



International Foundation
for Electoral Systems

Risk- Limiting Audits

A Guide for Global Use

Risk-Limiting Audits: A Guide for Global Use

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Authors' Note and Acknowledgments

This paper considers how the risk-limiting audit (RLA), which has been pioneered in elections in the United States, could be applied globally. RLAs are a particularly methodical form of post-election audit that can open a window for the public to the mechanics of the election process. As Mark Lindeman, acting co-director of Verified Voting, has described to us, RLAs should be thought of as “part of a movement to bolster trust in election processes and officials.”

As a long-time partner of election administrators around the globe, the International Foundation for Electoral Systems (IFES) is dedicated to expanding the range of tools available to reinforce confidence in the electoral process and to ensure that outcomes reflect the will of the voters. The authors have conducted an extensive literature review – including of practitioner manuals, scholarly articles and RLA pilot reports – and attempted to extrapolate from the U.S. experience to the diversity of democracies around the globe. We are hopeful that this paper’s findings will be edited, added to and improved over time as RLA methods are tested and refined in other election contexts.

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Glossary

Ballot manifest: A document log created by audit officials that describes where and how ballots have been stored

Ballot-level comparison: An RLA method in which a random sample of ballots is manually interpreted, and each interpretation is checked against the machine interpretation of the same ballot; ballot-level comparison audits can also be adapted for use in manual count jurisdictions

Ballot-marking device (BMD): An electronic device used to mark a ballot

Ballot polling RLA: An RLA method in which cast ballots are randomly sampled and interpreted to determine if there is strong statistical evidence that the initial vote count and tabulation is correct

Batch: A collection of ballots for counting or auditing (e.g., a batch may consist of all ballots cast in a precinct or on a particular voting machine)

Batch-level comparison: An RLA method in which the votes in a random sample of batches are counted manually and compared to the corresponding machine or precinct counts, batch by batch, to measure discrepancies

Cast vote record (CVR): A record of how the tabulation system interprets each cast ballot

Compliance audit: Audits conducted around an election to determine if specific systems or processes are operating correctly (e.g., security checks or poll book accounting)

Diluted margin: The margin of victory as a percentage of the total number of ballots cast (including ballots that may contain invalid, spoiled or under-votes)

Direct-recording electronic (DRE): A voting machine designed to accept a voter's choices directly into the computer memory for tabulation, often without a paper record

End-to-end verifiability (E2E): Techniques that enable individual voters to confirm that their votes are both cast as intended and counted correctly; with E2E, the public should also be able to verify that every recorded vote is included in the vote total

Error rate: The frequency of miscounted votes in the tabulation process

Electronic voting machine (EVM): A broad category of voting machines that capture votes electronically (e.g., optical scanning systems, DRE voting machines, punch card voting and tabulation systems)

Outcome: The winner(s) of an election, rather than the final vote totals

Parallel vote tabulation (PVT): Independent verification of vote totals by citizen observer groups, often using a sampling methodology

Pseudorandom number generator (PRNG): An algorithmic approach to creating a string of numbers that are close to random, based on the use of an initial seed number

Random sampling: Selection of ballots using a methodology that ensures that any ballot or batch is as likely as any other to be chosen

Random seed: A number used to initiate the creation of a pseudorandom sequence of numbers; in an RLA, the seed may be created, for example, by casting dice in a public ceremony

Risk limit: The predetermined maximum probability that the audit will not uncover an incorrect outcome; this threshold also drives the unique sampling method of an RLA

Risk-limiting audit (RLA): A post-election tabulation audit that manually reviews a sample of ballots to provide statistical evidence that the reported outcome of an election is correct; the sample size is not fixed and can change during the audit to reach the desired confidence level

Sample: The set of ballots or batches that will be reviewed in an audit

Tabulation audit: A post-election audit that compares the initial tabulation of results against a manual interpretation of a sample of ballots

Transitive audit: Audit using a secondary scanning system that is capable of producing a CVR to conduct a ballot-comparison audit in jurisdictions that otherwise would not be able to

Usability test: Evaluation of a process by pilot testing it with likely end-users

Voter-verified paper audit trail (VVPAT)/voter-verifiable paper record (VVPR): Printed documentation of a voter's choices that theoretically enable the voter to confirm that the vote was cast correctly

Introduction

“Election audits are intended to accomplish two things. The first is to ensure that the election was properly conducted, that election technologies performed as expected, and that the correct winners were declared. The second is to convince the public of the first thing.”¹

As practitioners around the globe can attest, the requirements for administering elections can be staggeringly complex and the risks to public trust and democratic stability for any missteps may be high. A natural emphasis in the field is therefore on mechanics: effective deployment of the intricate, resource-intensive and theoretically dispassionate machinery that captures, aggregates and translates the will of the people – as expressed by voter preferences – into seats in a government. Increasingly, however, high-stakes elections in many countries are marked by polarization, rampant disinformation and allegations of impropriety. Good mechanics are therefore essential but insufficient; election administrators and other stakeholders should also assume a context of pervasive or increasing mistrust and plan accordingly. The 2020 presidential election in the U.S. clearly illustrates this phenomenon; although election administration has been widely lauded as sound and secure, the electoral process was marred by a deluge of applications for emergency legal injunctions, threats of violence against administrators and other election actors, and unsubstantiated allegations of fraud that found a receptive audience among some parts of the electorate.² It is likely that this potent stew of fantasy and conspiracy will undermine public confidence in U.S. elections for years to come.

In any context, the media scrutiny and significant time pressures that accompany elections only amplify the potential for errors, manipulation (or perceptions of manipulation) and campaigns to undermine trust in the electoral process and in democracy. This context may impact whether unexpected outcomes, or outcomes from an election fraught with irregularities, are accepted by the public. At a global level, the COVID-19 pandemic presents arguably the most pernicious threat to trust in government in recent times. A “potentially explosive cocktail” of polarization among people with differing views on the appropriate response to COVID-19 “risks undermining a key foundation of democracy: trust and public belief in the legitimacy of government actions.”³ A recent study of past health crises also finds that “epidemic exposure ... has a persistent negative effect on confidence in political institutions and leaders.”⁴ The authors note pointedly that “epidemics are stress tests for governments.”⁵

1 Caltech/Massachusetts Institute of Technology (MIT) Voting Technology Project. (2018, December 7-8). *Election Auditing: Key Issues and Perspectives*. Election Audit Summit, Summary Report. Retrieved from: http://electionlab.mit.edu/sites/default/files/2019-06/Election-Auditing-Key-Issues-Perspectives_2.pdf

2 Baker, P. & Gray, K. The New York Times. (2020). *In Key States, Republicans Were Critical in Resisting Trump's Election Narrative*. Retrieved from: <https://www.nytimes.com/2020/11/28/us/politics/trump-republicans-election-results.html>; Organization for Security and Co-operation in Europe. (2020). *International Elections Observation Mission, United States of America, General Elections, 3 November 2020: Statement of Preliminary Findings and Conclusions*. Retrieved from: <https://www.osce.org/odihr/elections/usa/469437>

3 Lührmann, A., Edgell, A. B., Grahn, S., Lachapelle, J. & Maerz, S. F. (2020). *Does Coronavirus Endanger Democracy in Europe?* Carnegie Europe. Retrieved from: <https://carnegieeurope.eu/2020/06/23/does-coronavirus-endanger-democracy-in-europe-pub-82110>

4 Aksoy, C. G., Eichengreen, B. & Saka, O. (2020). *The Political Scar of Epidemics*. European Bank for Reconstruction and Development. Working Paper No. 245. Retrieved from: <https://www.ebrd.com/cs/Satellite?c=Content&cid=1395291090296&d=&pagename=EBRD%2FContent%2FDownloadDocument>

5 Ibid.

The same is true for contentious elections – and even more so for contentious elections during a public health crisis. Trust is hard won, easily lost and very difficult to restore. Regardless of the political context, electoral frameworks must promote *competition* while limiting *contention*. New approaches are needed to increase public confidence in legitimate results or to uncover and address potential errors, fraud or malpractice in election administration, particularly during the results process. Post-election audits offer one avenue for enhancing trust and confidence in election results, if they are grounded in the law and performed by well-trained officials, and are predictable, transparent and observable by key election stakeholders.

There are multiple types of election audits, including *compliance audits* of specific systems or processes, and *tabulation audits*, in which administrators examine a set of ballots, interpret voter intent and check that determination against the results produced by the original tabulation process or system.⁶ This paper focuses on the risk-limiting audit (RLA), a type of post-election tabulation audit that relies on statistical evidence to confirm that the outcome of an election is correct.⁷ Proponents of the RLA contend that it is useful for election administrators with limited resources, and offers a straightforward way to bolster public confidence in the election result.

RLAs can be an *efficient* tool for testing the accuracy of election outcomes to a desired level of mathematical certainty; the audit is conducted incrementally, stopping only when it provides statistically strong evidence that the original outcome was correct.⁸ Unlike other tabulation audits, the number of ballots that are ultimately reviewed (the size of the sample) is not fixed. It is determined by a combination of factors, including the margin of victory, a predetermined risk limit (similar to a confidence level), and the specific method of RLA chosen (including ballot polling, ballot comparison, and batch comparison RLAs, discussed further below). The sample size can also change during the audit if tabulation errors are uncovered, as more ballots may need to be reviewed to reach the desired confidence level. In an RLA, the audit is not completed until the auditors have convincing statistical evidence the outcome of the election is correct.

In the U.S., a small community of practitioners has worked to convince legislators and administrators to adopt the practice in a number of states. According to recent figures, there have been more than 60 pilot RLAs in the U.S. and “currently 10 U.S. states require or specifically allow RLAs.”⁹ The Organization for Security and Co-operation in Europe’s Office for Democratic Institutions and Human Rights’ 2018 *Limited Election Observation Mission* report highlighted this dynamic, finding that “There is an emerging trend away from traditional post-election audits and towards risk-limiting audits (RLA) ... All jurisdictions using [new voting technologies] NVT should require post-election audits as a secondary results verification method. In particular, consideration could be given to using Risk-Limiting Audits.”¹⁰

6 Garland, L., Lindeman, M., McBurnett, N., Morrell, J., Schneider, M., & Singer, S. (2018). *Principles and Best Practices for Post-Election Tabulation Audits*.

7 Morrell, J. (2019). *Knowing It's Right, Part One: A Practical Guide to Risk-Limiting Audits*. Democracy Fund. p. 9.

8 Lindeman, M. & Stark, P. B. (2012). *A Gentle Introduction to Risk-limiting Audits*. *IEEE Security and Privacy, Special Issue on Electronic Voting*. p. 1.

9 Glazer, A. K., Spertus, J. V. & Stark, P. B. (2020). *Bayesian Audits Are Average But Risk-Limiting Audits Are Above Average*. International Joint Conference on Electronic Voting.

10 Organization for Security and Co-operation in Europe. (2020). *International Elections Observation Mission, United States of America, General Elections, 3 November 2020: Statement of Preliminary Findings and Conclusions*. pp. 25-26. Retrieved from: <https://www.osce.org/odihr/elections/usa/469437>

The purpose of this paper is to consider how RLAs could have global application and utility – particularly as a measure to build trust in election results – and to provide a basic framework for testing RLAs in diverse contexts. Even in the U.S., RLAs are a relatively new phenomenon. Considerable assessment will be needed to determine best practices for RLAs in different electoral systems globally. It should be noted that there are some limits to the capacity of an audit to shore up trust in elections. Any audit failing to meet a set of basic standards – including clear domestic ownership, predetermined and uniform application of procedures, thorough training of auditors, effective strategic communications and well-understood evidentiary requirements – may undermine an election’s integrity rather than reinforce it.¹¹ The efficacy of the RLA is also highly dependent on a secure audit trail and trust in that security, as will be discussed further below. Thoughtful planning and testing of RLAs – which offer significant advantages to election administrators over other forms of audits – can mitigate these concerns and ensure that the audit fulfills its trust-building function.

Risk-Limiting Audits Background and Overview

As noted previously, the U.S. has been the primary laboratory for RLA testing. It is therefore useful to briefly consider the context for elections there. Trust in U.S. elections overall has declined precipitously in recent years; 2019 polling from Gallup found that nearly 60 percent of respondents lacked confidence in the “honesty” of U.S. elections, and “majorities of Americans have consistently lacked confidence in the honesty of elections every year since 2012.”¹² Responsibility for setting rules and administering elections in the U.S. is largely devolved to the state and local levels, leading to great variability in the voter experience and in how and when results are tabulated, certified and audited.¹³ Nearly all votes in the U.S. have some kind of paper record – whether a paper ballot or a printed summary of votes cast from a direct recording electronic machine or a ballot-marking device – and are counted using various computerized systems. Such systems are known to have “produced outcome-changing errors through problems with hardware, software, and procedures.”¹⁴ For decades, some states have used fixed-percentage tabulation audits to check the accuracy of the computer voting system results by comparing them against a manual interpretation of paper ballots.¹⁵ However, these states mainly rely on a sample of a fixed percentage of ballots for this type of audit – meaning that “even in a landslide election, they will count the same number of ballots as they would in a nail-biter.”¹⁶

RLAs, in contrast, use a type of statistical sampling that can be more effective and efficient – saving both time and money – than other kinds of post-election audits. An RLA enables auditors to confirm the accuracy of the reported outcome before certifying the results – at least to a predesignated degree of statistical certainty. This degree of certainty is known as the risk limit.¹⁷ If, for example, the risk limit is set at 5 percent, then there is, at minimum, a 95 percent chance that the audit will uncover incorrectly reported outcomes.

11 Vickery, C. & Shein, E. (2017). *Election Audits*. In Norris, P. & Nai, A. *Election Watchdogs: Transparency, Accountability and Integrity*. Oxford University Press.

12 Reinhart, R.J. (2020). *Faith in Elections in Relatively Short Supply in U.S. Gallop*. Retrieved from: <https://news.gallup.com/poll/285608/faith-elections-relatively-short-supply.aspx>

13 IFES. (2020, November 1). *Election Administration: A Whiteboard Video*. <https://www.youtube.com/watch?v=99NFVfEV5s8>

14 Garland, L., Lindeman, M., McBurnett, N., Morrell, J., Schneider, M., & Singer, S. (2018). *Principles and Best Practices for Post-Election Tabulation Audits*. p. 5.

15 Ibid.

16 National Conference of State Legislatures. (2019). *Post-Election Audits*. Retrieved from: <https://www.ncsl.org/research/elections-and-campaigns/post-election-audits635926066.aspx>

17 Lindeman, M. & Stark, P. B. (2012). *A Gentle Introduction to Risk-limiting Audits*. IEEE Security and Privacy, Special Issue on Electronic Voting. p. 2.



RLAs have the advantage of being both effective and efficient because they adjust the workload to get just enough evidence that contest results are correct, if contest results are indeed correct.”¹⁸

While there are a variety of factors to consider in the selection of an appropriate risk limit – explored in more detail further in this paper – that choice has a direct impact on the sample size of the audit. Even when reported results are correct, more evidence – a larger sample – is needed to reach the higher level of certainty implied by a lower risk limit. However, the sample can still be much smaller than that of a fixed-percentage audit when the reported results are correct, especially in races with large margins. Conversely, the sample size would increase for races with smaller margins where there is a higher risk of declaring an incorrect winner. In some cases where the risk limit is low and the margin is extremely small, the RLA may become a full manual recount.

This variable approach to sampling enables resources to be used in contests where they are most needed, while also supporting confidence in the election outcome. As the final report from a pilot conducted in Rhode Island in 2019 notes, “resourceful adversaries” will take advantage of any and all opportunities “to undermine public confidence in election integrity.”¹⁹ A properly planned and executed RLA could considerably narrow those opportunities.

While there are a variety of methods for conducting RLAs, the general process is as follows:²⁰

1. **Determine the risk limit** prior to the audit, as directed by the law. The law may specify the risk limit, provide the criteria to be used, or give the mandate for selection to a particular official or institution.
2. After the initial vote tabulation is completed – but before certification of the results – **create a ballot manifest** that describes where and how ballots have been stored. Conduct necessary ballot accounting checks.
3. **Determine the initial (first-round) sample size** of ballots to be audited, either manually or using audit software.
4. Manually or using a random number generator, **create a random sample of ballots or batch numbers**.
5. **Retrieve and manually review** the sample. Input the results from the manual review into the formula/audit software, as appropriate.
6. If the manual or software-powered statistical analysis reveals that there is sufficient evidence that the results are correct, as determined by the established risk limit, **stop the audit and certify the results**. If the statistical analysis reveals that there is not sufficient evidence that

18 Howard, L., Rivest, R. L. & Stark, P. B. (2019). *A Review of Robust Post-Election Audits*. Brennan Center for Justice. Retrieved from: https://www.brennancenter.org/sites/default/files/2019-11/2019_011_RLA_Analysis_FINAL_0.pdf

19 Rhode Island RLA Working Group. (2019). *Pilot Implementation Study of Risk-Limiting Audit Methods in the State of Rhode Island*.

20 Howard, L., Rivest, R. L. & Stark, P. B. (2019). *A Review of Robust Post-Election Audits*. Brennan Center for Justice. p. 5. Retrieved from: https://www.brennancenter.org/sites/default/files/2019-11/2019_011_RLA_Analysis_FINAL_0.pdf

the results are correct, **increase the sample size and review more ballots** until the risk limit is met or until a full manual recount is conducted, correcting the results.

As will be discussed below, the RLA process has some fundamental system requirements. RLAs require, for example, paper ballots or another verifiable paper record of the voter's intent.²¹ This should not be widely prohibitive, as only a relatively small number of jurisdictions globally use direct recording electronic voting machines without a paper trail.²² For countries using ballot scanners, some methods of RLA (as will be discussed further below) will also require *cast vote records* (CVR) – records of how votes were interpreted by ballot scanning machines – to compare those interpretations with the manual review of the ballot during the audit. Another challenge may be adapting RLAs to different electoral systems, as RLAs were initially developed for first-past-the-post voting in the U.S.²³ Regardless of the vote casting and results management system in use, or the RLA method chosen, the audit trail must be carefully preserved. An initial compliance audit should be used to ensure that audit trail procedures are followed closely and to bolster confidence in the RLA that follows.

“Even among the numerically sophisticated, understanding how risk-limiting audits work requires a level of statistical knowledge few people possess. As a result, adopting risk-limiting audits risks asking the public to shift blind trust from election officials to statisticians [...].”²⁴

Another predictable – and therefore manageable – challenge for the use of an RLA is the unfamiliarity of its approach to sampling ballots and reaching a statistically satisfactory conclusion to the audit. Although open-source software enables the calculations deriving the sampling methodology, they are not simple to explain. A handbook for U.S. RLA practitioners notes that “it is a complex idea that even subject-matter experts struggle to communicate clearly,”²⁵ but there are thus far only limited resources available to guide such communication efforts. Not addressing this issue head-on could undermine the confidence-building power of the tool, the willingness of legislators to adopt the needed legal framework and the ability of election administrators to conduct the audit. It is worth noting,

21 While it is theoretically possible to use machine-produced paper trails for RLAs, there is evidence that they may not reliably reflect voter intent. For further discussion, see “Verifiable Paper Records of Voter Intent,” *infra* pp. 8-9.

22 According to International IDEA’s database on information and communication technologies (ICTs) in elections, 16 countries use DRE voting machines with and without voter verifiable paper trails, while an additional four countries use electronic ballot printers. International IDEA, *ICTs in Elections Database*, <https://www.idea.int/data-tools/question-view/743>.

23 “The [RLA] methods can be extended to audit contests that require a supermajority, contests with more than one winner, cross-jurisdictional contests ... Auditing instant-runoff or ranked-choice (IRV/RCV) contests is a topic of research.” Lindeman, M. & Stark, P. B. (2012). *A Gentle Introduction to Risk-limiting Audits*. IEEE Security and Privacy, Special Issue on Electronic Voting. pp. 8-9; RLAs in proportional representation systems. Stark, P. B. & Teague, V. *Journal of Election Technology and Systems*, Vol. 3, No. 1. (2014). *Verifiable European Elections: Risk-Limiting Audits for D'Hondt and its relatives*. p. 19; RLAs for Transferable Vote elections in Australia. Chilingirian, B., Perumal, Z., Rivest, R. L., Bowland, G., Conway, A., Stark, P. B., Blom, M., Culnane, C. & Teague, V. (2016). *Auditing Australian Senate Ballots*. Retrieved from <http://people.csail.mit.edu/rivest/pubs/CPRBx16.pdf>; RLAs in instant runoff voting. Cary, D. (2011). Estimating the margin of victory for instant-runoff voting. In Proceedings of the 2011 Electronic Voting Technology Workshop/Workshop on Trustworthy Elections. USENIX.

24 Caltech/MIT Voting Technology Project. (2018, December 7-8). *Election Auditing: Key Issues and Perspectives*. Election Audit Summit, Summary Report.

25 Morrell, J. (2019). *Knowing It's Right, Part Two: Risk-Limiting Audit Implementation Workbook*. Democracy Fund. p. 29.

however, that this concern is similar for other commonly used sampling methodologies, like parallel vote tabulation (PVT) exercises.

If a country has determined that an RLA could be a beneficial credibility-building mechanism, the decision to conduct one should be made with a commitment to good design, planning and training. Pilot testing is an essential step, both to understand the requirements for the RLA and to begin the important process of setting expectations and educating stakeholders on its mechanics. Considerable work remains, both in the U.S. and globally, to ensure that the RLA process can be explained in clear and simple terms to policymakers, election administrators, lawyers and judges who may interact with the electoral process and, ultimately, the electorate. The outline for the remainder of this paper is described in the roadmap below, covering three principal areas of importance for a successful RLA: foundational prerequisites, operational considerations, and legal and regulatory considerations.

Paper Roadmap

Prerequisites for Risk-Limiting Audits

- Trustworthy and robust audit trail, derived through effective ballot security procedures and compliance checks
- Paper records that reflect voter intent
- Ballot storage and tracking system

Operational Considerations for Selecting and Implementing Risk-Limiting Audits

- RLA methods
- Tabulation method and type of voting system
- Location of the vote count and audit
- Ballot sampling process
- Cost
- Training
- Public education and information

Introducing Risk-Limiting Audits in the Legal and Regulatory Framework

- Legal definition
- Selecting contests to be audited
- Setting the risk limit
- Establishing a timeframe
- Correcting inaccurate reported outcomes
- Ensuring transparency and public accountability
- Requiring security and integrity measures
- Introducing RLAs through pilots

Prerequisites for Risk-Limiting Audits

While RLAs can be adapted to fit a variety of contexts, there are certain basic requirements and processes that will be necessary regardless of the RLA method applied. Prior to embarking on an RLA planning process, it is therefore worth considering whether the electoral system provides: (1) verifiable paper records of voter intent; (2) a trustworthy and robust audit trail; and (3) a ballot manifest, which is a detailed list, independent of the voting equipment, identifying how and where ballots are organized and stored. These three requirements are discussed below.

Verifiable Paper Records of Voter Intent

An RLA requires a paper record that reflects voter intent when a ballot is cast.²⁶ For the majority of countries in the world that use paper ballots marked directly by voters – approximately 85 percent according to International IDEA’s *ICTs in Elections Database*²⁷ – this requirement is automatically satisfied.²⁸

“Regardless of how a ballot is marked, an essential step in the process is the ability for voters to intentionally and deliberately verify that the paper ballot correctly records their choices.... Without such a deliberate and intentional process, it is harder to deem the paper ballot a trustworthy record of voter intent. Relatedly, it is equally important that polling place layouts preserve ballot secrecy and poll workers take care to ensure that the secrecy of a voter’s ballot is preserved.”²⁹

If a country uses a voting system that does not generate a voter-verifiable paper record of the voter’s intent (e.g., internet voting) when they cast their ballot, by definition an RLA is impossible. This is because there is no independent record of the votes cast to assess the accuracy of the voting system’s results. Some direct recording electronic machines produce a paper receipt that can be used as part of the audit trail, though this premise has been controversial in the U.S. and elsewhere.³⁰ In India, for example, the Supreme Court ruled that all voting machines must be equipped with printers to provide “voter-verifiable paper audit trails” (VVPAT) to “allow each voter to verify that his or her intended selections are correctly printed on a paper record, which is collected in a separate container called the VVPAT box.”³¹

While it is technically possible to use these types of machine-produced paper trails to conduct RLAs, some studies have shown that “many voters fail to check [voter verifiable paper records] VVPRs, and fail to notice deliberately introduced errors even when they do check.”³² Additionally, “security reviews of currently deployed voting systems have demonstrated the feasibility of attacks that produce false

26 Risk-Limiting Audits Working Group. (2012, Version 1.1). *Risk-Limiting Post-Election Audits: Why and How*, p. 20.

27 International IDEA, *ICTs in Elections Database*, <https://www.idea.int/data-tools/question-view/743>.

28 Risk-Limiting Audits Working Group. (2012, Version 1.1). *Risk-Limiting Post-Election Audits: Why and How*, p. 20.

29 Verified Voting. (2019). *The Role of Risk-Limiting Audits in Evidence Based Elections*. <https://verified-voting.org/the-role-of-risk-limiting-audits-in-evidence-based-elections/>

30 *Ibid.*, p. 32.

31 Mohanty, V., Akinyokun, N., Conway, A., Culhane, C., Stark, P. B. & Teague, V. (2019). *Auditing Indian Elections*. p. 2. Retrieved from: <https://arxiv.org/pdf/1901.03108.pdf>.

32 Risk-Limiting Audits Working Group. (2012, Version 1.1). *Risk-Limiting Post-Election Audits: Why and How*, p. 21.

VVPRs.”³³ Other challenges to using VVPRs include the possibility of printer failures or inadequate quality of the printing.³⁴

Trustworthy and Robust Audit Trail

While there are many possible benefits of an RLA, including building public trust in the results of an election, it is also important to understand the inherent limitations. RLAs are designed to check the accuracy of the vote tabulation process, so irregularities occurring prior to the initial count may go undetected absent other important measures. As Verified Voting has noted, “Risk-limiting audits are one piece of the larger ecosystem of evidence-based elections that depend upon a trustworthy record to give confidence to election outcomes. ... They do not tell us whether the voting system has been hacked. They do not and cannot determine whether voters actually verified their ballots. But they can detect and correct tabulation errors that could alter election outcomes — or provide strong evidence that a full hand count would yield the same outcomes.”³⁵

Accordingly, complementary procedures and compliance checks are needed that ensure that the paper and electronic records that form the basis for the RLA are “fully secured from the time the ballots are received by election authorities until all audit or recount activity is completed and election results are finalized.”³⁶ To build public confidence in the audit trail, election administrators must be able to demonstrate that the procedures have been effectively followed. Such chain-of-custody requirements are common to all election investigations, not only RLAs. As IFES’ *Election Investigations Guidebook* notes, “Proper chain of custody is a crucial component of investigation and dispute resolution, more generally, as adjudication decisions may be affected by the quality of the physical evidence supporting a complaint.”³⁷ Compliance checks would also be of value in the event of a court challenge against the results. Some examples of compliance audit checks are included in “Examples of Compliance Audit Checks” at right.

Examples of Compliance Audit Checks

Poll book accounting to compare the number of voters with ballots cast

Ballot accounting to reconcile the number of ballots distributed with the number of ballots cast and the number of blank or spoiled ballots returned

Reconciliation of votes to check mathematical accuracy of tabulation forms

Chain of custody checks to review signature logs and ensure custody of all secure election materials

Security checks to ensure that ballots and boxes have been protected with tamper-evident seals and other security features

33 Ibid.

34 Ibid.

35 Verified Voting. (2019). *The Role Of Risk-Limiting Audits In Evidence-Based Elections*. Retrieved from: <https://verifiedvoting.org/the-role-of-risk-limiting-audits-in-evidence-based-elections/>

36 Garland, L., Lindeman, M., McBurnett, N., Morrell, J., Schneider, M., & Singer, S. (2018). *Principles and Best Practices for Post-Election Tabulation Audits*. p. 12.

37 Vickery, C. & Ellena, K. (2020). *Election Investigations Guidebook*. Retrieved from: <https://www.ifes.org/publications/election-investigations-guidebook>

Ballot Manifest

A ballot manifest is a document log created for the audit that describes where and how ballots are stored. Ballot manifests enable auditors to pull a random sample and locate specific ballots.³⁸ It is important that ballot manifests are not produced by the voting system; they should be created separately by local election officials.³⁹

Although the design of the ballot manifest will differ depending on the voting, tabulation and ballot storage systems in use, a ballot manifest can include unique identifiers for the batch number and ballot container and provide information on the total number of ballots included in the batch. Later these ballots may be assigned numbers for the purposes of retrieving individual ballots.⁴⁰ Software can be used to automatically enumerate ballots based on the quantity in each batch for the purposes of sampling, but ballot manifests need not be complex or rely on sophisticated software.⁴¹ For example, “a ballot manifest may be a simple spreadsheet where information is entered directly from the batch folders or ballot storage container labels.”⁴² More detailed information on producing this log can be found in the Democracy Fund’s Risk-Limiting Audit Implementation Workbook.⁴³

| | A | B | C | D | E | F | G | H |
|----|--------------|-----------------|------------|---------------|----------|-------------|--------------------|-------------------|
| 1 | Municipality | Precinct Number | Box Letter | Folder Number | Batch ID | # of Sheets | First Imprinted ID | Last Imprinted ID |
| 2 | Bristol | 201 | A | 1 | 0201-A-1 | 297 | 237000001 | 237000297 |
| 3 | Bristol | 201 | A | 2 | 0201-A-2 | 100 | 237000298 | 237000397 |
| 4 | Bristol | 201 | A | 3 | 0201-A-3 | 99 | 237000398 | 237000496 |
| 5 | Bristol | 201 | A | 4 | 0201-A-4 | 99 | 237000497 | 237000595 |
| 6 | Bristol | 201 | A | 5 | 0201-A-5 | 99 | 237000596 | 237000695 |
| 7 | Bristol | 201 | A | 6 | 0201-A-6 | 99 | 237000696 | 237000794 |
| 8 | Bristol | 201 | A | 7 | 0201-A-7 | 54 | 237000795 | 237000848 |
| 9 | Bristol | 202 | B | 1 | 0202-B-1 | 198 | 237000849 | 237001047 |
| 10 | Bristol | 202 | B | 2 | 0202-B-2 | 199 | 237001048 | 237001247 |

Figure 1: Example of a ballot manifest from the Rhode Island RLA pilot report⁴⁴

38 Stark, P. B. & Teague, V. Journal of Election Technology and Systems, Vol. 3, No. 1. (2014). *Verifiable European Elections: Risk-Limiting Audits for D'Hondt and its relatives*. p. 19.

39 Morrell, J. Democracy Fund. (2019). *Knowing It's Right, Part Two: Risk-Limiting Audit Implementation Workbook*. p. 14.

40 Ibid., p. 10.

41 Ibid., p. 14.

42 Morrell, J. Democracy Fund. (2020). *Knowing it's Right, Part Three: Planning and Conducting a Risk-Limiting Audit Pilot*. p. 15.

43 Morrell, J. Democracy Fund. (2019). *Knowing it's Right, Part Two: Risk-Limiting Audit Implementation Workbook*. pp. 14-15.

44 Rhode Island RLA Working Group. (2019). *Pilot Implementation Study of Risk-Limiting Audit Methods in the State of Rhode Island*.

Operational Considerations for Selecting and Implementing Risk-Limiting Audits

Once a jurisdiction determines that these prerequisites are in place, it must assess which RLA method will be most suitable for the context as well as the operational factors needed for implementation. It is important to consider at the outset how decisions will be made; a range of electoral stakeholders – including political parties, domestic observer groups, members of the judiciary, scholars from local universities and others – should be involved in discussing and designing the RLA. An inclusive approach from the beginning will increase domestic ownership of the process and help to socialize an otherwise unfamiliar audit approach more widely. This section will touch on many of the elements described in the U.S.-focused declaration on *Principles and Best Practices for Post-Election Tabulation Audits* but will emphasize and expand on operational considerations for adapting RLAs outside the U.S.⁴⁵

Risk-Limiting Audit Methods

There are two principal RLA methods: *comparison* (at the ballot or batch level) and *ballot polling*. These methods are described in more detail in Figure 2 below. In a ballot comparison RLA, auditors review a random sample of ballots and check the manual interpretation of those ballots against the interpretation from the original vote count. To be able to make these comparisons, the count system must produce or be capable of producing a CVR noting how each ballot was interpreted, in addition to giving administrators the ability to identify and pull the specific ballot at a later time.⁴⁶ CVRs, which will be discussed further below, can, however, be controversial from the perspective of voter secrecy, an issue of fundamental concern for all election processes.

A *ballot polling* RLA works much like an exit poll, but instead of polling voters on their choices as they leave the polling station and extrapolating to the final results, cast ballots are randomly sampled and interpreted to determine if there is strong statistical evidence that the initial vote count and tabulation is correct.⁴⁷ *Knowing It's Right, Part III* describes this method as “a type of RLA in which individual paper ballots are randomly selected, the voter markings are examined and interpreted manually. If a large enough sample shows a large enough majority for the reported winner, the audit stops. This type of RLA cannot identify whether a specific ballot was mistabulated, but it can provide convincing evidence about whether the reported outcome is correct.”⁴⁸ This approach requires much less from the voting system – in fact, “every jurisdiction that uses paper ballots could conduct ballot polling RLAs immediately, without changing their voting equipment.”⁴⁹ However, a ballot polling RLA will require that more ballots be audited than a ballot-level comparison RLA, *ceteris paribus*.

45 Garland, L., Lindeman, M., McBurnett, N., Morrell, J., Schneider, M., & Singer, S. (2018). *Principles and Best Practices for Post-Election Tabulation Audits*.

46 Rhode Island RLA Working Group. (2019). *Pilot Implementation Study of Risk-Limiting Audit Methods in the State of Rhode Island*.

47 Appel, A. W. & Stark, P. B. (2020). *Evidence-Based Elections: Create a Meaningful Paper Trail, Then Audit*. p. 10. Retrieved from: <https://www.cs.princeton.edu/~appel/papers/Appel-Stark-GLTR-2020.pdf>

48 Morrell, J. Democracy Fund. (2020). *Knowing It's Right, Part Three: Planning and Conducting a Risk-Limiting Audit Pilot*. p. 9.

49 Stark, P. B. (2018). *An Introduction to Risk-Limiting Audits and Evidence-Based Elections*. p. 2. Retrieved from: <https://www.stat.berkeley.edu/~stark/Preprints/lhc18.pdf>.

| Method | Requirements | Advantages | Disadvantages |
|---|---|--|--|
| <p>Ballot-level comparison</p> <p>A random sample of ballots is manually interpreted, and each interpretation is checked against the machine interpretation of the same ballot</p> | <ul style="list-style-type: none"> • Voter verifiable paper ballots (enables manual interpretation of voter intent) • CVR (a record of how the voting system interpreted individual ballots) • Ballot manifest | <ul style="list-style-type: none"> • Generally requires the smallest sample size of the three RLA methods, and this sample size is predictable at the start of the audit • Identifies specific discrepancies between the voting system's interpretation of a ballot and a manual interpretation, which can provide important information for improving the audit and election processes | <ul style="list-style-type: none"> • Voting system must be capable of producing a CVR. • Considerable time and resources needed to retabulate and scan, if necessary, to match ballots to the CVR |
| <p>Batch-level comparison</p> <p>A random sample of batches is selected, and the votes in each batch are counted manually. These counts are compared to the corresponding machine on precinct counts, batch by batch, to measure discrepancies. A "batch" may consist of all the ballots cast in a precinct or on a particular voting machine.</p> | <ul style="list-style-type: none"> • Voter verifiable paper ballots • Ballot manifest • Results of initial batch counts | <ul style="list-style-type: none"> • Requires little special preparation in jurisdictions that already store ballots by batches • Relatively easy to conduct in parallel in multiple locations in a decentralized audit • Sample size is generally predictable at the start of the audit • Can provide information about the accuracy of specific machines, procedures or polling places | <ul style="list-style-type: none"> • Better suited to larger contests. In contests with few batches, this method would usually require a full hand count. • Generally requires auditing more ballots than a ballot-level comparison audit, but may require transporting and opening fewer ballot containers |
| <p>Ballot polling</p> <p>Cast ballots are randomly sampled and interpreted to determine if the sample shows a large enough majority to confirm the victory of the reported winner</p> | <ul style="list-style-type: none"> • Voter verifiable paper ballots • Ballot manifest • Results of initial tally | <ul style="list-style-type: none"> • Requires the least from the voting system • Mechanics may be familiar in jurisdictions that use PVT • Process is easily observable | <ul style="list-style-type: none"> • For close margins, the sample size expands substantially • Less predictable workload that can be affected substantially by an outlier sample even when the machine count was very accurate • Provides no information on the cause of discrepancies • Generally requires a larger sample size than a ballot-level comparison audit |

Figure 2: The content in this chart was adapted or sourced from the 2018 Election Assistance Commission publication Risk-limiting Audits: Practical Application, authored by Jerome Lovato Verified Voting's [Differences between RLA Methods](#); and the Rhode Island RLA Working Group's Pilot Implementation Study of Risk-limiting Audit Methods in the State of Rhode Island (January 2019).

The following sections will explore some factors that can help determine which RLA method to apply in different contexts. This information is based on the most commonly used vote-casting and counting methods globally and comparative experience with other types of audits and will benefit from updating with lessons learned as RLAs are applied outside the U.S. context.

Tabulation Method and Type of Voting System

One important consideration is whether a country counts votes electronically or manually. As discussed above, RLAs were developed in the context of U.S. elections, where electronic vote tabulation systems are prevalent⁵⁰ and where the main goal of post-election tabulation audits has traditionally been to assess the accuracy of computerized voting systems. In this context, comparison RLAs are seen as advantageous because they are able to check the tabulation process in addition to the final results.⁵¹ Comparison RLAs reveal “the most information about which ballots are being miscounted in what ways,”⁵² enabling administrators to make improvements to future audit and election processes.⁵³ This is not possible in ballot polling RLAs.

However, most vote counting processes in the U.S. do not currently allow for the comparison of the physical ballot with the voting system’s interpretation of that specific ballot as required for the ballot comparison method,⁵⁴ which could also be the case in other countries that use electronic counting systems that only produce a tally of the results.⁵⁵ Even if a voting system produces a CVR – a record of how ballots were interpreted by a specific machine – most do not provide a way to match the physical ballot with the interpretation recorded in the CVR.⁵⁶ Therefore, if a country uses electronic vote counting systems, which is the case for at least some contests in around 20 percent of countries,⁵⁷ there might be substantial up-front

Parallel Vote Tabulation and Ballot Polling RLAs

In countries that have PVT exercises – independent tabulation undertaken by domestic observers – voters may perceive there to be less value add from a ballot polling RLA. In some contexts in which trust in the electoral process is low, the PVT can play an important confidence-building role, but they are not a replacement for a formal tabulation audit. In some cases, PVTs have been performed incorrectly and the EMB would be well served in having additional checks to shore up credibility of the official results.

There are also significant sampling differences between a PVT and a ballot polling RLA, though these may not be as obvious to most stakeholders. A PVT collects results from entire polling stations (similar to a batch comparison RLA) rather than individual ballots from randomly selected polling stations as in a ballot polling RLA. Where relevant, voter education efforts around the RLA can address the complementary but different functions and approaches of the PVT and RLA.

50 Schürmann, C. (2017). *A Risk-Limiting Audit in Denmark: A Pilot*. p. 2. Retrieved from: <https://core.ac.uk/download/pdf/156888937.pdf>

51 Stark, P. B. (2012). *Ballot polling Risk-limiting Audits in Two Pages* (± 1). p. 1.

52 Risk-Limiting Audits Working Group. (2012, Version 1.1). *Risk-Limiting Post-Election Audits: Why and How*. pp. 9-10.

53 Rhode Island RLA Working Group. (2019). *Pilot Implementation Study of Risk-Limiting Audit Methods in the State of Rhode Island*. p. 8.

54 Risk-Limiting Audits Working Group. (2012, Version 1.1). *Risk-Limiting Post-Election Audits: Why and How*. p. 3.

55 Ibid., pp. 9-10.

56 Ibid.

57 Out of 175 countries surveyed. International IDEA, *ICTs in Elections Database*. <https://www.idea.int/data-tools/question-view/743>.

costs to alter the voting system to produce the needed CVR that outweigh the comparative advantages of a ballot comparison RLA. Regardless, options for creating CVRs in electronic vote counting jurisdictions are explored in the text box below.

One way to conduct a comparison RLA without a CVR is to sample *batches* of ballots instead of individual ballots (a *batch comparison* RLA rather than a *ballot comparison*). Batches can consist of all of the ballots from a precinct or voting district or only the ballots from a specific voting machine, depending on the specific capabilities of the machines. Batches can also be *any* set of ballots that are tabulated and stored together (e.g., batches of postal ballots). Batch comparison RLAs only require “timely, convenient reporting of auditable ‘batch’ subtotals.”⁵⁸ Depending on the size of the batch, they may require auditing more ballots than either ballot comparison or ballot polling RLAs because “the errors that the audit is intended to detect are by no means guaranteed to be evenly spread across the jurisdiction.”⁵⁹ For example, if the batch included all of the ballots in a precinct, then the batch comparison audit will require auditing all of the ballots in a sufficiently large sample of the total precincts, while ballot polling or ballot comparison audits may review only a few ballots from many more precincts. But, even with this increased sample size, a batch comparison audit may be simpler and more efficient than a ballot-comparison RLA. For instance, auditing 10,000 ballots from 20 batches may be simpler than auditing 1,000 random ballots from across hundreds of batches.⁶⁰

In the approximately 80 percent of countries that do not use any type of electronic system to cast or count ballots,⁶¹ a CVR is not needed, but it is still necessary to record how individual ballots were interpreted in the initial count. To do this, all that is theoretically required is that ballots be sorted and stored in batches by candidate during the counting process, which takes little effort, especially if ballots are simple and contain few contests (e.g., in presidential races and first-past-the-post elections). If a sampled ballot is pulled from a stack purported to include votes for candidate X, the auditor would assume that the initial tally counted that cast ballot as a vote for candidate X when assessing whether the interpretation was correct. This was the method used in Denmark’s RLA pilot, which was “the first application of a comparison audit to a paper-only election”⁶² (although the method was piloted for a referendum, so votes were sorted by “yes” or “no” rather than by candidate). If ballots are complicated, or if multiple contests are being audited from the same ballot paper, then a ballot polling RLA may need to be conducted instead even if the sample size may be larger.

58 Risk-Limiting Audits Working Group. (2012, Version 1.1). *Risk-Limiting Post-Election Audits: Why and How*. p. 8; Stark, P. B. (2018). *An Introduction to Risk-Limiting Audits and Evidence-Based Elections*. p. 39. Retrieved from: <https://www.stat.berkeley.edu/~stark/Preprints/lhc18.pdf>.

59 Risk-Limiting Audits Working Group. (2012, Version 1.1). *Risk-Limiting Post-Election Audits: Why and How*. p. 9.

60 Lindeman, M. (2021, January 13). *Personal communication*.

61 Out of 175 countries surveyed. International IDEA. *ICTs in Elections Database*. <https://www.idea.int/data-tools/question-view/743>.

62 Schürmann, C. (2017). *A Risk-Limiting Audit in Denmark: A Pilot*. Sec. 4.1. Retrieved from: <https://core.ac.uk/download/pdf/156888937.pdf>

Creating Cast Vote Records for Electronic Vote Counting Systems

It is possible to modify an electronic vote counting system to produce a CVR that can be matched to corresponding ballots using pre-printed identification numbers or by imprinting unique, pseudorandom numbers on each ballot at the time it is cast. However, both of these approaches present significant challenges for secrecy of the ballot.

Given the need for transparency in the RLA process, the CVR should be available for public scrutiny. Accordingly, the way that CVRs identify ballots is an important consideration. Using ballots with pre-printed identification numbers could in theory permit poll workers to note which ballots they have given to whom and would therefore violate the fundamental principle of secrecy of the vote.⁶³ Similarly, if ballots are scanned at polling locations where they can be tied directly to the voter's identity, imprinting unique numbers could also compromise voter secrecy. This would not be an issue when ballots are scanned at a central location.

In some contexts where trust in the election administration is low, it will be particularly important to address the possibility of misperceptions about the CVR and ballot identifiers, through careful planning for voter education and strategic communications that emphasize the secrecy of all ballots cast. Anticipating what misinformation or disinformation may emerge about the process can inform proactive communication strategies that reach voters before they encounter false or problematic information that would cause them to distrust the process.

One alternative is to conduct a *transitive audit*, which rescans the cast ballots using a secondary system that is able to produce a CVR.⁶⁴ If the results of the second scan match the reported outcome, then the results of the transitive audit can be reasonably applied to the official voting system and its results.⁶⁵ However, the rescanning and sorting⁶⁶ involved in conducting a transitive audit can substantially increase the costs of conducting a comparison RLA.

A simpler option, outlined by the authors of *Auditing Indian Elections*, resembles the method used for hand counting. They noted that while the electronic voting machines in India do produce VVPATs, they

63 Risk-Limiting Audits Working Group. (2012, Version 1.1). *Risk-Limiting Post-Election Audits: Why and How*. p. 8; Stark, P. B. (2018). *An Introduction to Risk-Limiting Audits and Evidence-Based Elections*. p. 27. Retrieved from: <https://www.stat.berkeley.edu/~stark/Preprints/lhc18.pdf>.

64 Ibid.

65 Mohanty, V., Akinyokun, N., Conway, A., Culnane, C., Stark, P. B. & Teague, V. (2019). *Auditing Indian Elections*. pp. 4-5 (noting that because a transitive audit is auditing a secondary system, it does not confirm that the official system tallied the votes correctly even if it reached the same result as the secondary system; "indeed, the two systems might disagree about the interpretation of every ballot, but still agree who won.") Retrieved from: <https://arxiv.org/pdf/1901.03108.pdf>

66 The process of conducting a transitive ballot comparison RLA was documented in the Rhode Island RLA pilot report: "Ballot-level comparison RLAs typically involve examining the fewest number of ballots, but they require individual cast ballots to be linked with a one-to-one association to each individual corresponding cast vote record (CVR). This linkage can be achieved by imprinting a unique pseudorandom number on the physical ballot and including this number in that ballot's CVR. In Rhode Island, most voters cast their ballots in-person using a DS200 scanner which currently lacks this capability. Therefore, conducting a ballot-level comparison audit requires officials to re-scan the ballots and imprint each one during the second scan.... Rescanning and imprinting adds time and cost to the audit, and the additional step creates more room for mishandling and error." The authors of this report recommended that vendors make voting equipment that is capable of generating and imprinting pseudorandom numbers on each ballot after scanning to enable the creation of a CVR that is suitable for directly conducting ballot comparison RLAs. Rhode Island RLA Working Group. (2019). *Pilot Implementation Study of Risk-Limiting Audit Methods in the State of Rhode Island*. p. 70.

do not create CVRs.⁶⁷ Given the context, they suggest the creation of a “preference manifest,” which addresses the need for a CVR.⁶⁸ Because Indian ballots are relatively simple and contain only one contest, the VVPATs can be easily sorted into bundles that (purportedly) show the same voter preferences, counting the number of VVPATs in each batch and labeling each bundle with the number of ballots and the voter preferences it purports to contain.”⁶⁹ A preference manifest can then be generated that includes “the bundle labels, the number of VVPATs in each bundle, and the reported voter preference for the bundle.”⁷⁰ This is similar to the method described for hand-count jurisdictions above.

Location of the Vote Count and Audit

Another important consideration is the location of the vote count, which will impact the choice of audit location(s). In some jurisdictions, the count is completely centralized; ballots are transported directly to one or more count centers after the close of polls. In other cases, ballots are counted at the polling station and results forms are tabulated at the next level of counting center. In countries where vote counting is primarily decentralized, special ballots (e.g., postal or military ballots) may still be counted centrally.⁷¹

The level of decentralization may dictate the relative ease of conducting certain methods of RLAs over others. Centralized count jurisdictions could enjoy a variety of logistical benefits in conducting all methods of RLAs, including the need to hire and train fewer auditors and the relative ease of management, coordination and observation in a single location versus across many distant places at the same time.⁷² Because an essential characteristic of an RLA is that *it can correct an incorrect election outcome*, it must be completed before the official election results are finalized and announced. This can put substantial pressure on the timeframe to complete an RLA. In jurisdictions that already have the infrastructure and capacity to quickly, transparently and securely move ballots to a central location to be counted, RLAs can be conducted in this same location directly after the initial count. However, if ballots are counted at polling stations, for instance, conducting a centralized audit would require additional time and resources for ballot transportation – including ballot security – as well as a sufficiently large and secure central location to conduct the audit.

In decentralized count jurisdictions where centralizing the audit would be either extremely costly or impractical, batch comparison audits may provide some benefits over ballot polling or ballot comparison audits. As discussed previously, ballot polling and ballot comparison audits generally require auditing fewer ballots than a batch comparison audit.⁷³ However, the reduced workload derived from this smaller sample is tempered in a decentralized auditing context because auditors and election officials would

67 Mohanty, V., Akinyokun, N., Conway, A., Culnane, C., Stark, P. B. & Teague, V. (2019). Auditing Indian Elections. p. 5.

68 Ibid.

69 Ibid.

70 Ibid.

71 ACE Electoral Knowledge Network. *Vote Counting*. <https://aceproject.org/ace-en/topics/vc/default>

72 The Rhode Island RLA pilot explored the costs and benefits of both centralized and decentralized audits. See Rhode Island RLA Working Group. (2019). *Pilot Implementation Study of Risk-Limiting Audit Methods in the State of Rhode Island*. pp. 46-47.

73 Risk-Limiting Audits Working Group. (2012, Version 1.1). *Risk-Limiting Post-Election Audits: Why and How*. p. 9.

need to be trained across the entire jurisdiction, and there would need to be considerable coordination and supervision across all audit locations.

Batch comparison RLAs, on the other hand, can permit auditors to tailor the sample unit or batch to the ballot counting and storage processes already in place. For instance, if ballots are counted and initially aggregated and stored at the district or municipal level by polling station, then a batch might consist of the total ballots cast at a polling station. If they are counted and stored by district, then the batch might consist of the total ballots for a district. This means that if the reported outcome of the election is correct (and the audit does not escalate to a full manual recount), the audit would not take place in every district or municipality across the jurisdiction, but rather in a randomly chosen subset of them.

If the context allows and the election management body (EMB) is comfortable in doing so, some estimates could be made in advance to enable planning to allocate training and resources more efficiently. Three pieces of information (or ranges) would be useful: the risk limit, an estimated rate of counting error and the potential or anticipated margin. The estimated rate – or range of rates – of counting error could be based on previous elections or pilot tests. The potential margin may be the most controversial figure to estimate, but it should be emphasized that it is not necessary to anticipate the likely winner, only the potential margin. Such a range could be derived by looking at the largest and smallest margins in desired races in some set of historical elections and finding a mid-point, or, more conservatively, using the smallest recent margins to estimate the largest possible group of polling stations that might be involved in the audit.

Random Sampling

As noted in the introduction to this paper, an important goal of post-election audits is to build trust.⁷⁴ A sound sampling methodology is essential for avoiding perceptions of any manipulation in the audit process that could undermine that objective. Accordingly, ballot sampling pool should include all ballots for a particular contest. For example, if the RLA will review ballots from a nationwide presidential race, all relevant jurisdictions must be included in the potential sample. An affidavit filed in a civil action against the governor of Georgia (U.S.) regarding a pilot audit is instructive in this regard. The affidavit alleges that “the ‘audit’ was not a risk-limiting audit” in part because it only audited one county in a statewide contest.⁷⁵ While this is less important for a pilot, it is necessary for an official RLA. The authoritative *Principles and Best Practices for Post-Election Tabulation Audits* notes that “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.”⁷⁶ For global implementation, auditors should also consider including invalid ballots. In addition to controversy over whether ballots were accurately allocated to parties or candidates, disagreement can also arise about whether ballots were correctly deemed invalid, particularly in close elections where it could impact the results.

Trustworthy methods of generating a random sample of any set of things “often have two features: a physical source of randomness (such as dice rolls) and inputs from multiple parties (so that even if some parties collude, any non-colluding party could foil an attempt to rig the sample.)”⁷⁷ While it is possible

74 Ibid., p. 4.

75 *Curling v. Kemp*. N.D. Ga. (2019). Fifth Supplemental Declaration of Philip B. Stark. Retrieved from: http://gaverifiedvoting.org/pdf-litigation/20200824-809_2-Exhibit-1-Decl-Philip-Stark.pdf

76 Garland, L., Lindeman, M., McBurnett, N., Morrell, J., Schneider, M., & Singer, S. (2018). *Principles and Best Practices for Post-Election Tabulation Audits*.

77 Lindeman, M. & Stark, P. B. (2012). *A Gentle Introduction to Risk-limiting Audits*. IEEE Security and Privacy, Special Issue on Electronic Voting. p. 5.

to produce a random sample manually – and this might be a useful tool in contexts where there is deep-seated mistrust of technology⁷⁸ – one common and time-saving approach in RLAs is to generate a *random seed*, or an initial number that can be plugged into a pseudorandom number generator (PRNG).⁷⁹ The number of digits in the random seed “should be long enough to be unpredictable (more is better).”⁸⁰ For example, in Colorado, the seed is generated using 20 10-sided dice.⁸¹ This type of seed generation process can be done publicly and involve representatives of multiple stakeholder groups, to generate both interest and trust in the process. Once the seed is determined, it can be plugged into a PRNG, which will randomly generate numbers that correspond to ballots.⁸²

It is not necessary to use audit software for an RLA, as explored in the textbox below. However, if software is used, it is recommended that the PRNG be integrated.⁸³ The PRNG should use a publicly available algorithm so that “anyone with access to the random seed, ballot manifest, and PRNG algorithm can confirm the ballot sample was selected correctly.”⁸⁴ This is important because, to build trust in the post-election process and the election itself, the public must be able to independently verify that it has been done correctly.⁸⁵ In addition, it is important that the public also have the opportunity to observe the audit process, including through online livestreaming wherever possible.⁸⁶ For example, in California’s pilot program, the Orange County Registrar of Voters advertised the process and invited the public to attend the seed generating ceremony,⁸⁷ and livestreamed the RLA.⁸⁸

Use of Audit Software and Other Technology

While audit software is not strictly necessary to conduct an RLA, it can be useful to help manage data and speed up the process. As outlined in *Knowing It’s Right, Part Two*, audit software can help election officials with the following:

- Collecting ballot manifests from local jurisdictions, creating statewide ballot manifests and cross-checking them against reported results (for comparison audits, the software can perform a similar function for the CVR);
- Estimating the sample size;

78 Cordero, A., Wagner, D. & Dill, D. (2006). *The Role of the Dice in Election Audits – Extended Abstract*.

79 Morrell, J. (2019). *Knowing It’s Right, Part One: A Practical Guide to Risk-Limiting Audits*. Democracy Fund. p. 11.

80 Morrell, J. (2019). *Knowing It’s Right, Part Two: Risk-Limiting Audit Implementation Workbook*. Democracy Fund. p. 10.

81 Ibid.; Post-Election Audit Initiative, Grant No. EAC110150E. *State of Colorado Risk-Limiting Audit – Final Report*.

82 Morrell, J. (2019). *Knowing It’s Right, Part Two: Risk-Limiting Audit Implementation Workbook*. Democracy Fund. p. 10.

83 Ibid.

84 Ibid.

85 Garland, L., Lindeman, M., McBurnett, N., Morrell, J., Schneider, M., & Singer, S. (2018). *Principles and Best Practices for Post-Election Tabulation Audits*. p. 10.

86 Ibid.

87 Orange County, CA. (2018). Press Release. *Orange County, CA Elections to Conduct Risk Limiting Audit of June Primary Election Results*. Retrieved from: <https://ocvote.com/press-releases/orange-county-ca-elections-to-conduct-risk-limiting-audit-of-june-primary-election-results>

88 Orange County, CA. (2020). *Risk Limiting Audit & 1% Manual Tally*. Retrieved from: <https://www.ocvote.com/results/risk-limiting-audit>.

- Applying the random seed and PRNG to select a random sample and then identifying where to find the selected ballots;
- Collecting the auditors' interpretation of voter intent from the audited ballots;
- Accounting for discrepancies and determining if the audit needs to be escalated to another round; and
- Calculating when the risk limit has been met and the audit is complete.⁸⁹

A caveat is in order: To build trust in the audit and the election process, the public must be able to independently verify that the audit has been conducted correctly.⁹⁰ Therefore, it is important that any software output can be *manually verified* and the information needed to reproduce the audit outcomes should be made public.⁹¹ In the Rhode Island RLA pilot, software was used to identify and generate the list of the randomly selected ballots and calculate when the risk limit was reached.⁹² The report noted that while the software was used to speed up the process, it was not required: "Risk-limiting audits can be replicated by anyone, even without software, as long as they have the right information."⁹³ A manual verification process could be especially useful in contexts of mistrust of election technology and could be formally incorporated into the RLA process. There are few large-scale precedents for such an effort in the U.S., however.

Cost

The costs of implementing an RLA, regardless of the method chosen, will undoubtedly vary significantly from country to country. Aside from fixed setup costs, most anticipated expenses, including labor, transportation and security,⁹⁴ are driven by the number of ballots or batches that are audited.⁹⁵ As one of the unique characteristics of RLAs is that they continue sampling until the risk limit is reached or else escalate into a full manual recount, the sample size is inherently unpredictable, which "could mean that the time and resources needed for the audit deviate from what was anticipated during planning."⁹⁶

However, it is possible to estimate a range for the sample size that may be required in advance of an election. There is open-source software available to help with this sample size estimate.⁹⁷

89 Morrell, J. (2019). *Knowing It's Right, Part Two: Risk-Limiting Audit Implementation Workbook*. Democracy Fund. p. 15.

90 Garland, L., Lindeman, M., McBurnett, N., Morrell, J., Schneider, M., & Singer, S. (2018). *Principles and Best Practices for Post-Election Tabulation Audits*. p. 10.

91 Post-Election Audit Initiative, Grant No. EAC110150E. *State of Colorado Risk-Limiting Audit – Final Report*, p. 21.

92 Rhode Island RLA Working Group. (2019). *Pilot Implementation Study of Risk-Limiting Audit Methods in the State of Rhode Island*. p. 21.

93 Ibid.

94 A key consideration for level of effort and cost is the number of ballot containers that must be opened. The costs of moving a batch to and from secure storage to the audit location and using appropriate security procedures when opening and resealing the container can be significant, especially in ballot polling RLAs.

95 McLaughlin, K. & Stark, P. B. (2011, June 5). *Workload Estimates for Risk-Limiting Audits of Large Contests*. p. 2.

96 Lovato, J. (2018). *Risk-Limiting Audits – Practical Application*. Election Assistance Commission. Retrieved from: https://www.eac.gov/sites/default/files/eac_assets/1/6/Risk-Limiting_Audits_-_Practical_Application_Jerome_Lovato.pdf.

97 Morrell, J. (2019). *Knowing It's Right, Part Two: Risk-Limiting Audit Implementation Workbook*. Democracy Fund. p. 15.

The sample size is primarily driven by the choice of RLA method, though the results margin also impacts the sample size, as more evidence is required to confirm the results in contests with smaller margins than in those with larger margins.⁹⁸ Unlike in traditional post-election audits, the size of the electorate may have little or no bearing on the size of the sample for RLAs: “in a ballot-level comparison audit, if the margin is 5% of ballots cast in the contest, auditing 96 ballots may suffice to reach a 10% risk limit – whether the total number of ballots cast was one thousand or many millions.”⁹⁹ Smaller contests typically require a sample that represents a larger proportion of ballots than larger contests.¹⁰⁰ There are two additional factors that factor into the RLA sample size calculation:

- Risk Limit: Lower risk limits can increase the sample size because more evidence is required to establish that the audit would uncover incorrect results to a higher degree of certainty. For example, “a 1% risk limit often requires about twice as much counting as a 10% risk limit.”¹⁰¹ The choice of risk limit is discussed in the section on the legal and regulatory framework below.
- Error Rate: While error rates can be anticipated to a certain extent in the sampling process, more errors than predicted can increase the sample size. It is also possible that a full hand count could be called if large or frequent errors that raise clear doubts about the outcome are uncovered during the audit.¹⁰²

As touched upon previously, the method of RLA selected will also impact the cost of the audit. While a ballot comparison RLA needs a CVR, the sample size is generally smaller than for a ballot polling RLA.¹⁰³ In countries that count votes electronically where it would require an upfront investment to enable the generation of a CVR, then “comparison audits may have little or no advantage over ballot polling audits, which place much lower demands on the voting system.”¹⁰⁴ Ballot polling RLAs can be very efficient when the margin of victory is large, but “the hand count workload for ballot polling audits grows rapidly as the margin shrinks.”¹⁰⁵

98 Lindeman, M. & Stark, P. B. (2012). *A Gentle Introduction to Risk-limiting Audits*. IEEE Security and Privacy, Special Issue on Electronic Voting. p. 1.

99 Risk-Limiting Audits Working Group. (2012, Version 1.1). *Risk-Limiting Post-Election Audits: Why and How*. pp. 11-12.

100 Garland, L., Lindeman, M., McBurnett, N., Morrell, J., Schneider, M., & Singer, S. (2018). *Principles and Best Practices for Post-Election Tabulation Audits*. p. 15.

101 Risk-Limiting Audits Working Group. (2012, Version 1.1). *Risk-Limiting Post-Election Audits: Why and How*. p. 17.

102 Ibid., p. 33.

103 California Secretary of State. *Post-Election Risk-Limiting Audit Pilot Program 2011-2013: Final Report to the United States Election Assistance Commission*. p. 3

104 Ibid.

105 Ibid., p. 10.

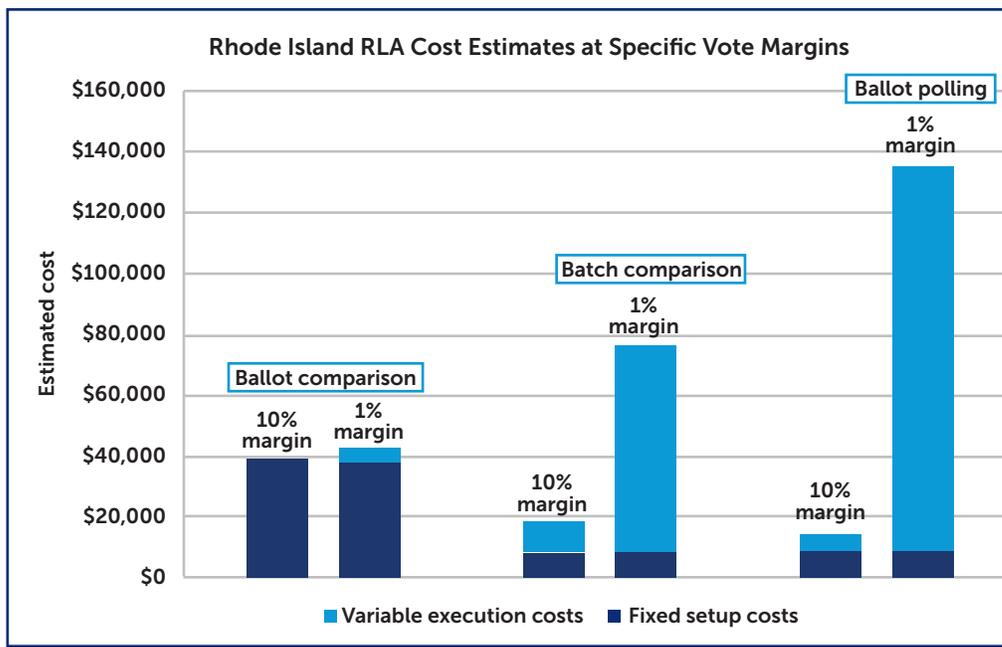


Figure 3: Data from Rhode Island RLA Working Group. (2019). *Pilot implementation Study of Risk-Limiting Audit Methods in the State of Rhode Island*

The 2019 Rhode Island pilot provides an important illustration of how both margin of victory and the method of RLA have the potential to have significant impacts on cost (see figure 3 above).¹⁰⁶ The pilot report estimated both setup and execution costs, at different margins, and showed that while the setup costs for the ballot comparison RLA were substantially higher than for the other methods, the execution costs were so low that costs remained relatively stable regardless of the margin.¹⁰⁷ However, it should be noted that, due to the need to rescan and imprint all ballots with a unique sequential identification number in the pilot, the setup costs shown for the ballot comparison audit is much higher than would be expected in a manual count system. In comparison, the cost increase for the ballot polling method and the batch comparison methods were both significant, although the difference for ballot polling was the highest.¹⁰⁸ The ballot comparison RLA method was found to have the most predictable costs, if the reported election outcome is correct; however, the ballot polling method might be the most affordable at higher margins for systems that count votes electronically.¹⁰⁹

Another way to help guarantee cost efficiency is to provide for the use of multiple methods of RLA under the law, introducing rules that provide that a ballot polling RLA should be used for higher margins (e.g., more than 5 or 10 percent), while ballot comparison RLAs can be used for smaller margins if they would

106 Rhode Island RLA Working Group. (2019). *Pilot Implementation Study of Risk-Limiting Audit Methods in the State of Rhode Island*. pp. 57-60.

107 The increased cost from a 10 percent margin to a 1 percent margin was only \$4,036. Ibid.

108 The cost difference from a 10 percent margin to a 1 percent margin was estimated at \$120,866 for ballot polling and \$58,064 for batch comparison. Ibid.

109 It is also worth noting that the Rhode Island data provides several possible cost levels for ballot polling, as “unlike ballot-level comparison and batch comparison methods, the sample size needed to attain a specified risk limit in the first round of auditing (assuming only minor discrepancies) is quite variable for a ballot polling audit. For instance, if by chance the randomly chosen sample includes many more ballots with the loser selected than appear on average in all the ballots, many more ballots would require examination than would be required on average.” For the purposes of Figure 3, we have selected the highest cost level, which assumes a large sample needed for review. Ibid.

be more resource-effective.¹¹⁰ However, this difference is largely only relevant in electronic counting systems; for jurisdictions using manual count processes, the cost differences will be much smaller.

While the unpredictability of costs may be a challenge to implementing RLAs, “even the largest auditing costs are small compared with other election costs.”¹¹¹ Additionally, RLAs can be more cost-efficient than fixed-percentage tabulation audits, “in that risk-limiting audit methods typically require only limited resources for election contests with wide margins of victory while investing greater resources in close contests.”¹¹² RLAs can be more efficient particularly for large contests, for which RLAs would “often require much less counting than many current audit laws mandate.”¹¹³ Regardless of the actual size of the sample, the benefit of using RLAs is that they can be designed to limit the sample to the smallest feasible size while guaranteeing that the election results are either confirmed to the specified risk level or corrected. For example, the U.S. state of California’s 2011-2013 *Post-Election Risk-Limiting Audit Pilot Program: Final Report* reported that “eleven counties successfully completed their audits and confirmed the official election results by reviewing a relatively small number of individual ballots” while “the statutorily-mandated 1% manual tally conducted in the same elections provided little statistical evidence that the election outcomes were correctly tallied by the voting system, despite requiring substantially more ballots to be hand-counted and examined.”¹¹⁴

Training

In addition to other operational considerations, the RLA planning process must take into account the process of training auditors and other election officials who will be involved in the audit, as well as political party agents, observers and relevant judicial actors. These training considerations will be similar across RLA methods, although it is important to consider that different stakeholders may need different materials and information according to their respective role in the process.¹¹⁵ As with other election processes, any underprepared participant could compromise the integrity of the audit outcome and undermine trust in the election’s results. Professionally trained and competent participants, on the other hand, can be key players in building public trust in the institution and ensuring its legitimacy and credibility.

As IFES has noted previously, auditors must “fully understand their mandate, how to implement audit procedures in a consistent manner, and the importance of doing so impartially ... effective training can be challenging where capacity may be low, or where an audit is taking place under both time and political pressures. However, this step is key to garnering the trust of political parties, contestants, and the general public in the audit and its results.”¹¹⁶ International good practice emphasizes that domestic

110 Stark, P. B. (2018). *An Introduction to Risk-Limiting Audits and Evidence-Based Elections*. p. 8. Retrieved from: <https://www.stat.berkeley.edu/~stark/Preprints/lhc18.pdf>.

111 Risk-Limiting Audits Working Group. (2012, Version 1.1). *Risk-Limiting Post-Election Audits: Why and How*. p. 11.

112 RI Gen L § 17-19-37.4 (2017)

113 Risk-Limiting Audits Working Group. (2012, Version 1.1). *Risk-Limiting Post-Election Audits: Why and How*. pp. 11-12.

114 California Secretary of State. *Post-Election Risk-Limiting Audit Pilot Program 2011-2013: Final Report to the United States Election Assistance Commission*. Retrieved from: https://www.eac.gov/sites/default/files/eac_assets/1/28/AUDIT%20PILOT%20FINAL%20REPORT%20TO%20EAC%20FINAL.pdf

115 Darnolf, S., Ellena, K., Lippolis, E., Shein, E. & Vickery, C. (2015). *Election Audits: International Principles that Protect Election Integrity*. Retrieved from: <https://www.ifes.org/publications/election-audits-international-principles-protect-election-integrity>

116 Vickery, C. & Shein, E. (2017). *Election Audits*. In Norris, P. & Nai, A. (2017). *Election Watchdogs: Transparency, Accountability and Integrity*. Oxford University Press.

election administrators should maintain ownership over their own election audits; “the main caveat to this advice is the recognition that some of the advanced statistical techniques being employed in election audits today may require expertise from third parties outside the country—such possibilities, however, should be planned for and made transparent well in advance of an actual audit.”¹¹⁷ In this context, it will be especially important to provide training to domestic experts and statisticians, and for election administrators to consider building partnerships with neutral and respected university faculty.

Consistent and effective training for observers and party agents is also important. While Carter Center observers of the state of Georgia’s RLA of the results of the 2020 elections found that the audit overall “can and should serve as the basis for increased confidence in the electoral system,” they also noted that “party monitors appeared poorly versed in all aspects of the process.”¹¹⁸ The Carter Center found that party monitors were not trained to systematically collect information nor did they have checklists or observation forms to record data.¹¹⁹ When party monitors do not understand the audit process, they cannot participate effectively in the audit and can even leave the system vulnerable to politicization or mistrust.¹²⁰ This was the case in Afghanistan’s 2014 election, for example, where “disagreements between candidate teams in the audit warehouse were frequent.”¹²¹ A clear understanding of the audit process can help mitigate these challenges.

Another important element of the RLA introduction process is pilot testing, which serves as a valuable training device for auditors and other participants. In the U.S. context, where RLAs have been tested over time on a small scale in individual jurisdictions, the Brennan Center notes that a “key factor to ensuring RLA scalability is the ability to continue to provide opportunities to election officials from across the state to observe the process and provide input.”¹²² When advisory groups or working bodies are formed to design pilots, it can have the “added benefit of forming a cadre of local RLA subject-matter experts.”¹²³

In addition to training audit participants on the mechanics of the audit process, it is important to ensure that audit officials are aware of the jurisdiction’s rules on determining ballot validity and voter intent and provided with clear guidelines in that regard: “An audit can only yield reliable results if it applies explicit, previously established standards for what should count as a valid vote.”¹²⁴ Such guidelines should be created for the entire election process – including the initial count, if done manually – and might cover, for example, the types of target area on the ballot (e.g., the shape in which the voter is to mark their choice), valid markings, the types of incomplete marks that constitute valid votes, obvious

117 Caltech/MIT Voting Technology Project. (2018, December 7-8). Election Auditing: Key Issues and Perspectives. Election Audit Summit, Summary Report. p. 26. Retrieved from: http://electionlab.mit.edu/sites/default/files/2019-06/Election-Auditing-Key-Issues-Perspectives_2.pdf

118 The Carter Center. The Carter Center Congratulates the State of Georgia on a Successful Audit Process. Retrieved from: https://www.cartercenter.org/resources/pdfs/news/peace_publications/democracy/georgia-audit-nov020.pdf

119 Ibid.

120 Darnolf, S., Ellena, K., Lippolis, E., Shein, E. & Vickery, C. (2015). Election Audits: International Principles that Protect Election Integrity. Retrieved from: <https://www.ifes.org/publications/election-audits-international-principles-protect-election-integrity>

121 Ibid.

122 Howard, L., Rivest, R. L. & Stark, P. B. (2019). A Review of Robust Post-Election Audits. Brennan Center for Justice. Retrieved from: https://www.brennancenter.org/sites/default/files/2019-11/2019_011_RLA_Analysis_FINAL_0.pdf

123 Morrell, J. (2020). “Knowing It’s Right, Part Three: Planning and Conducting a Risk-Limiting Audit Pilot.” Democracy Fund.

124 Risk-Limiting Audits Working Group. (2012, Version 1.1). Risk-Limiting Post-Election Audits: Why and How.

“stray” or “hesitant” marks, overvotes, corrected votes and how the election official is to interpret each scenario.¹²⁵

Public Education and Information

As IFES has noted in previous publications, education is a crucial component of a successful audit process, and the need will increase for an unfamiliar audit approach or in contexts where credibility of electoral processes may be low or in question. As with training of audit officials, public education and information needs will be similar across the respective RLA methods. Various forms of education and informational campaigns are needed to reach the public broadly, as well as specific groups like candidates, political parties, observers and others who are likely to interact with the election process.

“It is critical for audit managers to think carefully about the role various groups will play and how they can be enlisted to support the process and outcomes. Deficiencies in training and education leave the system vulnerable, particularly with regard to candidate interaction with an audit process, where it is critical to emphasize the rules around observation to avoid interference. This can make the process even more challenging for EMBs and international stakeholders ... While political disagreements among even trained candidate agents may be inevitable, emphasizing and enforcing rules and procedures are important mitigating steps to limit these conflicts.”¹²⁶

The U.S. experience has demonstrated that risk-limiting audits can be cost-effective and efficient. These benefits, however, will be squandered if essential stakeholder groups do not understand the process or trust its outcomes – in turn wasting a valuable opportunity to secure trust and confidence in an election’s final result. The process and principles underpinning the RLA must be both transparent and intelligible to voters, candidates, parties and observers, a daunting task given its complexity and, thus far, relative unfamiliarity. As Jennifer Morrell – an experienced election official who was deeply engaged in introducing RLAs in the U.S. state of Colorado – has observed:

“Communicating the RLA process to voters, candidates, election officials, and policymakers in a way that is both meaningful and understandable is a challenge. The definitions are technical, and the formulas for calculating the sample size or when the risk limit has been satisfied, for instance, are grounded in math and statistics that can be difficult to explain.”¹²⁷

The U.S. experience offers several lessons for election administrators as they are planning RLAs, as does global experience from public education and information campaigns focused on introducing new electoral processes. Planning for RLA education and information should be incorporated into an EMB’s strategic and operational planning processes well before the election event, with sufficient resources devoted to such campaigns. Important components include (but are not limited to):

125 See, for example, Colorado guidelines on interpreting voter intent, <https://www.sos.state.co.us/pubs/elections/docs/voterIntentGuide.pdf>

126 Vickery, C. & Shein, E. (2017). Election Audits. In Norris, P. & Nai, A. (2017). *Election Watchdogs: Transparency, Accountability and Integrity*. Oxford University Press.

127 Morrell, J. (2019). *Knowing It’s Right, Part Two: Risk-Limiting Audit Implementation Workbook*. Democracy Fund

- Conducting a pilot RLA exercise – or, ideally, multiple pilots in individual constituencies – that is open for observation by all relevant stakeholders, followed by a lessons learned process and a detailed and accessible public report. Audit administrators will develop a deeper understanding of the audit mechanics and will be better positioned to explain audits to external audiences and answers questions.¹²⁸
- Convening an advisory board – including domestic stakeholders from political parties, civil society, the media, as well as individuals with relevant audit and statistics experience – to draft and implement a public communication plan.¹²⁹
- Establishing standard definitions and terminology for communicating about RLAs and using this vocabulary correctly and consistently with stakeholders.¹³⁰ Tailor educational materials and information to specific audiences and focus primarily on the audit purpose and basic principles.
- Creating simple informational materials¹³¹ in multiple accessible formats and languages, as appropriate, that highlight the major steps in the RLA and emphasize the objectives and outcomes of the audit. Materials could also outline the mathematical process and assumptions underlying the RLA to enable individuals or groups to observe and replicate the results.
- Ensuring the informational campaigns emphasize that the RLA can correct the outcome of the election if it escalates to a full recount, assuming that is the case under the law.
- Conducting detailed usability test with diverse participants groups and refining informational materials and campaigns based on the results.¹³²
- Posting audit-related documents, event announcements and results where they can be accessed by the public so voters can observe and understand the RLA process.¹³³

128 Morrell, J. (2019). *Knowing It's Right, Part One: A Practical Guide to Risk-Limiting Audits*. Democracy Fund. p. 15.

129 Morrell, J. (2019). *Knowing it's Right, Part Two: Risk-Limiting Audit Implementation Workbook*. Democracy Fund. p. 5.

130 Ibid., p. 29.

131 See *Post-Election Audits*. Center for Tech and Civic Rights. <https://www.techandciviclife.org/course/post-election-audits/>

132 See *Usability testing kit*. Electiontools.org. <https://electiontools.org/tool/usability-testing-kit/>

133 Morrell, J. (2019). *Knowing It's Right, Part Two: Risk-Limiting Audit Implementation Workbook*. Democracy Fund. p. 29.

Introducing Risk-Limiting Audits in the Legal and Regulatory Framework

The incorporation of RLAs into the legal and regulatory framework may require harmonization with other legal provisions, including the results certification process, legally mandated deadlines and recount and dispute resolution procedures. Accordingly, it is necessary to conduct a thorough review of the legal framework before introducing RLAs.

An advisory committee or working group, composed of relevant stakeholders (e.g., election administrators, lawyers, scholars and technical assistance providers), can help to identify changes needed to integrate RLAs into existing electoral law and procedures and eliminate any contradictions. These bodies can also support the design and implementation of pilot audits. As has been noted elsewhere in this paper, pilot testing is a critical step in the process that should not be skipped. Pilot testing can be an important way to test new rules and procedures before formalizing them and can identify gaps or inconsistencies in the legal and regulatory framework, yielding recommendations regarding the legal reforms necessary to fully implement an RLA.¹³⁴

Given the vast diversity of electoral systems and legal tradition across countries, RLAs can be effectively incorporated into an electoral legal framework using various combinations of legislation, regulation, procedure and practice.¹³⁵ Regardless of the approach taken, the following seven essential elements should be addressed clearly in the framework:

- A meaningful and clear definition for an RLA;
- Details on when RLAs are mandatory or which contests should be selected for audit;
- The process for selecting the risk limit (or the risk limit itself, if it will be stipulated in the law);
- A time frame to complete RLAs;

134 Singer, S. & McBurnett. (2018). *Orange County, CA Pilot Risk-Limiting Audit*. Verified Voting. p. 25.

135 In the U.S., elections are highly decentralized and governed primarily by the laws and regulations of each individual state – even for federal contests – so the approaches taken by state legislatures to delegate these details have varied. Both California and Colorado, for example, specifically provide for implementing regulation to be created by the respective state’s secretary of state. However, while Colorado’s legislation broadly tasks the secretary of state with “promulgat[ing] rules ... as may be necessary to implement and administer the requirements of [the RLA provisions],” California’s legislation charges the secretary of state with adopting regulations that achieve a list of specific goals, including establishing “procedures and requirements for testing and disclosing the algorithms and source code of any software used ... for the selection the ballots” and “content for the risk-limiting audit report.” Ohio, on the other hand, establishes procedures for RLAs and other post-election audits entirely through directives from the secretary of state’s office rather than legislation. In general, by delegating the specifics of RLA procedures, especially when first being introduced to a jurisdiction, American legislators have helped to support election officials to innovate and improve the efficiency and effectiveness of RLAs. See Colo. Rev. Stat. §1-7-515 (4); Cal. Elec. Code § 15367 (b). See also, Nevada Senate Bill 123 (2019) § 8 (tasking the secretary of state with establishing regulations to conduct an RLA, listing possible content, but not limiting or requiring its inclusion: (a) procedures to conduct a risk-limiting audit; (b) criteria for which elections must be audited; and (c) criteria to determine the scope of the RLA); Verified Voting. *Ohio Audit Laws*. <https://verifiedvoting.org/auditlaw/ohio/>; Morrell, J. (2019). *Knowing It’s Right, Part One: A Practical Guide to Risk-Limiting Audits*. Democracy Fund. p. 14.

- The legal basis under which RLAs can correct inaccurately reported outcomes;
- Provisions for transparency and public accountability; and
- Required security and integrity measures.¹³⁶

At the time of writing, Denmark, and the U.S. states of Colorado, Rhode Island, Nevada, Georgia, Indiana, Ohio, California, Washington and Oregon are the only jurisdictions known to the authors that have enacted RLA-enabling legislation.¹³⁷ The following sections will use these legal frameworks as a lens to consider how the seven essential legal elements might be practically applied in other contexts globally.

Defining a Risk-Limiting Audit

A comprehensive legal framework for conducting RLAs will include a clear definition of an RLA. This definition should, at a minimum, stipulate that the audit relies upon a statistical method and limits the risk of a jurisdiction certifying an outcome that differs from what a full hand recount would show.¹³⁸ The specific RLA method can be included in the law or left to the regulatory or rulemaking authority of the EMB depending on the legal tradition and context of the country. While some U.S. states have chosen to leave this detail for rules and regulations that can more easily be adapted as needed in the future,¹³⁹ this flexibility may not be necessary in more centralized systems. On the other hand, including the method of RLA in the law might increase clarity and consistency of the process, which may enhance the RLA's trust-building function in the long term. If the decision is made to incorporate the specific RLA approach into the law, it is especially important to identify the appropriate method in advance through a pilot process, as discussed further below, and to ensure that the law's provisions are limited to fundamental elements of RLAs and details left to rulemaking.

Selecting Contests to Be Audited

Ideally, the law should clearly specify when it is mandatory or possible to conduct an RLA. This includes identifying which contests will be audited or how the contests will be selected for audit.¹⁴⁰ While RLAs may be introduced in phases, perhaps starting with local elections when those may offer a more salutary context for pilots (see below), the law might ultimately require that all national-level elections be audited.

136 Stark, P. B. (2018). *An Introduction to Risk-Limiting Audits and Evidence-Based Elections*. pp. 9-10. Retrieved from: <https://www.stat.berkeley.edu/~stark/Preprints/lhc18.pdf>; Risk-Limiting Audits Working Group. (2012, Version 1.1). *Risk-Limiting Post-Election Audits: Why and How*. pp. 2-3.

137 The legal code in the Commonwealth of Virginia explicitly states that audits will have no effect on election results. Accordingly, the RLAs conducted in Virginia have been used primarily "to study the accuracy of ballot scanner machines." Virginia Department of Elections. (2020). *Chapter 4 Voting Equipment and Electronic Pollbooks*. p. 8. Retrieved from: [https://www.elections.virginia.gov/media/grebandbook/2020-individual-chapters/4_Voting_Equipment_\(2020\).pdf](https://www.elections.virginia.gov/media/grebandbook/2020-individual-chapters/4_Voting_Equipment_(2020).pdf)

138 See RCW29A.60.185 (1)(c); Rhode Island Gen L § 17-19-37.4(e)(ii)(3); Colorado Rev. Stat. §1-7-515; Nevada Senate Bill 123 (2019) § 8.

139 For example, in California the type of RLA is left to the discretion of election authorities. California Elec. Code § 15367 (a)(3).

140 Allowances for "opportunistic auditing" could also be considered, in which all contests on a ballot are reviewed regardless of whether or not they are selected for an RLA. While opportunistic audits have no impact on the results of those contests, they can provide valuable information to election administrators. Caltech/MIT Voting Technology Project. (2018, December 7-8). *Election Auditing: Key Issues and Perspectives*. Election Audit Summit, Summary Report. p. 30. However, election administrators should carefully consider any potential negative perceptions or confusion that could arise prior to embarking on an opportunistic audit, as well as the additional resources that may be needed.

For example, in Rhode Island, the law requires that an RLA be conducted after the presidential primary and general elections.¹⁴¹ Additionally, a country could also audit all or a portion of local elections. For RLA processes in which only a portion of subnational contests are to be audited, the process should ensure that the selection cannot be predicted ahead of time.¹⁴²

In Colorado, for example, the secretary of state has until the Friday after an election to select contests to be audited, which means that the contests subject to an RLA cannot be predicted ahead of the election—or even before the start of the initial count.¹⁴³ Colorado’s regulation provides the secretary of state with six factors to consider when selecting the contests for audit: “(1) The closeness of the reported tabulation outcome of the contests; (2) The geographical scope of the contests; (3) The number of ballots counted in the contests; (4) Any cause for concern regarding the accuracy of the reported tabulation outcome of the contests; (5) Any benefits that may result from auditing certain contests; and (6) The ability of the county clerks to complete the audit before the canvass deadline.”¹⁴⁴ Similarly, in Nevada, the legislation tasks the secretary of state with developing regulations, including criteria for which elections are to be audited.¹⁴⁵ If this type of approach is adopted, it is especially important that an EMB’s rulemaking processes are transparent and inclusive and that there is sufficient public trust in the institution.

While it is also possible to make RLAs mandatory for contests with low margins – e.g., for contests with reported percentage margins lower than 5 percent – it is important to consider the potential impact of using RLAs only in highly contested or potentially politically contentious elections. This may have the unintended consequence of making RLAs controversial and eroding their trust-building potential. Instead, it may be beneficial to require RLAs consistently as a standard integrity measure that is fully integrated into the electoral process. Similar concerns should be considered when determining whether political parties or candidates should be allowed to request RLAs for contests that would not otherwise be subject to them.

Setting the Risk Limit

The risk limit is the largest possible chance that the audit will not correct the reported outcome if that outcome is wrong. While risk limits generally seem to be 10 percent or less, there is no common approach used to determine an appropriate risk limit in a given context. The authors theorize that smaller risk limits – for example 5 percent or less – *might* have a stronger impact on public trust in the audit process and ultimately the election results, though there is no evidence available yet on this point. However, they also may be more resource- and time-intensive. For example, lower risk limits increase the sample size because more evidence is required to establish that the audit would uncover incorrect results to a higher degree of certainty.¹⁴⁶

Small risk limit (5% or less):
Potentially more expensive and more labor intensive, longer timeline, but could increase trust in the process, more efficient for smaller contests

Large risk limit (more than 5%): Potentially less expensive and lower labor requirements, particularly for larger contests, quicker timeline, but leaves more room for mistrust of the audit outcome

141 Rhode Island Gen L § 17-19-37.4(b).

142 Stark, P. B. (2018). *An Introduction to Risk-Limiting Audits and Evidence-Based Elections*. p. 11. Retrieved from: <https://www.stat.berkeley.edu/~stark/Preprints/lhc18.pdf>.

143 Colorado Secretary of State Election Rule 25.2.2(i).

144 Ibid.

145 SB123 § 8(1)(b). Retrieved from: https://www.leg.state.nv.us/Session/80th2019/Bills/SB/SB123_R3.pdf.

146 Risk-Limiting Audits Working Group. (2012, Version 1.1). *Risk-Limiting Post-Election Audits: Why and How*. p. 17.

Perhaps due to the inherent subjectivity involved in setting the risk limit, or to allow election officials the discretion to adapt to differing circumstances, several U.S. jurisdictions have left the risk limit to the discretion of the secretary of state or other election officials.¹⁴⁷ On the other hand, California requires RLAs to be conducted with a 5 percent risk limit regardless of the RLA method in use or the contest being audited.¹⁴⁸

Another approach is for jurisdictions to set larger risk limits for smaller contests recognizing the increased burden on a smaller team to audit what is often a larger percentage of ballots than audits of larger contests (where work can also be divided across more jurisdictions).¹⁴⁹ For example, in Colorado, the secretary of state has set the threshold at 5 percent for statewide contests and 10 percent for countywide contests.¹⁵⁰ The regulations also permit the secretary of state to establish different risk limits for comparison and ballot polling RLAs.¹⁵¹

Establishing a Time Frame

RLAs are used to confirm election results and correct incorrectly reported outcomes. Because there is often a legal deadline by which election officials must release finalized election results,¹⁵² the time frame required to conduct an RLA may be incompatible with existing legal deadlines.¹⁵³ Given these potential challenges, policymakers may want to consider changing the deadlines for certification to provide more time to finish RLAs, considering the “possibility that the audit will uncover problems that require additional auditing or counting.”¹⁵⁴ In general, it is important that the RLA process be integrated into the operations plan. It may also be necessary to harmonize the introduction of RLAs with election dispute resolution processes, especially when deadlines are set in the law or constitution.

Under Colorado’s post-election audit regulations, most of the important steps of an RLA include specific deadlines, including setting the risk limit (at least 32 days before Election Day),¹⁵⁵ appointing an audit board (at least 15 days before Election Day),¹⁵⁶ completing a ballot manifest and RLA tabulation (no later than nine days after Election Day),¹⁵⁷ generating a random seed and selecting ballots for audit (on the 10th day after an election),¹⁵⁸ selection of target contests (no later than the Friday after Election Day)¹⁵⁹ and submitting audit reports (one business day before canvass deadline).¹⁶⁰ Additionally, the regulations provide that if the RLA report indicates that the risk limit has not yet been met, the secretary of state must expand the selection, and that the RLA will continue until the risk limit is met or a full hand count

147 RCW 29A.60.185 (1)(c)(ii).

148 California Elec. Code § 15367(a)(3).

149 Risk-Limiting Audits Working Group. (2012, Version 1.1). *Risk-Limiting Post-Election Audits: Why and How*. pp. 11-12, 18.

150 Colorado Secretary of State Election Rule 25.2.2(a).

151 Ibid.

152 Risk-Limiting Audits Working Group. (2012, Version 1.1). *Risk-Limiting Post-Election Audits: Why and How*. p. 17.

153 Ibid.

154 Ibid., p. 40.

155 Colorado Secretary of State Election Rule 25.2.2(a).

156 Ibid., Rule 25.2.2(b).

157 Ibid., Rule 25.2.2(d).

158 Ibid., Rule 25.2.2(h).

159 Ibid., Rule 25.2.2(i).

160 Ibid., Rule 25.2.3(a).

is conducted.¹⁶¹ In this case, the secretary of state may instruct the county to delay canvass until the RLA is complete.¹⁶²

In Washington, the legislation explicitly states that the RLA must be completed prior to certification of the results without specifying the timeline of the audit itself.¹⁶³ However, care should be taken to ensure that the process of implementing an RLA is compatible with existing legal deadlines for post-election audits. For example, one of the key takeaways from the 2018 Fairfax, Virginia, pilot RLA was that in order for RLAs to be implemented prior to the finalization of election outcomes, there would need to be several changes to Virginia law.¹⁶⁴ More specifically, the pilot RLA report identified that it may be necessary to extend the election calendar or introduce provisions that facilitate the creation of a ballot manifest before an audit.¹⁶⁵

Some jurisdictions may allow election results to be modified after results are initially certified. In these cases, it is important that the legislation requires the RLA to be completed ahead of the finalization of the results or while modification is still possible.¹⁶⁶ In Ohio, post-election audits are conducted after the certification of election results, but can amend the certified results if they are found to be incorrect within 81 days of the election.¹⁶⁷ However, this model could lead to other legal challenges. For example, in U.S. presidential elections, federal law dictates that disputes regarding the results must be concluded within five weeks of Election Day.¹⁶⁸

Additionally, as RLAs have the potential to reduce the need for recounts and election contest litigation, RLA provisions might also need to be harmonized with existing provisions for recounts and election dispute resolution.¹⁶⁹ Some jurisdictions have automatic recounts for contests with close margins. In these cases, it might be more efficient to lower the thresholds for contests subject to RLAs or replace automatic recounts with discretionary ones that can be requested after the RLA is completed.¹⁷⁰ In other jurisdictions, it may be worthwhile to introduce mandatory recounts for contests with small margins in lieu of RLAs, as the sampling required to conduct the RLA may approach a full hand count but be more difficult than conducting a full recount immediately after the election.¹⁷¹ It is imperative that election lawyers and judges be familiar with the role of RLAs and relevant procedures, and be involved in incorporating them into the legal framework, particularly in regard to how RLAs may or may not interact with established dispute resolution processes or remedies.

161 Ibid., Rule 25.2.3(c).

162 Ibid., Rule 25.2.3(e).

163 RCW 29A.60.185(1); See RCW 29A.60.190 (as modified by Session Law 5273) (“Ten days after a special election held in February or April, ten days after a presidential primary held pursuant to chapter 29A.56 RCW, fourteen days after a primary, or twenty-one days after a general election, the county canvassing board shall complete the canvass and certify the results.”).

164 Lindeman, M. (2018). City of Fairfax, VA Pilot Risk-limiting Audit. Verified Voting. p. 23

165 Ibid.

166 Eds. Bretschneider, Jennie et al., “Risk-Limiting Post-Election Audits: Why and How,” p. 17.

167 Ohio Revised Code § 3505.32 (<http://codes.ohio.gov/orc/3505.32>); §3505.331 (D)(3) (<https://codes.ohio.gov/orc/3505.331v1>).

168 Risk-Limiting Audits Working Group. (2012, Version 1.1). *Risk-Limiting Post-Election Audits: Why and How*. p. 24; IFES. (2020). *The U.S. Electoral College: A Whiteboard Video*. <https://www.youtube.com/watch?v=ONly4VhZMWo&feature=youtu.be>.

169 Risk-Limiting Audits Working Group. 2012 (Version 1.1). “Risk-Limiting Post-Election Audits: Why and How,” p. 24.

170 Ibid. pp. 37-38.

171 Ibid.

Correcting Inaccurate Reported Outcomes

As discussed, RLAs by definition continue until the risk limit is attained or a full hand count is completed.¹⁷² Therefore, it is important that legislation makes clear that RLAs can change the reported outcome of an election if it escalates to a full manual hand count. Otherwise, there is limited value or benefit in completing an RLA as opposed to another type of post-election audit, and it would likely contribute to eroding trust in the process if the RLA uncovers an incorrect result that is ultimately certified.

Colorado's, Rhode Island's and California's legislation each include provisions that directly state that if the RLA escalates to a full hand count, the results of the hand count replace the earlier reported results.¹⁷³ For example, Rhode Island's legislation states: "If a risk-limiting audit of a contest leads to a full manual tally of the ballots cast using the voting system, the vote counts according to that manual tally shall replace the vote counts reported ... for the purpose of determining the official contest results ..."¹⁷⁴ Additionally, as discussed above, RLAs take place after the certification of the election results in Ohio; however, regulations state that the certified results can be amended "[i]f the post-election audit results in change of vote totals reported in the official canvass."¹⁷⁵

On the other hand, Virginia law explicitly states that audits will have no effect on election results.¹⁷⁶ This may be due to the fact that RLAs in Virginia are not used to confirm the election results, but "to study the accuracy of ballot scanner machines."¹⁷⁷ In this case, Virginia's audit effectively functions as an internal check for the election authorities, rather than an RLA with the potential to instill voter confidence that the certified outcomes are accurate.

Ensuring Transparency and Public Accountability

While post-election audits, and RLAs in particular, can provide important information to election officials, they should also "inform the public and provide evidence as to whether reported election outcomes are correct."¹⁷⁸ To ensure that RLAs can build public confidence in election results, it is crucial that the legal and regulatory framework enable stakeholders to observe the process and verify the audit results.¹⁷⁹

To make an RLA observable, policymakers can require RLAs to be conducted in view of the public. This is a requirement in Rhode Island, California, Washington, Oregon and Colorado.¹⁸⁰ Some jurisdictions require the auditors to provide a certain amount of notice to the public prior to sampling or auditing of ballots. For example, Colorado requires seven calendar days¹⁸¹ and California requires five days.¹⁸² Rhode Island requires the same notice requirements as all open meetings, that is, at least 48 hours beforehand.¹⁸³ In addition to opening the audit to the public, Washington also includes provisions

172 Ibid., p. 17.

173 Colorado Rev. Stat. §1-7-515 (5)(b); Rhode Island Gen L § 17-19-37.4(d); California Elec. Code § 15366 (h).

174 Rhode Island Gen L § 17-19-37.4(d)

175 Ohio Election Office Manual, Ohio Secretary of State, 9-35.

176 Virginia Code § 24.2-671.1(B)

177 Virginia Code § 24.2-671.1(A).

178 Risk-Limiting Audits Working Group. (2012, Version 1.1). Risk-Limiting Post-Election Audits: Why and How. p. 24.

179 Ibid.

180 Colorado Secretary of State Election Rule 25.2.2(h); Rhode Island Gen L § 17-19-37.4 (c)(5); California Elec. Code § 15367 (b)(2)(F)-(G); RCW 29A.60.170(2); Oregon Senate Bill 944 § 2(4)(a).

181 Colorado Secretary of State Election Rule 25.2.2(h).

182 California Elec. Code § 15367 (c)-(d).

183 Rhode Island Gen L § 17-19-37.4 (c)(2) (citing Rhode Island Gen L § 42-46-6).

specifically to recruit political party observers and requires that they observe once they are appointed.¹⁸⁴ Colorado has incorporated public participation by, for example, requiring the secretary of state to “randomly select[s] members of the public who attend the meeting to take turns rolling the die,” among other provisions.¹⁸⁵

While public observation is important, an RLA must also be verifiable, meaning that members of the public have access to all information necessary to confirm the results of the audit. California’s legislation explicitly requires the secretary of state to ensure that “the audit process is observable and verifiable by the public, including disclosing the methods used to select samples and to calculate the risk, providing public opportunity to verify that the correct ballots were inspected during the audit, and providing public opportunity to observe the inspection of the voters’ marks on the ballots during the audit.”¹⁸⁶ In Colorado, the secretary of state must “publish the seed on the Audit Center [website] immediately after it is established,” and the legislation requires the use of a pseudorandom number generator using SHA-256.¹⁸⁷

Ensuring that the audit results are verifiable and transparent can be facilitated through the publication of a clear and thorough audit report. For example, Rhode Island law requires that the results of a post-election audit “be published on the website of the state board within 48 hours of being accepted by the state board.”¹⁸⁸ Additionally, if the RLA resulted in a manual tally, “the names and numbers of all precincts audited and a comparison of the vote tabulator results with the hand counts for each precinct shall be published with the audit results on the website.”¹⁸⁹

Requiring Security and Integrity Measures

It should be emphasized that an RLA will only uncover errors or fraud in the tabulation process and will not uncover or prevent manipulation of ballots prior to or on Election Day. While RLAs can increase public confidence in election results and provide evidence that the election results are correct, they are not designed to reveal loss, substitution, dilution or alteration of ballots.¹⁹⁰ While it is possible that they will uncover some of these issues, there is no assurance or guarantee that they will. Accordingly, RLAs should be introduced in tandem with additional security and integrity measures to support a secure audit trail, as described earlier in this paper. Some common security measures include ballot accounting, seals and locks to control access to the ballots, chain-of-custody records and video surveillance.¹⁹¹

RLA laws or regulations can explicitly require a compliance or procedural audit. Oregon¹⁹² and California¹⁹³ laws both reference security measures and delegate development of security procedures

184 RCW29A.60.170(1), 185(1)(a).

185 Colorado Secretary of State Election Rule 25.2.2(i).

186 California Elec. Code § 15367 (b)(2)(F)-(G).

187 Colorado Secretary of State Election Rule 25.2.2(h).

188 Rhode Island Gen L § 17-19-37.4 (f).

189 Ibid.

190 Risk-Limiting Audits Working Group. (2012, Version 1.1). Risk-Limiting Post-Election Audits: Why and How. pp. 20-22.

191 Ibid., p. 7.

192 Oregon Senate Bill 944 § 2(4)(c) (“A risk-limiting audit conducted under this section must ... Ensure that all ballots tabulated or examined during an audit are protected from loss, substitution, alteration or addition.”).

193 California Elec. Code § 15367 (b)(2)(C) (“The Secretary of State, in consultation with recognized statistical experts, election verification and integrity stakeholders, voting system manufacturers, and local elections officials, shall adopt regulations to implement and administer this article. The regulations shall ... Establish procedures to ensure the security of the ballots.”).

to the secretary of state's office or other election officials. Some examples of security provisions are included in Colorado's Election Rule 25. For instance, the rule requires a county audit board to "verify that the seals on the appropriate storage containers are those recorded on the applicable chain-of-custody logs" when collecting the sample.¹⁹⁴ Additionally, while the board conducts an RLA, it must "secure and maintain in sealed ballot containers all tabulated ballots in the batches and order they are scanned" in addition to "maintain[ing] and document[ing] uninterrupted chain-of-custody for each ballot storage container."¹⁹⁵ Security provisions, such as the use of security seals and chain-of-custody logs, should also be required for auditors.

Introducing Risk-Limiting Audits Through Pilots

Before establishing a legal requirement to implement an RLA, it is highly advisable to conduct multiple pilots, ideally with the support of experienced audit practitioners. In most U.S. states with laws requiring RLAs, pilots were conducted before the requirement went into effect. Pilots can be conducted after an election is certified and may not have a legal impact on the results. Additionally, pilot audits can target local elections, as they may be less politically challenging and easier to manage logistically due to the smaller geographic area and number of ballots. However, it is important that pilot reports consider challenges to scaling up to a national RLA, including the relative benefits of different RLA methods when conducted in larger contests. In some contexts, it may reduce political contention to conduct pilots in ruling party and opposition strongholds in parliamentary elections before being applied formally to tighter contests. Contests with large margins are often selected for pilot RLAs because they allow testing of the process with a relatively modest level of effort; in some contexts, such a choice may also help to allay concerns around undermining the confidence in certified outcomes before RLAs have the legal authority to correct results.

In addition to providing an opportunity to educate a range of electoral stakeholders about RLAs, these pilot audits should aim to inform election administrators and legislators how the seven elements discussed above – legal definition; selection of contests; setting the risk limit; time frame; correcting incorrect outcomes; transparency and public accountability; and security and integrity measures – should be incorporated into the country's legal and regulatory framework to help ensure the RLA is successful. For example, ahead of a legal deadline to begin conducting RLAs in 2020, and after extensive planning efforts following the 2017 passage of an RLA law, Rhode Island conducted a pilot RLA in three municipalities in early 2019.¹⁹⁶ The pilot gathered a group of professionals with expertise in election administration and security to test and compare all three methods of RLA.¹⁹⁷ The pilot process yielded advice for the Rhode Island Board of Elections, including recommendations to conduct ballot comparison RLAs, to centralize the audit process and to create and publish a schedule with audit milestones. In addition, the pilot report recommended that rulemaking processes be initiated for key policy choices, such as establishing ballot interpretation rules, setting risk limits, criteria for selecting contests for audit, adjusting the election calendar and harmonizing audits with recount processes.

194 Colorado Secretary of State Election Rule 25.2.3(a).

195 Colorado Secretary of State Election Rule 25.2.2(c).

196 Rhode Island RLA Working Group. (2019). *Pilot Implementation Study of Risk-Limiting Audit Methods in the State of Rhode Island*.

197 Ibid.

Quick Reference Guide: Risk-Limiting Audit Implementation in Global Contexts

Why should we consider a risk-limiting audit?

The significant pressures that accompany elections amplify the potential for real or perceived errors and manipulation and provide opportunities for actors to strategically undermine trust in the electoral process. Post-election audits offer one possible avenue for enhancing trust and confidence in election results. An RLA is a newer variant of traditional post-election tabulation audits, offering an efficient check on the accuracy of the vote tabulation process and confirmation of the final outcome of the audited contest, to a desired level of mathematical certainty. This approach can conserve limited time and resources.

The RLA practitioner community has created multiple resources to support implementation in the U.S. that have utility for global use. Some of these resources are highlighted in the Reading List at the conclusion of this paper. For detailed checklists and guidance on conducting an RLA, please refer to the Democracy Fund's [Risk-Limiting Audit Implementation Workbook](#) and [Knowing It's Right, Part 3: Planning and Conducting a Risk-Limiting Audit Pilot](#).

Is a risk-limiting audit possible in our context?

To determine whether an RLA is an appropriate post-election tabulation audit for your country context, consider whether the voting system in use can fulfill three fundamental requirements.

- A VVPR of the voter's intent when the ballot was cast, such as a paper ballot
- A trustworthy audit trail: To support public confidence in the electoral process and its results, complementary procedures and compliance checks are needed that ensure that the paper and electronic records that form the basis for the audit are fully secured for the audit, as is common in all election investigations. Such processes must also reflect the fundamental importance of secrecy of the ballot and ensure that ballots cannot be traced to specific voters.
- A ballot manifest: a document log that describes where and how ballots have been cast, which enables auditors to pull a random sample and locate specific ballots

What are the different methods of risk-limiting audits?

Once these prerequisites are in place, we can assess which RLA method will be most suitable for the context. It is important to consider at the outset how implementation decisions will be made; a range of electoral stakeholders should be involved in discussing and designing the RLA model. An inclusive approach from the beginning will increase domestic ownership of the process and help to socialize an otherwise unfamiliar audit approach more widely. An RLA pilot could test multiple RLA options to help determine the most efficient and effective choice.

| | | |
|--------------------------------|--|--|
| Ballot-Level Comparison | <p><i>Process:</i></p> <p>A random sample of ballots is manually interpreted, and each interpretation is checked against the machine interpretation of the same ballot.</p> <p><i>Requires:</i></p> <ul style="list-style-type: none"> • VVPRs • CVR • Ballot manifest | <p><i>Advantages:</i></p> <ul style="list-style-type: none"> • Generally requires the smallest sample size of the three methods • Identifies specific discrepancies between the voting system’s interpretation of a ballot and a manual interpretation • Supports opportunistic auditing of other contests on the audited ballots <p><i>Disadvantages:</i></p> <ul style="list-style-type: none"> • Requirements for CVR may exceed what is available in most jurisdictions and could require significant upfront costs |
| Batch-Level Comparison | <p><i>Process:</i></p> <p>A random sample of batches is selected, and the votes in each batch are counted manually. These counts are compared to the corresponding machine or precinct counts, batch by batch, to measure discrepancies. A “batch” may consist of all of the ballots cast in a precinct or on a particular voting machine.</p> <p><i>Requires:</i></p> <ul style="list-style-type: none"> • VVPRs • Ballot manifest • Results of initial batch counts | <p><i>Advantages:</i></p> <ul style="list-style-type: none"> • Requires little special preparation in jurisdictions that already store ballots by batches • Relatively easy to conduct in parallel in multiple locations • Can provide information about the accuracy of specific machines, procedures or polling places <p><i>Disadvantages:</i></p> <ul style="list-style-type: none"> • Better suited to larger contests • Often requires a higher number of ballots to be reviewed than the other RLA methods |
| Ballot Polling | <p><i>Process:</i></p> <p>Cast ballots are randomly sampled and interpreted to determine if there is strong statistical evidence that the initial vote count and tabulation is correct</p> <p><i>Requires:</i></p> <ul style="list-style-type: none"> • VVPRs • Result of initial tally • Ballot manifest | <p><i>Advantages:</i></p> <ul style="list-style-type: none"> • Requires the least from the voting system • Generally requires small sample size, as long as the margins are not close <p><i>Disadvantages:</i></p> <ul style="list-style-type: none"> • For close margins, the sample size expands substantially • Less predictable workload that can be affected substantially by an outlier sample • Provides no information on the cause of discrepancies |

How do we get started?

An advisory committee or group, including election administrators, lawyers, scholars and technical assistance providers, should review the legal and regulatory framework with an eye to what changes are needed to integrate RLAs into existing electoral law and procedure and eliminate any contradictions. The law and regulations should:

- Clearly define the purpose and parameters of the risk-limiting audit.
- Specify how contests are selected to be audited, including a random element.
- Select an appropriate risk limit by balancing benefits and resources needed. Smaller risk limits might have a stronger impact on public trust but may be costlier and more time-consuming. The risk limit may be established directly in the law or may be delegated to the EMB to determine based on clear and objective legal criteria.
- Ensure the timeframe for the RLA is compatible with legal deadlines for election counts and results certification and that the audit is appropriately harmonized with election dispute resolution processes.
- Provide for public accessibility and verifiability of the entire RLA process.
- Require security and integrity measures, including appropriate ballot accounting procedures.

Whenever possible, conduct multiple RLA pilots, ideally with the support of experienced audit practitioners. Pilot testing is a valuable training device for auditors and other participants and helps resolve questions about the process.

- Pilots can be conducted after an election is certified and may not have a legal impact on the results, but consideration should be given to selecting contests with large margins where the pilot is less likely to undermine confidence in the certified outcome.
- Pilots can focus on local elections as they may be less politically challenging and easier to manage logistically – although, it is important that pilot reports consider challenges to scaling up to a national RLA.

As with other election processes, any underprepared participant in the audit could compromise the integrity of the audit outcome and undermine trust in the election's results. Training programs should address:

- The mechanics of the audit process
- Observer and political party roles and responsibilities
- The jurisdiction's rules and guidelines on determining ballot validity and voter intent

Education is a crucial component of a successful audit process, and the need will increase for an unfamiliar audit approach or in contexts where credibility of electoral processes may be low or in question.

- Conduct a pilot RLA exercise (or, ideally, multiple pilots in individual constituencies) open for observation by all relevant stakeholders, followed by a lessons learned process and a detailed and accessible public report.

- Convene an advisory board to draft and implement a public communication plan.
- Establish standard definitions and terminology for communicating about RLAs and use this vocabulary correctly and consistently with stakeholders.
- Create simple informational materials in multiple formats and languages that highlight the major steps in the RLA and emphasize the objectives and outcomes of the audit.
- Conduct detailed usability tests with diverse participant groups and refine informational materials and campaigns based on the results.
- Post audit-related documents, event announcements and results where they can be accessed by the public.

Reading list

Guidelines and Good Practices

Morrell, J. 2019-2020. Democracy Fund.

[Knowing It's Right, Part 1: A Practical Guide to Risk-Limiting Audits.](#)

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McLaughlin, K. & Stark, P. B. 2011. [Workload Estimates for Risk-Limiting Audits of Large Contests.](#)

Pilot Reports and Case Studies

Kirk, J. 2021. Bartow County Board of Elections and Voter Registration (Georgia). [Risk-Limiting Audit Report, January 5, 2021 Runoff Election.](#)

Morrell, J. 2019. Democracy Fund. [Putting Election Integrity to the Test: A Case Study of New Jersey's First Pilot of Risk-Limiting Audits.](#)

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Lindeman, M., McBurnett, N., Ottoboni, K. & Stark, P. 2018. [Next Steps for the Colorado Risk-Limiting Audit \(CORLA\) Program.](#)

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Other Resources

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Goggin, S. N., Byrne, M. D., Gilbert, J. E., Rogers, G. & McClendon, J. 2008. [Comparing the Auditability of Optical Scan, Voter Verified Paper Audit Trail \(VVPAT\) and Video \(VVAT\) Ballot Systems](#). Proceedings of the 2008 USENIX/ACCURATE Electronic Voting Technology Workshop.



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