

Clinical Engineering and health policies in Venezuela: challenges and achievements in a changing political context

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ABSTRACT

This article summarizes the evolution of clinical engineering in Venezuela and its interaction with the political environment and health policies.

Method: The study consists of a comprehensive review of publications from the Health Technologies Management Unit of Simón Bolívar University throughout 1992-2023, organized into three thematic areas: Technological and Environmental; Relationship with Public Health Policies; and Influence of the Political System.

Conclusions: The early history of clinical engineering in Venezuela stands out for its impact on training and technological management to ensure quality and efficiency in the Venezuelan healthcare system. In the first area, it demonstrated the potential for improvement in medical technologies, generating high expectations. The second area focuses on the relationship between technologies and health policies, emphasizing the need to align public policies and technological management. However, challenges identified include the lack of evaluation and selection of appropriate medical technologies and political influence in acquisitions. The third area addresses political influence on the quality of medical care, emphasizing the importance of considering political and technological aspects in decision-making.

Keywords – *Clinical engineering, health technology, public policies, political systems.*

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INTRODUCTION

Venezuela’s humanitarian crisis, the resurgence of vector-borne diseases, and the implications of contagion in the region are well known [1]. What is little known is the struggle of the Health Management Unit to improve medical technologies. Health Technologies are attached to the Research and Development Foundation of the Simón Bolívar University (UGTS-USB).

For the last 30 years, UGTS-USB has conducted clinical engineering research. In this article, we will share how these investigations have been enriched thanks to the interaction with other areas of knowledge in a context marked by the political situation in Venezuela, like many Latin American countries. However, we want to point out that this experience is in Venezuela. The desire is to make known a little-known reality.

Our contribution in this field is especially relevant due to the challenges we have faced when researching in a country that has gone from a fragile democracy (1992-1999), authoritarianism (1999-2018), and finally, a dictatorship (2019 to the present). Initially, our focus focused exclusively on technology and the environment, aiming to develop technical capabilities and solve problems around clinical engineering. However, we soon realized that it was crucial to understand and consider the country’s political system to have any impact on society.

Therefore, we broadened our perspective and understood that technologies originate through public health policy. In this way, our research took a new direction, incorporating health policy study, evaluation, and analysis.

This more holistic understanding allowed us to generate greater value in our research and, most importantly, better understand the results obtained for the national and international organizations requesting our work. By considering the country’s political context, we were able to interpret the results of our contributions more accurately and how these may or may not be accepted to contribute to improving the health system in a challenging environment, as is often the case in countries of Latin America.

METHODOLOGY

The study consists of an exhaustive review of UGTS-USB publications covering the period 1992-2023, categorizing them into three thematic areas:

a) Technological and Environmental Approach:

We focus on advancing technical capabilities in the field of clinical engineering. We explore how these capabilities have delivered tangible results, particularly in a democratic context.

b) Intersection of Technologies and Public Health Policies:

This area delves into the integration of health technologies into public policies. Examines how this integration can influence the application and utilization of technologies, especially in a politically authoritarian system.

c) Influence of the Political System:

The third area focuses on analyzing how the political system, particularly a dictatorship, impacts the performance of public policies.

Since the article is a narrative, Table Number 1 is presented to analyze the essential elements that characterize it.

TABLE 1. Fundamental Elements of the Article Narrative.

Characters	
Protagonist	The Health Technologies Management Unit (UGTS-USB), affiliated with the Research and Development Foundation of Simón Bolívar University, is the central figure in this narrative.
Antagonists	During the research period, governments emerged as the primary antagonists. In secondary roles, national institutions, private companies, organized social entities, and non-governmental and international organizations that commissioned the research also feature, each playing a role that adds complexity to the narrative.
Setting	
Place	Venezuela, located in South America.

Historical period	1992-2023
Political conditions	Fragile democracy (1992-1999), authoritarianism (1999-2018) and finally a dictatorship (2019 to present).
Social conditions of the protagonists	The decrease in university salaries in the last 22 years in Venezuela reaches historic levels. At the end of 2001, a full-time professor had a salary equivalent to about \$2,440. For January 2023, the salary of a top-level and dedicated teacher is \$26.14, calculated at the official rate of the Central Bank of Venezuela (BCV).
Mood	
During the democratic period, hope, optimism, and confidence defined our days, even facing challenges. The transition to authoritarianism plunged us into a sense of “amazement” as we witnessed foreign professionals taking precedence over Venezuelans. In the dictatorship phase, tension gripped us. Regime sympathizers closely monitored the execution of projects with international organizations within hospitals. Aware that we could face disappearances or imprisonment upon completing our tasks, we lived under constant pressure. However, we keep the hope alive for a return to democracy in Venezuela and eagerly anticipate contributing to improving our healthcare system.	
Theme	
This article summarizes the evolution of clinical engineering in Venezuela and its interaction with the political environment and health policies.	
Point of view	
We opt for the first person, identifying ourselves with the acronym UGTS-USB. This approach immerses us in an intimate perspective, allowing us to explore the thoughts and emotions of the Management Unit throughout its research journey.	
Conflicts	
Inside the UGTS-USB	During the democratic era, internal harmony prevailed as we all belonged to the engineering field. However, resistance surfaced within the group with the onset of authoritarianism and the incorporation of areas related to public policies and knowledge of political systems. This juncture evolved into a phase of discussion and analysis, highlighting the imperative to address conflicts and integrate specialists in those areas.

External	In the democratic period, access to information was relatively straightforward. Yet, during authoritarianism, although we could gain entry to health institutions, formal requests for information often went unanswered. The challenge escalated during the dictatorship when we lacked access to public institutions and information. When access was finally secured during the dictatorship, it came through international organizations, with the commitment to maintaining information confidentiality—no direct or indirect disclosure to third parties without the prior written consent of the Contracting Party. The possession of sensitive information directly impacting the health of Venezuelans, coupled with the inability to disclose it, poses an ethical and moral conflict. Nevertheless, we maintain hope that these highly esteemed organizations will carry out effective work.
Style	
We adopt a realistic approach reflected in the faithful and detailed representation of reality over time, as depicted in our published research. Our narrative authentically portrays everyday life and organizational dynamics. Before publication, many of our investigations underwent public discussions, hoping they would be subject to contradictions and debates, fostering a broadening of perspectives. However, our resource constraints and the necessity to meet established deadlines added an additional challenge to this process.	

Source: table prepared by the researcher. Information on social conditions can be detailed in: Human Rights Observatory (2023), on its [website](#).

HISTORICAL BACKGROUND

The early history of clinical engineering in Venezuela is characterized by three fundamental milestones that have shaped its evolution. In the 1970s, a technical health training program known as “Hipólito Unanue” was established, which impacted not only Venezuela but throughout Latin America, laying the foundations for the training of personnel in the management of technologies. In 1993, a survey conducted among engineers from the Foundation for the Maintenance of Medical Assistance Infrastructure

(FIMA) revealed the pressing need for training in medical devices, underscoring the importance of continuous training in this constantly evolving field.²

However, the highlight was the introduction of clinical engineering in Venezuela in 1992 under the visionary guidance of Professor Luis Lara Estrella. His focus on technological management as an integral part of health care led to the creation of the Health Technology Management Unit (UGTS), which became a fundamental pillar in optimizing technological aspects in health institutions. His definition of clinical engineering as integrating various engineering and management processes, seeking efficient and effective technological management with high availability and satisfaction, reflected the holistic vision necessary to ensure quality and efficiency in medical care.³

These historical milestones marked the beginning of clinical engineering in Venezuela and underlined the crucial relevance of technical training in health. The combination of technical training and sound technological management became the cornerstone to ensure the quality, availability, and efficiency of medical infrastructure and devices used in the country's health system.

RESULTS

a) The first area was technological and environmental.

In the first area, which spanned since 1996, the Venezuelan health system observed a push toward technological and environmental modernization. A notable milestone was the transformation of the JM de Los Ríos Children's Hospital into an autonomous service as part of the decentralization of the health system. The newly assumed administration decided to work with the UGTS-USB to improve the hospital's technological capacity, which resulted in a significant increase in the hospital's operational level, rising from 26% to 64% in just one year.⁴ The operational level refers to recovering installed technologies, which require corrective maintenance.

The fundamental points that generated this positive and encouraging result have to do with a) financing; b) political decentralization; c) transparency, by having scrutiny

by the press or any interested organization; and d) the link between the hospital authorities (public world), the university (knowledge), and the private world.

On the other hand, the European Community generously offered financing to continue the modernization process. However, the political dynamics changed under the new administration led by Mr. Hugo Chávez. The proposal to involve the Cuban government in the project caused disagreements and tensions, ultimately preventing this opportunity from materializing. This disruption negatively impacted the hospital's ability to provide quality care to patients by limiting their access to technology and resources that would have significantly improved medical services.

To understand the decision of President Hugo Chávez, to create a new healthcare model in Venezuela, directed and inspired by Cuba; An investigation was carried out with another group of colleagues from the USB. One of the most important conclusions was that the quantitative data found did not allow for measuring the impact of the Cuban mission, expressed in the population's improvements in health conditions and the prevention of diseases.⁵

In 2001, an evaluation of the Ministry of Health's main hospitals revealed a common deficiency in their technological management, highlighting recurring problems in key areas such as the electrical system, elevators, and air conditioning systems. This lack of adequate technology management posed significant challenges to providing an optimal healthcare environment.⁶

In 2019, evaluations were carried out in two hospitals in Caracas by the UGTS-USB, under the observation of international organizations. Although the results were not published due to confidentiality requests, it can be noted that the hospital infrastructure experienced a deterioration concerning the evaluation narrated in the previous paragraph. This decline was exacerbated by a drinking water shortage and environmental sanitation deficiencies resulting from inadequate cleaning practices. Additionally, a worrying 23% rate of healthcare-associated infections was recorded. The work was presented to the country's health authorities and international organizations.

In 2001, the Essential Public Health Functions (FESP) of the Ministry of Health of Venezuela were evaluated. “Guarantee and improvement of the quality of individual and collective health services” obtained the lowest score.⁷ These results highlighted the importance of addressing technology management in health policy planning. These results prioritized our future work.

The UGTS-USB prioritized the creation of a protocol for the evaluation of medical devices, which, after its development, obtained approval from the Ministry of Health as official policy. However, despite these established regulations, devices purchased by public entities do not undergo evaluations before use, raising concerns about the effective implementation of such a policy.⁸ Likewise, it should be noted that the medical devices used and acquired by Cuba were not subjected to evaluation either.

The UGTS-USB included the incorporation of the environmental aspect in the studies. The disposal of hospital waste and mercury by dental personnel were evaluated. The findings pointed out deficiencies in waste management and potential health risks in the hospital environment, underlining the importance of addressing environmental aspects in the management of technologies.⁹⁻¹⁰

In 2013, a study carried out in collaboration with an oil company exposed the relationship between technological management and health infrastructure by identifying damage to medical equipment due to fluctuations in the electrical supply. This example highlighted the systemic challenges in technology management and its impact on public service delivery.¹¹

Finally, with the emergence of the COVID-19 pandemic in 2020, the capacity for collaboration between health organizations (private clinics), private companies, and universities in creating essential medical devices was demonstrated. The response to the crisis led to the development of mechanical ventilators and protective equipment prototypes, evidencing the importance of clinical engineering in critical moments of public health. Although the work was presented to the Red Cross and communication was maintained with government entities, the expected viability was not achieved, highlighting

possible challenges in promoting and accepting innovations in the health system.¹²⁻¹³

These episodes highlight the evolution of clinical engineering in Venezuela over the decades, marked by technological advances, political challenges, and the importance of technical training and effective management to ensure quality and efficiency in medical care.

b) The second phase includes the relationship between technologies and public health policies.

Research and health policies adopted by developed nations significantly influence public health strategies in developing nations. Typically, this process involves adaptation, collaboration, and consideration of local needs. Effective public policies in health must be based on scientific evidence, local context, and international collaboration.

Our first work on this topic took place in 2003, in collaboration with the Venezuelan Society of Cardiology, when the institutional performance of a Cardiology service was evaluated from 1990 to 2000. This analysis found that the service complied with 73% of the guidelines established by the American College of Cardiology and the American Heart Association (AHA).¹⁴ It should be noted that technological considerations were not addressed in this study.

In 2004, we developed a conceptual and methodological proposal in the context of a medical technology management project sponsored by the Ministry of Health. The main objective was to establish coherence between public health policy and medical technology management.¹⁵

Subsequently, after a year of studying the health system in France at the University of Nancy, we wrote an article in 2005 to conceive a political-management model, supported by two specific experiences: a) the execution of projects in various health institutions in Venezuela and b) an in-depth analysis of the European health system, particularly the French system.¹⁶

Our approach is built on a series of crucial steps that allow for a more effective and sustainable intervention: defining objective morbidity and mortality, analyzing the

determinants of health, evaluating current public health policies, delimiting the geographic and local context, and selecting the relevant technologies. Without a doubt, it is imperative to have the participation of all the actors involved to carry out this work.

Delimiting the geographical and local context is essential due to the great differences in Venezuela. Our study considers data from various sources and finds relevant differences between territorial entities when designing national public policies based on evidence.¹⁷

Throughout our work in public health policies related to the cardiovascular system, we have observed a lack of evaluation and even less in selecting appropriate medical technologies. In this sense, it has been identified that the acquisitions of technologies after 1999 have been carried out through agreements with ideologically related allied nations. In many cases, they are selected by another country without due evaluation of their quality and relevance.

An example of acquisitions from ideologically related countries was observed in the adoption of radiotherapy and nuclear medicine rooms in 19 public centers through a bilateral agreement with Argentina in 2011. This agreement revealed that numerous pieces of equipment lost their five-year maintenance guarantees because they were at customs. In addition, several regulations related to radiotherapy and those of the Health Comptroller's Office were not complied with. Unfortunately, the clause relating to the training of human resources was not adhered to.¹⁸

In October 2000, the Cuba-Venezuela Comprehensive Cooperation Agreement was established, a strategic mechanism that would impact both countries' health, economy, education, sports, and culture. The relationship between them is determined by two fundamental variables: politics and economics.

In the political sphere, both nations share a socialist ideology. However, economically they seek progress through cooperative advantages, through the exchange of goods and services according to their respective capabilities. Venezuela provides oil, while Cuba provides its human capital.¹⁹

If we focus on the technological aspect in the health area, although Venezuela has its own human resources, as a financial provider, it could be expected that its personnel would have a dominant position in the relationship. However, it is totally passive. Currently, due to the economic situation that Venezuela is going through, experts warn of a notable technological lag in the field of medical technologies. More than 60% of medical equipment is estimated to be obsolete.²⁰ No other situation could be expected because, in both authoritarian and dictatorial periods, the positions of the Venezuelan specialists who had decision-making were postulated, not because of their capacity but because of their ideological affinity.

Other specialists think that the Venezuelan government found in Cuba great support to develop its regional political project, involving the military sphere to remain in power, avoid uprisings, and fight against internal opposition and international pressure that advocates for a regime change in Venezuela.²¹

c) The third area will analyze how the political system influences the quality of medical care.

We are fully aware of the importance of considering political and technological aspects when making sound decisions. For a broader understanding, it is enriching to examine the work of Togerson.²²

An illustrative example is evident in evaluating the quality of cardiology services in a hospital during the study period (1990-2009). In the first stage (1990-1999), a decline in the quality of care is observed, decreasing from 73% to 58% in the second stage (1999-2009), influenced by two contrasting political systems.²³

In the second stage, despite implementing improvements in the environmental setting and acquiring medical devices (unfortunately, we lacked information on the entity responsible for these acquisitions and on the evaluation of the quality of these devices, in compliance with Health Oversight), a decrease in the quality of medical care was observed. The increase in coverage by 75%, without conducting fundamental studies to structure the local care offering [16] effectively, resulted in a decline in quality. The results were shared with authorities and patients. In

2014, hospital authorities decided to revert to the same coverage they had in 1999, indicating a lack of preparedness to manage a 75% increase in the population served in the second stage.

Likewise, we conducted a comparative analysis of the management status of the JM de Los Ríos Children's Hospital about its situation two decades ago (1996-2016). In 1996, a significant improvement in operational capacity was evident, increasing from 26% to 64%. However, by 2016, a reduction in operability was observed, falling below 25%. Additionally, unsanitary conditions were identified, such as contamination of freshwater sources.²⁴ It is worth mentioning that, in 1999, despite the European Community seeking collaboration on the technological improvement project alongside the USB, this initiative did not receive government approval.⁴

These unsanitary conditions, among other pieces of evidence, were used by the non-governmental organization "Prepara Familia" to request the adoption of measures to protect the rights to life and personal integrity of the children hospitalized at the JM de Los Ríos Hospital. Consequently, in February 2018, the Inter-American Commission on Human Rights (IACHR-OAS), in its Resolution 8/2018, issued precautionary measure No. 1039-17, which was expanded in Resolution 43/2019 dated August 21, 2019.²⁵⁻²⁶

In 2018, we shared our first experience with an organized civil society that had the desire to collaborate in improving the healthcare system in their municipality. UGTS-USB gathered information and transformed it into a "Social Agenda" aligned with the Constitution. Subsequently, this agenda was discussed with various regional social and political stakeholders.²⁷ The regime rejected the support.

Later, with the support of an international agency (which we are prohibited from identifying), we managed to secure adequate funding to improve the living conditions of healthcare professionals in the locality. Subsequently, the Civil Association took the initiative to create its own spaces to provide medical care to the region's citizens.

In 2021, two international organizations hired UGTS-USB to conduct research to assess the situation of hospitals. However, restrictions limiting the disclosure of the resulting information made it impossible to make the obtained results public. We do not want to speculate on the reasons for this limitation. Nevertheless, it is important to note that censorship impacts the discussion of issues concerning the problems in Venezuela in the context of a dictatorial government situation.

Finally, based on our experiences, we propose conducting "Longitudinal Analysis of the Intersection between the Political System, Public Policies and Technological Management in the Context of Health", abbreviated as "policy-tech." However, the challenges we face in this type of research are notable, especially regarding information acquisition.

Describing a political system seems like a relatively accessible task. When it comes to public policy, a review of medical records (when possible) reveals a loss of 47% of such records. However, collecting technological information in a longitudinal analysis is the real challenge. Critical data such as annual inventory, operational status of the equipment, life history of the equipment, operation and maintenance manuals, experience evaluations of technical personnel, selection procedures, and contracting of service companies, among other fundamental aspects, are non-existent. The absence of this data represents a substantial obstacle to achieving a complete and accurate evaluation.

Exploring the works cited in our bibliography provides suggestions for addressing these challenges. For example, in public policy, we seek guidance from statistical experts. Regarding technological management, we condense our strategies into the following activities: identify colleagues or companies with experience in the institution, carry out systematic literature reviews, and establish dialogues with doctors, nurses, and technicians who manage these technologies. Notably, many of these institutions had been previously evaluated by the UGTS-USB, which allowed comparisons to be made that would facilitate decision-making.

CONCLUSION

The health system is suffering degradation as a dictatorship consolidates, resulting in a currently complex humanitarian crisis. While the general situation is widely recognized, the clinical engineering narrative is poorly understood.

Clinical engineering in Venezuela is characterized by three fundamental milestones: the establishment of the “Hipólito Unanue” technical health training program in the 1970s, laying the foundation for medical technology training throughout Latin America; the introduction of clinical engineering in 1992 under the visionary direction of Professor Luis Lara Estrella, focused on comprehensive technological management in health; and the evolution towards technological and environmental modernization of Venezuelan hospitals, although hindered by political challenges and inadequate management.

In the first realm, clinical engineering in Venezuela experienced notable technological advancements, political challenges, and the constant need to adapt to ensure quality healthcare. Collaboration between the public and private sectors and efficient management emerge as crucial elements to overcome these challenges.

The second domain underscores the importance of coherence between health policies and technological management, the necessity of considering the local context in policy formulation, and the challenges associated with technology acquisitions lacking proper evaluations. Additionally, the strategic relationship with Cuba has significantly influenced the landscape of clinical engineering in Venezuela.

The third domain highlights how political changes can directly impact healthcare quality. Instances such as the decline in the quality of cardiology services, the management of JM de Los Ríos Children’s Hospital, and collaboration with civil society emphasize the complexity and challenges associated with the interaction between the political system and public health. The presence of censorship in a dictatorial context underscores the limitations in discussing and evaluating the healthcare situation in Venezuela.

Finally, the narrative underscores the imperative of overcoming challenges in the “policy-tech” research. However, the lack of essential data poses a substantial obstacle. Nevertheless, it is recommended that these challenges be addressed by exploring cited works in the bibliography. In the realm of public policies, seeking the expertise of statistical experts is suggested to overcome the loss of records. For technological management, concrete strategies are proposed, including locating colleagues or companies with experience in the healthcare institution, conducting systematic literature reviews, and engaging in direct dialogues with healthcare professionals.

The mention of previous evaluations by UGTS-USB provides valuable insights to facilitate future decisions. A proactive and collaborative approach is emphasized to tackle the inherent challenges in the proposed research.

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