

HEALTH CARE: INTEGRATIVE REVIEW OF KNOWLEDGE PRODUCED IN LIGHT OF COMPLEXITY

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ABSTRACT

This is part of an integrative review whose object of study was the production of knowledge in journals concerning nursing studies that have used the Complexity Theory as a theoretical framework. This study gathers seven articles collected from a literature review of 18 publications found on the databases: Medical Literature Analysis and Retrieval System on-line (MEDLINE), Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS) and Cumulative Index to Nursing and Allied Health Literature (CINAHL) from 1998 to 2008. In the two former databases, the following combination of key words was used: "complexity theory" and "health" and "nursing", and in the third: "complexidade" and "saúde" and "enfermagem. Content analysis was the methodological framework that allowed for organizing the knowledge aggregated in the theme: health Care. It was observed that the Complexity Theory has based the comprehension of the health care process, pointing out the care provider with his practices and the environment.

Keywords: Non-linear Dynamics. Comprehensive Health Care. Nursing. Health.

INTRODUCTION

Precursors of new science paradigms often suggest that a *nuova scienza* is in full development, requiring epistemological categories themselves (as seems to be the category of complexity), new theoretical models (such as "chaos theory") and new logic forms of analysis (as, for example, non-linear mathematical models, fractal geometry, fuzzy logic and network theory)⁽¹⁾

In this scenario, postmodern science develops from the systemic perspective, and even before the 40s, numerous scientists had already used the terms "system" and "systems thinking".

But the open and closed system conceptions of Ludwig Von Bertalanffy implicated in its general systems theory, which established systems thinking as scientific movement. This theory offered a general conceptual framework for unification of different scientific disciplines that have become isolated and fragmented⁽²⁾.

This author considers "systems" as a set of mutually related units classified as open or closed. Living organisms are examples of open

systems, because they keep themselves alive through a continuous flow of matter and energy extracted from their environment⁽²⁾.

Unlike closed systems that do not communicate with the outside world and always contain the same components remaining in a state of thermal equilibrium, open systems are distant from this equilibrium, in a state of flux and change over time, where entropy (disorder) is increasing, characteristics which lead to self-regulation⁽²⁾.

It is found in the literature another concept created by Edgar Morin, which, from the epistemological point of view, is a new theoretical paradigm called "complex thought".

Complexus means, originally, what may be woven together⁽³⁾, and is not synonymous with complication. Complex thinking is a thought that aims to distinguish (but not separate) and simultaneously gather⁽⁴⁾.

Complex thinking is the thinking that deals with uncertainty and is capable of conceiving the self-organization. It is a thought able to gather, contextualize, globalize, while recognizing the unique, the individual, the concrete.

It is not, therefore, to abandon order,

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separability and logic principles, but to integrate them. It is not empty holism contraposition to mutilating reductionism; it is the resumption of parts to the whole. It is the articulation of the principles of order and disorder, separation and junction, autonomy and dependency that are dialogic (complementary, competing and antagonistic), within the universe⁽⁴⁾.

"Complexity is the challenge, not the answer. I am looking for a chance to think through complication (i.e., the innumerable inter-retroactions), through uncertainties and through contradictions. The idea of complexity involves imperfection, given that it involves uncertainty and the recognition of the irreducible. Simplification is necessary, but must be relativized, i.e. I accept conscious reduction, which knows it is reduction, not arrogant reduction that, after all, believes to hold the plain truth behind the apparent multiplicity and complication of things"^(5:102).

The fundamental concept of complexity is not that the essence of the world is complex and not simple, but rather that the essence is inconceivable. Complexity is the dialogical order/disorder/organization, but behind complexity, order and disorder are dissolved, distinctions come undone⁽⁵⁾.

As regulative principle of thought, complexity does not lose sight of the reality of the phenomenal fabric we are in and that is our world⁽⁵⁾, allowing relationships, interrelationships and interconnections, conceiving the integration of diverse knowledge⁽⁶⁾.

Therefore, the complex thinking may offer new strategies to look our uncertain world, and gathering teaches an ethic of solidarity or alliance⁽⁴⁾.

Given the relevance of this new paradigm of science - Complexity Theory (CT) - this study has the following guiding question: How has the theoretical framework been used in the production of knowledge in the area of health care?

This study is part of a broader integrative literature review on the theoretical framework of CT in nursing and health and aims to present knowledge concerning the topic of "healthcare assistance" in a systematic way.

METHODOLOGY

This article is part of an integrative literature whose object of study was the use of CT in nursing and health. Because it is a long work, it was decided grouping topics of interest in order to meet publication standards of national journals. The *corpus* of original analysis was composed of 18 articles, which after categorization generated four themes. Now one of them is presented (healthcare assistance), consisting of seven articles. Data collection was performed at the following databases: CINAHL (Cumulative Index to Nursing and Allied Health Literature), MEDLINE (Medical Literature Analysis and Retrieval System online) and LILACS (Literatura Latino-Americana e do Caribe em Ciências da Saúde). In the two first databases, the following combination of key words was used: "complexity theory" and "health" and "nursing", and in the third: "complexidade" and "saúde" and "enfermagem". It was adopted as a criterion for inclusion entire articles on Portuguese and English, from national and international journals, indexed in those databases, in the period from 1998 to 2008. Articles regarding the theme of complexity towards complex, complicated situations, as well as those that were repeated among databases were excluded. For this reason, 18 articles were established as an analysis *corpus*: seven indexed to LILACS, nine to MEDLINE and two to CINAHL (Figure 1). The representativeness of the sample corresponded to 75% of indexed publications.

This analysis corpus is mostly international (61.1%), from the United States of America (USA) (38.8%), published in English (61.1%), followed by Portuguese (38.9%). The kind of research that most uses CT as theoretical reference is the qualitative one (77.8%). About authors, the professionals who most published were nurses (52.9%), all of them linked to higher education institutions.

It is noteworthy that, as a strategy to systematically organize the production of knowledge in the area of health care assistance, regarding CT, content analysis was used in the thematic representational approach rooted in the pre-analysis, analysis and exploration of material phases⁽⁷⁾.

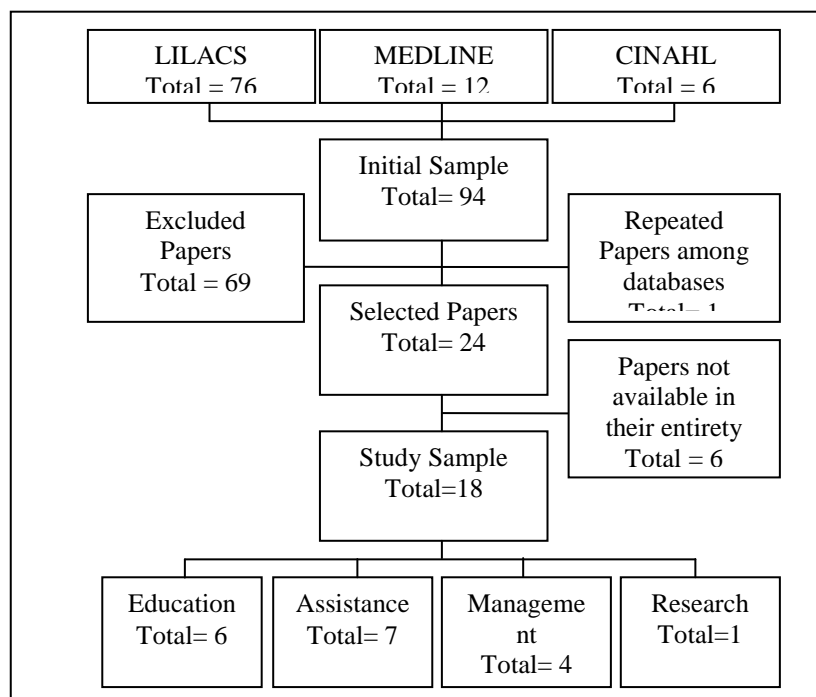


Figure 1. Flowchart of the constitution of the sample and distribution of articles by thematic analysis.

RESULTS AND DISCUSSION

From analysis, two thematic categories related to the subject health care were organized. The criteria for presenting the results occurred

from the initial reading of articles, grouping them according to their core meaning.

The concepts and principles of CT used by the authors of the articles regarding the theme were organized in Table 1.

Article's title	Concepts/Principles of the Complexity Theory
Understanding change in primary care practice using complexity theory	Retroactive ring principle; complex and adaptive dynamical systems; strange attractors; edge of chaos; dialogic principle.
The physic making and the complex and affective being of the nursing appointment: action of significative consistence in the work market	Dialogic principle; apparent inductive and deductive postulate; cosmic solidarity.
Revealing contradictions and incorporating best practices in oral health care for the elderly.	Self-eco-organizer principle; holographic principle; dialogic principle, retroactive ring principle; systemic principle.
The Plight of The Marsh Arabs, an environmental and human rights crisis	Complex and adaptive dynamical systems; dissipative structures; self-organization.
Achieving change in health care practice.	Retroactive ring principle; Complex and adaptive dynamical systems; recursive ring principle; systemic principle; holographic principle; dialogic principle.
Interprofessional partnership in chronic illness care: a conceptual model for measuring partnerships effectiveness.	Complex dynamical systems; recursive ring principle, retroactive ring principle.
Improving assessment and treatment of pain in critically ill.	Complex dynamical systems; complex algorithms; dialogic principle; complexity zone; chaotic emissions.

Table 1. TC concepts found in the sample articles

Mental representations and internal meanings on changes in health practices

This thematic category discusses health actions derived from mental models of the involved actors and the mental models derived from experienced health practices, i.e., in a reciprocal relationship.

The first article⁽⁷⁾ of the subject presents a theoretical model deduced from TC in order to understand the change of practice on primary care in health. Authors consider such practices resulting from a Complex and Adaptive Dynamic System (CADS), consisting of agents, patients, staff and physicians, which ordain and approve models of income generation, patient care and organizational operations.

This type of system is open, interacts internally and with external environment, forming dynamic patterns, sometimes called dynamic fractals or strange attractors. An open system exchanges matter and energy with the environment in constant interchange, while a closed system has no inputs or outputs to the environment and everything that happens in it boils down to its components. Living beings are considered the most important category of open systems. Institutional organizations, including health, too, can be considered as open systems and the individuals that constitute them are actors allowing this view⁽⁸⁾.

CADS can exist in three stages: stability, instability and chaos. Stable systems are at equilibrium; they are resistant to change and small disturbances are quickly quelled in order to maintain the *status quo*. Unstable systems are in a state of disequilibrium, they are highly sensitive to changes and small turbulence can conducted them quickly to disintegration. Chaotic systems are in a state far from equilibrium, they are sensitive to small disturbances, being able to promote rapid changes⁽⁹⁾.

However, unlike unstable systems, chaotic can reach a critical point in which they organize themselves spontaneously into a new complexity structure or behaviour pattern. Thus, in the state of chaos, small effects are required to change the system. Therefore, a CADS can move from one state to another by manipulating its control parameters⁽⁹⁾.

In the abstract space of the parameters needed to completely represent the system and its evolution, the trajectory of the system in the long term is represented by an object, attractor, non-integer dimension (fractal), which are called "strange attractors" when related to the dynamics with sensitive dependence on initial conditions⁽¹⁰⁾. With assistance of strange attractors one can make the distinction between mere randomness, or noise, and chaos. Chaotic behaviour is deterministic and standardized, and strange attractors allow the transformation of seemingly random data into distinct visible ways⁽¹¹⁾.

The model presented by the authors suggest three strategies to promote changes in practice and behaviour of the practitioner⁽⁷⁾:

Transforming: changing an attractor or increasing a new one. There are three methods of transformation – *Hammering*: external change of a complete attractor with intentional coercion. – *Wedging*: refers to pushing work practices toward turbulence, also been referred to as "edge of chaos", space or boundary between order and disorder. – *Shocking*: today is more a description than a method, provided that practices succeed with various directions.

Joining: increasing the existence of the use of attractors in the knowledge of internal models. Reinforces the existence of practices that value the system.

Learning: refers to the instruction directed to medical personnel, patients, and staff regarding necessary techniques to increase their perceptions of internal models.

Authors show that practices are much more complex than what the conventional strategies of change understand. These internal models interact dynamically to create each unique practice, which is determined by primary goals⁽⁷⁾. A CADS simultaneously adapt or respond to change and contribute so that it occurs, corresponding to the idea of circularity, a "self-productive looping." Given that we are both products and producers in a system and the effect is simultaneously a cause⁽⁹⁾.

In search of health practices improvements, the second article⁽¹²⁾ uses the CT to understand being a nurse and doing nursing. Doing nursing in the provision of health service presents its substance by the essentiality of the actions of

caring, explained by the cognitive image of nurses being creative, ethical, and by their humanistic sensitivity, motivating client's and community group's self-esteem.

The temporality of the being towards doing nursing demonstrates the existence of constant worries of being a nurse involving doing and being. According to the authors, in practice, there are three units of thought when watching the child through nursing consultation: the consultation, material and professional environment. Each of these units interacts with the dynamic order-disorder-organization, during the process of caring, being related to doing and being a nurse⁽¹²⁾.

It was noticed that during the nursing consultation, the need of doing in order to be have internal significance in formal institutions and external significance in community systems. It represents the definition of affective professional care with social mission towards the new configurations of the labour market⁽¹²⁾.

Today we begin to conceive a complementary enigmatic relationship, although logically antagonist among notions of order, disorder and organization. Conceptualizing disorder as widespread dispersion and order as an arbitrary constraint imposed upon this diversity. Order is all that is repetition, consistency, invariance, a highly likely relationship under legal dependence. Disorder is all that is irregular, random, deviation, unpredictability. There is no phenomenon of pure order or disorder in the universe. The non-equilibrium is a source of order, and order and disorder are required to self-organization⁽¹³⁾.

Self-organization is the ability to learn from one's own mistakes, it is correcting oneself before noise and life prolixity. The more internally organized a system is the greater creativity and adaptation to evolutionary difficulties. A system with a low organizational level lives in constant relationships conflict in which recurring situations repeat themselves in a compulsive and involuntary way. As the system itself becomes aware of these patterns of repetition, there is an irreversible and cumulative cognitive reorganization, a progressive change throughout its internal structure. Being creative in this context means finding new answers to

this compulsive tendency of the system towards repetition⁽¹⁴⁾.

Considering the existing contradictions in the process of oral health care of the elderly, in the third article of the theme, it was found the presence of contradictory, ambivalent concepts coexisting in conflicting harmony, and converging to determine the processes and structures, components of oral health care of the institutionalized elderly⁽¹⁵⁾.

The recognition of the contradiction in fact reveals the limits of logic and the complexity of the real, setting not a failure, but the beginning of a progression towards knowledge. Normative and experienced needs are concepts that are often in disharmony and conflict between health professionals and the elderly. Being in the condition of institutionalized elderly reveals the contradiction of inclusion/exclusion of the elderly in society. The inclusion of the elderly in collective living grants them living the absence of an idealized family in their imagination⁽¹⁵⁾.

Because Long-Term Institutions (LTI) remains on the sidelines, also excluded from public policy and, especially, oral health, institutionalized elderly is further excluded from access to public dental care and assistance. Oral health care in a LTI occurs between order and disorder. The health and oral health circulate between the whole and the parts, between the parts and the whole, the phenomenon of caring from the perspective of healthy aging. And in this circular motion, permeating contradictions, none is more important than the other, but they are intrinsically linked, establishing mutual relations and reciprocal influences⁽¹⁵⁾.

Care system structure is made up of management policies in the care production process, permeated by the variables of self-organizing process, drawing a network of connections and relationships. However, excess or rigidity of these rules may block the autonomy of individuals disadvantaging self-organizing environment⁽¹⁶⁾.

The components of the CADS require a proper environment in order to develop their creativity and provide innovation. Referring to a new structure that allows self-reflection and learning from experience, giving opportunity to order/disorder, unpredictability and lack of control⁽¹⁶⁾.

It is noticed that we bring life to our ideas, and once we bring them life, they guide our behaviour, telling us to kill or die for them; therefore such products are our own producers, and imaginary and mythological realities are an essential aspect of human reality⁽¹⁷⁾.

Structural changes in organizational systems influencing health

This thematic category discusses some practical ways of interference in the structure of organizational systems and their consequences on health.

Structural explanations are fundamentally important due to the fact that they are the only ones to affect the causes of behaviour at a level in which behaviour patterns can be modified. Structure generates behaviour and, by changing the structure, there may be different behaviour patterns⁽¹⁵⁾.

In the first article of this thematic category⁽¹⁸⁾, it is discussed the destruction of marshes of southern Iraq and its interference in the existing connectivity network between environment and climate changes and their effects on human health.

In the case of marshes, each component of the system definitely had a relationship with the water component. The analysis of the characteristics of an internal component of a system will reveal emerging qualities of this system. No solitary change for an ecosystem can be long range. On a large scale, effects cannot be increased. The system is described as dissipative when forces of external or internal events disturb the direction of a highly disorganized state, which then abruptly ends up becoming more organized⁽¹⁸⁾.

External forces to the regime of Saddam Hussein directed the events of the marshes system into a high dissipation. CADS may involve unpredictable pathways when they are in the state far from equilibrium. There is potential for great complexity or great disorder. First-aid workers and researchers interested in the bad situation of the Marsh Arab need to be prepared and admit the required time for the evolution of this CADS⁽¹⁸⁾.

There are many complex systems models, including: algorithmic complexity, percolation, population dynamics, spin glasses, deterministic

chaos, dissipative structures, noise complexity⁽¹⁰⁾.

Dissipative structures are characterized by the fact that the associated states evolve to configurations structured in time or space. These are phenomena that create order from distant states of equilibrium in open nonlinear systems. This process of self-organization is defined mainly from the properties of the environment itself and is independent or a little dependent on the characteristics of sources of non-equilibrium and on initial conditions. This system behaves as a whole, every part of it seems to be "informed" about the global state⁽¹⁰⁾.

Corroborating these findings, other authors indicate the need to use tools that consider the organizational context for evaluation of health practices, since the team's involvement in the changing process, allowing feedback loops, can sustain it. The second article⁽¹⁹⁾ of this thematic evaluates a program of practice development, consisting of nine projects known as South Thames Evidence-Based Practice (STEP). The goal of STEP is to establish and give advice to evidence-based practice in nursing and other health care⁽¹⁹⁾.

The results revealed that the dissemination of information to the staff and the staff adherence to the rules of the new practice are important factors in the changing process. The perceived values in all evaluated health centers were high with relatively slow adherence, suggesting that other factors prevent high adhesion, such as: work overload, short time to implement changes. In three centers the changing process was dynamic and chaotic. The implementation of the guidelines for change in these three centers was affected by organizational barriers (organizational restructuring, insufficient resources, inadequate staff, inflexible communication channels and hierarchical management). The linear model of change can work in establishments that work with high degree of certainty, but CT is more likely to deal with changing processes in organizations characterized by uncertainty⁽¹⁹⁾.

Studying another CADS, Partnerships between the Health Service and Social Security (PHSSS), other researchers also noticed that the increase of circulated information and feedback loops precipitate in mutual adjustment of

procedures, beliefs or plans in response to changes in demand. This third article used CT to develop a conceptual model of PHSSS. Based on the concept that multiple and often complex needs of people affected by chronic diseases require comprehensive approach between health and social services and extension beyond the sudden tradition, episodic care health and services of a solitary organization. PHSSS are proposed for this, being defined as virtual interorganizational structures formed around the needs of customers, through formal and/or informal relations of health frontline and social service providers from various organizations that collaborate to provide global and integrated assistance on care and support services⁽²⁰⁾.

PHSSS were considered CADS, as self-organizing and interorganizational systems, in which experiences are exchanged and influenced, but not controlled, by external factors to the group. Mutual adjustments occur while learning, allowing creativity, reflection and evaluation. The new conceptual model presented assumes inter-relationship between the salient attributes of the group process, the influence of external factors to the group process and results. This model has limitations in the effectiveness of organizational teams, because the organizational context in which each team operates is rarely considered, although the context influences the success of the team⁽²⁰⁾.

In the last article of this thematic category, it was noticed that small structural changes (organizational context) can lead to desirable changes in health practices, so CT was used in the control of pain in patients admitted to intensive care units⁽²¹⁾.

The baseline for evaluation of pain is 42% and the baseline for treatment, 59%. After five weeks, the pain evaluation improves to 71% and the pain management improves to 97%. Results are consistent with the CADS theory in which improvements effects involving complex decisions can achieve greater success in applying a few rules, preferably creating complex algorithms. The model suggests certainty-agreement diagram, with a degree of agreement on one axis and one degree of certainty on the other. Simple emissions have high degrees of both certainty and agreement. "Chaotic" emissions have low degree of

certainty and agreement. The rest of the issues fell in the "zone of complexity"⁽²¹⁾.

For the authors, their interventions significantly increased pain care and treatment of patients without increasing adverse events related to therapy. Interventions are relatively simple and can be implemented in a comprehensive way in other places, having provided insights for the application of CT in the applied efforts⁽²¹⁾.

The creative process towards a difficult goal may arise from some simple and flexible rules, or the so-called minimum specifications. However, current organizational thinking is based on the assumptions that the plans for progress should provide the "best way", completely specified and consistently applied in that same level of details. Such thinking fails to take advantage of the natural creativity of the organization and does not allow the inevitable unpredictability of events. CT suggests that the relations between the parties are more important than the parties themselves, and that the minimum specifications end up yielding more creativity than detailed plans⁽²²⁾.

In general, CADS are nonlinear. Self-organization does not require the behaviour of CADS to be independent of the environment. In fact, the system needs the environment, because the rules the agents follow (among other things) are responses to environmental stimuli. Therefore, modifying the environment is a way through which the behaviour of CADS can be changed. When the CADS self-organizes, the emerging structure of the system can be influenced by the behaviour of the component units, i.e. once organized, the resulting systems affect the components⁽²³⁾.

FINAL THOUGHTS

Using the bibliographic review as a method for increasing the knowledge about CT allowed the understanding of the use of this theory in healthcare assistance. Care is complex and holds numerous interactions among individuals involved in the process, the environment and health practices.

The study gave visibility to CT concepts used by different authors and its possible applications in the field of health care assistance, i.e., action-

reflection-action. Recognizing that this theory presents strategies to transform health practices in favour of dialogue, of best relationships and of sharing of information are challenges for making advance the new science.

It is believed that one of the main contributions of CT is its ability to be a leading reference in building service assessment tools as well as identifying gaps and possible strategies for the reorganization of health practices.

ASSISTÊNCIA EM SAÚDE: REVISÃO INTEGRATIVA DO CONHECIMENTO PRODUZIDO À LUZ DA COMPLEXIDADE

RESUMO

Trata-se de um recorte a partir de uma revisão integrativa, cujo objeto de estudo foi a produção do conhecimento em periódicos, acerca de pesquisas na área da Enfermagem, que se utilizaram da teoria da complexidade como referencial teórico. Este estudo reúne sete artigos, a partir de pesquisa bibliográfica com 18, localizados nas bases de dados: Medical Literature Analysis and Retrieval System on-line (MEDLINE), Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS) e Cumulative Index to Nursing and Allied Health Literature (CINAHL), no período de 1998 a 2008. Nas duas primeiras foi utilizada a seguinte combinação de palavras-chave: "complexity theory" and "health" and "nursing", e na terceira: "complexidade" and "saúde" and "enfermagem". A análise de conteúdo foi o referencial metodológico que permitiu organizar o conhecimento, agregado no tema: assistência em saúde. Percebeu-se que a Teoria da Complexidade tem embasado a compreensão do processo do cuidado em saúde, destacando o cuidador com suas práticas e o meio-ambiente.

Palavras-chave: Dinâmica Não Linear. Assistência Integral à Saúde. Enfermagem. Saúde.

ASISTENCIA EN SALUD: REVISIÓN INTEGRATIVA DEL CONOCIMIENTO PRODUCIDO A LA LUZ DE LA COMPLEJIDAD

RESUMEN

Se trata de un recorte hecho con una revisión integrativa, cuyo objeto de estudio fue la producción del conocimiento en periódicos acerca de investigaciones en el área de la Enfermería, que usaron la teoría de la complejidad como referencial teórico. Este estudio reúne siete artículos de investigación bibliográfica escogidos entre 18, ubicados en las bases de datos: Medical Literature Analysis and Retrieval System on-line (MEDLINE), Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS) y Cumulative Index to Nursing and Allied Health Literature (CINAHL), en el período de 1998 a 2008. En las dos primeras se utilizó la siguiente combinación de palabras clave: "complexity theory" and "health" and "nursing", y en la tercera: "complexidade" and "saúde" and "enfermagem". El análisis de contenido fue el referencial metodológico que permitió organizar el conocimiento agregado al tema: Asistencia en salud. Se percibió que la Teoría de la Complejidad está en la base de la comprensión del proceso del cuidado en salud y destaca al cuidador con sus prácticas y el medio ambiente.

Palabras clave: Dinámica no Linear. Atención Integral de Salud. Enfermería. Salud.

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