Big Data in HealthCare as a driving force in progress and Innovation: From in-Vitro Diagnostic to in-Algorithmo-Diagnostic

By Tobias D. Gantner, MD, MBA, LL. M.

Every single day more than 28,000 scientific publications appear. More than 90% of all data available were generated within the last two years and by the day new data sources surface. It is obvious to search for patterns within these abundant piles of data and derive information from these. Especially in health-care, good experiences derive from this approach ever since the foundation of epidemiology. For the first time in known history of humankind, adequate computer capacities and programs are available for comprehensive data analytics. Hence, Data-Driven health-care has become an electrifying promise of future innovation through IT and a moral obligation to patient safety through data security.

Sometimes discussions get stuck at a certain point and all parties obviously have lost sight of their goal. This brings a Zen saying to mind: “If I show you the moon, don’t look at my finger.”

It is a phenomenon quite similar with Big data in health-care or Data Driven health-care. The topic appears under a number of names such as “episode mining”, “predictive medicine” or “medical decision support”, just to name a few. This provides a strong hint that there is no commonplace definition as to what Big Data is. In the context what I will be talking about, Big Data could have a significant impact on medicine and healthcare. However what is out there today are sales expectations of analysts, strategic decisions on C-Levels of major companies and patient expectations. Unclear still is what there is realistically to be expected from such a technology trend. What we talk about in most cases is the justified worries and concerns brought about by data protectors and patient representatives in the face of unclear applicability. To the same extent as every single one of them is justified, we nonetheless do not know where digitalization of health-care and the health-care system could lead us to and to what we could be enabled.

Let us thus have a glimpse together on one possible future scenario of medical progress:

The expression “Big Data” means bulk of data that is hardly manageable due to its sheer volume with normal hardware and common methods of data processing. Data are generated with every click, with every online purchase, every input into the navigation system, every financial transaction, every telephone call with a cell phone, every visit in the gym, every move in social networks and every usage of sensors, that measure functions of our body.

The same amount of data that humankind has produced since its origin up until 2011 is produced within every 10 minutes in the year 2014.
Big Data does not only mean data per se but also analysis and usage. The data abundance is thus being used by automatically screening it for patterns and interdependences. The soul of pattern recognition is the algorithm and algorithms create logic and a sense of organized thinking from significant amounts of data.

Any kind of online shopping for example uses „Big Data“ on a regular basis through the implementation of personalized customer profiles which contain individual fields of interest.

Also in the medical field „Big Data“ is relevant: Through automatic interpretation of Twitter tweets in the USA the spread of a flu wave could be predicted and contained. (S. Burton et al. “Right Time, Right Place” Health Communication on Twitter: Value and Accuracy of Location Information. Journal of Medical Internet Research, 2012; 14 (6)).

Facts about Big Data: Big Data – Big Bullshit?

It were technology changes that opened up a good opportunity for Big Data: The increase of data storage capacity in combination with advances in machine learning.

Processor capacities and the development of self learning algorithms rendered us possible to get structured data from unstructured and to decipher patterns with statistical methods. These patterns are invisible to the human eye and give way to their secrets when huge amounts of data and intelligent algorithms go into an alliance. The predictive power of “Data-Driven health-care” will lead to a sociodemographic change. As a consequence the “digital patient” will then not only be a dashboard of events of the past but will be essential in predicting the future. More patients will actively partake in what kind of medical treatment they shall undergo.

They will make wiser and more educated decision based on data, if it comes to physician choice, nurture or drug therapy. For this to happen it will be necessary to offer reliable information on how to use this additional knowledge the best way possible. This will lead to a political mind change triggered by the tangible decisions of educated users and it will lead to a discussion on data safety that will offer action options. The recently passed law in Germany on patient empowerment clearly points into this direction and shows the will of the legislation (see §§ 630c, d, e and especially. g BGB).

Companies will feel the urge to react to these new circumstances because through a strategic change and in this through a mind-change only it will be possible to adjust the current business
model to the current and future challenges. We will explore that more later.

It is being said that data were the new oil. This means it will be the now possible analysis of big junks of data that will bring new insights in medicine within the next ten years thus will fuel progress and innovation in these areas: The product of raw oil keeps us moving for more than hundred years now, the distillation of data will keep us going even further. Data today are as important for us as was oil in the times of the industrial revolution. For them to lead to a destination, both need to be processed.

In our times data are as important as oil in the ages of industrialization

In the USA in the year 2015 1.9 Million jobs will be created in the IT arena that deal with Big Data projects. Any one of these jobs will be supported by three other jobs outside of the IT business. This means overall six Million jobs will come into existence thanks to Big Data.

This mostly possible due to the fact that more and more data are being generated: The “internet of things” is the main reason that the number of devices that are today connected with the internet will skyrocket from 13 Billion to 50 Billions in 2020. According to the Economist by the very year 80% of the adult population globally will own a smartphone that is online. These devices today are already stuffed with sensors that continuously collect data. If these data were better integrated into the health-care system in the USA alone $300 Billion in spending could be saved. The Big-Data industry has a growth potential from $ 10.2 Billion in 2013 to over $54 Billion in the year 2017. But one thing we must not forget: It is about the patient: Data-Driven health-care needs more physicians to deal with it than investors.

“Data-Driven Healthcare“ is multifold and yet still roughly defined

Google and Twitter are currently at a stage to predict customer behavior in the health-care system on a local and national level almost exactly. Internet researches run by customers can predict the amount of emergency room admissions in the next day. The outbreak of infections can be identified within the search behavior of service subscribers. These data influence logistics, stocking and staff planning of pharmacies and wholesalers in the region affected.
Health-care has become a common good that we take for granted. The “half-god in white”, in case you are wondering, I am referring to the MD, does only exist in cheap paperbacks anymore. Health-care and its sidekick self-care (medical selfies) are a constant part of a society that believes in self-optimization of the individual.

This democratization in health-care is made possible through technologic advances and the availability of interface devices and sensors accompanied by the possibility to store (cloud) and interpret (app) data also in the private arena. The future patient will be addressed earlier already in the stage where she is still a customer and will move from being a passive participant to being an active agent of her own wellbeing. Through this big new market segments will come into existence for established companies as well as for startups in health-care and self-care e.g. in the areas of cosmetics, personal training and functional food alike.

The surveyed customer and the challenge of quantified self in a democratized medicine.

The new buzzword in this is „quantified self“. Trust in a medical system that covers for everything has diminished in times of implicit rationing. Self-care and self-reliance have stepped in at this point and this has given rise to a new way of prevention also known as physical self-improvement. Up until now companies that tried to populate this market segment could only make revenue in the secondary healthcare market, this being the market of self-pay and minor regulations on efficacy and reimbursement. Private insurance companies that have more freedom at their hands than government run trusts or statutory health-care insurance companies have proven to be more adventurous in this field by supplying early stage chronic patients e.g. Diabetics with technical devices and personal training. It remains to be expected that the government run bodies will soon catch up and we will occasionally see contracts between sick funds and solution providers. Latest at this point the topic “Big-Data” will have surfaced in the conscious of governmental payers who crave for cost effectiveness proves before reimbursing new therapies. The decision gap between sick funds and out of pocket payment for private leisure is currently being filled by consumers who express an undogmatic joy to measure themselves and share their results with others on social media without being held back by questions of data safety.

In this area, more and more services are that address structural and historical weak points in the health-care systems are coming up. Part of the huge field of service offers that are being offered on a complimentary basis to the first health-care market, this one being the sick fund market, are for example guidance systems based upon outcomes research data. These provide patients with the possibility to get oriented in the health-care market towards their individual disease and the therapeutic options as well as the physicians that show proven and thus outcomes based expertise. This company matches patients and physicians based on disease, area and expertise. In this patients will find out the answer to the question: “Which hospital should I go to and which doctor is the most competent one for my individual condition?”

The future is full of new insights but also abundant with new challenges

But not only in the therapy of existing conditions we will see profound changes. Also prevention as we know it will change for good. In current practice the risk of acquiring a disease has always been a snapshot of certain conditions at a certain point in time. Big Data will be able to add the fourth dimension of fluent time. It will be possible to predict according to individual risk profiles the time when exposure to certain germs is highest. This has been done in a number of hospitals for nosocomial infections such as C. Diff. This resembles somewhat, what is in military circles known as “Defcon-Status”, an actual index of hazard which is using a risk profile nurtured with environmental data and individual medical information.
Applications and ways to capitalize on these changes seem to be almost infinite.

- Side effects and interactions of molecules can be predicted approximately in computer models and based on experience.
- The usage patterns of mobile phones can allow deductions on certain medical conditions such as depression. Intervention can be brought on its way.
- In knowledge workers the usage patterns of smartphones can give hints to burn out situations and thus intervention measures can be taken.

Data-Driven health-care needs more physicians than investors

From Digital to 3-D Data storage: If nothing unexpected happens, digitalization, this means the breaking down of data into 1 and 0 will just be a transit en route to 3-D storage: We will keep on learning from nature who shows us that information can also be stored within the 3-D pattern of molecules and proteins. Think prion disease and you get the idea. This will open up immense possibilities in data generation, data storage and data interpretation. New doors will open up to decipher patterns and gain overviews of interdependencies previously not detectable.

We will see major changes in the basic sciences: What on one end genetics will reveal through tests in a laboratory, that also IT will detect using computer generated biomarkers.

In the future, diseases will still be classified according to their characteristic with their Latin name or the ICD classification. For therapeutic approaches, though we will use a coordinate system derived from insights gained through predictive medicine run and acquired through big data settings. At the union point of IT and genetics the actual and necessary personalized and patient centric health-care and medicine is waiting for us. It will be pieced together from in-vitro-diagnostics to in-algorithmo-diagnostics. In other words this is a clear shift of thinking about how we deliver health-care and medicine. This change in thinking begs or suggests our need to deliberate a number of questions:

Will the future consider data donation a moral obligation such as organ donation? Both happen anonymously and embodies altruistic aspects. Will we have social networks where anonymously medical data can be shared to give others a chance to predict possible future scenarios? Will data compatibility be an accepted match point such as HLA (human lymphocyte antigen) that is a thorough biologic indicator as to how long a transplanted organ will survive in an organ donation?

Still Big Data in Healthcare is rather an electrifying phrase. The ones it renders benumbed and others are being energized. A quite realistic scenario is that findings about diseases will then not only come from classic biotech research facilities to us but also from their very own data processing centers. This is a novelty: A change that will also change ourselves. However, does it not completely not matter what leads us to insight, who or what will uncloak what we have not seen previously? Be it a test tube or an algorithm. We are already part of a great development even though we are not able to see the final destination. At the end, please allow me to one more time point to the moon. In the third verse of the evening song by Matthias Claudius (1740 – 1815) one of the most famous pieces of German poetry it says:

*Behold the moon - and wonder why half of her stands yonder, yet she is round and fair. We follow empty visions and artisans' ambitions because our minds are unaware.*

*About the author: Tobias Daniel Gantner, MD, MBA, LL. M. studied medicine, philosophy, economics and law in Germany, Switzerland, the PR of China and the USA. After his residency in transplant surgery, he worked with Siemens on international consulting mandates. His next positions included Novartis pharma strategy and head of health economics and outcomes research. At Bayer Healthcare, he built the department of Market Access from scratch. He is...*
founder and CEO of the “HealthCare Futurists GmbH”, an international network and think tank from experts of diverse disciplines with a focus on medicine, health-care and life sciences. His interest goes out to disruptive innovations in the health-care system in systemic, political and technologic aspects and the change of business models rooted in it. He leads the “In-Algorithm Diagnostics Group”, that is dealing with topics in predictive health-care and the inherent change of business models in the pharmaceutical industry and the approach towards patients and clients. Tobias Gantner holds a number of teaching appointments in the fields of health-care management, market access and Innovation in health-care. He is speaker in topics related to the future in health-care, medicine and life sciences.