

21 Sep 2023 | Analysis

The Power Of AI To Map The Patient Journey

by Jo Shorthouse

Mapping the patient journey uncovers a wealth of insights into care, diagnosis and intervention. The onset of advanced analytics tools and sensors now augment the pharma industry's understanding of the challenges of traversing health care systems. Layering AI into the mapping process not only has the power to provide insights into the current clinical pathway, it can be used to predict and intervene in clinical care.

Mapping the patient journey, the experience of a patient as they navigate through the various stages of care for a specific condition, provides a vital wealth of knowledge for health care providers, health systems and biopharmaceutical companies to assess the patient experience from multiple angles.

These insights create an invaluable window into the obstacles faced in delivering care, the effectiveness of patient-physician interactions, specific areas of concern for patients and the reasoning behind care-related decisions, all of which are critical pieces of the therapeutic and diagnostic development puzzle. It is a fundamental piece in improving the *Triple Aim* of healthcare; the improvement of patient experience, raising the health of populations and reducing health care cost.

Patient journey mapping facilitates a continuous and comprehensive visualization of information while incorporating both quantitative and qualitative aspects. Critically, it encompasses the behaviors of patients, caregivers and healthcare providers, enabling a better understanding of the overall care experience.

The patient's journey begins with the onset of symptoms, followed by seeking medical attention for diagnosis. From there, the pathway involves initiating treatment to manage the diagnosed condition, which can ultimately result in a cure or long-term disease management. It may also

involve the patient's participation in a clinical trial. However, the patient journey is not a straight line, and can highlight moments when individuals encounter frustrations or challenges such as uncertain diagnoses, misdiagnosis, additional evaluations and second opinions.

Power To The Patient

Looking at the pharmaceutical industry today, with the role of chief patient officer and patient centricity roles located within the C-suite, one would be forgiven for thinking that the importance placed upon understanding the patient journey had always been central to pharma's product development strategy.

Not so. Anthony Yanni recalled a time to *In Vivo*, around 15 years ago, when working as a physician and talking to a room full of executives at a large pharma and asking them why they weren't talking to the patients. "That question was not well received," he explained. "Now, you fast forward all these years, we have robust systems, and other companies are integrating the patient perspective into decision making," said Yanni, now head of patient centricity at [Astellas Pharma, Inc.](#)



ANTHONY YANNI, HEAD OF PATIENT CENTRICITY, ASTELLAS *Source: Astellas*

In 2014, [Sanofi](#) was the first large pharma to create the role of chief patient officer. When the French major announced the appointment of Anne Beal to the position, it said that "interactions with patients were a source of strength for the company," with Beal adding that she would "infuse the patient perspective into Sanofi's work that will advance our ability to deliver health care solutions that matter most to patients and those who care for them."

Nine years later, and patient participation in decision making, both commercial and clinical is embedded within pharma. Disease foundations, patient advocacy groups, regulators, physicians and technology providers are connected to place the patient at the center of the pharmaceutical ecosystem. With the patient and their caregivers now placed at the heart of

pharma strategic thinking, mapping the patient journey for better health outcomes and improving the patient experience takes on a greater significance.

"What we try to do, and across industry, we include the caregiver, we include the provider, we understand the environment in which the patient lives in a real-world setting. All those things are critically important to understanding that group of patients that have similar experiences, so we can best understand not only what solutions they are looking for, but how do you deliver

those solutions in their world,” said Yanni.

Traditional Patient Journey Mapping

Traditional market research methods, created through physician surveys, to map the patient journey would have consisted of the sequence in which a patient passes through a healthcare system, *see Exhibit 1*. This doctor-centered map would fail to show emotional or behavioral aspects to the journey from symptom to treatment, and fundamental events that would happen outside the physician’s environment such as pain and the variation of symptoms. Importantly, it did not include drug adherence, drug burden, age, culture, lifestyle, or the way in which caregivers were impacted.

Exhibit 1: A Sequential Patient Journey

[*Click here to explore this interactive content online*](#) ✎

It also failed to show the impact of payer decisions and oversimplified the process with which the patient entered and exited the healthcare system. Mapping a patient’s journey is a complicated undertaking, said Yanni, that should not use a one-size-fits-all approach. “The definition of a patient journey depends on the patient. This is why it’s important to talk to patients in different geographies, a diverse set of patients to understand their personal experiences, and all the variables that impact it,” he explained. “There are different populations within a disease, we cannot map one Parkinson’s disease patient and think we have completed the task,” he said.

The importance of culture, age, and comorbidities all play a role in understanding the various cohorts of a population living with a specific condition, making it a fundamental undertaking to investigate and understand the journey as completely as possible.

This is where modern digital means enter the situation. Advances within patient-owned technology, such as the smartphones and the use of social media, coupled with wearable technology, connected electronic medical records (EMRs) and the increasing use of advanced analytics to make meaning from big data create a burgeoning environment in which to map the patient journey with detail never seen before.

The Digital Era

Any company developing a product needs to know their customer intimately, and a drug manufacturer is no different. Tools are now at hand for drug makers such as telehealth solutions, remote monitoring, blockchain for data security, data interoperability and Internet of Things devices such as sensors, wearables and apps. These elements continue to mature in sophistication and accessibility, and if brought together in a strategic and deliberate way can create a digital patient journey that is integrated within life science company decision making.

Clinical and commercial decisions are made from qualitative and quantitative information gleaned from digital patient journey mapping and, increasingly, drug makers are using artificial intelligence (AI) and machine learning (ML) to find insights into patient behavior, often in real time.

While understanding the real-world patient journey is complex because of big data, the lack of scalable solutions, and the personal nature of each patient's journey, ML and advanced analytics can now be applied to a crucial part of pharma's commercial toolkit.

Companies such as [Medidata Solutions Inc.](#), which provides cloud services to those involved in clinical research, are using AI to create a holistic picture of the patient's journey. "One of the biggest changes in the mapping of the patient journey, especially in clinical trials, is more use of patient-reported outcomes, more use of sensors and wearables. That allows you to get a better understanding of the true condition of the patient at variable points in time," said Fareed Melhem, head of AI for Medidata.

With the incredible amount of data now being generated through sensors the only way to create insights, and to connect the patient reported outcome (PRO) data with physical data is to use AI, Melhem told *In Vivo*. "We capture and maintain all of that data and use a number of algorithms to pull out key events and correlate it with other data that's coming in," he explained. If a patient is reported that they feel well in their PRO log, for instance, Medidata can correlate that with sensor data at that time. Data from sensors that record physical actions or states such as sleep, activity, or gait can be added to AI data to create a more holistic picture of the patient journey.

The journey through the health care system is fluid and dependent on many factors such as patient age and location. Product strategy, too, must respond to this mutability and take it into consideration within lifecycle management strategy.

Not only can AI augment the patient journey, but it can also create new approaches and alternative pathways. For instance, at the American Society of Clinical Oncology (ASCO) 2022 meeting, Medidata presented research that showed using AI could predict adverse events at a patient level. In the CAR T-cell therapy space, cytokine release syndrome (CRS) is the most common life-threatening adverse event. Medidata, alongside Michael Kattan of the Cleveland Clinic, compiled and analyzed the largest pooled clinical trial data set in existence from anti-CD19 CAR-T treatments, spanning more than 540 patients from multiple CAR-T clinical trials.

The team used big-data modeling techniques to quantify the relationship between patients' lab measurements and the development of severe CRS. They analyzed common markers such as platelet counts, serum albumin concentration, creatinine, and neutrophil counts to spot changes or patterns occurring in the days following key milestones in CAR-T treatment pathways, which could lead to new approaches such as novel REMS for severe CRS. "Now a physician can

intervene sooner when they see certain predictive markers and preempt those issues. So that way, AI moves the patient to a new branch of the patient journey,” explained Melhem.

“AI can go beyond just the mapping of the journey to improve the patient journey and sometimes be integrated within the patient journey,” he told *In Vivo*.

Proceed With Caution

Astellas’ Yanni sees the onset of digital capabilities as an adjunct to traditional patient journey mapping techniques, rather than a replacement. While advanced analytics approaches allow a broader understanding of the patient journey because of the large datasets that were unavailable for analysis before now, this requires more discernment.

The access to information is incredible, Yanni believes, but we need to ask vital questions. “Is the information we’re looking at accurate? Does it apply to the patient population and the questions we are asking? Is there hidden bias in the accumulation of that information you’re looking at? There are so many things that we have to be cautious of because, in my view, more data does not necessarily mean more accurate information,” he said.

“We need to be very careful in how we approach this so that we understand what we’re utilizing, what questions we’re asking, and how we are applying the information we find,” he warned.

Yanni’s instinct seems to be echoed throughout the rest of big pharma. While the buzz around potential use cases of AI to innovate the development of new therapies has a long news tail attached to it, it has only reached widespread adoption in activities such as site selection and enrolment modelling. Big pharma is, of course, exploring the potential for AI-powered innovation, in fact large pharma companies have agreed to more than 75 AI partnerships with institutions in recent years.

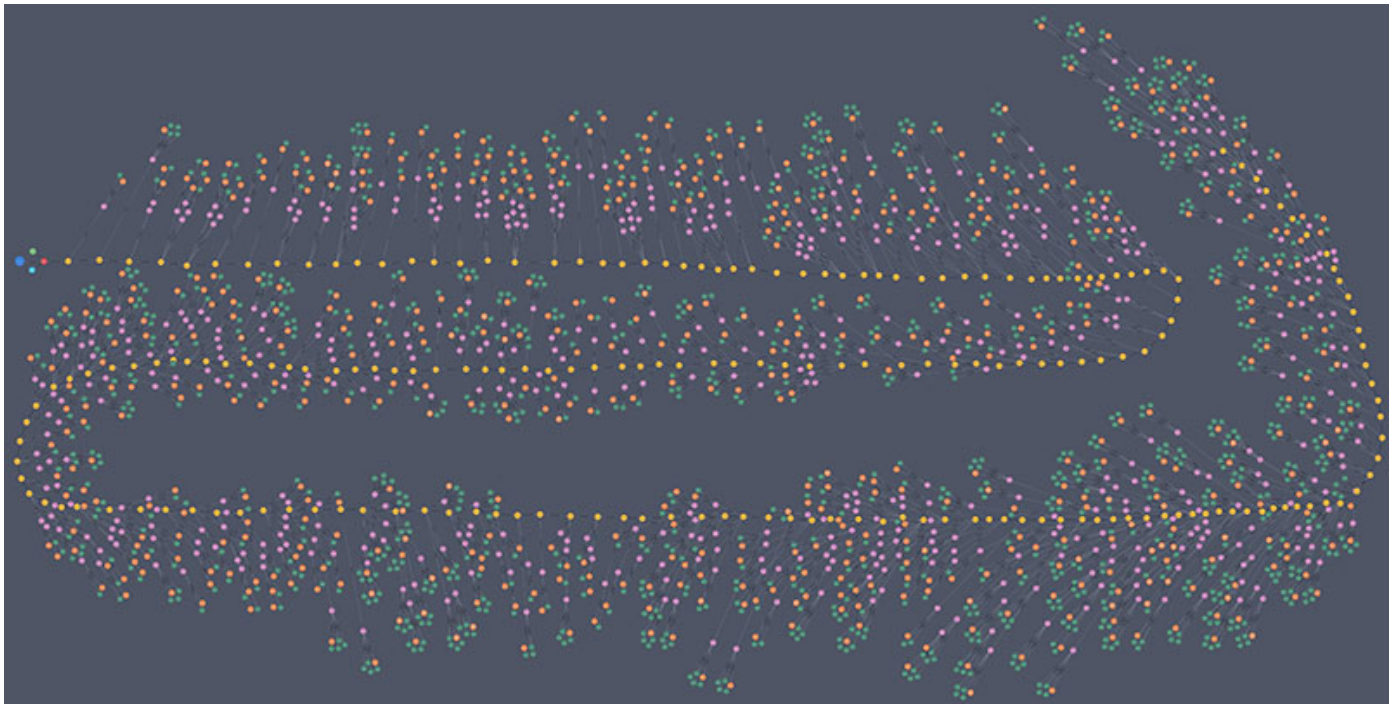
Partnerships such as those announced by [Janssen Pharmaceuticals Inc.](#) and MIT (which also facilitates the Machine Learning for Pharmaceutical Discovery and Synthesis Consortium), [AbbVie Inc.](#) and Calico and Sanofi and [Exscientia plc](#) have all grabbed the headlines. While [Novartis AG](#) said it has “applied AI broadly” to innovate across R&D to develop novel therapies and engage with patients, it concurrently published its commitment to the ethical and responsible use of AI.

A recent ZS report, it cites barriers such as the need for high-quality data, navigating intricate regulatory landscapes, overcoming organizational resistance to change, developing AI algorithms that are interpretable and trustworthy, and bridging the talent gap between data science and industry-specific expertise. “Integrating AI demands significant workflow alterations and a workforce that possesses both data science proficiency and deep industry knowledge,” said author Pranava Goundan.

“There is this growing need for large data science centers that have GPUs which are very expensive, and take a lot of energy to run,” said David Hughes, graph practice director at Graphable. “We’re starting to recognize is that there are significant barriers to operationalize machine learning and large language models, the cost of running, retraining, fine tuning and then actually generating insights from trained models is going to be prohibitive to all but the top tier of tech company.”

Visualization And Modelling

Hughes, having previously worked at the Seattle Cancer Care Alliance, All4Cure and [Octave Bioscience Inc.](#), has an intimate knowledge of how the [patient journey mapping](#) process and the creation of a clinical pathway can be a powerful combination to capture a comprehensive view of the complex nature of a disease, its effect on a patient and the actions of a healthcare system, see *Exhibit 2*.



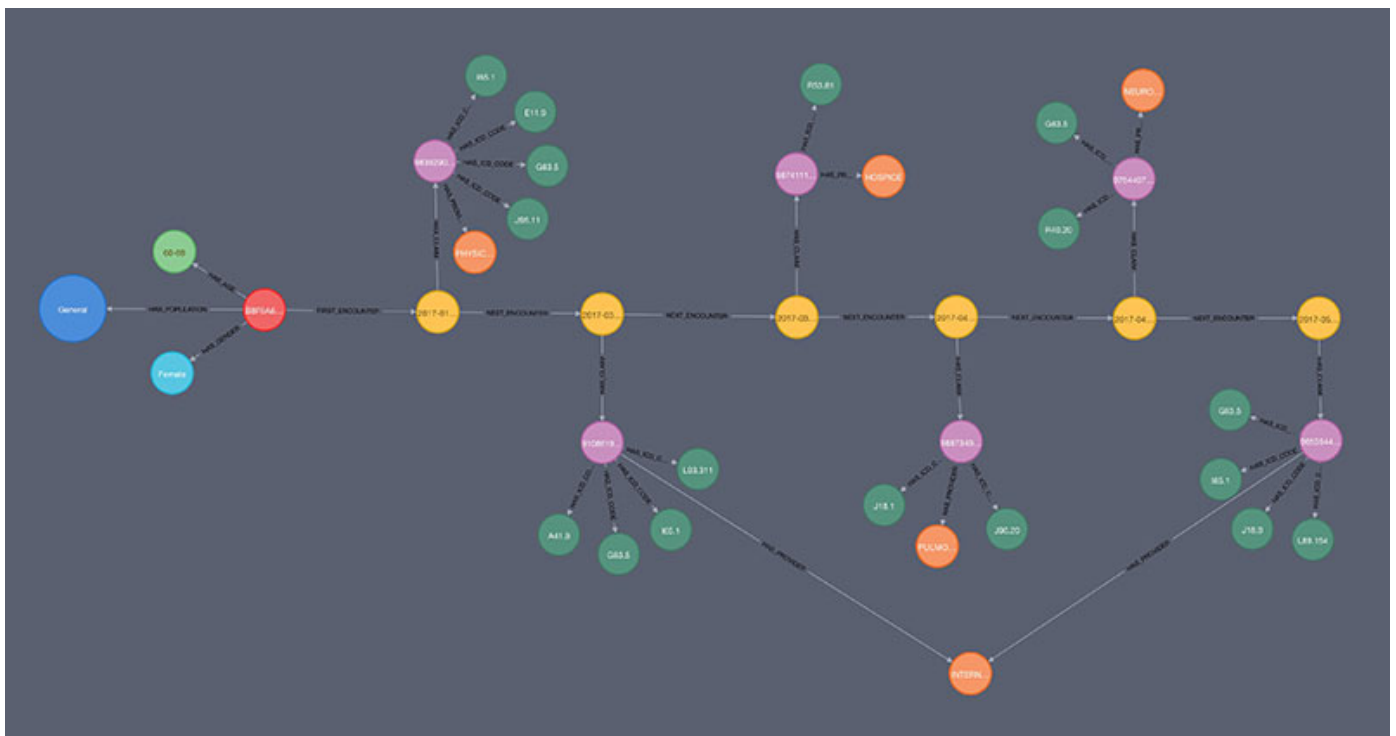
[Source: Graphable](#)

Graphable works with companies to make sense of data and is working with pharma on everything from drug discovery, novel protein development and synthesis, and patient journey mapping to better understanding disease progression. Hughes believes that by using graph science and databases within patient journey mapping, pharma can uncover meaningful clinical insights that will lead to a better understanding of a patient’s journey and outcomes at scale.

The image above depicts a digital twin of a single patient's cancer journey. A digital replica of a patient's healthcare journey within the system is formed by first inputting the patient's clinical data into a clinical knowledge graph through graph models. This digital twin is then constructed with the aid of sophisticated schema-based clinical analytic systems. By mapping the patient journey, digital twins serve as valuable tools for uncovering real-world obstacles, care process gaps, and various challenges encountered by patients and their families.

To gain insights into a patient's clinical care, including aspects such as disease progression and cost analysis, a specialized graph schema is developed to facilitate these investigations. *Exhibit 3*, displayed below, illustrates the graph schema corresponding to the journey depicted in *Exhibit 2*. This schema represents a patient (depicted as a red node) with a chronological sequence of clinical encounters (represented by yellow nodes).

Each clinical encounter is intricately connected to an insurance claim event and further associated with the claim's procedures, diagnoses, medications, imaging, clinical providers and other pertinent facets of care. This comprehensive linkage offers a holistic perspective of a patient's journey through the months and possible years of clinical interventions.



Source: Graphable

The use of schematics such as that shown above may begin with the intention of finding ways to

save cost within the health care system, but it can lead to epiphanies such as linking seemingly unrelated diagnoses given six months previously to a patient's main diagnosis "That might lead researchers and pharma to start exploring the mechanism of action, and better understanding what else is happening here in the patient's world. They can then explore pathways, uncover insights, and even intervene earlier in a treatment," Hughes told *In Vivo*.

Graphs enable discovery opportunities which a company could then layer with machine learning, large language models or generative AI to hypothesize on prevention, treatment, or care. "Graph data helps to ground hypotheses into truth, which makes it easier to decide on investment or clinical avenues because there's evidence that supports the decision," Hughes said.

The Digital Journey Ahead

The rise of the digital patient, at the epicenter of their own health care journey, is now the expectation within modern health care and therapeutic choice. This is only the beginning of the future of digital patient journey planning, which will be characterized by increased personalization, the widespread use of advanced technologies like AI and telehealth, and a strong emphasis on patient engagement and empowerment.

These advancements have the potential to enhance the overall patient experience and improve healthcare outcomes. However, they also raise important ethical and regulatory considerations that will need to be addressed as health care continues its digital transformation.