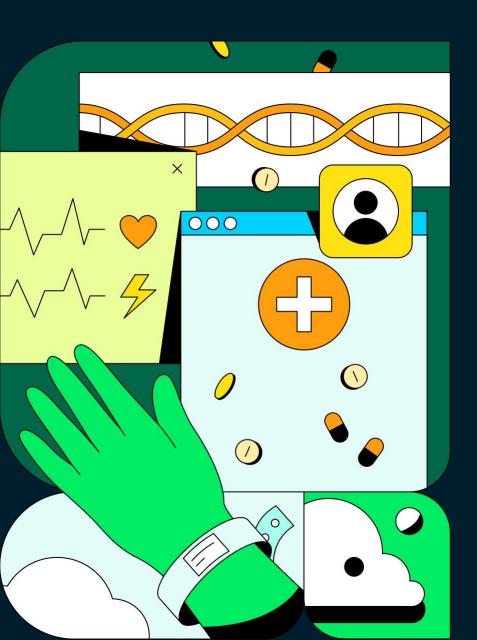
Healthcare and Life Sciences



AI is transforming healthcare by enhancing decision-making, improving patient experiences, and boosting operational efficiency.

In life sciences, AI accelerates research, drives drug discovery, and personalizes treatments, leading to breakthroughs in innovation and tailored medicine.

Transformative Potential of Generative AI in Healthcare and Life Sciences

The healthcare and life sciences sectors have witnessed a significant surge in the application of artificial intelligence (AI) and machine learning (ML) over recent years. These technologies have been increasingly integrated into various aspects of healthcare, from diagnostics and treatment planning to operational efficiencies and patient engagement. The acceleration of AI and ML adoption is evident in the exponential growth of FDA-approved algorithms, reflecting a broader acceptance and reliance on these technologies to enhance healthcare delivery.

However, the advent of generative AI marks a new frontier in this evolution, bringing the potential to disrupt and revolutionize even more areas of the industry. Unlike traditional AI, which primarily focuses on analyzing and predicting, gen AI can autonomously read and interpret multimodal data, and generate new content, offering unprecedented possibilities in automation, personalized medicine, drug discovery, and beyond.

The challenge: Administrative burden and clinician burnout

Healthcare professionals have long been the cornerstone of patient care, responsible for inputting vast amounts of information into electronic health records (EHRs) with the promise that it would lead to improved patient outcomes. However, many clinicians feel they have yet to see the tangible benefits of these systems. Studies reveal that clinicians spend twice as much time on administrative tasks as they do in direct contact with patients. Additionally, 57% of healthcare providers report that excessive documentation contributes to clinician burnout. This administrative overload not only affects the well-being of healthcare providers but also has a negative impact on patient care, with two out of three patients reporting a lack of empathy from their healthcare providers due to these constraints.

The solution: Leveraging gen AI to alleviate administrative burden

Gen AI has the potential to dramatically reduce the administrative workload on healthcare professionals, allowing them to focus more on patient care. Technologies such as ambient listening, combined with advanced patient records, could automate much of the documentation process, reducing the time clinicians spend on EHRs. By harnessing these capabilities, healthcare providers can reclaim valuable time, improve the quality of patient interactions, and ultimately enhance overall patient outcomes.

This technology could also facilitate the summarization of patient records and present them in visually rich interfaces tailored to the specific needs of each organization, specialty, and even individual healthcare providers. Gen AI can also assist in the documentation and analysis of insights from medical imaging and lab results, as well as automate prior authorization processes to enhance efficiency for both providers and payers. These advancements would significantly lighten the workload and reduce the burden on clinicians, allowing them to dedicate more time and energy to patient care.

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Transforming patient communication and engagement

Gen AI is not only transformative for healthcare providers but also holds promise for enhancing patient communication and engagement. By offering personalized and customized communication strategies, gen AI can help create more meaningful patient interactions, build customized patient journeys, and promote preventive care. This increased engagement could lead to better patient outcomes and higher satisfaction rates, as patients feel more connected and understood by their healthcare providers.

Impact on life sciences: Accelerating the medication lifecycle

In the life sciences sector, gen AI is poised to impact the entire medication lifecycle, from discovery to post-marketing surveillance. In the realm of basic research, gen AI has shown success in simulating new molecules and interactions, providing researchers with novel ways to interact with vast amounts of scientific literature. This could accelerate the drug discovery process, leading to faster development of new therapies.

During clinical trials, gen AI can improve the accuracy and speed of developing clinical

study reports (CSRs) and other essential documents. By streamlining these processes, gen AI can reduce the time required to bring new medications to market, ultimately benefiting patients by providing quicker access to new treatments.

In the post-marketing phase, AI can enhance surveillance efforts by monitoring real-world data for adverse effects and other key indicators, ensuring that medications remain safe and effective after they have been approved.

Prioritization

With the rapid progression of AI, decision makers are now faced with the challenge of prioritizing these numerous opportunities. The possibilities are vast, but the path forward requires careful consideration and strategic planning. Keep reading to explore how industry leaders are already applying these groundbreaking technologies and discovering offering insights that can help navigate this complex and exciting landscape.

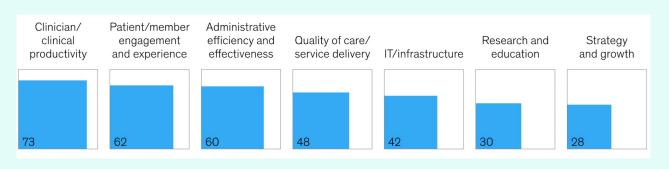


Figure 48: <u>Mckinsey</u>: Areas believed to benefit from generative AI (% of respondents)

In healthcare, transforming data into actionable insights is vital for enhancing clinical outcomes and advancing patient care. From medical professionals improving care delivery to administrators optimizing workflows and researchers advancing knowledge, data is the lifeblood of the healthcare ecosystem. Today, AI emerges as a pivotal technology, with the potential to enhance decision-making, improve patient experiences, and streamline operations—and to do so more efficiently than traditional systems.



Patient Experience & Engagement While they may not expect it based on past interactions, patients crave a seamless experience with healthcare providers. Ideally, patient data from healthcare services, including telehealth platforms, patient portals, wearable devices, and EHR, can be shared securely across interoperable channels. Unfortunately, disparate data sources, burdensome and time-consuming administrative work for providers, and overly complex and bloated solution stacks at the health system level stand in the way of that friction-free experience. AI can synthesize vast amounts of data and provide actionable insights, leading to personalized and proactive patient care, automated administrative processes, and real-time health insights. AI technologies, such as ML algorithms, natural language processing (NLP), and chatbots are being used to enhance and quantify interactions. Additionally, AI-powered systems can automatically schedule appointments, send notifications, and optimize clinic schedules, all of which can reduce patient wait times. AI-enabled chatbots and virtual health assistants provide 24/7 support, offering instant responses, medication reminders, and personalized health education. AI can even identify trends and predict health events, allowing for early intervention and reducing adverse outcomes.

MongoDB's flexible data model can unify disparate data sources, providing a single view of the patient that integrates EHRs, wearable data, and patient-generated health data for personalized care and better patient outcomes. For wearables and medical devices, MongoDB is the ideal underlying data platform to house time series data, significantly cutting down on storage costs while enhancing performance.

On the patient care front, MongoDB can support AI-driven recommendations for personalized patient education and engagement based on the analysis of individual health records and engagement patterns, and Atlas Vector Search can power search capabilities within patient portals, allowing patients to easily find relevant information and resources, thereby improving self-service.



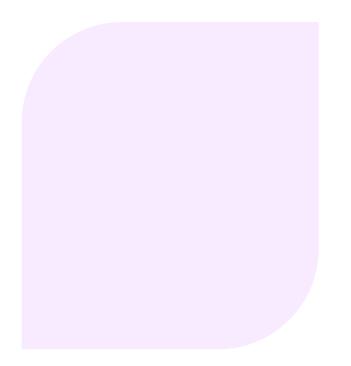
Enhanced Clinical Decision Making

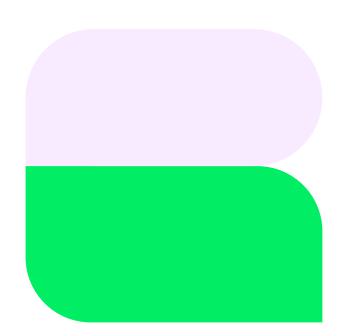
Healthcare decision making is critically dependent on the ability to aggregate, analyze, and act on an exponentially growing volume of data. From EHRs and imaging studies to genomic data and wearable device data, the challenge is not just the sheer volume but the diversity and complexity of data. Healthcare professionals need to synthesize information across various dimensions to make informed, real-time, accurate decisions. Interoperability issues, data silos, lack of data quality, and the manual effort required to integrate and interpret this data all stand in the way of better decision-making processes.

The advent of AI technologies, particularly NLP and LLMs, offers transformative potential for healthcare decision making by automating the extraction and analysis of data from disparate sources, including structured data in EHRs and unstructured data in medical literature or patient notes.

By enabling the querying of databases using natural language, clinicians can access and integrate patient information more rapidly and accurately, enhancing diagnostic precision and personalizing treatment approaches. Moreover, AI can support real-time decision making by analyzing streaming data from wearable devices, alerting healthcare providers to changes in patient conditions that require immediate attention.

MongoDB, with its flexible data model and powerful developer data platform, is uniquely positioned to support the complex data needs of healthcare decision-makers. It can seamlessly integrate diverse data types, from FHIR-formatted clinical data to unstructured text and real-time sensor data, in a single platform. By integrating MongoDB with large language models, healthcare organizations can create intuitive, AI-enhanced interfaces for data retrieval and analysis. This integration not only reduces the cognitive load on clinicians but also enables them to access and interpret patient data more efficiently, focusing their efforts on patient care rather than navigating complex data systems. MongoDB's scalability ensures that healthcare organizations can manage growing data volumes efficiently, supporting the implementation of AI-driven decision-support systems. These systems analyze patient data in real time against extensive medical knowledge bases, providing clinicians with actionable insights and recommendations, thereby enhancing the quality and timeliness of care provided.





MongoDB's Atlas Vector Search further enriches decision-making processes by enabling semantic search across the database. This integrated approach enables the application of prefilters based on extensive metadata, enhancing the efficiency and relevance of search results without the need to synchronize with dedicated search engines or vector stores, meaning healthcare professionals can utilize previously undiscoverable insights, streamlining the identification of relevant information and patterns.

Enhancing Medical Imaging with Generative AI

Generative AI offers a transformative solution by automating the extraction, analysis, and summarization of information from medical images. By leveraging advanced NLP, embeddings, and ML techniques, generative AI can rapidly analyze large datasets, identify key insights, and generate accurate, comprehensive summaries. This significantly reduces the time radiologists spend on manual data review, allowing them to focus more on patient care and decision-making.

For instance, AI-powered tools can be integrated into radiology workflows to automatically generate impressions and diagnostic summaries based on imaging data. These tools not only streamline the reporting process but also enhance the accuracy of diagnostics by cross-referencing findings with historical data and known medical conditions. Moreover, chat-based AI assistants can provide real-time support to clinicians by answering queries and offering contextually relevant information derived from patient records and imaging results.

MongoDB's role in supporting AI applications

MongoDB plays a crucial role in enabling these AI-driven applications. By providing a flexible and scalable database architecture, MongoDB allows for the efficient storage and retrieval of vast amounts of unstructured medical data, including reports, and metadata from DICOM files. Its support for vector search capabilities is essential for implementing retrievalaugmented generation (RAG) approaches, which enhance the accuracy and relevance of AI-generated summaries.

Medical visual question answering (MVQA)

Building on the broader capabilities of generative AI in radiology, MVQA specifically targets the intersection of medical imaging, clinical reporting, and NLP. In this sub-use case, generative AI is utilized to not only generate summaries but also to directly answer clinician-specific queries regarding medical images and reports.

Aa an example, a clinician might ask, "What are the signs of pulmonary embolism in this CT scan?" The MVQA system would analyze the CT image, cross-reference it with the clinical report, and provide a precise answer such as, "Presence of filling defects in the pulmonary arteries consistent with pulmonary embolism."

This application significantly enhances the comprehension of imaging reports, providing concise and clinically relevant answers, which improves diagnostic accuracy and speeds up decision-making processes.

MVQA combined with vector search streamlines diagnostics and supports a more targeted and effective approach to analyzing complex medical images.

Vector embeddings for biopsy image analysis

Another compelling use case involves applying vector embeddings to store and analyze predefined images with suspicious findings, such as those from large biopsy images. Similar to text analysis, where large texts are divided into smaller chunks, large medical images can be segmented into tile sets (e.g., 100x100 pixels).

A vector representation is generated for each tile, capturing its unique characteristics. By leveraging Atlas Vector Search, a specialized viewer tool can rapidly identify and highlight suspicious tiles within the image. This process allows pathologists to quickly pinpoint areas of concern, significantly enhancing the accuracy and efficiency of their reviews.

Additionally, MongoDB's partnership ecosystem, including collaborations with AI pioneers, accelerates the development and deployment of these cutting-edge solutions in the medical field.

The following figure shows the recommended architecture to implement this use case using MongoDB Atlas.

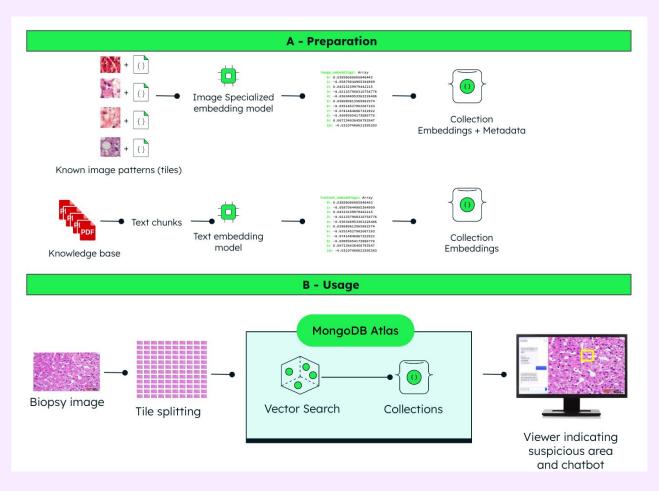


Figure 49: Gen AI in medical imaging with MongoDB Atlas for the detection of suspicious biopsies combined with a knowledge base chatbot

By integrating generative AI into the medical imaging workflow, healthcare providers can achieve significant improvements in diagnostic accuracy, reporting efficiency, and overall patient care. The synergy between MongoDB's robust data management capabilities and advanced AI technologies paves the way for a future where healthcare professionals can deliver faster, more reliable diagnoses, ultimately improving patient outcomes and reducing operational burdens.

This use case demonstrates how generative AI, combined with MongoDB, can revolutionize the way medical imaging data is handled in healthcare, offering a powerful solution to streamline processes, enhance accuracy, and support better patient care.

In life sciences, transforming vast amounts of data into actionable insights is critical throughout the entire medicine lifecycle—from basic research to market. With the rise of precision medicine and genomics, AI is playing a transformative role by tailoring treatments to individual patients based on genetic, environmental, and lifestyle factors. Generative AI accelerates drug discovery, analyzes genomic data for personalized treatment pathways, and optimizes clinical trials.

Revolutionizing Clinical Study Reports (CSRs) with Generative AI and MongoDB

The pharmaceutical industry faces immense pressure to expedite the regulatory approval process for new drugs and therapies. A critical component of this process is the creation of Clinical Study Reports (CSRs), which are comprehensive documents detailing the methodology, execution, and results of clinical trials. Traditionally, compiling a CSR is a labor-intensive task, often requiring several weeks to complete and involving multidisciplinary teams. This prolonged timeline not only delays the introduction of potentially life-saving treatments but also incurs significant costs associated with prolonged R&D cycles.

Challenge

The process of generating CSRs is complex, involving the integration of vast amounts of clinical data, including statistical outputs and detailed narratives. Manual methods are time-consuming and error prone, which can further delay regulatory approvals. Plus, the need for compliance with stringent regulatory standards, such as those set by the FDA and EMA, adds another layer of complexity to the document creation process.

Solution: Generative AI and MongoDB Atlas

Generative AI, integrated with MongoDB Atlas, offers a groundbreaking solution to these challenges by automating the CSR creation process. This approach can reduce the time required to generate CSRs from weeks to mere minutes, allowing pharmaceutical companies to accelerate their time-to-market for new drugs.

With MongoDB Atlas, companies can leverage a flexible, scalable database environment that supports the dynamic and varied data structures inherent in clinical trials. This flexibility is crucial for managing the diverse data types involved in CSR generation, including text, tables, and complex statistical data. By using generative AI models, companies can automate the drafting of CSRs, producing high-quality, compliant documents that require minimal human intervention.

For example, these AI models can automate the importation and transformation of data tables, generate accurate narratives, and ensure that the final documents meet the compliance standards required by regulatory bodies. MongoDB's Vector Search capabilities further enhance this process by enabling the retrieval of relevant data with high precision, which the AI uses to generate consistent and accurate content.

Extended benefits to any medical writing

The same approach described here for CSRs can provide an end-to-end approach that covers a wide range of regulatory documents, including CSRs, clinical trial narratives (CTNs), summary clinical safety (SCS), and summary clinical efficacy (SCE). This comprehensive coverage ensures that companies can automate much of their regulatory submissions, reducing the risk of human error and speeding up the entire process.

Conclusion

By integrating generative AI with MongoDB Atlas, pharmaceutical companies can transform their approach to generating clinical study reports. This solution offers unparalleled speed, accuracy, and compliance, enabling companies to bring new treatments to market faster while maintaining the highest standards of quality and regulatory adherence. The result is a more efficient drug development process that ultimately benefits patients by accelerating access to innovative therapies.



Novo Nordisk accelerates drug approval with gen AI and MongoDB Atlas

Novo Nordisk, a global leader in healthcare, is transforming how it brings new medications to market using generative AI and MongoDB Atlas. Known for its pioneering work in diabetes care, Novo Nordisk produces 50% of the world's insulin and serves millions of patients worldwide.

NovoScribe: Revolutionizing regulatory submissions

With the introduction of NovoScribe, the company has significantly reduced the time required to generate clinical study reports (CSRs), which is a critical step in the regulatory approval process.

NovoScribe, built on Amazon Bedrock, LangChain, and MongoDB Atlas, has enabled Novo Nordisk to reduce the time to compile CSRs **from 12 weeks to just 10 minutes**. This innovation is helping Novo Nordisk get new medicines to patients faster, enhancing both the speed and quality of their regulatory submissions. By leveraging MongoDB Atlas's capabilities, NovoScribe automates complex data retrieval and analysis, allowing the company to scale its operations efficiently and securely across multiple cloud platforms.

"We've reduced the time taken to create clinical study reports from 12 weeks to 10 minutes, with higher quality outputs and a fraction of the team. In terms of value, each day sooner a medicine gets to market can add around \$15 million in revenue to the company."

<u>Learn more</u> Waheed Jowiya

Digitalisation Strategy Lead at Novo Nordisk

Accelerating Drug Discovery with Generative AI

Current state and challenges

In the pharmaceutical industry, the drug discovery process is a complex, resource-intensive endeavor, often involving extensive experimentation, data integration, and analysis. Traditional methods, which rely heavily on manual research and iterative testing, can be slow and costly, delaying the time to market for new drugs and driving up overall development expenses.

A key challenge in this domain is managing and interpreting **vast volumes of diverse data**. Researchers must sift through enormous datasets of molecular structures, chemical reactions, and historical research to identify promising candidates. The process requires not only identifying molecules with desirable properties such as high efficacy and low toxicity but also predicting their behavior in complex biological systems.

The iterative nature of drug discovery, combined with these data challenges, results in high costs and significant time investment, with no guarantee of success. This underscores the need for more efficient, data-driven approaches to accelerate the discovery process and reduce development costs.

Leveraging advanced technologies to transform drug discovery

The drug discovery process is poised for transformation through the integration of advanced technologies such as vector embeddings, SMILES notation and MongoDB Atlas. By converting both textual information and molecular data into vector representations, researchers can unlock new efficiencies and insights, setting the stage for more effective NLP applications in drug discovery.

At the core of this transformation is the ability to convert diverse data types—ranging from textual descriptions in scientific literature to molecular structures and chemical reactions—into vector representations. These embeddings serve as compact, high-dimensional numerical representations that capture the essential properties and relationships of the data.

 Molecular embeddings: Molecules, including those represented by SMILES notation, are transformed into vector embeddings that encapsulate their structural and functional characteristics. This allows for the comparison of molecules based on their properties rather than their chemical structures. As a result, molecules with similar therapeutic potential can be identified even if they differ in their chemical makeup.

- **Reaction embeddings:** Chemical reactions can also be represented as vector embeddings, capturing the transformation of reactants to products. This facilitates the search for reactions that are functionally similar, helping researchers identify alternative synthesis pathways or optimize existing reactions.
- **Text embeddings**: Scientific literature, patents, and other textual data are converted into vector embeddings that represent the semantic content of the text. This enables the system to understand the context and meaning behind complex chemical terms and descriptions, making it easier to link related concepts across different documents.

By embedding all these data types into a unified vector space, researchers can perform powerful similarity searches, clustering, and predictive modeling, significantly enhancing their ability to discover new drug candidates.

MongoDB Atlas as a developer data platform

MongoDB Atlas provides the robust infrastructure needed to store and manage the diverse data types involved in drug discovery. With the ability to handle both structured and unstructured data, MongoDB Atlas supports the integration of molecular structures, textual descriptions, reaction pathways, and their corresponding vector embeddings into a single, scalable database.

This unified data platform allows for seamless querying and retrieval of data. Researchers can access molecular structures, related literature, and embeddings all within the same environment, ensuring that they have the comprehensive information needed to drive their research forward. MongoDB Atlas supports the use of vector search technologies, enabling efficient and accurate exploration of the chemical space.

Enhanced discovery through Atlas Vector Search and NLP

Atlas Vector search allows researchers to explore chemical and textual data in a way that was previously impossible. When a researcher inputs a molecular structure or a piece of text, the system can rapidly identify other molecules, reactions, or documents that are similar in the vector space.

For instance, a researcher could input the vector representation of a promising molecule, and the system would return a list of similar molecules from the database, ranked by their similarity in the vector space. This enables the identification of potential drug candidates that might not have been considered through traditional search methods.

By leveraging NLP, researchers can run complex queries in plain language, such as "What are the most recent studies on molecules similar to this compound?" or "Show me reactions that convert this functional group to another." The NLP models interpret these queries, search the vectorized database, and return the most relevant results, whether they are molecular structures, reaction pathways, or related literature.

This capability drastically reduces the time and effort required to find relevant information, allowing researchers to focus more on analysis and decision making rather than data retrieval.

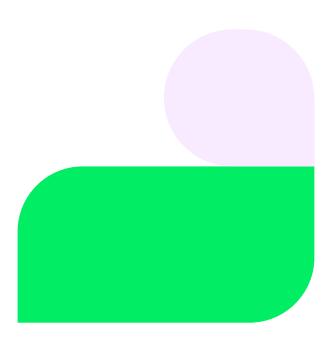
LLMs for hypothesis generation and decision support

Large language models (LLMs) trained on extensive datasets of chemical and biological information can further enhance the drug discovery process by generating hypotheses, proposing new molecules, and optimizing reactions. Given a specific query or a set of parameters, LLMs can generate novel SMILES strings for potential drug candidates, predict their properties, and suggest optimal synthesis routes.

LLMs also play a crucial role in decision support. By analyzing the vast amount of data stored in MongoDB Atlas, they can provide insights that might not be immediately apparent, such as identifying unexpected correlations between different molecules or predicting potential side effects based on historical data.

Outcome and benefits

- Time and cost savings: The integration of AI with MongoDB Atlas significantly reduces the time required for drug discovery and reaction optimization, leading to faster time-to-market and lower R&D costs.
- Improved accuracy: AI-driven predictions are more accurate, reducing the need for extensive manual experimentation and iteration.





Cutting-edge recommendation engine leverages advanced language models and vector search technology.

This AI-driven system integrates MongoDB's modern data platform to store and manage complex molecular data, allowing scientists to perform natural language queries for rapid identification of promising molecular structures. The platform also unifies data from various sources, including time series data from PLC devices, enabling faster and more refined molecule discovery processes. The implementation of Exafluence's solution is expected to reduce the time-to-market for specialty life sciences products by 40%. The enhanced system enables faster and more accurate molecule discovery, streamlining the production of specialty chemicals across various industries. Additionally, the planned introduction of a mobile app will use real-time data to further improve the accuracy of molecular predictions, enhancing research decisions and overall operational efficiency.

Learn more

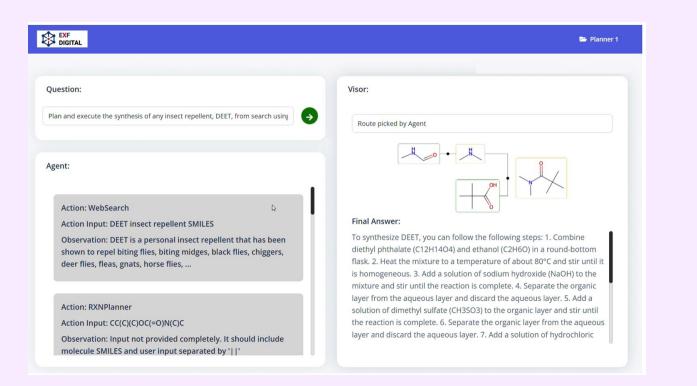


Figure 50: Screenshot from Exafluence AI-powered platform showcasing the automated synthesis planning of DEET using integrated web search and reaction planning tools

Other Notable Use Cases

Behavioral health monitoring and sentiment analysis

Generative AI integrated into wearables or apps can monitor conditions like depression and anxiety by analyzing speech, activity levels, physiological signals, and sentiment. It provides early alerts and suggests interventions, enabling proactive care and improving mental health management.

Automating prior authorization, coding, and billing

Generative AI automates prior authorization, coding, and billing by assisting with form completion, accurate record coding, and reviewing insurance policies. This reduces errors, speeds up approvals and reimbursements, and improves efficiency for both providers and payers.

Personalized patient history visualization

Generative AI customizes and summarizes patient history views based on the specific needs of each healthcare professional. By highlighting the most relevant records, results, and treatments, and providing concise summaries, AI streamlines access to critical information.

Personalized treatment pathways in clinical trials

Generative AI analyzes patient data to create personalized treatment plans for clinical trials, predicting responses and optimizing trial designs. This improves efficiency, accelerates drug development, and enhances patient outcomes.

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