Translational Medicine - The Need for Integrative Informatics

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Abstract. Translational Medicine (TM) explores the barriers in translating innovations all the way from bench to policy by better translating results of studies in related disciplines, such as socio-economic, psychological and ethical studies. This panel discussion aims at exploring whether major paradigm changes redefine the known TM's barriers and what could be the role of integrative informatics in enabling interdisciplinary scalability needed to reach from bench to mainstream healthcare policy.

Keywords. Translational Medicine, Integrative Informatics, Interdisciplinary Scalability

1. Introduction

Translational Medicine (TM) is about the barriers in the way of biomedical discoveries to become accepted and useful knowledge utilized in healthcare. Current TM studies are conducted by multi-disciplinary teams of researchers capable of bringing basic biological discoveries to the clinical environment, and translate the results into new or revised clinical practice, informed by evidence from social, economic, psychological and other relevant sciences [1].

Developing new treatments towards the improvement of healthcare typically involves three translational barriers denoted "T1 - Bench to Bedside" where promising discoveries of biomedical research are tested in randomized controlled trials; "T2 - Bedside to Community" where bedside success stories are scaled up to work in a community; and "T3 - Community to Policy" where the new intervention becomes part of healthcare policies [2]. Some TM researchers also add the T4 barrier in the translation to population health.

However, TM might perpetuate existing processes by looking for its predetermined barriers T1, T2, and T3, while it could be beneficial to also explore fundamental transformations in healthcare and then revisit these barriers. The hypothesis is that major transformations in healthcare could fundamentally change the barriers identified in TM and influence the TM research agenda (see examples in next section).

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The fields of informatics are already enabling transformations in healthcare and life sciences but they are still disparate (e.g., bioinformatics versus medical informatics). Using basic principles of informatics could lead to integrative health informatics that better facilitates major paradigm changes and helps overcoming the barriers across the TM landscape. Informatics could a barrier on its own due to its additional complexity and new information system models could help in this regard [3].

2. Are We Coping with the Right Barriers?

The aforementioned, Translational Medicine (TM) barriers might be the ramifications of existing paradigms of the biology and healthcare worlds and so a question arises: if paradigms change, do we still cope with the same barriers?

For example, is research done merely at the bench (hypothesis-driven) or is there also benefit in discovery-driven research where data & knowledge mining along with machine learning algorithms are used to analyze real-time data of operational information systems in healthcare? Such research could provide evidences that have not gone through the usual cycle of controlled clinical trials but yet shed light on fuzzy areas of current clinical guidelines.

The hypothesis-driven approach is also confronted with the fact-driven approach where facts are collected (at the point of care) that are relevant to a human disease and that process sets the hypotheses to be tested at the bench side [4]. A known example of that approach is the course of discovering the helicobacter pylori as a main cause of peptic ulcer, an observation that stemmed from fact collection in a clinic setting, conflicting the main paradigm of ulcer at that time.

In the area of access to the rapidly accumulating knowledge worldwide, if current access restrictions change substantially and allow massive secondary use of information, it could revolutionize the analytics potential of the data. For example, if anonymous medical histories become available for research, it has real potential in aiding decision making at the point of care. A secondary use of data brings many advances needs to be enabled by new policy and legal measures that become the main translational barrier in paradigm change [5,6].

The fee-for-service paradigm slowly changes to pay-for-outcome. This is a fundamental change in the way incentives are aligned in healthcare, and as such has significant influence on the translational barriers especially in T2 and T3 that deal with scaling an intervention up to the community and the general policy. For example, a new genetic testing that assesses the odds of having a breast cancer has different incentives for the genetic lab, the healthcare provider and the patient, depending on the overall reimbursement model. Fuzzy knowledge might lead to more conservative decisions, whereas new software simulations [7] could help healthcare providers in simulating the consequences of incorporating a new treatment in their policies.

In the course of enrolling subjects to clinical trials, the challenge of accessing medical records that are rich, structured and complete, is crucial to the success of the clinical trial. The current paradigm of medical records sustainability in healthcare is that data is best kept where it was created. However, in this way, medical records are dispersed and semantically disparate and thus it is hard to find the right subjects for the trial and control groups (clinical data and proper consent). A different paradigm of health record sustainability where patient data is aggregated in a longitudinal health record sustained by independent health record banks [8] could significantly change the

barriers in this regard to mostly privacy concerns of subjects and confidentially issues for pharmaceutical companies.

3. Integrative Informatics

The above examples of paradigm changes could be facilitated by the use of informatics in a consistent manner and help redefine the Translational Medicine (TM) barriers [9,10]. A main informatics challenge in TM is the need for an interdisciplinary scalability, that is, it is not just the numbers (users, data sets, knowledge items, rules and features for learning, etc.) but the fact that each milestone along the scalability journey resides in a very different discipline. There is a need to satisfy technological, ethical and economic requirements of scalability, while continue the core biomedical research [11]. An integrative health informatics could be the basis of interdisciplinary scalability by offering a common ground for the various fields of informatics involved in the translational continuum.

An integrative health informatics could help converging presumably unconnected studies to an insight on how newly-created evidences can evolve and get to healthcare mainstream. A universal health language is needed and one of the most noticeable efforts heading in this direction is the EC vision of Virtual Physiological Human, which aims at establishing an ICT and computational science framework for digital, personalised, and predictive medicine [12].

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