Principles and Best Practices for Post-Election Tabulation Audits

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These principles and best practices were written to guide the regulation and design of high-quality post-election audits. They were developed by an ad hoc group including former election officials, public advocates, computer scientists, statisticians, and political scientists. This version of the principles and best practices updates a previous version written in 2008 by Mark Lindeman, Mark Halvorson, Pamela Smith, Lynn Garland, Vittorio Addona, and Dan McCrea.

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Introduction

This document is meant to provide guidance to relevant legislative bodies, state and local election administrators and vendors.

Why Audit Elections?

A healthy democracy requires widespread trust in elections. In particular, people need to be sure that the official election outcomes match the will of the voters.[1] Election audits that examine voted ballots provide direct evidence that the people who take office and the ballot measures enacted were in fact chosen by the voters.[2]

Audits differ from recounts. Audits routinely check voting system performance in contests regardless of how close margins of victory appear to be.[3] Recounts repeat ballot counting in special circumstances, such as when preliminary results show a close margin of victory. In most cases, audits require checking a small fraction of ballots, while a recount requires checking all ballots. Ideally, a post-election audit can lead to a full recount if necessary to correct the reported outcome.

Voices from across the political spectrum agree that we should be auditing our election outcomes. According to a 2018 Senate Intelligence Committee report, "States should consider implementing more widespread, statistically sound audits of election results. Risk-limiting audits, in particular, can be a cost-effective way to ensure that votes cast are votes counted."[4] The bipartisan Presidential Commission on Election Administration recommended that audits "must be conducted after each election, as part of a comprehensive audit program," and specifically endorsed risk-limiting audits.[5] The National Academies of Science, Engineering, and Medicine's 2018 consensus study report on election security similarly recommended audits that "include manual examination of statistically appropriate samples of paper ballots cast," and advocated implementing risk-limiting audits.[6]

[1] We will use "outcome" to refer not to specific vote totals, but to the legal and official consequences of an election, such as: which candidate will take office (outcome of a general election); whether a government will issue a bond (outcome of a ballot question).

[2] See *Evidence-Based Elections*, P.B. Stark and D.A. Wagner, IEEE Security and Privacy, Special Issue on Electronic Voting, 2012. http://statistics.berkeley.edu/~stark/Preprints/evidenceVote12.pdf

[3] We will use "contest" to refer to any ballot item (such as an election to public office or a ballot initiative) – not to a challenge to the results, as in some states.

[4] https://www.intelligence.senate.gov/publications/russia-inquiry

[5] http://web.mit.edu/supportthevoter/www/files/2014/01/Amer-Voting-Exper-final-draft-01-09-14-508.pdf

[6] National Academies of Science, Engineering, and Medicine, Securing the Vote: Protecting American Democracy (National Academies Press, 2018), available at https://www.nap.edu/catalog/25120/securing-the-vote-protecting-american-democracy

About Tabulation Audits

Nearly all US votes today are counted by computerized voting systems. Such voting systems have produced outcome-changing errors through problems with hardware, software, and procedures.[7] Errors can also occur in hand counting of ballots or in the canvassing of results. Even serious errors can go undetected if results are not audited effectively.

Well-designed and properly performed post-election tabulation audits provide solid public evidence for the initial outcome when it is correct — and an opportunity to recover gracefully when it is not. Good tabulation audits create resilience against damage from human error, system flaws or malicious interference, and should be applied routinely to any voting system.

A tabulation audit checks that the outcome of the election reflects the selections of the voters, as expressed on the ballots accepted for counting by the election authority. By "tabulation audit," we mean more than just resumming numbers that represent votes. A tabulation audit also includes the separate, preliminary step of determining voter intent (did this voter vote for this choice in this contest?) from the marks on the ballot.

Tabulation audits involve people (auditors) physically examining and interpreting votes on paper ballots that people (voters) have had the opportunity to verify, and using those interpretations to check the computer (voting system) results. The benchmark of tabulation accuracy is what an accurate hand count of all ballots accepted for counting by the election authority would reveal. Additional measures, including additional audits, are needed to check that ballots have been appropriately accepted or rejected, and that the ballots have been preserved unchanged — no ballots added, removed, or altered. Many other aspects of election administration also can benefit from routine auditing, although we do not discuss such audits here.

[7] In Wisconsin in 2016, the recount found that the Optech Eagle voting machines miscounted votes because they did not detect some of the inks or pencils used by the voters. (https://host.madison.com/wsj/news/local/govt-and-politics/state-to-end-use-of-ballot-counting-machine-that-had/article_7a087f85-8894-5f0e-9d16-19920b3065ee.html) In Rhode Island in 2016, the voting machines' initial result selected the wrong winner because "the scanners were only programmed to record one ballot style when a second was actually sent to the polling station. The initial unofficial results... were so lopsided that election officials questioned the outcome, and discovered the discrepancy." (http://www.providencejournal.com/news/20170914/vote-tally-audits-criminal-sentencing-overhaul-on-ri-lawmakers-agenda) In Pottawattamie County, Iowa, in the June 2006 primary election for County Recorder, the original optical scan count showed challenger Oscar Duran defeating the incumbent, John Sciortino. A hand count showed that Sciortino actually had won handily; the scanners had been misprogrammed.

Tabulation audits can give solid evidence about the outcome of an election contest, often by looking at a rather small random sample of voted ballots (depending on the winning margin and other circumstances), as long as the audit samples are chosen truly at random. Analogously, one can tell how salty a big vat of soup is by tasting one teaspoonful, as long as the soup is well-stirred. The sampling units are called audit units; every voted ballot is assigned to an audit unit before the sample is selected. An audit unit may comprise a batch of ballots, such as all ballots cast in a precinct, all ballots counted on a machine, or some other set of ballots that were tabulated and stored together. Alternatively, an audit unit may be an individual ballot, or one card of a multi-card ballot.

Tabulation audits perform best when voting systems are designed to support them. Any new voting system should provide, for each paper ballot, a corresponding cast vote record (see appendix) that can be efficiently associated with that paper ballot. This capability often makes it possible to rigorously audit contests by inspecting a small number of ballots. Specific technical features supporting tabulation audits are listed in the Voluntary Voting System Guidelines 2.0, Principle 9.[8]

At a modest cost,[9] tabulation audits provide extensive benefits including:

- Deterring tampering with the tabulation
- Finding error, whether accidental or intentional
- Recovering from error and producing correct outcomes via a full hand count, if necessary
- Providing for continuous improvement in the conduct of elections
- Promoting public confidence in elections

No one model for tabulation audits is best for all states. Election traditions, laws, administrative structures and voting systems vary widely. Nonetheless, some guiding principles apply generally across all states. In any particular jurisdiction there may currently be barriers to implementing audits that satisfy all these principles. Best-effort tabulation audits should be performed even if the deployed technology does not support optimal audits, or even if the laws do not permit optimal remedies.

[8] https://collaborate.nist.gov/voting/pub/Voting/CyberSecurity/Principle-9-AuditabilityRequirements-20180423-Clean.pdf

[9] While audit costs will vary depending on the scope of the audits and other considerations, they are a small fraction of election administration costs. For instance: The cost to retrieve and audit ballots for the November 2017 Coordinated Election in Arapahoe County, Colorado was approximately $500 for auditing 516 ballots; the audit followed the best practices recommended in this document. This cost does not include the development cost for the open-source audit software (used statewide) or expenses tied to ballot imprinting, ballot storage and organization, and other types of overhead. The county tabulated ballots centrally. In Minnesota, where voting is by precinct-based optical scan machines, the cost for the audit after the 2006 general election was estimated to be $24,500 to $27,000 statewide for the labor costs for pollworkers to count votes – 9 to 10 cents per hand-counted vote, and about 1.2 cents per voter in the election.

Principles for Tabulation Audits

1. **EXAMINATION OF VOTER-VERIFIABLE PAPER BALLOTS:** Audits require human examination of voter-marked paper ballots — the ground truth of the election. Voter-marked paper ballots may be marked by hand or by ballot marking device. Audits cannot rely on scanned images or machine interpretations of the ballots to accurately reflect voter intent.

2. **TRANSPARENCY:** Elections belong to the public. The public must be able to observe the audit and verify that it has been conducted correctly, without interfering with the process.

3. **SEPARATION OF RESPONSIBILITIES:** Neither the policy and regulation setting for the audit, nor the authority to judge whether an audit has satisfied those regulations, shall be solely in the hands of any entity directly involved with the tabulation of the ballots or the examination of ballots during the audit.

4. **BALLOT PROTECTION:** All the ballots being tabulated and audited must be verifiably protected from loss, substitution, alteration or addition.

5. **COMPREHENSIVENESS:** All jurisdictions and all validly cast ballots, including absentee, mail-in and accepted provisional ballots, must be taken into account. No contest should be excluded *a priori* from auditing, although some contests may be prioritized.

6. **APPROPRIATE STATISTICAL DESIGN:** Audits should produce and scientifically assess evidence about tabulation accuracy while making efficient use of available resources. A risk-limiting audit (RLA) with a small risk limit assures a large chance that an incorrect outcome will be detected and corrected.

7. **RESPONSIVENESS TO PARTICULAR CIRCUMSTANCES:** Audit processes must include a way to respond to circumstances that come to light affecting particular devices, ballots or contests.

8. **BINDING ON OFFICIAL OUTCOMES:** Audits, including any full hand counts that result, must be completed in time to change official outcomes if hand counts so indicate.

9. **INVESTIGATING DISCREPANCIES AND PROMOTING CONTINUOUS IMPROVEMENT:** The data gathered from post-election audits should be analyzed and used to continuously improve voting processes.

Best Practices for Tabulation Audits

1. EXAMINATION OF VOTER-VERIFIABLE PAPER BALLOTS

Audits require human examination of voter-marked paper ballots — the ground truth of the election. Voter-marked paper ballots may be marked by hand or by ballot marking device. Audits cannot rely on scanned images or machine interpretations of the ballots to accurately reflect voter intent.

a. Paper ballots, whether marked by hand or by a ballot marking device, are easy for both voters and auditors to read or verify. They are durable and easy to handle during an audit.

b. Ballots are designed to reduce ambiguity and to reliably reflect the intent of the voters. Care is taken to urge voters to confirm that the paper ballot reflects their votes as intended, whether they mark their ballots by hand or using a ballot marking device.

c. The audit treats as authoritative only marks on paper that the voter could verify. It does not rely upon the accuracy of barcodes (including QR codes),[10] images of ballots, electronically transmitted ballots, remade ballots or other unverified products of the election system. See box on page 9.

d. The auditors do not know the machine interpretations or counts of the ballots they are auditing.

[10] If some voters may verify their votes by "reading" barcodes (including QR codes) instead of human-readable marks or text, the implementation must allow voters to do so without relying upon any component of the voting system, and auditors, in addition to auditing the human-readable marks on ballots selected for audit, should also check that the barcoded information matches the human-readable marks.

e. Human auditors interpret voter intent as recorded on the paper ballots, although technology may be used to assist and augment audits. Since audits help ensure the "software independence" of the election results,[11] care is taken to ensure and document software independence of the audit itself: no undetected change or error in any technology system used to assist with the audit will be able to cause an undetected change in the audit outcome. In no case is the vote-tabulating system a trusted component of the audit process. In particular, the ballot manifest must be created or verified independent of the voting system.[12]

Barcodes cannot be used for tabulation audits because the voters can neither interpret nor verify them. However, there may be other appropriate uses for barcodes in the election process, such as machine tabulation.

Images of ballots cannot be relied upon for tabulation audits, because the voter has no opportunity to verify the images and because images and other electronic evidence "can be altered by compromised or faulty hardware or software."[13] Images also may not match the paper ballots due to dust in the scanners, scratches in lenses, creases in paper ballots, voter marks in non-detectable ink and other causes. Using software to examine the images of the ballots can provide useful information. But software retabulation based on images cannot be considered a tabulation audit and will not offer robust assurance that the outcomes are correct.

Electronically transmitted ballots cannot be used for tabulation audits, because the paper ballots representing those submissions by electronic means such as fax, email or other internet delivery mechanisms have not been verified by voters. Electronically transmitted ballots are subject to many threats, including modification during transmission. These ballots must be accounted for in the audit calculations, but they cannot provide positive evidence for any particular election outcome. In other words, the audit will take into account the number of such ballots, but it will not assume that their indicated votes are accurate. See also Best Practice 5a.

Remade (or duplicated) ballots cannot be verified by the voter, so only the originals can be used in the audit.

[11] See Ron L. Rivest, *On the notion of "software independence" in voting systems*. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 366(1881):3759–3767, 2008. (http://rsta.royalsocietypublishing.org/content/roypta/366/1881/3759.full.pdf)

[12] Small jurisdictions may be able to achieve this independence by hand; larger jurisdictions may need to use precision scales or other mechanical devices.

[13] National Academies of Science, Engineering, and Medicine, Securing the Vote: Protecting American Democracy (National Academies Press, 2018), available at https://www.nap.edu/catalog/25120/securing-the-vote-protecting-american-democracy

4. BALLOT PROTECTION

All the ballots being tabulated and audited must be verifiably protected from loss, substitution, alteration or addition.

a. To safeguard the ballots and audit records from loss and tampering, paper records and electronic records of the results are fully secured[16] from the time the ballots are received by election authorities until all audit or recount activity is completed and election results are finalized.[17]

b. Compliance audits assess the trustworthiness of the paper trail.[18] These compliance audits include ballot accounting to prevent the addition, subtraction, substitution, or alteration of ballots, polling place reconciliations (e.g., comparing counts of voters voting to ballots cast); reconciliation of other vote types (e.g., confirming that the number of absentee ballots received matches the total of absentee ballots counted and absentee ballots rejected); and reconciliation to ensure that all votes from all audit units are correctly summed in the election totals.

c. The audit begins as soon as possible after the random selection of audit units, which commences as soon as feasible after election officials provide the data needed for the audit (see 2c above).[19] Timely auditing reduces concerns about ballot tampering.

d. Ballot anonymity is preserved: once a ballot is accepted for tabulation, neither the ballot nor its tabulation can be matched to the voter who cast it.[20]

e. Any information (e.g., counts of ballots in batches scanned) taken from the vote-tabulating system is independently checked (e.g., by weighing ballot batches on a precision scale).

[16] Procedures regulating access to ballots and equipment could include requiring signatures for access, documenting the reason for access, preventing access by a single person, requiring that access be observed by members of opposing parties, or using surveillance cameras to guard storage areas.

[17] This includes the expiration of all legal recourse to challenge or correct the election.

[18] See, for example, the Compliance Audits section of Philip Stark's testimony to the Little Hoover Commission (https://www.stat.berkeley.edu/~stark/Preprints/lhc18.pdf).

[19] Starting to audit only when all the audit units have already been counted is the most straightforward method. With proper statistical and sampling designs, auditing may begin before votes from all audit units have been counted.

[20] Sometimes, depending on the voting system and the audit method, sorting ballots by ballot style and redacting some cast vote record data may be helpful to preserve ballot anonymity.

5. COMPREHENSIVENESS

All jurisdictions and all validly cast ballots, including absentee, mail-in and accepted provisional ballots, must be taken into account. No contest should be excluded *a priori* from auditing, although some contests may be prioritized.

a. All types of ballots, even those used by few voters, are subject to random selection for auditing — taking care to preserve ballot anonymity. Alternatively, the audit can be designed to omit certain ballots from the random selection as long as they are treated in the audit calculations in the way that casts the most doubt on the outcome (e.g., in a two-candidate plurality contest, as if each ballot were voted for the reported loser).[21] These ballot types may include overseas and military ballots, telephone ballots, ballots transmitted over the internet, ballots cast through accessible interfaces, and other ballots for which paper artifacts verifiable by the voter are not available to the auditors, including ballots that must be withheld from the audit to protect the anonymity of the voter.

b. The ballots from all jurisdictions involved in a contest are subject to audit. Because the type of equipment in each jurisdiction may vary, the audit method may differ between jurisdictions, but the statistical analysis is based on the audit results for all jurisdictions.

c. All contests are subject to some degree of possible auditing, but the audit may prioritize some contests (for instance, as described in the box on page 15).

[21] The worst-case assumption would be inappropriate in the context of the tabulation. But in the context of the audit calculations, the assumption is appropriate because if the ballot available for the audit could not have been verified by the voter, there is no software-independent evidence that the ballot was counted as the voter intended. In other words, a ballot that a voter was unable to verify does not provide proof that the voter intended to vote for the winner.

6. APPROPRIATE STATISTICAL DESIGN

Audits should produce and scientifically assess evidence about tabulation accuracy while making efficient use of available resources. A risk-limiting audit (RLA) with a small risk limit assures a large chance that an incorrect outcome will be detected and corrected.

a. Audit design considers current procedures and equipment[22] (e.g. post-election deadlines and whether the voting system supports particular methods of auditing), the variety of contests to be audited, and priorities for how rigorously to audit the various contests. Matching anticipated workload with available time and resources can involve subtle choices and long-term planning.

b. Statistical experts knowledgeable about post-election audits participate alongside stakeholders in designing the audit process.

c. Audit units are selected using appropriate publicly verifiable random sampling methods.[23]

d. Risk-limiting audits are implemented as widely as is considered feasible given the current equipment. (See box on page 15 for information on RLAs.)

e. RLAs of contests that span multiple jurisdictions, such as governor or mayor of a city that crosses county lines, are coordinated across jurisdictions or at the state level.

f. If audits that are not risk-limiting are combined with, or used instead of, RLAs, they use valid risk-measuring designs, in order to assess the strength of the audit evidence that the reported outcomes are correct.

g. In comparison audits (see appendix), audit units are defined to be as small as the voting equipment supports: single ballots (or cards) are most efficient; smaller batches are preferable to larger batches; individual voting machines are preferable to entire precincts; and individual early voting machines daily totals are preferable to entire early voting sites.

h. If auditing begins before all the ballots have been tabulated (which may be reasonable, e.g., when absentee or provisional ballots are processed late in the canvass), care is taken to incorporate the later-tabulated ballots completely and correctly into the audit process.

[22] Some principles for voting system design relevant to audits are available at Verified Voting (https://www.verifiedvoting.org/voting-system-principles/).

[23] One sound approach is to have many stakeholders and observers make a total of 20 rolls of ten-sided dice to generate a random "seed" for a well-designed pseudo-random number generator (PRNG). Statistical experts should be consulted on the specifics of mapping the sequence(s) of random numbers to particular audit units.

i. Criteria are specified for the circumstances under which additional audit units should be audited, and how many — or, if applicable, under what circumstances a full hand count should be conducted.

Risk-limiting audits are designed to ensure strong audit evidence that a reported outcome is correct – if the outcome is indeed correct. ("Outcome" refers to consequence, such as who won; see footnote 1. The "correct outcome" means whatever a full hand count would show.) If a full hand count would show a different outcome than the initial tabulation, RLAs have a large chance of leading to a full hand count that corrects the reported outcome.[24] The corresponding predetermined small maximum chance that an RLA of an incorrect outcome will *not* lead to a full hand count is called the risk limit. Beyond providing high assurance in specified contests, RLAs can reduce overall audit burden by allocating more resources to closer contests where more checking is needed to validate outcomes.

Risk-limiting audits of some contests can be combined with non-risk-limiting audits of others. For instance, a state could decide to audit all statewide contests to a 5% risk limit, all congressional and state legislative contests to a somewhat higher risk limit, and other contests (1) as they happen to appear on ballots already selected for audit ("opportunistic auditing"), (2) through some random selection of additional contests to audit, not necessarily to a risk limit, or (3) for a fixed number of ballots or a percentage of ballots.

The sample size for an RLA will depend on the audit method (see appendix), the margin of victory, and other factors, including what the audit finds as it progresses. Smaller margins of victory require auditing more audit units to attain a given risk limit; smaller risk limits require auditing more audit units. Small contests typically require auditing a larger *fraction* of ballots than large contests.

[24] RLAs are designed never to overturn a correct outcome: Only a full hand count can change an outcome.

7. RESPONSIVENESS TO PARTICULAR CIRCUMSTANCES

Audit processes must include a way to respond to circumstances that come to light affecting particular devices, ballots or contests.

a. Factors such as major election-day problems or preliminary results that deviate significantly from historical voting patterns might focus interest in particular sets of ballots, "targeted samples." Such targeted samples may be selected by candidates, issue committees, parties, election administrators, or others as provided by regulation.[25]

b. A requested targeted sample may be used either in conjunction with a random audit, or by itself for a contest not selected for audit.

[25] One way to contain the cost of targeted samples is to require that the requesting candidate or group pay for additional ballots to be audited. Such a law was passed in Minnesota in the 2008 legislative session; under this law, the requesting candidate is refunded by the jurisdiction conducting the recount if the recount leads to the initial result being overturned.

8. BINDING ON OFFICIAL OUTCOMES

Audits, including any full hand counts that result, must be completed in time to change official outcomes if hand counts so indicate.

a. Because audits can lead to 100% hand counts, audit and recount provisions should be appropriately harmonized.

b. The election calendar may have to be adjusted to provide time to complete the audit before results are finalized.

9. INVESTIGATING DISCREPANCIES AND PROMOTING CONTINUOUS IMPROVEMENT

The data gathered from post-election audits should be analyzed and used to continuously improve voting processes.

a. All discrepancies are recorded, their causes are investigated, and they are categorized by apparent cause — regardless of whether they raise doubts about outcomes. The broad categories include: (1) Machine and election process errors (e.g. ballot programming error, lens scratch, ballot crease interpreted as a mark); (2) Audit errors (e.g. wrong ballot retrieved, miscount in audit); (3) Computer misinterpretations of voter intent (e.g., mark in target area not intended as vote, overvote intended as a correction).

b. The discrepancies found are compared to historical results. Recommendations to reduce future discrepancies are developed and implemented.

c. Suggestions and action plans are developed for reducing future discrepancies, including better ballot design and instructions, improved training for officials conducting the initial tabulation or the audit, etc.

APPENDIX: Audit Practicalities

Election traditions, laws, administrative structure and voting systems vary widely, and they all affect tabulation audits. As more jurisdictions institute audits, or transition from traditional percentage audits to risk-limiting audits, it is helpful to consider the interplay between various logistical and administrative choices and the audit process. The purpose of this appendix is to present some logistical details of the audit process, in order to ease the integration of audits into existing election law, policy and administration. This discussion is selective, not comprehensive.

Audits generally use one of three broad methods:[26]

Batch-level comparison: Presently, most audits are *batch-level comparison audits*, where some batches (often corresponding to individual precincts or voting machines) are randomly selected. The votes in each selected batch are audited by hand, and the audit counts are compared to the reported tabulation subtotals for the selected batches, as published before the random sample is drawn. Auditors must check that the batch subtotals — including all batches, not just the selected batches — add up to the reported vote totals. (See best practice 2b and its footnote.)

Ballot-level comparison: More efficient, when feasible, is a *ballot-level comparison audit*, in which a sample of individual ballots (or ballot cards) are sampled, audited, and compared to how each ballot was interpreted by the voting system. Today, many voting systems do not support ballot-level comparisons, but most recently developed systems do in central count situations. To support a ballot-level comparison audit, a voting system must produce a cast vote record (a record of the machine interpretation of the vote selections in every contest) for each ballot, with enough information to pair the cast vote record with the physical ballot from which it was created. Auditors must check that the vote totals calculated from the cast vote records match the reported vote totals.

Ballot polling: In *ballot-polling audits*, individual ballots are sampled and audited, and the audited vote totals are used to assess the correctness of the outcome, much as an election poll predicts outcomes. Ballot polling does not directly identify misinterpreted ballots or batches, and therefore cannot be used, in general, to pinpoint system or process problems. But in some cases it is the easiest method for verifying that specific contest outcomes — for instance, who won, or whether a referendum passed — are correct.

There are three common ways to determine the sample size of the audit:

- Fixed percentage: Select a fixed percentage of units to audit.[27]

[26] These methods are described in more detail in A Gentle Introduction to Risk-Limiting Audits (https://www.stat.berkeley.edu/~stark/Preprints/gentle12.pdf).

[27] For instance, in New York, each county audits 3% of its voting machines or systems.

- Tiered: The percentage or number of units to audit varies depending on the margin of victory: the smaller the margin of victory, the more ballots to audit.[28]
- Risk-limiting: The sample size depends on (among other things) the margin of victory, the set risk limit, and what the audit finds.[29]

Risk-limiting audits are designed to examine enough ballots to provide strong evidence that outcomes of contests are correct – or to correct the outcomes, via full manual recounts, if they are wrong. (In practice, risk-limiting audits can audit larger samples than the risk limit would require, producing additional evidence about vote tabulation accuracy.) Other methods may audit far fewer, or far more, ballots than necessary to check particular outcomes. Some implementations of these methods provide rules for expanding the audits based on the results, which *could* lead some incorrect outcomes to be corrected. Many implementations provide no means to correct incorrect outcomes.

For batch-level comparison audits, for efficiency, the audit units should be as small as possible. For polling-place counted ballots, this means using the smallest unit available where the group of ballots can be associated with a reported result. This unit may be a precinct, an individual voting machine, or an individual voting machine on a particular day of early voting. It also is possible to audit arbitrary batches of ballots, in which case complete subtotals for every batch must be reported prior to the audit.

Ballots sometimes consist of multiple cards (sheets of paper). For auditing purposes, separate cards of a ballot from an individual voter do not need to be kept together and they are often best audited independently.

Sorting can sometimes lead to efficiencies. For example, sorting centrally counted ballots by precinct or ballot style, to separate out contests such as mayor of a small town which appear on only a small fraction of the ballots, can permit a risk-limiting audit to use a smaller sample size. If the audit relies on the sorting, then the sorting must be done — or confirmed — independently of the tabulation system.

Voting systems that imprint an identification number onto voted ballots as they are scanned can make a ballot-polling or ballot-level comparison audit more efficient by cutting down on the time it takes to confirm that the ballots pulled for examination are indeed the ballots determined by the random sampling. In some cases, such as in-precinct voting, where ballots may get shuffled, imprinting may be the only way to efficiently match a ballot to the CVR. Any imprinting needs to preserve ballot anonymity.

Auditing contests that combine results from separate jurisdictions — contests such as governor or US Senate or a ballot question in a town that is split between jurisdictions — requires cooperation and coordination between jurisdictions. Uniformity of process and voting technology across jurisdiction lines can simplify and smooth the audit.

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[28] For instance, in New Mexico, the sample size ranges from 4 to 165 precincts depending on the reported margin: https://law.justia.com/codes/new-mexico/2016/chapter-1/article-14/section-1-14-13.2/, Table 1.

[29] As of August 2018, Colorado has mandated and implemented risk-limiting audits statewide; Rhode Island has mandated risk-limiting audits, but not implemented them. For details on these and other state audit requirements, you can consult Verified Voting's State Audit Law Database at https://www.verifiedvoting.org/state-audit-laws/.

Risk-limiting audits are generally conducted in one or more rounds. There is no hard and fast rule for choosing the number of ballots to be audited in each round. The larger the number of ballots, the more likely the audit will end in that round. Conversely, the smaller the number of ballots in each round, the less likely the audit will examine more ballots than strictly necessary. Logistics of ballot retrieval and coordination between different jurisdictions are worth considering as the choice is made. In unusual cases, it may at some point be easier to conduct a full hand count than to expand the random audit sample.