Molecular Health GmbH
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# Molecular Health—intelligent solutions for smarter healthcare

Better data for better insights and improved outcomes—Molecular Health has built one of the largest, deepest and fully curated digital platforms for biomedicine in the world. The company's 'Dataome' provides the foundation for actionable insights for stakeholders across the healthcare ecosystem.

Molecular Health GmbH is an IT-biotech company developing databases and software solutions for precision medicine. Headquartered in Heidelberg, Germany, the company focuses on the capture, curation, integration, and analysis of structured and unstructured biomedical and drug data sets, to generate molecular understanding of health and disease for physicians, providers and pharma. With its Dataome platform, which combines careful quality assessment of the data input with state-of-the-art artificial intelligence (AI)- and machine learning (ML)-based output analytics, Molecular Health offers a unique deep and broad set of capabilities for stakeholders in precision medicine.

Advances over the past two decades in 'omics' technologies such as genomics, transcriptomics, proteomics, epigenomics, or metabolomics, and the association of their readouts with clinical phenotypes from individual patients, have set the stage for a new transformative medicine, adding molecular understanding of diseases and therapeutic interventions to observation-based medicine. However, the promise of the 'omics' revolution and the associated flood of big data has been slower to materialize than initially envisioned due to the sheer complexity of the large data sets being acquired and the analytical challenges they pose. One of the largest hurdles facing the field has been assessing data quality and reproducibility, and simply being able to tell apart validated data from unvalidated ones.

Recognizing that addressing this main challenge would be the premise for improving the predictive value of any AI/ML–based data-mining platform, Molecular Health adopted a two-pronged approach that puts equal emphasis on ensuring the highest quality of the data being considered and on developing the most sophisticated analytical pipelines to extract and deliver actionable insights of real value for decision makers (Fig. 1).

"As a pioneer in precision medicine, we ensure that available clinical and molecular knowledge is made accessible and usable for daily patient care," said Friedrich von Bohlen, CEO of Molecular Health (Fig. 2). "A strategy of paying equal attention to the quality of data feeding data bases and to the strength of analytical tools themselves makes us the ideal partner for physicians, providers and pharma seeking to improve outcomes for patients or to develop better new drugs."
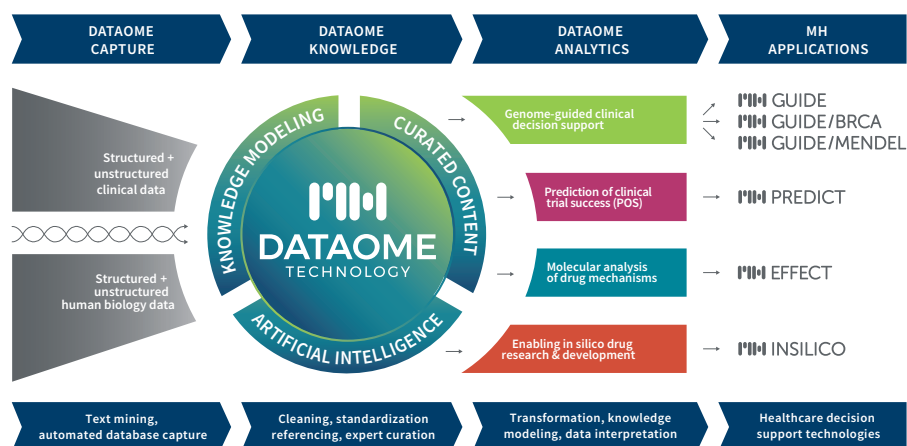
Fig. 1 | The Molecular Health knowledge pipeline. Molecular Health has built a fully curated digital platform for biomedicine, 'Dataome', that puts equal emphasis on using the highest quality data and on developing the most sophisticated analytical pipelines to extract and deliver actionable insights of real value for decision makers. The pipeline consists of a comprehensive data capture module, a data curation process, and a knowledge modeling and interpretation platform that support a portfolio of healthcare decision support applications.

Dataome–ground supporting life science's big data

Since the DNA sequencing of the human genome was completed almost two decades ago, a new dimension has become actionable for medicine: the molecular dimension, which does not only read the genetic code, but puts a meaning to molecular interactions in healthy and disease states.

The complexity of the steadily accumulating health data has been increasing at an unprecedented pace and it still is. The development of specialized 'omics' technologies that collect data at a systems level generates a vast and diverse range of structured and unstructured data types that continuously evolve over time. This poses a challenge not only for harmonizing and integrating information derived from analyzing different levels of biological organization, but also for determining the quality and validity of individual data points. The lack of uniform standards for data collection and deposition further complicates the process of ensuring the necessary level of quality of the data entering the analytical pipeline.

From the beginning, Molecular Health recognized the centrality of ensuring that data quality was at a level comparable to the data processing pipelines being developed for analyzing those

data, and to meet this challenge, the company launched its core platform: Dataome.

Molecular Health's Dataome is a global digital platform for biomedical and pharmaceutical information and real-world patient data built by continuously and rigorously mining, curating, and structuring billions of molecular and clinical data points related to genes, molecular mechanisms, phenotypes, diseases, drugs, and outcomes. The platform is designed to process both structured and unstructured data. Structured data are integrated into Dataome using a real-time processing pipeline to normalize and quality control the data. Unstructured data are integrated using Molecular Health's proprietary natural language processing (NLP) technology, a combination of rule-based linguistic, ML and deep learning models trained to identify critical biomedical facts from sources of unstructured knowledge such as drug labels, patents and peer reviewed literature. This initial ML-based data gathering step is followed by a proprietary curation pipeline powered by an extensive network of biomedical experts.

"With the development of Dataome, Molecular Health became a trailblazer in the personalized medicine space, offering a unique, high-quality source of clinico-molecular knowledge," said von

Fig. 2 | Friedrich von Bohlen, CEO of Molecular Health: "Empirical evidence without molecular understanding is inferior. Molecular Biology stands for the new dimension in medicine. Our data and technologies are validated enablers for this transformation in precision medicine, and causal understanding of diseases help providers to treat patients better and pharma develop better drugs more efficiently for patients worldwide."

Bohlen. "Dataome captures and contextualizes global data about interventions, outcomes and molecular mechanisms that can be harnessed to develop any disease model, identify new drug targets, predict drug repurposing, anticipate patient drug response, to identify personalized treatment options for patients, or to predict drug toxicity and side effects, based on genomic and molecular evidence."

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>
> Friedrich von Bohlen, CEO, Molecular Health

Unlocking the potential of Dataome

As early as during the fourth century BC, Aristotle established the centrality of data in the scientific inquiry process. Data allow both induction and deduction of the basic principles that determine nature's workings. Data, however, only provide insights when placed within a framework—a theory, a causal model, some other type of logical construct—that establishes their connection to some version of reality. In other words, data do not speak for themselves but rather need to be embedded within a narrative that organizes their connections and derives meaning in the process.

This is the guiding principle behind Molecular Health's efforts toward building cutting-edge analytical software solutions that maximize the extraction of 'meaning' from life sciences' big data for decision-making in the space.

Molecular Health has brought together a comprehensive group of experts in the fields of medicine, biology, bioinformatics, drug development, clinical and translational research, medical practice and healthcare IT that is continuously developing and refining novel analytical pipelines to deliver actionable intelligence for the company's customers and collaborators. Using a broad canvas of bioinformatics, chemoinformatics, systems biology, clinical data science, AI and ML tools, the team has developed a holistic suite of software solutions for discovery, evaluation, and implementation of new insights in the health sciences space:

- **MH Guide**: supporting molecular pathologists, oncologists and other medical professionals in the clinical annotation of genetic variants, enabling physicians to make precision oncology decisions. MH Guide is a tool for identifying the most effective, ineffective or potentially toxic medications for a cancer patient by analyzing the molecular profile of the patient's tumor in the context of all relevant and related information contained in Dataome. By mapping the patient's specific tumor mutations to the world's knowledge in the field of oncology, MH Guide creates a patient-specific report that includes a list of recommended medications and other therapeutic approaches. MH also includes two components specifically designed for the analysis of hereditary diseases (MH Guide/BRCA and MH Guide/Mendel).

- **MH Effect**: helping regulators and pharmaceutical companies re-label drugs, identify repurposing drugs and predict drug side effects. MH Effect is a tool for the comprehensive clinical and molecular assessment of drug action and adverse events. By tapping into millions of patient records of drug outcomes, including of emerging safety issues, MH Effect helps discover adverse events associated with marketed drugs that might have gone unnoticed but could be relevant to other drugs by simulating and analyzing drug interaction, and predict potential safety issues of drug candidates in development. In turn it can identify the desirable effects of drugs.

- **MH Predict**: supporting the pharmaceutical industry and investors alike make the right investment decisions by predicting the success of clinical trials. MH Predict is a tool that uses AI and ML algorithms for intelligent simulations and analysis of clinical study programs with the goal of mitigating the risks inherent in the process of drug development. By giving users complete control over these algorithms and making the process fully accessible, MH Predict exponentially increases the level of confidence with which the user will implement any of the actionable outcomes determined by the underlying AI and ML algorithms.

- **MH InSilico**: enabling in silico drug research and development. MH InSilico is a service for the rapid development of testable molecular hypotheses from unique custom-built causal-molecular disease models. This allows to create hypotheses for both patient care and drug development. Through MH InSilico, new drug targets can be found and validated, clinical trials can be better planned and stratified, and drugs can be more precisely positioned. Moreover, MH InSilico reveals molecular interactions in patients that can help to guide individual treatment schemes. Thus, MH InSilico blends the knowledge of Dataome with the company's analytics and experts in collaboration with customers' experts to reach novel insights in care and drug development.

Based on the power to build causal disease models Molecular Health sees the convergence of patient care and pharma R&D. Disease understanding at the molecular level allows better treatment and better drug development.

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