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The Kuhnian incommensurability thesis and its use in nursing for critique of the scientific fact of "skin wound in bedridden patients"

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Abstract

Introduction
This study presents an epistemological reflection on nursing based on the philosophy of Thomas Kuhn. The incommensurability thesis is a central element of his framework, allowing for a critique of epistemic shifts occurring as paradigms are replaced. Nursing scholars have identified two successive paradigms: the Empirical and the Nightingale paradigms, the latter of which laid the foundation for the professional and scientific development of the field. Applying the Kuhnian thesis to nursing requires selecting a common scientific fact across paradigms. This study's scientific fact under analysis is the "skin wound in bedridden patients."

Objective
To apply the incommensurability thesis to understand the concept of the scientific fact "skin wound in bedridden patients" across paradigm traditions in nursing during the 19th century.

Method
The following research question guided this study: *How does the incommensurability thesis influence the concept of the scientific fact "skin wound in bedridden patients" across paradigm traditions in nursing?* To comprehensively address this question, we structured the text into three sections: (1) an overview of the key elements underpinning the Kuhnian thesis, (2) the development of the concept of the scientific fact within the Empirical paradigm, and (3) its development within the Nightingale paradigm, based on the text *Notes on Nursing: What It Is and What It Is Not.*

Results
The concept of the scientific fact remained stable across paradigm traditions.

Conclusion
Applying the incommensurability thesis made it possible to assess that the concept of "skin wound in bedridden patients" remained unchanged within both the Empirical and Nightingale paradigms. This finding supports the understanding that conceptual modifications are rare and tend to be limited to a specific type, which Kuhn termed "point by point." The Nightingale paradigm introduced substantive changes in patient care, organizational structures, education, and the promotion of research practice.

Keywords
Nursing; Knowledge; Health; Research; Wounds and Injuries.

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Introduction

This study presents an epistemological reflection on nursing based on the philosophy of Thomas Kuhn. The incommensurability thesis is a central pillar of his framework, providing a means to evaluate epistemic changes that occur as paradigms replace one another. Nursing scholars have identified two successive paradigms: the Empirical paradigm and the Nightingale paradigm, the latter of which laid the foundation for the professional and scientific development of the field. Moreover, nursing adopts the term *paradigm* in the sense of professional transformation, indicating the occurrence of a revolution.[1-4]

The Empirical paradigm emphasizes the art of the profession and technical-scientific knowledge as fundamental to nursing care. The Nightingale paradigm introduced a broader perspective, valuing knowing how to do (art and management), knowing how to think (scientific knowledge and research), and knowing how to coexist (ethics). This paradigm shift led to substantive changes in care practices, organizational structures, education, and the promotion of research activity, thereby breaking away from the Empirical paradigm. Consequently, nursing, as a scientific discipline, must undertake an intellectual effort to conduct an epistemic critique of its paradigmatic tradition. This process requires the establishment of a common scientific fact between these traditions.[1-7]

The incommensurability thesis is the most significant consequence of replacing one paradigm with another. For Kuhn, scientific revolutions are episodes of non-cumulative scientific development in which an older paradigm is entirely or partially replaced by a new one that is incompatible and incommensurable with the previous one. Applying Kuhn's theory to nursing requires adjustments that respect the idiosyncratic characteristics of the discipline.[1-4]

Two assumptions must be accepted to accommodate the distinct nature of nursing and, consequently, apply the Kuhnian thesis. The first is the recognition that nursing constitutes a scientific community. For Kuhn, science is a collective construction, where its members establish commitments, define shared objectives, and, through manuals, educate future generations, thereby forming a community. All these elements are present in nursing, notably in its professional and scientific education, the definition of common goals, and the formal training process through manuals.[5-11]

The second assumption is the adoption of the Nightingale paradigm. It is important to clarify Kuhn's understanding of the term *paradigm*, particularly after he revised his original formulation in response to critiques from his peers. He identified four constitutive elements: symbolic generalizations, metaphysical parts, epistemic values, and exemplars. From this perspective, these elements will be described within the context of nursing. For the nursing community, the Nightingale paradigm guides both professional and scientific activities, making it possible to identify symbolic generalizations—in Kuhnian terms, these are expressions, terms, or formulations that members of a scientific community use without requiring prior explanation or justification. The Nightingale paradigm includes terms and expressions whose meanings are undisputed, such as health, person, environment, and nursing.[1.3,5-11]

Within the Nightingale paradigm, it is also possible to identify the metaphysical parts of the paradigm, epistemic values, and exemplars. In Kuhn's theory, the metaphysical parts of the paradigm refer to the commitments accepted by researchers that are linked to a system of beliefs. In nursing, this can be observed from a holistic perspective, which serves as an integrative element in education, professional practice, and research.[1,3,5-11]

The epistemic values of science, identified by Kuhn as simplicity, fecundity, internal coherence, and plausibility, are acknowledged in nursing's scientific production. By *exemplars*, he refers to problem-solving models that students of a given science are trained to *recognize* through the education they receive from manuals, shaping their scientific worldview. This characterization is evident in nursing, as students have access to manuals that guide their professional and scientific training, allowing them to engage with the problems and solutions that define professional practice and its existing challenges.[1,3,5-11]

Based on these assumptions, it was necessary to identify a scientific fact in the literature from both the Empirical and Nightingale paradigms, enabling a philosophical analysis between these paradigmatic traditions. The selection process was complex due to the scarcity of scientific literature on nursing in the 19th century. Thus, the criterion for identifying the scientific fact was to choose a phenomenon of interest to both paradigms in clinical practice and education contexts. As a result, the scientific fact "skin wound in bedridden patients" was established".[1,2,12-17]

The justification and relevance of this study lie in the premise that nursing, as a science in the process of becoming, must shed light on its paradigmatic tradition. This effort enables the field to understand the process of its construction and, consequently, to either rectify or reaffirm the direction it currently follows.

This study aimed to apply the incommensurability thesis to understand the concept of the scientific fact "skin wound in bedridden patients" throughout the 19th century within different paradigmatic traditions in nursing.

Method

The following research question guides this study: *How does the incommensurability thesis influence the concept of the scientific fact "skin wound in bedridden patients" across paradigm traditions in nursing?* To comprehensively address this question, the text is structured into three sections. The first section presents the key elements that underpin the Kuhnian thesis. The

second develops the concept of the scientific fact "skin wound in bedridden patients" within the Empirical paradigm. Finally, the third section examines the concept of this fact within the Nightingale paradigm, based on the text *Notes on Nursing: What It Is and What It Is Not*.[1,3]

Development

Key elements underpinning the incommensurability thesis

Kuhn draws on the political meaning of the term *revolution* to illustrate the rupture between the old and the new, thereby supporting the incommensurability thesis. To this end, he examined various scientific works and, through them, identified the radical transformations within the scientific community, demonstrating how these shifts led to changes in thought and in the practice of science. According to Kuhn, a scientific revolution begins when there is a growing perception that the prevailing paradigm no longer provides satisfactory answers to the questions posed. At this point, researchers develop an internal awareness of the paradigm's shortcomings.[3,5,6,10,18-21]

Kuhn notes that observers external to the scientific community often perceive no significant changes occurring. However, among scientists dissatisfied with the prevailing paradigm, a rupture becomes evident as the emerging research problems differ from those of the previous paradigm. Once deemed inadequate, scientific works begin to demand and establish a new approach to scientific inquiry.[3,5,6,10,18-21]

For Kuhn, this is not merely an assessment of the methods or techniques accepted by a given scientific community but rather an insurrection against the prevailing paradigm that guides normal science. It is not uncommon for groups engaged in scientific debate to simultaneously employ arguments rooted in both the current and emerging paradigms. However, this debate serves only to persuade and gain support for the new paradigm.[3,5,6,10,18-21]

Kuhn aims to convince critics to acknowledge the discontinuity between the current and the revolutionary paradigm, thereby reinforcing the validity of his argument in favor of the incommensurability thesis. He challenges the notion that science progresses through sequential growth and development as the sole means of expanding scientific knowledge. If accepted, this premise would substantiate the thesis of a rupture between paradigms. To support his reasoning, Kuhn poses a key question: *Is there an intrinsic reason why assimilating a new type of phenomenon or a new scientific theory requires the rejection of older paradigms?*[3]

Some argue that the solution to a scientific problem could emerge without destroying previous scientific practice, as it might simply address previously unknown situations. Alternatively, a new theory could provide an explanation that, while novel, does not significantly alter the paradigm but rather represents an update. If these possibilities were accepted, the growth and development of scientific knowledge would be strictly cumulative and linear. For Kuhn, despite the apparent reasonableness of this model of scientific progress, historical evidence suggests otherwise, as the end of a paradigm period leads to a new theory that compels researchers to generate new knowledge.[3,5,6,10,18-21]

It is important to clarify that Kuhn does not claim that cumulative and linear growth does not exist. Instead, he presents a philosophical critique of this model, highlighting its limitations and weaknesses. He acknowledges that during the period of normal science, knowledge production is predominantly cumulative, which in turn makes it difficult for scientists to recognize that this is not the only mode of scientific development.[3,5,6,10,18-21]

Furthermore, Kuhn raises another question: *How can new scientific knowledge emerge if everything is so rigid?* According to him, a discovery can only arise when prior expectations about the nature of a phenomenon and the scientist's instruments prove incorrect. Thus, new knowledge emerges from anomalies found within a paradigm, as these anomalies drive researchers to seek solutions that are not accounted for in the traditional paradigm. As a result, the researcher turns to developing new concepts, methods, instruments, and techniques.[3,5]

According to Kuhn, three conditions lead to the emergence of a new theory. The first is the exhaustion of the existing paradigm's ability to analyze phenomena. However, its transformative power is limited, as exhaustion alone is insufficient to justify researchers abandoning a paradigm. The second condition involves a phenomenon whose essence is identified by the paradigm but whose details can only be refined through the broader articulation of the theory. Although this is the researcher's primary focus, this type of investigation aims to further delineate the paradigm rather than generate something new. When investigative dissatisfaction persists and the possibilities for accommodation are exhausted, the researcher encounters the third condition that leads to paradigm disruption—the anomaly. This anomaly cannot be explained within the framework of the existing paradigm, and consequently, only the anomaly itself has the intrinsic power to generate something new. Kuhn asserts that new theories emerge to address anomalies, meaning that a successful theory must allow for predictions that differ from those derived from its predecessor. If the theories were logically compatible, such differences would not occur [3,5]

In this way, Kuhn establishes a critique of the notion that scientific development is exclusively linear and cumulative. He highlights historical evidence supporting this perspective and presents a position opposing the idea of strict logical plausibility. For example, he refers to the historical comparison between Newtonian and Einsteinian theories. While they use identical terms, these terms do not retain the same meaning, as they are embedded in distinct theoretical frameworks that represent different realities. Thus, the differences between successive paradigms over time are both necessary and irreconcilable. A new theory introduces new problems, which in turn require new

strategies, solutions, and methodological tools, further distinguishing it from its predecessor. Consequently, the science that emerges from a scientific revolution is incompatible and incommensurable with the science that preceded it.[3,5,10,18-21]

After facing strong criticism from Karl Popper and Imre Lakatos, Kuhn sought to clarify his argument regarding the incommensurability thesis, particularly in his essay *What Are Scientific Revolutions?*. In this text, Kuhn differentiates between two types of scientific development: cumulative and linear progress and revolutionary progress. He argues that the majority of scientific research results from the former, as normal science builds knowledge by adding to the existing body of scientific understanding, making cumulative progress the most common conception of scientific advancement.[5]

However, Kuhn also points out that scientific development can occur in a non-cumulative and non-linear manner, allowing historians of science to identify distinctive clues indicative of a revolutionary form of knowledge development. This revolutionary process involves discoveries that cannot be accommodated within the conceptual boundaries of previously accepted theories. To make or assimilate such discoveries, altering how phenomena are conceptualized and described becomes necessary.[5]

Kuhn highlights a scientific discovery of a revolutionary nature—Newton's Second Law of Motion. In this law, the concepts of force and mass differ from those previously in use before its introduction. He emphasizes that a change in the way of thinking occurs, expressed through a new meaning assigned to these terms. With this example, Kuhn demonstrates that the development of scientific knowledge cannot be exclusively cumulative, as it is impossible to transition from the old to the new merely by adding to pre-existing knowledge. Naturally, this does not mean that no terms retain their original meaning, allowing for communication among practitioners of a given paradigm. Rather, Kuhn argues that the semantic understanding of terms—when modified by a new theory—causes their usage to differ between paradigms. He designates this process as point-by-point translation, which he considers the foundation of incommensurability.[3,5,10]

In alignment with the previously discussed elements of the incommensurability thesis, certain approximations must be made to understand the scientific fact "skin wound in bedridden patients" across paradigm traditions, given that Kuhn primarily focused on analyzing scientific theories within the field of physics.[3]

Three key assertions can be made to address the research question posed in this study: (1) every paradigm possesses an epistemological identity, meaning it exhibits distinct characteristics; (2) the scientific knowledge within a paradigm is linked to the belief that its framework is operational, though philosophical shifts may be underway; and (3) the development of a paradigm dictates a specific mode of action for researchers. In nursing, both the Empirical paradigm and the Nightingale paradigm adhere to the first two assumptions (1 and 2), defining professional practice in care and education. However, only the Nightingale paradigm actively promotes knowledge production in the field (3). With this distinction established, the next step is to examine the concept of "skin wound in bedridden patients" within the Empirical paradigm.

The concept of the scientific fact "skin wound in bedridden patients" in the Empirical paradigm

Before proceeding, it is important to recognize that, from a historical perspective, the scientific fact "skin wound in bedridden patients" has undergone various classifications and terminological changes before reaching its contemporary designation as pressure injury. However, in the teaching of both the science and art of nursing in the 19th century, this condition was referred to as *eschar* or *decubitus ulcer*. This section seeks to comprehensively examine this fact.[1,2,15-17,22]

The term *eschar* or *decubitus ulcer* emerged within the Empirical paradigm and was used to describe a type of wound that develops on the skin of bedridden patients. In this study, the term *bedridden* is assumed synonymous with immobility in bed, as this nomenclature reflects the prevailing scientific thought of the 19th century. The term was introduced by the French physician Jean-Martin Charcot, who worked at the Salpêtrière women's asylum. Charcot observed and described a type of wound found on the skin of hospitalized, bedridden patients with spinal cord injuries, designating it *decubitus eschar*. This nomenclature appears in his book *Lectures on Diseases of the Nervous System*, published in 1877.[16]

Charcot's initial concerns regarding skin wounds in patients with spinal cord injuries date back to 1868. In response to this observed phenomenon, and based on a cause-and-effect relationship, he formulated an explanation by associating this type of wound with trophic alterations that affected tissue nutrition. In his theorization, the wound resulted from an interruption in the supply of nutrients to the nerves, leading to what became known as Charcot's Neurotrophic Theory. In describing the wound that developed on the skin of hospitalized and bedridden patients, he noted that its progression followed a pattern of ulceration, eventually leading to deep necrosis in the sacral region. According to Charcot, localized pressure was not the primary cause of its development.[15-17,22]

Charcot considered the development of decubitus eschar to be slow, progressive, and asymptomatic. His theory differentiated between skin wounds based on their pathophysiological origins, categorizing them into passive lesions (resulting from functional inactivity) and trophic disturbances secondary to acute nervous system injuries. In this classification, he identified three distinct types of lesions based on their onset: *decubitus ominosus* (wounds appearing on the buttocks before the patient's death), *acute decubitus* (wounds appearing after a neurological injury,

correlating the location of skin damage with the affected nerve), and *chronic decubitus* (wounds developing in the skin of inactive patients).[15-17,22]

The widespread dissemination of Charcot's Neurotrophic Theory within the scientific community sparked intense debate. It is well established that scientific progress occurs through the confrontation of ideas among scholars, facilitating the refinement of existing knowledge, the formulation of theories, and the identification of evidence to support or refute explanations. Such a dynamic was evident in the historical debate in health sciences involving Eduard Brown-Séquard, a neurophysiologist and prominent critic of Charcot's Neurotrophic Theory.[3-5,10,15-17,22]

In his experimental studies involving animals, Brown-Séquard asserted that when the spinal cord of a test subject was severed, no ulceration occurred as long as preventive measures were implemented, such as daily skin hygiene, keeping the area dry, and ensuring it was free from bodily waste. Furthermore, he observed that in cases where ulceration did develop, the wound could be healed by relieving compression and maintaining the aforementioned preventive actions. Based on these experiments, Brown-Séquard concluded that skin ulceration in paraplegic patients was not a direct consequence of paralysis.[15-17,22]

Brown-Séquard's work focused on identifying preventive actions to avoid the emergence of skin wounds, whereas Charcot's theory rejected the possibility of prevention. According to Charcot, decubitus eschar was an inevitable outcome of a slow, gradual, and irreversible process of nerve degeneration.[15-17,22]

In 1873, the English surgeon and pathologist James Paget, in his article *Clinical Lectures on Bedsore*, contributed to the debate by proposing that pressure on the skin could be a causal factor in developing these wounds. He argued that if the affected area was not kept clean and free from bodily waste, the skin wound would progress rapidly, particularly in bony prominences, most notably the calcaneus, hip, and sacral region.[15-17,22]

Amid this scientific debate, nursing was developing its practical care approach, blending traditional and modern practices in caring for hospitalized, bedridden patients with skin wounds. Because nursing was practiced within the hospital setting, it played a fundamental role in transforming hospitals into therapeutic environments. Among the key aspects of nursing practice at the time were patient nutrition, personal hygiene, and comfort.[15-17,22]

Within the Empirical paradigm, nurses were educated through manuals written by physicians. In normal science, scientific findings are disseminated through manuals, fostering unity within the scientific community, essential for building a body of scientific knowledge and transmitting it to new members. In the context of nursing practice, these manuals provided nurses with guidelines for action and justification for their practical knowledge.[15-17,22]

Hospital medicine recognized that hospitals could not fully evolve into therapeutic spaces without improving nurses' intellectual training. This growing relationship between medicine and nursing allowed nurses access to scientific discoveries and theoretical developments, such as cell theory, microbiology, and the conceptual debate between Charcot and James Paget on decubitus eschar.[15-17,22]

In this context, nursing established a curriculum that included subjects such as anatomy, hygiene, preparation and administration of medications, and theoretical and practical training in patient care. Within the Empirical paradigm, nurses were responsible for treating decubitus eschar, with their interventions including washing, covering with gauze, cauterization, and removal of devitalized tissue.[15-17,22]

The debates among Charcot, Paget, and Brown-Séquard regarding this topic reflect what Kuhn identified as the most common mode of scientific development and progress—the cumulative and linear model, which enables the construction of scientific knowledge. In this model, the various contributions of researchers help assemble the "puzzle" of knowledge, thereby structuring scientific understanding and providing answers to the problems posed. Within this development mode, participants analyze the phenomenon—skin wound in bedridden patients—from a specific perspective that defines its scope. This allows for establishing cause-and-effect relationships, identifying characteristics, and proposing solutions, whether in the form of treatment or prevention.[15-17,22,23]

Given these considerations, within the Empirical paradigm, the concept of *decubitus eschar* refers to a type of wound that develops on the skin of bedridden patients, particularly in the sacral region (buttocks), hip joint, and calcaneus (heel). It is characterized by significant tissue damage below the epidermis, which is aggravated by external factors, such as the presence of bodily waste in the wound.

The concept of the scientific fact "skin wound in bedridden patients" in the Nightingale paradigm

It is acknowledged that the "world" envisioned by Florence Nightingale differs from the "world" of the Empirical paradigm. Her worldview enabled her to recognize a phenomenon that had previously gone unnoticed, particularly regarding nursing practice and its three dimensions: knowing how to act (practical knowledge), knowing how to think (scientific reasoning), and knowing how to interact (ethical conduct).[1,4]

According to Hoyningen-Huene, when a member of a scientific community adopts a new paradigm, their worldview is altered, leading them to perceive the environment in which they work in a completely different way. In this sense, Florence Nightingale was immersed in a new worldview, undergoing a philosophical transformation that enabled her to approach scientific knowledge of nursing practice (the phenomenal world) from a new perspective. This shift had a profound impact on her

professional practice. Her revisited world allowed her to identify the professional and scientific transformation she introduced into nursing through epidemiological methods. This enabled her to conduct quantitative assessments of the health-disease relationship and the causal connection between nursing care and decubitus eschar.[4,10]

Florence Nightingale introduced into nursing practice an element that had never before been applied to patient care: observation guided by the scientific method. Through this approach, she sought to identify cause-and-effect relationships in the health-disease process by recognizing signs and symptoms.[1,3,4,10]

In scientific rationality, systematic observation corresponds to the data collection stage of an investigation. It is well known that this is the starting point of the research process. In professional nursing practice, the nurse initiates the nursing process through this type of observation. According to Florence Nightingale, a scientifically trained nurse can recognize and distinguish between different illnesses, such as the various types of eruptions caused by fevers or measles, along with their prodromal signs and symptoms. This observational ability results from systematic training, which stems from scientific rationality and enables nurses to differentiate physiological manifestations from pathological conditions in the human body. Consequently, nurses become skilled in assessing the skin's condition, whether it appears dry or perspiring. By conducting a rigorous study of the patient's reactions—a process essential for identifying cause-and-effect relationships—the nurse can assess the patient's health condition with scientific critical thinking. This allows the nurse to develop the necessary knowledge about the patient and perform lucid, well-reasoned professional actions.[1,3,4,10,16.23]

Florence Nightingale identified the relationship between biological and physical factors and the occurrence of decubitus eschar, as well as the nurse's role in its prevention. In her view, the development of decubitus eschar was directly linked to insufficient nursing care provided to the patient. The occurrence of such wounds carried a negative connotation, as it was regarded as a failure in nursing care. According to Nightingale, if a patient feels cold, develops a fever, experiences fainting spells, feels unwell after meals, or presents with decubitus eschar, these conditions are generally not due to the illness itself but rather to inadequate nursing care.[1,3,4,10,16,23]

Although the etiology of skin injuries is now better understood, nurses remain responsible for preventing these wounds, requiring specialized knowledge for early identification and implementation of preventive measures. It is widely recognized that skin care is a central aspect of nursing practice within the Nightingale paradigm.[1,3,4,10,16,23]

Florence Nightingale was convinced that preventing decubitus eschar depended on the nurse's ability to thoroughly assess the patient's skin condition, particularly in individuals who were bedridden and unconscious. By the time of her work, the studies of Charcot and Paget were already circulating, and the term *decubitus eschar* was being used to describe this type of skin injury. During her experience in the Crimean War, Nightingale had access to soldiers with various types of wounds, including those with gunshot-related traumatic brain injuries who were unconscious. It is well established that unconscious and immobilized patients, especially when affected by additional risk factors, have an increased likelihood of developing decubitus eschar. Given this, it can be inferred that Nightingale recognized two fundamental elements of the concept of *decubitus eschar* within the Empirical paradigm: skin integrity loss and prolonged immobility in bed.[1-4,16-23]

Additionally, Florence Nightingale understood that improperly maintained or poorly adjusted bed linens could cause skin wounds in bedridden patients, particularly in areas of bony prominence. In this regard, maintaining an appropriate standard of hygiene was a primary objective of nursing care, as skin contact with fecal or urinary residue exposed the patient to both physical and microbiological harm. According to Nightingale, maintaining patient hygiene was essential for recovery and the prevention of decubitus eschar. Based on this reasoning, a third defining element of decubitus eschar, common to both the Empirical paradigm and Nightingale's thought, can be identified: the formation of a wound in an area of bony prominence in bedridden patients.[1-4]

Thus, within the Nightingale paradigm in the 19th century, the concept of *decubitus eschar* referred to a type of wound affecting bedridden patients who had partially or completely lost their ability to move independently, with its appearance localized in areas of bony prominence. It is evident that the conceptual elements identified by Florence Nightingale were the same as those found in the Empirical paradigm.

Conclusion

Kuhn's incommensurability thesis revealed that the concept of the scientific fact "skin wound in bedridden patients" remained unchanged, reinforcing the proposition that conceptual modifications are a rare phenomenon, typically limited to a process that Kuhn termed *point by point*. The paradigm shift in nursing led to a transformation in both the science and the art of the profession. The Nightingale paradigm introduced a new way of thinking, acting, and engaging, thereby establishing a decisive break from the Empirical paradigm, fundamentally altering clinical care, professional organization, education, and research practices. It is assessed that the dimension of scientific reasoning (knowing how to think) allowed nursing to engage with the scientific advances and debates of the late 19th century. Kuhn's thesis proves to be a valuable tool for the epistemological critique of nursing, particularly in analyzing the transition between the Empirical and Nightingale paradigms. It is believed that, in the event of a future rupture of the currently dominant

Nightingale paradigm, identifying a new scientific fact could indicate the occurrence of point-by-point conceptual modifications.

Authorship

Guimarães GL: Conception and design of the study; Writing the manuscript; Critical revision of the manuscript; Approval of the final version of the manuscript and taking responsibility for it;
Mendonza IYQ: Conception and design of the study; Writing the manuscript; Critical revision of the manuscript; Approval of the final version of the manuscript and taking responsibility for it;
Goveia VR: Conception and design of the study; Writing the manuscript; Critical revision of the manuscript; Approval of the final version of the manuscript and taking responsibility for it;
Ribeiro EG: Conception and design of the study; Writing the manuscript; Critical revision of the manuscript; Approval of the final version of the manuscript and taking responsibility for it;
Barbosa JAG: Conception and design of the study; Writing the manuscript; Critical revision of the manuscript; Approval of the final version of the manuscript and taking responsibility for it;
Guimarães MO: Conception and design of the study; Writing the manuscript; Critical revision of the manuscript; Approval of the final version of the manuscript and taking responsibility for it.

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