

## Research Article

# Translational Research: A Concept Emerged from Health Sciences and Exportable to Education Sciences

Aymerich M<sup>1,2\*</sup>, Rodriguez-Jareño MC<sup>2,3</sup>, Castells X<sup>2</sup>, Carrion C<sup>2</sup>, Zamora A<sup>2,4</sup> and Capellá D<sup>2</sup>

<sup>1</sup>Department of Health Sciences, Open University of Catalonia, Spain

<sup>2</sup>Department of Medical Sciences, University of Girona, Spain

<sup>3</sup>Prevention Service, Integrated Health Services Baix Empordà, Spain

<sup>4</sup>Department of Internal Medicine, Blanes Hospital, Spain

\*Corresponding author: Aymerich M, Department of Health Sciences, Open University of Catalonia, Av. Tibidabo 39-43, 08035 Barcelona, Catalonia, Spain

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## Abstract

The objective of this paper was to analyze the concept and evolution of translational research in order to explore if it can be used in fields other than health sciences such as higher education.

A mini review was conducted using Medline as a main source for identifying papers. We selected papers that appeared to be relevant according to our objective. Data extraction of these papers was made by summarizing documents using short textual descriptions.

Search results yielded 1186 papers, 28 of which were finally selected for the mini review.

The main aim of translational research is bridging the “know – do” gap. Several multiphase models have been identified. The first described model had two phases (T1, T2) but there are models with three (T1-T3) or four phases (T1-T4). However, regardless of the model used, three main gaps exist that can be placed in the knowledge chain underpinning translational research.

Translational research could be seen as a bidirectional bridge connecting the laboratory to practice either in health or in education. Its interdisciplinary “back and forth” ultimately contributes to improved health or education outcomes. This improvement can be achieved if the three gaps of the knowledge chain are overcome. Namely, these gaps are located: (1) between the discovery of new knowledge and dissemination to potential users of that knowledge; (2) between knowledge dissemination to potential users and its routine application to health or education practice; and (3) between clinical or educational practice and improvement of health or education outcomes.

**Keywords:** Translational research; Medical education; Education sciences

## Introduction

Translational research is becoming one of the most relevant topics in health sciences research of the beginning of this century. Good evidence of this is the appearance of several journals totally devoted to the subject, Annals of Translational Medicine & Epidemiology as a nice example. At this point, now may be the right time to explore the possibility of exporting the concept of translational research to other scientific fields such as education. This idea came to our minds as researchers of the Translational Medicine and Decision Science Lab (founded in 2009) and at the same time professors at the School of Medicine (founded in 2008) at the University of Girona, where problem-based learning is the main strategy used on the curriculum of medical degree program.

The need for health research to ensure that new treatments and research knowledge actually reach the patients or populations for whom they are intended is also the need for medical education research [1]. That is, to ensure that new knowledge from research and teaching innovations actually reach the medical students for whom they are intended. Moreover, if this is true for medical education, it could also be true for higher education in general or even for education as a whole. Since the latter is not our field of expertise we decided to focus our thoughts on higher education, bearing in mind, however, that it may be also applicable to education in general.

Thus, the objective of this paper was to analyze the concept and evolution of translational research in order to explore if it can be used in fields other than health sciences such as higher education.

## Methods

A mini review was conducted where the MedLine search strategy was as follows: “translational science” [ti] OR “translational medicine” [ti] OR “translational research” [ti]. Since our objective was focused on the origin and evolution of the concept of translational research rather than on the findings obtained by applying “translation” methods, we decided to restrict the search strategy to terms shown at the title, as the most efficient way of identifying relevant papers. No filters by publication year or language were added but we did add filters regarding availability of abstract and electronic full text. The abstract was necessary for the screening of retrieved papers. The availability of electronic full text was required for the sake of efficiently obtaining documents.

Additional papers were identified by searching “translational research in education” at Google Scholar and also by reference chaining, that is, searching the reference list of retrieved articles as well as automatically recommended papers by search engines when looking for the articles in some repositories such as Science Direct.

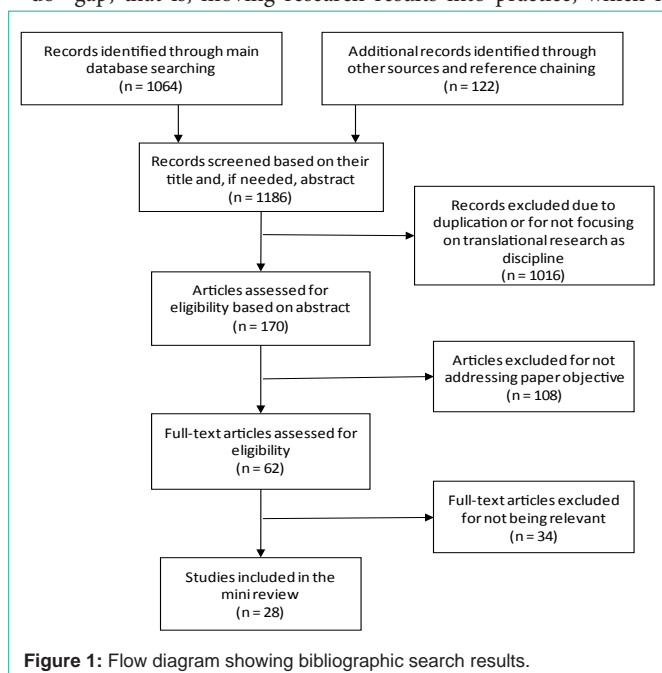
We screened search results looking for studies clearly focused on translational research as a discipline based on their title and, if needed, abstract. We then selected papers that appeared to be relevant according to our objective. Data extraction of selected papers was made by summarizing documents using short textual descriptions [2].

## Results and Discussion

Search results yielded 1186 papers (Figure 1) of which 28 finally met our inclusion criteria. A total of 1124 references were excluded after reading the title ( $n = 1016$ ) or the abstract ( $n = 108$ ), leaving 62 potentially relevant citations identified whose full-text was retrieved and screened for eligibility. Then, a further 34 papers were excluded for not being relevant analyzing the concept and evolution of translational research. Thus, we excluded those that did not address the definition, development or models of translational research and those that despite mentioning it, focused mainly on other aspects such as impact indicators, bibliometric filters, researcher training or research best practices, among others. Other papers were also excluded for being only focused on specific research problems of some areas such as cancer, orthopedics, biotechnology, drug discovery or clinical trials. As a result, 28 documents were finally selected for the mini review.

The wording “translational research” has been used interchangeably with “translational medicine” and “translational science” [3]. As far as we know it was first used in the field of oncology in 1993 [4] and gained strength by the beginning of this century [5]. However, the concept, or some of its elements, has been present for much longer. Some authors state that “its evolution can be traced back to ancient Egypt (c. 2600 BC) when philosophers serving as clinicians, observed and promoted the use of various dietary and topical remedies for disease (e.g. fruits, linseed oil)” [6].

The main aim of translational research is bridging the “know – do” gap, that is, moving research results into practice, which is



certainly a difficult endeavor [7]. It was originally described as the implementation of “bench to bedside” research, i.e., research that moved new discoveries from the basic science laboratory toward patient care by developing clinical applications such as new drugs, devices or biomarkers [8]. The vision is that of a bridge connecting the lab to the clinic, thereby expediting the transformation of clinical practice based on scientific progress, and ultimately leading to improvements in care and health outcomes. However, this vision remains elusive because first, this gap can take a long time to be bridged [9,10] and second, obstacles, or “blocks”, to translation prevent the application of basic biomedical research findings to clinical needs [11].

### Translational research phases in the knowledge chain

The first distinction between two “translational blocks” was articulated by the Institute of Medicine (IOM) Clinical Research Roundtable set in June 2000 [12]. They described a model with a two-phase framework that essentially consists of “blocks” that exist in the process of moving from basic research to improved health. The first translational phase or “T1 research” was described as “the transfer of new understandings of disease mechanisms gained in the laboratory into the development of new methods for diagnosis, therapy, and prevention and their first testing in humans [12].” The second translational phase or “T2 research” was described by the Roundtable as “the translation of results from clinical studies into everyday clinical practice and health decision making.”<sup>12</sup> Later on, these two phases were sub-divided into three [13-17] or four [18-20], although terminologies and position of the translation phases are inconsistent across the literature and at least 12 models of translational research have been identified [21].

Some authors tried to conceptualize these models through hills and valleys [22]. Meanwhile, Trochim et al [23] made an attempt to compare and integrate in a temporal continuum the four major models they identified: IOM’s Clinical Research Roundtable [12], “Blue Highways” [13], “3T’s” [14] and Four-phase Model [18]. We have placed these models on a “bridge” ranging from the generation of knowledge through research to its impact on health outcomes. Hence, once knowledge has been generated from research, both basic and clinical, then it needs to be interpreted by synthesizing all scientific evidence (all the knowledge) about a particular health problem. Thus, the interpretation of knowledge facilitates its implementation into clinical and/or public health practice to finally make an impact on the health of individuals. That continuum or knowledge chain is neither linear nor unidirectional since, for example, knowledge can also be generated in clinical practice and then incorporated into an evidence synthesis. Or developing a clinical practice guideline, knowledge gaps or hypotheses may arise that involve new research. However, we simplified the knowledge chain in the diagram to clearly communicate the concept of translational research (Figure 2).

The above mentioned reviews [21,23] are claiming to overcome the definition of discrete phases and move forward to a process pathway from research to practice. Other authors agree to that vision of translational research as a dynamic process but they still sustain that regardless of the model used, three main gaps exist [24].

According to Figure 2 these three gaps are at the transition points in the knowledge chain that underpins translational research.

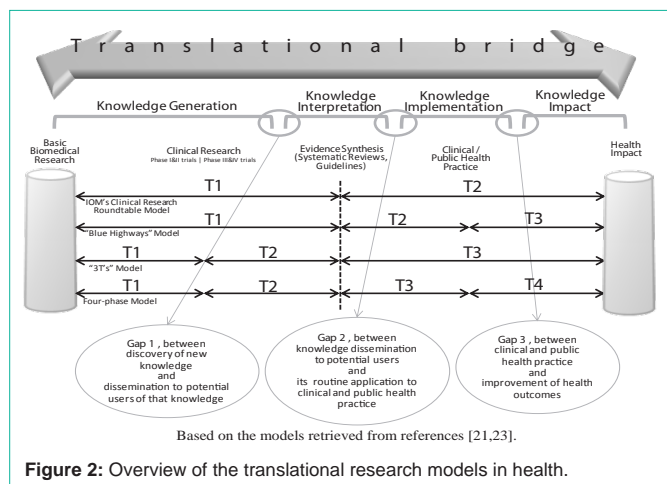


Figure 2: Overview of the translational research models in health.

A knowledge chain which is not unique to health research could also be characteristic of educational research. In fact, other authors already made the comparison between medical research applicability pathway and educational research [25-27] stating that although “physicians often participate in clinical research and in that work, as well as in their routine professional practice, function as knowledge workers, educators also engage in knowledge work but their practice is not always regarded in that way” [25].

Medical education research had focused for a considerable length of time on structures (e.g., curriculum) or program admissions (e.g., candidate attributes); yet the translation from the knowledge and skills presumably acquired during undergraduate training to the actual practice expertise has been weak [28]. In addition, many teaching methods in medical education are not based on the results of well-designed studies, thus pointing out the need for higher-quality medical education research [1].

The same reasoning can be applied not only for the education of physicians and teachers but also for any other undergraduate education. And even for secondary and primary education. In fact, one could draw a parallel between healthcare practice and educational practice. Truly, the methods of effectiveness studies of a given medical or educational intervention in patients or students respectively, could be very similar. Likewise, clinical practice can be comparable to teaching practice, and so on and so forth up to find all the similarities of the translational continuum. Figure 3 illustrates translational research as a bridge, leading from “basic research” at one side to “educational impact” at the other side, based on three pillars that allow to build the bridge and to move forward overcoming the gaps.

However, teachers do not have available to them the same kind of research about their practice that physicians have [28]. Some authors sustain that in education, vital knowledge too often remains with the researchers and is unavailable to the professionals, who are in a position to apply the best technique for learners to acquire knowledge and skills [29]. Therefore, translational research in education should be enhanced to have the best evidence implemented in educational practice. This is the way to contrast different educational theories (or research hypotheses, if you will) and demonstrate which ones are more effective. Then data from its application to students should be collected to generate enough effectiveness studies. All this scientific

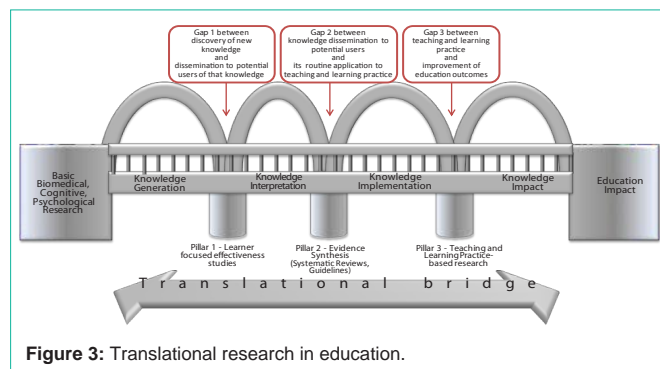


Figure 3: Translational research in education.

evidence should then be synthesized, published (in journals such as Review of Educational Research, Educational Researcher or Educational Research Review) and further disseminated in order to be implemented in everyday teaching and learning practice. The improvement in the translational process from research, enhanced with the feedback obtained from the field (educational practice) could create a virtuous circle with an impact on educational outcomes.

Additionally, we have no doubt that truly translational research depends upon continuous and dynamic information exchange. We agree with other authors that this sort of information flow will not be possible without coordinated information technology systems that can collect and manage large volumes of diverse and heterogeneous data. In the healthcare field, analysis of these data could help to facilitate the emergence of research hypotheses as well as to give answers to clinicians’ queries [11]. The same can be valid for education, particularly for online education, which is becoming increasingly popular with the new introduction of MOOCs (Massive Open Online Courses).

Finally, as mentioned in the Trochim et al. review [23], several authors who have conceptualized translational health research seem to agree on some issues -which in our opinion are also applicable to translational research in education. First, translational research involves movement along the research-practice continuum, with an ultimate aim to have an impact on health or education. Second, translational research is bidirectional with respect to this continuum with information and feedback flowing throughout. Third, translational research will often involve interdisciplinarity and new modes of communication to develop hypotheses through collaborative effort. And fourth, the “matter” that is being translated can evolve and change dramatically along the span of the research-practice continuum.

### Conclusion

Translational research could be seen as a bidirectional bridge connecting the laboratory to practice either in health or in education. Its interdisciplinary “back and forth” ultimately contributes to improved health or education outcomes. This improvement can be achieved if the three gaps of the knowledge chain that underlies the translational continuum are overcome. Namely, these gaps are located: (1) between the discovery of new knowledge and dissemination to potential users of that knowledge; (2) between knowledge dissemination to potential users and its routine application to health or education practice; and (3) between clinical or educational practice and improvement of health or education outcomes.

Through this mini review we have revised the concept of translational research and its evolution. We have spotted the possible parallelisms between health and education, and we have tried to demonstrate that it is possible to export the concept from health sciences (where it is well established) to education sciences.

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