Auditing in non-CVR counties in Colorado: 2017 and beyond (3/13/2017)

From: Mark Lindeman and various election integrity/RLA advocates
To: Colorado Risk-Limiting Audit Representative Group

We have been invited to comment on specifics of implementing risk-limiting audits in "non-CVR counties": that is, counties that are unable to match individual ballots to their machine interpretations (Cast Vote Records) – either because the equipment does not produce CVRs or because the CVR that corresponds to a particular ballot cannot be identified quickly and reliably. These counties cannot perform ballot-level comparison audits, the approach to RLAs that generally requires examining the fewest ballots.

We believe that as counties replace their voting systems, they should ensure that new systems support ballot-level comparison audits. A less desirable alternative is to use ballot-polling audits or batch comparison audits, described below in (2). What should non-CVR counties do in 2017?

A few points at the outset: The best answer may vary from county to county, depending on the size of the county and its current procedures for tracking and organizing ballots. We do think it is important that no county be exempted from auditing. See the specific suggestions on page 3.

A definitional reminder: By "outcome," we always mean the *decision* of the election – the winner(s), not the exact vote totals.

Briefly enumerating the possible approaches
Each of these approaches has been used successfully, and can work with multiple contests.

1. Modified ("transitive") ballot-level comparison audits:
   - Rescan the ballots on commercial scanners; process the scans using software that can produce individual CVRs linked to the corresponding physical ballots.
   - Tabulate those CVRs. If the outcome is the same as the outcome of the official voting system, perform a ballot-level comparison RLA using the new CVRs.

2. Batch comparison audits:
   - During the initial tally, divide the ballots into the smallest feasible physical batches whose vote subtotals can be tallied (or computed).
   - Export subtotals for every batch from the voting system. Verify that the subtotals sum to give the results for the contest.
   - Audit by randomly selecting batches, comparing the hand-count subtotal for each selected batch to machine-reported subtotals.

3. Ballot-polling audits:
   - Randomly select and interpret some ballots – without knowledge of how the voting system interpreted those ballots
   - A ballot-polling RLA continues until it finds strong evidence for the originally reported outcome, or until a full hand count is expedient.

4. Full hand counts:
   - ✓ Columbia County, NY (44,000 registered voters) *routinely* hand-counts most contests during the audit.

Below, we briefly assess advantages (✓) and disadvantages (—) of each approach.

Assessing the approaches

1. Modified (transitive) ballot-level comparison audits after rescanning all ballots
   - ✓ Ballot-level comparisons are statistically most efficient: error rates are easier to measure than vote shares.
   - ✓ Both commercial vendors and non-profits have expressed interest in supporting such audits; open-source software is available (but will require further development), and "commercial off the shelf" scanners and computers can be used.
   - ✓ After rescanning the ballots, this approach is the same as the approach being used for CVR counties
   - — Most counties don't have these resources in hand.
   - — Rescanning all ballots takes time and imposes costs, and creates ballot management concerns.

2. Batch comparison audits
   - ✓ Can produce direct evidence of low error rates ("we hand-counted X batches, and the counts all matched within a tiny percentage" is easy to grasp).
   - ✓ Some counties already have ways to do this with existing voting systems and with reasonable efficiency.
   - — Even where feasible, may require considerable extra work during the initial tally in order to obtain subtotals by batch.
   - — Far less efficient than ballot-level comparisons: e.g., counting five batches of 200 ballots each is much less informative than comparing 50 random ballots to CVRs.
   - — Small discrepancies can be hard to explain and learn from.

3. Ballot-polling audits
   - ✓ Require almost no equipment or special ballot handling.
   - ✓ Full hand counts are always available as a fallback (also true for (1) and (2)).
   - ✓ Use the same basic workflow (random selection, ballot retrieval, ballot interpretation) needed for ballot-level comparison audits.
   - ✓ Provide a convenient uniform audit solution in multi-county contests.
   - ✓ Can be implemented in a risk-measuring form.
   - — In contests with small (but correct) margins, ballot-polling RLAs require substantially larger samples than ballot-level comparison RLAs. For instance, for 6% margin and 5% risk limit with no ballots originally miscounted:
     - Ballot-level comparison RLA requires auditing 104 ballots
     - The median ballot-polling RLA requires auditing over 1,000 ballots; about 10% of these audits would require auditing over 3,000 ballots (although more efficient methods are possible in small jurisdictions)
     - The workload disadvantage widens quickly for smaller margins
   - — Provide no evidence that ballots or batches were counted correctly.

4. Full hand counts
   - ✓ Conceptually simple and predictable.
   - ✓ Can draw upon extensive collective experience and knowledge of best practices in jurisdictions around the country.
   - — Require the same amount of work no matter how large the margin.
   - — Small discrepancies are hard to confirm, explain or learn from (as in (2)).

Conclusions

1. All non-CVR counties should use one of these methods in 2017. In particular, ballot-polling audits require nothing more than an accurate ballot manifest, which every county should be required to create. (The "legacy" audit requirements for central count systems yield essentially uninterpretable results.) We also believe that to implement efficient audits in 2018 and beyond, all counties should move toward systems that produce CVRs that can be matched with ballots, *unless* they are willing to accept the limitations and burdens of the alternatives to ballot-level comparison audits.

2. Some of us think that in this transitional year, it is acceptable for some counties to obtain partial waivers from an RLA, instead using pilot protocols that set the stage for RLAs next year. Others among us think there is no reason every county cannot at least use ballot-polling RLAs in November. The issue arises in part because, as shown above, ballot-polling RLAs can require retrieving a rather large number of ballots when the margin is small. Because the expected workload does not depend on the size of the contest – only on the percentage margin – ballot-polling audits may still be the most efficient alternative for large, multi-jurisdictional contests

that include counties without auditable CVRs. (Methods are currently under development that allow RLAs to combine results for ballot-level comparisons in the CVR counties and ballot-polling in the non-CVR counties.)

The audit work required this November should be equitable (not necessarily equal) across counties, and should help all counties prepare for RLAs in 2018. We therefore recommend that counties who seek RLA waivers in 2017 be required to state how they intend to be capable to implement RLAs in 2018, and how their proposed participation in the 2017 audit supports that plan. It may be possible to agree upon specific waivers as part of the rule.

3. Here is a sketch of possible alternatives for 2017:

a) Hand-count counties can do an independent hand count of lowest margin contests (or, if they prefer, a ballot-polling audit). A full hand count is, in effect, an RLA with 0% risk limit.

b) In many ways, a transitive audit would be a good solution for 2017. We encourage exploring the possibility that some counties can conduct transitive audits in cooperation with non-governmental partners. If the logistics of rescanning can be managed, this approach implements an RLA and offers ideal preparation for future ballot-level comparison audits.

c) Some counties may wish to use batch comparison audits this year. We caution, again, that the evidence provided by these audits depends largely on the *number of batches audited*, not the total number of ballots (unless this is a large fraction of ballots cast). Therefore, this approach may be very demanding for RLAs in competitive contests within a county – and it does not seem to provide a bridge to efficient RLAs in 2018 and beyond. Some form of batch comparison audit might nonetheless be appropriate as a 2017 transitional protocol, for counties that can implement batches small enough to make this approach viable for an RLA.

d) Ballot-polling audits are the most broadly applicable approach: every jurisdiction with a paper trail and a reliable ballot manifest can do them. We see several possible implementations in 2017, and have no consensus about what should be required under a ballot-polling approach. One scenario is for non-CVR counties to treat ballot-polling as a pilot of ballot-level comparison audits, by retrieving and interpreting as many ballots as would be required in a ballot-level comparison RLA (despite the lack of CVRs to compare them to). A second scenario is to implement risk-*measuring* audits of county-wide and intra-county contests, with a fixed minimum requirement of how many ballots to sample (perhaps expressed as a percentage of ballots cast). This approach could in fact achieve low measured risk in contests that are not very close, and jurisdictions could expand the sample if desired. Both those scenarios would require waivers from the RLA requirement. A third scenario is simply to require ballot-polling RLAs (or RLAs using other methods) of the same contests, at the same risk limits, as CVR counties.