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DEVELOPING AN IMPROVEMENT STRATEGY IN HEALTH RESEARCH INNOVATION AND QUALITY BASED ON TECHNOLOGY WATCH ADOPTION: A CUBAN CASE STUDY

DESENVOLVIMENTO DE UMA ESTRATÉGIA PARA MELHORAR A CIÊNCIA, INOVAÇÃO E QUALIDADE EM SAÚDE A PARTIR DA ADOPÇÃO DA VIGILÂNCIA TECNOLÓGICA: UM CASO CUBANO

DESARROLLO DE UNA ESTRATEGIA DE MEJORA DE LA CIENCIA LA INNOVACIÓN Y LA CALIDAD EN SALUD BASADO EN LA VIGILANCIA TECNOLÓGICA: UN CASO CUBANO

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Abstract

Objective: To develop an improvement strategy on research, innovation and quality of health, based on technology watch adoption.

Method: A non experimental study that comprehends descriptive and bibliometric analysis was used, along with the implementation of technology watch procedure to support the strategy.

Originality/Relevance: Technology watch along with strategic intelligence are acknowledged to be key tools in innovation processes as well as in strengthening National Science Technology and Innovation Systems (Guagliano, Villanueva, Perez and Sánchez Rico, 2019); its use has spread to numerous public and private companies, government agencies, consulting institutions, universities and research centers which are being interested in anticipating the continous and emerging challenges from the changing environment and hence making proper strategic decisions (Guagliano, Massaro and Rodríguez Bianchi, 2015); particularly in health care its applications are extended to technology assessment, care services improvement and academic research capacity planning and strengthening (Carrillo Zambrano, Páez Leal, Suárez and Luna-González, 2018). Specifically, Research, Quality and Innovation management at a local health system in Cuba, needs to generate high value-added information and knowledge to enhance performance and accurate decision making.

Results: Here we show how the development of technology watch enhance and support the formulation of research, development and innovation projects; and standardization of healthcare services and processes, which were selected as relevant variables in a previous prospective study.

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Social / management contributions: The results are aligned with the Cuban healthcare strategic goals, for among its current demands, it prioritizes the generation of high-impact scientific and innovative results, as well as the development of a quality strategy that portrays, among its core objectives, health services continuous improvement, based on developing standards, Clinical Practice Guidelines and therapeutic protocols.
Theoretical/Methodological contributions: The adoption of Technology and Innovation management and knowledge-based techniques may offer valuable benefits within research and quality of healthcare context.

Keywords: Technology watch. Innovation. Quality management. R&D projects. Healthcare.

Resumo
Objectivo: desenvolver uma estratégia para melhorar a ciência, inovação e qualidade em saúde a partir da adopção de vigilância tecnológica.
Método: Foi desenvolvida uma pesquisa não experimental que incluiu análises descritivas e bibliométricos integrados à aplicação de um procedimento de vigilância tecnológica.
Originalidade / Relevância: A Vigilância Tecnológica e a Inteligência Estratégica são reconhecidas como ferramentas fundamentais nos processos de inovação, bem como no fortalecimento dos Sistemas Nacionais de Ciência, Tecnologia e Inovação (Guagliano, Villanueva, Perez and Sánchez Rico, 2019). Seu uso foi estendido a várias empresas públicas e privadas, agências governamentais, organizações de consultoria, universidades e centros de pesquisa que precisam se antecipar aos desafios contínuos e emergentes desafios do ambiente em mudança, para consequentemente tomar decisões estratégicas (Guagliano, Massaro and Rodríguez Bianchi, 2015). Particularmente, no sector da saúde, suas aplicações têm incluído a avaliação de tecnologias, a melhoria dos serviços de saúde, o planeamento e o aprimoramento da pesquisa e da capacidade académica (Carrillo Zambrano, Páez Leal, Suárez and Luna-González, 2018). O sistema de ciência e inovação de um sistema territorial de saúde em Cuba requer a geração de informação e conhecimento de alto valor agregado para potencializar o desempenho deste sistema e tomar decisões oportunas.
Resultados: Mostra-se como a aplicação de ferramentas de vigilância tecnológica permite aprimorar e apoiar a formulação de projectos de investigação, desenvolvimento e inovação; e a protocolização dos serviços e processos de saúde, em alinhamento com as duas variáveis estratégicas seleccionadas em estudo prospectivo precedente.
Contribuições sociais / gerências: Os resultados estão alinhados aos objectivos estratégicos da saúde pública em Cuba, pois entre suas demandas actuais prioriza a geração de resultados técnico-científicos de alto impacto, com capacidade de se tornarem inovadores; bem como o desenvolvimento de uma estratégia de qualidade que traça a melhoria contínua entre os seus objectivos estratégicos, com base no desenvolvimento de normas, Normas de Prática Clínica (NPC) e protocolos de acção.
Contribuições teóricas - metodológicas: A gestão da tecnologia e inovação integrada em técnicas baseadas no monitoramento do meio ambiente, a gestão da informação e do conhecimento pode oferecer benefícios valiosos no contexto da pesquisa e da qualidade em saúde.

Palabras-chave: Vigilância tecnológica. Inovação. Gestão da qualidade. Projectos de investigação. Saúde.

Resumen
Objetivo: desarrollar una estrategia de mejora de la ciencia, la innovación y la calidad en salud basada en la adopción de la vigilancia tecnológica
Método: Se desarrolló una investigación no experimental que comprendió análisis descriptivos y bibliométricos integrados a la aplicación de un procedimiento de vigilancia tecnológica
Originalidad/Relevancia: La Vigilancia Tecnológica y la Inteligencia Estratégica se reconocen como herramientas clave en los procesos de innovación asi como en el fortalecimiento de los Sistemas Nacionales de Ciencia Tecnologia e Innovación (Guagliano, Villanueva, Perez and Sánchez Rico, 2019); su utilización se ha extendido a diversas empresas publicas y priuvadas, agencias gubernamentales, organizaciones de consultoría, universidades y centros de investigación que necesitan

anticiparse a continuos y emergentes retos del entorno cambiante, para consecuentemente, tomar decisiones estratégicas (Guagliano, Massaro and Rodríguez Bianchi, 2015). Particularmente, en el sector de la salud sus aplicaciones han abarcado la evaluacion de tecnologias, mejoramiento de servicios de salud, planificación y perfeccionamiento de capacidades investigativas y académicas (Carrillo Zambrano, Páez Leal, Suárez and Luna-González, 2018). Por su parte, el sistema de ciencia e innovación de un sistema territorial de salud en Cuba, precisa de la generación de información y conocimiento de alto valor agregado para potenciar el desempeño de este sistema y la toma de decisiones oportuna.
Resultados: Se muestra como la aplicación de herramientas de vigilancia tecnológica permiten perfeccionar y apoyar la formulación de proyectos de investigación, desarrollo e innovación; y la protocolización de servicios y procesos asistenciales, en alineación a las dos variables estrategicas seleccionadas en un studio prospectivo precedente.
Contibuciones sociales/gerenciales: Los resultados están alineados con los objetivos estratégicos de la salud pública en Cuba, pues entre sus demandas actuales, prioriza la generación de resultados científico-técnicos de alto impacto, con capacidad de convertirse en innovaciones; así como el desarrollo de una estrategia de calidad que delinea entre sus objetivos estratégicos el perfeccionamiento continuo, basado en desarrollar normas, Guías de Práctica Clínica (GPC) y protocolos de actuación.
Contibuciones teóricas/metodológicas: La gestión de la tecnología y la innovación integrada a técnicas basadas en el monitoreo del entorno, la gestion de la información y del conocimiento puede ofrecer valiosos beneficios en el contexto de la investigación y la calidad en salud.

Palabras-clave: Vigilancia tecnológica. Innovación. Gestión de la calidad. Proyectos de investigación. Salud.

1 Introduction

National Research and Innovation in Cuba is regulated by the Ministry of Science, Technology and Environment by means of a legal framework that is gradually enhancing and upgrading the organization of research and innovation process across all econonomic and scientific institutions (Resolución 287, 2019).

Aproximately 26% of those organizations are devoted to health research, development and innovation. National Health Research and Innovation System (NHRIS) is composed of a network of primary, secondary and tertiary health services, research and training institutions, and that reveals a distintive feature, which is the interrelation between care services, research and training making it a unique and integral system (Rojo Pérez, Valentti Pérez, Martínez Trujillo, Morales Suárez, Martínez Torres, Fleitas Estéves, Portuondo Sao, M., Torres Rojo and Sierra González, 2018).

Then technological innovation process in health care is argued to be preceded by research of social and economical needs (Pérez Sánchez, Paredes Esponda, León Rodríguez and Pérez de Hoz, 2017).

Its development is based on three dimensions: stakeholders (technological institutions and universities); methological requirements stated by The Ministry of Public Health, which establish: an assessment question, objective, evidence sistematic searching criteria, evidence

analysis and synthesis, results discussion report, dissemination, implementation and appraissal (Toledo Hernández, Portuondo Sao, Morales del Rosario, Norabuena Canal and Mejías Sánchez, 2016); and subsystems in which it is structured. These subsystems are research, development programs and projects, results introduction, integration interfaces, intelectual property and quality of health; the latter has been modeled by a national strategy (Ministerio de Salud Pública, 2016), whose main objectives are:

1. To continuosly improve health service quality by means of legal rules, standards, clinical practice guidelines and therapeutic protocols.
2. To foster health care accreditation, focused on three components: patient safety and care, hospital safety and management, and research and learning (Colectivo de autores, 2016).

The relevance of Health care in Cuba is also revealed by its economic and social importance, as confirmed in The Guidelines for the Economic and Social Policy whereby it is stated the need to foster innovation, quality and human capital training, in order to face health problems, care delivery issues and technological constraints limiting the sector´s proper development (Comité Central del PCC, 2017).

Numerous facts, showed in different references, support the guidelines outlined in the aforementioned Guidelines for the Economic and Social Policy; for example Hernández Betancourt (2015) they state that it is a pressing need to speed up the implementation of quality management systems, which can guarantee and support health care services, providing them with credibility, efficiency, dependability, scientific rigor and safety, thus guaranteeing a continuous and upward increase from the patient´s fulfillment; while Rojo Pérez et al. (2018) they consider as basic challenges to strengthen research competences, to generate more impact published articles and patents, as a way to validate high level scientific results. This indicates that quality, innovation and research are two strategic goals for the Cuban health care system

Nowadays improving the quality of care is gradually relying on the uses of data, information and knowledge to support clinical decisions (Hoffmann, Stichele, Bates, Björklund, Alexander, Andersson, Auraaen, Bennie, Dahl, Eiermann, Hackl, Hammar, Hjemdahl, Koch, Kunnamo, Le Louët, Panagiotis, Rägo, Spedding, Seidling, Demner-Fushman, and Gustafsson., 2020) and even on applying the whole methodology of technology watch (Barreneche, García, Serrano, Brand and Hernández, 2015).

Health care systems around the world have been recommending the use of protocols and Clinical Practice Guidelines to improve decision making and deliver safe and effective care

(Elías Dib, 2009). As a result indicator of quality of service, protocols use in clinical practice have spread around the world (Torres Andrade, Alarcón, Berthet, Cantero, Llanquipichún, Sáez and Yáñez., 2016). They contain directions to diagnosis, prevention and treatment of certain diseases; its design is conditioned by health problem definition and research statement and it is based on the principle of providing scientifc validity to the standardization of clinical and care processes (Artalejo and Ortún Rubio, 1990; Torres Andrade et al., 2016). Clinical Practice Guidelines (CPG) are as well commonly used as quality standardiation instrument in clinical environments; for Hou, Li, He, Wang, Yan, Han, Li, Cao, Zhou, Lu, Jia, Li, Hui and Li (2019) evidence-based guidelines are expected to provide clinicians with explicit recommendations on how to manage health conditions and bridge the gap between research and clinical practice.

On the other hand, Research development and innovation (R&D&i) management is acknowledged to involve planning, directing, controlling and coordinating the development and implementation of R&D&i capabilities in order to shape and accomplish the strategic and operational objectives of organizations (Cetindamar, Phaal and Probert, 2009); hence it includes the management of basic research, applied research, and experimental development (Organisation for Economic Co-operation and Development, 2015); which is methodologically organized and structured into a Project. Research and development and innovation (R&D&i) projects design is increasingly challenging in knowledge-based organizations as it needs to involve many variables: technological, social and economical, culture, laws and policies, knowledge generation frameworks, world trends among others. The coordinated and structured interaction between all these elements is aided by tools like Technology Watch, Competitive Intelligence and Foresight, because they can provide a fundamental basis for capacity and competitive advantages (Aguirre Ramirez, Cataño Rojas and Rojas López, 2013).

According to Gaínza (2006) R&D projects´ main content is associated to links between science technology and innovation priorities and the problem identified, relevant information searching about products or strategic technologies, as well as bibliography analysis for state of art formulation. All those activities are supported by technology watch actions; this statement is similar to that of García Delgado, Delgado Fernández and Infante Abreu (2014) who report several proposals adopting technology watch as a support tool to R&D projects development.

Technology Watch Systems can be defined as compilers of information that are in charge of obtaining and processing all knowledge that might be of interest for an organization (Gaviria Roa, Hernández Martínez and Montiel Ariza, 2019).

Alfonso Sánchez and Ponjuán Dante (2016) refer that an efective use of information allows higher levels of quality in teaching, research, innovation and medical care; this last setting is gradually favoured by information and communication technologies beign used mainly in diagnosis, therapeutics, clinical care, management and epidemiology.

In fact, Technology Watch and related tools like Competitive Intelligence or information and knowledge based techniques, have been comprehensively adopted by different health related issues such as: proving effectiveness and viability of innovations and technological development of new biofarmaceutical products (Guagliano, Tornillo, Pascal, & Massaro, 2017; Vargas, Duque Beltrán, Arévalo Jamaica and Quintero Vargas, 2018) scientific evidence searching and adoption of propper clinical guidelines and protocols aiming to reduce adverse effects or consecuences (van der Veer, Jager, Nache, Richardson, Hegarty, Couchoud, de Keizer and Tomson, 2011) hospital service improvement (Barreneche et al., 2015); and research development and prioritization (Carrillo Zambrano et al., 2018; Luque Clavijo, Sepulveda Carrillo and Cano Urrego, 2011).

The advantages afforded by technology watch to monitor the environment, the information and knowledge adquisition and processing, would certainly favor decision making, and to design improvement strategies in areas which are considered a challenge for the Cuban Health care system such as the increase on the quality and quantity of I&D&I projects; generating and introducing high value research results, which may increase the quality of health services. These two challenges are conditioned by difficulties on the sistematic uses of information and knowledge that supports the scientific innovation, topicality and correspondence among projects and investigation research lines, trends, novel technologies and high value scientific evidence whereas the development of impact innovations (Hernández Nariño, López Álvarez, Castro Hernández, & Ponce de León Narváez, 2019).

Consequently, the outcome of this work is to implement an improvement strategy on research, innovation and quality of health, based on technology watch adoption.

2 Brief theoretical framework

2.1 Research, tecnology and innovation

Research development and innovation (R&D&i) management involves planning, directing, controlling and coordinating the development and implementation of R&D&i capabilities in order to shape and accomplish the strategic and operational objectives of organizations (Cetindamar et al., 2009). According to the Frascati manual, R&D&i

management includes the management of basic research, applied research, and experimental development (Organisation for Economic Co-operation and Development, 2015).

According to Arciénaga Morales, Nielsen, Bacarini, Martinelli, Kofuji and García Díaz (2018) technology and innovation management comprehends a logical or heuristic sequence of the decision-making process: gathering of information; prospective, technology surveillance, and competitive intelligence; evaluating and devising strategic solution based on problems and opportunities; executing concrete actions to obtain such solutions such as new product development, R&D management, commercialization (including introduction of new products), intellectual property protection, technology-based entrepreneurship, input management, knowledge management, project, internal process and product management, and technological innovation; and financing all the above activities.

Cerezo Narváez, García Jurado, González Cruz, Pastor Fernández, Otero Mateo and Ballesteros Pérez (2019), based on literature review, stated that R&D&i, in any of its conceptions, has a positive effect on the performance of organizations, and this idea is supported by the following arguments extrated from authors statements: innovation is one of the key factors for companies long-term success; the development of technological innovations favours the introduction of improvements in the organizational management context, and also quicker knowledge, learning and exchange; companies with the ability to innovate face and resolve challenges and conflicts quicker than non-innovative ones.

Mardani, Nikoosokhan, Moradi and Doustar (2018) summarize the view of several researchers about the relation between organizational innovation and knowledge. Pespectives analysed arouse the following concept: innovation is the combination of a firm's existing knowledge assets to create new knowledge, then, the primary task of the innovating firm is to reconfigure existing knowledge assets and resources, and to examine new knowledge; empirical case study evidence shows mixed results whereby on one hand it is confirmed the positive role of knowledge dissemination on innovation success, while on the other it is not found any significant effect; different types of innovation are affected by Knowledge Management (KM), as they require different resources and hence a differentiated KM strategy. Authors conclude that effective KM as presented in the literature, is a method for improving innovation and performance. Based on the summary of Arciénaga Morales et al. (2018), R&D, KM and strategy approach are commonly included by authors in innovation management.

As for technology and KM it is assumed a strong relation when considered that technology has been defined as a compendium of knowledge and information generated in a

specific domain, and sistematically used for products and services design, production and marketing; it also includes the proper application of managerial techniques (Delgado Fernández, 2013).

As organizations need more new ideas for adopting technologies, accessing new markets, and implementing business models, so they put pressure on their Research and Development (R&D) departments (among others) to initiate and implement projects to fulfill these demands (Vicente Oliva, Martínez Sánchez and Berges-Muro, 2015).

According to Gaínza (2006) R&D projects´ main content is associated to links between science technology and innovation priorities and the problem identified, relevant information searching about products or strategic technologies, as well as bibliography analysis for state of art description.

In health care, a project is recognized as a particularly useful way to introduce innovations, address new challenges or find solutions for problems that the existing procedures and routines do not accommodate. Different types of health projects can be distinguished: research projects, which aim to increase knowledge than can serve as a basis to make "evidence based" decisions; development projects, which involve the development and pre-testing of an intervention to address a particular problem in a particular population or target group; implementation projects, which are concerned with the dissemination and implementation of an existing intervention in a particular target group or population (Santos, Santos, Tavares and Varajão, 2014).

Particularly knowledge, as stated by Bucheli et al and Cantin et al reffered by Back, Kovaleski, and Andrade Junior (2015), is the main engine of growth, then it is necessary to follow the technological advance that happens at high speed and consequently generates a great amount of information. In this sense Technology Watch is considered an important tool for information management.

2.2 Technology watch and associated topics

Technology watch is a very relevant topic, given the increasing importance of knowledge in today's economic environment since it responds to systemic changes, temporary competitive advantage, faster decision-making, products and services with lower lifecycles and new forms to compete and interact between actors in the world (Acosta Prado, Mojica Sastoque, Linares Salazar and Ortegon Torres, 2015).

Jürgens (2017) defined it as a methodology for organisations to systematically analyze technical information in a continuous way in order to gain insight and competitive advantage in a specific technical domain. This definition is not far different from the concept exposed by UNE 166006:2011 (AENOR, 2011).

Many terms have been related to TW:

- Strategic watch: information based process by which the company collect, process and share information in order to reduce future threaths and take advantage of ongoing opportunities. It considers three dimensions (concurrent, comercial and technological watch) to impact on innovation capability (Hourenatou and Zangai Ranbo, 2020).
- Competitive intelligence (foresight and monitoring of data, information and knowledge, as well as filtering, interpretation and value generation for decision making and competitiveness (Pomim Valentim, Ferreira Lenzi, Nogueira Cervamtes, Leão de Carvalho, Dominguez Garcia, Catarino and Tomaél, 2003). Giacomin Menezes and Fernandes De Muylder (2020) design an analysis model that proposes competitive intelligence´s contribution to organizational innovation and performance**.**

Technology Watch is being considered and increasingly used as a tool or the first step into adopting competitive intelligence (Medina Nogueira, 2016); in fact, authors combined both terms: technology watch and strategic intelligence (Palop and Vicente, 1999).

Back et al. (2015) referred that TW of environment favours scientific and technological information management since this process emphasizes on planning, direction, control and coordination of the development and implementation of information system.

To reinforce this idea, we asume the statement of Castiglioni and Adam (2018) around how important is the strategic management of scientific and technological information to innovate and survive in the actual complex and changing environment, what makes TW an essential tool to detect opportunities of technological innovation and new ideas to facilitate improvements in processes, products and services in organizations.

Zárraga-Rodríguez and Álvarez (2016) analyses 25 practices around the use and management of information. One of the studied perspectives was the information management and authors related it to competitive and technology surveillance; systematic information gathering from the environment and the inner workings; ensuring availability of information for stakeholders as needed; data transformation into useful information that can be used for

decision making; having updated databases so as to ensure that people are using the best information available; distribution and exchange of information and the scope covered.

2.3 Quality management. Relations with research and knowledge and general issues for health care

Trying to denote the pecualiarities of quality improvements projects and research, Kumar, Nesbitt and Bakkum-Gamez (2019) refer that while research generates new, generalizable knowledge, quality improvement in healthcare is the translation of existing knowledge, generated initially by research, into clinical practice with the goal of improving the quality of health care in specific populations.

Zárraga-Rodríguez and Álvarez (2016) acknowledge Total Quality Management (TQM) as information-intensive management model, thus a company with a TQM model should manage and use information effectively and with excellence.

As stated by Kim, Gaukler and Lee (2016) healthcare quality is a major driver of innovation, growth, and competitiveness. Healthcare quality and its relevant associated businesses, particularly from a managerial perspective, are a key source of business dynamism, innovation, and improvements in the social ecosystem. Through relevant studies the authors examine the relations between quality of care, knowledge and innovation.

Well defined protocols following standard operating procedures and continually trained staff are the internal measures to control quality, and they are considered as frequent tools to continually improve the effectiveness of quality management system (Aggarwal, Aeran and Rathee, 2019).

Protocols in clinical practice being considered as a result indicator (Torres Andrade et al., 2016); they are the result of a health problem definition and research statement and are based on the principle of providing scientific validity to the standardization of clinical and care processes (Artalejo and Ortún Rubio, 1990; Torres Andrade et al., 2016).

Chan, Tetzlaff, Altman, Laupacis, Gøtzsche, Krle a-Jerić, Hrobjartsson, Mann, Dickersin, Berlin, Dore, Parulekar, Summerskill, Groves, Schulz, Sox, Rockhold, Rennie and Moher (2015) add that evidence based recommendations are key to protocols formulation and therefore they suggest to accomplish thoroughly research studies on benefits and adverse events (published and unpublished) in antecedent phase. Then, with no doubt, research, development, innovation and quality management are useful managerial tools for healthcare improvement, with common bases on information management and knowledge.

3 Methodology

A non experimental study was structured that covers three phases which are shown as follows:

Phase I Prospective study

There were key elements identified to local Research, Technology and Innovation (RTI) in health sector based on:

1) Relevant bibliography analysis that covers the following sequence:

- Search strategy setting: combination of terms "innovation", "technological innovation", "scientific research", "innovation", "quality" or "quality management", "innovation system", "health" and "Cuba"; sources and data bases listing (Google Scholar, Scielo and Science Direct); definition of three search criteria, that is i) title, abstract and keywords, ii) research or original publications, Master and PHD tesis, iii) a five year time frame (2014- 2019).
- Information collecting and filtering: information search was carried out and documents were exported to Endnote. Information gathered was analysed according to duplicates finding and elimination of papers not related to the research área; the latter was aided by an examination of title and abstract
- Literature review. After selecting the texts, there were identified relevant and most frequent variables associated to science and innovation systems, particularly in health care sector.

2) Definition of relevant variables to Research Technology and Innovation development in local health sector whereby there were firstly listed all possible factors that describe RTI with the aid of documents and working reports examination, brainstorming sessions with science and technological innovation specialists and a structured interview to a 20 years experienced director in science and innovation in medical sciences; secondly it was organized a prospective workshop with specialists from Science, Technology and Environment Office, medical university, and health care institutions, and attendants selected the most important topics and were asked to optionally propose additional themes not previously considered. Finally, experts analyzed the direct influence among variables and that information was processed with the aid of MICMAC software, that produced the key variables as the most influencing and dependent (Acosta Valera, 2018).

Phase II Variables appraissal and improvement strategy

Those key variables´ behaviour were assessed based on: reports reviews, science and technology indicators analysis and trends, and an online questionaire sent to four specialists in charge of training and learning activities as well as three scientific board presidents from the most important healthcare institutions located in the city. The online questionaire consisted on six questions that investigated: if research projects are sistematically evaluated; what issues are considered when the project is evaluated; if the hospital update protocols and CPGs; what is the frequency of evaluation of protocols and CPGs; if scientific information from prestigious data bases is used for projects and protocols; and finally what are the most frequent problems affecting protocols and CPGs´ design.

The main flaws and limitations to strategic sucess of the RTI system came up from this analysis. This was the starting point to establish the improvement strategy, supported by external and internal information and knowledge management actions.

Phase III Improvement strategy implementation

To implement the actions, it was adopted the UNE 166006:2011 approach for technology watch development (AENOR, 2011):

Information needs definition: there was a questionaire designed (as shown in table 1) aiming to identify informational needs according to two interest groups: academic and healthcare professionals and researchers working in R&D&i projects.

Table 1 – Questionaire for informational needs

Interest group	Information requested
Academic and Healthcare professionals	**Mention three key health problems and research topics you consider relevant**: **Which information would be useful for research** Research and innovation projects: trends and up-to-date projects, research groups _____ High value scientifc results Scientific journals: highlited publications, journal metrics, submission guidelines Scientific production: bibliometric analysis, university rankings; impact metrics ____ PHD thesis: health care research in Cuba, current progress in PHD research in university_____ Innovation: technological development; health care technologies; educational innovations in medicine_____ Intellectual property: world and Cuba patents in health and biomedical research; progress in intelectual property rights _____ Quality strategy: state of scientific evidence, protocols development ___ Other topics _____ **¿Which would be the most apropriate distribution source(s) of a RTI bulletin or other scientific information products?** ___email ___ University webpage____Local Infomed web __work meetings __ Posters ___ Other:
Researchers in R&D&i projects	Information requested: Key words Brief search description Output format Time frame of scientific information

Source: Authors.

Technology watch scheme that consists of devising, according to informational needs analysis, the relevant topics to monitor, key factors to watch; information sources and products to generate; and a chekclist designed so as to implement quality audits focused on identification of critical areas, scientific information searching to support clinical service protocolization and clinical guidelines formulation.

Information seeking, adquiring and processing that comprehends:

a) The evaluation of appropriate search routes and selection of specialized information services according to complexity and nature of the topic to seek;
b) Documents search, recovery and selection for analysis: there were defined the search and criteria strategy, the last consisting of the terms allocated in title, abstract and keywords, range of year; and there were selected relevant documents according to Negri Pagani, Kovaleski, & Martins de Resende (2018) approach as follows: for each document was determined a) impact factor according to Scopus CiteScore

metric; and number of citations based on Google Scholar). InOrdinatio index calculation, based on the expression (1)

$$(1)\ InOrdinatio = \left(\frac{IF}{1000}\right) + (\alpha * (10 - (Researchyear - PublishYear))) + Ci$$

IF stands for impact factor, α represents a weighting factor ranging from 1 to 10 and it is assigned by the researcher, "Research Year" is the period of study, "Publish Year" refers to the year the article was published and Ci the number of citations to the document.

b) documents ranking according to InOrdinatio index, the most relevant would have the higher InOrdinatio index.

c) Bibliometric studies that were supported by number of documents produced, articles per year, and co-word analysis.

Information and knowledge sharing: according to preceding actions it was devised a Research Technology and Innovation Bulletin and other information products according to informational needs suggested by users.

4 Results

4.1 Prospective study

Each stage of phase I was relevant to identify determinant variables to prospective development of health RTI system (Table 2).

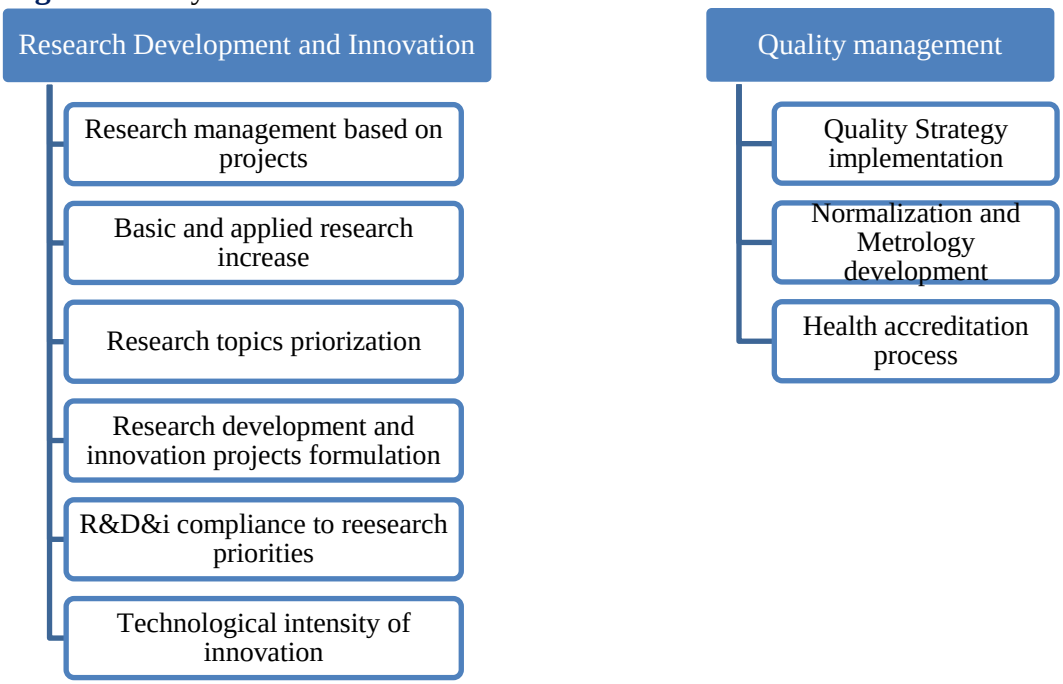
Table 2 – Key variables analysis in Health Research Innovation and Technology system

Phase I	Results
Bibliographic review, Documents and working reports analysis	Review of 24 research articles, six PHD thesis, 15 Master thesis, evaluation and accreditation manuals, Ministry of Public Health´s policy and strategy, and Research Technology and Innovation reports from years 2013 up to 2018; 56 related variables were primarily extracted
Brainstorming	After eliminating duplicates and variables not directly related to the study, 27 variables were proposed by specialists; nineteen of them were very similar to those extracted from bibliography and reports examination
Structured interview	The information provided by the interviewed matched with the variables already selected; they besides proposed the addition of nine topics
Prospective workshop	In general 35 variables were evaluated and proposed by workshop attendants as important issues in RTI in local health system
Experts and MICMAC analysis	Ten variables, out of previous 35, were considered as key ones

Source: Authors.

Figure 1 shows ten key variables for RTI prospective development, grouped in two general themes: Rersearch, development and innovatin and quality management.

Figure 1 – Key variables selected



Source: Authors.

3.2 Variables evaluation and definition of improvement strategy

Table 3 shows the gap between total number of R&D projects and Innovation based projects in a period of four years

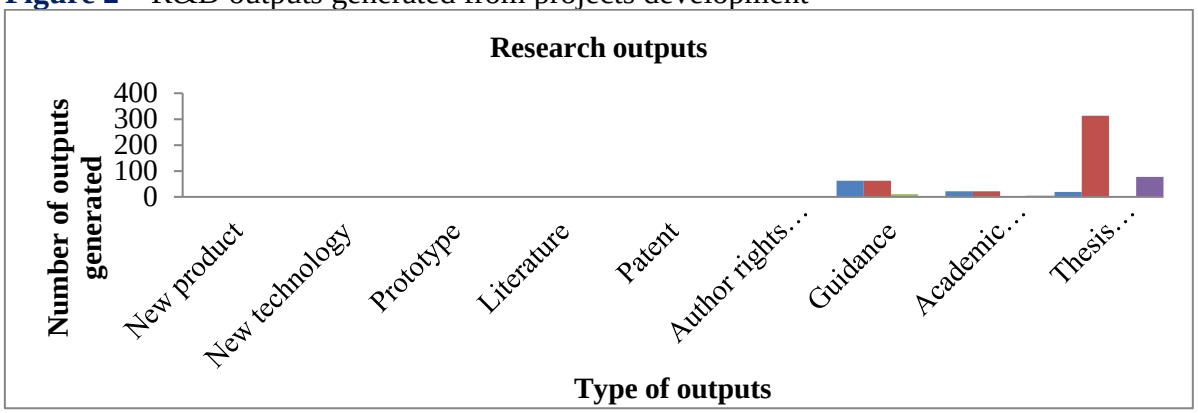
Table 3 – Innovation projects versus total number of projects

Project category/year	2015	2016	2017	2018
Total number of projects	113	112	91	113
Total number of Innovation projects	48	68	53	2

Source: Research data.

There is a clear predominance of research over innovation projects whose number abruptly decreased in 2018. Additionaly the outputs of research in similar timeframe were examined (Figure 2).

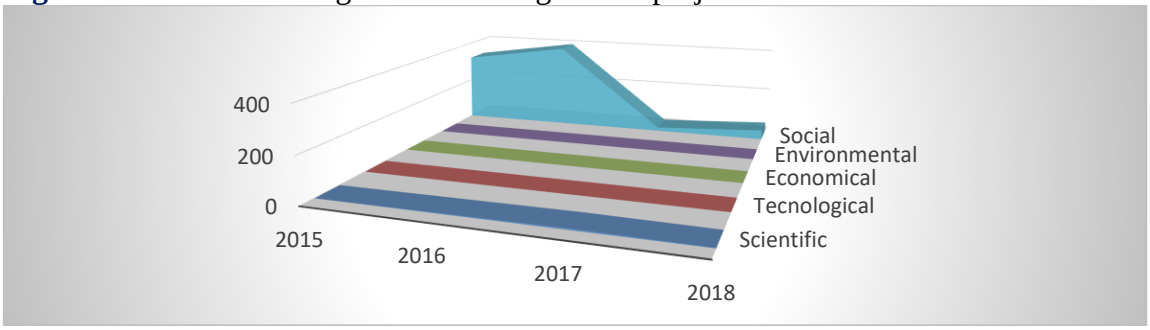
Figure 2 – R&D outputs generated from projects development



Source: Research data.

The main outpouts reported were asociated to academic materials and guidance as well as specialty thesis. As for the main benefits generated during these years, figure 3 shows that social based benefits are predominant though they decreased in 2017-2018.

Figure 3 – Main benefits generated through R&D projects



Source: Research data.

Projects analysis from table 3, figures 2 and 3 show gradual low value´s results being generated from research and development with low focus on technology and innovative based outputs.

A review of protocols and clinical practice guidelines in five hospitals of the province revealed on one hand that services not using protocols or clinical guidelines still remain and, on the other hand there are design limitations in existing ones (Table 4).

Table 4 – Protocols and CPGs evaluation in the province´hospitals

Institution	Protocolled Services (representing percentage out of total services)	Total number of protocols	Protocols and CPGs with appropriate design	Protocols and CPGs with design limitations
Hospital I	47	136	103	33
Hospital II	63	40	0	40
Hospital III	100	116	14	102
Hospital IV	100	43	43	0
Hospital V	100	135	0	135

Source: Research data.

Use of protocols and CPG is yet to become a solid instrument for quality of care, as shown in table 4, considering that there still are services with low presence and systematic use and updating of these tools.

The electronic questionaire confirmed the problems revealed above as follows:

- Projects: the main causes for projects rejection are problem setting and scientific contribution, reference update, alignment to research priorities.
- Protocols: most frequent failures are associated to design, research methodology used (lack of skills to problem, objectives, scientific evidence referenced).

The three most frequent non conformities revealed by interviews to specialists and internal audits reports pointed out to: 1) protocols not structured in the standard format, 2) non existence of adherence guide nor evaluation scale and 3) lack of upgrading.

In summary, the former diagnosis pointed out limitations in R&D&i projects design and impacts, quality of service delivery and hospital performance due to difficulties in projects, protocols and CPGs design and implementation. These limitations are mainly relying on non existing mechanisms to systematically analyze evidence, research and technological trends, to process relevant scientific information either from comprehensive and updated literature review as from other sources of information like patents, and afterward generate valuable knowledge that help producing better and innovative results and valid recommendations to improve clinical care.

Therefore the improvement strategy formulated was the adoption of knowledge and information based actions to foster research, innovation and quality, consisting of: a) monitoring and information search system supported by information needs evaluation; b) Information and knowledge based actions: research priorities definition as a way to asign strategic resources to projects that prove to have potential to solve main health problems;

managing projects design and implementation based on information and knowledge study; investigating research fields and scientific evidence on quality of health care services protocols and clinical practice guidelines; Creation and sistematic use of information based products for knowledge sharing to health managers, professionals, researchers and teachers.

3.3 Improvement strategy implementation

3.3.1 Main information needs and monitoring system

Considering that trends, scientific production analysis, journals, research, technology and patents in biomedical research and protocols and CPG up-to-date were the most frequent type of information revealed by academic and healthcare professionals, the table 5 summarizes the scheme adopted for technology watch.

Table 5 – Scheme for technology watch

Topic	Relevant issues to monitor	Key variables to watch	Information sources	Information product
Research development and innovation	Trends in health research Health and care system problems	Research priorities	Internal sources: Specialists Researchers and professors External sources: SciELO: http://scielo.sld.cu. Scholar google: https://scholar.google.es ScienceDirect: http://www.sciencedirect.com Matanzas Annual Health Report	Science and Innovation bulletin Bibliometric analysis
	Biomedical research projects	Scientifc domains: Main authors, prublications produced, journals Pre-Clinic research and Clinical trials	Internal sources: Information center External sources: SciELO: http://scielo.sld.cu. Google Académico: https://scholar.google.es Socbio: http://www.socbio.sld.cu Cmhw: http://www.cmhw.cu ScienceDirect: http://www.sciencedirect.com Specialized Information center for technology management	CD compilation Bibliometric analysis
	Innovation and patents	Technological and health products	Specialized Information center for technology management	RSI bulletin CD compilation
Quality	Protocols and clinical practical guidelines	Documents upgrade level Clinical practice guidelines and protocols adherence News and trends Scientific evidence	Internal sources: Internal audits in health care units External sources ScienceDirect: http://www.sciencedirect.com Pubmed: https://ncbi.nlm.nih.gov/pmc/	RSI bulletin Technological alerts Bibliometric analysis

Source: Authors.

A checklist was designed to support quality audits to protocols and clinical guidelines documentation based on organizational, methodological and scientific evidence issues (Table 6).

Table 6 – Checklist designed for quality audits on protocols and guidelines

Documentation item to review	Yes	No
Are there sufficient protocols and clinical guidelines to support quality improvement in hospital services?		
The procedures and protocols accomplished the established requirements (format, adherence guideline and evaluation scale)		
Is the scientific evidence and information available?		
Is an explicit notification on changes, upgrading and documents revision registered?		
Are external documents under control?		
Is a valid copy of all legal documents preserved?		
Are Information search and monitoring methods used?		
Is there access to legal documents?		

Source: Authors.

3.3.2 Information and knowledge based actions

The information adquisition and processing supported the following improvement actions:

- Research priorities setting

Trends and health care problems analysis resulted in the establishment of priorities for research technology and innovation in the province. Out of 353 documents were downloaded; the revealed topics were health administration (166 papers); Maternal and child health (55); Epidemiology and social detarminants (53); Innovation, Informatics and health quality (18); Cancer (17); Knowledge management, Human Capital Training (17); Primary Care (13); Natural and traditional medicine, Farmacology (13); Biomedical research (11); Aging (6); Integrative, translational and precision medicine (4). The first 11 subjects were very similar to the province main health problems; as for the latter in spite of being apparently recent is aknowledged as a growing scientific field. This implied the addition of new research therm considering university´s capabilities (technological and knowledge-based) to conduct research development and innovation projects in this area.

Consequently the research priorities set were as follows: a) Maternal and child health; b) Epidemiology and communicable diseases; c) Mortality and non communicable diseases; d) Aging; e) Psycosocial research; f) Biomedical research and Natural and Traditional medicine; g) Health administration, efficiency quality and innovation for health services; h) Technology information applications for health and training; i) Training and development; j) Integrative medicine.

- Projects design and implementation based on information and knowledge study

Table 7 shows the activities adopted to support and add value to projects design and implementation with the aid of information and knowledge analysis.

Table 7 – Information and knowledge based activities to support projects design and implementation

Project codification/research priority covered	Life cycle stage of project	Activities
I122MT929/Biomedical research	Implementation	Evaluation of the most relevant journals and authors and hence appropriate scientifc information sources and collaboration strategies
P122MT967/Biomedical research	Design	Bibliographic review on the theme. Useful to devise a comprehensive state of the art and support research problem statement. Analysis of most relevant journals authors and approriate scientific information sources
P122MT995/Integrative medicine	Design	Bibliographic and patent review on the theme. Identification of trends, patent analysis and main technological fields
I122MT993/Quality and innovation for health services	Implementation	Intellectual property study; feasibility appraisal to evaluate possible patent strategy for product under design and technology assessment
I122MT1035/ Quality and innovation for health services	Design	Technology assessment and analysis to support the design of the innovation project

Source: Authors.

- Investigating research fields and scientific evidence on quality of health care services protocols and clinical practice guidelines

Figure 4 shows the results of the theme search in scopus, in terms of articles published per year associated to the topics: Quality and protocol and health (figure 4a); health care quality and clinical practice or clinical guideline or clinical pathway (figure 4b); health care quality and scientific evidence or evidence based or evidence based medicine or evidence based practice or knowledge based practice (figure 4c).

Figure 4 -Theme search in Scopus for quality terms

Total number of documents: 35 917

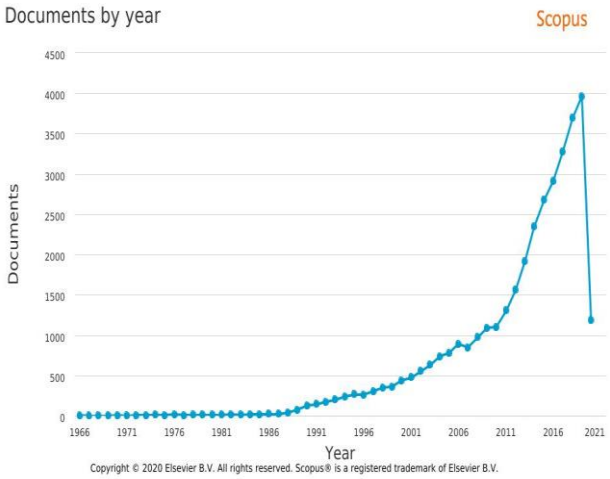


Figure 4a

Total number of documents: 6123

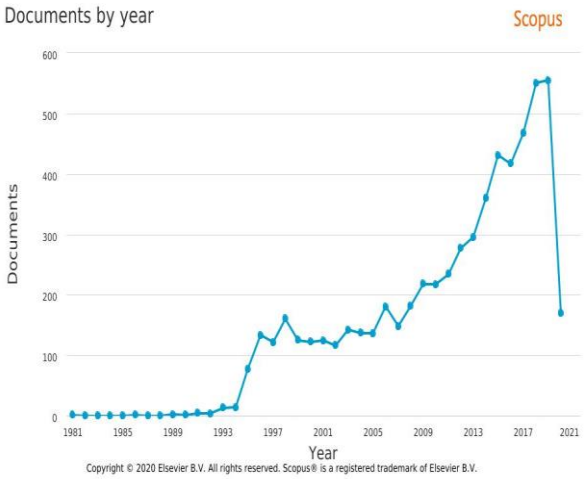


Figure 4b

Total number of documents: 2 193

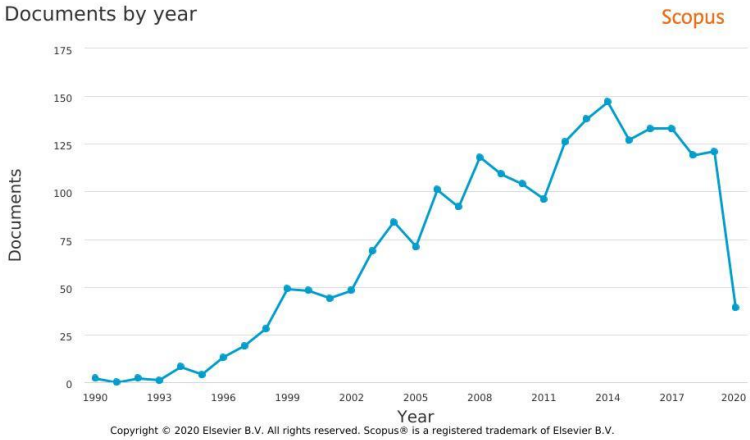


Figure 4c

Source: Research data.

This figure shows how research production have increased with similar tendency for all the topics, in the last 20 years; and also coincidentaly, from 2016 and on, almost all themes (except the third with low numbers in the last two years) reached the highest numbers, which could be an indication of relevance and level of update on the subject. Then there were explored number of documents in other databases in the last five years which is shown in table 8.

Table 8 - Results of general search strategy on other databases

Topics	Springer	Emerald	Taylor and Francis	Elsevier	Pubmed
Quality and protocol and health	189522	2000	33945	58541	90
health care quality and clinical practice or clinical guideline or clinical pathway	191728	6000	6792	58 659	634
health care quality and scientific evidence or evidence based or evidence based medicine or evidence based practice or knowledge based practice	69 098	8000	160527	26639	370

Source: Research data.

These imply that there is a considerable amount of papers around the topic. Nonetheless, Springer and Elsevier turn out to be the most recommended databases when studying the first two search strategies; while Taylor and Francis and Springer are valuable suggestions for looking up on the third search strategy.

After recovering 300 documents, 128 documents were obtained when eliminating duplicates; the examination of abstracts resulted in further elimination of ninety papers not directly related to the topic. Then the analysis focused on 60 articles.

With the aplication of InOrdinatio, 27 documents were finally selected. Weighting was done according to recency of papers, then 10 points were assigned to papers published in the last 5 years; publications from prior periods down to a 10 years time frame were weighted on 9 and prior to 10 years time frame papers received 8 points (Table 9).

Table 9 – Documents selection according to InOrdinatio index (continued)

Selected articles	Journal	Publication year	InOrdinatio
Progress in evidence-based medicine: a quarter century on	The Lancet	2017	326
Transforming evidence generation to support health and health care decisions	New England Journal of Medicine	2016	184
Modern clinical research: How rapid learning health care and cohort multiple randomised clinical trials complement traditional evidence based medicine.	Acta Oncologica	2015	149
Effect of Published Scientific Evidence on Glycemic Control in Adult Intensive Care Units	JAMA Intern Med	2015	146
Nursing perception of patient safety culture	Ciencia y Enfermería	2013	131
Translating knowledge on best practice into improving quality of RRT care: a systematic review of implementation strategies.	Kidney International	2011	111
Developing a framework to guide the de-adoption of low-value clinical practices in acute care medicine: a study protocol.	BMC Health Serv Res	2017	109
Safety and quality of maternal and neonatal pathway: A pilot study on the childbirth checklist in 9 Italian hospitals	Procedia Manufacturing	2015	108

(conclusion)

Selective Dissemination of Clinical Guidelines in Healthcare Communities	IEEE International Conference on Industrial Engineering Management	2015	102
Quality and compliance with Clinical Practice Guidelines of Chronic Noncommunicable Diseases in primary care.	Salud pública de México	2017	101
Protocol: Using N-of-1 tests to identify responders to melatonin for sleep disturbance in Parkinson's disease	Contemporary Clinical Trials Communications	2019	101
Management protocols for chronic heart failure in India	Indian Heart Journal	2018	101
Standardizing hypertension management in a primary care setting in India through a protocol based model	Indian Heart Journal	2019	101
Evidence-based practice: beliefs, attitudes, knowledge, and skills among Colombian physical therapists	Colombia Médica	2015	98
Assessment of evidence and quality of clinical practice guidelines on deterioration of skin integrity: ulcers and chronic wounds	An. Sist. Sanit. Navar.	2016	94
A Scoping Review to Map Empirical Evidence Regarding Key Domains and Questions in the Clinical Pathway of Delirium in Palliative Care	Journal of pain and symptom management	2019	93
An ontology-based approach to patient follow-up assessment for continuous and personalized chronic disease management	Journal of Biomedical Informatics	2017	93
Evidence-based medicine: A data-driven approach to lean healthcare operations	International Journal of Healthcare Management	2019	92
Hospital-based intervention to reduce tPA administration time	Interdisciplinary Neurosurgery	2019	91
Efficacy of a transdiagnostic, video-based online program for reducing depression, anxiety, and suicidal ideation in adults: Protocol for a randomised controlled trial	Contemporary Clinical Trials Communications	2019	90
Non-randomized comparative study on the efficacy of a trauma protocol in the emergency department	Chinese Journal of Traumatology	2019	90
Use of scientific evidence by dentists in Brazil: Room for improving the evidence-based practice.	PLoS ONE	2018	86
Sustained Reduction and Prevention of Neonatal and Pediatric Central Line-Associated Bloodstream Infection Following a Nurse-Driven Quality Improvement Initiative in a Pediatric Facility	Journal of the Association for Vascular Access	2018	85
Implementing Trauma-Informed Care in Primary Medical Settings: Evidence-Based Rationale and Approaches	Journal of Aggression, Maltreatment & Trauma	2019	84
Quality assessment of clinical practice guidelines of the Chilean explicit guarantees in healthcare program	Rev Med Chile	2016	84
Enhancing behavioral treatment for women with pelvic floor disorders: Study protocol for a pilot randomized controlled trial	Contemporary Clinical Trials Communications	2020	80
Effects of evidence-based clinical practice guidelines in cardiovascular health care quality improvements	F1000Research	2019	71

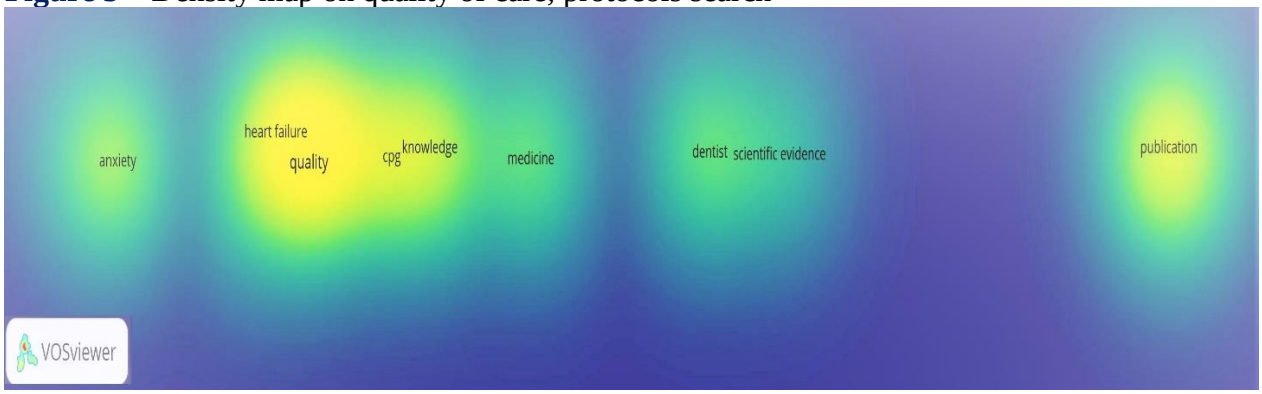
Source: Research data.

These documents selected were submitted to co-word analysis to denote clinical and care services studied and subjects examined, thus providing scientific information, which can be useful to clinical practitioners, researchers and decision makers.

The main services under analysis in those publications are: Palliative Care; RRT care; non comunicable chronic diseases (cardiovascular; chronic heart failure; personalized chronic disease management; hypertension management); Glycemic Control in Adult Intensive Care Unit; Trauma-Informed Care; dentistry; physical therapy; Neonatal and Pediatric Central Line-Associated Bloodstream Infection; pelvic floor disorders; maternal and neonatal; Parkinson's disease; tPA; depression, anxiety, and suicidal. In an overall examination it is denoted the similarities among these services and the established research priorities for health science and innovation

According to co-ocurrence of keywords, based on title and abstract, it is shown in figure 5 the strongest links among quality, clinical practice guidelines (CPG), medicine and knowledge on one hand, and scientific evidence and publications on the other. That confirms how important is the issue of knowledge and scientific evidence for CPG and protocols, and at the same time how strongly related they are to quality of care.

Figure 5 – Density map on quality of care, protocols search



Source: Research data.

All of the above shows the role of scientific information and knowledge on the quality of medical services. Some outlined articles on formulation and assessment of CPG within areas of general medicine, odontology and anxiety studies.

- Information and knowledge sharing

To share information and knowlegde through organization bulletins and other information products were designed. The RTI bulletin had the following features: frequency of distribution (Quaterly); format (Digital and Print); distribution channel (email, institutional

webpage scientific fórums); content (sections were designed according to priorities and information needs previously established); target users (researchers, managers, students, health professionals).

Other information products created were: CD compilations of relevant articles and patents; and bibliometric studies based reports. In this case they were handed in to individual researchers or research groups.

Discussion

From table 2 there is a decreasing in innovation projects in disregard to research projects increase

The trend of impacts generated shows no better, and is consequently linked to projects development; there is a predominant number of social impacts while scientific impacts undergone a peak in 2015-2016 due to PhD tesis being presented, but afterwards it declined again.

When aligment between innovation projects and outputs generated is evaluated, it is evident that a substantial number of scientific results are not transfered into practice as they are no converted into innovations on processes, products or organizational methods. As for protocols it is interesting to note that in spite of being annually reviewed, there still exists a lack of consolidate design and the frequent use of scientific evidence and information in protocols and practice guidelines formulation.

When matching the activities involved in research priority setting, projects design and monitoring and scientific evaluation of quality of care, CPG and protocols, with the concept of TW systems as compilers of information that help to obtain and process all knowledge that might be of interest for an organization; it can be clearly denoted how useful this tool can be to boost strategic development of science innovation and quality of services.

The results obtained by Luque Clavijo et al. (2011) support this statement. Applying TW in SENA, was a determining factor to identify guidelines related to health care and provided cuantitative information about technology for four drills: Nursing, Public Health care, pharmaceutical services and Health care management. It is interesting to notice that quality - related topics are emerging as key sub topics in the four studied knowledge areas; and among them: identifying the pressing need for suitable information supply about natural products to improve the quality of life in patients.

Figure 4 supports the idea that, on one hand quality improvement and standardization of care services is a growing topic in scientific literature and therefore there exists a huge amount of information and knowledge to consider as published evidence for protocols and CPG design and assessment; on the other hand it reveals that along with medicine and nursing being natural perspectives of analysis in this regard, there are other sciences also involved, which provides a multidisciplinarity nature management and improvement decisions on quality of health care.

Then it is clearly acknowledged how important is information acquisition, processing and sharing to foster research and innovation process as well as therapeutic and clinical practices standardization. In this sense there could be shown some literature documents proving this statement:

On one hand Guagliano et al. (2015) work focused on developing a model of TW for the design of market strategies and innovation based on the VTeIE in a cluster of medical technologies. This model promotes the collective and multidisciplinary I&D&i, integrating hospitals, universities and institutions, within the science and technology system in Argentina.

There is no doubt universities are the leading components in the foield of TW as supporters in the science, tecnhnology and innovation management and medicine schools are not far apart from this role as in the research of Argote Cusi (2020) where TW was a key factor to value technological capacities which could favor the creation of products database and/or services with commercial and/or patentability potential.

On the other hand, in the work of Achan, Wanzira, Mpimbaza, Tumwine, Namasopo, Nambuya, Serwanga and Nantanda (2020) the surveillance system adopted enhanced the compilation of data and analysis of trends in a timely manner and promoted regular feedback to health workers and the administration. The authors pointed out the use of audits based on available data, supporting organizational planning, changing in practices and considered it an efective instrument in improving professional practice.

Then the audit checklist designed in this article aims to identify areas of improvement concerning the use of protocols and clinical practice guidelines as useful tools for quality of care services. It is important to note that the focus of this analysis is on three dimensions: level of utilization of such tools for quality improvement; use of scientific information, evidence and knowledge for devising and updating; and quality of its design.

The use and flow of information and knowledge have been similarly analysed in two approaches for information and knowledge audit (González Guitián, de Zayas Pérez, and

Martínez Ríos, 2016) and kowledge management audit (Medina Nogueira, YE, Nogueira Rivera, Medina León, Medina Nogueira, El Assafiri Ojeda and Castillo Zúñiga., 2017). The study of González Guitian and Martínez Ríos (2016) pointed out important directions for strategic planning, training programs development, and specific guidelines for process improvement and quality system implementation in a research center. Meanwhile, the proposal of Medina Nogueira, YE et al. (2017) may contribute to the efficiency and effectiveness of the organization's objectives, based on knowledge management and continuous improvement, so as to ensure the establishment of good practices, as well as the acquisition and conservation of the knowledge; so the audit should respond to questions related to: necessary knowledge to acquire in the process, knowledge organization and dissemination and use.

As for the quality of its design this is just a first approach into adopting very common practices in protocols and CPG appraisal, such as the AGREE (Appraisal of Guidelines, Research and Evaluation) tool, which is widely used to evaluate the quality standard, methodological rigour and transparency of guideline development of CPGs in six quality-related domains: scope and purpose, stakeholder involvement, rigor of development, clarity and presentation, applicability, and editorial independence (Chua, Ming, Chang, Santos, Mistry, Silangcruz, Bayley and Koyle 2018; Hou et al., 2019; Shallwani, King, Thomas, Thevenot, De Angelis, Aburub and Brosseau 2019; Yang, Zhang, Tan, Zhang and Zhang, 2019).

The authors discussions and conclussions converged into two interesting issues for this investigation, as they place particular emphasis on: rigor of CPGs as a limitation to improve, considering that it focuses on the methodological process of literature review, evidence gathering and appraisal and recommendations formulation depending on the best available evidence (Chua et al., 2018; Hou et al., 2019); and sistematic review, and sharing of CPGs´ evidence and information may help health professionals to access to well-developed and appropriate materials for knowledge interpretation (Shallwani et al., 2019) and to identify gaps that can be improved (Yang et al., 2019).

In fact it is well recognized in literature the relevance of available scientific information and evidence consideration when formulating or evaluating the efficiency of a CPG (Niven, Rubenfeld, Kramer and Stelfox, 2015; Ramírez-Morera, Tristan and Vazquez, 2019) or supporting health care decisions (Califf, Robb, Bindman, Briggs, Collins, Conway, Coster, Cunningham, De Lew and DeSalvo, 2016); but then the dissemination of CPG for health professionals via the use of communication technologies is also a study under examination (De

Angelis, Davies, King, McEwan, Cavallo, Loew, Wells and Brosseau., 2016; Puustjärvi and Puustjärvi, 2015).

Then it could be said that there are relevant links among quality, knowledge, research as it is shown in density map from co-ocurrence analysis (figure 5) according to a sample of the published articles with highest impact.

The authors assume as limitations that the study might not have applied the audit checklist to empirically confirm its validity, compare its results with the scientific study and literature review. Secondly is not evaluating the impact of this improvement strategy on research results, quality management and decission making and the third lies on the combination of tools used. These, at the same time are future research directions.

Final considerations

Science and innovation management in health sector faces important challenges that have become priorities nowaday, those being: generation of high impact scientific and technological results that may turn into innovations, as well as the development of a strategy of quality that lies on key goals like those promoting continuous improvement and developing protocols and clinical practice guidelines.

For instance quality management and research and development variables turn out to be the selected key factors for prospective and strategic sucess of local health science and innovation system. The evaluation revealed improvement opportunities related to find, process and use scientific information to identify relevant research, global and regional trends, emergent health technologies and updated evidence that aim to produce R&D &i projects and protocols to boost quality of service.

The adoption of TW tools allowed the design of improvements into processes of R& D projects and quality of care management, and it is based on using and sharing scientific information and knowledge which would eventually provide higher value to research and innovation results as well as scientific evidence to clinical practices and protocols establishment in care services.

There are future directions deriving from this experience, mainly measuring the impact of information and knowledge management into health innovation and quality performance and integrating other tools like data mining, BPM and other TW software.

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