Digital Technologies and Business Strategy

Final Report

Selected technology:	Artificial Intelligence

TITLE:

Evaluating IBM Watson for Oncology and Alternative AI-driven Therapeutic Strategies

Words: 2965

Executive summary

Technology in healthcare is continuously evolving, presenting challenges and opportunities in the delivery of cancer care. In response to the knowledge gap in cancer treatment, this case study analyzes the existing implementation of Watson for Oncology (WFO) developed by IBM and explores alternative strategies leveraging artificial intelligence (AI) to address this critical issue. WFO was an ambitious project by IBM to close the gap between leading research and current knowledge by oncologists. While there has been a clear increase in concordance rates with the implementation of WFO, it still falters in certain areas, with concerns such as the bias in training data and its limited capabilities to operate outside of the U.S. Due to these reasons we have discussed alternative solutions.

After careful analysis, our recommendation is to prioritize the implementation of AI-powered clinical trial matching platforms. Benefits of this solution include increased patient participation in clinical trials, accelerated drug development, and improved treatment outcomes. Moreover, by streamlining the patient recruitment process and reducing the time and cost associated with conducting trials, these platforms contribute to greater clinical trial efficiency and facilitate faster drug approvals and commercialization. There are still concerns with regards to data privacy and security, as well as algorithm bias and accuracy, but these issues can be mitigated by IBM if care is taken during development and implementation.

The adoption of AI-powered clinical trial matching platforms represents a strategic investment in driving innovation, improving patient outcomes, and contributing to the fight against cancer. By embracing this recommendation, IBM can position themselves at the forefront of medical research and make a meaningful impact on the lives of individuals affected by cancer.

1. Introduction and statement of the problem

Cancer remains one of the most challenging and devastating diseases, affecting millions of people worldwide. Traditional methods of diagnosing and treating cancer often involve lengthy processes that may not fully personalize treatment to the patient's unique condition. Additionally, the body of knowledge concerning cancer is also expanding at an exponential rate, leading to a widening knowledge gap for clinical physicians (Denu et al., 2016). IBM, a global leader in technology and innovation, recognized these challenges and sought to leverage its capabilities in artificial intelligence (AI) to transform cancer care. This initiative aligns with IBM's strategic vision to pioneer technology that not only advances business operations but also addresses critical societal issues (Lombardo, 2017).

IBM Watson for Oncology (WFO) was developed by IBM Corporation with help of oncologists from Memorial Sloan Kettering Cancer Center (MSK) to tackle these challenges directly by utilizing advanced AI algorithms to support decision-making in cancer treatment. WFO analyzes a vast amount of medical data, including patient medical records, clinical trials, and emerging research. It uses natural language processing and machine learning to provide oncologists with evidence-based treatment options that are personalized to each patient's specific health profile. This technology was designed to function as an assistant to oncologists, allowing for quicker and more informed decisions that could lead to better patient outcomes (Jie, Zhiying and Li, 2021).

By integrating AI into oncology, IBM addresses both a significant market need and a vital health care challenge, promising to improve efficiency and effectiveness in cancer treatment protocols. This application of AI in healthcare is reflective of broader trends in the medical field, where technology is increasingly seen as a crucial tool in enhancing the delivery of care and personalized medicine (Gulshan et al., 2016). While there is other research on AI in oncology, such as DNA nanorobots functioning as cancer therapeutic (Li et al., 2018) and application of AI in "Prognostic Prediction in Epithelial Ovarian Cancer" (Kawakami et al., 2019), Watson for Oncology represents a forward-thinking solution that aligns with IBM's broader commitment to innovation and the improvement of human life through technology.

2. Analysis

As the comprehension of individual patient cases deepens, physicians are required to assimilate an ever-growing amount of information from medical literature to provide evidence-based cancer treatments. Studies indicate that clinical physicians manage to dedicate only about 4.6 hours per week to updating their professional knowledge (Woolhandler and Himmelstein, 2014). This limited time for learning results in delayed information uptake and contributes to a growing disparity between the outcomes at academic research centers and those in actual clinical practice (American Society of Clinical Oncology, 2016).

The gap between accumulating knowledge and its application in clinical practice is particularly critical in oncology, where treatment advancements can significantly influence patient survival rates and quality of life. A study by Arruebo et al. in 2011 highlight the rapid evolution of cancer treatments and the necessity for clinicians to integrate the latest research findings into their practice to offer state-of-the-art care. However, the vast amount of data and the rapid publication of new research findings make this increasingly challenging. This gap not only affects the quality of

patient care but also widens the disparity between well-resourced academic research institutions and general hospitals, where most patients receive treatment.

Advantages and Effectiveness

Several studies have analyzed and demonstrated WFO's impact on cancer care. One significant study published in the journal The Oncologist assessed the level of concordance between WFO's treatment recommendations and clinical decisions made by oncologists in China (Zhou et al., 2018), below is a table of the results:

Type of Cancer	Concordance Rate (%)
Ovarian	96
Lung	83
Breast	82
Rectal	74
Colon	64
Cervical	64
Gastric	12

This relatively high level of concordance (except for Gastric Cancer) across the board indicates that AI can effectively supplement oncologists' efforts by providing evidence-based treatment options. The study attributes the low concordance rate of Gastric Cancer to the difference of the cancer therapy situation between the East and West. Due to the WFO being trained on data from U.S. oncologists, and the incidence of Gastric Cancer in China being much higher than its U.S. counterpart resulting in more experience and drug development, this is highlighted in the low concordance rate and proves the necessity to accelerate the localization of WFO so it can be rapidly applied in other countries.

Patients' perception and acceptance of WFO are also crucial as it directly affects the extent of how successful WFO will be integrated into routine cancer care. In a study titled "Patient Perspectives About IBM Watson for Oncology", nine focus groups were conducted to "collect and analyze patients' attitudes and perspectives concerning WFO and how it may be used in clinical care" (Hamilton et al., 2019). Feedback from participants indicated significant patient interest, perceived value, and acceptance of WFO when employed as a supplementary tool to guide their physicians' decision-making. However, participants also expressed notable concerns, such as the necessity for rigorous procedures to ensure the accuracy and completeness of the data provided, and the potential for physicians to excessively rely on WFO.

Moreover, several studies have demonstrated that WFO is a helpful clinical decision-support system especially at centers/regions where expert resources and knowledge on select cancer types are limited (Somashekhar et al., 2018). However, while WFO has the potential to improve the efficiency and overall quality of cancer care, in regions such as Mexico, the recommendation of

high-cost therapies provided are limited in terms of real-world applications (Sarre-Lazcano et al., 2017).

Challenges and Limitations

Despite its advantages, the deployment of WFO has faced challenges. Criticisms include instances where the AI provided recommendations that were not aligned with the patients' specific conditions due to variations in treatment guidelines across regions. Additionally, the initial high costs of implementing and maintaining AI systems like Watson can be a barrier for many institutions, potentially limiting widespread adoption (Price, 2023)

First, a good proportion of studies done on the effectiveness of WFO were conducted using concordance levels as the only performance metric for the validity of treatment options. As the platform has been developed on US-based treatment guidelines, it "does not take into account differences in incidence or risk of certain kinds of cancers in different populations" (Tupasela and Di Nucci, 2020), thus, IBM developers have created a 'ground truth' against other treatment options that would otherwise be recommended by other national guidelines established by other countries. As it is not compared to or validated against any other treatment standards this can be considered a type of bias that is introduced into the program (Gianfrancesco et al., 2018).

Another challenge that has been discussed regarding the WFO platform is that we do not know what goes into their algorithm in terms of feature importance or regarding the scoring and ranking of different cancer studies. The process of training the platform masks many biases that are contained in several clinical trials for cancer drugs (Naci et al., 2019), which is not made transparent by IBM. As a consequence, WFO is unable "unable to provide criteria or explanation for the differences in expert judgement in different contexts" (Tupasela and Di Nucci, 2020), thus, it is difficult to assess why certain treatments are ranked higher than others.

3. Discussion

IBM's implementation of WFO in the healthcare sector aligns with the company's broader strategic vision of leveraging AI to address complex challenges and improve human decision-making processes. IBM's strategy in implementing WFO encompasses several key elements aimed at maximizing its impact and ensuring its successful integration into clinical practice:

1. By harnessing IBM's reputation and expertise as a pioneer in technology innovation, it provided a solid foundation for the development and deployment of WFO as a cutting-edge solution for enhancing cancer care

2. IBM has forged strategic partnerships with leading healthcare institutions, research organizations, and oncology experts to develop and refine WFO. This ensures that WFO is grounded in clinical evidence and tailored to the needs of healthcare professionals and patients (Strickland, 2019).

3. In establishing WFO, IBM utilized its expertise and experience in data security and responsibility to "to address issues such as patient privacy, HIPAA [Health Insurance Portability and Accountability Act] compliance, and data security" (Cavallo, 2019).

Alternative Solution 1: Enhanced Continuing Medical Education (CME) Programs

One of the main issues WFO attempted to solve was the gap between the latest medical research and its application in clinical practice for oncologists. However, in mitigating this issue it created new problems pertaining to WFO outlined in the previous sections. One way of to address these concerns is to shift the way AI is used in this scenario, instead of directly assisting in the decision making of oncologists, AI is used to enhance CME programs to address specific gaps in oncologists' knowledge and skill sets, ensuring targeted learning and professional development.

CME programs can play a vital role in keeping oncologists informed of the latest advancements through the integration of real-time updates on cancer research and treatment protocols (Fox and Bennett, 1998). By providing evidence-based guidelines and case studies directly relevant to clinical practice, these programs not only enhance oncologists' knowledge but also complement their decision-making processes. This integration ensures that oncologists stay ahead of the dynamic landscape of cancer care while receiving practical insights that can be directly applied in their clinical settings, ultimately leading to improved patient outcomes. Ultimately, this would be a platform where AI is used to condense all the latest research, convert them into more practical and digestible formats for oncologists to consume.

Although the data bank and collection needed for the platform already exists, there are still further costs and resources that need to be considered. Developing high-quality educational content for CME programs requires investing in designing the curriculum, creating teaching materials, and training faculty members. It's also important to make sure that these programs are easily accessible to healthcare professionals in different places. This means investing in technology localization and online platforms to deliver the content efficiently. By focusing on both creating good content and making it easy to access, organizations can help healthcare professionals learn and improve patient care everywhere.

It's important to note that this initiative can offer both short to medium-term benefits and long-term impact. In the short to medium term, investing in CME programs can lead to relatively quick returns by boosting oncologists' knowledge and decision-making abilities, resulting in more efficient and effective patient care (Davis, 1992). However, the true value of CME programs becomes evident over the long term, as they contribute to improved patient outcomes, decreased medical errors, and increased professional satisfaction among oncologists (Cervero and Gaines, 2014). By recognizing and investing in the long-term benefits of CME programs, organizations can ensure sustained improvements in healthcare delivery and patient outcomes.

As for the risks associated with these programs, it's crucial to address two key areas: quality control and engagement/participation. Maintaining the quality and relevance of CME content is paramount to prevent the dissemination of inaccurate or outdated information, safeguarding the integrity of educational initiatives (Dixon et al., 2011). However, ensuring active engagement and participation in CME activities poses a significant challenge, particularly among busy healthcare professionals who may face time constraints and competing priorities (Casebeer et al., 2010). Overcoming these obstacles requires innovative approaches to foster engagement, such as interactive learning formats, personalized content delivery, and incentives for participation, ultimately ensuring the effectiveness and impact of CME initiatives.

Alternative Solution 2: AI-Powered Clinical Trial Matching (CTM) Platforms

AI-powered CTM platforms offer a different approach to addressing the knowledge gap in cancer treatment by leveraging ML algorithms to match patients with appropriate clinical trials. While WFO primarily focuses on providing treatment recommendations based on existing medical data, the CTM platform specifically targets the identification and matching of patients with appropriate clinical trials. Its primary function is to connect patients with potential research opportunities rather than providing treatment recommendations (Alexander et al., 2020).

It aims to accelerate the enrolment of participants in research studies, thereby facilitating the advancement of medical science and the development of new treatments. Unlike WFO, which focuses on analysing existing medical data, the CTM platform continuously scans for new trial opportunities and provides real-time updates to oncologists and patients. It ensures that both healthcare providers and individuals have access to the latest research opportunities as they become available.

There will be various costs that are required for this project to succeed. Firstly, the development and implementation phase demand substantial investment in software development, data infrastructure, and seamless integration with existing healthcare systems, which could incur significant upfront costs and possible downtime (Harrer et al., 2019). Secondly, ensuring access to comprehensive and up-to-date patient data from electronic health records (EHRs), genomics databases, and clinical trial registries is imperative for accurate patient matching, underscoring the need for resources dedicated to data acquisition and maintenance. These efforts are essential to facilitate the platform's functionality, optimize patient matching processes, and ultimately contribute to advancements in oncology research and cancer care (J et al., 2017).

While the initial development and implementation phase require investments in time and resources, these platforms can offer significant long-term returns. Increased patient participation in clinical trials facilitated by the platform leads to accelerated drug development and improved treatment outcomes, ultimately enhancing patient care (Harrer et al., 2019). Moreover, the streamlined patient recruitment process and accelerated trial enrolment achieved through these platforms contribute to enhanced clinical trial efficiency. By reducing the time and cost associated with conducting trials, they facilitate faster drug approvals and commercialization, further amplifying their long-term impact on advancing medical science, improving patient outcomes, and greater returns for the business in question.

In considering the risks associated with this solution, two critical areas demand attention: data privacy and security, and algorithm bias and accuracy. Protecting patient data and ensuring compliance with privacy regulations are non-negotiable to mitigate the risks of data breaches and associated legal liabilities. Additionally, ensuring the accuracy and fairness of AI algorithms in patient matching is essential to prevent bias and ensure equitable access to clinical trial opportunities for all eligible patients (Angus, 2020). By addressing these risks and implementing robust safeguards, organizations can foster trust among patients, healthcare providers, and regulatory bodies, thereby maximizing the effectiveness and acceptance of clinical trial matching platforms in oncology research and patient care.

5. Conclusion and recommendation

In conclusion, the exploration of alternative solutions to address the knowledge gap in cancer care has revealed several promising strategies, each with its own benefits, costs and considerations. From the use of collaborative decision support platforms to the enhancement of continuing medical education (CME) programs, to the implementation of AI-powered clinical trial matching platforms, there are a number of options available in optimizing cancer care and improving patient outcomes.

After careful evaluation, our recommendation is to pursue the implementation of AI-powered CTM platforms. While all three solutions offer valuable contributions to oncology practice, the CTM platform stands out for its potential to impact patient care, accelerate medical research, and drive innovation in cancer treatment. By leveraging AI to match patients with appropriate clinical trials, this solution addresses a critical need in oncology research and facilitates access to cutting-edge treatments for patients.

The medium to long-term return on investment (ROI) of AI-powered CTM platforms is substantial, with benefits including increased patient participation in trials, accelerated drug development, and improved treatment outcomes. Moreover, by streamlining the patient recruitment process and reducing the time and cost associated with conducting trials, these platforms contribute to greater clinical trial efficiency and facilitate faster drug approvals and commercialization.

However, it's essential to acknowledge the risks associated with AI-powered platforms, such as data privacy and security concerns and algorithm bias and accuracy. IBM will have to implement robust safeguards and adhere to regulatory requirements to protect patient data and ensure fair access to clinical trial opportunities for all eligible patients.

In summary, the adoption of AI-powered CTM platforms represents a strategic investment in advancing oncology research, enhancing patient care, and driving positive outcomes for individuals affected by cancer. By committing to the development, implementation, and continuous improvement of these platforms, IBM can position themselves at the forefront of medical innovation and contribute to the ongoing fight against cancer.

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