Rate of false conviction of criminal defendants who are sentenced to death

Samuel R. Gross[a,1], Barbara O'Brien[b], Chen Hu[c], and Edward H. Kennedy[d]

[a]University of Michigan Law School, Ann Arbor, MI 49109; [b]Michigan State University College of Law, East Lansing, MI 48824; [c]American College of Radiology Clinical Research Center, Philadelphia, PA 19103; and [d]Department of Biostatistics and Epidemiology, University of Pennsylvania School of Medicine, Philadelphia, PA 19104

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The rate of erroneous conviction of innocent criminal defendants is often described as not merely unknown but unknowable. There is no systematic method to determine the accuracy of a criminal conviction; if there were, these errors would not occur in the first place. As a result, very few false convictions are ever discovered, and those that are discovered are not representative of the group as a whole. In the United States, however, a high proportion of false convictions that do come to light and produce exonerations are concentrated among the tiny minority of cases in which defendants are sentenced to death. This makes it possible to use data on death row exonerations to estimate the overall rate of false conviction among death sentences. The high rate of exoneration among death-sentenced defendants appears to be driven by the threat of execution, but most death-sentenced defendants are removed from death row and resentenced to life imprisonment, after which the likelihood of exoneration drops sharply. We use survival analysis to model this effect, and estimate that if all death-sentenced defendants remained under sentence of death indefinitely, at least 4.1% would be exonerated. We conclude that this is a conservative estimate of the proportion of false conviction among death sentences in the United States.

capital punishment | criminal justice | wrongful conviction

In the past few decades a surge of hundreds of exonerations of innocent criminal defendants has drawn attention to the problem of erroneous conviction, and led to a spate of reforms in criminal investigation and adjudication (1–3). All the same, the most basic empirical question about false convictions remains unanswered: How common are these miscarriages of justice?

False convictions, by definition, are unobserved when they occur: If we know that a defendant is innocent, he is not convicted in the first place. They are also extremely difficult to detect after the fact. As a result, the great majority of innocent defendants remain undetected. The rate of such errors is often described as a "dark figure" (4)—an important measure of the performance of the criminal justice system that is not merely unknown but unknowable.

However, there is no shortage of lawyers and judges who assert confidently that the number of false convictions is negligible. Judge Learned Hand said so in 1923: "Our [criminal] procedure has always been haunted by the ghost of the innocent man convicted. It is an unreal dream" (5, p. 649). And in 2007, Justice Antonin Scalia wrote in a concurring opinion in the Supreme Court that American criminal convictions have an "error rate of [0].027 percent—or, to put it another way, a success rate of 99.973 percent" (6, p. 182). This would be comforting, if true. In fact, the claim is silly. Scalia's ratio is derived by taking the number of known exonerations at the time, which were limited almost entirely to a small subset of murder and rape cases, using it as a measure of all false convictions (known and unknown), and dividing it by the number of all felony convictions for all crimes, from drug possession and burglary to car theft and income tax evasion.

To actually estimate the proportion of erroneous convictions we need a well-defined group of criminal convictions within which we identify all mistaken convictions, or at least most. It is hard to imagine how that could be done for criminal convictions generally, but it might be possible for capital murder.

The rate of exonerations among death sentences in the United States is far higher than for any other category of criminal convictions. Death sentences represent less than one-tenth of 1% of prison sentences in the United States (7), but they accounted for about 12% of known exonerations of innocent defendants from 1989 through early 2012 (2), a disproportion of more than 130 to 1. A major reason for this extraordinary exoneration rate is that far more attention and resources are devoted to death penalty cases than to other criminal prosecutions, before and after conviction.

The vast majority of criminal convictions are not candidates for exoneration because no one makes any effort to reconsider the guilt of the defendants. Approximately 95% of felony convictions in the United States are based on negotiated pleas of guilty (plea bargains) that are entered in routine proceedings at which no evidence is presented. Few are ever subject to any review whatsoever. Most convicted defendants are never represented by an attorney after conviction, and the appeals that do take place are usually perfunctory and unrelated to guilt or innocence.

Death sentences are different. Almost all are based on convictions after jury trial, and even the handful of capital defendants who plead guilty are then subject to trial-like-sentencing hearings, usually before juries. All death sentences are reviewed on appeal; almost all are reviewed repeatedly. With few exceptions, capital defendants have lawyers as long as they remain on death row. Everyone, from the first officer on the scene of a potentially capital crime to the Chief Justice of the United States, takes capital cases more seriously than other criminal prosecutions—and knows that everybody else will do so as well. And everyone from defense lawyers to innocence projects to governors and state and federal judges is likely to be particularly careful to avoid the execution of innocent defendants.

This extraordinary difference in resources and attention generates two related effects. (*i*) Advocates for a defendant are much more likely to pursue any plausible postconviction claim of innocence if the defendant is under sentence of death. (*ii*) Courts

Significance

The rate of erroneous conviction of innocent criminal defendants is often described as not merely unknown but unknowable. We use survival analysis to model this effect, and estimate that if all death-sentenced defendants remained under sentence of death indefinitely at least 4.1% would be exonerated. We conclude that this is a conservative estimate of the proportion of false conviction among death sentences in the United States.

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[1]To whom correspondence may be addressed. E-mail: srgross@umich.edu.

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(and other government actors) are much more likely to consider and grant such a claim if the defendant is at risk for execution. As a result, false convictions are far more likely to be detected among those cases that end in death sentences than in any other category of criminal convictions.

The high exoneration rate for death sentences suggests that a substantial proportion of innocent defendants who are sentenced to death are ultimately exonerated, perhaps a majority. If so, we can use capital exonerations as a basis for estimating a lower bound for the false conviction rate among death sentences.

Since 1973, when the first death penalty laws now in effect in the United States were enacted (8), 143 death-sentenced defendants have been exonerated, from 1 to 33 y after conviction (mean = 10.1 y) (9). In a previous study we found that 2.3% of all death sentences imposed from 1973 through 1989 resulted in exoneration by the end of 2004 (7). A study by Risinger (10) estimated that had biological samples been available for testing in all cases, 3.3% of defendants sentenced to death between 1982 and 1989 for murders that included rape would have been exonerated by DNA evidence through February 2006. That estimate, however, is based on a small number of exonerations (n = 11) (10). Both studies were limited to convictions that occurred 15 y or more before the study date, and so include a high proportion of all exonerations that will ever occur in the relevant groups. Nonetheless both studies underestimate the false conviction rate for death-sentenced defendants because they do not reflect exonerations that occur after the study period, and do not include false convictions that are never detected at all.

Capital defendants who are removed from death row but not exonerated—typically because their sentences are reduced to life imprisonment—no longer receive the extraordinary level of attention that is devoted to death row inmates. (This applies as well to those who are executed or die on death row from other causes.) If they are in fact innocent, they are much less likely to be exonerated than if they had remained on death row. As a result, the proportion of death-sentenced inmates who are exonerated understates the rate of false convictions among death sentences because the intensive search for possible errors is largely abandoned once the threat of execution is removed.

In other words, the engine that produces an exoneration rate that is a plausible proxy for the rate of false conviction among death-sentenced prisoners is the process of reinvestigation and reconsideration under threat of execution. Over time, most death-sentenced inmates are removed from death row and resentenced to life in prison—at which point their chances of exoneration appear to drop back to the background rate for all murders, or close to it. Thus, we will get a better estimate of the rate of false capital convictions if are able to estimate "what the rate of capital exonerations would be if all death sentences were subject for an indefinite period to the level of scrutiny that applies to those facing the prospect of execution" (7). This study does just that.

Current Study

Data. We examine exonerations among defendants sentenced to death from the beginning of the "modern" death penalty in the United States in 1973, after the Supreme Court invalidated all prior death sentencing laws (11), through the end of 2004. Our data come from two sources. (*i*) Death sentences since 1973 are tracked by the Bureau of Justice Statistics (BJS) of the Department of Justice, which maintains data on the current status of all death-sentenced defendants in that period (12). We know that 7,482 defendants were sentenced to death in the United States from January 1973 through December 2004, and we know when (if ever) each defendant was removed from death row by execution, death by other means, or legal action by courts or executive officials. (*ii*) The Death Penalty Information Center maintains a list of defendants who were sentenced to death in the United States and exonerated since the beginning of 1973 (13), including 117 who were sentenced to death after January 1, 1973 and exonerated by legal proceedings that began before the end of 2004. We collected additional data on these cases from public records and media sources, expanding on the dataset used by Gross and O'Brien (7). We were able to match on several key variables 108 of the 117 death sentence exonerations in this period to specific cases in the BJS database to produce the database we analyzed.

Table 1 displays the status of the 7,482 death-sentenced defendants we studied as of December 31, 2004, the final day of our study period. On that date, 12.6% of these defendants had been executed, 1.6% were exonerated, 4% died of suicide or natural causes while on death row, 46.1% remained on death row, and 35.8% were removed from death row but remained in prison after their capital sentences or the underlying convictions were reversed or modified.

Table 1 is a snapshot of the status of these defendants at the end of the study period. (It would look quite different if it displayed the status of death-sentenced defendants at the end of 1985, for example, or 2000.) It cannot be used directly to estimate the rate of exoneration because exonerations are a function of time. Many of the defendants on death row at the end of 2004 had only been there for a year or two, far less than the mean of 10.1 y from conviction to exoneration for all capital exonerations since 1973.

Over time, many of those who remained on death row at the end of 2004 will be removed (or already have been); most will end up with sentences of life imprisonment. If the pattern for death sentences from 1973 through 1995 holds, over two-thirds of prisoners sentenced to death will have the judgments against them overturned. The majority will remain in prison for life (14, 15), but some will be exonerated and released.

Threat of Execution. A central variable of interest is whether an exoneration took place while the defendant was still under threat of execution (for detailed information, see *SI Materials and*

Table 1. Death-sentenced defendants in the United States, 1973–2004 (n = 7,482)

Status as of December 31, 2004	Proportion of all cases Percent (n)	Time on death row, y Mean (SD)	Time to release, y Mean (SD)
Executed	12.6 (943)	10.7 (4.8)	NA
Died on death row but not executed	4.0 (298)	7.7 (5.9)	NA
Still on death row	46.1 (3,449)	10.5 (6.3)	NA
Removed from death row but not exonerated	35.8 (2,675)	5.4 (4.9)	NA
Exonerated, all	1.6 (117)	6.7 (5.1)	9.1 (5.9)
Exonerated, under threat of execution*	1.4 (107)	7.0 (5.2)	8.6 (5.6)
Exonerated, not under threat of execution†	0.1 (10)	3.6 (2.6)	13.8 (7.5)

NA, not applicable.

*The defendant was exonerated by legal proceedings that were initiated before the end of 2004 and while the defendant was under sentence of death.

†The defendant was exonerated by legal proceedings that were initiated before the end of 2004 but after the defendant was no longer under sentence of death. Data from the Death Penalty Information Center (9) and the BJS of the US Department of Justice (12).

Methods, section 1). The status of the defendant as under threat is obvious when a defendant is exonerated and released directly from death row. On the other side, a defendant is clearly not under threat of execution when the exoneration is the product of a process that began years after removal from death row.

In other cases, determining the threat status of the defendant at the time of exoneration is more demanding. We identify defendants who were under threat of execution to focus on exonerations that benefited from the extraordinary levels of effort and scrutiny that are applied to defendants who might be put to death. Many defendants who leave death row might be sent back. Hence the under-threat-of-execution category includes defendants who were removed from death row but remained eligible for resentencing to death, and in whose cases the prosecution was actively pursuing a new death sentence or considering whether to do so. For example, Ronald Williamson was sentenced to death in Oklahoma in 1988, and awarded a new trial in 1997 because of constitutionally inadequate representation by his trial lawyer (16). He was exonerated by DNA testing 2 y later, in 1999, while awaiting a retrial at which he might have been sentenced to death again. His exoneration was under threat of execution.

We also count an exoneration as under threat if the process that ultimately led to the exoneration began while the defendant was on death row, even if the final decision to release the defendant was made after he left death row. This sort of delay is common for defendants who are removed from death row when their convictions are reversed by reviewing courts but not released until months or years later when the prosecution decides to dismiss the charges. In some cases the process is more elaborate. For instance, John Thompson was sentenced to death in Louisiana in 1985 (13). In 2001 he sought a new trial based on newly discovered evidence, but received only a reduction in his sentence to life imprisonment. Thompson successfully appealed the denial of a new trial and was acquitted in 2003. Thus, although his death sentence was vacated 2 y before his acquittal, we treat him as exonerated under threat of execution because the legal proceedings that led to exoneration began while he was on death row and ran to their conclusion two years later.

We define an exoneration under threat of execution as an exoneration that is the result of legal proceedings that were initiated while the defendant was on death row. The date we assign to an exoneration is the date of removal from death row, the last date on which the exoneration can be initiated and still count as under threat, not the date on which the process was completed. Using these criteria, we determined that 107 of the 117 exonerations that occurred before the end of 2004 were under threat of execution, and 10 exonerations were not under that threat. The significance of this classification is apparent from Table 1. Of defendants sentenced to death since 1973, 35.8% had been resentenced to a prison term by the end of 2004. However, only 8.5% of capital exonerations (10 of 117) came from this group even though these prisoners were, by definition, at a later stage of their imprisonment than those who remained on death row. (Except for those who are exonerated—and a very small group who are resentenced to lesser penalties and eventually released—all prisoners who are sentenced to death do ultimately die in prison. They all start out on death row, some stay there until death by execution by other means, and the rest eventually are moved to the general prison population where they remain until they die.)

Our estimate of the rate of false convictions among death-sentenced defendants is based on the hypothesis that death-sentenced prisoners who remain under threat of execution are far more likely to be exonerated than those who remain in prison but no longer face that threat. We use a Cox proportional hazards model with a time-dependent covariate to test that hypothesis. We find, consistent with expectations, that death-sentenced defendants who are no longer under threat of execution had a rate of exoneration approximately one eighth of that for defendants who remained on death row, 0.131 ($P < 0.0001$) (with 95% confidence interval of 0.064–0.266) (*SI Materials and Methods*, section 3).

Analysis. Our task is to estimate the cumulative probability over time of the event of interest, exoneration, in the population of death-sentenced defendants who remain under threat of execution. The temporal measure (t) is time from conviction. Estimating this probability is complicated by the structure of the

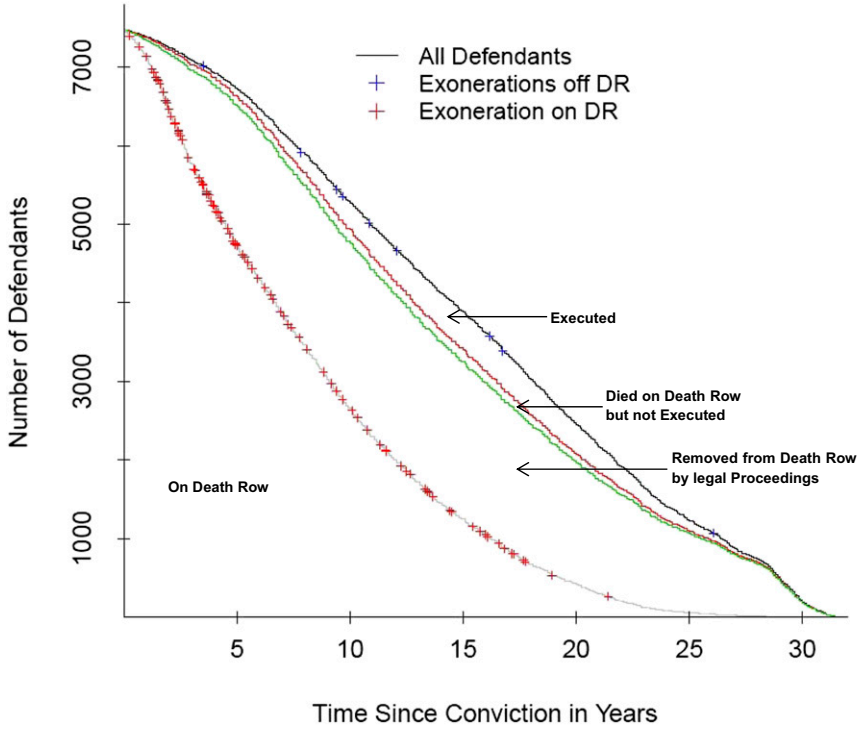

Fig. 1. The status of death-sentenced defendants and the occurrence of exonerations, by time from conviction. The black line represents the total number of all death-sentenced defendants by time from conviction and the gray line the number of defendants who remained on death row (DR) and were therefore available for exoneration under threat of execution by time from conviction. The three areas between the black and gray lines display the dispositions of those defendants who were removed from death row over the time period by mode of removal: execution, suicide or death from natural causes, and legal proceedings (court orders or executive clemency). A minority of defendants who were removed from death by legal proceedings were exonerated. The plus symbols mark exonerations by date measured in time from conviction. The 10 blue plus symbols (on the black line) mark exonerations that were not under threat of execution by the date of the completion of the exoneration. The 107 red plus symbols (on the gray line) mark exonerations that were initiated under threat of execution by the date of removal of the defendants from death row.

population for two reasons. (*i*) Individual defendants joined this population across a 32-y period. Their duration in the study period varied from 1 to 32 y. (*ii*) All death-sentenced defendants began, at conviction, under threat of execution, but for most that threat, and their membership in the population of interest, ended within several years, usually because they were resentenced to life imprisonment. The net effect is that the number of defendants under threat of execution is a decreasing function of time from conviction, ranging from $n = 7{,}482$ at $t = 0$ y to $n = 0$ at $t = 30.7$ y (Fig. 1).

To estimate this cumulative probability, we use survival analysis. This technique has been used in a related context, to estimate the rate of all reversals of death sentences in the United States (15). It is most commonly used, however, to evaluate the efficacy of medical treatments when not all patients experience the outcome of interest. The issue we address is analogous, but the analogy is counterintuitive.

We use survival analysis to assess the prospects of members of a population that is subject to a special risk. In the usual medical context, the condition that defines the population is a pathology such as Lyme disease or diabetes; for our study the defining condition is "death sentence." As a result of this condition, every member of this population is subject to the risk of a terminal event that might remove him from the group that has survived with this condition. In biomedical survival studies, that terminal event that is studied is death from the pathology in question; for our study it is exoneration. This is a counterintuitive equivalence: For our purposes, remaining in prison following a death sentence counts as "survival;" and exoneration, which removes the subject from prison, is analogous to "death" in the common context in which survival analysis is used.

Survival analysis is often used to evaluate the efficacy of a medical treatment that may reduce mortality from a pathology. In this study the "treatment" that lowers the probability of the terminal event of interest (exoneration) is removal of the threat of execution. (This too is a counterintuitive analogy. Exonerating an innocent defendant is, of course, a good thing for that defendant, but removal from death row is equivalent to a treatment that reduces the "risk" of exoneration.) Our focus, however, is not on the treated group (those removed from death row) but on those who remain untreated (defendants who remain under threat of execution and therefore at high risk of exoneration).

In this study, as in medical research, subjects may be removed from the population of interest by means other than the terminal event at issue. In survival analysis of a disease, the usual means of exit by other means are death from a different cause or discontinuation of participation in the study. In our study, all deaths after capital sentencing (by execution, suicide, or natural causes) remove the person from the population that is subject to the risk of execution. However, most removals from the population by means other than exoneration are by legal action that reduces the defendant's sentence to life in prison and thereby eliminates the threat of execution.

A primary difficulty in estimating the cumulative probability of exoneration is that some defendants were censored, i.e., they did not have an opportunity to be exonerated under threat of execution during the study period. Some defendants were removed from that threat during the study period but would have been exonerated had they remained under threat; others, who were sentenced to death relatively recently, remained under threat and had not been exonerated at the end of the study period but would have been exonerated at some later point if the study period were extended. As a result, a simple proportion of exonerated defendants to all defendants is a biased estimate of the cumulative probability of exoneration.

We therefore use the Kaplan–Meier estimator to calculate the cumulative probability of exoneration under threat of execution for death-sentenced defendants, by time from conviction through 2004. This estimator takes account of the censoring of observations caused by recency of incarceration on death row, death from suicide or natural causes, or other removals from the threat of execution. The Kaplan–Meier survival function estimates the probability of being event-free (remaining on death row) up to a given length of time from conviction. Its complement (1 minus the estimator) estimates the cumulative incidence of the event (exoneration) up to the given length of time from conviction. Unlike a simple proportion, the Kaplan–Meier estimator is unbiased in the presence of independent censoring (see further discussions in *Sensitivity Analysis*), and is completely nonparametric; it can be viewed as a censored data analog of the empirical distribution function. (17, 18) (*SI Materials and Methods*, section 2).

As Fig. 2 shows, the cumulative probability of exoneration for death-sentenced defendants who remained under threat of execution for 21.4 y was 4.1% (with a 95% confidence interval of 2.8–5.2%). [We replicated the Kaplan–Meier estimate of the cumulative probability of exoneration under threat of execution using the Fleming–Harrington estimator. Both results are virtually indistinguishable (*SI Materials and Methods*, section 3).]

This 4.1% estimate may approach the underlying rate of false convictions because it reflects the cumulative effect of a process that is uniquely efficient at detecting such errors. To rely on this estimate, however, two additional steps are necessary.

Sensitivity analysis. An important assumption for the validity of the Kaplan–Meier estimator is that censoring events that remove subjects from consideration are statistically independent of the time to the event of interest if the subjects had not been removed. In this context, that assumption is plausible with respect to censoring by recency of conviction and by death from suicide or natural causes while under threat of execution. On the other hand, there are strong reasons to believe that both execution and removal from death row by legal procedures without exoneration are not independent of time-to-exoneration. Because the assumption of independence may be violated, sensitivity analysis is necessary.

Specifically, (*i*) 13% of death-sentenced inmates were removed from death row by execution (943 of 7,482). Some executed defendants may have been innocent, and, although none has been exonerated after execution (9), they might have been exonerated if they had remained alive and on death row. However, we expect that the proportion of innocent defendants is

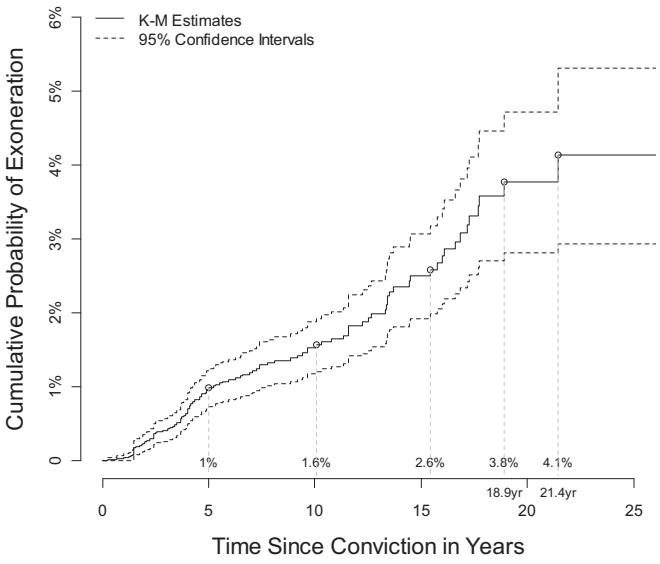

Fig. 2. Kaplan–Meier (K-M) estimate of the cumulative rate of exoneration (solid line) and 95% confidence interval (dashed line) under threat of execution for defendants sentenced to death in the United States from 1973 through 2004 by time from conviction to removal from death row. Exoneration under threat of execution is defined as exoneration that resulted from legal proceedings that were initiated before the end of 2004 and while the defendant was under sentence of death.

lower among those who are executed than among those who remain on death row (7) (*SI Materials and Methods*, section 4). The threat of execution is the engine that drives the process of exonerating innocent death row prisoners, and it is likely that this process becomes more painstaking as inmates approach their execution dates. This concern about executing innocent defendants also drives a second bias: (*ii*) It increases the proportion of innocent defendants among the 36% of death row inmates who were removed from death row and resentenced to prison but not exonerated (2,675 or 7,482). Courts and executive officials explicitly recognize that it is appropriate to take the possibility of innocence into account in deciding whether to reverse a conviction for procedural error or commute a death sentence to life imprisonment, and a wealth of anecdotal evidence suggests that this practice is widespread (*SI Materials and Methods*, section 4). As a result, those who are resentenced to punishments less than death are more likely to be innocent than those who remain on death row.

In short, we believe that (*i*) executed defendants are less likely to have been exonerated if they had remained on death row than those who in fact remained on death row, and (*ii*) defendants who were removed from death row but remained in prison are more likely to have been exonerated if they had remained under threat of execution.

These two biases are not equivalent in magnitude. Nearly three times as many unexonerated death-sentenced defendants were resentenced to prison (2,675) as were executed (943). Even a modest increase in the proportion of innocent defendants among death-sentenced prisoners resentenced to life imprisonment, compared with those who remain on death row, would more than offset a complete absence of innocent defendants among those who are executed.

We use competing risks methodology (18), along with explicit assumptions about the counterfactual probability of exoneration for those who were executed or resentenced to prison, to develop a sensitivity analysis for the Kaplan–Meier estimate of the cumulative exoneration rate. First, we estimate the cumulative incidence of exoneration subject to the competing risks of execution and resentencing by 21.4 y after conviction, on the assumption that censoring by recency, suicide, or natural death was independent of these three event processes. The estimates of the probabilities of removal from risk of exoneration by exoneration under threat of execution, by execution itself, or by resentencing, are 2.2% (1.7%, 2.7%), 23.8% (22.3%, 25.3%), and 48.3% (46.7%, 50.0%), respectively. Thus, a defendant sentenced to death had an estimated 2.2% chance of being exonerated while under threat of execution by 21.4 y after conviction, assuming those executed or resentenced had zero chance of being exonerated (i.e., allowing for the competing risks of execution and resentencing) (*SI Materials and Methods*, section 3).

Consider instead the assumption that, had they remained on death row, (*i*) those who were executed would have had zero chance of exoneration, and (*ii*) those who were resentenced would have had twice the chance of exoneration as the entire population of defendants sentenced to death. This yields the following estimate of the cumulative probability of exoneration, had those who were exonerated or resentenced instead remained on death row: 2.2% + 0 (23.8%) + 2 (2.2%) (48.3%) = 4.4%. Using the Delta method, the confidence interval for this estimate is 3.41–5.28%, assuming that the cumulative incidences of exoneration and resentencing have zero covariance.

A zero probability of exoneration for executed defendants had they remained on death row is necessarily, for the purposes of this estimate, a conservative assumption. We believe that the assumed probability of exoneration for those who were removed from death row and resentenced to prison, twice the mean for the population, is reasonable. We conclude that the Kaplan–Meier estimate we obtained is conservative. Indeed the same result we would obtain if we assume that the probability of exoneration for those resentenced to prison, had they remained on death row, is equal to or greater than 1.77 times the population average [2.2% + 0 (23.8%) + 1.77 (2.2%) (48.3%) = 4.1%].

Estimating false convictions from exonerations. Because there is no general method to accurately determine innocence in a criminal case, we use a proxy, exoneration: an official determination that a convicted defendant is no longer legally culpable for the crime for which he was condemned. There will be misclassifications. Some exonerated defendants are guilty of the crimes for which they were sentenced to death. We expect that such errors are rare, given the high barriers the American legal system imposes on convicted defendants in persuading authorities to reconsider their guilt (1–3, 7) (*SI Materials and Methods*, section 4). To date, one such case has come to light, and has been reclassified (19). Monte Carlo simulations reveal that the effect of such misclassifications on the cumulative rate of exoneration is linear: If 10% of exonerated defendants were in fact guilty, the mean cumulative rate of innocence for death-sentenced defendants would be 3.7% rather than 4.1% (95% confidence interval of 3.3–4.0%); if 20% were guilty, the mean rate would be 3.3% (95% confidence interval of 2.8–3.7%) (*SI Materials and Methods*, section 3).

On the other side, some innocent defendants who remained on death row for more than 21.4 y but were not exonerated are misclassified as guilty. Some may still be exonerated; some may be executed; and most will likely die in prison, on death row or off, of natural causes or suicide. In the absence of better data we assume that the probability of a legal campaign to exonerate any prisoner under threat of death who has a plausible innocence claim is 1, and we assume that the probability of success for an innocent prisoner who remains under such threat for at least 21.4 y is also 1. These are necessarily conservative assumptions. To the extent that these probabilities are in fact less than 1, our estimate will understate the actual rate of false convictions.†

The distribution of possible misclassifications is asymmetrical: 216 defendants remained on death row longer than 21.4 y, whereas only 107 were exonerated under threat of execution. Unless the process of death row exoneration is assumed to be unrealistically thorough, it is likely that the number of innocent death-sentenced defendants misclassified as guilty exceeds the number of guilty defendants exonerated under threat of execution and misclassified as innocent. [The proxy we use (the exoneration rate) is also important in its own right: It is a direct measure of the rate of death sentencing of defendants later determined to be legally not guilty.]

Taken together, the sensitivity analysis and the likely net effects of misclassification both point in the same direction and suggest that our 4.1% estimate of the rate of false conviction among death-sentenced defendants is conservative.

Discussion

We present a conservative estimate of the proportion of erroneous convictions of defendants sentenced to death in the United States from 1973 through 2004, 4.1%. This is a unique finding; there are no other reliable estimates of the rate of false conviction in any context. The main source of potential bias is the accuracy of our classification of cases as true or false convictions. On that issue it is likely that we have an undercount, that there are more innocent death row defendants who have not been identified and exonerated than guilty ones who have been exonerated in error.

The most charged question in this area is different: How many innocent defendants have been put to death (6)? We cannot estimate that number directly but we believe it is comparatively

†A reviewer of an earlier draft suggested an alternative analytic approach. The suggested approach postulates a campaign process that gives some but not all death-sentenced defendants the opportunity to be exonerated. Identification of the false conviction rate is then based on independence assumptions between innocence and removal from death row. With more complete data of the sort required for the best realization of this insightful approach, we believe that it would offer a particularly valuable supplement, and test of the robustness, of our findings and conclusions.

low. If the rate were the same as our estimate for false death sentences, the number of innocents executed in the United States in the past 35 y would be more than 50 (20). We do not believe that has happened. Our data and the experience of practitioners in the field both indicate that the criminal justice system goes to far greater lengths to avoid executing innocent defendants than to prevent them from remaining in prison indefinitely. One way to do so is to disproportionately reverse death sentences in capital cases in which the accuracy of the defendants' convictions is in doubt and to resentence them to life imprisonment, a practice that makes our estimate of the rate of error conservative. However, no process of removing potentially innocent defendants from the execution queue can be foolproof. With an error rate at trial over 4%, it is all but certain that several of the 1,320 defendants executed since 1977 were innocent (21).

It is possible that the death-sentencing rate of innocent defendants has changed over time. No specific evidence points in that direction, but the number and the distribution of death sentences have changed dramatically in the past 15 y (22). One change, however, is unlikely to have much impact: the advent of DNA identification technology. DNA evidence is useful primarily in rape rather than homicide investigations. Only 13% of death row exonerations since 1973 (18 of 142) resulted from postconviction DNA testing (13), so the availability of preconviction testing will have at most a modest effect on that rate.

Unfortunately, we cannot generalize from our findings on death sentences to the rate of false convictions in any broader category of crime. Capital prosecutions, and to a lesser extent murder cases in general, are handled very differently from other criminal cases. There are theoretical reasons to believe that the rate of false conviction may be higher for murders in general, and for capital murders in particular, than for other felony convictions, primarily because the authorities are more likely to pursue difficult cases with weak evidence of guilt if one or more people have been killed (23). However, there are no data that confirm or refute this hypothesis.

We do know that the rate of error among death sentences is far greater than Justice Scalia's reassuring 0.027% (6). That much is apparent directly from the number of death row exonerations that have already occurred. Our research adds the disturbing news that most innocent defendants who have been sentenced to death have not been exonerated, and many—including the great majority of those who have been resentenced to life in prison—probably never will be.

This is only part of a disturbing picture. Fewer than half of all defendants who are convicted of capital murder are ever sentenced to death in the first place (e.g., 49.1% in Missouri as in ref. 24, 29% in Philadelphia as in ref. 25, and 31% in New Jersey as in ref. 26). Sentencing juries, like other participants in the process, worry about the execution of innocent defendants. Interviews with jurors who participated in capital sentencing proceedings indicate that lingering doubts about the defendant's guilt is the strongest available predictor of a sentence of life imprisonment rather than death (27). It follows that the rate of innocence must be higher for convicted capital defendants who are not sentenced to death than for those who are. The net result is that the great majority of innocent defendants who are convicted of capital murder in the United States are neither executed nor exonerated. They are sentenced, or resentenced to prison for life, and then forgotten.

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