Surgical Site Infection (SSI) Surveillance Program for Mastectomy in the Department of Surgery of the University of the Philippines-Philippine General Hospital

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ABSTRACT

Background. Mastectomy is a common surgical procedure done worldwide. Surgical site infection (SSI) is a common healthcare-associated infection. Mastectomy SSIs are frequently under-reported.

Objectives. The study aimed to determine the incidence of SSI among mastectomy cases of the Department of Surgery, University of the Philippines – Philippine General Hospital (UP-PGH) during one year of full implementation of the Surgical Site Infection Surveillance Program and evaluate the program's surveillance follow-up rate.

Methods. This study was an observational practice audit research that included all adult patients who underwent a mastectomy in UP-PGH from January 1, 2018, to January 31, 2019, when the SSI Surveillance Program was fully implemented. SSI was monitored and assessed during the patient's hospital stay, on the day of hospital discharge, and at 30 days (± 2 days) after surgery, either during an outpatient visit or via phone call by a nurse navigator. SSI frequency for mastectomy was computed both during the in-hospital stay and at 30 days after surgery. Surveillance follow-up rate, defined as the proportion of patients who could follow-up up to 30 days after surgery, was determined.

Results. The 30-day SSI rate for mastectomy was 6.8% (19/279). All 279 patients were followed up to 30 days after surgery. Of the 279 patients, 277 (99.3%) were through clinic visits, one was through phone calls, and one was still admitted to the hospital.

Conclusion. Full implementation of the SSI Surveillance Program for mastectomy in UP-PGH for one year showed a higher SSI rate than in published international literature. The program had a complete 30-day patient follow-up, contributing to more accurate SSI reporting. Implementing an SSI surveillance program with standardized protocols, dedicated personnel, patient education component, and the analysis of the information derived from such programs can improve an institution's quality of surgical care.

Key Words: surgical site infection, mastectomy, breast surgery, infection surveillance program

INTRODUCTION

Surgical site infection (SSI) is among the most common healthcare-associated infections (HAIs), accounting for 17.5% (95% confidence interval (CI) 14% to 21.5%) of all HAIs, according to the US Center for Disease Control and Prevention National Healthcare Safety Network (CDC-NHSN).[1] In 2014, there were 14.2 million in-patient operative procedures performed in the US.[2] Based on a US CDC HAI prevalence study in 2015, there were approximately 110,800 SSIs associated with in-patient surgeries.[2] In a systematic review of 57 observational studies, median SSI incidence was 3.7%, ranging from 0.1% to 50.4%.[3] A

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prospective, multinational, multi-center surveillance cohort study by the International Nosocomial Infection Control Consortium Hospitals (INICC) reported SSI prevalence of 2.9% for all types of surgeries.[4] In the same report, breast surgery was ranked fourth among surgical operations, with the least incidence of SSI at 1.7%.[4]

Mastectomy is one of the most common operations performed. Published data on the SSI rates after mastectomy in the Philippines is limited. An SSI prevalence study in a local tertiary hospital involving 166 patients who had cancer surgery reported an overall SSI rate of 4.8%, but no specific report for mastectomy patients.[5] In a randomized controlled trial investigating routine use of prophylactic antibiotics for patients undergoing mastectomy in the University of the Philippines – Philippine General Hospital (UP-PGH) showed a high SSI rate of 14.2% out of 254 patients.[6] There are no reports on SSI rates for mastectomy in a routine clinical care setting.

The morbidity and mortality associated with SSI significantly impact patient outcomes and contribute to increased healthcare costs. The severity of SSI ranges from superficial skin infection to life-threatening conditions. Patients with SSI required significantly more outpatient and emergency room visits, radiology services, longer hospital stays, readmissions, and home health aide services.[7] SSIs were associated with a 3% mortality rate.[2] Hospital costs were 2.9 times greater in patients with SSI recognized after discharge.[7] Additionally, SSIs delay the time to administer adjuvant therapies for patients undergoing surgery for cancer.

Given the epidemiological data and direct and indirect consequences of incurring SSIs, SSI prevention and detection are essential priorities in surgical care delivery. An active SSI surveillance program is a recognized strategy to reduce SSI risk. With the implementation of the SSI surveillance program for orthopedics and trauma cases, SSI rates decreased over time from 1.86% to 0.66%, with 418 hospitalization days saved.[8] Hospitals that were participating in an SSI surveillance program for more than two years were found to have a 29% reduction in the SSI rates.[9] The decrease in the SSI rates was attributed to the implementation of the surveillance program and the other prevention interventions that often accompanied such a program.[9]

Thus, this study aimed to report the mastectomy SSI rates and the surveillance follow-up rate after a year of full implementation of an SSI surveillance program in the Department of Surgery, UP-PGH. These data are an essential quality of care indicator for benchmarking efforts to improve surgical care delivery.

METHODS

This was an observational practice audit research that involved a review of patient records of all adult patients (age > 18 years) admitted to the surgical wards of UP-PGH who underwent mastectomy for benign or malignant breast disease during a year of full implementation of the SSI Surveillance Program from January 1, 2018, to January 31, 2019. Patients who underwent surgery before the full implementation of the SSI Surveillance Program, those admitted to other hospital units, and those initially admitted to the surgical wards but transferred to another division of the hospital before the 30-day postoperative period were excluded. Patients with dirty wounds (ulcerated or fungating tumor with grossly purulent discharge) were also excluded. Mastectomy (partial mastectomy, total mastectomy, modified radical mastectomy, or radical mastectomy) was performed according to the standard technique. As per department protocol, patients had a single dose of preoperative intravenous antibiotic therapy and application of Jackson-Pratt drain in the surgical site postoperatively.

Briefly, the UP-PGH Department of Surgery SSI Surveillance Program involved identifying patients who underwent one of the ten pre-identified index operations (including mastectomy), who were then actively monitored postoperatively until 30 days (±2 days) after surgery. An infection surveillance nurse navigator guided the patient and their caregivers on proper wound care in the immediate postoperative period. The nurse navigator also provided patients with health teaching with visual aids on detecting and reporting signs and symptoms of SSI. Before discharge, patients were advised to consult immediately in the event of possible SSI. Patients were reminded through a text message of their 30-day follow-up. The attending surgical team members filled up the standardized SSI in-hospital surveillance form and the follow-up surveillance form during the patients' hospital stay and the follow-up visits.

The occurrence of SSI was determined during the in-hospital stay and up to 30 days (±2 days) postoperatively by the members of the attending surgical team. Patients were routinely followed-up at 7 and 30 days (± 2 days) after surgery as per the standard procedure. Additional visits were left to the discretion of the attending surgical team and largely depended on surgical drain output and expected time to removal. The nurse navigator followed up patients who were unable to come for clinic visits through a phone call. If signs and symptoms of possible SSI were reported during the phone call, patients were asked to send pictures, do a clinic visit or both for verification and management. SSI occurrence was recorded in the patient's hospital record (in-patient or outpatient, as applicable) and on the SSI surveillance forms. For patients who developed SSI, the number of post-operative days to develop SSI, the intervention, and wound swab culture results were recorded, where appropriate. The attending surgical team members and the nurse navigator received standard orientation regarding the SSI definition as per CDC criteria, detection, and reporting. Blinding the attending surgical team members and nurse navigators who served as outcome assessors, while ideal, was not deemed necessary since this was not a clinical trial and the study was meant to approximate real-world practice.

The SSI surveillance forms were the principal sources of data for the study. A complete chart review to include in-hospital, outpatient, emergency room, and operative records were done for those with incomplete data to abstract the preliminary information.

Study data included baseline demographic and clinical data (age, sex, primary diagnosis, ASA classification, history of diabetes, Human Immunodeficiency Virus (HIV) infection, steroid use or intake of other immunosuppressive medications, and smoking history), surgical and treatment factors (type of surgery, urgency of operation, wound classification, duration of surgery, skin closure technique, prophylactic antibiotic use, postoperative antibiotic use, and postoperative surgical drain use), and postoperative factors and outcomes (length of postoperative hospital stay, other nosocomial infections acquired, development of hematoma or seroma, occurrence of SSI and compliance to follow-up). Data were presented as means with standard deviations and frequency with percentages.

The primary outcome measure of this study was the superficial or deep incisional SSI rate within 30 days of surgery. As defined by the CDC, the diagnosis of SSI requires that the patient has at least one of the following: purulent drainage from the superficial or deep (fascia or muscle) incision but not from within the organ/space component of the surgical site; at least one of pain or tenderness, localized swelling, redness, heat, fever, and the incision is opened deliberately or spontaneously dehisces; and/or abscess within the wound that is clinically or radiologically detected.[2]

The surveillance follow-up rate was determined by calculating the proportion of patients who completed the 30-day (± 2 days) follow-up through out-patient visits or phone calls.

Patient and surgery-related factors were compared between patients who developed and did not develop SSI using unpaired Student's t-test for continuous variables and Chi-squared test for categorical variables. All analyses were 2-sided, and the level of statistical significance was set at $p\text{-}value \leq 0.05$. The online GraphPad QuickCalcs t-test calculator (GraphPad Software, Inc., San Diego, California) and MedCalc comparison of proportions calculator (MedCalc Software version 20.008, Ostend, Belgium) were used.[10,11]

The study was conducted following the guidelines of the Declaration of Helsinki. The study protocol was reviewed and approved by the University of the Philippines Manila Research Ethics Board (UPMREB 2019-034-01). The Surgical Site Surveillance Program and the research studies conducted under the program were funded through a grant from the Foundation for the Advancement of Surgical Education, Inc. and a research fund provided by the PGH Expanded Hospital Research Office to the Department of Surgery.

RESULTS

There were 279 patients included in the study. All patients were female with a mean (standard deviation, SD) age of 53 (10.1) years. More than half (55.9%, 156/279) of the mastectomy procedures mastectomy were performed for locoregionally advanced-stage breast cancer. Most patients had good functional capacity. Only 9.3% (26) and 8.2% (23) of the 279 patients were diabetics and smokers, respectively. One hundred patients (35.8%) received neoadjuvant chemotherapy. None of the patients had HIV or concurrent use of steroids or other immunosuppressive drugs (Table 1).

All surgeries were done on an elective basis except for one who had an emergency total mastectomy for an uncontrollable bleeding tumor. The majority of patients (89.6%, 250/279) had modified radical mastectomy. There were 101 out of 279 (36.2%) patients who had open, contaminated wounds, which meant that tumors were ulcerated or fungating without evidence of gross infection (*i.e.*, no purulent discharge). Wound cultures were not routinely obtained for these patients as there was no clinical evidence of infection. All patients received a single preoperative dose of Cefazolin 2 grams intravenously. Most of the mastectomy

Table 1. Demographic and clinical profile of UP-PGH mastectomy patients

Clinicodemographic factors	Frequency (%) / Mean (SD) n=279
***Age**, in years*	53 (10.1)
Gender	
Male	0
Female	279 (100%)
ASA	
1	16 (5.7%)
2	242 (86.7%)
3	20 (7.2%)
4	1 (0.4%)
Diagnosis	
Breast cancer	257 (92.1%)
Stage 0	4 (1.4%)
Stage I	7 (2.5%)
Stage II	90 (32.3%)
Stage III	156 (55.9%)
Phyllodes tumor	21 (7.5%)
Fibroadenoma	1 (0.4%)
Diabetes mellitus	26 (9.3%)
HIV	0
Steroid use	0
Other immunosuppressive medications	0
Neoadjuvant chemotherapy	100 (35.8%)
Smoking history	
Smoker	23 (8.2%)
Non-smoker	256 (91.8%)

%, percentage; SD: standard deviation

operations were closed primarily (95.0%, 265/279) using sutures, typically employing subdermal and subcuticular techniques using polyfilament, braided, absorbable sutures. The operation's average duration (SD) was 3 hours and 25 minutes (1 hour and 35 minutes). The longest operative time at 6 hours and 33 minutes was recorded for a stage IIIB breast cancer with neoadjuvant chemotherapy and modified radical mastectomy with split-thickness skin grafting. Ten patients (3.6%) required split-thickness skin graft (STSG), two (0.7%) had latissimus dorsi flap with STSG, one (0.4%) had transverse rectus abdominis myocutaneous flap, and one (0.4%) patient had a total mastectomy with en bloc resection of anterior 4th, 5th and 6th ribs with chest wall reconstruction using methylmetacrylate and prolene mesh, latissimus dorsi flap with STSG. No patient received a breast implant. Except for the eight cases who underwent STSG, most (97.1%, 271/279) had postoperative drainage using the Jackson-Pratt drain. The drain was removed on an average of 13 days postoperatively. Antibiotics were continued postoperatively in 51 patients (18.3%), either intravenously (Cefazolin) or orally (Sultamicillin or Cefuroxime or Cefazolin). The average postoperative hospital length of stay was 4.7 (3.1) days. Five patients (1.8%) developed a hematoma, and 13 patients (4.7%) had seroma (Table 2). There was no mortality reported within 30 days from surgery.

Nineteen of the 279 patients (6.8%) had superficial SSI within 30 days (± 2 days) postoperatively (Table 3). All of the cases of SSI were detected after hospital discharge. Of the 19 cases of SSI, 17 (89.5%) were breast cancer patients, almost (8 of 19, 42.1%) half of whom had advanced stage requiring prior neoadjuvant chemotherapy with doxorubicin, cyclophosphamide, and docetaxel. One patient with SSI had a phyllodes tumor, while the other one had complex fibroadenoma. Two of the ten patients who had STSG developed SSI. Three of the 19 patients who developed SSI were previous smokers (15.8%) and had diabetes mellitus (15.8%). Four had prolonged (>16 days) JP drain duration. None of the patients with SSI developed seroma or hematoma. The majority of the cases of SSIs presented with pain, swelling, erythema, and purulent discharge from the surgical wound. Three patients had wound dehiscence. The majority were treated with oral antibiotics, commonly using Sultamicillin or Clindamycin for a week. Five had bedside drainage procedures at the clinic visit, and wounds were left open for wound care and healing through secondary intention. Wound culture studies were not performed in all SSI cases. All SSI cases were eventually resolved after treatment intervention. There was no mortality among patients who developed SSI.

There was no significant difference in several patients- and surgery-related SSI risk factors between the group of patients who did and did not develop SSI (Table 4). SSI rate was higher among patients with wound classification of "contaminated" due to ulcerating or fungating mass at 8.9% (nine out of 92) compared to those with "clean" wounds or those who have intact skin over the mass at 5.6% (ten out of 178). Still, the difference was not statistically significant (p=0.31).

All 279 patients were assessed up to 30 days (± 2 days) from surgery. All except two had visited the clinic at the end of the monitoring period. Of the two, one was readmission for flap necrosis and had debridement, tertiary closure, and one was followed up through phone (Table 3).

Table 2. Surgery-related risk factors in the development of SSI

Surgery-related factors	Frequency (%) / Mean (SD) n=279
Urgency of operation	
Emergency	1 (0.4%)
Elective	278 (99.6%)
Type of operation	
Partial mastectomy	1 (0.4%)
Total mastectomy	27 (9.7%)
Modified radical mastectomy	250 (89.6%)
Radical mastectomy	1 (0.4%)
Wound classification	
Clean	178 (63.8%)
Contaminated	101 (36.2%)
Operative time, *in minutes*	205 (95)
Wound closure	
Primary	265 (95%)
Suture	265 (95%)
Stapler	0
Split Thickness Skin Graft (STSG)	10 (3.6%)
Flap	4 (1.4%)
Use of postoperative drain	
Yes	271 (97.1%)
No	8 (2.9%)
Antibiotic prophylaxis given	
Yes	279 (100%)
No	0
Continued antibiotics postoperatively	
Yes	51 (18.3%)
No	228 (81.7%)
Length of postoperative stay, *in days*	4.7 (3.1)
Other hospital-acquired infections	
Yes	1 (0.4%)*
No	278 (99.6%)
Hematoma	
Yes	5 (1.8%)
No	274 (98.2%)
Seroma	
Yes	13 (4.7%)
No	266 (95.3%)
Flap necrosis	
Yes	2 (0.7%)
No	277 (99.3%)

*%, percentage; SD: standard deviation; *phlebitis*

Table 3. SSI and surveillance follow-up outcomes of mastectomy patients included in UP-PGH SSI surveillance program

Outcomes	Frequency (%) n=279
SSI rate*	19/279 (6.8%)
In-hospital	0
After discharge	19/279 (6.8%)
***Surveillance follow-up rate**†*	279/279 (100%)
Outpatient clinic visit	277 (99.3%)
Phone call	1 (0.4%)
Still admitted	1 (0.4%) ‡

** SSI rate among patients with follow-up (outpatient clinic visit or phone call) up to 30 days postoperatively and included SSIs detected during an in-hospital stay or after discharge*

† Proportion of patients who completed 30-day follow-up, either via outpatient clinic visit, phone call, or while still admitted in the hospital

‡ Patient was readmitted for flap necrosis.

Table 4. Comparison of patient and surgery-related factors between patients who developed and did not develop SSI

Patient and surgery-related factors	With SSI Frequency (%) / Mean (SD) n=19	Without SSI Frequency (%) / Mean (SD) n=260	p-value
***Age,** in years*	50.5 (10)	53.1 (10)	0.28
Diabetes Mellitus	3 (15.8%)	24 (9.2%)	0.35
Smoking	3 (15.8%)	21 (8.1%)	0.25
Neoadjuvant chemotherapy	8 (42.1%)	92 (35.4%)	0.56
***Operative time,** in minutes*	225 (62)	204 (96)	0.35
Postoperative antibiotic use	5 (26.3%)	46 (17.7%)	0.35
***Duration of JP drain,** in days*	12.8 (5.1)	11.4 (7.3)	0.41
***Length of stay,** in days*	5 (2)	4.7 (3)	0.67
Contaminated wound	9 (47.4%)	92 (35.4%)	0.29

**%, percentage; SD: standard deviation*

DISCUSSION

SSI rate in mastectomy patients was high at 6.8% in this study compared with the results from both INICC and US CDC-NHSN, which reported SSI rates in breast surgery of 2.3% and 1.7%, respectively.[4,12] However, it is lower than the 14.2% SSI rate in mastectomy cases reported in the randomized trial evaluating prophylactic antibiotic therapy performed in the same institution done a decade prior.[6]

Several patient, disease, and surgery-related factors may contribute to SSI development and thus be considered in the surveillance program. Patients with diabetes have reported a 50% higher risk of developing SSI than non-diabetic patients, hence the emphasis on achieving good glycemic control perioperatively.[13] Diabetes was not significantly associated with SSI in this study. The presence of co-morbidities, reflected by higher ASA scores, likewise resulted in greater SSI rates even in patients undergoing clean general surgical procedures.[14] Patients who developed SSI in this study were all ASA 2. Factors that put a patient in an immunocompromised state such as HIV infection, malignancy, use of immunosuppressive drugs, and steroids are associated with increased risk of SSI.[15-17] SSI rate was reported to be twofold higher with more severe presentation among HIV patients compared to the general population.[15] Malignancy in itself puts a patient in a relative immunocompromised state, making it a risk factor for the development of SSI.[17] Current cigarette smoking is likewise associated with SSI but was not observed in this study.[18] In this study, almost all of the patients who developed SSI were breast cancer patients. Half of them received neoadjuvant chemotherapy that could have put them in a relative immunocompromised state.

Emergency operations have a higher risk of SSI than elective operations, and an increasing trend of SSI rates was seen when stratifying by wound classification.[19,20] Half of the patients who developed SSI in this study have contaminated wounds (eight with grossly uninfected ulcerated breast cancer tumor who underwent neoadjuvant chemotherapy and one grossly uninfected ulcerated bleeding phyllodes tumor who underwent emergency mastectomy). None of the patients with contaminated wounds had cultures done. Given the greater proportion of patients with contaminated wounds who developed SSI than those with clean wounds, albeit not statistically significant, it may be worthwhile to get wound cultures to determine if there is a need to change prophylactic antibiotics recommendation for this subset of patients. A prospective cohort study is underway in the institution to investigate common bacterial isolates and antibiotic sensitivity among patients with ulcerating or fungating breast tumors.

The length of operation is also correlated with SSI risk.[12] The mean duration of operation in this study was 205 minutes, at par with the cut-off duration for mastectomy of 196 minutes, as recommended by the National Nosocomial Infection Surveillance System (NNIS).[12] Duration of surgery was not significantly associated with SSI in this study. However, thirteen of the 19 patients (68.4%) who developed SSI had a total operative time of >196 minutes with a mean of 258 minutes. As for wound closure materials and techniques in mastectomy, no high-level evidence was shown to prevent SSI. Mastectomy incision sites of the study patients were closed using the same technique using sutures except for one patient who had STSG for whom staplers were used for graft fixation.

The presence of a foreign body in the postoperative site in the form of a drain, lack of standard aseptic technique protocol in handling the drain, and aspiration of hematoma-seroma are risk factors for SSI.[21] A prospective cohort study of 308 breast surgery patients showed that SSI was five to six times higher in patients with prolonged drainage than without drainage (hazard ratio (HR) 5.6, 95% CI 2.2 to 14.3). SSI was also three times higher in patients with seroma-hematoma formation (HR 2.7, 95% CI 1.55 to 4.96).[21] The median duration of drainage removal in the current study was consistent with the published report at

16 days.[21] While the duration of JP drainage in this study was not associated with higher SSI risk, four of the 19 SSI patients (21.1%) had JP drain removal beyond 16 days. Interestingly, in this study, no patients who developed SSI had hematoma-seroma formation.

The absence of significant association in this study between SSI risk and the presence of the patient and surgical variables found to be risk factors in the published literature is most likely due to the study being underpowered to detect such differences.

Antibiotic prophylaxis for mastectomy remains a controversial issue, and practices are still highly variable. The general recommendation is that antimicrobial prophylaxis is not warranted for clean breast surgeries without risk factors (e.g., immunosuppression, diabetes, obesity, etc.).[22] Several individual RCTs on the use of antimicrobial prophylaxis in breast surgery, including the trial performed in the same institution, have not shown a significant reduction in SSI risk.[6,23,24] However, a 2014 Cochrane Database Systematic Review of 11 RCTs on the use of prophylactic antibiotics in breast cancer surgery without reconstruction showed a 33% reduction in risk of SSI with prophylactic antibiotic (relative risk (RR) 0.67, 95% CI 0.53 to 0.85).[25] Moreover, SSI risk in breast surgery has been reported to range from 2% to 16% in the literature, much higher than the expected SSI risk in clean procedures.[26] Hence, several groups, including the American Society of Breast Surgeons (ASBS), have recommended prophylactic antibiotics in breast cancer surgery.[26] The UP-PGH Department of Surgery protocol recommends using a single dose of Cefazolin 2 grams intravenously one hour before cutting for mastectomy, which all patients in this study received.

Continuation of antibiotics postoperatively is generally not recommended except for specific clinical indications.[26] In the study, almost 20% of patients had continued antibiotics postoperatively either intravenously or as oral home medications as per surgeons' discretion for various reasons such as hematoma, seroma, ulcerated tumors, and diabetes.

SSI rate in this study was lower than the reported rate in the randomized controlled trial for prophylactic antibiotics done in the same institution (6.8% vs. 14.2%).[6] These two studies had almost the same number of included patients (279 vs. 254) and follow-up rates (100% and 95%).[6] In the present study, a higher preoperative dose of Cefazolin at 2 g was given to patients than Cefazolin at 1 g in the trial. However, the difference in the SSI rates cannot be solely attributed to this, as other patient and surgery-related factors may contribute.

Culture-guided antibiotic therapy is recommended to avoid the unwarranted use of antibiotics and the development of multi-drug-resistant microorganisms. Staphylococci, the most commonly isolated from breast surgery infections, have reported drug and multi-drug resistance rates of up to 63% and 31%, respectively.[27] Local data on the antibiogram of SSI for breast surgery is lacking. The ASBS consensus guidelines have recommended obtaining aerobic and anaerobic cultures and sensitivity for breast surgery SSI as this practice can prompt appropriate changes in antibiotic management.[26] None of the SSI cases in this study had culture, and sensitivity testing as this is currently not yet part of routine practice in the institution. Given the high SSI rates, obtaining cultures from SSI cases should be institutionalized to guide the choice of empiric antibiotic therapy.

Results of the one-year implementation of the SSI Surveillance Program have shown that having a defined and well-planned program that included a standardized definition of SSI for surgeons, the routine use of surveillance forms for standard documentation of information, patient education, and a dedicated infection control nurse, facilitates accurate SSI monitoring. Before the program implementation, SSI cases were largely unreported, or if at all, grossly inaccurate and underestimated. The 100% compliance rate to the 30-day follow-up in this study has important implications in the accuracy of reported SSI rates.

The routine text messaging reminder for patient follow-up and phone calls to do remote patient reviews emphasize the role of telecommunications technology in increasing compliance to the SSI surveillance program follow-up. A study in India on mobile-phone-based SSI surveillance in rural settings showed that 74.5% of follow-up was completed through mobile phones.[28] This alternative follow-up method is essential in our setting where several socioeconomic factors (transportation costs, work schedule conflicts, need for accompanying person, etc.) may limit adherence to clinic follow-up. This strategy to improve SSI monitoring should be coupled with patient education and the employment of a nurse navigator to do health teaching before patient's discharge and oversee patient follow-up compliance, as was done in this SSI surveillance program.

The current study has shown that the SSI surveillance program can be fully implemented and sustained in a tertiary government university hospital in the Philippines with good follow-up compliance. The study provided an opportunity to assess and improve current management protocols, including the rational use of antibiotics, policies on wound culture investigations, and SSI management. Additionally, with the program came the standardization of certain aspects of surgical care apart from antibiotic use, including prepping techniques and regular feedback of SSI rates to individual surgeons. The latter is essential, particularly in a training institution where complication rates serve an evaluation purpose. The study has reinforced the importance of having a dedicated infection control nurse navigator and technology in the SSI surveillance implementation to improve follow-up and increase the accuracy of SSI rate reporting.

A significant limitation of the study is the report on one-year outcomes only. To ascertain the SSI Surveillance Program's overall impact on the surgical care of the institution, it is recommended to continue its full implementation to generate more data for trends analysis. It is suggested that standardized protocols for the different aspects of care of

mastectomy patients, particularly relating to antibiotic use, should be in place, adherence to which should likewise be monitored and reported as part of the surveillance program. Routine culture and sensitivity study of the wound discharge of patients with SSI should be institutionalized to generate local antibiogram for SSI in mastectomy and guide empiric antibiotic use. Lastly, the mastectomy SSI rates should be monitored regularly and communicated to stakeholders, including surgeons, infection control committee, and operating room management, for continued assessment and improvement of current practices.

CONCLUSION

The full implementation of the SSI Surveillance Program for Mastectomy of the Department of Surgery of the University of the Philippines-Philippine General Hospital revealed a high SSI rate (6.8%) for mastectomy compared to reported international SSI rates. It achieved a 100% compliance rate for follow-up, thereby contributing to accurate SSI reporting. Having a dedicated SSI surveillance program with standardized protocols, dedicated personnel, patient education component, and technology utilization and the information derived from such programs can improve the quality of surgical care.

Statement of Authorship

All authors contributed in the conceptualization of work, acquisition and analysis of data, drafting and revising and final approval of the version to be published.

Author Disclosure

All authors declared no conflicts of interest.

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REFERENCES

1. Magill SS, O'Leary E, Janelle SJ, Thompson DL, Dumyati G, Nadle J, et al. Changes in Prevalence of Health Care-Associated Infections in US Hospitals. N Engl J Med. 2018 Nov 1;379(18):1732–44.
2. Centers for Disease Control and Prevention National Healthcare Safety Network, Surgical Site Infection Event [Internet]. 2021 [cited 2021 Jun 17]. Available from: https://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf
3. Korol E, Johnston K, Waser N, Sifakis F, Jafri HS, Lo M, et al. A Systematic Review of Risk Factors Associated with Surgical Site Infections among Surgical Patients. PLoS One. 2013 Dec 18;8(12):e83743.
4. Rosenthal VD. International Nosocomial Infection Control Consortium (INICC) resources: INICC multidimensional approach and INICC surveillance online system. Am J Infect Control. 2016 Jun;44(6):e81–90.
5. Baclig R, Siguan S, Salutan S. A Survey on Surgical Site Infection among Cancer patients. Philipp J Surg Spec. 2003;58(3):88–92.
6. Cabaluna ND, Uy GB, Galicia RM, Cortez SC, Yray MDS, Buckley BS. A Randomized, Double-blinded Placebo-controlled Clinical Trial of the Routine Use of Preoperative Antibiotic Prophylaxis in Modified Radical Mastectomy. World J Surg. 2013 Jan;37(1):59–66.
7. Perencevich EN, Sands KE, Cosgrove SE, Guadagnoli E, Meara E, Platt R. Health and Economic Impact of Surgical Site Infections Diagnosed after Hospital Discharge. Emerg Infect Dis. 2003 Feb;9(2):196–203.
8. Mabit C, Marcheix PS, Mounier M, Dijoux P, Pestourie N, Bonnevialle P, et al. Impact of a Surgical Site Infection (SSI) Surveillance Program in Orthopedics and Traumatology. Orthop Traumatol Surg Res. 2012 Oct;98(6):690–5.
9. Marchi M, Pan A, Gagliotti C, Morsillo F, Parenti M, Resi D, et al. The Italian National Surgical Site Infection Surveillance Programme and Its Positive Impact, 2009 to 2011. Eurosurveillance [Internet]. 2014 May 29 [cited 2021 Jun 17];19(21). Available from: https://www.eurosurveillance.org/content/10.2807/1560-7917.ES2014.19.21.20815
10. GraphPad QuickCalcs t-test Calculator [Internet]. San Diego, California: GraphPad Software; 2021 [cited 2021 Jun 17]. Available from: https://www.graphpad.com/quickcalcs/ttest1/
11. MedCalc Comparison of Proportions Calculator [Internet]. Osten, Belgium: MedCalc Software Ltd.; 2021 [cited 2021 Jun 17]. Available from: https://www.medcalc.org/calc/comparison_of_proportions.php
12. Edwards JR, Peterson KD, Mu Y, Banerjee S, Allen-Bridson K, Morrell G, et al. National Healthcare Safety Network (NHSN) Report: Data summary for 2006 through 2008, issued December 2009. Am J Infect Control. 2009 Dec;37(10):783–805.
13. Martin ET, Kaye KS, Knott C, Nguyen H, Santarossa M, Evans R, et al. Diabetes and Risk of Surgical Site Infection: A Systematic Review and Meta-analysis. Infect Control Hosp Epidemiol. 2016 Jan;37(1):88–99.
14. Khan M, Rooh-ul-Muqim, Zarin M, Khalil J, Salman M. Influence of ASA score and Charlson Comorbidity Index on the Surgical Site Infection Rates. J Coll Physicians Surg Pak. 2010 Aug;20(8):506–9.
15. Drapeau CMJ, Pan A, Bellacosa C, Cassola G, Crisalli MP, De Gennaro M, et al. Surgical site infections in HIV-infected patients: Results from an Italian Prospective Multi-center Observational Study. Infection. 2009 Oct;37(5):455–60.
16. World Health Organization, Web Appendix 12 Summary of a Systematic Review on the Perioperative Discontinuation of Immunosuppressive Agents, Global Guidelines for the Prevention of Surgical Site Infection [Internet]. Geneva: World Health Organization; 2018 [cited 2021 June 17]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK536412/
17. Kadija S, Stefanović A, Jeremić K, Tavcar J, Argirović R, Pantović S. Malignant Disease as a Risk Factor for Surgical Site Infection. Clin Exp Obstet Gynecol. 2012;39(1):53–6.
18. Nolan MB, Martin DP, Thompson R, Schroeder DR, Hanson AC, Warner DO. Association Between Smoking Status, Preoperative Exhaled Carbon Monoxide Levels, and Postoperative Surgical Site Infection in Patients Undergoing Elective Surgery. JAMA Surg. 2017 May 1;152(5):476–83.
19. van Walraven C, Musselman R. The Surgical Site Infection Risk Score (SSIRS): A Model to Predict the Risk of Surgical Site Infections. PLoS One. 2013;8(6):e67167.
20. Ortega G, Rhee DS, Papandria DJ, Yang J, Ibrahim AM, Shore AD, et al. An evaluation of surgical site infections by wound classification system using the ACS-NSQIP. J Surg Res. 2012 May 1;174(1):33–8.
21. Gil-Londoño J-C, Nagles-Pelaez J-A, Maya-Salazar W-A, Madrid J, Maya-Restrepo M-A, Agudelo-Pérez R-A, et al. Surgical Site Infection after Breast Cancer Surgery at 30 Days and Associated Factors. Infect [Internet]. 2017 Mar 24 [cited 2021 Jun 17];21(2). Available from: http://www.revistainfectio.org/index.php/infectio/article/view/653
22. Bratzler DW, Dellinger EP, Olsen KM, Perl TM, Auwaerter PG, Bolon MK, et al. Clinical Practice Guidelines for Antimicrobial Prophylaxis in Surgery. Am J Health Syst Pharm. 2013 Feb 1;70(3):195–283.

23. Bold RJ, Mansfield PF, Berger DH, Pollock RE, Singletary SE, Ames FC, et al. Prospective, Randomized, Double-blind Study of Prophylactic Antibiotics in Axillary Lymph Node Dissection. Am J Surg. 1998 Sep;176(3):239–43.
24. Crawford CB, Clay JA, Seydel AS, Wernberg JA. Surgical Site Infections in Breast Surgery: The Use of Preoperative Antibiotics for Elective, Nonreconstructive Procedures. Int J Breast Cancer. 2016;2016:1–7.
25. Jones DJ, Bunn F, Bell-Syer SV. Prophylactic Antibiotics to Prevent Surgical Site Infection after Breast Cancer Surgery. Cochrane Wounds Group, editor. Cochrane Database of Systematic Reviews [Internet]. 2014 March 9 [cited 2021 June 17]; Available from: http://doi.wiley.com/10.1002/14651858.CD005360.pub4
26. The American Society of Breast Surgeons, Consensus Guideline on Preoperative Antibiotics and Surgical Site Infection in Breast Surgery [Internet]. 2018 [cited 2020 Feb 8]. Available from: https://www.breastsurgeons.org/docs/statements/Consensus-Guideline-on-Preoperative-Antibiotics-and-Surgical-Site-Infection-in-Breast-Surgery.pdf
27. Berríos-Torres SI. Evidence-Based Update to the U.S. Centers for Disease Control and Prevention and Healthcare Infection Control Practices Advisory Committee Guideline for the Prevention of Surgical Site Infection: Developmental Process. Surg Infect. 2016 Apr;17(2):256–61.
28. Pathak A, Sharma S, Sharma M, Mahadik VK, Lundborg CS. Feasibility of a Mobile Phone-Based Surveillance for Surgical Site Infections in Rural India. Telemed J E Health. 2015 Nov;21(11):946–9.