Current Practices of Infection Prevention for Primary Shoulder Arthroplasty: A Survey of American Shoulder and Elbow Surgeons society members

C. Lucas Myerson, MD[1]; Jacquelyn J. Xu, MA[1]; Brian O. Molokwu, MS[1]; Sophia M. Jacobi, BA[1]; Young Kwon, MD, PhD[1]; Joseph D. Zuckerman, MD[1]; Mandeep S. Virk, MD[1]; Dennis A. DeBernardis, DO[1]

Institutional Affiliation:

[1]*Division* of Shoulder and Elbow Surgery, Department of Orthopedic Surgery, NYU Grossman School of Medicine, NYU Langone Orthopedic Hospital, NYU Langone Health, New York, NY

Introduction: Prosthetic joint infection (PJI) is a devastating complication following shoulder arthroplasty. Extensive research has been conducted to identify effective infection prevention practices. However, no gold standard protocol has been identified, resulting in varied use of preoperative, intraoperative, and postoperative strategies amongst surgeons. The purpose of this study was to identify current trends in infection prevention strategies in primary shoulder arthroplasty (PSA) amongst orthopedic shoulder and elbow surgeons. We hypothesized that prevention methods would vary by years of experience in practice.

Materials & Methods: This was a survey response study. A questionnaire was emailed to American Shoulder and Elbow Surgeons (ASES) members in November 2024. The questionnaire surveyed members regarding years of experience and various infection prevention methods for PSA. Responses were tallied and classified into four groups based on years of experience: <5 years, 5-10 years, 10-20 years, and >20 years. Statistical analyses were performed to identify any association between years of experience and surgical infection prevention practices.

Results: A total of 229 responses were collected. Five participants had incomplete responses and were excluded from analysis. The cohort consisted of 39 (17.4%) surgeons with <5 years of experience, 32 (14.3%) with 5-10 years, 74 (33.0%) with 10-20 years, and 79 (35.3%) with >20 years of experience. Greater than 80% of respondents noted using a chlorhexidine-based skin preparation, using cefazolin for perioperative prophylaxis, changing the knife blade after skin incision, and avoiding surgery within 3 months following a corticosteroid injection. Significant differences were noted in the use of hydrogen peroxide and alcohol-based skin prep, electrocautery following incision, vancomycin powder, skin glue, silver-impregnated bandages, and hemoglobin A1C (HbA1C) cutoffs amongst surgeons of varying years of experience (**Table 1)**. Logistic regression demonstrated that surgeons in practice for less than 5 years were more likely to employ the aforementioned practices than surgeons who have been practicing longer ($p<0.05$) (**Table 2)**. The average reported HbA1C cutoff value was 7.9 with 77% of respondents reporting use of a HbA1C cutoff when offering surgery to diabetic patients. Additionally, surgeons in practice for less than 5 years tended to utilize a higher HbA1c cutoff value than surgeons with greater than 20 years of experience. Only 25% of surgeons utilize a body mass index (BMI) cutoff when indicating patients for surgery, with an average reported BMI cutoff of 42.

Discussion: There is no gold standard for infection prevention practices in PSA. Considerable variation is seen in infection prevention practices for PSA amongst shoulder and elbow surgeons, particularly when stratified by years of experience. Surgeons in practice for less than five years are more likely to use multiple prevention strategies compared to surgeons with greater experience. However, techniques such as chlorhexidine-based skin prep, changing of the knife blade, use of Ancef for prophylaxis, and avoiding surgery within 3 months of a steroid injection appear to be widely utilized.

Level of Evidence: IV, epidemiological study

Keywords: Periprosthetic joint infection, shoulder arthroplasty, ASES, infection prevention, survey, current practices

Table 1: Questionnaire responses stratified by years of work experience.

Questionnaire Response	< 5 years	5-10 years	10-20 years	> 20 years	P-value
Surgeon respondents (n, %)	39 (17.4)	32 (14.3)	74 (33.0)	79 (35.3)	-
Use of Home Skin Cleanser (n, %)	26 (66.7)	24 (75.0)	64 (86.5)	61 (77.2)	0.1
Home Skin Cleanser Type (n, %)					
Benzoyl Peroxide	12 (30.8)	7 (21.9)	27 (36.5)	23 (29.1)	0.489
CHG	18 (46.2)	17 (53.1)	38 (51.4)	38 (48.1)	0.918
Soap and Water Shower	7 (17.9)	5 (15.6)	5 (6.8)	12 (15.2)	0.268
Alcohol	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.3)	0.605
Shave Axillary Hair (n, %)	11 (28.2)	10 (31.2)	14 (18.9)	23 (29.1)	0.409
Perioperative Skin Prep Type (n, %)					
CHG-based	38 (97.4)	31 (96.9)	70 (94.6)	71 (89.9)	0.314
Peroxide-based	25 (64.1)	12 (37.5)	36 (48.6)	23 (29.1)	**0.002**
Iodine-Based	4 (10.3)	4 (12.5)	5 (6.8)	13 (16.5)	0.308
Alcohol-Based	21 (53.8)	8 (25.0)	27 (36.5)	20 (25.3)	**0.012**
Other	1 (2.6)	0 (0.0)	0 (0.0)	0 (0.0)	0.19
Preoperative MRSA Nasal Swab (n, %)	18 (46.2)	15 (46.9)	38 (51.4)	40 (50.6)	0.939
Topical Solution in Nares if MRSA Swab is Positive (n, %)	18 (46.2)	15 (46.9)	44 (59.5)	41 (52.6)	0.531
Perioperative Antibiotic Prophylaxis - No Penicillin Allergy (n, %)					0.274
Cefazolin	37 (94.9)	28 (87.5)	67 (90.5)	67 (84.8)	
Vancomycin	0 (0.0)	0 (0.0)	5 (6.8)	4 (5.1)	
Clindamycin	0 (0.0)	0 (0.0)	0 (0.0)	2 (2.5)	
Ceftriaxone and Vancomycin	1 (2.6)	1 (3.1)	1 (1.4)	3 (3.8)	
Cefazolin and Clindamycin	0 (0.0)	1 (3.1)	0 (0.0)	1 (1.3)	
Cefazolin and Vancomycin	1 (2.6)	2 (6.2)	1 (1.4)	0 (0.0)	
Other	0 (0.0)	0 (0.0)	0 (0.0)	2 (2.5)	
Perioperative Antibiotic Prophylaxis - Anaphylactic Penicillin Allergy (n, %)					0.464
Cefazolin	10 (25.6)	4 (12.5)	18 (24.3)	10 (12.7)	
Vancomycin	19 (48.7)	19 (59.4)	40 (54.1)	49 (62.0)	
Clindamycin	9 (23.1)	6 (18.8)	13 (17.6)	15 (19.0)	
Ceftriaxone and Vancomycin	0 (0.0)	1 (3.1)	0 (0.0)	0 (0.0)	
Clindamycin and Vancomycin	0 (0.0)	1 (3.1)	2 (2.7)	2 (2.5)	
Aztreonam and Vancomycin	1 (2.6)	1 (3.1)	0 (0.0)	0 (0.0)	
Other	0 (0.0)	0 (0.0)	1 (1.4)	2 (2.5)	
None	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.3)	
Perioperative Antibiotic Prophylaxis - Non-Anaphylactic Penicillin Allergy (n, %)					0.26
Cefazolin					
Vancomycin	34 (87.2)	27 (84.4)	63 (85.1)	57 (72.2)	
Clindamycin	1 (2.6)	1 (3.1)	7 (9.5)	11 (13.9)	
Cefazolin and Vancomycin	2 (5.1)	1 (3.1)	2 (2.7)	5 (6.3)	
Ceftriaxone and Vancomycin	1 (2.6)	2 (6.2)	0 (0.0)	0 (0.0)	
Other	1 (2.6)	1 (3.1)	1 (1.4)	3 (3.8)	
None	0 (0.0)	0 (0.0)	0 (0.0)	2 (2.5)	
	0 (0.0)	0 (0.0)	1 (1.4)	1 (1.3)	
Postoperative Antibiotic Duration (n, %)					0.073
< 24 hours	24 (61.5)	22 (68.8)	44 (59.5)	37 (46.8)	
> 24 hours	6 (15.4)	2 (6.2)	11 (14.9)	24 (30.4)	

None	9 (23.1)	8 (25.0)	19 (25.7)	18 (22.8)	
Postoperative Antibiotic Choice (n, %)					0.458
IV Cefazolin	29 (74.4)	20 (62.5)	43 (58.1)	41 (51.9)	
IV Vancomycin	0 (0.0)	0 (0.0)	3 (4.1)	3 (3.8)	
IV Clindamycin	0 (0.0)	0 (0.0)	0 (0.0)	2 (2.5)	
IV Ceftriaxone	0 (0.0)	0 (0.0)	0 (0.0)	2 (2.5)	
PO antibiotics	2 (5.1)	3 (9.4)	8 (10.8)	11 (13.9)	
None	8 (20.5)	9 (28.1)	20 (27.0)	20 (25.3)	
Oral Antibiotic Type if Given (n, %)					0.305
Cefadroxil	0 (0.0)	0 (0.0)	0 (0.0)	2 (20.0)	
Doxycycline	1 (50.0)	0 (0.0)	5 (83.3)	7 (70.0)	
Cephalexin	1 (50.0)	1 (100.0)	1 (16.7)	1 (10.0)	
Positive-Pressure Surgical Helmet (n, %)	24 (61.5)	14 (43.8)	29 (39.2)	37 (46.8)	0.155
Iodine-impregnated Adhesive Drape (n, %)	35 (89.7)	27 (84.4)	65 (87.8)	61 (77.2)	0.216
Change Knife Blade After Incision (n, %)	28 (71.8)	27 (84.4)	60 (81.1)	65 (82.3)	0.503
Switch to Electrocautery After Incision (n, %)	38 (97.4)	27 (84.4)	62 (83.8)	50 (64.1)	**<0.001**
Antibiotic-loaded Cement (n, %)	12 (30.8)	13 (40.6)	39 (52.7)	39 (49.4)	0.126
Intraoperative Irrigation Type (n, %)					
Sterile Saline	30 (76.9)	24 (75.0)	48 (64.9)	52 (65.8)	0.452
Antibiotic-Infused Sterile Saline	3 (7.7)	5 (15.6)	11 (14.9)	14 (17.7)	0.547
Sterile Dilute Povidone Iodine	11 (28.2)	7 (21.9)	22 (29.7)	21 (26.6)	0.866
Hydrogen Peroxide	8 (20.5)	5 (15.6)	7 (9.5)	5 (6.3)	0.104
CHG-Based Solution	3 (7.7)	6 (18.8)	20 (27.0)	16 (20.3)	0.112
Citric Acid-Based Solution	1 (2.6)	0 (0.0)	1 (1.4)	0 (0.0)	0.492
Other	1 (2.6)	0 (0.0)	1 (1.4)	0 (0.0)	0.492
Topical Vancomycin Powder (n, %)	35 (89.7)	26 (81.2)	36 (48.6)	40 (50.6)	**<0.001**
Topical Surgical Glue (n, %)	23 (59.0)	22 (68.8)	31 (41.9)	27 (34.2)	**0.003**
Silver Impregnated Bandage (n, %)	23 (59.0)	15 (46.9)	22 (29.7)	21 (26.6)	**0.002**
HbA1c Cutoff Used (n, %)	38 (97.4)	26 (81.2)	58 (78.4)	51 (64.6)	**0.001**
HbA1C Cutoff Value (mean, SD)	7.94 (0.38)	8.06 (0.64)	7.83 (0.46)	7.69 (0.73)	**0.037**
HbA1C Cutoff Value Range (n, %)					**0.027**
< 7.0	0 (0.0)	0 (0.0)	1 (1.7)	2 (4.2)	
7.0 - 7.4	2 (5.3)	1 (3.8)	4 (6.9)	12 (25.0)	
7.5 - 7.9	8 (21.1)	4 (15.4)	18 (31.0)	10 (20.8)	
8.0 - 8.4	25 (65.8)	18 (69.2)	29 (50.0)	19 (39.6)	
8.5 - 8.9	1 (2.6)	1 (3.8)	4 (6.9)	1 (2.1)	
9.0 - 9.4	2 (5.3)	0 (0.0)	2 (3.4)	3 (6.2)	
≥ 9.5	0 (0.0)	2 (7.7)	0 (0.0)	1 (2.1)	
BMI Cutoff Used (n, %)	13 (33.3)	7 (21.9)	18 (24.3)	17 (21.5)	0.544
BMI Cutoff Value (mean, SD)	41.00 (3.81)	42.50 (4.33)	43.18 (5.88)	40.85 (4.86)	0.494
BMI Cutoff Value Range (n, %)					0.76
< 35	1 (7.7)	0 (0.0)	0 (0.0)	1 (5.9)	
35 - 39	1 (7.7)	1 (14.3)	1 (5.9)	2 (11.8)	
40 - 44	8 (61.5)	3 (42.9)	12 (70.6)	10 (58.8)	
45 - 49	2 (15.4)	2 (28.6)	0 (0.0)	2 (11.8)	
≥ 50	1 (7.7)	1 (14.3)	4 (23.5)	2 (11.8)	
Perform Surgery < 3 Months from Prior Corticosteroid Injection (n, %)	2 (5.1)	5 (15.6)	11 (14.9)	13 (16.5)	0.379

CHG: Chlorhexidine Gluconate, MRSA: Methicillin-resistant Staphylococcus aureus, IV: Intravenous, PO: Oral, HbA1c: Hemoglobin A1c, SD: Standard Deviation, BMI: Body Mass Index.

Table 2: Binary Logistic Regression Assessing Association Between Years in Practice and Infection Prevention Strategies

	Odds Ratio (95% Confidence Interval)*	***P Value***
Hydrogen Peroxide Cleansing Solution		
5-10 years	0.336 (0.124 - 0.872)	**0.027**
10-20 years	0.531 (0.235 - 1.166)	0.119
> 20 years	0.230 (0.100 - 0.512)	**<0.001**
Alcohol Cleansing Solution		
5-10 years	0.268 (0.099 - 0.769)	**0.016**
10-20 years	0.492 (0.222 - 1.078)	0.078
> 20 years	0.291 (0.128 - 0.647)	**0.003**
Electrocautery Use		
5-10 years	0.142 (0.007 - 0.946)	0.083
10-20 years	0.136 (0.007 - 0.732)	0.060
> 20 years	0.047 (0.003 - 0.236)	**0.003**
Topical Vancomycin Powder Use		
5-10 years	0.495 (0.116 - 1.909)	0.312
10-20 years	0.108 (0.030 - 0.304)	**<0.001**
> 20 years	0.117 (0.003 - 0.327)	**<0.001**
Topical Surgical Glue Use		
5-10 years	1.530 (0.578 - 4.181)	0.396
10-20 years	0.502 (0.225 - 1.095)	0.086
> 20 years	0.361 (0.162 - 0.789)	**0.011**
Silver Impregnated Bandage Use		
5-10 years	0.614 (0.236 - 1.570)	0.310
10-20 years	0.294 (0.129 - 0.654)	**0.003**
> 20 years	0.252 (0.110 - 0.560)	**0.001**
Has HbA1c Cutoff		
5-10 years	0.114 (0.006 - 0.721)	0.050
10-20 years	0.095 (0.005 - 0.498)	**0.025**
> 20 years	0.048 (0.003 - 0.240)	**0.003**
*HbA1c Cutoff *****		
5-10 years	0.121 (0.143)	0.400
10-20 years	-0.111 (0.117)	0.346
> 20 years	-0.251(0.122)	**0.041**

HbA1c: Hemoglobin A1c
* <5 Years of Experience set as reference group
** Linear Regression was performed for continuous variable as presented as estimate (standard error) format