Synthesis

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ImpossibleMA: Bounded Synthesis of Cochrane Meta-Analyses Declared Unpoolable

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Correspondence: mahmood.ahmad2@nhs.net · Code: https://github.com/mahmood726-cyber/impossible-ma · Dashboard: https://mahmood726-cyber.github.io/impossible-ma/ · License: CC BY 4.0

Primary estimand: Possibility Envelope on the log-effect scale.

Summary

Cochrane meta-analyses whose prediction intervals cross the null are conventionally deemed unpoolable, leaving guideline panels with narrative synthesis.

Screening 6,229 MetaAudit meta-analyses (68,519 audit rows) for any CRITICAL flag, only prediction_gap fires CRITICAL, so the contribution is the envelope construction, not multi-module triage.

The Possibility Envelope—(lower, upper, point|None, min_info, assumptions)—is computed by an adversarial engine enumerating inclusion-rule combinations and reporting REML+HKSJ extremes.

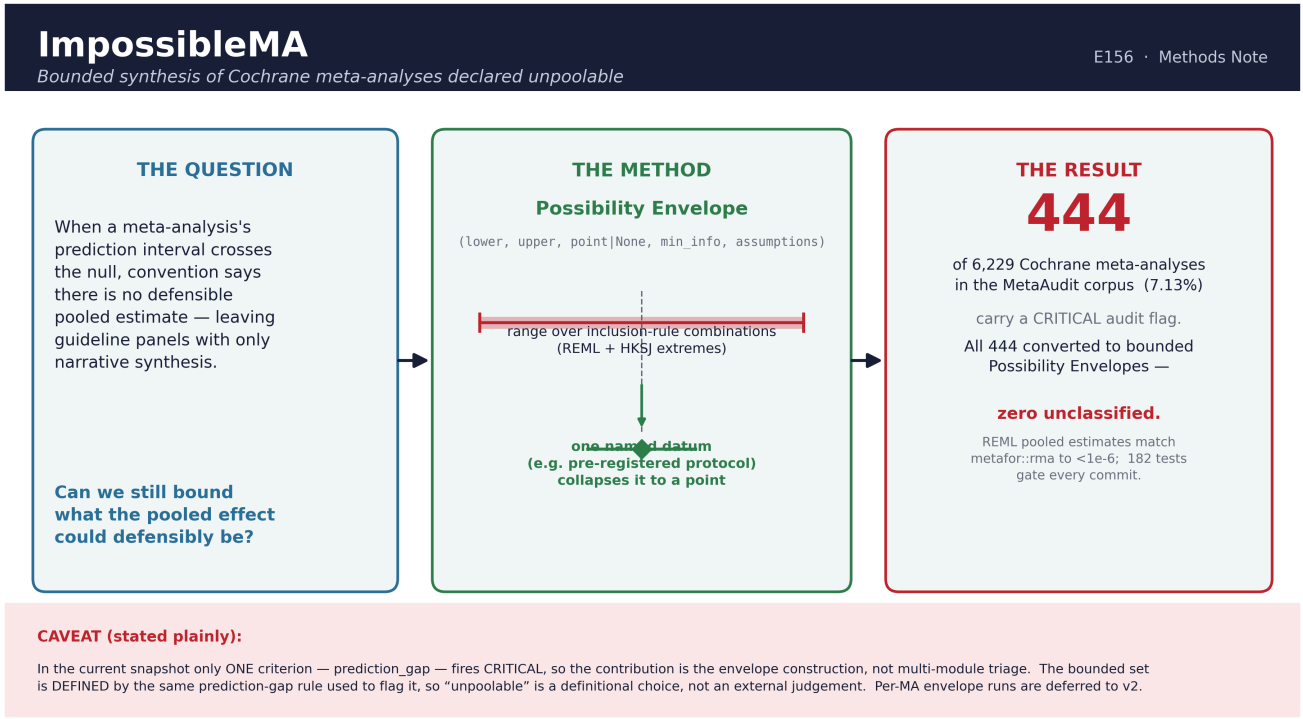
444 of 6,229 (7.13%) carried a CRITICAL flag, all converted to bounded adversarial envelopes, zero unclassified.

REML matches metafor::rma below 1e-6 (our house ideal; τ≈1e-7 except the degenerate $\tau^2=0$ boundary); monotonicity and full-data containment property-tested across 23 inputs, 182 tests gating every commit.

The envelope bounds defensible pooled effects under stated rules, and one named datum—a pre-registered protocol—collapses it to a point; since the bounded set is defined by the same prediction_gap criterion, “unpoolable” is definitional, not external.

v1 covers adversarial, k=1, and missing-SE cases; figure-extraction, incommensurable outcomes, and per-MA runs are deferred.

Visual abstract & figures



Visual abstract. Visual abstract: question, method (an adversarial envelope over inclusion rules reporting REML+HKSJ extremes), headline result (444 of 6,229; 7.13%), and the two stated caveats (a single criterion fires CRITICAL; the bounded set is defined by the same criterion that flags it).

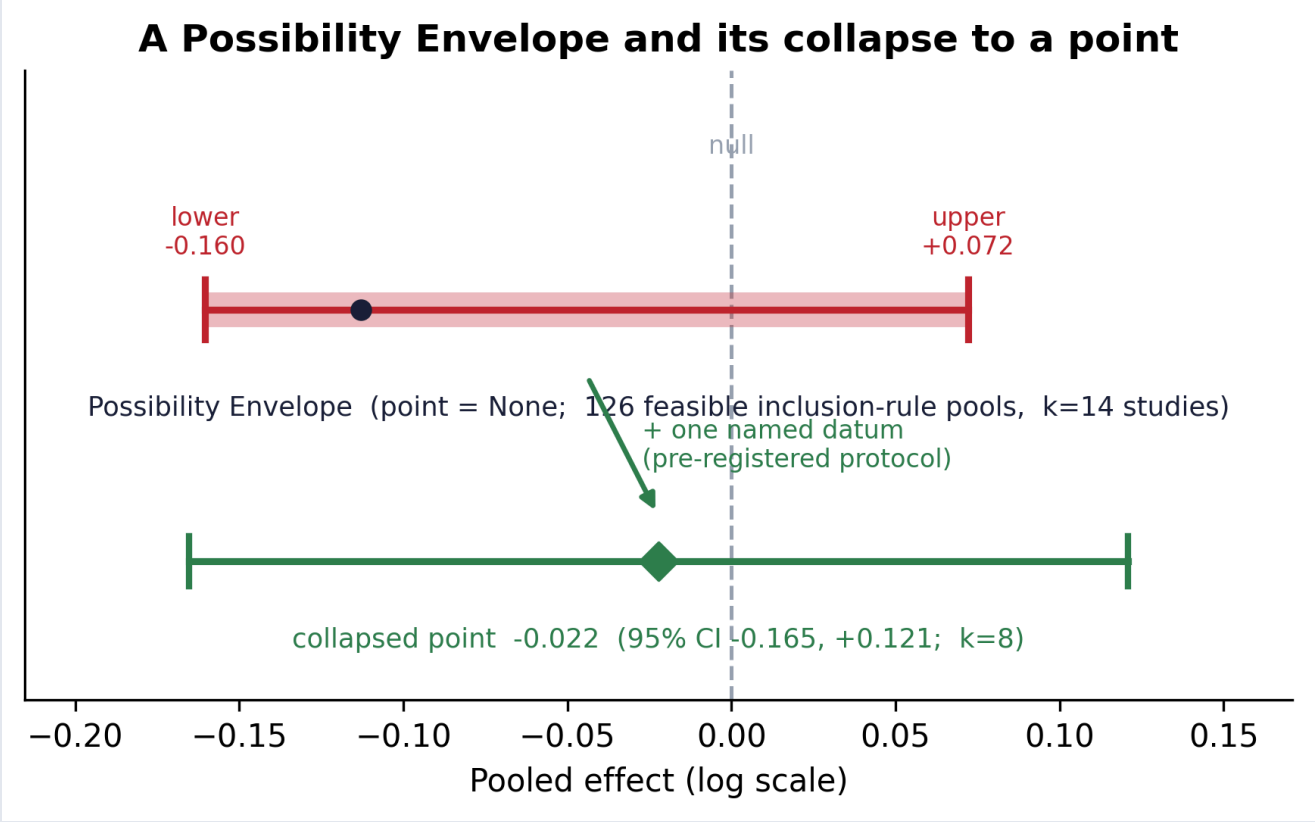


Fig1. A Possibility Envelope and its collapse to a point, computed live by the adversarial engine on the built-in covid_early demonstration dataset (k=14 studies, 126 feasible inclusion-rule pools). The red bar is the envelope of REML+HKSJ pooled estimates (lower −0.160, upper +0.072; point = None) and crosses the null, so no single defensible pooled effect exists under the rule grid. Supplying one named datum — a pre-registered inclusion protocol — selects a single rule and collapses the envelope to a point (−0.022; 95% CI −0.165, +0.121; k=8).

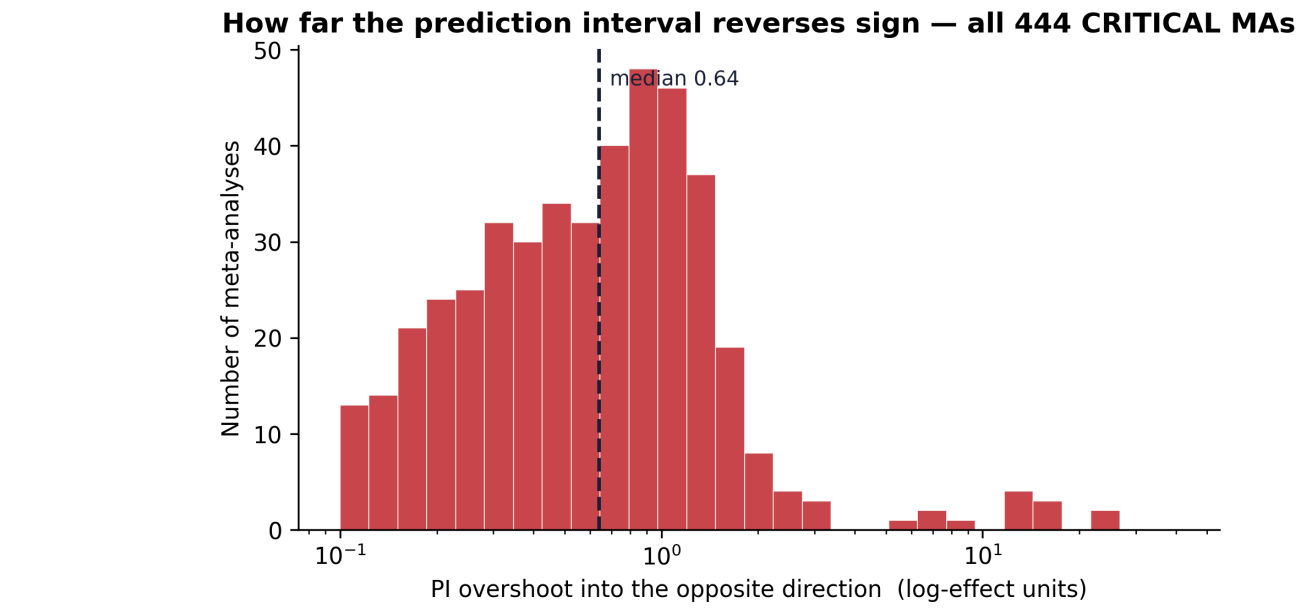


Fig2. Distribution, across all 444 CRITICAL meta-analyses, of how far the prediction interval extends into the opposite direction (log-effect units; log x-axis). This overshoot — parsed directly from the prediction_gap detail strings — is the quantity that flags each meta-analysis as unpoolable (median 0.64; IQR 0.32–1.07; range 0.10–40.5). Full per-MA envelope widths require per-study data and are deferred to v2.

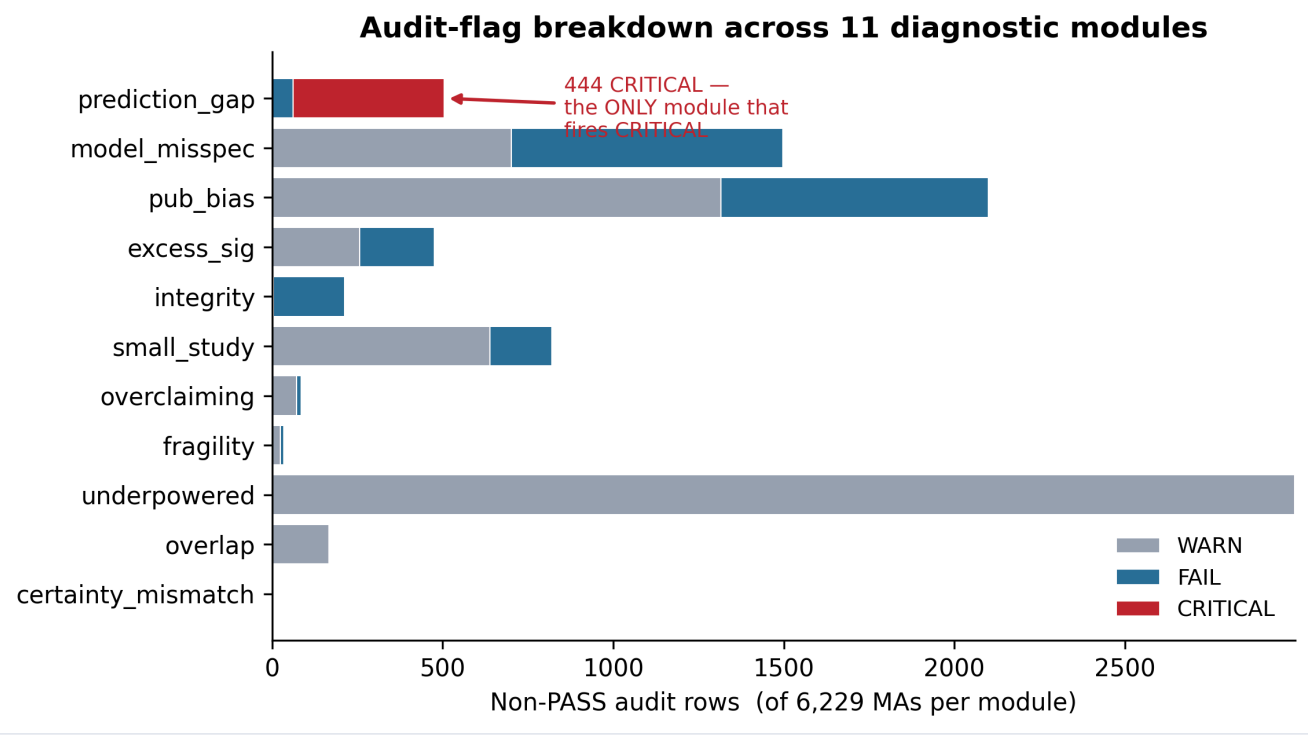


Fig3. Audit-flag breakdown across the 11 MetaAudit diagnostic modules over the 6,229 meta-analyses. Although the corpus runs 11 modules, only prediction_gap ever fires CRITICAL (444 flags); every other module tops out at WARN or FAIL. This is why the contribution is the envelope construction rather than multi-module triage.

Verified quantities (Table 1)

Quantity	Verified value
Corpus size	6,229 Cochrane meta-analyses; 68,519 audit rows
Diagnostic modules run	11 (only prediction_gap fires CRITICAL)
CRITICAL meta-analyses	444 (7.127949911703% → 7.13%)
Converted to bounded envelopes	444 / 444 (zero unclassified)
REML vs metafor::rma (heterogeneous case)	$\Delta\mu = 2.8\times10^{-10}$; $\Delta se = 1.7\times10^{-9}$; $\Delta\tau = 5.0\times10^{-9}$ (all < 1e-6 house ideal)
REML τ at degenerate $\tau^2=0$ boundary	Python floors at $\approx 4.5\times10^{-5}$ (log-scale optimizer bound); metafor returns exactly 0
Property tests	23 hypothesis inputs (15 full-data containment + 8 monotonicity)
Automated test gate	182 tests (157 engine + 25 Selenium); 156 pass / 1 skip on this machine

References

1. Schmidli H, Gsteiger S, Roychoudhury S, O'Hagan A, Spiegelhalter D, Neuenschwander B. Robust meta-analytic-predictive priors in clinical trials with historical control information. Biometrics. 2014;70(4):1023-1032. doi:10.1111/biom.12242
2. Viechtbauer W. Conducting meta-analyses in R with the metafor package. J Stat Softw. 2010;36(3):1-48. doi:10.18637/jss.v036.i03

Methods Note in the E156 micro-paper format (single paragraph, 7 sentences, ≤156 words). All quantitative claims were re-computed against the source corpus (F:/MetaAudit/results/audit_results.csv) and independently cross-verified; see VERIFICATION_REPORT.md. DOI pending at routing.