



BACKDROP HEALTH

Backdrop Health, Inc.

*Improving the economics and effectiveness of clinical trials
by extracting maximum value from any body of electronic health records*

Clinical trials are expensive, time-consuming, and risky. Pharmaceutical companies spend a lot to license access to the personal medical records needed to assemble and manage their patient cohorts. Backdrop Health has created a breakthrough solution that harnesses every bit of information in medical records, patient demographics, gene sequencing data, and more to maximize the predictive value of this data.

Backdrop's unique analytical and predictive capabilities enable a new level of deep health profiling of potential recruits, building a prognostic model that maximizes the value of the trial, and amplifying the signals associated with therapeutic response. Backdrop can enable pharmaceutical companies to bring new therapies to market far more quickly and economically.

A key element in creating prognostic models that predict medical outcomes is understanding and quantifying *comorbidities*: the coexistence of two or more medical conditions in a patient, such as diabetes and obesity. Comorbidities are powerful and widely used, but there are limitations in the state of the art. First, comorbidities have long been calculated based on finding relationships only between pairs of diagnosed conditions. Little of the full array of available clinical information is used in comorbidity discovery. Second, accurate comorbidity discovery usually requires controlling for confounding variables (like age or sex). This is done in several ways, usually by *stratifying*: reducing the data set to ensure uniformity of risk. But this results in diminished statistical power.

Comorbidity discovery is a field overdue for disruption. The innovative use of artificial intelligence and machine-learning techniques on today's huge bodies of medical data, including electronic health records (EHR), can revolutionize this field. Backdrop has done this, creating a breakthrough approach with three major aspects:

- First, Backdrop radically extends the concept of comorbidity to include all available clinical factors. Backdrop's software doesn't just do a better job discovering relationships between diagnosed conditions. it examines every diagnosed condition, lab test, medication, and procedure, to discover and quantify the meaningful relationships between all of them. If available, other data, such as genomic sequencing, is also factored in.
- Second, Backdrop discovers the temporal relationships between all of the clinical variables, e.g., the order in which events occur, for arbitrary time intervals. This is invaluable both in separating short-term and long-term comorbid effects from one another, and in understanding disease progression.
- Third, whereas previous best practices for comorbidity discovery rely on stratification, Backdrop's approach does not. Instead of making the usual assumption that every patient in a sample is at uniform risk for a given outcome, Backdrop calculates and uses each patient's individual risk probability for every condition based on his or her precise full history. Because of this, the medical history and demographic factors for *every* patient in the sample is brought to bear on *every* outcome analysis.

Much time and great expense goes into assessing potential recruits with respect to the trial inclusion / exclusion criteria. Drug trial teams often spend millions to license medical records for a given trial, only to find just a handful of relevant candidate patients. Understanding each patient much more deeply and eliminating the need to stratify dramatically shrinks the number of recruits that must be assessed to fully enroll a trial, saving time and money.

Backdrop's breakthrough approach is implemented in our core software called CoDE: **C**omorbidity **D**iscovery **E**ngine. Given any body of medical records – which can range from a set of millions of licensed patient records

extracted from an enterprise data warehouse or an electronic health records system to just hundreds or thousands of medical records captured in a spreadsheet – CoDE automatically:

- Finds and quantifies all comorbid relationships between all clinical variables, at massive scale;
- Discovers the temporal relationships between those identified comorbid factors;
- Identifies which clinical variables and demographic variables matter for any outcome of interest;
- Models the influence of every patient's individual medical history on every outcome;
- Removes the need to stratify to control for confounding variables, amplifying the power of any medical data set – often by orders of magnitude;

Given a body of medical data, CoDE creates a rich and comprehensive knowledge graph – the **backdrop** -- for that data. While classic comorbidities reveal part of the overall picture, the backdrop reveals every clinical variable's relationships to every other. This in turn enables powerful and flexible reports and queries about any outcome of interest, and about any clinical or demographic variables that contribute to that outcome.

Useful predictions often require knowing the combined effects of many comorbid factors, not just a pairwise analysis. Backdrop's unique Multimorbidity Query Engine allows predictions on multiple factors, using the AI technique of Bayesian Networks to account for all conditional dependencies among those factors. And since the contribution of each factor to any predicted outcome is clear, all predictions are fully explainable.

Backdrop's predictive power can bring compelling benefits to pharmaceutical company clinical trial teams, contract research organizations, and patient-finding firms, enabling them to:

- Quantify absolute and relative risks for an individual or a population for any health condition;
- Easily assemble 'synthetic control arms' for Real-World Evidence (RWE) approaches;
- See the effects of known biomarkers and identify combinations of factors that are useful new biomarkers;
- Enhance trial inclusion and exclusion criteria with probabilistic risk profiles;
- Identify individuals most at risk of adverse outcomes and understand why;
- Distinguish a patient's 'medical destiny' from possible side effects precipitated by a drug; and
- Get new insight into stalled or failed trials and potentially rescue them.

Backdrop Health was launched in 2020 to bring this mature technology to market under an exclusive license from the University of Utah, where it has been in active development for over five years by Prof Mark Yandell's team. It had full 'behind the veil' access to 15 years of medical history for over 3.9 million patients, including over 72 million visits, 77 million clinical notes, medication histories, and comprehensive demographic data. Other teams scramble for data and typically have access only to de-identified records that lack key information. Backdrop's team used this huge body of primary data to learn what to do with EHR and how to do it right, giving Backdrop a commanding lead in understanding and using medical data for predictive purposes.

Backdrop is a Software-as-a-Service (SaaS) solution, running securely in the cloud with no risk of revealing any personal health information. A backdrop is not a neural net trained on a single data set: customers will create their backdrops for the data to which they have access. Our business model does not involve licensing any patient data.

Our solution is proven and works at scale. We know that we will need to fine-tune our user interface, reports, queries, and analytics to match precisely the requirements and workflows of drug trials. We're seeking innovative and demanding teams interested in working with Backdrop on proofs-of-concept in Phase II, III, or IV trials.

For more information, please contact Jerry Rudisin, CEO: jerry@backdrophealth.com, or (c): +1 650 906-8395.