Strategies of technological innovation for medium and high complexity IPS in Cúcuta

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Abstract. The purpose of this research was to design strategies for technological innovation for the Institutions that Provide Health Services IPS in Cúcuta. A random sample of eight Institutions was selected and estimated under the probabilistic sampling technique for finite population. The elaboration of the strategies started from an internal analysis. Simultaneously, an external analysis was carried out through a technological mapping of the Institutions to identify the technological gaps through comparisons with the national benchmarks of the health sector in Medellín and Cali. The competitive position that served as the basis for designing technological innovation strategies was determined. The focus of the commitment of the institutions providing health services in Cúcuta should be based on the generation of added value and comprehensive care for the patient, specialized human talent and use of ICT for the provision of services. In conclusion, the high impact factor corresponds to the implementation of new technologies in the provision of healthcare services under the use of ICT tools, to provide comprehensive care to the patient; together with the transfer of technology in biomedical equipment to provide diagnostic services and treatments tailored to the users’ needs.

1. Introduction

There are multiple definitions of the concept of innovation, which enunciate all its dimensions, according to different approaches. One of the first definitions is the establishment of a new production function. That is, a new product, a new form of organization such as the merger and opening of new markets [1].

At the same time, innovation is a particular instrument of innovative entrepreneurs; the resource to take advantage of the occasion of a different business, is the action of providing resources with a new ability to generate wealth [2].

The strategy of technological innovation is defined as the process aimed at organizing and directing the available resources, human, technical and economic, with the aim of increasing the creation of new knowledge, generating ideas to obtain new products, processes and services or improving existing ones, and transferring those same ideas to the manufacturing and marketing phases [3].

Successful innovation management originates when the solution helps solve the market problem in the context of an organization's strategy [4]. Innovation management must also generate particular knowledge to become a competitive advantage [5].

In terms of technological innovation and its contribution to improving the performance of health service organizations, the available information that demonstrates the impact of medical technology on the development, quality, and safety of hospital care is growing [6].
Colombia presents a broad scenario of possibilities and complex needs to face the challenges of implementing innovations in health. On the other hand, the recurrent economic crisis of the system and the increase in the proportion of chronic diseases pose the need for different political and organizational measures that improve the quality of the service, under a transparent management of resources [7].

However, the panorama of the health sector in Cúcuta presents fragile processes of service provision associated with bad administrative and missionary practices within organizations; few comprehensive and specialized services offered; incipient strategies and insertion of innovation in strategic plans in the short, medium, and long term; little culture of innovation; plus, the low development of the capacities of human talent that is linked to these Healthcare Providers Institutions (IPS).

For this reason, in this research strategies of technological innovation were designed for the Institutions that provide Health Services of medium and high complexity in Cúcuta, in order to incorporate substantial changes in the value chain to improve the processes and services offered, that will strengthen the competitiveness of the companies in the sector.

2. Methods
A descriptive type of research with a qualitative approach was applied in this study. The sample was defined by probabilistic sampling for a finite population, taking eight institutions that provide health services of medium and high complexity in the city of Cúcuta. They were selected at random.

The methodology used was the following: The characterization of the innovation capacity of the high and medium complexity IPS of the city of Cúcuta was done through the application of an information collection instrument classified as a structured survey type aimed at managers and directors of the Health Institutions surveyed. The document focused on the detailed analysis for the development of an innovation management model, in such a way that different criteria are considered at the level of culture and strategies for innovation. This was built taking the Guide for the Self-assessment of Management of Business Innovation in Spain of the Andalusian Institute of Technology and the Andalusian Center for excellence in management as a reference, which is a questionnaire to determine good practices in business innovation management, including the evaluation of the culture and capacity for technological innovation [8].

There are multiple ways and methodologies to measure technological gaps. One of them corresponds to technological indicators that show the distance at the level of knowledge and soft and hard technology between local industry and world class companies [9].

At the same time, different criteria that have been used for their identification are acknowledged. These include aspects of business development, technology and research, investment, physical capital, human talent, and competitiveness policies [10]. Another way to measure the technological gap is through the comparison of production and service systems, which can be evaluated considering the level of global capacity, equivalent to the sum of the capacities of the levers of resources, technological management, and infrastructure [11].

According to the above, the technological mapping of the medium and high complexity IPS of Cúcuta was developed in comparison with the national health innovation models of Medellin and Cali, knowing that these two are examples of successful cases of competitiveness and innovation in the health sector at the national level, to have a reference and identify technological gaps in the regional health sector.

The analysis of technological characterization and gap analysis to diagnose the technological innovation capacity of medium and high complexity IPS of Cúcuta was taken as a reference. For this purpose, the Matrix of Strengths, Weaknesses, Opportunities and Threats was used, describing the DOFA Matrix as an important tool to analyze the internal and external profile of organizations, and which allows managers to project their goals and act in a specific period of time [12].

The construction of short, medium, and long-term strategies was carried out under the prioritization of actions through the MIC MAC structural analysis, which allows the system to be described thanks to a matrix that integrates all its constituent elements [13].
Through the prioritized strategies of medium and high complexity Health Services Providers in Cúcuta, the sector's commitment was defined with a vision to the year 2025. This was done in order to propose a central strategy and design the strategic plan of technological innovation based on it, with their respective actions and indicators of the prioritized strategies as a route for the improvement of technological capacity.

3. Results

3.1. Characterization of the technological innovation capacity of medium and high complexity IPS in Cúcuta

The characterization of the capacity of technological innovation of medium and high complexity Health Services Providers in Cúcuta was based on the analysis of the innovation management model, evaluating business management good practices from the point of view of senior management. For the above, the culture of innovation, spaces for conception, human talent and technological innovation were addressed.

As a result, it was determined that the Institutions that provide Health Services, although they recognize that innovation is a fundamental factor to increase productivity and competitiveness, improve services and processes. However, the innovation culture has not been included within its strategies due to two factors: The business model focuses on expanding the coverage and quality of the services provided; this, added to the fact that they do not have the capacity or the knowledge, to apply formal procedures of management of technological innovation within the Institutions providing Health Services (IPS).

Regarding the spaces that are created in the organization for the conception process to respond to the planning of technological innovation, in the IPS of the city of Cúcuta, this was considered a high weakness. This generates a negative impact on creative thinking and on the development of new and quality ideas that allow the development of new services or significantly improve the existing ones; all this is due to the lack of formalization and use of tools, methodologies, and procedures that stimulate creative thinking and the capacity for innovation.

Human talent is a fundamental factor for the implementation of technological innovation in each of the IPS, in this causal link between the management of human talent and the results of the organization, human management practices play a leading role to improve the capacity and innovation culture of employees, associated with the qualification, promotion and development of workers to contribute to organizational performance.

The IPSs studied are in default to establish formal policies and programs of incentives and recognition that enable the empowerment and leadership of the workforce, which are essential in the innovation management processes. More concretely in the conception of innovative ideas, which generates a barrier to the development of creative thinking, since it is not stimulated, and it doesn’t motivate the workforce to propose new alternatives for the improvement of processes and development of services.

The technological level of the IPS is one of the tools that allow the generation of new services and greater added value, according to the level of technology and procedures implemented from it. The technological state of the biomedical equipment, devices, instruments and medicines of the IPS of medium and high complexity in the city of Cúcuta is adequate for the assistance and creation of new services in their portfolios.

However, some adjustments must be made to the instrumentation so that it is in accordance with the procedures applied. This is an aspect to be improved, being classified as a low weakness, because it does not generate a high impact on the provision of the service under adequate conditions.

3.2. Analysis of technological gaps

The national benchmarks that were taken to analyze the technological gaps in Colombia were the Medellin and Cali health cluster to compare them to a technological and innovation level with high and medium complexity IPS in the city of Cúcuta. It became clear that including substantial changes in their
business models, that are based exclusively on the provision of service with minimum quality standards and basic coverage principles, is a priority; without including innovation systems that allow for the development of new world-class services and products in the agenda.

Health systems are increasingly dependent on technologies. Moreover, health technologies have gained important spaces in the political and technical agendas of policymakers due to concerns about the lack of knowledge of their effectiveness, cost, and real security in average application conditions. The permanent need for the issuance of health policies in scenarios of tight budgets and wide uncertainty of information, require the use of analytical techniques and clear and standardized methodologies. The evaluation of health technologies provides a practical application of an important group of these techniques. Each time, health systems invest more on this type of research, because they have seen that their results are cost-effective.

In Colombia there are some cases of success in the strengthening and consolidation of the health sector, as the main reference is the case of Medellín with the formulation and consolidation of the Health cluster.

The foundation of the Medellín health cluster in Antioquia is defined as the geographical concentration of specialized and complementary companies and institutions in the activities of medicine, dentistry, education and research, production and / or marketing of hospital supplies, devices, biomedical technology, telemedicine, production and / or distribution of medicines, development of scientific software and knowledge. They interact with each other, creating a business climate in which everyone can improve their performance, competitiveness, and profitability [14].

Within the health cluster model in Medellín, a series of strategies have emerged to strengthen the competitiveness of public and private IPS, which are focused on the following aspects: a) Development of a strategic plan that responds in essence to how to understand and address the market needs, especially in the specialized health service sectors, b) Definition of the portfolio of products and services according to the innovation criteria, quality, and compliance with existing standards and legislation, both nationally and internationally, c) Creation of strategic alliances with support and research and development support institutions, whose functions are the competitive strengthening of companies; working on diseases, technological management of procedures, biotechnology, orthopedics, research, and processes design generation of complementary services and adjustment to health regulations, among others, d) Definition of quality standards for products, services, and procedures; through the way of certification and accreditation before private, governmental, national and international entities e) Design and definition of the different profiles of knowledge of health professionals in a joint work with the university institutions, the accrediting institutions, the state and private health institutes, developing training programs consistent with the companies needs , f) Definition of the exporting capacity about the services and products that are being offered, oriented to the comparative and competitive advantages of the city to the international offer, g) Development of new Cloud Computing platforms that allow the development of products and services, together with the commercialization of the results of research and technological development, h) Development of technological platforms supported in the information and communication technologies for health, on topics such as software applied to e-health, remote control and operation and integrated information systems for patient care during the provision of health services (Siups): patient monitoring, telemedicine, tele assistance, tele surgery and systems of robotic assistance [14].

The Valle del Cauca has specialized health institutions and advanced technologies, high level professionals in different medical and dental areas; universities with nationally prominent health programs; research centers with trajectory; strong pharmaceutical industry, hospital supplies and medical devices; and innovative companies in information and communication technologies that can also contribute in the area of health [15].

Within the cluster of health in Cali, in which the public and private IPS are immersed, the main competitive advantages have emerged from the following developments and innovations: a) Nanotechnology used in health innovation processes, b) Development and application of Biotechnology (nutraceutical, and pharmaceutical cosmetics) and natural products and Research and innovation in the
pharmacological local offer, c) Manufacturing of optoelectronic devices with medical applications, d) Groups and Universities working hand in hand with health institutions dedicated to the area of e-Health, e) Research work on infectious diseases such as malaria and tuberculosis, f) Research and innovation in approaches and models in Primary Health Care, Promotion and prevention of prevalent diseases, g) Epidemiological research and innovation, intervention on tropical and endemic diseases, h) Research and innovation on ICT applications (Telemedicine/tele diagnosis, SGPS) in service and in health interventions, i) Line of research and application of natural products and plants in pharmacology and Bioindustry (essences, extracts, new materials and medicines), J) Creation of knowledge networks such as the University Network for Innovation of Valle del Cauca Rupiv, to formulate and organize macro projects.

3.3. Strategies for strengthening the technological innovation capacity of medium and high complexity healthcare service providers in San José de Cúcuta

The design of the strategies was constructed based on the results found in the analysis of technological characterization and technological gaps in the institutions providing health services that were studied (Table 1).

| Strategy | Name of the strategy |
|----------|----------------------|
| 1        | Creation of networks and strategic alliances between public and private institutions and the IPS. |
| 2        | Use and update of ICT tools for the provision of services. |
| 3        | Consolidation of associative strategies between the IPS and other links of the cluster for the promotion of the development and transfer of technology. |
| 4        | Investment management in research and innovation in the sector. |
| 5        | Design and development of new services and products that differ from the current offer. |
| 6        | Improvement of prevention and promotion services, specialized advice. |
| 7        | Diversify services and products. |
| 8        | Certifications and accreditation in national and international quality standards. |
| 9        | Improvement of the capacity and specialization of the human talent of the IPS of Cúcuta. |
| 10       | Develop research and innovation projects that improve the competitive advantages of IPS. |

3.4. Structural analysis Mic Mac

The MIC MAC method was used to prioritize the medium and high complexity IPS strategies of Cúcuta to establish the main influential and dependent strategies, together with their correlation. The objective of this method was to determine the main variables that are influential and dependent on the strategies to be able to systematize them according to the degree of importance and impact on the innovation model of the health sector.

| No. | Description                                                                 | Total | %  |
|-----|------------------------------------------------------------------------------|-------|----|
| 1   | Creation of networks and strategic alliances between public and private institutions and the IPS. | 28    | 12 |
| 2   | Use and update of ICT tools for the provision of services.                    | 27    | 11 |
| 3   | Consolidation of associative strategies between the IPS and other links of the cluster for the promotion of the development and transfer of technology. | 23    | 10 |
| 4   | Investment management in research and innovation in the sector.              | 29    | 12 |
| 5   | Design and development of new services and products that differ from the current offer. | 25    | 10 |
| 6   | Improvement of prevention and promotion services, specialized advice.        | 19    | 8  |
| 7   | Diversify services and products.                                             | 18    | 7  |
| 8   | Certifications and accreditation in national and international quality standards. | 26    | 11 |
| 9   | Improvement of the capacity and specialization of the human talent of the IPS of Cúcuta. | 25    | 10 |
| 10  | Develop research and innovation projects that improve the competitive advantages of IPS. | 21    | 9  |
For the structural analysis of the strategies of the medium and high complexity Health Services Providers in San José de Cúcuta, the correlation matrix between strategies was designed to prioritize them in hierarchical order. Table 2 shows the correlation matrix and in Figure 1, the graph of dependence influence in order to determine the main strategies.

In Figure 1, the strategies numbered from 1 to 10 are presented in the graph, according to the ones selected from the DOFA Matrix it can be affirmed that there are strategies that have a high impact on the Healthcare Providers Institutions of medium and high complexity in San José de Cúcuta, with a high level of correlation.

![Figure 1. Relationship of influence dependence of each selected strategy for the IPS of medium and high complexity in San José de Cúcuta.](image)

As described above, the prioritization of the strategies according to their influence and dependence is presented (Table 3).

**Table 3. Prioritized Strategies of Medium and High Complex Health Services Providers in San José de Cúcuta.**

| Nº  | Strategy | Name of the Strategy                                                  |
|-----|----------|-----------------------------------------------------------------------|
| I   | 5        | Design and development of new services and products that differ from the current offer. |
| II  | 9        | Improvement of the capacity and specialization of the human talent of the IPS of Cúcuta. |
| III | 2        | Use and update of ICT tools for the provision of services.             |
| IV  | 4        | Investment management in research and innovation in the sector.       |
| V   | 8        | Certifications and accreditation in national and international quality standards |
| VI  | 1        | Creation of networks and strategic alliances between public and private institutions and IPS |
| VII | 6        | Improvement of prevention and promotion services, specialized advice. |
| VIII| 10       | Develop research and innovation projects that improve the competitive advantages of IPS |
| IX  | 7        | Diversify services and products                                       |
| X   | 3        | Consolidation of associative strategies between the IPS and other links of the cluster for the promotion of the development and transfer of technology |

3.5. **Definition of the commitment of the health sector in the Institutions that provide health services of medium and high complexity in San José de Cúcuta**

Through the prioritized strategies of medium and high complexity Health Services Providers in San José de Cúcuta, the sector's commitment with a vision to the year 2025 was first established, with the aim of proposing a collective central strategy.
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4. Conclusions

Through the strategies designed at the strategic level for medium and high complexity IPSs the route to explore new business opportunities based on the users' knowledge of the services offered was traced; strengthen strategic alliances with support institutions to boost the transfer of knowledge and specialization in health services; redefining the strategies of business management oriented to the fulfillment of high standards of quality, normativity and with added value according to the environment and the market needs; create new business models based on the experiences of the Institutions and technological surveillance to maximize efficiency and provide world-class services.

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