

## Topic of Interest

### Advances and Setbacks: Is a Paradigmatic Shift in Medical Research Possible?

Marchas y contramarchas ¿Es posible un giro paradigmático en la investigación médica?

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## Introduction

Science has not evolved in a linear manner. The history of science presents discontinuities, advances and retreats, and epistemological ruptures. Each discipline exhibits diverse qualities and peculiarities; indeed, a nature common to all science remains a subject of debate to this day <sup>(1)</sup>. Scientific ideas develop within a specific timeframe to demonstrate their advantages and acquire the robustness necessary to survive in the face of uncertainty <sup>(2)</sup>. A set of scientific norms accepted by an epistemic community at a given time, which provides models as solutions in a dynamic and changing manner, is known as a paradigm <sup>(2)</sup>. These cycles govern the work of scientists in generating knowledge throughout the evolution of the philosophy and history of science. There is no equitable distribution of the benefits of scientific and technological knowledge applied to societal life. This situation increases the disparities between developed countries and those termed developing <sup>(1)</sup>.

Individuals or groups produce knowledge that is embedded in everyday life and is a consequence of their natural needs, contextualized within historical and social settings. From this perspective, knowledge is generated as a complex interplay of multiple factors, such as biological, social, and cultural elements <sup>(3)</sup>. Depending on the relationship established among the aforementioned factors, either non-scientific knowledge (grounded in subjectivity) or scientific understanding—episteme (which involves elements related to the contents of the sciences and their rules)—may be produced.

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Scientific knowledge provides a specific framework for the notion of paradigm, as it establishes methodological, ontological, and epistemic assumptions that are endorsed and accepted by the epistemic community.

Since antiquity, medicine has been a discipline that developed a systematic relationship between science and technique. From that time onward, factors pertaining to religion, law, mythology, and others were incorporated into a more social concept of disease. According to Foucault, medical practice utilizes science for application rather than creation <sup>(1)</sup>. The birth of the clinic in medicine emerges under conditions defined by the potential for mastering experience and rationality <sup>(4,5)</sup>. Clinical experience is governed by the scientific method, which emphasizes general laws and theories. The clinical mind emphasizes action, resulting in a tendency toward improvisation. The symbolic power of physicians' viewpoints and words becomes hegemonic over the dominated subjects within the medical epistemic community <sup>(6)</sup>. Medical research is a broad and diverse field encompassing various areas of study, each with its own approach and methodologies.

The objective of this essay is to present the predominant paradigms in medicine in Paraguay, the debates surrounding them, and a reflection on the possibility of a paradigmatic shift.

## Research Paradigms

The antecedents of positivism date back to the Enlightenment of the 17th and 18th centuries, inspired by the philosophers Descartes and Locke. The scientific community of the era promoted a departure from medieval notions of totalitarianism based on royal decrees. However, it was in 1840 that Auguste Comte published his discourse on positivism, marking the beginning of the positivist paradigm in research. Positivism emerged as a paradigm in the physical or natural sciences and later extended its application to the social sciences <sup>(6)</sup>. The methodology employed focuses on data analysis procedures related to mathematics and statistics. Hence, this knowledge is methodical, predictive, communicable, and law-governed. It must be generalizable or arrive at general laws. It is the result of a replicable design that must accept or reject hypotheses. It collects and analyzes data, relying on numerical measurement and the use of statistics <sup>(7)</sup>. Scientific knowledge, according to the quantitative approach, is characterized by rationality, objectivity, and that which is observable, manifest, and verifiable <sup>(8)</sup>. Neopositivism emerged as a response to hermeneutic criticisms, focusing on language and empirical verification.

"The precursor of the social sciences is Max Weber (1864–1920), who introduced the term understanding and recognized that the description and measurement of social variables must consider subjective meanings and the understanding of the context in which a phenomenon occurs. Understanding or interpreting data from descriptions, details of situations, people, observed behaviors, and documents leads to the exploration and description of the aforementioned elements and generates theoretical perspectives <sup>(9)</sup>.

According to interpretive logic, knowledge can be generated through interpretation or phenomenology. Interpretation, or hermeneutics, requires constructing a discourse and using dialectics to understand and confront the facts of reality through judgment based on reflection <sup>(10)</sup>. According to Gadamer, it is a way to access and transform knowledge. When the 'other' is recognized, knowledge is constructed, and one accesses the meaning that each individual perceives as an internalized and appropriated reality <sup>(11)</sup>. The fundamental qualities of the interpretive paradigm relate to the specific relevance of deepening the steps of an investigation and the recovery of methodological designs appearing in contexts that favor the

participation of the subjects, emphasizing dialogue and discussion to foster knowledge creation and the understanding of various problems. Interpretive logic focuses on reality conceived as a social construction, in which various perspectives and a diversity of visions coexist, converging in communication and interpretation within the natural contexts where the events originate <sup>(6)</sup>.

On the other hand, being and consciousness are the priority of phenomenology, although it does not exclude sensory experience resulting from lived experiences, interaction, and participation with the object of study. The researcher validates their participation in the process through the subjective interpretation of that perceived reality, enriched by diverse perspectives. Prominent figures in this school of thought include Heidegger, Sartre, and Husserl <sup>(9)</sup>.

### **The Critical, Socio-Critical Paradigm: Liberation and Social Change**

The critical theory of knowledge—the foundation of the critical or socio-critical paradigm—positions reflection and social liberation as a response to hegemonic domination. Through consciousness, it seeks to achieve social demands in the face of injustice and to attain the common good.

The contributions of theorists such as Marcuse, Giroux, Habermas, and Freire propose a science with a critical perspective. This approach emphasizes the generation of actions that contribute to change and the liberation of the subject from oppression, as well as the possibility of reflecting on one's reality to take action and transform it <sup>(6)</sup>.

Research processes are viewed as spaces for participation, social responsibility, and commitment regarding the needs and expectations of communities. To transform their reality, these communities proceed along paths toward decision-making for the common benefit. Along this path, social practices are

guided by a theory that is internalized, reflected upon, and critically analyzed to achieve social transformation and collective knowledge; consequently, its methods are flexible <sup>(9)</sup>.

### **The Pragmatic Paradigm**

The pragmatic paradigm emerges with the aim of focusing efforts on the search for solutions to practical, real-world problems through research. It is grounded in the principles of modern science and the experimental method, which serves as a reference for problem-solving. In the context of pragmatism, research utilizes human experience as a means to construct knowledge and understand reality, rather than relying on absolute truths. It serves as a framework for action research within communities.

One of the founders of the pragmatic paradigm, John Dewey, argued that social relations are characterized by cooperation, debate, consultation, and participation. Pragmatism adopts this perspective to address social problems, giving a leading role to the individuals experiencing them in the development of research questions, while employing appropriate methods to answer them <sup>(10)</sup>.

Dewey posits that the construction of knowledge occurs through interactions between human beings and their environments, a concept he terms transactional realism. Knowledge is explicitly linked to experience. In pragmatism, research conducted using the scientific method enables reflective decision-making processes and choices aimed at achieving intended outcomes. It employs a pluralistic methodological approach. Here, a greater active role for the researched subject is sought <sup>(10)</sup>.

### **Medical Research and Prevailing Paradigms**

Medical research encompasses distinct areas of study, each with specific approaches and appropriate methodologies. These areas

can be categorized into clinical, biomedical, and public health research, which in turn encompass other specialized dimensions. In Paraguay, medical research adheres to these aforementioned categories.

In the field of clinical research, studies cover topics such as the efficacy and safety of medical treatments, interventions, and procedures. This yields benefits by enabling the development of new therapies and the consolidation of existing ones. Clinical research includes clinical trials, in which new drugs, medical devices, or treatment protocols are tested on specific patient populations to evaluate their efficacy and potential adverse reactions. The prevailing paradigm is quantitative, utilizing experimental studies. However, it may be combined into a mixed-methods approach or a purely qualitative one to analyze patient experiences, treatment adherence, and the influence of medical interventions on individual well-being and quality of life.

When considering biomedical research, it is observed that it studies the biological processes underlying the health-disease continuum. This field of research enables the understanding of disease mechanisms, the identification of potential intervention targets for new therapies, and the development of diagnostic tools. Biomedical research is based, in the majority of cases, on laboratory experiments where the data obtained are quantitative. However, it is also possible to employ a mixed-methods or purely qualitative approach when studying ethical issues, patient perceptions regarding emerging technologies, and the social implications of biomedical advances. Here, cultural, economic, religious, and philosophical contexts must be considered in the research and application of biotechnologies. In this regard, the socio-critical or pragmatic paradigms could provide a significant contribution.

Public health research studies the factors influencing population health to inform the development of policies, plans, programs,

and projects aimed at improving health indicators within the population. This field of study encompasses social, economic, cultural, environmental, and behavioral factors that contribute to a state of comprehensive health. The quantitative approach is dominant in research encompassing epidemiology, biostatistics, or the administration and management of health services. Conversely, qualitative research provides information regarding community health needs, health education, and the effectiveness of public health interventions. Approaches grounded in the socio-critical or pragmatic paradigms contribute to generating awareness and action for health promotion and disease prevention activities.

## Debate Regarding Paradigms

A paradigm presents components derived from ontology, epistemology, methodology, and methods. Ontology is the science that studies being. Epistemology concerns itself with the nature and forms of knowledge. Methodology and methods are concerned with devising, producing, and communicating knowledge <sup>(11)</sup>.

The differences in approach, depending on the paradigm, offer researchers alternatives for improved decision-making within the research process, enabling the use of conceptual tools and procedures that allow for the correct and pertinent conduct of research. As a consequence of this situation, questions or critiques emerged.

Thus, hermeneutics challenges the application of the scientific method of the natural sciences to the social sciences. It opposes the concept of a single valid method for all sciences, arguing that the human sciences require an autonomous methodology. It criticizes methodological reductionism, which attributes a single cause to social phenomena. It rejects historical determinism, suggesting that history does not follow a linear path. It proposes that the researcher must understand the cultural and social context to adequately interpret

human actions.

Some of the main objections to the qualitative approach center on its relativism, the difficulty in establishing absolute truths, and a potential lack of methodological rigor. On the other hand, the socio-critical paradigm and pragmatism are questioned regarding their limited scientific objectivity and a methodology that emphasizes action over rationality, which hinders the generalizability of research findings <sup>(12)</sup>. Pragmatism faces specific criticism regarding weaknesses in the configuration of its mixed-methods approach and the lack of experience in its application among researchers. Furthermore, the organization of collected data often presents discrepancies and difficulties in interpretation.

The realities of the research process demand clarity from the researcher regarding the approach, tradition, and perspective for the development of their research topic. Here, the researcher must choose the paradigm to guide the study process, adopting it both conceptually and methodologically. The challenge of making sense of the research process through the selection of a paradigm presents itself as a conscious exercise in the face of the changes and needs of contemporary societies <sup>(10,13)</sup>.

## A Paradigmatic Shift?

In recent years, the approach to research has shifted, and this variation is likely to continue in the future. The global rise of the digital era has driven various paradigm shifts regarding information, books, authors, and digital libraries across numerous scientific and other academic publications. Currently, the majority of digital resources are housed in virtual environments subject to copyright, entailing a cost for interested parties.

Open science represents a paradigm shift in scientific practice, entailing the execution of all stages or phases of scientific research (design, data collection, peer review, and publication) with an open approach. Its values

are grounded in process quality and integrity, collective benefit, diversity, and inclusion. Its principles are articulated as transparency, scrutiny, critique, and responsibility aimed at equal opportunities. Furthermore, it encompasses accountability, collaboration, and the democratization of scientific knowledge. It is a movement and concept that, according to UNESCO, encompasses principles and practices enabling scientific knowledge from all disciplines to be accessible to everyone. Additionally, it promotes collaboration and information exchange, featuring open access to publications, open-source software, citizen science, and open infrastructures <sup>(14)</sup>.

During the SARS-CoV-2 pandemic, the severity of the situation gave rise to various circumstances in which open science had the opportunity to demonstrate its potential. In fact, unprecedented collaboration was observed among academics, government, industry, and civil society for the development of the vaccine. The application of the open science model revealed distinct areas of opportunity. It is important to conduct critical and reflective studies that allow for an understanding of the utilization of open science in its various modalities, specifically in the context of health emergencies <sup>(14,15)</sup>.

Since the turn of the century, research groups in different regions of the world have incorporated cooperative work, the widespread use of data, and the open and free sharing of such data. Through the interconnections of numerous research teams across different parts of the globe, collaborative work was conducted, enabling advances in genetics, physics, and other disciplines.

The development of open science is contingent upon progress in each of the aforementioned dimensions and depends on the evolution of changes in the incentive model and the establishment of new publication metrics. Progress across the majority of these dimensions must be uniform and harmonious; otherwise, widespread adoption of this new

research paradigm will not be possible. Likewise, it is necessary to invest in open science promotion and training, as well as to provide incentives to increase broad adoption in the medium term <sup>(14,16)</sup>. In Paraguay, this movement is being introduced through CICCO/Conacyt, currently in the phase of training the epistemic community.

It is worth emphasizing that open science differs from open access. Open science is an inclusive construct that combines various movements and practices to ensure that multilingual scientific knowledge is openly available, accessible, and reusable for everyone. It aims to increase scientific collaboration and information exchange for the benefit of science and society, and to open the processes of scientific knowledge creation, evaluation, and communication to social actors beyond the traditional scientific community <sup>(14)</sup>.

In contrast, open access refers to the free availability (of scientific literature) on the public internet, permitting any user to read, download, copy, distribute, print, or use it for any lawful purpose, without any financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. One of the few limitations involved is the authors' control over the integrity of their work and the right to be properly acknowledged and cited <sup>(16)</sup>.

## Conclusion

The advances and retreats of research paradigms have also followed global political shifts. From a structured and closed manner of conducting research processes, we have arrived at approaches that seek to validate the acquisition of knowledge in a flexible manner—albeit with an eye toward scientific rigor and a renewed intent for the participatory collaboration of the study subjects.

The emergence of the critical—or socio-critical—and pragmatic paradigms contributes a dialectical process that allows for greater understanding, in the Kantian sense, in the deepening of findings that provide answers to research questions. Critiques regarding their relativism or potential limitations in rigor will persist in scientific debate. Medicine in Paraguay, to a greater or lesser extent, has adopted these approaches alongside traditional ones since the 1980s and 1990s.

Paradigm shifts are part of Kuhnian dynamics because science is a living entity, an integral part of civilization and everyday life. Currently, the proposal of open science confronts us with a reality that is not new; it challenges us in the face of the rise of the digital era and the epistemic community's adaptation to it, with the aim of establishing open research processes, data, software, and infrastructure to transform the way we produce scientific knowledge.

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