

## Challenge of the translational neuroscience

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### Abstract

The development of Neurosciences in the last few years has changed a set of paradigms in the production of knowledge, from which new scenarios have arisen in the understanding of the structure and function of the human nervous system, as well as in some of the most relevant diseases involved. Nonetheless, the impact of all the scientific information on this topic has played a limited role in the proposals in the diagnostic, therapeutic,

rehabilitation and social reintegration fields, when the effect on the daily life of patients that have a neurological impairment is considered. Thus, the emergence of translational science is an alternative for a more direct and pragmatic link that allows the connection between basic research and applied research, and in the short term will achieve results that can be promoted in the communities. In addition, this process involves an interaction with technological development and transfer following a global knowledge management model. Every discipline in the neurological sciences field poses different critical challenges to tend to the new epidemiologic profiles. emerging in areas such as neurodevelopment disturbances found in the pediatric population, trauma and addictions in the young, as well as neurodegenerative diseases in older adults. This model reviews the demands from society, expecting more compelling results from the scientific community, particularly in creating strategies that actually change the natural course of neurologic diseases from the bench to the bedside.

**Key words:** Medical research; Neurology; Neurosurgery; Neuroscience education; Neuroethics; Translational medicine

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**Core tip:** The society of knowledge has expanded with information produced all over the world. But unfortunately, only a small part of such knowledge has had an impact on decision-making pertaining health, and on the ability to solve specific problems in a given population. Translational Neurosciences represent an innovative proposal for a direct line between basic research, applied research, technology transfer and knowledge management for the resolution of a specific problem in the neurological sciences, either in diagnosis, therapy, rehabilitation or social integration. This design requires commitment with education and training of human resources in Neurosciences from a proactive and innovative viewpoint.

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## INTRODUCTION

The control of certain emerging diseases and proposals for prevention has been fostered by the growth of science and technology. New innovative strategies have been devised that have favorably changed the worldwide standards of life quality and life expectancy.

However, the creation of new information does not necessarily mean that scientific knowledge is duly applied at every public health level. The society of knowledge has expanded with information produced all over the world, but unfortunately, only a small part of such knowledge has an impact on decision-making pertaining health, and on the ability to solve specific problems in a given population.

The gap between the production of knowledge and its application in daily life and health issues in the communities is today a major challenge<sup>[1,2]</sup>.

## TRANSLATIONAL MEDICINE

One of the best methodological strategies to rethink the paradigm of the production and application of knowledge is found on translational science. It comes forth under the promise of change and a direct short-term impact on the interaction between knowledge and problem resolution. For pragmatic purposes in health sciences this precept is applicable to the concept of Translational Medicine<sup>[3]</sup>.

A crucial fact from its origin is that it arises from the same demand of the so called translational epidemiology, which has been profiled as an emerging condition that supports. That is due to the pertinence of its origin, to try get the different fields of biomedical research to have an impact on public health at the shortest possible term<sup>[4]</sup>.

This protocol makes it more feasible to allow for the transition of basic research into action and resources that are specifically an answer to clinical needs in a more timely and specific way.

One of the most accepted definitions states that it is a process by which the scientific research discoveries are transformed by clinical projects that allow for new treatments promote diagnosis, treatment and disease prevention in the short term. In the scientific literature it is identified as a collection of monographs that are described in a format called "from the bench to the bedside".

This proposal is put forth as bidirectional, since multidisciplinary work is a commitment from the members of the basic research team and the clinical investigators, and it also allows to rethink the prevailing problems in clinical work that need support from basic science. In other words, the proposal strengthens competences and

promotes resolution of concrete problems punctually and specifically, under a strategy of multidisciplinary leadership and teamwork.

The way of thinking is linear, dynamic, bidirectional, with innovation in the pivotal points and the traditional scope of biomedical research, where the commitment lies on the idea that knowledge coming from a reality must go back to it and transform it, beyond a mere description under the perspective of scientific rhetoric<sup>[3,4]</sup>.

Its field of action is broad, since on one hand it requires, due to its own nature, an operative link with technology transfer, creation of patents, promotion of intellectual property and even entrepreneurship. On the other hand, it requires an accurate link with knowledge management and the impact on management guidelines and decision-making in a specific problem in the realm of public health.

## TRANSLATIONAL PERSPECTIVE IN NEUROSCIENCE

Basic neurosciences have had an extraordinary progress in the last 30 years which has modified the frontiers of knowledge and has changed paradigms in neurogenesis, molecular structure, genetics, network functions and specific circuits. This has led to better understanding of basic science and neural pathophysiology and neuropathology, having a high impact on clinical neurology and cognitive neurosciences. In spite of all that, the molecular mechanisms underlying the different diseases and their respective treatment have not been totally elucidated, therefore, many questions remain unanswered in every branch of the knowledge<sup>[5]</sup>.

In view of these events, societies and some political leaders have questioned the fact that although brain research has been consistently supported, compelling advances have not been obtained in the treatment or prevention of the most disabling cerebral diseases in human beings<sup>[6,7]</sup>.

Aside from the complexity in the analysis of the human brain, transfer of neuroscientific knowledge to the biosanitary field has not been easy. This is related in terms not only of primary research and its application, but also including some other factors such as the so called T2 translational research that puts forth limitations and barriers so that the relevant products of basic and clinical research can move on to be applied in health systems at short term, due to feasibility and cost-benefit implementation difficulties<sup>[8]</sup>.

This feature has a direct impact on the creation of new treatment strategies for neurologic diseases of every sort, which are the ones that account for a high rate of disability. Also have an effect on people's independence and the consequent social and economic impact on public health systems.

This scenario in Neurosciences is an overt example where we find an imperative need to transfer knowledge to the bio-health sector, which has led the Health

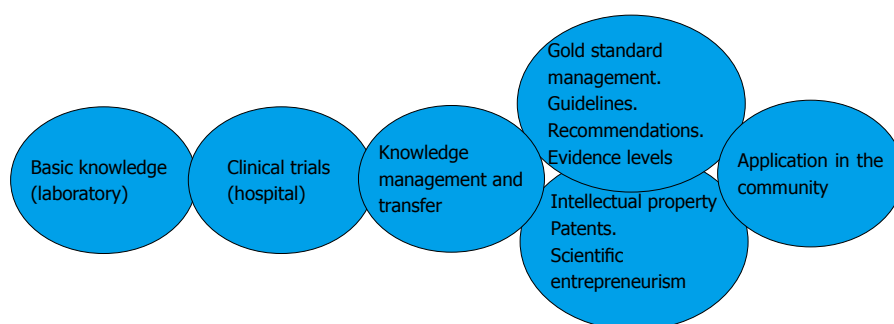


Figure 1 Lineal representation that links the different phases in the production and application of knowledge from the translational perspective.

Institutes - National Institutes of Health, INH- to redirect the funds from research lines to advanced projects in the field of Translational research, in view of a predictable social and public health impact<sup>[9]</sup>.

Consequently, the scientific world has undertaken a series of steps for the creation of a more integrative multidisciplinary strategy between Basic and Clinical Neuroscience.

Ever since the decade of the brain<sup>[10]</sup>, and up to the implementation of more recent study projects such as the BRAIN project<sup>[11]</sup>, and the recently created project of the human connectome<sup>[12]</sup>, every effort in the different scientific communities has the goal of conducting research to discern the map of the human brain and its implications for disease in different clinical areas, such as Neurology, Neurosurgery, Neuropsychopathology and Psychiatry. However, the real challenge must be to discuss the goals with the greatest reach that will be able to link the different research levels with concrete applications at short term, that can actually have direct impact on health and that also promote public healthcare and prevention policies<sup>[13]</sup>.

In the case of Neurosciences, the demand is for almost immediate application. First, due to the large amount of scientific information that is produced in the field. Second, because of the still perceptible distance between research and its effects, since it is considered that such impact has not been big enough to change the epidemiology of diseases that involve the human nervous system and that are a challenge and an emergency in worldwide public health<sup>[14]</sup>.

Translational Neurosciences represent a new proposal for a direct line between basic research, applied research, technology transfer and knowledge management for the resolution of a specific problem in the area of neurological sciences, either in diagnosis, therapy, rehabilitation or social integration (Figure 1).

This feature gives a reference framework according to world trends, but also sets the limits and scope concerning specific topics in basic science and clinical work. Also, this design requires commitment for education and training of human resources in this topic from a proactive and innovative viewpoint. The model pursues not only to be involved in the transformative practice offered by translational science, but also to promote proactive

mechanisms of knowledge management that can support the algorithms in the decision making. Also, other process around health and public policies at a global level with more compelling scientific strength, but supported on local needs.

## TRANSLATIONAL IMPACT IN TIME

Some of the limitations of this process are the so called gaps or death valleys, where time sequence plays a crucial role. They involve extended laboratory research time periods due to their own nature, with the consequent loss of continuity and validity on a specific subject of knowledge to be applied in clinical settings (Long periods between biomedical research phases I-II-III, approval delays, flaws in research product feasibility and availability, questions in cost-benefit balance). Additionally, it must be considered that regulatory criteria and scientific rigor itself can occasionally reduce the implementation of new projects and their clinical application, in spite of having been successful and promising in the research laboratory.

Under emerging conditions, these time periods are shortened by common sense and the existing social pressure under certain circumstances such as epidemics. Or due to the individual decision of patients about using experimental therapies at their own risk even if they are still not approved. This is particularly obvious in case of diseases for which there are no curative treatment options, as happens in certain neurodegenerative diseases<sup>[5]</sup>.

Nevertheless, this condition must not misrepresent the fundamental premise in Bioethics and now Neuroethics by assuming that the viability of the translational process to apply knowledge at short term could compromise the values, rights and responsibilities in protecting health and integrity of patients as a primary endpoint<sup>[15,16]</sup>.

## CHALLENGES IN NEUROSCIENCES

The World Health Organization (WHO) has proposed studies that have led to public policies on global health, based on surveys and epidemiological analysis in the area of neurological sciences. Agreements among different institutions, have integrated a proposal concerning

Neurological	Dementia
	Epilepsy
	Headache disorders
	Neurological pain
Translational	Multiple sclerosis
	Neuroinfections
	Neurological disorders associated with malnutrition
Challenges	Parkinson disease
	Traumatic brain injuries
	Neuro-oncology

**Figure 2** The most relevant challenges for global health in neurosciences for the future years.

neurological disorders as a public health challenge<sup>[1]</sup>.

Under the basic public health principles and knowledge management, a very specific proposal has been postulated involving the most relevant challenges for global health, not only for today but also with future projection under different schemes for years to come: (Figure 2).

In this illustrative outline a methodological design is set forward, contemplating basic public health precepts, such as global health, community health, prevention, monitoring, epidemiologic surveillance and social conditions to attain equitable health.

According to this project, decisions for primary prevention (measures to avoid the onset of disease), secondary prevention (accurate and timely diagnosis, appropriate treatment and management of risk factors), and tertiary prevention (rehabilitation, palliative care, treatment for complications, patient and caretaker education, self-help groups, reducing stigma and discrimination and fostering social integration) are duly stipulated<sup>[1,17]</sup>.

If we analyze the new challenges for Neurosciences as a projection into the future, a new position and a new strategy are required, so that in a practical way there can be a direct reflection on the epidemiological framework, under a translational format<sup>[18]</sup>. An example is the case of the comparative analysis applied to the use of a helmet and its effect on consequences of traumatic brain injury as evidence<sup>[19]</sup>.

On the other hand, it is also pertinent that the proposals to solve these problems should have a long term and obvious impact on functional quality and the quality of life of subjects who have neurological disorders. Consequently, the translational challenges of the new research projects in Neurosciences must also find a way to have a favorable impact or effect on the disability and physical limitations, cognitive sequelae, behavior sequelae, communication and daily life activities as well as psychosocial issues in patients. All, within a global social context and under a scheme that is associated with the commitment of preserving health as a crucial component of the individuals universal rights.

## CONCLUSION

It is crucial that under this vision of things new educational schemes that strengthen the training of human resources on basic neurosciences and all neurological sciences should be created, with a clear commitment of collaboration in "translational teams". In such a way that they are able to update the core curricula (undergraduate and postgraduate), continuing medical education, accreditation and certification; the creation of international networks, the integration of non-medical professionals, the rational use of new technology and consideration of the projective public healthcare and emerging conditions.

Translational Neuroscience must face the challenge of growing from methodological and technological innovation to the production of new knowledge through basic and applied research, promoting discipline and leadership. The exchange and optimization of research work must consider knowledge and transfer management as a priority, for the benefit of community health.

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