

## ANESTHESIOLOGY

# Substance Use Disorder in Physicians after Completion of Training in Anesthesiology in the United States from 1977 to 2013

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## EDITOR'S PERSPECTIVE

### What We Already Know about This Topic

- Substance use disorders among anesthesiologists are common and hazardous to both the involved physicians and their patients
- The incidence of substance abuse among U.S. anesthesiologists remains unclear, as does the relapse risk and consequent mortality

### What This Article Tells Us That Is New

- The estimated cumulative 30-yr incidence of substance abuse among graduates of U.S. residency programs is about 1.6%, with opioids and alcohol being the most commonly abused substances
- A substantial proportion of anesthesiologists who develop substance use disorder die of the condition, and the risk of relapse is high in those who survive at approximately 40%

Substance use disorder among physicians can have serious consequences both to the physicians and their patients. There is surprisingly little information regarding the epidemiology and outcomes of substance use disorder among physicians, including for those specialists thought to be high risk, such as anesthesiologists. Information regarding the prevalence of physician substance use disorder is largely limited to cross-sectional self-report surveys, and outcomes can only be estimated from reports of selected programs that treat physicians with substance use disorder.<sup>1–4</sup> Such information could help formulate rational policies to guide the difficult decisions facing physicians who develop substance

## ABSTRACT

**Background:** Substance use disorder among physicians can expose both physicians and their patients to significant risk. Data regarding the epidemiology and outcomes of physician substance use disorder are scarce but could guide policy formulation and individual treatment decisions. This article describes the incidence and outcomes of substance use disorder that resulted in either a report to a certifying body or death in physicians after the completion of anesthesiology training.

**Methods:** Physicians who completed training in U.S. anesthesiology residency programs from 1977 to 2013 and maintained at least one active medical license were included in this retrospective cohort study (n = 44,736). Substance use disorder cases were ascertained through records of the American Board of Anesthesiology and the National Death Index.

**Results:** Six hundred and one physicians had evidence of substance use disorder after completion of training, with an overall incidence of 0.75 per 1,000 physician-years (95% CI, 0.71 to 0.80; 0.84 [0.78 to 0.90] in men, 0.43 [0.35 to 0.52] in women). The highest incidence rate occurred in 1992 (1.79 per 1,000 physician-years [95% CI, 1.12 to 2.59]). The cumulative percentage expected to develop substance use disorder within 30 yr estimated by Kaplan–Meier analysis equaled 1.6% (95% CI, 1.4 to 1.7%). The most common substances used by 353 individuals for whom information was available were opioids (193 [55%]), alcohol (141 [40%]), and anesthetics/hypnotics (69 [20%]). Based on a median of 11.1 (interquartile range, 4.4 to 19.8) yr of follow-up, the cumulative proportion of survivors estimated to experience at least one relapse within 30 yr was 38% (95% CI, 31 to 43%). Of the 601 physicians with substance use disorder, 114 (19%) were dead from a substance use disorder–related cause at last follow-up.

**Conclusions:** A substantial proportion of anesthesiologists who develop substance use disorder after the completion of training die of this condition, and the risk of relapse is high in those who survive.

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use disorder and those who employ them.<sup>5–7</sup> In a previous report, we utilized the data resources of the American Board of Anesthesiology (Raleigh, North Carolina) to describe the incidence and outcomes of substance use disorder among anesthesiology residents in the United States, finding increasing incidence through time and a high rate of relapse.<sup>8</sup> However, there are no comparable data available for physicians after the completion of residency training, which represents a much longer period of risk. Indeed, there are special challenges in ascertaining substance use disorder in practicing physicians compared with residents, who are closely monitored by their training programs.

The purpose of this study was to describe the incidence and outcomes of substance use disorder that resulted in either a report to the American Board of Anesthesiology

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or death among a cohort of physicians after they completed training in a United States anesthesiology residency program.

## Materials and Methods

The Mayo Clinic Institutional Review Board determined that the study protocol was exempt from review.

This study includes physicians who completed an anesthesiology residency program accredited by the Accreditation Council for Graduate Medical Education in the United States from January 1, 1977 to December 31, 2013, held at least one active medical license after completing residency training (used as an indication that a physician was eligible for clinical practice), and had no evidence of substance use disorder during residency training.

Two methods were used to ascertain incident substance use disorder cases after completion of residency: records available to the American Board of Anesthesiology and cause of death information.

### Ascertainment: American Board of Anesthesiology Records

Our previous publication reporting the incidence and outcomes of substance use disorder in anesthesiology residents describes the method used to ascertain substance use disorder cases from the American Board of Anesthesiology records, which are summarized here.<sup>8</sup>

Since its inception in 1938, the American Board of Anesthesiology has collected information on all physicians who entered accredited residency programs in the United States, including those who did not ultimately achieve initial certification in anesthesiology. One element of the American Board of Anesthesiology dataset is an indicator set by American Board of Anesthesiology personnel when information is received to indicate the presence of possible substance use disorder (known as substance use disorder flag). This flag can be set either during or after residency training using several potential sources. An important trigger of raising the substance use disorder flag is the Disciplinary Action Notification Service provided by the Federation of State Medical Boards. This service aggregates information from all U.S. state medical boards regarding actions taken that resulted in loss of medical license or restrictions from the practice of medicine. This information is forwarded to the American Board of Anesthesiology (since 2004) for individuals who have participated in the American Board of Anesthesiology certification process, and is reviewed as a potential basis for actions on board certificates. Reports to the American Board of Anesthesiology may include any license actions (before or after 2004). In addition, the American Board of Anesthesiology notes any direct communication regarding potential substance use from any source. For example, anesthesiologists certified in or after 2,000 are required to participate in maintenance of

certification program; this program is voluntary for others. Physicians in this program are queried every 10 yr regarding whether they have a history of substance abuse.

The records of all physicians with a substance use disorder flag set in the American Board of Anesthesiology database were reviewed for confirmatory evidence that is consistent with substance use disorder as defined by *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* criteria (including evidence of hazardous use, social/interpersonal problems related to use, neglected major roles due to use, legal problems, and indicators of substance dependence). If the review revealed that the substance use disorder flag was set for a reason clearly not related to substance use disorder in the individual (e.g., inappropriate prescribing of opioids), that individual was excluded from analysis.

### Ascertainment: Cause of Death Information

The Social Security Administration Death Master File was used to identify individuals who died after the completion of their residency training. The National Death Index, an index of death record information on file in state vital statistics offices, was used to determine the cause of death for these individuals. Those individuals whose cause-of-death codes were related to substance use according to the definitions of the Centers for Disease Control<sup>9</sup> (e.g., *International Classification of Diseases, Tenth Revision* code X42, accidental poisoning by exposure to narcotics and hallucinogens) were included as incident cases in this analysis.

### Data Abstracted

For each case, information was abstracted by American Board of Anesthesiology personnel into the web-based Research Electronic Data Capture system (Version 3.6.7; Vanderbilt University, Nashville, Tennessee). For the initial episode of substance use disorder, the date of manifestation (to anyone, if known) was recorded, as was the date of first substance use (if known). If neither date was known, for purpose of calculating incidence, the dates were set to the date that the substance use disorder was reported to the American Board of Anesthesiology, or the date of death. The immediate consequences of the initial episode and participation in treatment programs were noted. Similar information was abstracted for any relapses to substance use disorder (known use after the initial episode up to December 31, 2013), including actions against medical licenses.

To probe for changes in the risk of relapse during the period of study, relapse rates from cases detected from 1977 to 1994 and the period from 1995 to 2013 were compared.

### Statistical Analysis

Substance use disorder cases were stratified by age, sex, and calendar year of first use. Incidence rates of substance use disorder in a given year were estimated using the number of cases as the numerator, with corresponding denominator

of total number of physicians who completed anesthesiology residency training and had at least one active medical license in that year (information obtained from the Federation of State Medical Boards). Active medical licenses were used to estimate the number of physicians engaged in active practice, with the limitation that holding a license is necessary but not sufficient for practice. Denominators were not adjusted for incidence cases as the number of cases in a given year is small in relation to the total number of physicians. Incidence rates were summarized using point estimates and 95% CI assuming a Poisson distribution for the number of cases. Incidence and relapse during the 30 yr after completing training (*i.e.*, the length of a typical career) were estimated using the Kaplan–Meier method, with follow-up to December 31, 2013. Data from individuals who did not have the event of interest (substance use disorder incidence or relapse) at last follow-up are right censored.

All analyses were performed using R software version 3.4.1 (R Foundation for Statistical Computing, Austria). The threshold of statistical significance was set at  $P < 0.05$ , and two-sided tests were utilized in all analyses. The central tendency of data was presented as either mean or median, and variability is presented by interquartile range (*i.e.*, the distance between the median of the top half of the data [75th percentile rank] and the median of the bottom half of data [25th percentile rank]). CI were presented for incidence and relapse rates. All available data were utilized, so that no *a priori* sample size calculation was done to achieve a certain level of precision.

## Results

### Case Ascertainment

A total of 44,736 unique individuals (25% female) completed residency training in anesthesiology from January 1, 1977 to December 31, 2013, had at least one active medical license after the completion of training, and had no evidence of substance use disorder during residency training. The mean age of these individuals at the end of follow-up was 50 yr (interquartile range, 41 to 57 yr). The 384 individuals who developed substance use disorder during residency training and were the subject of our previous report<sup>8</sup> are not included in the current analysis.

Of the 44,736 individuals, American Board of Anesthesiology records identified and confirmed 488 substance use disorder cases after completion of training. An additional 620 individuals who were not previously known by the American Board of Anesthesiology to have substance use disorder died after the completion of training and before December 31, 2013. Of these, the etiology of death was consistent with a substance use disorder–related cause in 113 (18%). Thus, a total of 601 individuals (1.3% of 44,736 and 78 [13%] were female) developed substance use disorder after residency training and before December 31, 2013, and form the basis of this report.

### Incidence

The median age at substance use disorder incidence for the 488 cases ascertained *via* American Board of Anesthesiology records was 41 yr (interquartile range, 36 to 46 yr); the median age at date of death for the 113 cases ascertained *via* the National Death Index was 42 yr (interquartile range, 37 to 50 yr). The overall incidence of substance use disorder during the study period was 0.75 (95% CI, 0.70 to 0.80) per 1,000 physician-years (0.84 [95% CI, 0.78 to 0.90] in men and 0.43 [95% CI, 0.35 to 0.52] in women), with 802,565 physician-years analyzed. Incidence varied within the study period analyzed (fig. 1), with peak incidence occurring in 1992 (1.79 [95% CI, 1.12 to 2.59]). The cumulative percentage expected to develop substance use disorder within 30 yr after the completion of training estimated by Kaplan–Meier analysis was 1.6% (95% CI, 1.4 to 1.7%).

The median time from the completion of training to the time of first substance use (available in 417 individuals) was 68 months (interquartile range, 38 to 134 months), and the median time from first use to detection (available in 457 individuals) was 7 months (interquartile range, 0 to 29 months).

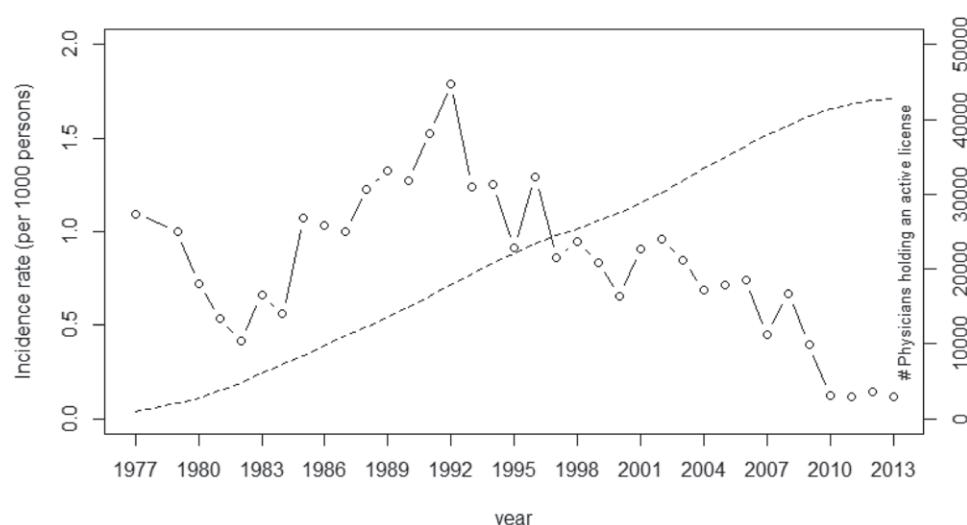
Among 488 cases confirmed from the American Board of Anesthesiology records, the substance(s) used could be determined in 353 individuals (72%). When known, the most common substance category involved in the initial substance use disorder episode was intravenous opioids, followed by alcohol, anesthetics/hypnotics, and marijuana/cocaine, with 125 (26%) individuals using more than one substance (table 1). A prior history of substance use was documented after the first detection and diagnosis in 78 (16%) of the 488 substance use disorder cases identified using American Board of Anesthesiology records, including alcohol (46 [9%]), marijuana (16 [3%]), and cocaine (13 [3%]), with 27 (6%) individuals abusing multiple substances.

### Consequences of Initial Substance Use Disorder Episode

Of the 488 cases identified using American Board of Anesthesiology records, one died as a result of the substance use. Thus, of the 601 physicians who developed substance use disorder after training, at the time of last follow-up on December 31, 2013, 114 ([19%] 1 case from the American Board of Anesthesiology records and 113 cases from National Death Index) were dead from a cause related to substance use disorder. The mean age at death of these physicians was 41 yr (interquartile range, 37 to 49 yr).

Of the 487 who survived, 334 (69%) had at least one adverse action against their medical licenses, including revocation in 141 (29%) and license restrictions or conditions in 193 (40%).

Of the 487 survivors, there was evidence in American Board of Anesthesiology records that 276 (57%) received treatment for their substance use disorder, with 179 (37%) reporting inpatient treatment. Because there was no



**Fig. 1.** Incidence of substance use disorder according to year of first substance use for physicians completing anesthesiology training from 1977 to 2013.

**Table 1.** Substances Used at Initial Episode (If Known)

Substance (n, %)	Total (n = 353)	Male (n = 311)	Female (n = 42)
Opioids	193 (55%)	165 (53%)	28 (67%)
Intravenous	166 (47%)	146 (47%)	20 (48%)
Fentanyl	118 (33%)	104 (33%)	14 (33%)
Sufentanil	32 (9%)	32 (10%)	0 (0%)
Other intravenous opioid	57 (16%)	46 (15%)	11 (26%)
Oral	59 (17%)	44 (14%)	15 (36%)
Alcohol	141 (40%)	126 (41%)	15 (36%)
Anesthetics/hypnotics	69 (20%)	56 (18%)	13 (31%)
Propofol	13 (4%)	8 (3%)	5 (12%)
Ketamine	7 (2%)	6 (2%)	1 (2%)
Volatile anesthetics	8 (2%)	8 (3%)	0 (0%)
Benzodiazepines	50 (14%)	40 (13%)	10 (24%)
Marijuana/cocaine	58 (16%)	55 (18%)	3 (7%)
Marijuana	26 (7%)	24 (8%)	2 (5%)
Cocaine	42 (12%)	40 (13%)	2 (5%)
Others*	72 (20%)	61 (20%)	11 (26%)

The substance(s) used during the initial episode of substance use disorder were known in 353 individuals (72% of 488 cases confirmed from the American Board of Anesthesiology records), and unknown in 135 (28%) individuals. Values represent the numbers (and percentages) of individuals who used each substance among those whose substance used was known. 125 (26%) individuals used more than one substance (18 [14%] females, 107 [86%] males), therefore percentages in each column do not total 100%.

\*Others include nitrous oxide, bupivacaine, zolpidem, carisoprodol, methamphetamines, clonidine, dextromethorphan, phenobarbital, and butalbital.

consistent format for reporting treatment over the study period, absence of treatment information does not imply that treatment was not received.

Overall, of the 601 individuals, 523 (87%) achieved American Board of Anesthesiology initial certification (either before or after substance use disorder incidence).

For the 44,736 individuals in this analysis, the cumulative incidence of substance use disorder was 0.72 (95% CI, 0.67 to 0.77) per 1,000 physician-years in those who achieved certification ( $n = 41,195$ ) and 1.07 (95% CI, 0.88 to 1.29) per 1,000 physician-years in those who did not ( $n = 3,541$ ). Thirty-five (7%) of those who were certified at the time of substance use disorder incidence had their certification revoked because of substance use disorder.

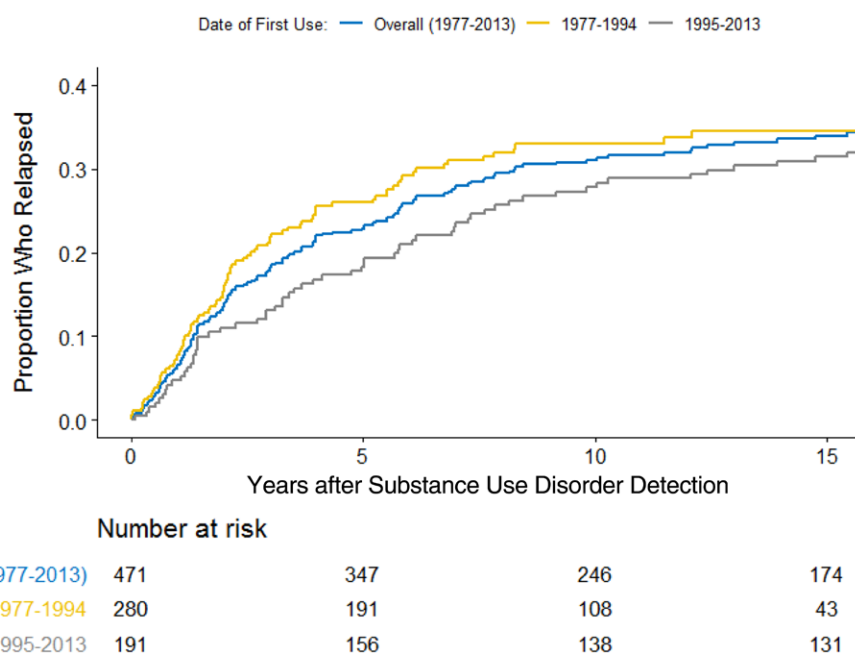
## Relapse

Of the 487 individuals who survived their initial episode, 158 (32%) relapsed at least once, with 54 (11%) individuals relapsing more than once (40 [8%] individuals relapsed twice, 10 [2%] relapsed three times, and 4 [1%] individuals relapsed four times). Based on a median of 11.1 yr (interquartile range, 4.4 to 19.8 yr) of follow-up, Kaplan–Meier analysis estimated that the cumulative percentage expected to experience at least one relapse within 30 yr after the initial episode was 38% (95% CI, 31 to 43%). Among those who relapsed, the median time from first substance use disorder use to first relapse was 2.6 yr (interquartile range, 1.2 to 5.8 yr), with none dying at the time of relapse. The relapse rates from cases detected in the period from 1977 to 1994 and the period from 1995 to 2013 were not significantly different (fig. 2;  $P = 0.300$ , log rank test).

Relapse rates were similar regardless of the class of substance abused (table 2). In all individuals for whom information regarding the substance used at first relapse was available ( $n = 54$ ), it overlapped at least one of the substances used in the initial episode.

Among the 158 who relapsed, 108 (68%) were certified by the American Board of Anesthesiology at the time





**Fig. 2.** Relapse to substance use for individuals in whom substance use disorder was detected after residency and a relapse date was documented ( $n = 471$ ), showing the percentage of physicians who relapsed as a function of the time after their initial episode was detected. If the date of first use was not available, the date that substance use disorder was reported to the American Board of Anesthesiology (if individuals survived) or date of death was utilized. To compare relapse rates during the earlier and later periods of the study, data are shown for individuals whose date of first use was from 1977 to 1994 ( $n = 280$ , yellow line) and from 1995 to 2013 ( $n = 191$ , gray line), as well as for the entire study period (overall [1977 to 2013],  $n = 471$ , blue line). Rates did not differ between the 1977 to 1994 and 1995 to 2013 periods ( $P = 0.300$ ; log rank test). For example, the proportions who were estimated to relapse at year 15 were 0.345 (95% CI, 0.283 to 0.402) and 0.314 (95% CI, 0.245 to 0.377), for the 1977 to 1994 and 1995 to 2013 cohorts, respectively. Numbers along the abscissa refer to the number of individuals at risk (*i.e.*, had not relapsed and were not censored at the time of last follow-up [December 31, 2013]) in each group at each time point.

of relapse; 44 (28%) of these individuals had their certificates revoked. Regarding actions against medical licenses, 112 (71%) had licenses revoked and 50 (32%) had license restrictions or conditions imposed as a result of relapse (percentages do not sum to 100% because 32 individuals had multiple relapses that resulted in multiple actions).

## Discussion

This study provides a comprehensive description of the epidemiology and outcomes of substance use disorder that resulted in either a report to the American Board of Anesthesiology or death among a cohort of physicians after they completed training in a United States anesthesiology residency program.

There are several challenges to case ascertainment in the study of physician substance use disorder, including the stigma associated with substance use disorder and privacy or legal concerns that may limit reporting. Self-report *via* anonymous surveys have been commonly employed.<sup>4,10–12</sup> For example, a recent national survey of physicians<sup>13</sup> found a prevalence of alcohol abuse or dependence (ascertained *via* a validated screening test) of 15% across all specialties,

with anesthesiologists at above-average risk (prevalence of approximately 18%). The prevalence of other substances used was not reported by specialty, but the rate of self-reported opioid abuse was 1.3% across all specialties. In contrast, our method ascertains only substance use disorder cases with two types of consequences: death and notification of a certifying body (the latter occurring primarily *via* state medical board license actions). As a result, the substance use disorder rates found in this study are not comparable with survey self-reports. Our method for identifying substance use disorder cases has other limitations, including: (1) delays from detection to actions by regulatory bodies, such that incidence in more recent years may be falsely low; (2) the possibility for substance use disorder that results in consequences, but is not reported to regulatory bodies; (3) the possibility for misclassification of cause of death in National Death Index information (*e.g.*, distinguishing between suicide *vs.* unintended death from substance use, or errors in determination of cause of death by the coroner); and (4) the fact that not all practicing anesthesiologists in the United States were trained in this country and thus, a small proportion may be unknown to the American Board of Anesthesiology. Taken

**Table 2.** Outcomes According to Class of Substance Used in Initial Episode among Those Whose Substance Use Disorder Detected after Completion of Residency and Survived Initial Episode through December 31, 2013 (n = 487)

Outcomes	Substances Known						Multiple Substances (n = 125)	Overall (n = 353)	Substances Unknown Overall (n = 134)
	Opioids, IV (n = 166)	Opioids, Oral (n = 59)	Alcohol (n = 141)	Anesthetics/Hypnotics (n = 69)	Marijuana/Cocaine (n = 58)	Others* (n = 72)			
Relapse, no. (%)	81 (49)	25 (42)	73 (52)	23 (33)	27 (47)	12 (17)	51 (41)	158 (45)	72 (53)
5 yr, % (CI)§	28 (21–35)	28 (15–39)	26 (18–33)	26 (15–36)	23 (11–34)	20 (9.1–29)	26 (18–33)	23 (19–27)	16 (10–22)
15 yr, % (CI)§	39 (30–46)	44 (28–57)	35 (26–43)	39 (24–50)	37 (22–49)	20 (9.1–29)	36 (27–45)	34 (29–38)	28 (20–36)
20 yr, % (CI)§	40 (32–49)	44 (28–57)	36 (27–44)	39 (24–50)	37 (22–49)	20 (9.1–29)	36 (27–45)	36 (31–40)	29 (21–37)

Of those whose substance use disorder were detected after residency and survived their initial episode (n = 487), the substance(s) used during the initial episode were known in 353 (72%) individuals and unknown in 135 (28%) individuals. Numbers in the column headings represent the number of individuals who used the given substance. There were 125 (26%) individuals who used more than one substance and are included in the columns for each substance as well as the column summarizing those using multiple substances.

\*Others include zolpidem, bupivacaine, carisoprodol, methamphetamines, clonidine, dextromethorphan, phenobarbital, and butalbital. §The Kaplan–Meier method was used to obtain point estimates and 95% CI for relapse at 5, 15, and 20 yr.

together, these limitations suggest that this study method almost certainly underestimates the true incidence of substance use disorder in anesthesiologists, as the method only ascertains cases resulting in severe consequences.

The incidence of substance use disorder in these physicians (0.75 per 1,000 physician-years) was lower than what was observed in our previous analysis of anesthesiology residents (2.16 per 1,000 resident-years).<sup>8</sup> This difference could reflect that residents are under closer supervision, and thus, are more likely to have substance use disorder detected by their residency programs. It could also be a true difference in incidence. For example, those at higher risk for substance use disorder may be more likely to be detected during residency, such that the remaining cohort is truly at lower risk.

The death rates attributed to substance use disorder are similar between residents and physicians after training in the current analysis: 15.7 deaths per 100,000 person-years during residency training attributed to substance use disorder in residents (28 deaths in 177,848 resident-years)<sup>8</sup> and 14.2 deaths per 100,000 person-years in physicians after training (114 deaths in 802,565 person-years).

Other features are also similar to our previous analysis of residents,<sup>8</sup> including higher rates in men, opioids being the most commonly abused drug class followed by alcohol, and high risk of relapse (30-yr risk of 43% [interquartile range, 34 to 51%] in residents and of 38% [interquartile range, 31 to 43%] in physicians after training) with similar relapse rates regardless of substance used. As in the resident analysis, relapse rates do not appear to be changing during the period of analysis, despite efforts to improve treatment and surveillance.<sup>8</sup> However, some features differed between the two analyses. Relapse was more likely to be associated with death in residents (death was the first presenting sign of relapse in 13% of resident relapse cases). Of note, it is possible that some deaths in posttraining physicians may in fact

represent relapse episodes for substance use disorder cases that were not previously reported. Also, substance use disorder incidence appears to still be increasing in residents,<sup>8</sup> but in contrast, peaked in 1992 for posttraining physicians. This is an encouraging trend, but as noted previously, delays from detection to report in posttraining physicians may bias toward lower incidence rates in more recent years. It is also possible that if more physicians at risk for substance use disorder are being detected as residents, the pool of at-risk posttraining physicians may be decreased.

These results highlight the serious consequence of substance use disorder to physician health and practices. Our two studies have identified a total of 985 individuals with substance use disorder who either entered an Accreditation Council for Graduate Medical Education–accredited residency program in the United States for training in anesthesiology from 1975 to 2009, completed training from 1977 to 2013, or both. Among all physicians included in these two analyses, a total of 740 were deceased as of the time of last follow-up. Of the 985 cases, 168 (17.1%) have died as of December 31, 2013 of a cause related to substance use disorder based on National Death Index search. Thus, 23% (168 of 740) of the total mortality was attributable to substance use disorder, a substantial proportion of overall mortality in anesthesiologists of working age. This represents a rate of approximately 17.1 substance use disorder–related deaths per 100,000 physician-years. This rate is consistent with the rate of “drug-related deaths” reported in an analysis of anesthesiologists during the period of 1979 to 1995,<sup>14</sup> which also used the National Death Index cause of death codes. In their analysis, the risk of drug-related deaths was almost three-fold higher in anesthesiologists compared with a cohort of internists. An argument can be made that substance use disorder is, at least to some extent, an occupational hazard for anesthesiologists, given their

ready access to potent drugs that could be abused. From this point of view, anesthesiology could be considered to be one of the most hazardous occupations in the United States. The riskiest occupation in the United States in terms of fatal work-related injuries in 2017 was farming, fishing, and forestry, with a death rate of 20.9 per 100,000 person-years (Bureau of Labor Statistics report, December 18, 2018).

Our data suggest the urgent need for action by specialty societies and others concerned with physician well-being, and novel strategies to reduce risk.<sup>15,16</sup> For example, although anesthesiologists who develop substance use disorder can be successfully treated and reenter practice, these physicians and those who treat them should recognize that, as is characteristic of substance use disorder in general, there is a substantial risk for relapse. It is unknown how many of the substance use disorder cases ascertained *via* the National Death Index represented cases of relapse. Also, there is little information beyond anecdotes regarding how physician substance use disorder may affect patient care, but there is ample cause for concern.<sup>7,17</sup>

In summary, among physicians who complete anesthesiology training in the United States and did not develop known substance use disorder during training, 1.6% are expected to develop substance use disorder that has significant consequences (death or being reported to a certifying body) during a 30-yr career. Nearly one in five deaths among physicians of working age who have completed anesthesiology training can be attributed to substance use disorder, and the lifetime risk of relapse is high.

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## Competing Interests

Dr. Warner is a Director of the American Board of Anesthesiology, and Drs. Sun, Harman, and Wang are employees of the American Board of Anesthesiology. Dr. Berge reports speaker fees from Fresenius-Kabi (Homburg, Germany). The authors declare no competing interests.

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## References

- Domino KB, Hornbein TF, Polissar NL, Renner G, Johnson J, Alberti S, Hanks L: Risk factors for relapse in health care professionals with substance use disorders. *JAMA* 2005; 293:1453–60
- Skipper GE, Campbell MD, Dupont RL: Anesthesiologists with substance use disorders: A 5-year outcome study from 16 state physician health programs. *Anesth Analg* 2009; 109:891–6
- McLellan AT, Skipper GS, Campbell M, DuPont RL: Five year outcomes in a cohort study of physicians treated for substance use disorders in the United States. *BMJ* 2008; 337:a2038
- Brewster JM: Prevalence of alcohol and other drug problems among physicians. *JAMA* 1986; 255:1913–20
- Carinci AJ, Christo PJ: Physician impairment: Is recovery feasible? *Pain Physician* 2009; 12:487–91
- Berge KH, Seppala MD, Lanier WL: The anesthesiology community's approach to opioid- and anesthetic-abusing personnel: Time to change course. *ANESTHESIOLOGY* 2008; 109:762–4
- Oreskovich MR, Caldeiro RM: Anesthesiologists recovering from chemical dependency: Can they safely return to the operating room? *Mayo Clin Proc* 2009; 84:576–80
- Warner DO, Berge K, Sun H, Harman A, Hanson A, Schroeder DR: Substance use disorder among anesthesiology residents, 1975–2009. *JAMA* 2013; 310:2289–96
- Miniño AM, Murphy SL, Xu J, Kochanek KD: Deaths: Final data for 2008. *Natl Vital Stat Rep* 2011; 59:1–126
- Oreskovich MR, Kaups KL, Balch CM, Hanks JB, Satele D, Sloan J, Meredith C, Buhl A, Dyrbye LN, Shanafelt TD: Prevalence of alcohol use disorders among American surgeons. *Arch Surg* 2012; 147:168–74
- McAuliffe WE, Rohman M, Santangelo S, Feldman B, Magnuson E, Sobol A, Weissman J: Psychoactive drug use among practicing physicians and medical students. *N Engl J Med* 1986; 315:805–10
- Lutsky I, Hopwood M, Abram SE, Jacobson GR, Haddox JD, Kampine JP: Psychoactive substance use among American anesthesiologists: A 30-year retrospective study. *Can J Anaesth* 1993; 40:915–21
- Oreskovich MR, Shanafelt T, Dyrbye LN, Tan L, Sotile W, Satele D, West CP, Sloan J, Boone S: The prevalence of substance use disorders in American physicians. *Am J Addict* 2015; 24:30–8

14. Alexander BH, Checkoway H, Nagahama SI, Domino KB: Cause-specific mortality risks of anesthesiologists. *ANESTHESIOLOGY* 2000; 93:922–30
15. Berge KH, Dillon KR, Sikkink KM, Taylor TK, Lanier WL: Diversion of drugs within health care facilities, a multiple-victim crime: Patterns of diversion, scope, consequences, detection, and prevention. *Mayo Clin Proc* 2012; 87:674–82
16. Fitzsimons MG, Baker K, Malhotra R, Gottlieb A, Lowenstein E, Zapol WM: Reducing the incidence of substance use disorders in anesthesiology residents: 13 years of comprehensive urine drug screening. *ANESTHESIOLOGY* 2018; 129:821–8
17. Berge KH, Seppala MD, Schipper AM: Chemical dependency and the physician. *Mayo Clin Proc* 2009; 84:625–31

## ANESTHESIOLOGY REFLECTIONS FROM THE WOOD LIBRARY-MUSEUM

### Future Nobelist Richard Wilstätter Synthesizes Tropacocaine: Raise a Cup of Java!



Dr. Carl Koller opened the medical community's eyes to the local anesthetic potential of cocaine in 1884. Cocaine's success as a topical and spinal anesthetic surged coca leaf exports, first from South America and then from Java, whose stimulating trade also included coffee. Although local anesthetic tropacocaine was present in higher concentrations in Javanese coca plants, future Nobelist Richard Wilstätter braved antisemitism and synthesized tropacocaine with "keto-tropins" in Munich. Thereby simpler to produce than cocaine, tropacocaine featured longer shelf life, quicker anesthetic onset, and fewer side effects. Wilstätter assigned his 1899 patent to E. Merck of Darmstadt, Germany (bottles above flanking Merck's wax cork seal, center). Although praised as an ophthalmic and spinal anesthetic, tropacocaine was saddled with shorter anesthetic duration and less vasoconstriction than its more addicting cousin, cocaine. However, none of the early cocaine derivatives or substitutes would match the lower toxicity and greater commercial success of addiction-free procaine or "Novocaine." (Copyright © the American Society of Anesthesiologists' Wood Library-Museum of Anesthesiology.)

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