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Auditing the public clinical-trials record: a registry-integrity atlas of registration, reporting and completion gaps

A registry-integrity audit of the ClinicalTrials.gov public record across twenty-four analyses in eight thematic families.

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ABSTRACT

Background. Prospective registration and results reporting underpin trustworthy evidence synthesis, yet registration quality, results-reporting compliance and completion status are themselves rarely audited at scale, and the gaps they leave are inherited silently by downstream meta-analyses.

Methods. We audited a full-registry snapshot of ClinicalTrials.gov obtained from the ClinicalTrials.gov API v2 on 29 March 2026 (578,109 records; 441,191 interventional; 290,524 closed interventional), with a primary cohort of 249,507 eligible older closed interventional studies whose primary completion was at least two years before the snapshot. Across twenty-four pre-specified analyses in eight thematic families we computed two-year no-results rates, ghost-protocol rates (missing results plus missing publication links), hiddenness scores, full visibility, black-box stock and study-mix-adjusted excess, broken down by registration fields, trial architecture, reporting era, intervention type, enrollment, stopped-trial status, geography, outcome density, design purpose, completion delay, site footprint, sponsor class, disease family and named sponsor.

Results. Among closed interventional studies with primary completion at least two years earlier, 72.7 percent had no posted results, and recent eligible cohorts (2021–2024, 77.0 percent) were no cleaner than the FDAAA 801 era (2008–2016, 67.1 percent), with full visibility at 10.8 percent. Structural fields were strong opacity signals: missing actual enrollment 100.0 percent, one-arm studies 72.8 percent, blank primary purpose 86.4 percent and same-year submission-to-completion 85.7 percent. Opacity concentrated by geography and sponsor — single-site studies 79.5 percent versus 31.7 percent for studies with 20 or more sites; any-U.S. 52.1 percent versus 88.7 percent for no-U.S.; Egypt 95.8 percent among large named countries — and by disease family (cardiovascular 75.0 percent, metabolic 76.2 percent, oncology 67.0 percent). Study-mix-adjusted watchlists ranked France (2,187 excess no-results studies), oncology (543) and Assistance Publique – Hôpitaux de Paris (265) highest.

Conclusions. Audited end to end, the public clinical-trials record carries systematic, measurable and structurally patterned gaps that reviewers should screen for before pooling.

KEY WORDS clinical trial registries; ClinicalTrials.gov; results reporting; reporting bias; research transparency; meta-research; evidence synthesis

> Among eligible older closed interventional studies, 72.7 percent had no posted results — and the most recent cohorts were no cleaner.
>
> ClinicalTrials.gov API v2 · 249,507 studies · 29 March 2026 snapshot

Introduction

Prospective trial registration and results reporting are foundations of trustworthy evidence synthesis: a complete public record lets reviewers find every relevant study, detect selective reporting and weigh what is missing. Yet registration quality, results-reporting compliance and completion status are themselves rarely audited at scale, and the gaps they leave are inherited silently by every downstream meta-analysis.

We asked a single question across the entire public record: does ClinicalTrials.gov capture the studies it is meant to track, and where does it break down? To answer it we ran twenty-four pre-specified analyses on one registry snapshot, grouped into eight thematic families spanning registration fields, trial architecture, reporting era, intervention type, enrollment, stopped-trial disclosure, geography, outcome density, design purpose, completion timing, site footprint, sponsor class, disease family and named-sponsor accountability.

Methods

Data source and cohort. We analysed a full-registry snapshot of ClinicalTrials.gov obtained from the ClinicalTrials.gov API v2 (https://clinicaltrials.gov/api/v2/studies) on 29 March 2026, comprising 578,109 registry records, of which 441,191 were interventional studies and 290,524 were closed interventional studies. The primary analytic cohort was the 249,507 eligible older closed interventional studies — closed interventional records whose primary completion date fell at least two years before the snapshot, so that every included study had had at least two years in which to post results.

Metrics. For each grouping we computed the two-year no-results rate (the share of eligible studies with no results posted); the ghost-protocol rate (missing results together with no linked publication); full visibility (both results and a publication link present); a composite hiddenness score; black-box stock (records missing both results and descriptive text); and, for the watchlist analyses, a study-mix-adjusted excess (observed minus expected no-results or ghost stock under a model that holds the registry-wide study mix constant) alongside a strict U.S.-nexus core. These flags are derived from registry status, dates, counts and linkage fields; they index registry-visible omission rather than adjudicated legal compliance.

Analyses. Twenty-four pre-specified analyses were organised into eight thematic families: registration fields, trial architecture and reporting-rule era; intervention type, enrollment size and stopped-trial disclosure; geography, country and outcome density; design purpose, completion delay and country–condition interactions; site footprint, sponsor class and US-versus-global geography; a cross-registry hiddenness atlas covering the overall, industry and completion-cohort views; disease-family hiddenness in cardiovascular, metabolic and oncology portfolios; and country, condition and sponsor excess watchlists. Disease families were keyword-derived registry groupings; country involvement was exploded at the study–country level from the recorded locations module; and sponsor classes and named sponsors were taken from registry lead-sponsor fields. Each analysis is fully reproducible from its public code-and-data repository (see Data and code availability).

Results

We report the twenty-four analyses under their eight thematic families; every figure below is a registry-visible rate or count computed on the cohort described in Methods.

Registration fields, trial architecture and reporting-rule era

Actual-field discipline. We examined the 249,507 eligible older closed interventional studies, tracking three closed-study actual-field indicators and comparing two-year no-results rates, ghost-protocol rates and status-specific missing-actual patterns across primary-completion, completion and enrollment discipline. Missing actual enrollment corresponded to a 100.0 percent no-results rate and a 62.8 percent ghost-protocol rate; missing actual primary completion reached 100.0 percent no results; and missing actual completion reached 95.3 percent, with suspended studies the worst on actual-field discipline. Closed-study actual-field discipline therefore functions as a direct structural warning sign for opacity rather than a minor metadata defect: the separation is visible across all three fields and links directly to the stopped-study audit within older registry cohorts. These actual-field flags are derived from registry status and date/count types; they are not external audits of what sponsors truly knew, or when.

Trial-architecture gap. Grouping the same snapshot by arm-group and intervention counts, we compared two-year no-results rates, ghost-protocol rates, hiddenness scores and phase-specific contrasts across simple and complex trial architectures. One-arm studies showed a 72.8 percent no-results rate, a 48.5 percent ghost-protocol rate and a hiddenness score of 3.44, whereas studies with 10 or more arms fell to 55.3 percent no results; one-intervention studies remained quieter than trials with larger intervention counts. Simpler-looking architectures are therefore not more transparent — they often sit within much quieter registry segments — and that pattern holds in both early-phase work and later confirmatory programmes with broader designs. Arm and intervention counts are registry-structure fields and may not capture protocol nuance, adaptive features or downstream analytic complexity.

Reporting-rule era. Finally, we grouped studies into four completion eras anchored to reporting-rule landmarks, estimating two-year no-results rates, ghost-protocol rates and the share with both results and publication visible. The FDAAA 801 era (2008–2016) showed a 67.1 percent no-results rate; the recent eligible era (2021–2024) rose to 77.0 percent. Ghost protocols likewise increased from 39.6 percent in the FDAAA 801 era to 46.7 percent in the recent eligible era, and full visibility fell to 10.8 percent. Later eligible cohorts do not look cleaner on these registry-visible measures, even though each included study had at least two years in which to report. These policy-era comparisons are descriptive; they do not adjudicate applicable-clinical-trial status or legal compliance within this registry frame. (Figure 1)

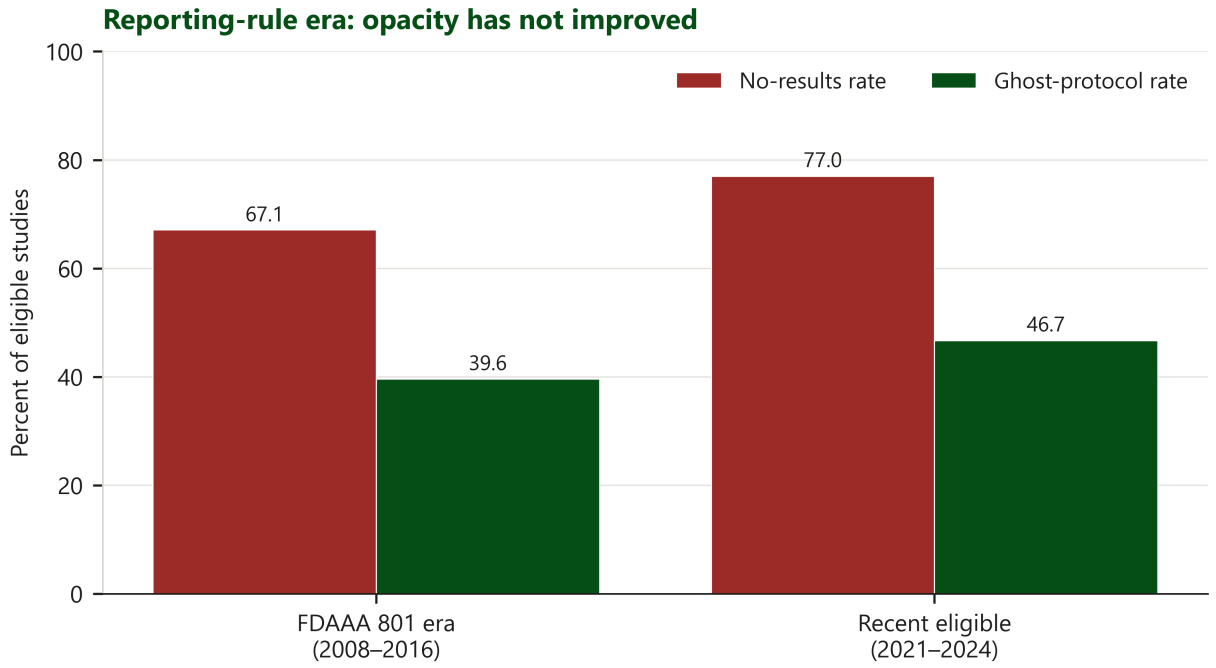

Figure 1. Reporting-rule era. Two-year no-results and ghost-protocol rates for the FDAAA 801 era (2008–2016) versus the recent eligible era (2021–2024); registry-visible opacity has not improved.

Intervention type, enrollment size and stopped-trial disclosure

Intervention-type gap. Which intervention types are quiet on ClinicalTrials.gov when older closed interventional studies are grouped by declared intervention family? Merging raw intervention-type labels, we compared two-year no-results rates, ghost-protocol rates, full visibility and single-versus-multi-type contrasts across the drug, device, behavioral, procedure, biological, dietary-supplement and other intervention families. Drug studies were the largest family, at 118,202 studies, with a 62.6 percent no-results rate. Dietary-supplement studies reached 90.6 percent no results, procedure studies 85.3 percent and biological studies 58.5 percent; multi-type studies outperformed single-type studies. The declared intervention family therefore behaves like a strong visibility classifier rather than a cosmetic label, and the contrast persists even when the large drug stock dominates the overall denominator. Studies often carry multiple intervention types, and the labels are sponsor-entered registry categories rather than audited therapeutic taxonomies.

Enrollment-size gap. Binning the snapshot by recorded enrollment, we compared two-year no-results rates, ghost-protocol rates, full visibility and sponsor-class contrasts across enrollment buckets from 1–50 through 5,001+ participants. Studies enrolling 1 to 50 participants showed a 73.2 percent no-results rate and a 47.6 percent ghost-protocol rate, whereas studies enrolling 1,001 to 5,000 participants fell to 62.4 percent no results and 18.7 percent ghost protocols; large OTHER-sponsored studies nonetheless remained highly obscured. Trial scale matters, but size alone does not erase sponsor-driven reporting debt within the public registry surface, and the pattern persists across tiny studies and large non-industry backlogs alike. Enrollment is registry-recorded and can be missing, estimated or misclassified, so these buckets describe visible scale rather than adjudicated participant counts.

Stopped-trial disclosure gap. Isolating completed, terminated, withdrawn and suspended records, we compared two-year no-results rates, ghost-protocol rates, visible shares and reason-missing contrasts across final statuses and stopped-study subgroups. Withdrawn studies reached a 100.0 percent no-results rate and an 81.9 percent ghost-protocol rate; suspended studies reached 99.3 percent no results and terminated studies 58.3 percent. Stopped studies with missing termination reasons rose to 82.1 percent no results. Stopping a trial does not merely change its status; it sharply deepens the risk that the public

record stays silent and structurally thin, especially when reason fields are already absent and final statuses are not 'completed'. Final-status labels and missing reason fields are registry entries; they do not adjudicate operational history or legal reporting obligations.

Geography, country and outcome density

Disease geography gap. Does geography reshape the hiddenness of major disease families once older ClinicalTrials.gov studies are grouped into U.S.-only, mixed, non-U.S. and no-country buckets? Linking geography buckets to the oncology, cardiovascular and metabolic families, we compared two-year no-results rates, ghost-protocol rates, visible shares and hiddenness scores. U.S.-plus-non-U.S. studies were the cleanest geography bucket in every disease family: 29.9 percent no results in cardiovascular, 29.4 percent in metabolic and 39.4 percent in oncology. Non-U.S. studies were worse — 89.9 percent no results in cardiovascular, 90.3 percent in metabolic and 86.8 percent in oncology. The data story depends on geography structure: the same clinical area can move from moderately visible to deeply hidden depending on where its studies are located. (Figure 2)

Country reporting map. Merging named country lists from the raw locations module, we exploded country involvement at the study–country level and compared two-year no-results rates, ghost-protocol rates and visible shares across countries with at least 800 eligible older studies. The United States appeared in the largest stock, at 104,882 eligible older studies, with a 52.1 percent no-results rate. Egypt was the worst large named country, at 95.8 percent no results; China reached 81.7 percent, while Poland fell to 33.5 percent and Australia to 43.4 percent. Named-country involvement revealed large geographic transparency divides that simple country-count buckets conceal. (Figure 3)

Outcome-density gap. Bucketing primary outcomes, secondary outcomes and primary-outcome description fields, we compared two-year no-results rates, ghost-protocol rates, full visibility and description contrasts across sparse and dense outcome structures. Studies with zero recorded primary outcomes showed a 100.0 percent no-results rate and a 65.1 percent ghost-protocol rate, whereas studies with ten or more secondary outcomes fell to 56.7 percent no results; studies missing primary-outcome descriptions still reached 94.4 percent no results. Outcome density is likely a proxy for public-record seriousness — sparser protocols are far more likely to remain hidden — and this gradient survives across counts, text fields and both primary and secondary outcome layers. Geography buckets use recorded locations rather than verified recruitment shares, sponsor domicile or disease-burden denominators, and outcome counts capture declared registry structure rather than scientific importance.

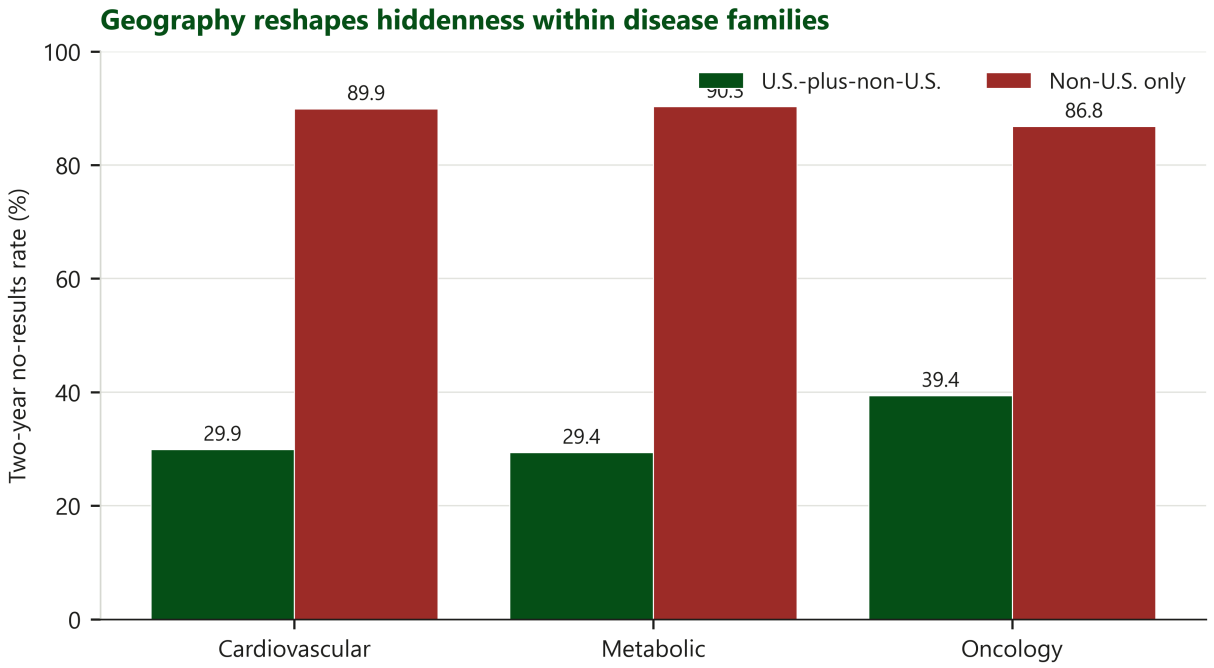

Figure 2. Geography within disease families. Two-year no-results rate for U.S.-plus-non-U.S. versus non-U.S.-only studies across the cardiovascular, metabolic and oncology families.

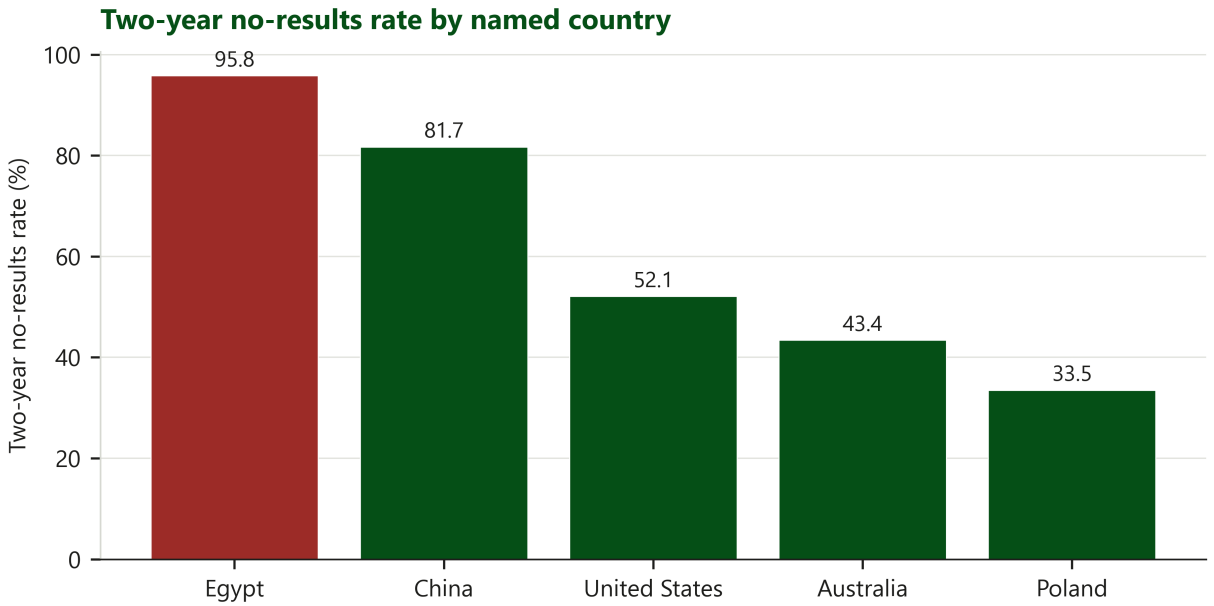

Figure 3. Named-country reporting map. Two-year no-results rate for selected named countries with at least 800 eligible older studies.

Design purpose, completion delay and country–condition interactions

Design-purpose hiddenness. Comparing sponsor-entered purpose and allocation fields, we estimated two-year no-results rates, ghost-protocol rates, full visibility and allocation contrasts across the treatment, prevention, diagnostic, supportive-care and unlabelled purpose groups. Treatment trials showed a 68.3 percent no-results rate and a 40.5 percent ghost-protocol rate, whereas trials with no recorded primary purpose rose to 86.4 percent no results and 59.2 percent ghost protocols; device-feasibility studies remained highly obscured. Design intent matters, and blank or underspecified purpose fields mark especially quiet registry segments — unlabelled intent is a durable warning sign for weak public documentation across sponsors and phases. Primary-purpose and allocation fields are sponsor-entered labels rather than externally audited design adjudications.

Completion-delay debt. Calculating submission-to-completion delay buckets, we compared two-year no-results rates, ghost-protocol rates, full visibility and purpose-specific contrasts across registration-to-completion intervals. Studies completed in the same calendar year they were first submitted showed an 85.7 percent no-results rate and a 54.1 percent ghost-protocol rate, whereas studies with a 6-to-10-year delay fell to 57.6 percent no results and 28.8 percent ghost protocols, and long-lag treatment studies looked substantially cleaner. Fast-cycle studies appear most hidden, suggesting that short operational timelines do not translate into faster public reporting; the contrast is visible across treatment studies and other major purpose groups. The submission-to-completion lag is a registry proxy for operational duration and may reflect backfilled dates, protocol amendments or a changing trial mix, so the analysis remains registry-structural rather than legal.

Country–condition hiddenness. Exploding named-country involvement within selected condition families, we compared two-year no-results rates, ghost-protocol rates and visible shares for oncology, cardiovascular and metabolic studies across country–condition cells with at least 400 studies. Oncology studies involving China alone reached 79.0 percent no results, versus 52.6 percent for oncology studies involving the United States. Cardiovascular studies involving Egypt reached 95.9 percent no results — the highest of any country — while metabolic studies involving China reached 78.9 percent and those involving Denmark 79.6 percent. Disease and geography interact rather than add independently: the same condition family looks materially different once specific country footprints are named. These cells reflect recorded study locations rather than country-specific enrollment shares, sponsor domicile or national reporting mandates.

Site footprint, sponsor class and US-versus-global geography

Geography-scale visibility. Are larger multi-site and multinational trials more visible on ClinicalTrials.gov than single-site studies once older closed interventional records are isolated? Grouping by site and country footprint, we compared two-year no-results rates, ghost-protocol rates, full visibility and phase-specific contrasts. Single-site studies showed a 79.5 percent no-results rate, whereas studies with 20 or more sites fell to 31.7 percent. Among phase III trials, single-site studies reached 76.3 percent no results while 20-or-more-site trials fell to 25.7 percent. Geography footprint behaves like a strong visibility gradient inside the registry, and this gap survives even within the late-phase trials that should be easiest to find. (Figure 4)

U.S. versus ex-U.S. sponsor classes. Grouping studies by U.S. presence using recorded country locations, we compared two-year no-results rates, ghost-protocol rates, visible shares and sponsor-class contrasts across any-U.S., no-U.S. and no-country portfolios. Any-U.S. studies showed a 52.1 percent no-results rate, versus 88.7 percent for no-U.S. studies and 80.9 percent for studies with no named country. Within no-U.S. studies, OTHER reached 94.9 percent no results and industry 70.9 percent, whereas any-U.S. industry fell to 45.5 percent and any-U.S. NIH to 52.3 percent. U.S. presence behaves like a di-

vider across sponsor classes: the ex-U.S. backlog is much quieter than the any-U.S. registry surface.

U.S. versus global gap. Assigning each study to a geography bucket using recorded country locations, we compared two-year no-results rates, ghost-protocol rates, visible shares and sponsor-class contrasts across U.S.-only, U.S.-plus-non-U.S., non-U.S. and missing-country records. U.S.-plus-non-U.S. studies formed the cleanest bucket, at 30.2 percent no results, versus 55.8 percent for U.S.-only studies and 88.7 percent for studies with no U.S. location. No-country records remained fairly obscured, at 80.9 percent no results and 53.6 percent ghost protocols, while mixed U.S.–global studies reached 46.3 percent full visibility. Geography bucket is therefore a visibility classifier: cross-border participation looks associated with cleaner registry surfaces than domestic-only or non-U.S.-only portfolios. Site and country counts come from sponsor-entered location metadata and may not capture every participating site, and country buckets reflect recorded locations rather than verified enrollment shares, sponsor domicile or legal reporting duties.

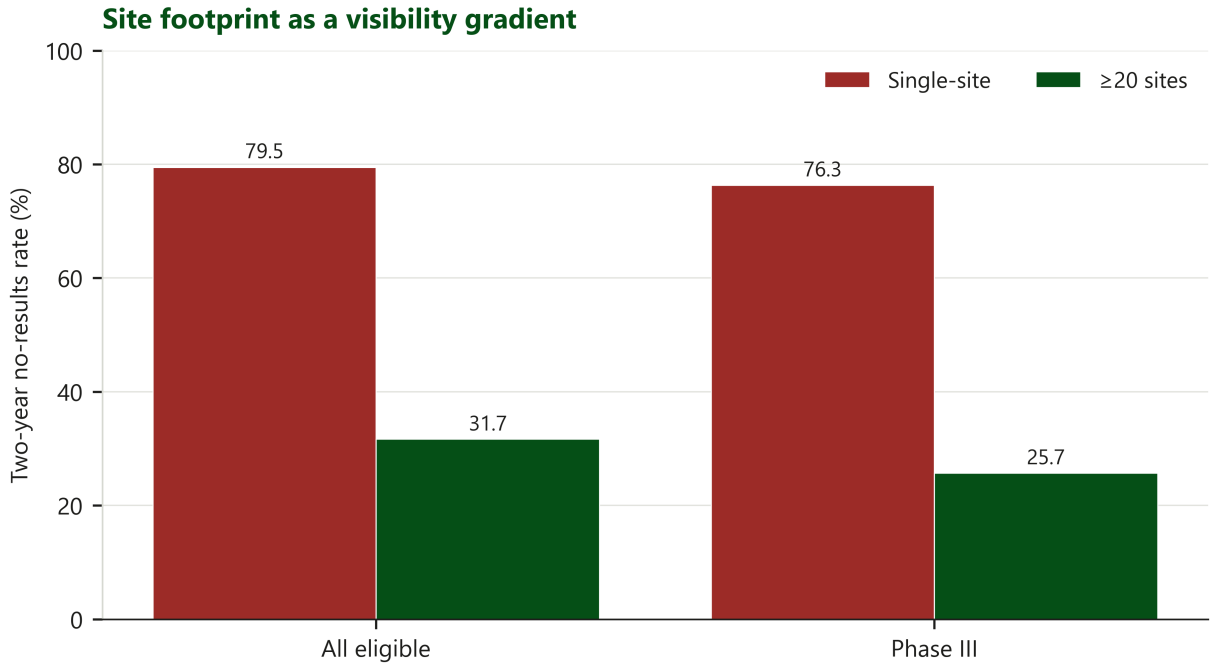

Figure 4. Site footprint. Two-year no-results rate by site footprint, overall and within phase III trials.

Cross-registry hiddenness atlas: overall, industry and completion cohort

Hiddenness atlas. We analysed 578,109 registry records downloaded on 29 March 2026, including 441,191 interventional studies and 290,524 closed interventional studies, deriving omission flags for missing results, missing actual completion dates, missing actual enrollment, absent IPD statements, absent publication links, sparse outcomes and undisclosed stopping reasons, summarised by sponsor class, sponsor and phase. Among closed interventional studies with primary completion at least two years earlier, 72.7 percent still had no posted results: OTHER_GOV was worst on rate, at 95.7 percent, and OTHER largest on volume, at 127,704 studies, while industry still carried 44,007 two-year no-results studies. Phase I had the highest non-reporting rate, at 76.7 percent, and NIH the highest average hiddenness score among named sponsor classes. Registry opacity is concentrated differently by class, so rates, volumes and structural missingness must be read together.

Industry disclosure gap. Focusing on 128,464 industry-linked studies and 87,296 closed interventional industry studies, we derived sponsor-level omission flags and preserved sponsor-level counts so that absolute backlog and rate-based silence could be read together across named firms. Among eligible older closed interventional industry studies, 58.1 percent still had no posted results, leaving 44,007 unresolved

two-year no-results records in the industry bucket alone. The biggest absolute backlogs were held by GlaxoSmithKline, AstraZeneca, Boehringer Ingelheim, Sanofi and Pfizer, and several smaller sponsors exceeded 95 percent on the same rate metric. Industry records were also structurally sparse: 63.2 percent lacked IPD statements, 66.6 percent lacked publication links and 53.8 percent lacked detailed descriptions.

Completion-cohort debt. Grouping 249,507 eligible older closed interventional studies by primary-completion year and broader completion eras, we estimated two-year no-results rates, ghost-protocol rates (missing results plus missing publication links) and the share with both signals visible. The 2008–2012 completion era showed a 64.4 percent no-results rate and a 38.8 percent ghost-protocol rate; by 2021–2024, comparable rates worsened to 77.0 percent and 46.7 percent, while the fully visible share fell to 10.8 percent. Year-level summaries showed the same recent drift, indicating that eligibility alone does not erase newer registry silence. These measures capture registry-visible omission rather than legal violation, and cohort comparisons are descriptive: they can reflect a changing trial mix, backfilling and publication-linking practices.

Disease-family hiddenness: cardiovascular, metabolic and oncology

Cardiovascular hiddenness. We analysed 26,062 eligible older cardiovascular studies from the 29 March 2026 full-registry snapshot, spanning coronary, stroke, heart-failure, rhythm and vascular records, with primary comparisons tracking two-year no-results rates, ghost protocols, sponsor-class mix, phase patterns and the sponsors holding the largest unresolved stock. Among older cardiovascular studies, 75.0 percent lacked posted results and 39.3 percent showed neither results nor a linked publication trail; PHASE1 remained the largest phase bucket. Assistance Publique – Hôpitaux de Paris carried the biggest named-sponsor stock, at 144 older missing-results studies in the cardiovascular family. The cardiovascular record is incomplete and remains structurally quiet across common phases, which matters for guideline-facing cardiovascular medicine. (Figure 5)

Metabolic hiddenness. We analysed 17,294 eligible older metabolic studies from the same snapshot, covering diabetes, obesity, lipid and endocrine-related portfolios, comparing two-year no-results rates, ghost-protocol rates, sponsor-class contrasts, phase structure and the leading sponsors by unresolved stock. Across older metabolic studies, 76.2 percent lacked posted results and 41.9 percent showed neither results nor a linked publication; EARLY_PHASE1 remained the dominant phase bucket. Novo Nordisk A/S carried the largest named-sponsor stock, at 391 older missing-results studies in the metabolic family. Metabolic hiddenness is not confined to one sponsor sector — it remains visible across large clinical-development and registry-sparsity channels — which is especially important because diabetes and obesity evidence directly shapes prescribing, prevention and public-health decisions.

Oncology hiddenness. We also analysed 42,344 eligible older oncology studies from the same snapshot — oncology is the largest named disease family in the portfolio — comparing two-year no-results rates, ghost-protocol rates, sponsor-class patterns, phase gradients and the largest named sponsors by unresolved stock. Across older oncology studies, 67.0 percent lacked posted results and 42.5 percent showed neither results nor a linked publication. Phase EARLY_PHASE1 was especially quiet, at 87.9 percent on the no-results metric. The National Cancer Institute (NCI) carried the largest sponsor stock, at 909 older missing-results studies. Oncology hiddenness is about scale as much as silence — a very large stock spread across public, academic, network and industry sponsors — which matters for cancer policy and treatment evaluation. These family-level estimates measure registry-visible absence rather than legal culpability or publication quality. (Figure 6)

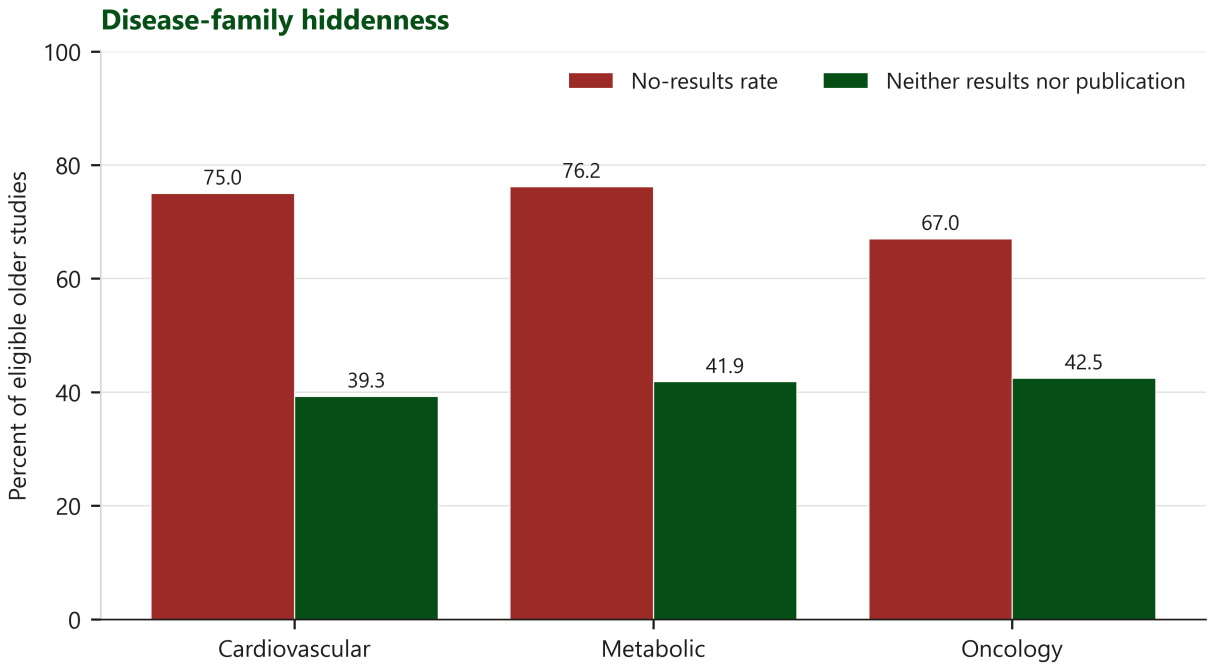

Figure 5. Disease-family hiddenness. Two-year no-results rate and the share with neither results nor a linked publication, by disease family.

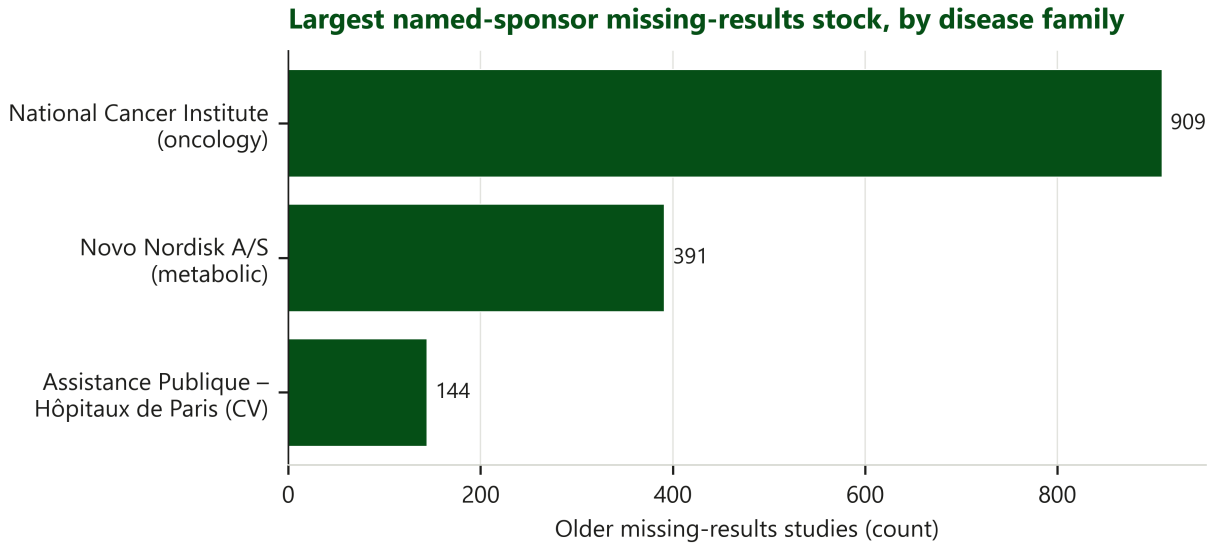

Figure 6. Named-sponsor stock. Largest named-sponsor stock of older missing-results studies, by disease family.

Country, condition and sponsor excess watchlists

Country excess watchlist. We analysed 249,507 eligible older closed interventional studies from the 29 March 2026 full-registry snapshot and exploded named-country links, summing adjusted no-results excess, adjusted ghost excess, black-box stock and strict-core spillover across country-linked portfolios with at least 500 linked studies. France carried the largest country-linked adjusted excess no-results stock, at 2,187 studies, followed by China at 1,299 and Egypt at 824; China and Egypt also showed large ghost excess. South Korea reached a 21.2 percent black-box rate and France carried 3,093 black-box studies. The geography story mixes large Western institutional stock with sharper hiddenness tails in several Asian and Middle Eastern portfolios once adjusted stock, ghost excess and black-box depth are read together.

Condition excess watchlist. Using one condition-family label per study, we ranked condition families by adjusted no-results excess, adjusted ghost excess, black-box stock and strict-core carryover under the same study-mix adjustment. Oncology carried the largest adjusted excess no-results stock, at 543 studies, then cardiovascular at 373 and metabolic at 251. Healthy volunteers were different: near expected on no-results, yet 1,032 studies above expectation on ghost protocols and a 33.9 percent black-box rate. Condition families split into stock-heavy disease backlogs and a separate healthy-volunteer silence pattern that is much more ghosted than merely overdue.

Sponsor excess watchlist. For the third analysis, we reused the study-mix-adjusted no-results and ghost models on the same eligible older closed interventional studies and ranked sponsors with at least 100 studies by observed-versus-expected excess, black-box stock, overdue depth and strict-core carryover. Assistance Publique – Hôpitaux de Paris carried the largest adjusted excess no-results stock, at 265 studies, followed by Sanofi at 197 and Cairo University at 164; Sanofi also showed 219 excess ghost protocols. The strict U.S.-nexus core was led by the National Cancer Institute, at 361 missing-results studies. The sponsor backlog does not collapse into one sector: major industrial and hospital systems remain prominent repeat offenders across the international registry and its strict-core subset. Country watchlists count country-linked studies rather than assigning each study to one nation, so multinational records can contribute to several national portfolios; condition families are keyword-derived registry groupings approximating therapeutic portfolios rather than adjudicated disease ontologies; and these watchlists use registry-visible sponsorship and adjusted excess estimates, not audited legal responsibility, ultimate funder structure or causally attributable silence.

Discussion

Across every lens, the same signal recurred: structural thinness in the public record is not random noise but a patterned, measurable property of identifiable study types, sponsors, geographies and eras. Fields that ought to be administrative — a missing actual enrollment count, a one-arm design, an absent primary-purpose label, a same-year submission-to-completion lag — behaved as strong predictors of total reporting silence rather than minor metadata defects.

Opacity also concentrated by who and where. Ex-U.S.-only portfolios, single-site studies and several specific national and sponsor portfolios were markedly quieter than multinational, multi-site or U.S.-anchored work, while large industrial and hospital sponsors carried both the biggest absolute backlogs and, in places, the highest rates. Crucially, more recent eligible cohorts were not cleaner than older ones on registry-visible measures, even though each had had at least two years to report — so the problem is not merely a legacy backlog being slowly cleared.

For evidence synthesis the implication is direct: a registry search that treats the public record as complete will systematically under-count exactly the studies most likely to be unreported, and the resulting reviews will inherit that bias. The structural signals identified here — actual-field discipline, trial architecture, design-purpose labelling, geography and sponsor class — can serve as screening cues for where unseen evidence is most likely to lie.

Limitations

Several limitations follow from the registry-structural design. All flags index registry-visible omission, not audited legal compliance, applicable-clinical-trial status, or what sponsors knew and when; policy-era and cohort comparisons are descriptive. Sponsor-entered fields — intervention type, primary purpose, allocation, enrollment, phase and final status — are registry categories rather than externally adjudicated facts, and can be missing, estimated or misclassified. Geography and country analyses use recorded locations rather than verified recruitment shares, sponsor domicile or national reporting mandates, and a multinational record can contribute to several country portfolios. Condition families are keyword-derived approximations of therapeutic areas rather than curated ontologies. The submission-to-completion lag is a proxy for operational duration that may reflect backfilled dates or protocol amendments. The watchlist excess estimates are study-mix-adjusted associations, not audited legal responsibility, ultimate-funder structure or causally attributable silence.

Conclusion

Audited end to end, the public clinical-trials record carries systematic, measurable and structurally patterned gaps in registration, reporting and completion. These gaps are concentrated in identifiable fields, designs, geographies, sponsors and disease families, and they are not diminishing in the most recent eligible cohorts. Evidence synthesists should screen for these signals before pooling, and the registry community should target them directly; the per-analysis repositories released with this paper provide a reproducible basis for both.

Data and code availability

All analyses derive from a full-registry snapshot of ClinicalTrials.gov obtained from the ClinicalTrials.gov API v2 (https://clinicaltrials.gov/api/v2/studies) on 29 March 2026 (578,109 studies). The analysis code for each of the twenty-four analyses is openly available in its own repository at https://github.com/mahmood726-cyber/<repository>: Registration fields, trial architecture and reporting-rule era — ctgov-actual-field-discipline, ctgov-trial-architecture-gap, ctgov-rule-era-reporting-gap; Intervention type, enrollment size and stopped-trial disclosure — ctgov-intervention-type-gap, ctgov-enrollment-size-gap, ctgov-stopped-trial-disclosure-gap; Geography, country and outcome density — ctgov-disease-geography-gap, ctgov-country-reporting-map, ctgov-outcome-density-gap; Design purpose, completion delay and country–condition interactions — ctgov-design-purpose-hiddenness, ctgov-completion-delay-debt, ctgov-country-condition-hiddenness; Site footprint, sponsor class and US-versus-global geography — ctgov-geography-scale-visibility, ctgov-us-vs-exus-sponsor-classes, ctgov-us-vs-global-gap; Cross-registry hiddenness atlas — ctgov-hiddenness-atlas, ctgov-industry-disclosure-gap, ctgov-completion-cohort-debt; Disease-family hiddenness — ctgov-cardiovascular-hiddenness, ctgov--metabolic-hiddenness, ctgov-oncology-hiddenness; Country, condition and sponsor excess watchlists — ctgov-country-excess-watchlist, ctgov-condition-excess-watchlist, ctgov-sponsor-excess-watchlist. The original 29 March 2026 snapshot was not retained (it was excluded from version control); the processed aggregate summaries underlying every figure and statistic in this article, the published figures and a data-provenance statement are archived at https://github.com/mahmood726-cyber/ctgov-hiddenness-atlas/tree/main/paper_data. The code re-derives these summaries from a fresh ClinicalTrials.gov API v2 query, and the headline figures were independently reproduced on a later snapshot (see Reproducibility). The repositories are hosted on the journal operator's GitHub account and were produced by an automated analysis pipeline. Data and figures are released under CC BY 4.0; no Zenodo archival DOI has been minted at the time of publication.

Reproducibility

This article was independently reproduced by re-running the analysis code against a ClinicalTrials.gov snapshot captured 14 days after the article's; the headline figures reproduced closely, with approximately 24 of 26 matching within 0.3 percentage points. The exact original 29 March 2026 snapshot was not retained, so bit-for-bit reproduction is not claimed; the remaining figures differed only marginally, consistent with two weeks of new registrations and results postings. The processed summary datasets and figures underlying every reported statistic are archived at https://github.com/mahmood726-cyber/ctgov-hiddenness-atlas/tree/main/paper_data.

Declarations

Ethics: not required (secondary meta-research on publicly available registry metadata; no human participants or identifiable data). Funding: none. Competing interests: the analysis repositories are hosted on the journal operator's GitHub account (github.com/mahmood726-cyber) and were generated by an automated analysis pipeline; the author declares no financial competing interests. Editorial independence: the author had no role in the editorial decision on this manuscript, which was handled by an independent editor with no involvement in the analysis. AI disclosure: computational tooling, including AI-assisted drafting and coding, was used to assemble this analysis; no data, numbers or citations were invented. Reporting: this is a cross-sectional meta-research audit of registry metadata, not a systematic review; no trial-level reporting guideline such as PRISMA applies.

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