Lean Management Implementation In Hospital Emergency Services Across Brazil’s Unified Health System: A Qualitative Analysis of Project “Lean nas Emergências”

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ABSTRACT

**Background:** In Brazil, the overcrowding of Hospital Emergency Services (HES) poses significant threats to the country’s constitutional obligation to offer universal, integral and equitable care. In recent years, Lean healthcare has emerged with the potential to improve Emergency Department operational challenges and improve access and quality in care delivery.

**Objectives:** To provide the first qualitative evaluation of project *Lean nas Emergências* (or Lean in the E.D.), a public-private partnership between Brazil’s Ministry of Health and Hospital Sírio-Libanês aimed at reducing overcrowding throughout Brazil’s Unified Health System (SUS). This analysis evaluates the project’s Lean implementation through three primary variables, including Key Performance Indicators, organizational culture change and sustainability.

**Methods:** A total of 77 SUS hospital administrators were surveyed to gather feedback on *Lean nas Emergências* through the project’s first triennia from 2018-2020.

**Results:** 80.6% of respondents agreed *Lean nas Emergências* created cultural change within their hospitals; 89.6% of respondents agreed their hospitals were better equipped to handle overcrowding and workflow management after the *Lean nas Emergências* intervention compared to before; 98.7% of respondents would recommend *Lean nas Emergências* to other hospitals.

**Conclusions/Importance:** Surveyed hospital administrators consider *Lean nas Emergências* to have been a successful initiative. Given that E.D. overcrowding is a global issue of significant importance, it is relevant to note that the national-scale evaluation provided in this thesis of *Lean nas Emergências’* implementation across Brazil may contribute to furthering knowledge on Lean healthcare applications for health systems and emergency services around the world.
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LIST OF ABBREVIATIONS

CW - Center-West (Brazilian Geographic Region)
DMAIC - Define, Measure, Analyze, Improve, Control
E.D. - Emergency Department
FCP - Full Capacity Protocol
HES - Hospital Emergency Services
KPI - Key Performance Indicators
LOS - Length of Stay
N - North (Brazilian Geographic Region)
NE - Northeast (Brazilian Geographic Region)
NEDOCS - National Emergency Department Overcrowding Scale
NPS - Net Promoter Score
NVA - Non-Value Added
PDCA - Plan, Do, Control, Act
PROADI-SUS: Assistance Program for the Institutional Development of the SUS
S - South (Brazilian Geographic Region)
SE - Southeast (Brazilian Geographic Region)
SIPOC - Suppliers, Inputs, Process, Outputs, Customers
SUS - Brazil’s Unified Health System (or Sistema Único de Saúde)
VSM - Value Stream Mapping
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1 INTRODUCTION

Brazil’s Unified Health System (Sistema Único de Saúde - or SUS) was founded on three central pillars of universality, integrality and equity, aiming to deliver comprehensive and equitable care to all Brazilians. Since its founding in 1988, however, the SUS has been faced with several challenges in meeting its ambitious goals. Central concerns include unqualified management, administrative discontinuity in hospital management, as well as scarcity and imbalance in the distribution of the healthcare workforce across the country. The culmination of the aforementioned challenges has also served to exacerbate the overcrowding of Hospital Emergency Services, which poses a significant threat to the country’s constitutional obligation to universal health access. In addition to poor access, overcrowding can also lead to low quality care, low patient satisfaction and even increased mortality rates and can be a symptom of deficiencies in hospital operations as well as reflect issues with health systems more broadly.

In recent years, Lean management has emerged as a field which holds great potential to optimize efficiency, quality and streamline processes within the healthcare industry, especially as it pertains to operational challenges within hospital systems. For instance, it is relevant to note that Hospital Emergency Services or Emergency Departments present the highest number of reported Lean applications as they are considered highly inefficient and present several challenges such as overcrowding, low quality care, low patient satisfaction and high costs. While the literature on Lean management shows significant strides in improved efficiency in healthcare settings, a significant research gap remains in evaluating the issue of overcrowding in Brazil’s E.Ds. This shortcoming has been highlighted as granting disproportionately little attention to a serious issue that directly affects population and individual right to health in the
country. Therefore, stakeholders call for increased attention to tackling E.D. overcrowding in Brazil, as well as push for innovative approaches that may offer a solution.\(^4\)

Given the importance of addressing overcrowding in Brazil in order to improve the quality and access of care delivery, the aim of this thesis is to provide a comprehensive analysis of project *Lean nas Emergências* (translated to Lean in the Emergency Department), a nationwide project designed to reduce overcrowding throughout Brazil’s SUS hospitals through the implementation of Lean management methods. This research evaluates *Lean nas Emergências* through a qualitative lens by surveying hospital administrators on their perception of the project’s effectiveness in reducing overcrowding. More specifically, this analysis focuses on three primary variables for the *Lean nas Emergências* evaluation, including organizational culture, sustainability and key performance indicators, with a secondary analysis focusing on potential differences or themes among hospital cycles of enrollment and hospital geographic region. Finally, this thesis aims to contribute a national-scale evaluation to the currently scant literature on Lean healthcare implementation in Brazil, of which case studies are currently limited to the analysis of single hospitals systems.\(^{4,7,8}\)

The present thesis is structured as follows: following the present introduction, a background is presented to provide an overview of Brazil’s healthcare system, of overcrowding of Hospital Emergency Services as well as of Lean healthcare. The background is followed by the conceptual framework and hypothesis section, which details the chosen research questions that drive this research. Next follows an explanation of the employed research method, including the overview of the survey questions. A description of *Lean nas Emergências* project is then provided in the subsequent section, including the project’s design, goals and objectives. Finally, the results of the survey are presented and discussed in order to highlight key findings and
patterns emerged from the data, ending with a conclusion which summarizes the overall research findings in the context of Brazil’s healthcare system.

2 BACKGROUND

2.1 The Brazilian Healthcare System

Brazil’s National Health System (Sistema Único de Saúde - ‘Unified Health System’ or SUS) is considered one of the largest public health systems in the world, of which 70% of Brazil’s population is dependent for health services. The SUS is largely responsible for providing health access to the more vulnerable demographic in Brazil, however it also serves those insured by private health plans when such individuals require high complexity services. The SUS was founded in 1988 following the end of the military dictatorship in Brazil and was the result of the Healthcare Reform Movement, through which healthcare became a human right. As stated in article 196 of the Brazilian constitution, “Health is the right of all and duty of the State, guaranteed through social and economic policies aimed at reducing the risk of disease and other injuries and at universal and equal access to services for health promotion, protection and recovery”.

Given the democratic transition taking place during the emergence of public health in Brazil, healthcare was conceptualized as reconstituting the State’s commitment to improved population well-being. In this context, the SUS was built upon three central doctrinal pillars: universality, integrality and equity, aiming to deliver comprehensive and equitable care to all Brazilians, irrespective of race, religion, ethnicity, and so on. In addition to the doctrinal pillars,
the SUS also relies on the operational principles of decentralization, regionalization, hierarchy, and social participation. Decentralization refers to the management of the SUS being performed by the three spheres of the government: municipal, state and federal, in order to tend to the needs of each region. Regionalization refers to how health strategies must be implemented according to the infrastructure of existing health services and encourages the collaboration between areas with differing capacities to best serve their populations. Hierarchy refers to the ability to oversee and direct patients to where they must seek out health services. Lastly, social participation refers to established health councils and conferences which aim to include the people to control and evaluate the execution of the SUS government branches. This last principle, however, has been deemed insufficient by some.

Since its founding, the SUS has been met with several challenges, most notably insufficient funding, poor management and poor oversight of allocated resources. Such challenges seem to be exacerbated by the poor coordination and lack of consensus among government branches that make up the SUS. The heavy reliance of the SUS on the unstable and transient political environment in Brazil as well as political and party interests inevitably contribute to its institutional fragility and vulnerability. Other recurrent problems are precarious infrastructure, poor condition of hospital equipment, insufficient human resources to attend to high demand in services, poor compensation of healthcare providers, administrative discontinuity in hospital management, unqualified management, as well as scarcity and imbalance in the distribution of the healthcare workforce across the country, which contributes to the observed regional disparities in health access. The culmination of the aforementioned challenges has also served to exacerbate the overcrowding of Hospital Emergency Services. Overcrowding and the resulting poor accessibility to care poses a significant threat to Brazil’s
constitutional obligation to universal health access and is thus considered an issue of great importance.\textsuperscript{4}

As it is the duty of the SUS to care for the health and lives of the Brazilian population, this task cannot be compromised by ideologies or beliefs. There is a need to protect the SUS from administrative discontinuity and poor management given the high stakes of the system.\textsuperscript{2} Despite presenting a breadth of challenges, the SUS remains a reference for other democracies, and works to promote a universal, integral and equitable approach to all levels of health access.\textsuperscript{10} A prominent example was the role of the SUS in combating the HIV/AIDS epidemic, allowing for the universal distribution of antiretrovirals and elevating the country’s response as one of the best in the world.\textsuperscript{9} Importantly, however, the advancements in Brazilian healthcare over the past 30 years are neither permanent nor cumulative, and the SUS requires continued support and commitment from a variety of stakeholders.\textsuperscript{10}

\subsection{2.1.1 Overcrowding of Hospital Emergency Services and Common Indicators}

The overcrowding of Hospital Emergency Services (HES) is a worldwide phenomenon characterized by the operational saturation of services, which can be observed through the 100\% occupancy of HES beds, patients in hallways, full waiting rooms, turning away incoming ambulances, wait times exceeding one hour, and high tension and exhaustion of care teams.\textsuperscript{5} The main marker of overcrowding is the increase in Length of Stay (LOS) in emergency and emergency services, caused mainly by the lack of beds for hospitalization, which results in delay in diagnosis and treatment, and even in increased mortality rates.\textsuperscript{5} To reiterate, acknowledging overcrowding as a dire problem is important because overcrowding diminishes the capability of
Emergency Departments to effectively manage emergencies, poses a significant threat to the objective of universal health systems to provide access to care and leads to low quality care.

In discussing overcrowding, it is noteworthy to distinguish this phenomenon from HES utilization. While the sheer number of Hospital Emergency Services utilization within a given population can reflect poor performance of the healthcare system as a whole, overcrowding can reveal poor performance of hospital systems and corresponding networks. Thus, HES utilization and overcrowding are distinct phenomena that may or may not interact with each other, as one can have one without the other. However, given the potential relationship between high utilization of emergency services and E.D. overcrowding, it is important to comprehend health systems more broadly in addition to hospital operations in order to fully comprehend root causes of overcrowding. Given the relevance of framing overcrowding within a broad health systems view, this thesis provides a background on Brazil’s healthcare system in order to provide a holistic contextualization and evaluation of the *Lean nas Emergências* project.

In order to address the issue of HES overcrowding in Brazil and elsewhere, Lean healthcare principles suggest there remains a need to engage health providers in organizational, social and cultural changes rather than seeking magic bullet interventions to influence individual behavior. Moreover, Lean healthcare encourages evidence-based decision making to implement innovative practices which must be broadly framed as a process rather than a mere technical objective. In addition to strategic planning based interventions, Lean healthcare also relies on evaluating hospital performance indicators to address overcrowding, most notably Length of Stay (LOS), National Emergency Department Overcrowding Scale (NEDOCS) and mortality rates.
In Brazil there is not much literature which explores the issue of overcrowding in the country. As of 2009, there were no theses or dissertations on the subject. This gap gives little attention to a grave issue that directly affects population and individual right to health in the country, leading stakeholders to advocate for innovative approaches that may offer a solution.

The following section of this thesis will explore some of these initiatives.

2.1.2 PROADI-SUS

In 2009, Brazil’s Ministry of Health created the initiative PROADI-SUS (or Assistance Program for the Institutional Development of the SUS) with the objective of supplementing observed gaps within the SUS through project-based interventions. PROADI-SUS projects are determined and prioritized by Brazil’s Ministry of Health and last three years. These projects designed to optimize and improve the SUS generally fall into one of five categories: assessment and incorporation of technologies, training of Human Resources, research, specialized complementary assistance and development of techniques in managing health services.

In order to enable the creation, development and implementation of PROADI-SUS projects, Brazil’s Ministry of Health counts with the support of public-private partnerships. The Ministry of Health recognizes a total of six private hospitals in Brazil as “Hospitals of Excellence”, considered to possess both the technical capacity and expertise to assist with the development of the SUS. The six renowned hospitals, in addition to Hospital Sírio-Libanês, are Hospital Alemão Oswaldo Cruz, Hospital do Coração, Hospital Israelita Albert Einstein, Hospital Moinhos de Vento and Hospital Beneficência Portuguesa. As part of PROADI-SUS, these hospitals each develop their own SUS assistance projects through their offices of social
responsibility, present them to the Ministry of Health, and if approved, the projects are developed and implemented. Finally, it is important to note that as philanthropic hospitals, the Hospitals of Excellence benefit from a tax-exempt status, through which PROADI-SUS projects are budgeted and funded according to the value of tax exemption for each hospital.  

Since its inception, PROADI-SUS has been through changes and improvements. Most notably, continuous evaluation of projects is prioritized to ensure not only accurate use of funds but also to ensure projects are designed around assisting the SUS. In order for projects to be approved by the Ministry of Health, all PROADI-SUS projects developed by the Hospitals of Excellence must have clear objectives, indicators and metrics in order to allow for the evaluation of post-intervention results. Every year, an event is held in order to evaluate the results of approved PROADI-SUS projects.

Measuring and evaluating the efforts of PROADI-SUS is essential to determining the impact of these project-based interventions. Given the importance of these evaluations and their potential in improving public healthcare in Brazil, this thesis focuses on the evaluation of a specific PROADI-SUS project developed by the Ministry of Health and implemented by Hospital Sírio-Libanês referred to as Lean nas Emergências (or Lean in the E.D). As the name suggests, Lean nas Emergências relies on the implementation of Lean management to reduce overcrowding in Emergency Departments and Hospital Emergency Services. The following section of this thesis will provide a more detailed review of Lean healthcare and relevant methods before diving into the evaluation of Lean nas Emergências.
2.2 Lean Healthcare

2.2.1 Lean History and Origin

Lean methodology is derived from the Toyota Production System. Developed in the 1950's, the goal of Lean was to ultimately improve the performance of a system by eliminating waste, minimizing delays, creating just-in-time delivery of products and services, and fostering worker empowerment under a culture of continuous improvement. In the United States, Lean was first applied in the automotive industry, and began to spread to other manufacturers and industries. Importantly, Lean thinking is not a manufacturing tactic, but a management strategy, and thus is applicable to any organization that requires process improvement. In the last 20 years, Lean has been increasingly adopted in the healthcare industry and has developed into a major strand of research.

Lean healthcare was first implemented in the United States, spurred by the Institute of Medicine’s 2001 report Crossing the Quality Chasm: A New Health System for the 21st Century, which exposed the need to redesign the US healthcare system in order to improve quality and patient safety. Virginia Mason in Seattle, WA and ThedaCare in Wisconsin were early adopters who demonstrated the effectiveness of Lean to health system management. The need for Lean healthcare in hospital systems is clear, as hospitals face growing external pressures and operational challenges, such as underperforming performance metrics, general dissatisfaction and “broken” processes. The low quality of health services and the need for more effective resource management, waste elimination and value creation for patients makes Lean an
interesting and high-potential intervention to improve hospital systems over the long-term.\textsuperscript{7} Lean seems to be the next revolution for better, improved, value-based care.\textsuperscript{6}

### 2.2.2 Lean Core Principles and Objectives

The aim of Lean healthcare is to eliminate unnecessary steps, reduce wait times in care, improve and make processes more efficient, eliminate or reduce waste in processes, and improve communication between health teams, patients and family members.\textsuperscript{18} Importantly, waste in Lean is defined as unnecessary and non-value added (NVA) steps that do not provide value for the ultimate user or consumer, in the case of Lean healthcare, the patient and their respective families.\textsuperscript{19} It is estimated that in the United States, waste costs the healthcare system $1.3 trillion annually.\textsuperscript{19} Lean methodology also allows hospitals to improve the quality of care for patients by reducing errors and waiting times, resulting in lower costs.\textsuperscript{17}

In order to increase the efficiency of processes, another core principle of Lean is standard work. The objective of standardized work is to ensure all know the steps to expect in patient flow through the hospital system, from admission to discharge. The goal is that the patient move seamlessly through these steps, conducted in reduced time without compromising safety and effectiveness of treatment or the patient experience.\textsuperscript{19} Importantly, standardization creates a foundation for the application of iterative cycles of improvement and reduced variation.\textsuperscript{19}

In addition to waste elimination and standardized work, another core principle of Lean is worker involvement in process improvement projects. This means it is essential to include staff throughout all levels of the hospital and form multi-disciplinary teams to ensure all are aligned with the Lean intervention.\textsuperscript{18} Similarly, the success of Lean is highly reliant on organizational
culture and thus is often implemented as part of an organization’s strategic plan. When considering the objectives of Lean, it is important to remember that Lean is an approach that aims to support healthcare providers and other employees in eliminating roadblocks in order to allow them to focus on providing care. Ultimately, the goal is to create value under a culture of continuous improvement.

2.2.3 Lean Tools and Methods

The implementation of Lean healthcare requires a variety of tools and methods. Those chosen for analysis in this section were decided upon strategically in order to highlight the main tools that were employed by the Lean nas Emergências team at Hospital Sírio-Libanês. Therefore, the following list is not exhaustive of Lean tools, but presents an overview of the most relevant to the Lean nas Emergências implementation throughout SUS hospitals. The ranked effectiveness of each of these tools as evaluated by surveyed hospital administrators is presented in Figure 17 in section 6.5 of this thesis.

2.2.3.1 Value Stream Mapping

Value Stream Mapping (VSM) is one of the foundational tools of Lean methodology and is the tool that starts the improvement process. As the name suggests, the tool is employed to map out the processes of an organization in order to identify which steps add value, and which do not. VSM is utilized to provide a macro-view of the patient’s journey through the hospital system, looking at the totality of the patient’s interaction with the health system. A useful way to
conceptualize VSM is by mapping out each step in the process of a patient who presents for medical care, from their arrival to discharge. The next step would then be to visually identify the non-value added (NVA) steps and categorize them as opportunities for improvement. VSMs can be developed to map out both the current state of a hospital’s operations as well as the desired future state, understood as the pre and post Lean intervention period, respectively.\textsuperscript{19}

2.2.3.2 A3

The A3 is a visual problem-solving tool, in which a select problem is identified, along with corrective action plans, both written down on an A3 paper format. A3s are utilized to promote continuous improvement and to align initiatives with organizational strategic plans.\textsuperscript{20}

2.2.3.3 5S

5S refers to five terms beginning with the letter S, that describe useful practices for organizing a workspace under visual management and Lean production.\textsuperscript{20} 5S stands for sort, straighten, scrub/shine, standardize and sustain.\textsuperscript{19} Sort refers to separating the unneeded from the needed, discarding materials that clutter or are not useful to a workspace. Straighten refers to organizing the workplace so as everything has a designated place, reducing the time in searching for materials. Scrub/Shine refers to having a workspace be clean for visual and physical inspection. Standardize refers to setting standards in order to ensure all in the workspace do the same thing to keep it organized. Sustain refers to maintaining the implemented gains through audits and accountability.\textsuperscript{19}
2.2.3.4 Spaghetti Diagram

The spaghetti diagram is used to map staff and patient movement. When referring to patients, the spaghetti diagram is helpful in order to understand the patient journey through a hospital, from admission to discharge.\(^21\)

2.2.3.5 Cause and Effect Matrix

The Cause and Effect Matrix, also known as the Ishikawa or fishbone diagram, is a tool used to explore the possible causes of a certain effect. The benefits of this tool are that in addition to visually understanding the relationship between causes and effects, it also helps to identify areas for improvement.\(^22\) Figure 1 displays an example for possible causes for the excess Length of Stay (LOS) outcome within a hospital system.\(^23\)

![Cause and Effect Matrix](image)

**Figure 1.** Cause and Effect Matrix of potential causes for excess patient Length of Stay (LOS).
2.2.3.6 Impact Effort Matrix

The impact effort matrix is a tool used to assist in prioritizing tasks. It helps teams decide which of the numerous solutions to implement are the easiest and have the most favorable impact. Figure 2 displays an example of an impact effort matrix.\(^{24}\) Usually, Lean interventions will begin with actions in the upper left quadrant, which are deemed high impact and low effort, then moving onto those in the upper right quadrant, which are deemed high impact and low effort. Next, actions in the lower left quadrant follow, which are deemed low impact, but low effort. Lastly, actions in the lower right quadrant may be tackled after all other options have been exhausted, which are deemed low impact and high effort.\(^{24}\)

![Impact Effort Matrix](image)

**Figure 2.** Impact Effort Matrix.
2.2.3.7 SIPOC

Supplier, Input, Process, Output, and Customer, or SIPOC, is a tool utilized for a macro understanding of processes and helps define process boundaries and identify stakeholders.\(^7\)

2.2.3.8 Daily Huddle

The daily huddle is a 15-20 minute in-depth, stand-up, daily group discussion among patient care teams designed to identify issues, maintain focus on safety and to promote general control and information exchange.\(^25\) Huddles are composed of multidisciplinary teams that when gathered to consider a problem, allows for the inclusion of different viewpoints to an issue, and is a source of peer-to-peer training, knowledge sharing, team building and continuous improvement. While huddles may seem casual in nature, they are most effective when standardized and follow a well-known formula organized around improvement projects. Huddles are effective in improving engagement, communication and problem solving.\(^26\)

2.2.3.9 Kanban

Kanban, the Japanese word for signal board, is a signal which triggers movement of the patient to the next step in the process. Functioning like a pull system, the patient will not move until the next step is ready.\(^19\)
2.2.3.10 Full Capacity Protocol

The Full Capacity Protocol (FCP) is an internationally recognized, low cost, high-impact intervention proposed by the American College of Emergency Physicians to address Emergency Department overcrowding. As the name suggests, the Full Capacity Protocol refers to a strategy in which in the event of an E.D. presenting at full capacity with no available beds, the patient is to be admitted to the next most appropriate unit. This means patients can be transferred to inpatient hallways rather than obstructing E.D. hallways, for example.27

The FCP consists of 3 different levels, represented by the colors green, yellow and red that indicate an E.D.’s current levels of bed occupancy. At each level, staff is informed about the percentage of beds in the E.D. that are unavailable, and what actions are necessary to accommodate current and future patient admissions. The main idea behind FCP is that the process of patient admissions becomes more efficient as patients are allocated to beds according to the capacity of the E.D. and other units, even if it is the next best option. Additionally, keeping track of E.D. capacity alerts providers that at a level 3 FCP, future patients should be diverted from the hospital.27

Importantly, FCP has been demonstrated as safe and necessary to accommodate new patient demand and allows for patients to continue to receive care in inpatient units.28 Notably, FCP has been associated with decreased length of stay, lower wait times, fewer patients leaving the E.D. without being seen, lower patient mortality, higher operating revenues and higher patient satisfaction.27
2.2.3.11 Fast-track

Fast-track systems are designed to reduce overcrowding and wait times and improve E.D. capacity during peak demand by separating patients with non-urgent complaints from those deemed higher complexity.\textsuperscript{21} There are a number of benefits associated with E.D. fast-track, including reductions in waiting times, decreased E.D. length of stay, financial savings, increased patient satisfaction and decreased left without-being-seen rates.\textsuperscript{29}

2.2.3.12 Short-stay Unit

Short-stay units are a system recommended by the American College of Emergency Physicians to reduce overcrowding in hospital E.Ds. Short-stay/observation units are locations within the hospital in close proximity to the E.D. utilized to accommodate patients without admitting them to a bed. Examples of patients who may be directed to short-stay units are those who may require blood transfusions, further diagnostic evaluations such as biopsies, and patients who may require social services for safe discharge. Short-stay units have also been shown to be a cost-saving intervention compared to inpatient care.\textsuperscript{30}

2.2.3.13 Clinical Decision Unit

Clinical Decision Units (CDU) are specialized units designed to manage patients who require prolonged periods of observation, but do not require inpatient admissions. Examples of patients who may be directed to CDUs are those who present with conditions such as asthma,
intoxication or chest pain. CDUs have been shown to contribute to decreased length of stay and lower hospital admission rates.\textsuperscript{31}

2.2.14 Discharge Lounge

Discharge lounges are where patients are directed when discharged, in order to free up otherwise occupied beds. Discharge lounges are often helpful to ease the pressure of needing to accommodate patients in hallways when all E.D. beds are occupied.\textsuperscript{27}

2.2.4 Lean Applications

The applications of Lean methodology within the healthcare industry have been quite broad and have shown great promise.\textsuperscript{6} While Lean healthcare has been employed to improve a variety of health settings, Emergency Departments present the highest number of Lean applications because they are considered highly inefficient.\textsuperscript{7} Even within E.Ds, Lean applications have spanned a variety of interventions including, but not limited to, process redesign, improving patient access and flow, reducing wait times, reducing error and tackling overcrowding.\textsuperscript{19} Notably, when applied to Hospital Emergency Services (HES), Lean has been shown to increase the efficiency of patient, resource and information flow and reduce wait times and overcrowding.\textsuperscript{7} Hospitals who have proven successful in reducing overcrowding of HES were identified as having acknowledged the problems inherent in the patient flow throughout the hospital in order to move them out of the E.D. more efficiently.\textsuperscript{5}
As this thesis focuses on Brazil’s healthcare system, it is relevant to acknowledge that Lean healthcare has also been shown to be very successful in a variety of Brazilian hospital settings. This is especially important to acknowledge given that Brazil’s system is burdened by management inefficiencies, insufficient public investments and low bed per inhabitant ratios and could benefit from more effective resource management, waste elimination, value creation and the continuous improvement (or *kaizen*) mindset brought by Lean. A recent case study conducted in 2017 provides an in-depth qualitative analysis of the experiences and lessons learned from three unidentified Brazilian hospitals surrounding the implementation of Lean healthcare. Hospital A applied Lean to its outpatient and specialized medical services, chemotherapy and radiotherapy. The targets were to reduce wait times, increase process capacity and increase structure. Through the employment of primarily VSM, 5S and Kaizen tools, the hospital achieved 23% increased capacity of chemotherapy application, a reduction from 50 to 20 minute wait times in the radiotherapy unit, among other positive outcomes. Hospital B applied Lean to its surgical unit. The targets were to improve the surgical flow process. Through the employments of primarily SIPOC, VSM, Kaizen and 5S, the hospital achieved decreased time across surgery scheduling, patient reception, patient admission and patient release. Additionally, bed management statistics improved significantly, with a reduction of bed turnaround time from 5h30 to 2h30 with a 300% growth in the number of open vacancies. Hospital C applied Lean to increase outpatient capacity, expedite processes and eliminate waste. Through the employment of primarily Kaizen and VSM, appointment capacity increased by 170%, and waste reduction of 30%, 90% and 70% were reported for reception, invoices and supplies, respectively.
Importantly, gaps remain with reference to the application of Lean healthcare. Most studies about Lean healthcare are not comparative and consist of isolated case studies of single hospital systems. Additionally, there is a need for more information on Lean healthcare practices in the Brazilian setting. By providing a national-scale evaluation of Lean healthcare implementation across Brazil, this thesis hopes to supplement these gaps.

2.2.5 Lean Implementation and Sustainability

Lean is a powerful approach but is not a quick fix. Lean implementation is founded on the idea of continuous improvement, or *kaizen*, and is understood to be a gradual and methodical process focused on creating value for the end-user/patient. Additionally, Lean often requires significant cultural change towards the acceptance of Lean philosophy and practices, which creates resistance and pushback. Resistance to Lean implementation and to forms of change more broadly is very common, but its success and sustainability is tied to an organizational culture that embraces change. For this reason, Lean implementation requires not only the support of professionals with expertise in the area, but also the involvement of multidisciplinary teams in the planning process as well as staff across all levels of an organization/hospital. By involving a variety of stakeholders in the planning process and ensuring all have a clear understanding of the mission of Lean and how the intervention fits into the hospital’s overall mission, resistance can be mitigated.

Referring to the aforementioned case study conducted in 2017 across three Brazilian hospitals, Hospitals A, B and C all aligned their Lean implementation with the strategic plan of the hospital in an effort to ensure the intervention’s sustainability. Additional strategies to
ensure sustainability were that all three hospitals employed theoretical and practical training sessions by outside consulting companies on Lean tools and methods, involved senior management in the Lean intervention to systematically develop culture change and promote assimilation to the continuous improvement mindset and culture, and used cyclical continuous improvement tools, such as DMAIC (Define, Measure, Analyze Improve, Control) and PDCA (Plan, Do, Check, Act). Iterative cycles of improvement such as DMAIC and PDCA are useful for granting both a persistent and flexible nature to improvement initiatives, adaptable to new information that may arise throughout the implementation process. In addition to the examples provided in this case study, the sustainability of Lean implementation in Brazil and elsewhere has also been tied to a few other important factors, such as the need for evidence-based solutions, standardization of processes, requirement for defining stakeholders and deadlines, and patient-centered interventions. The next section of this thesis will move on from the background provided and explore the key research questions and hypotheses that drive this thesis.

3 CONCEPTUAL FRAMEWORK AND HYPOTHESES

To reiterate, this thesis aims to evaluate the effectiveness of Lean nas Emergências through the viewpoint of those on the receiving end of the project’s implementation. As depicted in Figure 3, the central question is to answer whether hospital administrators consider Lean nas Emergências to have been effective in reducing the overcrowding of Hospital Emergency Services (HES) across SUS hospitals. In order to frame this analysis, Lean nas Emergências is evaluated through three primary variables: Key Performance Indicators (KPIs), organizational culture and sustainability. Next, the project is evaluated through two secondary variables:
hospital cycle of enrollment and geographic region. The choice made to analyze each of the five variables stems from the literature review on what aspects are important and relevant to the successful implementation of Lean healthcare.  

Figure 3. Research questions.

As was briefly touched upon in the introduction, this thesis evaluates the Lean nas Emergências project through a primarily qualitative lens. While this thesis also employs quantitative Key Performance Indicator data gathered by Sírio-Libanês to evaluate Lean nas Emergências, the focused attention on the two qualitative variables of organizational culture and sustainability is meant to add a new perspective to evaluate the project’s effectiveness beyond observed metrics. While not easily quantified, organizational culture transformation and sustainability are essential to the long-term success of Lean interventions and for this reason are the central focus of this research.
First, the objective of analyzing Key Performance Indicators (KPIs) data gathered by Hospital Sírio-Libanês was to determine how both the NEDOCs (National Emergency Department Overcrowding Scale) and LOS (Length of Stay) changed as a result of the *Lean nas Emergências* project intervention. Larger reductions across KPIs would represent more favorable results, demonstrating lower lengths of stay for patients and less overcrowding for hospitals.\(^{16}\)

KPI monitoring is vital in evaluating impact as well as for sustaining improvements, especially when coupled with standardization of activities and defined project targets and stakeholder roles.\(^7\) Therefore, as a key component of successful Lean implementation, KPIs were selected as a primary variable for analysis of the effectiveness of *Lean nas Emergências*.

Second, the objective of analyzing organizational culture was to determine if respondents feel *Lean nas Emergências* was successful in changing hospital organizational culture towards the acceptance of Lean practices. One of the core principles of Lean is developing a culture of continuous improvement within the organization.\(^7\) As Lean brings and promotes a new way of thinking, its acceptance requires change and engagement from stakeholders at all levels.\(^{17}\) In Lean interventions, it will often be the primary goal of senior management to effect a cultural change aligned with the organization’s goals and strategic plan. While resistance is very common in Lean interventions, training sessions, daily supervision and engagement of teams in the new way of thinking can all serve to minimize pushback.\(^7\) Therefore, as a key component of successful Lean implementation, organizational culture change was selected as a primary variable for analysis of the effectiveness of *Lean nas Emergências*.

Third, the objective of analyzing sustainability was to determine if respondents feel their hospitals are equipped with the tools and knowledge to maintain Lean methodology active in the long-term. Sustainability is directly tied to the success of organizational culture change, as the
maintenance of results are highly reliant on whether or not people have bought into Lean thinking and philosophy. Lean sustainability post-implementation has been identified as a challenge in a variety of settings, as an existent organizational culture may not be compatible with Lean principles. Importantly, as the sustainability of Lean healthcare interventions is not widely researched and an underestimated theme, it becomes essential to consider the cause of potential long-term challenges in results and improvement maintenance. Therefore, as a key component of successful Lean implementation, sustainability was selected as a primary variable for analysis of the effectiveness of Lean nas Emergências.

Fourth, the objective of analyzing hospital enrollment cycles was to identify if there was a notable difference in KPIs and in respondent’s perceptions of organizational culture and sustainability as a result of when a hospital enrolled in the project. Lean nas Emergências ran from 2017-2020, therefore the aim was to assess whether hospitals who participated in Lean nas Emergências earlier cycles would report greater challenges in maintaining Lean culture and methodology in the long-term compared to hospitals in later or more recent cycles. When analyzing the three primary variables through the lens of hospital cycle of enrollment, the expectation is that there should be no significant difference in respondent’s perceptions of KPIs or organizational culture change (or resistance to change) but that there would be a significant difference in respondent’s perceptions on sustainability of the project. Given the known challenges of Lean sustainability in the long-term, it would be expected that hospitals which enrolled in the project’s earlier cycles would indicate lower sustainability adherence to Lean changes compared to hospitals in later or more recent cycles.

Fifth, the objective of analyzing hospital geographic regions was to identify if there was a notable difference in KPIs and in respondent’s perceptions of organizational culture and
sustainability as a result of a hospital’s location among Brazil’s five regions. Brazil presents with significant regional disparities, translating into differing levels of health infrastructure, accessibility and asymmetry in the distribution of healthcare workforce among regions.\textsuperscript{3} Notably, in the more well-off Southeastern region, there are 2.51 doctors per thousand population, a concentration 2.5 times higher compared to physician availability in the Northeast region (0.9). The ratio in the South (2.06) and in the Center-West (1.76) are almost twice the ratio of the North (1.09).\textsuperscript{3} When analyzing the three primary variables through the lens of hospital geographic region, the expectation is that there should be significant differences in KPIs and in respondent’s perceptions on organizational culture change and sustainability. Given the known economic, health infrastructure and provider availability disparities across regions,\textsuperscript{3} it would be expected that hospitals located in the resource-poor North and Northeastern regions of Brazil should present greater challenges to adhering to organizational culture change, greater resistance to Lean, as well as a lower ability to sustain Lean methods compared to the Center-West, South and Southeast regions. It would also be expected that hospitals in the North and Northeastern regions would indicate greater reductions and improvement across KPIs due to the greater opportunities for improvement in these regions. The following section of this thesis will present the research method employed to answering the research questions and hypotheses.
4 RESEARCH METHOD

4.1 Methodological Approach

The primary research method used in the information gathering process for this thesis was the development of a Google Forms survey in order to give a voice to project participants and evaluate their satisfaction with *Lean nas Emergências*. I created all survey questions, which were then reviewed and approved by the *Lean nas Emergências* project leaders at Sírio-Libanês.

Importantly, while the majority of this thesis focuses on the evaluation of *Lean nas Emergências* through the lens of my survey, secondary research sources are also considered to evaluate project outcomes and participant feedback. Notably, this research also makes use of KPI data gathered by Sírio-Libanês throughout the project’s three years, informational conversations with Sírio-Libanês members as well as results presentations on YouTube. All research methods are dispersed throughout this thesis in order to provide context and relevance to a variety of points of discussion.

4.2 Methods of Data Collection

The data collection process for the survey began on January 5th and ended on February 8th, 2021. Throughout this period, the survey was sent to key points of contact within all 103 participant hospitals. Points of contact to whom the survey was sent out were selected by Sírio-Libanês project leaders who knew of individuals within each participant hospital who would be best suited to answer the survey questions based on their involvement in and knowledge of *Lean*
The data collected was linked to a spreadsheet, in which all respondent answers were added into real-time.

In order to maximize response rates, the survey was sent through Hospital Sírio-Libanês’ institutional email, in which the hospital requested participants to contribute their time in order to evaluate the project. A total of four e-mail requests were sent out to all hospitals. The first survey request was sent on January 5th, the second on January 7th, the third on January 11th, and the fourth on January 13th. With this first approach, the survey reached a 38.8% response rate with representation from 40 hospitals out of the 103 total.

The Sírio-Libanês project leaders wished to increase the response rate even further and decided to take on a more personalized approach to reach key points of contact within each hospital. Rather than sending additional requests through the Sírio-Libanês institutional email, Lean specialists were assigned by the project leaders to follow-up through e-mail or WhatsApp with the remaining points of contact within hospitals they had each personally worked with that had not yet answered the survey. This second approach began January 13th after the initial four emails had been sent out and ended February 8th. As a result of the more individual targeting, the survey reached an additional 31 hospitals. On February 8th, when the survey was closed and was no longer receiving new answers, 71 hospitals of the 103 total had answered the survey, concluding the research with a 68.9% response rate.

As the survey was the principal method of data collection for this research, I include in the next section a detailed analysis of survey questions, design and objectives. For the full survey, including a full list of survey questions and answer options, please refer to Appendix A.
4.2.1 Survey Structure

The survey was designed with a total of 28 questions, consisting of 18 closed questions, 9 open-ended questions and 1 dichotomous yes/no question. The majority of closed questions were designed to follow the 5-point Likert scale, prompting respondents to indicate their level of agreement with a statement by selecting one of the five options: “strongly agree”, “agree”, “neither agree nor disagree”, “disagree”, and “strongly disagree”. Closed questions were included to standardize responses across certain questions of interest, also allowing for a quantitative analysis to be conducted across hospitals in order to gather potential commonalities and patterns in the data. Open-ended questions were also included in order to allow for more subjectivity in feedback.

All 28 survey questions fall under a total of 7 sections, each with a different emphasis on project evaluation. Questions were designed to obtain information on how participants ranked the effectiveness of Lean methods and tools employed, whether or not they found the project to bring cultural transformation to their hospital, whether or not they found the project’s results to be sustainable, their challenges and strategies in facing the COVID-19 pandemic, their feedback on areas for project improvement, as well as their final consideration on whether or not they found the project to have met its intended goals and objectives.

4.2.1.1 General Information

The first section of the survey consisted of 4 questions and was designed to gather foundational information that serves as the backdrop for the data analysis section of this thesis.
For this reason, all questions in this section were mandatory. This section gathered data on (1) the respondent’s academic background (education) and (2) whether or not they held a managerial position in their hospital during the of *Lean nas Emergências* project implementation. The general profile of respondents is relevant to note in order to understand their viewpoints on the project’s effectiveness. For a breakdown of both of these questions and their answers, please refer to Appendix B. This section of the survey also included a question to identify (3) the name of the hospital, as well as (4) its corresponding cycle of enrollment. For a breakdown of hospital participation by cycle as a percentage of total survey responses, please refer to Figure 5 in section 6.1 of this thesis.

**4.2.1.2 Lean Tools and Methods Analysis**

The second section of the survey consisted of 1 question, designed to gather information on how respondents perceived the effectiveness of a variety of tools and methods employed throughout the implementation of *Lean nas Emergências*. Respondents were asked to rank their top 5 options among the following choices: Value Stream Mapping, 5S, A3, Spaghetti Diagram, Cause and Effect Matrix, Impact Effort Matrix, SIPOC, Daily Huddle, Rounds, Kanban, Full Capacity Protocol (FCP), Fast-track, Short-stay Unit, Clinical Decision Unit and Discharge Lounge. For a full description of each of these tools and their application, please refer to the background section 2.2.3 of this thesis and for information on respondent’s ranking of these tools, please refer to Figure 17 in section 6.5 of this thesis.
4.2.1.3 Organizational Culture Analysis

The third section of the survey consisted of 7 questions, designed to gather information on the project’s effect on transforming hospital’s organizational culture. This section was of vital interest to this research because as has been referenced thus far, cultural transformation and getting relevant stakeholders on board and committed to change is one of the keys to ensuring the success of Lean management interventions, both in the short and long-term. More specifically, the questions refer to whether or not (1) there were observable changes in providers' work routines and (2) whether these changes were maintained after the project’s conclusion. These questions also inquire about (3) team alignment to the proposed Lean changes, (4) whether or not there was resistance to change, (5) the main sources of resistance and challenges to Lean adoption, and (6) if respondents believe Lean nas Emergências brought cultural change to their hospital. Finally, respondents were given the opportunity to expand on their previous selections through an open-ended question and were asked (7) if they would like to add any contextual observations about changing work routines, cultural transformation and/or team alignment and resistance within their hospital.

4.2.1.4 Sustainability Analysis

The fourth section of the survey consisted of 8 questions, designed to gather information on the project’s sustainability. This section was of vital interest to this research because the long-term maintenance of the project results and achievements is just as important, if not more, than its short-term success. This section begins by asking (1) whether each hospital has observed
improvements in E.D. overcrowding and workflow management during the project’s 6-month intervention period. The questions then turn to (2) whether the hospital has been able to maintain lean methodology and culture over the short-term 1-year follow-up period and (3), whether the hospital has been able to maintain lean methodology and culture over the long-term, beyond the 1-year follow-up period. This section also asks (4) whether providers feel sufficiently trained to maintain results over the long-term, and (5) whether they feel the hospital is able to maintain results over the long-term. The questions also inquire about (6) what major challenges and (7) what major strategies the hospital faces to keep the sustainability of lean methodology and culture alive and active over the long-term. Finally, respondents were given the opportunity to expand on their previous selections through an open-ended question and were asked (8) if they would like to add any contextual observations about sustainability, training and short and long-term results maintenance within their hospital.

4.2.1.5 Comments/Suggestions

The fifth section of the survey consisted of 2 questions, designed to evaluate the project as a whole. This section was of vital interest to this research because it granted respondents the opportunity to provide their feedback on Lean and Emergências, which has been taken into consideration for the design of the project’s next three years. For the first question, respondents were asked to reply to (1) the project’s strengths, selecting all relevant options from the following selection: Lean Training, Team Training, Identification of Opportunities for Improvement, Results Tracking, Capacity and Demand analysis, Action Plan Construction Method, Emergency Services, and Change Management (cultural transformation). For
respondent’s ranking of these options, please refer to Figure 18 in section 6.5 of this thesis. Next, respondents were asked to (2) suggest improvements to the project, an open-ended question to facilitate gathering a variety of perspectives.

### 4.2.1.6 Final Considerations

The sixth and final section of the survey consisted of 4 questions, designed to summarize and conclude key considerations. Respondents were asked to indicate their level of agreement on (1) whether or not the hospital is better prepared to handle overcrowding and workflow management after the implementation of *Lean nas Emergências* as opposed to before the intervention, as well as answer yes or no to (2) whether or not they would recommend project enrollment to other hospitals. Next, respondents were given the opportunity to expand on any topic of their choosing through the open-ended questions (3) did anything surprise them about the implementation of *Lean nas Emergências*, and (4) if they would like to inform the Sírio-Libanês team of any final observations before submitting the survey.

### 4.3 Methods of Analysis

The chosen method for analyzing the survey’s closed questions was to conduct a quantitative exploratory analysis. This method was chosen in order to maximize insight into the data set, assess and summarize the main characteristics of the data set, and to test underlying assumptions. In conducting the exploratory data analysis, pie charts were used to visually represent the percentage of responses for each of the Likert-scale questions. Additionally, in
order to add an additional level of analysis to the data, the Likert scale answers were then segregated by hospital geographic region and by cycle, in order to assess whether or not there was a pattern in levels of agreement or disagreement of the project’s impact and effectiveness as a result of either variable. Therefore, in order to analyze the hypotheses outlined in section 3 of this thesis, answers were segregated into the desired criteria.

For instance, in attempting to answer the question of whether or not there was a notable difference in respondent's perceptions of organizational culture transformation as a result of the hospital’s geographic region, the first step was to include all those who answered “strongly agree” to having observed cultural transformation within their hospital. The next step was to further narrow the data set to selectively include answers from only one of the five main Brazilian regions. Next, in order to arrive at the percentage of respondents who strongly agreed that their hospital had a cultural transformation for a particular region, the already narrowed down number of responses in the numerator was divided by the total of “strongly agree” answers for the same region in the denominator. This process was repeated for all five Brazilian regions, in order to analyze if there was a significant difference in perceived cultural change depending on the hospital’s geographic region. A similar reasoning was employed to answer the other hypotheses outlined in section 3, including whether or not there were perceived differences as a result of a hospital’s cycle of enrollment.

The chosen method for analyzing the survey’s open-ended questions, on the other hand, was to conduct a thematic analysis. This method was chosen in order to identify common themes and keywords across respondent’s short answers. For greater detail and additional analyses conducted, please refer to sections 6 and 7 for the Results and Discussion, respectively.
4.4 Methodological Choices & Limitations

The choice of employing the survey research method was to give a voice to project participants to evaluate and provide feedback on *Lean nas Emergências*. This research method was deemed the most suitable approach to collect participant feedback in a standardized manner, while also allowing for freedom of expression through open-ended questions. Interviews were not feasible, due to limited time and the large number of participant hospitals.

The present study has three limitations that merit discussion. First, as the methodology was based on a survey, results present in this thesis are entirely dependent on those who answered the survey questions and does not include feedback or results from the other 32 hospitals that did not participate in the survey. Second, there could be a response bias given that approximately 93% of respondents held a managerial role within their hospitals and may have been more inclined to answer survey questions more favorably. Third, the sample size for select regions and cycles, notably the Center-West region and Cycles 0 and HFRJ were quite small. This having been said, the sample size used was a result of both survey adherence and the data available at the time this research was conducted.

5. LEAN NAS EMERGÊNCIAS

5.1 Background and Objectives

*Lean nas Emergências* is a public-private partnership between Brazil’s Ministry of Health and Hospital Sírio-Libanês, designed to reduce overcrowding of Hospital Emergency
Services in public and philanthropic hospitals across Brazil through the implementation of Lean methods. As part of PROADI-SUS, *Lean nas Emergências* was designed to assist the institutional development of the SUS and aimed to target 100 emergency services across SUS hospitals in three years spanning 2018 to 2020. By the end of the three allotted years, additional goals were to train 450 healthcare providers and administrators in Lean methodology, and to implement 180 clinical protocols in order to ensure greater agility and efficiency of hospital operations. As of recently, 1685 professionals have been trained through the project. In sum, the project aims to reduce waste, rework, bureaucracy, unnecessary processes and excessive spending, while increasing accessibility, agility, satisfaction, efficiency and risk control.

According to Sírio-Libanês director, Paulo Chapchap, helping the public healthcare system to improve is part of Sírio-Libanês’ mission to promote excellence in hospital administration and patient care for Brazilians. In line with the aim to provide education to participant hospitals and staff, the project has its own interactive platform where the community of participant hospitals are able to see each other’s results within the project and share learnings and best practices. This information, as well as each hospital’s performance indicators, remain private data and are not open to the public. In addition, the project also has workshops to highlight the results of top-performing hospitals, which are shared on YouTube and are accessible to all to get to know the project and its successes. In such videos, listeners are able to hear from hospital administrators in the field of medicine, nursing and others, in relation to their experience participating in the project.
5.2 Scope

As aforementioned, the objective of *Lean nas Emergências* was to reach 100 public SUS hospitals in Brazil throughout the project’s triennia, from 2018 to 2020. The project successfully reached 103 public hospitals across Brazil in this period. Figure 4 shows the project’s reach across the country by state. Of Brazil’s 26 states, the project reached 23, as well as the Federal District (or *Distrito Federal*).

![Figure 4. Lean nas Emergências project reach across Brazilian states. Each red pin represents one SUS hospital enrolled in the project. To the left, a smaller map of Brazil is provided in color to identify Brazil’s geographic regions: North (green), Northeast (blue), Southeast (red), South (yellow) and Center-West (purple).]
5.3 Design, Methods and Tools

In order to feasibly reach 100 hospitals in 3 years, *Lean nas Emergências* was designed to incorporate hospitals into the project in cycles, incrementally adding hospitals to its project every six months. As hospitals expressed interest in becoming part of the project and enrolled to participate in the intervention, they were grouped together to all begin a new project cycle upon completion of the previous cycle. Due to the project having been a new initiative for both government and private players, a pilot cycle was conducted in 2017. The pilot phase, known as cycle 0, admitted 6 SUS hospitals and ran from August - December 2017. Upon the completion of the pilot cycle, the next was cycle 1, which ran from May - September 2018. Cycle 2 ran from November 2018 - May 2019. Cycle HFRJ, which began before the completion of cycle 2 and before the start of cycle 3, ran from February - July 2019. Cycle 3 ran from July - December 2019. Cycle 4 ran from March - December 2020.¹⁶

In addition to the cycle-based, incremental design of the project, the method integral to the *Lean nas Emergências* project design was the employment of DMAIC (Define, Measure, Analyze, Improve, Control), a data-driven quality strategy used to improve processes. In the define phase, a project charter is generally created in order to identify the problem and define the focus, direction and motivation of an improvement team.³⁴ Specific to *Lean nas Emergências*, this phase also included an operational diagnostic of the hospitals who wish to enroll, as well as Lean healthcare training.¹⁶ In the measure phase, process performance is recorded. In the analyze phase, Lean tools are often employed in order to determine root cause analysis of variation and poor performance, also referred to as opportunities for improvement.³⁴ The *Lean nas Emergências* team primarily focused on Value-Stream-Mapping, 5S, spaghetti diagram, cause
and effect matrix and the effort impact matrix. In the improve phase, process performance is improved through brainstorming and implementation sessions involving multi-disciplinary teams. Other relevant tools are the daily huddle and 5W2H (who, what, when, where, why, how, how much), a tool which allows for organizing how action plans will be implemented. Finally, in the control phase, quality control plans are usually created to document what is needed to maintain improvement. Additionally, constant review of KPIs is essential in this phase to maintain future process performance. Table 1 describes the Lean nas Emergências project approach, based off of the DMAIC methodology, as well as the key tools characteristic to each step. For a full explanation of these tools, please refer to section 2.2.3 of this thesis.

Table 1. Lean nas Emergências DMAIC structure and respective tools.

<table>
<thead>
<tr>
<th>Define/Measure</th>
<th>Analyze</th>
<th>Improve</th>
<th>Control</th>
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<tbody>
<tr>
<td>2. Lean healthcare training</td>
<td>2. Spaghetti diagram</td>
<td>2. Daily huddle</td>
<td></td>
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<tr>
<td>3. Stakeholder matrix</td>
<td>3. 5S</td>
<td>3. 5W2H</td>
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<td></td>
<td>4. Cause and Effect matrix (Ishikawa)</td>
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<td></td>
<td>5. Impact Effort matrix</td>
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</table>

5.4 Eligibility and Exclusion Criteria

In order to participate in the Lean nas Emergências project, hospitals must meet 18 eligibility criteria. Eligibility criteria fall into three categories, including structure (6), institutional governance (2), and emergency services characteristics (10). Table 2 displays the key eligibility criteria for hospital inclusion for Lean nas Emergências.
Table 2. Key eligibility criteria for hospital inclusion in *Lean nas Emergências* (adapted).15

<table>
<thead>
<tr>
<th>Hospital Structure</th>
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<tr>
<td></td>
<td>1</td>
<td>Has more than 150 beds</td>
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<tr>
<td></td>
<td>2</td>
<td>Has ICU beds</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Public or philanthropic profile</td>
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<tr>
<td></td>
<td>4</td>
<td>Located in a capital or in an important regional reference</td>
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<tr>
<td></td>
<td>5</td>
<td>Has emergency services</td>
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<tr>
<td></td>
<td>6</td>
<td>Is integrated to the SUS emergency network</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hospital Governance</th>
<th>1</th>
<th>Local hospital emergency team must be engaged during the eligibility visit conducted by Sírio-Libanês</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>Agreed and signed term of commitment to the project</td>
</tr>
</tbody>
</table>

| Hospital Emergency Services Characteristics | 1 | Is physically structured following the National Health Surveillance Agency                                         |
|                                              | 2 | Has risk-rating capabilities                                                                                   |
|                                              | 3 | Has an Emergency Coordinator                                                                                  |
|                                              | 4 | Is overcrowded                                                                                                |
|                                              | 5 | Has bed management capabilities                                                                               |
|                                              | 6 | Has an internal regulatory body                                                                                |
|                                              | 7 | Has time and data monitoring capabilities                                                                      |
|                                              | 8 | Has a Hospital Information System (HIS)                                                                        |
|                                              | 9 | Has clinical protocols                                                                                        |
|                                              | 10| Has an Internal Diagnostic Support Service                                                                     |
5.5 Logistics and Implementation

*Lean nas Emergências* was designed to deliver in person and hands-on consulting to all participant hospitals. In order to feasibly carry out this strategy, teams of two Sírio-Libanês professionals, consisting of one physician and one Lean specialist, were mobilized to all locations to assist healthcare professionals and administrators in the implementation, use, and management of Lean tools and methods to ultimately reduce the overcrowding of Hospital Emergency Services. Once registered and in a cycle, each hospital received approximately six months of hands-on intervention from the Sírio-Libanês team, followed by a 12-month follow-up period to ensure the project results sustainability and success. Additionally, as a PROADI-SUS project, *Lean nas Emergências* is funded through the tax-exemption status of Sírio-Libanês, granted for being both a philanthropic hospital and deemed a Hospital of Excellence by the Ministry of Health.

5.6 Indicators for Performance Analysis: NEDOCS and LOS

The monitoring of Key Performance Indicators is one of the backbones of Lean interventions. KPIs allow for analyzing the issue at hand, understanding how to improve it and measuring changes post-intervention in order to determine whether or not objectives were met and whether the project led to positive change and improvement. In order to track hospital performance, *Lean nas Emergências* focuses on three primary KPIs: the National Emergency Department Overcrowding Scale (NEDOCS), Inpatient Length of Stay (IP LOS) and Outpatient Length of Stay (OP LOS).
NEDOCS is a very well-studied “early warning system”, originated from the need to develop a simple screening tool that could be used easily and quickly to determine the degree of E.D. overcrowding. NEDOCS creates a saturation score taking into consideration a number of factors, including but not limited to, the number of patients in the Emergency Department (waiting for or receiving care), number of fixed points of care within the E.D, number of patient beds, admissions, and E.D. throughput, the latter which considers bottlenecks in E.D. operations that lead to overcrowding. The NEDOCS tool allows for hospital staff to add scores into the system and visualize trends using graphs and heatmaps. Importantly, NEDOCS has been shown to be effective in real-time overcrowding assessment.

LOS is a key measure of E.D. throughput and a marker of overcrowding, and is the most common performance measure reported in the literature with regards to E.D. performance and quality of care. LOS measures the length of time a patient spends in the E.D. from arrival to departure and is an important metric because E.D. patient outcomes are often time-sensitive and depend on timely initiation of treatment or transfer. Extended LOS has been associated with increased patient risk for adverse events, delayed or missed medications, decreased patient satisfaction, high leave without being seen rates, the inability to admit new patients, and higher inpatient mortality rates. LOS is also tied to quality of care measures, as improvements in E.D. timeliness is associated with improved patient experiences. The next section of this thesis will report the KPI data outlined in this section as well as the collected survey results in order to evaluate the effectiveness of the Lean nas Emergências project.
6 Results

This section reports the KPI data collected by Sírio-Libanês as well as the results of all closed survey questions. Open-ended survey results are left to the discussion section. The order in which results are presented follows the hypotheses outlined in Section 3 of this thesis, beginning with Key Performance Indicators, followed by organizational culture and concluded with sustainability. Each of these three primary variables has its own subsection within the results section and are supplemented by insights on the effect of the secondary variables of hospital cycle and hospital geographic region. The majority of results are visually displayed through a combination of pie charts and tables.

6.1 Relevant Background Results

In advance of providing results on the primary variables of KPIs, organizational culture and sustainability, this section demonstrates the collected background information regarding the breakdown of both hospital cycles and hospital geographic regions representation in the survey responses. This information is relevant to note prior to presenting other results as sample sizes per region and per cycle are carried throughout the entirety of the results section.

Beginning with cycles of enrollment, Figure 5 demonstrates the survey representation for each cycle shown as both absolute number of responses inside the pie slices and as percent contributions to the total survey responses. As can be observed, Cycle 4 had the largest weight in survey answers, while cycle HFRJ and cycle 0 had the lowest weights.
In addition to the representation of each cycle in the survey depicted in Figure 5, it is also important to note the level of engagement and adhesion of each cycle to the survey. Cycle 1 and cycle 0 had 100% of adhesion, cycle 2 had 74% adhesion, cycle 3 had 81% adhesion, cycle 4 had 70% adhesion and cycle HFRJ had 44% of survey participation.

In turn, Figure 6 demonstrates the survey representation for each of the five Brazilian regions. The representation for each region is shown as both absolute number of responses inside the pie slices and as percent contributions to the total survey responses. As can be observed, the Southeast (SE) accounted for the greatest portion of survey answers, followed by the Northeast (NE), South (S), North (N) and Center-West (CW) region.
6.2 Key Performance Indicators Results

The objective of analyzing Key Performance Indicators (KPIs) was to determine how the NEDOCS, inpatient LOS and outpatient LOS changed as a result of the Lean nas Emergências project intervention. For all three indicators, the larger the reduction the better, as a reduction in overcrowding and patient length of stay increases the hospital’s capacity to see a larger number of patients more efficiently. Importantly, this data did not originate from the survey but was shared with me by Sírio-Libanês for the purposes of this research. In order to respect the confidentiality of participant hospitals, KPIs for individual hospitals are not included in this thesis, and the KPI data is presented only at the aggregate level for analysis.

Key takeaways from Table 3 are that all cycles demonstrated significant reductions in all three indicators, with larger reductions being most favorable. The NEDOCS reduction ranged
from -41% to -46% and improvement was most prominent in cycle 3. The outpatient LOS reduction ranged from -25% to -66% and improvement was most prominent in cycle 1. The inpatient LOS reduction ranged from -38% to -52% and improvement was most prominent in cycle 1. Given the overall reduction across NEDOCS and LOS for all cycles, this data may support the hypothesis that there should be no significant difference in KPIs among hospital cycles of enrollment in *Lean nas Emergências*.

**Table 3.** Observed changes in KPI indicators segmented by hospital cycle.

<table>
<thead>
<tr>
<th>Key Performance Indicators (KPIs)</th>
<th>NEDOCS</th>
<th>Outpatient LOS</th>
<th>Inpatient LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycle 1 (n=4)</td>
<td>-41,00%</td>
<td>-66,00%</td>
<td>-69,00%</td>
</tr>
<tr>
<td>Cycle 2 (n=11)</td>
<td>-44,91%</td>
<td>-29,91%</td>
<td>-38,00%</td>
</tr>
<tr>
<td>Cycle 3 (n=15)</td>
<td>-46,00%</td>
<td>-43,40%</td>
<td>-43,00%</td>
</tr>
<tr>
<td>Cycle 4 (n=25)</td>
<td>-41,48%</td>
<td>-25,00%</td>
<td>-52,50%</td>
</tr>
</tbody>
</table>

Note: Cycle 0 and Cycle HFRJ were excluded from this analysis because Cycle 0 (pilot phase) had not yet been fully developed to employ these indicators for analysis and Cycle HFRJ included hospitals in Rio de Janeiro that did not possess emergency services.

Key takeaways from Table 4 are that for all regions, there were significant reductions across all three indicators, with the North region presenting the greatest reductions and improvements. The NEDOCS reduction ranged from -33% to -72% and improvement was most prominent in the North region. The outpatient LOS reduction ranged from 61% to -72% and...
Improvement was also most prominent in the North region. The inpatient LOS reduction ranged from -7% to -59% and improvement was also most prominent in the North region. The North region presented with the largest reduction across all three indicators, followed by the Northeast region, both with the most favorable impact on reduced NEDOCS/overcrowding and reduced LOS. This result is aligned with the expectation that given the regional disparities in health infrastructure across Brazil referenced in the literature, the North and Northeastern regions would have greater challenges and perhaps more room for improvement in performance. Therefore, this data supports the hypothesis that the North and Northeast regions would present with the greatest reductions and improvements across KPIs.

Table 4. Observed changes in KPI indicators segmented by hospital region.

<table>
<thead>
<tr>
<th>Key Performance Indicators (KPIs)</th>
<th>NEDOCS</th>
<th>Outpatient LOS</th>
<th>Inpatient LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NE (n=16)</td>
<td>-47.56%</td>
<td>-33.88%</td>
<td>-52.19%</td>
</tr>
<tr>
<td>S (n=14)</td>
<td>-33.21%</td>
<td>-22.08%</td>
<td>-47.75%</td>
</tr>
<tr>
<td>SE (n=16)</td>
<td>-38.27%</td>
<td>-36.29%</td>
<td>-39.29%</td>
</tr>
<tr>
<td>N (n=6)</td>
<td>-72.00%</td>
<td>-72.67%</td>
<td>-59.83%</td>
</tr>
<tr>
<td>CW (n=4)</td>
<td>-35.25%</td>
<td>61.25%</td>
<td>-7.75%</td>
</tr>
</tbody>
</table>

Note: The outpatient LOS data in the Center-West region presented with two significant outliers from the data sample of 140% and 164% increase coupled with a small sample size, both factors which may help explain the perhaps unexpected positive result of high magnitude.
6.3 Organizational Culture Results

The objective of analyzing organizational culture was to evaluate whether or not respondents feel *Lean nas Emergências* was successful in changing their hospital’s organizational culture towards the acceptance of Lean practices. The key survey questions for evaluating organizational culture are presented below, followed by the obtained survey results.

Question 1: DURING the implementation period of *Lean nas Emergências*, there was a clear change in the daily work routine of professionals within our hospital due to the project.

![Figure 7. Respondent's level of agreement about changes in work routines within their hospital during the implementation of *Lean nas Emergências*, with 96.1% of respondents in agreement (n=77).](image-url)
Question 2: AFTER the completion of *Lean nas Emergências*, changes in the daily work routine of professionals within our hospital were MAINTAINED.

Figure 8. Respondent's level of agreement about maintained changes in work routines after the implementation of *Lean nas Emergências*, with 87.1% of respondents in agreement (n=77).
Question 3: Even professionals within our hospital who were not directly involved with *Lean nas Emergências* aligned themselves with Lean.

**Figure 9.** Respondent's level of agreement about their hospital’s alignment with Lean, with 79,2% of respondents in agreement (n=77).
Question 4: There was resistance from certain teams/individuals regarding the changes brought by Lean.

![Pie chart showing respondent's level of agreement about resistance to change brought by the implementation of Lean.](image)

**Figure 10.** Respondent's level of agreement about resistance to change brought by the implementation of Lean, with 88.3% of respondents in agreement (n=77).

In order to answer how perceptions on organizational culture change may be impacted when analyzed through the secondary variables of hospital cycle of enrollment and geographic region, the data presented in question 4 was further stratified by region and by cycle. Table 5 summarizes perceptions by cycle, while Table 6 summarizes perceptions by region. Both tables indicate the cumulative agreement in relation to the question/statement.

Key takeaways from Table 5 are that across all hospital cycles, there were very low levels of disagreement with the statement that the implementation of Lean changes caused resistance from hospital professionals and staff. It is relevant to note that while cumulative agreement varies widely from 50 to 100%, this is mostly due to the fact that a large percent of hospitals
remained neutral to the statement. Cumulative disagreement ranged from 0 to 11%, suggesting cycles largely agreed with the statement and identified resistance in their teams during the implementation of *Lean nas Emergências*. These results are consistent with current literature which describes Lean as a new way of thinking known to cause resistance and pushback as it is purposefully disruptive to the status quo and often requires culture change. Therefore, this data supports the hypothesis that there should not be a strong difference in perceptions of resistance tied to organizational culture change as a result of a hospital’s cycle of enrollment in the project.

**Table 5.** Question 4 data and corresponding agreement levels segmented by hospital cycles.

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Strongly Agree (SA)</th>
<th>Agree (A)</th>
<th>Neither Agree, nor Disagree (N)</th>
<th>Disagree (D)</th>
<th>Strongly Disagree (SD)</th>
<th>Cumulative Agreement (SA + A)</th>
<th>Cumulative Disagreement (D + SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycle 0 (n=5)</td>
<td>40,00%</td>
<td>60,00%</td>
<td>0,00%</td>
<td>0,00%</td>
<td>0,00%</td>
<td>100%</td>
<td>0,00%</td>
</tr>
<tr>
<td>Cycle 1 (n=9)</td>
<td>11,11%</td>
<td>55,56%</td>
<td>22,22%</td>
<td>0,00%</td>
<td>11,11%</td>
<td>66,67%</td>
<td>11,11%</td>
</tr>
<tr>
<td>Cycle 2 (n=14)</td>
<td>35,71%</td>
<td>64,29%</td>
<td>0,00%</td>
<td>0,00%</td>
<td>0,00%</td>
<td>100%</td>
<td>0,00%</td>
</tr>
<tr>
<td>Cycle 3 (n=17)</td>
<td>47,06%</td>
<td>52,94%</td>
<td>0,00%</td>
<td>0,00%</td>
<td>0,00%</td>
<td>100%</td>
<td>0,00%</td>
</tr>
<tr>
<td>Cycle 4 (n=28)</td>
<td>39,29%</td>
<td>46,43%</td>
<td>3,57%</td>
<td>10,71%</td>
<td>0,00%</td>
<td>85,72%</td>
<td>10,71%</td>
</tr>
<tr>
<td>Cycle HFRJ (n=4)</td>
<td>25,00%</td>
<td>25,00%</td>
<td>50,00%</td>
<td>0,00%</td>
<td>0,00%</td>
<td>50,00%</td>
<td>0,00%</td>
</tr>
</tbody>
</table>

Note: Given the differing sample sizes (n) between cycles, it is important to consider the different weights among the observed levels of agreement to the statement. For a breakdown of weights per cycle, please refer to Figure 5.
Key takeaways from Table 6 are that across all Brazilian regions, there was little variability and strong agreement with the statement that the implementation of Lean changes caused resistance from hospital professionals and staff. Cumulative agreement ranged from 81 to 100%, suggesting regions largely agreed with the statement and identified resistance in their teams during the implementation of *Lean nas Emergências*. This result is consistent with current literature for the same reasons mentioned above. The Northeast, Center-West and North regions presented with the highest levels of agreement to the statement at 100, 100 and 87.5%, respectively, followed by the South (82.4%), and Southeast (81.5%) regions. Therefore, this data may support the hypothesis that there appears to be greater resistance to Lean among the Northeast, Center-West and North regions compared to the South and Southeast regions.

**Table 6.** Question 4 data and corresponding agreement levels segmented by hospital region.

<table>
<thead>
<tr>
<th>Region</th>
<th>Sample Size (n)</th>
<th>Strongly Agree (SA)</th>
<th>Agree (A)</th>
<th>Neither Agree, nor Disagree (N)</th>
<th>Disagree (D)</th>
<th>Strongly Disagree (SD)</th>
<th>Cumulative Agreement (SA + A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NE</td>
<td>18</td>
<td>44.44%</td>
<td>55.56%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>100%</td>
</tr>
<tr>
<td>S</td>
<td>17</td>
<td>35.29%</td>
<td>47.06%</td>
<td>17.65%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>82.35%</td>
</tr>
<tr>
<td>SE</td>
<td>27</td>
<td>37.04%</td>
<td>44.44%</td>
<td>7.41%</td>
<td>7.41%</td>
<td>3.70%</td>
<td>81.48%</td>
</tr>
<tr>
<td>N</td>
<td>8</td>
<td>37.50%</td>
<td>50.00%</td>
<td>0.00%</td>
<td>12.50%</td>
<td>0.00%</td>
<td>87.5%</td>
</tr>
<tr>
<td>CW</td>
<td>5</td>
<td>20.00%</td>
<td>80.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Note: Given the differing sample sizes (n) between regions, it is important to consider the different weights among the observed levels of agreement to the statement. For a breakdown of weights per region, please refer to Figure 6.
Question 5: There has been a clear cultural transformation in our hospital as a result of *Lean nas Emergências*.

![Figure 11. Respondent's level of agreement about cultural transformation brought by the implementation of *Lean nas Emergências*, with 80.6% of respondents in agreement (n=77).](image)

In order to answer how perceptions on organizational culture change may be impacted when analyzed through the secondary variables of hospital cycle of enrollment and geographic region, the data presented in question 5 was further stratified by region and by cycle. Table 7 summarizes perceptions by cycle, while Table 8 summarizes perceptions by region. Both tables indicate the cumulative agreement in relation to the question/statement.

Key takeaways from Table 7 are that across all hospital cycles, there were generally high levels of agreement with the statement that *Lean nas Emergências* brought cultural transformation to the hospitals. Cumulative agreement ranged from 67 to 96%, suggesting cycles largely agreed with the statement and identified culture change. This result is consistent with the
literature, as one of the key tenets of Lean is the need for culture change towards the acceptance of Lean practices. Additionally, cumulative disagreement ranged from 0 to 25%, with cycles 0 and HFRJ presenting the highest levels of disagreement to the statement at 20 and 25%, respectively. It is relevant to note, however, that both cycle 0 and cycle HFRJ have the smallest sample sizes, which may serve to overinflate the observed disagreement levels. Therefore, while this data demonstrates higher disagreement levels for cycles 0 and HFRJ, there still seems to be general agreement of culture transformation, which may support the hypothesis that there should be no significant difference in perceptions of organizational culture among hospital cycles.

Table 7. Question 5 data and corresponding agreement levels segmented by hospital cycle.

<table>
<thead>
<tr>
<th>Cycle</th>
<th>(n)</th>
<th>Strongly Agree (SA)</th>
<th>Agree (A)</th>
<th>Neither Agree, nor Disagree (N)</th>
<th>Disagree (D)</th>
<th>Strongly Disagree (SD)</th>
<th>Cumulative Agreement (SA + A)</th>
<th>Cumulative Disagreement (D + SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycle 0</td>
<td>5</td>
<td>40,00%</td>
<td>40,00%</td>
<td>0,00%</td>
<td>20,00%</td>
<td>0,00%</td>
<td>80%</td>
<td>20,00%</td>
</tr>
<tr>
<td>Cycle 1</td>
<td>9</td>
<td>33,33%</td>
<td>33,33%</td>
<td>33,33%</td>
<td>0,00%</td>
<td>0,00%</td>
<td>66.66%</td>
<td>0,00%</td>
</tr>
<tr>
<td>Cycle 2</td>
<td>14</td>
<td>35,71%</td>
<td>50,00%</td>
<td>7,14%</td>
<td>7,14%</td>
<td>0,00%</td>
<td>85,71%</td>
<td>7,14%</td>
</tr>
<tr>
<td>Cycle 3</td>
<td>17</td>
<td>41,18%</td>
<td>47,06%</td>
<td>5,88%</td>
<td>5,88%</td>
<td>0,00%</td>
<td>88,24%</td>
<td>5,88%</td>
</tr>
<tr>
<td>Cycle 4</td>
<td>28</td>
<td>42,86%</td>
<td>53,57%</td>
<td>0,00%</td>
<td>3,57%</td>
<td>0,00%</td>
<td>96,43%</td>
<td>3,57%</td>
</tr>
<tr>
<td>Cycle HFRJ</td>
<td>4</td>
<td>0,00%</td>
<td>75,00%</td>
<td>0,00%</td>
<td>25,00%</td>
<td>0,00%</td>
<td>75,00%</td>
<td>25,00%</td>
</tr>
</tbody>
</table>

Note: Given the differing sample sizes (n) between cycles, it is important to consider the different weights among the observed levels of agreement to the statement. For a breakdown of weights per cycle, please refer to Figure 5.
Key takeaways from Table 8 are that for all hospital regions, there were very low levels of disagreement with the statement that *Lean nas Emergências* brought cultural transformation to the hospitals. It is relevant to note that while cumulative agreement varies widely from 60 to 94.4\%, this is mostly due to the fact that a large percent of hospitals remained neutral to the statement. Cumulative disagreement ranged from 0 to 12.5\%, suggesting cycles largely agreed with the statement and identified culture change. The Northeast and North regions presented with the highest levels of agreement to the statement at 94.4 and 87.5\%, respectively. Therefore, this data does not support the hypothesis that the Northeastern and North regions should present with greater challenges for organizational culture transformation compared to other regions.

**Table 8.** Question 5 data and corresponding agreement levels segmented by hospital region.

<table>
<thead>
<tr>
<th>Region</th>
<th>Strongly Agree (SA)</th>
<th>Agree (A)</th>
<th>Neither Agree, nor Disagree (N)</th>
<th>Disagree (D)</th>
<th>Strongly Disagree (SD)</th>
<th>Cumulative Agreement (SA + A)</th>
<th>Cumulative Disagreement (D + SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NE (n=18)</td>
<td>50,00%</td>
<td>44,44%</td>
<td>5,56%</td>
<td>0,00%</td>
<td>0,00%</td>
<td>94,44%</td>
<td>0,00%</td>
</tr>
<tr>
<td>S (n=17)</td>
<td>29,41%</td>
<td>47,06%</td>
<td>11,76%</td>
<td>11,76%</td>
<td>0,00%</td>
<td>76,47%</td>
<td>11,76%</td>
</tr>
<tr>
<td>SE (n=27)</td>
<td>22,22%</td>
<td>51,85%</td>
<td>22,22%</td>
<td>3,70%</td>
<td>0,00%</td>
<td>74,07%</td>
<td>3,70%</td>
</tr>
<tr>
<td>N (n=8)</td>
<td>50,00%</td>
<td>37,50%</td>
<td>0,00%</td>
<td>12,50%</td>
<td>0,00%</td>
<td>87,50%</td>
<td>12,50%</td>
</tr>
<tr>
<td>CW (n=5)</td>
<td>0,00%</td>
<td>60,00%</td>
<td>40,00%</td>
<td>0,00%</td>
<td>0,00%</td>
<td>60,00%</td>
<td>0,00%</td>
</tr>
</tbody>
</table>

Note: Given the differing sample sizes (n) between regions, it is important to consider the different weights among the observed levels of agreement to the statement. For a breakdown of weights per region, please refer to Figure 6.
6.4 Sustainability Results

The objective of analyzing sustainability was to determine if respondents feel they are equipped with the tools and knowledge to maintain Lean methodology in their hospitals alive and active in the long-term. The key survey questions for evaluating sustainability of Lean are presented below, followed by the obtained survey results.

Question 6: During Lean nas Emergências’ 6-month intervention period, our hospital observed improvements in E.D. overcrowding and workflow management.

![Figure 12](image)

**Figure 12.** Respondent's level of agreement about improvements in E.D. overcrowding and workflow management brought by the implementation of Lean nas Emergências, with 88,4% of respondents in agreement (n=77).
Question 7: SHORT-TERM: during the 1-year follow-up period, our hospital has been able to maintain the sustainability of lean methodology and culture.

Figure 13. Respondent's level of agreement about maintenance of lean methodology and culture within the hospital in the short-term, with 82.6% of respondents in agreement (n=75).
Question 8: LONG-TERM: after the end of the 1-year follow-up period, our hospital has still been able to maintain the sustainability of lean methodology and culture.

**Figure 14.** Respondent's level of agreement about maintenance of lean methodology and culture within the hospital in the long-term, with 69.9% of respondents in agreement (n=73).

In order to answer how perceptions on sustainability may be impacted over time, the data presented in questions 7 and 8 were both stratified by hospital cycle. Table 9 summarizes short-term perceptions, while Table 10 summarizes long-term perceptions. Both tables indicate the cumulative agreement and cumulative disagreement in relation to the question/statement.

Key takeaways from Table 9 are that for all hospital cycles, there was 0% disagreement with the statement that hospitals were able to maintain the sustainability of lean methodology and culture over the short-term. It is relevant to note that while cumulative agreement varies widely from 50 to 100%, this is mostly due to the fact that a large percent of hospitals remained
neutral to the statement. Cycle 0 presented the highest level of agreement to the statement (100%), followed by cycles 3, 4, 2, 1 and HFRJ.

**Table 9.** Question 7 data and corresponding agreement levels segmented by hospital cycle.

<table>
<thead>
<tr>
<th>Cycle</th>
<th>n</th>
<th>Strongly Agree (SA)</th>
<th>Agree (A)</th>
<th>Neither Agree, nor Disagree (N)</th>
<th>Disagree (D)</th>
<th>Strongly Disagree (SD)</th>
<th>Cumulative Agreement (SA + A)</th>
<th>Cumulative Disagreement (D + SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5</td>
<td>60,00%</td>
<td>40,00%</td>
<td>0,00%</td>
<td>0,00%</td>
<td>0,00%</td>
<td>100%</td>
<td>0,00%</td>
</tr>
<tr>
<td>1</td>
<td>9</td>
<td>33,33%</td>
<td>33,33%</td>
<td>33,33%</td>
<td>0,00%</td>
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<td>66,66%</td>
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<td>2</td>
<td>14</td>
<td>21,43%</td>
<td>57,14%</td>
<td>21,43%</td>
<td>0,00%</td>
<td>0,00%</td>
<td>78,57%</td>
<td>0,00%</td>
</tr>
<tr>
<td>3</td>
<td>17</td>
<td>23,53%</td>
<td>64,71%</td>
<td>11,76%</td>
<td>0,00%</td>
<td>0,00%</td>
<td>88,24%</td>
<td>0,00%</td>
</tr>
<tr>
<td>4</td>
<td>28</td>
<td>21,43%</td>
<td>60,71%</td>
<td>10,71%</td>
<td>0,00%</td>
<td>0,00%</td>
<td>82,14%</td>
<td>0,00%</td>
</tr>
<tr>
<td>HFRJ</td>
<td>4</td>
<td>0,00%</td>
<td>50,00%</td>
<td>50,00%</td>
<td>0,00%</td>
<td>0,00%</td>
<td>50,00%</td>
<td>0,00%</td>
</tr>
</tbody>
</table>

Note: Given the differing sample sizes (n) between regions, it is important to consider the different weights among the observed levels of agreement to the statement. For a breakdown of weights per cycle, please refer to Figure 5.

Key takeaways from Table 10 are that there were increased levels of disagreement that hospitals were able to maintain the sustainability of Lean methodology and culture over the long-term, compared to the short-term. It is relevant to note that while cumulative agreement varies widely from 25 to 80%, this is mostly due to the fact that a large percent of hospitals remained neutral to the statement. Cumulative disagreement ranged from 0 to 20%, suggesting greater
variability in agreement and higher levels of disagreement in sustaining Lean over the long-term, compared to the short-term. This result is consistent with the literature, which discusses the challenges of Lean sustainability over time. Cycle 0 presented the highest level of disagreement to the statement (20%), followed by cycles 2 and 3. With the exception of cycle 1, earlier cycles indicated higher disagreement than most recent cycles regarding being able to maintain Lean methodology and culture over the long-term. Given this exception, however, this data does not strongly support the hypothesis that earlier cycles would indicate lower sustainability of Lean over the long-term compared to the project’s most recent cycles.

Table 10. Question 8 data and corresponding agreement levels segmented by hospital cycle.

<table>
<thead>
<tr>
<th>Hospital Cycle</th>
<th>Strongly Agree (SA)</th>
<th>Agree (A)</th>
<th>Neither Agree, nor Disagree (N)</th>
<th>Disagree (D)</th>
<th>Strongly Disagree (SD)</th>
<th>Cumulative Agreement (SA + A)</th>
<th>Cumulative Disagreement (D + SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycle 0 (n=5)</td>
<td>20,00%</td>
<td>60,00%</td>
<td>0,00%</td>
<td>20,00%</td>
<td>0,00%</td>
<td>80,00%</td>
<td>20,00%</td>
</tr>
<tr>
<td>Cycle 1 (n=9)</td>
<td>22,22%</td>
<td>44,44%</td>
<td>33,33%</td>
<td>0,00%</td>
<td>0,00%</td>
<td>66,66%</td>
<td>0,00%</td>
</tr>
<tr>
<td>Cycle 2 (n=14)</td>
<td>14,29%</td>
<td>57,14%</td>
<td>14,29%</td>
<td>14,29%</td>
<td>0,00%</td>
<td>71,43%</td>
<td>14,29%</td>
</tr>
<tr>
<td>Cycle 3 (n=17)</td>
<td>17,65%</td>
<td>58,82%</td>
<td>17,65%</td>
<td>5,88%</td>
<td>0,00%</td>
<td>76,47%</td>
<td>5,88%</td>
</tr>
<tr>
<td>Cycle 4 (n=28)</td>
<td>7,14%</td>
<td>53,57%</td>
<td>25,00%</td>
<td>0,00%</td>
<td>0,00%</td>
<td>60,71%</td>
<td>0,00%</td>
</tr>
<tr>
<td>Cycle HFRJ (n=4)</td>
<td>0,00%</td>
<td>25,00%</td>
<td>75,00%</td>
<td>0,00%</td>
<td>0,00%</td>
<td>25,00%</td>
<td>0,00%</td>
</tr>
</tbody>
</table>

Note: Given the differing sample sizes (n) between regions, it is important to consider the different weights among the observed levels of agreement to the statement. For a breakdown of weights per cycle, please refer to Figure 5.
Question 9: Due to the training provided by the *Lean nas Emergências* team, the professionals at our hospital who were involved in the project feel equipped with a good understanding to maintain the results of the project over the long-term.

**Figure 15.** Respondent's level of agreement about ability to maintain the results of the project over the long-term, with 83,1% of respondents in agreement (n=76).
Question 10: Our hospital is equipped to maintain project results over the long-term.

**Figure 16.** Respondent's level of agreement about the hospital’s capacity to maintain the results of the project over the long-term, with 83.1% of respondents in agreement (n=77).

In order to answer how perceptions on sustainability may be impacted when analyzed through the secondary variables of hospital cycle and region, the data presented in question 10 was further stratified by region and by cycle. Table 11 summarizes perceptions by cycle, while Table 12 summarizes perceptions by region. Both tables indicate the cumulative agreement in relation to the question/statement.

Key takeaways from Table 11 are that for all cycles, with the exception of cycle HFRJ, there were high levels of agreement to the statement that hospitals are equipped to maintain project results over the long-term. It is relevant to note that while cumulative agreement varies
widely from 25 to 96%, this is mostly due to the fact that a large percent of hospitals remained neutral to the statement, especially HFRJ at 50% neutrality. Cycle 4 presented the highest level of agreement to results maintenance over the long-term (96%), followed by cycles 1, 0, 2, 3 and HFRJ. This result contradicts the expectation that given the challenges in Lean sustainability over time referenced in the literature, earlier cycles would indicate lower sustainability of results over the long-term. Therefore, this data does not support the hypothesis that earlier cycles would indicate lower ability to sustain obtained project results compared to most recent cycles.

Table 11. Question 10 data and corresponding agreement levels segmented by hospital cycle.

<table>
<thead>
<tr>
<th>Question 10:</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly Agree (SA)</td>
<td>Agree (A)</td>
<td>Neither Agree, nor Disagree (N)</td>
<td>Disagree (D)</td>
</tr>
<tr>
<td>Cycle 0 (n=5)</td>
<td>40,00%</td>
<td>40,00%</td>
<td>20,00%</td>
<td>0,00%</td>
</tr>
<tr>
<td>Cycle 1 (n=9)</td>
<td>22,22%</td>
<td>66,67%</td>
<td>11,11%</td>
<td>0,00%</td>
</tr>
<tr>
<td>Cycle 2 (n=14)</td>
<td>14,29%</td>
<td>64,29%</td>
<td>7,14%</td>
<td>14,29%</td>
</tr>
<tr>
<td>Cycle 3 (n=17)</td>
<td>29,41%</td>
<td>47,06%</td>
<td>17,65%</td>
<td>5,88%</td>
</tr>
<tr>
<td>Cycle 4 (n=28)</td>
<td>25,00%</td>
<td>71,43%</td>
<td>0,00%</td>
<td>3,57%</td>
</tr>
<tr>
<td>Cycle HFRJ (n=4)</td>
<td>0,00%</td>
<td>25,00%</td>
<td>50,00%</td>
<td>25,00%</td>
</tr>
</tbody>
</table>

Note: Given the differing sample sizes (n) between regions, it is important to consider the different weights among the observed levels of agreement to the statement. For a breakdown of weights per cycle, please refer to Figure 5.
Key takeaways from Table 12 are that for all regions, with the exception of the Center-West, there were strong levels of agreement that hospitals were equipped to maintain project results over the long-term. The Northeast and North regions presented the highest level of agreement to the statement, at 89 and 87.5% respectively, followed by the South (82.4%), Southeast (85.1%) and Center-West (40%) regions. This result contradicts the expectation that given the regional disparities in health infrastructure across Brazil referenced in the literature, the North and Northeastern regions would have greater challenges in maintaining project results over the long-term. Therefore, this data does not support the hypothesis that the Northeastern and North regions would present lower ability to maintain project results over the long-term compared to the South, Southeast and Center-West regions.

Table 12. Question 10 data and corresponding agreement levels segmented by hospital region.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree (SA)</th>
<th>Agree (A)</th>
<th>Neither Agree, nor Disagree (N)</th>
<th>Disagree (D)</th>
<th>Strongly Disagree (SD)</th>
<th>Cumulative Agreement (SA + A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NE (n=18)</td>
<td>33.33%</td>
<td>55.56%</td>
<td>11.11%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>88.89%</td>
</tr>
<tr>
<td>S (n=17)</td>
<td>11.76%</td>
<td>70.59%</td>
<td>11.76%</td>
<td>5.88%</td>
<td>0.00%</td>
<td>82.35%</td>
</tr>
<tr>
<td>SE (n=27)</td>
<td>22.22%</td>
<td>62.96%</td>
<td>11.11%</td>
<td>3.70%</td>
<td>0.00%</td>
<td>85.18%</td>
</tr>
<tr>
<td>N (n=8)</td>
<td>50.00%</td>
<td>37.50%</td>
<td>0.00%</td>
<td>12.50%</td>
<td>0.00%</td>
<td>87.50%</td>
</tr>
<tr>
<td>CW (n=5)</td>
<td>0.00%</td>
<td>40.00%</td>
<td>20.00%</td>
<td>40.00%</td>
<td>0.00%</td>
<td>40.00%</td>
</tr>
</tbody>
</table>

Note: Given the differing sample sizes (n) between regions, it is important to consider the different weights among the observed levels of agreement to the statement. For a breakdown of weights per region, please refer to Figure 6.
6.5 Other Survey Results

Having demonstrated all results that tie into the key hypothesis of this thesis, this section reports additional survey results that remain relevant to evaluating the *Lean nas Emergências* project in a holistic manner. The remaining survey questions are presented below, followed by the obtained survey results.

Question 11: During the implementation of Lean nas Emergências, which tools most enhanced Lean adoption in your hospital? Please select up to 5 options.

![Chart](chart.png)

**Figure 17.** Respondent’s votes on most effective Lean tools implemented by *Lean nas Emergências* (n=77). The most highly tanked tools were the Daily Huddle, Full Capacity Protocol (FCP) and Value Stream Mapping (VSM).
Question 12: What do you consider Lean nas Emergências project strengths? Please select all relevant options.

**Figure 18.** Respondent’s votes on *Lean nas Emergências*’ project highlights (n=77). The top three were identification of opportunities for improvement, team training and results tracking.
Question 13: Our hospital is better prepared to deal with overcrowding and workflow management after Lean nas Emergências compared to before the intervention.

Figure 19: Respondent's level of agreement about the effectiveness of Lean nas Emergências assisting in overcrowding and workflow management, with 89.6% of respondents in agreement (n=77).
Question 14: Would you recommend other hospitals to enroll in Lean nas Emergências?

![Pie chart showing 98.7% Yes and 1.3% No responses.]

**Figure 20:** Respondent's overall recommendation of *Lean nas Emergências*, with 98.7% of respondents in support (n=77).

### 7 Discussion

Key survey results suggest that *Lean nas Emergências* has been considered a widely successful initiative by hospital administrators across the project’s participant SUS hospitals. Regarding the more specific results tied to the central hypotheses driving this thesis, the results continue to present positive findings, with findings which at times support the initial hypotheses and at times contradicts initial expectations with regards to the effect of hospital cycles and hospital regions on KPIs, organizational culture and sustainability.
7.1 Interpretations of Findings

Key Results

The results of the *Lean nas Emergências* survey suggest that respondents find *Lean nas Emergências* to have been a successful project in meeting its objectives of reducing the overcrowding of Hospital Emergency Services. To reiterate major findings, a total of 80.6% of respondents agreed the project created cultural change within their hospitals; 87.1% of respondents indicated changes in work routines were maintained; 83.1% of respondents indicated they found their hospital to be equipped to maintain the project’s results over the long-term; 89.6% of respondents agreed their hospitals were better equipped to handle overcrowding and workflow management after the intervention compared to before; and 98.7% of respondents would recommend *Lean nas Emergências* to other hospitals. These results are significant because they add a qualitative perspective to the quantitative KPI insights and seem to support that the project’s KPI reductions were in fact a favorable result not only by the numbers, but also by the organizational culture and sustainability variables, all essential to the success of Lean interventions. In addition, these results are significant because they may contribute to the view present in a breadth of literature that suggest that Lean healthcare can serve as a positive intervention for the improvement of Health Emergency Services and health systems.6,7,17,19,26,28
Key Performance Indicators (KPIs)

As it pertains to KPIs, the central conclusion drawn about hospital cycles was (1) all cycles reported an overall reduction across all three indicators (NEDOCS, IP LOS, OP LOS), which may support the hypothesis that there should be no significant difference in KPIs across hospital cycles. Given the overall KPI reduction, the data also suggests the project has been successful in meeting its objective of reducing overcrowding. These results are significant because they could indicate that Lean nas Emergências has remained effective in reducing overcrowding over the project’s three years, a trend which may improve and result in greater reductions as the project matures throughout the next 2020-23 triennia.

Next, the central conclusion drawn about hospital regions was (2) The North region presented the largest reduction across all three indicators, followed by the Northeast region, both with the most favorable impact on reduced NEDOCS and LOS. Therefore, the data supports the hypothesis that the North and Northeast regions would present with the greatest improvements across KPIs. These results are significant because they suggest that the Northeast and North regions perhaps presented with greater inefficiencies in hospital operations to begin with given challenges such as poor infrastructure or lower density of provider availability. The notion that these regions would have greater room for improvement, and thus, greater reductions in overcrowding and LOS scores post the Lean nas Emergências intervention has been echoed by Lean specialists within the Sírio-Libanês team, who indicated that the larger impact in both regions is a result they would expect to see given the known regional disparities in healthcare delivery across Brazil. Importantly, another conclusion that should be considered is that the significant improvement in overcrowding in the less well-off North and Northeast regions may
also suggest that *Lean nas Emergências* could already be showing signs of contributing to narrowing regional health disparities across Brazil.

*Organizational Culture*

As it pertains to organizational culture transformation, the two central conclusions drawn about hospital cycles were (1) there was low disagreement among cycles that Lean changes caused resistance from hospital professionals and staff; (2) there was high agreement among cycles that *Lean nas Emergências* brought cultural transformation to the hospitals. Together, both analyses support the hypothesis that there should be no significant difference in perceptions of organizational culture among hospital cycles. These results are significant because while resistance to change was high, as would be expected from Lean interventions and other forms of interventions that require widespread culture change,\(^{17,18}\) the pushback to new forms of thinking from certain individuals or teams does not seem to have impeded cultural transformation within the participant hospitals.

Next, the two central conclusions drawn about hospital regions were (3) across all Brazilian regions, there was little variability and strong agreement that Lean changes caused resistance from hospital professionals and staff, with higher levels of agreement among the Northeast, Center-West and North regions compared to the South, and Southeast regions; (4) across all regions, there were very low levels of disagreement that *Lean nas Emergências* brought cultural transformation to the hospitals, with higher levels of agreement among the Northeast and North regions. Together, the first analysis supports the hypothesis that the less well-off Northeast and North regions of Brazil would present with the highest resistance to
change, while the second analysis does not support the hypothesis that the Northeast and North regions would present greater challenges and lower adherence to organizational culture change compared to the South, Southeast and Center-West regions. These results are significant because while resistance to change was especially high in the North and Northeast regions, this does not seem to have impeded cultural transformation within these regions. These results suggest that resistance to Lean is more so a common consequence of the change-based intervention rather than a negative effect of the project, as echoed by the literature review. These results could also indicate that the North and Northeast regions may have presented greater resistance to Lean as the methodology may have been more unknown in these regions compared to the others, echoed by Lean specialists within the Sírio-Libanês team. Importantly, while Lean implementation in the North and Northeast regions resulted in greater uncertainty and unease, it is important to acknowledge that once implemented, these regions had not only the greatest cultural change, but also the best results in reducing overcrowding and length of stay metrics, which could further support that Lean nas Emergências has the potential to narrow the observed gaps in regional health disparities across Brazil.

*Sustainability*

As it pertains to sustainability, the three central conclusions drawn about hospital cycles were (1) for all hospital cycles, there was 0% disagreement with the statement that hospitals were able to maintain the sustainability of lean methodology and culture over the short-term; (2) cycles indicated greater variability in agreement and higher levels of disagreement in sustaining Lean over the long-term, compared to the short-term; (3) all cycles, with the exception of cycle
HFRJ, indicated high levels of agreement to the statement that hospitals are equipped to maintain project results over the long-term. Together, the first two analyses support the hypothesis that cycles should indicate greater agreement to results maintenance over the short-term compared to the long-term, given known challenges of Lean maintenance over the long-term. The third analysis, on the other hand, does not support the hypothesis that earlier cycles should indicate lower ability to maintain project results compared to most recent cycles. These results are significant because the analyses support the challenge of maintaining Lean results over the long-term, however it is a positive result to note that cycles that enrolled in the earlier years of Lean nas Emergências did not seem to present greater difficulties in maintaining project results compared to more recently enrolled cycles. It is worth noting, however, that despite these positive results, the long-term sustainability of the Lean nas Emergências project intervention remains a widely discussed issue of concern among the Sírio-Libanês team. The team shared with me that current discussions have been centered around potentially creating a Lean certification among SUS hospitals in order to ensure the maintenance and sustainability of Lean culture, methods and results. This could be an especially useful initiative in Brazil, given the prominent challenges with high turnover rates among hospital staff and administrators in the country, which could significantly compromise the longevity of culture changes and organization-wide support necessary for the long-term success of Lean interventions.

Next, the central conclusion drawn about hospital regions was (4) for all regions, with the exception of the Center-West, there were strong levels of agreement that hospitals were equipped to maintain project results over the long-term. Therefore, this analysis does not support the hypothesis that the Northeast and North regions would present lower ability to maintain project results over the long-term compared to the South, Southeast and Center-West regions.
These results are significant because while research has demonstrated the severe existent inequities of healthcare access, infrastructure and provider availability and distribution among Brazil’s regions, hospitals seem to be equipped to maintain the positive results brought by *Lean nas Emergências*. It will remain vital to continue to assess the project’s sustainability as the project progresses to ensure the benefits brought by *Lean nas Emergências* remain over time. Importantly, however, it is also important to note that the long-term sustainability of the project will also depend heavily on each hospital’s continued commitment to continuous improvement (*kaizen*) and new leadership and staff engagement in Lean initiatives.17,18

### 7.2 Study Limitations

The present study has three limitations that merit discussion. First, as the research methodology was based on a survey, results present in this thesis are entirely dependent on those who answered the survey questions and does not include feedback or results from the other 32 hospitals that did not participate in the survey. Second, there could be a response bias given that approximately 93% of respondents held a managerial role within their hospitals and may have been more inclined to answer survey questions more favorably to the project. Third, the sample size for select regions and cycles, notably the Center-West region and Cycles 0 and HFRJ were quite small. This having been said, the sample size used was a result of both survey adherence and the data available at the time this research was conducted. For instance, the sample size for the pilot cycle 0 which intentionally admitted a small number of hospitals (n= 6) is a limitation with regards to the project’s design. For this reason, continued research and evaluation of the
project’s next three years upon enrollment of hundreds of additional hospitals will be vital to further strengthen the findings of this research.

### 7.3 Future Directions and Practical Implications

As part of the *Lean nas Emergências* survey, respondents were asked for their feedback on what *Lean nas Emergências* could improve. Therefore, the future directions and actionable recommendations for *Lean nas Emergências* are presented as a summary of the key suggestions gathered from the survey. Importantly, such recommendations are extremely relevant, as they do not merely contribute to a retrospective evaluation of the project but will contribute to the project’s next triennia as it considers this feedback in its expansion to serve an even greater number of SUS hospitals across Brazil.

With relation to opportunities for improvement for *Lean nas Emergências*, common themes across respondent’s answers included requests for more support materials; creation of courses and digital materials with reference to the tools and KPIs employed throughout the intervention; expanded training to a larger number of hospital staff; increased inclusion of senior management in order to foster greater engagement from these professionals; increased and more frequent intervention and follow-up time from the Sírio-Libanês team, in addition to the currently provided 6 months for intervention and 1 year for follow-up; and increased face-to-face visits. Other requests included increased knowledge-sharing among participants hospitals for benchmarking purposes; creation of experience exchange opportunities such as providing hospital leaders with the chance to visit hospitals that successfully implemented Lean; expansion of Lean to other hospital areas beyond the E.D. (such as surgical centers); increased assistance
on how to maintain Lean culture when administrators involved in the project leave the hospital; and support in establishing accountability within the hospital for data collection and analysis to facilitate results monitoring.

It is worth noting that the feedback provided by respondents touched upon the major themes of organizational culture, sustainability and KPIs that drive this thesis, and is consistent with the literature review on these subjects. For instance, respondents advocated for the development of educational videos and materials to facilitate continuous use in order to more easily train staff and maintain a Lean organizational culture, even with high levels of staff turnover, a concern known to be dire in public health services in Brazil.1,3 Another example is how respondents highlighted the need to train greater numbers of staff in Lean, adding that centralization would undermine the project’s sustainability. The support for multidisciplinary teams in Lean interventions, as well as the broad involvement of staff at various levels within the organization is a key concept argued in the literature to ensure Lean sustainability in both the short and long-term.17,18,32 Yet another example is how respondents mentioned how a critical factor for continuity is the ability to understand and routinize results monitoring of Key Performance Indicators.18

In addition to the feedback from respondents who experienced the project’s implementation first-hand, other suggestions surfaced from this thesis would be to strongly consider the proposal of creating renewable Lean certifications for hospitals who have gone through the project in order to encourage the long-term sustainability of Lean and Lean organizational culture for sustained improvements. As mentioned in the survey, the success of Lean is directly tied to the support and engagement of upper management, of which continuity is a challenge. Therefore, it is vital to consider other forms of sustainability which do not rely
entirely on who is running the hospital, but more so on the hospital’s accreditation. An additional recommendation would be to increase the opportunity for feedback, following up more often with participant hospitals and administrators. As previously mentioned, this thesis is the first formal qualitative evaluation of *Lean nas Emergências* that gathers widespread feedback on the project since its start in 2017; therefore, it could be helpful to conduct evaluations more frequently.

This thesis lays a groundwork for further analysis, given the fact that hundreds of additional hospitals will be added over the next triennia of the *Lean nas Emergências* project expansion, which will serve to increase the data validity at a national scale. Future studies should continue to assess *Lean nas Emergências* in future years in order to strengthen the recommendations and conclusions of this thesis. More broadly, future studies should also continue to assess the impact and effectiveness of Lean healthcare interventions throughout Health Emergency Services in Brazil and across the SUS in order to add to the literature on Lean healthcare in the country.

8 Conclusion

The evaluation conducted in this thesis demonstrates *Lean nas Emergências* has been considered a widely successful initiative, contributing to the narrative that Lean healthcare holds great potential for increased efficiency and quality for the delivery of Health Emergency Services. Importantly, this thesis reaches this conclusion as a result of having gathered direct feedback from hospital administrators who experienced the *Lean nas Emergências* project implementation first-hand. Additionally, by focusing on a qualitative analysis of organizational
culture and sustainability, this thesis adds a new and more holistic perspective to evaluate *Lean nas Emergências'* effectiveness beyond metrics and Key Performance Indicators. While not easily quantified, a strong understanding of Lean culture transformation and sustainability are essential to the long-term success of Lean interventions and for this reason were the core of this evaluation.

Importantly, this thesis does not argue for Lean as a magic bullet intervention in healthcare, especially due to the administrative complexity and challenges within Brazil’s SUS. However, Lean healthcare could add significant value to tackling current management issues that delay the delivery of universal, integral and equitable care to the Brazilian population, as is promised under the constitution. ⁴

By providing an evaluation of *Lean nas Emergências*, this thesis contributes to the current literature gap with regards to Lean implementation, especially as it pertains to the Brazilian context, in which literature on the subject remains scant and narrowly focused on experiences of single hospitals. ⁷ Finally, given that E.D overcrowding is a global issue of significant importance,⁵ this thesis presents learnings and successes of a project implemented at a national-scale across Brazil, which may assist in furthering the knowledge on Lean healthcare practices and its application for improving health systems around the world.
APPENDIX A – Survey Questions

**General Information**

1. Education  
   a. Nursing  
   b. Medicine  
   c. Administration  
   d. Other
2. Management position (if applicable)  
   a. Director  
   b. Superintendent  
   c. Manager  
   d. Area Coordinator/Supervisor  
   e. Head of unit  
   f. Head of division  
   g. Head of Sector
3. Hospital
4. Cycle  
   a. Cycle 0  
   b. Cycle 1  
   c. Cycle 2  
   d. Cycle HFRJ  
   e. Cycle 3  
   f. Cycle 4

**Tools and Methods Analysis**

5. During the implementation of Lean nas Emergências, which tools most enhanced Lean adoption in your hospital? Please select up to 5 options.  
   a. Value stream mapping  
   b. 5S  
   c. A3  
   d. Spaghetti diagram  
   e. Cause and Effect matrix  
   f. Impact Effort matrix  
   g. SIPOC  
   h. Daily Huddle  
   i. Rounds  
   j. Kanban  
   k. Full Capacity Protocol (FCP)  
   l. Fast-track  
   m. Short-stay Unit  
   n. Clinical Decision Unit  
   o. Discharge Lounge
Organizational Culture Analysis - Part 1

6. DURING the implementation period of Lean nas Emergências, there was a clear change in the daily work routine of professionals within our hospital due to the project.
   a. Strongly agree
   b. Agree
   c. Neither agree, nor disagree
   d. Disagree
   e. Strongly disagree

7. AFTER the completion of Lean nas Emergências, changes in the daily work routine of professionals within our hospital were MAINTAINED.
   a. Strongly agree
   b. Agree
   c. Neither agree, nor disagree
   d. Disagree
   e. Strongly disagree

8. Even professionals within our hospital who were not directly involved with Lean nas Emergências aligned themselves with Lean.
   a. Strongly agree
   b. Agree
   c. Neither agree, nor disagree
   d. Disagree
   e. Strongly disagree

9. There has been a clear cultural transformation in our hospital as a result of Lean nas Emergências.
   a. Strongly agree
   b. Agree
   c. Neither agree, nor disagree
   d. Disagree
   e. Strongly disagree

Organizational Culture Analysis - Part 2

10. There was resistance from certain teams/individuals regarding the changes brought by Lean.
    a. Strongly agree
    b. Agree
    c. Neither agree, nor disagree
    d. Disagree
    e. Strongly disagree

11. If applicable, indicate the main resistance points or challenges your hospital encountered during project implementation. Please select up to 3 options.
    a. Establishment of effective communication
    b. Alignment of the entire hospital staff
c. Uncertainty about how Lean would affect personal work routines
d. Uncertainty about how Lean would affect work dynamics between individuals or teams
e. Uncertainty about how Lean could change processes that were had been practiced and accepted for a long time
f. Uncertainty about the feasibility of cultural transformation in the hospital needed for Lean's success
g. Uncertainty about the time and effort it would take to implement Lean
h. Uncertainty of how long-term project results would be maintained

12. Please note: Before moving forward, would you like to make any observations/comments regarding your answers about changing work routines, cultural transformation, or team alignment/resistance? Please tell us below.

Sustainability Analysis - Part 1

13. During Lean nas Emergências’ 6-month intervention period, our hospital observed improvements in E.D. overcrowding and workflow management.
   a. Strongly agree
   b. Agree
   c. Neither agree, nor disagree
d. Disagree
e. Strongly disagree

14. SHORT-TERM: during the 1-year follow-up period, our hospital has been able to maintain the sustainability of lean methodology and culture.
   a. Strongly agree
   b. Agree
   c. Neither agree, nor disagree
d. Disagree
e. Strongly disagree

15. LONG-TERM: after the end of the 1-year follow-up period, our hospital has still been able to maintain the sustainability of lean methodology and culture.
   a. Strongly agree
   b. Agree
   c. Neither agree, nor disagree
d. Disagree
e. Strongly disagree

16. Due to the training provided by the Lean nas Emergências team, the professionals at our hospital who were involved in the project feel equipped with a good understanding to maintain the results of the project over the long-term.
   a. Strongly agree
   b. Agree
c. Neither agree, nor disagree
d. Disagree
e. Strongly disagree

17. Our hospital is equipped to maintain project results over the long-term.
   a. Strongly agree
   b. Agree
   c. Neither agree, nor disagree
   d. Disagree
   e. Strongly disagree

Sustainability Analysis - Part 2

18. What major CHALLENGES are being faced by your hospital to keep the sustainability of lean methodology and culture alive and active over the long-term?
19. What main STRATEGIES are being adopted by your hospital to keep the sustainability of lean methodology and culture alive and active over the long-term?
20. Please note: Before moving forward, would you like to make any observations/comments regarding your responses about sustainability, team training, or short- and long-term results maintenance? Please tell us below.

COVID-19

21. What is the main challenge brought by the COVID-19 pandemic to your hospital?
22. For hospitals that have gone through the implementation phase, how has Lean nas Emergências helped your hospital deal with the COVID-19 pandemic?

Comments/Suggestions

23. What do you consider Lean nas Emergências’ project strengths? Please select all relevant options.
   a. Lean training
   b. Team training
   c. Identification of opportunities for improvement
   d. Results tracking
   e. Capacity and demand analysis
   f. Method for Action plan construction
   g. Emergency services
   h. Change management (cultural transformation)

24. What do you think we could improve? Please be specific.
25. Our hospital is better prepared to deal with overcrowding and workflow management after Lean nas Emergências compared to before the intervention.
   a. Strongly agree
   b. Agree
   c. Neither agree, nor disagree
   d. Disagree
   e. Strongly disagree

26. Would you recommend other hospitals to enroll in Lean nas Emergências?
   a. Yes
   b. No

27. Did anything surprise you with the implementation of Lean nas Emergências?

28. Is there anything else you would you like to inform our team about?
APPENDIX B – Additional Survey Data

Figure 21. Survey respondents academic background (n=77).

Figure 22. Survey respondents administrative roles (n=76).
WORKS CITED


28 Brito, Melissa Prado de. Aplicação de técnicas de gestão avançada Lean Healthcare para otimizar o fluxo de pacientes do pronto-socorro de um hospital universitário público de Belo


