

Features, Topics, and Barriers in Scientific Collaboration

Subjects: Social Issues

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Collaboration is defined as “a joint effort towards a common goal”. Collaboration drives complexity in organizational problems and is the key to innovation at the intra- and inter-organizational levels. Exploring scientific collaboration in large groups implies exploring human, social, and organizational factors.

Keywords: research ecosystem ; research sustainability ; collaboration ; translational research

1. Introduction

Translational research bridges the gap between scientific discoveries and practical healthcare, comprising four phases: T1 (basic research), T2 (preclinical studies), T3 (clinical trials), and T4 (implementation and dissemination). The goal of translational research is to bridge the gap between basic science and clinical practice, with the ultimate aim of improving patient outcomes ^[1]. This has been particularly relevant in cancer research because of recent advances in the understanding of the molecular characterization of tumors and the tumor microenvironment, enabling the development of novel treatments ^[2]. According to Dolgos et al. (2016), by integrating basic science research with clinical development, translational medicine has helped to improve target understanding, patient subpopulation selection, and organizational learning. It has also led to advances in areas such as disease model validation, human cell- or tissue-derived models, and molecular characterization of retrospective human materials through biobanks, bioinformatics, and translational pharmacokinetics/pharmacodynamics ^[3]. The complexity and multifaceted nature of cancer demands a multidisciplinary and collaborative approach that brings together experts from a broader network of stakeholders, including researchers, clinicians, research centers, universities, government agencies, pharmaceutical partners, patient advocacy groups, and philanthropic organizations, all of whom play a vital role in supporting and advancing cancer research.

Therefore, collaboration is the cornerstone of successful large-scale translational research projects in cancer treatment. By fostering collaboration, these projects gain access to a diverse pool of knowledge, skills, and resources, which are essential for tackling the multifaceted challenges of cancer research ^[4]. Collaboration enhances the speed and efficiency of research, promotes knowledge exchange, and fosters innovation ^[5] by joining together advanced technologies, methodologies, extensive infrastructure, expertise, and resources, making it possible to undertake ambitious research endeavors that would be challenging for individual institutions to achieve. Collaborating with international partners allows for the exchange of insights and data from diverse patient populations, which can lead to more robust and generalizable findings.

The significant role of digital platforms in translational research has been crucial in providing support for the storage and integration of big data, an analysis context, and additional information from external sources. They were created as a solution to the growing amount of omics data and use informatics methods to link molecular and clinical data ^[6]. The benefits of these platforms include the ability to identify biomarkers, develop personalized medicine, and improve patient outcomes ^[7]. It is understood that such platforms enable collaboration by sharing research data and tools, such as in the case of Cancer Core Europe ^[8] or REDCap ^[9]. However, their actual impact on collaboration has not received attention in the literature in a systematic manner.

Effectiveness in translational medicine projects rests on seamless collaboration between individuals, teams, and institutional and organizational stakeholders, ensuring that promising discoveries are efficiently tested, validated, and translated into clinical applications that ultimately save lives. However, collaboration is naturally “difficult to manage, and the likelihood of disappointing outputs is high” ^[10]. However, managing large collaborations proves challenging, often leading to less than satisfactory outcomes ^[11]. Therefore, assessing collaborative processes is a key activity to reach sustainable research ecosystems that go beyond the period of funding and transform activities in health solutions in the long term. Several evaluation models can be traced in the literature in three categories: indices, processes, and

relatedness. Indices are related to bibliometric analysis ^{[12][13][14]}, processes focus on the method of evaluation and the dimensions that must be analyzed ^{[15][16][17]}, and relatedness is explored frequently through social network analysis (SNA) ^{[18][19]}.

Assessing collaboration implies exploring several factors such as planning, infrastructure, relationships, complexity, boundaries, dialogue, and human behavior. Some evaluation models involving these collaboration principles can be traced in the literature, focused mainly on bibliometric indices ^{[12][13][14]}, collaboration processes ^{[15][16][20]}, and social network analysis ^{[18][21]}. Despite the efforts of these studies, researchers are cautioning that traditional approaches are difficult to operationalize in real contexts ^[15]. Nevertheless, more empirical research on actual translational projects is necessary, including the conditions and outcomes of collaborative initiatives ^[22].

2. Features, Topics, and Barriers in Scientific Collaboration

Collaboration is defined as “a joint effort towards a common goal” ^[23]. Collaboration drives complexity in organizational problems and is the key to innovation at the intra- and inter-organizational levels ^{[24][25][26]}. In collaborative settings, entities share information, resources, and responsibilities to jointly plan, implement, and evaluate a program of activities to achieve a common goal, thereby jointly generating value ^[27]. Collaboration leads to enhanced capabilities by sharing engagement, trust, time, effort, and dedication.

Exploring scientific collaboration in large groups implies exploring human, social, and organizational factors. A clinical and translational research project often involves the interaction and input of several stakeholders, such as “researchers, clinicians, pharmacists, statisticians, information technology staff, educators, institutional review board members, administrators, and others” ^[17].

Inter-organizational collaboration produces some benefits for participating organizations, including access to complementary assets, knowledge exchange, the creation of new knowledge, and the sharing of costs ^[28]. Collaboration can create value ^[29] and it also increases productivity ^[30]. Accordingly, collaborative research incorporates social interactions and a range of potential roles for those involved throughout the research process. Previous studies have outlined means of collaboration in the form of “linkage mechanisms” between researchers and users, such as the involvement of intermediaries (boundary spanners), formal and informal communication with users during the research, the participation of users in data collection, and the provision of interim feedback ^[22].

Interdisciplinary collaboration has gained importance in the last ten years for developing therapeutic discoveries more quickly than traditional methods and tackling more complicated biological challenges in translational projects. By analyzing 19.9 million papers and 2.1 million patents over 5 decades, Wuchty and colleagues found that “teams increasingly dominate solo authors in the production of knowledge” ^[31]. Building collaboration in biomedical research at individual and institutional levels leads to improved information sharing between researchers, increased publishing productivity, and new research resources and projects ^[32].

There are some important reasons for scientists' collaboration in translational sciences. From a scientific perspective, motivational factors for collaboration are research data availability, co-authoring, synergy of the research, visibility of the research results, the possibility of solving complex research problems, and the legitimacy of one idea or solution. Regarding the financial dimension, research funding and financial incentives are the lead motivators. The social dimension is based on resource availability, such as data, equipment, materials, or technology ^{[30][33][34]}.

Furthermore, research problems drawing scientists' attention have changed because they are now more ill-defined, technically complex, and interdisciplinary, requiring highly specialized knowledge of a variety of disciplines ^[35]. For instance, a university research center can be an expert in developing molecules to reduce the effects of chemotherapy on the nervous system, and a pharmaceutical company can have the knowledge and technology to synthesize the molecules into a commercial product. Therefore, collaboration is now actively encouraged by universities and research institutions ^[30]. Industry–university collaborations conducting interdisciplinary research are required to solve social and human problems ^[36] such as COVID-19 ^[37]. Solutions derived from n-helix initiatives are often accepted as “close prototypes of complex evolving networks” ^[38]. Therefore, translational research supported by proper public policy can promote technology transfer mechanisms ^[39], or organizational initiatives such as new research institutes, research centers, and technology centers ^{[15][40]}. A comprehensive analysis of the literature about academy–industry–government relationships reveals recurring themes concerning the attributes of collaboration:

- Planning and careful design are relevant in achieving the goals of the collaborative initiatives ^{[41][42][43]}.

- Collaboration requires a knowledge infrastructure for learning and sharing information ^{[44][45][46]}.
- Structure and relational elements determine social interaction and the quality of relationships ^{[41][43][44][47]}.
- Differences between individual and group interests often increase complexity in collaboration ^{[42][48][49]}.
- Collaboration embraces fuzzy boundaries at intra- and inter-organizational levels ^{[16][50][51]}.
- Dialogue, reflection, questioning, and clarification inform collaboration performance ^{[52][53]}.
- Collaboration is grounded in human behaviors within a workgroup setting ^{[47][54]}.

Collaboration at the institutional level in translational research implies challenges related to differences in governance structures, funding mechanisms, protocols regarding human subjects' protection, data integrity, authorship criteria, intellectual property laws, conflict resolution, institutional leadership, and support ^[55]. Moreover, differences in languages and time zones can present practical challenges to communication ^[56]. In addition, geographic distance and disciplinary disparities can also affect the success of partnerships ^[57].

Experience in collaboration networks has reduced the barriers of distance or interdisciplinarity ^[58]. In translational research, researchers prefer to collaborate with researchers with shared experiences and prefer those with whom they have interacted in previous projects ^[59]. However, collaboration between individuals and teams can also suffer in the absence of supportive and enabling group and institutional leadership ^[33].

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