



# Regulation and Use of Health Information Systems in Brazil and Abroad

## Integrative Review

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There is increasing debate about the importance of using information and communication technologies to strengthen health systems. Information systems are one of the most widespread technologies for this end in different healthcare contexts. The primary objective of this study was to highlight and discuss the main characteristics of the regulation and use of health information systems in Brazil and abroad. As a secondary objective, the main characteristics identified in Brazil were compared with the findings for other countries. A robust search strategy incorporated five electronic databases. The research question was defined using the SPIDER strategy, and thematic content analysis was applied. Fourteen articles composed the final sample, and three analytic categories were identified: “Use in the Context of Health Systems”; “Implications for Health Management”; and “Communication and Interoperability.” The regulation and use of health information systems in different countries was directly related to their socioeconomic context. In Latin America and Africa, policy strengthening and implementation possibilities for health management were discussed. In the United States, Europe, and Asia, the discussions on interoperability between different services was emphasized. The complexity of the Brazilian health system leads to similarities in the data analysis with several countries from different regions and with distinct political configurations.

**KEY WORDS:** Government regulation, Health information systems, Health policy, Health systems

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In recent decades, technological progress has outlined significant changes in all sectors, including health, with the creation of health information systems that seek to meet the needs of professionals and patients.<sup>1</sup>

An information system “collects, processes, stores, analyzes and disseminates information for a specific purpose,”<sup>2 (p40)</sup> and although there is a global consensus that better health outcomes are dependent on strengthened health systems and approaches that overcome the fragmentation and specific diseases, there are still very few countries that have health information systems that monitor indicators in a sufficiently effective manner.<sup>3</sup>

In the Brazilian Unified Health System (SUS), information systems are on the essential list of health technologies that must be present in all spheres of care—from primary care to hospital care. As with other health technologies, such as medication and healthcare products in general, it needs to be regulated by federal government and require evaluation for subsequent incorporation and use in the country's health system.<sup>4</sup> However, despite the creation of the National Commission for the Incorporation of Health Technologies, responsible for advising the Ministry of Health on the incorporation, exclusion, or modification of new technologies by the SUS,<sup>5</sup> studies show that information systems are not yet part of the routine evaluation and neither incorporated in the requests analyzed by the National Commission for the Incorporation of Health Technologies.<sup>6</sup> This clearly evidences the need to strengthen this regulation.

Having quality information in healthcare implies better decision making for professionals and managers, consequently leading to better health conditions for the populations.<sup>3</sup> In this sense, it is important to discuss the regulation and use of health information systems to strengthen health systems and care for people in different socioeconomic contexts. Thus, the primary objective of this integrative review was to highlight and discuss the main characteristics of the regulation and use of health information systems in Brazil and abroad. A secondary objective was to compare the main characteristics of health information systems existent in Brazil with other countries.

## METHOD

### Design

We opted for an integrative review, since this method can help to achieve a better understanding of a particular phenomenon or health issue. It permits the inclusion of studies with different methodological approaches and regulations, supporting decision making and policy formulation. This is a particularly appropriate review method for the health-related regulations to inform evidence-based practice as traditional systematic reviews, which place an emphasis on randomized clinical-based trials, limit the scope, and often fail to answer complex decisions that decision makers are faced with in a real-word context.<sup>7,8</sup>

This review followed the systematic approach to integrative reviews devised by Cooper<sup>9</sup> incorporating an updated methodology of this framework by Whittemore and Knafl.<sup>8</sup> A five-stage process for conducting integrative reviews was used in the development of the review: (1) problem identification, (2) literature search, (3) data evaluation and extraction, (4) data analysis, and (5) presentation of the results.

### Stage 1: Problem Identification

To elaborate the research question and perform the search in scientific databases, the strategy called SPIDER was used, which emerged as an alternative instrument due to the difficulty in using the traditional patient/population, intervention, comparison and outcomes in the search for qualitative and mixed studies for metasynthesis.<sup>10</sup>

The acronym SPIDER can be described as follows: S = sample; PI = phenomenon of interest; D = design; E = evaluation; and R = research types.<sup>10</sup> Following this items, according to the controlled descriptors Medical Subject Headings and the use of the Boolean operators *AND* and *OR*, the following search key was obtained: [S AND P of I] AND [(D OR E) OR R], being S - "Health information systems" OR "electronic health records," PI - "government regulation," D - "government document" OR "interview" OR "surveys and questionnaire" OR "focus groups" OR "case reports" OR "observation," E - "health systems" OR "public health informatics" OR "public policy," R - "qualitative research" OR "quantitative analysis" OR "mixed method."

### Stages 2 and 3: Literature Search and Data Evaluation

The literature search was carried out in March 2020 in the databases SCOPUS, Web of Science, CINAHL, MEDLINE, and LILACS, with the chosen descriptors and search key according to SPIDER in English, Portuguese, and Spanish, with a historical cutoff from 2011 to 2020. We set the start of the search period in 2011 because, in that year, the National Commission for the Incorporation of Technologies in the SUS was established in Brazil, and it is considered an

important historical and conceptual milestone for the use of health information systems at the governmental level.<sup>5</sup>

The inclusion criteria were original articles published between 2011 and 2020, in Portuguese, English, and Spanish, with full text available, related to the theme of regulation and use of health information systems by the Brazilian government and other countries, as well as government legislation and technical standards related to the theme. The exclusion criteria were articles published in a different language, systematic or integrative literature reviews, dissertations, theses, books and book chapters, opinion articles, and articles beyond the scope of the research.

For the organization of the search and application of the inclusion and exclusion criteria, the steps suggested by Preferred Reporting Items for Systematic Reviews and Meta-Analyses<sup>11</sup> were used to enhance the methodological rigor and detailing of the research documentation.

### Stage 4: Data Analysis

Thematic content analysis was applied to the selected articles, organized around three hubs: pre-analysis; exploration of the material; and treatment of the results, inference, and interpretation.<sup>12</sup> In the pre-analysis stage, the titles and abstracts extracted from the databases were read, and the articles were selected for reading in full, respecting the previously defined criteria. In the stage corresponding to the exploration of the material, repeated and in-depth readings of the pre-selected materials took place to define (1) which articles would be included in the final sample and (2) possible clusters of excerpts from the articles by themes and units of meaning. The units of meaning occurred through the observation of the repetition of themes (purposes of the use of the systems) in the studies, which were noted by the researchers according to frequency, and later grouped into categories according to the approximation of the content.

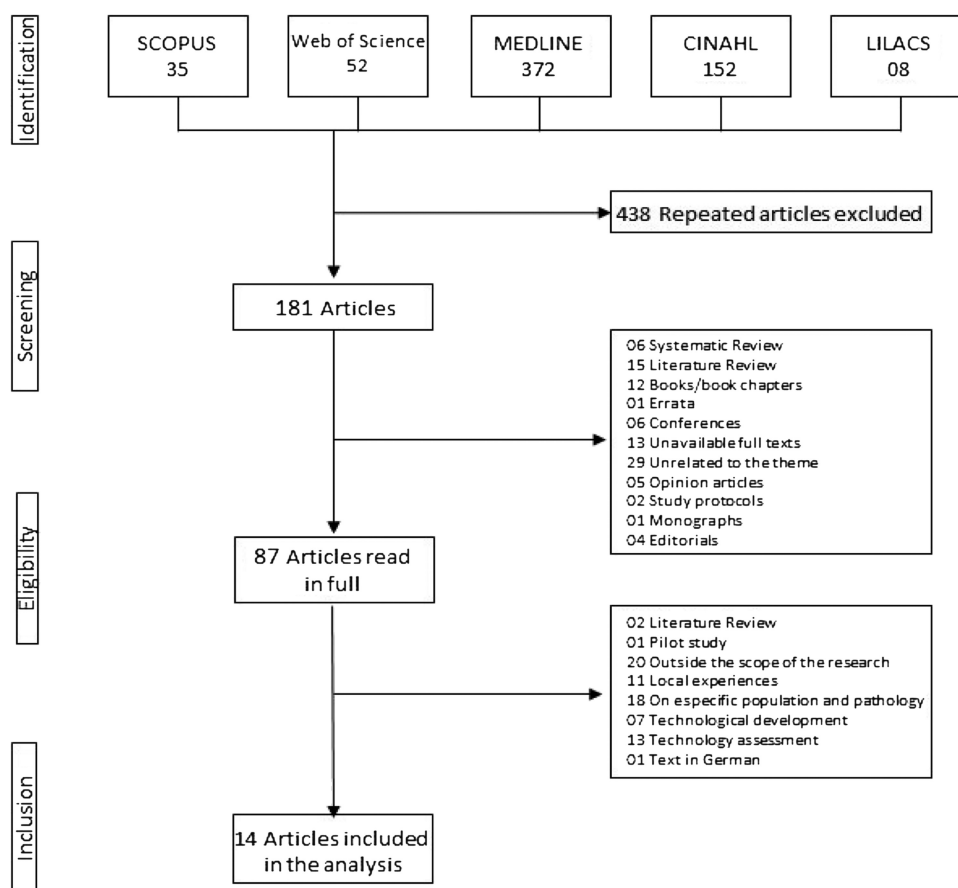
### Stage 5: Presentation of Results

In this stage, the categories of analysis were defined. In addition, tables were elaborated to condense the highlighted information and confront the researchers' inferences with existing evidence and theories on the topic.

## RESULTS

Of the 619 documents located with the search key, 87 were read in full and 14 scientific articles were selected to compose the final sample of this review, according to the application of the inclusion and exclusion criteria following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses recommendations (see Figure 1).

Of the 14 articles selected (see Table 1), seven were from the American continent, four were from Europe, two were from Africa, and one was from Asia. Nine of these were published in English, four were published in Spanish, and one



**FIGURE 1.** Flowchart of the study collection and selection process.

was published in Portuguese. Additionally, eight applied qualitative methods, five applied quantitative methods, and one applied mixed method. Considering the countries studied, two articles were from the United States, whereas Brazil, Kenya, Iran, Chile, Portugal, England, Cameroon, Mexico, Peru, and Finland had one article each; two articles referred to more than one country presenting comparative results. The year with the largest number of selected publications was 2018 with three publications, followed by 2011, 2015, 2016, and 2017 with two publications each, and 2013, 2014, and 2019 with one publication each. As for the journals, all articles were published in journals with an interdisciplinary focus, with 10 of them being focused on public health discussions and four being focused on health informatics.

The main findings concerning the regulation and use of health information systems at the federal government level (see Table 2), in different countries, were divided into three analytic categories: “Use in the Context of the Health Systems” (Category 1), which clearly evidenced the focus on the historical analysis, the laws, or the political situation, in addition to discussions on the importance of information systems for the enhancement of public health systems; “Implications for

Health Management” (Category 2), in which the main focus of the research was on the construction, control, and/or review of indicators in healthcare; and “Communication and Interoperability” (Category 3), focused on the discussion of the integration of health information across different systems, institutions, and organizational levels.

It was noted that, in the American continent, specifically in Latin American countries, there was greater emphasis on research aimed at the use of information systems, considering the political and socioeconomic context of the country (Category 1), followed by studies that address the use of indicators (Category 2), whereas articles from the United States adopted the analysis of forms of communication and interoperability as the main outcomes (Category 3). On the European continent, the four articles studied were divided between the usage categories in the context of “Health Systems” and “Communication and Interoperability.” In Africa, the studies were divided between discussions on the context of the health system and “Implications for Management.” The only article analyzed from the Asian continent discussed “Communication and Interoperability.”

**Table 1.** Synthesis of Selected Studies by Author, Year, Country Studied, Title, Journal, and Objective

Author/Year	Country	Title	Journal	Objective
Mathar, <sup>13</sup> 2011	Germany and England	Managing Health(-Care Systems) Using Information Health Technologies	<i>Health Care Analysis</i>	Compare and contrast how specific information health technologies were debated, how they proliferated, and what they made possible in the health systems of Germany and England
Palacio-Mejía et al, <sup>14</sup> 2011	Belize, Costa Rica, El Salvador, Honduras, Nicaragua, Panama, Mexico	Sistemas de Información en Salud en la Región Mesoamericana	<i>Salud Pública de México</i>	Evaluate and analyze health information systems in the Mesoamerican region
Hyppönen et al, <sup>15</sup> 2013	Finland	User Experiences With Different Regional Health Information Exchange Systems in Finland	<i>International Journal of Medical Informatics</i>	Compare the experiences of users of different types of regional health information exchange (RHIE) systems, as well as factors related to the experienced level of success of different types of RHIE systems
Obare et al, <sup>16</sup> 2014	Kenya	Indicators for Universal Health Coverage: Can Kenya Comply With the Proposed Post-2015 Monitoring Recommendations?	<i>International Journal for Equity in Health</i>	Determine the feasibility of the structure proposed by WHO or World Bank for the global monitoring structure of UHC in Kenya
Cavalcante et al, <sup>17</sup> 2015	Brazil	Panorama da Definição e Implementação da Política Nacional de Informação e Informática em Saúde	<i>Cadernos de Saúde Pública</i>	Analyze the current context of definition and implementation of the National Health Information and Informatics Policy
Curioso and Espinoza-Portilla, <sup>18</sup> 2015	Peru	Marco Conceptual para el Fortalecimiento de los Sistemas de Información en Salud en Perú	<i>Revista Peruana de Medicina Experimental y Salud Pública</i>	Present the most relevant essential components and policies in relation to the conceptual framework to strengthen health information systems in Peru
Vest and Kash, <sup>19</sup> 2016	United States	Differing Strategies to Meet Information-Sharing Needs: Publicly Supported Community Health Information Exchanges Versus Health Systems' Enterprise Health Information Exchanges	<i>The Milbank Quarterly</i>	Identify why hospitals and health systems choose to participate in community HIEs or establish corporate HIEs
Shah et al, <sup>20</sup> 2016	United States	Interoperability of Information Systems Managed and Used by the Local Health Departments	<i>Journal of Public Health Management and Practice</i>	Describe the level of interoperability of LHDs' information systems and identify factors associated with the lack of interoperability
Cresswell et al, <sup>21</sup> 2017	England	Safety Risks Associated With the Lack of Integration and Interfacing of Hospital Health Information Technologies: A Qualitative Study of Hospital Electronic Prescribing Systems in England	<i>BMJ Quality &amp; Safety</i>	Investigate two integration and interface strategies in hospitals that have implemented electronic prescribing systems to understand the risks to patient safety arising from failure in information integration and lack of effective information transfer and identify possible mitigation approaches
Bawack and Kala Kamdjoug, <sup>22</sup> 2017	Cameroon	Adequacy of UTAUT in Clinician Adoption of Health Information Systems in Developing Countries: The Case of Cameroon	<i>International Journal of Medical Informatics</i>	Investigate the adequacy of UTAUT in determining the intentions of doctors in developing countries to use health information systems

(continues)

**Table 1.** Synthesis of Selected Studies by Author, Year, Country Studied, Title, Journal, and Objective, Continued

Author/Year	Country	Title	Journal	Objective
Carrasco and Medina, <sup>23</sup> 2018	Chile	El Sistema Informático de la Reforma GES en Chile: Una Etnografía de Dispositivos de Gobierno Sanitario	<i>Physis: Revista de Saúde Coletiva</i>	Critically analyze the development and implementation of the “Information System for the Management of Health Guarantees”
Khajouei et al, <sup>24</sup> 2018	Iran	Error and Causes of Communication Failures From Hospital Information Systems to Electronic Health Record: A Record-Review Study	<i>International Journal of Medical Informatics</i>	Identify errors and causes of failure in communicating patient information from hospital information systems to EHRs in Iran (SEPAS)
Saturno-Hernández et al, <sup>25</sup> 2018	Mexico	Calidad del Sistema de Información em Salud: Análisis Comparativo de Indicadores Reportados, México OECD 2010–2016	<i>Salud Pública de México</i>	Analyze the quantity and quality of information on health indicators reported by Mexico to the OECD
Teixeira et al, <sup>26</sup> 2019	Portugal	Bringing Service to Design to the Development of Health Information Systems: The Case of the Portuguese National Electronic Health Record	<i>International Journal of Medical Informatics</i>	Show how a service design approach can support the successful development and implementation of national EHRs

Abbreviations: LHDs, Local Health Departments; OECD, Organisation of Economic Co-operation and Development; UHC, Universal Health Coverage; UTAUT, Unified Theory of Acceptance and Use of Technology; WHO, World Health Organization.

**Table 2.** Summary of the Main Findings by Geographical Region and Their Respective Analytical Categories

Continent	Country	Main Findings	Category
Europe	England and Germany	The debate and dissemination of health information technologies varies according to specific regulatory structures.	1
	Finland	Patients' preference for the type of regional information exchange system “virtual integrated”	3
	England	Integration and interfacing problems in autonomous systems pose a threat to patient safety.	3
	Portugal	Participatory design as a successful strategy for the development of health information systems	1
North America	United States	Barriers and facilitators for the interoperability of local health department systems	3
		The health system and policies are not prepared to permit the exchange of corporate and community information on health.	
Latin America	Brazil	The political landscape has slowly advanced. It needs to be legitimized, and several limitations need to be overcome.	1
	Peru	The intention is to achieve an integrated system in the country to improve people's quality of life and modernize public health.	1
	Chile	SIGGES mediates different levels and health agents to measure productivity, funding, and clinical activities.	1
	Mexico	Almost half of the indicators defined by the OECD are not reviewed. It is necessary to improve the quality of health information systems in Mexico.	2
	Mesoamerican Region	On average, 57% of HIS development in the region, with the best rating for Mexico and the lowest rating for El Salvador	2
Africa	Cameroon	The model is unfit to predict the adherence of professionals in developing countries to health information systems.	1
	Kenya	The country is able to reasonably report on five of the seven proposed indicators.	2
Asia	Iran	The main causes for the lack of information communication are administrative and financial errors, followed by national codes and clinical errors.	3

Abbreviations: HIS, Health Information Systems; OECD, Organisation of Economic Co-operation and Development; SIGGES, Information System for the Management of Health Guarantees.



Category 1: Use in the Context of Health Systems

Challenges such as low connectivity, inequality in the organization of the health system in the various regions of the country, and insufficient funding were highlighted in Brazil in the debates on the implementation of the National Health Information and Informatics Policy.<sup>17</sup> Two other studies from Latin American countries highlighted the expectations about the development of national systems and their respective planning and execution processes by the government.<sup>18,23</sup> A study<sup>22</sup> points to the low maturity of health information systems in developing countries on the African context, also reflecting the limited experience of doctors and nurses with the use of this technology.

The high decentralization of the health system in Germany outlined a scenario of greater difficulty in the implementation of health information technologies when compared with the English context.<sup>13</sup> Regarding the development of health information systems, considering the need for the health professionals to accept and adhere to their use, the study from Portugal showed that the participatory design with a holistic approach may be an effective strategy.<sup>26</sup>

Category 2: Implications for Health Management

The three studies listed in this category highlight that the creation, control, and analysis of the health indicators are based on the urgent improvement of health information systems in the countries where the research was developed.<sup>16,25</sup> Also, the legal framework for their implementation needs improvements,<sup>14</sup> and the input to calculate these indicators is an important part of strengthening the population's healthcare.

Category 3: Communication and Interoperability

In the Finnish Public Health System, the use of different health information systems working in primary and specialized care services highlights the expectation that these regional systems align with the national system.<sup>15</sup> In England, the lack

of technicians and national standards for system integration can hinder the choice and adoption of the most suitable systems for each specialty.<sup>27</sup> An Iranian study indicates that the differences among system users and different processes of institutions should also be considered when analyzing the communication problems of patients' health information.<sup>24</sup> Finally, only four out of every 10 local health departments in the United States report that their systems are interoperable,<sup>20</sup> and the exchange of health information between community and private institutions is not yet structured. It is necessary to strengthen public policies and make possible funding for community-based policies, such as what exists for the private sector.<sup>19</sup>

Similarities Between Brazil and Other Countries

When comparing the results from the Brazilian context with the others analyzed, we could observe similarities related to the difficulties in using health information systems in more remote regions and rural areas (due to territorial extension and social inequalities); insufficient public funding for the implementation of technologies; and challenges for participation of private initiative in the public health system (see Table 3).

DISCUSSION

Despite being quite heterogeneous, in the American region, health figures as a central discussion theme on many of the political agendas. Health not only is a human right but also drives economic development, investment, and educational performance.<sup>28</sup> To achieve universal access to health, however, countries in Latin America and the Caribbean still face the problem of lack of funding, combined with the inefficient use of resources.<sup>29</sup>

In several countries, especially in developing nations, there is chronic underinvestment in technologies for the analysis, dissemination, and use of health information, which jeopardizes the quality of care.<sup>3</sup> In low- and middle-income countries, a study conducted in Africa considers that the

Table 3. Countries That Have Challenges in Common With Brazil in the Implementation of Health Information Systems and Their Respective Health Systems

Brazil Universal health system, complemented by private initiative	Scope difficulty in poor and/or rural areas	Kenya Health divided among public, private, religious, and non-governmental services
	Insufficient funding for public services	Chile Mixed system, national health fund, and social security
		Cameroon Sector managed by the Ministry of Public Health
	Private interests acting on the public system	United States Mostly based on private or employment-based health insurance
		Germany Decentralized, mixed system

relationship between universal health coverage and information systems is inseparable, as quality health information is necessary for decision making, but so is political commitment for decisions to be made.<sup>16</sup>

One of the factors that still affect the quality and management of health information, especially in developing countries, is the storage of paper-based data or, as evidenced in this review, the improper and insufficient transfer of indicators. In this sense, the use of information systems and other digital technologies in health can substantially modify the way data are collected, with data becoming more timely and permitting better healthcare and planning management.<sup>30</sup>

In the European context, on the other hand, the analyzed studies focused on the strengthening or the improvement of the already existing use of health information systems, such as the studies from Finland, which quote *KanTa* as a national model for the exchange of health information; from Portugal, discussing the context of the national system, called the Health Data Platform; and from England, which already advances in the discussion on the interface among the different systems used to make progress in the coordination of care,<sup>15,21,26</sup> which could be related to greater economic development and, consequently, investment in this type of technology.

Interoperability can be defined as the capacity of different information systems to exchange data in a coordinated manner, within or beyond regional borders, aiming to optimize the health conditions.<sup>31</sup> Discussions on this topic are important, as they can ground decisions on actual health data.<sup>32</sup> Therefore, it has figured on the development agenda of different countries in search of care coordination. Contrary, however, to the example of other developed countries, in the United States, the insufficient promotion of interoperability among the systems used in local health departments stands out,<sup>20</sup> which refer to the part of public healthcare in the country. Although the government has launched different financial incentives towards interoperability, the exchange of information directed to the private service network prevails.<sup>19</sup> Therefore, even when considering a country's level of economic development, reflections are possible on the need to strengthen universal health coverage systems so that health technologies—especially information systems—are used to improve the care and living conditions of the populations.

The emergence of discussions on the National Policy of Informatics and Health in Brazil has gone through different stages throughout history. Initially, the organic health law (dated 1990), which discusses the principles and guidelines of the SUS, needed to be put in practice; as the public system gained strength as a public policy, progress was made with respect to the development, standardization, and control of health indicators; and currently, the challenge is the legitimization of the National Health Information and Informatics Policy.<sup>17</sup>

In a study that analyzed the incorporation of information technologies in primary care in Brazil, it was pointed that, although the process is taking place, there are not many teams with a high degree of incorporation. Nevertheless, a positive relationship can already be observed between the use of information technology and the quality of healthcare.<sup>33</sup> Improvements are also necessary in the implementation of the strategy known as e-SUS (which aims to reorganize primary care information at the national level) as a resource for healthcare and management in Brazil.<sup>34,35</sup> Furthermore, it needs to be expanded to the other care levels, beyond the primary, permitting more effective communication among them.

It was identified that, for the implementation of health information systems, Brazil faces difficulties that are similar to socioeconomically developing countries, while facing strength similar to those in countries with more widespread technology use. In this context, insufficient funding and inequality between regions pose a challenge in the country, but the existence of a universal health system acts as a strength. From the viewpoint of territorial inequalities and use in rural areas, Brazil sees similar results and discussions presented in other countries in Latin America and Africa.<sup>16,23</sup> Nevertheless, reflections on the consequences of the public-private relationship existing in the country are very similar to European models,<sup>13</sup> as these can represent a challenge to the coordination of care and the overcoming of individual interests in the integration of information and macro-management.

Private interests and lack of sufficient funding are identified in the Brazilian context and need to be overcome; however, having a universal system, linked to the Federal Constitution, which provides for equity, decentralization, and social participation, can enhance the realization of the system<sup>36</sup> and, consequently, the use of health technologies.

## Study Limitations

Despite being considered in its inclusion criteria, the final sample of this review did not include any public legislation on the theme, which could entail weaknesses for the discussion of the findings. Furthermore, the cutoff period for the study, the distinct social and technological development realities, and the specific cultures of the countries in the selected studies do not permit any standardization for the sake of comparison. Nevertheless, these results present important points for consideration for the regulation and use of health information systems globally.

## CONCLUSION

The discussion on the regulation and use of health information systems in different countries is directly related to their socioeconomic context, with greater emphasis on the discussion of policies and possibilities for implementing this use in Latin American and African countries, whereas some countries in

Europe and Asia have reached a more mature stage in the implementation of these policies. The relationship with the private domain is another important point of debate, especially on issues surrounding communication and interoperability among different information systems and health services.

The complexity of the Brazilian health system, which is universal in its conceptual political basis and permits relationships with the private domain, leads to similarities in the data analysis with several countries from different regions and with distinct political configurations. Therefore, it is recommended to overcome barriers related to public management problems, such as funding below what is necessary for the sustainability of the universal health system, as well as the difficulties in reducing regional inequities. At the same time, it is necessary to advance in health information systems research and discussions on interoperability and communication among different services, and the possibilities of integration with private entities that work in partnership with the public sector, aiming for the coordination of healthcare by the public sector.

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