The Profile of Clinical Engineering in Espirito Santo, Brazil

L. A. Silva, F. L. Cunha, and K. L. Oliveira

Abstract

As a result of high rates of non-operating equipment due to the lack of maintenance and proper training, Clinical Engineering has been growing considerably in Brazil since the 1990s and, therefore, its demand. In the State of Espírito Santo (ES), the reality is different from found in large cities. Because of that, this article has the following purposes: to verify the presence of Clinical Engineers in ES; to analyze the team composition and the presence of predictive and preventive maintenance procedures; and to compare the proportion of CT and MRI equipment in ES with national and international data. For this, data gathering of 97 hospitals registered in the National Registry of Health Establishments was carried out to obtain a list of existing equipment in the places and the way that maintenance service of such equipment is performed, as well as the composition of the team. The results obtained shows most of the general hospitals have outsourced Equipment Maintenance Service and those responsible for Clinical Engineering do not have specialization in the area or a degree in engineering. In addition, there are 0.75 MRI equipment and 0.50 CT for each 500 thousand and 100 thousand inhabitants, respectively, in the Universal Healthcare Service, values below determined by ordinance MS 1101. Thus, these data corroborate the need of increasing the supply and training of professionals in Biomedical Engineering and Clinical Engineering areas to promote additional study in the technological management practices of such equipment.

Keywords

Clinical engineer • Biomedical engineer • Brazil

1 Introduction

Clinical Engineering has its origins in the 1940s in the United States with the implantation of a medical equipment course. However, it was not until the 1970s that the profession of clinical engineer was established, which is the professional responsible for the management, evaluation and transfer of hospital equipment [1, 2].

In Brazil, however, it was only in the 1990 s that the first courses of specialization in Clinical Engineering for electrical engineers were implemented: two of them in São Paulo; one in Paraíba; and one in Rio Grande do Sul. The trigger for the implementation of these courses was the high rate of non-operating equipment due to lack of maintenance and specific training [1]. Although there are currently several courses in Brazil, in the State of Espírito Santo (ES) there are still no specialized courses in the area, but since 2013 a degree in Biomedical Engineering has been offered by a private institution. It is important to point out the Brazilian Federal Council of Engineering and Agronomy (CONFEA) does not yet recognize Clinical Engineering as a specialty. It allows professionals such as technicians, managers, nurses, doctors, etc. to act in the position of clinical engineer [3, 4]. The Brazilian Association of Clinical Engineering (ABEClin) started an unsuccessful process in 2013 within CONFEA in order to obtain formal recognition by the professional council [5].

In this context of hospital technology management, the Information Technology Department of National Health System (Datasus) has made an online platform available to collect, process and disseminate data on health equipment: National Register of Health Establishments (CNES). On this basis it is possible to obtain information regarding health service providers, for instance: equipment; support services; professionals; among others [6, 7]. These data are extremely important to verify if there is a consonance between regulations applied by the federal government and what is seen in practice. As an example, it can be listed the one No. 1101/

L. A. Silva (✉) · F. L. Cunha · K. L. Oliveira
UCL—Faculdade Do Centro Leste, Serra, ES, Brazil
e-mail: 20092tcest0222@ucl.br

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GM elaborated in 2002 by the Ministry of Health that establishes that for every 100 thousand inhabitants there must be 01 Computed Tomography (CT); and for every 500 thousand inhabitants 01 Magnetic Resonance (MRI) [8].

Therefore, the present study is aimed at: verifying the presence of Clinical Engineers in Hospitals in ES; analyzing the composition of the teams responsible for Clinical and Hospital Engineering service and the presence of corrective and preventive maintenance procedures in these hospitals, as well as analyzing the proportion of CT and MRI equipment comparing these data with national and international ones.

2 Methods

During the end of 2017, an investigation was carried out at the base of CNES (National Registry of Health establishments). This database provided by federal government lists various information about establishments provide health services in country, both those are part of private network as well as those compose public network [6, 7]. The mainly research criteria adopted is the place of sample space: all cities and establishments in the State of Espírito Santo with at least one General Hospital. With this, the following data were obtained from each hospital: business name; County; telephone; disabled or not; legal nature; equipment maintenance service (SME); diagnostic imaging equipment. For the latter, we sought only for the presence of CT and MRI devices available in Unified Health System (SUS), which is the public health system in Brazil.

With CNES data, a questionnaire was created with 12 questions that were used in individual research. The questions consisted of verifying: academic formation of the person responsible for Clinical Engineering or Equipment Maintenance; formation of the team of Clinical Engineering or Maintenance of Equipment; presence of procedures to perform corrective and preventive maintenance; existence of CT and MRI equipment. Such research was carried out by telephone, e-mail and on-site and had the purpose of verifying the consonance between actual data and those provided by CNES.

3 Results

According to Table 1, information was collected on 97 general hospitals. It is possible to observe 18.6% answered the questionnaire directly, 12.4% did not respond when sent by e-mail and 13.4% of hospitals were disabled.

It is also possible to note 36.1% reported (via phone call, e-mail or on-site) the SME is outsourced. Of these, 11 hospitals have equipment park managed by the same private company. The 24 remaining (24.7%) have a direct contract with some technical assistance and, when necessary, a hospital employee triggers a service.

Table 1 Result after collection at CNES database

Result	Number of hospitals	(%)
Answered questionnaire	18	18.6
Outsourced SME	35	36.1
Hospital disable	13	13.4
Unanswered e-mail	12	12.4
Others	19	19.6
Total	97	100.0

Table 2 Comparison between CNES data and those purchased individually for each hospital

Description at CNES	Number of hospitals	(%)
Own	7	29.2
Outsourced	12	50.0
Own and outsourced	3	12.5
No information	2	8.3
Total	24	100.0

As mentioned in item 2, it is possible to obtain in CNES the form that SME is made: own; outsourced; and own and outsourced. In this way, a comparison was made between CNES data and those obtained individually from the 24 hospitals when contacted reported that service was outsourced.

It can be seen from Table 2 that half of these hospitals actually have outsourced services, while the rest go against what is registered with CNES.

As seen in Table 1, 18 hospitals responded directly to the questionnaire. Initially asked about academic training of the person in charge of the Clinical Engineering or Equipment Maintenance sector. It can be seen from Table 3 most of people in charge are not trained in specific area or even in Engineering.

When questioning about the form of SME, it is noticed there is no conformity between the data present in CNES's base and the reality of the hospital, according to Table 4. For example, in the sample of 5 hospitals that reported that SME was its own, only 2 had this information correctly at CNES.

Regarding the presence of a procedure for preventive and corrective maintenance, almost all (97.4%) hospitals reported there is a procedure, according to Table 5. It was also questioned about ease of finding equipment maintenance supplier in ES, 61.1% report there is facility, according to Table 6.

In addition to seeking information on SME, data were sought on the amount of CT and MRI equipment available at SUS. According to Table 7, it can be seen that for both cases

Table 3 Academic background of the responsible for the sector of clinical engineering or maintenance of equipment

Academic Background	Number of hospitals	(%)
Electrical engineering	5	27.8
Electronics technician	3	16.7
High school	3	16.7
Administration	3	16.7
Biomedical engineering	1	5.6
Mechanical engineering	1	5.6
Physiotherapy	1	5.6
Nursing	1	5.6
Total	18	100.0

there is not even 1 equipment at SUS available for each general hospital in the registry.

4 Discussion

One cannot deny the importance of CNES in accessing information on health institutes. However, it still encounters several flaws. Among them, there is a lack of data update for simple information, such as telephone number to keep contact. In this context, there were several obstacles such as difficulty contact by telephone and e-mail, difficulty to contact the person in charge of SME sector and obtain correct data. In this case, it is also noticed there is no consensus between the type of SME base and the reality observed through the contact with each general hospital. For example, less than half of hospitals reported in the questionnaire that SME was actually compliant with the CNES, as seen in Table 4.

In relation to the people in charge of Clinical Engineering or Equipment Maintenance sector, it is noted that majority (61.1%) of those do not have a specialization in Clinical Engineering or, at least in Engineering. For example, 16.7% have a high school education level. This data was also noticed when we contacted the 24 hospitals in Table 2. Among those with specialization in Clinical Engineering or undergraduate degree in Biomedical Engineering, it is not observed that such specialization or graduation was performed in ES. This information demonstrates the lack of specialized professional in this area in ES. In this context, the teams of hospitals that had an Engineer were also composed by at least 1 technician in electronics.

Besides the lack of consensus between the data of CNES and reality, it is also noticed that in other spheres it also occurs. As explained in item 1, Regulation No. 1101/GM provides minimum amounts of CT and MRI equipment to a certain number of people. In this research, it was observed, for both equipments, the legislation is not followed observed. In the case of the CT, this reality is not different from the State of São Paulo, for example, where there are 0.79 equipment per 100 thousand inhabitants [9]. When comparing these ES data to those available on World Health Organization (WHO) website, the values found for ES State are close to countries such as Costa Rica and Cuba for TC. As for as MRI, it is close to Jamaica and Albania [10].

Table 4 Comparison between CNES data and individually purchased for hospitals that answered the questionnaire

		CNES			
SME	Questionnaire	Own	Outsourced	Own and Outsourced	No Information
Own	5	2	1	1	1
Outsourced	7	5	1	1	0
Own and Outsourced	6	4	0	1	1
Total	18	11	2	3	2

Table 5 Presence of procedures for preventive and corrective maintenance

	Number of hospitals	(%)
Existing procedure	17	94.4
Non-existing procedure	1	5.6
Total	18	100.0

Table 6 Ease of finding equipment maintenance supplier in ES

	Number of hospitals	(%)
Easy	11	61.1
Regular	2	11.1
Difficult	5	27.8
Total	18	100.0

Table 7 Number of CT and MRI equipment per 100 thousand and 500 thousand inhabitants, respectively

CT equipment/100 thousand inhabitants	0.50
MRI equipment/500 thousand inhabitants	0.75

5 Conclusion

Although Clinical Engineering has advanced in Brazil since the 1990 s, in ES the reality differs from that found in developed countries, such as United States, for example. It is still necessary to invest and promote the area, either through recognition of the profession by CONFEA or legislation that determines the presence of this professional inside hospitals. Thus, these data corroborate the need to increase supply and

training of professionals in the area of Biomedical Engineering and Clinical Engineering in order to promote greater study in the technological management practices of such equipment.

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Conflict of Interest The authors declare that they have no conflict of interest.

References

1. RAMÍREZ, E. F. F.; CALIL, S. J.: Engenharia clinica: Parte I-Origens (1942–1996). Semina: Ciências Exatas e Tecnológicas, v. 21, n. 4, p. 27–33 (2004).
2. DE MORAES, Luciano et al. The multicriteria analysis for construction of benchmarkers to support the Clinical Engineering in the Healthcare Technology Management. European Journal of Operational Research, v. 200, n. 2, p. 607–615 (2010).
3. FRANÇA, A.S. D. A. Atribuição profissional na gestão de tecnologias em estabelecimentos de saúde no Brasil. Revista Organização Sistêmica, v. 7, n. 4, p. 130–141 (2016).
4. SOUZA, A. F.; MORE, R. F. O perfil do profissional atuante em engenharia clínica no Brasil. A Engenharia Biomédica como Propulsora de Desenvolvimento e Inovação Tecnológica em Saúde. Uberlândia-MG:[sn], p. 1086–1090 (2014).
5. DEL SOLAR, J. G. M.; SOARES, F. A.; MENDES, C. J. M. R. Brazilian clinical engineering regulations: health equipment management and conditions for professional exercise. Research on Biomedical Engineering, n. AHEAD, p. 0–0 (2017).
6. DE MATOS, C. A.; POMPEU, J. C. Onde estão os contratos? Análise da relação entre os prestadores privados de serviços de saúde e o SUS. Ciência & Saúde Coletiva, v. 8, n. 2 (2003).
7. FREITAS, M. B. D.; YOSHIMURA, E. M. Levantamento da distribuição de equipamentos de diagnóstico por imagem e freqüência de exames radiológicos no Estado de São Paulo. Radiol. bras, v. 38, n. 5, p. 347–354 (2005).
8. Portaria n° 1101/GM em 12 de junho de 2002, http://www.betim.mg.gov.br/ARQUIVOS_ANEXO/Portaria_1001;;20070606.pdf, last accessed 2018/01/21.
9. DE ARAÚJO, P. N. B.; COLENCI, R.; RODRIGUES, S. A. Mapeamento dos equipamentos e exames de diagnóstico por imagem no estado de São Paulo. Tekhne e Logos, v. 7, n. 2, p. 121–135 (2016).
10. Baseline country survey on medical devices, 2014 update: Medical Equipment, http://gamapserver.who.int/gho/interactive_charts/health_technologies/medical_equipment/atlas.html, last accessed 2018/01/25.