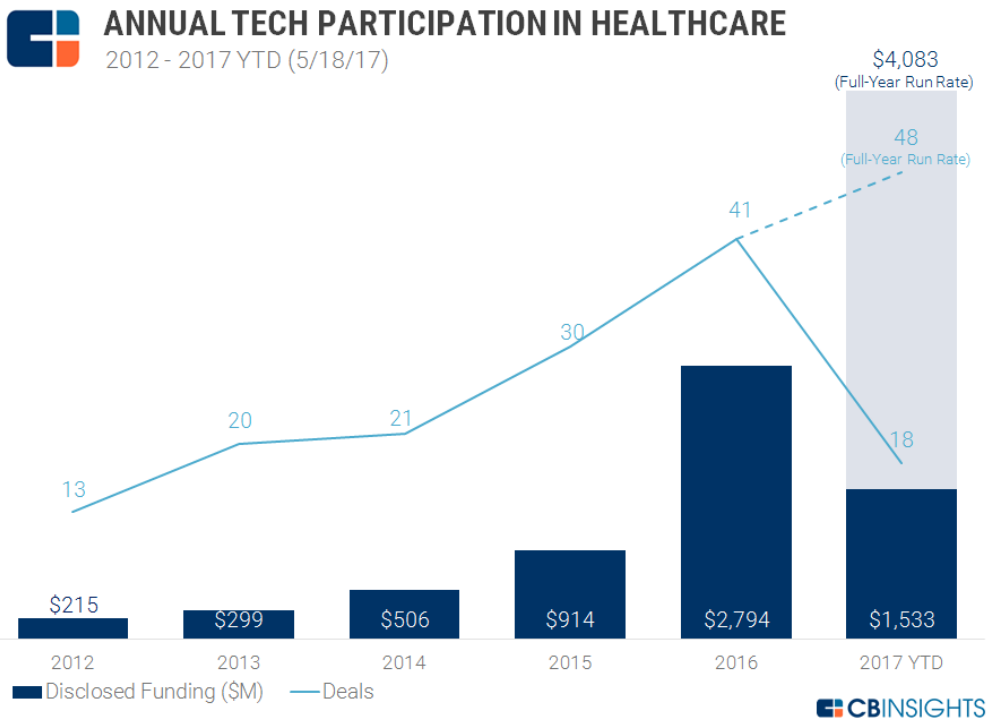
Database Technology for Effective Cancer Treatment

Erin Tsai, MSBA 304, Final Paper, Online, 08/12/2018

I. Introduction and Question Presented

Technology, in general, has increased its applicability to all fields, and particularly with healthcare. This can be easily seen through the Annual Tech Participation graphic below.



(CB Insights, 2017).

Moreover, database technology has become increasingly popular throughout all different fields. Specifically, there has been an increased use of database technology with various scientific fields and in healthcare. We are considering database technology and its uses in cancer treatment. The purpose of this paper is to ask: How has database technology changed cancer treatment and how do we expect it to expand in the upcoming years?

II. Research and Analysis

Many people die from cancer annually. With Big Data becoming increasingly popular, there have been attempts to utilize Big Data to improve cancer care. However, "[g]iven oncology's complexities – a single tumor can consist of more than a hundred billion cells, which have the ability to mutate individually – it has been a prime area for evidence-based, data-driven innovation and research." (Cota Team, 2017).

Paturel quotes Dr. Ramesh Renegan, "'Historically, doctors believed bigger surgeries, more radiation and more aggressive chemotherapy regimens reduced the chance of recurrence. Now we understand that a multipronged, targeted approach leads to better outcomes for patients – even when it comes to the deadliest cancers.'" (Paturel, 2018). The result of this is that computer science is now increasingly applicable to medicine, and researchers and scientists are working in conjunction with engineers and computer science minds.

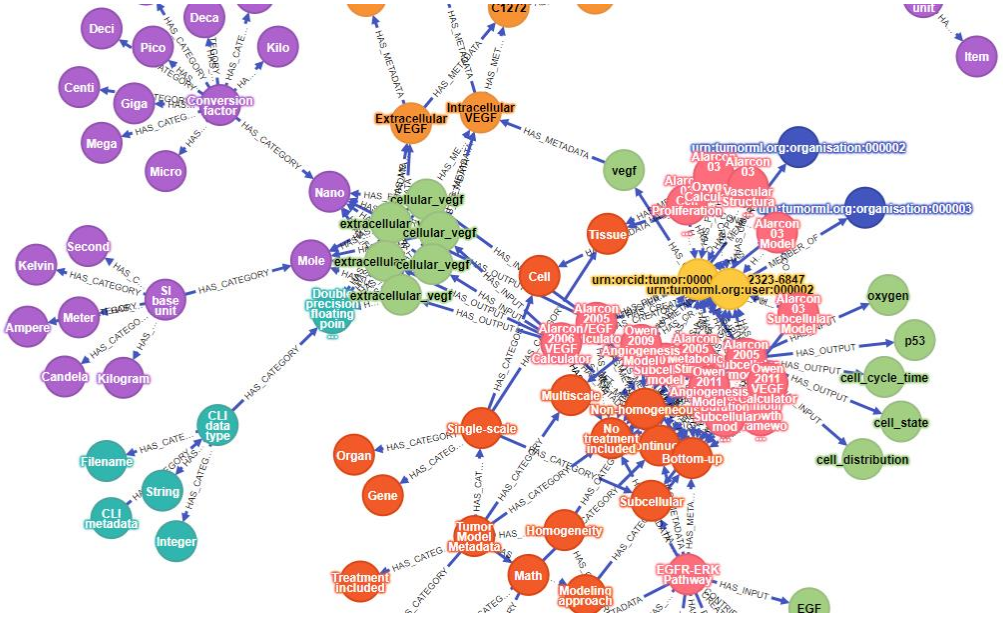
As with most cancer treatment, the goal is to kill the cancer, while minimizing destruction of health tissue and cells. Several types of treatments have been utilizes, but there remain issues. For instance, immunotherapy, using the patient's own immune system to battle the disease, has generally been very helpful in battling melanoma, lung, and kidney cancers. However, as noted by Paturel, "releasing the brakes on the immune system could cause it to careen out of control and attack the skin, lungs, intestines, joints, and other health organs and tissues."

a. Examples of Database Technology used in Cancer Treatment

One example of database technology in Cancer Treatment is "Graph Technology." They adopt graph databases to ensure that patients can "receive the most effective drugs as early as possible to maximize their chances of beating the illness." (Eifrem, 2015.) Graph databases help in relation to search and recommendation, because it keeps track of relationships between things. "The data relationships stored in the graph database can express the nature of each connection (e.g. drug family, type of cancer targeted) and capture any number of qualitative or quantitative facts about that relationship (e.g. optimal dosage level, treatment success rate, effectiveness against mutations, and date brought to market). (Eifrem, 2015). Using this information, doctors can ask and find information easily by asking the database specific questions regarding effective treatment, specific to gender, age group, and various other characteristics. Annai Systems, a genomics and data management company recently created a new system for this purpose. (*Id.)* Their team entered information from dozens of databases into a single graph database to create a uniformed database that connected all treatment options with specific patient biomarkers and ranked list of treatments. (*Id.*)

An example of what the graph database would look like is these:

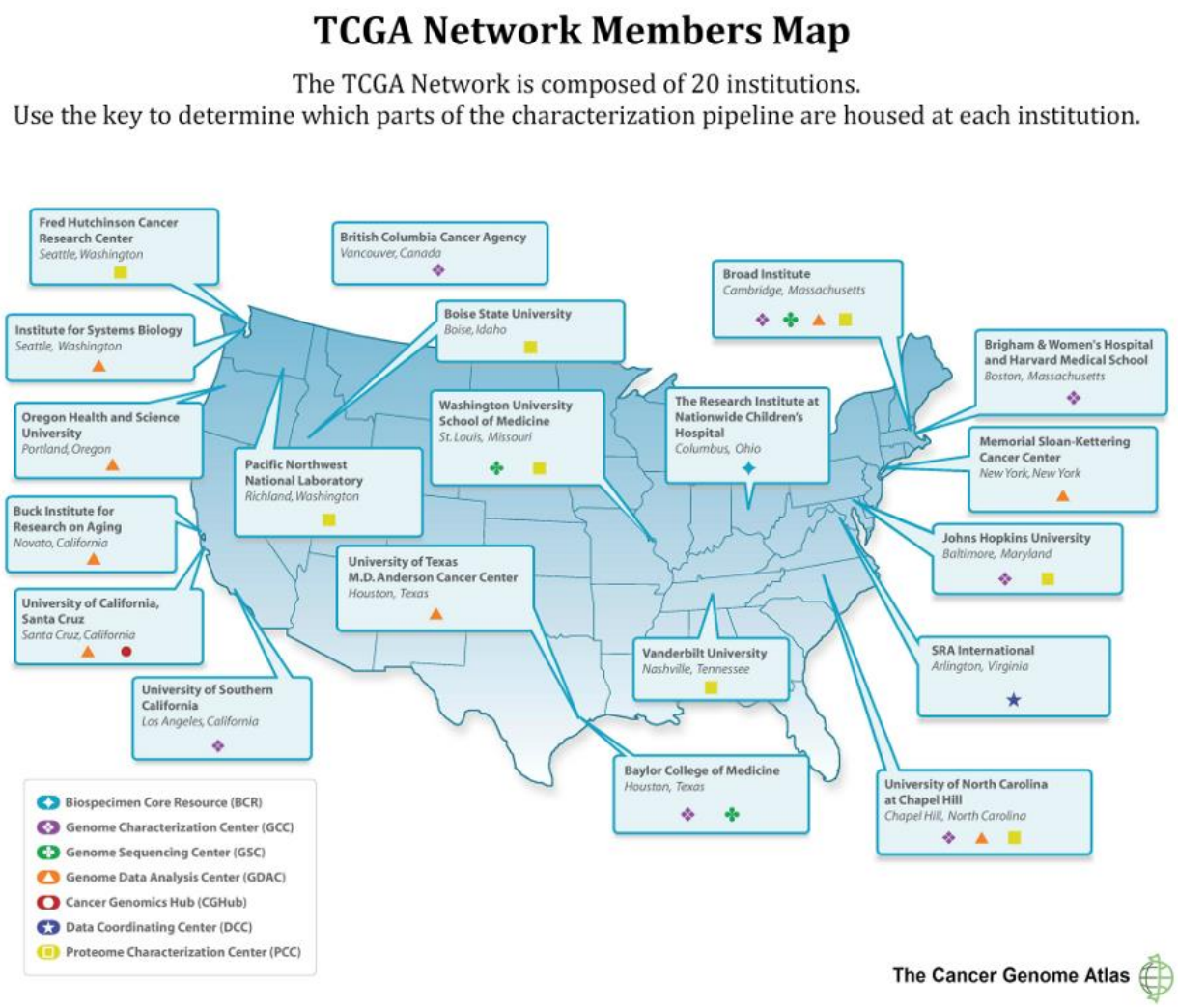
(Wang, Z., 2007).



(Johnson, D., 2018).

A man named Eric Dishman was diagnosed with a rare form of kidney cancer at a young age. (Swartz, 2016). He received 62 different kinds of chemotherapy, immunotherapy, and radiation. In 2012, a genome testing company had his cancerous tissue sequenced to determine the genetic mutations and abnormalities causing the cancer growth. Using this data, they were able to pinpoint a drug for pancreatic cancer to target his cancer growth. Within three months of his treatment, he was cancer free. (*Id.*)

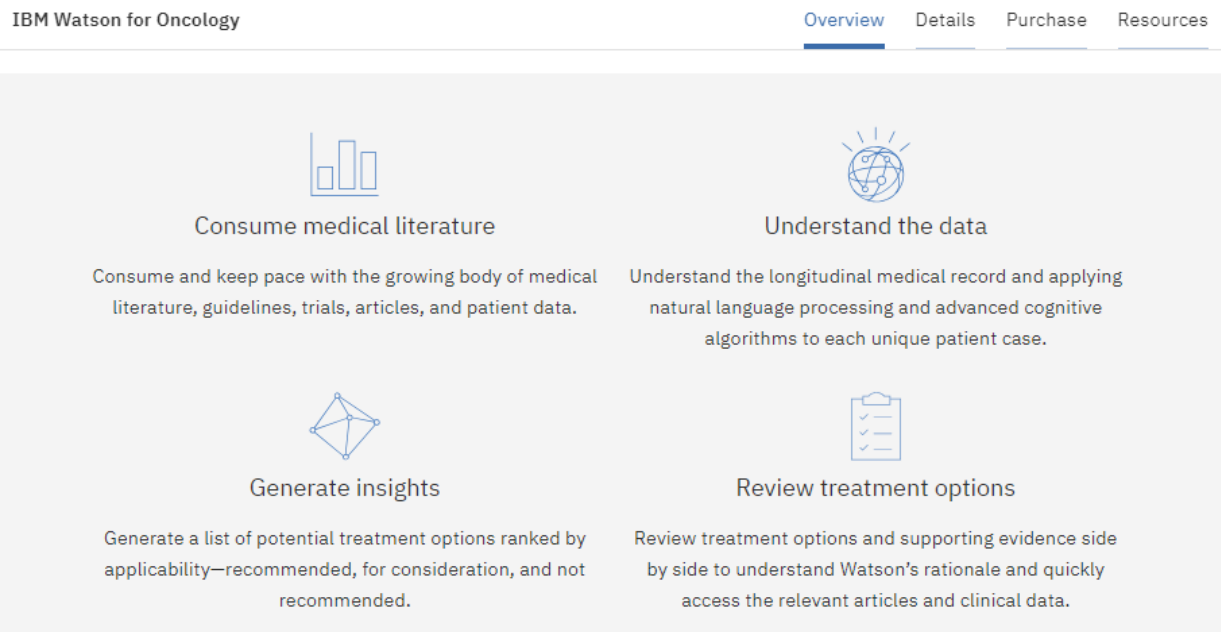
Intel and OHSU created an open-source platform called the "Collaborative Cancer Cloud" to allow people to access anonymous patient information. Additionally, the National Cancer Institute (NCI) and the National Human Genome Research Institute (NHGRI) collaborated to create the Cancer Genome Atlas. This dataset has tons of data, publically available, to help improve prevention, diagnosis, and treatment of cancer. (National Center Institute, 2018a.) It connects many institutions, allowing for easy access to tons of information.



(The Cancer Genome Atlas, 2018).

IBM Watson was first introduced in 2011 to compete in Jeopardy against two of the greatest champions, Ken Jennings and Brad Rutter. (Best, 2013.) It was developed for the purpose of being able to train Watson in order for it to utilize it for something else, something better. It ultimately became used for medicine. It went through the process of "content adaptation, training adaptation, and functional adaption" or in other words, it was fed information, and tested with practice questions, making adjustments as necessary. (*Id.*) It has been used to help choose the correct therapy for a cancer patient, assisting doctors in reviewing medical journals, articles, patient information, and more. (*Id.*) More recently, a study was done to analyze Watson's ability to identify treatment options for a cancer patients. (Johnson, 2017). Watson confirmed 703 cases, and found potential therapeutic options for 323 additional patients. "Human doctors had not identified 'recognized actionable mutations' in 96 of these patients." (*Id.*) What this means, is that Watson was able to systematically consider all options, and ensure that no stone is left unturned. This is extremely important in cancer treatment, and can significant improve survival rates for cancer patients.

There is a website, tailored to only IBM Watson for Oncology. It is made available for purchase in order to supplement cancer care. It helps doctors consider "individualized cancer treatments." (IBM Watson, 2018).



(IBM Watson, 2018).

As noted in the graphic, and through IBM's website, it is a way to combine information for medical journals, textbooks, patient records, evidence, and various other sources to identify the best treatment option. This is a huge improvement in cancer treatment since before database technology was utilized. This type of technological advancement is exactly what we look forward to seeing in the future as more is being developed.

b. Other Examples of Database Technology used in Healthcare and Medicine as a Comparison

There are other several instances of using Database Technology in the Healthcare and Medicine field. Databases have been created by the World Health Organization to combat falsified medicine. (Poladian, C, 2018). The database allows individuals to report falsified medicine to track them on a global scale. In the past, it saved lives in South America after discovering a contaminated products that caused deaths in Asia. (*Id.*) They were able to learn about what happened in Asia through the database and prevent further deaths in South America.

Apple and IBM are working towards collaborating a big data health platform so that iPhone and Apple Watch users' data can be shared with IBM's Watson Health so that they can gain medical insights through real-time activity and biometric data. (Marr, 2015). Big Data also helped in the fight against the spread of epidemics, such as the Ebola virus. (*Id.*)

c. What trends do we expect to see in upcoming years?

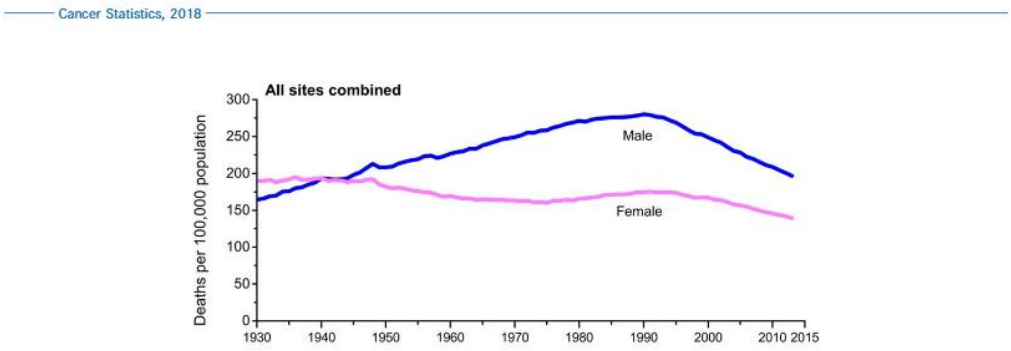
In the past 65 years, we can see a huge change in death rates, especially in death rates for young children between the ages of 0 and 4. There has been a decrease in death rate of about 18.8 percent for all ages.

All Primary Cancer Sites Combined

Age Group	Rate per 100,000			Annual Percent Change		Total Percent Change
	1950	1982	2015	1950-1982	1982-2015	1950-2015
Ages 0-4	11.1	4.4	2.0	-3.3*	-2.1*	-81.6
Ages 5-14	6.7	4.2	2.1	-1.9*	-1.7*	-68.4
Ages 15-24	8.6	5.8	3.3	-1.4*	-1.4*	-61.4
Ages 25-34	20.4	13.5	8.6	-1.4*	-1.7*	-58.0
Ages 35-44	63.6	48.2	27.0	-0.9*	-2.0*	-57.5
Ages 45-54	174.2	171.4	96.5	0.0	-1.8*	-44.6
Ages 55-64	391.3	435.5	282.0	0.4*	-1.8*	-27.9
Ages 65-74	710.0	832.7	609.0	0.6*	-1.3*	-14.2
Ages 75-84	1,167.2	1,249.3	1,095.6	0.3*	-0.6*	-6.1
Ages 85+	1,450.7	1,598.7	1,628.3	0.5*	-0.2*	12.2
All Ages	195.4	208.3	158.7	0.2*	-1.1*	-18.8

(National Cancer Institute, 2018b.)

Graphically, this is easily seen.



(Siegel, 2018).

In the upcoming years, we expect to see a continued decrease in death rates as a result of cancer. With the use of database technology, and the increased ability to target specifically cancer cells based on this data, we can look forward to see a continuing trend.

III. Conclusion

Over the years, we have seen several different ways that database technology has been used for cancer treatment. Doctors and researchers have used database technology to identify specific genome sequencing to identify the type of treatment that is best used. They have used database technology as groundwork to identify information about cancer treatment from similar

patients. They have used a combination of artificial intelligence with database processing to identify all possible forms of treatment to consider the best approach for patients.

This only proves the point that with database processing, and the increased use and improvement in technology, cancer treatment will only continue to improve, and hopefully minimize cancer deaths for all types and ages.

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