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ARTICLE

Technology transfer for COVID-19 vaccine in the Institute of Technology in Immunobiologicals (Bio-Manguinhos), Oswaldo Cruz Foundation

Transferência de tecnologia para vacina contra COVID-19 no Instituto de Tecnologia em Imunobiológicos (Bio-Manguinhos), Fundação Oswaldo Cruz

Transferencia de tecnología para vacuna contra la COVID-19 en el Instituto de Tecnología en Inmunobiológicos (Bio-Manguinhos), Fundación Oswaldo Cruz

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Abstract

Innovation is an essential element for development and growth, but it consists of a long process of knowledge accumulation, so technology transfer is used to accelerate this process. This study mapped the particularities of the technology transfer process for the COVID-19 vaccine between AstraZeneca and the Institute of Technology in Immunobiologicals (Bio-Manguinhos), Oswaldo Cruz Foundation, and identified enablers, obstacles, and gaps. Our analysis investigated the process from selection of the most suitable partner to incorporation of the new technology based on a comprehensive literature review on this topic, combined with a case study. The results showed that, although many actions still have to be performed to maximize technology capacity gains, the lessons learned from the technology transfer process will be used in future and ongoing agreements.

Technology Transfer; Vaccine; COVID-19

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Introduction

The vaccine industry is driven by innovation, which is critical to ensure more competitive advantages. The offer of new or improved products constitutes one of the main elements for a successful vaccine company, which must be an institutionalized value in its internal policy. However, the innovation process is not simple and is full of uncertainties, with only a small fraction converted into technological and commercial success, given the high complexity of developing a vaccine.

Regarding this aspect, a vaccine development can take decades to be approved and licensed, as it comprises several interconnected stages, which require extensive research and development (R&D) activity, huge investments in infrastructure and human resources, and extensive national and international regulatory requirements [1].

Then, the introduction of a new or improved product in the vaccine industry has become the result of a small number of multinationals that hold market power. With such high complexity, the need for high investments in uncertain and long-term projects, the importance of increasing technological capacity, developing countries, such as Brazil, began to use technology transfer, considering that mastering the production process is one of the first steps towards establishing innovative capacity [2]. Therefore, obtaining external knowledge is a common strategy in the vaccine industry in developing countries.

In this scenario, several technology transfer agreements have been made in Brazil, with support from the Brazilian Ministry of Health, which encouraged the national production of vaccines, allowing the country to meet the demands of the Brazilian National Immunization Program (PNI, acronym in Portuguese). Such agreements helped increase the quality in the vaccine industry and modernize the national production [3].

Based on these findings and aiming to contribute to this topic, this study focuses on analyzing the complex technology transfer process for the COVID-19 vaccine between AstraZeneca and the Institute of Technology in Immunobiologicals (Bio-Manguinhos) production facility, Oswaldo Cruz Foundation (Fiocruz, acronym in Portuguese), in 2020. An assessment of this partnership is extremely important, as it allowed the production of a vaccine in record time to address the public health emergency caused by COVID-19 and the incorporation of new technologies.

Method

This article is a literature review on technology transfer and a case study analysis. Regarding the literature review, some keywords were identified, such as: technology transfer, innovation, and knowledge absorption, based on reading the most important texts, and then a search was performed in the main journal databases, such as: CAPES Journal Portal, Google Scholar, SciELO, and Scopus.

The case study analyzed in our study refers to the specific agreement between Bio-Manguinhos and AstraZeneca for the manufacture of a COVID-19 vaccine.

In addition to the bibliographic material and the analysis of the agreement documents, a field study was performed in Bio-Manguinhos with several interviews conducted in April and May 2022. Selected interviewees were directly related to the technology transfer process for the COVID-19 vaccine. In total, 11 interviews were performed through videoconference, with the following employees: three senior management members, two project managers, two vaccine production employees, two professionals from the Technological Innovation Center (NIT, acronym in Portuguese) of Bio-Manguinhos, and two employees from the Bio-Manguinhos prospecting group. After the interviews, the results were compiled through content analysis.

Results and discussions about technology transfer in Bio-Manguinhos

Technology transfer

According to Takahashi & Sacomano [4] (p. 189), technology transfer is "*a complex process that comprises the identification of the technology to be transferred, the selection of transfer methods and mechanisms, and full implementation and absorption of the technology*".

Also, Gadelha [5] (p. 39) mentions that technology transfer consists of a "*tool to reduce the technological gap and a high-risk process*", because, "*if there is not a strong effort for technological development, it is possible that, when the technology cycle has been completely transferred, the frontiers of knowledge will have already been expanded*".

The authors above relate technology transfer to the transfer of knowledge from a sender to a receiver and highlight its complexity. Therefore, a movement of tacit and coded knowledge is observed, which may or may not be appropriate, depending on the technical and organizational competence of the receiver.

After briefly describing some definitions, we will discuss the main stages of the technology transfer process [6]. The first action for a successful technology transfer process consists of identifying the problem or intended improvement with a technological solution. Then, institutions must be identified that can offer the desired solution, so that a feasibility study can be conducted. This study assesses the practicality of a proposed plan. In this stage, several technologies are analyzed until one that best suits the strategic objectives is selected. In addition, the level of technological maturity and the availability of labor, equipment, among other elements are also assessed to confirm whether the receiver will have the ability to absorb and adapt the new technology.

After selecting the most suitable institution to offer the technological solution, negotiations are made and then an agreement is signed. Regarding the agreement, it is a difficult document to write, so it has to be written by a multidisciplinary and experienced team in order to eliminate gaps and ambiguities, reduce the costs of possible disputes, and meet interests of the parties.

Once the agreement is signed, the technology transfer phase starts. Upon completion of this stage, the technology should be adapted and internalized, and the receiver should be able to generate new technological capabilities [2].

However, all these stages may involve enablers and barriers, which will influence the outcomes. Therefore, it is essential to understand such enablers and barriers, as they are important to achieve a successful technology transfer process.

Regarding this aspect, Greiner & Franza [7] identified major obstacles resulting from the new technology, the actors involved, and requirements imposed by government bodies, classified as (i) technical, (ii) regulatory, and (iii) human obstacles.

Technical obstacles often occur when a more advanced technology is transferred, or when it has not yet been used by the receiver. For this reason, the receiver must have sufficient technological capacity to handle and assimilate the new technology. Therefore, more complex technologies require more employee training, structural adaptations, investment in R&D, and better communication between the parties [4].

Regulatory obstacles are caused by slow bureaucratic bodies, constant regulatory changes, legislations that are difficult to understand, and numerous health requirements. Problems in human resources are related to the lack of professionals that are able to absorb the technology and the lack of interest in finding them due to little motivation, insufficient training programs, and lack of autonomy to develop their own projects [8].

Also, obstacles may also be related to the absence of proper infrastructure for the various product development phases (spatial barrier) [2], or when it has a low economic, social, operational return, and return on knowledge when compared to the investment made.

Economic and financial obstacles are also seen, which are associated with low investment in training, staff competence, infrastructure and equipment maintenance, and the constant reduction of funds allocated to research [3].

Other factors that often affect the technology transfer process include prior experience and cultural differences. Regarding cultural differences, it should be noted that it is considered one of the major barriers in technology communication.

On the other hand, enablers in technology transfer refer to good relationship between the receiver and developer and strong leadership in both organizations. Also, Kaippert [2] (p. 74) mentions that "*human capital is an essential element, as qualified workforce is required to absorb the technology and subsequently replicate it*".

In general, several activities are recommended to enhance the success of a technology transfer process, and this is why enablers must be understood and used, and potential obstacles must be mitigated.

Technology transfer for COVID-19 vaccine

Considering that Fiocruz is an institution of excellence in vaccine production in Latin America and the largest supplier of vaccines to the PNI, the Brazilian Ministry of Health designated Fiocruz to incorporate the COVID-19 vaccine manufacturing technology [9]. Therefore, Fiocruz developed a document to hire AstraZeneca after a selection process.

Through legal and technical justification [10], the Institution demonstrated that the candidate vaccine developed by the University of Oxford (United Kingdom) and licensed by AstraZeneca would be the most appropriate. The selection was based on a technical and scientific analysis focused on the following aspects: technological platform, development phase, availability of published studies and sharing of additional data, clinical phase conducted in Brazil, interest in conducting the technology transfer process, submission of a negotiation proposal to the Brazilian Ministry of Health, and vaccine introduction in international initiatives of access to the vaccine.

Before the agreement with AstraZeneca was signed, information was exchanged with other institutions and multinationals to obtain more details about different vaccines. In total, the Brazilian institution contacted 19 companies, signed eight confidentiality agreements, and advanced discussions with three laboratories, as stated in *Minutes n. 40* of October 21, 2020, of the Brazilian Federal Court of Accounts [11].

After choosing the company, on July 31, 2020, Fiocruz and AstraZeneca signed a *Memorandum of Understanding* with the general conditions of the negotiation process and the guidelines for the partnership. The document structured the relationship between the parties in two distinct instruments: technology order contract (ETEC) and technology transfer contract for the active pharmaceutical ingredient (API) production for the vaccine against COVID-19.

On September 8, 2020, the ETEC was signed with AstraZeneca [12] for the COVID-19 vaccine manufacturing. This contract allowed the production of 100.4 million doses of the API for the final vaccine processing and provided the basis for technology transfer. Then, with the imported API, Bio-Manguinhos conducted the final vaccine processing and, starting in March 2021, started to provide the vaccine to the Brazilian Ministry of Health [13].

On June 1, 2021, the technology transfer contract for the COVID-19 vaccine was signed with AstraZeneca [14]. The technology transfer contract was based on the contract template of the Science, technology & Innovation Technical Chamber of the Brazilian Federal Attorney General's Office, consisting of 15 clauses. On February 14, 2022, the first batch of national vaccines was released by the internal quality control of Bio-Manguinhos [9]. Then on February 22, Bio-Manguinhos provided the Brazilian Ministry of Health with 550,000 doses of the COVID-19 vaccine produced with a national API, representing one of the fastest technology incorporation processes in Bio-Manguinhos. In total, the Brazilian Ministry of Health bought 105 million doses in 2022, 45 million of which were produced entirely in Brazil and the rest with imported API [15].

Technology transfer analysis in Bio-Manguinhos

Through field research, the main aspects that enabled a successful technology transfer process between Bio-Manguinhos/Fiocruz and AstraZeneca were identified, as well as the obstacles found during the incorporation process and some of the measures adopted to resolve them. The results will

be described in the following sections: (i) technological prospecting; (ii) negotiation and formalization of contractual instruments; and (iii) vaccine production.

- **Technology prospecting in Bio-Manguinhos**

The prospecting activity began to be structured in October 2019, with the purpose of expanding Bio-Manguinhos's competitive intelligence. However, with the pandemic, in January 2020, this activity was focused on mapping initiatives related to COVID-19 in Brazil and worldwide.

The prospect team conducted searches, analyses, and processing of information obtained from databases. First, the evolution of new product development was monitored. Data were accessed through different channels, from primary sources (institutional contacts and press releases) to secondary sources (such as AdisInsight – https://adisinsight.springer.com/, Clinical Trials.Gov – https://clinicaltrials.gov/, and International Clinical Trials Registry Platform – https://www.who.int/clinical-trials-registry-platform/about). Private database Questel Orbit (https://www.questel.com/) was also used to identify patents.

Such data were complemented with information extracted from reports from the World Health Organization (WHO) and other institutions, specialized websites, and pharmaceutical laboratory pages. After the search, repeated, incomplete or inaccurate information was excluded and categorized for easy visualization. After that, COVID-19 vaccine projects were assessed in different stages. Next, meetings were held with the developers of the most advanced projects that adhered to institutional competencies. Discussions with potential partners were important, considering that much information had not been publicly disclosed.

The decision of the government, after the Bio-Manguinhos's prospective analyses on the technological, scientific, economic, and clinical aspects of the different vaccines under development, was to celebrate an agreement with AstraZeneca.

The task of the prospecting team was complex and difficult because it was necessary to fill knowledge gaps as it involved a new disease and cutting-edge technology and ensure continuous data monitoring to correct and update the information, considering that prospective activities were conducted along with the development of candidate vaccines. In addition to the challenge to monitor vaccine developments, there was also the issue of uncertainty. Many technological platforms had not yet been used, which made it difficult to predict the vaccine effectiveness, not mention the risks of large-scale production and storage.

Therefore, the main challenges were: uncertainty, limited and inexact information, information asymmetry, and obstacles to data access, high volume of information, infodemic and fake news, initial lack of knowledge about the virus, public health urgency, and difficult interaction in remote work.

Despite these challenges, the prospecting team was one of the factors that contributed to a successful technology transfer process, representing one of the achievements. The prospective activity allowed them to understand the problem and the intended product and identify partner institutions that could offer the technological solution.

- **Negotiation and formalization of contractual instruments**

After selecting AstraZeneca, negotiation began with the company, involving the business department and the general management of Bio-Manguinhos, as well as the presidency of Fiocruz. It also had the participation of the Federal Attorney's Office of Fiocruz; the Coordination of Technological Management of Fiocruz; the Institute of Applied Economic Research; the National Chamber of Research, Development and Innovation of the Brazilian Attorney General's Office; and the Brazilian Chamber of Deputies.

One of the positive aspects of this stage was the fact that AstraZeneca had already provided technical information even before the negotiations began, allowing Bio-Manguinhos to evaluate scientific and technological information in detail. In May 2020, a confidentiality agreement was signed between the parties. After that, weekly meetings began to take place, enabling the transfer of information and better preparation of the institution. In mid-June 2020, AstraZeneca started to transfer information about the analytical methodology. However, despite the provision of data that are only

provided when the technology transfer instrument is signed, information about quality control of the final product and the formulation and packaging stages were only disclosed in detail after the agreement was signed.

On the other hand, one of the main obstacles was uncertainty, because around 100.4 million doses were purchased without any guarantee the vaccine would reach its final stage. Despite the uncertainty about the development and maintenance of immunity, and the possibility of results not being delivered, the Federal Government understood that the risk of research and production was necessary, given the urgency to maintain public health.

In addition to this challenge, time was also an issue. Given the emergency situation, there was a short period of time for the negotiation and formulation of legal instruments. One strategy used by Bio-Manguinhos, which accelerated agreement signing in just a few months, was the fast technology order instrument of the technology transfer process. As the negotiation of the API technology involved delicate and complex aspects that would delay the start of the partnership, the institution chose to conduct these activities separately to speed up the process. Other factors that helped accelerate the process were the availability of professionals dedicated to specific projects and their long working hours. Many meetings were held on weekends and the workload of Bio-Manguinhos employees increased, so home office activities and staff enthusiasm significantly contributed to the results.

Language was also another critical point, given that English was the official language of the process. Also, cultural differences made negotiations and communication more difficult between the parties.

In addition to these issues, legal complexity was also an obstacle, given the legal design of the contract. An ETEC instrument had to be written, which had never been done by the Brazilian institution, and technology transfer had to be incorporated into this document, respecting the preceding conditions, given a prior license from the University of Oxford to AstraZeneca, and avoid the use of restrictive clauses.

Another issue was that AstraZeneca found it difficult to understand the Brazilian legislation on technology order. The agreement with Fiocruz was different from all other partnerships made by AstraZeneca, as it did not involve a simple purchase, but a research and development project, which was not yet completed. This aspect sounded extremely strange to AstraZeneca, as it was not part of its business model. Several meetings were held for AstraZeneca to understand the contractual purpose and accept to include in the agreement that a project in technological development was being commissioned.

AstraZeneca also found it difficult to understand the limits of a governmental institution and accept that Fiocruz, as a public foundation, has its operations regulated by public laws. AstraZeneca also had trouble to understand the bureaucratic aspects and the number of instances required to approve the contract.

Besides the challenges above, the steps prior to the celebration of ETEC had to be performed fast. Given the need to shorten the steps and based on the Brazilian National Emergency Law, a parallelism was created between the stages.

Therefore, the entire process of contract formalization and its previous stages were very complex. Despite the familiarity of Bio-Manguinhos professionals with transfer agreements and the Institution's multidisciplinary team, major challenges were experienced during the negotiation and development of contractual clauses.

- **COVID-19 vaccine production in Bio-Manguinhos**

(a) Challenges in the production phase

Besides the challenges in the negotiation phase, some obstacles were also present during the production phase. Here, time was an issue again. Given the urgency to implement the production of COVID-19 vaccine, time was extremely short to conduct factory adaptations and training. However, although time was seen as an obstacle, it became a positive aspect considering that many technology transfer projects conducted by Bio-Manguinhos have long processes. When a technology is finally incorporated by the institution, it is often obsolete, given the long time taken to complete the transfer process.

In the specific case with AstraZeneca, the company's willingness, technological base in Bio-Manguinhos, and its financial support were some of the factors that contributed to a fast technology transfer process.

On the other hand, the acquisition of inputs and equipment in a high-demand market was also a strong obstacle. In relation to the shortage of inputs and equipment, Bio-Manguinhos adopted the following actions: intensive monitoring, frequent contacts with suppliers to ensure inputs delivered on the scheduled dates, and development of alternative solutions.

Among these solutions, for the final processing, some devices were replaced with others already existing in the Brazilian institution and the product was adjusted to the process already adopted in Bio-Manguinhos. Such adaptation was only possible given the experience of Bio-Manguinhos and the articulation with AstraZeneca. The adjustment procedure conducted by this production facility was well accepted by AstraZeneca. In fact, other AstraZeneca partners had the same adjustments, given the challenges found to purchase supplies.

Adapting the product to the Bio-Manguinhos process was an innovative strategy, since the technology transfers previously conducted by the institution followed exactly the procedure adopted by the developer, which reduces technological risks but takes considerably longer time. It should be noted that the adjustment procedure was an acceleration strategy, as if all devices had been bought, the process would have taken much more time.

In addition to all challenges mentioned above, the final processing capacity during the initial phase was also an issue. Bio-Manguinhos had to seek answers and support the Brazilian Ministry of Health contain the spread of the coronavirus, but it also had to respect the schedules established to supply other products to the government. In view of these facts, all planned operations and priorities had to be adjusted to maintain essential activities, and it was necessary to formulate a new logic for working remotely and set up new governance and management structures. With such replanning, it was possible to expand the final processing capacity.

With the problem of final processing capacity resolved, a new challenge came up, which was the delayed delivery of API due to bureaucratic issues. For this reason, meetings were held with AstraZeneca and support was obtained from the Brazilian Ministry of Foreign Affairs to make contacts with the Chinese Embassy, as the API was from China.

Lack of staff was also a major problem, considering that around 40% of the workforce was working from home. To resolve this situation, a communication channel was created between managers and employees, and new professionals were hired and trained.

On the other hand, outsourcing should also be considered one of the general problems of Bio-Manguinhos, since the institution adopts it to eliminate bottlenecks caused by labor shortage, because the number of professionals hired does not meet the needs of the organization. Regarding this aspect, the number of permanent employees has gradually decreased over the years. This situation has caused huge damage to the public administration, since many of the outsourced professionals are in charge of projects and the number of permanent employees represented only 10.91% of the total workforce in 2020 [16].

Also about outsourcing, a high turnover of these professionals is a clear problem, given the lack of a permanent link with the institution. A high turnover clearly generates a loss of investment and knowledge for public administration because the Institution should ensure training and retention of highly specialized professionals.

Operational challenges were also observed, including reorganization of production and logistics, preparation of facilities for the COVID-19 vaccine production, hiring of personnel, professional training, and establishment of a non-stop production system.

Also, one of the major problems was the budget approval process of Bio-Manguinhos. In recent years, there has been a reduction of research resources due to federal budget cuts. In 2019, only BRL 70 million were spent with R&D, which corresponds to 3.2% of the institution's total revenue, and a similar investment was reported in the previous year [17]. A low rate of investment in R&D in relation to the institution's total revenue when compared to pharmaceutical multinationals contributes to such scenario of dependence, considering that quality requires continuous investments.

Despite the low budget in recent years, investments were higher due to the pandemic. In 2020, Bio-Manguinhos invested around BRL 140 million in R&D [16], twice the amount invested in the previous year. However, the amount invested in R&D corresponds to 2.57% of total revenue, which increased from BRL 2.18 billion to BRL 5.29 billion.

Obviously, investments must be constant, not sporadic. As seen above, Bio-Manguinhos must continually develop its teams, modernizes, and expands its infrastructure, so that high levels of efficiency are achieved and, consequently, its productive and technological capacity will increase.

Therefore, more resources should be prioritized and allocated to science, technology, research and innovation projects in order to strengthen public institutions and expand human capacity.

(b) Enablers in the production phase

Despite the presence of these obstacles, several enablers were observed in the technology transfer process, including the institution's credibility, its team of researchers, and capacities. Although AstraZeneca/Oxford offered an innovative technological platform for COVID-19 vaccine, it was similar to Bio-Manguinhos' skills. In addition to these similarities, much of the knowledge was already incorporated into this Fiocruz production facility, assisting the progress of new technology manipulation and assimilation. Another element was the fact that Bio-Manguinhos had already signed several partnerships before. These experiences allowed an easier incorporation of knowledge and process improvements, avoiding repeated mistakes.

Transparency and effective communication with AstraZeneca should also be considered positive aspects. Considering that it was a pandemic, communication was significantly facilitated and negotiation was extended to obtain more gains. AstraZeneca was committed to producing the vaccine and introducing it to the market, and Bio-Manguinhos had to incorporate the technology for public health reasons. Within the Brazilian institution, information was shared between different departments and teams.

In addition to good communication between the parties, Bio-Manguinhos' employees were motivated, with trained professionals available. AstraZeneca also showed a desire to transfer the technology, providing training and holding numerous meetings. Regarding the meetings, they were held at least once a week, answering questions and informing how Bio-Manguinhos had to structure itself to absorb the technology.

Bio-Manguinhos provided training before starting a process stage. It was provided remotely due to the pandemic and the short time available, unlike traditional transfer processes. Remote training was both an opportunity and a challenge for the parties involved, as a high number of people could participate in the training, without having to share internal knowledge and travel abroad. On the other hand, the knowledge absorption is somehow affected.

In addition to training and meetings, two consultants hired by AstraZeneca provided face-to-face support during the process implementation. They spent around four months in Bio-Manguinhos. After the institution could manage the process alone, their support was no longer in-person, but they continued to participate in technical meetings.

Another important element was that Bio-Manguinhos conducted an in-depth analysis of the new technology and its compatibility with the existing technology of the institution. The information obtained during the prospecting phase supported the negotiation and writing of contracts, so detailed knowledge of the technology maturity degree was essential.

The use of an existing infrastructure also contributed to reducing time and costs. During the API incorporation, as mentioned above, the process was adapted, using the existing Bio-Manguinhos structure for final processing. For the API production, the Henrique Penna Center was adapted with the use of various instruments and specific equipment, such as bioreactors and purification systems. A new laboratory had to be built to meet the increased demand for quality control analysis, and a new API storage area was built.

Also, work organization in Bio-Manguinhos significantly contributed to a successful process, with a robust management structure set up by the institution. Bio-Manguinhos created a project management team of around 30 employees and one general manager, who reported directly to the director of Bio-Manguinhos, ensuring fast decisions and problem resolution. The general manager

had four work areas: (i) administrative management (legal compliance, acquisitions, supply chain, personnel adjustments, training, etc.); (ii) technology transfer management (final processing, API production, quality control); (iii) infrastructure management; and (iv) regulatory compliance and human resources (compliance with regulatory requirements in biosafety, environmental safety, occupational safety, good manufacturing practices).

Finally, the private sector played a relevant role in the process, supporting negotiations with suppliers of inputs and equipment and providing financial contributions. In this scenario, the collaboration of the Companhia de Bebidas das Américas (AMBEV; American Beverage Company) was essential, allocating 10 employees to help with the technology transfer process.

Regarding donations, until May 2022, Fiocruz, in partnership with individuals and public and private organizations, received the amount of around BRL 505 million. Part of these resources was used in infrastructure improvements and factory adaptation [18]. This contribution also supported Bio-Manguinhos inauguration of the Physical-Chemical Laboratory (LAFIQ) on November 23, 2021 in order to meet the increased demand for quality control analyses caused by the incorporation of the COVID-19 vaccine production.

Thus, support from the private sector, experience in biotechnology, the installed technological infrastructure, and management capacity were essential for the fast technology transfer.

Final considerations

The pandemic caused by SARS-CoV-2, in addition to showing the incipiency of the Brazilian biotechnology industry and the fragility of public policies for R&D activities, reaffirmed the importance of government institutions and the relevance of local and regional autonomy for the production of vaccines and strategic products for national and international public health. Dependence on inputs and equipment makes the health system completely vulnerable.

However, in recent years, the Brazilian scenario of research, technological development, and innovation in relation to vaccines has declined, given the reduced financial resources and few public policies that stimulate R&D activities.

Despite the few initiatives and minimal government investments aiming to overcome the situation of national dependence, Bio-Manguinhos has made partnerships to absorb new technologies, expand knowledge, and meet the demands of the PNI. The efforts of this production facility must be seen not only as a strategic element for public health, but mainly as a manner to expand innovation and promote economic growth.

Bio-Manguinhos has had many benefits through technology transfer agreements; however, many obstacles still have to be overcome. The repeated presence of some obstacles in partnerships only confirms that long-term public policies are required, with frequent investment and monitoring, as well as the need to expand formal actions of staff training and allocation of financial resources to R&D activities.

Finally, it should be noted that the lessons learned from the technology transfer process for the COVID-19 vaccine made by Bio-Manguinhos/Fiocruz will certainly support future and ongoing agreements. The incorporation of technology and the production of a completely national vaccine occurred in an extremely short time, which further highlighted the existing competence of this government institution.

Contributors

V. Z. Rosenberg contributed with the theoretical-conceptual foundation and problematization, data analysis, and writing; and approved the final version. A. M. S. Antunes contributed with the critical review; and approved the final version.

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Resumo

A inovação é um elemento fundamental para o desenvolvimento e crescimento, mas constituída por um processo demorado de acúmulo de conhecimento. Uma das formas de acelerar tal processo é por meio da transferência de tecnologia. Este artigo mapeou as particularidades da transferência de tecnologia para a vacina contra COVID-19, celebrado entre a AstraZeneca e o Instituto de Tecnologia em Imunobiológicos (Bio-Manguinhos), Fundação Oswaldo Cruz, bem como reconheceu os seus facilitadores, seus entraves e suas lacunas. Para tanto, foi realizada uma análise desde a etapa da seleção do parceiro mais adequado até a incorporação da nova tecnologia. A metodologia utilizada se baseou em uma ampla revisão bibliográfica sobre o tema, aliada ao estudo de caso. Os resultados apontaram que, apesar de muitas ações ainda precisarem ser realizadas para que os ganhos de capacidade tecnológica sejam potencializados, as lições aprendidas com o processo de transferência de tecnologia servirão de aprendizado e serão utilizadas nos acordos futuros e em andamento.

Transferência de Tecnologia; Vacina; COVID-19

Resumen

La innovación es un elemento fundamental para el desarrollo y el crecimiento, pero consiste en un proceso de acumulación de conocimiento que requiere mucho tiempo. Una de las formas de acelerar este proceso es mediante la transferencia de tecnología. Este artículo mapeó las particularidades del proceso de transferencia de tecnología para la vacuna contra la COVID-19, celebrado entre AstraZeneca y el Instituto de Tecnología en Inmunobiológicos (Bio-Manguinhos), Fundación Oswaldo Cruz, además de reconocer los facilitadores, obstáculos y brechas. Para ello se realizó un análisis, desde la etapa de selección del socio más adecuado hasta la incorporación de la nueva tecnología. La metodología utilizada se basó en una amplia revisión bibliográfica sobre el tema, combinada con el estudio de caso. Los resultados mostraron que, si bien aún es necesario llevar a cabo muchas acciones para maximizar las ganancias de capacidad tecnológica, las lecciones aprendidas del proceso de transferencia de tecnología servirán como lecciones y se utilizarán en acuerdos futuros y en curso.

Transferencia de Tecnología; Vacuna; COVID-19

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