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ORIGINAL ARTICLE

RELATIONSHIP BETWEEN TECHNOLOGY AND PRODUCTIVITY IN STERILIZATION AND MATERIAL CENTERS IN RIO GRANDE DO SUL

Luciano Lemos Doro*
Daniela Silva dos Santos Schneider**
Vivian Lemes Lobo Bittencourt***
Jeane Aparecida Gonzalez Bronzatti****
João Lucas Campos de Oliveira*****
Kazuko Uchikawa Graziano******
Ana Maria Müller de Magalhães*******

ABSTRACT

Objective: to assess the relationship between technological availability and productivity in Material and Sterilization Centers (CMEs, as per its Portuguese acronym), automated or not, in hospitals in Rio Grande do Sul (RS). **Methodology:** Cross-sectional and analytical study conducted in 43 randomly selected CMEs, located in the state of RS, Brazil. Data were collected through online interviews with managers of CMEs between December 2022 and May 2023. Data analysis was performed using descriptive and inferential statistics. **Results**: The CMEs are centralized, with uninterrupted operation and have heterogeneous technological availability, with 22 (51.2%) being characterized as automated. A significant association was found between technological availability (automation) and productivity in the CMEs. A significant association (p<0.05) and a positive correlation (Rho<0.65) were also found between technological availability, hospital size, and surgical output, although institutions were found with high surgical demand and limited technological availability in the cleaning area, indicating a predominantly manual process. **Conclusion:** A positive relationship was found between productivity and automation of CMEs. The automated ones proved to be more productive than the exclusively manual ones, even when comparing similar hospital sizes. The automation of the cleaning process should be promoted, as it positively reflects on productivity not only in numbers but also in the guarantee of reproducible results.

Keywords: Nurses. Sterilization. Hospital departments.

INTRODUCTION

The necessary stages for processing health products (PHPs) include reception, cleaning, inspection, preparation, sterilization, or disinfection according to the risk category of the material, storage, management, and distribution, aiming not only at patient safety but also at reducing hospital costs and length of stay[1]. In theClass II CMEs, all stages must be carried out in distinct areas, through a unidirectional flow, which contributes to controlling Healthcare-Associated Infections (HAIs)[1,2].

Semi-critical and critical PHP must be processed by the CME or a Third-Party Processing Company properly authorized by the local health surveillance, while non-critical products can be processed in a decentralized system, that is, in satellite units of health services. In relation to the shapeof thePHPs, the CMEs are classified as Class I or II. Class I refers to those that process non-critical, semi-critical, and critical health products with non-complex configurations.In turn, Class II is the one that processes all the PHPs, including those critically complex in shape, with a lumen less than 5 mm. According to the regulations of the Brazilian National Health Surveillance Agency (ANVISA, as per its Portuguese acronym), since 2012, the Class II CMEs must have an ultrasonic

*Nurse. Doctoral student in Nursing. Professor at the Pompéia School of Health and Moinhos de Vento College. Caxias do Sul, RS. E-mail:lucianolemosdoro@gmail.com; ORCID: 0000-0002-3741-4704
**Nurse, PhD in Nursing. Professor of the undergraduate program at the School of Nursing of the Federal University of Rio Grande do Sul. Porto Alegre, RS. E-mail: danielassantos@hcpa.edu.br; ORCID: 0000-0001-9593-9931
***Nurse, PhD in Science Education. Professor in the Undergraduate Nursing Program at the Integrated Regional University of Alto Uruguai and Missões, Santo Ângelo Campus. Santo Ângelo, RS. E-mail:vivillobo@hotmail.com; ORCID: 0000-0003-1488-0611
****Nurse, PhD in Health Sciences. Professor of the postgraduate program at São Camilo College. São Paulo, SP. E-mail:gonzatti.edu@uol.com.br; ORCID: 0000-0002-5412-5795
*****Nurse, PhD in Nursing. Professor of undergraduate and graduate programs at the School of Nursing at the Federal University of Rio Grande do Sul. Porto Alegre, RS. E-mail: jlcoliveira@hcpa.edu.br; ORCID: 0000-0002-1822-2360
******Nurse, PhD in Nursing. Senior Professor at the University of São Paulo. São Paulo, SP. E-mail:kugrazia@usp.br; ORCID: 0000-0001-6899-082X
*******Nurse, PhD in Nursing. Professor of undergraduate and graduate programs at the School of Nursing at the Federal University of Rio Grande do Sul.Porto Alegre, RS. E-mail: amagalhaes@hcpa.edu.br; ORCID: 0000-0003-0691-7306

washer or other proven efficient equipment for cleaning critically complex-shaped products, and processing them in incompatible structures and without adequate equipment is not allowed[1].

Due to technological advancement, the development of new surgical techniques, especially in minimally invasive surgeries, such as video surgeries and robotic surgeries, the PHPs has been constantly challenged, significantly expanding its responsibilities. More precisely, in the last decade, in order to keep up with the evolution of the surgical center, radical changes in operational processes with an emphasis on the cleaning stage have demanded the introduction of new technologies in Central Sterilization, that is, equipment that automates the performed activities with the guarantee of reproducing the results not depending solely on the human factor are essential[3, 4].

The technological oscillation among Brazilian CMEs is so great that, at times, it makes the comparative process impossible, as, even having a specified categorization in national legislation[1] and a minimum technological park to processcritically complex-shaped PHPs, this process is not scaled according to the volume of processed products.

In addition to exposing professionals to greater occupational risks, both physical and ergonomic, as well as chemical and biological, manual cleaning also presents limitations related to low productivity and reproducibility,due to the lack of uniformity in the execution of tasks by the different members of the operational team, as well as the lack of discipline on the part of the operational force to follow the standardized protocol[2].

In some aspects, working in the CME resembles the industrial production process in terms of the division of the work process and the sequential execution of activities. Understanding the operational capacity or the balancing of a production line makes the manufacturing process more predictable, while also providing the manager with greater safetyand reliability in decision-making, both in forecasting material resources and in allocating human resources to meet necessary production demand[1, 5].

Regarding productivity control in the CME, the manager needs to record sectoral production by filling out spreadsheets with data collection that identifies the productivity of each area.This monitoring can serve as a basis for calculating staff sizing. Nonetheless, it is necessary to systematize the recording of this production accurately in order to represent the reality of the service, thus avoiding inappropriate calculations[6].

The comparison of productivity amongCMEs is a very relevant factor regarding the planning of different institutions aiming at improving the quality of services. It can also be associated with assisting in making more assertive investment decisions and/or expanding this area, bringing more benefits to health institutions, and giving managers ownership in optimizing financial resources. This comparison, also known as benchmarking, can be internal, when the historical series of the same CME is compared, or external, when the data is compared to that of other institutions[7].

Accordingly, it is started from the following research question: what is the relationship between technological availability and productivity in CMEs, automated or not, in hospitals in a southern state of Brazil? In order to respond to this question, the objective of the study was to assess the relationship between technological availability and productivity in CMEs, automated or not, in hospitals in Rio Grande do Sul, Brazil.

METHODOLOGY

This is a cross-sectional and analytical study, with random sampling, conducted from December 2022 to May 2023, in Class II CMEs of the hospitals in the state of Rio Grande do Sul, Brazil.

CMEs from hospitals located in the territory of Rio Grande do Sul were included, registered in the database of the Regional Nursing Council of Rio Grande do Sul (COREN-RS, as per its Portuguese acronym) with a surgical center, whose CME was Class II[1].

Based on the data provided by the COREN-RS, 359 hospitals were listed, with 150 (43.6%) categorized as small-sized (SSH), with up to 50 beds; 141 (40%) as medium-sized (MPH), with 51 to 150 beds; 52 (15%) as large-sized (LSH), with 151 to 500 beds; and 5 (1.4%) as extra-large (ELH), with more than 500 beds. Of

these, 11 were excluded due to lack of information, leaving 348. The hospitals were subdivided among the eight subsections with the respective number of beds, namely: Caxias do Sul, Passo Fundo, Pelotas, Porto Alegre, Santa Cruz do Sul, Santa Maria, Santa Rosa, and Uruguaiana.

By delimiting the geographical scope of the entire state territory and guaranteeing randomness, the sample was stratified according to each Subsection of COREN-RS, as well as classified by size. Subsequently, the draw was conducted using the Microsoft Excel® software, version 2016, through the functions *randombetween* and *vlookup*, starting from 10% of the total number of institutions of each size located by subsection.

The technical responsible person for the nursing service of each hospital was contacted via telephone or email, and was invited to participate in the research after being informed about the content of the research, signing a consent form if he/she agreed, and scheduling an online interview according to the participant's availability. The freedom of the research participant to refuse to participate or withdraw their consent at any stage of the research, without any penalty, was guaranteed, respecting all ethical aspects according to the National Commission of Ethics in Research[8].

After the verbal acceptance, the Free and Informed Consent Form and an online form, using Google Forms, were sent to the participants via email.

As negative responses were received, new draws were held in order to replace the withdrawing institutions, maintaining the scope. After five months of attempts and new frustrated contacts, it was decided to analyze the achieved sample.

The online questionnaire (Google Forms) contained guiding questions for the interview, which was mirrored for the participant and the information was recorded in real time, guaranteeing the participant's confirmation of the content.

The collected data was grouped into an Excel spreadsheet, version 2006, and analyzed in the Statistical Package for the Social Sciences, version 29.0. For the continuous variables, the Shapiro-Wilk normality test was used; then, descriptive statistics were performed according to their distribution in mean, standard deviation, minimum and maximum or median and interquartile ranges. The categorical variables were described in absolute and relative frequencies. The Kruskal-Wallis, Mann-Whitney, and Pearson's Chi-squared tests were also used, along with Spearman's correlation to verify the relationship between the variables.

Considering that the thermal disinfecting washer is the only equipment that can almost completely automate the cleaning, rinsing, and drying process, and the ultrasonic has an involved legal requirement, it was determined in this study that the CMEs that had at least one example of each equipment would be categorized as automated CME.

The institutions were also classified by the type of funding and service provided, with three categories: public, which serve only users of the Brazilian Unified Health System (SUS, as per its Portuguese acronym); private, which serve only users of private networks and health plans; and mixed, which serve both.

The information was extracted from the database of the study "Management of Processes in the CME", registered in the Brazil Platform, under Ethical Appreciation Presentation Certificate nº 702207717.4.0000.5327, and with an addendum approved by the Research Ethics Committee of the Clinical Hospital of Porto Alegre, under protocol nº 5.269.488/2022.

RESULTS

Out of the 72 contacted hospitals, 43 CMEs composed the sample, representing 12.3% of the institutions in the state, predominantly large hospitals (15; 28.8%) and extra-large hospitals (2; 40%). Regarding the subsections of COREN/RS, those with the highest prevalence were: Porto Alegre (20.9%), Passo Fundo (18.6%), Santa Rosa (18.6%), and Caxias do Sul (11.6%), following the density of institutions (Table 1).

Table 1. Distribution of hospitals by subsection (COREN/RS*) and institutional size in RS. Porto Alegre/RS, Brazil, 2023.

Characteristics	Initial sample (348)	Final Sample 43 (12.3%)	
Subsection of COREN/RS*: (N=348)			
Caxias do Sul	36	5	(13.8)
Passo Fundo	63	8	(12.6)
Pelotas	34	3	(8.8)
Porto Alegre	89	9	(10.1)
Santa Cruz do Sul	38	3	(7.8)
Santa Maria	37	4	(10.8)
Santa Rosa	51	8	(15.6)
Uruguaiana	11	3	(27.2)
Hospital size: (N=348)			
Smallsize	150	10	(6.7)
Medium size	141	16	(11.3)
Large size	52	15	(28.8)
Extra-large size	5	2	(40.0)

Note: *Regional NursingCouncilof Rio Grande do Sul.

Of the 43 hospitals, most are of a mixed nature (27; 62.7%), with 26 (60.4%) lacking rooms dedicated exclusively to obstetric care. Among those that do have them, the number varies from one to four rooms (6; 13.9%), with a predominance of three rooms.

In contrast to the obstetric scenario, hospitals have a mean of 6.2 (standard deviation ± 5.7) surgical rooms, ranging from 1 to 22 operating rooms, with 55.7% of hospitals reporting that they perform up to 500 surgeries per month and only 13.9% exceed 1000 monthly procedures. Still regarding the perioperative area, 13 surgical specialties were mentioned, with the three most prevalent being: general surgery (33; 76.7%), followed by orthopedics/traumatology (25; 58.1%) and gynecology/obstetrics (20; 46.5%).

For the care of critically ill patients, the minority of hospitals (16; 37.2%) do not have Intensive Care Unit (ICU) beds. Among those that have ICU beds, 27 (62.8%) have a structure that varies between 7 and 96 beds. Regarding interventional cardiology services, the majority of hospitals (27; 62.7%) do not offer hemodynamics services. Nonetheless, when it comes to endoscopy, the scenario is different, as 18 (41.8%) institutions have one or two exclusive rooms for this purpose.

Still relating to the institutional structure, the majority of the CMEs (35; 81.3%) have a direct physical connection with the Surgical Center, while eight (18.6%) are physically located away from that area. Most (38; 88.3%) centralize all stages of processing, do not provide services to other units outside of the hospital structure, even if subjected to the same management (23; 53.4%) and operate 24 hours (30; 69.7%).

Concerning the structure and availability of technologies for health product processing in the CME, dividing the structure according to the stages of the process (Table 2), for the cleaning of the PHPs, a variation was found between zero and eight equipment units, among which a minority (4; 9.3%) do not have a cleaning system for cannulated instruments and five (11.6%) do not perform the rinsing stage automatically.As for the thermal disinfecting washers, most of the CMEs do not have this technology (21; 48.8%). The same applies to the fluent steam cleaning equipment, which is not available in 40 (93%) hospitals. Furthermore, compressed air is the most commonly used alternative for drying the PHPs (42; 97.7%). On the other hand, the automation of this stage with a dryer is not present in most hospitals (27; 62.7%).

For the sterilization stage, a greater investment from the CMEs was noticed for high-temperature steam autoclaves, ranging from one to seven machines.On the other hand, the

majority of hospitals (28; 65.1%) do not have low-temperature sterilizers using hydrogen peroxide.

Table 2. Technological availability by stage of the process in the CMEs of the participating hospitals. Porto Alegre/RS, Brazil, 2023.

Stages of the process and available technology	N=43 (%)	M*±SD**	Min***	Max****
CLEANING STAGE				
Total fluent steam cleaning equipment				
0	40 (93.0)			
1	1 (2.3)			
≥2	2 (4.7)			
Total ultrasonic washers				
0	6 (13.9)			
1	19 (44.1)			
2	10 (23.2)			
≥3	8 (18.6)			
Does it have a cleaning system for cannulated?				
Not applicable	6 (13.9)			
Yes	33 (76.7)			
No	4 (9.3)			
Does it have automated rinsing?				
Not applicable	6 (13.9)			
Yes	32 (74.4)			
No	5 (11.6)			
Total thermal disinfecting washers				
0	21(48.8)			
1	11 (25.5)			
2	8 (18.6)			
≥3	3 (6.9)			
Number of baskets per cycle				
<09 5 (22.7)				
10 16 (72.7)				
>11 1 (4.5)				
Does it have compressed air available for drying materials?				
Yes	42 (97.7)			
No	1 (2.3)			
ETAPA DE PREPARO				
Total dryers				
0	27 (62.7)			
1	11 (25.5)			
≥2	5 (11.6)			
PREPARATION STAGE				
Total high-temperature steam autoclaves		2.6±1.5	1	7
1	10 (23.2)			
2	16 (37.2)			
3	9 (20.9)			
≥4	8 (18.6)			
Total low-temperature hydrogen peroxide sterilizers?				
0	28 (65.1)			
1	9 (20.9)			
2	6 (13.9)			

Note:*mean; **standard deviation; ***minimum; ****maximum.

In Table 3, it is shown that the nurse is the professional responsible for compiling the production in most of the CMEs(30; 69.7%); in 31 (72%) of the cases, the data comes from the records of equipment loads with monthly collection of this information. The description

of the production is mostly done by items (26; 60.4%) and loads (23; 53.4%), although other ways of presenting the data have also been mentioned. On the other hand, seven (16.2%) managers claim not to carry out this type of control in their CMEs.

Table 3. Characterization of the productivity records of the CMEs. Porto Alegre/RS, Brazil, 2023

Characteristics n=43	**N(%)**	
Who is responsible for compiling production?		
Nurse	30	(69.7)
Nursing technician	5	(11.6)
Administrative staff	3	(7.0)
Not done	5	(11.6)
Where does the data come from?		
Equipment	31	(72.0)
Shift	3	(7.0)
Employee	3	(7.0)
Area	1	(2.3)
Not done	5	(11.6)
How often is this survey done?		
Daily	5	(11.6)
Weekly	2	(4.6)
Monthly	31	(72.0)
Not done	5	(11.6)
How does he/she describe the production?		
Items*	26	(60.4)
Pieces**	7	(16.2)
Surgical kits**	10	(23.2)
Loads****	23	(53.4)
Not done	7	(16.2)
Did he/she report full productivity when requested?		
Yes	21	(48.8)
No	22	(51.2)

Note:*Item corresponds to a set of pieces or a piece processed individually (separate); **Piece corresponds to each component of an item; ***Surgical kit is the set of items sent for a surgical/diagnostic procedure; ****Load corresponds to the sterilization cycle done.

In Table 4, when analyzing whether there is a relationship between the investment in the technological park of the CME, the hospital size, the structure, and the surgical production capacity, a significant association can be observed ($p< 0.05$), meaning that as the hospital size increases, the structure, surgical capacity, and number of available equipment in the CME also increase.

Nonetheless, through the Pearson'sChi-square test, no significant difference was identified ($p = 0.355$) between hospital size and automation of the CME, just as there was no significant difference between type of funding and automation of the CME ($p = 0.101$).

When analyzing, through the variables "automated CME" and "quantity of each type of equipment in the CME", a significant difference was found with most variables ($p< 0.01$), except with the low-temperature hydrogen peroxide sterilizer ($p = 0.667$) and the cleaning fluent steam cleaning equipment ($p = 0.083$).When relating the same variables to hospital size, a moderate correlation is observed with the total number of high-temperature steam autoclaves ($r = 0.650$), low-temperature hydrogen peroxide sterilizers ($r = 0.547$), and ultrasonic washers ($r = 0.540$); and a weak correlation with the total number of thermal disinfecting washers ($r = 0.396$) and dryers ($r = 0.391$).

Table 4. Comparison of the structure and productivity of the SC** and the technological park available in the CMEs with institutional size, type of funding, and automation of the CME. Porto Alegre/RS, Brazil, 2023.

Characteristic n=43	Hospital size	N(%)		p^a	p^b	p^c	Rho[d]	p^e
Number of operating rooms:								
	<2	13	(30.2)	< 0.001*	0.773	<.001*	0.761	<.001
	4-6	16	(37.2)					
	7-10	8	(18.6)					
	≥11	6	(13.9)					
Monthly surgicalproduction:								
	<50	6	(13.9)	<0.001*	0.447	<0.001*	0.727	<0.001
	51-150	8	(18.6)					
	151-500	10	(23.2)					
	501-1000	13	(30.2)					
	≥1001	6	(13.9)					
Total high-temperature steam autoclaves								
	1	10	(23.2)	<0.001	0.745	0.007	0.650	<0.001
	2-3	25	(58.1)					
	4-5	5	(11.6)					
	≥6	3	(6.9)					
Does it have a low-temperature hydrogen peroxide sterilizer?								
	Yes	15	(34.9)	0.233	0.031*	0.667	0.547	0.035
	No	28	(65.1)					
Does it have ultrasonic washer?								
	Yes	37	(86.1)	0.006	0.708	<0.001	0.540	<0.001
	No	6	(13.9)					
Does it have thermal disinfecting washers?								
	Yes	22	(51.2)	0.078	0.212	<.001	0.396	0.009
	No	21	(48.8)					
Do you have fluent steam cleaning equipment?								
	Yes	3	(6.9)	0.068	0.191	0.083	0.136	0.384
	No	40	(93.1)					
Does it have dryer?								
	Yes	16	(37.3)	0.041	0.573	<.001	0.391	0.010
	No	27	(62.7)					

Note: **Surgical center; a- Kruskal-Wallis test comparing the variables grouped by hospital size; b- Kruskal-Wallis test comparing the variables grouped by type of funding; c- Mann-Whitney test comparing the variables grouped by the automation of the CME; d- Spearman correlation coefficient between hospital size and other variables; e- Significance ($p < 0.05$) of the correlation with hospital size.

In Table 5, when comparing automated or non-automated CMEs with productivity in items, a significant association was found (p<0.01), meaning that automated CMEs are the most productive.

Table 5. Comparison of the automation of the CME with the overall productivity of the CME in items, Porto Alegre/RS, Brazil, 2023.

Characteristicn=43	Automated CME[ß]?		Mann-Whitney
	Yes	No	
	Md [P25-P75]	Md [P25-P75]	*P*
SSH	9818 [5738-13899]	340 [260-420]	0.011
MSH	10305 [7278-28844]	10371 [5807-14936]	
LSH	24909 [18917-59350]	8488 [5067-11909]	

Note: ß- CME with at least one thermal disinfecting washer and one ultrasonic washer available in the cleaning area.

DISCUSSION

This study identified the predominance of hospitals with mixed funding in the state in question.This finding aligns with the information from the Annual Observatory of the National Association of Private Hospitals in 2023, which indicates that private hospitals, both for-profit and philanthropic, that serve a portion of SUS users, characterized as mixed in this study, account for the highest health expenditures in Brazil[9].

There is a global trend towards increased surgical productivity, due to increasingly effective and innovative techniques. This exponential growth has been observed in the national scenario with a recorded 21% increase in surgical volume in just the first five months of 2024, reaching 75% of the target set for the entire year in just the first half[10].Even though the findings of this study point to the relationship between the number of beds, a determining factor for hospital size, and surgical productivity, it is important to consider that the need to meet surgical demand may influence the emergence of hospitals focused almost exclusively on the surgical specialty, aiming at the financial results that this sector tends to bring.

Another factor to be considered is the reflection of the period of isolation imposed by the Covid-19 pandemic, which forced not only institutions but also many patients to postpone procedures, requiring the health system to absorb this pent-up demand, which is why the surgical volume tends to grow even more[11].

Regarding the characterization of the CMEs, the location far from the surgical center, observed in eight services, can negatively impact productivity, due to the fact that the workflow requires more time for movement. Additionally, the five CMEs that still have decentralized processes may experience fluctuations in the quality of the dispensed product, because the processing stages occur outside the CME's structure. The difficulty in controlling dispersed processes is greater than in processes concentrated in just one location, which aligns with the principle that centralization of processing not only qualifies the work product but also adds more value and recognition to the workers who provide care, even if indirectly, to the institution'spatients[2].

It is considered that the centralization of the CME to serve different services under the same management may be a strategy aimed at optimizing processes through the introduction of leaner methodologies[12]. Some questions are pertinent regarding the legal aspects of this way of work, for example, concerning the premises related to the safe transportation of these materials, as provided for in Brazilian national legislation, which allows the centralization of a CME for more than one hospital, clinic, or other health services, as long as they are subordinate to the same manager[1, 13].

As for the characteristics of productivity records, the compilation of results from most hospitals is carried out by nurses, consuming part of their working hours that could be directed to guaranteeing the safety of the PHPs. Furthermore, the working hours of these professionals are higher than those of administrative professionals, which indirectly increases the costs of the CME.

Another problem that complicates the record of the CME's productivity is the lack of national standardization for this activity.The absence of this standardization can bring difficulties in personnel sizing, as prescribed by the regulations of the Brazilian Federal Nursing Council (COFEN, as per its Portuguese acronym), as well as create weaknesses regarding the management of activities and real processing costs. The COFEN does not specify the recording format, much less the compilation format, but defines the way to describe so that, based on the produced volume, applying the standard time for each activity, in order to find the number of professionals required for the sector[14].

Only five (11.6%) of the respondents stated that they do not record productivity routinely. On the other hand, 22 (51.2%) had difficulty in showing these results. These data reinforce that productivity control may be a recurring limitation among nurses working in the CMEs, as this information could be used to support requests for administrative assistance or even to expand the nursing staff of the service, guaranteeing process supervision, i.e.,it is fundamental for quality assurance.

In this purpose, it is understood that the record of productivity is fundamental both for

cost estimates and for the adequacy of human and material resources. These data should be periodically monitored by the process manager. It is also important to emphasize that the standardization of processes is an important factor in the nurse's practice, thus reflecting in practices that are increasingly aligned with current regulations[15, 16].

A heterogeneity was identified in the technological availability of the studied CMEs, even with the sample consisting of Class II CMEs. Six institutions of small, medium, and large sizes were found, which perform a significant surgical volume and use complex-shaped PHPs, but do not have an ultrasonic washer, the minimum recommended by Brazilian legislation[1].

In the current study, only 22 CMEs were categorized as automated, a result less significant than expected, especially because they are Class II CMEs[1]. This reality may have implications directly related to the prevention and control of Healthcare-Associated Infections (HAIs).Failures in the cleaning and sterilization process are among the most relevant factors when it comes to reported adverse events involving the CME[17].

As surgical technology expands to smaller hospitals and remote areas away from large urban centers, it is imperative that there is, concurrently, the availability of equipment capable of processing materials with greater safety and, above all, with reproducibility – especially in light of the increasing complexity in the cleaning of the PHPs. Thus, it is understood that cleaning is the most complex stage in the CME, which requires automation, whether to reduce occupational risks or operational costs, but mainly to guarantee the reproducibility of results, which is impossible to achieve with just the manual process[2].

Although the results do not show an association of the automation of the CME with hospital size (p = 0.355) or with the type of financing (p = 0.101), there was a significant association (p< 0.01) with the productivity of the CME, which may indicate the positive impact of automation on productive capacity. Furthermore, it is possible that this finding is reflected not only in larger numbers but also in quality, when one understands that the ability to reproduce results is much greater when the cleaning stage is automated[17].

The automation of processes in the CMEs is a very delicate issue, as it can be understood as a reduction of the workforce within services, just as it happens in industry. However, it is worth remembering that not all steps can be automated; they remain dependent on the human factor, whether performing the activity manually or supervising deliveries made by the equipment. Therefore, automation can be seen as a gain in the quality of life of workers, who should seek higher qualifications, favoring and assigning professionals to more strategic rather than operational roles[19].

Accordingly, it is evident that the automation of the CME keeps pace with the growth in both size and productivity of surgical centers, just as the number of available equipment is also greater in automated CMEs.

Nevertheless, it is important to emphasize that as crucial as technological availability is the knowledge possessed by the technical manager responsible for acquiring the specific equipment of CME, which must meet not only current regulations but also the needs of the service. It is fundamental that this professional is involved and actively participates from the identification of the need to the effective acquisition of the equipment[18,20].

As a limitation of the study, one can list the high number of negative responses from institutions regarding participation in the research, which suggests a restriction of these managers in relation to the activities carried out by the CME and its role in the financial sustainability of the institution. Thus, paradigm shifts need to take place in health services, which can happen through the production of scientific evidence on the topic, contributing to the visibility of the need to expand technological resources not only in theSCs but also in the CMEs.

CONCLUSION

Through the study, a positive relationship was found between productivity and automation of the CME. The automated systems proved to be more productive than the exclusively manual

ones, even when compared to similar hospital sizes.

Even so, the CMEs in RS are centralized, operate continuously, and have heterogeneous technological availability. Nonetheless, hospitals with a high surgical volume did not have ultrasonic washers, nor did they have a cleaning system for cannulated instruments, which is an unequivocal condition for the use of technology.

The scenario encountered denotes a predominantly manual process, relying almost exclusively on the human factor to determine the quality of the most important stage of thePHPs. The automation of the cleaning process should be promoted, as it positively reflects on productivity not only in numbers but also in guaranteeing reproducible results, a critical factor when quality is an unconditional premise in the PHPs.

RELAÇÃO ENTRE TECNOLOGIA E PRODUTIVIDADE EM CENTROS DE MATERIAL E ESTERILIZAÇÃO DO RIO GRANDE DO SUL

RESUMO

Objetivo: avaliar a relação entre a disponibilidade tecnológica e a produtividade em Centros de Material e Esterilização (CMEs), automatizados ou não, de hospitais do Rio Grande do Sul (RS). **Método**: Estudo transversal e analítico conduzido em 43 CMEs selecionados aleatoriamente, localizados no estado do RS, Brasil. Dados foram coletados através de entrevistas *on-line* com os gestores dos CME entre dezembro de 2022 e maio de 2023. A análise dos dados foi por estatística descritiva e inferencial. **Resultados**: Os CMEs são centralizados, com funcionamento ininterrupto e possuem disponibilidade tecnológica heterogênea, sendo 22 (51,2%) caracterizados como automatizados. Verificou-se uma associação significativa entre a disponibilidade tecnológica (automatização) e a produtividade dos CMEs. Verificou-se também uma associação significativa ($p<0,05$) e correlação positiva ($Rho<0,65$) entre a disponibilidade tecnológica, o porte hospitalar e a produção cirúrgica, embora tenham sido encontradas instituições com alta demanda cirúrgica e disponibilidade tecnológica limitada na área de limpeza, denotando um processo majoritariamente manual. **Conclusão:** Constatou-se uma relação positiva entre produtividade e automatização dos CMEs. Os automatizados demonstraram ser mais produtivos do que os exclusivamente manuais, inclusive quando comparados portes hospitalares semelhantes. A automatização do processo de limpeza deve ser propagada, pois reflete positivamente na produtividade não somente em números, mas na garantia de resultados reprodutíveis.

Palavras-chave: Enfermeiras e enfermeiros. Esterilização. Departamentos hospitalares.

RELACIÓN ENTRE TECNOLOGÍA Y PRODUCTIVIDAD EN CENTRALES DE EQUIPOS Y ESTERILIZACIÓN DE RIO GRANDE DO SUL

RESUMEN

Objetivo: evaluar la relación entre la disponibilidad tecnológica y la productividad en Centrales de Equipos y Esterilización (CEyEs), automatizadas o no, en hospitales de Rio Grande do Sul (RS)-Brasil. **Metodología:** estudio transversal y analítico realizado en 43 CEyEs seleccionados aleatoriamente, ubicados en el estado de RS-Brasil. Los datos fueron recolectados a través de entrevistas *on-line* con gerentes de CEyEs entre diciembre de 2022 y mayo de 2023. El análisis de datos se realizó mediante estadística descriptiva e inferencial. **Resultados:** las CEyEs son centralizadas, con un funcionamiento ininterrumpido y una disponibilidad tecnológica heterogénea, siendo 22 (51,2%) caracterizadas como automatizadas. Se encontró una asociación significativa entre la disponibilidad tecnológica (automatización) y la productividad de las CEyEs. También se encontró una asociación significativa ($p<0,05$) y una correlación positiva ($Rho<0,65$) entre la disponibilidad tecnológica, el tamaño del hospital y la producción quirúrgica, aunque se encontraron instituciones con alta demanda quirúrgica y disponibilidad tecnológica limitada en el área de limpieza, lo que indica un proceso predominantemente manual. **Conclusión:** se constató una relación positiva entre la productividad y la automatización de las CEyEs. Las automatizadas demostraron ser más productivas que las exclusivamente manuales, incluso al comparar hospitales de tamaño similar. La automatización del proceso de limpieza debe propagarse, pues impacta positivamente la productividad no solo en términos de números, sino también en la garantía de resultados reproducibles.

Palabras clave: Enfermeras y enfermeros; Esterilización; Departamentos de hospitalarios

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Corresponding author: Luciano Lemos Doro. Rua Governador Roberto Silveira, 1203 Ap 301. Bairro Santa Catarina. Caxias do Sul – RS Cep: 95032-710. Telefone: +55 54 981286665 lucianolemosdoro@gmail.com

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