

Adherence to Surgical Antimicrobial Prophylaxis Guidelines in a Tertiary Private Medical Center

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ABSTRACT

Background: With the continued diversity in antimicrobial prophylaxis methods offered to patients, this study is conducted to determine whether the prevailing antibiotic prophylaxis practices in Saint Luke's Medical Center (SLMC) are in compliance with the 2005 Philippine College of Surgeons (PCS) Clinical Practice Guidelines on Antibiotic Prophylaxis for Surgical Procedures.

Methods: The charts of all adult patients (18 years and above) admitted for elective surgery from July to September 2006 were reviewed for antimicrobial surgical prophylaxis indication, dose, route, and duration. The following surgical procedures were included: head and neck, breast surgery, open hernia repair, biliary surgery and laparoscopic cholecystectomies, colorectal surgery, orthopedic surgery, transurethral prostatectomy, spinal surgery (including cerebrospinal fluid shunting and craniotomy), thoracic and cardiovascular procedures.

Results: Of the 322 evaluable procedures in this study, only 94 (29%) were adherent to the guidelines in terms of indication. Of those procedures where antibiotic prophylaxis was indicated, 70% of patients received antibiotics which were not recommended by the guidelines. Appropriate antibiotic administration was highest (70%) among those who underwent orthopedic surgery while non-adherence was highest with thoracocardiovascular (96%) and biliary surgery (82%). However, of those procedures not requiring antibiotic prophylaxis, the overall error of commission was 71%, with 100% of patients given antibiotic prophylaxis for hernia repair and 84% for laparoscopic cholecystectomy. Wrong pharmacokinetics (60%) was the most common pattern of non-adherence followed by inappropriate implementation (40%) among surgical procedures where antibiotic prophylaxis was indicated. Of those due to wrong pharmacokinetics, prolonged use of antibiotics occurred in 30% of patients, and 25% did not receive the prophylaxis within 1 hour of surgical incision. Of those due to inappropriate implementation, almost 20% were given broad-spectrum agents at a prolonged duration and 16% received an ineffective antibiotic at a prolonged duration.

Conclusion: The overall non-adherence rate was 70.8% with error of commission and wrong pharmacokinetics particularly prolonged duration of antibiotic administration as the most common non-adherent practices. Adherence to the PCS guidelines is far from optimal. Further studies are recommended to determine the factors that limit adherence to the PCS guidelines. Surveillance studies for surgical-site infections should be explored.

KEYWORDS: Antimicrobial prophylaxis, Surgery

Surgical site infections account for approximately 15% of all hospital-acquired infections. These infections are complications of surgery, occurring in 2-5% of patients after clean extra-abdominal operations and in up to 20% of patients undergoing intra-abdominal operations.¹ Surgical site infections are responsible for the increasing hospital and patient costs due to prolonged hospital stay and antimicrobial therapy.

A local study done in a tertiary university hospital showed that 40% of charity patients admitted to the surgical ward were given antimicrobials inappropriately, and the antibiotics of those admitted at the obstetric ward were inappropriate in 78% of patients.² The study by Dumo et al. reviewing antibiotic use at Saint Luke's Medical Center (SLMC) showed that 89.4% of prophylactic antibiotics were given inappropriately³, while the study by Consunji emphasized that a wide variation of practices were observed regarding appropriate antibiotic selection, route, timing, and duration of administration.⁴ Antibiotic prophylaxis compliance at the Philippine General Hospital likewise showed high non-compliance rate to guidelines at 83.7%.⁵ In another government hospital, 92.4% were non-adherent to the 2001 Philippine College of Surgeons (PCS) guidelines, with inappropriate implementation being the most common non-adherent practice.⁶

With the continued diversity in antimicrobial prophylaxis methods offered to patients, this study was conducted to determine whether the prevailing antibiotic prophylaxis practices in SLMC are in compliance with the 2005 PCS Clinical Practice Guidelines on Antibiotic Prophylaxis for Surgical Procedures. Whether there is improvement or deterioration in the practice of antibiotic usage in surgical antimicrobial prophylaxis, the data gathered can be used in further studies to determine the factors that currently influence practitioners' behavior on antibiotic prophylaxis.

METHODS

The records of all adult patients, 18 years and above, who were admitted for elective surgery from July to September 2006 were reviewed for antimicrobial surgical prophylaxis indication, dose, route, and duration. The following operations were included: general surgery (head and neck), breast surgery,

Table 1. Frequency Distribution of Surgical Procedures and Chart Retrieval Rates

Type of Surgery	Patients Registered Frequency (%)	Charts Retrieved Frequency (%)
Head and neck	79 (11.4)	58 (73.4)
Breast	75 (10.8)	33 (44.0)
Thoraco-cardiovascular surgery	81 (11.7)	26 (32.0)
Biliary	113 (16.3)	78 (69.0)
Laparoscopic cholecystectomy	63 (9.1)	48 (76.2)
Colorectal	77 (11.1)	64 (83.1)
Transurethral resection of the prostate	80 (11.6)	29 (36.3)
Hernia	32 (4.6)	20 (62.5)
Orthopedic	42 (5.9)	33 (80.5)
Spine	50 (7.2)	42 (84)
Total	692 (100)	432 (62.4)

open hernia repair, gastroduodenal surgery, biliary surgery and laparoscopic cholecystectomies, colorectal surgery, orthopedic surgery, transurethral prostatectomy, spinal surgery (including cerebrospinal fluid shunting and craniotomy), thoracic procedures, and cardiovascular procedures. Only those with class I and II surgical wounds were included.

Emergency cases, patients receiving treatment with antibiotics for a pre-existing or ongoing infection, class III and class IV surgical wounds, and immunocompromised patients (e.g., diabetics, malnourished, or patients receiving corticosteroids) were excluded from the study.

The list of patients was taken from the operating room registry of all surgical procedures done in the hospital. Charts were retrieved from the medical records section and reviewed for inclusion. Data gathered included demographics (name, age, and sex), pre- and post-operative diagnosis, operation done, wound classification, date and time of procedure, duration of procedure, antibiotic prophylaxis prescribed (dose, route, duration, and timing), and patterns of adherence or non-adherence to the PCS guidelines.

Definition of outcomes: "Adherence" refers to the administration of appropriate antibiotic prophylaxis recommended by the PCS Clinical Practice Guidelines for each specific surgical procedure; it includes the non-administration of prophylaxis for procedures where it is not indicated. "Appropriate administration" is the

use of the recommended drug at the recommended dose, route, timing, and duration. "Non-adherence" is the administration of antimicrobial prophylaxis not recommended by the guidelines.

The patterns of non-adherence were further recorded as follows:

- Inappropriate drug - ineffective; too broad-spectrum and expensive.
- Wrong pharmacokinetics - wrong dose/timing/route, and inappropriate duration.
- Inappropriate implementation - inappropriate drug and wrong pharmacokinetics.
- Error of commission - unjustified or not indicated.
- Error of omission - indicated but not given.

Data analysis: Descriptive statistics was used to determine the pattern of adherence or non-adherence of antimicrobial prophylaxis practices. The overall rates of adherence and non-adherence were calculated, then adherence/non-adherence were subcategorized into choice, dosing, timing, and duration.

RESULTS

A total of 692 patients were listed in the operating room registry. Table 1 shows that majority of the patients underwent biliary surgery with 113 cases (16.3%). Of the patients registered for operative procedures, only 432 (62.4%) charts were retrieved from the medical records section. Of the charts reviewed, 103 (23.8%) were excluded from the study: 27 (26.2%) were emergency procedures; 40 (38.8%) had uncontrolled diabetes; 6 (5.8%) had preexisting chronic liver or kidney disease; 8 (7.8%) had malignancy; 17 (16.5%) were receiving antibiotics for a concurrent infection; 1 (0.9%) was malnourished; and 4 (3.8%) had Class III surgical wounds.

Of the 322 patients included in the study, there were slightly more females (52%) and more than half of the patients (54%) were below 50 years old. Majority of the patients (92%) were admitted under the pay service as shown in Table 2.

Table 2. Frequency Distribution of the Characteristics of Patients per Surgical Procedure

Type of Surgery	No. of Patients	Gender		Age Group			Type of Admission	
		Male	Female	<50	50-65	>65	Pay	Charity
Head and neck	47	8	39	35	10	2	43	4
Breast	33	0	33	18	13	2	30	3
Thoraco-cardiovascular surgery	22	16	6	9	9	4	22	0
Biliary	51	23	28	21	21	9	47	4
Laparoscopic cholecystectomy	31	16	15	22	7	2	29	2
Colorectal	35	21	14	22	6	7	33	2
Transurethral resection of the prostate	23	23	0	1	13	9	20	3
Hernia	20	17	3	12	4	4	17	3
Orthopedic	27	16	11	14	5	8	26	1
Spine	33	16	17	20	7	6	30	3
Total (%)	322	156 (48.4)	166 (51.6)	174 (54.0)	95 (29.5)	53 (16.5)	297 (92.2)	25 (7.8)

Table 3. Frequency Distribution of the Outcomes of Patients Studied per Surgical Procedure

Type of Surgery	No. of Patients	Referred for CMA	Length of Stay			Developed Nosocomial Infection		
			<24 hrs	24-72 hrs	>72 hrs	Pneumonia	Catheter-related	SSI
Head and neck	47	0	1	21	23	0	0	0
Breast	33	0	4	16	13	0	0	0
Thoraco-cardiovascular surgery	22	5	0	5	17	5	1	1
Biliary	51	3	0	28	23	0	0	0
Laparoscopic cholecystectomy	31	1	3	18	4	0	0	0
Colorectal ³⁵	2	1	17	17	1	0	1	
Transurethral resection of the prostate	23	4	0	3	20	0	0	0
Hernia	20	0	1	14	5	0	0	0
Orthopedic	27	0	3	11	13	0	0	0
Spine	33	3	0	8	25	0	2	1
Total (%)	322	18 (5.6)	13 (4.1)	141 (44.9)	160 (51.0)	6 (1.9)	3 (0.9)	3 (0.9)

CMA: Criteria-monitored antibiotic policy
SSI: Surgical site infection

Only 6% of the patients were referred to the infectious disease service for the Criteria-Monitored Antibiotics Policy (CMA) because of the use of broad-spectrum antimicrobials for surgical prophylaxis. Slightly more than half (51%) of the patients stayed in the hospital for more than 3 days prior to being discharged. Only 12 patients (3.7%) developed nosocomial infection, mostly pneumonia. The infections occurred predominantly (7/22, 32%) among those who underwent thoraco-cardiovascular (TCVS) procedures. See Table 3.

Of the 322 evaluable procedures in this study, only 94 (29%) were adherent to the guidelines in terms of indication. See Table 4. Of those procedures where antibiotic prophylaxis was indicated, 70% of patients received antibiotics which were not recommended by the guidelines. Appropriate antibiotic administration was highest (70%) among those who underwent orthopedic surgery while non-adherence was highest with thoracocardiovascular (96%) and biliary surgery (82%). An error of omission was noted in only one patient undergoing spine surgery who was not given any antibiotic prophylaxis. However, of those procedures not requiring antibiotic prophylaxis, the overall error of commission was 71%, with 100% of patients receiving antibiotic prophylaxis for

hernia repair procedures and 84% for laparoscopic cholecystectomy.

Table 4. Distribution of Adherence and Non-adherence to Antibiotic Prophylaxis Based on the 2005 Clinical Practice Guidelines of the Philippine College of Surgeons

Surgical Procedure	N	Adherent	Non-adherent
<i>Antibiotic prophylaxis indicated</i>			
Thoraco-cardiovascular	22	1	21 (95.5)
Biliary	51	9	42 (82.4)
Colorectal	35	9	26 (74.3)
Transurethral resection of the prostate	23	7	16 (69.6)
Orthopedic	27	19 (70.4)	8
Spine	33	11	22 (66.7)
Subtotal	191	56 (29.3)	135 (70.7)
<i>Antibiotic prophylaxis not indicated (error of commission)</i>			
Head and neck	47	24 (51.1)	23 (48.9)
Breast	33	9	24 (72.7)
Laparoscopic cholecystectomy	31	5	26 (83.9)
Hernia	20	0	20 (100)
Subtotal	131	38 (29.0)	93 (71.0)
Overall total (%)	322	94 (29.2)	228 (70.8)

Table 5a. Antibiotics Used Among Surgical Procedures Where Antibiotic Prophylaxis Is Indicated

Antibiotic Prophylaxis	Thoraco-cardiovascular Surgery	Biliary	Colon	Transurethral Resection of the Prostate	Orthopedic	Spine	Total (%)
<i>Cephalosporins</i>							
Cefazolin	–	5	–	–	8	3	16 (8.6)
Cefuroxime	2	5	6	4	10	7	34 (18.4)
Ceftriaxone	–	1	3	4	5	8	21 (11.4)
CFP	5	1	–	–	–	–	6 (3.2)
Cefoxitin	–	18	6	–	–	–	24 (13.0)
Ceftazidime	–	1	–	2	–	1	4 (2.2)
Cefepime	–	1	2	1	–	1	5 (2.7)
<i>Beta-lactams</i>							
AMC	–	4	5	–	–	–	9 (4.9)
SAM	5	1	1	2	1	–	10 (5.4)
<i>Quinolones</i>							
Ciprofloxacin	–	10	5	1	–	–	16 (8.6)
Ofloxacin	–	–	–	9	–	–	9 (4.9)
<i>Others</i>							
Metronidazole	–	–	5	–	–	–	5 (2.7)
AMP/GM	–	1	–	–	–	–	1 (0.5)
OXA/GM	–	–	–	–	–	9	9 (4.9)
CAZ/OXA	–	–	–	–	–	4	4 (2.2)
CXM/MET	–	1	–	–	–	–	1 (0.5)
CXM/CIP	1	–	1	–	–	–	2 (1.1)
CF/CIP	9	–	–	–	–	–	9 (4.9)
Total	22	49	34	23	24	33	185

AMC: amoxicillin/clavulanic acid, AMP: ampicillin, CAZ: ceftazidime, CF: cefazolin, CIP: ciprofloxacin
CXM: cefuroxime, GM: gentamicin, MET: metronidazole, OXA: oxacillin, SAM: ampicillin/sulbactam

The most commonly prescribed antibiotic among surgical procedures where antibiotic prophylaxis is indicated were as follows: cefazolin/ciprofloxacin, ampicillin-sulbactam and cefoperazone-sulbactam for thoraco-cardiovascular procedures; cefoxitin and ciprofloxacin for biliary surgery, cefoxitin and cefuroxime for colorectal procedures, ofloxacin for transurethral prostatectomy; ceftriaxone and oxacillin/gentamicin for spinal procedures; and cefuroxime and

cefazolin for orthopedic surgeries. See Table 5a.

Among surgical procedures where antibiotic prophylaxis is not indicated, the most commonly used antibiotics were: cefuroxime for head and neck surgeries; cefoxitin and amoxicillin-clavulanic acid for breast surgery; cefoxitin for laparoscopic cholecystectomy and groin hernia as shown in Table 5b.

Table 5b. Antibiotics Used Among Surgical Procedures Where Antibiotic Prophylaxis Is Not Indicated

Antibiotic Prophylaxis	Head and Neck	Breast	Laparoscopic Cholecystectomy	Hernia	Total (%)
<i>Cephalosporins</i>					
Cefazolin	2	–	1	–	3 (3.3)
Cefuroxime	6	3	7	4	20 (22.2)
Ceftriaxone	1	1	–	–	2 (2.2)
Cefoxitin	5	8	11	6	30 (33.3)
Ceftazidime	–	–	1	–	1 (1.1)
<i>Beta-lactams</i>					
Amoxicillin	3	–	–	–	3 (3.3)
Amox-clavulanic	–	8	–	3	11 (12.2)
Ampi-sulbactam	–	–	–	1	1 (1.1)
<i>Quinolones</i>					
Ciprofloxacin	5	3	5	2	15 (16.6)
Ofloxacin	–	–	–	2	2 (2.2)
<i>Others</i>					
Clindamycin	–	–	–	2	2 (2.2)
Total	22	23	25	20	90

Table 6. Patterns of Non-adherence Among Elective Surgical Procedures Where Antibiotic Prophylaxis Is Indicated

Surgical Procedure n=191	Inappropriate Drug		Wrong Pharmacokinetics			Inappropriate Implementation		
	Ineffective	Broad spectrum	Dose	Timing	Duration	Broad spectrum, wrong timing	Broad spectrum, wrong duration	Ineffective, wrong duration
Thoraco-cardiovascular surgery (n=22)	–	–	–	1	–	–	6	10
Biliary (n=51)	1	5	–	20	18	5	7	8
Colon (n=35)	–	–	–	–	–	–	2	11
Transurethral resection of the prostate (n=23)	–	–	7	7	9	–	–	–
Ortho (n=27)	–	–	2	9	10	1	4	1
Spine (n=33)	–	3	1	–	9	–	19	–
Subtotal	1	8	10 (5.2)	47 (24.6)	58 (30.4)	6	38 (19.9)	30 (15.7)
Overall total (%)	9 (4.7)		115 (60.2)			76 (39.8)		

The most common patterns of non-adherence among surgical procedures where antibiotic prophylaxis is indicated were wrong pharmacokinetics (60%) followed by inappropriate implementation (39.8%) and inappropriate antibiotic used (4.7%). Of those due to wrong pharmacokinetics, prolonged use of antibiotics occurred in 30% of patients, and 24.6% did not receive the prophylaxis within 1 hour of surgical incision. Route of administration was appropriate in 100% of the procedures that required antibiotic prophylaxis. Of those due to inappropriate implementation, almost 20% were given broad-spectrum agents at a prolonged duration and 16% received an ineffective antibiotic at a prolonged duration. See Table 6.

DISCUSSION

For more than 30 years, researchers have reported that as much as 50% of antibiotic usage in hospitals is inappropriate.⁷ The proper use of these agents has gained new urgency due to the impending crisis of antibiotic resistance.⁸ Also, perioperative antibiotic administration has been shown to complement aseptic technique in reducing wound infection rates. Currently, antibiotic prophylaxis takes up a large part (~30%) or more of antibiotic usage in hospitals.⁹ Adherence to local guidelines could keep costs, resistance, and surgical site infections to a minimum.

The principal finding in this study was that 29.2%

of 322 patients received appropriate care regarding antibiotic prophylaxis for surgical procedures. More than half of the patients (60%) were receiving the right drug at the wrong time and at the wrong duration. The most common inappropriate practice was extending the antibiotics beyond the single-dose or 24-hour dosing recommendation of the guidelines. Antimicrobials were frequently administered for 5-7 days after the procedure. The practice of prolonged dosing and wrong timing of administration have serious implications in promoting antibiotic resistance and increasing the risk for surgical site infections.^{8,17}

Similar to the study done by Flores and Peña⁶, error of commission was noted in all groin procedures. In addition, antibiotic prophylaxis was also administered in majority of breast surgeries and laparoscopic cholecystectomies. In contrast to the 2001 PCS Clinical Practice Guidelines, the 2005 guidelines do not recommend antibiotic prophylaxis for laparoscopic cholecystectomies assessed as low risk (i.e., no acute cholecystitis, no recent history of acute cholecystitis, no common bile duct calculi, jaundice, or immunosuppression) based on Grade I-A recommendation as opposed to a Grade C recommendation in the 2001 guidelines. Most surgical practitioners may not be aware of these changes, or the administration of the prophylaxis may also stem from the fact that the guidelines state that antibiotic prophylaxis “may be administered in specific situations which may increase the patient’s risks for surgical site infections, e.g., co-morbid medical

conditions, surgeon's experience, the length of the procedure, and the state of the hospital and operating room environment." This statement, however, is based on Level III evidence only.¹⁰

Twenty percent of the patients received broad-spectrum agents administered for prolonged periods of time. This practice may well lead to increased antibiotic resistance and healthcare costs. For example, several studies comparing short- and longer-duration antimicrobial prophylaxis for total joint arthroplasty have shown no advantage with prolonged prophylaxis. There is no evidence that continuing antimicrobials until all catheters and drains are removed will lower infection rates.¹¹ Also, longer-duration prophylaxis has been associated with higher rates of resistant organisms when surgical site infection occurs; and prolonged antibiotic prophylaxis was also not associated with a decreased risk of surgical site infection.¹² It is noteworthy that in this study, most patients given antibiotic prophylaxis for thoracic and cardiovascular procedures received broad-spectrum agents (cefazolin/ciprofloxacin, ampicillin-sulbactam and cefoperazone-sulbactam). The cephalosporins are currently the agents of choice for coronary procedures.¹³ The use of broad-spectrum agents may be one of the reasons why nosocomial infections were most frequently noted with cardiovascular procedures.

Meanwhile, the error of commission was high with 71% given antibiotic prophylaxis unnecessarily. Among those requiring antibiotic prophylaxis, a similarly high percentage (70.7%) received them inappropriately. This degree of misuse and overuse is relatively still lower compared to the rates reported in local studies done at the Philippine General Hospital⁵ and Quirino Memorial Medical Center⁶ and compared to foreign studies.^{14,15}

The overall non-adherence rate at SLMC, a private tertiary hospital, is 70.8%. Although this result is more favorable compared to those seen in government hospitals, there is still room for improvement. In a study done at a private university hospital, non-compliance rates of 46% and 29% that were observed across time periods turned out to be statistically significant.¹⁶

Many factors influence the antibiotic prophylaxis use of surgical practitioners. These factors should be identified in future studies through key informant interviews or questionnaires. The issue of a surgeon

opting to substitute antibiotics belonging to the same class as the recommended agent, or another antibiotic having the same spectrum of activity as the recommended agent, was not addressed in the 2005 guidelines. These practices may also contribute to non-compliance in terms of antibiotic choice.

The above findings provide evidence that protocol violations are frequent in preoperative antibiotic prophylaxis leading to considerable over-prescription. Adherence to guidelines is far from optimal. Institutions like SLMC face the challenge of disseminating evidence-based knowledge systematically and expeditiously in clinical practice and advocating adherence to improve quality of care.

Limitations of the study: Several records were not available for review. Other patients undergoing surgical procedures would have been included to improve the sample size for this study had their records been available. Also, data on postoperative infections were limited to those documented in the chart. No information on nosocomial surveillance or post-discharge complications was available.

RECOMMENDATIONS

We recommend that further studies be conducted to determine the factors that limit adherence to the PCS guidelines, including determining the physicians' current level of awareness of the guidelines' recommendations. These data will contribute to the standardization of the practice of surgical antimicrobial prophylaxis and help improve adherence. Because of the limited data on obstetric/gynecologic surgical antimicrobial prophylaxis, retrospective or prospective studies on surgical prophylaxis for such procedures are also recommended. Surveillance studies for surgical site or post-operative infections should be explored.

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