Prevalence and predictors of exposure to disruptive behaviour in the operating room

Prévalence et prédicteurs d'exposition à des comportements perturbateurs en salle d'opération

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Abstract

Purpose Disruptive intraoperative behaviour ranges from incivility to abuse. This behaviour can have deleterious effects on clinicians, students, institutions, and patients. Previous investigations of this behaviour used underdeveloped tools or small sampling frames. We therefore examined the prevalence and predictors of perceived exposure to disruptive behaviour in a multinational sample of operating room clinicians.

Methods A total of 134 perioperative associations in seven countries were asked to distribute a survey examining five types of exposure to disruptive behaviour: personal, directed toward patients, directed toward colleagues, directed toward others, or undirected. To compare the average amount of exposure with each type, we used a Friedman's test with select post hoc Wilcoxon tests. A negative binomial regression model identified socio-demographic predictors of personal exposure.

Results Of the 134 organizations approached, 23 (17%) complied. The total response rate was estimated to be 7.6% (7465/101,624). Almost all (97.0%; 95% confidence interval [CI], 96.6 to 97.4) of the respondents reported exposure to disruptive behaviour in the past year, with the average respondent experiencing 61 incidents per year (95% CI, 57 to 65). Groups reporting higher personal exposure included clinicians who were young, inexperienced, female, non-heterosexual, working as nurses, or working in clinics with private funding (all P < 0.05).

Conclusion Perceived exposure to disruptive behaviour was prevalent and frequent, with the most common behaviours involving speaking ill of clinicians and patients. These perceptions, whether accurate or not, can result in detrimental consequences. Greater efforts are required to eliminate disruptive intraoperative behaviour, with recognition that specific groups are more likely to report experiencing such behaviours.

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Résumé

Objectif Les comportements perturbateurs en salle d'opération vont de l'incivilité à l'abus. Ce type de comportement peut avoir des effets délétères sur les cliniciens, les étudiants, les institutions et les patients. Les études précédentes de ce type de comportement se sont servies d'outils sous-développés ou de cadres d'échantillonnage restreints. Nous avons donc examiné la prévalence et les prédicteurs d'une exposition perçue à un

comportement perturbateur dans un échantillon multinational de cliniciens de salle d'opération.

Méthode *Au total, on a demandé à 134 associations périopératoires issues de sept pays de distribuer un sondage examinant cinq types d'exposition à des comportements perturbateurs : personnel, dirigé vers les patients, dirigé vers des collègues, dirigé vers les autres, ou non dirigé. Afin de comparer le nombre moyen d'expositions à chacun de ces types de comportement, nous avons utilisé un test de Friedman accompagné d'une sélection de tests de Wilcoxon réalisés post-hoc. Un modèle de régression binomiale négative a identifié les prédicteurs sociodémographiques d'exposition personnelle.*

Résultats *Parmi les 134 organismes contactés, 23 (17 %) ont accepté de distribuer le sondage. Le taux de réponse total était estimé à 7,6 % (7465/101 624). Presque tous (97,0 %; intervalle de confiance [IC] 95 %, 96,6 à 97,4) les répondants ont rapporté avoir été exposés à des comportements perturbateurs au cours de l'année précédente, un répondant moyen subissant 61 incidents par année (IC 95 %, 57 à 65). Parmi les groupes rapportant une exposition personnelle plus élevée, les jeunes cliniciens, ceux avec peu d'expérience, les femmes, les non-hétérosexuels, le personnel infirmier ou les personnes travaillant dans des cliniques privées (tous P < 0,05) ont été identifiés.*

Conclusion *L'exposition perçue à des comportements perturbateurs était élevée et fréquente, les comportements les plus souvent rapportés étant la médisance à l'égard des cliniciens ou des patients. Ces perceptions, qu'elles soient vraies ou non, peuvent entraîner des conséquences délétères. Des efforts plus importants sont nécessaires afin d'éliminer les comportements perturbateurs en salle d'opération, en reconnaissant que certains groupes vulnérables sont plus à risque de rapporter avoir subi de tels comportements.*

Disruptive behaviour is a term used for a range of unacceptable workplace behaviours including incivility, bullying, and harassment.[1] It can be defined as interpersonal behaviour (i.e., directed toward others or occurring in the presence of others) that results in a perceived threat to victims and/or witnesses and violates a reasonable person's standard of respectful behaviour.[2] Disruptive behaviour can undermine the psychological well-being and productivity of victims and witnesses[3-5] and can affect patient care by undermining communication, teamwork, clinical decision-making, and technical performance.[4] It can also set a poor example to students by acting as part of the "hidden curriculum" in healthcare.[2,4,6] These consequences of disruptive behaviour ultimately have serious implications for healthcare institutions, including decreased productivity and increased legal liability.[4] The operating room (OR) is a particular concern, as the working conditions within the OR increase the propensity for clinicians to act badly[4] and most disruptive behaviour in the perioperative domain occurs in the OR itself.[7]

To develop strategies to reduce disruptive behaviour in the OR, it is important to establish the scope of the problem and to ascertain who is at higher risk of being exposed. Previous investigations in the OR have had methodological limitations relating to sampling frames, survey tool development, and statistical methodology..[8-23] Appropriate tools to measure exposure to disruptive behaviour have only recently been created[21,24,25] and previous studies have not examined disruptive behaviour in a large international cohort of OR clinicians. There is also limited data on the socio-demographic predictors of exposure to disruptive behaviour.

Therefore, the goals of this study were to: 1) estimate the prevalence and frequency of perceived exposure to disruptive behaviour in a multinational cohort; 2) describe the types of perceived exposure to disruptive behaviour; and 3) identify the socio-demographic predictors of perceived personal exposure to disruptive behaviour.

Methods

The Ethics Boards at the University of Manitoba, Washington University School of Medicine in St Louis and the University of Michigan approved this study. We distributed our previously developed scale[25] to 134 perioperative associations in Canada, Australia, New Zealand, Brazil, India, the USA, and the UK. The scale quantifies how often clinicians perceive themselves as having experienced and/or witnessed 14 examples of disruptive behaviour in the preceding year (see Fig. 1). Respondent socio-demographics were also collected. The targeted groups for distribution included anesthesiologists, nurses, surgeons, senior medical students, and OR technicians (i.e., perfusionists, surgical assistants, and anesthesia assistants). To achieve a more representative distribution of professions, we supplemented recruitment with email distribution and focused recruitment efforts on the institutions of the investigators. All clinicians who spent time in the OR in the preceding year were included.

The exposure questions were on a seven-point Likert scale: never (0), a few times per year (1), every few months (2), every month (3), every day (4), every few days (5), and at least once per day (6). Fourteen examples of disruptive behaviour were measured. These examples were grouped
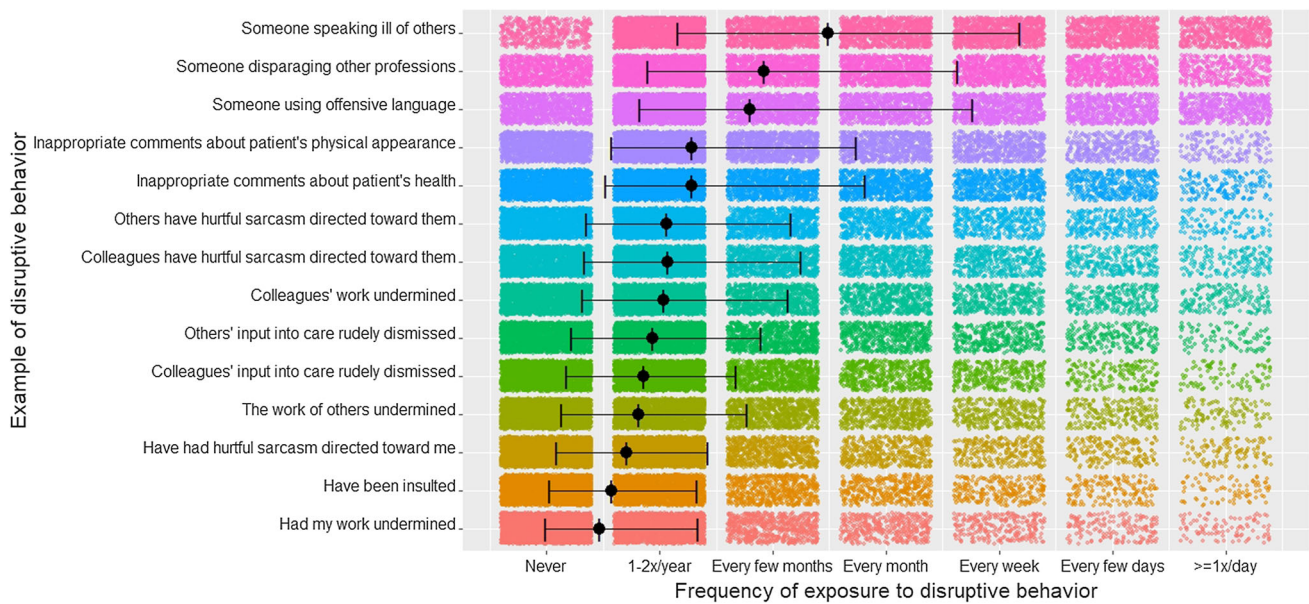
Fig. 1 Dot plot showing the distribution of responses to each of the 14 questions, with the distribution of responses represented by the density of points in each response category. Jitter was added to increase data visibility. The black dots represent the interpolated medians for each question, while the error bars show the interpolated interquartile range

into five categories of exposure: directed toward the respondent (personal); toward colleagues of the same profession (in-group); toward colleagues of different professions (out-group); toward patients; and not directed toward anyone in particular (undirected). A score for each of the five the categories of exposure was calculated by taking the sum of the scores on the individual questions in each category.

To characterize how clinicians were exposed to disruptive behaviours, we measured: 1) prevalence, defined as the proportion of all clinicians who reported experiencing or witnessing at least one disruptive behaviour in the preceding year; 2) how many of the 14 examples of disruptive behaviour were experienced by clinicians; and 3) the frequency of experiencing and/or witnessing disruptive behaviour in the preceding year. To calculate the frequency of each respondent's exposure, their Likert scores on each question were first converted to an absolute number. If the frequency category that was selected was a range (i.e., a few times per year), to be conservative the lower part of the range was used (i.e., once per year). Therefore, "a few times per year" = 1, "every few months" = 6, "every month" =12, "every week" = 52, "every few days" = 183, and "at least once per day" = 260 (the estimated number of workdays/year). Since it was unclear whether the events reported in the 14 questions were overlapping, two estimates of each respondent's frequency of exposure were calculated, which formed the lower and upper bounds of the possible frequency of exposure. The lower limit was taken to be the

frequency of the behaviour that each clinician reported the highest exposure to, which assumes that the events reported in the 14 questions are completely overlapping. The upper limit was calculated by taking the sum of the frequencies that were reported, which assumes that none of the events reported in the 14 questions overlapped. The interpolated median of each of these estimates was then calculated to give a wide sample range. To determine which of the five types of perceived exposure was most common, we conducted a Friedman's test with select post hoc Wilcoxon signed-rank tests. To identify the five most common examples of disruptive behaviour, the distribution of responses for the 14 behaviours was examined.

A negative binomial regression model was used to identify the socio-demographic predictors of perceived personal exposure. The negative binomial model was most appropriate, given the magnitude of over-dispersion in the data. Individuals who responded to at least one personal exposure question were included in this model. Candidate predictors were selected *a priori* based on theoretical considerations from sociology, management theory, and literature related to workplace bullying, and were entered into the model using the forced entry method. The candidate predictors included in the model were respondent age, profession, sex, sexual orientation, status as an ethnic or cultural minority, years since training was completed, country of work, funding source of the work environment, and the hours spent in the OR per week. Since some respondents did not answer all questions regarding perceived personal exposure, an offset variable

was used to account for these varying levels of completion. The offset was the log of the highest possible personal exposure score that an individual could achieve, given the number of questions that they answered. To confirm the generalizability of the predictors to the entire sample, a sensitivity analysis was used to calculate stratified model coefficients for North American countries (i.e., Canada and the USA) and countries outside of North America. Missing predictor data were treated using pairwise deletion.

Since the survey response rate was low, additional testing and efforts were undertaken to test for and correct possible non-response bias. Firstly, a modified wave analysis was conducted to test whether self-selecting bias inflated the prevalence estimates.[26] The wave analysis placed all respondents and non-respondents on a continuum, based on their motivation to complete the survey. Early respondents were assumed to be the most motivated, those with longer response times less motivated, and non-respondents the least motivated.[27] As the outcome measures of non-respondents are unknown, inferences can be made based on the relationship between how frequently clinicians were exposed to abuse and the time it took to respond. We adapted this methodology for continuous outcomes by examining the correlations between the time it took for an individual to respond to the survey and each of their five exposure scores. The purpose was to ensure that the prevalence estimates were neither inflated nor underestimated. Since sample sizes and response rates varied by the respondent's country of origin, there was concern that self-selecting bias may be present in certain countries. To evaluate this possibility, wave analyses were also performed separately on respondents from each targeted country as well as an "other" category. Secondly, the negative binomial regression model included the time to survey response as a covariate to adjust for any response bias.

Statistical analysis was conducted using R software (v.3.2.3, Vienna, Austria) and SAS (v.9.4, Cary, NC., USA). Confidence intervals for proportions were calculated using the Clopper-Pearson method, and confidence intervals for interpolated medians were calculated using a bootstrap method. Alpha was set at 0.05.

Results

Distribution

Seventeen percent (23/134) of the perioperative associations we asked to distribute the survey complied. Appendix 1 lists the participating associations and their sampling frames. The overall distribution rate was influenced by the large number of surgical associations who declined to distribute the survey or did not respond to

repeated requests (see further details in Appendix 2). In addition, focused recruitment efforts were undertaken at the institutions of the investigators (Appendix 2) to increase the number of responses, especially from those in the surgical profession, and to capture a sample of medical students in the USA.

Response rate and wave analysis

The survey was sent to an estimated 101,624 OR clinicians. Of this, we received 7,465 responses with sufficient data to examine exposure to disruptive behaviour (7.3%). The four professions had different response rates (range: 4.6-14.3%). Further details are available in Appendix 2. The wave analyses indicated that there was no overall statistically or clinically significant association between the time it took a respondent to respond to the survey and how often the respondents reported being exposed to the five types of disruptive behaviour (Appendix 3). Nevertheless, the stratified analysis revealed that there were statistically significant relationships between time to respond and both personal (rho = -0.4) and in-group (rho = -0.3) exposure to disruptive behaviour in the respondents from "other" countries (Appendix 3). This may be explained by the fact that these respondents were not targeted for recruitment and either sought out the study or were forwarded a survey link from other clinicians. These 74 respondents were excluded from all further analysis to avoid potential bias. Respondent socio-demographics are shown in Table 1. The number of clinicians with missing data was low (1.8%).

Prevalence of exposure

Nearly all of the included respondents (7171/7391, 97.0%; 95% confidence interval [CI], 96.6 to 97.4) reported experiencing or witnessing at least one disruptive behaviour in the preceding year. This number was comparable across countries, ranging from 96% to 99% (Table 2). Furthermore, over 50% of respondents reported being exposed to ten or more of the 14 disruptive behaviours that were measured, with 18% experiencing all of them.

Frequency of exposure to disruptive behaviour

Assuming completely overlapping events, the interpolated median for exposure was 12.4 (95% CI, 12.3 to 12.5) disruptive actions in the preceding year. Assuming non-overlapping events, the interpolated median for frequency of exposure was 60.8 (95% CI, 57.3 to 65.3) disruptive actions in the preceding year. Frequencies stratified by country can be found in Table 2. The interpolated median varied from 30 to 82, depending on the country (Table 2).

Table 1 Respondent socio-demographics

Variable	Category	Frequency (% of 7,465)
Country	Canada	2179 (29.2)
	United States	3472 (46.5)
	Brazil	369 (4.9)
	United Kingdom	291 (3.9)
	New Zealand	317 (4.2)
	Australia	315 (4.2)
	India	449 (6)
	Other	73 (1)
Institution funding	Public	3294 (44.1)
	Private/mixed	4171 (55.9)
Profession	Anesthesiologists	3366 (45.1)
	Nurses	2092 (28)
	Surgeons	869 (11.6)
	Other (technicians, medical students)	1138 (15.2)
In a management position	Yes	2100 (28.1)
	No	5365 (71.9)
Sex	Female	3629 (48.6)
	Male	3836 (51.4)
Visible ethnic or cultural minority	Yes	1246 (16.7)
	No	6219 (83.3)
Sexual orientation	Heterosexual	6842 (91.7)
	Non-heterosexual/prefer not to disclose	623 (8.3)
Age	< 30	1194 (16)
	30-40	1796 (24.1)
	41-50	1717 (23)
	51-60	1979 (26.5)
	> 60	779 (10.4)

Table 2 Prevalence of disruptive behaviour and the interpolated median number of disruptive behaviours that clinicians were exposed to (frequency of exposure) by country

Country	Prevalence of disruptive behaviour (%)	Interpolated median frequency of exposure to disruptive behaviour (assuming no overlapping events)	Interpolated median frequency of exposure to disruptive behaviour (assuming completely overlapping events)
Overall	97.0	60.8	12.4
Canada	98.0	58.8	12.5
USA	97.9	81.8	43.6
Brazil	96.7	53.0	12.2
United Kingdom	95.5	57.0	12.1
New Zealand	97.8	47.4	12.1
Australia	98.7	33.1	11.7
India	96.8	30.0	6.5

Table 3 Comparisons of the frequency of different types of disruptive behaviour

n	Friedman $X^{2 \text{ (degrees of freedom)}}$	P value	Interpretation
6,852	8,117.4 (4)	< 0.001	Some types of disruptive behaviour are experienced and witnessed more often than others
Comparison	Wilcoxon V	P value	Interpretation
Undirected *vs* patient	13,651,000	< 0.001	Clinicians are exposed to undirected behaviour significantly more often than behaviour directed toward patients
Patient *vs* in-group	11,093,000	< 0.001	Clinicians are exposed to behaviour directed toward patients more often than behaviour directed toward in-group members
In-group *vs* out-group	6,127,500	< 0.001	Clinicians are exposed to behaviour directed toward in-group members more often than behaviour directed toward out-group members
Out-group *vs* personal	9,632,000	< 0.001	Clinicians are exposed to behaviour directed toward out-group members more often than behaviour directed toward themselves

The greater the Wilcoxon V value, the greater the difference between the two groups being examined

Most common types of disruptive behaviour

Respondents were exposed to each of the five types of disruptive behaviour at different frequencies; from most to least, the order was: undirected, patient, in-group, out-group, and personal (Table 3, Fig. 2). This ordering is also reflected in the prevalence of the types of disruptive behaviour (Fig. 2).

The most common examples of disruptive behaviour

Figure 1 shows that four out of the five most common disruptive behaviours involved making inappropriate comments about other people, be they colleagues, patients, or unspecified groups.

Predictors of personal exposure

The negative binomial model included 7,327 respondents who answered at least one of the personal exposure questions. Predictors of perceived personal exposure were respondent age, sex, sexual orientation, profession, institutional funding, seniority, and hours spent in the OR, independent of country of work (Table 4). Contrasts showed a number of between-group differences (Table 4). A stratified model verified that coefficient size and direction were comparable for North American respondents and those outside of North America (Appendix 4), indirectly showing that there was no interaction between broad geographic location and the identified predictors. An adjustment was made to the total possible score that a participant could indicate (i.e., the "denominator") based on the number of personal exposure questions answered by the respondent.[28]

Discussion

Nearly all respondents reported experiencing or witnessing multiple examples of disruptive behaviour, with an average respondent observing between 12 and 61 events within the preceding year. These estimates are relatively stable across countries. The number of clinicians who are exposed and the effect of disruptive behaviour on workers, institutions, students, and patients is concerning.

The most common examples of disruptive behaviour involve clinicians making inappropriate remarks about other professions or patients. Making inappropriate remarks about other professions is concerning, as it may undermine the quality of inter-professional relationships, thereby undermining communication and teamwork. This would be problematic if realized, as there is an established association between teamwork/communication and patient outcomes.[29] Making inappropriate comments about the health state and physical appearance of a patient is unacceptable because it is disrespectful toward patients and breaches trust. Clinicians have a duty not only to provide the best possible care to patients, but to respect their patients as they deliver that care. Furthermore, if such actions become public they could potentially damage the clinician-patient relationship and undermine the public's trust in healthcare professionals.

Individuals who are members of groups that have traditionally been seen as having less status (e.g., females, nurses, etc.) report greater personal exposure, after controlling for the effect of respondent country. This is consistent with research in the general workplace and non-operative healthcare settings. These studies have found greater exposure to bad behaviour in females compared with males,[30] interns compared with attending physicians,[31] nurses compared with physicians,[21] and junior physicians compared with more senior
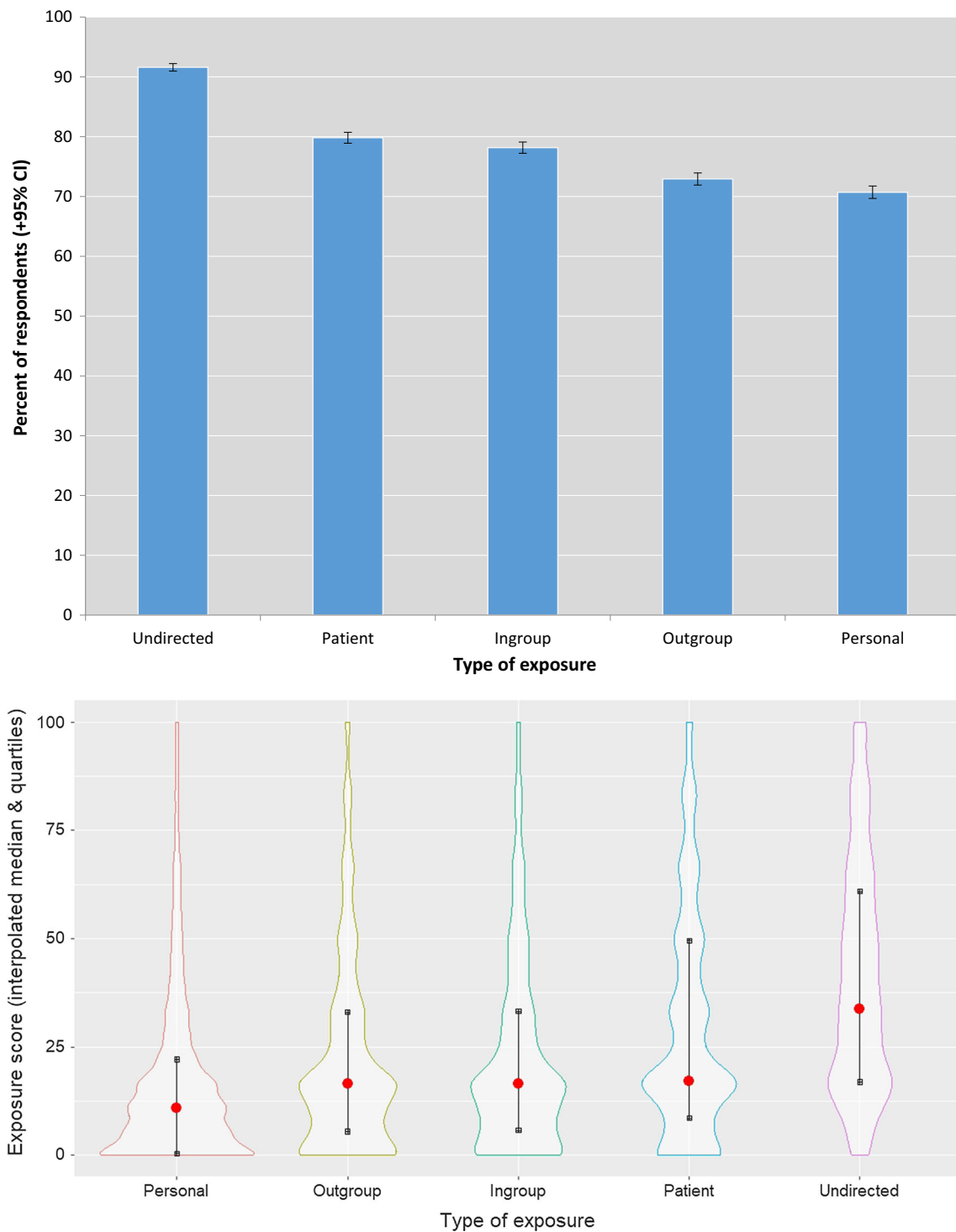
Fig. 2 The proportion of respondents who were exposed to each of the five types of disruptive behaviour (top). Violin plot of exposure scores expressed as a percent of the total possible score for the five different types of disruptive behaviour that clinicians were exposed to (bottom). The width of the violin in the bottom figure indicates the density of data for the corresponding exposure score. Red dots indicate interpolated medians and the bars indicate quartiles

physicians.[32] There are at least four potential explanations. The least plausible explanation is that these respondents intentionally exaggerate their exposure to disruptive behaviour. However, there is no *a priori* reason to suspect that these more marginalized groups would be less reliable respondents. A more plausible explanation is

Table 4 Socio-demographic predictors of personal exposure to disruptive behaviour

Variable	P value	RR (95% CI)
Intercept	< 0.001	-
Age of respondent (yr)	< 0.001	
REF: > 60		
Age < 30	0.01	1.28 (1.06 to 1.54)
Age 30-40	< 0.001	1.40 (1.19 to 1.64)
Age 41-50	0.007	1.21 (1.06 to 1.39)
Age 51-60	0.01	1.165 (1.04 to 1.31)
Sex	< 0.001	
REF: Male	-	-
Female	< 0.001	1.23 (1.16 to 1.31)
Country (covariate)	< 0.001	
Sexual orientation	0.02	
REF: non-heterosexual/prefer not to disclose	-	-
Heterosexual	0.02	1.12 (1.02 to 1.23)
Profession	< 0.001	
REF: Nurses	-	-
Anesthesiologist	< 0.001	1.68 (1.55 to 1.81)
Surgeon	0.70	1.02 (0.901 to 1.16)
Other	< 0.001	1.41 (1.24 to 1.59)
Minority	0.59	
REF: Visible minority	-	-
Not a Visible minority	0.59	1.02 (0.95 to 1.10)
Institution funding	< 0.001	
REF: For profit/mixed funding	-	-
Non-profit	< 0.001	1.12 (1.05 to 1.20)
Years since training ended	0.003	
REF: 11-20	-	-
Student	0.70	0.96 (0.79 to 1.17)
Senior trainee	0.004	1.26 (1.08 to 1.47)
< 2	0.547	1.05 (0.90 to 1.22)
2-5	0.321	1.06 (0.94 to 1.19)
6-10	0.589	0.97 (0.88 to 1.08)
21-30	0.194	1.06 (0.97 to 1.17)
31-40	0.346	0.94 (0.83 to 1.07)
> 40	0.047	0.79 (0.63 to 0.10)
Time to respond to survey	0.003	
Per unit increase	0.003	1.001 (1.001 to 1.002)
All questions answered	0.28	
REF: all answered	-	-
Not all answered	0.27	1.06 (0.95 to 1.18)
Hours spent in OR	< 0.001	
REF: > 60	-	-
Student (variable)	Estimate is already accounted for in student *vs* 11-20 parameter	
< 10	< 0.001	0.66 (0.55 to 0.78)
11-20	< 0.001	0.65 (0.58 to 0.74)
21-30	< 0.001	0.80 (0.72 to 0.89)
31-40	0.10	0.94 (0.87 to 1.01)
41-50	0.15	1.07 (0.98 to 1.18)

Table 4 continued

Variable	*P* value	RR (95% CI)
51-60	< 0.001	1.51 (1.35 to 1.69)

OR = operating room; REF = reference group. Greater RR values indicate that this group is at greater risk of personal exposure than the reference value, and RR values < 1 indicate lower risk of personal exposure than the reference value. Greater deviation from the reference value indicates greater difference in risk

that these individuals may hold others to a higher standard, and have a lower threshold for what they consider to be "hurtful sarcasm", "insults", and "undermining of a person's work". Another equally plausible explanation would be that these respondents are simply more perceptive or have greater recall of disruptive behaviour. A fourth plausible explanation is that OR workers may in fact show a greater disregard for proper behaviour in dealing with individuals who they perceive being as lower in status. All plausible aforementioned explanations suggest that the individuals who report greater exposure may be especially susceptible to the detrimental effects of disruptive behaviour, either through their more detrimental cognitive appraisals (i.e., how they interpret a situation), their more pronounced recollections, or their greater exposure to disruptive behaviour.

The role that the race of the clinician plays in predicting perceived exposure is less clear. While one study found that black and Asian doctors report greater exposure to bullying,[33] a recent survey found that Asian nurses were less likely to be exposed to disruptive behaviour than Caucasian nurses.[32] We found no additional perceived exposure to disruptive behaviour in ethnic and cultural minorities. These conflicting results may be the result of differences in workplace cultures.

Our results also show that certain work environments appear to result in greater exposure, including institutions with private or mixed funding. The causes of this are uncertain and merit further investigation.

This study has several limitations. The distribution rate of our survey was low, particularly among surgical associations. This may reflect several factors, including a reluctance of surgical associations to examine the issue. Another limitation is the low response rate, which increases the potential of having a biased sample. The potential for self-selecting bias exists for any research involving human subjects and requiring informed consent. We have tried to show that our sample is not biased relative to the population of associations who participated. While one of the wave analyses for the entire sample indicated that there was a relationship between time to respond to the survey and out-group exposure, this relationship was very small. In addition, this result has no bearing on the binomial model, which examined predictors of personal exposure.

Despite these limitations, the results of the study remain informative and significant. Firstly, the absolute number of clinicians being exposed is concerning, independent of the response rate. Secondly, the relationship between socio-demographics and personal exposure is an important outcome of this study, and the ability to accurately identify predictors depends more on an adequate range of both predictor values and exposure levels in the sample than a high response rate. Extrapolation to exposure levels or predictor values that were not present in the sample is unjustified and likely inaccurate. An over-representation of individuals with extreme exposure may be an asset, as it avoids such an extrapolation. A third limitation of this study is a reliance on retrospective self-reporting of experiencing and witnessing disruptive behaviour. The accuracy of prevalence estimates derived from survey studies is also dependent on the recall of respondents. To minimize this issue, we asked respondents to give a relative frequency for each behaviour (e.g., once per month, once per week, etc.), instead of asking for an absolute number. We also calculated the total frequency across all examples of disruptive behaviour so the respondents did not have to perform the calculations. The estimates of this study should ideally be replicated using other methods, such as prospective observational assessments using multiple trained evaluators and more objective measurement tools. A final limitation was that the model did not include predictors beyond general socio-demographics. Studies in the general workplace setting have found that both situational constraints and respondent personality characteristics are also predictive of victimization to bullying.[30,34-38] While additional factors should be considered in identifying individual victims, socio-demographics identify recognizable groups who experience greater exposure to disruptive behaviour.

This study has many strengths. It represents the largest study of disruptive intraoperative behaviour, both in terms of the number of respondents and their geographic spread. Exposure to disruptive behaviour was measured using an assiduously developed tool, therefore the scores are likely to be valid and reliable. Several metrics were used to describe the prevalence of disruptive behaviour, giving a more nuanced description of exposure than previous studies. This study also fills a knowledge gap, by

rigorously identifying a number of socio-demographic predictors that a respondent will report having disruptive behaviour directed toward them.

In conclusion, this study shows that over 7,000 clinicians perceive themselves as having recently been exposed to disruptive behaviour in the OR. Clinicians with membership in socio-demographic groups that have traditionally been afforded less power tend to report experiencing more disruptive behaviour. Institutions should consider developing and refining mechanisms to prevent the occurrence of disruptive behaviour. Special efforts should be made to ensure that clinicians speak respectfully about one another and the patients under their care. These combined efforts would help to improve worker well-being, promote good patient care, and even safeguard the public's trust in OR clinicians.

Appendix 1 Associations distributing the survey and the method of survey distribution

Country	Associations that distributed the survey	Method of distribution	Sampling frame
Canada	1. Canadian Anesthesiologists' Society	Link emailed	2,480 (100%) members
	2. Operating Room Nurses Association of Canada (ORNAC)	Posted on website	2,600 members
	3. The Canadian Society of Clinical Perfusion	Link emailed	319 (100%) members
	4. Canadian Federation of Medical Students	Link emailed	2,803 students
USA	5. Association of periOperative Registered Nurses (AORN)	Link emailed	5,500 members
	6. American Association of Nurse Anesthetists (AANA)-CRNA response	Link emailed	2,967 members
	7. American Society of Anesthesiologists (ASA)	Link emailed	23,523 (100%) members
	8. American Society of Extra-Corporeal Technology (AmSECT)	Link emailed	3,094 members
	9. American Academy of Anesthesiologist Assistants (AAAA)	Link emailed	874 members
United Kingdom & Ireland	10. Association for Perioperative Practice (AfPP)	Link emailed	4,939 members
	11. Association of Laparoscopic Surgeons of Great Britain and Ireland (ALSGBI)	Link emailed	488 members
	12. The Society of Clinical Perfusion Scientists of Great Britain and Ireland	Link emailed	373 members
	13. The Royal College of Anaesthetists	Posted on website	17,000 members
	14. The Association of Anaesthetists of Great Britain and Ireland (AAGBI)	Included in newsletter	9,708 members included in Royal College
India	15. Indian Society of Anaesthesiologists (ISA)	Link emailed	1,621 members
	16. Association of Spine Surgeons of India (ASSI)	Link emailed	934 members

continued

Country	Associations that distributed the survey	Method of distribution	Sampling frame
New Zealand & Australia	17. Perioperative Nurses College (NZNO-PNC)	Link emailed t	1,000 members
	18. Australia and New Zealand College of Anaesthetists (ANZCA)	Link emailed	987 members
	19. Australian Society of Plastic Surgeons	Link emailed	480 members
	20. New Zealand Anaesthetic Technicians society	Link emailed	476 members
	21. Royal Australasian College of Surgeons (Australia and New Zealand)	Included link in newsletter	7,198 members
Brazil	22. Brazilian Society of Anesthesiology	Emailed	9,767 members
	23. Canadian Association of General Surgeons	Viral distribution to surgeons across Canada	(estimated at 9,671 surgical specialists)
Total			101,624 clinicians

CRNA = Certified registered nurse anesthetist.

Appendix 2 Survey distribution and response rates, stratified by respondent profession

	Number of associations sent a request	Number of associations who distributed the survey	Distribution rate (%)	Approximate sampling frame (N)	Response (n)	Response rate (%)
Anesthesiology	17	7	41.12	55,378	3,366	6.07
Nursing	15	5	33.3	17,006	2,092	12.3
Surgery	83	5	6.0	18,771	869	4.6
Other (student, assistant, technician)	17	6	35.3	7,939	1,138	14.3
Mixed (combination of anesthesiology, surgery, and/or nursing)	2	0	0	n/a	n/a	n/a
Local distribution*	3 (sites)	3	100	1349	unknown	unknown
Total	134	23	17.2	101,624	7,465	7.35

*Specified clinicians added to the appropriate categories for calculation of the sampling frames, but unspecified operating room clinicians are shown here.

Focused recruitment efforts

Region	Coordinated by	Number of clinicians targeted
Manitoba region	E.J., A.V.	700 additional nurses
Michigan University Medical System	A.Y.	1,349 clinicians, 169 students
Washington University in St. Louis	M.A.	302 students

Appendix 3 Wave analyses

Form of exposure	Personal		Patient		In-group		Out-group		Undirected	
Respondent country of origin	rho	P value	rho	P value	rho	P value	rho	P value	Rho	P value
All	-0.007	0.547	-0.023	0.18	0.009	0.47	-0.030	0.012	0.02195777	0.064
Canada	0.013	0.566	-0.009	0.682	-0.039	0.025	0.062	0.005	0.121	2.404e-08
USA	0.016	0.360	0.012	0.482	-0.039	0.025	-0.002	0.892	0.001	0.970
Brazil	0.121	0.020	0.059	0.275	0.110	0.044	0.012	0.838	0.022	0.687
United Kingdom	-0.181	0.002	-0.042	0.489	-0.130	0.031	-0.180	0.003	-0.140	0.021
New Zealand	0.008	0.887	-0.096	0.094	-0.002	0.967	0.047	0.422	0.002	0.976
Australia	-0.032	0.563	-0.055	0.335	-0.064	0.284	-0.073	0.205	-0.09	0.123
India	0.157	0.001	-0.005	0.907	0.149	0.002	0.104	0.036	0.102	0.037
Other	-0.412	0.0002	-0.109	0.383	-0.313	0.012	-0.199	0.121	-0.180	0.159

Appendix 4 Sensitivity analysis: geographically stratified models

Beta coefficients				
Variable	Category	Overall	Respondents in North America	Respondents outside North America
Intercept		-2.917	-2.939	-2.675
Age of respondent (yr)	Age < 30 *vs* > 60	0.247	0.244	0.277
	Age 30-40 *vs* > 60	0.335	0.329	0.369
	Age 41-50 *vs* > 60	0.193	0.188	0.262
	Age 51-60 *vs* > 60	0.152	0.166	0.029
Sex	Female	0.210	0.235	0.126
Sexual orientation	Non-heterosexual/prefer not to disclose	0.110	0.082	0.170
Profession	Nurse *vs* anesthesiologist	0.516	0.506	0.584
	Surgeon *vs* anesthesiologist	0.024	0.071	0.005
	Other *vs* anesthesiologist	0.340	0.332	0.388
Visible ethnic or cultural minority	Yes	0.020	0.023	0.022
Institution funding	Private *vs* public	0.112	0.129	0.068
Years since training ended	Student *vs* 11-20	-0.038	-0.020	0.098
	Trainee *vs* 11-20	0.231	0.162	0.362
	< 2 *vs* 11-20	0.047	-0.123	0.363
	2-5 *vs* 11-20	0.059	0.034	0.127
	6-10 *vs* 11-20	-0.028	-0.025	-0.027
	21-30 *vs* 11-20	0.061	0.114	-0.171
	31-40 *vs* 11-20	-0.061	-0.049	-0.079
	> 40 *vs* 11-20	-0.234	-0.334	-0.003

Appendix 4 continued

Beta coefficients

Variable	Category	Overall	Respondents in North America	Respondents outside North America
Time to respond to survey		0.001	0.002	0.000
Any exposure questions incomplete	No	0.061	0.051	0.084
Hours spent in OR per week	Student *vs* 41-50	0.000	0.000	0.000
	< 10 *vs* 41-50	-0.423	-0.345	-0.776
	11-20 *vs* 41-50	-0.424	-0.425	-0.480
	21-30 *vs* 41-50	-0.225	-0.169	-0.363
	31-40 *vs* 41-50	-0.065	-0.048	-0.167
	51-60 *vs* 41-50	0.069	0.075	0.028
	> 60 *vs* 41-50	0.409	0.465	0.196

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