



Predictors of the response of operating room personnel to surgeon behaviors

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Abstract

Purpose Several studies have assessed the physician–nurse relationship, particularly between females working together. While the surgeon workforce is increasingly represented by females, gendered relationships and biases in the operating room remain largely unstudied.

Methods We performed a prospective randomized study in which operative support staff, including nurses, surgical technologists, and surgical assistants, assessed scenarios describing questionable surgeon behaviors. Respondents were randomized to a survey that either discussed a female or male surgeon. For each scenario, one of the four standardized responses was selected. The respondents' assessments of surgeon behaviors were analyzed.

Results The response rate was 4.4% (3128/71143). Females were more likely than males to deem the surgeon's behavior inappropriate regardless of surgeon sex ($p=0.001$). The likelihood of writing up the surgeon was predicted by role, with technologists, nurses, and assistants reporting surgeons at frequencies of 65.5%, 53.2%, and 48.8%, respectively ($p=0.008$). While the overall respondents did not show a propensity to write-up either sex differentially ($p=0.070$), technologists were significantly more likely to report female surgeons than male surgeons ($p=0.006$).

Conclusion Characteristics of operative personnel were correlated with varying tolerance of surgeon behaviors, with specific subgroups more critical of female surgeons than males. Further exploration of these perceptions will serve to improve interactions in a diverse workplace.

Keywords Gender bias · Sex bias · Surgeon behavior · Surgical team

Abbreviations

RN Registered nurse
OR Operating room
ST Surgical technologist
SA Surgical assistant

Introduction

Though the first medical school in the United States opened in 1765, it was not until 1849 that Elizabeth Blackwell, the first female American physician, graduated from medical

school [1]. Thereafter, in 1855, Dr. Mary Edwards Walker credited as the first US female surgeon, graduated and began her career in a field exclusively run by men [2]. Since that time, and particularly over the course of the last several decades, the face of medicine has progressed dramatically, and change has perhaps been most substantial in surgery and surgical subspecialties. While females accounted for less than 6% of the medical student population prior to 1970, they now make up approximately 50% of medical school applicants [3]. Furthermore, approximately one-fifth of academic general surgeons are women; this will likely continue to increase, as just over one-third of applicants to general surgery residency today are women [4, 5].

The physician–nurse relationship was once described as a dominant–subservient relationship consisting of a male–female interaction [6]. However, given the evolving status of medicine, there has been a growing interest in studying the relationships and interactions between nurses (a typically female-dominated occupation) with physicians (where the proportion of females is increasing). Multiple

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reports have demonstrated implicit sex-based biases in medicine. Several authors have largely attributed this to a mismatch between the expected behaviors of a female, as a gentle or subservient individual, competing with the dominant and powerful persona typically associated with physicians [6–9]. One recent investigation studied the language used in evaluations of obstetrics and gynecology residents by their nursing colleagues, finding that fewer positive and more negative competence-related comments were given for female residents, particularly junior residents in comparison with males [10]. Female physicians have reported being subject to differential treatment by nursing staff, receiving less assistance with a higher expectation for them to function independently; male physicians have likewise stated that they observe this difference as well [6, 9].

Surgery, a typically male-dominated field, is a unique microcosm of medicine, where extremes in biases appear to persist. Results provided by a survey conducted by the Association of Women Surgeons showed that over 90% of practicing surgeons have experienced sex-based discrimination at some point in their practice [11]. Another survey evaluated nurses' perceptions of surgeons who were described as being either male or female, as well as possessing traits which were either gender-normative or in conflict with these paradigms; their results suggested that nurses do not hold biases for or against either sex, but preferred surgeons described as supportive and nurturing over those who were direct and

assertive [7]. The interpretation of these findings, however, was limited, as respondents were not restricted to operating room (OR) nurses and the findings are reflective of the environment of a single institution.

Furthermore, while biases in the OR environment have not been widely characterized, little is known about the individuals who may hold such biases, including the personal characteristics that may dispose them to partiality. We, therefore, devised a prospective, randomized survey to first determine if sex-based implicit biases are present among OR ancillary staff, including registered nurses (RN), surgical technologists (ST), and surgical assistants (SA), from a variety of regions and hospital settings. We also wished to characterize the demographics and employment histories of respondents to determine predictors of bias.

Methods

Survey instrument development

A prospective randomized study was designed to evaluate the perceptions of OR personnel to surgeon behaviors. A survey (Table 1) was developed that described five scenarios typical to the OR setting. The scenarios were devised by a content expert (MBA) with experience across a variety of surgical fields. These scenarios included situations of rude

Table 1 Survey scenarios

Scenario	Title	Description
1	Impatience	Dr. SB is performing a major abdominal operation. In a matter of approximately 10 min, s/he asks for three instruments that were not part of the tray and which needed to be obtained from sterile supply. Dr. SB does not say please or thank you for any of these special requests. Dr. SB then asks for a suture, extending her/his hand without looking up from the field, and is inadvertently given the wrong suture. S/he then states, "This is not what I asked for. Give me a 3–0 vicryl!"
2	Late for case	Dr. SB is late to the hospital for a first-start case. Consequently, the operation is delayed by 15 min. The rest of the team, as well as the patient, were ready and waiting. Dr. SB apologizes to the team, explaining that s/he had to drop her/his children off at school. A similar situation had happened once before, approximately 1 year prior to the incident
3	Forgot Timeout	Dr. SB had scheduled a routine case, similar to many others s/he routinely performs. A few minutes after making the incision, a member of the team reminds Dr. SB that s/he has forgotten to do the timeout, which is required by hospital policy. S/he admits that s/he had forgotten and asks the team to overlook the policy, "just this time."
4	Swearing	The hospital has been excessively busy for several months, with prolonged waits to get into the clinic. To avoid having to turn any patients away, the surgeons have all been asked to increase their operative volume. Dr. SB came to the operating room straight from a meeting, where the surgeons had been informed of the push from administration. During the case, s/he talks about this issue to the team. At one point, s/he is heard to use expletives, saying, "This is @!&%^, I'm already pushed to the max. How can they expect me to do any \$%&^\$ more cases than I'm already doing!?"
5	Bleeding Patient and Shouting Surgeon	Dr. SB is in the middle of a complex, high-risk vascular procedure. S/he had encountered massive bleeding, and s/he had made a number of requests to help manage the situation. Dr. SB had asked for blood in the room, a different type of vascular clamp, more sutures, a second suction, and for the anesthesiologist to be called to assist the CRNA. After several minutes, the team has not yet fulfilled any of the requests, and the patient is continuing to bleed. Dr. SB shouts, "You' ve got to get these things in the room NOW, or else this patient is going to die!!!"

behavior, late arrival to the operating room, omitting the timeout, use of offensive language, and making demands with a patient in extremis. The scenarios were then reviewed and adjusted to improve the realistic nature with input from expert nursing personnel (NT). For each scenario, respondents were asked to choose how they would respond to the described behavior with the following options: (A) “the surgeon’s behavior was appropriate”; (B) “the surgeon’s behavior was inappropriate but I would let it go without further action”; (C) “the surgeon’s behavior was inappropriate and I would talk to the surgeon to address it”; and (D) “the surgeon’s behavior was inappropriate and I would report or write-up the surgeon to operating room management”.

Two versions of the survey were developed, which were identical in all respects, with one exception: one version referred to the surgeon as a female, using feminine pronouns throughout the descriptions of the actions, and the other version referred to the surgeon as a male, with corresponding masculine pronouns.

The survey experience was piloted among four OR personnel who provided additional feedback on the survey content and mechanism. Overall, this sample reported that the software, instructions, scenarios, and demographic questions touched upon a variety of routine occurrences and were representative of the OR experience. The survey was then distributed to respondents from participating associations via email.

Survey conduct

The survey was accompanied by an introduction that stated that the investigators were interested in determining the responses of OR personnel to various surgeon behaviors. Upon initiation of the survey, respondents were randomized to receive one of the two blocks of questions describing either a male surgeon or female surgeon for all scenarios. All other aspects of the survey were unchanged. Participants were randomized using a randomization software program built into the survey tool. Randomization occurred in a blocked fashion, such that randomization to receive the set of questions describing either a male or female surgeon would be even over time.

After completion of the five scenario questions, respondents were also asked to answer basic demographic and professional questions including sex, generation defined by year of birth, country of residence, training, certification, hospital setting, and years’ experience. The respondent’s training was categorized as either RN, ST, SA, or other. The hospital setting was defined as private, academic/university, government facility, or an outpatient surgery center. Finally, in responding to the question requesting generation by year of birth, the generations of the respondents were defined, according to their year of birth, as follows: Baby Boomers, 1946–1964;

Generation X, 1965–1976; Millennials (Generation Y), 1977–1995; and Generation Z, 1996 onwards [12–14].

This study was approved by the University of Texas MD Anderson Cancer Center Institutional Review Board (PA17-0441).

Study participants

The survey was distributed by email to a variety of associations representing OR personnel, including the Association of Perioperative Registered Nurses, the National Surgical Assistant Association, the Australian College of Perioperative Nurses, the Association of Surgical Technologists, and the Association of Surgical Assistants. The survey was further promoted on the websites of the respective associations for 4 weeks to attract additional respondents.

Surgical assistants are typically thought of as a first assistant, providing assistance with retraction, suction, or other aspects that may aid the surgeon in efficiently and expertly carrying out the operation. Surgical technologists are responsible for preparation of the OR and sterile instruments, as well as monitoring of the operative conditions, patient, and the sterile environment throughout the case. Registered nurses may contribute to both of these aspects, but may furthermore administer medications or monitor patient wellbeing during the operation at the direction of both the surgeon and anesthesiologist.

Statistical analyses

Completed responses to the male surgeon survey were compared to those of from the female surgeon survey. Responses were compared using Student’s *t* test, Pearson’s chi-squared test, or Fisher’s exact test, as appropriate. *p* values of < 0.05 were considered to indicate statistical significance. All analyses were performed using the SPSS software program (version 24, SPSS Inc., Chicago, IL).

Results

Participant demographics

The response rate was 4.4% (3128/71143), and the characteristics of the respondents are detailed in Table 2. After randomization, 1566 (50.1%) participants completed the survey exclusively describing a male surgeon, while 1562 (49.9%) participants completed the survey exclusively describing female surgeon. Most of the respondents (2545, 81.4%) were female. The roles for which the participants were trained were as follows: RN (55%, 93% female), SA (21%, 55% female), ST (15%, 81% female), or other (10%, 75% female). The respondents were mostly Baby Boomers

Table 2 Respondent characteristics

	Overall (%) <i>n</i> = 3128	Male surgeon survey (%) <i>n</i> = 1566	Female surgeon survey (%) <i>n</i> = 1562	<i>p</i> values
Female sex	2545 (81.4)	1275 (80.6)	1270 (81.3)	0.936
Generation				0.670
Baby boomer	1289 (41.2)	634 (40.5)	655 (41.9)	
Generation X	957 (30.6)	475 (30.3)	482 (30.9)	
Millennial	861 (27.5)	446 (28.5)	415 (26.6)	
Generation Z	21 (0.7)	11 (0.7)	10 (0.6)	
Training				0.589
Registered nurse	1706 (54.5)	844 (53.9)	862 (55.2)	
Surgical assistant	641 (20.5)	319 (20.4)	322 (20.6)	
Surgical technologist	472 (15.1)	237 (15.1)	235 (15.0)	
Other	309 (9.9)	166 (10.6)	143 (9.2)	
Years' experience				0.572
< 5 years	482 (15.4)	236 (15.1)	246 (15.7)	
5–10 years	511 (16.3)	259 (16.5)	252 (16.1)	
11–15 years	413 (13.2)	219 (14.0)	194 (12.4)	
> 15 years	1722 (55.1)	852 (54.4)	870 (55.7)	
Country of work				0.203
USA	2940 (94.0)	1478 (94.4)	1462 (93.6)	
Australia	149 (4.8)	74 (4.7)	75 (4.8)	
Other	39 (1.2)	14 (0.9)	25 (1.6)	
Hospital setting				0.280
Private	1706 (54.5)	831 (53.1)	875 (56.0)	
Academic/university	864 (27.6)	441 (28.2)	423 (27.1)	
Outpatient surgery center	446 (14.3)	239 (15.3)	207 (13.3)	
Government/veterans affairs	112 (3.6)	55 (3.5)	57 (3.6)	

(1289, 41.2%), with most of the remaining respondents indicating that they belonged to Generation X (957 (30.6%)) or were Millennials (861, 27.5%). Most of the participants had more than 15 years of experience in the OR (1722, 55.1%), while 482 (15.4%) had less than 5 years of experience. The respondents were primarily from the United States (2940, 94.0%), with a small percentage from Australia (149, 4.8%). Furthermore, most survey participants worked in a private hospital setting (1706, 54.5%), while a smaller proportion worked in academic or university-affiliated hospitals (864, 27.6%). The baseline characteristics of the respondents who completed the male surgeon survey and those who completed the female surgeon survey did not differ to a statistically significant extent.

Overall response to surgeon behaviors

We first evaluated the general response to surgeon behaviors, regardless of surgeon sex, across the entire set of five scenarios.

We first assessed the responses to determine the number of participants that would report or write-up the physician

(survey choice D) for at least one of the five scenarios. Overall, 54.3% of the respondents would have written up the physician for at least one of the scenarios (Table 3). This included 36.2% of participants who would only have written up the surgeon for one scenario; 13.9% indicated that they would have done so for two of the described situations. In comparison, 45.7% of respondents would not have reported the surgeon's behavior for any of the scenarios.

Next, we reviewed the responses to assess the proportion of participants who found the surgeon's behaviors inappropriate (survey choices B, C, and D) for at least one of the five scenarios (Table 4). When all respondents were evaluated across both surgeon sexes, 77.6% of respondents reported that the surgeon's behaviors were inappropriate in at least one scenario. Most (1173, 37.5%) of the respondents found the surgeon's behavior inappropriate to some degree in three of five scenarios. A smaller proportion (889, 28.4%) felt that four behaviors were inappropriate. Only 7 (0.2%) participants felt that the surgeon did not behave inappropriately in any of the five cases.

Table 3 Likelihood of writing up surgeon stratified by respondent characteristics

	All surgeons (%)	<i>p</i> values	Female vs. male surgeons	<i>p</i> values
All respondents	54.3		55.1% vs. 53.6%	0.406
Sex		0.499		
Male	55.6		57.9% vs. 53.3%	0.262
Female	54.0		54.4% vs. 53.6%	0.700
Training		< 0.001		
Registered nurse	53.2		52.0% vs. 54.4%	0.318
Surgical assistant	48.8		52.2% vs. 45.5%	0.089
Surgical technologist	65.7		71.5% vs. 60.0%	0.008
Other	54.7		53.1% vs. 56.0%	0.612
Years' experience		0.145		
< 5 years	56.8		55.7% vs. 58.1%	0.601
5–10 years	57.5		59.9% vs. 55.2%	0.282
11–15 years	54.5		53.6% vs. 55.3%	0.738
> 15 years	52.6		53.8% vs. 51.4%	0.322
Country of work		0.008		
USA	54.9		55.8% vs. 53.9%	0.303
Australia	43.0		41.3% vs. 44.6%	0.688
Other	75.9		71.4% vs. 61.5%	0.586
Hospital setting		0.113		
Private	53.9		55.8% vs. 52.0%	0.117
Academic/university	57.2		56.3% vs. 58.0%	0.596
Outpatient surgery center	50.2		49.8% vs. 50.6%	0.855
Government/veterans affairs	54.5		54.4% vs. 54.5%	0.986

p values of 0.05 or less was considered statistically significant

Response to surgeon behaviors stratified by surgeon sex and respondent sex

Next, we assessed the likelihood that the respondent would write-up the surgeon at least once, stratified by surgeon sex (Fig. 1). In examining all respondents, 55.1% would have written up the female surgeon at least once, while 53.6% would have done so for the male surgeon ($p=0.406$). When the respondents were stratified by sex, the likelihood of writing up the surgeon, regardless of surgeon sex, did not differ between the male and female respondents (55.6% vs. 54.0%, $p=0.499$). Similarly, there was no significant difference in the likelihood of the male respondents writing a female surgeon vs. a male surgeon (57.9% vs. 53.3%, $p=0.262$), or in the likelihood of the female respondents writing up a female surgeon vs. a male surgeon (54.4% vs. 53.6%, $p=0.700$).

We then determined the proportion of respondents who found the surgeon's behaviors inappropriate for at least one of the five scenarios. Across all respondents, there were no differences in the proportion who found the female surgeon's behaviors inappropriate vs. those who found male surgeon's behaviors inappropriate (78.4% vs. 76.9%, $p=0.322$). However, when respondents were stratified by sex, a significant difference was observed between the male and female

respondents, regardless of surgeon sex. Specifically, female respondents were more likely than their male counterparts to find the surgeon's behavior unacceptable (72.2% vs. 78.9%, $p=0.001$). The likelihood of the male respondents finding either the male surgeon's or female surgeon's behavior inappropriate did not differ to a statistically significant extent (72.3% vs. 72.2%, $p=0.980$), and the surgeon sex did not predict the likelihood of the female respondents finding the surgeon's behavior inappropriate (female surgeon 79.8% vs. Male surgeon 78.0%, $p=0.265$).

In analyzing individual questions, there appeared to be sex biases present in the response to scenario 3, which described a surgeon who forgot to complete the timeout. When the likelihood of writing up the surgeon was reviewed, support staff at private hospitals were more likely to report the female surgeon than the male surgeon ($p=0.007$), as were respondents with more than 15 years of experience ($p=0.005$).

Response to surgeon behavior stratified by respondent employment characteristics

We then wanted to evaluate the role of the training and employment characteristics on perceptions of surgeon

Table 4 Likelihood of finding surgeon's behavior inappropriate stratified by respondent characteristics

	All surgeons (%)	<i>p</i> values	Female vs. male surgeons	<i>p</i> values
All respondents	77.6		78.4% vs. 76.9%	0.322
Sex		0.001		
Male	72.2		72.3% vs. 72.2%	0.980
Female	78.9		79.8% vs. 78.0%	0.265
Training		< 0.001		
Registered nurse	81.9		81.4% vs. 82.3%	0.627
Surgical assistant	67.7		68.9% vs. 66.5%	0.501
Surgical technologist	79.4		81.3% vs. 77.6%	0.328
Other	71.8		76.2% vs. 68.0%	0.112
Years' experience		0.079		
< 5 years	82.2		82.9% vs. 81.4%	0.652
5–10 years	76.7		79.4% vs. 74.1%	0.162
11–15 years	76.5		78.4% vs. 74.9%	0.407
> 15 years	76.9		76.8% vs. 77.0%	0.916
Country of Work		0.088		
United States	77.2		78.0% vs. 76.5%	
Australia	84.6		82.7% vs. 86.5%	0.651
Other	82.1		88.0% vs. 71.4%	0.225
Hospital setting		0.024		
Private	76.1		77.5% vs. 74.7%	0.326
Academic/university	79.6		80.6% vs. 78.7%	0.481
Outpatient surgery center	77.1		74.4% vs. 79.5%	0.201
Government/veterans affairs	86.6		89.5% vs. 83.6%	0.365

p values of 0.05 or less was considered statistically significant

behavior. In assessing respondents across a variety of educational training categories to determine the proportion of respondents who found the surgeon's behavior inappropriate, differences existed across the categories (RN, 81.9%; ST, 79.4%; SA, 67.7%; other, 71.8%; $p < 0.001$). This difference also persisted when the likelihood of writing up the surgeon was analyzed across job categories (ST, 65.7%; RN, 53.2%; other, 54.7%; SA, 48.8%; $p < 0.001$) (Table 5). When the likelihood of writing up the surgeon was examined across job categories and stratified by surgeon sex, STs were more likely to write-up the female surgeon vs. the male surgeon (71.5% vs. 60.0%, $p = 0.008$). Although the difference did not reach statistical significance, there was also a trend for SAs to write-up the female surgeon more frequently than the male surgeon (52.2% vs. 45.5%, $p = 0.089$). The respondents' number of years of experience in the OR did not factor into the likelihood of them finding the surgeon's behavior inappropriate ($p = 0.079$), or in the likelihood of writing up the surgeon for unacceptable behavior ($p = 0.145$).

The respondent's nationality was associated with the likelihood of writing up the surgeon ($p = 0.008$). Respondents from Australia were least likely to write-up the surgeon (43.0%), those in the United States were somewhat more likely to write-up the surgeon (54.9%), and those in other countries were the

most likely to write-up the surgeon (75.9%). There were 39 individuals who reported nationalities other than American or Australian, their respective nations included: Canada ($n = 12$), Atlantic island nations ($n = 7$), and African countries ($n = 6$). The country of residence did not affect the proportion of respondents who wrote up the female surgeon vs. the male surgeon.

Finally, differences existed between hospital settings in the percentage of respondents who found surgeon behavior inappropriate (Government/Veterans Affairs [VA] hospital, 86.6%; Academic/University hospital, 79.6%; Outpatient surgery center, 77.1%; and Private hospital, 76%; $p = 0.024$). When stratified by hospital type, no difference as observed among the groups with regard to the likelihood of finding the behavior of the female or male surgeon inappropriate. Similarly, when stratified by hospital type, there was no difference in the likelihood of writing up the female surgeon vs. the male surgeon.

Discussion

Surgeons have historically been almost exclusively male, with the emergence of increasing proportions of female surgeons in recent decades. As a result, the evolution of the

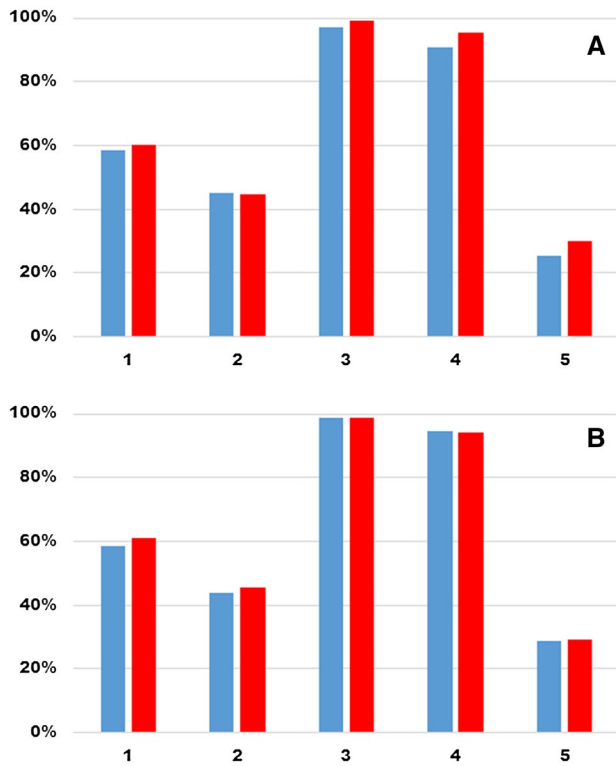


Fig. 1 Responses by question. **a** Percent of male (blue) and female (red) respondents finding the surgeon's behavior inappropriate in each question. **b** Percent of respondents finding a male (blue) or female (red) surgeon's behavior in appropriate in each question

surgeon–nurse dynamic has trailed in comparison with that of the physician–nurse relationship, which has benefited from the earlier and wider integration of women into non-surgical fields. The purpose of this prospective randomized study was to determine if sex-based biases exist in the OR setting amongst ancillary staff, not limited to RNs, as well as to determine predictors of bias. The present investigation demonstrates that the role of the support staff is strongly predictive of the likelihood of holding harsher perceptions of surgeon behaviors, as well as the likelihood of writing up the surgeon for unacceptable behaviors. In addition, when assessed across all scenarios, STs appeared to exhibit implicit sex-based biases against women. It is unclear if differences in the job training or duties of STs specifically most strongly impacted this result. Upon further investigation, it

was also evident that other populations of respondents, particularly those at private hospitals, as well as senior respondents (> 15 years of OR experience), display sex biases that are not globally present, but which seem to only be present in certain situations. Finally, female support staff appeared to be more critical of the surgeons than their male counterparts, as they more frequently found particular behaviors inappropriate.

The tendency for female support staff to be more critical of questionable surgeon behavior is curious, and likely multifactorial. Just as there have been changes in the makeup of the medical community, with increasing esteem for female physicians and surgeons, we are likely witnessing similar changes in the nursing community, which account for more than half of our surveyed population. Although this arena has always been female dominated, the physician–nurse relationship was long-regarded as one of the dominance and subservience [6]. However, many practices identify the importance of nurses and other support staff within the interprofessional healthcare team [15, 16]. This team-based approach is particularly applicable in surgery, where each individual is responsible for a variety of concrete tasks upon arrival to the OR, as well as throughout the case, to ensure the proper and safe completion of the operation in accordance with the World Health Organization Surgical Safety Checklist [17, 18].

In addition, given that the majority of surgeons are men, it is possible that the environment of the OR attracts a unique subset of women who thrive in this sort of setting, possessing the traditionally agentic characteristics attributed to men (assertive, confident, competitive). Stein's 1967 description of the “doctor–nurse game” detailed that “the nurse can communicate her recommendations without appearing to be making a recommendation statement” [19]. As women in support roles feel increasingly empowered as equal members on the surgical team, it is understandable that they would feel comfortable voicing concerns about inappropriate behaviors, as we have found in the current investigation. As there were different proportions of women among the various job categories, it is also possible that this factor may have contributed to the divergent responses among ST and other OR support staff.

With respect to differences among the countries in the frequency of writing up the surgeon, it is possible that our

Table 5 Likelihood of writing up surgeons for questionable behaviors according to job

	All surgeons (%)	<i>p</i> values	Female vs. male surgeons	<i>p</i> values
Surgical technologist	65.7	<0.001	71.5% vs. 60.0%	0.008
Registered nurse	53.2		52.0% vs. 54.4%	0.318
Surgical assistant	48.8		52.5% vs. 45.5%	0.089
Other	54.7		53.1% vs. 56.0%	0.612

results are highly heterogeneous, particularly with regard to respondents reporting “Other” countries of residence. While 43.0% and 54.9% of the Australian and American ancillary staff, respectively, would have written up the surgeon at least once, 75.9% of respondents from other countries would have done so. As mentioned earlier, these individuals represent a wide range of countries, including Canada ($n = 12$), Atlantic island nations ($n = 7$), and African countries ($n = 6$), and several other respondents singly represented other nations. With regard to the finding that Australian participants were less likely to write-up the surgeon in comparison with their American participants, it is possible that this difference was influenced by differences in regulatory policy as well as cultural tendencies.

The hospital setting was also a predictor of finding behaviors inappropriate. Among the individuals surveyed, 76.1% of the respondents from private hospitals, 77.1% of the respondents from outpatient surgery centers, and 79.6% of the respondents from university hospitals reported finding behaviors inappropriate at least once. In contrast, 86.6% of the respondents from VA hospitals found behaviors inappropriate. As prior investigations have reported a higher quality of patient care at VA hospitals in comparison with non-VA hospitals based on standardized safety measures, mortality, and effectiveness, this finding could reflect a higher standard of medical care, including interprofessional relationships, communication, and teamwork [20, 21].

It is noteworthy that scenario 3, in which the surgeon forgot to complete the timeout, proved to be an area in which sex biases were revealed. Unlike the other scenarios which involved questionable behaviors, where a great deal of subjectivity may be involved, scenario 3 presents a clear rule violation upon which nearly, all respondents could likely agree. However, it is interesting that, given such an unequivocal outcome, which is actually a true violation of most OR policies, the differential responses to the female and male surgeons became apparent, unlike in other scenarios. Specifically, respondents from private hospitals were more likely to write-up the female surgeon than the male surgeon. Senior respondents with more than 15 years of experience also responded more critically to the female surgeon who forgot the timeout in comparison with the male surgeon. It is unclear if this differential response represents a particular stance in which it is more unacceptable for females to “break rules” than males, or—as Gjerberg et al. [6] described—this represents a higher tolerance for or likelihood of excusing unacceptable behaviors due to inherent male–female sexual tension, especially given that a high proportion of our respondents were female.

This prospective randomized study specifically addressed the issue of sex bias in the unique setting of the OR. Although one prior report exists that has evaluated

this endpoint, the interpretation of the authors’ findings was limited, as it represented a single center’s viewpoints, only evaluated RNs, and also did not restrict responses to OR support staff [7]. In addition, our investigation characterizes the demographics and employment histories of survey respondents, thereby allowing for the identification of predictors of bias.

While this study is able to largely conclude that OR ancillary staff do not hold globally persistent sex-based biases against surgeons of either sex, we are limited in our ability to discriminate more subtle character traits, which may or may not be gender-normative—and, therefore, subject to sex biases. The fact that biases were present in particular situations, while absent from other situations, is indicative of these subtleties. Furthermore, as this investigation was conducted via a survey, we were unable to analyze additional factors that can contribute to interpersonal relationships and interactions, such as body language, gestures, tone of voice, or cadence of speech. Finally, although we were able to collect responses from 3128 participants, our response rate of 4.4% may reflect some degree of selection bias, in that those electing to complete the survey may not be reflective of the overall population of OR support staff. In particular, each job role appears to be represented by somewhat variable demographics, particularly in male–female representation, and it is possible that our survey data incompletely captures these differences.

In conclusion, female OR support staff, including RNs, STs, and SAs, were more likely to deem the surgeon’s questionable behaviors to be inappropriate. The job role was also predictive of the individual’s likelihood to write-up the surgeon for questionable behavior, with STs displaying sex-based biases against women. While we have demonstrated some particularly interesting findings, we have only begun to understand the multifaceted complexities that contribute to the ways in which surgeons are perceived by their colleagues in the OR. Moreover, it is clear that further investigations are warranted to fully characterize the factors that contribute to the perception of surgeon behavior by OR personnel, particularly among STs who exhibited sex-based biases against the female surgeon. Identifying the sources of unconscious bias will be critical to improving interpersonal relationships and team morale in an increasingly diverse workplace.

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Compliance with ethical standards

Conflict of interest The authors declare no conflicts of interest in association with the present study.

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