
National Evaluation of Needlestick Events and Reporting Among Surgical Residents



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BACKGROUND: Needlestick injuries pose significant health hazards; however, the nationwide frequency of needlesticks and reporting practices among surgical residents are unknown. The objectives of this study were to examine the rate and circumstances of self-reported needlestick events in US surgery residents, assess factors associated with needlestick injuries, evaluate reporting practices, and identify reporting barriers.

STUDY DESIGN: A survey administered after the American Board of Surgery In-Training Examination (January 2017) asked surgical residents how many times they experienced a needlestick during the last 6 months, circumstances of the most recent event, and reporting practices and barriers. Factors associated with needlestick events were examined using multivariable hierarchical regression models.

RESULTS: Among 7,395 resident survey respondents from all 260 US general surgery residency programs (99.3% response rate), 27.7% ($n = 2,051$) noted experiencing a needlestick event in the last 6 months. Most events occurred in the operating room (77.5%) and involved residents sticking themselves (76.2%), mostly with solid needles (84.7%). Self-reported factors underlying needlestick events included residents' own carelessness (48.8%) and feeling rushed (31.3%). Resident-level factors associated with self-reported needlestick events included senior residents (PGY5 29.9% vs PGY1 22.4%; odds ratio 1.66; 95% CI 1.41 to 1.96), female sex (31.9% vs male 25.2%; odds ratio 1.31; 95% CI 1.18 to 1.46), or frequently working more than 80 hours per week (odds ratio 1.42; 95% CI 1.20 to 1.68). More than one-fourth (28.7%) of residents did not report the needlestick event to employee health.

CONCLUSIONS: In this comprehensive national survey of surgical residents, needlesticks occurred frequently. Many needlestick events were not reported and numerous reporting barriers exist. These findings offer guidance in identifying opportunities to reduce needlesticks and encourage reporting of these potentially preventable injuries among trainees. (*J Am Coll Surg* 2019;229:609–620. © 2019 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

Needlestick injuries have potentially significant consequences in healthcare workers due to exposure to blood-borne pathogens.¹⁻³ Surgeons and surgical residents, in

particular, are known to be at high risk for needlestick injuries because they perform invasive procedures frequently.⁴⁻¹² Beyond potentially exposing healthcare

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Abbreviations and Acronyms

ABS	= American Board of Surgery
ABSITE	= American Board of Surgery In-Training Examination
GHQ-12	= General Health Questionnaire-12
OR	= odds ratio

workers to infectious diseases (eg HIV, hepatitis B, and hepatitis C),^{1-3,6,13,14} the event itself can cause substantial distress and can contribute to attrition.^{15,16}

Needlestick events among trainees in healthcare are common; a majority of medical students and surgical residents have experienced a needlestick during their training.^{1,3,7,8,11,17,18} However, comprehensive data on needlestick events in surgical trainees are lacking. Earlier studies were mostly limited to a small number of institutions and/or had low survey response rates, with the largest study (699 residents from 19 centers) performed more than a decade ago.⁸ Low rates of reporting needlestick injuries to employee health complicate the issue.^{1,8,17,19-23} Early reporting can offer the opportunity to rapidly initiate prophylaxis or treatment, and ensures that healthcare needs and expenses are covered by the employer.^{24,25}

Substantial knowledge gaps remain at a national level in the US concerning the frequency and circumstances of needlestick events in surgical residents, factors associated with the events, reporting rates, and barriers to reporting. In addition, since the last large study on needlesticks was published there have been changes in duty hour policies and a focus on resident wellness; it is unknown whether these contemporary issues have any associations with needlestick events and/or reporting of needlesticks. Using a national survey of all residents at the 260 ACGME-accredited general surgery programs in the US, our objectives were to examine the rate of self-reported needlestick events in surgery residents, assess resident- and program-level factors associated with needlestick injuries, understand the circumstances of the needlestick events, evaluate reporting practices of needlestick injuries among surgery residents, and identify barriers to reporting.

METHODS**Data source and study population**

The American Board of Surgery In-Training Examination (ABSITE) is administered annually in January to all residents in ACGME-accredited general surgery programs in the US ($n = 260$ at the time of this study). In partnership with the American Board of Surgery (ABS), all residents

taking the January 2017 ABSITE were offered an optional closed-ended survey at the end of the examination as a part of the FIRST (Flexibility in Duty Hour Requirements for Surgical Trainees) trial.^{26,27} Residents were included in the study population if they were clinically active and completed at least 1 question pertaining to needlesticks. Those residents who were not clinically active and those who did not answer any needlestick questions were excluded. Resident responses were collected by the ABS and de-identified before analysis. Resident- and program-level characteristics were provided by the ABS. The Northwestern University IRB office determined that this study constituted nonhuman subjects research as a part of the FIRST trial.^{26,27}

Survey instrument

The survey included questions on duty hour violations and flexibility, resident well-being, and safety-related events, such as needlesticks. Residents were specifically asked how many times they experienced a needlestick in the last 6 months (0, 1, 2, 3 to 5, or more than 5 times), which represented the current academic year at the time of the survey, to minimize recall bias. The responses were dichotomized for the analyses as 0 times vs 1 or more times. Those residents who reported experiencing a needlestick were then asked yes/no questions about the circumstances of their most recent needlestick and to select from a list of potential factors that played a role in the needlestick event. All respondents were asked about perceived barriers to reporting needlesticks to employee health. Residents were allowed to select multiple options. Additional survey items covered violations of duty hour regulations, time for rest, and fatigue. The General Health Questionnaire-12 (GHQ-12), an instrument used to evaluate psychiatric well-being and potential for psychiatric disorders, including depression; anxiety; and social dysfunction, was included to understand the association between residents' psychiatric well-being and their personal safety.²⁸⁻³² Survey items were adapted from previously published surveys and review of the literature, pretested with residents using cognitive interviews, and iteratively revised and retested before inclusion.^{26,27}

Statistical analyses

Cluster-weighted chi-square tests with clustering by residency program were used to assess differences in the rates of needlestick events, circumstances of the events, and reporting the event to employee health by resident and program characteristics. Separate multivariable hierarchical logistic regression models with random intercepts for residency program plus fixed effects for resident and program characteristics examined the association between

these characteristics and (a) experiencing a needlestick in the last 6 months, and (b) reporting it to employee health.

Resident characteristics examined included PGY, sex, separate variables for duty hour violations of ACGME duty hour policies (ie 3 or more times in the most recent month of a general surgery rotation of working more than 28 hours continuously, having fewer than 8 hours off between regular shifts 3 or more times, or working more than 80 hours in a week), and quartile of the GHQ-12 score. In accordance with earlier studies of healthcare professionals, poor psychiatric well-being was defined as a GHQ-12 score ≥ 4 .²⁸⁻³⁰ Program characteristics examined included program type, geographic region, and program size (dichotomized to ≤ 5 vs ≥ 6 categorical residents per PGY). Differences in the rates of reporting the most recent needlestick to employee health were examined based on resident self-reported factors that played a role in the needlestick and perceived reporting barriers to determine whether these variables were associated with reporting. All descriptive analyses included cluster-adjusted chi-square tests.

Finally, program-level rates of needlestick events among residents were calculated and plotted to assess variation across training programs. The level of significance was set at 0.05. Analyses were performed using Stata Software, version 14 (Stata Corp).

RESULTS

The total number of residents taking the 2017 ABSITE was 8,227. There were 786 residents who were not clinically active during the administration of the ABSITE, 46 who did not answer the clinically active question on the survey, and 4 residents who failed to answer any needlestick questions. Our study sample thus included 7,391 clinically active residents representing all 260 ACGME-accredited general surgery residency programs in the US. The response rate was 99.3%. Additional characteristics of the study cohort are described in [Table 1](#).

Self-reported needlestick event rate and factors associated with needlestick injuries

Of the study sample, 27.7% of surgical residents ($n = 2,051$) self-reported experiencing a needlestick within the 6 months before the survey (ie current academic year). When we examined resident- and program-level factors associated with needlestick events ([Table 2](#)), we found that senior residents were more likely to experience a needlestick compared with PGY1 residents (PGY1 22.4% vs PGY5 29.9%; odds ratio [OR] 1.66; 95% CI 1.41 to 1.96). Women were more likely to experience a

needlestick compared with men (women 31.9% vs men 25.2%; OR 1.31; 95% CI 1.18 to 1.46), and this pattern was similar at all PGY levels. Repeated violation of ACGME duty hour restrictions (working more than 28 hours continuously, having fewer than 8 hours off between shifts, or working more than 80 hours in a week 3 or more times during the most recent month on a general surgery rotation) was associated with greater likelihood of self-reporting a needlestick for all 3 types of violations (all, $p < 0.05$) ([Table 2](#)). Overall, 44.3% of residents were found to have poor psychiatric well-being (GHQ-12 scores ≥ 4). Residents with GHQ-12 scores of 6 to 12 (highest quartile) were more likely to experience a needlestick injury (31.2% vs GHQ-12 score 0 to 1 [lowest quartile] 23.0%; OR 1.33; 95% CI 1.15 to 1.54). At the program level, resident-reported needlestick rates ranged from 0% to 62.5%; only 2 residency programs had no resident-reported events during the past 6 months, and 8 programs had $\geq 50\%$ of their residents self-reporting experiencing a needlestick ([Fig. 1](#)).

Circumstances and self-reported factors playing a role in needlestick events

When asked about the circumstances of their most recent needlestick injury ([Table 3](#)), residents reported that most occurred in the operating room (77.5%; $n = 1,590$), commonly involved sticking themselves (76.2%; $n = 1,563$), and frequently involved solid needles (84.7%; $n = 1,738$). PGY1 residents were more likely to answer that they stuck themselves than PGY5 residents ($p = 0.01$). There were no sex differences in self-reported circumstances of the needlestick event.

Residents were asked about the conditions of their most recent needlestick event ([Table 3](#)). They most commonly described that their own carelessness played a role (48.8%; $n = 1,001$). Fatigue (21.4%; $n = 439$) and feeling rushed (31.3%; $n = 641$) were not commonly reported as contributors to the needlestick events. PGY1 residents more frequently attributed their needlestick event to inexperience (48.0% vs PGY5 4.0%; $p < 0.001$) or feeling rushed (39.2% vs PGY5 19.4%; $p < 0.001$). Higher PGY levels were associated with residents citing carelessness of a colleague as contributing to their needlestick compared with PGY1 residents (PGY5 28.5% vs PGY1 18.7%; $p = 0.004$). Women more frequently stated that their fatigue played a role in the needlestick event (23.9% vs men 19.3%; $p = 0.02$), and men more frequently stated that their inexperience played a role (23.0% vs women 18.7%; $p = 0.02$). Only 14.9% ($n = 306$) of the cohort thought that the needlestick event could not have been prevented.

Table 1. Resident and Program Characteristics

Characteristic	Total (n = 7,391)	
	n	%
Experienced needlestick event in the last 6 mo	2,051	27.7
PGY		
1	2,127	28.8
2	1,563	21.2
3	1,303	17.6
4	1,224	16.6
5	1,174	15.9
Resident sex		
Male	4,528	61.3
Female	2,829	38.3
Duty hour experience in most recent month of general surgery rotation		
Worked >28 h continuously ≥ 3 times	1,022	13.8
Had <8 h off between regular shifts ≥ 3 times	801	10.8
Exceeded 80 h in a week ≥ 3 times	1,120	15.2
General Health Questionnaire-12 score quartile		
First quartile (score range 0–1)	2,158	29.2
Second quartile of GHQ-12 scale (score range 2–3)	1,959	26.5
Third quartile of GHQ-12 scale (score range 4–5)	1,431	19.4
Fourth quartile of GHQ-12 scale (score range 6–12)	1,839	24.9
Program type		
Academic	4,448	60.2
Community	2,727	36.9
Military	216	2.9
Geographic region		
Northeast	2,473	33.5
Southeast	1,425	19.3
Midwest	1,597	21.6
Southwest	852	11.5
West	1,044	14.1
No. of PGY5 residents in program		
0–5	4,010	54.3
6 or more	3,381	45.7

Duty hour experiences listed are not mutually exclusive categories. Each is asked as a separate question in the resident survey. Percentages might not sum to exactly 100% due to rounding or missing data (missing resident sex from 34 respondents (n = 7,357) and General Health Questionnaire-12 score is missing for 4 respondents (n = 7,387)).

GHQ, General Health Questionnaire.

Needlestick reporting practices, barriers to reporting, and factors associated with reporting

Overall, 28.7% (n = 589) of the residents who noted experiencing a needlestick event in the past 6 months

did not report that event to employee health (Table 4). PGY level was not significantly associated with reporting. Men were less likely to report their most recent needlestick event (men 69.5% vs women 73.8%; OR 0.77; 95% CI 0.63 to 0.94). When duty hour policy violations were examined, residents who reported frequently having fewer than 8 hours off between shifts (fewer than 8 hours off 3 or more times 62.5% vs fewer than 8 hours off 0 to 2 times 72.9%; OR 0.73; 95% CI 0.54 to 0.99) or frequently working more than 80 hours in a week (more than 80 hours in a week 3 or more times 63.0% vs more than 80 hours in a week 0 to 2 times 73.5%; OR 0.70; 95% CI 0.52 to 0.93) were less likely to report their most recent needlestick. Residents with the poorest psychiatric well-being (top quartile of GHQ-12 scores) were also less likely to report needlesticks (score 6 to 12 [top quartile] 65.0% vs score 0 to 1 [bottom quartile] 76.8%; OR 0.61; 95% CI 0.46 to 0.81).

Residents were asked about the barriers to reporting their most recent needlestick event (Table 3). The most commonly cited reasons were that reporting takes too much time (80.3%; n = 1,647) and is too much of a disruption to operative cases (52.3%; n = 1,073). Women more frequently said that needlestick reporting takes too much time (women 83.2% vs men 78.1%; p = 0.007) and that reporting is too much of a disruption to operative cases (women 56.4% vs men 49.3%; p = 0.005).

When asked about reporting procedures, 11.2% (n = 229) of residents stated that they did not know how to report the event. PGY1 residents were more likely to respond that they did not know how to report a needlestick event compared with PGY2 to PGY5 residents (PGY1 17.0% vs PGY5 8.8%; p < 0.001). Additionally, 21.6% (n = 443) of residents thought that they did not need to report the event because they thought the infection risk was low, and 6.8% of residents (n = 140) did not report the event because they did not want to know the result of testing for communicable diseases. Men more frequently responded that there is no need to report needlesticks because the infection risk is low (men 24.6% vs women 17.9%; p < 0.001) or because they did not want to know the result (men 8.5% vs women 4.7%; p < 0.001). Only 7.5% of residents (n = 153) responded that they felt pressure not to report, but 25.5% of residents (n = 523) responded that there was a negative stigma associated with experiencing a needlestick event, and this negative stigma was most frequently perceived in PGY1 residents (PGY1 32.1% vs PGY5 17.4%; p < 0.001).

When we examined the rates of reporting their most recent needlestick to employee health according to the residents' self-reported circumstances of the event and barriers to reporting (Table 5), needlestick reporting rates were

Table 2. Factors Associated with Experiencing a Needlestick Event Within the Last 6 Months

Variable	Experienced needlestick event (n = 7,391)		p Value*	Adjusted odds ratio [†] for experiencing needlestick event (95% CI)
	n	%		
All residents	2,051	27.7		
PGY			<0.001	
1	477	22.4		1.00 (ref)
2	448	28.7		1.41 (1.21–1.64) [‡]
3	389	29.9		1.52 (1.29–1.79) [‡]
4	386	31.5		1.71 (1.45–2.01) [‡]
5	351	29.9		1.66 (1.41–1.96) [‡]
Resident sex			<0.001	
Male	1,141	25.2		1.00 (ref)
Female	901	31.9		1.31 (1.18–1.46) [‡]
Duty hour experience in most recent month of general surgery rotation				
Worked >28 h 0–2 times	1,675	26.3	<0.001	1.00 (ref)
Worked >28 h 3 or more times	376	36.8		1.24 (1.05–1.47) [§]
Had <8 h off between shifts 0–2 times	1,739	26.4	<0.001	1.00 (ref)
Had <8 h off between shifts ≥3 times	312	39.0		1.34 (1.12–1.61)
Worked >80 h in a week 0–2 times	1,624	25.9	<0.001	1.00 (ref)
Worked >80 h in a week ≥3 times	427	38.1		1.42 (1.20–1.68) [‡]
General Health Questionnaire-12 score quartile			<0.001	
First quartile (score range 0–1)	496	23.0		1.00 (ref)
Second quartile of GHQ-12 scale (score range 2–3)	525	26.8		1.17 (1.01–1.35) [§]
Third quartile of GHQ-12 scale (score range 4–5)	455	31.8		1.40 (1.20–1.64) [‡]
Fourth quartile of GHQ-12 scale (score range 6–12)	574	31.2		1.33 (1.15–1.54) [‡]
Program type			0.005	
Academic	1,294	29.1		1.00 (ref)
Community	715	26.2		0.87 (0.75–1.00)
Military	42	19.4		0.59 (0.40–0.89) [§]
Geographic region			0.89	
Northeast	700	28.3		1.00 (ref)
Southeast	380	26.7		0.95 (0.80–1.13)
Midwest	436	27.3		0.97 (0.82–1.15)
Southwest	242	28.4		1.04 (0.84–1.28)
West	293	28.1		1.01 (0.84–1.23)
No. of PGY5 residents in program			0.16	
0–5	1,080	26.9		1.00 (ref)
≥6	971	28.7		1.00 (0.87–1.14)

*Bivariate p values are from cluster-corrected chi-square tests of differences in needlestick rates across categories of each variable with responses clustered by residency program.

[†]Adjusted odds ratios are from a hierarchical logistic regression model containing all variables displayed and with random intercepts for residency program.

[‡]p < 0.001.

[§]p < 0.5.

^{||}p < 0.01.

GHQ, General Health Questionnaire.

lowest when residents responded that there was no need to report because the infection risk was low (47.6% vs residents who disagreed that infection risk was low 77.8%; p < 0.001). Needlestick reporting rates were lower when

residents thought certain factors contributed to their most recent needlestick, including inexperience (66.6% vs disagreed inexperience played a role 72.5%; p = 0.03), fatigue (65.4% vs disagreed fatigue played a role

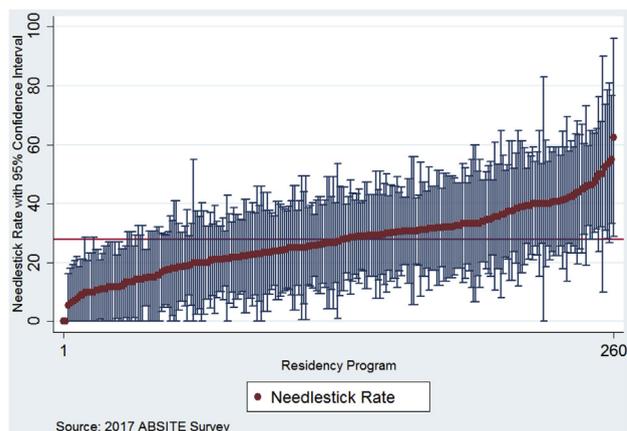


Figure 1. Variation in program-level rates of surgical resident needlestick events during the most recent 6-month period (representing the current academic year).

72.9%; $p = 0.006$), feeling rushed (67.9% vs disagreed feeling rushed played a role 72.8%; $p = 0.04$), or their own carelessness (66.7% vs disagreed own carelessness played a role 75.6%; $p < 0.001$). Residents were also less likely to report the event if they responded that reporting was too much of a disruption to operative cases (66.4% vs disagreed reporting was too much of a disruption 76.7%; $p < 0.001$). Residents were less likely to report the event to employee health if they disagreed that the carelessness of others played a role in their most recent needlestick (68.5% vs agreed carelessness of others played a role 81.3%; $p < 0.001$) or if they thought that the needlestick could have been prevented (69.7% vs agreed needlestick could not have been prevented 80.1%; $p = 0.001$).

DISCUSSION

Surgeons and, in particular, surgical residents are at high risk for needlestick injuries, given the procedural nature of the specialty. By surveying 7,391 surgery residents representing all 260 ACGME-accredited general surgery residents in the US with a 99.3% response rate, we were able to perform a detailed national evaluation of self-reported needlestick events in surgical residents and examine specifics about reporting practices, making this study the most comprehensive analysis of needlestick injuries to date. We found that 27.7% of surgical residents surveyed reported experiencing a needlestick within the last 6 months, and more than one-fourth of the residents did not report the event to employee health.

Needlestick event rate and factors associated with needlestick injuries

More than one-quarter (27.7%) of the residents surveyed self-reported experiencing a needlestick injury within the

6 months before being surveyed. Previous studies have shown that trainees have a high incidence of needlestick injuries during training, ranging from 12% to 83%, and that the rate tends to increase with time.^{3,7,8,11,18,33,34}

However, most studies were performed in smaller cohorts, often limited to a single-institution or smaller multi-institutional studies, and were usually not focused solely on surgical residents; the largest study to date was from 19 centers,⁸ and our study included all 260 ACGME-accredited general surgery residency programs in the US.

At the program level, there was considerable variation in needlestick injury rates. Although 2 programs had no needlesticks among their residents during the 6-month period included in this study, 8 programs had $\geq 50\%$ of their residents reporting a needlestick injury. This variation suggests that some programs have fairly low needlestick event rates, and there might be differences in program-level teaching and culture about handling needles that contributes to the low rate and can serve as examples of best practices.

We identified several factors that were associated with surgical residents experiencing needlestick injuries. Women were more likely to self-report experiencing a needlestick injury compared with men. This might be due to higher actual event rates or could be related to gender differences in health awareness and help-seeking behaviors.³⁵⁻³⁹ Residents who reported repeated violations of ACGME duty hour policies, specifically the limitations on shift length, time off between shifts, and limitations on total work hours, also had an increased likelihood of experiencing a recent needlestick injury. The easiest explanation for this association is resident fatigue.⁴⁰⁻⁴² However, although fatigue was not a commonly cited factor underlying the needlestick injury in this study, most needlestick injuries involved residents sticking themselves and almost half of residents blamed their own carelessness. This might indicate residents are not aware that their own fatigue can play a role in needlestick events. It is also important to acknowledge that it is uncertain whether more restrictive duty hour policies than those that are currently in place lead to improved resident or patient safety.⁴³

Although most residents in this study responded that their most recent needlestick event could have been prevented, 14.9% of residents thought that their most recent needlestick could not have been prevented. Because it is well established that needlestick events can be considered a preventable workplace injury,² the findings from this study highlight the need to educate not only residents, but also attending surgeons and other healthcare workers, in safe needle and sharp instrument handling practices, especially considering that 21.8% of residents reported that the carelessness of another played a role in their needlestick event.

Table 3. Resident-Reported Circumstances and Factors in Most Recent Needlestick Event and Perceived Barriers to Reporting by PGY and Sex

Variable	Total (n = 2,051)		PGY										p Value*	Resident sex				p Value*	
			1 (n = 477)		2 (n = 448)		3 (n = 389)		4 (n = 386)		5 (n = 351)			Male (n = 1141)		Female (n = 901)			
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
Circumstance of most recent needlestick incident																			
Stick occurred in operating room	1,590	77.5	326	68.3	303	67.6	311	80.0	332	86.0	318	90.6	<0.001	880	77.1	703	78.0	0.67	
Stuck oneself	1,563	76.2	380	79.7	353	78.8	299	76.9	285	73.8	246	70.1	0.01	852	74.7	705	78.3	0.06	
Stick occurred during a call shift	752	36.7	141	29.6	180	40.2	166	42.7	153	39.6	112	31.9	0.001	401	35.1	346	38.4	0.19	
Stuck with a hollow-bore needle	313	15.3	84	17.6	76	17.0	64	16.5	48	12.4	41	11.7	0.13	169	14.8	142	15.8	0.60	
Factor that played a role																			
Personal inexperience played a role	431	21.0	229	48.0	106	23.7	53	13.6	29	7.5	14	4.0	<0.001	262	23.0	168	18.7	0.02	
My fatigue played a role	439	21.4	97	20.3	97	21.7	117	30.1	71	18.4	57	16.2	<0.001	220	19.3	215	23.9	0.02	
I felt rushed	641	31.3	187	39.2	163	36.4	123	31.6	100	25.9	68	19.4	<0.001	337	29.5	300	33.3	0.11	
My carelessness played a role	1,001	48.8	222	46.5	234	52.2	200	51.4	187	48.5	158	45.0	0.19	572	50.1	424	47.1	0.17	
Carelessness of another played a role	448	21.8	89	18.7	84	18.8	80	20.6	95	24.6	100	28.5	0.004	242	21.2	204	22.6	0.45	
Could not have been prevented	306	14.9	58	12.2	58	13.0	61	15.7	66	17.1	63	18.0	0.11	166	14.6	140	15.5	0.56	
Perceived barrier to needlestick reporting																			
Takes too much time	1,647	80.3	368	77.2	351	78.4	320	82.3	316	81.9	292	83.2	0.17	891	78.1	750	83.2	0.007	
Too much of a disruption to operative case	1,073	52.3	231	48.4	200	44.6	222	57.1	232	60.1	188	53.6	<0.001	562	49.3	508	56.4	0.005	
Do not know how to report event	229	11.2	81	17.0	49	10.9	37	9.5	31	8.0	31	8.8	<0.001	127	11.1	100	11.1	0.98	
No need to report because infection risk is low	443	21.6	97	20.3	101	22.5	92	23.7	88	22.8	65	18.5	0.41	281	24.6	161	17.9	<0.001	
There is pressure not to report	153	7.5	43	9.0	29	6.5	34	8.7	28	7.3	19	5.4	0.35	75	6.6	77	8.6	0.13	
Negative stigma associated with needlestick event	523	25.5	153	32.1	128	28.6	98	25.2	83	21.5	61	17.4	<0.001	295	25.9	227	25.2	0.73	
Do not want to know test result	140	6.8	32	6.7	32	7.1	31	8.0	27	7.0	18	5.1	0.65	97	8.5	42	4.7	<0.001	

*p Values are from cluster-corrected chi-square tests of differences in needlestick rates across level and sex with responses clustered by residency program.

Based on responses from 2,051 residents who reported experiencing a needlestick in the 6 months before survey administration. Each potential circumstance was asked as an independent yes/no question. Factors and perceived barriers were presented as lists where respondents could select all that applied.

Table 4. Factors Associated with Reporting Most Recent Needlestick to Employee Health

Variable	Rate of reporting to employee health (n = 2,051)		p Value*	Adjusted odds ratio [†] for reporting needlestick event to employee health (95% CI)
	n	%		
Needlestick event reported to employee health	1,462	71.3		
PGY			0.58	
1	344	72.1		1.00 (ref)
2	319	71.2		0.84 (0.62–1.13)
3	269	69.2		0.76 (0.56–1.04)
4	268	69.4		0.75 (0.55–1.03)
5	262	74.6		0.96 (0.69–1.33)
Resident sex			0.06	
Female	665	73.8		1.00 (ref)
Male	793	69.5		0.77 (0.63–0.94) [‡]
Duty hour experience in most recent month of general surgery rotation				
Worked >28 h 0–2 times	1,197	71.5	0.74	1.00 (ref)
Worked >28 h 3 or more times	265	70.5		1.33 (0.99–1.78)
Had <8 h off between shifts 0–2 times	1,267	72.9	0.001	1.00 (ref)
Had <8 h off between shifts ≥3 times	195	62.5		0.73 (0.54–0.99) [‡]
Worked >80 h in a week 0–2 times	1,193	73.5	<0.001	1.00 (ref)
Worked >80 h in a week ≥3 times	269	63.0		0.70 (0.52–0.93) [‡]
General Health Questionnaire-12 score quartile			0.002	
First quartile (score range 0–1)	381	76.8		1.00 (ref)
Second quartile of GHQ-12 scale (score range 2–3)	382	72.8		0.84 (0.62–1.12)
Third quartile of GHQ-12 scale (score range 4–5)	325	71.4		0.79 (0.58–1.07)
Fourth quartile of GHQ-12 scale (score range 6–12)	373	65.0		0.61 (0.46–0.81) [§]
Program type			0.15	
Academic	901	69.6		1.00 (ref)
Community	530	74.1		1.25 (0.97–1.62)
Military	31	73.8		1.34 (0.62–2.88)
Geographic region			0.12	
Southwest	183	75.6		1.00 (ref)
Northeast	482	68.9		0.68 (0.47–0.98) [‡]
Southeast	287	75.5		0.95 (0.64–1.43)
Midwest	311	71.3		0.71 (0.48–1.05)
West	199	67.9		0.62 (0.41–0.94) [‡]
No. of PGY5 residents in program			0.02	
0–5	796	73.7		1.00 (ref)
≥6	666	68.6		0.77 (0.61–0.98) [‡]

Based on responses from 2,051 residents who indicated they experienced a needlestick in the 6 months before survey administration.

*Bivariate p values are from cluster-corrected chi-square tests of differences in reporting rates across categories of each variable with responses clustered by residency program.

[†]Adjusted odds ratios are from a hierarchical logistic regression model containing all variables displayed and with random intercepts for residency program.

[‡]p < 0.05.

[§]p < 0.01.

GHQ, General Health Questionnaire.

Table 5. Resident Rates of Reporting Most Recent Needlestick Events to Employee Health by Perceptions of Contributing Factors and Reporting Barriers

Factor/barrier, agreement	Reported to employee health		p Value
	n	%	
Most recent needlestick event factor			
Personal inexperience played a role			0.03
Agreed	287	66.6	
Disagreed	1,175	72.5	
My fatigue played a role			0.006
Agreed	287	65.4	
Disagreed	1,175	72.9	
I felt rushed when needlestick occurred			0.04
Agreed	435	67.9	
Disagreed	1,027	72.8	
My carelessness played a role			<0.001
Agreed	668	66.7	
Disagreed	794	75.6	
Carelessness of another person played a role			<0.001
Agreed	364	81.3	
Disagreed	1,098	68.5	
The needlestick could not have been prevented			0.001
Agreed	245	80.1	
Disagreed	1,217	69.7	
Perceived barrier to needlestick reporting, agreement with factor/barrier			
Reporting the event takes too much time			0.33
Agreed	1,183	71.8	
Disagreed	279	69.1	
Too much disruption to operative case			<0.001
Agreed	712	66.4	
Disagreed	750	76.7	
Do not know how to report the event			0.92
Agreed	164	71.6	
Disagreed	1,298	71.2	
No need to report the event because the risk of infection is low			<0.001
Agreed	211	47.6	
Disagreed	1,251	77.8	
There is pressure not to report			0.24
Agreed	102	66.7	
Disagreed	1,360	71.7	
Negative stigma associated with a needlestick			0.94
Agreed	372	71.1	
Disagreed	1,090	71.3	
Do not want to know the test result			0.24
Agreed	93	66.4	
Disagreed	1,369	71.6	

Based on responses from 2,051 residents who reported experiencing a needlestick in the 6 months before survey administration, of whom 1,462 (71.3%) reported their most recent needlestick to employee health. p Values are from cluster-corrected chi-square tests of differences in needlestick rates across categories of each variable with responses clustered by residency program.

Circumstances and self-reported factors playing a role in needlestick events

As with previous studies,^{3,5,8} most needlesticks in surgical residents occurred in the operating room with solid needles, presumably when suturing. Although sharp-tip needles cannot be eliminated, some have advocated for the use of blunt-tip suture needles whenever possible, which have been shown to reduce the risk of needlestick injury.^{1,2,44,45} Another way to reduce the risk of transmission of blood-borne pathogens is through encouraging the practice of wearing 2 layers of gloves during bedside procedures, in addition to the safe needle handling education.^{1,46}

Needlestick reporting practices, barriers to reporting, and factors associated with reporting

Reporting of needlestick injuries by residents to their institution's employee health service is essential for many reasons. Reporting the event allows for testing of both the involved resident and patient for the presence and transmission of blood-borne pathogens, rapid initiation of prophylaxis in appropriate circumstances, early treatment of actual pathogen transmissions, and ensures that any healthcare needs and expenses related to this occupational safety event will be covered by the employer.^{24,25} More than one-fourth (28.7%) of the residents in this cohort who noted experiencing a needlestick did not report that event to employee health and, distressingly, a considerable proportion (21.6%) of residents reported feeling no need to report their needlestick injury because they thought the infection risk was low. Although the reporting rate in this study is higher than reported historical rates (usually around 50%),^{8,11,18-21,23,47} additional efforts are needed to educate all healthcare providers about the benefits of reporting needlestick injuries and the risks of not reporting and eliminate fears that there are negative consequences to reporting (eg negative perceptions of the resident among attending surgeons).

Overt external pressure on residents to not report needlestick events was rare, which is similar to a previous single-institution report.¹¹ However, 52.3% of residents responded that reporting is too much of a disruption to operative cases, and 25.5% of residents thought there is a negative stigma associated with needlestick events. Therefore, attending surgeons and other hospital staff need to be aware of the subtle, implicit pressures that residents might incorrectly or correctly perceive to prioritize their work over their health. Of additional concern is that 17.0% of PGY1 residents reported not knowing how to report a needlestick event and the majority of surgery residents (80.3%) thought that reporting takes too much time. More work might be needed to reinforce workplace

injury-reporting procedures in junior residents and make injury-reporting procedures easier and more accessible for all residents. This is likely to help all healthcare workers.

Similar to the association observed with needlestick events, violations of ACGME duty hour policies, specifically the limitations on shift length, time off between shifts, and limitations on total work hours, were associated with a lower likelihood of reporting that injury to employee health. Of additional concern is that residents with the poorest psychiatric well-being were more likely to self-report experiencing a needlestick and were less likely to report their needlestick injury. When these data are considered together, it might be that residents with poor psychiatric well-being, possibly from either being fatigued or burned out by excessive work demands, are at higher risk for preventable workplace injuries, such as needlesticks, and then not reporting that injury. However, there is a notable limitation to this hypothesis in that we were only able to identify associations, and the converse hypothesis could be true: a needlestick event could be a major contributor to poor psychiatric well-being. Another possibility is that the frequent duty hour policy violations and poor resident psychiatric well-being reflect negative training environments in which residents at these programs are tacitly or actively discouraged from reporting workplace injuries. Easier and more accessible workplace injury reporting processes might be beneficial in these programs. Although it is tempting to examine residents' responses to specific questions from the GHQ-12 to gain additional insight into this association, there is research to support that the GHQ-12 assessment is unidimensional; therefore, use and interpretation of subscale scores of the GHQ-12 is not recommended.⁴⁸

Limitations

This study has several limitations. First, this study was based on a survey of surgery residents and might not be generalizable to all specialties. Second, though all survey-based studies are susceptible to recall and reporting bias that might lead to either underestimation or overestimation of needlestick events, we believe the shorter time frame of recall (6 months, representing the current academic year at the time of the survey vs 1 year or longer in most studies^{8,11,17,18,34}), a broad study population that included residents in every ACGME-accredited general surgery residency program, and the exceptionally high response rate mitigate these biases. It should also be emphasized that the associations identified in this study are correlations, and conclusions about causation cannot be made. Finally, although we found an association between frequent violations of duty hour policies and having experienced a recent needlestick injury, we are unable to

determine whether current duty hour policies have a stronger association with needlestick injuries compared with more restrictive policies.

CONCLUSIONS

In this most comprehensive national survey of surgical residents to date, needlesticks occurred frequently. Many needlestick events continue to not be reported, and numerous barriers to reporting exist. These findings can help identify opportunities to reduce needlestick injuries among trainees and encourage reporting of these preventable injuries to receive timely care.

Author Contributions

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