TEXTO & CONTEXTO ENFERMAGEM
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DIFFUSION OF INNOVATIONS THEORY AND ITS APPLICABILITY IN RESEARCH STUDIES ON NURSING AND HEALTH

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ABSTRACT

Objective: to reflect on the Diffusion of Innovations Theory, as a theoretical-methodological framework for research studies on Nursing and Health.
Method: a reflective study, based on the principles and concepts of the Diffusion of Innovations Theory as a theoretical-methodological framework, and its applicability in studies on innovations in health.
Results: using the framework enables the conduction of studies encompassing qualitative, quantitative and mixed approaches, applicable for the identification of the need for innovation in the elaboration, design, implementation, evaluation and adjustment of the innovations. The diffusion process evaluation through the elements of innovation, time, social systems and communication channels enables apprehending contributing factors for the success of a given innovation.
Conclusion: the theoretical perspective herein presented offers conceptual grounds to apprehend the process corresponding to the diffusion of innovations in the health field, through sensitive models and evaluation and elaboration of diffusion processes suitable for various contexts.

DESCRIPTORS: Diffusion of innovations. Innovation. Health communication. Health information systems. Nursing research.

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TEORIA DA DIFUSÃO DA INOVAÇÃO E SUA APLICABILIDADE EM PESQUISAS EM SAÚDE E ENFERMAGEM

RESUMO

Objetivo: refletir sobre a Teoria da Difusão da Inovação, como referencial teórico-metodológico para pesquisas em saúde e enfermagem.
Método: estudo do tipo reflexivo, assentado nos princípios e conceitos da Teoria da Difusão da Inovação, como referencial teórico-metodológico e aplicabilidade em estudos de inovações em saúde.
Resultados: o uso do referencial teórico instrumentaliza a condução de estudos abarcando abordagens qualitativas, quantitativas e mistas, aplicável para identificação da necessidade da inovação, na construção, delineamento, implantação, avaliação e ajuste das inovações. A avaliação do processo de difusão através dos elementos inovação, tempo, sistema social e canais de comunicação possibilitam a apreensão de fatores contribuintes para o sucesso de uma inovação.
Conclusão: a lente teórica aqui apresentada oferece bases conceituais para a apreensão do processo de difusão de inovações no campo da saúde, através de modelos sensíveis a avaliação e elaboração de processos de difusão adequados a contextos diversos.

DESCRITORES: Difusão de inovações. Inovação. Comunicação em saúde. Sistemas de informação em saúde. Pesquisa em enfermagem.

LA TEORÍA DE LA DIFUSIÓN DE INNOVACIONES Y SU CAPACIDAD DE APLICACIÓN EN INVESTIGACIONES EN LAS ÁREAS DE SALUD Y ENFERMERÍA

RESUMEN

Objetivo: reflexionar sobre la Teoría de la Difusión de Innovaciones como un referencial teórico-metodológico para investigaciones en las áreas de Salud y Enfermería.
Método: estudio del tipo reflexivo, asentado en los principios y conceptos de la Teoría de la Difusión de Innovaciones, como referencial teórico-metodológico y su capacidad de aplicación en estudios de innovaciones en salud.
Resultados: utilizar el referencial teórico instrumentaliza el desarrollo de estudios que abarcan enfoques cualitativos, cuantitativas y mixtos, aplicable para identificar la necesidad de la innovación en la elaboración, el diseño, la implementación, la evaluación y el ajuste de las innovaciones. La evaluación del proceso de difusión a través de los elementos innovación, tiempo, sistema social y canales de comunicación permite percibir factores que contribuyen al éxito de una innovación.
Conclusión: la perspectiva teórica aquí presentada ofrece bases conceptuales para percibir el proceso de difusión de innovaciones en el campo de la salud, a través de modelos sensibles a la evaluación y elaboración de procesos de difusión adecuados a diversos contextos.

DESCRIPTORES: Difusión de innovaciones. Innovación. Comunicación en salud. Sistemas de información en salud. Investigación en enfermería.

INTRODUCTION

Technological advances increasingly lead to innovations that can be incorporated into health practices, services and systems[1]. Reflecting on the effects of the incorporation of Information and Communication Technologies (ICTs) in the society in which we live inevitably brings us back to innovation and its transformative potential. However, the conception that innovation and technology are synonyms is frequent and recurrent[2]. In this article, the proposal is to broaden the conception of innovation, resuming its semantic origin from the Latin *innovare*, which means "to do something new"[3]. Advances in science and technology have accelerated information exchange and consequently encouraged a superficial and compartmentalized production of knowledge[4]. In this context, the subversion of the concept of the word innovation has notably favored the idea that, to innovate, it would be necessary to "create" a "machine".

In the world scenario, large financial resources have been invested in the acquisition of innovations, but their effective use depends on the success of their diffusion and evaluation among the possible adopters[5–6]. Especially in the Health area, the process of diffusion of innovations occurs in fragile and complex scenarios, with interference from political, social and cultural contexts, resulting in deployed technologies, but not always used appropriately[1]. In the Nursing field, innovation is commonly understood as synonymous with the use of machines in the care process[2]. The aspects capable of impacting and influencing the diffusion process of an innovation are plural and heterogeneous, ranging from the training of health professionals to the production of knowledge in the area. Thus, continuous research becomes necessary in order to overcome barriers and weaknesses that emerge in this context.

It is in the interface of diverse knowledge, of the practices and experiences in the health area, that innovations emerged, in order to optimize production of care. The terminology of Care Technologies is used in the Nursing field to characterize the set of technical-scientific knowledge and practices based on scientific research studies, theoretical bases and practical application[2].

Incorporation of technologies in health care is a natural process that exerts a positive effect on the assistance provided to the population. The understanding that technology and care are separate dimensions, like water and oil that do not mix, still permeates the ideals of health professionals and managers. The configuration of health care networks, on the other hand, stratifies health technology into soft, soft-hard, and hard levels[7]. Soft technologies refer to the interactional and subjective character of work in health, while knowledge structured as protocols and norms are considered soft-hard technologies. The non-human aspect, represented by the equipment and machines used, for example, corresponds to the hard technologies[7].

It is in the interaction of diverse knowledge, practices and experiences in the health area that innovations emerged in order to optimize Nursing care, and the use of technologies was expanded. The Brazilian Federal Council of Nursing (*Conselho Federal de Enfermagem*, COFEN) held the 22nd Brazilian Congress of Nursing Councils in November 2019, a moment that provided an opportunity for reflective agendas and debates about the advances regarding technological innovations in Nursing[8].

In the same year, in partnership with the Pan American Health Organization (PAHO), the "Innovation in Nursing Laboratory" was created, with the scope of "Valuing and Strengthening Universal Health" and with the objective of systematizing and disseminating innovative experiences, produced by Nursing, in the scope of the Unified Health System (*Sistema Único de Saúde*, SUS)[8]. The innovative initiatives of Nursing from the North to the South of the country totaled 239 experience reports and, of these, 16 stand out for their innovative aspect and relevance to the Unified Health System and to Nursing[8–9]. The efforts of the Federal Nursing Council and the PAHO can contribute to the understanding by health professionals and nursing professionals of the magnitude and potential

intrinsic to creativity, inventiveness and ingenuity to overcome barriers and achieve goals through innovative actions. The analysis of the award-winning studies in the 2019 edition of the "Innovation in Nursing Laboratory" translate the innovative capacity of Nursing, from the creation of technological tools such as apps to the elaboration and implementation of protocols for assistance in riverside regions and the implementation of changes in the flows of low-, medium- and high-complexity health services[6].

Nursing uses countless technologies in its practice, in the technical care field, in the field of scientism, in diagnostic taxonomies and in interpersonal and ethical skills, as well as in education. At this interface of possibilities, there are communication and information technologies, in domains such as management and communication systems, which can be used for diagnostic, management, counseling, education or support purposes, such as computerized systems for diagnostic decision support and information systems for electronic health records. Robotics has also been used to assist in procedures, in the incorporation of applications for self-care, in standardization and scales in assistance and management and in virtual simulation in teaching, among other technological resources[9–10].

Diffusion of innovations involves different conceptions, dimensions and contexts of application; consequently, it is understood under different theoretical approaches[11–12]. In this article we highlight Rogers' Diffusion of Innovations Theory (DIT), which has been the basis for studies to evaluate diffusion of innovations in the health area and which can also be used in Nursing, qualifying the evaluation of innovations[13–14].

Currently, the Innovations and Information Technology Laboratory of the Study Group on Self-Care, Aging and Educational Processes in Health and Nursing (*Laboratório de Inovações e Tecnologias da Informação do Grupo de Estudos Sobre Autocuidado, Envelhecimento e Processos Educativos em Saúde e Enfermagem*, LABIN/GAPESE), from *Universidade Federal de Juiz de Fora* (UFJF), in partnership with the Nursing Administration Research Center (*Núcleo de Pesquisas em Administração em Enfermagem*, NUPAE), from the Nursing School of the Universidade Federal de Minas Gerais (EENF/UFMG), has been developing studies using the DIT as a theoretical-methodological reference. The theoretical-reflective article proposed is the result of the multicenter study entitled "Analysis of the implementation and effects of the Citizen's Electronic Medical Chart of the Primary Care e-SUS strategy", involving the aforementioned institutions.

DIFFUSION OF INNOVATIONS THEORY: CONCEPTUAL AND THEORETICAL BACKGROUND

The DIT is widely used in the design and conduction of research studies seeking to understand and assess the process corresponding to the diffusion of innovations. The first version of the theory was applied in the area of Rural Sociology, in the study of pea seeds, specifically. The success of the study and the robustness of the theoretical framework propitiated diffusion of the DIT as a theoretical framework in the conduction of studies with varied approaches[14]. The author's proposal is that any and all innovations inevitably go through the process called "diffusion". Thus, to evaluate the success of an innovation, it is necessary to understand its diffusion, with diffusion being defined as the process by which an innovation is transmitted over time, through certain communication channels, among the members of a social system. In this sense, the main elements of diffusion of innovations are as follows: the innovation itself, the communication channels, time and the social system. In the DIT, such elements exert an influence on the diffusion process and must be understood, in order to enhance acceptance of the innovations[14].

In the DIT, innovation is understood as an idea, practice, object or process perceived by people as "innovating". People's perception of what is characterized as "new" or "innovation" in the DIT is a central element of the analysis, as it influences people's behavior in interacting with the proposal[14].

By emphasizing people at the center of the evaluation process of innovations in the DIT, it is understood that the perception of innovation can change over time. Innovation is disseminated from the interaction processes in which people and the innovation itself are involved. It is necessary to know the process corresponding to the diffusion of innovations and the transformation that take place regarding its adoption. What is considered innovative depends on the people's perception (the potential adopters) about the transformations provided by the innovation[14]. Use of the DIT in the health field was the object of a review study that pointed out the beneficial aspect of the theory and its timeless character[15].

In this sense, in order to be accepted, innovations have their own characteristics that awaken in potential adopters the recognition of favorable and qualifying transformations of daily life in its various contexts. Thus, the innovation itself has characteristics that influence its diffusion among the adopters, which are conceptualized in the DIT as attributes of an innovation, namely: relative advantage, compatibility, complexity, experimentation and observability[14].

The relative advantage is the perception that innovation is better that the previous idea, practice or object. The advantage represented by innovation is directly related to its nature and importance for the potential people who will adopt it. In his studies, Rogers identified that some advantages contribute to a great extent to the adoption of an innovation, such as the offer of incentives, initial cost and the possibility of obtaining or gaining social status[14].

The compatibility attribute refers to the perception that the innovation is consistent with the beliefs, values, norms, past experiences and needs of its potential adopters. According to Rogers, the more compatible a new idea, practice or object is with the context in which it will be applied, the lower the uncertainty regarding its potentialities and benefits. In general, any innovation must be adapted to the sociocultural values, clearly not opposing the practices and beliefs. Compatibility with previously adopted ideas/innovations must also be observed, offering a connotation of evolution to the innovation that is intended to be implemented[14].

Complexity of the innovation is linked to the perception of difficulty in using and understanding it by those who adopt it. In some specific situations, the importance of complexity bears no comparison with the relevance of the relative advantage and compatibility. As an example, the author cites the process of computer diffusion, in which, despite difficulty of use, people who admire technologies insist on using them, mobilized by their own need to meet the demands of daily work and various other contexts. However, in the DIT, innovations recognized as complex in their use tend to have difficulties in their diffusion process, and may even be rejected, underused or replaced over time[14].

The experimentation attribute refers to the possibility of a given innovation to be experienced, either in a temporary or definite version of the new idea, practice or object. According to Rogers, it is a way of bringing future adopters and the innovation closer together, which can favor the other attributes (relative advantage, complexity, compatibility, observability) through adjustments to necessary reformulations/adaptations[14].

Another attribute, observability, refers to the visibility of the results obtained from applying the innovation. When they see positive results from the innovation, its adopters tend to more easily accept it and contribute to the diffusion process. In this context, it is believed that the other individuals from a given social system are more receptive to the ideas, practices or objects already adopted by their peers. As an example, Rogers cites the diffusion process of mobile telephony devices, initially high-priced objects that became objects of desire due to the conspicuous visibility of their use[14].

In the DIT, the communication channels constitute another fundamental element in the process corresponding to the diffusion of innovations. Communication is a process for the creation and exchange of diverse information between individuals and/or groups, in order to reach mutual understanding on

a given topic. Starting from this perspective, it is noted that the communication process that involves innovations encompasses three stages[14].

The first is initiated with what a person, group or adoption unit (a sector in a company, for example) knows about a given innovation. The second stage involves that adoption unit and a second unit which, unlike the first, has no knowledge about the innovation. The diverse information about the innovation is exchanged between these two units through digital or non-digital communication channels. The third stage encompasses the link created between both adoption units, which "connect" with each other through these channels[14].

The communication channels represent the way in which messages and/or information are exchanged between the individuals, according to the nature of the information. In addition, according to the author, mass communication is the most effective way to reach an extensive public, while face-to-face communication favors persuasion of a potential adopter[14].

It is known that human communication takes place largely between people/sectors that share the same beliefs, values, goals, habits and social status, among other characteristics. The individuals' degree of similarity favors communication, called homophily. The opposite situation, in which the degree of similarity between the individuals is lower, is called heterophily[14].

According to Rogers, in innovation diffusion processes, the individuals involved are often heterophilous, which hinders communication. On the other hand, it is believed that, over time, the innovation can maintain its adoption levels with the emergence of a "*critical mass*", which is a trend, just like what happened in the diffusion process of air conditioners, mobile phones and e-mail, among others[16].

In the DIT, the dimension of time elapsed between the first contact with the innovation and its adoption/rejection is considered crucial, configuring what Rogers calls the "innovation-decision" process. This process comprises the individual's approach to the innovation and the development of an attitude/behavior, towards the decision for the adoption/rejection, implementation and confirmation of the decision taken. This is a complex process, based on decisions, choices and actions, which, over time, gradually define incorporation of the innovation[14–16].

In this sense, the DIT offers a model for the innovation-decision process that involves five subsequent time stages, namely: knowledge, persuasion, decision, implementation and confirmation, described below:

Knowledge: it concerns the search for knowledge about the innovation, which can occur in the dimensions of awareness (*awareness-knowledge*), referring to the existence of innovation, use of the innovation (*how-to knowledge*) and the principles of the innovation (*principles-knowledge*)[14–16].

Persuasion: in the DIT's perspective, persuasion does not refer to a type of induction, differing in the sense of inducing human behavior to something, because the potential adopter will have his autonomy of critical analysis, experimentation and, finally, of decision[15].

Decision: it involves the choice between adopting or rejecting the innovation, so that adoption refers to the decision to fully utilize an innovation in the best way, while rejection comprises the decision not to adopt it[14].

Implementation: it occurs when the innovation is put into practice. Implementation may require a long period of time, until it is institutionalized or becomes a habitual practice for its adopters[14].

Confirmation: it occurs when the adoption unit (individual/group) seeks to reinforce the decision taken in the previous stage. Although the decision for adoption or rejection has in fact occurred, there may still be continuity of the innovation-decision process due to uncertainty regarding the decision made. Thus, those who adopt the innovation look for diverse information reinforcing their choices, in the face of conflicting data that checkmate the definitions adopted[14].

As one of the influential elements in the diffusion of innovations, the social system constitutes the boundaries in which the diffusion process occurs, defined as a set of interrelated units engaged in achieving the same goal. The members of the social system vary according to their nature and, in general, they are individuals, informal groups or an organization and/or subsystems. The social structure confers stability and regularity to human behavior and is contained in a social system, which can facilitate or impede diffusion of an innovation, as can normative structure, which establishes a behavioral pattern[14].

It is in this context that the opinion leader and the change agent emerge. Both comprise the social system and their representativeness is not only conferred by organizational position or definitions. Opinion leaders are characterized as subjects capable of influencing their peers, unlike the change agents, who are recognized by technical knowledge and must be able to influence customers (consumers of the innovation).

The decision for the innovation can occur in three ways, namely: optional: it occurs whenever the decision to adopt or reject the innovation occurs in an independent manner; collective: it occurs whenever the decision for adoption or rejection occurs in a collective manner; authoritarian or normative: it occurs when the decision to adopt or reject an innovation is made by a small part of members of the social system, who have statuses that give them certain power over others[14].

According to Rogers, the individuals belonging to a social system do not adopt a given innovation simultaneously, for presenting different characteristics between each other. In his studies, the author establishes the adopters' stratification into five categories, considering the ideal profile for each one, such as, the innovators: they can understand technical knowledge, are interested in new ideas and circulate through different social systems; the early adopters: they present the leadership trait and are respected and followed by their peers, helping them in the innovation adoption process; the early majority: they are deliberative and follow adoption of the innovation before half of the members of the social system, but do not lead their peers; the late majority: skeptical, born followers of the other adopters of the system, resistant to change; and the laggards: they constitute a portion of the social system, who distrust the innovation and the change agent, slowly adopting the innovation[14].

DIFFUSION OF INNOVATIONS THEORY AND ITS APPLICATION IN RESEARCH STUDIES ON NURSING AND HEALTH

The DIT offers the theoretical support to analyze the diffusion of innovations, their adoption or rejection, as well as the understanding of how people react to the changes, proposed through the implementation of the technologies. These reactions not only encompass behavior, but also thought.

The DIT allows for a complex analysis of the diffusion of technologies, their applicability and context, considering that innovation must be compatible with sociocultural values, needs and demands, as well as with work practices, understanding that such innovations must be flexible to the care, educational, relational or managerial reality and must optimize the processes. Subsequently, the analysis dimensions proposed by the DIT assist in the assessment regarding the implementation of new knowledge in the health area. The theory also fosters the need to innovate and apply the ideas[17].

Diffusion of innovations in services, products and knowledge in the health area has increased throughout history. Use of the DIT, either isolated or combined with other theoretical perspectives, reflects the empowerment and intensification of the complexity inherent to the barriers and challenges to be overcome. The DIT enables researchers to capture their study object (innovation) through the evaluation of its aspects, ranging from the decision process for innovation to the evaluation of the results after diffusion. The DIT encompasses the perception of people/human beings about the innovation and is not limited to only analyzing the innovation itself[12].

The influence of the social system on the diffusion process of technologies directed to health services is pointed out in a number of studies[18–19]. A study described three phases of the elaboration of an educational software, based on the *North American Nursing Diagnosis Association-International* (NANDA-I) taxonomy, developed in a university hospital in southern Brazil, to improve the accuracy of Nursing diagnoses. The software presented Nursing diagnoses and clinical cases, which could be edited by the professors, in order to help the students' clinical reasoning and offer more dynamic teaching[20].

Another study dealt with the development and validation of an app, in *IOS*® and *Android*® versions, about the Nursing process in a neonatal intensive care unit. As results of the implementation, it can be noticed that the app was able to provide quality, effectiveness and safety in Nursing care and personal satisfaction[21].

In a research study, the authors elaborated and validated a checklist for Nursing care, when admitting patients in the immediate postoperative period of cardiac surgeries. The checklist defined essential parameters for quality care, ensuring greater agility and patient safety, which was validated with three topics, four categories, 16 items, and 86 sub-items of care attributions to be applied in the clinical practice. It was consolidated as a resource for planning Nursing actions, providing quality care, facilitating communication between teams and minimizing possible risks[22].

Such experiences confirm the possibility of successfully implementing technological innovations and apply them to the routing of care, research and study in Health.

The essence of the diffusion process is information exchange, in which an individual communicates a new idea to another person or to several individuals[19,23]. In its most elementary form, the process involves the following: an innovation, an individual or other adopting unit, which has knowledge or experience with the use of the innovation, another individual or other unit, which has yet no knowledge of the innovation, plus a communication channel connecting the two units. A communication channel is the means by which the messages are conveyed from one individual to another[14].

Health is established in biopsychosocial contexts, such as expressions of feelings, signs and symptoms, stages of life, that is, peculiar phenomena and not always collective, but manifested in different ways[15]. The incorporation of innovations proposes an even greater challenge in the health area, not only for the technological operationalization, but for the integration of technology and science, with the humanistic issues inherent to the area of human care.

In this way, technologies must consider that care, treatment and health evaluation, both in research and in their applicability, must go beyond the positivist determination of biomedical rationality and be guided by human needs in Health and by cultural and subjective aspects, so that care is not fragmented even more in the Cartesian mold, dissociating important relationships to be fully understood for quality care. In addition to these facts, health technologies need to be pre-existing and concomitant causal nexuses, providing safe and effective guidelines, results and processes. In summary, technological development should not omit or neglect ethical and humanitarian aspects, which are intrinsic to the health area[24].

The option for implementing an innovation in the health system must also consider the sector's service provision, the epidemiological and demographic characteristics of the population, and the ability to access the Internet networks, which are, in fact, confluent for solving health problems, thus avoiding work overload, rework and frustrations due to technical malfunction, considering the importance of democratization and technological inclusion between the services, institutions and professionals[14,24].

Regarding human resources, the technologies may interfere with the functions performed by certain professionals of the team, intervening in their work process, role and function, which can become the limiting factor on the adoption of innovations. In addition to that, the incorporation of new technologies, depending on their objective and direction, can lead to new demands, which, consequently, may increase work intensity and require workers to have complementary specific knowledge in order to operate and master them[24].

CONCLUSION

The objective of the study was to reflect on the DIT as a theoretical-methodological framework in research in the Health and Nursing areas. The elements and attributes of the DIT are recognized in several studies, as determining factors, to understand the innovations incorporated in health care organizations. The deepened analysis of diffusion of innovations contributes to knowing the factors that interfere in acceptance or nonacceptance.

The incorporation of innovations proposes an even greater challenge in the health area, not only for technological operationalization, but for the integration of technology and science with humanistic issues, inherent to the area of human care and all the subjectivities involved, namely: cultural, beliefs, behaviors issues that are not linear and homogeneous in the social environment and that need to be contemplated in any facilitator of the work process, whether it is assistance, relational, investigative or informative. It is to be considered that innovations need to be contextualized to the specific requirements of their users and potential adopters. In addition to that, there is fear, regarding the commitment of the professionals' function with their work process, the increase in work intensity and complexity, and the need for continuous updates and studies, with the advent of new implementations.

It is also important to point out that the applications of the results arising from innovations in technological segments still present obstacles in Nursing. The practical implementation of the results from research studies is often slow, hindering incorporation of innovating processes. The dissemination of results and innovative proposals, when not applied in favor of changes, improvements and adjustments, in real-life practice, can widen the distance between the theory and what is consistently done.

Given the above, use of the DIT can contribute more safety in adherence to innovating technologies, favoring practical applicability. It is necessary to encourage studies about the theory and mainly use it to assess the results of new technologies in Health and Nursing.

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NOTES

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CONTRIBUTION OF AUTHORITY

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