Artificial intelligence for the oncologist: hype, hubris or reality?

C. Vulsteke, MD, PhD[1,2], M. del Pilar Ortega Arevalo, Bsc[3], C. Mouton, ir., MBA[1], K. Stam, Msc[1], R. Goethals, MD[1], F. Ameye, MD, PhD[1], C. Populaire, Apr[1], M. Peeters, MD, PhD[2], P. Verdonck, ir., PhD, MBA[1,3]

SUMMARY

Keeping up with the rising amount of clinical data, guidelines and approvals of new antineoplastic drugs is a major challenge for every oncologist. Artificial intelligence promises to address this and to revolutionise health care and cancer treatment. What is the current state of artificial intelligence for the oncologist, and is it ready for prime time? In this article, the current, available tools of artificial intelligence are highlighted, which try to take a privileged role in the daily practice of the oncologist.

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INTRODUCTION

More than five years ago, the American multinational IBM announced that its supercomputer Watson would revolutionise cancer treatment by using its artificial intelligence to help the oncologist digest the exponential amount of clinical trial data.[1] Moreover, this supercomputer would interpret cancer patients' clinical information and identify individualised, evidence-based treatment options, hereby outperforming the oncologist and even identifying new approaches.[2-4] This would make every cancer centre an expert centre. The adoption of the latest research and evidence into clinical practice would be possible in the blink of an eye. To reach this goal, IBM has been collaborating with one of the most famous cancer institutes to apply Watson's talents to cancer treatment: The Memorial Sloan-Kettering Cancer Center (MSKCC).[1]

A recent publication in ESMO Open estimated that a physician should read 29 hours per working day to stay updated with the latest medical research.[1] This clearly exceeds human capability and compromises the time available for our patients and research. Adaptive tools to deal with this overwhelming amount of information are therefore eagerly needed.

Several companies and associations worldwide are trying to prelude a new era of oncology through clinical decision tools based on artificial intelligence and intelligent data platforms. This overview focuses on Watson for Oncology, CancerLinq, UpToDate and DisQover.

WATSON FOR ONCOLOGY AND MOSAIQ

Undoubtedly, one of the most promising tools that have been released is Watson for Oncology, from IBM. Watson for Oncology is born as an application of IBM Watson, the multinational's artificial intelligence system famous for beating human contestants on the television show Jeopardy in 2011.[5] It is a cognitive computing system designed to support all oncologists considering treatment options for their patients.[3] A cognitive computing system should be able to read, reason and learn from vast sets of structured and unstructured content.[6,7] To turn datasets into actionable medical insights you need clean data and flexible analytics, which are major chal-

[1]AZ Maria Middelares, Ghent, Belgium, [2]Department of Molecular Imaging, Pathology, Radiotherapy & Oncology, Center for Oncological Research, Antwerp University, Antwerp, Belgium, [3]Department of Electronics and information systems, Ghent University, Ghent, Belgium.

Please send all correspondence to: C. Vulsteke, MD, PhD, Head of Integrated Cancer Center Ghent, AZ Maria Middelares, Buitenring Sint-Denijs 30, 9000 Ghent, Belgium, tel: +32 92468462, email: christof.vulsteke@azmmsj.be.

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lenges.[6,8] Watson can read 800 million pages per second, and it draws on the combined contents of PubMed, The National Cancer Institute Drug Dictionary, the Sanger Institute's Catalogue of Somatic Mutations in Cancer database, every study registered on clinicaltrials.gov and many other resources.[8] The New York hospital MSKCC's clinicians and analysts partnered with IBM to train Watson for Oncology.

However, a closer look into this system unravels that it is based on human operators: a couple dozen physicians at this single centre in New York. These experts were allowed to put their own recommendations into Watson, even when high grade evidence was lacking.[4] Watson for Oncology doesn't make its recommendations based on its own insights derived from the massive amount of digested data, but from the training provided by the hospital's doctors. It does provide relevant studies and background information to support this.[4] This means that this computer system is also based on human-inputted algorithms taught by expert opinion, which resembles a low grade of scientific evidence and is leading to a lot of bias. In fact, it could even be disadvantageous if this self-reinforcing system recommends the preferred literature by MSKCC to oncologists worldwide. Moreover, the guidelines and protocols used in American hospitals differ from the ones used in Europe or other parts of the world.[4] Furthermore, this computing system does not consider the national insurance system, leading to recommendations that are simply not applicable. Finally and most important, a patient seen at a peripheral cancer centre in Belgium, or even at a tertiary centre, does not represent per definition the type of patients seen at MSKCC. Therefore, Watson for Oncology may not be relevant for these cancer centres.

Another problem Watson for Oncology is facing, is the interface with the different electronic health records per hospital and the difficulty to subtract information.[4,8] Reports of experts familiar with Watson for Oncology describe issues with written case reports, notes and other text-heavy information.[8] Data quality problems in unstructured data are one of the underestimated challenges that delay the development of Watson for Oncology and even influence partnerships. In February 2017, after five years of partnership, a famous cancer centre – MD Anderson – cancelled its contract with IBM for the Watson for Oncology platform.[8]

A Danish centre, Rigshospitalet in Copenhagen, stopped the collaboration with IBM early because of its limited view on the international literature, putting too much stress on American studies and too little stress on big, international, European and other-part-of-the-world studies. The local doctors agreed with Watson in only about 33 per cent of cases.[4]

To our knowledge, there is up to present only one peer-reviewed, published, full scientific paper demonstrating the extent to which the technology works as claimed.[7] Somashekhar *et al.* investigated the concordance of recommendations by Watson for Oncology with an expert multidisciplinary tumour board in 638 breast cancer patients, seen at the Manipal Comprehensive Cancer Center in Bengaluru (India) between 2014 and 2016. Watson for Oncology provided its treatment recommendations for these cases in 2016. To account for treatments and guidelines not available before 2016, a blinded second review was carried out by the expert tumour board in 2016 for all cases in which there was no agreement. They concluded that treatment recommendations made by Watson for Oncology and the tumour board were highly concordant for the breast cancer cases that were examined (up to 93%). Breast cancer stage and patient age, however, had a significant influence on concordance. Their subgroup analysis showed that patients with stage I or IV disease were less likely to be concordant than patients with stage II or III disease.

But what does this concordance of 93% mean? Is this a high level of accuracy? Does this mean that for common clinical scenarios the technology was wrong in up to 7% of cases? Or does this mean that technology was not able to give a good advice in more complex cases in which treatment decisions may not be that clear-cut?

Furthermore, this is only an observational, retrospective study in which only the discordant cases were re-reviewed by the expert board increasing the concordance from 73% to 93%. This means that the expert board changed its therapeutic decision according to correct for the scientific state before 2016 only for the discordant cases. The originally concordant cases were not re-reviewed by the expert board and assumed to remain concordant. More studies with a contemporaneous assessment of cases by Watson for Oncology versus experts are definitely needed.

The expert board also states that this technology could be helpful especially at centres where expert breast cancer resources are limited, which is not applicable for Europe.

Recently, IBM signed a collaboration with Elekta, which will introduce the Watson for Oncology technology in its current management system for oncology: MOSAIQ Oncology Information System.[9,10] Elekta has coupled its already existing oncology information system with artificial intelligence (AI) provided by Watson and plans to start selling Mosaiq with Watson for Oncology.

CANCERLINQ AND CANCERLINQ DISCOVERY

CancerLinQ is defined as a health information technology platform aimed at enhancing and improving the understanding and treatment of cancer.[11] It has been

launched by CancerLinQ LLC, a non-profit subsidiary of the American Society of Clinical Oncology (ASCO), well known among all oncologists as the leading cancer society worldwide.

CancerLinQ is born under the premise that clinical trials are often not enough to evaluate cancer care: only 3% of the population participates on clinical trials, and they are often not representative for the society.[12] The platform aims to gather clinical and demographic information in order to improve quality care by analysing and processing all the patient's data that is submitted on a daily basis. The system is supported by the data platform SAP HANA, and the data increase every day making CancerlinQ being in a continuous learning process.[11]

The overall approach of CancerLinQ is different from the other tools since it is not commercialised by a company but initiated by a non-profit organisation, which is no other than ASCO. Participating health organisations share their patients' electronic health records with the database of CancerLinQ. Therefore, CancerLinQ gathers information from millions of patients, and this information can be used by the practitioners to improve cancer care.[12,13]

Clinicians using CancerLinQ are able to analyse their patients' data in an easy and intuitive way, and more importantly, compare it to the national cohorts, trends and statistics to improve the quality of patient care. It is a tool that indirectly connects the knowledge and expertise of all the participating clinicians to benefit the patient. The regulatory framework for privacy and research protection has been carefully considered. As a Health Insurance Portability and Accountability Act (HIPAA) business associate, CancerLinQ will be subject to stringent requirements for data privacy and security.[12]

Up to now, CancerLinQ is only available for organisations in the United States (US), but in an interview with Robert S. Miller, Medical Director at CancerLinQ, it was stated that in the coming year they will continue their effort to expand to other continents.

CancerLinQ Discovery, however, is not limited to the US. This allows the oncology community to conduct real-world research using big de-identified patient data from CancerLinQ's pool.[14] To use these data, a CancerLinQ Discovery Data Request form containing a detailed summary of the proposed research has to be filled in and uploaded through a secured ASCO website. This request has to be reviewed and approved by the Research & Publications Committee before the data are released. The major drawback is that the waiting period for the request approval may be up to eight weeks making it feasible for a research group, but not for a clinician.

UPTODATE

UpToDate is a well-known tool that is widely used by oncologists in Belgium and abroad. It presents a comprehensive synthesis of the evidence, followed by recommendations that can be acted on at the point of care. It combines an advanced publishing platform with the rigour of a sophisticated editorial process managed by a faculty of accomplished physician authors and editors, renowned leaders in their specialties.[15] It includes up to 10,000 recommendations that apply the Grading of Recommendations Assessment, Development and Evaluation (GRADE) framework.[16] A recently published article showed that the proportion of discordant recommendations in UpToDate is small (3.7% of all recommendations) and that the proportion that is truly problematic (strong recommendations that would best have been weak) is very small (0.6%).[16]

Nevertheless, clinicians should be cautious and look for clear explanations in UpToDate and elsewhere when guidelines offer strong recommendations based on low certainty evidence.[16] In addition, it is expensive for hospitals to foresee access to UpToDate for their doctors.

UpToDate, however, is an intelligent data platform rather than a cognitive computing system and therefore not an example of AI.

DISQOVER

DISQOVER from ONTOFORCE is a semantic search platform that integrates disparate data of life sciences. Complex queries can be run intuitively and are delivered at high speed. DISQOVER is built to easily integrate private, public and third party data resources while looking through a much bigger lens and to find knowledge and insights in places where before, you might not have considered to look.[17] This looks very promising for a researcher finding out whether a certain gene, compound or biological target has already been studied.[18] At present, it is not yet useful for an oncologist in daily practice. Moreover, it is not specific for the oncology practice but for the medical field in general. This search engine is available for free with a Community License that allows 99 queries every week for free or through a Professional or Enterprise License with more advanced features.

CONCLUSIONS

Watson for Oncology remains underdeveloped and its flaws are getting exposed on the front lines of care by doctors and researchers turning the hype down into realism and punishing IBM for their hubris. So far, only one scientific paper has been published among some abstracts at international meetings. Furthermore, this cognitive computing system is human inputted by key opinion leaders from a single centre

KEY MESSAGES FOR CLINICAL PRACTICE

1. **Artificial intelligence cannot yet assist the oncologist struggling with the rising amount of clinical data, guidelines and approvals of new antineoplastic drugs.**

2. **The use of electronic patient files by cognitive computing systems to give individualised therapeutic decisions is challenged by data quality problems in unstructured data, leading to delay in the development.**

3. **Intelligent data platforms, such as UpToDate, remain the best aid for the oncologist up to now.**

institution not necessarily representing cancer patients from a Belgian Hospital.

In contrast with the development of new antineoplastic drugs that make it to market only after their efficacy is proven in big randomised trials, Watson for Oncology was commercially launched too early in its development process, lacking strong evidence or rigorous validation. According to our opinion, the business model of Watson for Oncology and the current development stage are not in equilibrium.

CancerLinQ has a smart strategy to gather lots of patient information aiming to improve cancer care, although it is still limited to the US and thus will need to expand, taking into account the essential elements of data quality, data security and privacy protection. In general, data quality problems are still a huge challenge for AI initiatives.

CancerLinQ Discovery is only a useful tool for researchers; not (yet) for clinicians.

The best aid for the oncologist up to now consists of intelligent data platforms such as UpToDate. UpToDate has shown to be reliable, but the oncologist should stay attentive with its use.

In conclusion, AI in oncology is not yet ready for prime time, but remains 'work in progress'.

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