Medical Errors Involving Trainees

A Study of Closed Malpractice Claims From 5 Insurers

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Background: Despite wide recognition that the delivery of medical care by trainees involves special risks, information about the types and causes of medical errors involving trainees is limited. To describe the characteristics of and factors contributing to trainee errors, we analyzed malpractice claims in which trainees were judged to have played an important role in harmful errors.

Methods: The claims were closed between 1984 and 2004, and the errors occurred between 1979 and 2001. Specialist physicians reviewed random samples of closed malpractice claim files at 5 liability insurers from 2002 to 2004 and determined whether injuries had occurred, and if so, whether they were due to error. We described the clinical circumstances and contributing factors associated with harmful errors involving trainees (“cases”). We also compared the characteristics of cases with their nontrainee counterparts and probed trainee errors attributed to teamwork problems and lack of technical competence or knowledge.

Results: Among 240 cases, errors in judgment (173 of 240 [72%]), teamwork breakdowns (167 of 240 [70%]), and lack of technical competence (139 of 240 [58%]) were the most prevalent contributing factors. Lack of supervision and handoff problems were most prevalent types of teamwork problems, and both were disproportionately more common among errors that involved trainees than those that did not (respectively, 54% vs 7% \(P < .001\) and 20% vs 12% \(P = .009\)). The most common task during which failures of technical competence occurred were diagnostic decision making and monitoring of the patient or situation. Trainee errors appeared more complex than nontrainee errors (mean of 3.8 contributing factors vs 2.5 \(P < .001\)).

Conclusions: In addition to problems with handoffs, house staff are particularly vulnerable to medical errors owing to teamwork failures, especially lack of supervision. Graduate medical education reform should focus on strengthening these aspects of training.

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Graduate medical education poses unique challenges for the delivery of safe patient care,\(^1\)\(^-\)\(^3\) and medical trainees face special risks of involvement in medical errors.\(^4\)\(^-\)\(^10\) This is predictable: trainees are inexperienced, often fatigued, and occasionally unsupervised, and the academic medical centers in which they work are typically large and complex facilities charged with treating the sickest patients. Despite recognition of these risk factors, information about the types and causes of trainee errors is limited.\(^8\) This knowledge gap inhibits the design of effective prevention strategies, such as targeted educational programs and system changes to reduce trainee errors and advance patient safety.\(^11\) An improved understanding of the causes of trainee errors could help guide the implementation of the Accreditation Council for Graduate Medical Education’s (ACGME) core competencies into residency curricula in directions that advance patient safety.\(^2\)

For editorial comment see page 2025

The Malpractice Insurers Medical Error Prevention Study (MIMEPS), a review of 1452 malpractice claims from 5 insurers, provided us with a valuable opportunity to investigate trainee involvement in medical errors.\(^12\) We conducted a subanalysis of the MIMEPS claims in which study reviewers detected harmful errors and judged that 1 or more interns, residents, or fellows played an important causal role. Our main goals were to describe the characteristics of these “trainee errors” and identify their contributing factors. We an-

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ticipated that problems of technical competence, hand-off,\textsuperscript{13} and other aspects of teamwork\textsuperscript{14} would figure prominently, so we explored these areas in depth.

**METHODS**

**STUDY SITES**

Five malpractice insurance companies in 4 regions (northeastern, mid-Atlantic, southwestern, and western United States) participated in the study. The companies covered approximately 33,000 physicians, 61 acute care hospitals (35 academic and 26 nonacademic), and 428 outpatient facilities. The study was approved by ethics review boards at the investigators’ institutions and by the review sites.

**CLAIMS SAMPLE**

Data were extracted from random samples of closed claim files at each insurer in on-site reviews conducted between 2002 and 2004. The claim file is the repository of information accumulated by the insurer during the life of a claim. While the claim is open, it includes medical records pertaining to the episode of care at issue. For all sampled claims, we reacquired the relevant medical records from insured institutions.

We defined a claim as a written demand for compensation for medical injury.\textsuperscript{13,18} We focused on 4 clinical categories—(1) obstetric, (2) surgical, (3) missed and delayed diagnoses, and (4) medication—and applied a uniform definition of each across sites. These categories cover approximately 80% of all medical malpractice claims filed in the United States.\textsuperscript{18} Insurers contributed to the study sample in proportion to their annual claims volume. The number of claims by site varied from 84 to 662 (median, 294).

**STUDY INSTRUMENTS AND CLAIM FILE REVIEW**

Reviewers were board-certified attending physicians, fellows, or final-year residents in surgery (surgical claims), obstetrics (obstetric claims), and internal medicine (diagnosis and medication claims). Physician investigators from the relevant specialties trained the reviewers in the content of claims files, use of the study instruments, and confidentiality procedures in 1-day sessions at each site. Reviews took a mean of 1.6 hours per file and were conducted by 1 reviewer.

A sequence of 4 instruments guided the review. The review process has been described in detail in previous publications.\textsuperscript{12,16} In summary, reviewers made an initial judgment about whether an adverse outcome had occurred, and if it did, they scored the outcome on a severity scale ranging from emotional injury to death.\textsuperscript{20} For claims with identifiable adverse outcomes, reviewers proceeded to consider the potential contributory role of 17 possible contributory factors in causing the adverse outcome. Next, they judged whether the adverse outcome was due to medical error, defined as “the failure of a planned action to be completed as intended (i.e., error of execution) or the use of a wrong plan to achieve an aim (i.e., error of planning).”\textsuperscript{21} Reviewers’ confidence in the error judgments was recorded on a 6-point scale ranging from 1 (little or no evidence that adverse outcome resulted from error/errors) to 6 (virtually certain evidence that adverse outcome resulted from error/errors).\textsuperscript{21,22} Claims that scored 4 (more likely than not that an adverse outcome resulted from error/errors; more than 50-50 but a close call) or higher were classified as involving an error. Finally, for the subset of claims judged to involve an adverse outcome due to error, reviewers gathered details of the clinical circumstances, including the specialty of involved clinicians and their contributory role as rated on a 5-point scale (1, somewhat important, to 5, highly important).

To test the reliability of the claims file review, 10% of the files were reviewed by a second physician from the relevant specialty who was unaware of the first review. On the basis of 1,48 pairs of reviews, \( \kappa \) scores were 0.78 (95% confidence interval, 0.65-0.90) for the determination of injury and 0.63 (95% confidence interval, 0.12-0.74) for the judgment that error occurred. More detailed results of the reliability testing are reported elsewhere.\textsuperscript{12,19,24}

**TRAINEE SAMPLE**

The unit of analysis in MIMEPS was the episode of care in claims judged to involve errors that led to an adverse outcome. For ease of exposition, we henceforth refer to such episodes as “cases.” For this study, we drew a subsample of cases from the full sample of cases identified in MIMEPS (n=889). The subsample consisted of cases in which the reviewer had rated the contributory role of a medical student, intern, resident, or fellow at 4 or 5 and rated it 3 and no other involved clinician had a higher rating. Reliability testing for the determination that 1 or more trainees were involved, which was based on 47 pairs of original reviews, showed good agreement (89% agreement; \( \kappa = 0.64 \) [95% confidence interval, 0.34-0.94]).

**STATISTICAL ANALYSIS**

Analyses were conducted using the Stata/SE 8.0 (StataCorp, College Station, Texas) software package. We generated descriptive statistics to examine the characteristics of the trainees, patients, and adverse outcomes in the study sample. We compared the frequency with which contributing factors were associated with trainee errors vs nontrainee errors using Fisher exact tests.

We conducted an in-depth analysis of cases involving problems of teamwork and technical competence, respectively. With respect to teamwork problems, we investigated the personnel relationships in which they occurred. Cases with teamwork problems were defined as those in which the original reviewer had judged that 1 or more of the following contributory factors played a role in the error: communication breakdowns, supervision problems, handoff problems, failures to establish clear lines of responsibility, and conflict among clinical staff. Defining teamwork according to such behaviors is consistent with previous conceptualizations of teamwork in medicine\textsuperscript{29} and the World Health Organization’s definition of the term.\textsuperscript{29}

For problems of technical competence or knowledge, we identified the task being performed by the physician when the error occurred. The task options were drawn from a list of categories of general practitioner tasks provided by the Occupational Information Network,\textsuperscript{37} which are general enough to adequately capture the work of clinicians in a range of specialties. We made several modifications to the Occupational Information Network list. Specifically, we split 1 of the categories (“specialized medical care to treat or prevent illness, disease, or injury”) into nonprocedural and procedural work, and then further divided the latter into procedures that were related to obstetric deliveries and those that were not.

**RESULTS**

Of 889 cases (claims with both error and injury) identified in the parent study, 240 (27%) involved trainees whose role in the error was judged to be at least moderately important. The claims were closed between 1984
and 2004 and the errors occurred between 1979 and 2001; 72% of the claims were closed in 1990 or later.

**SAMPLE CHARACTERISTICS**

Table 1 gives the characteristics of trainees, patients, and adverse outcomes in the study sample. The mean age of injured patients was 30 years, and 51% were female. Residents were involved in 87% of the cases. The adverse outcomes were generally severe: one-third resulted in significant physical injury, one-fifth in major physical injury, and an additional third in death. Nearly a third (30%) of the cases occurred in the outpatient setting.

One-third of the cases involved trainees in obstetrics and gynecology (Table 2). The next most prevalent specialties were general surgery, adult primary care, orthopedic surgery, and pediatrics. Collectively, 78% of the cases involved trainees from 1 or more of these 5 specialties.

Characteristics of the parent study sample have been reported elsewhere. The 240 trainee errors differed from their 649 nontrainee counterparts on several measures. A larger proportion of trainee errors occurred during inpatient care (70% vs 52% [P < .001]). Patients injured in trainee errors were younger on average (30 years vs 38 years [P < .001]) and more likely to sustain fatal injury (33% vs 24% [P = .008]). In addition, a larger proportion of trainee errors involved obstetrics events (30% vs 21% [P = .003]) and fewer involved missed or delayed diagnosis (21% vs 32% [P = .002]).

**CONTRIBUTING FACTORS**

Cognitive factors contributed to nearly all of the trainee errors, with 72% of cases involving judgment errors and 57% involving failures of vigilance or memory (Table 3). Fifty-eight percent of the cases involved lack of technical competence or knowledge and 70% involved teamwork-related factors. The most prevalent types of teamwork factors were lack of supervision and handoffs.

Eight contributing factors were significantly more prevalent among trainee cases than nontrainee cases (Table 3). Lack of technical competence (58% vs 42% [P < .001]), lack of supervision (54% vs 7% [P < .001]), handoff problems (19% vs 13% [P = .02]), and excessive workload (19% vs 5% [P < .001]) were particularly noteworthy contributing factors in the comparison, both because the differences were large and because these contributing factors were prevalent within the trainee group. At the aggregate level, teamwork factors contributed to 70% of trainee errors, more than twice the frequency with which they contributed to errors (P < .001).

The trainee errors involved a mean of 3.9 contributing factors, compared with a mean of 2.7 factors among nontrainee cases (Table 3). The next most prevalent factors contributing to trainee errors were medication errors (21% vs 11% [P < .001]) and missed or delayed diagnosis (21% vs 13% [P < .001]).

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Table 1. Characteristics of Trainees, Patients, and Adverse Outcomes in 240 Trainee Errors

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trainees</strong></td>
<td></td>
</tr>
<tr>
<td>Residents</td>
<td>208 (87)</td>
</tr>
<tr>
<td>Interns</td>
<td>31 (13)</td>
</tr>
<tr>
<td>Fellows</td>
<td>30 (13)</td>
</tr>
<tr>
<td><strong>Patients</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>121 (51)</td>
</tr>
<tr>
<td>Age, mean, y</td>
<td>30</td>
</tr>
<tr>
<td>&lt; 1</td>
<td>61 (25)</td>
</tr>
<tr>
<td>1-17</td>
<td>23 (10)</td>
</tr>
<tr>
<td>18-34</td>
<td>54 (23)</td>
</tr>
<tr>
<td>35-49</td>
<td>52 (22)</td>
</tr>
<tr>
<td>50-64</td>
<td>30 (12)</td>
</tr>
<tr>
<td>&gt; 64</td>
<td>20 (8)</td>
</tr>
<tr>
<td>Health insurance</td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>46 (36)</td>
</tr>
<tr>
<td>Medicaid</td>
<td>32 (25)</td>
</tr>
<tr>
<td>Uninsured</td>
<td>31 (24)</td>
</tr>
<tr>
<td>Medicare</td>
<td>11 (9)</td>
</tr>
<tr>
<td>Other</td>
<td>8 (6)</td>
</tr>
<tr>
<td><strong>Adverse outcomes</strong></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td></td>
</tr>
<tr>
<td>Breach of informed consent</td>
<td>1 (&lt;1)</td>
</tr>
<tr>
<td>Psychological or emotional</td>
<td>3 (1)</td>
</tr>
<tr>
<td>Minor physical</td>
<td>29 (12)</td>
</tr>
<tr>
<td>Significant physical</td>
<td>79 (33)</td>
</tr>
<tr>
<td>Major physical</td>
<td>48 (20)</td>
</tr>
<tr>
<td>Death</td>
<td>80 (33)</td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td></td>
</tr>
<tr>
<td>Inpatient</td>
<td>168 (70)</td>
</tr>
<tr>
<td>Outpatient</td>
<td>72 (30)</td>
</tr>
<tr>
<td><strong>Clinical area</strong></td>
<td></td>
</tr>
<tr>
<td>Operative</td>
<td>77 (32)</td>
</tr>
<tr>
<td>Obstetrics</td>
<td>73 (30)</td>
</tr>
<tr>
<td>Missed or delayed diagnosis</td>
<td>51 (21)</td>
</tr>
<tr>
<td>Medication</td>
<td>39 (16)</td>
</tr>
</tbody>
</table>

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Table 2. Specialty of Trainees Involved in Errors

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Cases, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstetrics-gynecology</td>
<td>80 (33)</td>
</tr>
<tr>
<td>General surgery</td>
<td>45 (19)</td>
</tr>
<tr>
<td>Adult primary care</td>
<td>28 (12)</td>
</tr>
<tr>
<td>Orthopedic surgery</td>
<td>19 (8)</td>
</tr>
<tr>
<td>Pediatrics</td>
<td>14 (6)</td>
</tr>
<tr>
<td>Anesthesiology</td>
<td>13 (5)</td>
</tr>
<tr>
<td>Emergency medicine</td>
<td>11 (5)</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>9 (4)</td>
</tr>
<tr>
<td>Plastic surgery</td>
<td>6 (3)</td>
</tr>
<tr>
<td>Radiology</td>
<td>5 (2)</td>
</tr>
<tr>
<td>Urology</td>
<td>5 (2)</td>
</tr>
<tr>
<td>Medical student</td>
<td>4 (2)</td>
</tr>
<tr>
<td>Cardiology</td>
<td>3 (1)</td>
</tr>
<tr>
<td>Hematology or oncology</td>
<td>3 (1)</td>
</tr>
<tr>
<td>Neurology</td>
<td>3 (1)</td>
</tr>
<tr>
<td>Cardiothoracic surgery</td>
<td>3 (1)</td>
</tr>
<tr>
<td>Ophthalmology</td>
<td>3 (1)</td>
</tr>
<tr>
<td>Infectious disease</td>
<td>2 (1)</td>
</tr>
<tr>
<td>Physical medicine or rehabilitation</td>
<td>2 (1)</td>
</tr>
<tr>
<td>Ear, nose, and throat</td>
<td>2 (1)</td>
</tr>
<tr>
<td>Vascular surgery</td>
<td>2 (1)</td>
</tr>
<tr>
<td>Psychiatry</td>
<td>1 (&lt;1)</td>
</tr>
</tbody>
</table>

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a Percentages do not sum to 100% because multiple providers were involved in some errors.

b Patient’s health insurance was missing in 112 claims (46%). Percentages were calculated using nonmissing observations as the denominator.
LACK OF SUPERVISION AND HANDOFF PROBLEMS

In 82% (106 of 129) of the cases involving lack of supervision, attending physicians’ failure to supervise residents was at issue; in 12% (16 of 129) of the cases, supervision failures by both senior residents and attending physicians were apparent (Table 4). Handoff problems occurred most commonly in handoffs between trainees (19 of 56 [34%]) and between trainees and attending physicians (18 of 56 [32%]). Four cases were related to poor communication over the telephone between the trainee and the attending physician. In general, the chains of communication within which these breakdowns occurred were complex. Approximately a fifth (12 of 56) of handoff problems involved more than 2 entities, and a quarter (14 of 56) of the chains extended to interactions with nurses, pharmacy and laboratory personnel, and entities external to the trainee’s home institution.

LACK OF TECHNICAL COMPETENCE OR KNOWLEDGE

Diagnostic decision making was the primary task at hand in nearly half (67 of 139 [48%]) of cases in which technical competence or knowledge problems occurred (Table 5). For example, in one case, a surgical resident missed the diagnosis of a bile leak following abdominal...
surgery; in another case, an obstetric resident misdia-
nosed a breech presentation.

Forty-three percent of cases (60 of 139) had second-
ary tasks associated with the technical competence prob-
lem and 17% (24 of 139) had tertiary tasks (mean of 1.6
tasks per problem). For example, one resident’s failure
to diagnose a high-risk pregnancy was accompanied by
inadequate fetal heart rate monitoring; in this case, di-
agnostic decision making was classified as the primary
task and monitoring, as a secondary task. Considering
all tasks (n=223) associated with technical competence
breakdowns and not just the primary one, diagnosis re-
mained the most common task (36%), followed by moni-
toring (17%).

COMMENT

This study of malpractice claims data identified several
distinctive features of errors involving trainees. Trainee
errors were characterized by frequent teamwork and com-
unication breakdowns, especially failures of supervi-
sion and handoffs. They were also disproportionately
likely to involve technical failures and problems of ex-
cessive workload. Diagnostic decision making and moni-
toring activities were the most common tasks at hand
when trainee errors occurred.

The sample of errors we examined is noteworthy for
its scope. Malpractice claims data from multiple insur-
ers are a powerful repository of information on care break-
downs from a diverse range of institutions and physi-
cians. Other studies of trainee error have focused on a
single discipline or setting and relied on surveys and in-
terviews.4,8,9,28 The chief causes of error identified in this
previous work include lack of supervision, handoffs, in-
experience and lack of competence in a surgical task, and
excessive work hours leading to sleep deprivation and/or
fatigue.4,8,12,29-31 Our study corroborates and extends
these findings. For example, in addition to finding that
handoffs between house staff are an important risk fac-
tor for preventable adverse events,13 we found that similar
information transfer problems occur between trainees and
other agents in the delivery system, including attending phy-
sicians, nurses, pharmacists, laboratories, and institutions
external to the home institution of the trainee.

Communication failures among residents may stem
from several tensions in teamwork, such as medical hi-
erarchies, role ambiguity, and interpersonal dynam-
ics.28 Our study confirms the relationship of poor team-
work to preventable errors22 and quality of care.33 Despite
ACGME systems-based practice competencies and at-
tention to implementation of a team-based system of care
in graduate medical education,34 the development of team-
work and other specific communication skills is prob-
ably underemphasized in residency. For instance, we
found telephone communication to be problematic in se-
ceral cases, but this skill has not been evaluated or spe-
cifically taught.35 One reason why uptake of teamwork
training has been slow may be the current lack of effec-
tiveness of formal teaching programs such as Medical
Team Training.36,37 Information transfer problems are
likely to grow. Implementation of the 80-hour-per-
week work limit has increased both the volume of in-
formation transfers and the pressures on clinicians, mak-
ing error prevention strategies in this area38 more critical
than ever. (The errors we studied occurred prior to the
introduction of ACGME duty-hour regulation in 2003.)

Better supervision of residents has been flagged as one
of the more remediable contributors to substandard care.30
Our data underscore the importance of appropriate su-
ervision. The program requirements of the ACGME place
supervision responsibilities squarely on the shoulders of
the attending physician of record.40 Although existing
guidelines state that residents should be supervised, best
practices in this area have received little theoretical or ex-
periential evaluation.41,42 Moreover, explicit state-
ments about what constitutes adequate supervision are
lacking within some specialty areas.43 Nonprocedural work
is especially impoverished in this regard, which is prob-
lematic because we found supervision breakdowns were
no less common there. In addition, 1 in 8 of our cases
linked errors by junior residents to poor supervision by
senior residents, yet no clear guidelines for resident-to-
resident supervision are broadly available. The design of
curricula to help residents become better teachers and
leaders44 should incorporate specific strategies geared to
improve supervision skills of residents. The 80-hour-
week requirement may create additional challenges to ad-
quate supervision, making the case to advance the field
of trainee supervision even more compelling.42

Recognition of the types of tasks most commonly as-
associated with failures of technical competence may also
help to shape ACGME competencies in ways that im-
prove patient safety. For example, errors during diag-
nostic work were prevalent, and educational interven-
tions to reduce these errors could focus on competencies
such as medical knowledge and patient care.45 Good di-
agnostic decision making depends on a mix of system fac-
tors,46 including communication of information be-
tween the treating physician, laboratory personnel, and
radiologists47 and other consultants. Thus, the much
needed improvements in this area48 could be viewed
within the spectrum of 4 different competencies includ-
ing the ones that relate to systems-based practice and com-
munication skills.

Technical competence problems arose relatively fre-
quently during monitoring activities, a finding that re-
forces existing evidence that this type of failure is a trou-
bling source of medical error.9,30 Although team training
emphasizes skills such as situational awareness to im-
prove monitoring,51 there is a need for specific instruc-
tional strategies to improve technical skills. Both simu-
lation52 and use of information technology53 hold promise,
as do interventions to bolster and support cognitive skills.54

The methodological approach we used to identify trainee
erors has a number of advantages over previously used
approaches, such as surveys. In particular, claims data pro-
vide a valuable triage point with rich information on a large
number of errors that caused serious harm. However, it
also has limitations. First, litigated claims are the “tip of
the iceberg” of all errors.55 Whether that tip is represen-
tative of what lies beneath depends on the characteristic
in question. Severe injuries are certainly overrepre-
sented, factors involving communication breakdowns may
be also, as might procedural breakdowns that are easily observed by patients. Despite these biases, we know of no reason why the causal patterns associated with errors that lead to litigation would differ from the causal patterns associated with their nonlitigated counterparts. Nonetheless, generalizability beyond the serious injuries observed in malpractice claims is uncertain.

Second, certain contributing factors may not have been detectable through claims file review even though they played a role; fatigue and workload are particularly likely to have gone undocumented, unless they formed part of the plaintiff’s allegation. Consequently, the prevalence estimates for such factors represent lower bounds, and the multifactorial causality we observed probably understates the true complexity. In addition, our review could not prioritize the relative contributions of contributing factors to the adverse events nor disentangle causal relationships among factors. Third, because we examined events that predated the 2003 ACGME duty-hour regulation, we cannot evaluate its effect on trainee errors.

Finally, the reviewers’ judgments about the appropriateness of care are likely to have been influenced by hindsight bias. One possible version of this bias is the knowledge of the litigation outcome, which may have encouraged findings of errors in paid claims and vice versa. Another version relates to the presence of adverse outcomes, especially severe ones, which may have prompted inferences that care was inappropriate.

Aside from some attention to handoff errors among house staff, trainee errors have gone largely unstudied. The causal characteristics we detected in malpractice claims data suggest special vulnerabilities around teamwork, multiple levels of supervision, and diagnostic decision making. Our findings should help leaders of residency programs and the ACGME to orient training interventions toward these problem areas and also stimulate further research into why and how trainee errors occur.

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Author Contributions: Drs Studdert and Singh had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Singh, Thomas, Petersen, and Studdert. Acquisition of data: Singh, Thomas, and Studdert. Analysis and interpretation of data: Singh, Thomas, Petersen, and Studdert. Drafting of the manuscript: Singh and Studdert. Critical revision of the manuscript for important intellectual content: Singh, Thomas, and Petersen. Obtained funding: Thomas, Petersen, and Studdert. Administrative, technical, and material support: Singh, Petersen, and Studdert. Study supervision: Thomas, Petersen, and Studdert.

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