Big Data Algorithms in Medicine - Medical Competence and Critical Judgment Required?

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Abstract:

Every week we read about new diagnoses that can be made faster and with greater certainty by an algorithm than by a human being. This commentary is dedicated to the risks and opportunities, data monopolies, the influence of politics, and the future role of physicians.

Keywords: Artificial Intelligence, Big Data, Medicine, Algorithms, Politics, Causality

There is a gold-rush atmosphere in medicine. Once again, one looks to the West, full of expectations, toward Silicon Valley, and its utopia of the emerging capabilities of artificial intelligence. But there are also times, when the current German Minister of Health, as author of a book, represents theses such as "data protection is for healthy people"[1]. How will everyday medical life change with digitalization and what influence should doctors exert?

Every week we read about new diagnoses that can be made faster and with greater certainty by an algorithm than by a human being. While doctors have to inform themselves about current studies and guidelines in addition to their clinical work and bureaucracy is accounting for an increasing share of working time, an algorithm can fall back on enormous computing capacities. Between the years 100,000 BC and 2003, a total of 5 exabytes of data were generated worldwide; today this amount of data takes two days [2]. According to IBM, the amount of medical data doubles every 3 years and this timespan will be reduced to 73 days by 2020 [3]. In the field of oncology, with its numerous possibilities of gene therapy, algorithms can be used to find optimal therapeutic approaches much faster. But how do algorithms work?

It is worth taking a look behind the beautiful applications of companies such as IBM and Google. So-called neuronal networks, first researched playfully using examples such as chess, are fed as much data as possible, such as possible chess moves or laboratory parameters. The outcome of the game or the correct diagnosis are also entered by humans. The more data the high-performance computer receives, the better the correlation it can calculate, whereby an actual causality can never be calculated. A good example is pulmonary edema, which is diagnosed by algorithms from thoracic X-ray images [4]. Researchers found that the software in X-rays did not link the edema itself with the diagnosis, but rather pacemakers in the image. Thus, it was often correct, since patients with pacemakers often have pulmonary edema, but the connection was wrong. Based on this, Gerd Antes, head of Cochrane Germany, predicts a "descientification" of medicine by Big Data and a wrong focus on correlation instead of causality [5]. How exactly these correlations are calculated by algorithms, however, is not clear, even to computer scientists. The weights, vectors and thresholds of the paths in neural networks can no longer be re-

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constructed, if they are greater than 2x10 perceptrons (synapse in neural networks), similar to tree diagrams. The developers of algorithms therefore affectionately call these "black boxes". Parameters can be integrated, but the algorithm decides how they are weighted in individual cases.

This can have far-reaching consequences, for example if the parameter is "cost efficiency". Companies, such as Aspire Health in the USA, use patient information to calculate individual life expectancy [6]. The background is, that ¼ of the money spend in healthcare is used in the last year of the patient's life. Prognosis programs could ensure, that patients, who are thought to be in the last year of their life are offered outpatient and thus more favorable therapy, instead of aggressive inpatient therapy. In Great Britain, similar software can already be used when deciding whether chemotherapy is indicated. While this can spare many patients from having to undergo futile and strenuous treatment, such decisions must be based on transparency, as to which interests have an influence on the decision. Is it the patient's welfare and thus humanitarian interest that is in focus, or is it the fulfilment of an economic plan? Naturally, an algorithm cannot answer this question.

It is therefore not surprising that health insurance companies are very interested in the further development of such algorithms. As variables reduce an individual to a score that may deny him or her access to public services, the original idea of solidarity among health insurers is increasingly eroding. Just in time for the new basic data protection service, many health insurers assured themselves that they would be allowed to pass on data to third parties. One example of the new cooperation between health insurance companies and computer companies is the project between a German health insurance company and IBM for an electronic patient file, in which case, according to Techniker Krankenkasse (a german health insurance company), the customer does not have to agree to the transfer of his or her data to the company providing the software [7]. While programs, such as the "Google Deep Variant", used for gene sequencing, advertise with user-friendliness, large computing capacity and free use, the companies receive huge data sets in return. In a digital age in which data is traded as the new currency, this increasingly secures the monopoly position of software companies.

The doctor-patient relationship will also change. While the expert knowledge of physicians has been trusted up to now, in some areas algorithms are trumping this more precisely and quickly. Although this could give patients greater independence, it could also erode public trust in physicians and the doctor-patient relationship. Whereas in 1970 95% of the population still trusted doctors, by 2014 this proportion had fallen to 66% in Germany [8]. However, it has been sufficiently proven, that trust in the abilities of the treating physician has a significant influence on patient's recovery [9].

In addition to the ethics in digitization, demanded by German Federal President Steinmeier, the digital evolution in medicine has so far been largely influenced by software companies and politics [10]. The medical profession can and should discuss the crucial questions about algorithms such as: If they can reduce physicians' tasks, for example in diagnostic or bureaucratic areas, how will the freed-up time be used by medical doctors? Will it be used for seeing more patients, or do we get more time for each patient? Should the medical curriculum be adapted to the new requirements of the medical profession and how? What criteria are used to produce the algorithms, and to what extent are economic parameters taken into account? Where is the ethical aspect of medical practice? Physicians must play a leading role in this discussion, which sets the course for the future of the medical profession. This is beneficial not only to medical students and doctors, but above all to the addressees of all medical action: our patients.

The new Big Data technology is only a tool of the trade. It opens up good opportunities, but the danger of misuse should not be neglected. The framework conditions for digitization in medicine still have to be defined, and we as doctors should

be more involved in this discussion. Because, as the saying goes, not all that glitters is gold.

Resumo:

Ĉiusemajne ni legas pri novaj diagnozoj, kiuj povas esti faritaj pere de algoritmo pli certe kaj pli rapide ol per homo. Tiu ĉi komentario okupiĝas kun la riskoj kaj eblecoj, datenmonopoloj, la influo de politiko kaj la estonta rolo de kuracistoj.

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