Evaluating Lean Healthcare implementation with data mining: opportunities and improvements in emergency services

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Abstract
The waiting time for care in emergency services impacts overcrowding. The Fast Track method contributes to reducing this waiting time. The objective of this study was to evaluate the problems identified and improvements made in emergency services through the execution of the Lean Healthcare project. With the qualitative research approach, data mining allowed reaching results that demonstrated similar problems in emergency services in eight federative units. The improvements implemented contributed to the reduction of patient waiting time. Data mining allowed evaluating groups with similar characteristics, which showed the correlation between the problems encountered and the improvements made in the emergency services.
Keywords: Total quality management; Lean Healthcare; Evaluation study; Data mining.

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Avaliando a implementação do *Lean Healthcare* com mineração de dados: oportunidades e melhorias nos serviços de emergência

Resumo
O tempo de espera por atendimento nos serviços de emergência impacta na superlotação. O método *Fast Track* contribui para reduzir esse tempo de espera. O objetivo desse estudo foi avaliar os problemas identificados e melhorias realizadas nos serviços de emergência através da execução do projeto *Lean Healthcare*. Com a abordagem de pesquisa qualitativa, a Mineração de Dados permitiu chegar aos resultados que demonstraram problemas similares nos serviços de emergência em oito unidades federativas. E as melhorias implementadas contribuíram com a redução do tempo de espera dos pacientes. A mineração de dados permitiu avaliar grupos com características semelhantes, que evidenciou a correlação entre os problemas encontrados e as melhorias realizadas nos Serviços de Emergência.
Palavras-chave: Gestão da qualidade total; *Lean Healthcare*; Estudo de avaliação; Mineração de dados.

Evaluación de la implementación de *Lean Healthcare* con minería de datos: oportunidades y mejoras en servicios de emergencias

Resumen
El tiempo de espera para la asistencia en los servicios de emergencia incide en el hacinamiento. El método *Fast Track* contribuye a reducir este tiempo de espera. El objetivo de este estudio fue evaluar los problemas identificados y las mejoras realizadas en los servicios de emergencia a través de la ejecución del proyecto *Lean Healthcare*. Con el enfoque de investigación cualitativa, la Minería de Datos permitió llegar a resultados que evidenciaron problemas similares en los servicios de emergencia de ocho unidades federativas. Y las mejoras implementadas contribuyeron a reducir el tiempo de espera de los pacientes. La minería de datos permitió evaluar grupos con características similares, lo que mostró la correlación entre los problemas encontrados y las mejoras realizadas en los Servicios de Emergencia.
Palabras clave: Gestión de calidad total; *Lean Healthcare*; Estudio de evaluación; Minería de datos.

Introduction

The overcrowding of emergency departments is a serious public health problem. Recent studies have reported that overcrowding in emergency departments affects the quality of emergency departments and clinical decisions about admission (JUNG; KIM; KIM; PARK; CHUNG; CHUNG; LEE, 2021; LIU; HAMEDANI; BROWN; ASPLIN; CAMARGO JUNIOR, 2013; TSAI; WENG; LIU; TSAI; GOTCHER; CHEN; CHOU; KIM, 2020).

In general, overcrowding management seeks to improve operational, economic-financial, quality performance, etc. Consequently, efficient management of overcrowding benefits patients, their families, medical professionals, hospital teams and society (VIERA; REIS; CHAVES; CALADO; BOURGUIGNON; LORDELO, 2021).

The increasing use of emergency services as the first point of contact for health is a multifactorial issue that is present on a global scale (HEYMANN; WICKY; CARRON; EXADAKTYLOS, 2019).

In Brazil, universal, egalitarian, and orderly access to health actions and services begins at the doors of the Unified Health System (SUS) and is completed in the regionalized and hierarchical network, according to the complexity of the service (BRASIL, 2015).

The 24-hour Emergency Care Units (UPA 24h) are health establishments of intermediate complexity, which are articulated with primary care; the Mobile Emergency Care Service (SAMU 192), home care, and hospital care aim to contribute to the improvement of the functioning of the Emergency Care Network (RAS) (BRASIL, 2018).

Lean Thinking originated from the Toyota Production System (MAGALHÃES; ERDMANN; SILVA; SANTOS, 2016). This management process began in the industrial sector and came to be applied in various services, including the health area.

Implementing and adapting the Lean philosophy in healthcare can help make necessary changes and improvements. It was highlighted in a recent study that the need to create new circuits of patient care according to the type of medical consultation reduces the patient lead time (MORELL-SANTANDREU; SANTANDREU-MASCARELL; GARCIA-SABATER, 2021). Identifying the need to reorganize the agendas according to the care needs allowed the reduced workload.

The structured method often used in Six *Sigma* is the DMAIC (define-measure-analyze-improve-control) method and statistical tools that assess improvement opportunities (FREIRE; CALADO; PAES, 2021).

While lean focuses on reducing waste and non-value-added activities, Six *Sigma* focuses on reducing process variation by following the DMAIC approach and using statistical tools. Therefore, the two methodologies complement each other (ZEPEDA-LUGO; TLAPA; BAEZ-LOPEZ; LIMON-ROMERO; ONTIVEROS; PEREZ-SANCHEZ; TORTORELLA, 2020).

Production sequencing rules, or production scheduling and dispatch rules, are placing orders, parts, or tasks in the system (SILVA; COSTA; SILVA; PEREIRA, 2012, p. 72). In this perspective, Fast Track is understood as a method that finds similarities when applied in healthcare.

Patient sequencing is the sequence of steps to be completed, from admission to reintegration into society. It starts with a reception in the risk classification sector, and they consider that Fast Track has proved to be an effective management strategy in reducing patient hospitalization time and, therefore, improving the performance of hospital services (VIERA; REIS; CHAVES; CALADO; BOURGUIGNON; LORDELO, 2021).

Therefore, the objective of this study was to evaluate opportunities and continuous improvements through data mining.

Method

With the implementation of the Lean in the UPA 24h Project, executed in partnership with the Ministry of Health, through the team of the Department of Hospital Care and Urgency (DHU/MS) and the Fluminense Federal University, represented by the Coordination of the Lean in the UPA 24h Project, this study was carried out, which consists of qualitative research of the descriptive type (MINAYO; COSTA, 2018).

The methodology can follow a summative evaluation approach, as it is conducted after the implementation or completion of the project, with the aim of providing an overall assessment of the results achieved. In addition, the methodology includes steps of data preparation, exploratory analysis and interpretation of results, which are consistent with guidelines for conducting effective estimates (FITZPATRICK; SANDERS; WORTHEN, 2011).

For evaluating opportunities and continuous improvements in the UPA 24h, the results from the application of the DMAIC method were compiled and data mining

processed. Data mining is an effective approach to dealing with large sets of clinical data and extracting useful knowledge for decision-making (GONZALEZ; TAHSIN; GOODALE; GREENE, 2015).

The data were collected from two databases built by the results compilations of technical visit reports, from the DMAIC Method application in the UPA 24h for the evaluation of opportunities and continuous improvements, to be processed in the R Interface software (LOUBÈRE; RATINAUD, 2014).

The IRAMUTEQ software was chosen because it allows performing statistical analyzes such as word frequency, co-occurrence frequency analysis, and correspondence analysis, which helped identify patterns and trends in textual data. As well as presenting the data more simply with its visualization features that allow it to be graphically represented as a word cloud, and correspondence analysis graphs, *etc*. (TINTI; BARBOSA; LOPES, 2021).

Furthermore, IRAMUTEQ is a software specialized in textual analysis, being able to handle different languages, including Portuguese; large volumes of textual data, which was the case in this study; organize and segment the *corpus* into categories, facilitating the comparative analysis and the identification of similarities and differences between the databases. The program is free to access, allowing researchers to perform data mining without the need to invest in licenses (TINTI; BARBOSA; LOPES, 2021).

Procedures

Defining evaluation is complex, and one must consider the context in which the evaluation was used. To encompass the assessment in different contexts, Fitzpatrick, Sanders and Worthen (2011) define evaluation as the identification, clarification, and application of defensible criteria to determine an evaluation object's value (worth or merit) about those criteria. The evaluation process uses inquiry and judgment methods, such as collecting relevant information; determining the criteria and standards (relative or absolute) for judging; and applying the standards to determine value, quality, utility, effectiveness, or significance. It leads to recommendations that bring the assessment object closer to the intended objective(s) or help stakeholders determine whether it is worthy of adoption, continuation, or expansion.

The evaluation process assists with judgments about a program's overall worth or merit about important criteria, which are considered essential to judging something. According to the authors, valuing is the *sine qua non* of evaluation.

Fitzpatrick, Sanders and Worthen (2011) describe some evaluation methods: the formative, when the primary purpose is to provide information for program improvement; the summative when evaluations are concerned with providing information to serve decisions or assist in making judgments about program adoption, continuation, or expansion. These need to focus on issues such as "needs assessment," "process," and "outcome." And they may also be internal and external if conducted by a team member who does not belong to the institution.

Thus, the evaluation of opportunities and Continuous Improvements was carried out in steps (FITZPATRICK; SANDERS; WORTHEN, 2011; HAN; PEI; KAMBER, 2011; WITTEN; FRANK; HALL, 2011):

- First step: construction of databases about opportunities and improvements, were collected from the reports of each UPA 24 H, which received a random numbering, UPA 01 up to UPA 50;
- Second step: assignment of a code in letters of the alphabet according to the size of each of the 50 UPA that was part of this study: Size I letter A, size II letter B, and size III letter C;
- Third step: identification of the Federative Units of the UPA;
- Fourth step: the opportunities and improvements described in the technical visit reports by the UPA 24 H teams were compiled according to the parameters of the IRAMUTEQ software, which instructs the formatting of expression dictionaries, to remove the words linked by hyphens (-) apostrophes (') or spaces, that we can treat expressions as a whole, thus avoiding the division of compound words.

Fifth step: the data were compiled in the columns of the Excel spreadsheets, then transferred to two documents in Word, which were saved without formatting and using the encoding Unicode (UFT-8), according to the parameters established by the IRAMUTEQ software, thus creating the databases: 1_waste and 2_improvements_continuous.

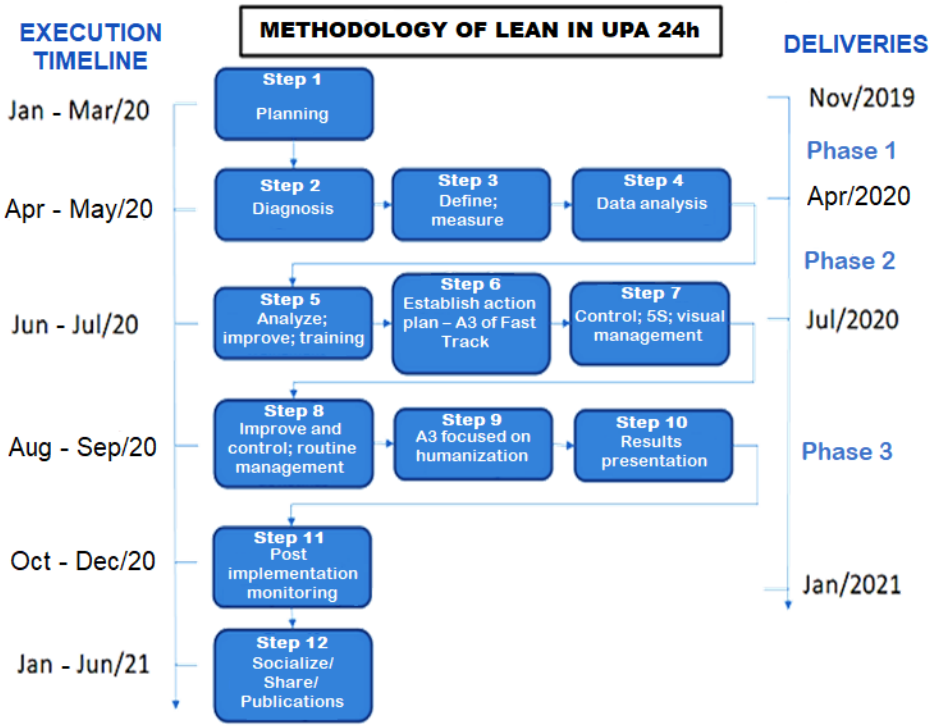
When accessing the databases, each database's Descending Hierarchical Classification (DHC) was obtained, which allowed the evaluation of text segments (TS). These are classified according to their respective vocabularies, and the set of them is

divided according to the frequency of the reduced forms according to the processing in the IRAMUTEQ software. Then, it was possible to carry out the Correspondence Factor Analysis (CFA), which associates texts with variables, enabling the evaluation of textual production in terms of the characterization variables. The CFA calculation process results from the crossing of the occurrences of each lexical form of the vocabulary with the resulting classes of the two databases DHC, one of the textual *corpus* on waste and the other textual *corpus* on continuous improvements, were processed in different moments, which allowed the construction of graphics for textual evaluation. Based on the processing results, evaluations were carried out regarding the opportunities and continuous improvements carried out by the teams of the UPA 24h in this study.

Results and discussion

Under the proposed objectives, the coordination of the Lean in the UPA 24h Project with the group of tutors executed the DMAIC Methodology in the 50 UPA 24h, which took place in three phases over the year 2020. The DMAIC method consists of an acronym of the words define, measure, analyze, improve and control (FREIRE; CALADO; PAES, 2021).

Figure 1 - Execution schedule of Lean in the UPA 24h Project



Source: COELHO; BOURGUIGNON; CHAVES; SILVA; BARBOSA; TEIXEIRA; BRAGA NETO; CALADO, 2020.

The initial stage made it possible to program technical visits according to the schedule in which the groups of tutors were formed to advise the intervention. In stages 2 and 3, on-site technical visits were carried out for the execution of the Lean Project in the 50 UPA 24h, where the teams of each unit received, in addition to training, guidelines to indicate waste and carried out actions for continuous improvement. The tutor groups described these activities in technical visit reports. The tutors carried out technical visits to the 50 UPA 24h in eight Federative Units: Ceará, Maranhão, Tocantins, Mato Grosso, Goiás, São Paulo, Rio de Janeiro, Santa Catarina, and in the Federal District. According to the plan, each UPA 24h received 09 visits by the groups of tutors, resulting in 450 reports that describe the waste and the 689 continuous improvements carried out in the 50 24h UPA. Following the ethical precepts that make up research, it was decided to assign a number in ascending order to the 24h UPA, preserving the identity of the institutions, following the methodology of this study.

Figure 2 - UPA 24h *per* federative unit according to size category

Federative Units	**UPA 24H CATEGORY**			**NUMBER OF UPA 24H**
	Size I	**Size II**	**Size III**	
Ceará		UPA38, UPA28, UPA27	UPA34, UPA30, UPA05, UPA23, UPA35, UPA33, UPA48, UPA36, UPA32	12
Distrito Federal			UPA43, UPA16, UPA42, UPA18, UPA11, UPA46,	06
Goiás		UPA17, UPA44,	UPA49	03
Maranhão		UPA39	UPA19, UPA45, UPA41	04
Mato Grosso		UPA50		01
Rio de Janeiro		UPA21		01
Santa Catarina			UPA20, UPA47, UPA40	03
São Paulo	UPA07, UPA02, UPA25, UPA12,	UPA10, UPA15, UPA26, UPA01, UPA13, UPA09, UPA08, UPA24, UPA06, UPA04,	UPA29, UPA14, UPA22, UPA03,	18
Tocantins			UPA37, UPA31	02
TOTAL				50

Source: The authors (2020).

Like the study by Xiao, Jing, Xu, Zheng, Gan and Wen (2021), data mining was performed in this study by applying data mining techniques to textual medical data.

The steps of data collection, data processing, data analysis and evaluation and interpretation of results were followed. For the data mining carried out in this study, a text database based on the reports was built, which obtained the following results.

The qualitative analysis of the results extracted from the reports related to the technical visits carried out in the UPAS, using the IRAMUTEQ software, enabled the textual statistical analysis for each UPA of the Lean Project. In the reports of technical visits, the results referring to the application of the DMAIC method were emphasized (FREIRE; CALADO; PAES, 2021; TAVARES; YUKITA; GERALDINI; FRANCO; MUNIZ JUNIOR, 2017; RITTER; THEY; KONZEN, 2019).

Data mining is a methodology for discovering valuable information and hidden patterns in huge datasets using statistical approaches. Data mining also allows analyzing the immense amount of medical data and extracting useful knowledge and relevant information. In addition, data mining techniques were used, such as clustering, classification, association, and regression rules, which were applied in the analysis of medical data (XIAO; JING; XU; ZHENG; GAN; WEN, 2021; QUESADO; DUARTE; SILVA; MANUEL; QUINTAS, 2022).

When submitting the coded text, called the 1_waste database, the IRAMUTEQ software recognized 50 texts, separated into 217 text segments (STs), with 168 STs (77.42%) being used. 7517 occurrences (words, forms, or words) emerged, with 1064 distinct forms and 18 supplementary forms. With 543 hapaxes, i.e., words that appeared in the textual *corpus* only once. Six clusters were formed, named here by classes.

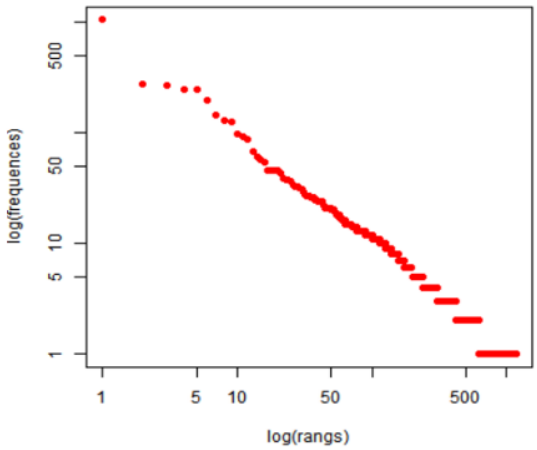
The thental axis represents the number of words or forms in the textual *corpus*. As can be seen in graphic 1, on the vertical axis, the higher the frequency of words, the lower the number of these words in the text. Words with frequency 1 exist in greater quantity in the text, and words with frequencies above 100 in less quantity.

When applying Data Mining with IRAMUTEQ, it is possible to perform a statistical analysis of the frequencies of words in a textual *corpus* and verify that the results follow Zipf's Law. That is, the frequency of occurrence of a word in a text is inversely proportional to its ranking in the frequency list (PIANTADOSI, 2014).

The red dots and dashes represent the words' occurrence in the waste database's textual *corpus*. The logarithms of the vertical axis with the division in numbers from 1 to more than 500 mark the number of times the word appeared in the textual *corpus* of the waste database. As you can see in the graphic on the vertical axis on the left side, only one dot appears in red. This means that few words appeared

more than 500 times. As you look at the horizontal axis, you can see that the number of points increases, which means that few words appeared with a frequency above 100 times. Next to the horizontal axis, on the lower right side, it is possible to visualize the graphic representation in red of many very close points that form small lines in this color. This means that many words appeared a few times and an amount above 500 words appeared at least once.

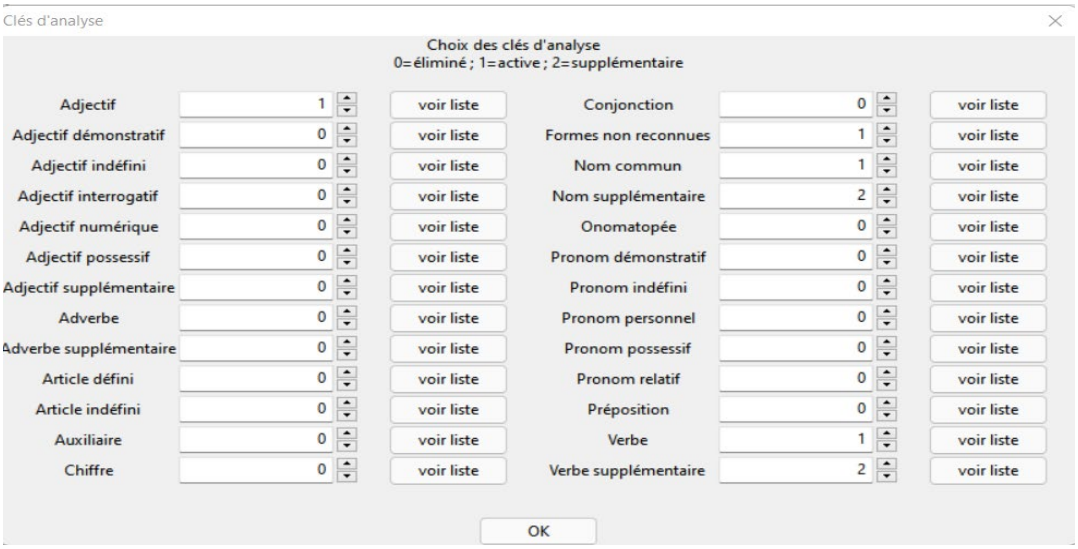
Graphic 1 - Behavior of the frequencies of words in the textual *corpus* on the waste indicated in the UPA 24h



Source: The authors (2021).

For the evaluations, the same parameterization was applied to both databases, with the selection of forms being marked with the number 1, the active forms, and with the number 2, the supplementary forms, and excluding the forms signed with the 0 (zero), aiming to facilitate the analysis of the set of text segments.

Figure 3 - Parameterization of the databases 1_waste and 2_continuous_improvement



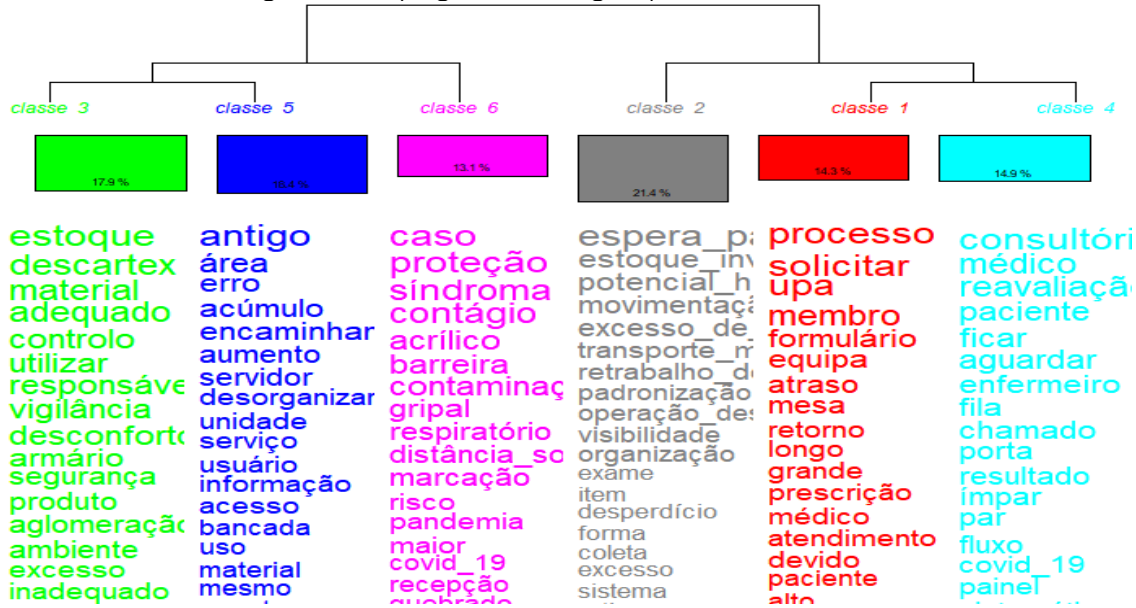
Source: The authors (2021).

Xiao, Jing, Xu, Zheng, Gan and Wen (2021), the authors performed medical data mining, which allowed cluster analysis, classification, association rules and regression. In this study, mining data on waste, it was possible to identify DHC.

Data mining was performed in this study by applying data mining techniques to textual medical data. The steps of data collection, data processing, data analysis and evaluation and interpretation of results were followed (KOLLING; FURSTENAU; SOTT; RABAIOLI; ULMI; BRAGAZZI; TEDESCO, 2021; FITZPATRICK; SANDERS; WORTHEN, 2011; XIAO; JING; XU; ZHENG; GAN; WEN, 2021).

The database 1_waste made it possible to understand the text segments that formed six classes in DHC, represented in the phylogram, whose graphic representation of the words that appeared in the TS is by the similarity of each class. That is, the closer to the top of the list, the larger the word size, the greater its influence in your class.

Figure 4 - Phylogram of subgroups A and B classes



Source: The authors (2021).

Kolling, Furstenau, Sott, Rabaioli, Ulmi, Bragazzi and Tedesco (2021) identified 19 themes with data mining, eight main ones, highlighted in a thematic network. In this study, six themes were identified according to the similarity between the words. Thus, the interrelation of the groups was discovered. The results can be used as a strategic intelligence approach to identify the most relevant topics in the research field.

After evaluating the Text Segments (TS) of the courses, they indicate that, as opportunities identified by the result of the UPA 24h's evaluation, the opportunities were identified by the different scenarios that make it possible to establish the evaluation of the classes.

The evaluations of the text segments about the context of the waste in each of the six classes reveal a profile of the problems experienced by the teams of the 50 UPA 24h where the Fast Track was implemented. By UPA 24h teams. When approaching a critical look at this evaluation of each type of waste, it becomes evident how interventions with the Lean Healthcare approach, through the DMAIC Method with the implementation of Fast Track, contribute to the reduction of waste with the continuous improvements made.

Regarding class 1 - Work process: it was evaluated that the flow of patients without signaling becomes a problem, and a series of consequences, such as the work overload of the teams, the excess movement in search of supplies for providing care to patients, is also related to the absence of most of the tasks standardization performed. Due to the lack of communication between team members, it causes misinformation, which does not add value to patients.

In class 2 – Patient Waiting: it was evaluated that the problems identified by the UPA 24h teams have the time factor as a background, seen as one of the main indicators of waste in terms of patient waiting for care. The increase in lead time causes severe problems for the health of patients. Considering the clinical picture presented, regardless of the diagnosis, it can worsen, in addition to the physical and psychological wear to which patients are exposed, with a risk of contagion from COVID-19.

Regarding class 3 – UPA 24h Materials: it was evaluated that the "failure" waste was evidenced about materials or equipment, highlighting managers' need for preventive action and maintenance. It was also found in the evaluation of the TSs of this class the problems related to linen, which presented control problems in the distribution and organization of the sector. In this class, the "failure" waste was also described as the risk of accidents, especially contamination due to COVID-19.

As for class 4 - Patient Care: it was evaluated that the teams of the UPA 24h signaled to the waste, focusing on care with the reception of patients. The problems

highlighted were, facing the demand for care for patients with suspected or confirmed COVID-19.

About class 5 - Teamwork: it was evaluated that in the TSs of this class, the problems with the disorganization of the sectors are the ones that cause failures in patient care, meeting room with boxes of old medical records and other materials, making it impossible to use the room for meetings and training. The absence of a room for dressing and undressing was also pointed out by the UPA 24h teams in this class, which makes teamwork very fragile and exposed to contamination in the face of the current health crisis. For the development of teamwork, meetings to improve work and provide training on the various procedures are essential. The waste of failure and human potential are characterized in the face of these problems indicated by the teams of the UPA 24h.

For class 6 - COVID-19: it was evaluated that the difficulties pointed out revealed an excellent demand for the organization of the work process in the reception sector and the organization of the waiting room. The problems worsened with the emergence of the health crisis that demanded special care in these sectors to prevent contamination, both on the part of the teams and towards the patients.

It is necessary to consider that the problems identified by the 24-hour UPA teams were related to the difficulties faced in the daily life of the 24-hour UPA, in which the work process is related to patient care, and that teamwork is only possible through material inputs. However, the patient's lead time consisted of presenting problems that permeated all the other problems identified in the other classes. Furthermore, the health crisis emerged as another problem that forced everyone to take a critical look at issues related to the safety of patients and teams (AHSAN; ALAM; MOREL; KARIM, 2019; DREI, 2020; IVANOV, 2020; SANTOS; CALADO; CHAVES; NASCIMENTO; SILVA; BOURGUIGNON; 2021).

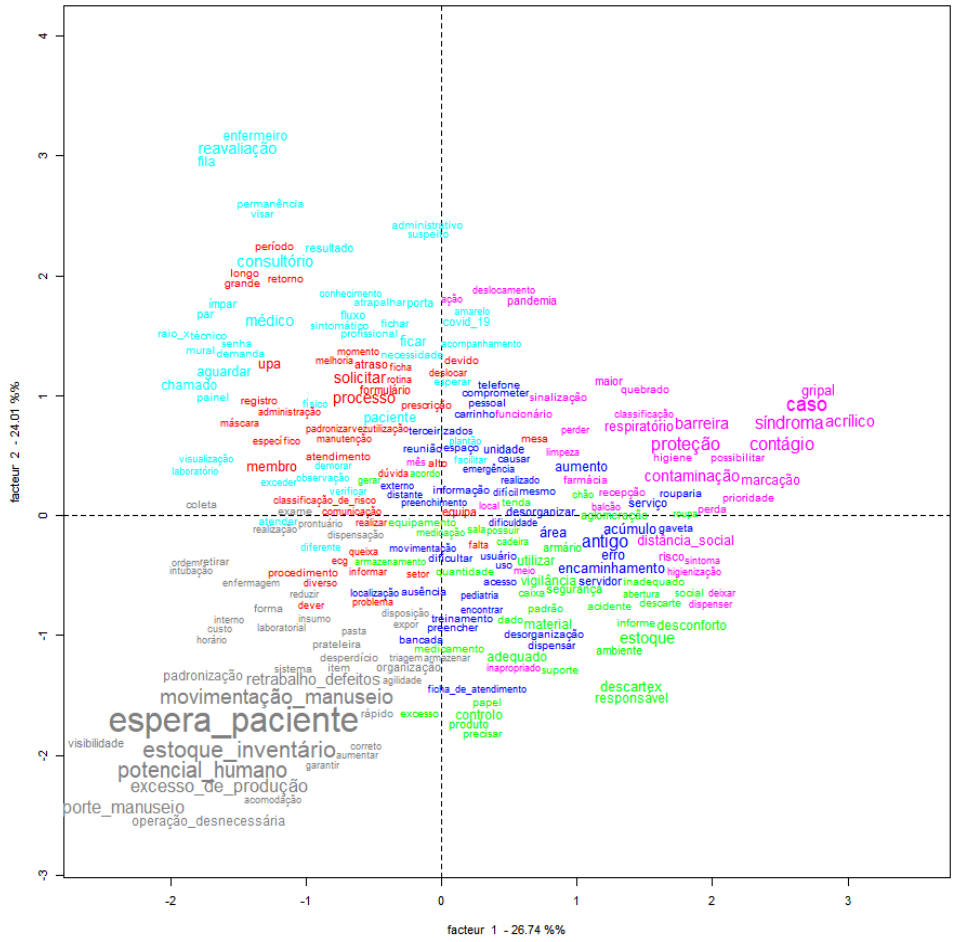
The correspondence factor analysis (CFA) about the waste identified in the UPA 24h resulted in the representation of a Cartesian plane divided into quadrants, in which the words found in the TSs are distributed in the colors of the classes assigned in the DHC. It enabled the evaluation of the interaction between the classes related to waste indicated by the UPA 24h teams.

The Cartesian plane shows the approximations and distances between the classes that can be identified according to the disposition in the upper and lower

quadrants on the left and right sides of the plane, where the six classes that were created in the descending hierarchical classification (DHC) are distributed., according to the processing of the waste database.

The CFA allowed the evaluation of each six classes considering the distribution of words and their size about the set of words presented in the TSs regarding their similarity through processing with the IRAMUTEQ software (TINTI; BARBOSA; LOPES, 2021; LUCIANI-MCGILLIVRAY; CUSHING; KLUG; LEE; CAHILL, 2020).

Figure 5 - CFA of TSs on waste according to DHC classes

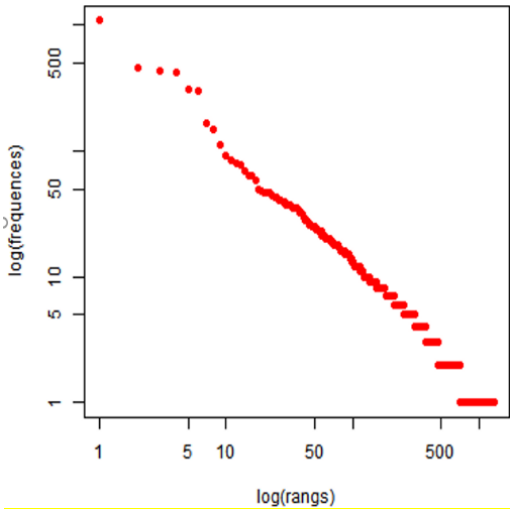


Source: The authors (2021).

When processing the database on the continuous improvements made in the UPA 24H for the evaluation of the Descending Hierarchical Classification (DHC), the following results were obtained: the IRAMUTEQ software recognized 50 texts separated into 256 text segments (TS), using 197 TS (76.95%); 9208 occurrences (words, forms or

words) emerged, with 1746 distinct forms and 608 with a single occurrence; and 06 clusters or classes were formed.

Graphic 2 - Behavior of the frequencies of words in the textual *corpus* on the continuous improvements made in the UPA 24H



Source: The authors (2021).

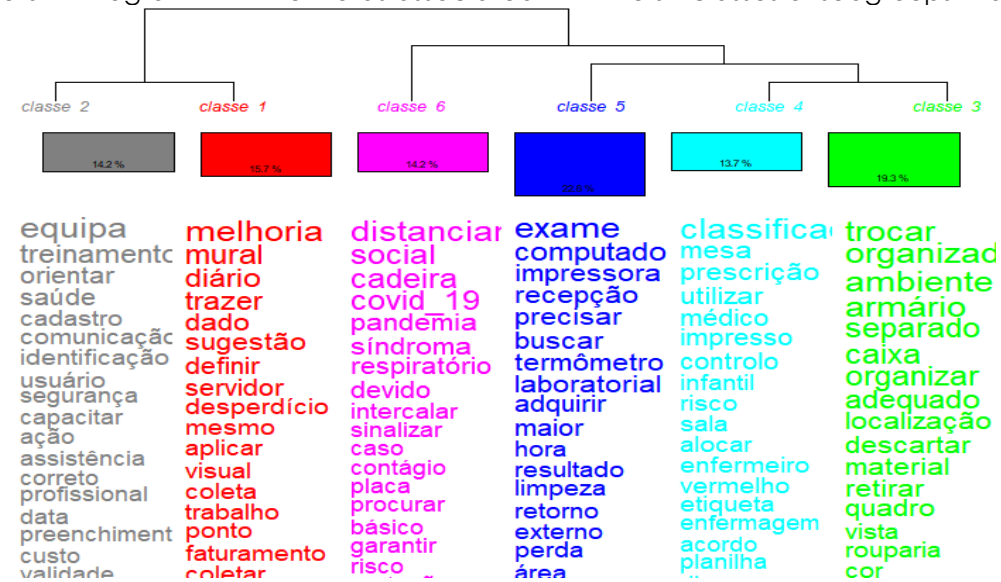
After evaluating the TS, it was found that in subgroup A, the text segments signal continuous improvements with actions related to the UPA 24h management process. Therefore, classes 3 and 4 were named by Class 3 - UPA 24h Organization and Class 4 – Risk Management, since they are two classes that have many similar words in the context of continuous improvements related to the management process, according to the analysis of the STs of this subgroup A.

Realizing that class 5 was isolated from classes 3 and 4, after evaluating the TS of this class, it was observed that it is coherent to name it as Class 5 - UPA 24h Equipment, as it presented in its TS the issues related to the improvements of the inputs, which is strongly related to classes 3 and 4.

Class 6 TS presented issues related to patient safety. For this reason and realizing that it was isolated from the other classes, it was named Class 6 - Patient Safety, which is also in the context of the management process in this subgroup A.

The two other classes in subgroup B, which are very close, were named Class 1 - Teamwork and Class 2 - Team Qualification. Both classes present common words, which complement each other, as was verified in the evaluation of the STs of these classes.

Figure 6 - Philogram with the words associated with the six classes of subgroups A and B



Source: The authors (2021).

The DHC evaluation made it possible to understand the text segments of each class according to the phylogram, with the graphic representation of the words that appeared in the TS according to the similarity of each class. The closer to the top of the list and the larger the word size, the greater its influence on the class (AHSAN; ALAM; MOREL; KARIM, 2019; TLAPA; ZEPEDA-LUGO; TORTORELLA; BAEZ-LOPEZ; LIMON-ROMERO; ALVARADO-INIESTA; RODRIGUEZ-BORBON, 2020).

In class 1 - Teamwork: it was evaluated that the actions of continuous improvement reflect the results obtained in terms of reducing the length of stay of low acuity patients, considering the set of measures, such as those that make up the Fast Track, but are not limited to creating the fast track only. As each continuous improvement follows the sequencing rules, from the simplest to the most complex, it can be identified in these actions that the Fast Track was implemented since the sequencing rules establish the priority according to the sequence in which the tasks arrive at the system. Therefore, with this method, an attempt was made to reduce the length of stay of low acuity patients.

For class 2 – Qualification of UPA 24H Teams: it was evaluated that professional qualification adds value for people who start to perform their work effectively in solving problems in the daily life of UPA 24H. The continuous improvements made in the UPA 24H contributed to the reflection on humanization about the humanized reception of patients and fraternity among people in the teams, with improvements aimed at the correct use of PPE.

Regarding class 3 - Organization of 24H UPA: it was evaluated that the continuous improvements made in 24H UPA in this class favored structural changes that considered the safety of the team in the provision of care and the safety of patients, based on the guidelines of the plans of contingency against Covid-19 in force. For this reason, the proximity of this class to class 4 was verified, which presents continuous improvements aimed at risk management.

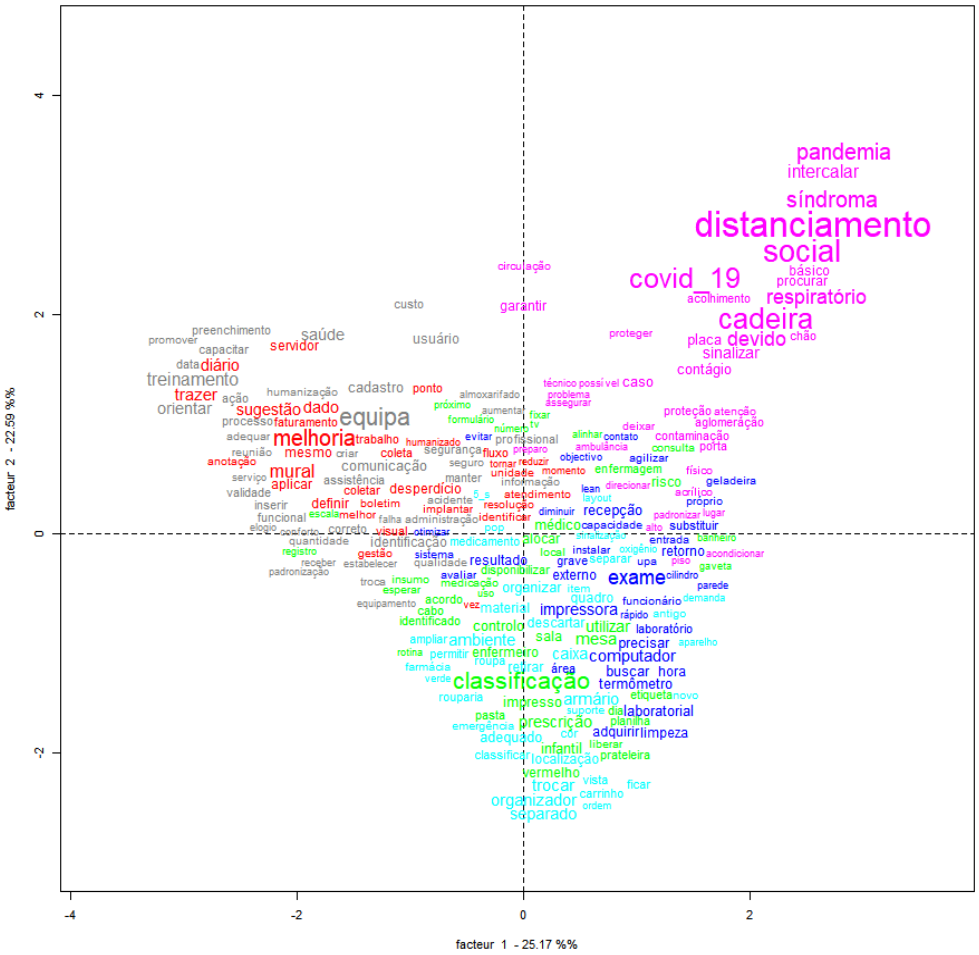
For class 4 - Risk Management: it was evaluated that the changes in the flow of patients, especially those related to the organization of queues with the marking of social distance on the floor and chairs, were continuous improvements carried out by the teams of the UPA 24 H. What contributed to the reduction of the length of stay of patients with low acuity and the flow of patients that, after their reordering, favored the reduction of agglomerations and problems related to the risk of contamination by COVID-19.

In class 5 - UPA 24H equipment: it was evaluated that the continuous improvements made by the UPA 24H teams are very close to the demands presented about organization and risk management, as demonstrated in the CFA with the Cartesian plane. The consistency observed by the teams of the UPA 24H when proposing continuous improvements related to the demands for the acquisition of supplies and their storage in the different sectors of the UPA 24H, and the care with the equipment in handling, avoiding the occurrence of accidents. The continuous improvements carried out by the teams of the UPA 24H brought an outstanding contribution to the hospital economy by observing the safety standards of preventive actions for the maintenance of equipment.

And for class 6 - Patient Safety: it was evaluated that continuous improvements were carried out in the reception sector, with the marking of social distancing on the chairs and placement of acrylic protection on the counters to protect the teams of the UPA 24H. In this class, continuous improvements in humanized reception were emphasized by the UPA 24H teams, corroborating the current National Humanization Policy.

Correspondence Factor Analysis (CFA) represents all six classes with their respective colors.

Figure 7 - CFA of the behavior of words separated by class colors



Source: The authors (2021).

The Lean Healthcare approach to implementing Project Lean in the UPA 24h, through the DMAIC and the Fast Track Method, made it possible to carry out continuous improvements by the UPA 24h teams.

With the Correspondence Factor Analysis (CFA), the actions of continuous improvement evidenced the transformations in the UPA 24H that resulted in eliminating waste and reducing the length of stay of low acuity patients.

Actions in healthcare, with all their complexity in the face of the work process, translate here the daily life of the UPA 24H teams in a collective effort to overcome difficulties and carry out continuous improvements, as programmatic actions were carried out with the DMAIC and Fast Track Method.

The waste related to the work process with the improvements focused on activities in the care of patients who demand equipment that is organized in the

environment of the UPA 24H and that focused on safety, both for users and the teams, brought significant changes in the scenarios of the UPA 24H. These improvements favored the continuous flow in the care of patients with low acuity because as they are treated primarily, there is a reduction in crowds.

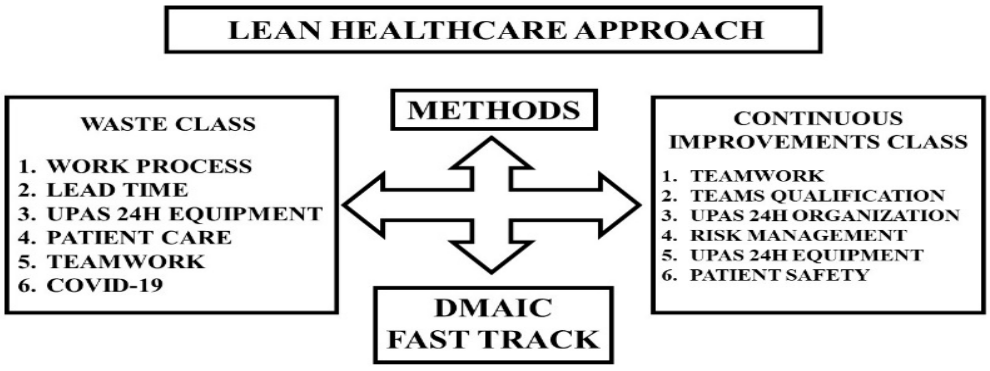
It was observed that there is a reduction in the length of stay of patients with low acuity with the implementation of the Fast Track, as they have health care demands that can be solved in a simpler and faster way, that is, following the sequencing rule. In this way, the UPA 24H teams, by implementing these actions of continuous improvement, could accelerate the pace of work, enabling a continuous flow in patient care.

Conclusions

Waste and continuous improvements made by the UPA 24H teams were evaluated using the DMAIC and Fast Track Methods through the IRAMUTEQ software. This evaluation made it possible to identify the relationships that can be established between each of the classes in the two different databases used in the textual statistical evaluations in this study using data mining.

As they were analyzed, the interrelation between the classes allows expanding the discussion about the Fast Track Method and considering that by naming them, anchored in the images produced, in DHC and FCA, and with the reading of the text segments of these classes, it is possible to observe this interrelation.

Figure 8 - Interaction of Classes on waste and continuous improvement



Source: The authors (2021).

As the databases were processed separately, it was concluded that through the implementation of Project Lean in the UPA 24H, the 50 24-hour emergency care units presented a hegemonic scenario regarding the problems that were identified through the evaluations of the classes formed in data processing, as demonstrated in the DHC and CFA of each of the evaluated databases.

In the same way, the continuous improvements carried out by the UPA 24H teams pointed to solutions in the face of the opportunities that were presented when identifying waste, which made it possible to reduce the length of stay of patients with low acuity in these units.

In this study, it was concluded that overcrowding impacts the length of stay of patients in urgent and emergency units. The use of Fast Track as a strategy allows the organization of flows more quickly, reducing the length of stay of patients with low acuity. The Fast Track Method consists of a set of actions regulated by sequencing, providing a continuous flow in a management process with the Lean Healthcare approach. It was evidenced that this Method provides the arguments to implement change strategies that demand health services.

The biggest beneficiaries were the patients treated at the UPA 24H, where Project Lean in the UPA 24H was carried out. When considering the monthly service rates *per* UPA, certain 13 million people are assisted in the 24-hour Emergency Care Units.

Based on the results found with the evaluation, the authors recommend using Fast Track in emergency and urgency environments as a work method to reduce LOS. However, to make fast-track deployment possible, it is still necessary to advance in the discussions on the construction of knowledge of the Lean Healthcare approach, especially in the topics related to the systematization of nursing care and standardized work, which opens a range of options for future research.

Another perspective that is presented concerns the understanding of organizational culture, which still needs to be explored from the perspective of institutional analysis. Theoretical constructs on institutional analysis can bring to light some understanding of belonging and its implications, which are presented in the management process with the Lean Healthcare approach.

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