I have a few questions to clarify the patient groups.

How many of these were performed through minimal access methods and what was the rate of SSI in these particular cases?

Secondly, have you noticed a change in the microbiology and seen more MRSA? I know you didn't really study them in the paper, but I am sure you have got an intuition on that factor.

Length of operation is likely a surrogate for both complexity and blood loss and do you think we ought to be using a longer-acting antibiotic because redosing clearly is going to be an issue in these patients if we don't remember to do so.

The reoperative finding of a higher SSI rate in incisions made through old scars is certainly interesting and I wonder if that related in particular to groin incisions in reoperative vascular surgery where that has clearly been shown to be the case.

I want to congratulate you on this great study. I think some of these measures clearly are amenable to corrections such as malnutrition and COPD and I wonder if these are going to be added to the list that is sponsored by CMI.

Dr Mark A. Malangoni (Cleveland, Ohio): We did not break out our laparoscopic cases per se to look at the infection rate in those cases. But what we did do in our matching process is match patients that had minimally invasive approaches with a minimally invasive approach on the other side. So as good as that is, that is what our data really reflect.

One of the things about laparoscopic surgery is while it has decreased the incidence of superficial surgical site infections it has not had an effect on deep organ space infections, which suggests that there are really a different set of factors that influence those different types of infections. And indeed that was one of the important things that we observed in our study and I think something that all of us are going to have to look at more vigorously in the future.

The redosing issue, I think, is extremely important. And whether that turns out to be a longer antibiotic or making certain we redose at the proper time, I think those are two different strategies that can be used to make certain that we have the right amount of drug on board at the time that the incision is at risk. I think the key there is to have surgeons involved in what really is now a multi-disciplinary approach with our anesthesiologists, the nurses, the pharmacists, et cetera, in making certain that those things happen on time, or we take other measures to make sure that all of those things are done.

Dr Jay L. Grosfeld (Indianapolis, Ind): One of the things over the years that I have always been concerned about is reoperating through a previous wound, and you have alluded to that being a factor. However, what you didn't tell us is how many of those previous wounds have had an infection. Because if you operate through

a previous wound that has been previously infected, I am sure that the infection rate must be much higher. And I wonder whether you sought to try to elucidate between clean and dirty wounds the first time around and then going back to the same wound. What is the outcome?

Dr Mark A. Malangoni (Cleveland, Ohio): That is an important observation, and that is another limitation of our study. While we did record when a previous incision was used, we did not record when that incision had been infected previously. I would absolutely agree with your observations, however, avoiding that incision when it has previously been infected is an absolute key to staying out of trouble. Because certainly I think all of us would have that experience that once infected, when that incision is traversed again, it is certainly much more likely to be infected the second time.

Dr Thomas A. Stellato (Cleveland, Ohio): Dr Malangoni, congratulations on an important paper. You mentioned diabetes. But I wonder, do you have any information about the adequacy of control of the diabetes at the time of surgery, both preoperatively, intraoperatively, and perioperatively? Did patients have glucoses below 200 at the time they underwent surgery? And the second issue is body mass index. Did you have any information about the significance or lack of significance of obesity and morbid obesity in these patients?

Dr Mark A. Malangoni (Cleveland, Ohio): We did not track obesity as a risk factor in this particular patient group. And I think that is because the prevalence of that problem is so high. But nonetheless, we didn't track it. We also don't have information about how well controlled our diabetics were, either by a measurement of hemoglobin A1C as an idea of how well they are controlled chronically before the operation, nor did we track the data about glycemic control after the operation. So we do not have that information.

Dr Patrick Vaccaro (Columbus, Ohio): I have a question about groin infections in vascular cases. Were you able to break that out from the other elective vascular cases and were you able to look at whether or not they had concurrent lesions on their extremities while you were operating on those people with ulcerations or actually foot infections at the time of their vascular procedure?

Dr Mark A. Malangoni (Cleveland, Ohio): Again, we used our case control matching system in order to have like patients in both groups. So while we did not track infection at a particular incision site, we matched patients by identical procedures. So if a patient had a groin incision as part a vascular operation in the infected group, then we tried to match that patient who had a similar operation with a groin incision in the case control group. But otherwise, we don't have any more information. We did look at whether or not there were any skin rashes or lesions around the site of the incision or the area being prepped. We did not look at the presence of skin lesions at other sites, for instance on the same extremity, unless they were infected. So 14% of our patients had infection in remote sites. But again, I don't have the detail about how many of those were on an extremity in the particular circumstance you addressed.