Towards Smarter Health Care: Can Artificial Intelligence Help?

Peter J. F. Lucas[1], Fabio A. Stella[2]

[1]Department of Data Science, Faculty of EEMCS, University of Twente, Enschede, the Netherlands
[2]Department of Informatics, Systems and Communication, University of Milan-Bicocca, Milan, Italy

1. Towards digital health care and health data science

Health care and medicine were one of the first areas where artificial intelligence (AI) was applied, although initially with little impact on health care itself. Most of the impact of early AI in Medicine (AIME) research was in terms of the development of new AI methods. Now, with the increasing availability of health-care data, there is renewed interest in AIME, however, this time with the promise of having impact on health care.

In particular, with the introduction of electronic health records (EHRs), health care is finally catching up with the rest of society where digitization of core processes has become the norm. The EHR has increased the availability of observational health-care data, that are highly heterogeneous in nature and demand complex methods for their analysis. How to deal with such health-care data and what can be achieved by their analyses is seen by many as a big challenge.

2. Biomedical knowledge is key

At the same time, artificial intelligence research has made considerable progress, in particular in tackling real-world problems. At the moment, a large number of AI researchers are focusing their research on low-hanging fruit, such as applying deep learning methods to clinical diagnostic imaging. However, medicine and health care are much more than just interpreting digital images: it involves highly complex decision making to ensure that the trajectory a patient with a disease needs to take for achieving a diagnosis, treatment, recovery, and final outcome is optimal in some sense. As a consequence, researchers have to draw methods from the entire field of AI, not just deep learning. In addition, health care data is usually problematic because of failure of systematic coding, use of free text to describe essential aspects of the disease follow-up, missing data, and lots of coding mistakes.

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peter.lucas@utwente.nl (P. J. F. Lucas); fabio.stella@unimib.it (F. A. Stella)
http://www.cs.ru.nl/~peterl/ (P. J. F. Lucas); https://www.unimib.it/fabio-antonio-stella (F. A. Stella)
0000-0001-5454-2428 (P. J. F. Lucas); 0000-0002-1394-0507 (F. A. Stella)

Health care and medicine are built upon a rich body of knowledge, concerning the pathophysiology of diseases, molecular, genetic, cytological, and histological characterization of stages of a disease, described by temporal and spatial disease patterns. For example to help patients with a chronic diseases managing their disorder and to prevent exacerbations, one needs knowledge about common causes of an exacerbation, typical symptoms and signs, and effective treatment to prevent or suppress the worsening of these signs and symptoms. Much of this clinical knowledge is evidence based, based on research but unable to guarantee optimal outcome. Nevertheless, clinical decisions on disease management are based on the best available evidence and it makes sense to incorporate such knowledge when building AI solutions.

3. Scope of the workshop

Clinicians and health care researchers have recently spotted the potential of AI for clinical decision making, clearly inspired by success stories from the popular press and novel health care projects by Big Tech. This has created a new enthusiasm for medical AI in the health-care community. The workshop builds on the rationale that learning from scratch is not possible at the current state of the art, while model-based and knowledge-based methods have been shown to support effectively analysis of data to address complex decision making problems in both static and dynamic settings. Validity and usability, as well as ethical and legal implications, of decision making based on models are also important issues in health care, in the sense that models completely learnt from data are ill-justified, cannot be explained, and therefore hard to accept by the health care community. The workshop offers a venue for researchers and practitioners to show how model-based artificial intelligence, theory, models and algorithms can provide help physicians and clinicians to make actionable and effective decisions.

Medicine and health care require highly complex decision making to ensure that the trajectory a patient with a disease needs to take for diagnosis, treatment, recovery, and finally outcome is optimal in some sense. As a consequence, researchers have to draw methods from the entire field of AI. On the other hand, health care and medicine are built upon a rich body of knowledge, e.g. concerning the pathophysiology of diseases, molecular, genetic, cytological, and histological characterization of stages of a disease, described by temporal and spatial disease patterns. Such knowledge can also act as background knowledge to guide machine learning.

This workshop aimed at elucidating the relationship between what can be expected from AI methods when applied to health care problems and the role knowledge of health care and clinical medicine can play in developing AI solutions to health care and clinical problems.

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