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ORIGINAL RESEARCH

Disease and Illness as Objects of Transdisciplinary Study for the Prevention, Treatment, and Control of Type 2 Diabetes

Enfermedad y padecimiento como objetos de estudio transdisciplinario para la prevención, tratamiento y control multidisciplinario de la diabetes tipo 2

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Abstract

In Mexico, type 2 diabetes poses a significant challenge in terms of its prevention, early detection, and control, as it is currently the second leading cause of death. However, in theory, this condition should already be under control. Since the 1980s, it has been well documented that we possess the necessary scientific knowledge and technology to manage it effectively. This paper analyzes two key factors contributing to this situation:1) The conventional approach to treating diabetes focuses primarily on the disease itself, using a biomedical model designed for acute infectious conditions, while neglecting the study and management of the illness experience. 2) Although the importance of illness (as experienced by individuals) in understanding and documenting diabetes has been widely recognized—particularly in research from the social sciences—this body of knowledge has not been adequately integrated into the biomedical treatment frameworks, which are predominantly led by health science disciplines. Given that illness is a crucial component in the control of type 2 diabetes, this paper examines the reasons behind the lack of integration between the theoretical frameworks of the social sciences and those of the health sciences. It proposes that both disease and illness should be studied as transdisciplinary objects in order to improve prevention, treatment, and control strategies for type 2 diabetes.

Keywords: type 2 diabetes, disease-illness, multidiscipline, interdiscipline, transdiscipline

Resumen

En México, la diabetes tipo 2 representa un verdadero desafío, en cuanto a su prevención, detección y control, ya que constituye actualmente, la segunda causa de fallecimiento. No obstante, en teoría, debería estar controlada. Desde los años 80 del siglo pasado, se ha documentado que se cuenta con los conocimientos científicos y la tecnología necesaria para ello. En el presente escrito se analizarán dos de las causas que están determinando esta situación: 1) La forma de tratar a la diabetes, dado que, convencionalmente, se ofrece atención a la enfermedad conforme el modelo biomédico para las enfermedades agudas infectocontagiosas y se elude el estudio y atención del padecimiento. 2) Se ha documentado ampliamente sobre el padecimiento y su importancia para el registro de la diabetes, no obstante, este conocimiento, generado principalmente por disciplinas de las ciencias sociales, no se ha incorporado suficientemente como marco teórico en el plan de tratamiento biomédico, ejercido básicamente por las disciplinas del área de la salud, para la atención de esta enfermedad. Como el padecimiento es una condición esencial para el control de la diabetes tipo 2, se analizarán las razones por las que no ha sido posible la integración de marcos teóricos de las disciplinas de las ciencias sociales con las disciplinas de las ciencias de la salud, con la finalidad de proponer el estudio de la enfermedad y el padecimiento como objetos de estudio transdisciplinario para la prevención, tratamiento y control de la diabetes tipo 2.

Palabras Claves: diabetes tipo 2, enfermedad-padecimiento, multidisciplina, interdisciplina, transdisciplina

1– Contextual Background and Epidemiological Overview

Diabetes mellitus is characterized by an insufficiency in the secretion and/or efficacy of insulin, which disrupts the metabolism of macronutrients, resulting in a persistent state of hyperglycemia. This hyperglycemia is linked to a myriad of complications that impact both small blood vessels, including those located in the kidneys, eyes, and extremities, as well as large blood vessels, thereby contributing to conditions such as coronary artery disease, strokes, and peripheral artery disease[1]. Diabetes is the leading cause of blindness, non-traumatic amputations, and renal failure, and it ranks among the top ten reasons for the utilization of medical services and subsequent hospital admissions[2].

Type 2 diabetes (T2D) poses a considerable challenge regarding its prevention, detection, and management, particularly given its significant increase in prevalence over recent decades. It currently represents a major public health concern worldwide, ranking as the seventh leading cause of death[1]. In Mexico, the situation is even more critical, as it is the second leading cause of death and the primary cause of disability[3].

In Mexico, the 2022 National Health and Nutrition Survey (ENSANUT) reports that the prevalence of diagnosed diabetes stands at 12.6%, while the prevalence of undiagnosed diabetes is recorded at 5.8%. This leads to a total prevalence of 18.4%. Furthermore, a prevalence rate of 22.1% for prediabetes has been reported[3].

In terms of disease management, the National Institute of Public Health reveals that only one in four individuals with diabetes in Mexico has effectively managed their condition[4].

This epidemiological insight contributes to the perception that T2D may be unmanageable.

2. Problem Statement

In theory, T2D should be manageable. The scientific knowledge and technological resources required to attain this objective have been accessible since the 1980s[5]. This raises an inevitable question: What are the factors that impede the effective control of this disease?

Multiple factors contribute to this situation. This paper will analyze two of these factors:
1) The traditional biomedical approach addresses TD2 as an acute infectious disease, thereby overlooking the subjective experience of **i**llness. 2) Although the significance of illness in chronic disease classification is well-documented, knowledge generated by the social sciences has not been sufficiently integrated into biomedical treatment plans, which are dominated by the health sciences.

Given that illness is a “sine qua non” condition for the control of T2D, an analysis will be conducted on the reasons behind the lack of integration of theoretical frameworks from social science and health science disciplines. The objective is to advocate for the study of disease and illness as transdisciplinary objects of inquiry for the prevention, treatment, and multidisciplinary management of T2D.

3. Disease-Illness

In Mexico, the terms **disease** and **illness** are frequently understood and employed interchangeably. Within the prevailing biomedical discourse, they serve primarily to alleviate redundancy. However, these terms represent two distinct concepts that relate to different characteristics and conditions associated with T2D.

In English, the term “disease” is typically used to refer to an infirmity, “illness” refers specifically to the experienced condition[6], and “sickness” encompasses the social and cultural dimensions of illness. This distinction is not merely an academic exercise; rather, it clearly delineates two separate facets of a disease.

T2D encompasses two interconnected dimensions: the medical condition itself and the associated experience of suffering. The distinction between possessing the disease and enduring its repercussions is crucial. It is essential to establish a care model for both of these dimensions: one focused on the management of the disease, and

another dedicated to addressing the experience of suffering[7].

Treatment for T2D is often approached similarly to acute infectious diseases, involving an assessment of the individual's underlying causes of disease, which are identified through their symptoms. This encourages individuals to seek medical assistance in an effort to restore their health.

In the context of an acute infectious disease, the physician conducts an interview and a physical examination, with the objective of restoring the patient's health. By utilizing diagnostic support resources, a comprehensive series of data, signs, and symptoms are gathered, enabling the identification of the disease or its characteristics in most instances[8].

Once the diagnosis is confirmed, the physician formulates a treatment plan—including medications, rest, dietary guidelines, and specific precautions—aimed at fostering recovery. Consequently, precise instructions for medication administration are provided alongside lifestyle restrictions. Through these measures, the clinical expectation is that the patient will return to their prior state of health[7].

Since scientific medicine categorizes T2D as a chronic and incurable condition, the treatment plan is "designed to alleviate symptoms, sustain metabolic control, prevent acute and chronic complications, enhance quality of life, and reduce mortality associated with the disease or its complications"[9].

Scientific medicine identifies the causes of T2D within biological processes, utilizing various disciplines such as anatomy, pathology, pathophysiology, microbiology, endocrinology, nutrition, and, more recently, molecular biology. This multidisciplinary approach clarifies the condition through quantifiable biological markers and data derived from physical examinations[10]. In order to accomplish this, highly specialized tests are typically conducted, including biochemical, histological, immunological, and radiological assessments, among others[11].

From this perspective, physicians interpret symptoms as indicative signs and associate them with the affected organ or body system to define the impairment of bodily processes. This enables them to guide treatment aimed at modifying or restoring the identified cellular or systemic damage[5], utilizing medications, dietary changes, and physical activity[12-13].

This conceptual framework for understanding, explaining, and managing TD2 parallels that of infectious diseases, focusing predominantly on the biological dimensions. This methodological orientation limits the effective management of T2D. Healthcare professionals often acknowledge only a subset of the challenges patients face. By primarily concentrating on the acute phase of symptoms and associated complications, they overlook the experiences of individuals in their daily lives[14].

Due to the limitations of the acute infectious disease model, the management of T2D requires the development of a care model that integrates the disease with the individual's lived experience. This approach considers how a person lives with diabetes daily, accounting not only for biological aspects but also for psychological, social, cultural, and economic factors[8].

Under this framework, illness encompasses: a) An individual's health beliefs, including their experiences, assumptions, hopes, fears, and attitudes regarding their perceived or diagnosed condition; and b) Their knowledge of and attitudes toward medicine and healthcare practitioners, their interactions with psychosocial support networks, their degree of religiosity, and their perceptions of the economic burden associated with the disease and its treatment[8].

Suffering encompasses the symptoms and physiological indicators of illness as perceived by the individual. Distinct from the clinical definition of illness, suffering arises when a person encounters the body's inability to fulfill their needs. It signifies a loss of harmony that exists within consciousness but is expressed solely through the body[15].

In contrast to the biomedical concept of **disease**—which denotes irregularities in the structure or function of organs and body systems regardless of cultural recognition[15]—**illness** pertains to the subjective dimension of the condition. It seeks to elucidate how an individual experiences and copes with their health status. In summary, disease represents "what one possesses," whereas illness signifies "what one experiences."

Focusing solely on the disease while overlooking the illness, has contributed to the unfortunate reality that, despite an abundance of scientific and technological resources, T2D currently ranks as the second leading cause of death in Mexico. To reverse this trend, it is imperative to study and address the illness alongside the biological condition.

4– Disciplinary Integration

In the field of health, for at least four decades, the importance of the integrated participation of various disciplines in the care of chronic diseases has been emphasized, and T2D is no exception. Although this premise has been accepted as a fundamental truth, it has yet to be fully actualized. Still, an ongoing initiative exists, aimed at realizing this vital objective.

If integrated participation of various disciplines has long been considered essential, what factors have impeded its successful consolidation?

Disciplinary integration represents a complex and multicausal issue. The integration of knowledge has consistently attracted epistemological interest throughout human history; however, reaching a consensus on the definitions of pluridisciplinarity, multidisciplinarity, interdisciplinarity, and transdisciplinarity[17] has proven to be both challenging and intricate.

Confusion arises from the multiple definitions of disciplinary integration. This level of confusion is concerning, as it generates ambiguity among the terms pluridisciplinarity, multidisciplinarity, interdisciplinarity, and transdisciplinarity[18]. Juntsch's observation[19] serves as a relevant example: numerous initiatives categorized as interdisciplinary are, at best, pluridisciplinary. Addressing this confusion is imperative, as the conceptualization of these terms will significantly affect the collaboration among disciplines concerning T2D.

The following analysis focuses on four primary frameworks: pluridisciplinarity, multidisciplinarity, interdisciplinarity, and transdisciplinarity.

Pluridisciplinarity

A general consensus is established concerning the conceptualization of pluridisciplinarity, as elucidated here:

> "Pluridisciplinarity involves the analysis of an object associated with a single discipline, conducted concurrently by several disciplines[18]."
>
> "Understanding of the object within its respective discipline is augmented through a productive pluridisciplinary contribution. Pluridisciplinary research produces added value for the discipline in question (such as art history or philosophy); however, this added value is exclusively beneficial to the interests of that same discipline. In other words, while the plurdisciplinary process transcends individual disciplines, its objective remains limited within the framework of disciplinary research[18]."

Pluridisciplinarity, or multidisciplinarity, does not alter the fields, objects of study, or methodologies of the participating disciplines; instead, it integrates various fields so that each can provide a distinct perspective on a specific subject[20].

T2D effectively exemplifies this notion. Until the late 20th century, the condition was perceived as the exclusive domain of scientific medicine. However, the advent of the 21st century brought initiatives promoting openness and collaboration, welcoming contributions from additional disciplines to develop a more comprehensive understanding. Nonetheless, the study of T2D remains largely confined to the field of biomedicine.

Pluridisciplinarity is commonly defined as the examination of a specific object, or one associated with a particular discipline, that is subsequently enriched by insights from other fields. However,

this newly defined object remains within the parameters of the original discipline. This distinction is significant, as it facilitates the enhancement and evolution of knowledge related to the subject while maintaining disciplinary boundaries.

Nevertheless, the guidance that this conceptualization aims to provide for fostering interdisciplinary integration is compromised by the ambiguities that arise across different contexts. For example, on the UMEM's website[10], pluridisciplinarity is conceptualized as multidisciplinarity, employing two distinct terms to refer to the same process.

Multidisciplinarity

Regarding the conceptualization of multidisciplinarity, confusion often arises due to contradictory definitions. Furthermore, diverse terminologies are frequently used for the same concept, resulting in controversy within multidisciplinary practice. For instance:

> According to Juntsch[19], multidisciplinarity is defined as "a range of disciplines offered simultaneously, but without explaining the possible relationships between them."
> From Palmade's perspective[21], multidisciplinarity refers to "the juxtaposition of diverse disciplines, sometimes with no apparent relationship between them."
> Marín[22] characterizes multidisciplinarity as the convergence of several disciplines within the same educational institution.
> Campos[23] posits that multidisciplinarity entails the coordination of various members of an academic team and the individual contributions of each, which are fundamentally of a declarative-administrative nature.
> Palencia[24] further elucidates that multidisciplinarity is the amalgamation of disciplines devoid of any relationship between them.
> In the context of the FES Zaragoza UNAM, multidisciplinarity is defined as "a set of disciplines that contribute their theoretical and methodological frameworks to solve a problem, without interacting with each other.[25]"

These abstractions characterize multidisciplinarity as an approach involving various disciplines, regardless of whether coordination exists among them. To address a problem effectively under this model, it is sufficient to provide contributions relevant to each discipline's specific area of study.

In contrast, alternative definitions consider multidisciplinarity to be the integration of various disciplines. This perspective signifies the sharing of knowledge and methodologies, presenting them in a manner that facilitates their incorporation into a comprehensive framework of understanding and explanation. For instance:

According to Apostel[26], multidisciplinarity arises when addressing a problem necessitates information derived from multiple scientific disciplines, without altering or enhancing the contributing disciplines.

Ribes [27-28] asserts that multidisciplinarity involves coordinating various disciplines at the action level, centered on a shared object of interest. Within this model, concepts, methodologies, and techniques from distinct disciplines are harmonized within a single operational framework while maintaining their original identities. Essentially, multidisciplinarity represents a process in which diverse disciplines engage practically with a shared subject.

Alonso[29] posits that multidisciplinarity originates from a theoretical-practical perspective, emphasizing the significance of both the rationale and methodology, as well as the understanding of the problem and the potential pathways for transforming reality.

Cardoso[30] articulates that,

> "multidisciplinarity is the coordinated interaction of different professionals through the application of their disciplinary theoretical frameworks for the explanation, understanding, and resolution of a problem. It serves as a platform for

> disciplinary problematization, aimed at addressing, through research, a deficiency in explanatory and comprehensive capacity."

Reality is inherently multidisciplinary, thus requiring the collaboration of multiple fields for thorough analysis. This necessitates the involvement of at least two distinct disciplines within a single investigation, ensuring that each remains true to its own character and retains its established methodologies. Each discipline clarifies a phenomenon, articulating and enhancing it through its unique concepts and methodological research strategies. Consequently, practitioners and scholars within the participating disciplines are encouraged to intensify their efforts to understand these intricate phenomena or systems in a unified manner[31].

The cover of the CCH-UNAM Gazette, dated April 17, 2025, identifies its primary theme as: Multidisciplinarity, the new paradigm. The issue asserts:

> "It is inadequate to conceive of teaching that does not integrate a subject with other subjects, content, and disciplines; teaching can no longer occur in isolation. The coordination of the sciences and the humanities is essential, as it constitutes one of the foundational principles of the CCH. This coordination has become increasingly urgent, as the post-crisis landscape necessitates the consideration of concepts, theories, ideas, and interpretations from a multidisciplinary perspective[32]."

Multidisciplinary research integrates various disciplines, professionals, and perspectives to broaden available knowledge and methodologies. The advantage of this approach is that each topic and subtopic can be examined through the lens of a specific discipline, which is often essential for addressing complex research challenges. Outcomes are typically achieved through the synthesis of these individual disciplinary contributions[33].

The management of diabetes serves as a pertinent example:

> "To develop a comprehensive work plan, it is essential to reach a consensus on and implement this plan, while providing support that encompasses not only pharmacological treatment but also psychological and lifestyle considerations. Ultimately, it is important to assess whether the plan has met the desired objectives and to make any necessary adjustments. This approach can only be effectively executed within the framework of multidisciplinary teams. Indeed, this method has been shown to enhance the prevention and treatment of complications, facilitate habit change strategies, and address the emotional challenges that may accompany diabetes"[34].

These definitions conceptualize multidisciplinarity as the integration of various disciplines to address a practical problem. For this endeavor, both a clear elucidation of the problem and the coordinated operations required to solve it are essential. This necessitates the contribution of information from multiple scientific domains, without altering or expanding the participating disciplines.

The multitude of definitions—which can be categorized into those that endorse fragmentation and those that advocate for integration—complicates the practice of multidisciplinarity. This confusion has generated a conceptual antinomy, further complicating the collaborative process.

Interdisciplinary

The ambiguity that characterizes the conceptualization of pluridisciplinarity and multidisciplinarity manifests similarly in the understanding of interdisciplinarity. Furthermore, the complications arising from the diverse and conflicting definitions are intensified by the fact that different authors interpret the same process using distinct terminologies; that is, while some regard a certain strategy as multidisciplinarity, others label it as interdisciplinarity. Paoli suggests,

> "Frequently, the terms multidisciplinarity and interdisciplinarity are used as equivalents and interchangeable[31]." Nonetheless, there is a prevailing

> agreement on the definition of interdisciplinarity.

For instance, Juntsch defines interdisciplinarity as a collection of axioms shared by a group of related disciplines, positioned at a hierarchical level or sublevel above the individual fields, thereby incorporating a unified objective [19].

For Palmade, interdisciplinarity is defined as the

> "interaction existing between two or more disciplines. This interaction can range from the simple communication of ideas to the comprehensive integration of guiding concepts of epistemology, terminology, methodology, procedures, data, and the organization of research and corresponding teaching. An interdisciplinary group is composed of individuals who have received training in different fields of knowledge (disciplinary), each possessing their own concepts, methods, data, and terms"[21].

For Cardoso, "interdisciplinarity [is] the process of creating a new disciplinary theoretical framework with its own object of study and methodology, generated from the fusion of two or more disciplines"[30].

For Paoli, interdisciplinarity requires a transition from a unilateral perspective rooted in diverse disciplinary viewpoints to the design and construction of a complex vision, derived from a shared theoretical foundation and analyzed using a unified methodology. Interdisciplinarity, therefore, demands conceptual integration[31].

Interdisciplinarity is defined as "the theoretical, methodological, and practical integration of multiple disciplines, which leads to the development of new methodological approaches for addressing problems that require analysis through the interaction of diverse disciplinary fields"[25].

A comprehensive definition of interdisciplinarity can be articulated as follows: Interdisciplinarity involves the organization of knowledge and methodologies that have proven effective within one discipline for application in another, supported by a rationale designed to enhance or corroborate discoveries. This process has the potential to yield improvements and transformations in the employed methodologies and may ultimately result in the emergence of a new discipline characterized by its hybrid nature[20].

Transdisciplinarity

Transdisciplinarity is a term often used indiscriminately, leading to confusion with pluridisciplinarity, multidisciplinarity, and interdisciplinarity [18]. Like these other approaches, transdisciplinarity faces challenges in comprehension due to conceptual ambiguities that can promote separation and antagonism among disciplines. Although the terms interdisciplinarity and transdisciplinarity are frequently used interchangeably, they possess distinct but complementary connotations, signaling the construction of non-fragmented knowledge [35].

Historically, transdisciplinarity was considered a "mega-discipline" or "hyper-discipline." Today, this approach aspires to achieve the most comprehensive understanding possible by engaging with an extensive range of human knowledge [20].

The prefix "trans" signifies exceeding boundaries; thus, transdisciplinarity embodies both an attitude and a mode of action [35]. As noted in the literature, "The concept of transdisciplinarity suggests that experts are aware of the limitations of their respective disciplines and seek to transcend the self-containment characteristic of each [31]." Therefore, the prefix "trans" does not imply a diminishment of disciplinary identification but rather establishes a connection between interconnected and interdependent disciplines [36].

Transdisciplinarity is characterized by an emphasis on the intersections between disciplines and the connections that link them, extending into realms beyond traditional boundaries. It examines the relationships that exist between, though, and beyond all disciplines to promote a collective understanding of the world[18]. This necessitates the development of a novel theoretical framework with its own object of study and methodology [31].

This approach does not seek to undermine the value of individual disciplines or their specific methods; nor does it aim to replace the distinct ways of thinking and acting inherent to those fields. Indeed, transdisciplinary knowledge is contingent upon the participation of these existing disciplinary frameworks [37]. However, the knowledge required to address the complex challenges of contemporary society cannot be derived from a single discipline alone; it requires a transdisciplinary approach to cultivate essential insights.

Article 3 of the Charter of Transdisciplinarity articulates: "Transdisciplinarity complements the disciplinary approach: through the confrontation of disciplines, it generates new information that connects them and provides us with a renewed perspective on Nature and Reality. Transdisciplinarity does not aim for the dominance of multiple disciplines; rather, it encourages the expansion of all disciplines to include those that traverse and transcend them"[18].

In this context, transdisciplinary research endeavors to meet the increasing demand for innovative knowledge and methodologies to tackle complex social challenges related to the common good—challenges that are often inadequately addressed within multi- or interdisciplinary frameworks [38]. Ultimately, the primary objective of transdisciplinarity is to establish a "new humanism," which is expected to be associated with a transformative approach to education [19].

Due to the growing interest in transdisciplinarity, and in order to facilitate its advancement, it is essential to consider potential deviations that may impede its establishment[18].

These deviations lead to varying degrees of confusion regarding the relevant transdisciplinary framework. The fundamental confusion arises from overlooking the discontinuity between different levels of Reality and levels of perception. This oversight can be significantly detrimental, as it fosters and enhances ambiguity among the concepts of pluridisciplinarity, interdisciplinarity, and transdisciplinarity.

A second point of concern is the ongoing inclination to simplify all levels of perception into a single, exclusive level, despite recognizing the existence of multiple levels of Reality. This tendency can foster the reductive notion that a sole form of knowledge—scientific knowledge—provides the exclusive means to access truth, suggesting a new form of scientism.

Furthermore, some may accept various levels of perception while simultaneously disregarding the acknowledgment of multiple levels of Reality. This misinterpretation results in the association of transdisciplinarity with hermetic irrationalism, consequently reducing it to a mere linguistic phenomenon—a language that attempts to convey everything while ultimately focusing on nothing but "the transdisciplinary" itself.

Finally, even when the existence of multiple levels of Reality and perception is acknowledged, the rigorous correlation between them is often overlooked. A prime example of this phenomenon is the assimilation of the transdisciplinary impulse by the New Age movement.

"Transdisciplinarity functions under the guidance of a vision—the essential balance between the interiority and exteriority of the human being—and this vision exists within a level of Reality that is distinct from the prevailing world"[18]. The references pertaining to pluridisciplinarity, interdisciplinarity, and transdisciplinarity, along with those concerning multidisciplinarity that advocate for integration, according to Paoli [31,] reflect the view that the process of disciplinary integration is gaining momentum. This integration occurs in contrast to the historical trajectory of disciplines that became specialized in knowledge generation and subsequently segregated into isolated or poorly interconnected departments.

Therefore, pluridisciplinarity, multidisciplinarity, interdisciplinarity, and transdisciplinarity all endeavor to facilitate and promote disciplinary integration. Attaining such integration requires the involvement of at least two disciplines that offer diverse perspectives, thereby enriching the knowledge and methodologies available for a specific object of study. Thus, pluridisciplinarity

emerges when a discipline seeks to enhance its conceptual and methodological understanding of its object of study through the contributions of other disciplines, while the examination and application of that object continue to be dominated by that original discipline.

Multidisciplinarity occurs when tackling a practical problem requires the integration of information from more than one scientific domain, without altering or enriching the participating disciplines themselves.

Interdisciplinarity, in contrast to pluridisciplinarity and multidisciplinarity—both of which require the participation of multiple disciplines—aims to promote the emergence of a new discipline characterized by its hybrid nature. According to Nicolescu, the objective of interdisciplinarity is fundamentally distinct from that of pluridisciplinarity (or multidisciplinarity), as it focuses on the transfer of methodologies from one discipline to another. In this context, regarding the specific object of study, individual disciplines are inclined to dissolve, thereby facilitating the establishment of a new discipline [18].

In contrast, according to the same author, transdisciplinarity seeks to promote the construction of non-fragmented knowledge, manifested in a new cohesive understanding of a specific object of study. Achieving this requires the establishment of connections among disciplines without diminishing their disciplinary identity. To accomplish this, it draws upon the interstices that exist between, through, and beyond the participating disciplines, thereby contributing to the formation of a new theoretical framework with its own object of study and methodological approach.

This proposal does not imply a rejection of individual disciplines, their respective methodologies, or their techniques, nor does it seek to replace them; instead, it asserts that transdisciplinary knowledge requires the active involvement of various fields [18]. Through the interaction and confrontation among different disciplines, new information emerges that integrates them and provides an enhanced understanding of Nature and Reality.

To rephrase, within the contexts of pluridisciplinarity, multidisciplinarity, and transdisciplinarity, the participating disciplines maintain the original identities that contributed to their formation; indeed, the advancement of these frameworks is fundamentally grounded in the progress achieved within individual disciplines. Conversely, in the realm of interdisciplinarity, disciplines relinquish their distinctiveness in relation to the object of study, thereby facilitating the emergence of a new discipline.

Another distinguishing characteristic is that in multidisciplinarity and pluridisciplinarity, multiple disciplines converge to address a shared problem within a practical context. In interdisciplinarity, the integration of epistemological concepts, terminology, and methodology is essential for developing new approaches to training specialized professionals. In transdisciplinarity, the primary objective is to construct a cohesive body of knowledge that encompasses and connects the contributing disciplines.

5- Transdisciplinarity: A Strategy for Generating Non-Fragmented Knowledge for Understanding and Explaining T2D

The management of T2D constitutes a complex, multi-causal challenge requiring immediate attention. While various care approaches have positively impacted patient well-being, effective control of the disease remains a significant public health concern. This situation is particularly alarming given that adequate scientific knowledge and technological resources for prevention, treatment, and management have been available since the 1980s. Theoretically, one would anticipate that the disease should have been brought under control by now.

Initially, T2D management adopted a strictly disciplinary approach. As previously noted, because it is categorized as a biological disease affecting organ systems, medicine has been the primary discipline tasked with its care. damage andch has mirrored that of other chronic diseases: recognizing them as incurable, the objective of treatment has been to suppress signs and symptoms, attenuate the progression of damage, and prevent the emergence of complications [9].

Consequently, treatment has focused on modifying or repairing identified cellular or systemic damage [5] through pharmacological interventions and lifestyle modifications, predominantly regarding diet and exercise [12-13].

To achieve more effective management of diabetes, the care approach evolved from a disciplinary framework to a pluridisciplinary one, necessitating disciplinary integration. Under this model, the investigation and treatment of diabetes are no longer confined solely to the medical field; instead, the field has opened to insights from various disciplines, such as Pharmaceutical Biological Chemistry (QFB). QFB facilitates the oversight of pharmacological treatments through capillary blood glucose or glycated hemoglobin assessments. It also aids in the recognition of symptoms indicating treatment efficacy, the need for dosage modifications, and the identification of adverse effects. Additionally, it provides guidance regarding dietary choices that complement medications and cautions against combining medications with medicinal plants or other products without prior consultation [38-39]. Nonetheless, despite these advancements, diabetes research and monitoring continue to reside largely within the scope of medicine.

Consequently, the care process has evolved to incorporate a multidisciplinary approach. Teams of professionals from various disciplines have been established to implement clinical and technical interventions for T2D. This approach is framed as a practical challenge necessitating insights from multiple scientific disciplines, without altering or adding to the foundational disciplines involved. In this context, interdisciplinary integration involves the exchange of theoretical, conceptual, and technical information to formulate a comprehensive treatment plan for individuals with T2D, grounded in a well-structured interdisciplinary intervention, where synergy is essential. Exemplifying this type of care are the Centers of Excellence established by the International Diabetes Federation. In Mexico, the federal government also provides multidisciplinary care through the Ministry of Health, the Mexican Social Security Institute (IMSS), and the Institute for Social Security and Services for State Workers (ISSSTE). Additionally, the Faculty of Higher Studies Zaragoza, at the National Autonomous University of Mexico (UNAM) offers the program: "Diabetes: a multidisciplinary care program."

Interdisciplinarity has emerged as an effective strategy for the prevention and management of T2D. This methodology primarily focuses on training professionals who specialize in the care of this condition through the establishment of specifically designed programs. Notably, diplomas in Diabetes Education and Bachelor's degrees in Diabetes and Obesity have been developed, among other educational offerings. In this context, disciplinary integration relies on the contributions of theoretical frameworks and methodologies from various disciplines to formulate a new field of study. This necessitates that the participating disciplines, concerning their contributions to diabetes research and surveillance, must temporarily set aside their distinct identities to facilitate the creation of this new discipline, which will subsequently develop its own theoretical framework and methodologies.

Transdisciplinarity is increasingly capturing the attention of a growing number of professionals involved in the study and management of diabetes, as it facilitates the creation of unified knowledge, articulated as a comprehensive understanding of this condition. Unlike interdisciplinarity, which may lead to the dislocation or substitution of disciplines, transdisciplinarity is approached from an integrative perspective that encompasses research, development, and practice [17].

Although this process is promising, there exist few initiatives that have sought to address the issue of T2D from this perspective. This paper seeks to contribute to the prevention, treatment, and control of T2D by presenting an examination of the illness within a transdisciplinary conceptual framework.

6 - The illness as a transdisciplinary field of study for the prevention, treatment, and control of T2D

A primary step in this framework is to acknowledge two distinct yet complementary domains for comprehending and managing T2D, each characterized by its own objectives and methodologies. Traditionally, the approach to T2D

has encompassed two interdependent processes that form a cyclical relationship: 1) Research: Focused on generating new knowledge through the application of the scientific method, and 2) Clinical Care: Focused on addressing practical problems through the development of techniques derived from that new knowledge.

Research generates the knowledge required to foster broader explanations of T2D. This understanding, in turn, enhances the management of the disease by leading to the development of new techniques or modifications of existing methodologies, all aimed at achieving effective control.

While research resides within the theoretical domain—encompassing epistemological and theoretical abstraction—care operates within the practical domain. Care addresses the actual challenges that impede an individual's ability to manage the condition in their daily life. As articulated by Pérez-Tamayo, this distinction is summarized as research necessitating "doing to know," whereas treatment and management require "knowing to do" [40].

Pluridisciplinary, multidisciplinary, interdisciplinary, and transdisciplinary approaches have been promoted across both domains, grounded in continuous disciplinary development. Specifically, each discipline engages in research to formulate methods and techniques aimed at addressing T2D. Subsequently, through interdisciplinary integration, these fields share their knowledge and methods as deemed appropriate for the objectives of each strategy.

Transdisciplinary initiatives often encounter obstacles due to insufficient attention to the distinctions between the **research domain** and the **practical domain**. Activities are frequently executed without adequately considering their classification within either sphere, often under the false assumption that these activities belong interchangeably to both.

Transdisciplinarity is primarily positioned within the research domain because its core objective is to enhance the "understanding of the present world, with a key imperative being the unity of knowledge"[18]. While the value of individual disciplinary knowledge is recognized, transdisciplinarity strives to reduce the presentation of knowledge in a fragmented manner, requiring an interrelation among disciplines that does not compromise their unique identities.

A vital subsequent step involves establishing consensus on a common object of study. Conventionally, T2D is perceived and addressed solely as a **disease**. However, it actually incorporates two dimensions:

- **The Disease**: The biological manifestation characterized by clinical signs and symptoms.
- **The Illness**: The subjective experience of suffering and the daily challenges faced by those living with the condition.

Extensive evidence has established that investigating the "illness" dimension is crucial for the effective management of T2D. While scientific and technological resources for the disease have been available since the 1980s, effective containment has not been achieved. This failure can be attributed to the absence of clinical management of the *illness* within the standard biomedical treatment plan. To correct this, it is imperative to incorporate the subjective experience of the patient into a transdisciplinary body of knowledge, establishing a common theoretical framework to guide the clinical management of T2D. Two events must be considered when formulating this transdisciplinary framework.

1) The fragmentation of knowledge regarding T2D and the necessity for its unification.

The investigation of T2D, considering its dual characteristics as both a **disease** and an **illness**, encompasses contributions from a vast array of academic disciplines. These fields span the chemical and biological sciences—including medicine, nursing, dentistry, nutrition, psychology, and pharmaceutical chemistry—as well as socio-humanistic domains such as anthropology, economics, and sociology, among others.

In relation to the study of T2D as a disease and an illness, the chemical and biological sciences have provided a significant volume of information,

contributing substantially to our understanding of both conditions. Currently, an extensive amount of information is available, which ideally should facilitate effective control of T2D. Therefore, given the robust body of scientific knowledge and technological advancements, one might reasonably expect the condition to be managed effectively already. However, prevailing statistics reveal a contrary situation, presenting a stark paradox.

The primary issue is not a deficiency in knowledge, but rather an improper application of the available information. Knowledge has been disseminated in a fragmented manner; each discipline tends to communicate insights based on its own specific criteria, operating under the assumption that other disciplines will inherently comprehend and integrate this information. This approach is founded on the reductionist belief that the whole is merely the sum of its individual parts—a notion effectively challenged by transdisciplinary perspectives, which assert that reality invariably exceeds the mere aggregation of its components [18].

Disciplinary contributions are essential; however, they are insufficient on their own. When these contributions are merely aggregated, they result in a form of specialized knowledge where the researcher holds increasingly detailed information within an increasingly narrow scope [40]. As a result, knowledge is derived solely from isolated components. In contrast, when the interactions among these contributions are taken into account, a more comprehensive and holistic understanding emerges, revealing interpretations that cannot be discerned through isolated analysis.

It is imperative to recognize that holistic knowledge is established on the foundation of reductionist knowledge. For instance, the biomedical model for T2D operates under the assumption that patients will invariably respond positively to a prescribed treatment plan, provided that adherence effectively manages their T2D. Nonetheless, this prescription necessitates that patients face significant challenges within their social environments, which are influenced by a culture that functions as an implicit and controlling force. This cultural influence often shapes patient behaviors in ways that are counterproductive to the prescribed medical treatment[6].

This situation presents a stark paradox: the very prescription intended to support the patient simultaneously leads them to encounter other significant life challenges. Consequently, a transdisciplinary framework must integrate these social and cultural variables into the clinical understanding of the illness to move beyond the limitations of a purely biological approach.

2) Characteristics of Different Types of Thinking Employed in Generating Reductionist and Holistic Knowledge.

Knowledge regarding T2D is frequently presented in a fragmented manner because research often relies on a singular perspective, neglecting the multifaceted nature of the condition. This results in divergent forms of perception: the chemical-biological disciplines primarily employ **reductionist thinking** to study the biological "disease," while socio-humanistic disciplines utilize **holistic thinking** to study the "illness" as a human experience.

The methodology within chemical and biological fields involves deconstructing T2D into its smallest manageable components for isolated analysis before developing synthesized solutions. Conversely, socio-humanistic approaches perceive T2D as a cohesive entity, seeking to integrate its various constituent aspects[40]. Historically, these two methodologies have been viewed as antagonistic, leading to professional conflicts and hindering the advancement of knowledge. However, it is essential to recognize that these represent two distinct, yet complementary and indispensable processes for achieving a comprehensive understanding of T2D.

7- Description of a Transdisciplinary Integration Process and Multidisciplinary Care for T2D

While adequate scientific and technological resources to manage and control T2D currently exist, effective control remains elusive. A comprehensive scientific explanation for this gap has yet to be formulated. This paper proposes that

the issue stems not from a lack of knowledge, but from a deficiency in its application. To remediate this, T2D should be examined through a transdisciplinary lens while delivering care within a multidisciplinary framework.

The following delineates the procedure implemented in the **Diabetes Project: a multidisciplinary care program (DUPAM)** at the Faculty of Higher Studies Zaragoza of the National Autonomous University of Mexico (FESZ-UNAM). DUPAM approaches the study of T2D transdisciplinarity while treating patients multidisciplinarily. The involved disciplines include:

- Anthropology
- Dentistry
- Nursing
- Medicine
- Nutrition
- Psychology
- Pharmaceutical Chemistry

The team is divided into two groups: **Research Professors (RPs)** and **Social Service Interns (SSIs)**. While SSIs provide direct care to individuals and fulfill academic requirements through thesis work, RPs are responsible for conducting research and advising interns in their development.

The care process consists of two primary components. The first begins with standard disciplinary care, where every consultation is meticulously recorded in a multidisciplinary clinical record. Following this, **multidisciplinary clinical case analysis (MCCA)** sessions are conducted. For these sessions, an individual is selected based on their inability to control their diabetes despite following prescribed clinical guidelines. This case is then presented for collective analysis during the MCCA session.

The dynamics of this session are structured as follows:

1. Each discipline provides a clinical overview of the individual's condition. The presentation sequence is organized as follows: medicine, nursing, dentistry, nutrition, psychology, pharmaceutical chemistry, and anthropology. Each discipline presents, in accordance with its area of expertise, the individual's current condition, therapeutic measures, outcomes achieved through disciplinary intervention, and the barriers that have hindered the individual's adherence to the treatment plan.
2. A multidisciplinary assessment of the individual's overall health status is formulated.
3. A comprehensive analysis of the challenges faced by the individual is conducted to ascertain the reasons impeding compliance with clinical instructions.
4. Synergistic strategies are devised and proposed, customized to the individual's specific characteristics, in order to revise the treatment plan.
5. The individual is afforded consultations with each area of expertise. At times, these consultations are disciplinary; at other times, two or more disciplines collaborate as necessary.
6. The treatment plan is subject to ongoing monitoring.

Component B encompasses multidisciplinary group care programs. These programs integrate various disciplines and provide workshops designed to promote and enhance the development of daily living skills, while consistently assisting individuals in managing their T2D. Some of the workshops include: functional physical activity, cognitive stimulation, and the principles of nutrition.

The research process at DUPAM consists of two primary components. The first component is strictly disciplinary, meaning that studies are conducted to address specific disciplinary interests related to the challenges faced by individuals with T2D treated within the program. The core objective of this phase is to equip patients with appropriate therapeutic measures to effectively manage their condition.
In the second component, disciplinary knowledge is integrated in a holistic manner. Traditionally, research findings generated within a specific discipline are disseminated independently, under the presumption that mere dissemination will

naturally facilitate their integration. However, what is actually required is a thoughtful and deliberate consideration of the level of integration; independent dissemination frequently results in a fragmented, reductionist contribution.

T2D demands a holistic understanding, requiring an additional effort to complement disciplinary research by unifying scientific findings across various fields. This process involves examining diverse contributions and their interrelationships, rather than treating them as separate components to be aggregated. It is not solely about establishing disciplinary knowledge; it is also about constructing connections between these disciplines and transcending traditional boundaries. This endeavor presents significant challenges because, as noted in the literature:

> "human beings can have fun jumping from one branch of knowledge to another, but they cannot find any bridge that links one mode of knowledge to another"[18].

In order to unify disciplinary knowledge, the **Transdisciplinary Seminar (TS)** is conducted. This seminar begins by identifying specific challenges in diabetes management that are prevalent among patients attending **DUPAM** and which have been previously analyzed within the **multidisciplinary clinical case analysis (MCCA)**. Following this identification, disciplinary explanations for these challenges are formulated. Subsequently, an integrative explanation is developed by synthesizing the diverse disciplinary perspectives that have been presented. In certain instances, this transdisciplinary explanation offers improved clarity and a comprehensive understanding of the issue, thereby facilitating the redesign of the individualized multidisciplinary treatment plan.

Nevertheless, in certain instances, disciplinary knowledge proves to be insufficient, necessitating the creation of new holistic knowledge. One of our proposals in this context is to focus on both the **illness** and the **disease**; that is, to consider both the patient and the individual experiencing the illness, which ultimately leads to more effective multidisciplinary care. The transdisciplinary theoretical foundation of this proposal was developed in the TS, which asserts that diabetes encompasses two dimensions: the disease and the experience of suffering (illness). These dimensions are not synonymous; rather, they represent two distinct, yet complementary, aspects essential for understanding and addressing T2D.

The disease pertains to the physical signs and symptoms, while the illness relates to the individual's experience of living with these manifestations. Possessing the disease is one aspect; living with it encompasses another. The principal challenge in managing diabetes lies not solely in the physical domain, but also extends deep into the socio-cultural realm[7-8]. The intention is that, in discussing the disease and the afflicted individual, the analysis should prioritize physical manifestations. Conversely, when addressing the suffering and the sufferer, the analysis must emphasize the subjective experience of these physical manifestations and how all their vicissitudes are confronted.

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8- Conclusions

Diabetes is recognized as a significant public health concern globally, and Mexico is no exception. It currently ranks as the second leading cause of death among the Mexican population. However, since the end of the last century, the treatment and management of T2D have presented a paradox. Despite the availability of scientific knowledge and technology necessary for its control at that time, the long-desired objective of effective management remains elusive more than four decades later.

Several explanations have been proposed. A prevailing perspective, which garners widespread agreement, is that the issue should be approached within a framework that incorporates multiple disciplines rather than relying on a singular one.

While this proposal is compelling, progress has been minimal. This is likely due to the absence of a consensus regarding the conceptualization of disciplinary integration. Various proposals have been made; however, they have not gained significant traction primarily due to the lack of agreement on the definitions of pluridisciplinarity, multidisciplinarity, interdisciplinarity, and transdisciplinarity. This confusion has simultaneously facilitated and obstructed the integration of disciplines.

According to the analysis presented, pluridisciplinarity is evident when a discipline seeks to expand its knowledge of an object of study, both conceptually and methodologically, through contributions from other disciplines, while retaining the prerogative of its study and management. Multidisciplinarity emerges when it becomes necessary to address a practical problem by obtaining information from multiple scientific fields, without modifying or augmenting the involved disciplines.

Interdisciplinarity likewise entails the collaboration of diverse disciplines; however, in contrast to pluridisciplinarity and multidisciplinarity, it is distinguished by the creation of a new discipline that possesses a hybrid nature.

Transdisciplinary research seeks to deliver integrated knowledge, resulting in a novel body of insights and methodologies designed to address complex issues within social contexts that are not adequately addressed in pluri-, multi-, or interdisciplinary frameworks. This approach requires collaboration among disciplines while preserving their distinct identities. The development of pluridisciplinary, multidisciplinary, and transdisciplinary approaches builds upon advancements within individual disciplines. In contrast, interdisciplinarity results in disciplines losing their individual identities concerning the object of study, thereby facilitating the emergence of a new discipline.

In alignment with this conceptual framework, the DUPAM program has been established to conceptualize disease and illness as subjects of transdisciplinary inquiry, with the objective of generating comprehensive knowledge that encourages multidisciplinary clinical care strategies for the prevention, treatment, and management of T2D.

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