Cronicon OPEN ACCESS
EC PULMONOLOGY AND RESPIRATORY MEDICINE
Editorial

It's Elementary My Dear Watson: Cancer Counseling by Cognitive Computing; Do you Concur?

Shahid S Siddiqui[1,2]*, Fathy El-Fasakhany[1], Sivakumar Loganathan[2,3] and Ravi Salgia[2,4]

[1]Department of Basic and Clinical Oral Sciences, College of Dentistry, and College of Medicine, Umm Al Qura University, Makkah, Saudi Arabia

[2]Department of Medicine, University of Chicago, Chicago, USA

[3]Department of Environmental Science, Periyar University, Tamil Nadu, India

[4]Department of Medical Oncology and Therapeutics Research, Duarte Road, Duarte, CA, USA

***Corresponding Author:** Shahid S Siddiqui, Department of Basic and Clinical Oral Sciences, College of Dentistry, and College of Medicine, Umm Al Qura University, Makkah, Saudi Arabia.

Received: May 25, 2018; **Published:** July 04, 2018

Keywords: *IBM's Watson for Genomics; Lung Cancer; Cognitive Computing; Artificial Intelligence*

Abbreviations

CAR-T: Chimeric Antigen Receptor-T cell; CRISPR: Clustered Repeated Interspersed Repeated sequences; FDA: Food and Drug Administration, USA; NGS: New Generation Sequencing; NPL: Natural Language Processing; NSCLC: Non-Small Cell Lung Cancer; PaaS: Platform as a Service Model; PM: Personal Medicine

Cancer Precisely

Cancer is a catastrophe for the patient and caregivers as it is complex and ranks among the top diseases globally with high morbidity. Many novel approaches (such as CAR-T immune therapy; CRISPR/Cas 9 driven gene editing; NGS screening, the new generation sequencing of genomic DNA etc.) are under trial to analyze and develop therapies for cancer. Nevertheless, huge gaps remain in finding the magic bullet or the perfect moonshot. What are the challenges in cancer diagnosis and therapeutics?

With the former US President Barack Obama's initiative on "Precision Medicine, PM" the emphasis is on individual therapy precisely tailored for a given patient. The customized approach in PM deals with the medical decisions, practice, treatment options, and products are specified to the individual patient. Although no new drugs are invented for an individual in the PM model, generally patient's genetic profile is obtained and matched with other histological and molecular markers (genetic analysis, imaging and analytics) to prescribe a treatment regimen on actionable genetic analysis.

With the increasing volume of knowledge base emanating from basic and clinical research in medicine, clinical trials, genomic databases, it is difficult for an individual medical practitioner to fathom the large and complex deluge of information. This has been partly addressed by progress in information technology and computing powers that are accessible through the use of modern computing devices. "Watson" is a super-computer, based on artificial intelligence algorithms is an important initiative from IBM corporation that attempts to internet-based knowledge (also known as IoT, Internet of Things) to develop analytics for health sector and facilitate existing services. Among various variants of Watson one of them is dedicated to oncology platform that is based on Open Source Apache and integrated with IBM Bluemix Cloud. It is available to users through a (PaaS) Platform as a Service model.

Watson for genomics

The remarkable thing about computer-based diagnostics such as IBM's Watson is that it can identify treatment options that the human clinicians may fail to recognize. This is due to the vast amount of data that Watson for genomics can store and analyze. These data include history of clinical trials, big and small, patient's histories and genetic alterations in human genome such as single nucleotide polymorphisms, gene copy number variations, insertions and deletions, chromosomal translocations and gender specific differences. Furthermore, it is not just the large amount of data that Watson can store, and process. Complex algorithms in neural network-based learning such as the 'error back-propagation' model helps Watson 'learn' from such analytical challenges.

Workflow for the Treatment

From the physician's clinic patient's biopsy from the cancerous tissue is sent for DNA sequencing of the patient's genome. This genomic sequence data is sent to the IBM's Watson supercomputer for genomic analysis. The computer compares and analyzes data from the previous clinical trials and a vast array of publications from medical data bases. Watson provides a medical report and identifies genomic mutations related to the patient's tumor mutations. Watson for genomics extracts multiple attributes from a subject's health records kept in e-files that encompass laboratory reports, physician's notes, and analyzes these using natural language processing (NPL) algorithms. This technology enables Watson to highlight treatment options for a given patient with a degree of confidence by comparing similar treatments to arrive at better therapy strategy for that patient. This evidence-based report is evaluated by a cancer pathologist and makes recommendations for the treatment of the patient by the consulting oncologist and clinician. One such agency is Quest Diagnostics that mediates Watson based clinical recommendations for the cancer patients.

Watson Advantage

How has Watson performed when its diagnostic abilities are compared with human 'expert's ability to suggest treatment options for a given patient? Can we harness cognitive computing to examine large volumes of data from scientific studies and databases to determine potentially relevant clinical trials or therapies for patients with cancer based on genetic background of subjects in cancer clinical trials? In a report from University of North Carolina's Lineberger Comprehensive Cancer Center at Chapel Hill, authors Nirali Patel, and co-author Vanessa Michelini from IBM Watson Health in Boca Raton, FL employed IBM Watson for Genomics to investigate whether cognitive computing can outperform selected group of cancer expert panel in determining the therapeutic treatments for patients with tumors with specific mutational background.

Dr. William Kim 's group at UNC sought treatment options for little more than a thousand cancer cases (1,018 subjects), Watson was not only able to suggest treatment options for 70% of the patients, but Watson also made recommendations for the remaining 30% for whom the experts had missed genomic mutations based therapeutic options [1]. Variants in eight human genes (*APC, ARID1A, ATR, BRIP1, CDNK2B, FBXW7, MITF, and RAD50*) were identified by Watson in 283 patients that were missing in Molecular Tumor Board recommendations.

Since this cognitive computing was a retrospective study, not all suggested therapeutic options were acted upon (e.g. Subjects free from cancer symptoms, or that some patients had died), nevertheless for 96 patients Watson for genomics provided an insight that was missing from the University's 'Molecular Tumor Board' panel of experts. Thus, as a result of Watson's analysis it may be possible to begin treatment for patient soon after the information could became available from the cognitive computing powers of Watson. In short, Watson can be a very valuable resource to supplement cancer diagnosis that is routinely provided by the Molecular Tumor Board (consulting oncologists harnessing the genomic DNA sequence from patients to recommend actionable treatment options).

Watson’s Victory

Thomas “TJ” Richard from Florida is one of the beneficiaries of the Watson analytics, who suffered from lung cancer (NSCLC, non-small cell lung cancer). Thomas’s case was referred to Watson analytics, which suggested that since Thomas has a genetic disposition, causing his body to overproduce a protein that was promoting cancer growth; and recommended an immunotherapy (PD-L1) that is highly specific for Thomas’s type of NSCLC patients. The CAR-T therapy exploits patient’s own immune cells (white blood cells, called T-cells), by reprogramming these T-cells to counter patient’s tumors, thus it offers a highly personalized treatment from patient’s own T-cells. This treatment approach was the same as recommended by doctors taking care of Thomas. Training of Watson is done by a team of oncologists at Memorial Sloan Kettering Cancer Center, and Watson harnesses the information on similar cancer clinical trials, clinical publications, and general cancer guidelines. Watson recommended “keytruda” (a checkpoint inhibitor) immunotherapy for Thomas. Keytruda is a trade name for pembrolizumab that is a humanized antibody used in the treatment of cancer (sold by Merck, it is an IgG4 isotype antibody, which inhibits a protective mechanism of tumor cells, and facilitates the immune system to kill those cancer cells). That was in concurrence with the medical team treating Thomas at Jupiter Medical Center in Florida. Thomas TJ Richard is on therapy and making progress.

Watson’s Hurdles

One can be positively impressed with the possibilities that Watson oncology holds for the treatment options that a patient may receive using Watson analytics support. However, recent critique by a STAT team [2], has identified a number of issues dragging Watson’s performance and potential several notches down. What ails Watson is its still limited access to the cancer patient records worldwide. Three years after its ceremonious launch in 2015, Watson serves only a handful of hospitals and institutions, thereby limiting Watson’s access to huge patient health records, treatment options and ethnic and regional diversity of cancer patients.

Based on STAT’s evaluation IBM marketed Watson for genomics rather prematurely and some of the promises that were envisaged for Watson remain in infancy [2]. One of the reasons for this limitation is that Watson for genomics is trained by a tumor board oncologist team from New York’s Memorial Sloan Kettering Cancer Center (MSK), and they lack cancer patient’s health records from highly diverse and global perspective. MSK’s team does not have access to the vast amount of patient data that is not within the Watson’s memory bank, thus limiting their recommendations for treatment options for precision medicine in a wide variety of cancer cases.

Watson for genomics utilizes cloud-based algorithms to store enormous amount of information obtained from physician’s notes, clinical trials data, and oncology guidelines, however the treatment options provided by Watson are not driven from the analytics of the stored information, and likely recommendations for treatment are entirely based on training by Memorial Sloan Kettering Cancer Center (MSK)’s team of professionals. These cancer ‘experts’ provide input to Watson for genomics; on how these patients with specific health records should be given a treatment. Similar expert training of Watson for genomics has been tried at MD Anderson Center in Houston, Texas, but technical and financial issues ended in MD Anderson not pursuing this approach. Details of this breakup between MD Anderson Center in Houston, Texas and Watson for oncology are lacking.

More Access to Cognitive Computing

Watson’s architecture is based on artificial intelligence (AI) that should allow any competent seeker to access Watson’s vast resources of knowledge and analysis, but in healthcare, especially in the care of cancer patients Watson for genomics has remained on the sidelines. One of the main reason of Watson’s slow progress is that it is not widely used in cancer clinics and its ability to provide additional treatment options to a cancer patient have been very limited. Doctors from most institutions and hospitals prescribe the cancer treatment based on their own experience and training, and Watson for genomics in those institutions where Watson is available, may be merely used to confirm the decision of that treatment.

An important factor limiting Watson’s potential is the cost of running cancer diagnosis and treatment options using Watson for genomics. This cost depends on patient volume, number of consultants, data processing staff, and health record keepers. Thus, there is a significant running cost for feeding patient’s records manually where this is not directly linked to Watson for genomics.

Improving Watson

There is also an underlying problem in cancer treatment and therapeutic approaches based on ethnic diversity and environmental factors. For example, in India and South Korea, Asian nations, Watson has made inroads and it has been in use with some success, however since Watson for genomics is primarily trained with the US based medical practices, its full impact in Asia becomes compromised, since Asian patients may differ significantly in genetic background, diet preferences and environmental factors affecting their health. Furthermore, unlike other medical products such as in the case of new drug development, the FDA (USA based Federal Drug Administration) plays an important role to evaluate the efficacy and side-effects of the product. However, Watson for genomics has got a pass and runs in hospitals in many countries without an independent FDA assessment of its capacity to arrive at the correct treatment options for cancer treatment. This can be seen as an ethical issue if the treatment suggested by Watson for genomics is not the best option for the health of the subject.

Furthermore, since Watson for genomics inferences affect real cancer patients, it is necessary that its performance is critically appraised and compared with human experts to find out if Watson for genomics performs at the level of claims of which it has been sold. These evaluations may still lack some aspects of ethical issues emanating from Watson's treatment options. The bottom line is that we are still not sure if Watson for genomics is free from delivering 'harm' to the patients.

Need for Good Clinical Decision via Physician and Multidisciplinary Team

Improved clinical decision making by physicians is vital to better diagnosis and actionable treatment if these decisions are aided by multidisciplinary team members. In spite of high power of cognitive computing, contribution of an experienced physician cannot be underestimated. The Clinical Decision Support (CDS) involves health related information technology, which may include patient specific data, biomedical knowledge, screened to enhance health care. The multidisciplinary teams may include primary physicians, clinical geneticists, nursing staff, information technologists and bioinformatics personnel and pharmacists. However, in the final analysis CDS can only assist a physician at the point of care, i.e. that clinicians can utilize CDS to help to analyze the patient data and reach a diagnosis and treatment option. Watson can thus provide this assistance, but its use cannot be overemphasized; good clinical decision by the clinician remains critical.

What is next for Artificial Intelligence in Healthcare?

Artificial Intelligence (AI) will continue to contribute at an increasing pace in future healthcare. Electronic health records (EHR) and other patient data will come in newer formats and processed forms. Future medical graduates and physicians will be ever exposed to AI based gadgets and diagnostic options. New surprises such as a recent report suggesting higher incidence of lung cancer in women than in men [3]; will require continual updating the Watson databases and algorithms. Since cancer is a highly complex disease and every cancer may offer unique challenges the need for a combination of AI and clinician's skills will grow. As more genetic data pours in, we are begin to learn that genetic makeup of cancer is complex, e.g. there are tumor specific genetic variants that are not in the patient (non-tumor tissue does not show tumor specific genetic changes). Certain class of genes such as c-MET is key inducers of cancer, and therefore specific classes of drugs will be needed. For an appropriate treatment a subject will benefit from a combination of molecular genetic tests to arrive at best options. This is where Watson and clinicians will work together for improved outcomes. In brief, Watson for genomics has great potential in offering treatment options based on cognitive computing. This is the future of medicine, but simultaneously users are cautioned to understand the limitations of this paradigm. Increased input from real practicing physicians across the globe, such as the introduction of Watson for genomics in European Union, the Middle East and North Africa countries can bring more comprehensive data for cancer cases and corresponding environmental factors that compound the diagnosis and treatment. In addition, lowering the cost for the access to Watson for genomics for many institutions across the continents will only enhance the power of therapeutic analysis. Do you concur? [4-6].

Acknowledgements

We thank Ms. Christine Moore for her excellent editorial assistance and making ECPRM a valuable publication with increasing impact in respiratory medicine. Research reported in this publication was supported by the National Cancer Institute of the National Institutes of Health under award number P30CA033572. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Conflict of Interest

No financial conflict of interest exists in the publication of this editorial. SSS serves as a member of the ECPRM editorial board.

Bibliography

1. Patel NM., *et al*. "Enhancing next-generation sequencing-guided cancer care through cognitive computing". *Oncologist* 23.2 (2017): 179-185.
2. Ross C and Swetlitz. "A STAT Investigation: IBM pitched its Watson supercomputer as a revolution in cancer care. It's nowhere close". STAT Reports (2017).
3. Jemal A., *et al*. "Higher Lung Cancer Incidence in Young Women Than Young Men in the United States". *New England Journal of Medicine* 378.21 (2018): 1999-2009.
4. Johnson S. "Study: IBM's Watson Found Cancer Treatments That Doctors Overlooked" Big Think (2017).
5. Miller A. "The future of health care could be elementary with Watson". *Canadian Medical Association* 185.9 (2013): E367-E368.
6. Printz C. "Cognitive computing, paired with Genomics, may benefit cancer treatment". *Cancer* 124.5 (2018): 883.

Volume 7 Issue 8 August 2018