


Analysis of Managers' Perception Regarding the Use of Traceability Tools in the Context of Brazilian Health

INQUIRY: The Journal of Health Care Organization, Provision, and Financing
Volume 58: 1–8
© The Author(s) 2021
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/00469580211065681
journals.sagepub.com/home/inq


Emerson P. Vidal¹ , Márcia M. C. De Liberal², and Paola Zucchi²

Abstract

Our society has advanced in terms of technology, and health could not be different. Despite the benefits and advantages that such improvements entail, it is unknown what contributions have been added to the hospital environment and whether such technological engineering has managed to generate value and adapt to different factors within such institutions' professional culture to establish relevance to the base of utilitarian nature. The use of tools can be conditioned to the view that the managerial sectors have such instruments. The work aims to identify and understand the perception that health managers have traceability tools such and their view on their efficiency and effectiveness in the hospital environment. The results direct us that the traceability tools have a significant expression in the hospital context, collaborating for efficiency and efficacy. Traceability tools can help the entire health system to be more uniform in service, in accountability, and in inspection processes.

Keywords

efficacy, efficiency, health system, internet of things, management, radio frequency identification, traceability

What do we already know this topic?

Traceability tools have been widely used in the health system and increasingly taking part in hospital processes.

How does your research contribute to the field?

The traceability tools contribute to hospital effectiveness and efficiency so that they enable greater agility in the processes and a more satisfactory work in the manager's view.

What are your research's implications toward theory, practices, or policy?

The use tools it implies a greater expenditure on the party of health institutions in the short term. In the long term, it brings advantages that outweigh the investment. The gain with health intangibles, such as patient satisfaction, streamlining the processes, and the image of the organization are essentially very important attributes.

Introduction

All activities involving the patient care process are essential in obtaining information. Still, the chain of tasks in which each of the health service activities is supported has significant relevance.¹ In this sense, there is a search for better management and health of high quality and high performance, providing the basis for the processes to become more agile and fluid.

Therefore, making healthcare processes more operational is one of the most fundamental objectives that a hospital's

¹Federal University of São Paulo, UNIFESP, São Paulo, Brazil

²Department of Health Management and Economics, School of Medicine, UNIFESP, São Paulo, Brazil

Corresponding Author:

Emerson P. Vidal, Federal University of São Paulo, UNIFESP, Rua Botucatu n° 740 - 3° andar - Sala 307, Edifício Octávio de Carvalho, São Paulo 04023-062, Brasil.

Email: emervidal@hotmail.com



Creative Commons Non Commercial CC BY-NC: This article is distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits non-commercial use, reproduction and distribution of the work without further permission provided the original work is attributed as specified on the SAGE

and Open Access pages (<https://us.sagepub.com/en-us/nam/open-access-at-sage>).

management may be seeking. Methods of avoiding unnecessary harm to the patient and promoting safety are highly desired. Safer hospital systems are more adaptable, and they are generally urgent for the quality of health to be high. At present, intense research has been carried out to achieve a determining factor for patient safety.¹ It is known that one of the sectors that occupy a fundamentally important level is supply chain management (SCM) in the healthcare scenario.²

And not only the hospital administration seeks these processes, but indirectly, our entire society, in general, is looking for medical assistance that is safe, agile, fast, and available whenever necessary. Managing the technology park of a healthcare organization requires actions that can anticipate the consuming public's needs. Traditionally, health management was focused on the institutional organization so that health professionals, specifically doctors, could exercise assistance work with significant autonomy. In the current context, in a movement for effectiveness, quality, and efficiency in health, management has significantly expanded its scope of action, requiring the integration of different types of services and their care processes.³

For this feeling, the health system is responsible for the effectiveness, quality, and efficiency of the services that are in their mission. These transformations have many implications because the care processes are no longer the absolute autonomy of health professionals and become an organizational purpose, materialized in expected protocol standards, in constant development and updating.⁴

It is known that the management of inpatient units lives with an absence or little global planning, with difficulty in coordinating the set of care and administrative processes, the lack of daily practices for classifying users' care needs, and the correlated indication of the dimension of professionals necessary nursing care, little or no systematic measurement of assistance and organizational performance, communication problems, and lack of participatory management. Thus, there is a need for technologies to address these needs, integrate care and administrative processes, practice continuous performance improvement, and encourage comprehensive and interdisciplinary care, generating positive impacts on the quality of care and the work environment.⁵

The use of traceability tools in our society has been spreading and many consider such use a modern trend, in which the fact that it allows the system to be safe, timesaving, and uniform weighs in its favor. The error in medication administration is considered one of the key factors that increase the length of stay of patients in hospitals and the cost of hospitalization.⁶ Thus, many authors attribute to traceability the ability to manage and optimize such systems.^{7,8}

Some studies suggest that technologies such as Barcodes, RFID (radio frequency identification), QR Codes (Quick Response), NFC (Near Field Communication), among others are fundamental for the accomplishment of daily activities within a healthcare organization when it comes to process management. It thus considered the traceability tools a promising tool for

process standardization and regularization of actions within the hospital environment.^{9,10,7} However, some publications diverge from this view by pointing out possible dangers of traceability, which in turn can bring with it risks regarding data protection and loss of freedom of action for the traceability of people, fraudulent and ethically and morally pernicious practices.¹¹

The traceability practices have been conforming and gaining more and more space in the scientific literature, in such a way that it is no longer a novelty that worldwide-recognized institutions use them as a tool to maintain the quality of patient care. Anyway, resources such as RFID and Barcodes are part of the hospital organizational framework, and what is discussed is about the real efficiency and effectiveness of these devices.¹² Since the human being can be flawed when performing his daily tasks, with the occurrence of memory lapses, fatigue, lack of knowledge, lack of communication, inattention or even irresponsibility in his professional work, measures are urgently needed to overcome these deficiencies and it is this gap that the traceability tools come to fill.^{8,13}

For hospitals to achieve their goals, it is not enough to be managed efficiently. They must be conducted effectively, that is, use all available methodologies, tools, and resources. The effective use of these resources will depend on hospital management's scope and its success.¹⁴

As the focus of the work is the traceability tools that enable the integration of hospital processes, allowing them to be more agile and easily operationalized, the following research question arises: what is the perception that managers have about efficiency and efficacy traceability tools in your daily life?

The research objective is to analyze the efficiency and efficacy of the traceability tools such as bar code, RFID, card technology, QR CODE, iBeacons, through the manager's perception regarding its use in the hospital system. Articulating the view, those managers have about the efficiency and efficacy of such tools in the hospital environment. Therefore, it is recommended to investigate the relationship that hospital managers maintain with the tools and their daily and routine use (when applicable).

Method

The study sample consisted of general private and public hospitals in the city of São Paulo. In 2018, the municipality of São Paulo had 147 general hospitals, according to a survey carried out by the Ministry of Health, in the National Registry of Health Facilities in Brazil (Cadastro Nacional de Estabelecimentos de Saúde). Of these, 71 were large and special, selected to compose the research, and 25 hospitals formed the last sample.

The study covered the period from December 2017 to December 2019 when primary data were collected for analysis. This occurred after the Ethics Committee duly approved the research, under opinion number 2,351,293 on October 26, 2017.

To get the data, a Survey questionnaire with a Likert scale was used, where multiple-choice questions were graded on a scale of 1 to 5 points, which encompassed the following

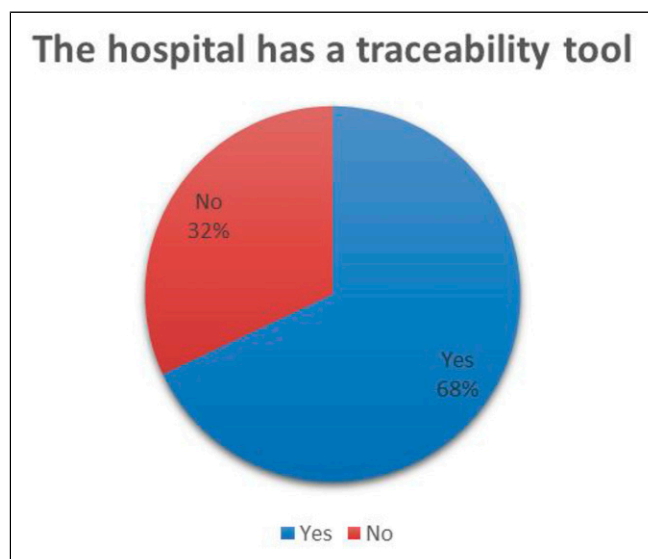


Figure 1. Number of institutions using traceability tools. Source: Elaborated by the author.

categories: “strongly disagree” (1), “slightly disagree” (2), “I don’t agree, nor disagree” (3), “I agree a little” (4), and “I totally agree” (5).

The questionnaire was prepared through a pre-test carried out with 5 large hospitals in the state of São Paulo. The managers involved, after answering the questionnaires, issued an opinion about questions that they considered irrelevant, unnecessary, or not in accordance with the purpose of the research. After the pre-test validation, a team formed by professionals in the area of management and health economics got together and judged the relevance of the opinions and interviews conducted with the professionals, and finalized the questionnaire. Although the questionnaire was not obtained directly from any source but was created by the research team, its theoretical foundation was based on the concerns of managers regarding the usefulness of tools that are described in texts of great references in the management area.

The analysis of Likert data comprised a series of procedures that involved descriptive statistics. For the calculation, a measure of central tendency was used in which the answers were gathered and from which the most frequent one was got, which made the answers more comfortable to be interpreted. It showed data (the distribution of responses) in a graph such as a bar and pie, where each response was discriminated against the category.

The questionnaire questions were assessed individually and aggregately, which allowed the visualization of an aspect, allowing them to have a dimensional notion of effectiveness and efficiency.

The research also involved a qualitative analysis regarding the managers’ experiences with the traceability tools, which through the expression of their opinion referred to the positive and negative aspects of the adoption of the traceability tools,

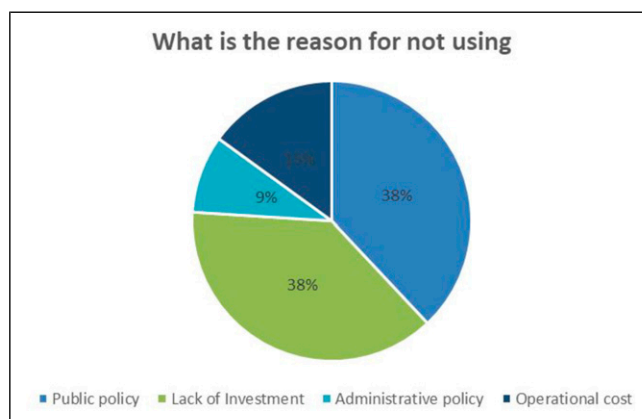


Figure 2. Main reasons for not using a traceability tool. Source: Elaborated by the author.

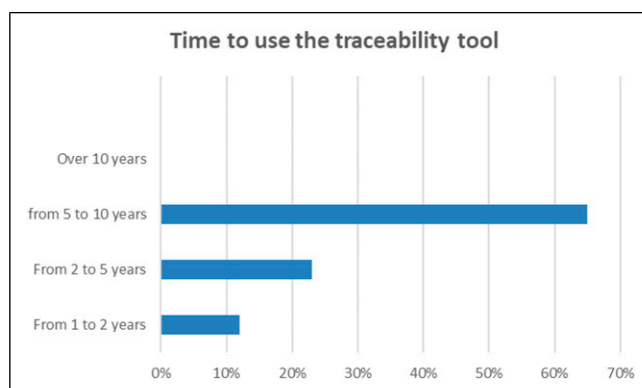


Figure 3. Time of use of the traceability tool. Source: Elaborated by the author.

which can be observed by means of graphs of the Likert questionnaires expressed.

Results

The surveyed hospitals’ population resulted in 25 contacted hospitals, who answered the questionnaire and the informed consent form, 17 (68%) of whom had traceability tools, and 8 (32%) declared that they did not have traceability tools. Thus, the hospitals’ sample was investigated under a 95% confidence index, with a margin of error (sampling error) of 10% (Figure 1).

Population and Sample

The hospitals that declare they don’t have traceability tools 38% blamed the lack of investment and the lack of public policies as the main reason for not adopting them, a reason mainly linked to hospitals that depend on projects and implementation by the state. Operating cost was another factor cited as a barrier to implementation. The data can be seen in the graph in Figure 2.

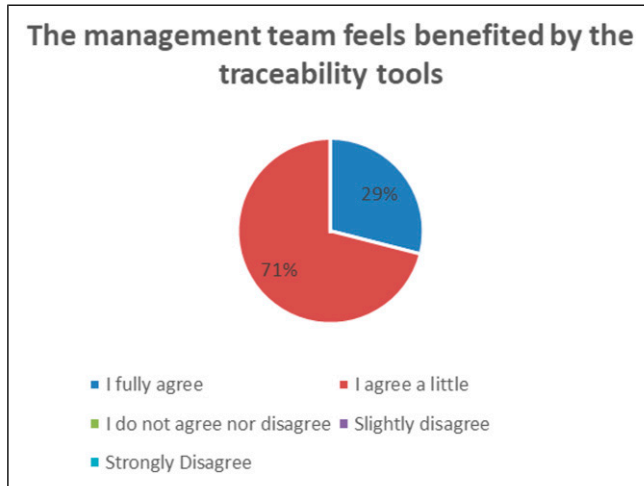


Figure 4. Traceability has brought benefits to the management team. Source: Elaborated by the author.

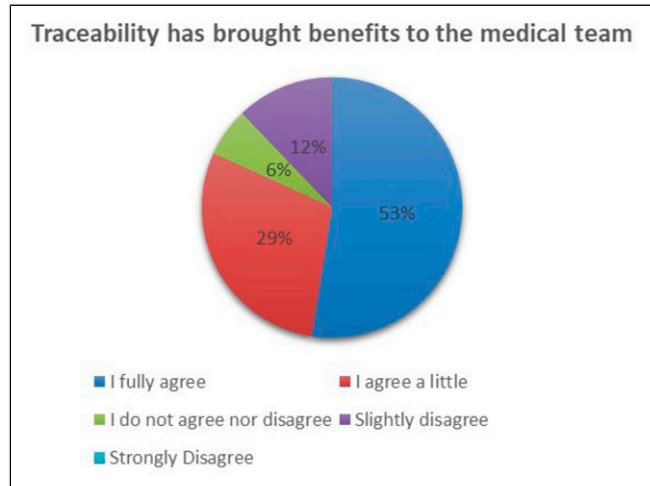


Figure 6. Traceability implied advantages for the medical team. Source: Elaborated by the author.

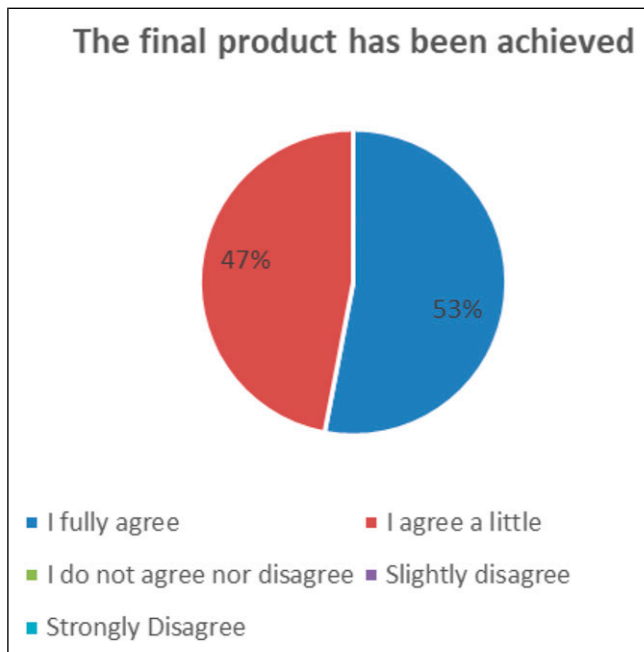


Figure 5. The final product (quality of service) was achieved after implementing traceability. Source: Elaborated by the author.

As for the time of using the tool, hospitals are still short of use, with the majority having (65%) 5 to 10 years of using the instrument (23%) with a time of 2 to 5 years, and 12% under 2 years old. No hospitals with over 10 years of use of the tool were observed, which shows the recent use of such instruments (see [Figure 3](#)).

Management Perception

The data on the managers' perception of the traceability tools indicate that they perceive them as essential items for

management with less expenditure on equipment and concern with patient care. This can be seen with the large number of managers who fully agree (29%) and partially (71%). Besides, no answer negatively declares the benefit of the tools. Thus, the sum of those who believe that the tools have positive characteristics reaches 100% ([Figure 4](#)).

Other inquiries confirm the proposition that the traceability tools represent an excellent implement for a more regular and continuous administration, in a way that makes it possible to reach a last product, quality service for the institution. Approximately 53% said they fully agree that the product has been achieved, and 47% said they partially agree. These results indicate that the traceability tools have been providing an advantageous scope in terms of objectives (see [Figure 5](#)).

Perception of the Treatment Team (Medical, Nursing, and Pharmaceutical)

The perception of the medical team, according to the general administration of the hospital, was positive. Only 2 hospitals (12%) stated that they disagreed a little that traceability implied benefits for doctors' general body, while another remained neutral. However, the majority chose to fully or somewhat agree with the advantages of the instrument for the medical team ([Figure 6](#)).

Another issue that suggests efficiency in medical and nursing processes is the one that asked about the benefits of patient control, its consequent administration, and better medical practices for them. The data got allowed us to see that approximately 65% of the respondents stated that they fully agreed, and 24% agreed to a little with the statement, leaving only 5% that claimed to disagree a little and another 6% who stated neutrality ([Figure 7](#)).

When the pharmacy team is evaluated, the results show everyone agrees that traceability has brought benefits to the sector in such a way that there has been more significant

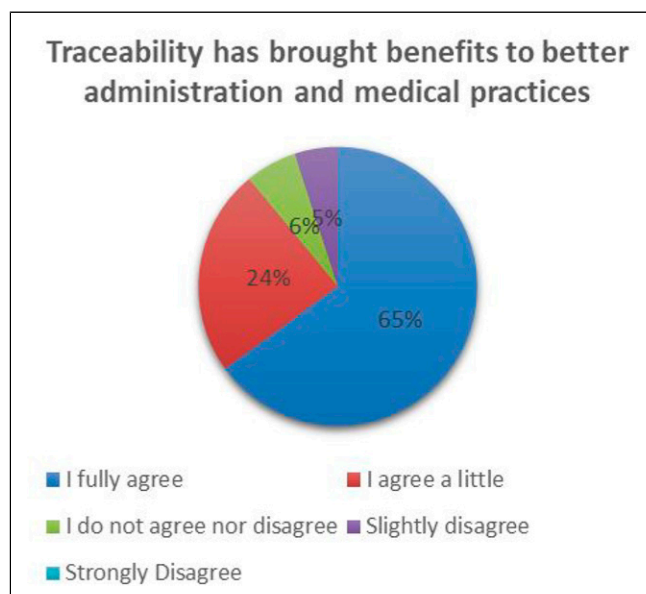


Figure 7. The benefits that traceability has brought to the patient via better administration and medical practices. Source: Elaborated by the author.

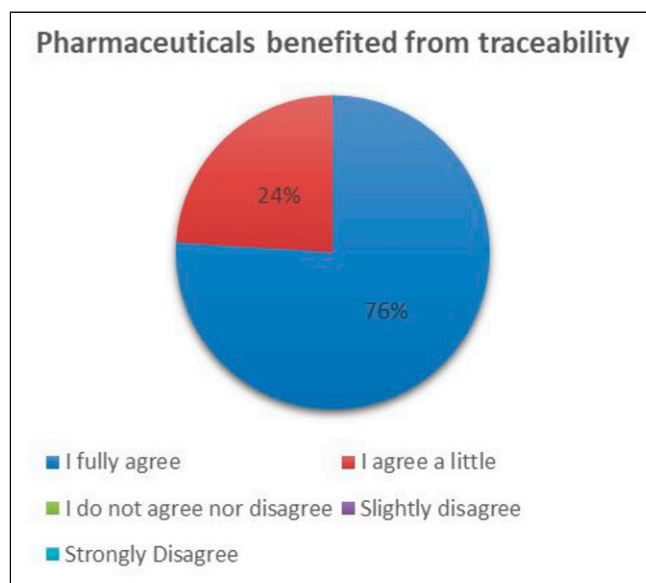


Figure 8. Traceability has brought benefits to the pharmacy sector. Source: Elaborated by the author.

control of medication, dispensing, checking, and storage. There are 76% who fully agree with the statement and 24% who agree with a little with the statement, and I strongly disagree and slightly agree, as well as the neutral did not present any score (Figure 8).

The data described here lead to the understanding that tools are a helpful option and have the original cause of their affiliation as providing greater data security.

Descriptive Data

Table 1 displays a summary of the medians of the Likert questionnaires. It can be observed that the managers' perception is between median results 4 and 5, which shows that their perception is that the traceability tools are efficient and effective. These constructs allow us to extrapolate that the taking part managers are unanimous in the conclusion that such technologies are useful in performing their tasks.

Based on what has been presented here from the point of view of managers of large and special hospitals, it can be said that traceability technologies confer advantages in the processes of hospitals that make use of them.

Discussion

Although health is the sector with the greatest need and the most considerable lag from a material point of view, it still needs massive investment, especially in public order hospitals. According to Yang, the resources that are promoted in health are still scarce in most parts of the world.¹⁵ In Brazil, data from 2009 reveal that spending in the area represents 8% of the country's Gross Domestic Product and that 60% of this total is invested in hospitals.¹⁶ With a scenario in which the aging of the population is configured. There are demographic and epidemiological transitions, it is understood that the demands for new technologies are present so that their use becomes increasingly important and less superficial.⁹

Some factors are crucial for the adoption of traceability; among them, we can mention, well-defined organizational values, stakeholders' recognition as an important part of the process, the organization's capacity for innovation, financial motivation, partnerships, cooperation among peers, internal organization, and competitive climate.¹⁷ Other factors are necessary for full implementation, such as management awareness of the vulnerability of its products and processes, adequacy of national standards and legislation, coordination, combating counterfeiting, risks linked to product recalls, strategic vision, technological, organizational and financial bottlenecks, and concern with regularized, recorded, identified, and recovered processes.¹⁸

The main barriers that hinder the full development of traceability tools are human and financial; among them, we can list the loss of privacy, the feeling of surveillance, concern about data protection, and the cost of implementation in the short term.¹⁹ Apart from the financial and technical part of the implementation, what underlies the challenges for implementing traceability are ethical/moral issues, about privacy and the right to secrecy, there is a socially constructed imaginary of data exposure and government surveillance.¹¹ The discussion is not without foundation, but much in terms of safety and care of hospital processes is lost in the course of it, model hospitals in São Paulo have successfully implemented such technologies and the results have been very favorable and satisfactory.

Table I. Median of the Likert Categories.

Item	Median
Traceability has brought benefits to the management team	4
The final product (quality of service) was achieved after implementing traceability	4
Traceability implied advantages for the medical team	5
The benefits that traceability has brought to the patient via better administration and medical practices	5
Traceability has brought benefits to the pharmacy sector	5

* Strongly disagree (1), slightly disagree (2), I don't agree, nor disagree (3), I agree a little (4), and I totally agree (5). Source: Elaborated by the author.

When evaluating an acquisition in the hospital technology park, we must keep in mind that it is not only the financial impact that will affect the institution but the set of characteristics that make it possible to have greater efficiency and efficacy added to the greater speed, with quality and reliability.

When we refer to management as an appraiser of traceability tools, we realize they attach significant value to them so that the sum of those who fully agree with this who partially agrees reaches 100%. It supported these data in the literature as to their usefulness, which is found in tools such as RFID, bar code, QR Codes, among others, a robust application, and better performance in the daily routine of hospital institutions.²⁰

The systems that make up these institutions are increasingly becoming popular in logistics, inventory, materials management, and automation operations, which replace manual identification processes.²¹ For example, RFID can provide many benefits for the healthcare industry, totally improving security and operational efficiency because it operates without a dial tone, providing read/write capabilities.²² Radio frequency identification can contribute to creating the hospital of the future by improving patient care and safety, optimizing workflow, reducing operating costs, and reducing the number of thefts.^{10,21}

Although such tools can be highly accurate and helpful, there are still those who see them as something to be viewed with some suspicion. Health professionals often fear that such a tool may interfere with their privacy and limit their freedom within your workspace. One attribute that makes traceability tools more efficient, especially regarding RFID, is the ability to track movement and hospital processes during the execution of tasks. Although limited a little, it is also an important instrument that not only ensures that the teamwork better also ensures that medical failures are more faithfully investigated, giving not only the patient safety, also the health professional the guarantee that they will not be wrongly accountable.²

The adoption of traceability tools still depends on public policies that guarantee free access. In the meantime, private hospitals predominate and, with a more focused eye on the efficiency of their processes, seek to guarantee an acceptable standard of quality. However, the adoption of more advanced devices is still limited by budgetary issues.¹³ Because of

financial issues, hospitals prioritize medical equipment, which is very important, but without the proper organization of processes ends up disrupting care in an orderly and streamlined manner.

The numbers that express what was already being said, the investment in technologies that increase in the safety of processes, is still seen as something unnecessary, besides introducing new technologies that expand institutional control to be seen as harmful to the research team job.

To implement tools that will increase institutional control, there is a need for organizational mobilization, which leads to commitment by members.

It is quite clear, in Brazil, those hospitals differentiate themselves as a business model, not only because of the peculiarity that is to help people who are in a delicate moment and, therefore, requires greater concern by society but because the quality that should be at the heart of the best service is often left in the background. When analyzing how far they are developed in technology, public hospitals are poorly computerized, and most computerized can be considered primary even when compared to the least computerized in the private sector. In the private sector, they are divided into 2 blocks: those that computerize by the obligation and those that use computerization as a competitive factor. These data converge with the data got in the survey so that the overwhelming majority of private hospitals taking part in the survey have traceability tools in their units. However, it falls short of health units in other countries, such as the United States, countries in Europe, and even some in Asia. In participating hospitals, it could consider only one a reference model for the use of traceability tools. In the public area, there is not even a single hospital that could be used as a computerization model, and in the private area, few have adequate systems for minimally efficient management.²³

Thus, although the hospital system needs more agile processes because of the high demand that seeks its services, the hospital organization does not invest in more effective tools to streamline its service, and its procedures become more time-consuming and, more uncomfortable and inefficient. The great paradox of hospital technology comprises having, on the one hand, cutting-edge technology applied in care processes (patient treatment), especially in imaging and surgeries using catheters and micro-video, and on the other, rudimentary systems for administration and management.

Conclusion

Improving the efficiency of a hospital is not one of the easiest or fastest tasks. Money, time, training, and patience must be spent, often facing resistance from the organizational culture that sees this as a kind of vigilance over their daily activities. However, in terms of security, much is gained in improving organizational care. The human being commits failures that can be previously avoided if the institution makes efforts to minimize them. However, even with hard training and with strong ethical rigor, these health workers are subject to the frantic workday that is within the health and inclement weather in life. Thus, it is not enough to pay attention. It is necessary to have material conditions that make human action more regularized.

Traceability tools can help the entire health system to be more uniform in service, in accountability, in inspection processes. Financing a holistic traceability project is not cheap, mainly if the institution aims at more robust technologies, such as RFID. But even other tools, such as barcodes, NFC, Beacons, among others, are extremely efficient in helping perform daily activities. It is a fact that the more computerized a health sector is, those who prescribe and issue reports, coordinate processes, and supervise through traceability tools, the better the service conditions, the more effective and which satisfies the client and the manager.

Managing a large and special-sized hospital is not the easiest task, and seeking a quality standard aimed at reducing or eliminating error is something that cannot only be found through human commitment; technical mechanisms must be developed that allow the team to minimize and possibly eliminate the error due to lack of attention or forgetfulness.

We can say that an emblematic factor of health is ethics and patient care, but that it is not always attended because of the large contingent, being relegated to poor service, either due to lack of care or standardization of practices. Of course, a mechanized service is not the ultimate aim but a humanized service with rigorous processes and that allows the user to feel that he is well-served without prejudice to his health.

Among the main barriers faced by the study we can say that even though it is a sample, reaching the number of participating organizations was costly and expensive since the manager is a professional with limited time, which required the team to always resend the questionnaires or reschedule interviews with such a professional; the lack of a unifying element of the professionals in the same organization to have direct access to the data is a serious problem in conducting research.

The study opens doors for future research regarding the accounting and gain bases with the use of such technology. What the study indicates is that there is a long-term financial gain with the traceability tools, but the values and the time it takes for the return are an open variable.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Research for this paper was Coordenação de Aperfeiçoamento de Pessoal de Nível Superior; 001.

ORCID iD

Emerson P. Vidal  <https://orcid.org/0000-0001-9906-030X>

References

1. Pérez MM, González V, Dafonte C. The development of a RFID solution to facilitate the traceability of patient and pharmaceutical data. *Sensors*. 2017;17:1-15.
2. Coustasse A, Cunningham B, Deslich S, Wilson E, Meadows P. Benefits and barriers of implementation and utilization of radio-frequency identification (RFID) systems in transfusion medicine. *Perspect Health Inform Management*. 2015;12:1-17.
3. Bohmer BRMJ. *Arquitetura e planejamento na gestão da saúde Porto Alegre: Bookmann*; 2011.
4. Toussaint J, Gerard RA. *Uma transformação na saúde: Como reduzir custos e oferecer um atendimento inovador Porto Alegre: Bookman*; 2012.
5. Lorenzetti J, Gelbcke L, Vandresen L. Tecnologia para gestão de unidades de internação hospitalares. *Texto Contexto Enfermagem*. 2016;25(2):1-11.
6. Bowers AM, Goda K, Bene V, et al. Impact of bar-code medication administration on medication administration best practices. *Comput Inform Nurs*. 2015;33:502-508.
7. Essink HM, Knops A, Liqui Lung AM, et al. Real-time person identification in a hospital setting: A systematic review. *Sensors (Basel)*. 2020;20:1-23.
8. Martínez-Péres M, Dafonte C, Gómez Á. Traceability in patient healthcare through the integration of RFID technology in a ICU in a hospital. *Sensors*. 2018;18:1-18.
9. Bruzzi S, Landa P, Tãnfani E, Testi A. Conceptual modelling of the flow of frail elderly through acute-care hospitals. *Manag Decis*. 2018;56(10):2101-2124.
10. Cerlinca TI, Turcu, Turcu C, Cerlinca M. *RFID-based information system for patients and medical staff identification and tracking*. Croatia: Interchopen; 2010.
11. Morana J. Barriers and dangers of traceability. In: *Les Rencontres Internationales de Recherche en Logistique et Supply Chain Management*, Lausanne, 2016 Setember, 1-14.
12. Aboelmegeed M, Hashem G. RFID application in patient and medical asset operations management: A technology, organizational and environmental (TOE) perspective into key enablers and impediments. *Int J Med Inform*. 2018;118:58-64.

13. Hu L, Ong DM, Zhu X, Liu Q, Song E. Enabling RFID technology for healthcare: Application, architecture, and challenges. *Telecommun Syst.* 2015;58:259-271.
14. Barbieri JC, Machline C. *Logística hospitalar. Teoria e prática.* 2nd ed. São Paulo: Saraiva; 2006.
15. Yang BM. The future of health technology assessment in healthcare decision making in Asia. *Pharmacoeconomics.* 2009;27(11):891-901.
16. Ribeiro JM. Desenvolvimento do SUS e racionamento de serviços hospitalares. *Ciência Saúde Coletiva* 2009;15(3):771-782.
17. Karâa M. *Les déterminants de l'adoption de la traçabilité par les entreprises de conditionnement de dattes en Tunisie.* Thèse de doctorat. Marseille: Université de la Méditerranée, Ecole Doctorale Sciences Economiques et de Gestion d'Aix-Marseille; 2010.
18. Lazzeri J. *Vers une traçabilité totale des supply chains: Les cas de l'agroalimentaire en France.* Thèse Doctorat. Marseille: Aix-Marseille Université, Sciences Économiques et de Gestion; 2014.
19. Lazzeri J, Fabbe-Costes N. La traçabilité totale des supply chains: Concept et modèle théorique de mise en oeuvre. *Revue Française de Gestion Industrielle* 2014;33(1):1-400.
20. Bhuptani M, Moradpour S. *RFID: Implementando o sistema de identificação por radiofrequência.* 1st ed. São Paulo: Instituto IMAM; 2005.
21. Marchand-Maillet F, Debes C, Garnier F, Dufeu N, Sciard D, Beaussier M. Accuracy of patient's turnover time prediction using RFID technology in an Academic ambulatory surgery center. *Journal Medical System.* 2015;39(12):12-15.
22. Wang T, He Y, Shi T, Jin T, Li B. Transformer health management based on self-powered RFID sensor and multiple Kernel RVM. *IEEE Trans Instr Meas.* 2019;68(3):818-828.
23. Salu J. *Administração hospitalar no Brasil.* 1st ed. Barueri: Manole; 2013.