



VALUE STREAM MAPPING AS LEAN HEALTHCARE'S TOOL TO SEE WASTAGE AND IMPROVEMENT POINTS: THE CASE OF THE EMERGENCY CARE MANAGEMENT OF A UNIVERSITY HOSPITAL

O MAPEAMENTO DO FLUXO DE VALOR COMO FERRAMENTA DO *LEAN HEALTHCARE* PARA ENXERGAR DESPERDÍCIOS E PONTOS DE MELHORIA: O CASO DO PRONTO ATENDIMENTO DE UM HOSPITAL UNIVERSITÁRIO

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Abstract: Lean manufacturing emerged as an evolution to traditional production management systems amid the crisis that plagued Japan and then required Japanese companies to dry up their spending and optimize their costs. An initial tool for deploying lean manufacturing in any enterprise is value stream mapping. Based on the great importance and applicability of lean manufacturing with the help of mapping the flow of value in industrial environments, the question of research has arisen: can the application of value-flow mapping in hospitals bring positive results as it has brought to the industries? Therefore, the main objective of this research is to analyze the productive environment of a university hospital, as a case study, identify bottlenecks and waste by mapping the current value flow, and propose improvements with the help of future value stream mapping. The expected results after the proposed improvements are implemented are reduction of the total lead time (time spent in the hospital), reduction of waste, better management in sight, and greater commitment of all those involved directly and indirectly in the process. This research, in its methodology, is classified as exploratory, qualitative, and used bibliographical review and case study to validate the researched content and potentiality of application in hospital environments through a conceptual debate about the central theme.

Keywords: Lean manufacturing. Value stream mapping. Hospital management. Lean healthcare.

Resumo: A manufatura enxuta surgiu como uma evolução aos sistemas tradicionais de gestão da produção, em meio à crise que assolava o Japão e então exigia das empresas daquele país que enxugassem seus gastos e otimizassem seus custos. Uma ferramenta inicial para a implantação da manufatura enxuta em qualquer empresa é o mapeamento do fluxo do valor. Com base na grande importância e aplicabilidade da manufatura enxuta com auxílio do mapeamento do fluxo de valor em ambientes industriais é que surgiu a questão de pesquisa: a aplicação do mapeamento do fluxo de valor em hospitais pode trazer resultados positivos como trouxe para as indústrias? Por isto, o objetivo principal desta pesquisa é analisar o ambiente produtivo de um hospital universitário, como estudo de caso, identificar gargalos e desperdícios através do mapeamento do fluxo de valor atual, e propor melhorias com o auxílio do mapeamento do fluxo de valor futuro. Os resultados esperados após a implantação das melhorias propostas é redução do lead time total (tempo em que o paciente passa dentro das dependências do hospital), redução de desperdícios, melhor gestão à vista, e maior comprometimento de todos os envolvidos direta e indiretamente no processo. Essa pesquisa, em sua metodologia, é classificada como exploratória, qualitativa, e utilizou de revisão bibliográfica e estudo de caso para validação do teor pesquisado e potencialidade de aplicação em ambientes hospitalares.

Palavras-chave: Manufatura enxuta. Mapeamento do fluxo de valor. Gestão hospitalar. Lean healthcare.

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1 Introduction

Going back to the historical evolution of the productive systems, it is possible to see clear progress in the managerial field of the same, since everything began in an organized way with the scientific administration of Taylor. He brought the sciences into the light of enterprise, counteracting the empiricism of the day, organized working methods, implemented controls, and gave the workforce a burden commensurate with its capabilities. Ford continued to follow this new era of factory management, deploying mass production and creating interchangeable parts, making it its largest contribution to the world's production systems, as an efficient and cost-effective way to standardize parts that they would serve in various car models. (SLACK et al, 2008).

According to Gaither and Frazier (2002), lean manufacturing can be divided into three levels: lean manufacturing as a production philosophy; lean manufacturing as a technique for production management; and lean manufacturing as a planning and control method. These levels, as well as the process for implementing the value stream mapping and its relationship with health management will be elucidated in the course of this article.

Based on the importance and applicability of lean manufacturing with vital assistance in mapping the flow of value in industrial environments, the research question arose from this article: the application of value-flow mapping in hospitals can bring positive results for management as brought to the industries? Therefore, the main objective of this research is to analyze the productive environment of a university hospital, as a case study, identify bottlenecks and waste by mapping the current value flow, and propose improvements with the help of future value stream mapping.

Taking into account the essential functions of management, this article will address: the evolution of hospital management, where it will be treated how it has evolved and what remains to be developed; the peculiarities of hospital management compared to other management of companies in other market segments, with their particularities and challenges; after which will be treated the level of hospital service to the client and cultural management change as key factors for the success of hospital management; Finally, the theme will be the mapping of the value stream, which will serve as a tool for the diagnosis of wastes and suggestions for future improvements. It will also work as an x-ray of the current situation of the process that will be the subject of the case study.



2 Theoretical reference

2.1 Hospital management

The main purpose of this topic is to treat hospital management as a management system that differs in the management of other segments, but also has several similar characteristics. Fayol (1990) inserted the five functions of the management that he defined as planning, organization, coordination, command and control. According to him, it was impossible to efficiently manage any company without the administrator being aware that he needs to address and master these five key factors. The literature on subsequent management modified the original Fayol functions.

Koontz, Weihrich and Cannice (2009) describe a new approach to management. Its Operational Management model brings planning, organization, human resources, leadership and control as the five essential functions of management. Inputs to their model include human, capital, management, and technology. A managerial transformation process, composed of the five management functions, converts these inputs into outputs such as products, hospital services, profits, satisfaction and goal integration.

2.1.1 Evolution of hospital management

It is essential to explain and evolve hospital management before treating the evolution of general administration. The administrative theory is little more than 100 years old, although by the year 5,000 BC the Sumerians already used written records of their commercial and financial activities. But it was in the Classical Industrial Age that everything began to appear in an orderly and grounded manner. The Classical Industrial Age prevailed during the first half of the twentieth century and was the driving force behind the changes that took place in the rest of the century. It was when the administrative theory launched its bases of foundations, focusing on the prescriptive and normative aspects for the administration of the organizations. Already in the Neoclassical Industrial Age came great innovations, replacing old prescriptive and normative concepts with new descriptive and explanatory concepts in management theory. In this era the Classical Theory is replaced by the Neoclassical Theory, the Theory of Bureaucracy by the Structuralist Theory and the Human Relations Theory by the Behavioral Theory. And in addition, the Contingency Theory and Systems are still emerging. After this comes the Information Age, where changes from a structural, cultural and behavioral point of view



directly affect organizations and their human, labor and social relations. In this era there are emphases still under study, besides the well-known emphases in the commitment, productivity and competitiveness. Everything focused on the search for excellence (PLANTIN; JOHANSSON, 2012).

It is important to remember that the Industrial Age goes from the year 1900 to the year 1950, the Neoclassical Era from the year 1950 to the 1990, and the Information Age from the year 1990 to the present day (CHIAVENATO, 2010).

Still according to Chiavenato (2010), all these theories were important to reach the current level of development and evolution. Today, in the 21st century, the emphasis on people, competitiveness, quality, productivity and excellence were only possible because there were strong and well-crafted previous theories that supported modern administrative thinking. It is in this context that hospital management is also found. Not unlike other organizations, health care organizations have also evolved, and have also gone through these eras and theories. To prove that the administrative approaches that once seemed to be industry specific fit nicely into health care, Barnes (1977) in his classic book *Motion and Time Study* has shown that health care was one of the sectors in which the principles of scientific management and industrial engineering are well applied in health care.

According to Chase and Apte (2007), several other studies have sequenced this approach, always linking the administrative theories applied to industry also being applied to the hospital services and health care sector. In the scientific management of Disney with the industrialization of fantasy, McDonald's with the production line approach, and the management of healthcare operations, all, to a greater or lesser degree, focused on transferring the concepts of production management and rationalization of the factories for the hospital services sector.

But all this was only possible thanks to the advancement of computerization, with its diffusion and domination. Hospital services organizations, where the health sector is located, currently invest in ERP software to integrate all departments of the organization, reduce communications noise, reduce waste, and support more assertive and agile decision making. ERPs were earmarked until recently only to industries. Recently the market was opened to other areas, such as hospital services and health. The supplier companies made adaptations to the peculiarities found in the hospital services sectors and began the implantations, with success (BOTTA-GENOULAZ; MILLET, 2006).



Even with the adoption of ERP software in the health care hospital services sector, traditional health care planning still takes an approach based on operational capacity rather than demand. Instead of combining the available capacity of different resources with demand, planners try to satisfy most of the demand based on the current levels of installed resources. There is a clear gap between demand analysis and resource allocation (ALVEKRANS et al., 2016).

Part is explained by the lack of knowledge and control of resource levels, and partly because of poor knowledge and understanding of demand levels and patterns, including variations, and how to manage demand to facilitate planning. Therefore, capacity in planning is based on historical production volumes and not expected demand. In addition, there is little investigation of variations in demand and capacity and how these variations can undergo changes and corrections. That is, traditional planning, which many hospitals currently apply, is based on service capacity, not on demand management (ALVESKRANS et al., 2016).

Today, in the 21st century, health managers (administrators working in the health care sector) have increasingly adopted tools, models and industrial management philosophies mainly in relation to operations management, since the health system is a production process, with input, processing and output. Many hospitals have invested in continuous improvements and increased operational efficiencies through decades-long production engineering techniques. Currently, the trend is to implement the Lean Healthcare philosophy (adapting the Lean Manufacturing philosophy, Lean Manufacturing, to the healthcare sector, such as hospitals, clinics, laboratories, etc.).

The central goal of Lean Healthcare is to eliminate wastefulness and cost increases for the hospital. He uses techniques from the Toyota Production System, starting with the mapping of the value stream, which serves as an x-ray and diagnoses the current situation of the process for later improvement of the bottlenecks and elimination of waste, through quality tools and leveling of production capacity according to demand focused on the reduction of lead time. Lean Healthcare, like Lean Manufacturing, advocates eliminating the seven basic wastes: overproduction waste, waste of inventory, waste of movement, waste of transport, waste of processing, waste of waiting, and waste of defects.

However, even though it is proven that the implementation of Lean Healthcare is extremely beneficial to the health sector, few professionals accept this philosophy. Perhaps out of ignorance, I fear the new and the cultural change it will generate. In the United States, Lean Healthcare is being implanted less than 5 years, and in Brazil there are only two cases of



implantation with positive results, the Hospital Bandeirantes de São Paulo and Albert Einstein Hospital. Therefore, it is a subject that requires much further study and several future studies must be done for the good of the population that uses hospital health services. (SOUZA, 2015).

Van Rossum et al. (2016) argue that the most successful cultural changes were led by transformational leaders who have the power to commit themselves and make the other leaders and members of the organization also commit to the success of change. These transformational leaders have the power to inspire their subordinates through encouraging, motivating, transformative initiatives. Only then will the changes that lead the organization to an evolutionary stage succeed in its implementation and maintenance.

2.1.2 Peculiarities of hospital management

The provision of medical services, as well as hospitals, clinics, imaging services and others related to health, must respect the following principles, according to Mezomo (1995):

- ✓ Equity: to offer hospital health services according to social justice criteria, according to the needs of the communities, ease of access, security and expectations;
- ✓ Quality: level of hospital services offered, compared to what was expected and what is offered;
- ✓ Efficiency: indicator of optimum use of resources;
- ✓ Effectiveness: this is how the goals of the health organization are achieved;
- ✓ Acceptability: positive evaluation of hospital health services to the community.

From the administrative point of view, health organizations are not like industries, differing in the aspects of individualization of the hospital service rendered, since the client is a unique patient that demands exclusive care and probably does not fit there massification of the production of the hospital service as in many industries , requiring a high degree of professionalism and non-uniform performance indicators among the organization's internal sectors. It is also important to bring the time of service differ from patient to patient, according to the complexity of each case, with age and emotional and psychological state, thus affecting the time of care, and making it difficult to establish a time - standard that serves for all the attendances of that medical specialty. Therefore, we work with average, rather than standard, service time. (MEZOMO, 1995).



According to Mezomo (1995), the health manager needs to focus on productivity and efficiency, as well as being able to plan and target planning not as a mere administrative act, but as the crucial factor for the success of his or her organization. No business survives long when its administrator, instead of planning and anticipating problems, wastes his time putting out fires. In addition, he needs to have strong leadership, good relationship with the community and suppliers, responsibility to the clientele, to know how to form strong and focused teams in the results, to be restless always looking for innovations and changes, to have vision of future and strategic reasoning, besides clear to look for tirelessly the excellence both in the processes and in the products offered to the community.

As recalled by Coelho et al. (2010), some peculiarities in health care organizations need to be addressed under the prism of efficient management. Currently, in the 21st century, organizations in this sector experience difficulties related to infrastructure, organization and planning of hospital services, quality of care, and the demand and capacity of care. Added to this are lagged public policies, little government support, increasing demand for hospital services and lack of qualification of personnel directly and / or indirectly involved in the process of providing hospital health services.

2.1.3 Level of hospital service to the client

The level of hospital service offered to the client is how efficient the health organization is in delivering the services regarding punctuality, quality and price. Who determines the level of service is the customer, since it is the one who defines the quality characteristics that will be evaluated and monitored (provided that the parameters established by the medical professional are obeyed, since it is he who determines the time of service and the technical parameters specific to each service), the expected delivery period and the price that he judges fair for the service provided in the quality offered.

Through satisfaction surveys with customers and future clients, we can achieve some common characteristics of quality desired by customers and from there begins the creation of indicators that truly reflect the needs of the target market, again remembering that it is the doctor who determines the parameters, and it is up to the clients / patients to determine which quality characteristics should be monitored and improved, if possible according to the specificities of each medical care (MEZOMO, 1995; SOUZA, 2015; ZANON, 2011).



One of the most used management philosophies today is the full adoption of Lean Manufacturing. This philosophy proves to increase the level of customer service, since it has as one of its main focuses the reduction of waste that does not add value to the customer and thus delivers only what he wants, at the moment he wishes, in the price and quality he desires. The implementation of Lean Manufacturing is not a fad, it is seen as a watershed, as a new management model that fits both in industries and service providers, as is the case of hospitals. (GLASER-SEGURA; PEINADO; GRAEML, 2011).

2.2 Value Stream Mapping

2.2.1 Starting Value Stream Mapping

First of all it is essential to define value flow. Rother and Shook (2003) say that value flow is every action, whether or not it adds value, that transforms and transports the product across the channel into the hands of the customer. This flow can be macro, going from the raw material source to the final consumer, or micro, from the stock of raw material to the stock of finished product (within the factory environment). It is prudent to start by understanding the internal, micro, door-to-door flow, and then expand to the macro level where the entire supply chain would be treated.

Mapping the value stream is simply that, in a simple way, to design the steps of the process sequentially, identifying wastes for subsequent improvement proposals. Teamwork at the time of mapping is critical to the successful roll out of VSM (Value Stream Mapping) (ROTHER; SHOOK, 2003).

According to Gill (2012), in making a quantitative evaluation in terms of metric assessment and identification, some criteria can be used to determine whether each step of the process is:

- Valuable: if it really creates value from the customer's point of view;
- Capable: the degree to which a result is of good quality (ability level or other relevant performance indicators);
- Available: the degree to which the stage is able to function when necessary (availability of resources and inputs);
- Adequate: the degree to which capacity is placed to respond to customer requests as needed;



- Flexible: the degree to which the process can change quickly and inexpensively from one member of one product family to another.

Rother and Shook (2003) provide in the table below the reasons why the VSM is important to reduce waste.

Table 1 - Reasons why VSM is important to reduce waste

<i>Why is Value Stream Mapping (VSM) an essential tool?</i>	
1	It helps to visualize more than simply the individual processes, for example assembly, welding. etc. You can see the whole flow.
2	Helps identify more than wastes. Mapping helps identify the sources of waste in the value stream.
3	Provides a common language for dealing with manufacturing processes.
4	Make flow decisions visible, so you can discuss them. Otherwise, many details and decisions on your shop floor only happen by default.
5	It joins lean concepts and techniques, which helps you avoid implementing some techniques in isolation.
6	Form the basis of an implementation plan. By helping you to design how door-to-door total flow should operate - a part that is lacking in many lean efforts - value stream maps become reference for lean implementation. Imagine trying to build a house without a plan!
7	Shows the relationship between the information flow and the material flow. No other tool does this.
8	It is much more useful than quantitative tools and layout diagrams that produce a set of steps that do not add value, lead time, distance traveled, inventory quantity, and so on. The value stream map is a qualitative tool with which you describe in detail how your production unit should operate to create the flow. Numbers are good for creating a sense of urgency or as measures and comparisons before / after. The value stream mapping is good for describing what you will actually do to get to those numbers.

Source: Rother e Shook (2003, p. 4).

Gill (2012) further states that the VSM may well be employed in health care services, such as hospitals, clinics, among others. This is because it is a tool that aims first to see the flow of value, then to identify wastes, to attack them and later to draw the map of the future state expected with the proposed improvements. It is a tool that has been successfully applied in the industry for years and is soon being brought to the service sector and all others that have a productive flow, whether tangible or intangible.

Rother and Shook (2003) point out that one must map not only the flow of materials but also of information, and one should also choose a family of products, the most representative in sales for example, to begin with the mapping. They also point out that it is vital to define



who will be the most responsible for the mapping, the leader who will be next to the stream raising the information.

Teichgraber and Bucourt (2012) reinforce the importance of VSM nowadays for medical services, which are easily adapted in these environments where it was previously believed that they would not be. They still provide an outline of the steps of the VSM implementation plan, which can be seen in Table 2 below.

Table 2 - Outline of the implementation plan of the VSM technique

<i>Step</i>	<i>Task</i>
1	Identify which major product or family of products, taking into account the relevant product families, supplementary materials and services required.
2	Create an VSM current from the current state, which describes the process with current steps, delays, and information flows.
3	Evaluate the VSM of the current state in order to create a lean flow, eliminating waste, waste and especially activities that do not add value.
4	Create a future state VSM with improved flow potential.
5	Implement the future state VSM.

Source: Teichgraber e Bucourt (2012, p. 48).

2.2.2 The current state map

The current state map is nothing more than a flow x-ray, door-to-door, showing the processes and their wastes. Rother and Shook (2003) point out that for the current state map to be efficient and achieve the expected objectives, it needs to: collect the information itself in the process by moving along the processes and flows of information and materials; start with a quick door-to-door walk for overview, and then return to point to point; start by the final expedition and then in the previous processes, thus making the path drawn by the consumer through the final processes, which are the ones that really define the rhythm; do not rely on ready data, make the measurements yourself; map yourself, even though your team is also involved; always draw your hand and pencil for probable changes and adjustments to the map.

According to Swalmeh et al. (2014), the value stream mapping, in its present state, aims, among other things, to see the wastes that were not previously seen in the traditional way of drawing. With the VSM the wastes become more evident, and have seen focus of attacks for improvements in the system.

The purpose of this article is not to teach to build the VSM, but to show the importance of it and its steps to apply it in the practical case.



2.2.3 Characteristics of a lean value stream

Swalmeh et al. (2014) recalls that in the health sector, organizations have increased their concern to improve patient experience and effectiveness and efficiency of the system. This sector is experiencing increasing costs, service demand and service quality expectations only increase. Corresponding to these challenges, managers were forced to think of new flexible ways to reduce waste, improve process control, and improve resource utilization. Lean philosophy is one of the most valuable techniques for achieving these ambitions. Lean is a philosophy-related concept derived from the Toyota production system to create more value with fewer features. The lean process evaluates step-by-step operations to identify waste and inefficiencies, and then creates solutions to improve them and thereby reduce cost. It represents an endless cycle toward perfection, in which services are continually improving and improving.

Peralta and Forcellini (2015) argue that lean thinking has been applied with great success in a wide variety of health-related services. They reinforce the importance of health organizations directly involving management, working in functional divisions, continuing to create value for patients and other clients, and sustaining long-term vision of continuous improvement.

Rother and Shook (2003) provide the procedures for achieving a lean value stream. Are they:

- Produce according to takt time: that is, only produce at the speed demanded by the market. If the demand today is 30 pieces you will make 30 pieces, even the capacity being 40. And takt time is the result of the division of demand by the time available to produce them;

- To develop a continuous flow where it is possible: to produce in continuous flow is to produce without stops, one piece at a time;

- Use supermarkets to control the production where the continuous flow does not extend to the above flow processes: when it is not possible to continuously align the productive flow, because the processes or have very fast processing times or are naturally unbalanced, semi-finished between stages that can not become continuous as an alternative to balance and level productivity.

- Send client programming only to a production process: and this process is called the pull process and is usually the last door-to-door process, the one closest to the client.

- Level the production mix: distribute the production of different products evenly over time in the puller process. The more level the product mix in the handle process, the better you



will be to respond to the different wishes of the customers with a small lead time, while maintaining a small stock of finished products. This also allows your next supermarkets to be smaller.

- Level the production volume: create an "initial pull" with the release and withdrawal of only a small and uniform increase of work in the handle process.

- Develop the ability to make every piece every day: this describes how often a process changes to produce variations on a part. The shorter the swap times and smaller batches in previous processes, these processes will be able to respond to process changes more quickly. But they will require even less inventory in supermarkets, which applies to both discrete part manufacturing and process industries.

2.2.4 The future state map

The central objective of mapping the future state of the value stream is to identify and eliminate waste sources, building a lean and continuous productive flow, producing only what the customer wants. (Rother and Shook, 2003).

Rother and Shook (2003) still bring eight key questions that must be answered for the effective construction of an efficient future value stream mapping. Are they:

- a) What is takt time?
- b) Will it be produced for a supermarket of finished products in which customers pull it or directly for shipping?
- c) Where can continuous flow be used?
- d) Where will it be necessary to introduce systems pulled with supermarkets in order to control the production of the above / previous processes?
- e) Where will the production pull process, which will receive all the programming?
- f) How will the production mix be leveled in the pull process?
- g) What increase of work will be uniformly released from the pull process?
- i) What process and flow enhancements will be vital to promote fluidity of the flow of value according to the specifications of the future state project?

According to Narayanamurthy and Gurusurthy (2014), it is already evident that the application of lean manufacturing concepts has won several business segments, including health care segments. This sector envisions a new philosophy, once industry specific, now being



applied quietly in health, and successfully in several practical cases in the international literature. And it is in this context that the importance of value stream mapping in its future state, planning and designing with a focus on waste elimination, is notorious even if some goals may seem utopian at first sight, they must be pursued in a motivating and I strongly.

2.2.5 Reaching the future state

In order for the future state map to be reached, Rother and Shook (2003) suggest that an annual value-flow plan be drawn up which will contain exactly what will be done step-by-step, measurable goals, and clear performance evaluation points. They further state that the improvements follow the following sequence:

- a) Create a continuous stream operated based on takt time;
- b) Create a pull system to control production;
- c) Introduce the leveling between the stages of the process, and between the process and the market demand;
- d) Create the routine of practicing kaizen continuously to eliminate waste, reduce batch size, reduce supermarkets and increase the reach of continuous flow.

Ford et al (2012) elucidates the importance of enterprise management in the efficient deployment of future value stream mapping as a revolutionary lean manufacturing tool that is. They also emphasize the great importance of teamwork and the autonomy of employees so that kaizen is actually always executed, with a focus on eliminating waste.

Finally, Rother and Shook (2003) argue that it is vital that management provides support and support tools so that the productive sector can level takt time as necessary. That is, to demand that takt time be fulfilled not only from the factory floor but also from all sectors of support linked directly or indirectly to production. They also point out that it is putting the hand in the dough that the lean manager will make the necessary changes, as well as preparing for the management shocks that all cultural change causes, because the old will give way to a new philosophy of lean management that aims to eliminate everything that does not add value, focusing on eliminating waste and improving company profits.



3 Methodological procedures

In this article we used applied research, in which the objective is to analyze and collect information that collaborate in the search for probable solutions based on the case study analysis. According to Lakatos and Marconi (2010), applied research is accurate and attempts to prove or deny theoretical methods in society.

As for the objectives, this research is exploratory, since, according to Yin (2015), it allows greater familiarity with the problems in question, with a view to making it explicit. This exploration was possible through the case study. Therefore, this research encompasses bibliographic survey and data collection in the company targeted by the case study, as well as informal observations and conversations.

This study had in its case study the priority source of information through the collection of data in the database of the hospital targeted by the case study. All information was collected from the hospital's database, or through observations and informal conversations.

Content analysis is an effective tool for analyzing search results. In this research the content analysis was used, whose main functions are the enrichment of the exploratory treatment, potentiating the discovery. In addition, it is intended to convey an expected result to a confirmation or affirmation.

The methodological procedure of content analysis is based on studies of transcriptions in the form of text of the obtained data, with the purpose of establishing comparisons, distinctions and raising textual elements based on information processing (BAUER and GASKELL, 2005).

4 Case study: mapping of the value flow in the emergency care of a university hospital

4.1 Current state value stream map

Health systems are complex. Although a significant part of the budgets of many governments is attributed to health, results are hardly matchable with expectations and many indicators of health system performance have shown limited improvement. Large queues of waiting, overcrowding, and patient dissatisfaction are the major health system problems in several countries. Health managers are challenged by the uncertainty of the demands and outcomes of care in the health system, in addition to high public demand for quality services, high levels of human involvement, both at the patient and resource level (doctors, nurses, etc.).



There is also the issue of being always working with limited budget and resources, and having to manage a large number of variables (eg scheduling / staffing, number of beds, etc.). As a result, health managers are continually studying the effectiveness of existing health systems and exploring opportunities for improvement.

As a result, Lean Manufacturing is increasingly being applied to health services, with a unique focus on waste reduction, as well as continuous improvement.

This article focused on the emergency care of a university hospital, more specifically in the specialty of medical clinic, to understand and see the flow, and identify waste.

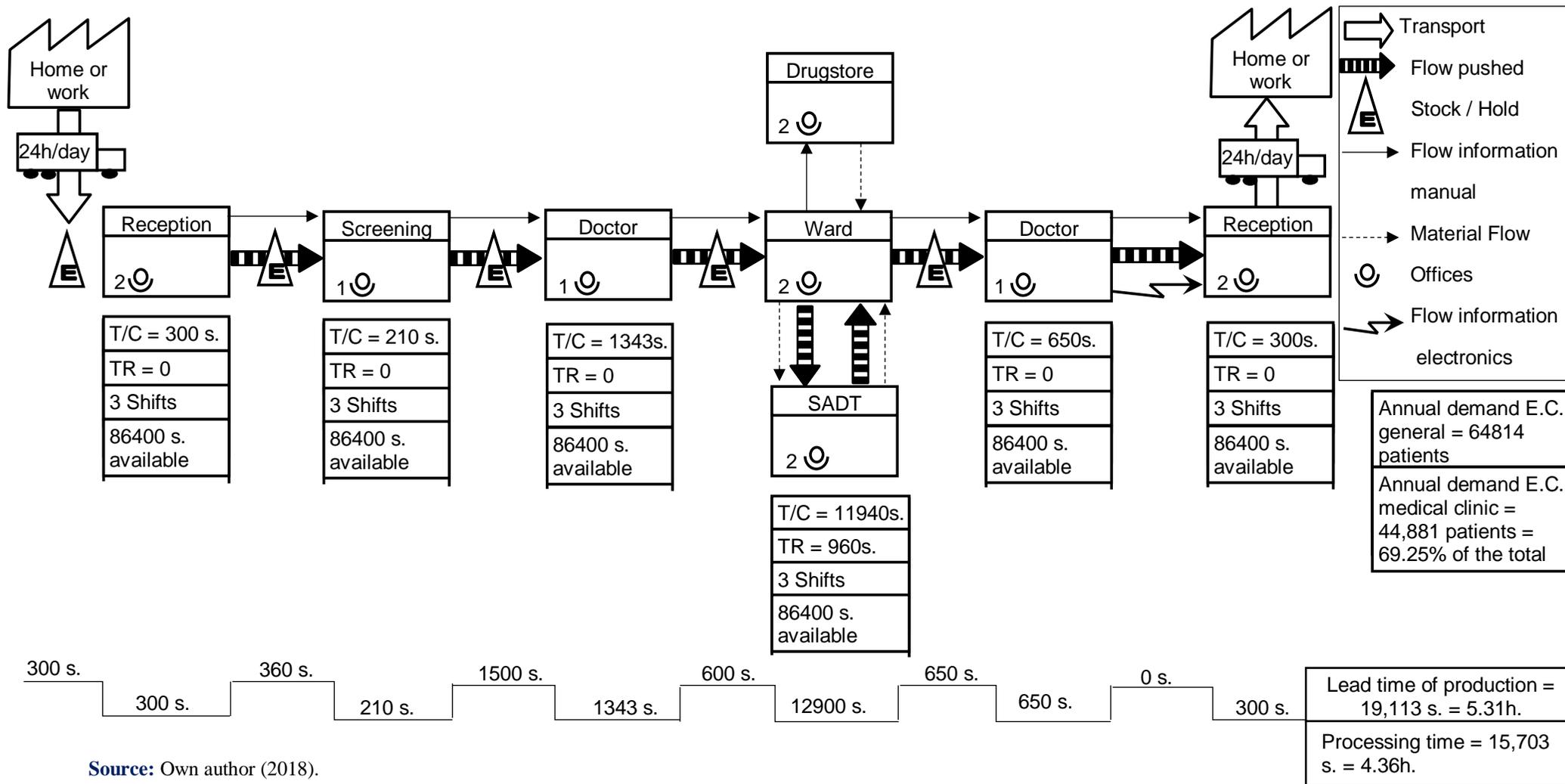
The following is the figure 1 which shows the current state of the value stream of the medical clinic in the care of the referred hospital. As mentioned earlier, it is not the intention of this article to teach how to construct value-flow maps, but to analyze the possibility of their applicability in the health sector. Therefore, the symbols adopted here are those taught by Rother and Shook (2003) in his work *Aprendendo a Enxergar*.

As can be seen in the mapping of Figure 1, there are no large wastes between the service process steps, but even though they are small, the waste is there. In the form of waiting, patient waiting to be attended by the doctor, the nurse or to do tests. In addition, the current flow of information is mostly based on manual information through tokens, medical records and so on.

In addition, the Manchester Classification, or risk classification, has not been implemented in this service. This classification may not reduce the overall lead time, but it improves the quality of care by giving priority to the care that needs it, as well as creating an important database for future decision making aimed at reducing the patient's emergency care.



Figure 1 - Mapping the Value Stream of the current state of emergency care to the medical specialty



Source: Own author (2018).





4.2 Map of the future state value stream

Passing the construction of the value stream mapping of the future state value in emergency care, in the specialty of medical clinic, we start by reducing the waiting times of patients between the stages of care. The first action suggested is to invest in receptionist training so that filling in the register and collecting basic information is streamlined, thus reducing the size of the reception queue and consequently the screening. In addition to this training, it is suggested to computerize the entire flow of information, from reception, through the sorting, through the doctor's office, through the ward and SADT, to the doctor and the reception. In this way, the information previously circulated manually will circulate in a computerized way, through the hospital's computer system, reducing errors and deviations of information and slow and wasted time in filling out paperwork that could simply be computerized and secure.

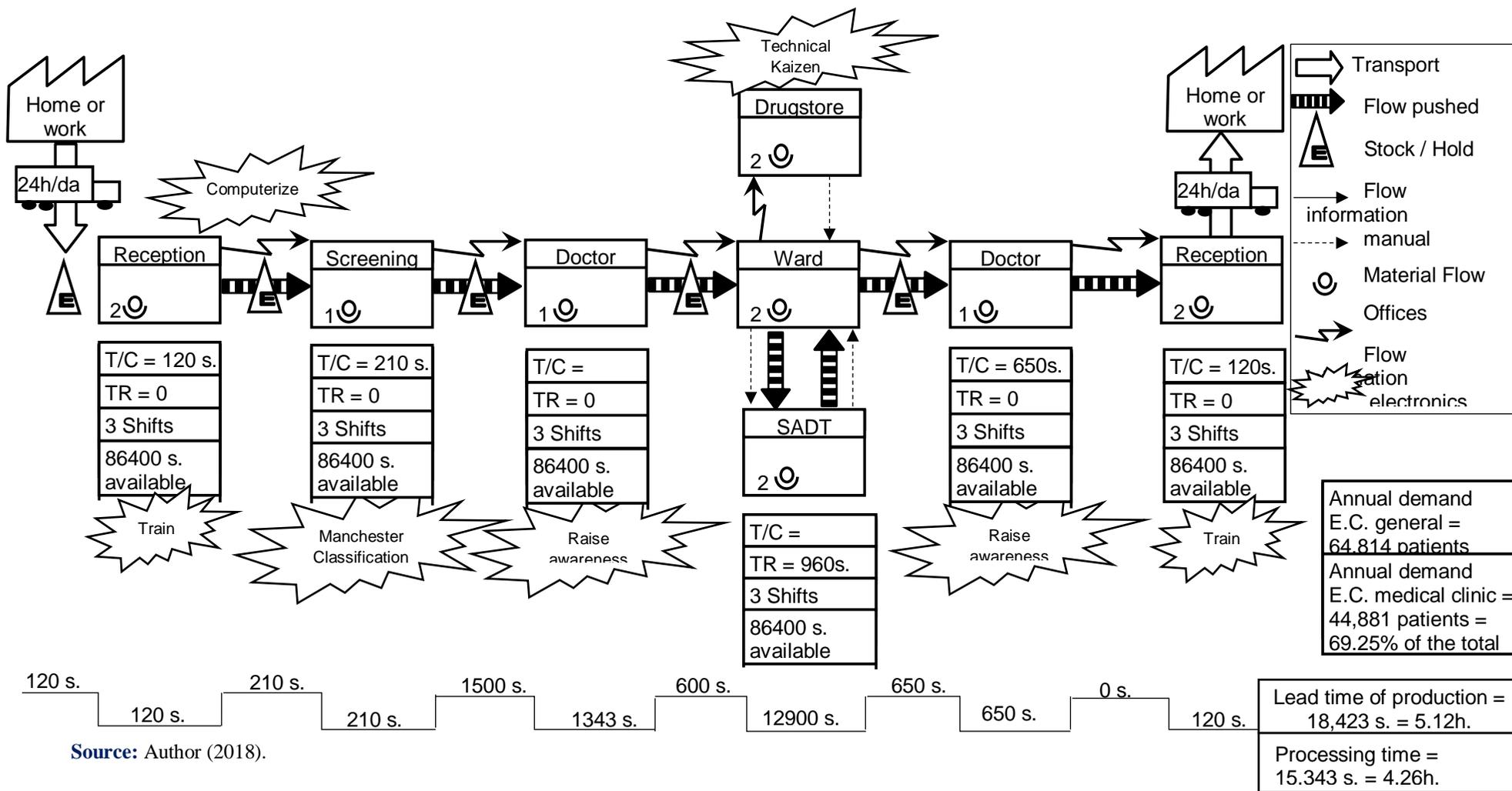
As already mentioned, the real and effective implementation of the Manchester Classification is also suggested. It is also suggested to educate physicians to speed up as much as possible, taking care to ensure that the quality of the service is not lost, in order to reduce the patient's stay in the emergency room. This would reduce the total lead time, reduce costs, and increase resource availability for new calls. In the ward and SADT it is suggested a technical kaizen with the employees of these sectors with focus on reducing wastes and time of permanence of the patient in the enclosure.

With these suggestions it is expected to reduce the lead time of total production from 5.31h to 5.12h, that is, a reduction of 3.7%. Recalling that technical kaizen in the infirmary and SADT is vital to reduce the lead time at this point which is the big bottleneck of the emergency care. Any reduction of time made in the bottleneck will represent gain for the whole emergency care system. Task forces should be created focused on reducing patients' time spent in the ward and SADT. With the reduction, the availability of resources will be improved and the attendance capacity and, consequently, the billing capacity will be increased.

Figure 2 below shows the value stream mapping in its future state, as expected, before the kaizen improvement that should be done in the ward and SADT sector.



Figure 2 - Value stream mapping of the future state of the care service in the medical clinical specialty



Source: Author (2018).





5 Final considerations

The purpose of this article was to demonstrate that Value Stream Mapping (VSM) is a Lean Manufacturing tool of great importance to see wastes and improvement points, thus supporting in a strategic way the diagnosis of the current situation of the process under analysis. The VSM can be applied in any productive environment, be it manufacture or services. Therefore, the research question raised in the introduction can be answered as follows: yes, it is possible and advisable to implant the VSM in hospital and health settings, as seen through the conceptual discussions addressed in this research and through proposals for improvements in the Current VSM.

In the case of the target hospital of this case study, more specifically in the emergency room where the VSM was performed, this tool, which in hospital and health care environments is approached within the Lean Healthcare philosophy, was of great importance to identify bottlenecks and faulty points in the patient care process. If the proposals suggested in this article are implemented, it is initially expected that there will be a 3.7% gain in the total lead time of the patient care process, from its entry to its release or discharge. And after technical kaizens in the ward and SADT this index can soar.

Finally, it is suggested that, before beginning the process of cultural change to implement the philosophy Lean Healthcare, begin by implementing the VSM, mapping and diagnosing the bottlenecks that deserve attention even before the implementation of the Lean. In this way, the Lean deployment process will be started in a mapped environment with less uncertainties.

As research limitations it is important to point out that many data in hospital environments are treated as confidential, in addition to access and living with some professionals not being so facilitated by their own position or routine, making it difficult to collect data and expand the research. And as a proposal for future work it is suggested to raise awareness of the importance and implementation of the philosophy of Lean Healthcare both in the emergency room and in the rest of the hospital.

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