

Commentary: Ed Corbett

A strategy for using AI in pharma R&D

Artificial intelligence (AI) has the potential to provide huge benefits for the pharmaceutical industry. Among these are an opportunity to improve the productivity of R&D, to deploy sales representatives more effectively and to manage supply chains better. Yet, there is a concern that the disruptive potential of AI will be difficult to manage, and that its benefits will be hard to realise.

Within pharma, the issue is not so much whether to incorporate AI into the R&D function but how. With the advance of new sequencing technologies, companies are facing an explosive growth of data, much of which could change the trajectory of medicine development. The conundrum is learning how to exploit this data using AI, while still exercising human control at critical points of decision-making. In this article, we explore some of the questions facing pharma leaders as they come to grips with the new technology.

As a term, AI has spawned many definitions but at its most basic, it is maths. It is the use of data that is fed into linked algorithms to create conditional probabilities about desired outputs. AI has a number of subsets. One of these is machine learning (ML) which describes the ability of an algorithm to learn with experience.

In its simplest form, machine learning is illustrated by Netflix, the online media service. Netflix combines a viewer's preferences for films or programmes with data from users who have similar profiles. It then uses an algorithm to make recommendations to viewers about which films or programmes they might enjoy. Based on whether the viewer acts on these suggestions, the machine can further refine the recommendations. Deep learning is the next subset. Here the machine teaches itself to improve, unsupervised by a human. AI and its subsets are designed to replicate, or even replace cognitive tasks that humans can do. It is this substitution effect that is causing the greatest alarm.

The concept of AI has been around for some time, but the availability and low cost of cloud computing, big data and raw computing power, has made it more accessible and relevant to a broader range of applications. This means that in all industries and sectors, AI is being applied in one way or another. Though AI has many benefits, it is not always perceived this way. Public perception is that it will replace people and/or jobs and at its most extreme, AI could lead humans to be controlled by robots. In fact, the best AI systems augment rather than replace human activity.

AI has benefits in many back-office functions that are not pharma specific such as invoice processing. It is however, in R&D in which there is currently the greatest excitement and investment. R&D productivity continues to be an industry wide challenge, with the cost of developing products continuing to rise. Many companies have turned to mergers and acquisitions to plug pipeline gaps, but this does not address one of the fundamental problems with R&D – it is very human-capital intensive and reliant on individual expertise in specific areas for success. It also has a very

high failure rate. AI has the potential to increase R&D productivity by addressing both of these challenges. It can be applied to drug repurposing, clinical trial recruitment and measuring patient responses to drugs, all tasks that are currently highly human intensive. For example, companies like Berg LLC are combining patient biomarkers with AI to better understand the patient response to innovative medicines. This has the potential to not only make clinical trials more efficient and effective, it also will mean that patients in the 'real world' get drugs that are more effective for them based on their unique biology.

Earlier in the drug development pathway, target identification is an area with a huge failure rate and is consequently of great interest to AI-focused companies. Currently, target identification often relies on human expertise to judge whether a molecule may or may not interact with the target site. This requires experience, is often conducted linearly (as often one site is tested at a time) and is consequently labour intensive. AI can run *in silico* experiments that test multiple sites and predict what the effect may be. This then narrows down, based on data, the sites that should warrant further human exploration. This is the essence of the benefit of AI – it augments human activity. In fact, the most effective application of AI is where human input and refinement to the algorithm is a key part of the process.

It is indeed ironic that an industry that has for years been so comfortable with scientific risk, is so fearful of taking a different type of technology risk - this has led to pharma companies approaching AI with mostly only limited enthusiasm. Novartis is one exception standing out by putting AI and data at the heart of its business, investing in the technology across the value chain - as Vas Narasimhan the company's chief executive has said: "We are going big on data and digital."

Evotec AG is another. Under a partnership with Exscientia Ltd, Evotec is using AI for molecule design and to prioritise compounds for synthesis. The AI technology learns from preceding experiments to progress compounds to the desired criteria.

Very few, if any, pharma companies are currently building in-house AI capability, instead relying on external partners to achieve results. An analysis conducted by our company showed that as of October 2018, there were over 100 different AI companies focused on pharmaceutical R&D *alone*. The landscape is extremely diverse and is primarily driven by intense investment from US venture capital companies. Such investment is of course welcome, but it is likely that many of these companies will not stand the test of time. Pharma executives therefore need to carefully understand what each company offers before investing and whether intended outcomes can actually be delivered. This can be achieved by asking the questions that cut through the hype. One company that has proven results is Cloud Pharmaceuticals Inc. They have shrunk the time from drug

target to lead molecule from its historical average of 5-6 years, down to 2-4 months.

Given the benefits of AI shown thus far, senior leaders need to at the very least understand what it is, what its potential benefits are and how it may (or may not) fit with the direction of the organisation – in short, they need a way of approaching the new technology. Our experience is that most companies are aware of AI's benefits and are now either assessing how it fits within the organisation, or exploring investment options. A select group are actively implementing AI, with only one or two driving continuous improvement.

We also see companies pursuing an 'AI first' strategy which says 'we must be in AI'. Whilst the sentiment towards innovation is to be applauded, companies run the risk of repeating mistakes seen with 'digital' – thinking about the technology first, rather than identifying what problem it fixes and the desired outcomes. Given the hype and hope around AI, it is easy to become giddy with excitement and rush to solutions – this is likely to lead to poor investment choices and subsequent returns. To ground themselves, organisations need to ask three key questions: i) What is AI and what does it mean for us? ii) What AI investment options are available to us and what are others doing? iii) What should we invest in and therefore expect as a result?

Engage the humans

Having made the decision to invest in AI, companies need to engage employees every step of the way to get the most from it. This is critical as the greatest benefits of AI are achieved with human input. For some employees, AI is a threat that is to be resisted; others may be excited but confused. Leaders need to cater for all levels of belief and to actively build the organisation's intelligence around AI. Making AI easy to understand will lead to greater adoption and subsequent business results. In addition to engaging the organisation, leaders need to go 'to war' to recruit the best talent. They

The AI provider landscape in pharmaceutical R&D is large and diverse

AI Company Area of Focus	No. of companies	Company HQ
Novel drug discovery	35	US/EU/CAN/SG
Data aggregation and synthesis	20	US/EU/CAN/CN
Drug repurposing	9	US/EU/KR
Drug candidate validation	9	US/EU/CAN/JP
Disease mechanism understanding	8	EU/CAN/US/IL
Drug design	6	US/EU/CAN/IL
Preclinical experimentation in silico	6	US/EU
Clinical trial design	6	US
Clinical trial optimisation	6	US/CAN
Clinical trial recruitment	4	US/EU
Preclinical experiment design	2	US/CAN
Data publishing	2	CN/US
Data and model generation	1	US

will also need to change and challenge existing business processes – failure to do this will mean AI benefits will not be realised.

That AI has benefits for the pharma industry is clear. Whether it is right for each company depends on each individual organisation, but leaders need to understand the potential benefits and develop a strategy for their unique situation. An absence of a strategy may lead to awkward questions from shareholders and leaders may not be replaced by a robot, but by another human.

This article was written by Ed Corbett, principal at Novasecta Ltd, a specialist strategy consulting firm dedicated to the pharmaceutical industry. He is based in London, UK.