

Collaboration networks in research and exchange of scientific knowledge

Redes de colaboração em pesquisa e intercâmbio de conhecimento científico

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For researchers, an important factor for a successful career is to conduct studies that bring important results and allow the development of impact publications. However, even though they are the main elements of success, achieving these goals is a difficult task, especially working in isolation, due to different reasons, such as few equipment, limited funds for inputs and the knowledge from other areas to interpret results. Thus, conducting research in networks, among researchers who add their efforts to get a more thorough analysis, may be the most advantageous option, helping to achieve goals and scientific growth of the groups concerned¹.

Cooperation among research groups has always existed and was important for its development. At the present time, with all the progress in communication and data transfer, the development of research networks has been growing rapidly. Researchers from different laboratories and institutions, both nationally and from other countries, have been collaborating with increasing frequency, focused on specific research questions. The establishment of research and collaboration networks offers the required flexibility to adapt to a broad vision of emerging challenges^{2,3}. In fact, at a time when technology has enabled the development of equipment that analyzes several aspects of a given sample or experiment, sharing these results with other researchers allows further exploration and discussion about them, showing important details set up by expertise in interconnected areas, even if they are different, but complement each other. Thus, working in research networks provides shared learning, new research opportunities, the development of new projects, joint applications of funds and technology transfer. With this gain in advisability and content, participations increase citations of research articles, especially if there is an international team of authors involved³, in addition to a broad dissemination of results. Building these networks is important for developing countries, especially in those where research funding is insufficient due to the country's peculiar characteristics or governmental decisions that are not prioritizing that nation's technological and scientific development.

Research shared among different groups allows the delivering of better outcomes in several ways. The ease and speed of communication make the distance an irrelevant factor. Electronic mail and videoconferences allow the instant exchange of ideas, discussions and opinions, helping in the quick interpretation and conclusion of analyzes. For those who have not lived through the pre-internet era, it may be difficult to understand and make a fair assessment of the power of these tools. However, for those who depended on travel and mail for the exchange of information, comparing these two moments shows that the internet has substantially provided cooperation in studies. As an example of this important role, we can mention the personal experience that an author had during his master's degree, during the pre-internet era, in the early 1990s. At that time, he worked with cytogenetics of neotropical monkeys (with classical methods) and had important contributions from classmates, studying morphological and molecular aspects in the same species, conducting their research in other states. They learned about these researches from conference abstracts or because they worked in groups that already had some contributions. There were no videoconferences, the bus trip between Rio de Janeiro and Curitiba was necessary to create interaction that nowadays is done instantly with a few clicks on a computer and data network. In addition, there were correspondences sending and receiving via mail. As a result of efforts in these interstate interactions, there were important elements in order to improve the work of all those people involved, with aspects that, on their own, they would have had no access to.

About cooperation between groups from different countries, it is important to notice that another point, which influences the good evaluation of postgraduate programs such as internationalization, meaning the exchange between students and international institutions⁴. In fact, internationalization is one of the questions used by the Coordination for the Improvement of Higher Education Personnel (CAPES) in the evaluation of national graduate programs⁵. In addition, the exchange of students reinforces an extremely important point for any research group, which is the knowledge transfer. In fact, it was the author's opportunity to conduct part of his doctorate course at a German institution which made it possible to transfer technology to his old laboratory, making it becomes a national reference in chromosomal and cytogenomic painting, which boosted scientific production and student training.

Currently, in the process of updating the lines of research, which are in cytogenomic analyzes, both in clinical cytogenetics and oncology, and others, the group of that author and Instituto Evandro Chagas Institute have been

using array CGH (Microarray-based Comparative Genomic Hybridization) in data generation for research, besides clinical reports for a public hospital in Belém, in the state of Pará. Even though that methodology has been used for more than a decade, it is still considered an important technological innovation, with few national groups having the opportunity to use it. This new line of research clearly illustrates the importance of cooperative work: data generated by the experiments need knowledge from different areas for a full analysis, and in the case of this group, it was clear the necessity to join a group that could help with bioinformatics tools; without those tools, they would hardly have scientific articles of content, as many aspects would no longer be explored, resulting in a purely descriptive work. Likewise, cytogenetic techniques and knowledge are important for the data validation obtained from analysis and genome assembly, completing this field of research.

Knowledge of genetics, genomics, bioinformatics, biochemistry and cell biology has been increasingly integrated into scientific articles that try to avoid simple description, in order to present functional and application data. Considering the progress that those areas have been experiencing in recent years, it would be impossible for a single research group to conduct them efficiently and profoundly.

And how can we start a research network? Congresses, conferences and symposia are good opportunities to make new connections. Posters and panels are great dissemination tools, both for the exhibition and discovering studies that may be associated with your line of research. Well-planned and solid cooperation will only benefit both sides⁶. But, for this purpose, we also need to be able to recognize the importance of each one's work, even if he or she is responsible for the samples, for an intermediate step or for the final analysis of the results generated: any of these procedures is essential to reach the planned objective.

Finally, it is important to remember that the formation of networks requires time and dedication. The knowledge of lines of research and studies published by the groups involved, besides the clearness in the explanatory statements and objectives, they are important for a faster connection between groups. Mutual respect and frequent interaction during the research are also points that must be considered. Groups that are used to work in cooperation had a better production and they barely return working alone; cooperation has long-lasting effects and it often creates other cooperation, always important for the progress of those people involved and for development of an extensive scientific knowledge.



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