

Evidence-Based Elections and Risk-Limiting Audits

Emerging Election Technologies Enhancing Integrity, Transparency, and Confidence
AAAS Annual Meeting

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Half of Republicans say Biden won because of a 'rigged' election: Reuters/Ipsos poll

By Chris Kahn

3 MIN READ



(Reuters) - About half of all Republicans believe President Donald Trump “rightfully won” the U.S. election but that it was stolen from him by widespread voter fraud that favored Democratic President-elect Joe Biden, according to a new Reuters/Ipsos opinion poll.



The Nov. 13-17 opinion poll showed that Trump’s open defiance of Biden’s victory in both the popular vote and Electoral College appears to be affecting the public’s confidence in American democracy, especially among Republicans.

Evidence-Based Elections

P.B. Stark and D.A. Wagner

Abstract—We propose an alternative to current requirements for certifying voting equipment and conducting elections. We argue that elections should be structured to provide convincing affirmative evidence that the reported outcomes actually reflect how people voted. This can be accomplished with a combination of software-independent voting systems, compliance audits, and risk-limiting audits. Together, these yield a resilient canonical framework: a fault-tolerant approach to conducting elections that gives strong evidence that the reported outcome is correct, or reports that the evidence is not convincing. We argue that, if evidence-based elections are adopted, certification and testing of voting equipment can be relaxed, saving money and time and reducing barriers to innovation in voting systems—and election integrity will benefit. We conclude that there should be more regulation of the evidence trail and less regulation of equipment, and that compliance audits and risk-limiting audits should be required.

Keywords elections, software-independent voting system, risk-limiting audit, resilient canonical framework E20C3 SEC-INTE, APP-CHM, APP-INTE, APP-OTIE.

I. INTRODUCTION

IDEALLY, what should an election do? Certainly, an election should find out who won, but we believe it also should produce convincing evidence that it found the real winner—or report that it cannot. This is not automatic: it requires thoughtful design of voting equipment, carefully planned and implemented voting and vote counting processes, and rigorous post-election auditing.

While approximately 75% of US voters currently vote on equipment that produces a voter-verifiable paper record of the vote, about 25% vote on paperless electronic voting machines that do not produce such a record [1].

Because paperless electronic voting machines rely upon complex software and hardware, and because there is no feasible way to ensure that the voting software is free of bugs or that the hardware is executing the proper software, there is no guarantee that electronic voting machines record the voter's votes accurately. And because paperless voting machines preserve only an electronic record of the vote that cannot be directly observed by voters, there is no way to produce convincing evidence that the electronic record accurately reflects the voters' intent. Internet voting shares the shortcomings of paperless electronic voting machines, and has additional vulnerabilities.

Numerous failures of electronic voting equipment have been documented. Paperless voting machines in Carteret County, North Carolina intractably lost 4,400 votes; other machines in Mecklenburg, North Carolina recorded 3,955 more votes than the number of people who voted; in Bernalillo County, New Mexico, machines recorded 2,700 more votes than voters; in Mahoning County, Ohio, some machines reported a negative total vote count; and in Fairfax, Virginia, county officials found that for every hundred or so votes cast for one candidate, the electronic voting machines subtracted one vote for her [2]. In short, when elections are conducted on paperless voting

EVIDENCE-BASED ELECTIONS: CREATE A MEANINGFUL PAPER TRAIL, THEN AUDIT

Andrew W. Appel* & Philip B. Stark**

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Public Evidence from Secret Ballots

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Abstract

Elections seem simple—aren't they just about counting? But they have a unique, challenging combination of security and privacy requirements. The stakes are high; the context is adversarial; the electorate needs to be convinced that the results are correct; and the secrecy of the ballot must be ensured. They also have practical constraints: time is of the essence, and voting systems need to be affordable and maintainable, as well as usable by voters, election officials, and pollworkers. It is thus not surprising that voting is a rich research area spanning theory, applied cryptography, practical systems analysis, usable security, and statistics. Election integrity involves two key concepts: convincing evidence that outcomes are correct and privacy, which amounts to convincing assurance that *there is no evidence about how any given person voted*. These are obviously in tension. We examine how current systems walk this tightrope.

Evidence-Based elections (Stark & Wagner, 2012)

- Elections should provide *affirmative* public evidence that reported winners really won, not just report who won.

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- Elections should provide *affirmative* public evidence that reported winners really won, not just report who won.
- Procedure-based versus evidence-based

EBE: trustworthy paper + risk-limiting audits

RLA: any procedure w/ a known maximum chance of not correcting the reported outcome if it's wrong & never changes correct outcomes.

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Risk limit: max chance of *not* correcting reported outcome if it's wrong, no matter why it's wrong.

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RLA corrects wrong outcomes via a full hand count of trustworthy paper trail.

CONSERVATIVE STATISTICAL POST-ELECTION AUDITS

BY PHILIP B. STARK

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There are many sources of error in counting votes: the apparent winner might not be the rightful winner. Hand tallies of the votes in a random sample of precincts can be used to test the hypothesis that a full manual recount would find a different outcome. This paper develops a conservative sequential test based on the vote-counting errors found in a hand tally of a simple or stratified random sample of precincts. The procedure includes a natural escalation: If the hypothesis that the apparent outcome is incorrect is not rejected at stage s , more precincts are audited. Eventually, either the hypothesis is rejected—and the apparent outcome is confirmed—or all precincts have been audited and the true outcome is known. The test uses a priori bounds on the overstatement of the margin that could result from error in each precinct. Such bounds can be derived from the reported counts in each precinct and upper bounds on the number of votes cast in each precinct. The test allows errors in different precincts to be treated differently to reflect voting technology or precinct sizes. It is not optimal, but it is conservative: the chance of erroneously confirming the outcome of a contest if a full manual recount would show a different outcome is no larger than the nominal significance level. The approach also gives a conservative P -value for the hypothesis that a full manual recount would find a different outcome, given the errors found in a fixed size sample. This is illustrated with two contests from November, 2006: the U.S. Senate race in Minnesota and a school board race for the Sausalito Marin City School District in California, a small contest in which voters could vote for up to three candidates.

Implementing Risk-Limiting Post-Election Audits in California

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Abstract

Risk-limiting post-election audits limit the chance of certifying an electoral outcome if the outcome is not what a full hand count would show. Building on previous work [18, 17, 20, 21, 11], we report pilot risk-limiting audits in four elections during 2008 in three California counties: one during the February 2008 Primary Election in Marin County and three during the November 2008 General Elections in Marin, Santa Cruz and Yolo Counties. We explain what makes an audit *risk-limiting* and how existing and proposed laws fall short. We discuss the differences among our four pilot audits. We identify challenges to practical, efficient risk-limiting audits and conclude that current approaches are too complex to be used routinely on a large scale. One important logistical bottleneck is the difficulty of exporting data from commercial election management systems in a format amenable to audit calculations. Finally, we propose a bare-bones risk-limiting audit that is less efficient than these pilot audits, but avoids many practical problems.



Home

Elections should be conducted with human-readable paper ballots. Paper ballots form a body of evidence that is not subject to manipulation by faulty software or hardware and that can be used to audit and verify the results of an election. Human-readable paper ballots may be marked by hand or by machine (using a ballot-marking device), and they may be counted by hand or by machine (using an optical scanner), the report says. Voters should have an opportunity to review and confirm their selections before depositing the ballot for tabulation. Voting machines that do not provide the capacity for independent auditing – i.e., machines that do not produce a printout of a voter’s selections that can be verified by the voter and used in audits – should be removed from service as soon as possible.

States should mandate a specific type of audit known as a “risk-limiting” audit prior to the certification of election results. By examining a statistically appropriate random sample of paper ballots, risk-limiting audits can determine with a high level of confidence whether a reported election outcome reflects a correct tabulation

- Pilots starting in 2008 in California; now ~60 in ~16 states.
- Routine statewide in CO since 2017. Statewide pilots in AK, KS, WY in 2020.
- Laws (of varying quality) in CA, CO, CT, GA, NV, NJ, OH, OR, RI, TX, VA, WA
- SHANGRLA (2020): unifies broad variety of sampling plans, audits of plurality, multi-winner plurality, supermajority, approval, IRV/RCV, D'Hondt, Hamiltonian, Borda, STARVote, all scoring rules

Wrinkles, Fallacies, and Conceptual Errors

- **Can't limit risk w/o trustworthy vote records. GIGO**
 - ~20% of U.S. votes aren't recorded on paper
 - many jurisdictions lack physical security, ballot accounting, pollbook reconciliation, secure chain of custody, rigorous canvass
 - reliance on universal-use BMDS:
 - HMPB records what *voters* did
 - Machine-marked ballots (BMD) records what *machines* did
 - BMD printout cannot provide affirmative evidence outcomes are correct

- auditing a contest provides no evidence about other contests
- *Cargo-cult audits*: go through some of the motions of an RLA but don't actually limit the risk of certifying wrong outcomes (GA 2020, 2022)
- some experts blur distinction btw *fault detection* & *affirmative evidence*: like checking for signs of forced entry vs. checking whether anything is missing.
- RLAs of trustworthy paper check whether anything is missing.
RLA procedures applied to untrustworthy paper just look for signs of forced entry.

Evidence-Based Elections: 5 C's

- Voters *CREATE* complete, durable, verified, trustworthy audit trail.
- LEO *CARES FOR* the audit trail adequately to ensure it remains complete and accurate.
- Verifiable audit *CONFIRMS* integrity of paper trail, *CHECKS* reported results against the paper & *CORRECTS* wrong outcomes