

From Bench to Bed, Back and Beyond: The Four Bs of Biomedical Research

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Abstract: Contemporary biomedicine is characterized by the ever-closer connection between clinical practice and research. Laboratories become nodes of articulated networks, making it no longer possible to consider them as single entities. In light of these changes, a wide range of actors – researchers, scientific instruments, data-bases, experts in bio-informatics and bio-statistics, pharmaceutical companies, clinicians, drugs, patients, cells, ethical and regulatory issues – are involved. In this Introduction, we address why these processes represent a relevant challenge for social sciences as well.

Keywords: biomedicine; clinical practice; translational research; laboratory studies; networks.

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It might seem banal to suggest that the most recent and radical changes in biomedicine may be summed up by the increasing interconnection between clinical practice and scientific research. From this viewpoint, the development of translational research surely represents the most consolidated example of such an evolution¹.

However, we must not forget that the ever-closer link between bench and bed evolved within the so-called “biomedical paradigm”, whose main

¹ Translational research first became a priority at the start of the new millennium. It has given rise to programs, research institutes and scientific journals (such as *Translational Medicine* and the *Journal of Translational Medicine*, for example). In Europe, it has been at the core of the Commission policy: the Horizon 2020 program grants an elevated budget (more than 6 billion Euros) to activities in this field. For a description of the significance of TR in the biomedical field, see Woolf 2008.

characteristics are the separation of mind and body, the prevalence of the analytical aspect within which illness is conceived as the result of an organic lesion (whether at tissue, cell or DNA-portion level) and the extension of the hospital's function to include systematic clinical observation and scientific research, as well as treatment and assistance.

"From bench to bed" is therefore the essence of a union built upon the exaltation of the individual dimension to the detriment of the collective one, the pre-eminence accorded to the body rather than lifestyle, the central role attributed to the hospital as a place of medical practice, and the consequent undervaluation of general practice and healthy living conditions (in homes, the urban territory, air and water quality, the workplace, diet and habitual behavior – in a nutshell, lifestyle). To use a perhaps outdated but still apt expression, medicine centered on the relationship between bed and bench places the cure center-stage, while setting aside prevention². Despite its becoming almost a commonsense statement, we argue the need to reaffirm that contemporary biomedicine is characterized by the ever-closer connection between clinical practice and research.

However, this is merely a starting point: in the first place, the sociological vision highlights the fact that "from bench to bed" not only fails to describe a tension-free relationship, but also indicates the gap between aspiring to a highly desirable future, in which many serious illnesses will finally find a cure, and daily organization of clinical practice and laboratories. Various strategies are adopted in an attempt to overcome this gap and reinforce the connection and continuity between clinical practice and research. Among these strategies are the cultural and political support guaranteed by the "translational imperative" and the idea that doctors and researchers may reciprocally benefit from the greater range of therapeutic resources available to the former and the funding available for research activities to the latter (see the scenarios by Harrington and Hauskeller in this special issue). Secondly, though it is now clear that the expression "from bench to bed" must be completed by adding "and back", many contributions received from Science & Technology Studies (STS), among which also those proposed in this special issue, have highlighted the necessity of further widening the scope to include a heterogeneous and articulated group of actors. Therefore, four "Bs" are to be considered: from Bench to Bed and Back, and Beyond.

The network of actors involved in the relationship between clinical practice and research does not merely include patients and their relatives,

² As we know, first-level prevention deals with environmental conditions and lifestyles, while the second level may be considered as "early diagnosis", i.e. an action perspective fully embraced by the biomedical paradigm. Indeed, "early diagnosis" highlights one of the contradictions arising when the discovery of a potential or initial pathological state fails to correspond to a real possibility of therapeutic intervention.

but also the State, pharmaceutical companies, scientific instruments, data and tissue banks, as well as more traditional characters (such as laboratory technicians and medical staff) and new experts (such as biostatisticians and bio-informaticians), together with experimental protocols and diseases. The list then comprises citizens' and patients' associations, which are more and more involved not only in funding research, but also in defining aims and orienting research activities (Callon and Rabeharisoa 2008; Epstein 1996). Thus, what first appeared to be restricted to only two groups of players, doctors and researchers, has rapidly become an issue that involves a growing number of heterogeneous elements moving within temporal and spatial regions in which global visions and local materiality interact (Law and Mol 2001; Law and Singleton 2003).

One of the emerging problems regards the statute and form of such networks: are they cluster or collective, platform or vector, merely the product of interaction among the involved actors or also the result of STS scholars' selection and pre-comprehension processes aimed at extracting, analyzing and representing data? In any case, as it also emerges from the contributions in this special issue, they are hybrid social spheres where elements become mediators and interact and produce a multiplicity of bio-objects (Webster 2012), such as the "triangle DNA origami" studied by Crabu or the umbilical cord, as shown by Beltrame. Notable among the artifacts emerging within these networks are the information infrastructures (Star and Bowker 2002; Mongili and Pellegrino, *forthcoming*) which produce, elaborate and make available ever more abundant and multi-form data: genetic sequences, publications, cell lines and tissues. On the other hand, while clearly not all which is deemed "translational research" deserves this definition *strictu sensu*, the opposite is also true: much of what happens outside this definition actually moves within the perspective of an ever-closer interconnection between clinical practice and research, as the contributions by Beltrame and Turrini show.

Together, these changes pose new questions and at the same time reformulate traditional ones, in the attempt not only to understand what bio-medicine is becoming, but also to rethink STS aims and methods. The opening contribution by Cambrosio, Bourret, Rabeharisoa and Callon proposes a deep and sophisticated reflection on this topic. Starting from the results of recent studies on evolution in biomedical research, the authors open a debate on how STS analyze such transformations, especially when adopting tools originally developed for handling the large amounts of data produced in the biomedical research field itself. In this way, STS are linked to a wider debate involving sociology as a discipline which addresses social phenomena departing from the Big Data perspective and by adopting "digital methods" (Rogers 2013) – including visualization tools. Here one of the critical issues is the degree of awareness sociologists may have of the agency of such tools and algorithms, as well as the reliability and accountability of the latter. Cambrosio and colleagues' proposal to see them as "dynamic experimental tools instead of tools for

having/representing static results” is thus of particular interest. Above all, it suggests not to analyze the evolution of networks starting from a stable, pre-determined group of actors, but rather to highlight the emergence of a progressive configuration of collectives made up of human and non-human actors, whose interaction makes the agency of each component reciprocally possible.

Therefore, a dynamic analysis of networks should not only mean observing how configurations of actors’ relationships in the same cluster change over time, but also what kind of new actors enter the scene, and which former actors leave it. Both the contributions by Nadine Levine and Conor Douglas reflect on this relationship between Big Data and interpretative processes in translational research.

In Levine’s contribution, the diverse concepts researchers and doctors refer to in translational research are explored through an ethnographic investigation in a laboratory working on the development of molecular markers in post genomic studies on metabolism. Due to the ways in which objects, illnesses and data are interpreted, we see the emergence of tensions generated by the interaction of researchers and clinicians. Translational research is therefore a complex and dynamic process, characterized by margins of uncertainty and the hard work involved in transforming this density of data into a greater understanding of illness.

Douglas’s contribution too looks at the possibility of translating huge research based data into clinical practice. The case study refers to a vast Canadian scientific network within which two bio-informatics tools – a database (InnateDB) and a suite of analytical visualization tools (Cerebral) – have been developed. Both tools are the result of developers’ work on an open source/open access basis in close contact with users in the clinical field.

In various ways and from different perspectives, the contributions in this issue also deal with the theme of standardization as a mix of strategies and combinations, with the scope of aligning the diverse actors involved in the setting up and development of a network. This is what happens in the cases illustrated by Turrini and Beltrame.

Turrini’s contribution analyzes how new pre-natal diagnostic technologies are trying to gain a foothold, causing tension in diverse professional traditions and epistemologies. In particular, conflict emerge when an approach based on molecular biomedicine is proposed as a basis for standardization and thus the possible engineering of pre-natal diagnostics, a field still largely dependent on the artful sight of those who observe the chromosomes in order to identify possible anomalies in cytogenetic analysis laboratories.

Beltrame’s article, on the other hand, illustrates the complex process through which human waste tissue (such as the umbilical cord) can be transformed into an object of study and innovation in biomedical research. The process of bio-objectification involving this human tissue allows us to observe the interactions between biological research and clini-

cal practice in the development of therapeutic applications for umbilical cord cells, while also highlighting how the emergence of a new class of actors, the bio-banks, produces diverse processes of bio-objectification and economic regimes for their exploitation. The bio-banks have become a hub of particular interest in analyzing the divergent articulations linking biomedicine and society, underlining the tensions which emerge when these actors enter into direct contact with the subjective dimension of social life.

Finally, Crabu's article and the conversation among Burri, Carusi and Aspradaki introduce and examine in depth two further elements which assume particular importance, to both understand the processes connecting heterogeneous actors in biomedical research collectives and analyze their transformations.

According to Crabu the promising scenarios presented by nanomedicine, similarly to what happens in translational research, act as connectors among actors with diverse aims and motivations, on the condition that such a promise might evolve into something concrete, such as in the case of the bio-object denominated "triangle DNA origami". The creation of a nanomedical laboratory, in which research for development of this new nanodevice is carried out, offers the opportunity of observing how this promissory bio-object becomes the terrain for a meeting between the anticipatory narrative level and the materiality of scientific activity.

While raising a series of ethical, economic and legal issues linked to the use of diagnostic images in and around the relationships between clinics and laboratories, Burri, Carusi e Aspradaki clearly show such images are capable of acting as a catalyst among researchers, doctors and patients. At the same time, it is clear that the information overload produced by the flow of Big Data also manifests itself in the form of a huge amount of diagnostic images generated by sophisticated and black boxed apparatuses anything but intelligible and unambiguous³.

At this stage, it appears clear that both translational and biomedical research move far beyond the laboratory. Laboratories have become nodes of articulated networks, making it no longer possible to consider them as single entities. In light of these changes, a wide range of actors – researchers, scientific instruments, data-bases, experts in bio-informatics and bio-statistics, pharmaceutical companies, clinicians, drugs, patients, cells, ethical and regulatory issues – are involved. Rather than pointing to the end of Laboratory Studies, this awareness promotes their revival. The laboratory becomes one of many actors interacting within a heterogeneous field, giving life to a dynamic network which challenges our possibilities of comprehension, the research tools we use and the theoretical hypotheses we depart from.

³ For a review, see Perrotta 2012.

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