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Attitudes Toward Perioperative Antibiotic Prophylaxis in Primary Hip and Knee Arthroplasty and Hip Hemiarthroplasty: A Survey of Egyptian Joint Replacement Surgeons—Is It Time for Developing National Guidelines?

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Abstract

Background: Periprosthetic joint infection is a severe complication after hip and knee arthroplasty, and using perioperative antibiotic prophylaxis (PABP) per guidelines and recommendations is one step in its prevention. The current study aimed to evaluate the attitude of Egyptian joint replacement surgeons toward PABP, their adherence to guidelines, and their insight into developing national guidelines. **Methods:** We conducted an online cross-sectional questionnaire study comprising three sections to collect information on various aspects of PABP and to gather insights into the development of national guidelines among members of the Egyptian Pelvis, Hip, and Knee Society (EPHAKS). The questionnaire targeted active practicing hip or knee replacement surgeons and was first sent by email to all members two weeks before the eighth EPHAKS annual conference. A reminder was announced during the conference, and subsequent email reminders were sent one week apart after the conference. The study was registered in clinicaltrials.gov (NCT06451224). **Results:** Out of 469 EPHAKS members, and among the 434 successfully delivered email invitations, 105 responded, giving a response rate of 24.2%. All were males, with a mean age of 42.98 $\pm$ 10.12 years; a total of 70.5% were consultants, and 13.3% performed more than 100 procedures annually. Most participants reported not following national or international guidelines, with response percentages of 80.9% and 62.9%, respectively. Consultants and surgeons performing more than 50 procedures annually showed significantly higher adherence to guidelines than others, with *p*-values of 0.046 and 0.004, respectively. Adherence to national or international guidelines for prescribing first- or second-generation cephalosporins was reported by 65.7% (preoperatively) and 59% (postoperatively). Only 9.5% reported prescribing antibiotics for the first 24 h postoperatively. Overall, 80% agreed that Egyptian patients are different and that PABP international guidelines do not suit them, and 98.1% agreed that developing national Egyptian PJI prevention guidelines is necessary owing to deficiencies and the broad applicability of the current national guidelines. **Conclusions:** Egyptian joint replacement surgeons rarely adhere to national or international guidelines for PABP, with higher adherence noticed among more experienced surgeons. The majority agreed that our patients are different and that international guidelines might not suit them, and nearly all participants expressed a strong desire to develop national guidelines.

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Keywords: total hip arthroplasty; total knee arthroplasty; hip hemiarthroplasty; periprosthetic joint infection; perioperative antibiotic prophylaxis

1. Introduction

Periprosthetic joint infection (PJI) after total joint arthroplasty (TJA) is a devastating complication with 5-year mortality rates reaching up to 26%, which is even worse than some malignancies [1,2]. Furthermore, it contributes significantly to failures and indications for revision, specifically after total hip and knee arthroplasties (THA and TKA) [3,4], further increasing their economic burden [5–7]. Moreover, hip hemiarthroplasty (HHA) for treating neck of femur fracture has about a 1.3% superficial surgical site infection (SSI) rate and even higher deep PJI reaching up to 3.5%, and the one-year mortality rate in patients who had PJI reached up to 40% compared to 27% for those who did not experience PJI [8,9].

Various variables related to the patients (including male gender, high BMI, and associated comorbidities), surgeon (such as experience and volume), surgical environment (air flow situations and traffic inside the operative theater), and healthcare system (insurance coverage or privately funded) have been identified as risk factors for PJI development; some are modifiable, while others are not [3,10,11].

Guidelines and recommendations addressing all possible aspects and risk factors related to PJI, aiming to prevent and treat it, were developed by various orthopedic associations and societies, and through expert consensus meetings [4,12–19]. Furthermore, perioperative antibiotic prophylaxis (PABP) is crucial in preventing PJI. Still, less compliance with guidelines and injudicious usage could lead to increased PJI incidence, the emergence of resistant bacterial strains, and the possibility of superadded infection [18,20,21]. However, the adherence to international guidelines and their suitability for all populations were questioned by authors from various countries [22–26], which was partially attributed to overcrowding in health facilities, financial restraints, fear of litigation, the culture of blame, the practice of defensive medicine, insufficient education regarding proper antibiotic prescribing and dosing, and, in most instances, to ignorance or inadequate adherence to these guidelines [27].

Apart from the countries where most guidelines originated, authors from other countries have sought ideas on various aspects of PJI prevention (including PABP) and management [23,25,28,29]; however, this is lacking in our area. Therefore, the current study aimed to evaluate the attitudes (practices) of Egyptian joint replacement surgeons toward perioperative antibiotic prophylaxis, their adherence to guidelines, and their insight into developing national guidelines for total hip, total knee arthroplasty, as well as hip hemiarthroplasty procedures.

2. Methods

This cross-sectional online questionnaire-based study was conducted after obtaining Institutional Review Board and ethics committee approval (April 2024, IRB No.: 04-2024-300439) and was registered on clinicaltrials.gov (NCT06451224, registration date: 23 May 2024, https://clinicaltrials.gov/study/NCT06451224). We followed all ethical considerations outlined in the Helsinki Declarations.

The questionnaire was designed to be anonymous (no personal details were required) to maintain data confidentiality and improve participation. The target participants were active members of the Egyptian Pelvis, Hip, and Knee Society (EPHAKS) registered in the society's 2024 membership directory (this data was obtained by contacting the EPHAKS president and secretary). We included surgeons who routinely perform hip or knee replacement surgeries

independently (including HHA), whether they work in governmental or/and private sectors, and excluded surgeons in training (residents and fellows who are not allowed to work independently) and members who are not joint replacement surgeons such as surgeons who exclusively perform trauma surgery (the first question in the questionnaire was designed for this purpose). Participation was voluntary, with no consequences for abstention.

A web-based questionnaire was developed using Google Forms (Google LLC, Mountain View, CA, USA), a free application for non-commercial use. The questionnaire consisted of 27 individual questions, provided in three sections:

Section I: Surgeons (demographic data such as age and gender) and their practice details (such as their position, type of practice, number of cases performed annually, working place, etc.).

Section II: Participants' practice regarding antibiotic prophylaxis prescription for joint replacement surgeries (this section was partially formulated based on the recommendations from the American Association of Hip and Knee Surgeons (AAHKS) [15,19], the 2018 second International Consensus Meeting on Musculoskeletal Infection (Proceedings of International Consensus on Orthopedic Infections) [12,30,31], and the American Academy of Orthopaedic Surgeons (AAOS) guidelines [15,32,33]). In this section, details regarding PABP prescriptions for primary total hip and knee arthroplasty were questioned, including the type of antibiotics, dosing, timing, route of administration, reasons for modifications, and whether the surgeons followed any specific guidelines.

Section III: Participants' antibiotic prescribing process (regarding adherence to or following specific guidelines, including the international guidelines (such as AAOS, AAHKS, NICE [16], or CDC [13]) and the national guidelines provided by the Egyptian Drug Authority [34]) and their oversight for developing or utilizing national or local policies. This section focuses on defining surgeons' preferred guidelines for antibiotic prophylaxis and on their insight into the need to develop national or regional guidelines tailored to our population-specific characteristics. (The complete questionnaire is provided in Supplementary File S1).

One crucial issue worth noting is that although there are no particular guidelines for PABP related to HHA, and some authors reported that patients with HHA differ in being frail and having multiple medical comorbidities, making them more susceptible to PJI, still, they supported using PABP guidelines applied to elective THA for patients having HHA [35–37].

After completing the preliminary questionnaire draft, it was distributed among surgeons at different experience levels in our department (five consultants, three fellows, and two residents) to assess the comprehensibility of the questions, ensure a smooth questionnaire flow, and estimate the expected completion time. Based on their feedback, polishing and minor adjustments were made, primarily to expand uncommon abbreviations and clarify some ambiguous questions.

Two weeks before the eighth EPHAKS conference (held on 29 May 2024), an email with a link to the online questionnaire, a complete description of the study purpose, information on data confidentiality, and the corresponding investigators to contact if needed was sent using the EPHAKS email directory. A QR code directing to the questionnaire homepage was generated and displayed during the conference sessions. Lastly, two follow-up reminder emails were sent after the conference (one week apart).

The first question determined whether the participant was eligible to participate, and the following 26 questions were mandatory to proceed; some had branching options (subquestions), and the final submission could only be performed if the participant completed the whole questionnaire.

The collected data were exported as a Microsoft Excel spreadsheet (Microsoft Corp., Redmond, WA, USA). All the responses were scanned for their completeness and appropriateness for inclusion in the final data analysis.

Statistical analysis: Data analysis was performed using SPSS version 26. Categorical data were presented as frequencies and percentages. Numerical data were checked for normality using the Shapiro–Wilk test and presented as mean ± standard deviation (SD) or median and range, depending on their distribution. The chi-square/Fisher Exact tests were used to compare proportions between groups to identify associations between position, years of experience, workplace, and the number of cases operated annually, with antibiotic prescription characteristics, and following guideline patterns. The level of significance was set at $p < 0.05$.

3. Results

Out of 469 EPHAKS members, emails could not be delivered to 35, and among the 434 successfully delivered email invitations, 105 responded (a response rate of 24.2%). All participants were males, with a mean age of 42.98 ± 10.12 years; a total of 70.5% were consultants, and 13.3% performed more than 100 procedures annually. The full details of the participants' demographics are shown in Table 1.

Table 1. Characteristics of participants and their practice details (total No. = 105).

Age * (Years)		**42.98 ± 10.12 (29–80)**
Years of experience † (years)		15.0 (1.5–55)
Current position ‡	Resident doctor	5 (4.8)
	Specialist	26 (24.8)
	Consultant	74 (70.5)
Working site of practice ‡	University Hospital	66 (62.9)
	Governmental Hospital	24 (22.9)
	Private practice/health insurance	15 (14.3)
Number of hospital inpatient beds ‡	Less than 50	19 (18.1)
	50–500	62 (59.0)
	501–1000	15 (14.3)
	Unsure	9 (8.6)
Regularly performed surgery ‡	Total hip arthroplasty	82 (78.1)
	Total knee arthroplasty	73 (69.5)
	Hip hemiarthroplasty	85 (81.0)
Most practice for total hip or hip hemiarthroplasty ‡	Cementless	64 (61.0)
	Cemented	67 (63.8)
	Hybrid	15 (14.3)
	Reverse hybrid	3 (2.9)
Number of surgeries performed annually ‡	Less than 10	16 (15.2)
	10–50	38 (36.2)
	50–100	37 (35.2)
	>100	14 (13.3)
The presence of an antimicrobial supervising or consulting team ‡	Yes	52 (49.5)
	No	34 (32.4)
	Unsure	19 (18.1)
Presence hospital/Department local guidelines for antimicrobial prescription ‡	Yes	47 (44.8)
	No	44 (41.9)
	Unsure	14 (13.3)

Table 1. *Cont.*

Age * (Years)		**42.98 ± 10.12 (29–80)**
Does the hospital/Department follow any international guidelines ‡	Yes	19 (18.1)
	No	60 (57.1)
	Unsure	26 (24.8)

* Data presented as Mean ± SD (range). † Data presented as median (range). ‡ Data presented as Numbers (percentage).

First- or second-generation cephalosporins were the most commonly prescribed antibiotics pre-operatively and postoperatively by 81% and 73.3% of the participants, respectively. However, either of these antibiotics was routinely prescribed (for patients reporting no Penicillin allergy), which is adherent to national and international guideline recommendations, by only 65.7% and 59% of the participants, pre- and postoperatively, respectively. Most participants (85.7%) reported selecting the type of antibiotics themselves. Only 9.5% reported prescribing antibiotics for the first 24 h postoperatively, while the majority (80%) prescribed antibiotics for a week or more.

Most participants reported not following local, national, or international guidelines (answered 'no' or 'unsure'), with combined incidences of 69.5%, 80.9%, and 62.9%, respectively. Consultants and surgeons performing more than 50 procedures annually showed significantly higher adherence to guidelines than other participants, with p values of 0.046 and 0.004, respectively. Further details related to antibiotic prescription patterns and attitudes are reported in Tables 2 and 3.

No formal training in antibiotic prescription was received by 80% of the participants, and 84.4% showed their desire to receive such training. A total of 86.6% reported confidently selecting the proper antibiotic. An infectious disease specialist consultation was the most chosen as helpful personnel for appropriate antibiotic prescription (84.8%), followed by a consultation with senior surgeons (77.1%). In contrast, 58.1% reported that consulting the anesthesiologist is not helpful (Table 4).

Table 2. Participants' practice regarding perioperative antibiotic prophylaxis utilization (Total = 105, 100%).

Following Guidelines ‡		**Yes**	**No**	**Unsure**
Use of local (Hospital-specific) guidelines when prescribing antibiotics		32 (30.5)	61 (58.1)	12 (11.4)
Use of national (provided by the Ministry of Health) guidelines when prescribing antibiotics		20 (19.0)	67 (63.8)	18 (17.1)
Use of any international (AAHKS, AAOS, CDC, NICE) guidelines when prescribing antibiotics?		39 (37.1)	50 (47.6)	16 (15.3)
Regularly prescribe antibiotic prophylaxis for your patients ‡			Preoperative	Postoperative
			103 (98.1)	102 (97.1)
Most prescribed antibiotics ‡	First-generation cephalosporin		55 (52.4)	50 (47.6)
	Second-generation cephalosporin		30 (28.6)	27 (25.7)
	Third-generation cephalosporin		20 (19.1)	20 (19.1)
	Fourth-generation cephalosporin		6 (5.7)	7 (6.7)
	Penicillin		4 (3.8)	9 (8.6)
Antibiotics were prescribed following guidelines (1st- or 2nd-generation cephalosporin routinely) ‡	Yes		69 (65.7)	62 (59.0)
	No		36 (34.3)	43 (41.0)
Preoperative practice				
Time of antibiotic administration ‡	Immediately before skin incision		19 (18.1)	
	30 min before skin incision		64 (61.0)	
	One hour before the skin incision		22 (21.0)	

Table 2. *Cont.*

Following Guidelines ‡		Yes	No	Unsure
Who chooses the type of antibiotic? ‡	Surgeon himself			90 (85.7)
	Infection control personnel			10 (9.5)
	Anesthesiologist			5 (4.8)
Modification of the antibiotic prophylaxis protocol. †	If the patient is overweight			72 (68.6)
	If there is increased blood loss			53 (50.5)
	If the surgical time increased			99 (94.3)
	If the patient reported a penicillin allergy			77 (73.3)
	In the case of high-risk patients (Diabetics, Rheumatoid, SLE)			79 (75.2)
	√ change the antibiotic			48 (60.8)
	√ increase the dose			59 (74.7)
	√ Prolong the period of postoperative antibiotic use			60 (75.9)
Intraoperative practice				
Use a kind of antiseptic wash (such as diluted betadine) routinely †				75 (71.4)
Leave local antibiotics (such as Vancomycin powder) in the surgical wound routinely †				52 (49.5)
Postoperative practice				
Route of antibiotics administration ‡	Oral			37 (35.2)
	Parenteral			68 (64.8)
Number of used antibiotics ‡	Single			52 (49.5)
	Dual			53 (50.5)
Duration of antibiotics administration ‡	First 24 h only			10 (9.5)
	For one week			41 (39.0)
	During hospital stay			11 (10.5)
	For two weeks			36 (34.3)
	Till sutures removal			7 (6.7)

‡ Data presented as Numbers (percentage). † Data presented for "Yes" answer as Numbers (percentage).

Table 3. Univariate analysis of position, years of experience, working place, and the number of cases operated upon annually, with antibiotics prescription characteristics and following guidelines patterns.

		Position		Years of Experience		Working Place (Hospitals)		No. of Cases Annually	
		Residents/ Specialist (n = 31)	Consultant (n = 74)	≤10 (n = 27)	>10 (n = 78)	University (n = 66)	Gov./ Insurance/ Private (n = 39)	≤50 (n = 54)	>50 (n = 51)
Follow any international guidelines	yes	7 (22.6%)	32 (43.2%)	8 (29.6%)	31 (39.7%)	25 (37.9%)	14 (35.9%)	13 (24.1%)	26 (51.0%)
	No/unsure	24 (77.4%)	42 (56.8%)	19 (70.4%)	47 (60.3%)	41 (62.1%)	25 (64.1%)	41 (75.9%)	25 (49.0%)
p-Value *		0.046		0.349		0.839		0.004	
Use of local (Hospital-specific) guidelines	yes	13 (41.9%)	19 (25.7%)	12 (44.4%)	20 (25.6%)	17 (25.8%)	15 (38.5%)	19 (35.2%)	13 (25.5%)
	No/unsure	18 (58.1%)	55 (74.3%)	15 (55.6%)	58 (74.4%)	49 (74.2%)	24 (61.5%)	35 (64.8%)	38 (74.5%)
p-Value *		0.099		0.067		0.172		0.281	
Use of national (provided by the Ministry of Health) guidelines	yes	5 (16.1%)	15 (20.3%)	5 (18.5%)	15 (19.2%)	13 (19.7%)	7 (17.9%)	12 (22.2%)	8 (15.7%)
	No/unsure	26 (83.9%)	59 (79.7%)	22 (81.5%)	63 (80.8%)	53 (80.3%)	32 (82.1%)	42 (77.8%)	43 (84.3%)
p-Value *		0.622		0.935		0.826		0.394	
Preoperative antibiotics	1st- or 2nd-generation Cephalosporin	21 (67.7%)	48 (64.9%)	17 (63.0%)	52 (66.7%)	45 (68.2%)	24 (61.5%)	35 (64.8%)	34 (66.7%)
	Others	10 (32.3%)	26 (35.1%)	10 (37.0%)	26 (33.3%)	21 (31.8%)	15 (38.5%)	19 (35.2%)	17 (33.3%)
p-Value *		0.777		0.727		0.488		0.842	

Table 3. *Cont.*

		Position		Years of Experience		Working Place (Hospitals)		No. of Cases Annually	
		Residents/ Specialist (n = 31)	**Consultant (n = 74)**	**≤10 (n = 27)**	**>10 (n = 78)**	**University (n = 66)**	**Gov./ Insurance/ Private (n = 39)**	**≤50 (n = 54)**	**>50 (n = 51)**
Postoperative antibiotics	1st- or 2nd-generation Cephalosporin	18 (58.1%)	44 (59.5%)	14 (51.9%)	48 (61.5%)	42 (63.6%)	20 (51.3%)	33 (61.1%)	29 (56.9%)
	Others	13 (41.9%)	30 (40.5%)	13 (48.1%)	30 (38.5%)	24 (36.4%)	19 (48.7%)	21 (38.9%)	22 (43.1%)
p-Value *		0.895		0.378		0.214		0.658	
Number of used antibiotics	Single	16 (51.6%)	36 (48.6%)	13 (48.1%)	39 (50.0%)	37 (56.1%)	15 (38.5%)	26 (48.1%)	26 (51.0%)
	Dual	15 (48.4%)	38 (51.4%)	14 (51.9%)	39 (50.0%)	29 (43.9%)	24 (61.5%)	28 (51.9%)	25 (49.0%)
p-Value *		0.782		0.868		0.081		0.772	
Duration of use for antibiotics	First 24 h/during hospital stay	1 (3.2%)	9 (12.2%)	1 (3.7%)	9 (11.5%)	7 (10.6%)	3 (7.7%)	4 (7.4%)	6 (11.8%)
	Other	30 (96.8%)	65 (87.8%)	26 (96.3%)	69 (88.5%)	59 (89.4%)	36 (92.3%)	50 (92.6%)	45 (88.2%)
p-Value *		0.275		0.447		0.741		0.519	

* Chi-square/Fisher Exact test compares proportions between groups.

Table 4. Responses regarding following guidelines, receiving training, confidence, assistance during antibiotic prescription, and insight into developing national guidelines (Total = 105, 100%).

Receiving Training About Antibiotic Prescription ‡			
	Yes	No	Unsure
Ever received formal training in antibiotic prescribing	21 (20.0)	82 (78.1)	2 (1.9)
Would you like to receive more training in antibiotic prescribing in your hospital?	89 (84.8)	11 (10.5)	5 (4.8)
Surgeons' confidence in antibiotic prescription ‡			
	not confident	confident	very confident
Prescribing the appropriate antibiotic	14 (13.3%)	62 (59.0%)	29 (27.6%)
Selecting the correct dose and interval of administration	26 (24.8%)	51 (48.6%)	28 (26.7%)
Selecting the proper route	20 (19.0%)	51 (48.6%)	34 (32.4%)
Prescribing the duration of the antibiotic treatment	34 (32.4%)	46 (43.8%)	25 (23.8%)
Evaluation of the helpfulness of certain measures to improve antibiotic prescription ‡			
	Not helpful	Helpful	very helpful
Consult a senior surgeon.	24 (22.9%)	44 (41.9%)	37 (35.2%)
Consult an infectious disease specialist.	16 (15.2%)	32 (30.5%)	57 (54.3%)
Consult with a microbiologist.	28 (26.7%)	31 (29.5%)	46 (43.8%)
Consult with an anesthesiologist.	61 (58.1%)	30 (28.6%)	14 (13.3%)
Implementation of international guidelines	7 (6.7%)	49 (46.7%)	49 (46.7%)
Availability of locally developed guidelines	13 (12.4%)	30 (28.6%)	62 (59.0%)
Opinions regarding developing national guidelines ‡			
	strongly disagree	Disagree	Agree	strongly agree
Egyptian patients are different, and international guidelines do not apply to them	2 (1.9%)	19 (18.1%)	47 (44.8%)	37 (35.2%)
Locally developed (hospital-specific) guidelines for antibiotic treatment are more useful than national or international ones	3 (2.9%)	17 (16.2%)	40 (38.1%)	45 (42.9%)
Developing national Egyptian infection prevention guidelines is mandatory	0 (0%)	2 (1.9%)	25 (23.8%)	78 (74.3%)

‡ Data presented as Numbers (percentage).

Eighty percent of participants agreed that Egyptian patients are considered different and that international guidelines for PABP do not suit them; overall, 81% agreed that

local (hospital-specific) guidelines are more helpful; and 98.1% agreed on the necessity of developing national Egyptian PJI prevention guidelines (Table 4).

4. Discussion

The current study aimed primarily to assess the current status and attitudes of Egyptian joint replacement surgeons (representative of North African and Middle Eastern countries) toward aspects of PJI prevention, particularly the use of PABP. The crucial findings of the current study are that most included surgeons do not follow specific guidelines for PABP, with senior surgeons showing greater adherence than their younger colleagues. There is a significant lack of formal training in the updated aspects of PABP, with the majority of participants showing interest in attending such activities. Lastly, nearly all participants agreed that developing national guidelines for PABP is mandatory.

It is well documented that a step toward initiating international and national PJI prevention and management protocols, or developing risk calculation tools, is partially based on insights from joint replacement specialized societies and on the availability of complete databases and registries, which help identify potential risk factors and define management deficiencies [38,39]. We tried to achieve this goal by questioning members within an Egyptian specialized joint replacement society (EPHAKS) rather than including orthopedic surgeons from all subspecialties.

As mentioned earlier, this questionnaire was formulated based on the commonly used international guidelines (provided by AAHKS) [15,19], the second International Consensus Meeting on Musculoskeletal Infection (Proceedings of International Consensus on Orthopedic Infections) [12,30,31]). The main reason is that our national health authorities' guidelines lack detailed specifications for PABP in hip and knee replacement surgeries, hindering the proper formulation of the questionnaire based on the available data. Furthermore, what was reported was merely a replication of international guidelines, without further specification or adaptation to our patients; this deficiency was evident in the current study, with only 19% of participants reporting adherence to national guidelines.

When solid regulations or clear protocols and guidelines governing PABP are missing or unclear, as in our case, antibiotic selection and use are usually driven by individual surgeons (85.7% of participants reported so) or by their local hospital protocols (if present). Furthermore, clear guidelines, combined with an auditing committee for PABP, are crucial for enhancing patient safety, ensuring compliance, and providing updates on these guidelines [40]. A deficiency was evident in the current study, where 55.2% reported no, or at least no awareness of, hospital or departmental local guidelines for antimicrobial prescribing. Furthermore, only 18.1% reported that their hospital follows some sort of international guidelines for PABP.

We found discrepancies in adherence to PABP guidelines across various aspects, with 30.5% reporting adherence to their hospital-specific recommendations. In comparison, more participants (37.1%) followed some international guidelines, whereas consultants and surgeons who performed more surgeries annually followed international guidelines significantly higher than other participants (Table 3). Similar to our results, in a study from India by Santoshi et al., who surveyed 401 orthopedic and traumatology surgeons (13.45% were joint replacement surgeons), 97.3% of the participants reported routine pre-operative antibiotic prophylaxis (Pre-ABP) usage; they reported that leaning toward routinely prescribing penicillin or cephalosporin as PABP agents increased with advancing surgeons' experience [23]. The discrepancy described above is not limited to "developing" countries, as a study from the United Kingdom by Mabrouk et al., evaluating the PABP regimens during primary joint replacements across 109 hospitals and trusts, found limited

adherence (34.9%) to the second International Consensus Meeting on Musculoskeletal Infection recommendations [41].

4.1. Which Aspects and to What Extent Were PABP Guidelines Followed?

I: Regarding the type of antibiotics to be used for prophylaxis: International [12,33] as well as national [34] guidelines recommended using first- or second-generation cephalosporin as PABP in patients with no Penicillin allergy. A total of 65.7% and 59.0% of the participants reported routinely adhering to such recommendations pre- and postoperatively, respectively.

II: Regarding PABP modifications (dosing, timing, and repetition): Most of the participants agreed upon on the necessity of modifying the antibiotics dosing in specific circumstances (overweight, increased operative time, penicillin allergy and as detailed in Table 2) which is adherent to guidelines recommendations which suggested weight-adjusted antibiotic doses and increasing the dosing in certain circumstances, such as increased intraoperative blood loss or increased operative time, which was supported by the international guidelines [12,15,42]; however, the national guidelines did not discuss issues related to dosing except for changing antibiotics (to Clindamycin) if patients are allergic to penicillin (which is another deficiency point in our national guidelines) [34]. However, two responses should have been investigated thoroughly, as they contradict international guidelines: the first is that a minority (26.7%) of participants would not change their antibiotics if the patient reported a penicillin allergy, and the second is that about half of participants would modify their antibiotic prescription if there were increased blood loss.

III: Timing of Pre-ABP: The majority of participants reported giving antibiotics 30 min before incision, which adheres to international guidelines [15,43]. Unless Vancomycin is being administered, which should be given at least one to two hours before skin incision, this could be the reason that some participants (21%) have reported giving Pre-ABP earlier. In a study from Spain by Castel-Oñate et al., which aimed to evaluate adherence of orthopedic surgeons to international guidelines for surgical site infection (SSI) prevention during elective orthopedic procedures, 138 surgeons participated. The majority of participants reported routinely using antibiotic prophylaxis pre-operatively, 30 min before incision [22]. Meanwhile, Santoshi et al. reported that >90% of the respondents gave antibiotics within one hour before skin incision [23].

IV: Regarding intraoperative measures: A total of 71.4% reported using some antiseptic wash intraoperatively, such as diluted betadine, which adheres to the strong recommendation toward using diluted betadine from the second International Consensus Meeting on Musculoskeletal Infection [30]. Furthermore, clinical practice guidelines reported by the World Health Organization (WHO) and CDC recommend using aqueous povidone-iodine solution as a prophylactic antiseptic wound irrigation [13,44]. In a recent systematic review by Ebrahimzadeh et al., the authors evaluated 63,950 patients across 13 articles; they concluded that intraoperative use of diluted betadine reduced the risk of PJI compared with saline (OR: 0.44; CI 95%: 0.34–0.56) [45].

V: Regarding postoperative antibiotic prophylaxis (Post-ABP): Nearly half of the participants are leaning toward prescribing dual antibiotics; however, the evidence regarding such practice is conflicting [15], as some authors suggested no added benefit with no further reduction in PJI incidence [46]; in contrast, some authors suggested the opposite [47]. Our results align with those reported by Santoshi et al., who found that 50.9% of Indian surgeons preferred dual antibiotics in cases where implants were used [23].

VI: For how long Post-ABP should be continued: As per international guidelines, Post-ABP administered for 24 h is appropriate [12,15,48]; however, in the current study, as few as a tenth of the participants adopted this strategy, which raises some concerns related to the development of antimicrobial resistance owing to their prolonged use, especially in

our community [49]. A study by Badge et al. included 1838 patients; they reported no difference in PJI risk when Post-ABP was administered for 24 h or more, and concluded that continuing Post-ABP beyond 24 h is unnecessary [50]. In a study by Parsons et al. reporting on the PABP practice among 42 arthroplasty societies, 17 only reported having guidelines, eight out of ten guidelines reported the length of Post-ABP, and recommended no more than 24 h [14].

Furthermore, an alarming finding is that a fair number of participants (41%) still believe that antibiotics should be continued for at least 2 weeks or until suture removal, which could be explained or influenced by participants' responses regarding PABP modifications, in which 75.9% reported prolonging the Post-ABP period in certain circumstances. Although such prolonged antibiotic administration practice could be supported by the findings of a study by Lipson et al., which showed that extended Post-ABP for PJI high-risk patients decreases PJI incidence and is cost-effective, it is worth noting that the authors defined an extended period as 7 days rather than 2 weeks [51]. Santoshi et al. reported that 40.4% of the participants continued antibiotics for only one day postoperatively (however, the details regarding arthroplasty procedures were not provided); furthermore, they reported that a few respondents preferred to continue Post-ABP for up to two weeks [23].

4.2. Do We Need National or Regional Guidelines?

Differences between races regarding perioperative complications have been demonstrated across various surgical specialties, including neurosurgery [47] and congenital heart surgery [52]. Furthermore, this disparity was proven true in patients undergoing TJA [53–55]. However, it is worth noting that some authors attributed the race disparity effect on joint replacement surgery results to the discrepancies in socioeconomic status, not merely an issue of race [56]. In a study by Johnson et al., the authors reported that race affects the incidence of post-operative complications and the LOS after THA, where blacks had more complications compared to non-Hispanic white patients [53]. The same results were later confirmed in a systematic review by Rudisill et al., which included 63 articles; the authors concluded that minorities have worse outcomes (more complications and readmissions) and lower rates of TJA utilization [57].

Considering the above facts, we believe the current study participants' thoughts are genuine regarding our patients being different (80% agreed), which could limit the complete application of international guidelines, and that developing national guidelines is mandatory (98.1% suggested so). In the context of developing national guidelines, it is worth noting that Parsons et al. concluded that there was significant diversity in PABP practice across societies. They attributed this diversity to differences in bacterial strains and resistance development, which vary across geographical regions and even between procedures (THA vs. TKA) [14].

The current study has some strengths. To the best of our knowledge, this is the first study to evaluate PABP practice among joint replacement surgeons from North Africa and the Middle East, where population characteristics and surgical practice are expected to be similar. However, we admit that it has some limitations. In a study by Parsons et al., apart from the Iranian Orthopaedic Association (IOA), no further societies or associations from the Middle East or North Africa were included; furthermore, the IOA reported no guidelines for PABP [14].

The current study has some significant limitations, first is that it only focused on one issue, which is the PABP practice (to keep the questionnaire as short and concise as possible to improve the responses), while PJI prevention entails various aspects such as general measures, including patient comorbidities optimization, operative environment

precautions, surgical wound care, surgical techniques, and so on, which were tested in other studies [22,23].

Second, we should have included questions about the incidence of PJI because we believed the answers could be unreliable, especially in the absence of a national joint arthroplasty registry. Furthermore, the study evaluated self-reported prescribing attitudes and practices but did not collect actual PJI incidence, microbiological culture results, or antimicrobial-resistance data; therefore, the relationship between reported prophylaxis practices and clinical infection outcomes could not be assessed.

The third relates to the participants' characteristics: their relatively small number and the fact that they are only male surgeons from different institutions could affect the generalizability of the results; however, this is offset by the fact that all participants are considered specialized joint replacement surgeons.

Fourth was related to not asking about the specific reasons leading participant to think that Egyptian patients are different and international guidelines does not apply to them; however, this questions was partially answered in some previous studies from Egypt, where the authors stated that the main reason was the antibiotic misuse and overuse which have led to a high prevalence of multidrug-resistant (MDR) bacteria among the population with the emergence of distinct local bacterial profiles, whereas international guidelines are based on lower resistance patterns, which led finally to the idea that adherence to international guidelines in Egypt can result in sub-optimal infection control [49].

Fifth, although participants were asked whether they regularly performed HHA as part of their practice profile, the questionnaire items addressing PABP considered HHA as a part of primary hip arthroplasty. HHA was therefore reported descriptively only and was not analyzed as a separate subgroup. However, we acknowledge that, owing to its different indications, patient profile, and infection-risk pathway compared with elective primary THA and TKA, a further subgroup analysis might have yielded different results. In this regard, it should be noted that although HHA patients are considered more susceptible to PJI, some authors agreed that the same guidelines for PABP applied in primary THA also apply to HHA, given that about 50% of HHA PJI are caused by Gram-positive organisms [35,36]. Furthermore, Amzallag et al. examined whether adding a single dose of gentamicin to the usual PABP in HHA, which consisted of three doses of cefazolin (to be increased if overweight), one dose to be administered one hour preoperatively, and the other two doses given within the first 24 h postoperatively (which is the same protocol for elective primary THA). They evaluated 1521 HHAs; overall, 22.1% received gentamicin in addition to the usual PABP, and 77.9% received the usual PABP alone. They found no significant difference between groups regarding the incidence of PJI or the rate of Gram-negative PJI, and concluded that changing the usual PABP for HHA procedures by adding antibiotics against Gram-negative bacteria is of no value [35].

Sixth, the relatively low response rate (24.2%) may have introduced non-response bias, as surgeons with a particular interest in infection prevention or antibiotic stewardship may have been more likely to participate.

Last, the economic constraints on the full adoption of international guidelines were not evaluated.

Based on the results and comments we received, the following recommendations should be considered. First, cooperation between the Ministry of Health, individual hospitals, and TJA surgeons to develop national guidelines for PJI based on internationally available guidelines, with modifications to accommodate our economic circumstances and patients' characteristics, is mandatory. Second, a musculoskeletal infection management society, or even a specialized working group on PJI within EPHAKS, would be beneficial for diagnosing, tracking, and providing guidance on PJI prevention and management. Third,

continuous, up-to-date training on antibiotic prescribing should be provided, given that 80% of participants reported a lack of such training. The efficacy of attending an updated training course was confirmed by a group of Egyptian researchers who evaluated improvements in antibiotic prescribing among 50 medical students after they attended a course titled "antibiotic prescribing etiquette". The authors reported significant improvements in participants' total knowledge and attitudes toward antibiotic resistance, and in their perceptions of optimal antibiotic prescription, dosing, and duration, with a total educational activity effect size ranging from −0.7 to −0.8, indicating a medium-to-large effect. The authors recommended that such courses, if implemented on a broader scale, might have the same effect on knowledge improvement [58]. Third, establishing a national joint arthroplasty registry to track surgeons' and patients' behaviors and outcomes is mandatory [38,39]. Last, this point is mainly related to improving clinical practice and is mainly related to situations where PJI develops despite recent PABP, especially in immunocompromised or otherwise high-risk patients who received prolonged postoperative antibiotic courses (as agreed by 75.9% of the participants); the possibility of resistance enrichment related to the prophylactic regimen should be considered. In such cases, therapeutic management should be guided by early microbiological sampling and antimicrobial stewardship principles. Multiple deep-tissue samples, synovial-fluid cultures, and sonication cultures, when feasible, should be obtained before initiating therapeutic antibiotics. Empirical treatment should not simply replicate the prophylactic agent and should be broadened according to the patient's risk profile and local resistance patterns. Furthermore, early infectious disease consultation is strongly encouraged, followed by prompt de-escalation to culture-directed therapy within 48–72 h whenever microbiological results become available. Finally, breakthrough PJI cases should be systematically tracked to inform future institutional and national prophylaxis protocols and guidelines.

5. Conclusions

Egyptian joint replacement surgeons partially adhere to the national or international guidelines for perioperative antibiotic prophylaxis. Surgeons who are more experienced and perform more surgeries adhere to international guidelines more than others. Most participants agreed that our patients are different and that international guidelines might not be suitable for them. Further studies evaluating aspects we may have missed in the current study are necessary, and a call to develop national guidelines is warranted.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/surgeries7020069/s1, File S1: The complete questionnaire used to obtain responses from the participants.

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Informed Consent Statement: Informed consent was obtained from all participants involved in the current study, ensuring that their identity and personal data will be kept anonymous.

Data Availability Statement: Data associated with this study is provided within the manuscript; the raw data could be provided on a written request to the corresponding author.

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