

## GUEST EDITORIAL

# To AI or not to AI - when will the medical e-revolution come around?

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## Introduction

Over the last few years, there has been an increasing interest in precision medicine and artificial intelligence (AI) and the jungle of methods they entail. Reading articles in different media - even the highest ranking medical journals - it is easy to get the impression that this is powerful stuff; the future is promising and the real challenge is if computers (and robots) will turn out morally sound or not, or even turn against their human creators. In the field of medicine, some understand this as a saviour and that computer algorithms, such as those represented by Google's AlphaGo Zero and IBM's Watson, are the future diagnosticians and maybe even clinicians. However, there is a huge catch to this optimistic (or frightening) worldview.

The catch is usually omitted, or barely touched upon in these articles. These systems are dependent on information - and often lots of information (e.g., Big Data). Nevertheless, the systems outcomes will, still, never be better than their inputs. If their inputs are flooded with noise and unstructured and unspecified variables, it will be increasingly difficult for the systems to disentangle the true underlying patterns. In clinical medicine, structured and standardized data are rare. Having an entire electronic medical record (EMR) in this structured and standardized way is even rarer. Thus, developing diagnostic or treatment algorithms based on these records might seem futile, especially for those colleagues who believe that natural language processing (NLP) will solve this problem. Here, it should be remembered that EMR is a cornucopia of noisy text and language specific challenges for most countries in the world. Nevertheless, we should of course acknowledge those diagnostic tools that have already been developed, based largely on "visual" pattern recognition in, for instance, pathology [1].

## Precision medicine, algorithms and complex dynamic and adaptive systems

Based on these fundamental limitations, the near future of systems medicine or precision medicine is very bleak and limited. For sure, a few researchers and authors stand out as more reflective than others. A recent article by Manrai, Patel and Ioannidis [2] portrayed the future of precision medicine as even gloomier. These authors highlight the problem with one of the seemingly most standardized and structured data variables, references in laboratory tests. In addition, Mentis and co-workers [3] point out the possible threat of precision medicine to global health. They emphasize the dangers of "placing too much emphasis on algorithms and not taking the patient's complex background and needs, such as culture, values, preferences, and beliefs, into consideration" [3]. In theory, at least, having algorithms analyzing structured and standardized complete EMRs from both small local hospitals, large university hospitals, and including the findings from general practice, rehabilitation institutions and nursing homes (among others), would address the effectiveness of much of our healthcare services from individual conditions to public health issues.

Such statements precede any reflection on the fact that the previous (and not unique) expected medical revolution was just a minor improvement, namely the sequencing of the genome. In the first "era" of precision medicine we should not expect to see great strides in medical treatment. A minority of patients, relative to the majority of patients seeking medical counselling, will potentially benefit, but the remaining majority are unlikely to see any clinically relevant change. This is, perhaps, unsurprising, given that the human body is a complex living, dynamic and adaptive

system, with scientific knowledge increasingly indicating that complex systems are rarely (intentionally) realigned by changing only one or two factors that seems to be essential in the pathogenesis of the given health condition [4]. Furthermore, complex systems are defined by their interactions, not their constituent components. Moreover, every single individual in all his/her complexity contains enough health data to overwhelm even the very best of clinicians [5]. Being a clinician is certainly challenging, but our intellectual inabilities are not really so deficient that they warrant replacement with AI. At least not yet.

## Addressing modern challenges

Addressing these challenges is possible and indeed necessary, but is unlikely to solve the problem. The ultimate challenge is when these algorithms encounter the most complex structure known to man, the human brain. Taking into account the neocortex on top of the basic aspects considered in precision medicine will introduce a complexity to these systems of previously unprecedented magnitude. To interpret this as abolishing the advances generated by computer science would be a flawed understanding. But what might be the most important influence from AI in clinical medicine and health sciences? Before considering that question, we must briefly review the current status of the scientific medical literature. Most (> 85%) research funding is wasted [6]; most publications are flawed, drawing inappropriate conclusions [7], most research is never reproduced and thus confirmed or refuted [8] and most researchers and clinicians are not able to interpret research findings correctly [9].

## Conclusion

What if we had algorithms sifting through the entire medical scientific literature to sort out the signals from the noise and telling us what we actually had learned from all our research endeavours? That would be a true medical revolution. Applying these algorithms dynamically (i.e., continuously) will enable the medical community always to be up-to-date, something which has clear benefits for all clinicians and thus the patients for whom they care.

Such an application would also enable the clinician to tailor the data to age, ethnicity, co-morbidity, previous medical history and most other health data variables. Another benefit from such a dynamic use of such algorithms will be to assess the methodologically rigorous criteria of the studies investigated. It would be important to apply different criteria to genome-wide association study (GWAS) studies, rare disease registry studies, discoveries of novel interventions, or scientific studies of reproducibility. Such improvements would give the clinician a true possibility to *engage and focus on the patient, the whole patient and nothing but the patient* - the core philosophy of person-centered healthcare.

## Conflicts of Interest

The author declares no conflicts of interest.

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