

By Götz Wehberg, September 2023

Why LLMOps is the new kid on the Health Care block

The way LLMs help Operations coping with complexity of individualized medicine like CGT, and how to leverage it, comprehensively.



When talking about Health Care innovation, new drug development such as mRNA vaccines against Covid is typically in focus. But Health Care is not limited to R&D. As a matter of fact, most of the staff working in the Health Care sector are delivering services and take care for their patients on a day-to-day basis. Daily Health Care operations are at scale. The supply chain and shopfloor of Pharma production proceeds with hundred thousand of orders and facilitates, e.g., that there are antibiotics available in the pharmacy. Practitioners and nurses in hospitals perform several thousands of diagnostics and treatments every day. While everybody talks about Digital Health Care, here exactly is where the rubber hits the road, in daily Health Care operations and delivery.

Where are we coming from in Health Care operations today: Shopfloor operations in Pharma have been extensively addressed with standard operations procedures (SOP) and parameters to secure Good Manufacturing Practices (GMP). Process analytics have tried to understand the stochastic part of it and increase transparency where typically judgment of the operator and thus heuristic decision making comes into play. Many consultants have spent decades to make such heuristics explicit. Software companies have tried to translate such heuristics into proper coding, with mixed outcomes dependent on the complexity of operations. The current rise of individualized medicine like cell and gene therapy (CGT), however, is challenging the existing landscape of operations procedures and tools even more.

Similar in hospitals, where standard procedures are expected to secure the quality of both diagnostics and treatments, just because not every physician and nurse shares 25 years of experience or has the entire compendium of scientific research results handy, e.g., in Nephrology or Cardiology. Standard procedures have helped to secure effective care delivery at scale, i.e., within the entire team of a treatment area. As the shortage of experienced labor force is becoming more serious, quality assurance of care delivery is being challenged. Moreover, diseases like multiple sclerosis (MS)

are big "drawers" in textbook medicine. There is no one simple form of treatment that covers it all. Rather, patients must be diagnosed and treated individually, where possible in an outpatient mode. Such individualized treatments and the higher complexity associated ask for an even better qualification of staff and quality control.

Rules versus self-organization – the better way to cope with the individualization

Typically, the approach to develop and define operations procedures has been rule-based in the past. Clinical trials explored the right medicine and scientific research offered evidence-based practices. Corresponding algorithms typically have been articulated in a kind of if-then instructions. Many scientists and doctoral students have been working to explore such law-like relationships and validate them using multivariate methods of statistics. Similarly, the supply chain managers and shopfloor operators have referred to rules of lot size optimization, sequencing, network and material balancing and so forth.

A weak point of such rule-based approach, however, is its limited potential to cope with the upcoming complexity in Health Care and its individualization. There is a seeing-knowing gap to recognize existing complexity as well as a knowing-doing gap to manage complexity in the right way. You might remember Ashby's law of "requisite variety" suggesting that only complexity "eats" complexity. This is exactly where the two types of gaps are coming from.

The technology to recognize complexity (and thus close the seeing-knowing gap) with means of better diagnostics tools, digital twins and sensors has developed rapidly. E.g., computed tomography (CT) helps to diagnose the brain, skeleton and internal organs and tracking & tracing tools help to understand the structure of the Pharma supply chain network.

For managing higher complexity (i.e., closing the knowing-doing gap), requirements have always been clearly defined in terms of self-organization, however, there were little tools and solutions, which practically helped to implement. In shop floor operations for example, first attempts refer to Wildemann's Modular Factory, Warnecke's Fractals, then Ptak's DDMRP and the begin of Machine Learning (and, by the way, I myself also tried to contribute with some earlier publications). Proper technology to manage higher complexity in a self-organized fashion and at scale has been premature for long (for more see [here](#)).

LLM based Operations in Health Care

This is where artificial intelligence (AI) and large language models (LLM) come into play. Can LLM help securing operations quality in the future? Can it make self-organization happen, close the knowing-doing gap and thus manage the higher complexity in Health Care operations and delivery? In brief, yes it can.

As LLM-based Operations (LLMOps) seem to be the elephant in the room, let's see what is it exactly and how does it work (for more on LLM see [here](#)). Let's have a quick look into Autonomous Driving and how the Automotive Industry uses LLM. Autonomous Driving has been evolving from a rule based to LLM based system too, like Tesla's Full Self Driving (FSD) technology (for FSD see [CNBC](#)). FSD 12, was based on a new concept that Tesla believes will transform autonomous vehicles and be a leap toward artificial general intelligence that can operate in physical real-world situations. Instead of being based on hundreds of thousands of rules, algorithms, or lines of code like all previous versions of self-driving software, this new system had taught itself how to drive by processing billions of frames of video of how humans do it. Similarly, ChatGPT and other large language model chatbots train themselves to generate answers by processing billions of words of human text.

This means Digital Health Care delivery becomes self-trained and self-organized rather than rule based in a conventional sense. Instead of teaching a hospital the “golden standard” treatment path based on rules, LLMOps will imitate experienced practitioners. Similar for shopfloor operators in Pharma, where resilience will be improved by imitating successful shopfloor as well as supply chain managers. Faced with a diagnosis, the neural network chooses a path based on what practitioners or operators have done in thousands of similar situations before, successfully. As much as it took Tesla to analyze millions of video clips on driving situations, Health Care players will need to fuel their systems with a huge number of quality proven examples of good treatment or effective operations.

The pure mass of data facilitating self-learning will not only allow to imitate practices, however, there is a good chance that it will create new evidence for an even more effective Health Care delivery as much as new practices to manage the Pharma supply chain and operations even more effectively in a “lot size 1” world.

Way forward to leverage LLMOps

Obviously, the speed of self-training and thus quality of LLMOps depends on three factors, at least.

First, Health Care players with a high number of good-practice examples learn faster than others. Therefore, established hospital chains as much as global Pharma market leaders do have the chance to develop faster than others in their markets.

Secondly, relevant data must be mobilized by a proper infrastructure. For this reason, Cloud will help to gather and analyze data along the patient journey or value chain. Cloudification will neither be limited to the electronic health record (EHR) of hospitals nor to data subject to serialization, material, or network planning in Pharma, but will be fueled by comprehensive data models based on strategy-led architecture. S/4 HANA can play a significant role in here because ERP data are vital to success.

Thirdly, data governance must evolve towards LLMOps. Scientific experiences about developing evidence through real-world data, instantly (i.e., over and beyond ex-ante clinical trials which provide real-world evidence) are rather pre-mature at this stage. This process needs to be governed thoroughly to maintain the Chief Medical Officers` comfort feeling in hospitals in the future and leverage LLMOps, boldly. In a same way, the Chief Operating Officers in Pharmaceuticals need to be able to determine the degree of resilience of their supply chain and be comfortable with GMP compliance. Of course, there are procedures to change procedures but, as of now, they are not necessarily LLMOps-compatible. Data governance, therefore, is asking for a real change process - not limited to a “technical” governance topic - where tech and med cultures come together, appreciate each other and create a new, innovation-driven Digital Health Care mindset.

The Health Care sector and its LLMOps approach is right at the beginning. Please feel free to share your thoughts, concerns and expectation with me, which is appreciated. Thanks much and speak soon!