

# LipoScope: An Integrated Platform for PubMed-Based Lipedema Literature Discovery and Standardized Cohort Data Collection

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## Article

**Keywords:** Lipedema, LipoScope, literature discovery, data harmonization, research informatics, Common Case Report Form

**Posted Date:** October 6th, 2026

**DOI:** <https://doi.org/10.21203/rs.3.rs-10828978/v1>

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**Additional Declarations:** No competing interests reported.

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# Abstract

Lipedema is a complex, chronic adipose tissue disorder that predominantly affects women and is characterized by painful, disproportionate subcutaneous fat accumulation, particularly in the limbs, that is often resistant to diet and exercise. It is frequently confused with obesity or lymphedema, lacks a confirmatory genetic or blood-based diagnostic test and remains challenging to diagnose and treat. Its research spans multiple clinical and biological disciplines and can be difficult to navigate in broad literature databases, particularly because lipedema overlaps conceptually with obesity, lymphedema and other adipose disorders. This creates a need for disease-specific literature tools that keep lipedema as the focus and organize evidence around its clinical, biological and therapeutic questions. At the same time, studies often use different variables and definitions to characterize patients, limiting comparison and reproducibility. LipoScope addresses these two needs within one browser-based application. Its literature functions support current PubMed searching and periodic in-browser checking of recent PubMed records, classify publications by research domain and study type, generate publication-trend analytics and support project-specific discovery. Separately, its Common Case Report Form Workspace operationalizes the Lipedema Foundation Version 1 data dictionaries through branching, validation, completeness checking and standardized export. By improving literature navigation and metadata consistency, LipoScope supports reproducible lipedema research and therapeutic investigation.

## Introduction

First described in 1940, lipedema (also known as lipoedema) is a chronic, progressive adipose tissue disorder characterized by the bilateral and symmetrical accumulation of fat, primarily in the legs and upper arms [1]. It occurs almost exclusively in women, typically manifesting during puberty and often exacerbating during periods of significant hormonal fluctuation [2]. Clinical features commonly include disproportionate limb enlargement, pain or tenderness, heaviness, easy bruising, relative sparing of hands and feet and substantial quality-of-life burden [3, 4]. Despite these characteristic features, lipedema remains under-recognized and frequently misdiagnosed as obesity, lymphedema, venous disease and other painful adipose or connective-tissue disorders [5, 6]. This diagnostic confusion is mainly due to lack of familiarity with the condition among clinicians, sparse literature and variable diagnostic criteria [7, 8].

Over the past decade, recognition of lipedema and scientific interest in the condition have increased substantially. This growth is reflected in biomedical databases such as PubMed; with more than half of the total lipedema research appearing within just the last five years [7]. A major milestone in recognition occurred in 2019, when the World Health Organization formally recognized the condition under the code EF02.2 [7]. As lipedema becomes more widely recognized, its research has expanded into other neighboring areas such as lipidology, lymphology, vascular connective tissue biology, endocrinology, immunology, and pain pathophysiology. However, this multidisciplinary expansion has also increased the complexity of evidence base. Studies frequently differ in how lipedema is defined and diagnosed, limiting comparability even among studies addressing similar research questions [4, 9]. This heterogeneity

complicates evidence synthesis, patient stratification, hypothesis generation, and the identification of reproducible biological mechanism. Particularly, genetic and molecular studies have identified candidate gene and molecular signatures in lipedema, but their validation requires larger cohorts with consistent phenotyping, standardized metadata collection, and rigorous clinical characterization [10–13].

Efforts to address diagnostic and methodological heterogeneity have led to important consensus initiatives. A Delphi consensus study established a set of consensus statements and highlighted the need for standardized case-report forms to support harmonized cohort development [8]. Building on this work, the Lipedema Foundation developed a consensus-driven framework that aims to harmonize lipedema data collection via Common Case Report Forms (CCRFs). CCRFs provide a unified research framework with four nested classifications (Core, Supplemental Highly Recommended, Supplemental, and Exploratory data dictionaries) and standardized questions, response options and data structures. The Foundation recommends selecting the most comprehensive classification feasible for a given study design [14, 15]. Although these resources provide an important foundation for developing comparable cohorts, their practical implementation remains challenging, particularly for research groups without an established electronic data capture infrastructure such as REDCap [16, 17]. Investigators must still select and implement the appropriate CCRF classification, preserve standardized response coding, configure branching logic, monitor missing and invalid data, track source versions, and generate reproducible datasets for analysis.

The rapid expansion of lipedema research creates a need for dedicated tools to facilitate systematic literature discovery and organization. A recent commentary highlighted the potential value of disease specific literature platforms that provide lipedema-focused indexing, extend beyond conventional bibliographic database searches [7]. Thus, the key challenge is therefore not simply a lack of literature, consensus statements or case report forms. Rather, it is the lack of an implementation platform that automates lipedema literature discovery and serves as an “all-in-one” interactive research workbench for guiding users to build a standardized, comparable research design by using CCRF framework [7, 8, 14, 18].

LipoScope was developed to address this translational gap as a PubMed-aware dynamic research workbench that combines lipedema-specific literature discovery with standardized research planning based on auditable implementation of the official CCRF source files [14, 15]. This “all-in-one” design integrates automated literature searching, organization, curation, and research-planning functions within a single workspace. It also reflects a “one-for-all” approach, allowing the same infrastructure to support different users and research questions. For example, researchers may use LipoScope to curate literature focused on genetics and molecular mechanisms, while others may investigate diagnosis, adipose biology, lymphatic system or treatment. By connecting disease-specific literature discovery and periodic PubMed checking with standardized research planning, LipoScope is intended to reduce fragmentation in the lipedema research workflow and facilitate more consistent, comparable, and reproducible investigation of the disease.

# Results

## LipoScope as a shareable, web-based and PubMed-aware dynamic research workbench for clinicians, researchers and patient groups

LipoScope was developed as a browser-local, PubMed-aware research application that operates locally within the user’s web browser while using an internet connection to query PubMed using NCBI E-utilities and retrieve lipedema-related publications [19–21]. The application then transforms lipedema-specific literature retrieval and classification into an interactive research environment that supports literature interpretation, curation and standardized research data planning.

LipoScope comprises six user-facing tabs: “Start Here”, “Browse Papers”, “Live Search”, “Analytics”, “CCRF Workspace” and “About” (Fig. 1A-D; Table 1). LipoScope user guide, web application screenshots and detailed descriptions of these user-facing tabs are provided in **Supplementary Note S1**.

Table 1  
LipoScope quick guide for users

| User intention                            | Shortest route                                                                |
|-------------------------------------------|-------------------------------------------------------------------------------|
| Find a Paper Already in the Workspace     | Browse Papers → Search or Filters → Open Card                                 |
| Add a PubMed Paper                        | Live Search → PubMed → Search → Add to Browse                                 |
| Check Recent PubMed Records               | Notification Bell → Check Now → Add to Browse                                 |
| Build a Clean Personal Article Collection | About → Hide All Default Literature → Add Papers through Live Search          |
| Restore the Starting Library              | About → Restore 200 Default Corpus                                            |
| Compare Collection with PubMed            | Analytics → Compare Upper Live Charts with Lower Visible-Corpus Charts        |
| Create a Research Record                  | CCRF Workspace → Choose Classification → New Record → Enter Applicable Fields |
| Find Missing Required Answers             | CCRF Workspace → Cohort Design Gap Radar                                      |
| Check an Official Variable                | CCRF Data Dictionary → Search by Variable or Question                         |
| Export Complete CCRF Data                 | CCRF Data Dictionary and Dataset Export → Download Complete Research Package  |
| Share Literature Curation                 | About → Share Current Browse View                                             |
| Remove Stored Local PDFs                  | About → Clear Stored PDFs for This Workspace                                  |

The LipoScope workflow integrates literature discovery with research data preparation (Fig. 2). **Start Here** introduces the tool and the disease, while **Browse Papers** provides a structured starting collection of lipedema articles shown as clickable paper cards. These paper cards summarize each article, study

type, source links, and open-access figure links where available. **Live Search** enables users to search PubMed for new lipedema literature or search a specific lipedema article to check whether it already exists in “Browse Papers” workspace and eventually build article sets around their own research interests, such as genetics, diagnosis or treatment. LipoScope also provides a ‘**New Paper Alerts**’ function that allows users to perform periodic in-browser checks for recent lipedema/lipoedema PubMed records and add selected records to their Browse Papers workspace without separately visiting the PubMed website. The alert function is intended as a convenience for recent-record discovery rather than as an exhaustive detector of newly indexed or newly published literature.

**Analytics** provides an overview of the broader PubMed lipedema literature, including publication trends, research topic distribution, publication frequency, study types and journal distribution. The **CCRF Workspace** then serves as a CCRF-based cohort building and research planning workspace that helps users apply the official CCRF Version 1 structure, review applicable fields, assess data completeness and produce standardized, de-identified research exports. The **About** tab explains the web application’s scope, data sources, privacy model and local workspace controls.

## Rapid expansion of the lipedema literature highlights a relative deficit in genetics research

On 28 July 2026, LipoScope Analytics displayed a headline PubMed query count of 740 lipedema/lipoedema records. The corresponding recent-publication indicator was 453 records (61.2% of the headline count) for the 2021–2026 publication-date interval, indicating substantial recent expansion of the indexed literature (**Supplementary Figure S1A**) [7]. Record-level Analytics at this snapshot were based on 718 browser-processed PubMed records. Of these, 716 had an identified harmonized journal and two lacked journal information; the identified-journal records represented 266 unique journals. Publications were distributed across a broad range of specialist and general clinical journals rather than being concentrated within a single disciplinary field. The journals with the highest publication counts were Phlebology (n = 37), British Journal of Community Nursing (n = 35), Lymphatic Research and Biology (n = 34), Aesthetic Plastic Surgery (n = 27), and Lymphology (n = 20) (**Supplementary Figure S1B**).

Among the 718 browser-processed records available for record-level Analytics at this snapshot, primary classification revealed an uneven topic distribution. Among records assigned to a supported topic, treatment and surgery was the largest domain (n = 148), followed by diagnosis and clinical studies (n = 106). In contrast, genetics and genomics studies represented a comparatively small component of the browser-processed record-level literature set (n = 16) (**Supplementary Figure S1C**). Independent PubMed ESearch queries produced a broadly similar ordering of the major topic areas, with treatment and surgery and diagnosis and clinical studies returning the largest numbers of records (**Supplementary Figure S1D**). Unlike the mutually exclusive primary classification in **Supplementary Fig. 1C**, the ESearch categories in **Supplementary Fig. 1D** showed overlapping patterns because individual records could match more than one topic query.

# LipoScope highlights interdisciplinary research topic distribution for lipedema:

- **Adipose Biology:** Lipedema involves abnormal, painful, disproportionate fat tissue [22].
- **Lymphatics and Vasculature:** Swelling, heaviness, fluid handling, and overlap with lymphedema are important research questions [3].
- **Hormones and Estrogen:** Lipedema mainly affects women and often appears or worsens around puberty, pregnancy, menopause, or other hormonal changes [4, 23].
- **Genetics and Genomics:** Some studies report family clustering, inherited risk, or candidate genetic findings but there is a lack of clarity on genetic landscape of lipedema [12, 24].
- **Pathophysiology:** Mechanisms, including inflammation, fibrosis, tissue remodelling, pain, and immune activity are important to understand lipedema [3].
- **Diagnosis and Clinical Features:** Lipedema diagnosis is still clinical, and the field needs clearer criteria, staging, imaging, genetic understanding and differential diagnosis [4, 8].
- **Treatment and Surgery:** Studies examine compression, exercise, nutrition, conservative care, liposuction, outcomes, and safety [4].
- **Epidemiology and Registries:** Prevalence, patient subtypes, and long-term research data remain incomparable across different studies due to insufficient or unstandardized metadata/dataset building practices [8, 15].
- **Guidelines and Consensus:** The field needs shared definitions and standardized research methods and metadata/dataset builder [8, 15].
- **Comorbidities and Quality of Life (QoL):** Pain, mobility, fatigue, mental health, obesity overlap, lymphatic disease, and daily function strongly affect patients [25].

**“CCRF Workspace” guides users to build consistent research records using the official Lipedema Foundation CCRF framework version 1**

## Standardized Cohort Builder

The “Standardized Cohort Builder” is a research-planning tool. A “cohort” is the group of individuals included in a research study. The tool helps users create a structured, standardized research dataset by operationalizing the Lipedema Foundation CCRF Version 1 data dictionaries (Exploratory, Supplemental, Supplemental Highly Recommended, and Core) in a browser-based, user-friendly workspace [14, 15]. LipoScope operationalizes the official CCRF Version 1 data dictionaries through an embedded source schema and browser-based data-entry workspace rather than requiring users to work directly with a technical data dictionary. The embedded schema and CCRF Data Dictionary preserve the official source variable names, field labels, coded response choices, validation metadata, required status, clinician and participant form assignments, branching expressions and other retained source metadata. Browser presentation does not necessarily reproduce every native REDCap widget; specifically, fields typed as

“slider” in the source dictionaries are presented in LipoScope v1.0.0 as numeric entry controls rather than graphical range sliders. Additionally, matrix members are displayed as separate controls and matrix-level instructional text is retained in the source metadata but is not separately rendered in the Standardized Cohort Builder. Locally collectable, non-identifying response fields are presented as browser-based controls, whereas identifier-marked source fields remain represented for source completeness but are not editable or stored in persistent LipoScope records; file/signature content is not retained and calculated fields remain unavailable in the Standardized Cohort Builder. The CCRF Workspace should therefore be interpreted as a browser-based implementation of the source data specification rather than a visually or functionally identical reproduction of every native REDCap data-entry control. The application’s implementation behaviour converts the CCRF technical data specification into an interactive browser-based research form while retaining the corresponding source field definitions and provenance. The implemented behaviour is documented in the Methods and in **Supplementary Methods S1**.

Many CCRF questions in a data-dictionary CSV are relevant only after a particular preceding answer. For instance, a follow-up question may appear only when a participant reports a particular symptom, treatment or medical history item. LipoScope evaluates the official branching expression and shows the follow-up field only when applicable. This is useful because branching rules stored in a data dictionary can be difficult for non-technical users to follow manually.

## Cohort Design Gap Radar

The Cohort Design Gap Radar identifies missing applicable required responses, invalid values, privacy-excluded identifier fields, retained responses whose branching conditions are no longer active and saved-record schema or source-version mismatches. Results are summarized by official CCRF form and section to support review of record completeness and data-entry issues. This is a LipoScope workspace-completeness assessment and it helps users identify data-entry issues before export or downstream analysis.

## CCRF Data Dictionary and Dataset Export

LipoScope can transform the completed records into several research outputs and it provides users with a complete research package (ZIP format) that includes:

- **CCRF\_records\_codes\_and\_labels.csv**: paired official codes and readable answers.
- **CCRF\_records\_coded.csv**: analysis-ready official codes.
- **CCRF\_records\_human\_readable.csv**: human readable answers.
- **CCRF\_records\_long.csv**: one field per row with code, label, status and source metadata.
- **CCRF\_data\_dictionary.csv**: variable definitions, codes, validation and branching.

- **CCRF\_data\_quality\_report.csv**: missing, invalid, privacy-excluded, inactive-branch and version-mismatched entries.
- **CCRF\_source\_manifest.txt**: LipoScope version, CCRF version, classifications and source checksums.

These outputs are important and required because statistical software usually needs coded variables, whereas researchers, clinicians, patient groups reviewing records may prefer readable labels.

While preserving the CCRF framework, the resulting dataset can support standardized metadata collection, descriptive cohort tables, participant-characterization analyses, comparison of study cohorts, phenotype stratification, data integration and preparation for import into another institutional research system.

## Discussion

Our findings position LipoScope as a PubMed-aware, practical research workbench which provides users with an automated lipedema literature discovery and a comparable study design environment. The PubMed-wide analytics showed that lipedema literature has expanded substantially in recent years, with most indexed records published since 2021, but unevenly distributed across research domains. The distribution suggests that while therapeutic interest in lipedema is increasing, the genetic base remains underexplored. A disease-scoped workbench is therefore useful not only for retrieving articles, but also for helping users understand where the field is dense and where it remains understudied. Current lipedema literature has not yet clearly explained the root mechanism of lipedema and there is no confirmed, consensus-aligned molecular or genetic marker for diagnosing lipedema [8]. As more comparable studies are published, the molecular signals differentiating lipedema from other similar conditions may also be resolved. For this reason, scientific progress in lipedema research depends on consistently designed studies, more standardized case definitions and datasets that can reliably be compared across studies.

LipoScope extends beyond a traditional literature search: PubMed and Google Scholar are essential platforms for locating individual publications but they primarily return lists of search results that users must independently filter, organize, compare and interpret [19, 26]. LipoScope converts the lipedema literature into an integrated research workspace in which publications can be explored through structured summaries, topic and study-type filters, publication trends, provenance links, figure access and a browser-local project library. This structure supports efficient literature curation, helps researchers organize references for manuscripts and review writing and enables relevant articles, figures and findings to be located quickly when developing research questions, interpreting results or preparing publications.

The Lipedema Foundation has developed important disease-specific resources, including a literature library, research roadmaps, patient education materials, and more recently, CCRF data-dictionary and

classification frameworks [14, 15, 27–29]. However, their lipedema-scoped literature library (Legato Library) is not designed as a user-customizable workspace for different research interests and the Foundation notes that identifying newly published lipedema articles relies heavily on manual human surveillance. A complementary research platform is therefore needed to support more efficient disease-specific literature discovery and periodic checking of recent records while allowing users to organize, filter and curate publications according to their individual projects. LipoScope was developed to address this gap by providing a disease-specific, customizable research workspace for PubMed-based literature discovery, organization and user-initiated or periodic in-browser recent-record checking.

General-purpose AI tools can summarize articles but lack a structured, disease-specific system for organizing and managing research literature. LipoScope provides a dedicated lipedema literature environment with structured article cards for search, citation and research planning. It also includes a CCRF Workspace that operationalizes the Lipedema Foundation's case report forms for standardized data entry, cohort design and de-identified export, integrating literature discovery with practical research execution.

LipoScope's browser-local design has practical implications for clinicians, researchers and patient groups because it lowers the technical barrier to using disease-specific research resources. The application can be opened directly in a standard web browser without installation, user accounts or dedicated server infrastructure. LipoScope allows literature collections and de-identified cohort records to be organized within the user's own device. This structure supports rapid research planning, reference curation, training and pilot data collection, particularly for research teams or community organizations that may not have immediate access to specialized database support. It also gives users direct control over their local workspace because articles and research records are not transmitted to an external LipoScope server. Importantly, standardized research cohort preparation within LipoScope is designed to align with the CCRF framework published by the Lipedema Foundation and the system does not independently redefine the underlying CCRF field definitions or coded response structures provided by the Foundation; instead, the source metadata are normalized into an application schema for browser-based use [14, 15]. As a result, exported datasets are designed to preserve the source CCRF variable definitions and coded response structures within the tested LipoScope implementation and can be used in downstream analysis or reporting without altering the original framework definitions.

Several limitations should be acknowledged. LipoScope relies on what is available in PubMed, including figures, citation details, abstracts and open-access full texts in PubMed Central. Because of this, some studies may have missing or limited information, which can affect how fully they can be summarized or classified. The Browse Papers workspace is initialized from a bundled 200-article default collection comprising a fixed built-in seed and a PubMed-expanded default layer. When internet access is available, the expanded layer may be refreshed in the browser from PubMed; automatic refresh is attempted when the browser-local default-corpus check is stale, currently after seven days. Consequently, membership of the default 200-article collection can change over time and should be regarded as an orientation and demonstration collection rather than an immutable, complete or systematic corpus of lipedema

literature. The summaries, topic labels, and study-type classifications are created using transparent rule-based methods based on public metadata and are intended to support navigation of the literature rather than replace careful reading and critical evaluation of the original articles.

The browser-based design improves accessibility of CCRF framework and gives users control over their local workspace but it does not provide centralized storage or institutional handling of identifiable research data. Source fields marked as direct identifiers are excluded from persistent browser-local CCRF records and exports and may be lost if browser storage is cleared.

The “CCRF Workspace” is based on the Lipedema Foundation CCRF Version 1 data dictionaries as they were available at the time of development. If the Foundation releases updated versions in the future, LipoScope needs to be updated to reflect these changes, including new fields, revised definitions or improved structure. Similarly, future versions of LipoScope can be extended or modified by other developers, as the system is designed to be adaptable and open to further development by the research community. Calculated-field rows are retained in the embedded CCRF schema and exported CCRF Data Dictionary rather than being independently redefined by LipoScope. Where the official source does not provide an executable calculation expression, no calculated value is generated. These calculated fields therefore remain represented as source metadata but are omitted from the record-level coded, coded-and-labelled, human-readable, long-format and data-quality exports.

Overall, LipoScope is intended for lipedema-specific literature discovery, evidence organization, research planning, standardized cohort preparation and data-completeness assessment. It should not be used for clinical diagnosis or replacement of regulated research infrastructure such as REDCap in clinical, identifiable or multicentre studies. Its value lies in connecting disease-specific literature surveillance with a standardized framework for generating future research data. The tool may continue to evolve over time as new research, updated CCRF versions and community feedback guide future improvements and refinements. More broadly, its architecture may offer a practical starting point for disease-specific platforms in other fields but transferability has not been established merely by the present implementation.

## Methods

### Application design and scope

LipoScope was developed as a self-contained browser-based research application for lipedema literature exploration, PubMed monitoring, literature analytics and standardized research data collection (Fig. 2; expanded technical implementation details are available in **Supplementary Methods S1**). The application was implemented using HTML, CSS and JavaScript and distributed as a single executable HTML file. It does not require installation, a user account or an application server and can be opened in a current desktop web browser.

LipoScope uses a browser-local workspace model. Literature customization, user-added papers, hidden records, workspace preferences and saved CCRF records are stored in the user’s browser. Optional local workspace profiles allow separate collections to be maintained on the same device. Profile-specific storage keys are used to separate the literature and CCRF records associated with each local profile.

Locally selected article PDFs are used only for device-local figure preview. PDF objects are held in the browser session, while optional persistent PDF storage uses IndexedDB when this function is enabled and supported by the browser.

Internet access is required for functions that retrieve current PubMed metadata, PubMed Central content or external article information.

## CCRF source materials and schema construction

The CCRF Workspace was generated from the four official Lipedema Foundation Common Case Report Form Version 1 classification-specific REDCap data dictionaries: Core, Supplemental Highly Recommended, Supplemental and Exploratory [14, 15]. The four classifications are cumulative and contain 288, 424, 618 and 682 official common data elements, respectively (Table 2).

Table 2

**Lipedema Foundation Common Case Report Form Version 1 classifications implemented in LipoScope.**

Official common data element (CDE) counts are reported for each cumulative CCRF Version 1 classification, together with the numbers assigned to clinician-completed and participant-completed forms in the source materials. Technical REDCap data-dictionary row counts are shown separately and should not be interpreted as unique CDE totals, because the source dictionaries contain response fields together with implementation-level entries such as instructions, calculated fields, identifiers and other REDCap-specific rows. Branching logic and other REDCap metadata are retained where supplied in the source dictionaries. The four classifications are cumulative, such that broader classifications include the elements contained within the more restricted classifications together with additional CDEs.

| Classification                  | Official CDEs | Clinician-completed | Participant-completed | REDCap data-dictionary rows |
|---------------------------------|---------------|---------------------|-----------------------|-----------------------------|
| Core                            | 288           | 86                  | 202                   | 300                         |
| Supplemental Highly Recommended | 424           | 89                  | 335                   | 445                         |
| Supplemental                    | 618           | 89                  | 529                   | 650                         |
| Exploratory                     | 682           | 120                 | 562                   | 739                         |

To ensure reproducibility, classification-specific source dictionaries were represented as a frozen row-level TSV snapshot retained in the software package. Independent source-fidelity validation reparsed the four release-pinned official XLSX dictionaries and regenerated this snapshot deterministically. The regenerated TSV was byte-for-byte identical to the frozen snapshot used by LipoScope and retained source and provenance fields matching without discrepancy.

The validated frozen snapshot was subsequently processed using a deterministic Python workflow to generate the compact CCRF schema embedded within LipoScope (**Supplementary Figure S2**). For each source row, the generated schema preserves the official variable name, form name, section heading, field type, field label, coded response choices, field note, validation type and bounds, required-field status, identifier status, branching expression, matrix metadata, annotation and source-row reference.

The official common-data-element totals are reported separately from technical REDCap dictionary-row counts and from the number of fields that are currently applicable to an individual record. This distinction prevents the published CCRF classification size from being confused with a participant's current completion denominator.

## Application build and validation

The release package (LipoScope v1.0.0) contains the frozen CCRF source snapshot, generated CCRF schema, source manifest, official count records, deterministic build scripts, automated tests and generated validation reports. Source fidelity was assessed independently by reparsing the four release-pinned official CCRF XLSX dictionaries and regenerating the frozen source snapshot. The regenerated snapshot was byte-for-byte identical to the committed snapshot, with 2,134/2,134 cumulative technical rows matching and no row- or field-level differences detected. This source fidelity assessment evaluates preservation and reconciliation of source data-dictionary content and embedded schema attributes; it does not imply pixel-level or widget-level reproduction of the native REDCap user interface, including matrix-group presentation. The subsequent source-to-schema workflow reconstructs the embedded CCRF schema from these validated frozen source rows and performs row-level reconciliation of key source field attributes between the frozen snapshot and generated application schema. Automated tests assessed the required application tabs, HTML structure, CCRF classification labels, official common-data-element counts, source checksums, source-row reconciliation, schema embedding, branching behaviour, inactive-response retention, direct-identifier exclusion, calculated-field policy, export behaviour and package contents. Deterministic-build tests confirmed agreement between the generated schema and the schema embedded in the distributed, template and release HTML files. Browser-based functional testing was performed using an automated Chromium environment to confirm tab navigation, literature controls and CCRF data-entry behaviour. The final release passed all 35 automated tests and the browser functional audit.

## Data and code availability

LipoScope (v1.0.0) is publicly available at [https://liposcope.github.io/LipoScope\\_v1.0.0/](https://liposcope.github.io/LipoScope_v1.0.0/) with source code and validation tests at [https://github.com/LipoScope/LipoScope\\_v1.0.0](https://github.com/LipoScope/LipoScope_v1.0.0). Literature records are retrieved or refreshed through NCBI PubMed E-utilities, and therefore live PubMed counts may change over time as PubMed indexing is updated. The PubMed-derived outputs and figures reported in this manuscript reflect the query date.

## Declarations

## Author contributions

SC: Visualization, Conceptualization, Software, Writing – original draft, Investigation, Resources, Writing – review & editing, Methodology, Validation, Formal analysis, Project administration, Data curation. YK: Conceptualization, Software, Writing – review & editing, Methodology, Validation. KB: Conceptualization, Writing – review & editing, Methodology, Validation. CK: Supervision, Conceptualization, Investigation, Resources, Writing – review & editing, Methodology, Validation, Project administration. NH: Supervision, Conceptualization, Investigation, Resources, Writing – review & editing, Methodology, Validation, Project administration. HS: Supervision, Conceptualization, Investigation, Resources, Writing – review & editing, Methodology, Validation, Project administration.

## Additional information

### Competing interests

The authors declare no competing interests.

### Funding

This work received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

### Conflicts of interest

The authors declare no relevant conflicts of interest for the work reported in this manuscript.

### Declaration of generative AI and AI-assisted technologies in the software design, code implementation, figure creation and grammar editing process

During the development of LipoScope, agentic AI (<https://openai.com/codex/>) and generative AI (OpenAI <https://openai.com>, GPT-5-class model, 2026) technologies were used to support code design, implementation, debugging, refactoring, and iterative tool development. Large-language-model tools (OpenAI <https://openai.com>, GPT-5-class model, 2026) were used to support language editing and figure creation. The authors take full responsibility for the accuracy, integrity and final presentation of the work presented.

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## Figures

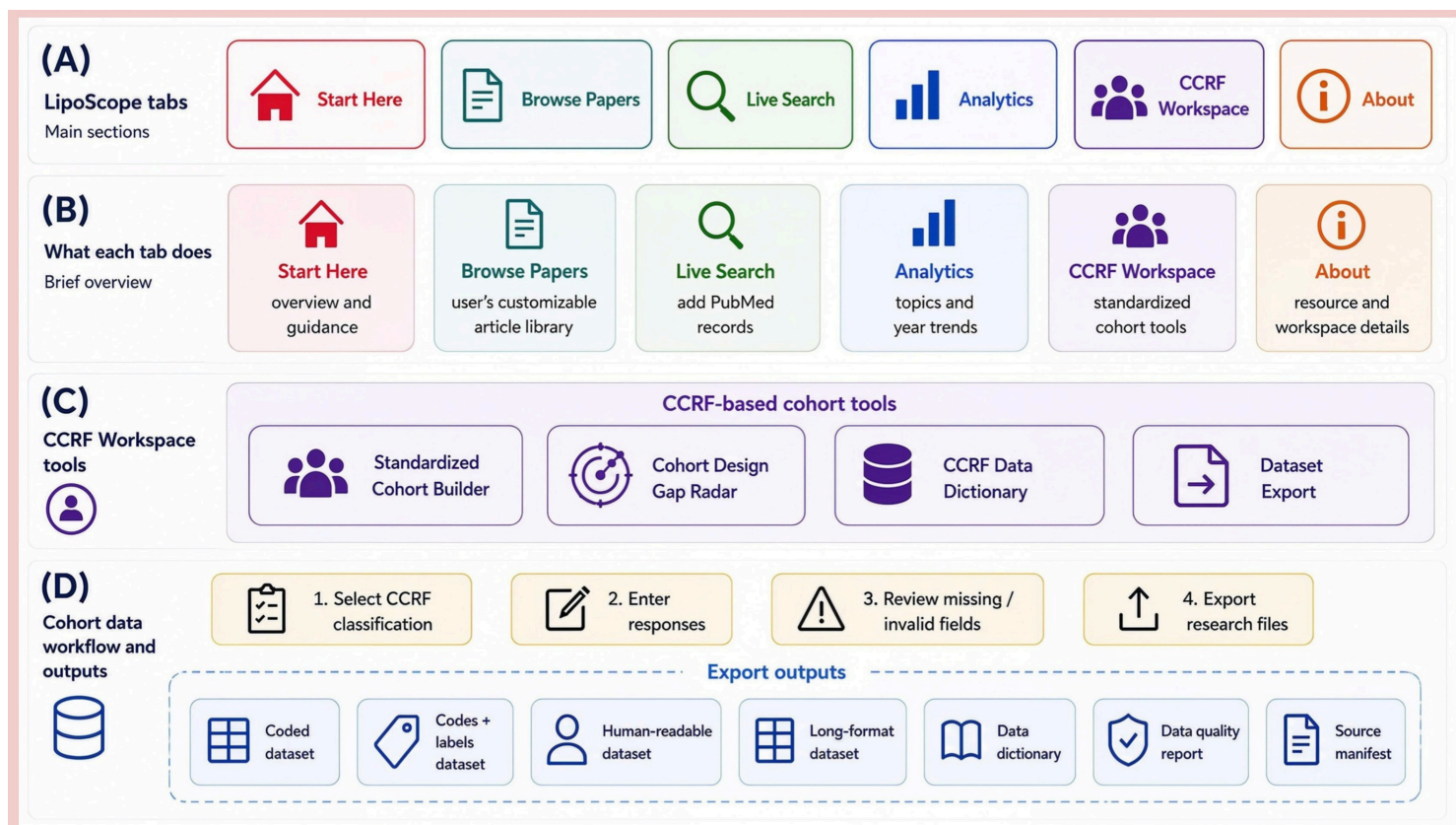


**Figure 1**

**Structure and workflow of LipoScope.** **(A)** Main LipoScope tabs: Start Here, Browse Papers, Live Search, Analytics, CCRF Workspace and About. **(B)** Brief overview of the function of each tab, including user guidance, a customizable article library, PubMed record retrieval, literature-topic and publication-year analysis, standardized cohort tools, and resource and workspace information. **(C)** CCRF Workspace modules comprise the Standardized Cohort Builder, Cohort Design Gap Radar, CCRF Data Dictionary and Dataset Export. **(D)** CCRF-based cohort data workflow, progressing from CCRF classification selection and response entry to review of missing or invalid fields and export of research files. Export outputs include coded, coded-and-labelled, human-readable and long-format datasets, together with the data dictionary, data-quality report and source manifest. **Generative AI disclosure:** This figure was created using OpenAI ChatGPT (GPT-5, <https://openai.com/>) based on author-defined content and instructions.

## LipoScope

A browser-based, disease-focused workspace for two separate lipoedema research tasks

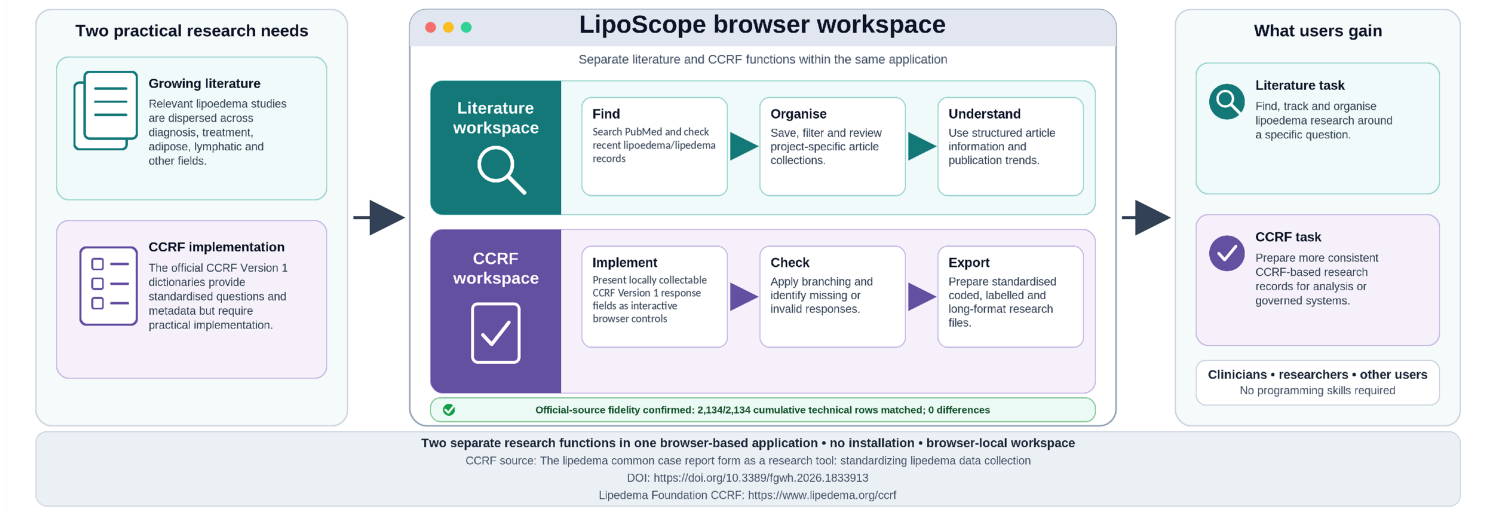


Figure 2

### Conceptual workflow and research functions of LipoScope.

Schematic overview of LipoScope as a browser-based, disease-focused workspace addressing two separate practical needs in lipoedema research. The literature workspace supports PubMed-based literature discovery and periodic in-browser checking of recent records, organization of project-specific article collections and structured review of article information and publication trends. Separately, the Common Case Report Form (CCRF) workspace operationalizes the Lipedema Foundation CCRF Version 1 data dictionaries as browser-based data-entry controls while retaining the corresponding source schema and metadata, applies source-defined branching and response checks and supports preparation of standardized coded, labelled and long-format research files. The left panel summarizes the motivating research needs, the centre shows the two independent LipoScope workflows, and the right panel summarizes their intended user benefits. Source-fidelity testing confirmed that all 2,134 cumulative technical rows from the pinned CCRF source dictionaries were reproduced in the implementation workflow with no detected differences. LipoScope is designed for clinicians, researchers and other users without requiring programming skills or software installation. **Generative AI disclosure:** This figure was created using OpenAI ChatGPT (GPT-5, <https://openai.com/>) based on author-defined content and instructions.

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [SupplementaryInformation.pdf](#)