# MedicineMaps: A tool for mapping and linking evidence from experimental and clinical trial literature

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medical imaging INFORMATICS

Bioengineering & Radiological Sciences 2 Computer Science 3 Neurobiology, Psychology, & Psychiatry

# **Researchers need tools to integrate find**ings from a diverse and growing literature

MedicineMaps allows translational scientists to formalize the way they summarize evidence and design clinical trials.

Randomized clinical trials (RCTs) are the de facto method for testing and reporting the efficacy and safety of treatments.

The literature available on even rare diseases often provides more information than any individual scientist can digest and process.

**Structuring clinical trial reports can help to** make causal information more digestible



What are the essential elements from a study that can guide decision making?

We studied clinical trial reports to identify which of their elements are essential for understanding the context of a trial's outcomes.

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Translational scientists thus need meta-analytic tools that can: integrate primary outcomes across multiple RCTs,

summarize what's known to explain effects on a population, and compare studies *methodologically* to inform future study design.

We explore these issues in the domain of Neurofibromatosis type I (NF1), a genetic disorder that causes cognitive deficits in children.

This work builds off ResearchMaps [2–3], a free web application for tracking and planning research in basic science (e.g., biology).

Graphical formalisms concisely encode observed statistical relations while intuitively visualizing causal relations.

We use a graphical formalism to annotate literature, leading to data structures that can be explored with intuitive queries:

MATCH (p:Paper)-[]->(i:Intervention), "Does lovastatin (i:Intervention)-[r:EXCITES]->(o:Outcome) improve attention WHERE i='lovastatin' AND o='attention' in children with NF1?" r.age<18 RETURN p,i,r,o; AND



MedicineMaps.org is a free web application that you can use to annotate clinical trials

MedicineMaps can show the dominant evidence for relations



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### **Can statins treat NF1?**

Animal models [1] suggest that statins could treat cognitive deficits caused by NF1, but studies in humans have shown mixed results.

To explore this issue, we used MedicineMaps to annotate studies of statins' effects on various cognitive measures in NF1 patients.

With each study's metadata, MedicineMaps visualizes methodological differences across studies to contextualize their results.

These visualizations can help researchers to design new studies.

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#### To contextualize results, MedicineMaps

#### We will link the databases of ResearchMaps

#### **Discussion and future work**

# shows how studies differ methodologically

Clinical trials on the use of statins in NF1 have had mixed results.

To systematize meta-analytic and methodological analyses, we visualize study results according to properties of their designs.

These methodological comparisons highlight, for example, the effect of different statins (lovastatin & simvastatin) on NF1 patients.

By identifying key differences/similarities in studies, researchers can design new studies to resolve unexplained results.

This plot shows

that the effects of

lovastatin across

not differ sharply

by the age of the

patient.

multiple studies did



# and MedicineMaps to identify etiologies

ResearchMaps.org is our related web application that represents causal relations between biological agents and targets.

Linking these applications' graph databases will allow us to explore the biological mechanisms underlying clinical trial results.

This hybrid system could facilitate collaboration across disciplines.



MedicineMaps summarizes available evidence for treatments and metadata associated with studies to aid experimental design.

By comparing trials methodologically, MedicineMaps facilitates meta-analyses that can contextualize the results of related studies.

As we further develop this app, we will perform usability studies to identify how clinical researchers can use this tool most effectively.

Currently, data is entered manually; we will use this labeled data to train our system to perform semi-automated annotation.

We invite you to visit www.medicinemaps.org to learn more.

[1] Li W, et al. The HMG-CoA reductase inhibitor lovastatin reverses the learning and attention deficits in a mouse model of neurofibromatosis type 1. Current Biology. 2005;15(21):1961-7. [2] Silva AJ, Landreth A, Bickle J. Engineering the next revolution in neuroscience: The new science of experiment planning. Oxford:

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[3] Silva AJ, Müller KR. The need for novel informatics tools for integrating and planning research in molecular and cellular cognition. Learning & Memory. 2015;22(9):494-8.

Oxford University;2014.