Universidade do Minho
Escola de Engenharia

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Value measurement in health care delivery process for a paediatric hospital in Guinea-Bissau

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«We must believe that we have a gift for something and that, whatever it takes, we will achieve it»

Marie Curie

STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration.

I further declare that I have fully acknowledged the Code of Ethical Conduct of the University of Minho.

Avaliação de resultados na prestação de cuidados de saúde num hospital pediátrico na Guiné-Bissau

Resumo

Este projecto resulta de um programa de voluntariado no Hospital Pediátrico S. José de Bôr (HPSJB), inserido na Comunidade de Bôr, sito na República da Guiné-Bissau (RGB).

Em geral, na Guiné-Bissau não existe água potável, não existe rede de saneamento nem higiene nos cuidados hospitalares com os padrões e exigências europeias. O fornecimento regular de electricidade só está disponível com geradores a gasóleo ou com recurso a painéis solares. O nível de educação, comparando com Portugal, é baixo e há muitas crenças sobre doenças infecciosas. Consequentemente, a taxa de infecção das doenças infecto-contagiosas no país é muito elevada devido aos hábitos de sexo desprotegido, devido à violência sexual e também pelo acesso desigual a tratamentos médicos.

A Guiné-Bissau tem escassos recursos logísticos e é frequente haver rupturas de stock de medicamentos e reagentes, durante meses seguidos, que são essenciais para o tratamento dos utentes. O HPSJB não utiliza tecnologias de informação o que é comparável com Portugal nos anos 70. O nível de conhecimentos informáticos, no hospital, é baixo. Não há rede informática estruturada entre os diversos departamentos e há necessidade do trabalho administrativo manual com elevado risco de erros associados. Isso prejudica a qualidade do HPSJB no fornecimento de serviços e cuidados de saúde.

Esta tese descreve as melhorias feitas pelo autor nos processos logísticos do hospital, o desenvolvimento e implementação de um sistema de informação que teve início em Março de 2018. Estas melhorias foram desenvolvidas com os princípios, métodos de lean manufacturing e desenvolvimentos de melhores práticas referenciadas em casos de estudo realizados na América, na Arábia Saudita e em Itália.

Como resultado, o hospital reduziu o tempo de espera dos utentes, melhorou os resultados dos utentes, aumentou o trabalho e a confiança dos médicos e dos técnicos do Laboratório de Análises Clínicas, conseguiu um trabalho mais eficiente para todo o pessoal e, em geral, o hospital tem agora um sistema de gestão melhorado. Ao trazer novas tecnologias para o Hospital e para o Laboratório de Análises Clínicas, o autor contribuiu para impulsionar o sector e torná-lo atractivo para o corpo clínico e para os utentes. A partilha de informação dentro dos departamentos médicos, tornou as pessoas muito mais envolvidas nos projectos. O incremento da produtividade do Laboratório de Análises Clínicas melhorou a sustentabilidade dos serviços médicos com base numa grande empatia entre o voluntário e o anfitrião.

Palavras chave

Ferramentas Lean na Saúde, Guiné-Bissau, Registo Médico Electrónico, Sustentabilidade, Voluntariado

Value measurement in health care delivery process for a paediatric hospital in Guinea-Bissau

Abstract

This project is the result of a volunteer programme that took place in the Republic Guinea-Bissau (RGB) at the Paediatric Hospital, Hospital Pediátrico S. José em Bôr (HPSJB) in the Bor Community.

In general, in Guinea-Bissau, there is no clean drinking water, no sanitation network, nor clean hospital care. Reliable electricity is available only with generators or solar panels. In general, the level of education is low and unscientific beliefs about infectious diseases are widespread. Consequently, the infectious disease burden in the country is very high, exacerbated by unprotected sex, sexual violence and unequal access to medical treatments.

Guinea-Bissau has scarce logistical resources to receive medications for their hospitalized outpatients, medical equipment and laboratory reagents. It frequently occurs that some key medications are not available for many months. The Paediatric Hospital in the Bor Community does not use information technology for their health care practices which is comparable with the situation in Portugal in the 1970s. Moreover, at the hospital, there are only few people with computer skills, there is no wired network between departments, and therefore a lot of administrative work is done using pen and paper with a high risk of mistakes. Hence, it is exceedingly difficult to provide quality health care by the hospital.

This thesis describes the improvements made by the author in the hospital logistical processes and in the development and implementation of an information system and started in March 2018. These improvements were developed based on lean manufacturing principles, and on methods and best practices for some referenced case studies from America, Saudi Arabia and Italy.

As a result, the hospital reduced outpatient waiting time, improved outpatient outcomes, increased confidence work for physicians and laboratory technics. technics. Additionally, increased efficiency has been achieved for all staff, and, in general, the hospital has now an improved management system. By bringing new technologies to Hospital and Clinical Analysis Laboratory there was a contribute to boostthe the sector and make it attractive to the medical staff and outpatients. By increasing information sharing within medical departments, people involved are now much more involved in projects. Finally, by improving the productivity of the Clinical Analysis Laboratory, we support the sustainability of medical services based on great empathy between the voluntarist and the host.

Keywords

Electronic Medical Records, Guinea-Bissau, Lean Healthcare, Sustainability, Volunteer programme

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List of Abbreviations and Acronyms

AHMS	Automated Hospital Management System
BCH	Boston Children's Hospital
CHCM/MCHC	Mean Corpuscular Haemoglobin Concentration
CPR	Paper records vs Computer-based Outpatient Records
DB	Data Base
ED	Emergency Department
EMR	Electronic Medical Records
ESG	Environmental, social and governance metrics
HCM/MHC	Mean Corpuscular Haemoglobin
HGB/Hb	Haemoglobin
HPSJB	Hospital Pediátrico S. José in Bôr
ICT	Information and Communication Technology
ID	Identification
KPI	Key Performance Indicator
KSA	Kingdom of Saudi Arabia
LABOR	Analysis Clinics Laboratory
LIS	Laboratory Information System
LT	Lead time
LM	Lean Manufacturing
LYM	Lymphocytes
MID	Cells population with intermediate volume
MMR	Maternal Mortality Ratio
NEU	Neutrophils
PDSA	Plan, Do, Study, Act
PID	Outpatient Identification
PLT	Platelet
RBC	Red Blood Cells
RCC	Ratio-of-cost-to-charges
RDW	Red Cell Distribution Width
RGB	Republic of Guinea-Bissau
SASB	Sustainability Accounting Standards Board

SB	Saúde Bor (Software)
SDE	Structured Data Entry
SDS	Same-day Service
SDGs	Sustainable Development Goals
SQL	Structure Query Language
SSMS	SQL Server Management Studio
SWOT	Strengths, Weaknesses, Opportunities, Threats
TDABC	Time-driven activity-based cost model
VA	Value added time
VB.Net	Microsoft Visual Basic.Net
VCM/MCV	Mean Corpuscular Volume
VPN	Virtual Private Network
VT	Value Time
WBC	White Blood Cells
YTD	Year to date

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1 Introduction

This chapter presents the background and motivation for this project carried out at Hospital Pediatrico S. José em Bor in Guinea-Bissau. In particular it describes the environmental conditions, the people's culture, the human resources, the skills, the technology, the facilities, the way they work and their expectations. Additionally, this chapter defines the specific objectives of this thesis and the research methodology.

1.1 Context and motivation

The Republic of Guinea-Bissau (RGB) (Picture #1 in Appendix 1) is one of the poorest countries in the world, rated as 164th among the 169 countries in the Human Development Index (2010), with 65.7% of the population living on less than 1 USD/day (UNDP 2010).

The population of RGB in 2009 was 1,520,830 of which 737,634 (48.2%) were male and 783,196 (51.8%) female (Instituto Nacional de Estatística, 2019). In 2019, the capital Bissau (Picture #2 in Appendix 1), had 387,909 inhabitants[1] and has one Public Hospital - Hospital Nacional Simão Mendes (Picture #3 in Appendix 1).

On average, OECD countries spent more than 11% of their gross domestic product on health, while the countries of the World Health Organization's (WHO) African and South-East Asia regions spent 4.7%. In absolute terms, low-income countries spent US$ 32 per capita on health care in 2004, and high-income countries spent US$ 3,724 per capita (Clifford *et al.,* 2008).

The author motivation for carrying out this study is to be able to contribute to the reduction of maternal-infant mortality by offering my knowledge and skills in industry management and logistics. Note that in Sub-Saharan Africa, the Maternal Mortality Ratio (MMR) per 100,000 live births was 546 in 2015 and lifetime risk of maternal death was 1 in 36. In comparison, in Central and Eastern Europe and the Commonwealth of Independent States, the MMR was 25 and lifetime risk of maternal death was 1 in 2,000 (Mendez and Sawan, 2011).

The HPSJB (Picture #4, Picture #5, Picture #6, Picture #7, Picture #9 and Picture #10 in Appendix 1) is the only health facility of its kind in RGB[2].

The HPSJB works with paper communication for interacting with other departments (in Picture #12 and Picture #13 in Appendix 1) or services (Picture #15, Picture #16 and Picture #17 in Appendix 1) and uses paper to write and record outpatient health problems and prescriptions.

[1] Source: https://pt.knoema.com/atlas/Guin%c3%a9-Bissau/Bissau last accessed in 19th August 2021

[2] Source: https://www.caritas.org/where-caritas-work/africa/guinea-bissau last accessed in 19th August 2021

Paper files consume a lot of the office space, and it is slow recording, processing and retrieval of outpatient details (John-otumu, 2018). And, past and present outpatient information is extremely vital in the provision of outpatient's care which guides the physician in the making of right decision about their diagnosis (John-otumu, 2018).

There is evidence that health information technology can improve quality, safety and reduce costs (Øvretveit *et al.,* 2007a). Likely, an increase in outpatient safety (e.g., clearer medication information) is much easier to find outpatient information. It will certainly save time because of this, and improves outpatient care because we don't have to wait to get the information from another system and potential for development (e.g. clinics could use electronic prescriptions and electronic dictation in the future) (Fontaine, 2013; Øvretveit *et al.,* 2007a).

The potential of Electronic Medical Records (EMR) systems to transform medical care practice has been recognized over the past decades, including the enhancement of healthcare delivery and facilitation of decision making processes.(Williams and Boren 2008)

In conclusion, it seems interesting and economically relevant to be able to organize a hospital that currently uses informal models, to develop and implement a system that aims to speed up access to clinical information, improve medical productivity, boost lead time performance and eliminate wrong or incomplete outpatient data.

1.2 Objectives

This master thesis has a special focus on improving the IT infrastructure at HPSJB and on identifying the main and urgent logistics problems that causes long waiting times and health problems, in particular to children and pregnant women.

This thesis will contribute to the United Nations goals for sustainable development[3], in particular:

- Goal 3, Good health and well-being:
    - To reduce the maternal mortality rate,
    - To end preventable deaths of new-borns and children under 5 years of age,
- Goal 8, Decent work and economic growth
    - To achieve higher levels of productivity of economies through diversification, technological modernization and innovation.

As a secondary objective, it is intended to implement a new logistics system that can improve health care system. Such a system must be previously validated, easy to understand and must demonstrate its practical utility.

[3] https://www.un.org/sustainabledevelopment/sustainable-development-goals/

To achieve the above-mentioned objectives, it is proposed to:

- Study the opportunities to improve processes adopting lean logistics principles and tools;
- Create algorithms and communication flows with laboratory equipment's, biologists, pharmacists, physicians, nurses, hospital administration and administrative areas. Additionally, train Guinean technicians to have skills to operate and participate, in order to drive the logistic implementations to another upgrade steps;
- Shape procedures and work habits that foster a prosperity balance of patient needs and simultaneously guarantee quality of care, timely interventions and ensure equity of access and well-being to all citizens;
- Develop an Automated Hospital Management System (AHMS) that will explore the best practices for reorganizing and coordinating health care, improving process efficiencies.

General speaking, an AHMS is a system that is used to manage outpatient information and its administration. It is meant to provide management and staff, with information in real-time to make their work more efficient and less stressing (John-otumu, 2018).

This project examines the latest strategies and organizational models for transforming the way health care is delivered, measured, and reimbursed. The scope is to build models based on a community's needs rather than imposing ideas of right and wrong, having a broader discussion about the systems behind the critiques, to help create more effective and impactful volunteer in the long run.

Specific goals of this thesis include:

a) standard working methods,
b) unique outpatient identification for all cycle care,
c) eliminate the manual transcription errors,
d) match clinical resources to clinical processes,
e) avoid medical errors due to error-prone analytical reports,
f) reduce complete cycle care and improve resource utilization,
g) reduce time to prepare and delivery analysis clinic report,
h) report haemoglobin statistics,
i) send alerts if clinical analyses report is not all completed,
j) send reports to e-mail,
k) medical statistics – no paper required,
l) administrative statistics – no paper required,
m) provide the Hospital to have access to free software without setup or maintenance cost.

1.3 Research methodology

To understand and detail the main problems, the Design Thinking tool was especially useful to this project. The Design Thinking process combines empathy, creativity and rationality to meet the needs of the HPSJB and creates solutions expediently and innovatively with the propose to be useful for all the stakeholders. It involves and prioritizes, as far as possible, the treatment for all children and pregnant women.

This work involves various departments, people, competencies, whose ambition is to converge in proposals with tools and designed solutions to put the hospital working as a better organization, with better logistics, better LM with new methods and computer support, aiming, in this way, to contribute to a better service.

It is important to understand the bad outcomes as also it is important to measure cost and compare cost with outcomes.

Figure #1 illustrates the road map of design thinking methodology.

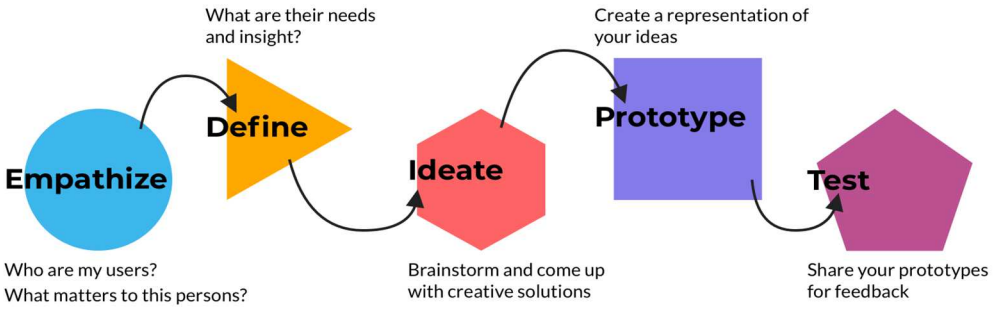


Figure #1 – Design Thinking

(Credit's image: https://uxplanet.org/wondering-if-design-thinking-works-102e7b3a3604)

Firstly, with the empathize, we find the problem and define stage. This is the line segment of the understanding the problem. Next line segment is solving the problem, moving to problem solving with ideas, prototype and test stage with the sense of opportunity that allow a U-turn. At the empathize stage (Figure #2), involving the administration and Hospital Staff, it will be possible to understand the value stream that stakeholders get from each part of the process. These are fundamental statements as first step towards user innovations. From this stage, the goal is trying to innovate in solving people's problems and get better value to people. Involving stakeholders turns this project more serious, identifying and drawing HPSJB needs (Picture #21 in Appendix 1).

Figure #2 – Empathy

(Credit's image: https://online.stanford.edu/courses/xine214-empathize-and-prototype-hands-dive-key-tools-design-thinking)

After the problem finding phase, the next line segment is the problem solving. At this point, from product specifications, the main ideas are:

- translate user needs into product specifications quantitatively,
- establish product metrics that can help to define those specifications (Picture #20 in Appendix 1),
- learn to apply creativity and brainstorming (Picture #18 in Appendix 1),
- concept generation process in designing solutions.

1.4 Structure of the document

This thesis starts with Chapter 1, Introduction, with an overview that provides helpful general information to the reader about RGB, specific HPSJB issues and objectives to achieve.

Chapter 2, Literature review, discusses and provides examples of health care system problems in different countries, the huge importance of sustainability as volunteer work and the tools that were important to use to this study.

Chapter 3, Description and analysis of the system, provides the reader with information on how was possible, due the circumstances, they manage the system. The chapter also details, in a holistic way, the main HPSJB logistical problems.

Chapter 4, Proposed system: development and implementation, reports all relevant aspects of the new proposed logistic system, management transformation and work habits.

Chapter 5, Discussion of results, contains and discusses the HPSJB outcomes from the proposed and implemented actions.

Finally, chapter 6, Conclusions and suggestions for future, provides the reader with a summary of the key points of this thesis and some possible ways to continue develop volunteer and sustainable work.

2 Literature review

This chapter resumes the advantages of shifting from a manual to an Automated Hospital Management System (AHMS), addresses the limitations and good practices, how to move from this forward, and tools that drives to more medical efficiency using lean concepts.

Cases from Kingdom of Saudi Arabia, Italy and USA are here described because they have similar issues to the issues of the system under study in this thesis. The purpose is to understand the difficulties that affect their organizations and how they improved and they developed the strategies to grow up and how they quantified their outcomes.

A sustainability model and a volunteer perspective are issues that are also here considered to ascertain how to engage the community to support the success of the initiatives.

2.1 The importance of moving from manual to automatized medical records

HPSJB includes patient arrival, nursing assessment, physical examination, LABOR service and physician appointment. Like UK Hospitals in 1980s (Idowu, Cornford, and Bastin, 2008), HPSJB used paper files, paper cards, manual referral of outpatients, manual medical records, paper registration and manual word processors, and the main obstacles were power supply, government attitude, cost of information and communication technology, inadequate telecom, resistance to technology, and bad maintenance culture.

Manual Medical records have advantages and disadvantages:

- Manual Medical records advantages:

  #1: They can easily be carried around;

  #2: Most freedom in reporting style;

  #3: Easy data browsing;

  #4: Requires no special training;

  #5: Never “down” as computers sometimes go down.

- Manual Medical records advantages:

  #1: Manual records can be destroyed, disappear or deteriorate relatively easily. Hurricane Katrina in 2005, which destroyed or left inaccessible the manual medical records of an untold number of people, highlighted the importance of electronic medical records (Williams and Boren, 2008).

  #2: Manual processing of outpatient information may lead to a variety of problems including: unnecessary duplication of the data especially for in-outpatients and out-outpatients, inconsistency of data may occur since records are kept in more than one location, which makes it hard to analyse the data collected (John-otumu, 2018).

#3: Paper-based record keeping has sufficed in the past, but now the 21st century calls for new, innovative systems. Throughout time paper-based systems have proven to become more and more inefficient and are continuously failing to meet the care provider's needs (Kalogriopoulos *et al.,* 2009).

EMR have many advantages and few disadvantages:

- EMR advantages:

  #1: Simultaneous access from multiple location, legibility, variety of views on data, Support of Structured Data Entry (SDE), decision support, support of other data analysis, electronic data exchange and sharing care support (Musen and Bemmel, 1997).

  #2: An Automated Hospital Management System (AHMS) is a system that manage outpatient information and its administration. It is meant to provide management and staff, with information in real-time (John-otumu, 2018).

  #3: The patient record is an account of a patient's health and disease after he or she has sought medical help. Usually, the notes in the record are made by the nurse or the physician. The record contains findings, considerations, test results and treatment information related to the disease process (John-otumu, 2018).

  #4: Outpatient information past and present is extremely vital in the provision of outpatient's care which guides the physician in the making of right decision about their diagnosis (John-otumu, 2018).

  #5: Information and Communication Technology (ICT) has become a major tool in delivery of health services and has had a revolutionary impact on how we live and perceive the world. ICT enables people to interact and communicates no matter the distance, also makes it easy for us to obtain goods and services in convenient ways (Idowu, Cornford, and Bastin, 2008).

  #6: At the same time, we aim to be possible to follow the LABOR results from Portugal and that can be useful to help LABOR technic to interpret certain patients results.

  #7: One overall objective of EPRs is to improve patient education and to enhance the patient experience through the use of Information Technology (IT) so as to facilitate the sharing of information between providers and their patients (Leonard, 2004). The most immediate benefits of EMR systems include accurate medication lists, legible notes and prescriptions, immediately available charts, decreased chart pulls, lower transcription costs by more efficient and accurate patient record-keeping and automated export of data for clinical purposes, medical errors reduction and improvement in quality care and standards in patient safety (Williams and Boren, 2008).

#8: The potential of EMR systems to transform medical care practice has been recognized over the past decades, including the enhancement of healthcare delivery and facilitation of decision making processes (Williams and Boren, 2008).

#9: Since they can be sent from one location to another instantaneously, EMRs would practically eliminate the manual labour of transporting papers or even scanning or faxing papers if that technology was available. This, in turn, would save time and manpower and would decrease the time that physicians and care providers take to communicate. This saved time could then be well spent for patient care, which would decrease waiting times for patients (Kalogriopoulos *et al.,* 2009).

- EMR limitations

  One limitation is the lack of hardware and software standardization. A survey of US primary care physicians identified 264 different EMRs in use. EMR systems development has had problems of proprietary and incompatibility (Williams and Boren, 2008).

It is important that a EMR should be easy to develop and modify, works for clinical personnel and saves waiting time. If personnel do not think it will save time, then implementation will be significantly more difficult and possibly impossible. The EMR should be intuitive, requiring little or no training (Øvretveit *et al.,* 2007b).

Eiseman and Fossum propose that any global health resource tracking system would contain valid, detailed data (who, what, where, how much) (Clifford *et al.,* 2008).

2.2 Lean manufacturing tools

The concept of lean manufacturing (LM) can be applied to HPSJB organization with the philosophy based on the elimination of all waste can be introduced into the production flow. Lean can be applied to the HPSJB and LABOR that produce services. Service processes tend to have long production cycles, many complex variables, multiple decision points and interactions with a diversity of computerised systems.

This work will use nine LM tools: Kaizen philosophy, the 5 S's, the Standard Work, the Heijunka or Levelled Programming, the Value Stream Mapping, the Pull System, the Three MU's, the Process Flow and the Visual Management.

A series of methods designed to minimize the waste of material and labour, makes for an organization that's better equipped, improved efficiency, frees up employees and resources for innovation and quality control that would have previously been wasted, while maintaining or increasing levels of production. The production process based on an ideology of maximising productivity while simultaneously minimising waste within a manufacturing operation. The lean principle sees waste is anything that doesn't add value that the outpatients are willing to pay for.

The benefits of LM include reduced lean times and operating costs and improved outpatients' outcomes.

2.2.1 Kaizen philosophy

Kaizen, Japanese business philosophy, means continuous improvement. To improve continuously, step by step, the Kaizen philosophy drives the whole team, that is part of the HPSJB project and creating a team atmosphere, so that together can improve the HPSJB processes and performance and adopt improvements that involve low investment and making a job more fulfilling, less tiring, and safer.

2.2.2 The 5 S's

The 5 S's is a framework that emphasizes the use of a specific mindset and tools to create efficiency and value. It involves observing, analysing, collaborating, whose focus is on the elimination of waste within production processes. The 5 S's is based on five principles: **Seiri** means sort, **Seiton** means Set in order, **Seiso** means shine, **Seiketsu** or Sense of Standardization, **Shitsuke** or sense of sustains. The process should happen gradually, following each of the S's. We look at HPSJB departments and objectively and, through a process of tidying up, identify what is essential from what is dispensable providing a safer, better organisation of resources and the working environment.

2.2.3 The standard work

The practice of standardised work identifies the best way to do a certain task or process. To this end, work instructions should be drawn up, duly optimised so that they can be carried out as quickly and efficiently as possible. All staff members must do their work in the same way to make sure that outpatients receive services of the same quality and consistency. Workers know when their daily routine is bloated or packed with unnecessary work, and it negatively affects morale. This method boosts not only productivity, but employee satisfaction.

2.2.4 Heijunka or levelled programming

This is a practice based on the idea of levelling out all production and eliminating all the unexpected things that happen occasionally. In order to level out production, the Heijunka practice says not to produce all the material for just one order but to intersperse several orders, so that it is possible to satisfy more than one outpatient at the same time. In addition, production is more balanced and stable.

2.2.5 Value stream mapping

Value stream mapping (VSM) is a lean methodology that helps to analyse activities, segmenting them into subdivisions according to their value: if they add a high of value to the project, if they add little value but are essential, or if they are completely expendable.

The concept of the 'value stream' comes from the Lean management approach. Value stream mapping analyses what is currently happening (the current state) and goes on to design a future state for the process focusing on how value is created and delivered to the outpatient (ACT Academy for their Quality, 2007).

As the plan evaluated, is expected to identify what will stop/start/continue doing as well as areas that need further improvements. Brainstorming sessions, involving all stakeholders include outpatients because the main drive of value stream mapping is to understand how value is delivered for the outpatient and what value means for different outpatient groups, are usually behind this new mapping that seeks to understand which elements should be considered as waste in this equation.

How value is created and delivered to the outpatient and improving the flow of these value streams first can have a big positive impact on service efficiency and outpatient experience (NHS, Improvement; Academy, 2007).

Draw a value stream mapping to be used to understand the steps in the outpatient journey and the outpatient experience of the journey, shows the reality of how the process is working.

Some definitions:

- Value added time (VT), the time that actually adds value to the outpatient journey.
- Lead time (LT), the time it takes for an outpatient to move all the way through a process or value stream.

The more accurately we can measure costs, the better we can make informed decisions to lower costs and improve outcomes.

Estimating the cost per time unit of specific activities allows clinical leaders to quantify the complexities of a process, assess cost accurately and eventually improve its value.

2.2.6 Pull system

Implementing the Pull System is very simple: each work cell only needs to pull materials from the previous cell when faced with a request from the next. In this way a chain process is established so that operations take place at the required time and in the required quantity. Each work cell can also receive production instructions via Kanban cards. The TDABC system assigns expenses of personnel, equipment, and space resources based on the quantity of time that patients, being treated for a specific medical condition, spend with each resource. The methodology allows an

institution to understand processes across its care continuum to subsequently identify opportunities for process improvement and to improve resource utilization.

The flowcharts show the analysis of a company's processes in order to eliminate any waste (such as material resources, time, space, among others) that ends up being useless and is somehow weighing as a cost in the organisation. Optimisation of the flow largely involves automating the processes

2.2.7 The three MU's

The concept of the Three Mus (Muda, Mura and Muri) is based on balancing capacity and demand. The words have their own meanings: Muda means waste and is used to denote capacity that exceeds demand. Mura, on the other hand, means variation and is used to define waste resulting from a lack of uniformity. Finally, Muri represents the irrationality of demand exceeding capacity.

2.2.8 The process flow

The process flow analysis is a combination of the tactics that help to identify and eliminate waste. Building business process has some benefits, like clarity over the current state of your processes, making process more visible, identifying places for automation and process improvement, improving communication between departments, consistency over the way you do things, removing redundancies and irrelevant process steps. After identifying some of the tools or methodologies inherent to this philosophy, we begin to have a basis to start implementing and maintaining lean thinking.

2.2.9 Visual management

Visual management, or visual control, is a technique widely used by Lean management to make the current situation of a process readily understandable. It could be implemented either in facilities or in software SB. In the AHMS the visual management is a driver to the quick and correct interpretations as the success of operations because the SB tell quickly, to physicians, nurses, LABOR technics, how the work should be carried out and if there is any deviation from standard. The intention is to reduce failures related to communication, better cooperation between the teamwork, alert for non-standard information, ease of prioritizing tasks (e.g. Manchester Triage), process monitoring and gather all the necessary information for each decision.

2.3 TDABC costing method

Time-driven activity-based costing (TDABC) methodology calculates a cost for each activity by determining the time spent and the actual cost of each resource used for that activity and allows a much more accurate determination of the true cost of providing care.

TDABC costs has huge advantages, seems to be clear, efficient, easy to explain, understand, estimate the time spend required to perform each process in the care cycle, measure the cost per time spend of each resource used in the care cycle, add up all the process step costs across the entire care cycle to obtain an estimate of total costs. TDABC study is one transparent cost analysis of patient care and an inexpensive way to learn how all resources are currently being used, determine excess capacity and measure the cost of unused capacity, resource by resource.

Mayo Clinic (Heaton *et al.,* 2019) is a real example that used TDABC costing methodology because this tool enabled the organization to measure the costs of medical activities accurately, including procedures and treatment of medical conditions.

TDABC helps providers find numerous ways to substantially reduce costs without negatively affecting outcomes (and sometimes improving them). Providers are achieving saving 25% or more by tapping opportunities such as better capacity utilization, more-standardized processes, better matching personnel skills to tasks, locating care in the most cost-effective type of facility and many others (Porter and Lee, 2013).

The time-driven activity-based cost model (TDABC) scribe project served as a tool to develop an accurate costing system based on actual resources and processes and allowed for understanding of use of resources at a more granular level (Heaton *et al.*, 2019).

TDABC is a new way to accurately measure costs and compare them with outcomes. To perform a cost analysis comparison for managing medical appointments and LABOR service from TDABC model requires the following steps:

- create process maps of the patient's care cycle,
- measure the cost per time spend of each resource used in the care cycle,
- estimate the time spend required to perform each process in the care cycle,
- multiply the time for each process step by the cost of the resource performing that step,
- add up all the process step costs across the entire care cycle to obtain an estimate of total costs.

TDABC captures all the resource costs incurred over a patient's complete care cycle for a specific medical condition (Chou et al. 2018). As a result, specific strategies can be implemented to help reduce cost, while maintaining, if not improving, quality of care.

This methodology also allows HPSJB to understand processes across its care continuum to subsequently identify opportunities for process improvement and to improve resource utilization.

TDABC method is simpler since it requires, for each group of resources, estimates of only two parameters: how much it costs per time unit to supply resources to the business's activities

2.4 Social sustainability model: the case of England

Organizations must find ways to recruit and engage volunteers that are committed to sustainable and lasting practices and that will truly engage the community in which they serve (Smith, Cohen, and Pickett 2016).

The sustainability model is a diagnostic tool that has been developed to support health care leaders to identify strengths and weaknesses in their implementation plans and predict the likelihood of sustainability for their improvement initiatives.

The National Health System (NHS) of England is based on a sustainability model that is used from the outset of an improvement initiative as it can provide a valuable understanding on which area to focus on to maximizing sustainability (NHS England, 2010).

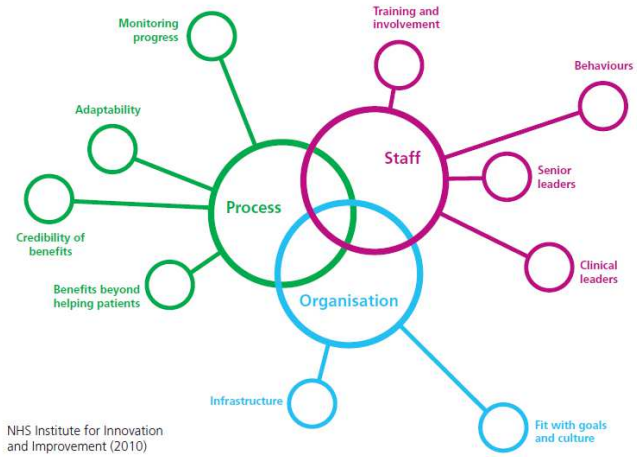


Figure #3 – NHS Sustainability model

This model seems to provide an important tool to analyse the success of our proposed work, due the holistic approach.

Here we identify three dimensions: Process, Staff and Organization. Inside each dimension there are general issue categories.

Process dimension:

Demonstrate that the change has a wide range of benefits beyond helping outpatients, for example by reducing waste, creating efficiency or making people's jobs easier. That changes are widely communicated, immediately obvious, supported by evidence and believed by stakeholders.

Staff dimension:

Staff have been involved and able to share their ideas regularly from the beginning of the change process. They have helped to identify any skill gaps and have been able to access training and development so that they are confident and competent in the new way of working.

Organisational leaders are highly involved and visible in their support of the change process. They use their influence to communicate the impact of the work and to break down any barriers.

Organization dimension:

The goals of the change are clear and have been shared widely. They are consistent with and support the organisation's strategic aims for improvement.

Staff are confident and trained in the new way of working. Job descriptions, policies and procedures reflect the new process and communication systems are in place. Facilities and equipment are all appropriate to sustain the new process.

2.5 Volunteering work – cost and benefit analysis

Both the individual making a decision to volunteer and the organization making a decision to use volunteer labour face benefits and costs of their actions yet these costs and benefits almost always remain unarticulated, perhaps because the common perception of the do-good volunteer who contributes his or her labour for free discourages rational benefit cost calculus (Handy and Mook 2011).

It has been documented that participating in volunteer work is good for one's mental health and physical health, and especially among older volunteers as re-entry strategy to return to the labour market, for example after raising children (Handy and Mook 2011).

There are always two perspectives involved, the particular and the hospital view.

2.6 Related study cases in health care institutions

Many hospitals around the world have proposed solutions to overcome the long waiting time problem in outpatient clinics. The following paragraphs will explain their solutions and the progress of their improvements and the inspiration for this thesis.

2.6.1 Kingdom of Saudi Arabia (KSA) Hospital

The case study "KSA Hospital" (Almomani and AlSarheed 2016) pretend to identify and solve the reasons behind the long waiting time in the outpatient clinic which affects the level of patient satisfaction, the quality of service, resource utilization and overall clinic management. They interviewed staff members, managers and used diagram fishbone to study the process from inside the outpatient management and find the root causes of the problem. They also used surveys to measure the satisfaction level of patients from an outside perspective and identify main problems. The authors have used SIMIO software to propose solutions to reduce waiting times. SIMIO is a simulation tool for building and executing models of process dynamically to see the impact of patient waiting time before building these changes in real systems. It a 3D animation of the behaviour of system over time.

Authors have feed SIMIO with data from Outpatient Management Software and test the following ideas:

a) send a short message to patients using the reminder and appointment confirmation services. If 100% of patients sent a cancellation response before appointment date, a total of 20 extra slots will be available.
b) using a serial number generated according to the appointment time. Consider overbooking if patient is late. Since overbooked is around 30% of overall appointments, the same percentage can be used to reduce the patient waiting time.
c) implementing the idea of card access, the software can detect the doctor sign-in by reading the log access control software and this app is linked to time attendance software. They simulate that vital waiting time drops down 53.3%, clinic waiting time drops down 20.0% and overall waiting time drops down 30.3%
d) queue software should not accept any patient 30 min before appointment time because makes waiting time longer. This function called clinic arrival control and the waiting time will go down 10 min and 52.3% improvement.
e) simulate using distribution list. This option always drives to a good solution. The best option is use four clinics with 54.17% of improvement.

2.6.2 Mayo Clinic

Mayo Clinic describes that documentation by physicians is expensive and limits their ability to see additional patients. Electronic Health Records documentation requires time from an expensive human resource (physician) and documentation need to be complete.

The resource team fill a table with average the duration of 5 tiers, scribe present and no scribe, with number 1 representing the most resource intensive patients. They learn that scribes decrease documentation time by 33% or an hour on average and $488 per shift by decreasing the physician time needed for these tasks and eliminating transcription needs. The remaining 10 minutes clinical time difference on shift can allow providers to do things that only a provider can do: e.g. educate resident learners and spend more time at the patient bedside.

2.6.3 Massachusetts Eye and Ear Clinic

In their study, Chou et al. (2018) assist physicians and staff in the appropriate allocation of resources at their own institution. The authors calculate the total costs that corresponding personnel, space and equipment costs for each segment of the process map were identified, based on expenses and included yearly salary, fringe benefits and liability insurance. Then, they calculate final costs based on time dedicated to clinical duties. The total cost comparison between the decision the local that patients should be treated on Emergency Department (ED) or Same-day Service (SDS) settings.

TDABC captures all the resource costs incurred over a patient's complete care cycle for a specific medical condition.

TDABC system assigns expenses of personnel, equipment and space resources based on the quantity of time that patients being treated for specific medical condition spend with each resource. Clinicians and staff can then consider innovative and tailored approaches to reduce costs, while sustaining and often improving patient outcomes.

As a result, total cost in the ED were higher compared with SDS for taking care of corneal abrasions, conjunctivitis, dry eye and styes.

The total costs drop down from 108.41 EUR to 81.53 EUR (24.8% less) for nonemergent eye complaints.

2.6.4 Tuscan districts

In Italy the unmet health care needs statistics refers that 21.4% of population reported to have renounced to treatment due long waiting list (Cavalieri 2013). Lungu, Grillo Ruggieri, and Nuti (2019) identify right actions to reduce waiting times for elective treatments, balance patient's needs and simultaneously guarantee quality of care, timely interventions and ensure access to all citizens. They used statistic method, graphical approach, a summary table and reallocated procedures.

The graphical approach used cross-checking waiting times – treatment rates and identified four different scenarios:

a) Hight waiting times and low use rate;
b) High waiting times and high use rate;
c) Low waiting times and low use rate;
d) Low waiting times and high use rate.

They used logical framework for dealing with long waiting times and their relationship with treatment rates. By jointly analysing their variations, they have concluded that there is no straightforward relationship between rates and waiting times.

The quintile approach considered the treatment rates and the average waiting times separately.

Low treatment rate (first quintile and lighter colour) and high treatment rate (fifth quintile and dark colour). The table it is useful because it enables extreme values to be identified and it focuses on the most critical areas, the dark ones.

Policy makers can use these tools to avoid the adoption of empiric or simplistic solutions that focus only on the short term and risk increasing supply in areas that are already over-supplied. The inclusion of measures of efficiency and resource allocation could further help finding specific solutions to reduce waiting time and tackle variation.

2.6.5 The University of Texas MD Anderson Cancer Center

Lawrence (2011) reports that the university of Texas MD Anderson Cancer Center has 30,000 new patients every year. The author realized that cost allocations were problematic at several levels. The center needed a costing system that could provide more accurate patient-level cost by medical condition so they used TDABC and they worked with a team of project manager, clinical and business manager, financial and staff members from each function being mapped and they estimated how much time it takes to perform each task and the capacity cost of each health care provider.

Creating a cost measurement system can be performed in seven steps:

a) Select the medical condition and/or patient population to be examined;
b) Define the care delivery value chain (principal activities involved in a patient's care);
c) Develop process maps for each activity in patient care delivery; identify the resources involved and any supplies involved used for the patient at each process;
d) Obtain time estimates for each process step;
e) Estimate the cost of supplying each patient care resource;
f) Estimate the practical capacity of each resource provider and calculate the capacity cost rate;
g) Compute the total costs over each patient's cycle of care.

With a complete picture of the time and resources involved, often reveal immediate opportunities for process improvement and cost reduction.

The modified process resulted in a 16% reduction in process time, a 12% decrease in costs for technical staff and a 67% reduction in costs for professional staff.

2.6.6 Boston Children's Hospital (BCH)

Patients made over 500,000 visits this Hospital. 40% of the costs of the first 18 month of care were incurred during few days they spent in the ICU after surgery.

The department of Orthopaedic Surgery used the ratio-of-cost-to-charges (RCC) approach as many hospital units to assign departmental costs to procedures and services.

The RCC was a simple and easy to use a cost system for hospital departments and physicians' practices. The RCC approach assumed that costs were proportional to charges.

To calculate the department's RCC rate they done the sum of all departmental traceable and allocated cost and divide by the department's total charges.

For example, if the department has the RCC of 0.6%, the cost of any single billable event was estimated by multiplying the procedure's charge by the RCC, say procedure's charge 350 EUR by 0.6% (RCC) = 210 EUR (cost).

Table #1 – Total costs with RCC method

	A	B	C	D = B x C	E = B - D	F = A x D
	Visits (year)	Charge	RCC	Cost	RCC Profit	Total cost
Plagiocephaly	5,400	350.00	60%	210.00	14.00	1,134,000
Neoplasm skin excision	2,000	350.00	60%	210.00	14.00	420,000
Craniosynostosis	800	350.00	60%	210.00	14.00	168,000
					TOTAL	**1,722,000**

Dr. Meara, Chair of the Department of Plastic and Oral Surgery, accepted to apply a new costing approach, the TDABC. So, Dr. Meara joined project team to map every administrative, clinical process and time required involved in the treatment of a medical condition over a complete care cycle, from first patient present and extended through surgery, recovery and discharge.

Second step consisted on estimating the cost per minute for the clinical and administrative personnel involved in the care process but they deduced, on average, some non-clinical meetings, breaks, weekends, four weeks of vacations, holidays, professional conferences, training, resource, teaching and education outside.

The third stage was creating process maps of the patient's care cycle and measure cost per minute for Plagiocephaly, Neoplasm skin excision, Craniosynostosis and for the personnel.

There are 5,400 visits per year for Plagiocephaly, 2,000 visits for Neoplasm skin excision and 800 for Craniosynostosis.

From this point, Dr Meara measure the actual scenario and the fourth stage has new logistic approach with TDABC method. They assume that they can have the same perform, without changing patient health care, sifting surgeon by RN on plagiocephaly exam with requires more RN but saves surgeon.

Dr. Meara said that BCH handle the same volume and mix of patients while spending $126,810 less on office visits. Surgeon time released could be used for surgeries – neoplasms, craniosynostosis – which likely are compensated much better.

The case describes two pilot projects on applying activity-based costing to measuring the cost of treating patients.

2.7 Concluding remarks

A belief that EMR could save time and money, has potential for increasing safety and productivity and EMR systems allow connections between services (Øvretveit et al. 2007b) and from this paper it is possible to get the best of two implementations: one hospital and fifteen clinics of one USA Kaiser Permanente system hospital and Sweden Hospital. The first one was full conversion from a paper to an EMR system and the second one, Swedish Karolinska hospital implementation, was join software work. Each case describes what was there experienced on good implementation and

not so good implementations methods or behaviours and long waiting list problems to the outpatient's health care.

The HPSJB thinks this project could be successful because organizing care/facilities around outpatients has huge potential on creating value to them and can focus on specific community needs (clinical and social) as start from the beginning.

Measures of success: performing better than the benchmark and outcomes that matter to outpatients: LABOR more efficient, trust service, trust analytical report and reduce lead time.

Drivers of that success: Focus on outcomes measurement and leadership.

How enhancing EMR and LIS will improve the waiting time in HPSJB?

What are the missed requirements that need to be considered to improve outpatient value?

The waiting time measure is the most important issue that has impact on patient satisfaction as well as resource utilization.

One of the main drawbacks in outpatients clinics is long waiting time for patients – which affects the level of patient satisfaction and the quality of services (Almomani and AlSarheed 2016).

There are four case that gives great attention to improving the quality of services provided by health care sectors including outpatient clinics and the solutions depend mainly on adding more human resources or changing business or management policies to improve wait times and outpatient outcomes.

3 Description and analysis of the system

This chapter starts by describing the RGB approach, social and economic context, how the HPSJB was funded, the actual HPSJB management perception of serious logistic problems reported, and how this was felt by administration, medical staff, technical laboratory, auxiliary staff and outpatients, i.e. all the stakeholders involved in the process. The chapter also describes and analyses the complete outpatient care cycle.

3.1 Overview of social and economic challenges in the RGB

RGB was ranked 175th of 189 countries listed in the Human Development Index Ranking[4], as of July 2021, the population of RGB was 2.0 million[5] and had thirty ethnic groups of which 5 (Fula, Balanta, Mandinga, Manjaco and Pepel) represent more than 85% of the population and different religious faiths (Islam, Catholic, Protestant and Animist). RGB is a coastal country in West Africa.

Three moments, of particular tension, could be highlighted in the country's history: the political-military conflict from June 1998 to May 1999, the coup d'état in 2012 and the fall of the government in 2015. This instability had a particular impact on the national economy, with clear effects on the degradation of roads, facilities and factories.

Main weakness RBG Health System Organization[6]:

a) Infrastructure, equipment and health products, logistics: Weak institutionalisation of procurement; lack of standardisation of equipment and infrastructure; insufficient materials and equipment; lack of periodic maintenance of infrastructure and equipment; irregular supply of medical equipment, drugs and reagents equipment; inadequate challenges in cold chain maintenance; inadequate inventory management;
b) Health information system: Irregularity of supervision; absence of data quality control; practice inadequate feedback mechanisms; low level of computerisation; multiplicity and non-harmonization of data collection; instruments inadequate or limited; monitoring inadequate; weaknesses in systematic data analysis and dissemination; inability to adopt innovations due to lack of knowledge management system (Guerreiro et al. 2019).

The main health problems, morbidity and causes of mortality, are:

a) Children above 5 years old: acute respiratory infections, anaemia, diarrhoea, malaria and malnutrition;

[4] http://hdr.undp.org/en/content/latest-human-development-index-ranking

[5] https://www.worldometers.info/world-population/guinea-bissau-population

[6] The causes were written by alphabetic order (Pública, 2017)

b) Pregnant Women: malaria, malnutrition, pregnancy and childbirth complications (abortion complications, anaemia, fistulae, haemorrhages, pre-eclampsia and eclampsia, uterine rupture);

c) New-born: HIV, low birth weight, prematurity, stillbirths.

We can get more important information such as detailed data of the endemic and infectious diseases such as co-infection malaria-HIV that is prevalent in sub-Saharan Africa (Idemyor, 2007):

- Malaria infection rates,
- Age and gender groups of malaria infected people,
- HIV infection rates,
- Age and gender groups of HIV infected people,
- Co-infection malaria-HIV rates,
- Age and gender groups of co-infected people,

Research other infectious diseases, such as hepatitis:

- HBV (Hepatitis B Virus) rates,
- HCV (Hepatitis C Virus) rates,
- Age and gender groups of HBV,
- Age and gender groups of HCV,
- Eventual co-infection between HBV e HCV.

3.2 HPSJB overview

The HPSJB was funded by Padre Ermanno Battisti, italian priest and it was designed and built to serve children, particularly those most in need. The Diocese of Bissau helped physicians to train abroad as an incentive to return to RGB and work on this cause.

Four managers: Clinic Manager, Paediatric Manager, Administrative Manager and Finance Manager, from HPSJB, respond to the CEO.

The CEO, Dr Jaime Katar, respond to the executive board of the HPSJB. The board respond to Caritas Diocesana (areas of intervention include healthcare, training, food security, emergencies and support to income-generating activities).

The HPSJB (Picture #4 in Appendix 1) as 5,479 m2 total area of the land and here have 6 buildings (Picture #6 in Appendix 1):

- The main building (Picture #7 in Appendix 1) with two floors of 520 m2 each, with:
    - grand flour: oxygen unit, ten wc, treatment rooms, four small surgical recovery rooms with Italy cities names, two ophthalmology rooms, nursery, urgency, small surgery room, medical staff room, informatic and accounting office.

- first floor: seven wc, two Breathing care rooms, one heart care room, infant resuscitation and four to paediatric hospitalisation, nursery, secretary and administration,

- Small hexagonal porch with 12 m2 for outpatients can wait for medical assistance,
- Another building with operating room with 370 m2,
- One Chapel with 100 m2,
- Another annex building with Clinical Analysis Laboratory sample collect room and LABOR reception, two medical offices, waiting room for outpatients, blood bank, pharmacy and Manchester triage with 190 m2,
- And another building with kitchen, food warehouse, staff canteen, laundry, bathroom, engine room and generator with 260 m2.

The distribution of human resources assigned to the HPSJB was as follows: between CEO, accounting, finance staff, social work service, reception and doorman, the HPSJB has 13 people. Medical staff are 10 people, nurses are 17 in paediatrics and 3 nurses on the surgery block. In the Laboratory Clinical Analysis (LABOR) there are 12 people between clinical director, technical, laboratory assistance and reception. People for cleaning are 7, for laundry are 2 and for kitchen are 3 people. There are 1 informatic, 1 man for garden treatment, 2 mechanics, 2 drive man and 11 security people. The total was 84 people (Figure #4 and Figure #5).

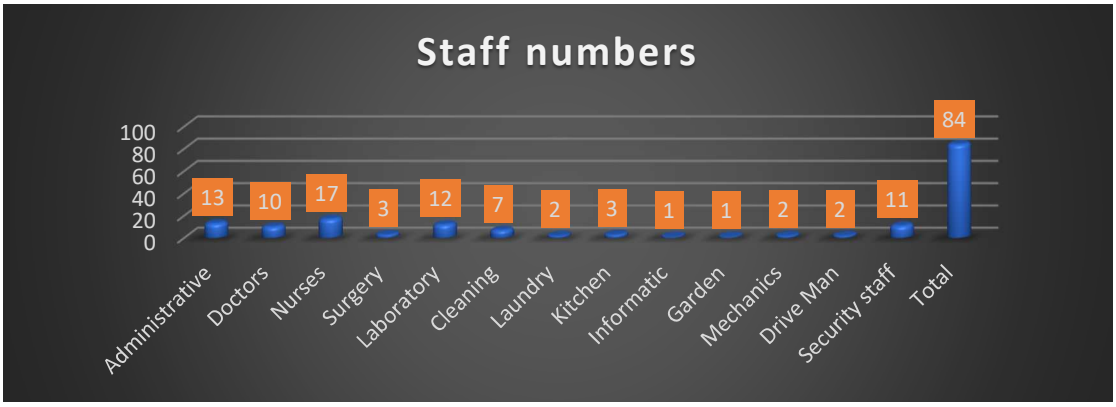


Figure #4 – HPSJB staff distribution

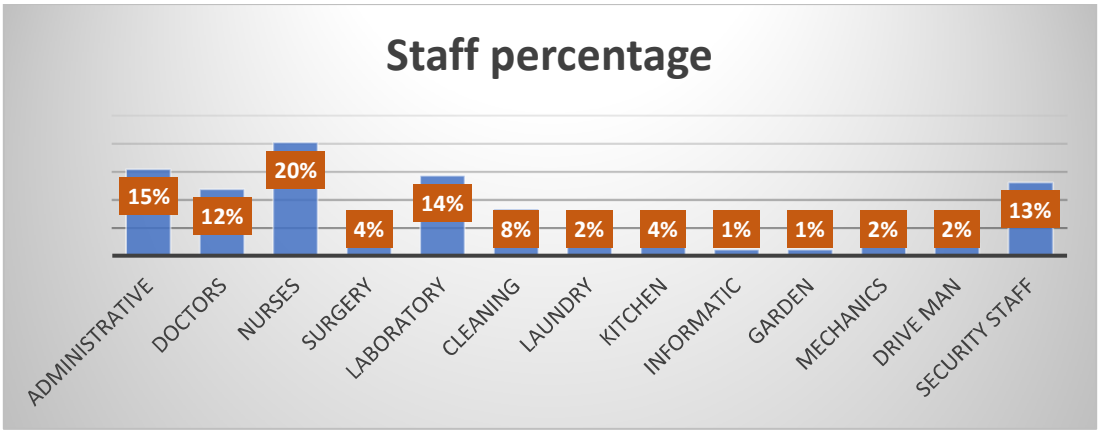


Figure #5 – HPSJB staff percentage distribution

The presence of this population analysed is stable, as are the age groups. 10% are babies (less than 1 year old), 25% are children between 1 and 5 years old and 30% are girls and women who have more than 18 years old. This statistic was produced by SB Software that it is in use in the reception.

Hospital general statistics

Table #2 and #3 resumes the total physician assistance during year 2019 and 2020. Note that these statistics start counting on 22/01/2019, so, in the first month, the value of 439 corresponds to a one week of records.

Table #2 – Total 2019 medical assistance (number of patients)

2019		
	Month	Number physician assistance
Start 22/01/2019	1	439
	2	1378
	3	1719
	4	1458
	5	1737
	6	1897
	7	1822
	8	2076
	9	1846
	10	2160
	11	1407
	12	1206

Table #3 – Total 2020 medical assistance

2020		
Month	Number physician assistance	Evolution 19/20
1	879	100,23%
2	1460	5,95%
3	1558	-9,37%
4	1100	-24,55%
5	194	-88,83%
6	0	-100,00%
7	0	-100,00%
8	533	-74,33%
9	1248	-32,39%
10	1155	-46,53%
11	1278	-9,17%
12	1107	-8,21%

Table #4 – Total 2021 medical assistance

2021 – Year to date (YTD)		
Month	Number physician assistance	Evolution 20/21
1	1,268	44.25%
2	1,247	-14.59%
3	1,143	-26.64%
4	1,122	2.00%
5	1,578	713.40%
6	1,097	YTD

3.3 SWOT analysis

The SWOT analysis is a very easy tool for business strategy analyse or supporting a department issue. It has four essentials' vectors (strengths, weaknesses, opportunities and threats) that give a holistic vision and understanding how the business is inside and outside the main door and help to build management decisions. A swot analysis was implemented to support the diagnosis stage concerning the activity at the HPSJB and LABOR.

Table #5 has four fields:

- two top fields (strengths and weaknesses) with internal issues, and
- two down fields (opportunities and threats) with external issues.

Reading from left to right, the two left fields have:

- positive issues (strengths and opportunities), and on the other side
- negative issues (weaknesses and threats).

Table #5 – SWOT board

Positive				**Negative**		
	strengths			**weaknesses**		
Internal		Facilities Trust		Lack standardization - equipment - routines - supply chain		**Internal**
	opportunities			**threats**		
External		Logistic Hardware		Competition Political & Economic Unstable		**External**
Positive				**Negative**		

The are several positive and internal **strengths** associate to HPSJB.

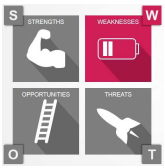
The fact there is no other hospital paediatric in RGB and they have the mission to help and treat children and women pregnant. They have an excellent building and surgery block. Caritas, as the staff, are looking forward for doing the best health care as they can. The HPSJB staff are extremely useful to the community. They have a strong and important medical volunteers' program from Italy (one of the best is Dr Dionísio Cumba) and from Portugal. Caritas helps local students to go to Europe to get medical degree and after the degree the students became physicians and return to HPSJB working in medical practices. More volunteer activities are developed in LABOR (the main help comes from Dr Manuel Pimenta – Portugal) with technicians training, reagents and new equipment's supply.

People from RGB has a lot of good expectation in health treatment on HPSJB. They frequently receive and treat children that take a 6-hour trip to get there.

This Hospital is well known by high standards of hygiene and great service and utility to the population. In RGB there are only three oxygen production units: HPSJB, Cumura and Simão Mendes National Hospital.

The unique services are consultations, laboratory analysis clinics, hospitalization, emergency, imaging RX, operating theatre, oxygen production unit and canteen for outpatients. And the HPSJB count on human resources placed by the Ministry of Health and those contracted for service providing. Most of the equipment and materials were donated by foreign benefactors, as it was the case of the LABOR that was equipped and still receive reagents, training and equipment by Dr Manuel Pimenta.

The HPSJB is better than other units standard hygienic, oxygen supply that sometimes is used to provide another's hospitals, medical treatment and diagnostic equipment. The population appreciate very much the institution and trust the medical care.



The negative and internal **weaknesses** were possible group in 4 items:

a) equipment: inadequate or limited instruments; lack of standardisation of equipment, cost and periodic equipment maintenance;

b) supply chain: irregular supply of medical equipment, drugs and reagents; inadequate inventory management;

c) software: no informatic system, software costs;

d) team: inadequate feedback mechanisms; non-harmonization of data collection instruments; no specialized workforce; absence of data quality control; no standard work task, low level of computer skills, need for ensure equity of access and well-being to all citizens, outpatient high waiting times and no value measuring outpatient outcomes.

These weaknesses caused long waiting times for medical assistance and reports from LABOR and stockouts in the pharmacy. Some services stopped due to lack of technical assistance (e.g. LABOR, echography and radiology).

In health safety context for volunteer's the best hospital in RGB is the airport. We do not have guarantee of complete medical assistance even in the public main hospital of the country, the Hospital Central Simão Mendes.

The positive and external **opportunities** are people or organisations who can do voluntary work and create projects to develop new standardization method work, logistic approach, install hardware and network devices, setup computers, software upgrade and marketing vision. Them, being an institution of the Catholic Church at the service of the population for more than a decade, will drawing up a communication and visibility plan for the HPSJB to attract more clients and build road signs that help community remember and understand the HPSJB direction. The administration aims to gain these services: computed tomography, haemodialysis, endoscopy, stomatology, ophthalmology and dentistry. The equipment, the quality of the technician, the assertiveness of the report and the time worked, greatly influence the degree of satisfaction of the outpatient.

The negative and external **threats** are some near institutions that try to carry out examinations and provide some medical assistance: i) Cardio clinic, 20 meters, ii) Militar Hospital, 2 Km, iii) Madre Lurdes Hospital, 3 Km, iv) Casa Emanuel, 4 Km, v) Hospital Nacional Simão Mendes, 6 Km, vi) Cumura Hospital, 20 Km, vii) Mauritanians' and Lebanese's pharmacies around.

All hospital departments are highly unstable due to the precarious economy and the political instability that the country has been experiencing for more than 20 years.

Another threat is the creation of partnerships between competing units. There are small hubs that have different medical services. These small hubs cannot have one hospital dimension but they can plan partnerships between each other's to respond to the market demands. Each competing hub can improve with necessary technological equipment, hiring specialists, creating strong and competent structures.

3.4 Hospital general logistic problems

Managers had difficulties balancing the supply and demand. They struggled with widespread long waiting list, both the urgency and the LABOR, which were a source of public interest as they lead to dissatisfaction among HPSJB outpatients. Long waiting times for these services drove outpatients to opt for another Health Care Locations or renounced the HPSJB service.

For better understand the Hospital logistic problems, the Figure #6 try to represent the outpatient logistic process inside the HPSJB.

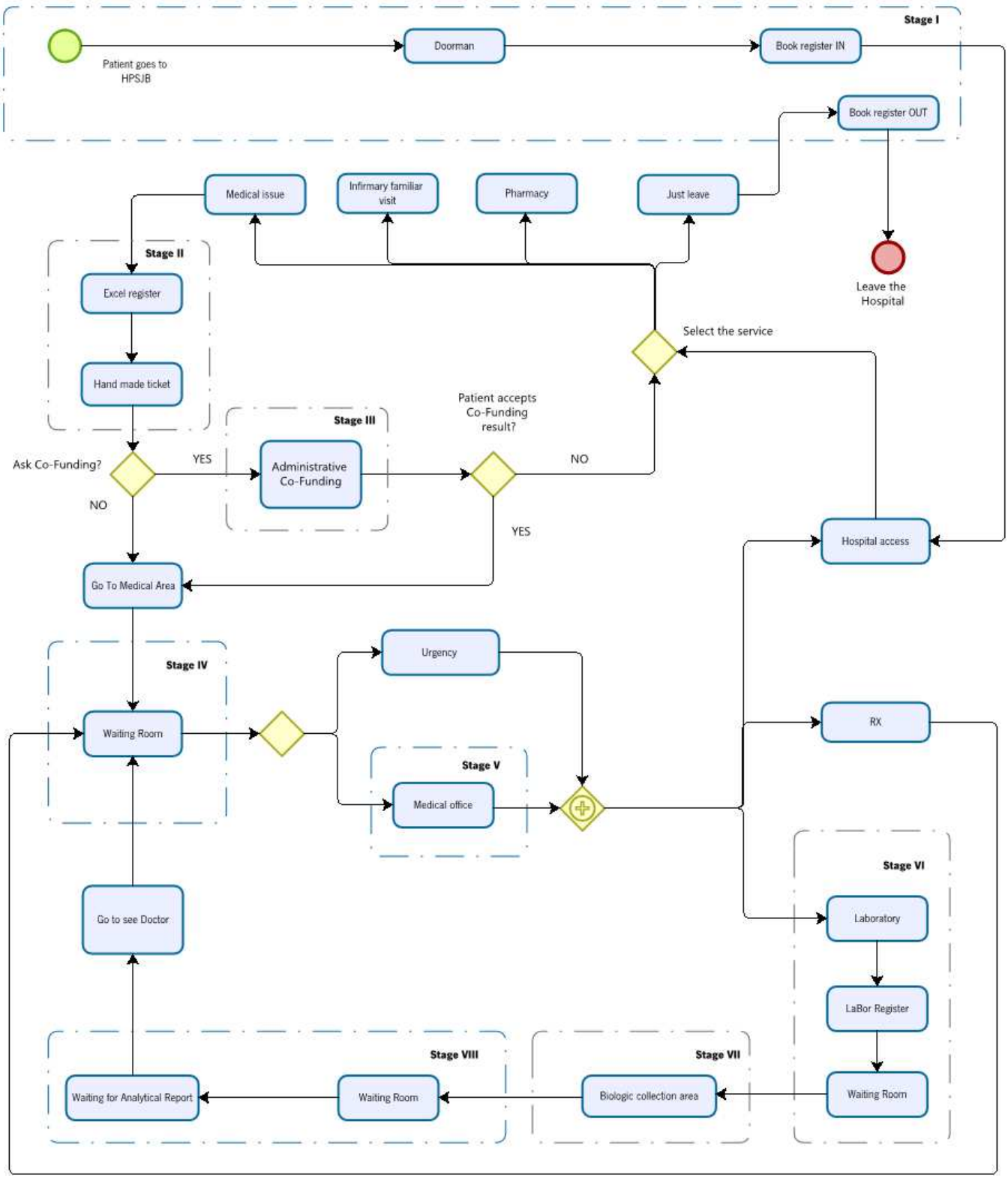


Figure #6 – Outpatient flow

This flow has pointed out eight stages and those stages have in common that have input or output PID (outpatient Personal Identification) data intervention.

Is necessary hand write PID on paper form or call the outpatient with all inconvenient associated.

- Stage I: doorman activity and the paperwork associated,

- Stage II: administrative outpatient registers and present the hospital bill,
- Stage III: administrative outpatient registers for co-funding the hospital bill,
- Stage IV: room without sorter criteria by acute medical conditions,
- Stage V: medical assistance with handmade medical prescription on paper form,
- Stage VI: match medical prescription form to PID,
- Stage VII: match the handmade PID to biologic collection,
- Stage VIII: input biologic collection ID on equipment and hand write the report equipment to Laboratory Information System (LIS).

On Hospital issues associated to logistics were identified:

- Issue #1 HPSJB reception,
- Issue #2 Different outpatient identification and duplicate task,
- Issue #3 Hard income statistics,
- Issue #4 Another PID for co-funding,
- Issue #5 Hard co-funder statistics,
- Issue #6 No statistics data from outpatients,
- Issue #7 Unknow number of outpatients waiting for medical services,
- Issue #8 Unknow statistics of medical conditions when outpatient arrives to HPSJB,
- Issue #9 Form paper communication,
- Issue #10 Insufficient informatic network.

The solutions to improve logistic operations and reduce waiting times have often entailed strengthening the supply side by increasing the resource availability (equipment, devices and personal), by working on provider's productivity or by paying extra money to the health professionals to increase production or other determinants that should be tackled.

Issue #1 HPSJB reception

Once the outpatients arrive to the HPSJB the doorman registers the PID and retain the citizen card, or other similar relevance card. The number of cards represent the control and the total outpatients inside the HPSJB installations (Picture #12 in Appendix 1). Hereafter the outpatient does not have citizen card to correct identify in other departments or hospital services with all possible inconveniences that came from. The doorman returns the document to the outpatient only when the outpatient leaves the HPSJB installations.

The Figure #7 indicate the average time, in seconds, that is necessary to spend since the outpatient arrive to the HPSJB until medical area. At this time there was no distinction in the severity of health cases neither if they were children or adults.

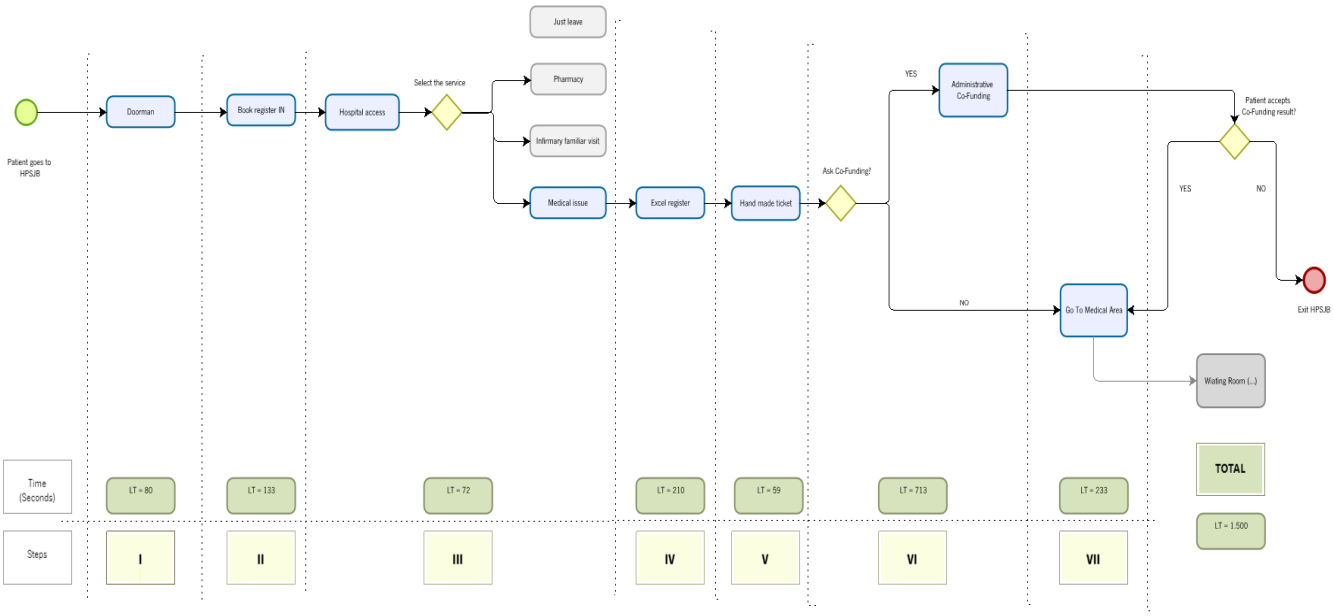


Figure #7 – Value Stream Map from Stage I until Stage III

The timeline at the bottom of the figure, under each process, helps to recognize the sum of each process. The journey includes the total Lead Time (LT) the amount of time that passes from the start of a process until its conclusion and total Value Time (VT) the amount of time that outpatients accept as compensation for the treatment.

Each process was measure for two weeks and the daily average was register in Excel.

Issue #2 Different outpatient identification and duplicate task

In case that outpatient need urgency, medical, RX or Laboratory service, the hospital had another handmade PID administrative process. The procedure to register the outpatients had no regular way. The way of register outpatients' names, on the hospital books, could be different because there was no policy about the way they should register.

The PID register was done in the Excel worksheet (Picture #14 in Appendix 1) and duplicated in paper form to which a small number ticket with the present date (Picture #13 in Appendix 1) were attached.

It was possible that outpatients return to HPSJB and the manual register could have had another PID format. If the outpatient's name was long, more probability to register different names or misunderstand the names or misspelled.

Issue #3 Hard income statistics

On the end of the day, another administrative used the duplicate ticket to measure the total income and order small duplicate ticket books if it was necessary.

There was no kind of value measurement for outpatients' statistics or services that outpatients ask for.

If the outpatient needed different hospital services, was necessary to inform his PID each time he/she moves from one department to another. This was a long task and repeated with every outpatient, several times with all hospital staff.

Issue #4 Another PID for co-funding

The outpatient always could request co-funding for all services in the HPSJB. The co-funding value could be 0%, 25%, 50%, 75% or 100% funded. Another PID was necessary and it was possible, for the same reasons described above, that the PID data could be different because there is no work habit, it was a possible error that the operator could short the outpatient's name or misunderstand the name.

The Figure #8 illustrate the outpatient flow between the doorman and the administrative co-funding stage. These steps have book register, excel register and administrative co-funding register and theses three PID data could be different.

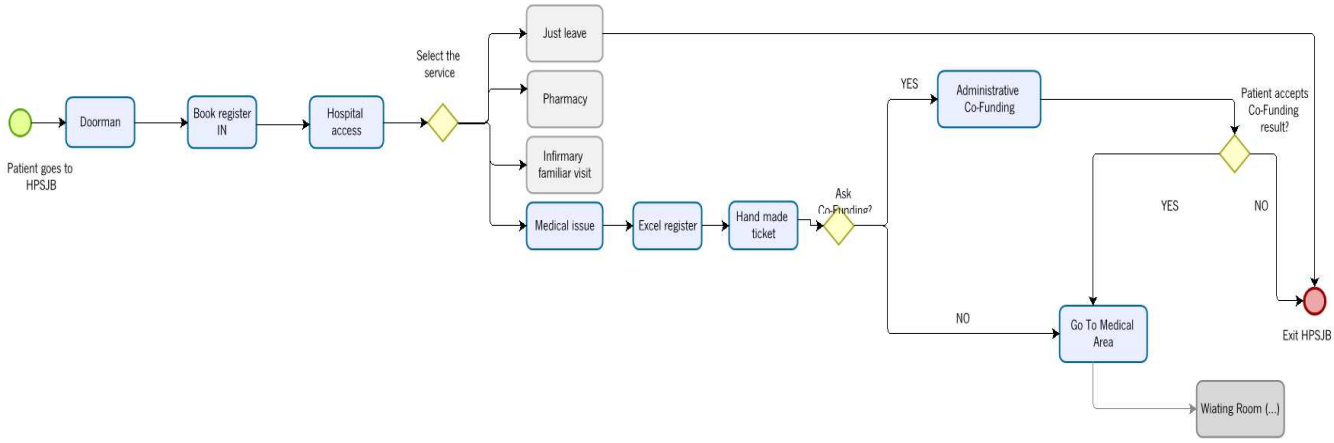


Figure #8 – Old administrative logistical model

Issue #5 Hard co-funder statistics

There was indirect internal hospital resource that needed to summarize that data. Monthly they prepared manually the report and sent it to the governance and other institutions with data of people. This document was useful to ask for appropriate contribution.

Issue #6 No statistics data from outpatients

Management found it difficult to count or find visitors history, date/time hospital check-in, date/time hospital check-out and other statistics related with outpatients.

If for some reason the outpatient returned to the treatment, the outpatient knew that must repeat the same PID experience as it was the first time and all over departments without exception. That fills tiring and boring.

This forced several permanent administrative people to grant the PID register in paper or Excel datasheet or LABOR software or accountability books.

Issue #7 Unknow number of outpatients waiting for medical services

It was not possible to know how many people are waiting for urgency care, medical assistance, nursery, RX room, analysis clinical laboratory (LABOR), paediatric room, surgery block, visitors waiting room, etc.... as statistics from the arrive time and leave time or day past. For management and physicians was a step forward ensure equity of access and well-being to all citizens.

Issue #8 Unknow statistics of medical conditions when outpatient arrives to HPSJB

The main problems were children and women that came to HPSJB and needed medical care. They should be the first outpatients to be treated like a green way on freeway. During the workday, there was a dark vision about the number of people that needed hospital care, who really was that people, the age and how serious was the health condition (Picture #9 and Picture #10 in Appendix 1). They also unknow people's name or age or gender or severity of health conditions.

There was a complete lack of knowledge how serious were the clinical cases as how many cases were waiting for help.

The physicians mentioned that was necessary to measure, in real time, how many outpatients were waiting for health care, how serious it was, gender and age.

They ambition to work with correct information about health conditions of children and women pregnant that wait for medical assistance so they could be prepared to respond correctly to the emergent and urgency health situation and drive a correct attitude for the outpatients and like this contribute to lower health care problems.

Issue #9 Form paper communication

The hospital worked with form papers and the communication between all stages identify in (Figure #6) was made by form papers. There was no informatic culture neither computer skills. There was no culture of share electronic documents or folders or using e-mail.

There were a lot of paper waste. For each outpatient, the HPSJB needed to register on paper at the hospital entrance, the ticket was shared view to medical assistance, administrative co-funding, physician for medical prescription, LABOR for identify the Biologic Sample and the LABOR analytical report. There was a lot of handmade outpatient's registers on several departments which could have compromised PID and medical information with wrong or incomplete data.

Issue #10 Insufficient informatic network

Network and the internet were available only in the administration office and 2 more offices. These computers were linked using one domestic internet router. They used one equipment that only accept 4 wired inputs. They have chosen 2 administration PC, 1 PC on the accountability room,

because they need to send information about payments and co-funders, and another PC on the LABOR (Picture #25 in Appendix 1) because some time they need to source information or update equipment drives.

The administration refers that were several internet problems and sometimes they needed to reboot all the hardware and that includes the internet router and PCs.

The hospital did not have a server neither wired network chain that linked different departments, offices, network devices or UPS for stable electrical power.

Issue #11 Access to past and present outpatient medical records

The physicians only had the present request because normally outpatients did not have old reports, and the HPSJB did not have working capacity to find or reprint the reports and diagnostic examinations. The access to clinical information history was reported like as a hard task.

3.5 LABOR logistic problems

The focus started on medical prescription, cross LABOR activity and ends when physician saw the Laboratory Analytical Report validated by LABOR technical manager.

The following issues had in common the long outpatient waiting times and resource costs:

- Issue #12 Medical request paper form
- Issue #13 Errors on PID in the LABOR
- Issue #14 Bill process
- Issue #15 Outpatient needs co-funder
- Issue #16 Too many PID
- Issue #17 LT LABOR production
- Issue #18 Identify biologic sample
- Issue #19 Use biologic sample ID in the laboratory equipment
- Issue #20 Collect laboratory equipment output data
- Issue #21 Input data from tickets to Laboratory Information System (LIS)
- Issue #22 Work habits
- Issue #23 Long outpatient waiting time

Issue #12 Medical request paper form

The physicians used paper form to write the analysis clinics request, hands the requisition to the outpatient and asked for more form if they needed to refill the stock. Paper files take up a lot of office space, slow processing of records and there was a remote possibility the outpatient loses or dirty the paper requisition and that was noise for the laboratory reception. Was guarantee that physician lose outpatient and analysis tracking. Past and present outpatient information is

extremely vital in the provision of outpatient's care. Also, the physician cannot checked if the outpatient and the laboratory present all the prescription done correctly to match clinical resources to clinical processes.

Issue #13 Errors on PID in the LABOR

Once the outpatient arrived at LABOR reception, a new identification process began. There was one LABOR administrative process that was necessary to complete and there was a short probability that the file name could be different than the medical request as well as reception book or excel map made by reception.

In some cases, the outpatient went home and return, with his stomach empty, in the next morning working day.

Once get LABOR reception, the outpatient showed the medical prescription (if it existed or had not lost) and some PID because some people in RGB have no identification whatsoever[7].

There were no measures of possible administrative errors like misunderstand physician letter due the physician's handwriting or condition of the paper requisition. It was possible miss some tests or change the kind of test to realize or both situations. These situations were not measure and no quality control was addressed nor was accountability addressed.

Issue #14 Bill process

The bill was done manually with all possible to do correct or wrong. There was a board with the price list (Picture #11 in Appendix 1) and the operator used that board for orientation or used one paper copied or used personal memory to write the test and match the test value.

Then, the operator accounted all the test values and the bill was ready to be delivery to the manager. The embarrassment was wrong test value or wrong total medical request value (Figure #9). The red balloons symbolize pain, logistic problems and duplicate PID task.

The price building process, which varies whether it was a request for private analysis or with co-payment, could be terribly slow and just one person at the service it could take more than 5 minutes to attend to the outpatient. If the queue had 13 people, the last one could wait one hour under the harsh sun.

[7] On the election's day, the authorities stamp the hand so they cannot vote twice

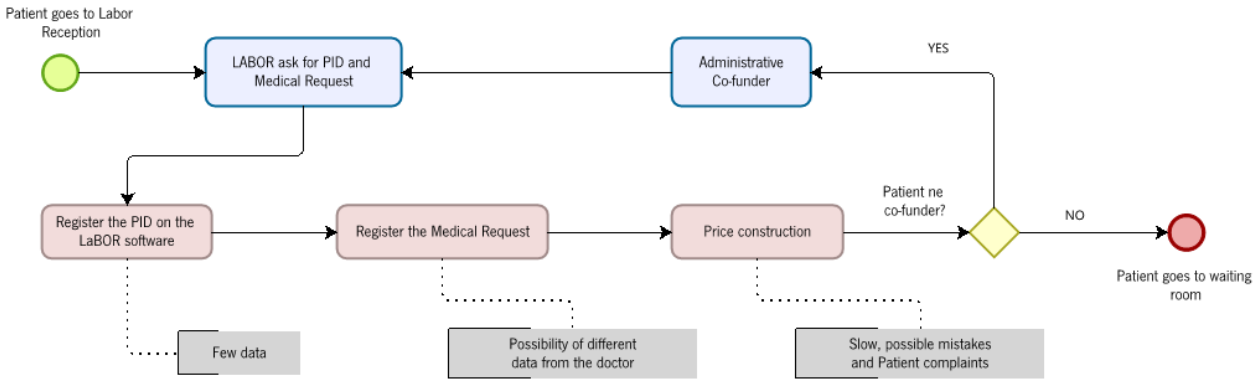


Figure #9 – LABOR reception logistics process

At the end of the day the operator calculated the total value and matched with the statistic of testes done on that day. The embarrassment was: explain wrong values.

Issue #15 Outpatient needs co-funder

Note that the outpatient could accepted and pay the medical request or asked for help contribution (another register with PID). If the PID LABOR was different from PID's co-funder the LABOR could dismiss the process and ask the outpatient to redo the co-funder process. This was painful for

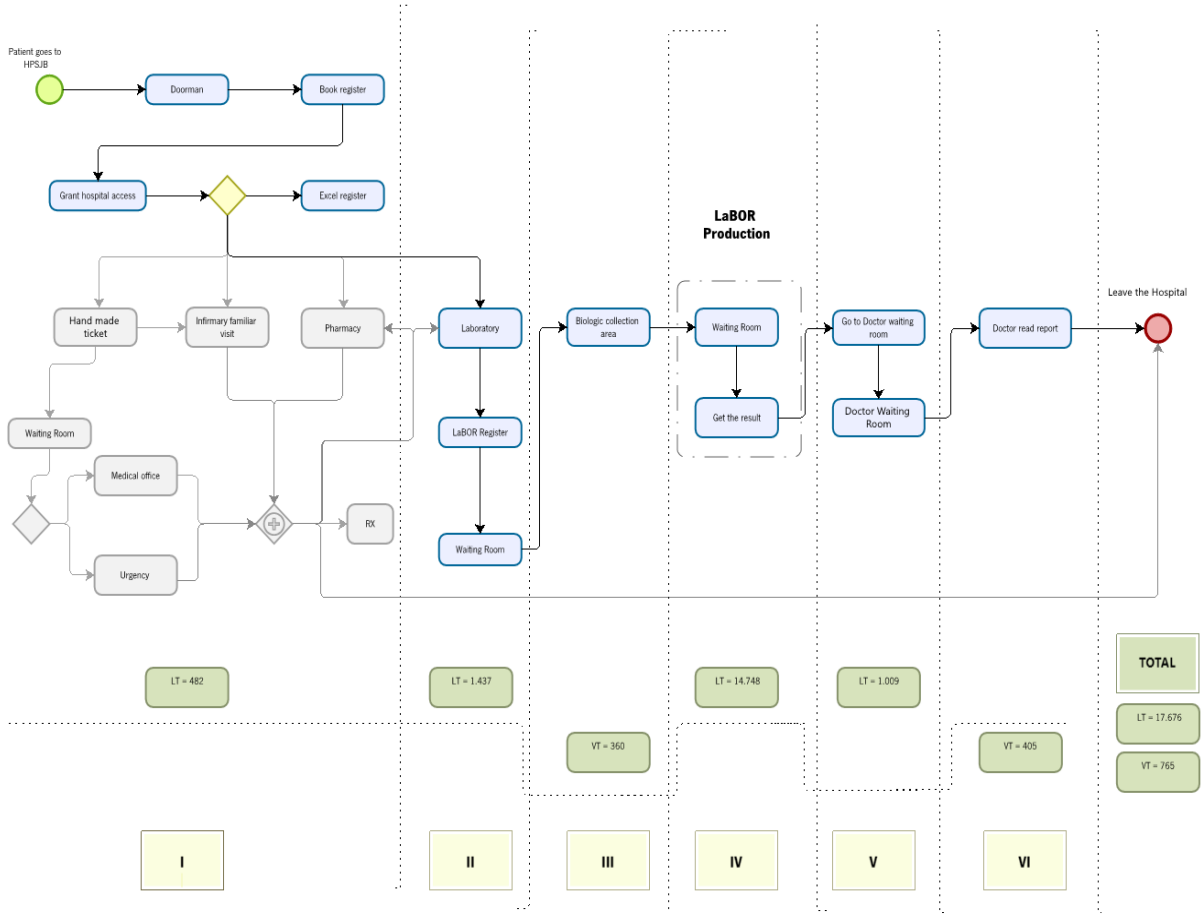


Figure #10 – Value Stream Map for outpatient and laboratory

outpatient, for administrative co-funder and for LABOR. Everyone wasted time. Long waiting times for these services could lead outpatients to opt for another Health Care Locations or renounce the HPSJB service.

Issue #16 Too many PID

Looking for Figure #9, the focus were the orange boxes identified pain zones. Several administrative hospital staff asked for PID for different proposes. The first time was necessary to register people who need to go inside hospital. Second time was to record the medical care and the ticket to show to the physicians and the co-funder process if applicable. Then registered the PID in the LABOR administration process as well as the physician analysis clinics request. It is comprehensive if outpatient name was too long the way that they register the PID was different in some departments but there was no statistic or value measurement about this issue.

Issue #17 LT LABOR production

The Figure #10 have six stages, they are numbered from I to VI. The fourth stage, IV, had the highest LT value for the outpatient's journey. It was important to analyse and try to reduce the value more than half of the average of LT.

Issue #18 Identify biologic sample

After identification process on the LABOR reception the outpatient waits for call, on the waiting-room, from the biologic collection room.

There were no standard outpatients' identification. The staff used label stickers and wrote the name of the outpatient or the number of the process or both by hand on the biologic sample container. This process was slow and low security profile.

There was no control, no records and no statistics about how many mistakes occurred on changing PID, labels, miss sample or incomplete requisition due administrative errors or laboratory produce less of tests them the necessary or change of analysis requests.

The next figure shows the Value Stream Value inside the LABOR.

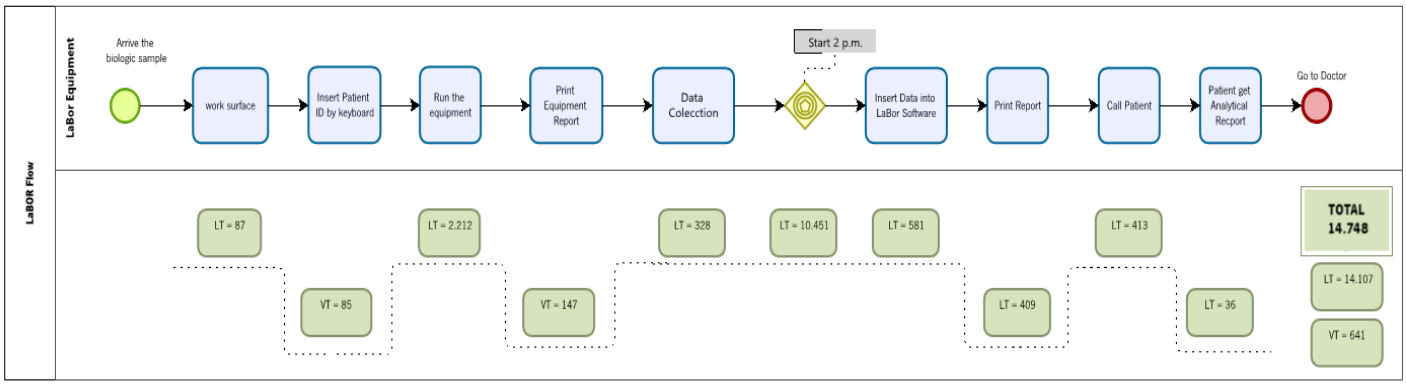


Figure #11 – Value Stream Map for LABOR

More than 95% is allocated to LT and about 5% to VT.

It was painful that the technic start writing the equipment result from paper tickets printed by equipment to LIS.

Issue #19 Use biologic sample ID in the laboratory equipment

The laboratory technic sends the biologic sample to the work surface that could be stools, urine, bacteriology, biochemistry, immunology or haematology collection.

The operator, for better organize work, should register the ID sample each time the operator used the equipment or repeated the test or moved from one to another equipment with the sample.

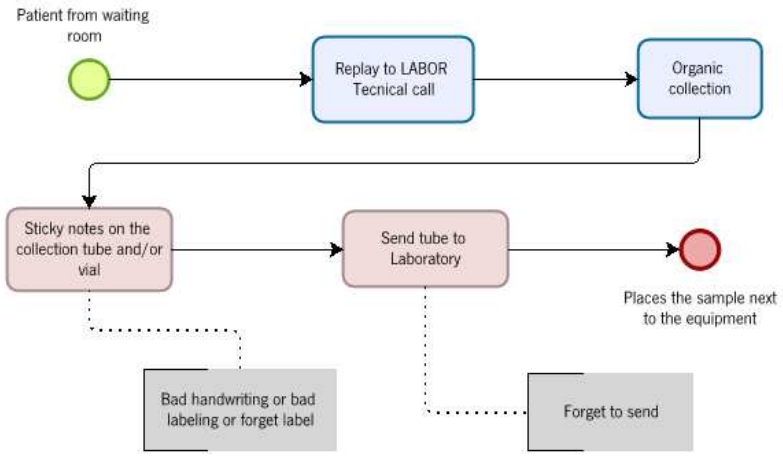


Figure #12 – LABOR logistic sample collection

The equipment works fine without label but staff was discouraged due raise the mistake possibility confusing tests or samples or PID.

The equipment allowed that the operator inserts manually, by keyboard or touch screen, sample ID that usually is the tube number. It was possible, to the operator, run the equipment without sample ID, or number switching or wrong data (the tube can have wrong label or switch label) and them could generated ID problems.

The sample collection had a label that can be degraded due sweaty hands on the label ink. It was possible that the organic the sample could have been lost or mistaken identity or misunderstand when it was transcribed to the laboratory equipment – input data to the laboratory equipment.

Also, there were few data, only name with short format, from PID to the label that could generated possible changes of clinical files between users.

There was a huge risk for the outpatient and a significant feeling of insecurity at this subject.

There was no control or records no measures or other kind of statistics about how many mistakes were occurred on those situations.

Data collections rely on labour-intensive collection techniques required responsibility, focus and the skills of specially trained teams.

Issue #20 Collect laboratory equipment output data

At the 2 p.m. the LABOR technic arrived so all biologic samples test result could be attended from 2 p.m. until 5 p.m. The Technical Laboratory start to collect all tickets with output data printed by each laboratory equipment and wrote down that data in the notebook (Picture #16 and Picture #17 in Appendix 1).

There was no possible to get analytical reports before 2 p.m. and this worsens health problems to the outpatients. This was a serious health problem.

The LABOR technician had two work stages. On the first stage, the technician inserts the biologic sample in the equipment and after the technician collected the equipment report. The Figure #13 represents the workflow and possible errors that could be happen because there was no robust quality control system.

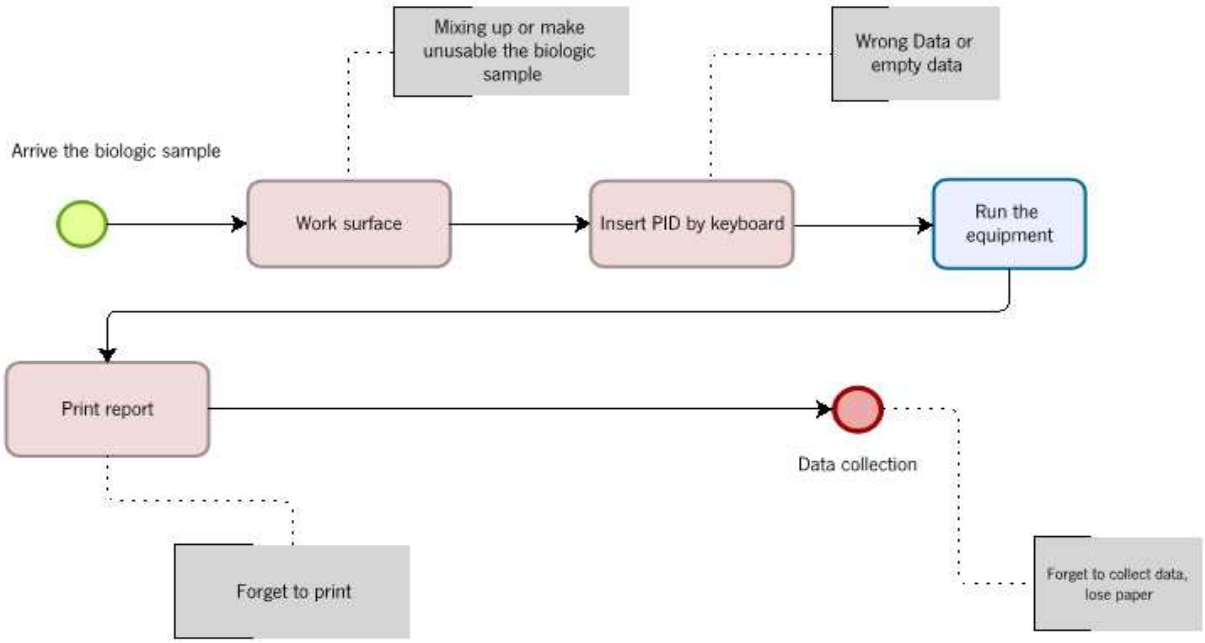


Figure #13 – Internal logistic issue before equipment

The second stage, the technician used the equipment report to insert data on computer. The Figure #14 illustrate the workflow as possible errors due there was no quality control system.

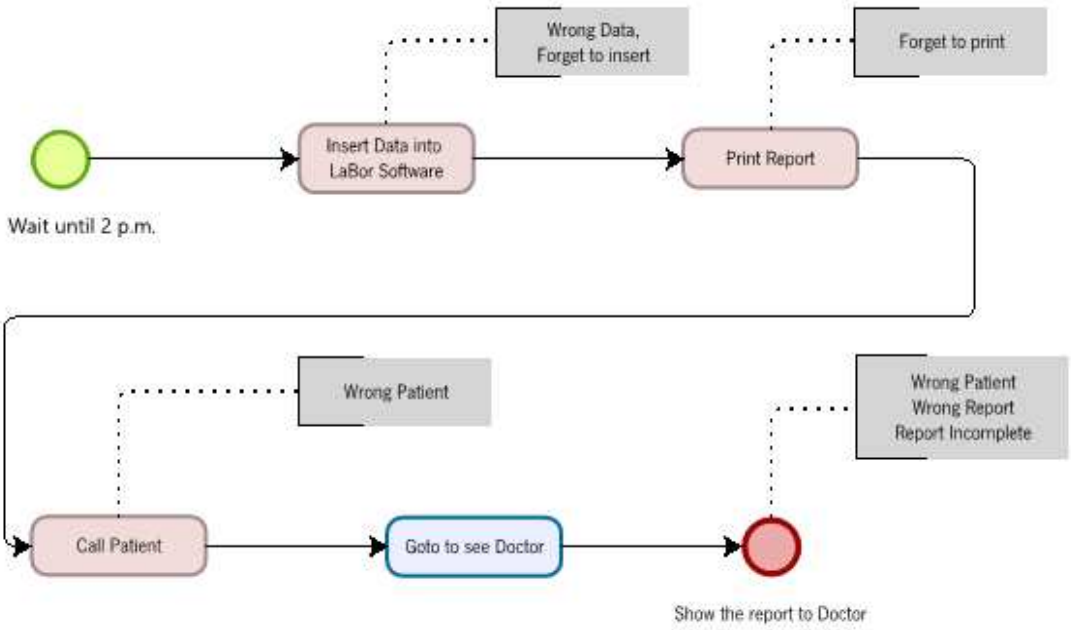


Figure #14 – Internal logistic issue after clinic analysis procedure

Issue #21 Input data from tickets to Laboratory Information System (LIS)

Each LABOR device had own network settings, communication protocol and communication link. This fact makes work of study and understand the equipment, create and draw the algorithm, test and implement the solution harder. The operator entered the ticket data to LIS because the equipment did not communicate with LIS automatically. This process was very slow.

This process could have some mistakes either by introduce misinterpret numbers or wrong PID, possible to the operator miscalculate values, change equipment results (Picture #15 in Appendix 1) or simply lost the paper with the report. Nobody could find this mistake because it was very difficult to identify these errors.

In brief, there was a risk of incomplete analytical report as some mistakes transcribe results from equipment to LIS and some mistakes can happen by confusing labels and outpatients ID.

This could cause problems to medical diagnostic that had bad effects to the society.

These potential problems were out of internal quality control and never has been count for statistic treatment. Those episodes or others could have contributed to an incorrect or miss laboratory result or drove revenue from unnecessary or duplicative tests and care.

Some examples of transcription gross errors are given in Figure #15 and Figure #16.

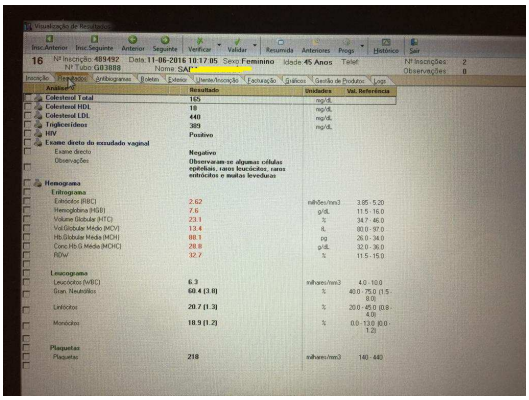


Figure #15 – Bad transcription MCV and MCH value

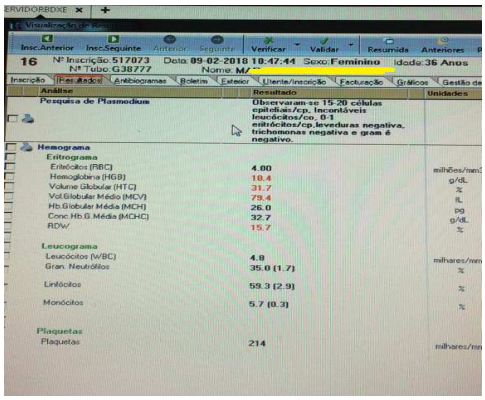


Figure #16 – Urine report on Plasmodium field

Issue #22 Work habits

There were no feedback mechanisms, no data quality control with alerts for incomplete analyses or data out of the standard values, no data server for share information and there was no schedule backup neither data backup. The supply-chain of medical equipment, drugs and reagents had many breaks and there was an inadequate inventory management.

On the knowledge side of the population, the medical research work to know the population's nutritional status or other pathologies and comorbidities without fast and trusting statistics makes investigative work lengthy and stressful.

Issue #23 Long outpatient waiting time

The demand for Laboratory request for HPSJB outpatient services exceeded supply.

This imbalance over time had generated long waiting lists resulting in patients not being seen within clinically recommended timeframe.

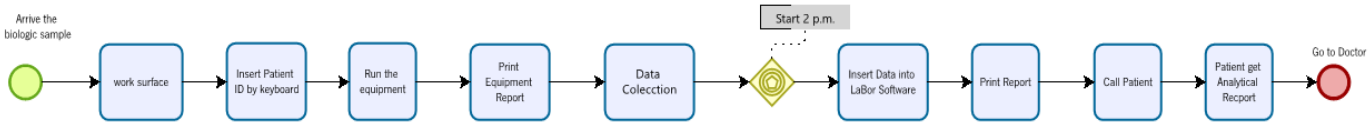


Figure #17 – Old LABOR production logistical model

3.6 Value measurement of complete outpatient care cycle

Draw to learn the complete outpatient cycle care cost, with BIZAGI MODELER tool[8], helped to redesign and propose care processes with the same treatment and outcomes for the outpatient before building changes in real systems.

[8] https://www.bizagi.com/pt

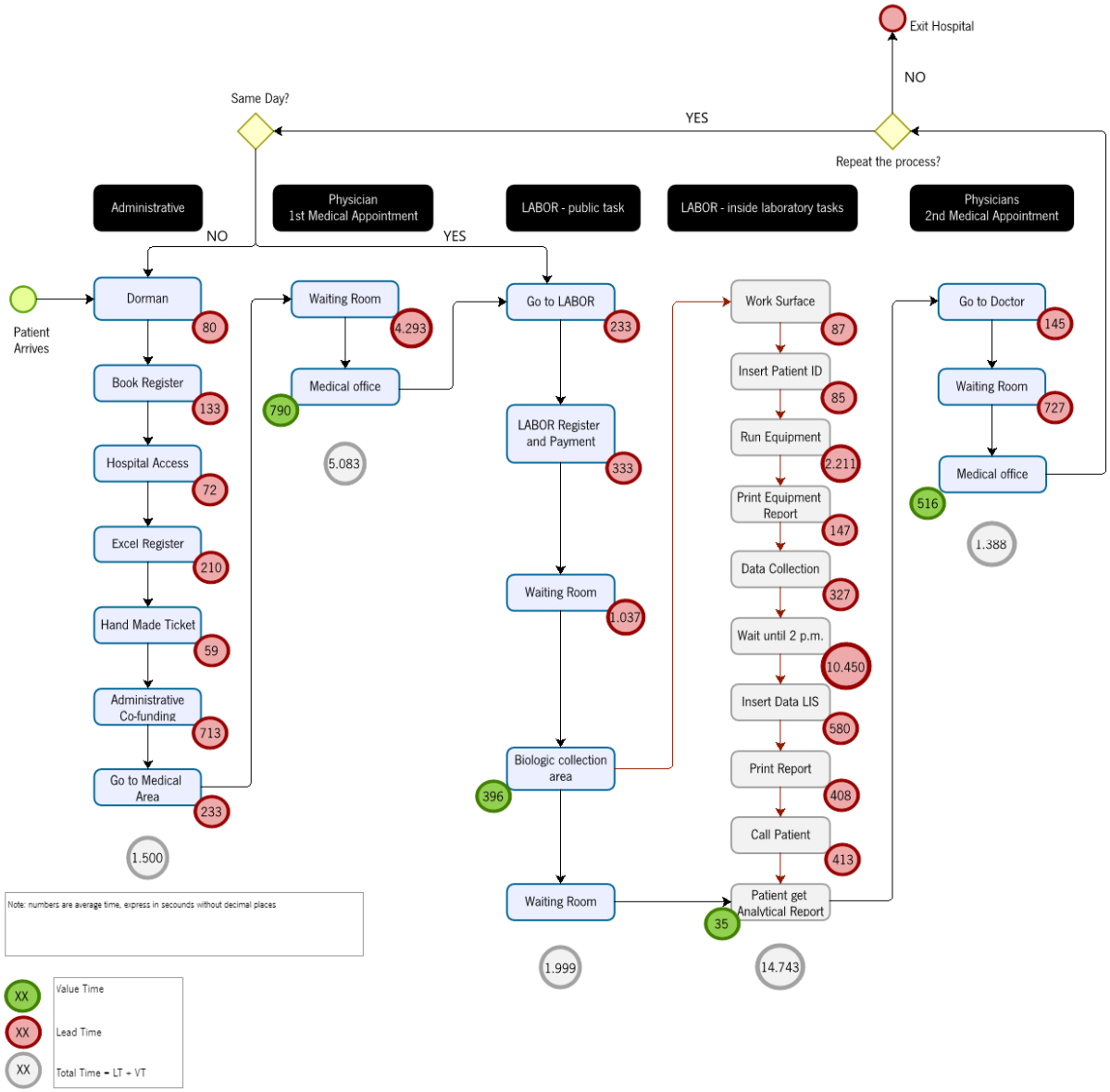


Figure #18 – Process maps patient's care cycle

This analysis should be performed to identify the right actions to unwarranted priorities in medical care, reduce waiting times, shortening misunderstandings or laboratory gross errors and answers to outpatient's needs.

Needs to measure costs over the complete cycle of care will get one price for the entire episode. Actually, for complete the total cycle care, the outpatient needs to cross five big steps as it shows Figure #18 and with the average time in seconds:

- the administrative task with total time 1.500 seconds;
- the first medical appointment with total time 5.083 seconds but only 790 seconds are assigned to value time where outpatient is inside the medical office. The remaining time corresponds to the average time that the outpatient is in the waiting room;

- the LABOR public task with total time 1.999 seconds but the value time for outpatient is only 396 seconds that correspond the average time to the biologic collection;
- inside LABOR task the total time is 14.743 seconds. For the outpatient the value time is 35 seconds that correspond the period of time to outpatient receive analytical report;
- the second physician appointment with total time 1.388 seconds but the outpatient only has 516 seconds of value time.

The outpatient complete cycle care, in average, takes in seconds: 1.500 + 5.083 + 1.999 + 14.743 + 1.388 = 24.713 seconds. The average value time is: 790 + 396 + 35 + 516 = 1.737 seconds ≈ 7,03 % and the lead time, 24.713 – 1.737 = 22.976 seconds ≈ 92.97%, is the time left over.

TDABC model

A TDABC study allows to identify what HPSJB procedures truly cost and what drives those costs. This incorporates a broad of evidence base as possible to make evidence-informed decisions and now this method has now been adopted in the management of operations.

Figure #18 shows the average LT and VT for patient flow through the administrative, physicians and LABOR settings. The map illustrates the common outpatient journey.

Root causes

As waiting time increases the patient satisfaction decreases and affecting their perception of overall treatment provided.

This research has identified some root causes that affecting the outpatient value. No queuing order, no devices that transmit directly to LIS or LIS to the devices, no EMR system and input laboratory results to LIS only available after 2 p.m.

Resources and costs analysis

The HPSJB staff was separate by tiers: Administrative, Physicians, Nurses, LABOR and Pharmacy. The amount costs for all employer's staff were represent in EUR and XOF (local currency) to better understand the value.

Table #6 – Summary of resources and costs analysis

Groups		Employers Staff	Monthly salary		%	ANUAL	
			EUR	XOF		EUR	XOF
1	Administrative	42	6,013.20	3,944,400	38.4%	78,171.59	51,277,200
2	Physicians	10	3,646.58	2,392,000	23.3%	47,405.55	31,096,000
3	Nurses	20	3,723.69	2,442,580	23.8%	48,407.96	31,753,540
4	LABOR	12	2,279.11	1,495,000	14.6%	29,628.47	19,435,000
TOTAL		88	15,662.58	10,273,980	100.0%	203,613.56	133,561,740

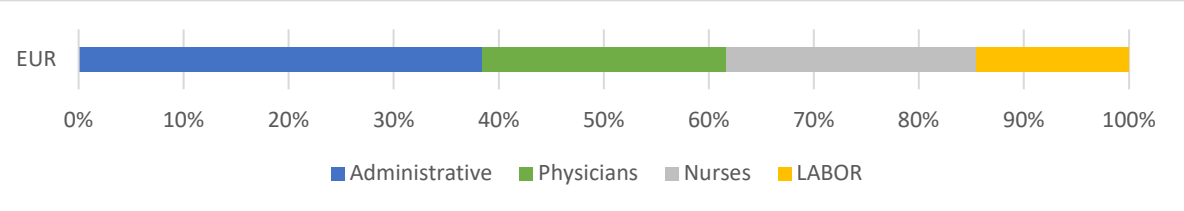


Figure #19 – Distribution of employer's staff salary

Table #7 – Personnel capacity cost rates

Calculate Personnel Capacity Cost Rates				
Resources names	**Physicians**	**Nurses**	**Admin**	**LABOR**
Group number	2	3	1	4
Weeks per year	52	52	52	52
Less: Vacations and holidays	4	4	4	4
Less: Training and leaving	-	-	-	-
Available weeks per year	48	48	48	48
Workdays per week	5	5	5	5
Hours per day	8.0	8.0	8.0	8.0
Less: Breaks, training, meetings	1.0	1.0	-	-
Available hours	7.0	7.0	8.0	8.0
Less: Estimate of research and education time (%)				
Clinical hours per day	7.0	7.0	8.0	8.0
Clinical minutes available per day	420	420	480	480
Clinical minutes available per year	100,800	100,800	115,200	115,200
Annual cost per person	47,405.55 €	48,407.96 €	78,171.59 €	29,628.47 €
Total employers	10	20	42	12
Annual cost per employers	4,740.55 €	2,420.40 €	1,861.23 €	2,469.04 €
Capacity cost rate per minute - EUR	0.047 €	0.024 €	0.016 €	0.021 €
Capacity cost rate per minute - XOF	30.85 XOF	15.75 XOF	10.60 XOF	14.06 XOF

Calculating the resources cost and personnel capacity cost rates to one outpatient, during the journey, permit to measure and understand the today reality and compare with possible future changes or upgrades.

Process time

After this and according to the patient's cycle care and process map, Table #8 to Table #10, have the association of HR plus staff time in minutes plus cost rate. Note that the resource group number, on Table #7, has the resource group cost rate per minute in local currency XOF.

The final cost, present in local currency XOF, was based on time dedicated to clinical duties.

Time was estimated based on observations by third parties in each setting.

Table #8 – Cost system for administrative group and physician group

	Administrative						Physicians – 1St Appointment				
	Time Seconds Outpatient	HR	Time Minutes Staff	Resource Group	XOF		Time Seconds Outpatient	HR	Time Minutes Staff	Resource Group	XOF
	80	1	1.33	1	14.13		4,293	-	-	-	-
	133	1	2.22	1	23.49		790	1	13.17	2	406.18
	72	-	-	-	-		-	-	-	-	-
	210	1	3.50	1	37.09		-	-	-	-	-
	59	1	0.98	1	10.42		-	-	-	-	-
	713	1	11.88	1	125.94		-	-	-	-	-
	233	-	-	-	-		-	-	-	-	-
TOTAL	1,500		19.92		211.08		5,083		13.17		406.18

Table #9 – Cost system for LABOR (public tasks and inside laboratory tasks)

	LABOR – public tasks						LABOR – inside laboratory				
	Time Seconds Outpatient	HR	Time Minutes Staff	Resource Group	XOF		Time Seconds Outpatient	HR	Time Minutes Staff	Resource Group	XOF
	233	-	-	-	-		87	4	5.80	4	81.54
	333	1	5.55	4	78.03		85	4	5.67	4	79.67
	1,037	-	-	-	-		2,211	4	147.40	4	2,072.28
	396	1	6.60	4	92.79		147	4	9.80	4	137.78
	-	-	-	-	-		327	4	21.80	4	306.48
	-	-	-	-	-		10,450	-	-	-	-
	-	-	-	-	-		580	4	38.67	4	543.61
	-	-	-	-	-		408	4	27.20	4	382.40
	-	-	-	-	-		413	4	27.53	4	387.09
	-	-	-	-	-		35	4	0.58	4	8.20
TOTAL	1,999		12.15		170.82		14.743		284.45		3999.05

Table #10 – Cost system for physicians group

Physicians – 2nd Appointment					
	Time Seconds Outpatient	HR	Time Minutes Staff	Resource Group	XOF
	145	-	-	-	-
	727	-	-	-	-
	516	1	8.60	2	265.30
TOTAL	1,388		8.60		265.30

Outpatient cost

Final costs were calculated based on the time spent during each process map segment.

Table #11 – Summary of HPSJB resources and total estimate XOF cost

1 Outpatient XOF Cost						
Group	Administrative	Physician First Appointment	LABOR public tasks	LABOR inside laboratory	Physician Second Appointment	Total
1	211.08	-	-	-	-	211.08
2	-	406.18	-	-	265.30	671.48
3	-	-	-	-	-	-
4	-	-	170.82	3,999.05	-	4,169.86
					TOTAL	**5,052.43**
%	**4.18%**	**8.04%**	**3.38%**	**79.15%**	**5.25%**	**100%**

Table #12 – Summary of HPSJB resources and total estimate time cost

1 Outpatient Time Cost (Seconds)						
	Administrative	Physician First Appointment	LABOR public tasks	LABOR inside laboratory	Physician Second Appointment	Total
	1,500	5.083	1.999	14.743	1.388	**24.713**
%	6.07%	20.57%	8.09%	59.66%	5.62%	**100%**

Be comparing process maps and resource costs for the same medical conditions across multiple sites, it will be possible to determine how much of the cost difference is attributable to variations in process, protocols and productivity and how much is attributable to differences in resources such as wages. From Table #11 and #12 it is possible to see clear as water that LABOR – inside Laboratory task has the highest cost and time value. 79.15% of total cost and 59.66% of total time of cycle care. More than 80% XOF cost and time cost is on the group The physician – first appointment plus LABOR – inside laboratory with 87.19% for XOF cost and 80.23% for time cost.

3.7 Concluding remarks

In RGB, the percentage of women and men who have done at least one of the nine specific computer science related activities in the last 3 months is (Finanças, Plano, and Estatistica, 2019):

- Women: 15 till 24 years old = 4.2%; 15 till 49 years old = 4.1 %
- Men: 15 till 24 years old = 12.6 %; 15 till 49 years old = 14.4 %

So, the hiring expectations of people with information and technology skills were very few. For example, sending reports by e-mail should be an easy and quickly routine task, but this has not been possible to implement. There is a great economic disadvantage of having a huge low computer skill. Table #13 show a 5W2H development tool, a set of questions used to compose action plans quickly and efficiently and defines effective tasks and follow-up in a visual, agile and simple manner, facilitate the definition, investigation and resolution of a problem. The first table (Table #13) is about information flow issues, the second table (Table #14) is about lack of facilities such as computer equipment, software or road indication, and the last table (Table #15) is about operational issues (long waiting times).

Table #13 – Information flow issues

WHAT	WHY	WHERE	WHEN	WHO	HOW	HOW MUCH
Ability to analyse income and quantify physician's appointments by period of dates	Administrative statistics: no paper required, flash preview statistics and no human resource need.	Administrative	22-01-2019	Me	Database and software statistics development	Volunteer project
Online statistic from medical condition when outpatient arrives to HPSJB	Full knowledge of the number of outpatients waiting for treatment and their severity, improve health care system	Physicians room	22-01-2019	Me	Software statistic development and TV monitor	Volunteer project
Online number of outpatients waiting each medical services.	Provide physicians with information in real-time to make their work more interesting and less stressing	Physicians room	22-01-2019	Me	Software statistic development and TV monitor	Volunteer project
Eliminate wrong or incomplete outpatient data	Increase outpatient safety	Physician appointment	22-01-2019	Me	Outpatient database and EMR development	Volunteer project
Access to past and present outpatient medical records	Increase outpatient safety	Physician appointment	22-01-2019	Me	Outpatient database and EMR development	Volunteer project

WHAT	WHY	WHERE	WHEN	WHO	HOW	HOW MUCH
Reports with alerts for incomplete analyses or data out of the standard values	Improve outpatient outcomes.	LABOR	22-01-2019	Me	EMR and LIS	Volunteer project
Clinic Analyse Report will all patient data						
Send reports to e-mail	Telemedicine, fast delivery, saving paper and print	LABOR	22-01-2019	Me	New software and database develop	Volunteer project
Report haemoglobin statistics	Better knowledge of the population's nutritional status	LABOR	22-01-2019	Me		
Improve outpatient outcomes. Guides the physician into good way to making the right decision about their diagnosis.	Past and present outpatient information is extremely vital in the provision of outpatient's care	Physicians room	22-01-2019	Me	Electronic Medical Records (EMR) systems.	Development informatic network, install hardware and develop AHMS solution.
Match clinical resources to clinical processes.	Handmade medical request and new LABOR identification process	LABOR	22-01-2019	Me	EMR and LIS	Volunteer project
Avoid failures or exchanges of clinical analysis requests. Improve quality and safety	Avoid medical errors due to error-prone analytical reports and reduce costs	LABOR	22-01-2019	Me	EMR and LIS	Volunteer project

Table #14 – Lack of facilities (computer equipment, software, road indication)

WHAT	WHY	WHERE	WHEN	WHO	HOW	HOW MUCH
Road signs	Better visualisation and marketing strategy	Metalwork	08-01-2019	Me	Aluminium plates with reflective material	Donation
Fix the road signs	Better visualisation and marketing strategy	At the beginning of the street	03-02-2019	Dr. Quematcha	Fix on the roadside	Donation
Eliminate manual and transcription errors	Avoid medical errors due to error-prone analytical reports and reduce costs	LABOR	22-01-2019	Me	EMR and LIS	Volunteer project
Standardisation of equipment and connections to LIS	Reduce time to prepare and delivery analysis clinic report. It should be immediately	LABOR	22-01-2019	Me	LIS architecture development to LABOR equipment	Volunteer project

WHAT	WHY	WHERE	WHEN	WHO	HOW	HOW MUCH
Provide the Hospital to have access to free software without setup or maintenance cost.	Follow up the possibility to install in other locations a low-cost solution to decrease heath care problems.	HPSJB	22-01-2019	Me	My contribution to HPSJB and RGB	Volunteer project
New network, routers, switch, server, computers, monitors and UPS.	Connecting all departments to the same network and monitors to show live information	HPSJB	15-01-2019	Me	Equipment donation	Volunteer project
Develop an Automated Hospital Management System (AHMS)	Create algorithms and communication flows with laboratory equipment's, biologists, pharmacists, physicians, nurses, hospital administration and administrative areas	HPSJB	22-01-2019	Me	Architecture, Database, Software, Network and Hardware	Volunteer project

Table #15 – Operational issues (long waiting times)

WHAT	WHY	WHERE	WHEN	WHO	HOW	HOW MUCH
Improving the logistic access to medical care	Eliminate doorman paperwork associated; No need to outpatient leaves ID at doorman; Outpatient can show ID if others departments ask for	Administrative	22-01-2019	Me	Lean Manufacturing and Automated Hospital Management System (AHMS)	Volunteer project
Different outpatient identification and duplicate task	Improve outpatient outcomes	HPSJB	22-01-2019	Me	Lean manufacturing and TDABC approach	Volunteer project
Implement Manchester Triage	Ensure equity of access and well-being to all citizens	Physicians waiting room	22-01-2019	Me	Manchester Triage Software Development	Volunteer project
Speed up access to clinical information, boost lead time performance and improve medical productivity	Clearer medical information and enhancement of healthcare delivery.	Physicians waiting room	22-01-2019	Me	Lean manufacturing associate logistics process, hardware and software development	Volunteer project

WHAT	WHY	WHERE	WHEN	WHO	HOW	HOW MUCH
New LABOR equipment; harmonization of data collection instruments	Reduce time to prepare and delivery analysis clinic report. It should be immediately	LABOR	22-01-2019	Me	LIS architecture development to LABOR equipment	Volunteer project
Reduce waiting time and upgrade quality service	Long waiting times for these services can drive outpatients to opt for another Health Care Locations or to renounce the HPSJB service	LABOR	22-01-2019	Me	EMR and LIS	Volunteer project
Change work habits	Better feedback mechanisms; specialized workforce; data quality control; standard work task, upgrade computer skills.	LABOR	22-01-2019	Me	EMR and LIS	Volunteer project
Assist the outpatient in a regular way.	irregular supply-chain of medical equipment, drugs, reagents and inadequate inventory management;	HPSJB	After this thesis complete	Me	Lean manufacturing tools, software and database	Volunteer project
Reduce the time and errors in sending the medical requisition to LABOR	Physicians use paper to record outpatient health problems, prescriptions and communication for interacting with other departments; Paper files that take up a lot of office space, slow processing of records as well as retrieval of external patient details	Physicians room	22-01-2019	Me	Development informatic network, install hardware and develop AHMS solution	Volunteer project

4 Proposed system: development and implementation

This chapter reviews and describes the progress made in identified problems: the hardware that has been installed and setup, the AHMS developed, the Manchester Triage and EMR implementation, the new LABOR internal logistics, the volunteer benefit and cost analysis.

4.1 Information technology equipment

Wired network

All hospital departments, such as the hospital reception, clinic services, urgencies, medical specialties, social assistance, clinic laboratory and administration, started to use the same hospital IT network and software so they could share information.

The wired option was more attractive than the wireless option because the connection stability is stronger between computers and other devices. Also, there are a lot of walls and different buildings that increment noise to wireless function because wireless signal becomes weak due to distance, the distance between buildings and having to go through walls.

Considering the stability of the connections, ditches were constructed and cables were installed through the buildings to link the server to the main departments and offices (see Picture #26, Picture #27, Picture #28 and Picture #29 in Appendix 1).

The wired network selected was UTP CAT6 that allows 250 MHz signalling and speeds of 1 Gbps up to 100 meters. Under the right conditions it can support 10 Gbps up to 30-50 meters. There are better than this wired cable solution such us CAT6a and CAT7 with fire protection and these admit 5G speed but are more expensive. The most expensive solution is the optical fibre network solution with fibre cable, switch, sockets, equipment to make fibre fusion and equipment to analyse the optical fibre network are awfully expensive and need qualified operator. Also, the maintenance of fibre network should be made only by personal qualified personal with professional equipment and it is exceedingly difficult to have both conditions in the RGB. These options were not justified in this context because they are out of budget and above current needs and those of the coming years.

The network sockets and cable paths spent 2 coils of UTP cable CAT6, up to 600 meters through clinicians' offices, urgency, RX, triage, laboratory, reception, account and administration office.

It was essential that the network links the IT office with all main departments and hospital offices (Figure #20).

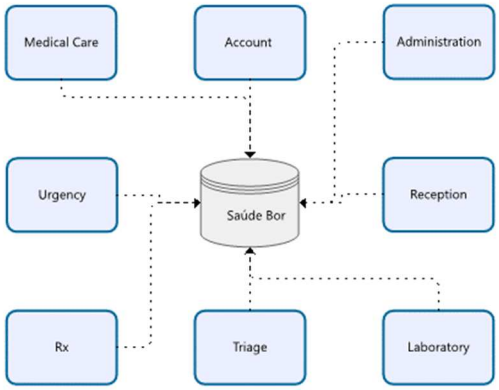


Figure #20 – Network Architecture

This architecture aimed to replace manual processing of outpatient info and laboratory results avoiding unnecessary duplication.

The outpatient records, that were currently stored in several locations, is kept in one central location which makes it easy to analyse and interpret the data. The database is backed up daily and stored in the cloud and since the data is compressed, the size of the file is less than 20 MB because the backup type is differential option. Due to a very unstable internet in the hospital, it is always important to get possible a flash upload.

All rooms were connected to the server by adequate network hardware which were thoroughly tested.

Testing wired network and sockets

For testing wired communications, a cable test (Picture #23 in Appendix 1) was available. This was useful to test communications between each end and the correct 8 sequence colours where respected. A better and professional equipment (Picture #24 in Appendix 1), that we haven't, can test the quality signal and detect if some of the 8 wires is broken and identify with precision the location of the broken cable.

Server

On the IT office has been installed one server for database, ups, access point, switch and all hardware was purchased from a reputable manufacturer (Picture #30 and Picture #32 in Appendix 1).

On the same range, the HPSJB bought one server where was possible to install and still use one robust database that can be accessed by all departments and offices without time restrictions. That database hosted and still host the main necessary data and the server was linked to wired network between server box, medical office, laboratory, administration, pharmacy, RX and reception.

SQL Server

The database was designed and created by using Microsoft SQL Server Express (64-bit) and the management by SQL Server Management Studio (SSMS) was installed on the new server. SSMS is an integrated environment for managing SQL infrastructure. SSMS provides tools to configure, monitor and administer instances of SQL Server and databases. The SQL Server does not require extra payments and no licenses for users are needed.

The software was developed using Microsoft Visual Studio Community 2019 tools and only authorized staff with user registered can use SB software using their own password to gain access. To each person was given different access according to the responsibility of their function.

UPS

The server needed a Unit Power Supply (UPS), which offered the best protection for all electronic systems sensitive to power cuts, micro-cuts and other electrical disturbances that could affect or interrupt operation. A UPS provide safe, uninterrupted, quality power to all connected loads, ensuring correct and continuous operation[9].

The server was placed in LABOR facilities which was a strategic point to reach every hospital room. Another advantage of this option was easy to keep an eye on it was safe and climate controlled.

Switch and sockets

The network project (Picture #7 in Appendix 1) used two switches, CISCO #1 and CISCO #2, with 24 ports each. They were donated from Portugal. The CISCO #1 was installed on a server box and then linked to the router, the server and 20 sockets. The CISCO #2 was installed in another building and linked to CISCO #1 and 21 sockets.

All connections to the 2 switches were tested and found stable and so internet connection. The sockets were tested by cable test and laptop.

Internet and PC

The internet infrastructure was also moved from administration room to the room where the server was located as this avoids interruption of the administration when maintenance was required. It was possible to join all main network hardware in the same room.

The internet router was changed by another professional draytek device.

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[9] https://www.salicru.com/pt-pt/ups-por.html

Were assembled and test new computers for six medical room, one for waiting room, one for Manchester triage and one for the pharmacy.

Laboratory equipment

In the Laboratory, one of the most expensive pieces of equipment (hemogram and biochemical) were replaced by ABACUS (Picture #34 in Appendix 1) and A15 (Picture #35 in Appendix 1) because the maintenance and operating costs were lower and they had recently communication protocols.

Lab hardware equipment

The printer Zebra GK420T USB Printer was used to print labels to identify the biologic sample.

When outpatient went to LABOR the user received the bill with the analysis described and several labels required for biologic samples to help the biologic sample identification.

Those two elements were delivery to the laboratory technician who double checks the PID and the number of laboratory test to collect the biologic sample from the outpatient.

Either install and setup the Zebra USB barcode reader on laboratory equipment so guaranty the correct biologic sample identification.

Also, there was a Zebra ZXP 1 for PID Cards (Picture #36 in Appendix 1). At a next visit to the hospital, the Outpatient only showed the LABOR card.

Webcam

The professional web cam (Picture #34 in Appendix 1) allowed web meetings with administration, LABOR and medical staff. Organising web meetings has improved the level of confidence and happiness at work and resulted in increased productivity.

Installing a webcam improved the stakeholders communication, including physicians, administrative, hospital administration and laboratory staff.

4.2 Apply methods to improve value for outpatient

This study intended to analyse the departments that were engaged with the outpatients. Each department had its own specifications.

The value proposal allowed a more efficient operational and logistic organization and increased manufacturing skills, medical assistance and medical care using standardized processes and low-cost solutions. All possible with stakeholder's engagement.

Some of the practical implementation and policy guidance from the research included:

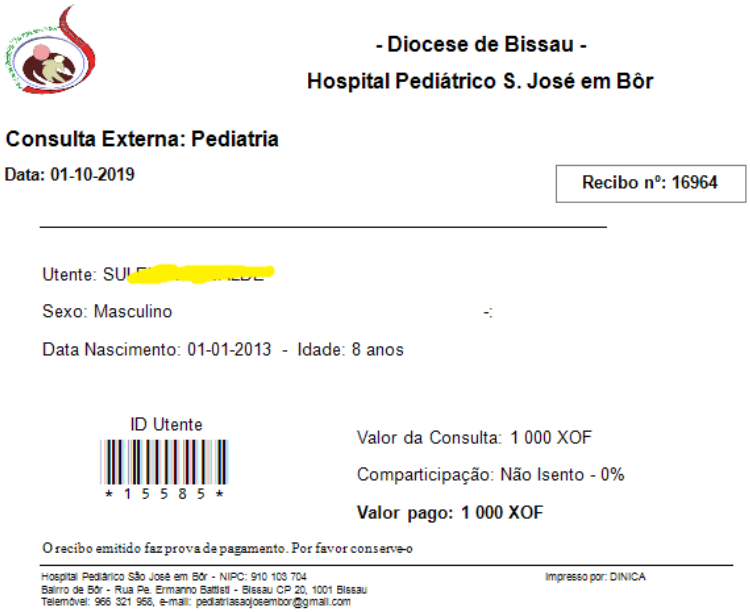
- Choose a system which allowed a range of needs to be met, rather than make compromises for a clinical or a business system, and an EMR which served this system,
- Choose a EMR which worked for clinical personnel and had proven to saved time. If personnel do not think that saved time, then the implementation was significantly more difficult and possibly impossible,
- Draw and created the conditions for a Lean transformation,
- The system was easy to develop and modify for the different departments and users,
- Enabled people to interact and communicated no matter the distance between them,
- Made it easier to share information between providers and their outpatients,
- Results in lower transcription costs, medical errors reduction and improvement of quality care and standards in outpatient safety,
- Designed a continuous flow because was central to Lean thinking. This was where the outpatient moves from one step in their journey to the next without delay. It was the most efficient way to manage the process reducing waste to a minimum.
- The "Seiri" (sort) for sort through materials, kept only the essential items needed to complete the procedure. This 5S tool involved going through a workspace to determine which items were needed and which was removed. Everything that was not in use to complete a work process leaved the work area. The new approach pretended to design and linked network departments and laboratory equipment. So fewer paper forms and paper reports from the equipment were necessary.
- The "Seiton" (set in order), ensured that outpatients were organized and each outpatient had a designated place.
- Proactive efforts to kept workplace areas clean and orderly to ensure purpose-driven work. This means cleaning and maintaining the newly organized workspace as it was described the "shine" or Japanese Term "Seiso".
- The "Seiketsu" (standardize) created a set of standards for both organization and processes, for example making rules for how and when tasks were performed.
- The concept of the Three Mus has here wide applicability because enabled to balance capacity and the demand.
- The Visual Management has improved the understanding and speed the interpretation of events, either in paper output or on SB application.

4.3 Move to AHMS

The working mode has changed from paper to electronic option. New workstation with SB has joined the PID in just one place – the SB Software. These evolutions were lighting by LM tool that promoted new routines and standard work that resulted in huge with advantages that will be mentioned along this presentation.

Inside administrative management, SB was used by human resources, informatic staff, accounting, treasury and reception staff. SB was intuitive and required little training.

During the inscription, the HPSJB registered PID with SB that shared this information to all departments and no need to register again much less in paper form.



- Diocese de Bissau -
Hospital Pediátrico S. José em Bôr

Consulta Externa: Pediatria

Data: 01-10-2019

Recibo nº: 16964

Utente: SUL [redacted]

Sexo: Masculino -:

Data Nascimento: 01-01-2013 - Idade: 8 anos

ID Utente

* 1 5 5 8 5 *

Valor da Consulta: 1 000 XOF

Comparticipação: Não Isento - 0%

Valor pago: 1 000 XOF

O recibo emitido faz prova de pagamento. Por favor conserve-o

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Telemóvel: 966 321 958, e-mail: pediatriasaojosembor@gmail.com

Impresso por: DINICA

Figure #21 – New admission invoice

The new admission invoice has visual management tools. The code bar and the hospital design.

In all Hospital services, when the outpatients establish the first contact with the reception services, the PID record has become electronic, so all departments now have access to it at the same time. All new outpatients visiting the hospital have an electronic record created for them.

Some tasks, paper and time have been eliminated, such us:

- book register next to the doorman when the Outpatient goes in and goes out the Hospital,
- excel register,
- handmade ticket,
- administrative co-funder paper book register

The Figure #22 show what was thinking to improve hospital logistic.

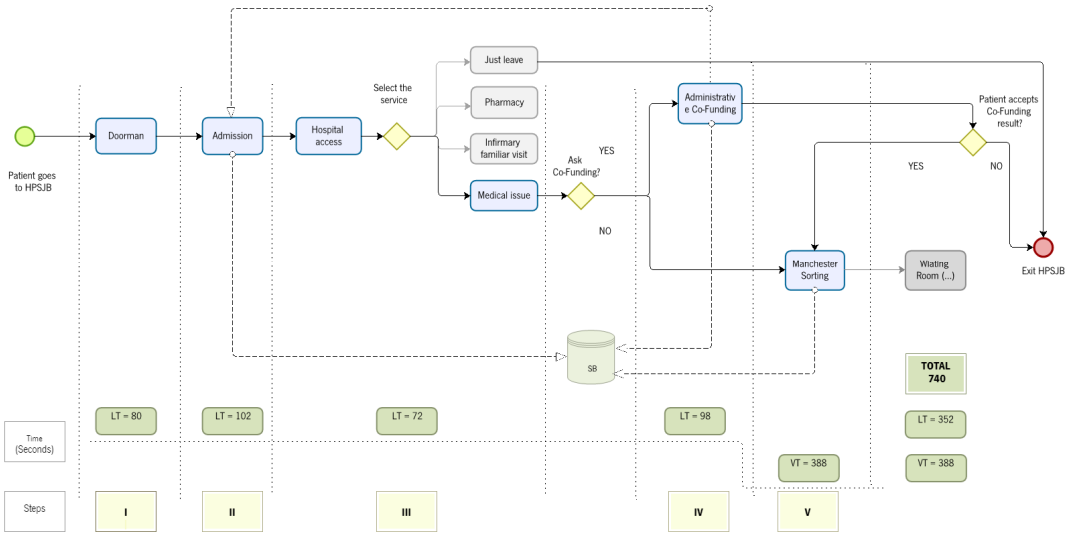


Figure #22 – Primary care redesign

And improvements were visible for all stakeholder, like Manchester triage.

The task: 'Book register', 'Excel register' and 'Handmade ticket' were merged to one single step: the admission with the automatic invoice print (Figure #53).

For the reception they need PID, invoice and summarize day end.

The average of total time decreases from 1,500 seconds to 740 seconds (more than 50%) and that was a huge benefit to children and women pregnant that came with serious health condition. They are now accepted more quickly and all outpatients have the same PID over the Hospital services.

Accounting at the end of the day has become a procedure almost instantaneous.

For administration, was important to have one report with the number of outpatients and total income for period for medical appointment and LABOR service. The SB software show that information and another report for co-funder.

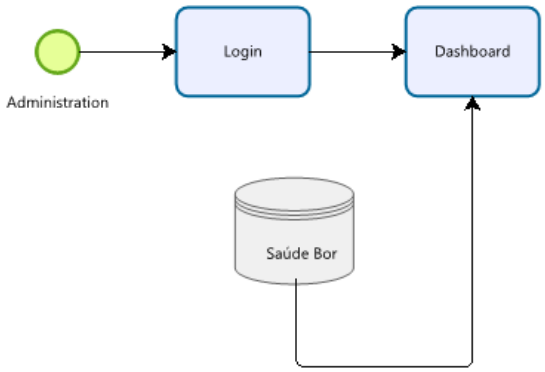


Figure #23 – SB architecture for administration for follow and end day

Figure #24 – SB Administration's Menu

4.4 Manchester triage

The Kaizen methodology, for improving processes and performance, goes on the way of reducing waiting times of patients who required major health care. There was special focus on local consideration and engaging the different actors involved, including the viewpoint of the patients and the Hospital. It was also fundamentally necessary for outpatient waiting list to physicians' appointment reflect the reality.

Manchester triage (Figure #26) was a big quality jump and that includes the 5S's practices, the "set in order" that ensured that all outpatients were organized by severity of the health condition. Organize all outpatients queue with live information screen in a logical way, made tasks easier for physicians. Nurses and physicians no longer needed to bend or make extra movements to ask or reach outpatients with acute health conditions.

Here the technics used SB software to call the outpatient (windows form update with reception data). Then registered the vital health signs on the SB and, according to the health conditions, gave a colour to the outpatient.

With Manchester triage the medical staff saw online how many outpatients were waiting for care and how serious their health problems were. These online information's were available on a computer monitor or TV screen like stock market and were particularly important to treat and gave updated outpatient health conditions every time to medical staff so physicians could react on time. The menu had the detailed data: who, what, where and how much. The tag ranges from blue "no problem" to red "emergency case".

This standard procedure saved time and manpower and decreased the time that physicians and care providers taken to communicate. This saved time could then be well spent for outpatient care, which would decrease waiting times for outpatients.

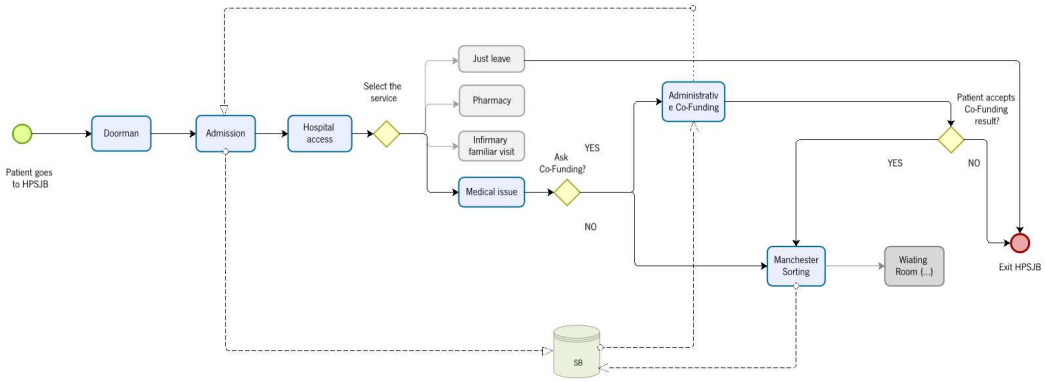


Figure #25 – New administrative logistical model proposed

The Manchester triage was developed with one form with SDE, so user never use the free-text option because this way is more efficient.

This form was made with visual management consideration. The tag colours equal to health relevance.

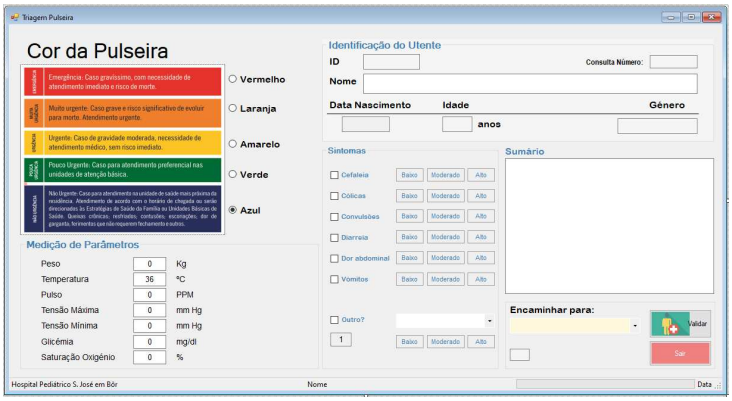


Figure #26 – Manchester triage

Using a serial number generated according to the appointment time, the outpatient assumes that the number is lower than another outpatient and has right to be served firstly.

The colour tag helps to understand and respect the health severity priority. So, after reception and PID registered, the medical specialty typed and the bill printed, the outpatient was forwarded to Manchester triage and had a colour tag associated to the health status. All stages were recorded in the same database without duplicate task or information.

The summary text was automatic according to the severity of symptomatology and the outpatient was referred for medical treatment (Figure #27).

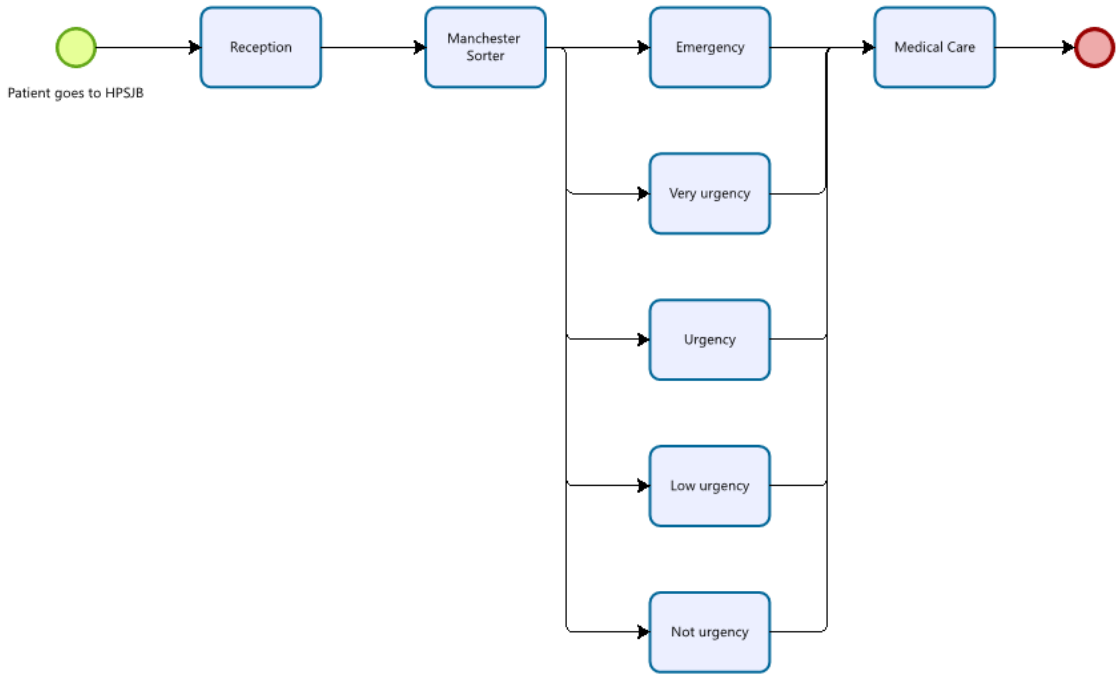


Figure #27 – Outpatient internal logistic until medical treatment

From this point, medical staff was able to see live workload score (Figure #55).

The great benefits were people attended by priority health status and arrival order. More and better medical attention to children and pregnant women because 100% of special care were visible on the screen, so physicians and medical staff made best decisions and potentially saving lives.

The SB software and new outpatient flow resolved Hospital logistic problems Issue #1 until Issue #10.

4.5 Move to EMR

For physicians, important stakeholders, it was important to have access to outpatient history, info of prescription drugs that physicians have been prescribed to outpatients without errors or gaps, to allow prioritization of treatment of children and pregnant woman who were in urgent need of emergency treatments.

Using EMR, physicians were enabled to identify those outpatients that were in greatest need to be treated. The electronic outpatient information entered were input by reception.

SB Software was used to register the PID and the same record was used for obtaining a prescription (Figure #29).

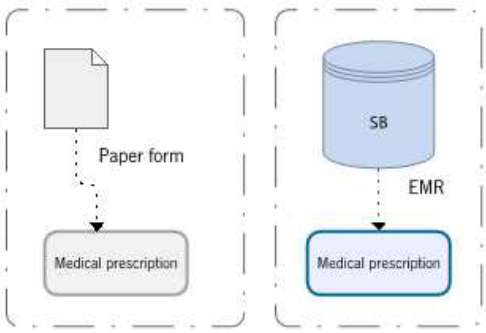


Figure #28 – Change to EMR

Basically, the physicians only needed to press buttons. It was created with the intent to be user friendly, easy, intuitive and fast.

Here the outpatient knows how much it cost and the data were saved in SB software. At the same time, LIS and the administrative co-funder had instantly electronic access.

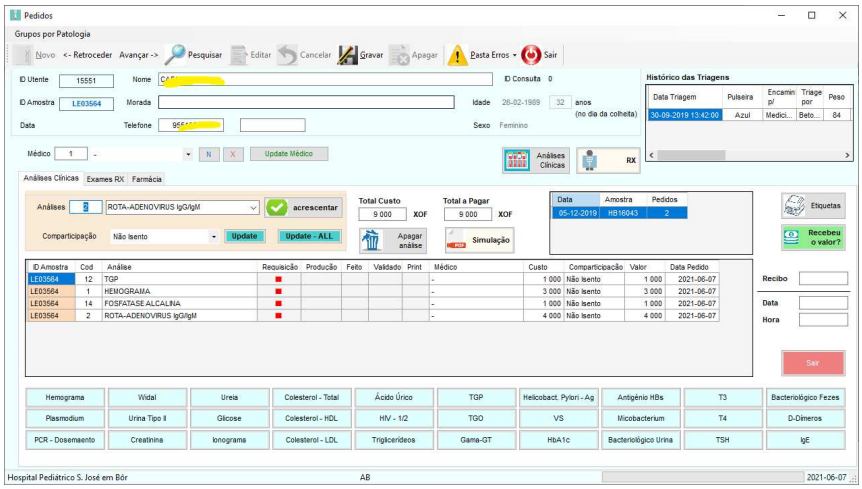


Figure #29 – Medical requisition

This menu (Figure #29) shows important information such as PID, analysis clinics history, Manchester triage history and invoice so the outpatients went prepared to LABOR reception.

In order to physicians understands at what stage of the process are the biologic samples, was created, on this menu, a table with all physician request and the actual laboratory stage – another visual management application.

In conclusion, the physician can easy view the Manchester triage report and call the outpatient based on their health priority. Physicians have security information about health outpatient situation and during the appointment they could send analysis clinics medical request directly to LIS, fast, instantaneous and without errors, misunderstandings, erroneous test results or lost requisitions.

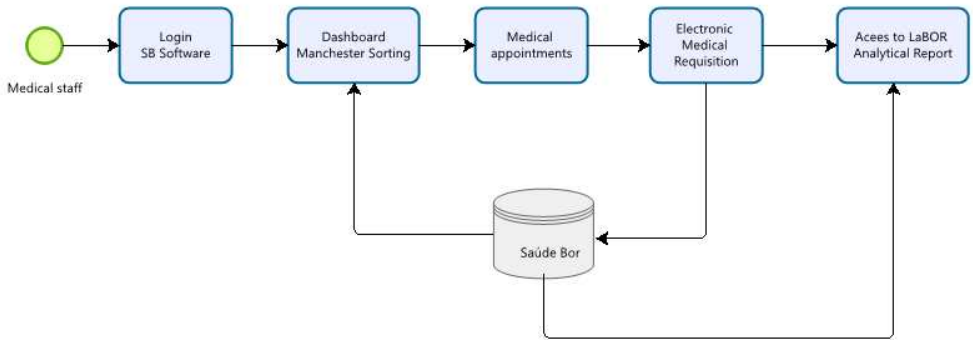


Figure #30 – SB Architecture for working day physicians

The great innovation was that the physician and the outpatient could receive the LABOR analytical report on a PC or mobile phone by e-mail promoting the telemedicine. There is a shortage of medical specialties and the possibility that LABOR offer to share the analytic report instantly grant greater health security for outpatient.

Outpatient and co-funder request

Using EMR, outpatients received the information on the cost of the medical treatment. After that, the outpatient decided if they can afford it in the LABOR or if they went to the administrative co-funder and asked for contribution. These situations avoids losing time in the queue of the LABOR and was the best decision asking the co-funder first.

PID LABOR

To draw all system was important to know what information that were useful to input to each department and function and the information available to show, who could get access to write, to read and to print information. There were selected people who can only read, there were people who can only write and there were people who can had access to read and write.

When physicians saved the medical request, those information's were immediately available on the LIS.

On the LABOR, the SB software shortened the time required and data errors like PID, bill, medical request and all the embarrassment that comes with it. Issue #12 to Issue #16 were successfully solved. The Analytical Laboratory had the intent to use the flowchart depicted in Figure #31.

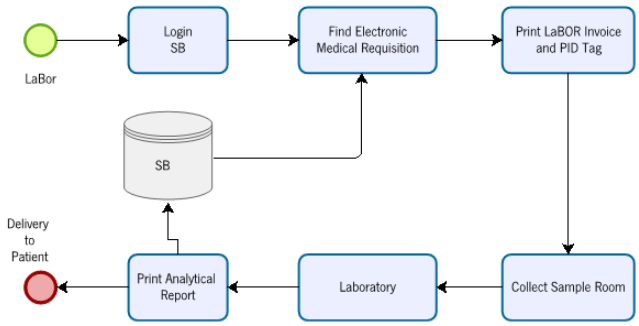


Figure #31 – LABOR Flowchart

4.6 LABOR internal logistic

Continuing scaling time rentability, the focus was creating standard models in the LABOR due the high importance to service the children, pregnant woman and other outpatients as soon as possible with high standard quality values with clears evidence. These were the challenging.

For LABOR was important to make sure they could work organized and with bullet-proof procedures and LABOR LM. Total guarantee there were no sample change or sample loss, not misunderstand the PID or misunderstand sample ID.

So, steps were eliminated in order to reduce delay between tasks and combined steps to prevent wasteful delay, simplify the system/process, review the sequence of events to support greater efficiency and upgrade the logistic LABOR flow. Example of making rules for how and when these tasks were performed: print bar code labels after admit outpatient and use the same bar code to identify each biologic sample. During the collection sample all biologic sample were identified on outpatient eyes and drove to the laboratory for testing. The equipment reads the sticker, with barcode reader, instantly and without errors and on the end the equipment saved data directly to LIS with HL7 standard protocol and no need to wait for 2 p.m. as it was before.

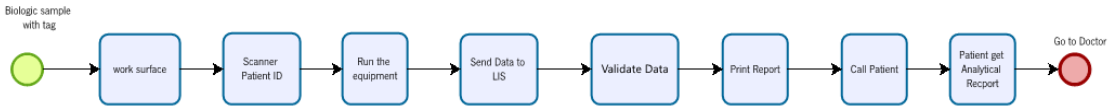


Figure #32 – New LABOR production logistical model

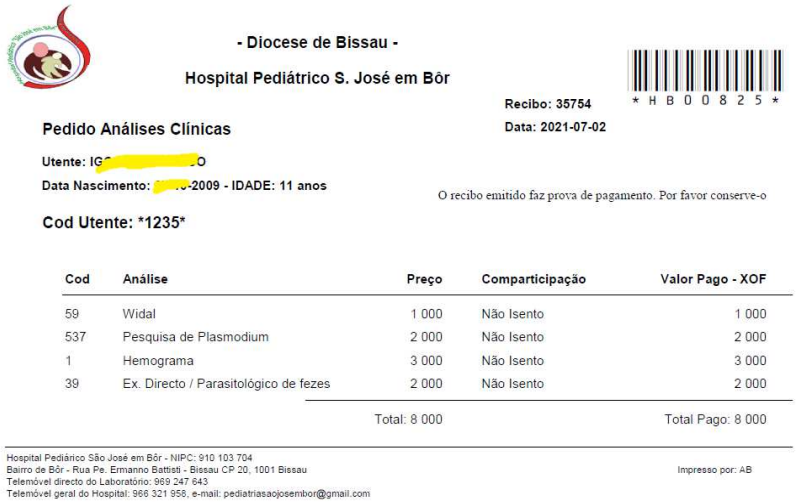
When all medical requests were ready and data had been sent to LIS the head LABOR technic could validate (new and quality important activity), print the analytical report and gave to the outpatient. This transformed the reality that was described on Figure #10.

So, the innovation was that physicians made medical requisition directly to LIS from SB software. The LABOR only needed to receive the payment, print the sticker and identify all the samples.

Another innovation were the transmitting events. The main laboratory equipment's started to transmit data directly to LIS.

In sum, the great advantages were:

- The laboratory receives automatic electronic PID from reception and electronic medical requisition directly from the physician,
    - reduce 100% time to introduce PID,
    - reduce 100% PID errors,
    - reduce 100% medical gaps or analysis change,
- After the outpatient pay the LABOR bill, received the invoice with the description of all exams and price on transparency way and equal to every patient (Figure #33).



- Diocese de Bissau -

Hospital Pediátrico S. José em Bôr

Recibo: 35754

Data: 2021-07-02

Pedido Análises Clínicas

Utente: IG[redacted]O

Data Nascimento: [redacted]-2009 - IDADE: 11 anos

O recibo emitido faz prova de pagamento. Por favor conserve-o

Cod Utente: *1235*

Cod	Análise	Preço	Comparticipação	Valor Pago - XOF
59	Widal	1 000	Não Isento	1 000
537	Pesquisa de Plasmodium	2 000	Não Isento	2 000
1	Hemograma	3 000	Não Isento	3 000
39	Ex. Directo / Parasitológico de fezes	2 000	Não Isento	2 000
		Total: 8 000		Total Pago: 8 000

Hospital Pediárico São José em Bôr - NIPC: 910 103 704
Bairro de Bôr - Rua Pe. Ermanno Battisti - Bissau CP 20, 1001 Bissau
Telemóvel directo do Laboratório: 969 247 643
Telemóvel geral do Hospital: 966 321 958, e-mail: pediatriasaojosembor@gmail.com

Impresso por: AB

Figure #33 – Invoice for outpatient

- The outpatient came with the feeling that they were well treated and has made it possible to reduce by 100%
    - mistakes or gaps or misunderstand,
    - and confusion with analysis prices,
- New label with unique barcode prints the PID and the collect sample time and this label allowed:
    - to reduce the errors of biological sample exchanges by 100%,
    - to ask and confirm PID on the biologic collect moment.
- The label was glued on the sample while the technic confirmed all label data with the outpatient.
- The LABOR equipment scanners were used to read barcode that was used to identify the biologic sample:

- this has reduced by 100% sample typing errors on the LABOR equipment,
- LIS transmission converted the report machine into SB Software so physician's had PC access automatically with no transcribe errors,
- This reduced transcribe errors by 100%.

Implementing the Pull System was enthusiastic. Each LABOR work cell has a monitor with a dynamic work list. They knew the biologic samples to be analysed so they, on the works end, could validate and send information to LIS.

If some thing or someone was missing, the final analytical report prints one missing message.

Some Heijunka or Levelled Programming examples are: send data from LIS directly to the equipment (Figure #34) which minimised chances of overload, chances of errors and the production takes place according to demand. The biochemistry equipment was able, in one shift, process all normal biological samples. In case of urgent requests, the SB had the option to process the urgent sample immediately.

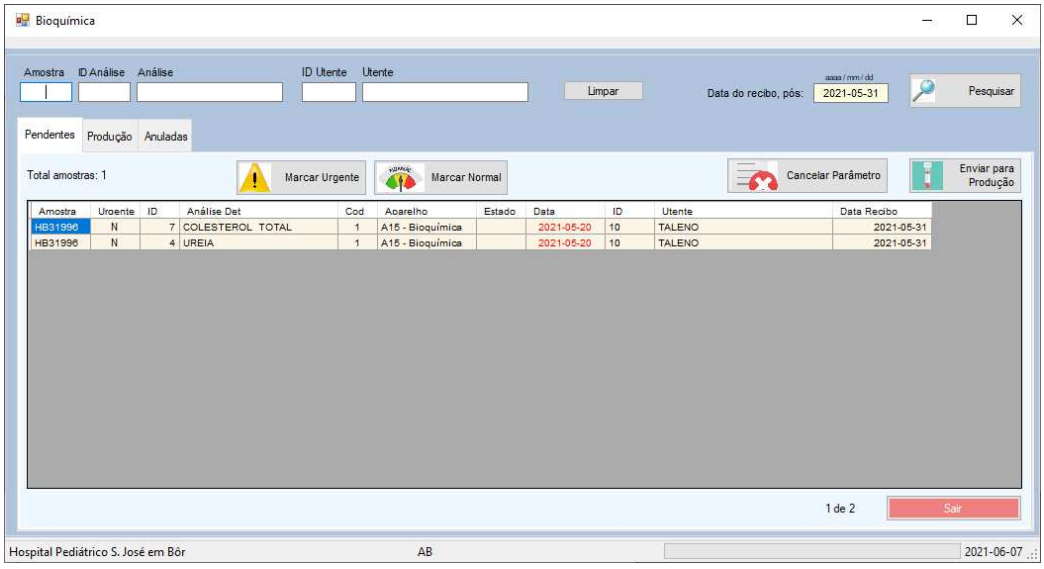


Figure #34 – Send data to equipment

On the way reverse, send data from equipment directly to LIS

More visual management applications were implemented as it can see in Figure #35 and Figure #36. The first one show red numbers that means they are out of normal value range. The signal (+) and (-) means higher or lower than normal range considering patient sex and age. Both forms have one orange icon, on the button form, that reports to operator if there was data cable disconnected from the socket. In this case, the operator only needs to verify and plug in the USB cable and them the message disappeared automatically. The second form had a green stamp visible after the biologic sample was transmitted and accepted by the technic.

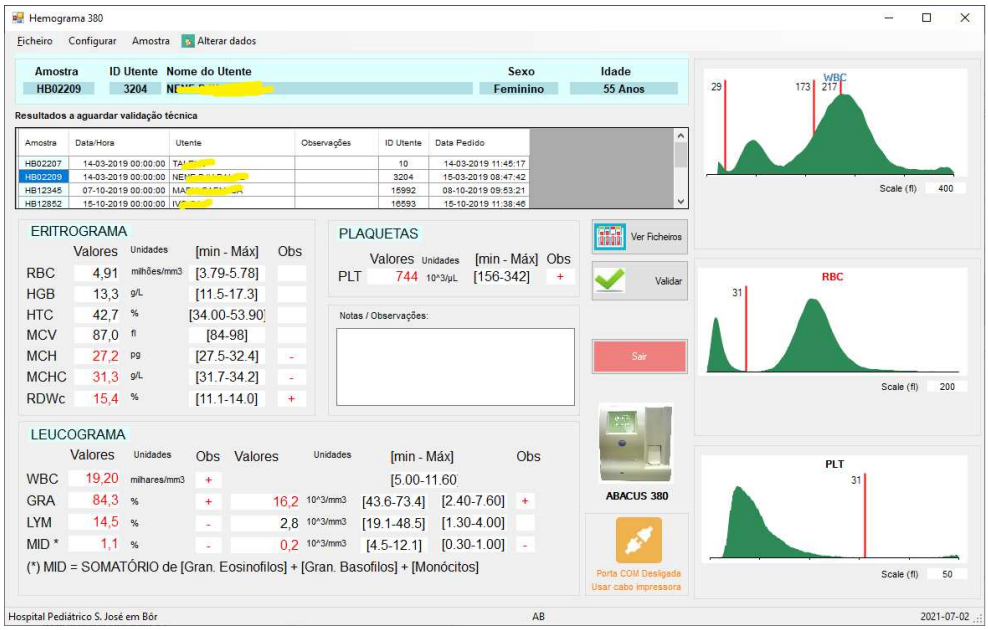


Figure #35 – Receive data from equipment

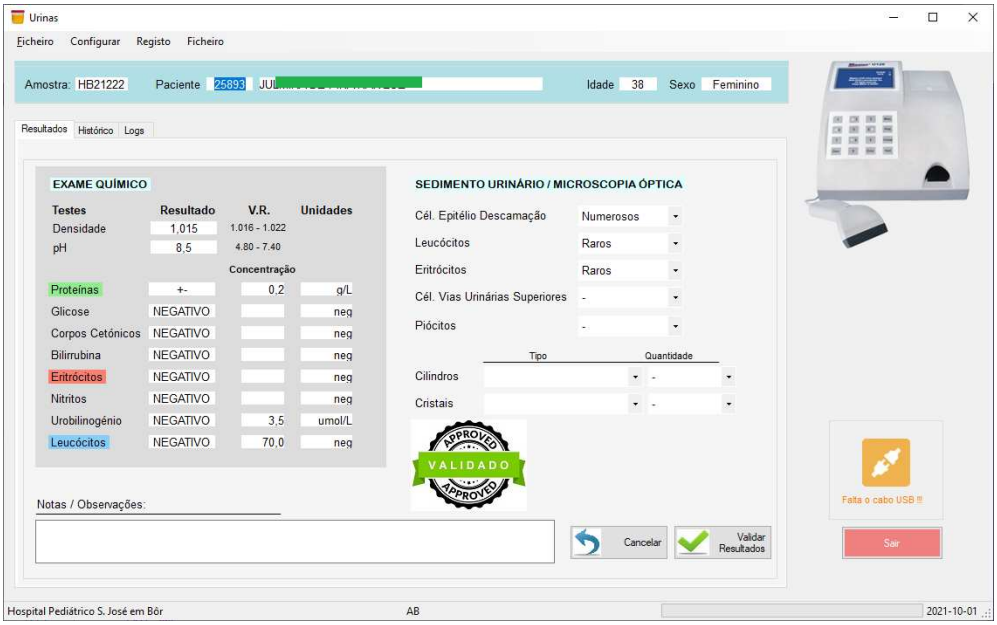


Figure #36 – Receive data from equipment

There is a form (Figure #57) that prevent missing test results and the final report broke new ground with an incomplete statement in case there was still analysis to be carried out or still to be validated with the inclusion of description and barcode (Figure #59) - this reduced to 100% the incomplete reports to outpatients. Physician had instantaneous access to the analytical reports after validated by LABOR.

Two horizontal marks, which were marked in green (Figure #60), that helped save half time to fold the A4 sheet into 3 equal parts.

Optimize workflows and efficiencies, improving outpatient outcomes and clinician satisfaction, enhance outpatient engagement with:

- complete reports and correct results,
- analyse and quickly mobilize clinical data for reporting, real-time assessment and ongoing quality improvement,
- collect data from most important laboratory equipment and manual techniques and share them instantly to the physicians as needed. Then, analysis and equipment's statuses can be followed live by all the LABOR techniques. Productivity can also be analysed instantly from Portugal,
- provide the solutions on many different devices to improve flexibility and effectiveness: computers, tablets and smartphones. All of them are connected to a central network infrastructure by wired or wi-fi.

Great new image of security, quick and work LABOR and Hospital efficient. Much better than the past.

After all sample requests were complete, like this example Figure #58, there were 8 required exams, 1 exam was rejected and there is no exam in production or waiting for confirm stage. The operator can print preview, print or send by e-mail the analytical report.

This is analytical information that physicians need to take care the outpatient and give the correct medical prescription. It is possible to send by e-mail to outpatient, to the physician or both.

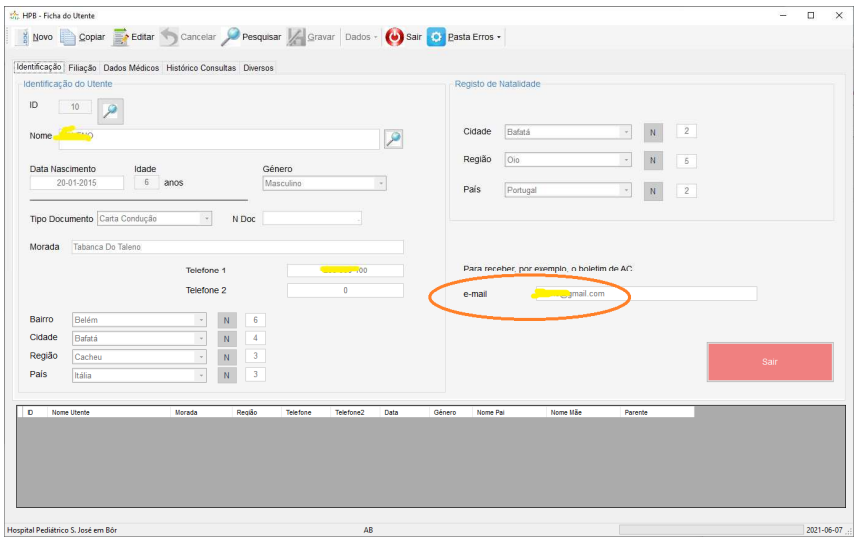


Figure #37 – Outpatient record

4.7 Volunteer benefit and cost analysis

Peace Corps was the first organized combination of volunteer work and travel abroad created by President John Kennedy on March 1, 1961. Peace Corps was a mission set forth by President

Kennedy during the height of the Cold War with a public service mission. Volunteers began serving in five countries in that year[10].

The benefit and cost approach are based on theories from several disciplines: social exchange (psychology), resource mobilization (sociology), and political economy (political science) (Chinman and Wandersman 1999a).

4.7.1 Material benefits

Is easy to accept that volunteer, the labour for free, discourages organization from doing benefit – cost calculus. Eventually more often them not, neither the volunteer neither the organization try to think in productivity volunteer vs productivity paid work or volunteering cost and benefits.

One of the most totted benefits of voluntourism is the potential for increased or faster economic development (Stein, 2017).

For the volunteer there are great as tangible benefits as acquire skills, develop skills, develop strategies, social networks, news places, new people and the résumé is vastly improved.

There is no unfinished project that the local community has neither the time nor resources to finish.

The SB project is an ongoing, continuous, project and will grow for further skills like pharmacy logistics and a more integrated supply chain (including to external parties).

For HPSJB, it already increased levels and quality of services, as well as reduced staff workload.

There are authors, like (Daldeniz et al., 2010), that describes the main driver for volunteers is the enhancement of their Curriculum Vitae (CV), gaining new skills and field experience, in order to find employment within their desired sectors or needed the experience as a credit in his university degree or doctoral research.

4.7.2 Emotional benefits

After emotions

Other benefits, not tangible, are the training, great work environment, respect of your attitude, feeling appreciated, large and genuine friendships are made, great days always with huge levels of happiness, pull of international adventure and a break from corporate burnout, the human interaction and a deeper understanding of personal privilege on the side of the voluntarist. We

[10] https://www.peacecorps.gov

come home with a sense of fulfilment that we added goodness to the world and that the volunteering aspect was the biggest highlight of their trip (Wood, 2010).

We meet another and great world. They are happier than us. We feel very loyal people toward the hospital. They socialize much more than we do. They celebrate the end of the day with more intensity than we do on new year eve.

This is a better experience than a school-leaving trip but both are important to understand and feel the differences and the purpose. I always think and thanks to my father-in-law, the pharmacist with a medal of honour of the board of pharmacists, this great moment of live that he proposes to me (Picture #20 and Picture #37 in Appendix 1). The status of an individual as volunteer enhances his or her utility for the society. When I returned from my trip, I felt a sense of fulfilment and a desire to travel more. We can develop peer network with people with the same values.

The motivation

The desire for young adults to travel and explore the world or to get away from a job or career that had left many of them with a sense of frustration but that is not my reality transform ordinary people in volunteer. They attempted to gain additional skills and experiences to build on their existing training in order to achieve a career change or a change from the private into the NGO sector or the desire to travel the world and live abroad for an extended period of time or wanted to "do something useful" (Daldeniz et al., 2010).

Volunteer tourism or voluntourism generally defined as an activity in which people decide to volunteer in development or conservation projects and is one of the fastest growing alternative tourism markets (Abreu and Ferreira, 2020) as one period of engagement and contribution to society.

A large variety of different motives for international volunteering were found: thirst for adventure, travelling and exploring the world, improving is cultural understanding and language skills, escaping from everyday life, the opportunity to gain work-related experience, finding oneself, help others, do good, feel useful, make the best of a bad situation or make a difference to others, the seek for cultural immersion and camaraderie, work experience and skills development, the personal development, a more intercultural competence and language skills, a better international knowledge and understanding, more civic and global engagement, so all these aspects can be considered as part of a bigger group called Professional Growth.

Other possible answers are willing to serve, helping the needy, contribute to reduce the global inequalities, transmitting knowledge and learn how to be humble (Abreu and Ferreira 2020).

Pre-trip conversation

A pre-trip conversation of the receiving country's history and the power dynamics at play in a 'help-based' relationship should be a required prerequisite of all voluntourism trips (Stein 2017).

The soul

Note this project is a personal project. There is no link, no participation and no sponsorship and no kind of agreement with any external company, organization, politician, institution or lobbying.
The most important resource that volunteer groups have is the volunteers themselves and the effort they forth (Chinman and Wandersman, 1999).

Post-trip

There is empirical evidence that higher levels of health, social status, and education are correlated gone with higher levels of happiness and these characteristics often generate a positional advantage over those who possess lower levels of these resources.
Almost all, 96%, managers believe that workplace skills can be gained from volunteering – including self-confidence, 50%, an understanding of social and cultural issues, 48% and teamwork, 43%. As many as 73% of managers believe that volunteering can increase the well-being of staff and 68% agree that it makes for a happier workforce (Gammon and Ellison, 2010).
This voluntourism it definitely is entirely positive. Were build models based on a community's needs rather than imposing ideas of right and wrong. Volunteer is for the sake of the public good.
The HPSJB benefits included increased public support, improved community relations, services that otherwise would not have been provided, contribution to the relationship between the hospital and local communities enhanced outpatient satisfaction scores and more detailed attention to clients.
A post-trip debrief should help the voluntarist to understand their feelings and evaluate the impact of their trip, both negative and positive (Stein, 2017).

4.7.3 Emotional costs

There are powerful volunteer tourists who have enough discretionary economic resources and with less powerful the host communities who are deemed "poor enough" to place them in the position of being 'volunteered' (Stein, 2017).
Most of the time was spend working for the hospital and not making tourism or looking for good meal. We are far away from family and friends (Picture #39 in Appendix 1).

Volunteers seen as substituting for or receiving greater recognition than paid employees could create negative morale. For that reason, there was a great stakeholder's involving (Picture #40 in Appendix 1).

In my way all the happiness that was described is must better them the cost and this is not short-term trip.

Other point of view is neglect of locals desires and customs, wrong motivations of the volunteers, the bad coordination of the volunteer activities, the abandonment of the projects, the neglects of the host needs and desires and the consequent future dependency (Abreu and Ferreira, 2020).

4.7.4 Tangible costs

The individual cost are vaccination and preventive medications, transportations, lodging, food, local transportation, local connections and internet access, leisure, foregone earnings or change holidays plan.

For a type of trip related with mission to improve healthcare services, a cost of 10-20 days trip without airfare can be $3,251 up to $3,575 in Africa (Stein, 2017).

For HPSJB there were no habitual volunteer costs like recruiting, training, managing, supervising volunteers as well as nonlabour costs such as the provision of space, computers, refreshments, uniforms, insurance, security checks, and health testing. We don't know how to measure the value of volunteering.

Since everything in our society is measured in monetary terms, we automatically attempt to construct a money-based measurement tool and assign a monetary value. Since work is valued by what it is paid, we apply the same thinking to volunteering. This generates the simplistic "replacement value" approach: add up the hours of volunteer work, assign some replacement value (what it would cost if you had to pay a person to do that same work), cut that replacement value by at least a third (because you don't ever want to be accused of inflating the value of volunteers work so you underestimate it) and report that figure in the justification for the next year's volunteer program budget.

The current estimated national value of each volunteer hour is: $28.54, updated April 2021[11].

We supplement the replacement value approach by counting everything that is countable: how many volunteers, how many hours, how many drives, how many meals delivered, how many calls

[11] https://independentsector.org/value-of-volunteer-time-2021

taken, how many clients seen, how many children taught, etc. We want to be scientific and counting generates numbers that seem scientific. We measure success by achieving bigger numbers this year than last year. The problem with the counting approach is that it shows we are very busy, but it hides whether we have accomplished anything! (Writer and Graff, 2001).

Public goods, if provided at all, have to be, or are best, supplied to all members of a group. But if this is so, the most rational course of action, for a self-interested individual, is to take a free ride, to enjoy the benefits of the collective goods without contributing to the costs (Udehn, 1993). This phenomenon is called the free rider problem.

Free-riding is not a problem if the group is small, or 'privileged', which means that 'each of its members, or at least some one of them, has an incentive to see that the collective good is provided, even if he has to bear the full burden of providing it himself. This happens when the value to any one individual (Vi) of a collective good is larger than the total cost of its production (C), when, therefore, the advantage (Ai) to this individual is a positive sum; when $Ai = Vi - C > 0$.

In small groups, there are also a number of social incentives at work, friendship, social status, prestige, etc. But, as the size of the group (Sg) increases, there is a decrease both in the relative importance of each individual's contribution to collective action and in each individual's share, or fraction (Fi), of the value of the collective good for the group as a whole (Vg). The formula is: $Fi = Vi / Vg$.

In the intermediate group, no single member benefits enough to supply the collective good for the group. But an intermediate group is not large enough to let a free rider remain anonymous. Hence, there is the possibility of obtaining collective (Udehn, 1993).

5 Discussion of results

This chapter reports and discusses the main outcomes for outpatients, medical staff and administrative staff, due to the implementation of the new (proposed) system. The chapter resumes the improvement in resource capacity utilization and defines the care delivery value chain. The chapter also exhibits charts with the main activities involved in outpatient's care for a better perception of the events before and after the implementation proposed models, tables that summarise the cost of the complete care cycle. Finally, the chapter discusses the sustainability of the new system in four dimensions: Process, Staff, Organization and Social dimension.

5.1 General costs

The TDABC model proved to be a catalysing agent for cost-conscious care redesign.

Next tables (Table #16 to #20) resume all cycle care with the new approach. The same five main groups were analysed (see Figure #43):

- the administrative, with 5 assignments;
- the physicians – first appointment, with 2 assignments;
- the LABOR public task, with 4 assignments;
- LABOR – inside laboratory, with 8 assignments;
- the physicians - second appointment, with 3 assignments.

Each assignment was measured in the row with the corresponding HR that were needed to complete the task. Table #7 has the cost per minute for each resource group number. So, HR plus time in minutes plus resource group cost per minute = value measure in XOF (last column).

Table #16 – Cost system for administrative group and physician group

Administrative							Physicians – First Appointment				
	Time Seconds Outpatient	HR	Time Minutes Staff	Resource Group	XOF		Time Seconds Outpatient	HR	Time Minutes Staff	Resource Group	XOF
	80	1	1.33	1	14.13		728	-	-	-	-
	102	1	1.70	1	18.02		762	1	12.70	2	391.78
	72	-	-	-	-		-	-	-	-	-
	98	1	1.63	1	17.31		-	-	-	-	-
	388	1	6.47	3	101.85		-	-	-	-	-
TOTAL	740		11.13		151.31		1,490		12.70		391.78

The Administrative table show that the total cost system was equal to 151.31 XOF (green row) and used two resources groups (yellow column): the number #1 (admin staff) and number #3 (nurses staff). The physicians – first appointment table show that the total cost system was equal to 391.78 XOF and used only one resource group, the number #2 (physician staff).

Table #17 – Cost system for LABOR (public tasks and inside laboratory tasks)

LABOR – public tasks							LABOR – inside laboratory				
	Time Seconds Outpatient	HR	Time Minutes Satff	Resource Group	XOF		Time Seconds Outpatient	HR	Time Minutes Staff	Resource Group	XOF
	196	-	-	-	-		87	4	5.80	4	81.54
	143	1	2.38	1	25.26		2	4	0.15	4	2.16
	968	-	-	-	-		2,211	4	147.44	4	2,072.84
	396	1	6.60	4	92.79		37	4	2.49	4	34.96
	-	-	-	-	-		105	4	7.00	4	98.41
	-	-	-	-	-		129	4	8.57	4	120.44
	-	-	-	-	-		413	1	6.89	4	96.87
	-	-	-	-	-		36	1	0.59	4	8.34
TOTAL	1,703		8.98		118.05		3,021		178.93		2,515.56

The LABOR – public task table show that the total cost system was equal to 118.05 XOF and used two resources groups, the number #1 (admin staff) and number #4 (LABOR staff).

The LABOR – inside laboratory table show that the total cost system was equal to 2,515.56 XOF and used only one resource group, the number #4 (LABOR staff).

Table #18 – Cost system for physicians group

Physicians - Second Appointment					
	Time Seconds Outpatient	HR	Time Minutes Staff	Resource Group	XOF
	145	-	-	-	-
	727	-	-	-	-
	516	1	8.60	2	265.30
TOTAL	1.388		8,60		265.30

The Physician – second appointment table show that the total cost system was equal to 265.30 XOF and used only one resource group, the number #2 (physician staff).

Table #19 – Summary of HPSJB resources and XOF costs

1 Outpatient XOF cost						
HR Group	Administrative	Physician – First appointment	LABOR – public tasks	LABOR inside laboratory	Physician - Second Appointment	Total
1	49.46	-	25.26	-	-	74.72
2	-	391.78	-	-	265.30	657.09
3	101.85	-	-	-	-	101.85
4	-	-	92.79	2,515.56	-	2,608.34
					TOTAL	3,442.00
%	1.44%	11.38%	2.70%	73.08%	7.71%	100%

Table #16 join the total system cost for all five main groups. The last column has the total of each row. The value measure for health care for one outpatient is: 3,442.00 XOF. The height cost for

LABOR inside laboratory was 79.15% (Table #11) and now the cost height is 73.08%. Here the time height reduces from 59.66% to 36.21% (Table #12 and Table #20 respectively). Table #19 shows that was expense reduction from 5,052.43 XOF to 3,442.00 XOF, the costs have decreased 31.87% and the time has been shortened 66.25%, from 24,713 seconds to 8,342 seconds. This was a huge upgrade for outpatient health care. Table #20 has the actual total time for each main groups considering one complete cycle care.

Table #20 – Summary of HPSJB resources and time costs

1 Outpatient Time Cost (Seconds)						
	Administrative	Physician – First appointment	LABOR – public tasks	LABOR inside laboratory	Physician - Second Appointment	Total
	740	1.490	1.703	3.021	1.388	8.342
%	6.07%	17.86%	20.42%	36.21%	16.64%	100%

5.2 Administrative Outcomes

The opportunity to improve value to outpatient in the Hospital intake had progresses in terms of outpatient waiting time and outpatient health conditions, by avoiding unnecessary administrative tasks that did not add value to outpatients. Simultaneously, the new processes reduced resource costs.

Table #21 has the measure value resume before (see Table #8) and value resume after the actions taken (see Table #16) and the outpatient time reduction was about 50.67%.

Table #21 – Summary of cost and time evolution

Administrative								
Before				After			Total reduction	
Cost XOF	Time			Cost XOF	Time			
211.08	19.92	Minutes		117.99	11.13	Minutes		
	1,195	seconds			668	seconds	527	seconds
							44.10	%

Table #22 resumes the cost and time benefits. The cost before was 211.08 XOF and now the cost is 151.31 XOF. The value reduction is 211.08 – 151.31 = 59.77 XOF (less 28.31%) and administrative time cycle before was 1,500 seconds and now is 740 seconds, less 760 seconds.

Table #22 – Resume cost and time percentage evolution

Cost XOF	Time (s)
28.31%	50.67%

The 'Book Register', 'Excel Register', 'Handmade Ticket' and 'Administrative Co-funding' processes were shift to AHMS and before that process represent about 74.33% of all administrative time.

5.3 Physicians' first appointment

This stage had two steps:

- the waiting room with LT = 4.293 seconds and
- the medical office with VT = 790 seconds

The total average time was 5.083 seconds. After new approach, there was a huge cost and time reduction that it benefits the outpatients' outcomes. Before, the average time to complete this stage was 5.083 seconds. After TDABC analyse and AHMS implementation the physicians' first appointment was completed in less than 70.69% time, the average time was:

- the waiting room with LT = 728 seconds and
- the medical prescription with VT = 762 seconds
- Total time: 1.490 seconds.

It was evident the best outcomes for patient due to a more then 70% of time reduction.

Table #23 – Physician Time reduction after TDABC

Physicians' first appointment average time (seconds)			
Before	After	Reduction	%
5.083	1.490	3,565	70.69%

This was a great potential cost-savings from using Manchester Triage, EMR and LIS rather than analogic data and unsorted outpatient.

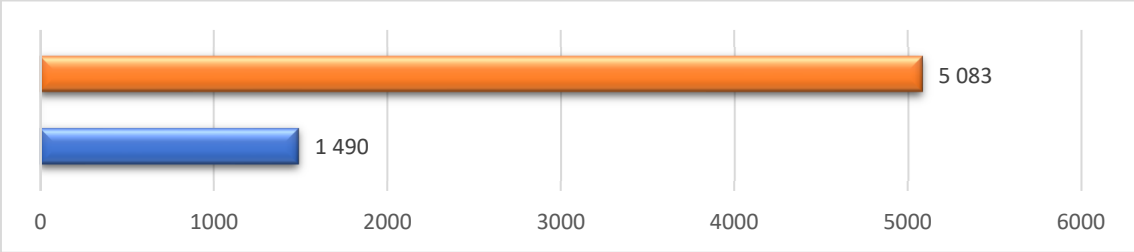


Figure #38 – Physicians' first appointment reduce time (orange–old; blue–new time)

5.4 LABOR

The LABOR had public task (patient intake) and inside task (biologic examination). The public tasks eliminated the register task because the electronic data comes from the medical prescription. As it was showed in Figure #18, to complete the LABOR – public task were needed 1.999 seconds and after implement AHMS, to complete the LABOR – public task, the outpatients needed, on average, 1.703 seconds as it show Table #24 and Figure #39.

Table #24 – LABOR time reduction after TDABC

Patient average time (seconds)			
Before	After	Reduction	%
1,999	1,703	296	14.81%

The same information can be present on the graphic way:

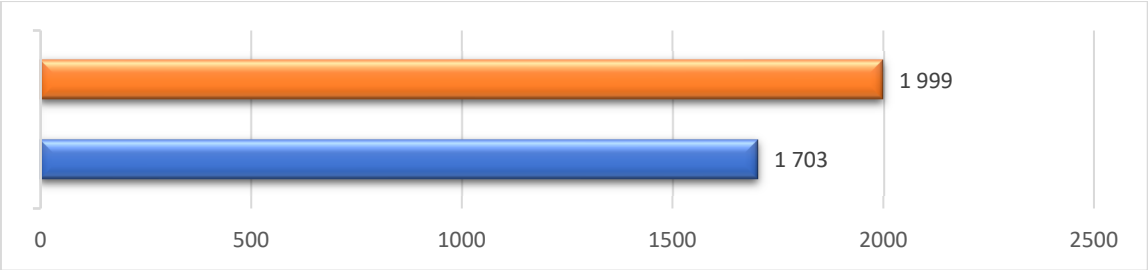


Figure #39 – LABOR – public task reduce time (orange–old; blue–new time)

After technician end biologic analysis process, their average time was 14,743 seconds and moved, with the same resources and a better LIS, to 3,021 seconds. The analysis report can be given to the patient and made available in PDF format for the Physicians in approximately 11,722 less seconds. The waiting time reduction was 79.51% as it shows Table #25 and Figure #40.

In terms of transcribing results, EMR and LIS had a high impact in improving the performance of the system, including the fact that they had eliminated gross errors. This was also a health benefit for patients because the patient, and the LABOR, could deliver to the physician the report early.

Table #25 – Patient LABOR Cycle

LABOR Service		
Before	14,743	seconds
After	3,021	seconds
	Reduction time	11,722 sec.
	Reduction %	79.51%

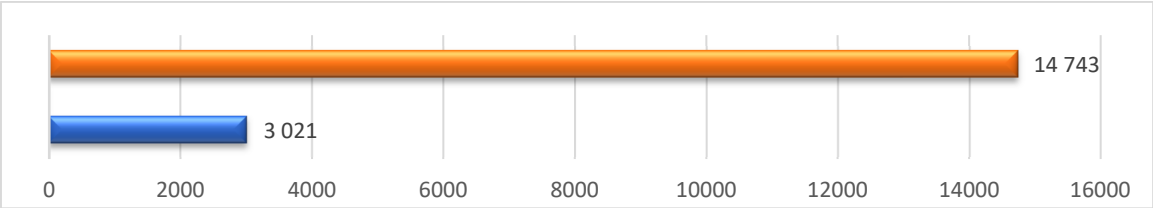


Figure #40 – LABOR waiting times (orange-old; blue-new time)

5.5 LABOR outcomes

To do another biologic sample, due gross errors, medical prescription misinterpretation, bad analytical reports or incomplete result, is necessary a new cycle care and start from the beginning.

The complete cycle care total cost, before the new approach, was 5,052.43 XOF (Table #11) and the staff time required to do the complete cycle care was 338.28 minutes (see columns 'Time Minutes Staff' from Table #8, Table #9 and Table #10).

The annual LABOR cost before the new approach was 19,435,000 (Table #6).

The new logistic methodology reduced the laboratory gross errors and saved huge resources to hospital as it can see in Table #26.

Table #26 – Annual unused capacity cost

Annual error cost				
One Laboratory error, represent:				
(A) Amount required	5,052.43	XOF		
(B) Time required	338.28	Minutes		
	minimum		maximum	
(C) Number of errors by week	30	errors	35	errors
(D) Available weeks per year	52	weeks	52	weeks
(E = C x D) Estimate number of errors by year	1,560	errors / year	1,820	errors / year
Annual Cost				
(F = A x E)	7,881,783.44	XOF	9,195,414.01	XOF
(G = B x E)	527,722.00	Minutes	615,675.67	Minutes
(H = G / 60)	8,795.37	Hours	10,261.26	Hours
(I) Workday Hours (Table #6)	8	Hours	8	Hours
(J = H x I) Annual workday cost	1,099.42	Days	1,282.66	Days
(K) LABOR Staff (Table #6)	12	employers	12	employers
(L) Total days / year	365	days / year	365	days / year
(M = J / K) Annual unused capacity days	91.62	days / employer	106.89	days / employer
(M / L) Annual unused capacity days	25.10%		29.28%	
(N) Annual LABOR Cost (Table #6)	19,435,000	XOF	19,435,000	XOF
(N / F) Annual unused capacity costs	40.55%		47.31%	

The annual unused capacity XOF ratio was between 40.55% and 47.31% and moved to 0,00%. The problem was solved with new logistic approach. Assuming there were 30 to 35 LABOR errors per week, the annual average errors cost is between 7,881,783.44 XOF and 9,195,414.01 XOF and this amount represented [40.55%; 47.31%] of all annual LABOR salary (19,435,000 XOF).

The dimension in working days was between [91.62; 106.89] days and the annual unused capacity days was between [25.10%; 29.28%]. With a new outlook, these errors no longer exist so the LABOR errors cost and unused capacity days are equal to zero.

5.6 2nd Physicians' outcomes

Some of the LABOR analytical results were incompatible with life and that problem was reporter on the Issue #21. When these cases occurred, it was necessary for the physician to fill another prescription for another biologic collection and LABOR examination. This could only be possible the next day, because the patient, in most cases, needed to be fasting. The most common gross errors were transcribed hemogram data (Table #27).

Resume of number average mistakes due transcribing errors:

a) hemogram = [8 – 10] weekly;
b) biochemistry = [3 – 4] weekly;
c) urine = [1 – 2] weekly.

Table #27 – LABOR transcribing errors by week

Weekly Number of Gross Transcribe Errors			
Analysis	min	max	actual
Hemogram	8	10	0
Biochemistry	3	4	0
Urine	1	2	0
TOTAL	**12**	**16**	**0**

The outpatients went to HPSJB and they were seen by physicians (the average value time was 13.17 minutes[12]) and them the outpatient went to the LABOR. After the patients had their analysis report they would come back to the physicians (average value time 8.60 minutes) to start treatment as it shows the Figure #18 and Table #10.

Each time that the physician did not accept the results because some values were true suspect, the physician asked for the outpatient to repeat the procedure and the physician saw the outpatient another time. The average time for one medical appointment to see the results was 8.60 minutes (Table #10) and the average physician cost per minute was 30.85 XOF (Table #7), the total cost for medical appointment to see the results was 8.60 x 30.85 = 265.30 XOF.

[12] These times were measure for two weeks and data was writing on excel datasheet.

The total annual XOF cost time, considering 52 labour weeks, was:

Minimum of 12 gross transcribe errors on one week x 52 weeks = 624 errors on one year.

Maximum of 16 gross transcribe errors on one week x 52 weeks = 832 errors on one year. So:

624 annual errors => 624 new medical appointment (annual quantity)

624 new medical appointment x 265.30 XOF (approximate) ≈ 165,549.18 XOF

624 new medical appointment x 8.60 minutes = 5,366.40 minutes

832 annual errors => 832 new medical appointment (annual quantity)

832 new medical appointment x 265.30 XOF (approximate) ≈ 220,732.24 XOF

832 new medical appointment x 8.60 minutes = 7,155,20 minutes

Table #28 resumes and have the annual total XOF, EUR and minutes for the minimum error cases and maximum error cases.

Table #28 – Annual return Physician cost

	Minimum error cases			Maximum error cases		
Analyse	XOF	EUR	Minutes	XOF	EUR	Minutes
Hemogram	110,366.12	168.25	3,577.60	137,957.65	210.32	4,472.00
Biochemistry	41,387.30	63.09	1,341.60	55,183.06	84.13	1,788.80
Urine	13,795.77	21.03	447.20	27,591.53	42.06	894.40
TOTAL	**165,549.18**	**252.38**	**5,366.40**	**220,732.24**	**336.50**	**7,155.20**

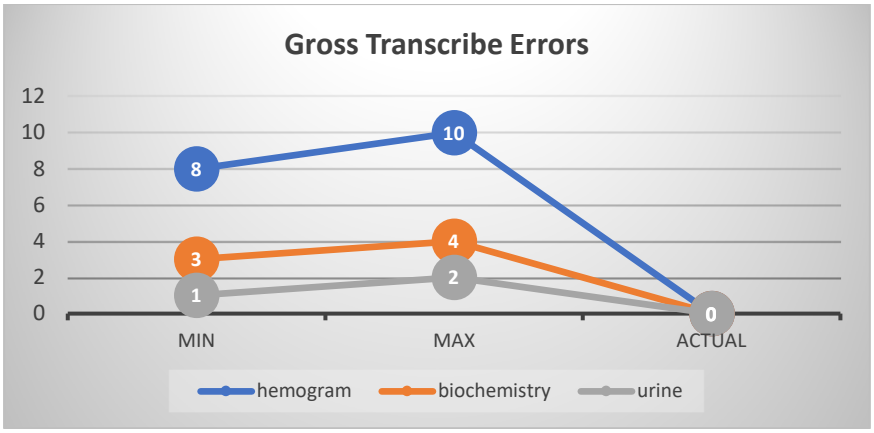


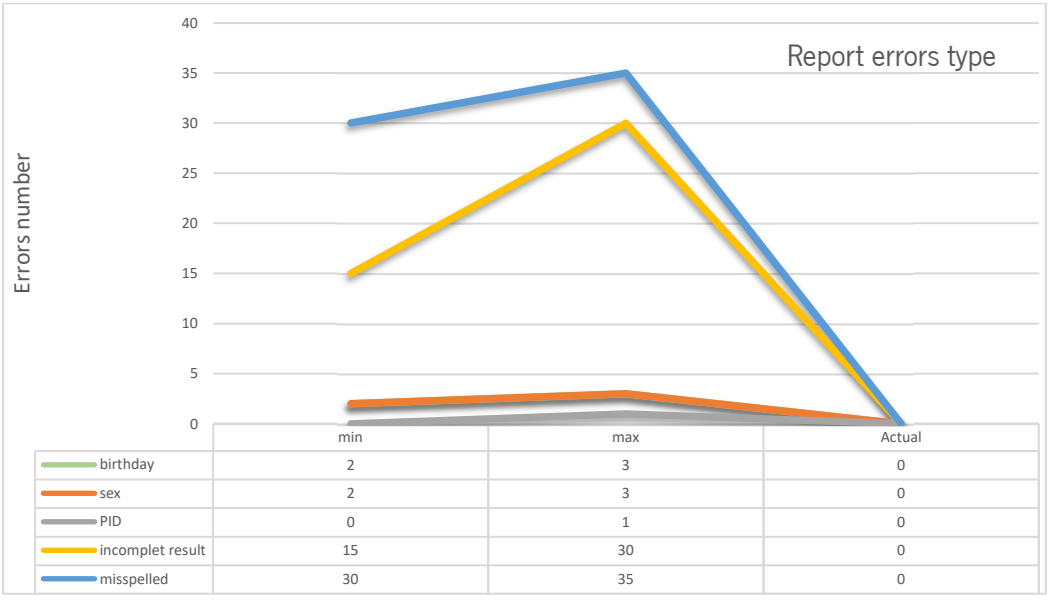
Figure #41 – LABOR Transcribe errors

The cost moved to zero XOF and the time moved to zero too. The time and cost reduction, for the second medical visits, were 100% and there were no medical errors provide by bad transcribe data. Before the AHMS, sometimes the physicians needed to see the patients twice per cycle care. The first time needed an average of 13.17 minutes and for the second visit, to saw the LABOR reports, needed an average of 8.60 minutes. Total average time was 13.17 + 8.60 = 21.77 minutes / patient.

After AHMS implementation the physicians, in annual average, can attend more people because was possible to eliminate gross error. The Table #28 has the annual average lower time and upper time that was consumed by physicians because they need to see the patient on second cycle care. The physicians needed from 5,366.40 minutes to 7,155.20 minutes to see the outpatient for the second cycle care. The total 5,366.40 / 21.77 and 7,155.20/ 21.77 = from 164 to 205 outpatients and that represent the annual physician's capacity to see more outpatients without spend human resources needs or facilities.

5.7 HPSJB complete cycle care

Bad medical diagnostics motivated by bad or incomplete information is a nightmare for physician and patients. For the clinic it was very important a clear PID. The normal health parameters change by age and change by gender. To have a correct PID was useful for the physician understand the present report and compare it with the past report, if any. It was also important to the physician to have the full clinical order so that they could better understand the severity of the outpatient health condition. It has become possible to match clinical resources to clinical processes and improved resource utilization.



	min	max	Actual
birthday	2	3	0
sex	2	3	0
PID	0	1	0
incomplet result	15	30	0
misspelled	30	35	0

Figure #42 – LABOR errors type, before and actual

The most common errors were misspelled. The LABOR misunderstand the request or the analytical report was incomplete. Now no errors found, so all the XOF costs and time costs were completed eliminated. There were no transcribing errors but if it were necessary to repeat the sample test, the differences are those depicted in Table #29. The value measurement, for the complete

outpatient cycle care, is in XOF units on the left side, and time is given in minutes, on the right side of the table.

Table #29 – Summary of HPSJB saving resources for complete cycle care

Complete Cycle – XOF Cost		
Before	Total cost (Table #11)	5,052.43
After	Total cost (Table #19)	3,442.00
	Reduction	1,610.42
		31.87%

Complete Cycle – Seconds		
Before	Total cost (Table #12)	24.713
After	Total cost (Table #20)	8.342
	Reduction	16.372
		66.25%

The HPSJB handles the same volume and mix of outpatients, while spending less, namely:

- 1,610.42 XOF and
- 16.372 seconds, per outpatient, for a complete cycle care.

In 2019, the HPSJB served 15,128 outpatients. This means a global saving of 15,128 x 1,610.42 XOF = 24,362,433.76 XOF.

In 2020, the HPSJB had 9,958 outpatients, then the global savings reaches a value of 16,036,562.36 XOF. Note that the year 2020 was very atypical, since there were less outpatients due to COVID-19 disease (the HPSJB was closed for two months).

Until 2021 December, the HPSJB served 15,338 outpatients. This means a global saving of 15,338 x 1,610.42 XOF = 24,700,621.96 XOF.

Table #30 – Value measurement for complete cycle care

Complete cycle care in seconds						
	Administrative	Physician 1st appointment	LABOR public tasks	LABOR inside laboratory	Physician 2nd appointment	Total
Before	Table #8		Table #9		Table #10	
Total Time	1,500	5,083	1,999	14,743	1,388	24,713
After	Table #16		Table #17		Table #18	
Total Time	740	1,490	1,703	3,021	1,388	8,342
				Reduction Time		16,372
				Reduction%		66.25%

The most influential factor was due to the ability of the EMR, LIS systems and LM tools.

5.8 Outpatient outcomes

Figure #43 shows the VSM and times of the new system developed by applying lean principles and tools. The new VSM shows that cycle times have decreased. The most evident was the LABOR Production site: the LT was 14,743 seconds and became 3,021 seconds. This means almost 80%

time reduction of the journey with lower data errors risk and boost the medical, the outpatient and the administration satisfaction.

The total time, for all activities, was 24,713 seconds and decreased to 8,342 seconds, i.e. more than 66% of time reduction (Figure #44).

The value of the health improvement grew to the patient, grew to the family and grew to the society. The opportunity for people to save on healthcare costs has greatly increased because the program makes the person healthier and people were able to return work and reduction in pain and suffering.

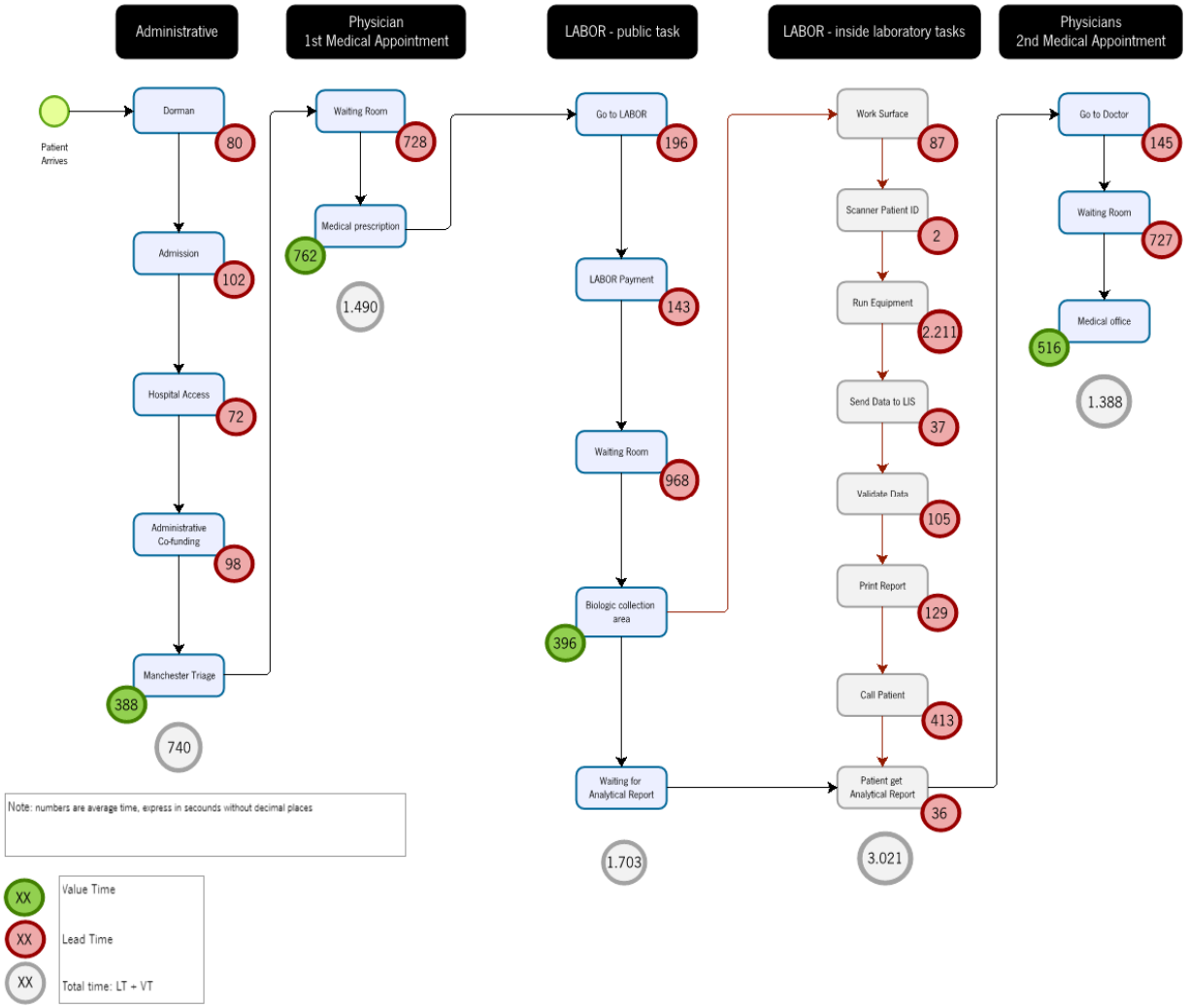


Figure #43 – New VSM for the HPSJB flow

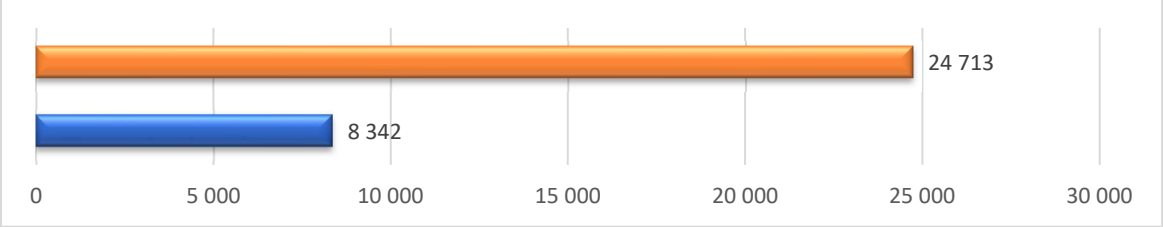


Figure #44 – HPSJB logistic improvement in seconds for each outpatient (orange-old; blue-new time)

This model reduced waiting times significantly. The best reduction they have got was 66.25% with the same people and the same service. The new approach has now bulletproof PID so cannot be changed or lost as all the medical prescription were intentional delivery.

The same resource, and three times more service capacity, included reduced transcriptions errors, administration times and cost savings related to decreased stock, workforce costs and waste.

Outcomes were incorporated in real time into process of care, allowing medical staff to track progress as they interact with outpatients.

5.9 HPSJB administration outcomes

In summary, the main administration and clinic outcomes were:

a) Access to the physician haemoglobin statistics:
    a. Figure #61 and
    b. Figure #65.
b) HIV statistic - Figure #66,
c) Other statistics, like results of diabetic values present by year, gender and age group,
d) Fast and clear administrative statistics – no paper required for:
    a. Total patient income from clinic and
    b. Total patient income from LABOR.
e) provide the Hospital to have access free software without setup cost or maintenance cost.

5.10 Comparative method

This logical logistical implementation associate to the SB software has the following advantages compared to what is available on the market:

Cost benefits

The software was free to develop and was free to install, had no fee and has no fee mensal fee to pay, no number of workstation limitation, and it was extremely easy to install in new workstations, anybody could install, free to interpret equipment standards protocols like HL7 and synchronize with LIS and SB, no additional license required to use SB, SQL Server free, Backup's diary automatic and free and Backup in cloud for free. Additionally, the software did not require expensive maintenance, nor it was a complex solution that needed a big team to develop. The software allowed to follow operational working on real-time from any part of the world, for free; only an internet connection was necessary.

Software architecture advantages

Assent logistical and procedures that were the best to HPSJB, assent medical requirements, speed (less than one second to show reports or statistics), joined the laboratory and hospital needs without duplicate task or information input, possibility of connecting new hospital or laboratory equipment that use HL7 standard protocol or other, no user's limitation to work at same time, not a complex tool that was necessary robust computers to work or a super server, it was not a global European or American Hospital solution that was closed to adapt to the reality of RGB, not heavy solution, just software functions that were necessary to use, draw architecture database by the book and just with useful information and space.

Relation with the user

Always adapted to HPSJB reality, easy and user friendly, not a complex tool that required personal specialized to work and to train, not was a complex neither a slow tool, not needed 3 or more different software:

- one for reception and accounting;
- another for Manchester triage, screen to outpatients follow the priorities (Figure #54);
- and another for Clinical Laboratory with 3 different suppliers and supporting and not linked.

Possibility to software grow on each hospital departments without necessary duplicate input task. Administration, medical staff, laboratory and administrative staff where excited to start work with organization and method. This helped to improve the outpatient health care outcomes.

5.11 Saúde Bor software productivity

To maintain the shareholders involvement and understand the SB software efficient, the staff answered to this survey:

Table #31 – Logistic SB efficient

Parameters	No comments	Bad	Agree	Fully agree
Help with organization				100%
Usefulness				100%
Reduction of tasks				100%
Increased efficiency				100%
Outpatient control				100%

Table #32 – Functionality SB efficient

Parameters	Impossible to work it	Bad	Good	Very easy
Login				100%
Terminology				100%
Fields to fill				100%
Communications Speed				100%
Database speed				100%
Degree of satisfaction				100%
Departmental links				100%
Print invoice				100%
Access to the outpatient file				100%
Making analysis requisitions				100%
Print labels				100%
Send data to LIS				100%
SB Insert data				100%
Save data				100%
Print reports				100%
User Interface				100%

It was possible to compare data from two different years and interpret the evolution of all LABOR analytical group: Biochemist, Haematology, Urine, Immunology, Parasitology, Microbiology, etc.

As the same way statistics were useful to better understand the population's needs.

By analysing the haemoglobin concentration and erythrocyte indicators, it was possible to evaluate the type of anaemia (iron deficiency anaemia, chronic diseases, haemoglobinopathies) and fond out the prevalence of anaemia by age group in the population.

To evaluate the nutritional status of the population studied and the food deficiencies through the evaluation of the blood count parameters.

To manage the massive flow of information exchanged between all the systems within hospital, was provided a cloud-based storage. Then, we secure and optimize the management of data.

5.12 Sustainability results

The reasons we advocated for sustainable development was that HPSJB depends on it, the stakeholders and community want it and it create value and drives growth.

The Sustainable Development Goals (SDGs) are the world's roadmap to tackle these challenges. and deliver a thriving planet.

The sustainable development includes various dimensions – process, staff, organization, social – that are discussed in the following paragraphs.

Process dimension

This project helped people and the organization, reduced waste, created efficiency and the stakeholders believed in the benefits and had that awareness present.

To continue improve the process the stakeholders must collaborate and be intent to continue the project. This item was the will of the board.

For the future will dedicate more time to communicate the results to the stakeholders and listen their feedback and this include updates or news framework.

Staff dimension

Staff were dipped involve in innovation, design and implementation of the changes. They received training as the project goes teste and implemented. The clinical leaders as the staff feels engage and motivated because they have been involved from the beginning of the change process helping to identify logistic problems and skill gaps. They were encouraged and able to express their ideas regularly throughout the change process. They were encouraged to use the culture PDSA as share information with or seek advice from leaders.

Organization dimension

The propose of this project was clear, accepted and approved by all stakeholders. They needed this and they participated with very loyalty, happiness and with "we want, we can do" spirit or followed "The man has a dream, God desires, the work comes to life"[13].

The staff were very confident because they were always involved and they ambitions were materialized with the correct and functional hardware and equipment.

The sustainability scope matched the HPSJB ambition and this top determination was the best due the purpose, stakeholder's collaboration and motivation.

Social dimension

The purpose of this project englobed ensuring quality and outpatient safety during clinical trials. The project has reached more service and more quality for outpatients and professional staff. It is credible that fast and high quality LABOR information, that was demonstrated in this project, drives more medical confidence and successful treatment.

[13] Fernando Pessoa

This work only used medical information relevant for the treatment and administration. Medical staff can propose to include or exclude information or policy to edit, read or print.

The HPSJB has the price of hospital services posted in the patient area and provides outpatients with the detailed invoice on admission (Figure #21) and do the same procedure in the LABOR. Outpatients can read and interpret the price construction (Figure #33).

Activity metric - Number of outpatients treated

This number was well known by statistic form and only account or administration staff could access to this information by SB software. The COVID-19 created a huge instability in HPSJB because all service stopped in May 2020 until August 2020 (see Figure #46).

Today they are remedying the situation by normalizing each of the sectors vital to the institution.

Flow outpatients' information can present two dimensions:

- statistic per week (Figure #45 and Figure #46),
- and per statistics per weekday (Figure #47 and Figure #48).

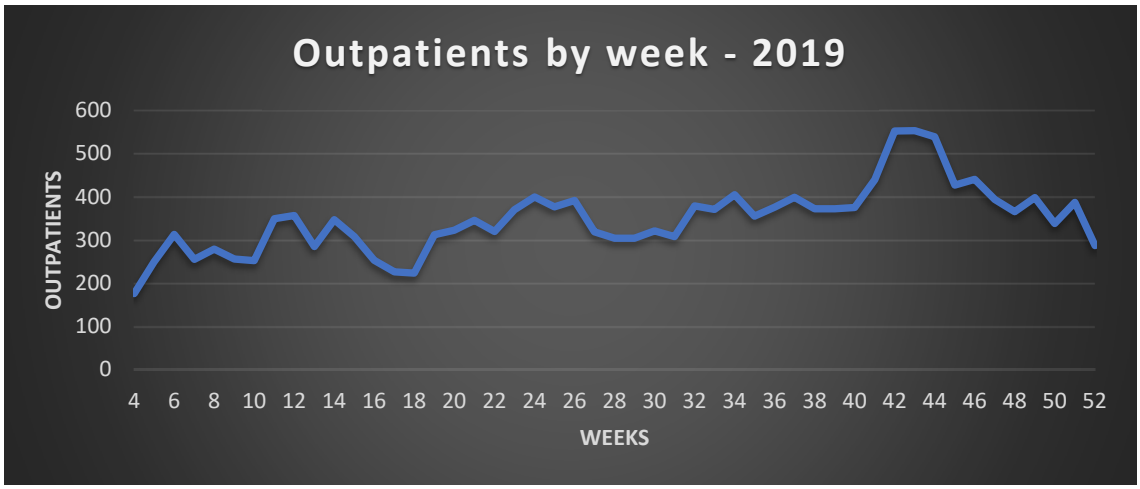


Figure #45 – Number of outpatients by week (2019)

In 2019, the year before COVID-19 that affected all normal statistics, 21,902 outpatients were admitted at HPSJB of which 48.5% were men and 51.5% women. In addition, HPSJB admitted 2,154 children less than 12 months of age and 5,457 children aged between 1 to 5 years. Women older than 18 years old were assisted 6,127. In 2020, HPSJB admitted 10,523 outpatients, 48.2% of which were men and 51.8% women. 960 were babies until 12 months and from 1 until 5 years old there were assisted 2,385 children. Women older than 18 years old were assisted 3,163.

To understand the difference between the year before COVID-19 the Figure #46 shows the statistic number of outpatients that used the HPSJB health care service from 2019 until YTD.

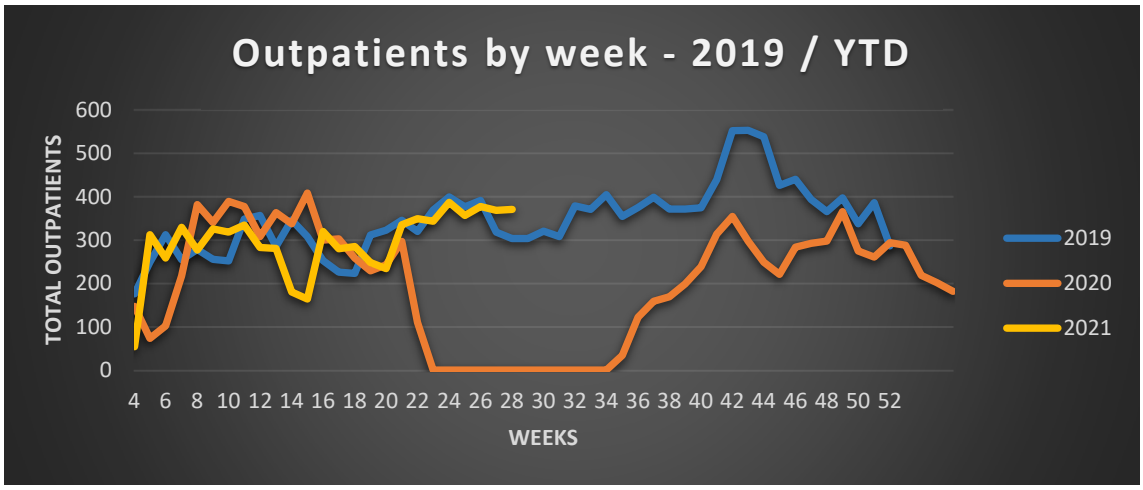


Figure #46 – Number of outpatients by week: 2019 to present

The Figure #47 has the average of total medical assistance by weekdays, from 2019 until YTD. The decrease in the number of patients from 2019 to 2020 is attributed to the COVID-19 pandemic.

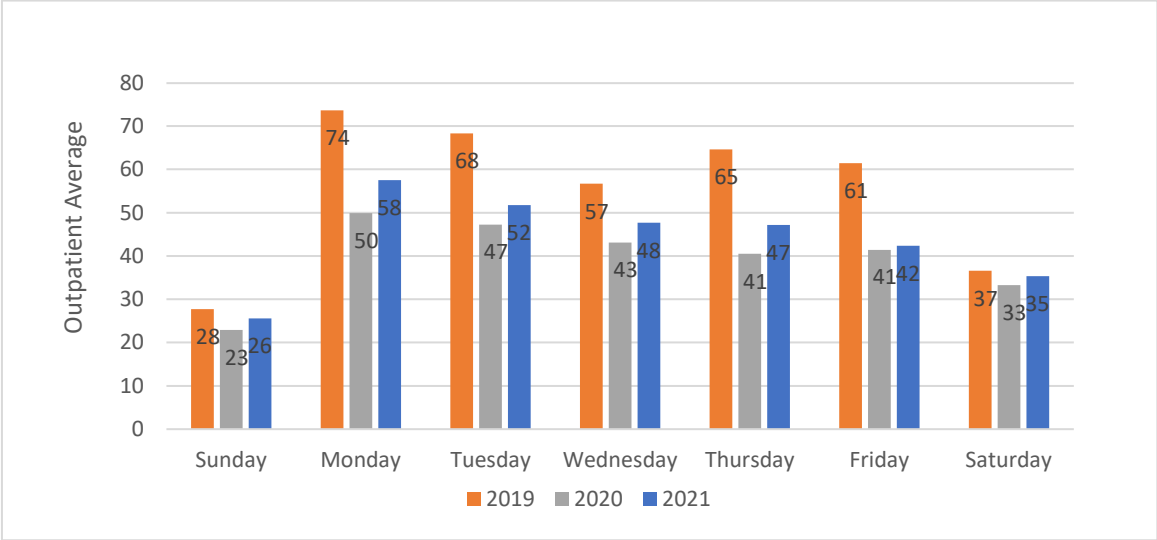


Figure #47 – Average weekday medical assistances: 2019 to present

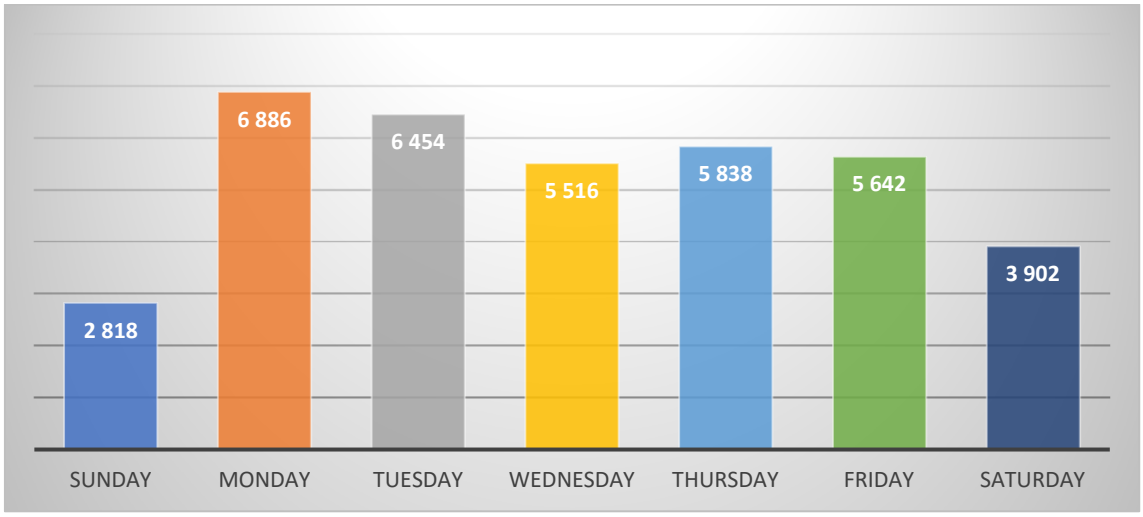


Figure #48 – Weekday total medical assistances: 2019 to present

Monday is the weekday with the highest flow and weekend with the lowest flow. The workday medical assistances average is about 70 and on weekend that number decrease to 30 medical assistances.

LABOR Statistics

The Figure #49 and Figure #50 shows the LABOR daily flow of outpatients. The first one has one bar for each year and the sound chart has the average of the last three years. Monday is the weekday with the highest flow and weekend with the lowest flow.

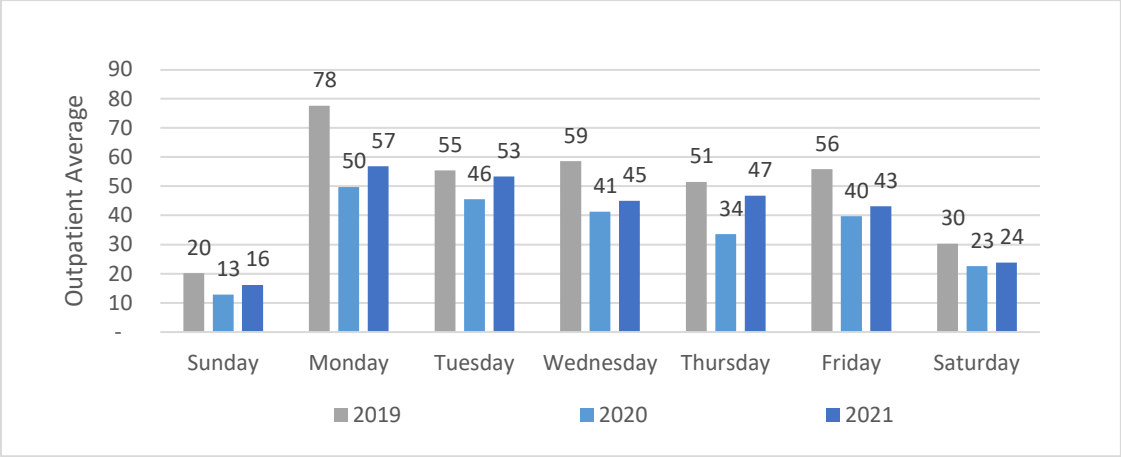


Figure #49 – Weekday LABOR average: 2019 to present

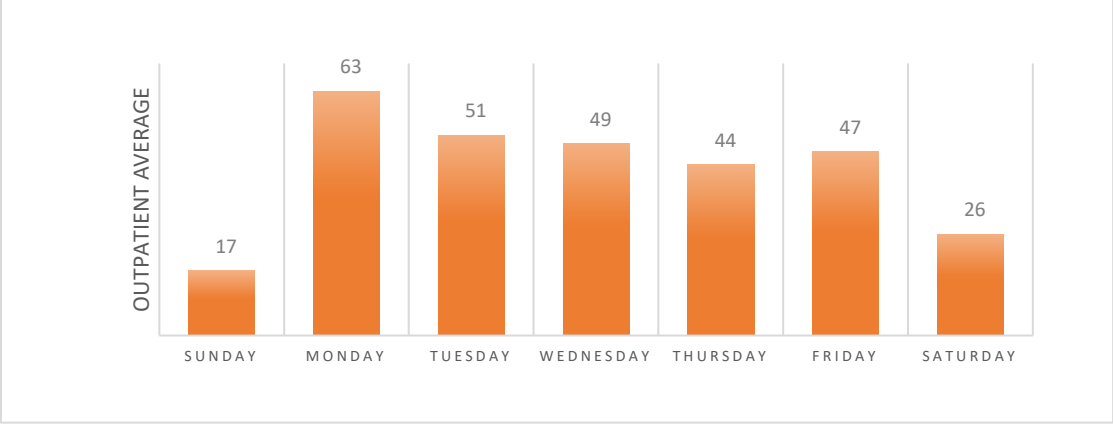


Figure #50 – Weekday: 2019 LABOR average

The Figure #51 shows the total of outpatients that used the LABOR service since 2019. The administration justification for low weekend incomes is because the co-funder office is close and not available to help pay the outpatient medical assistance and medical prescription.

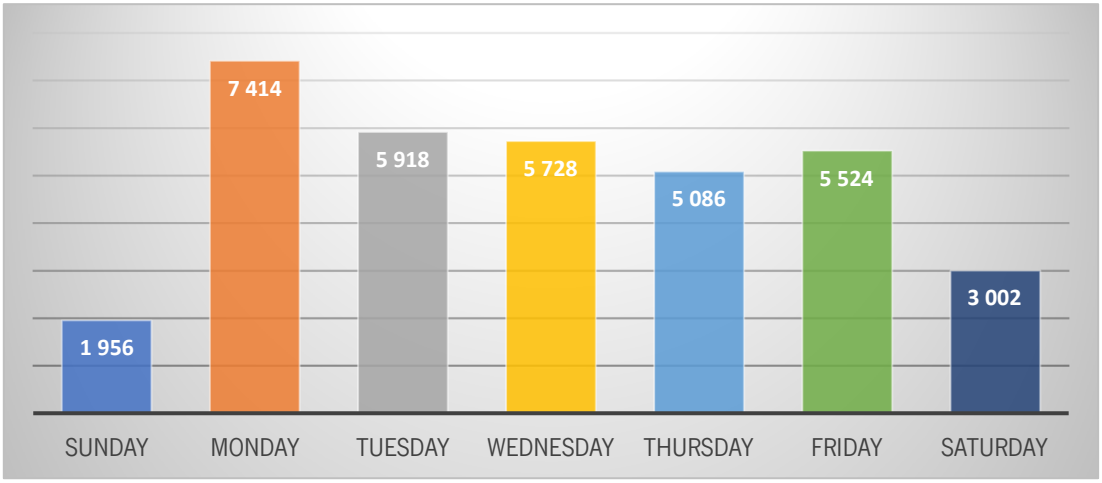


Figure #51 – Total LABOR's Outpatient on weekday: 2019 to present

6 Conclusions and suggestions for future

This project started to fill a gap in HPSJB health care. The HPSJB has had no standard work habits, no informatic network, no LIS, no organized outpatients' queues and a long list of logistical problems. The only way forward was the possibility of developing a volunteer project that started on March 2018 by studying and understanding the HPSJB and LABOR reality and design a road map of how to get the HPSJB goals which includes organization, standard work, data communication, organized outpatient queue by health care condition and shorten, about 66.25%, the treatment cycle time, eliminate LABOR errors (30 till 35 per week), reduce annual unused capacity costs (40.55% and 47.31% and now is 0,00%) and improve outpatient outcomes under the Goal 3 (Quality health) and Goal 8 (Dignified work and economic growth) that contribute to the United Nations goals for sustainable development and staff motivation.

In fact, during this project the HPSJB moved from a confused situation to an extraordinarily complex situation and, as a result of this project, the HPSJB moved from that complex situation to a better organized Hospital and LABOR, mainly due to the implementation of:

- Manchester Triage, for better classification of users' health status and fast medical intervention on acute health cases;
- "Saúde Bor" software that linked the hospital reception, the accounting department, the Manchester Triage, the physicians, the LABOR and the LABOR equipment.

Basically, all objectives and goals defined to this project were successfully achieved, as planned. The main outcomes includes: elimination of the manual transcription errors, match of clinical resources to clinical processes, avoidance of medical errors due to error-prone analytical reports, alerts if clinical analyses report is not all completed, reports sent by e-mail, and further gains like reduction of cycle care time, correct PID, reduction cost treatment and resources, better outcomes for the patient, much more productivity (physicians can now see annually from 164 to 205 more outpatients that they usually did in the past), promote the institutional trust and patient health status, and all of this without increasing human resources, nor applying huge hardware nor software investments. Additionally, other statistical tools are now available to administration, like haemoglobin, medical and administrative reports. From an inquiry to chairman, who heard all the stakeholders in this process, it is very clear that the staff are fully satisfied and more motivated with this new system.

Lean principles and tools, and the time driven activity-based cost model, were the key that sustain the new practices and maintain discipline. This means that such principles and tools, described in chapter 2, must be continuously applied over time.

During this work the good feelings came to face, and this enthusiasm can be contagious and inspiring to other volunteers, so more people with different knowledge and skills can join similar humanitarian projects and help to build a better society.

Our suggestions for further work are:

- To show how the HPSJB is working, by publishing this study in literature or web, aiming to share knowledge and best practices with other nongovernmental organizations or foundations (like 'Melisa and Bill Gates Foundation'), and get help to improve health care diagnostics and process development.
- To undertake more humanitarian projects where it is more important to population. This means that we should try to get a budget and voluntary people with knowledge to develop health care systems and implement low-cost solutions.
- To upgrade the SB software herein developed and implemented in the following aspects:
    - Hospital and LABOR:
        - stocks management;
        - blood donor's registration;
        - morgue registration.
    - Pharmacy:
        - stocks management;
        - waiting outpatient list;
        - electronic prescription;
        - invoice;
        - shelf life of medicines.
    - Kitchen and clean room:
        - stock management;
        - human resources;
        - time and attendance system;
        - holiday planning.
- Get donations of analytical and diagnostic equipment for LABOR and physicians:
    - staff training;

    - connect to LIS.
- Get more medical volunteer work:
    - needs assessment;
    - value measurement heath care.
- To use SASB standards (at HPSJB) according to the dimensions and metrics that are described in Appendix 2.

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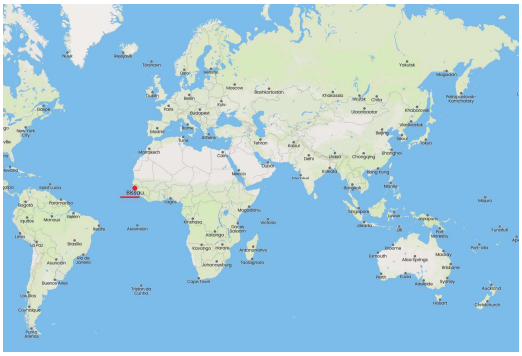
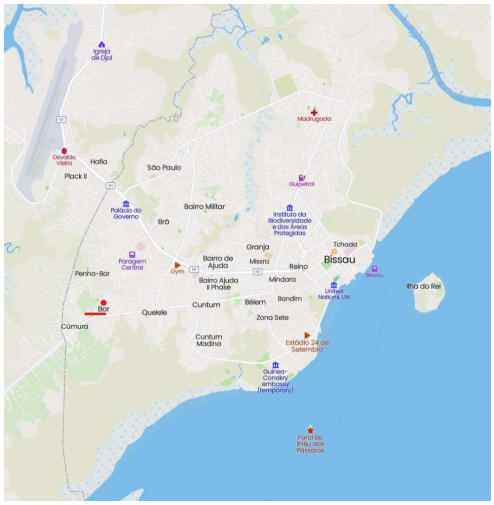
Appendix 1



Picture #1 – RGB

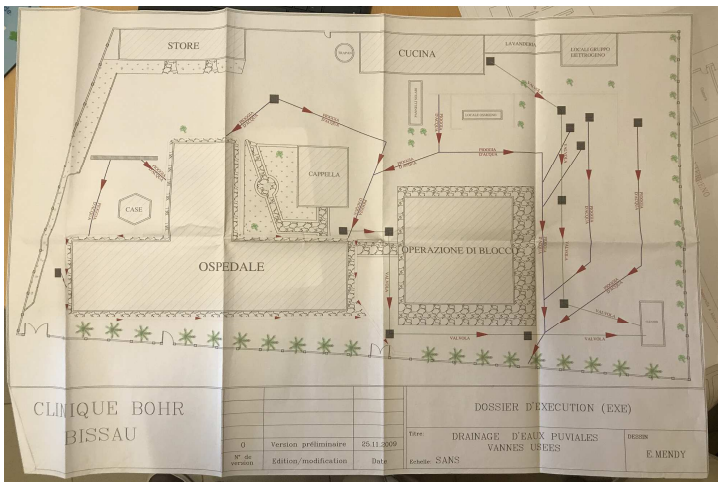


Picture #2 – Bissau community

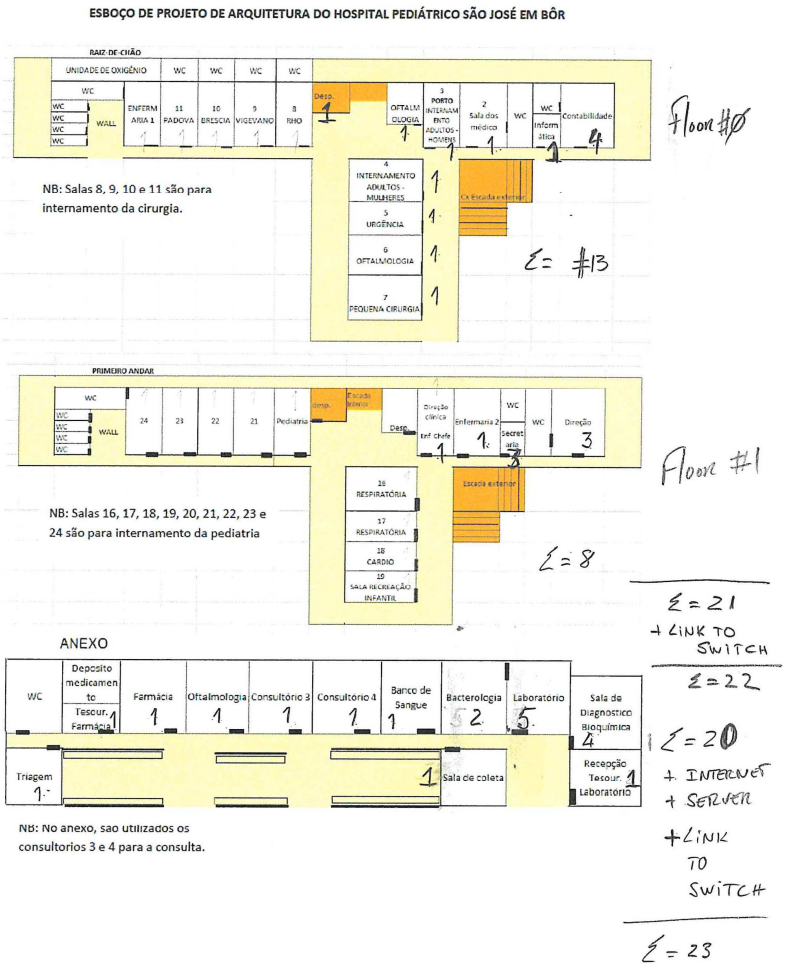
Picture #3 – Hospital Nacional Simão Mendes

Picture #4 – HPSJB main door

Picture #5 – Inside Hospital



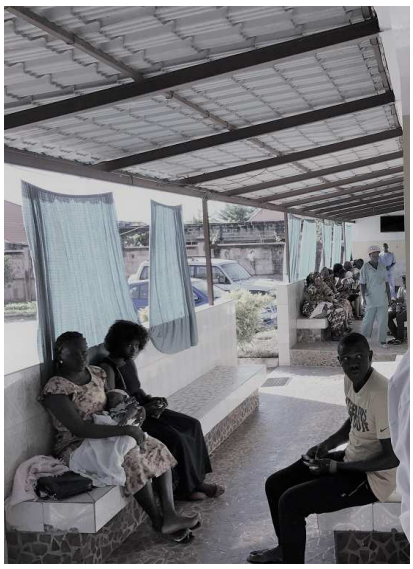
Picture #6 – Hospital floor plan



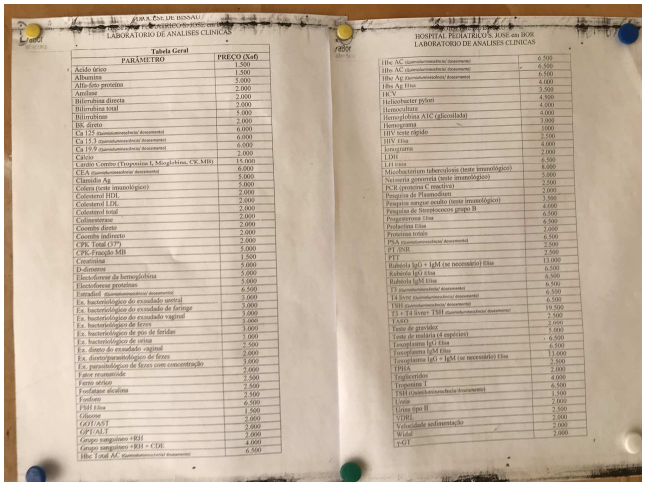
Picture #7 – Architectural and network project

Picture #8 – Visiting Hospital installations

Picture #9 – Outdoor urgency waiting room



Picture #10 – Medical assistance waiting room

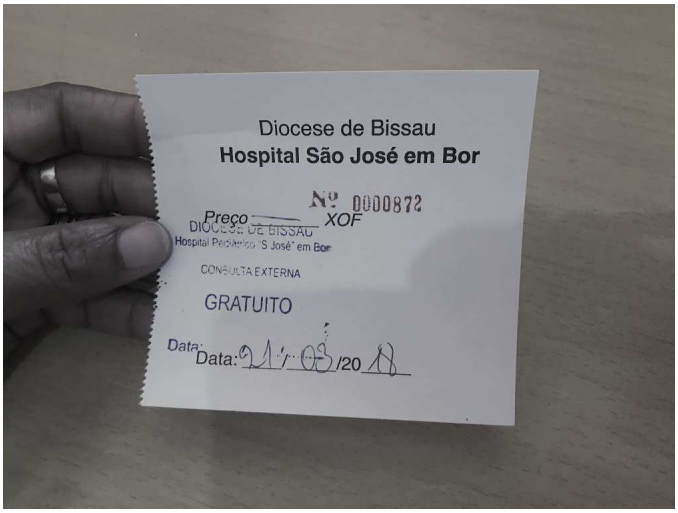


HOSPITAL PEDIÁTRICO S. JOSE em BOR
LABORATORIO DE ANALISES CLINICAS

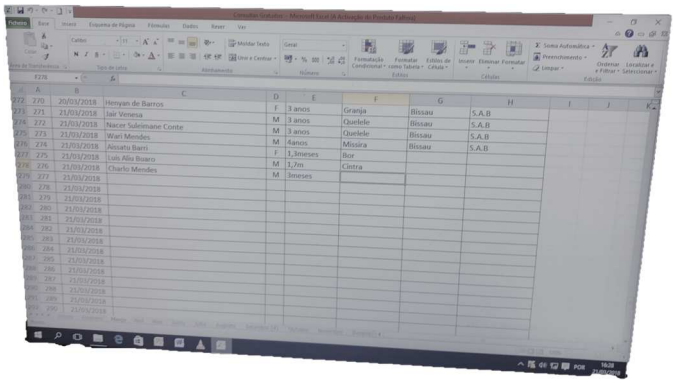
Tabela Geral	
PARÂMETRO	PREÇO (XOF)
Ácido úrico	1.500
Albumina	1.500
Alfa-feto proteína	5.000
Amilase	2.000
Bilirrubina directa	2.000
Bilirrubina total	2.000
Bilirrubinas	5.000
BK. directo	2.000
Ca 125 (quimioluminiscência/ fluorimetria)	6.000
Ca 15.3 (quimioluminiscência/ fluorimetria)	6.000
Ca 19-9 (quimioluminiscência/ fluorimetria)	6.000
Cálcio	2.000
Cardio Combo (Troponina I, Mioglobina, CK-MB)	15.000
CEA (quimioluminiscência/ fluorimetria)	6.000
Clamídia Ag	5.000
Colera (teste imunológico)	5.000
Colesterol HDL	2.000
Colesterol LDL	2.000
Colesterol total	2.000
Colinesterase	2.000
Coombs directo	2.000
Coombs indirecto	2.000
CPK Total (17')	2.000
CPK-Fracção MB	5.000
Creatinina	1.500
D-dimeros	5.000
Electroforese da hemoglobina	5.000
Electroforese proteínas	5.000
Estradiol (quimioluminiscência/ fluorimetria)	6.500
Ex. bacteriológico do exsudado uretral	5.000
Ex. bacteriológico do exsudado de faringe	3.000
Ex. bacteriológico do exsudado vaginal	3.000
Ex. bacteriológico de fezes	3.000
Ex. bacteriológico de pús de feridas	3.000
Ex. bacteriológico de urina	3.000
Ex. directo do exsudado vaginal	1.500
Ex. directo/parasitológico de fezes	2.000
Ex. parasitológico de fezes com concentração	3.000
Factor reumatóide	7.000
Ferro sérico	1.500
Fosfatase alcalina	2.500
Fosforo	2.500
FSH Elisa	6.500
Glucose	1.500
GOT/AST	2.000
GPT/ALT	2.000
Grupo sanguíneo +RH	2.000
Grupo sanguíneo +RH + CDE	4.000
Hbc Total Ac (quimioluminiscência/ fluorimetria)	6.500
Hbc AC (quimioluminiscência/ fluorimetria)	6.500
Hbc Ag (quimioluminiscência/ fluorimetria)	6.500
Hbc Ag Elisa	4.000
HCV	3.500
Helicobacter pylori	4.500
Hemocultura	4.000
Hemoglobina A1C (glicosilada)	3.000
Hemograma	3.000
HIV teste rápido	1000
HIV Elisa	2.500
Imunograma	4.000
LDH	2.000
Lítio	6.500
Micobacterium tuberculosis (teste imunológico)	8.000
Neisseria gonorreia (teste imunológico)	5.000
PCR (proteina C reactiva)	2.500
Pesquisa de Plasmodium	2.000
Pesquisa sangue oculto (teste imunológico)	3.500
Pesquisa de Streptococos grupo B	4.000
Progesterona Elisa	6.500
Prolactina Elisa	7.000
Proteinas totais	6.500
PSA (quimioluminiscência/ fluorimetria)	6.500
PT /INR	2.500
PTT	2.500
Rubeola IgG + IgM (se necessário) Elisa	13.000
Rubeola IgG Elisa	6.500
Rubeola IgM Elisa	6.500
Sífilis	6.500
T3 (quimioluminiscência/ fluorimetria)	6.500
T4 livre (quimioluminiscência/ fluorimetria)	6.500
TSH (quimioluminiscência/ fluorimetria)	19.500
T3 +T4 livre+ TSH (quimioluminiscência/ fluorimetria)	25.500
TASO	2.000
Teste de gravidez	5.000
Teste de malaria (4 espécies)	6.500
Toxoplasma IgG Elisa	6.500
Toxoplasma IgM Elisa	13.000
Toxoplasma IgG + IgM (se necessário) Elisa	2.500
TPHA	7.000
Triglicerídos	4.000
Tripanita I	6.500
TSH (quimioluminiscência/ fluorimetria)	1.500
Ureia	2.000
Urina tipo II	2.500
VDRL	2.000
Velocidade sedimentação	2.000
Widal	2.000
γ-GT	

Picture #11 – LABOR price list

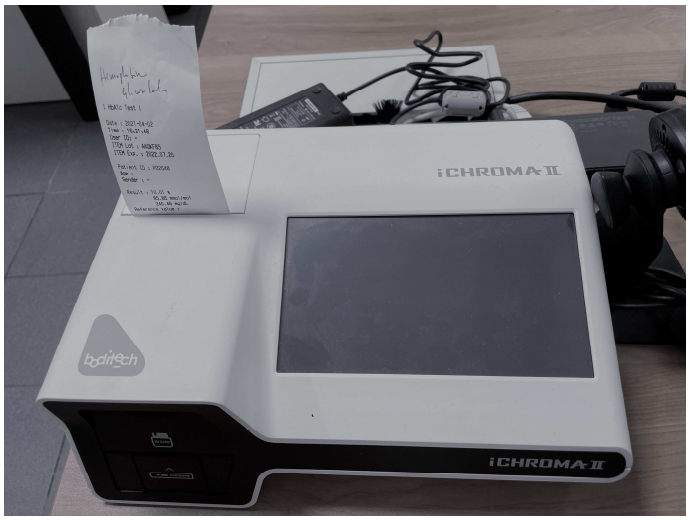
Picture #12 – Book register hospital visit



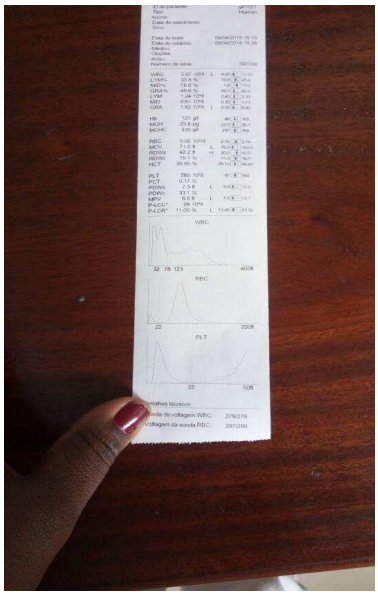
Picture #13 – Ticket number after pay the medical assistance



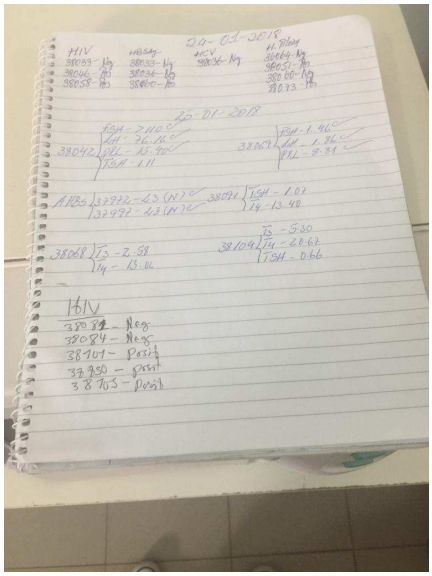
Picture #14 – Excel register medical assistance



Picture #15 – Print ticket from one LABOR Equipment

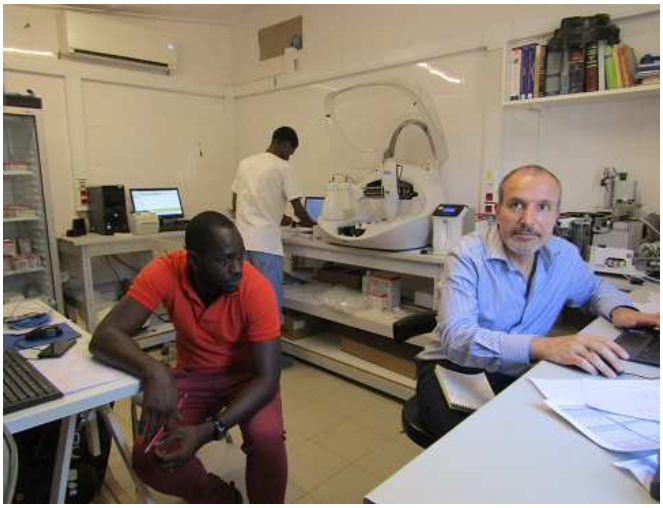


Picture #16 – Output print from LABOR device

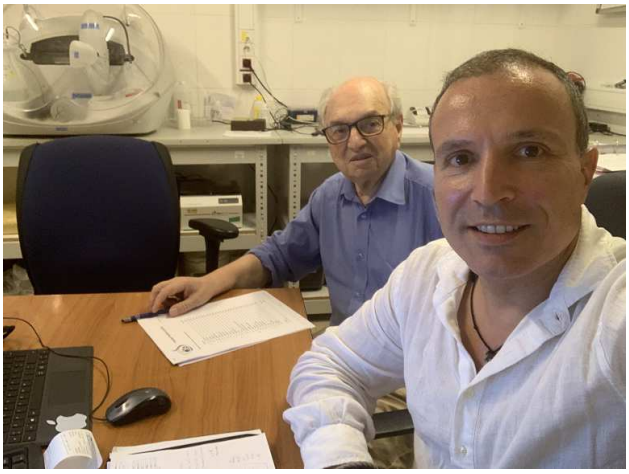


Picture #17 – Data in the notebook

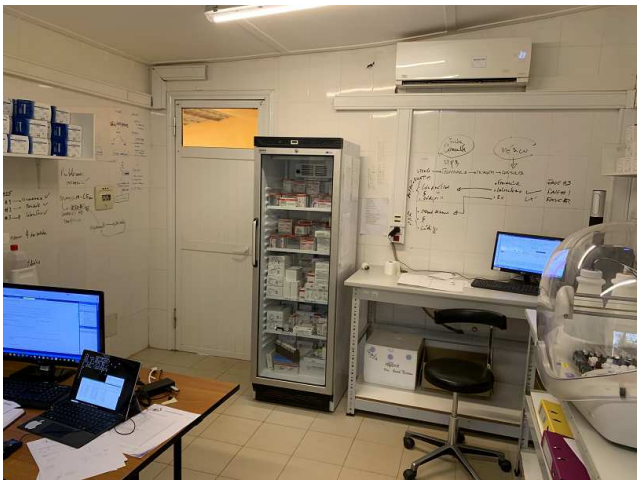
Picture #18 – Team building with administration and medical staff



Picture #19 – Working on the LABOR with technics



Picture #20 – Working on the LABOR with Pharmacist

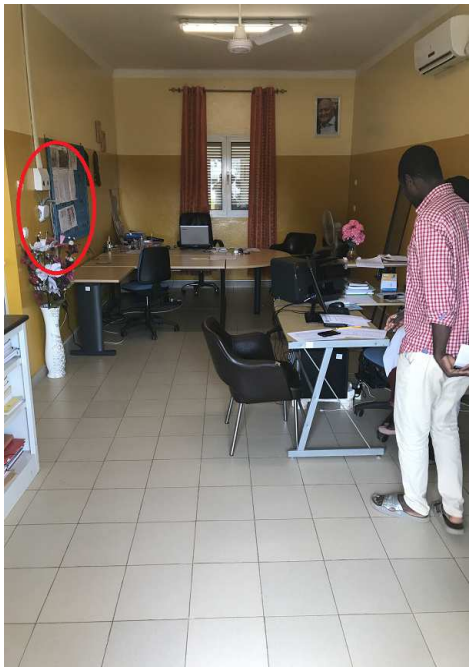


Picture #21 – Wall issues

Picture #22 – Personal tools and devices

Picture #23 – Cable teste

Picture #24 – Cable analyzer



Picture #25 – Internet router in administration room

Picture #26 – Wired network pipelines to link all hospital departments

Picture #27 – Prepare wired network pipelines to cross buildings

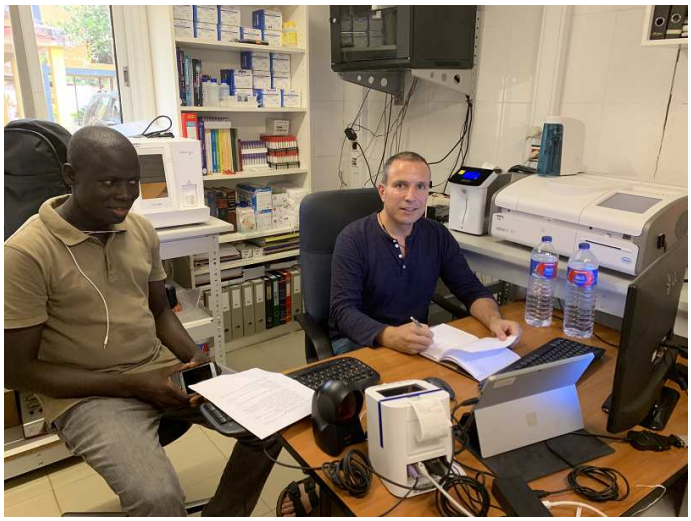
Picture #28 – Network pipelines crossing buildings

Picture #29 – Install office wired network and sockets for PC and printers

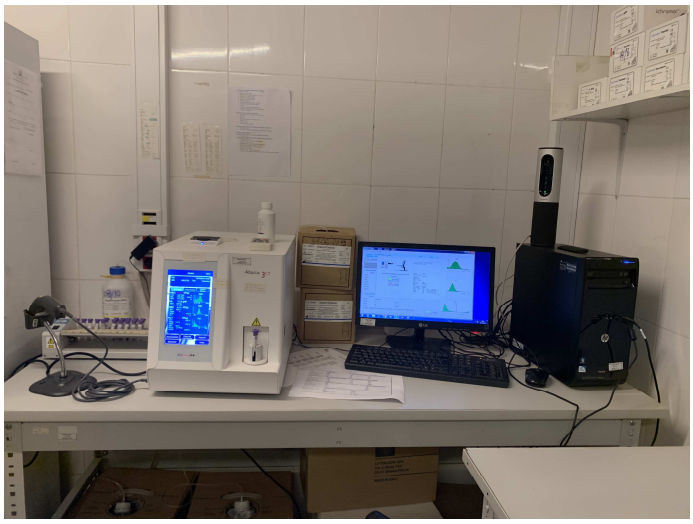
Picture #30 – Assembly and setup server, router, switch and UPS

Picture #31 – CISCO Switch 24 Ports

Picture #32 – Server, switches and internet router all together in same box



Picture #33 – Checking task with informatic Mr. Quinto



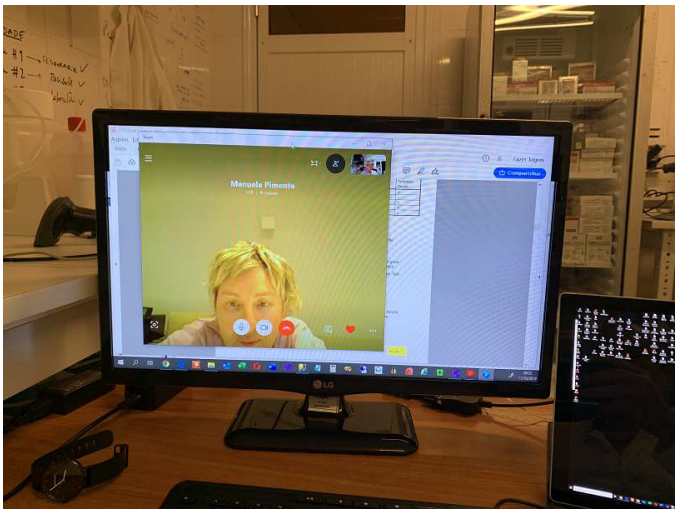
Picture #34 – Abacus equipment

Picture #35 – A15 equipment

Picture #36 – Print LABOR outpatients ID cards

Picture #37 – Testing solutions on the LABOR

Picture #38 – Manchester triage ready to start



Picture #39 – Zoom with my wife

Picture #40 – Engaging all stakeholders

Picture #41 – Interview to local TV Station

Picture #42 – Road signs, made in PT, to identify the HPSJB's location

Picture #43 – Baby on my arms after blood collection

Appendix 2

Table #33 – Social Capital accounting metric dimension

N	Sustainability-related business issues	ACCOUNTING METRIC	Category	CODIFIED METRIC CODE	General Issue Category
1	Safety of Clinical Trial Participants	Discussion of management process for ensuring quality and outpatient safety during clinical trials	Discussion and Analysis	HC-BP-210a.1	Humans right & community relations
2	Quality of care & outpatient satisfaction	Excess patient readmission ratio per hospital	Quantitative	HC-DY-250a.4	Product Quality & Safety
3	Data Security	Percentage of outpatient records that are Electronic Health Records (EHR) that meet "meaningful use" requirements	Quantitative	HC-DY-230a.1	Outpatient Privacy & Electronic Health Records
4	Data Security	Total amount of monetary losses as a result of legal proceedings associated with data security and privacy	Quantitative	HC-DY-230a.4	Outpatient Privacy & Electronic Health Records
5	Ethical Marketing	Total amount of monetary losses as a result of legal proceedings associated with false marketing claims	Quantitative	HC-BP-270a.1	Selling Practices & Products Labelling
6	Pricing & Billing Transparency	Description of policies or initiatives to ensure that outpatients are adequately informed about price before undergoing a procedure		HC-DY-270a.1	Selling Practices & Products Labelling
7	Pricing & Billing Transparency	Discussion of how pricing information for services is made publicly available		HC-DY-270a.2	Selling Practices & Products Labelling

CODIFIED METRIC CODE:

HC-BP-210a.1, Quality and outpatient safety: The evidence that the administration is fulfilling this goal is that committed to this project with genuinely concerned to see HPSJB more organized and efficient for all stakeholders.

HC-DY-250a.4, Excess patient readmission: Monthly the administration can have report access and the goal is decrease this numbers and register the actions if there is an opposite tendence.

HC-DY-230a.1, EHR that meet "meaningful use": All EHR must have total "meaningful use" The goal is 100% and the responsibility is the IT and administration to ensure the EHR data interest.

HC-DY-230a.4, Legal proceedings: The goal is 0 cases and money spend. For that, the EMR is restricted to medical staff and users have password. For the future, to aim a robust solution or in case that is necessary, the SB can register the user and the electronic files that were accessed.

HC-BP-270a.1, False marketing claims: Here the indicator is the total amount of monetary losses as a result of legal proceedings associated with false marketing claims. The best is that indicator is null.

HC-DY-270a.1, Adequately informed about price: There is list on the exterior board, the physician can inform during and after validating the requisition and the LABOR also can informing on the reception.

HC-DY-270a.2, Pricing information: Should be a minute of the board meeting that provide how pricing information for services is made publicly available.

Table #34 – Leadership & Governance activity metric dimension

N	Sustainability-related business issues	ACCOUNTING METRIC	Category	CODIFIED METRIC CODE	General Issue Category
8	Safety of Clinical Trial Participants	Total amount of monetary losses as a result of legal proceedings associated with corruption and briber	Quantitative	HC-BP-510a.1	Business Ethics
9	Business Ethics	Description of code of ethics governing interactions with health care professionals	Discussion and Analysis	HC-BP-510a.2	Business Ethics

CODIFIED METRIC CODE:

HC-BP-510a.1, Corruption and briber: The gold on this item is achieve every year the total amount of monetary losses as a result of legal proceedings associated with corruption and briber. The target is that the total amount equal to zero.

HC-BP-510a.2, Code of ethics: Description of code of ethics governing interactions with health care professionals is the administration aim. With this ethic code the HPSJB will not suffer ethical problems and emotionally is better for respect and comprehension between professionals. Is an administration responsibility to promote and distribute this crucial document.

Table #35 – Human Capital activity metric dimension

N	Sustainability-related business issues	ACCOUNTING METRIC	Category	CODIFIED METRIC CODE	General Issue Category
10	Employee Recruitment, Development, & Retention	Discussion of talent recruitment and retention efforts for scientists and other research and development personnel	Discussion and Analysis	HC-BP-330a.1	Employee Engagement, Diversity & Inclusion
11	LABOR Practices	(1) Number of work stoppages and (2) total days idle		IF-WM-310a.2	LABOR Practices

CODIFIED METRIC CODE:

HC-BP-330a.1, Talent retention: This is in the issue Employee Recruitment, Development and Retention. The proposal is measure days of salary delay, lower gap between HPSJB salary and other institutions, measuring levels of work happiness, training hours for staff, continuous improvement measures and stakeholder approval with ratings and to value and publish ideas aimed at improving the functioning of the organization of the hospital.

IF-WM-310a.2, LABOR Practices: It is important to measure and understand the number of work stoppages as each reason to be possible reversing the negative effects.

Another Key Performance Indicator (KPI) is the total days idle that should decrease every year on all departments and the best result is zero for all departments.

Table #36 – Environment activity metric dimension

	Sustainability-related business issues	ACCOUNTING METRIC	Category	CODIFIED METRIC CODE	General Issue Category
	Waste Management	Total amount of medical waste, percentage (a) incinerated, (b) recycled or treated, and (c) landfilled		HC-DY-150a.1	Waste & Hazardous Materials Management

CODIFIED METRIC CODE:

HC-DY-150a.1: The great focus on the environment is the issue of waste & hazardous materials management whose codified metric code is HC-DY-150a.1. Here the hospital should measure the total amount of medical waste divided in three group by percentage: incinerated, recycled or treated and landfilled. Those KPI should be made for Hospital and Laboratory separately.

Table #37 – Business Model & Innovation Activity metric

stainability-related siness issues	ACCOUNTING METRIC	Category	CODIFIED METRIC CODE	General Issue Category	Dimension
cycling & Resource covery	(1) Amount waste incinerated (2) percentage hazardous (3) percentage used for energy recovery		IF-WM-420a.1	Business Model Resilience	Business Model & Innovation

CODIFIED METRIC CODE:

IF-WM-420a.1. Here we have 3 KPI:

- amount waste incinerated,
- percentage hazardous,
- percentage used for energy recovery.

Table #38 – Activity metric

ACTIVIY METRIC	CATEGORY	UNIT OF MEASURE	CODIFIED METRIC CODE
Number of outpatients treated	Quantitative	Number	HC-BP-000.A

Appendix 3

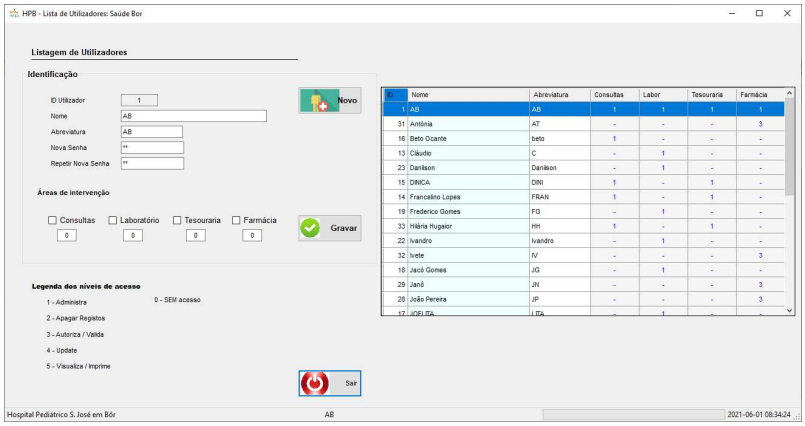


Figure #52 – Authorized staff

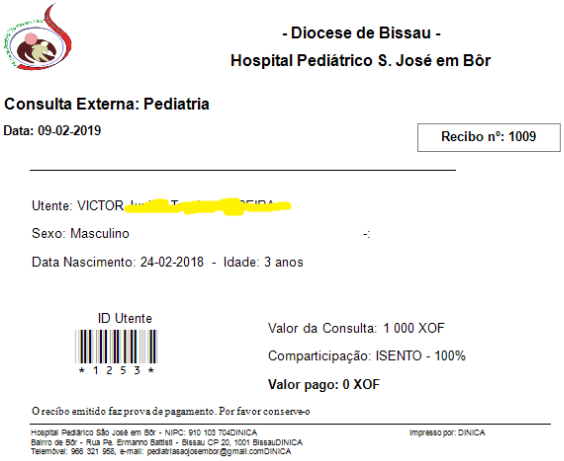


Figure #53 – Invoice

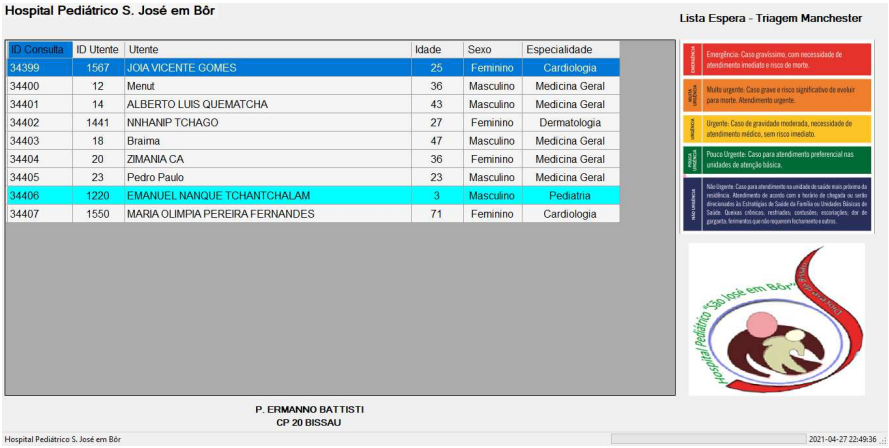


Figure #54 – Screen to call to "Manchester Triage"

Figure #55 – Statistic waiting outpatients by medical specialty and health severity.

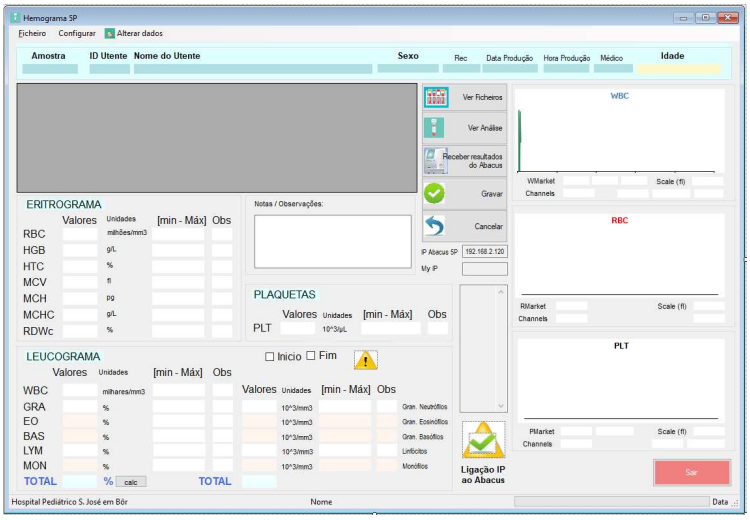


Figure #56 – Blood count transmission to the LIS using standard HL7 protocol

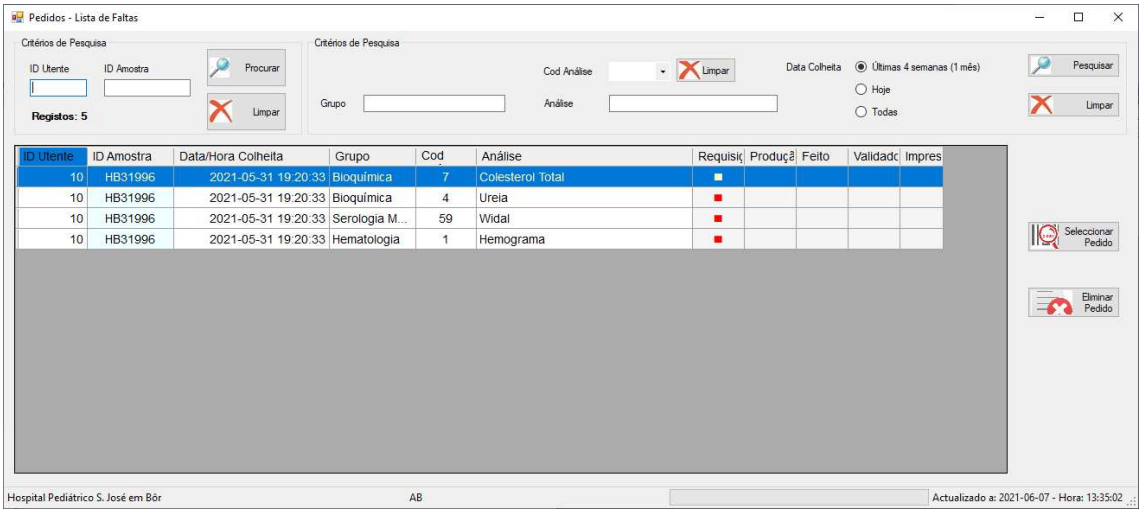


Figure #57 – List of missing jobs

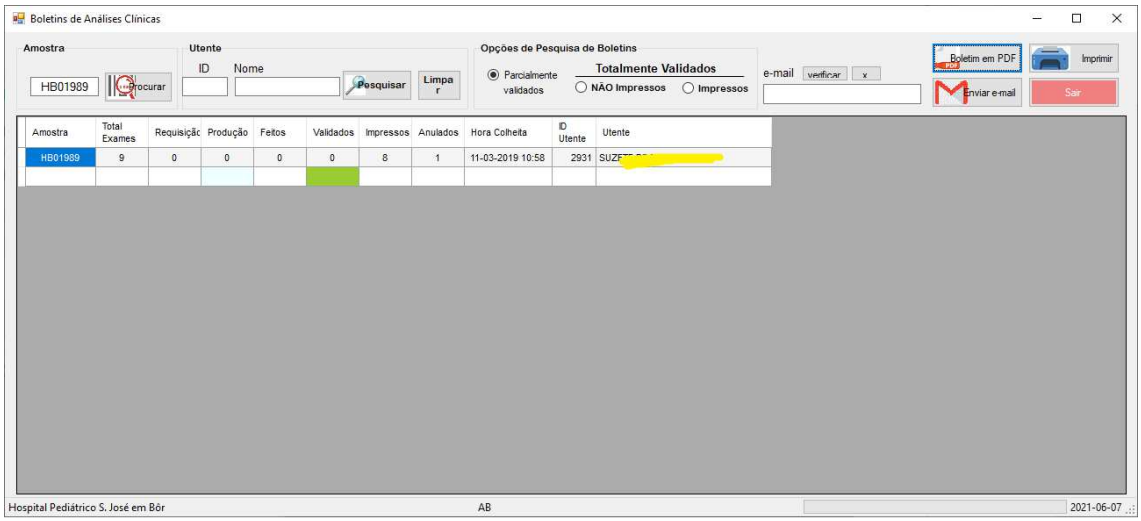


Figure #58 – pre order print report

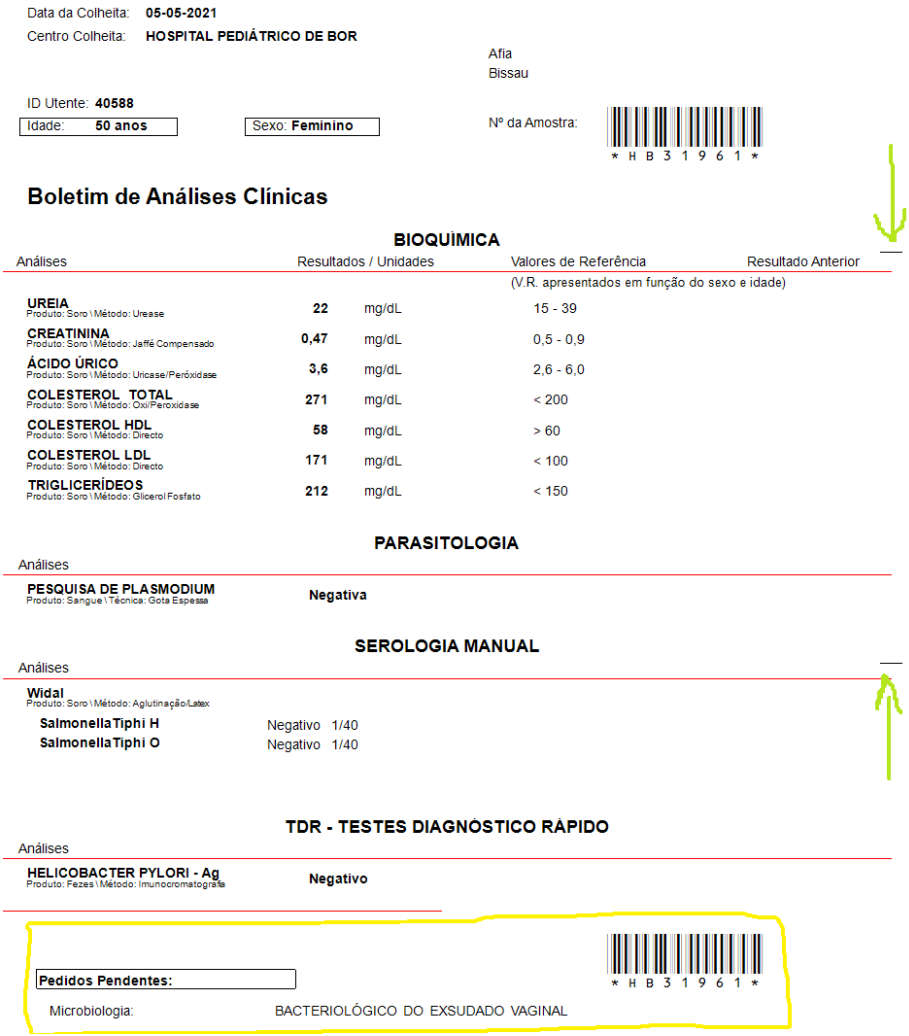


Figure #59 – Innovate incomplete statement on the analytical report with barcode

LaBor análises clínicas

Página: 1

Exma Sra:

SU[redacted]

Data da Colheita: **11-03-2019**
Centro Colheita: **HOSPITAL PEDIÁTRICO DE BOR**

C[redacted]
B[redacted]

ID Utente: **2931**
Idade: **38 anos** Sexo: **Feminino**

Nº da Amostra: *HB01989*

Boletim de Análises Clínicas

HEMATOLOGIA

Análises	Resultados / Unidades			Valores de Referência (V.R. apresentados em função do sexo e idade)			Resultado Anterior
HEMOGRAMA							
Eritrograma							
Eritrócitos (RBC)	**5,00**	10^{12}/L		3.85-5.20	10^{12}/L		
Hemoglobina (HGB)	**14,1**	g/dL		11.5-16.0	g/dL		
Hematócrito (HTC)	**44,5**	%		47.40-49.60	%	L	
Vol. Globular Médio (MCV)	**88,9**	fl		80.0-97.0	fl		
Hb. Globular Média (MCH)	**28,3**	pg		26.0-34.0	pg		
Conc. Hb. G. Média (MCHC)	**31,8**	g/dL		29,7- 36,8	g/dL	L	
RDW	**14,4**	%		11.5-15.0	%		
Leucograma							
Leucócitos (WBC)	**4,7**	10^9/L		4.00-10.00	10^9/L		
Gran. Neutrófilos	**45,6**	%	**2,10** 10^9/L	1.50-8.00	10^9/L		
Linfócitos	**48,3**	%	**2,30** 10^9/L	0.80-4.00	10^9/L		
Céluas Médias: (Incluí: Eosinófilos + Basófilos + Monócitos)	**6,1**	%	**0,30** 10^9/L	0.30-1.70	10^9/L	L	
Plaquetas							
Plaquetas	**278**	10^9/L		140-440			

BIOQUIMICA

Análises			Valores de Referência	
GLICOSE Produto: Soro \ Método: Oxidase/Peróxidase	**100**	mg/dL	70 - 105	
CREATININA Produto: Soro \ Método: Jaffé Compensado	**0,36**	mg/dL	0,5 - 0,9	
ÁCIDO ÚRICO Produto: Soro \ Método: Uricase/Peróxidase	**4,6**	mg/dL	2,6 - 6,0	
COLESTEROL TOTAL Produto: Soro \ Método: Oxi/Peroxidase	**285**	mg/dL	< 200	
COLESTEROL HDL Produto: Soro \ Método: Directo	**163**	mg/dL	> 60	
COLESTEROL LDL Produto: Soro \ Método: Directo	**91**	mg/dL	< 100	
TRIGLICERÍDEOS Produto: Soro \ Método: Glicerol Fosfato	**155**	mg/dL	< 150	

Dra. Zimania Cá
(Dir. Técnica)

Figure #60 – Analytical Report

ESTATÍSTICA DO LABOR

Resultados validados

Data: De 2019/01/18 a 2020-06-28 10:51:03 - HB23284

Ano: 2019/2020

			Bioquímica														
		Meses / Exames	3	4	5	6	7	8	11	12	13	14	15	17	27	28	29
			Glicose	Ureia	Creatinina	Acido Urico	Colesterol Total	Triglicerídeos	AST-GOT	ALT-GPT	Gama-GT	PAL	Bilirubina D	Ionograma	Ferro Ferozina	CALCIO	Phosforo - P
2019	1	Janeiro	58	17	20	30	33	24	9	9	2	0	0	0	0	2	0
	2	Fevereiro	193	73	115	103	107	70	32	32	2	0	0	0	1	4	0
	3	Março	182	77	126	121	135	89	50	51	13	3	3	0	0	11	0
	4	Abril	201	110	152	141	179	139	53	53	11	5	7	0	0	15	0
	5	Maio	240	103	158	145	216	184	53	55	15	6	11	0	0	13	1
	6	Junho	225	96	147	139	184	170	54	52	11	4	3	0	0	12	1
	7	Julho	255	113	205	186	198	115	50	50	5	1	3	0	0	21	0
	8	Agosto	207	100	143	135	178	171	62	62	4	2	4	0	1	9	0
	9	Setembro	247	109	170	177	230	213	63	63	9	4	7	0	0	24	0
	10	Outubro	330	170	228	219	287	267	85	84	6	4	7	10	1	13	0
	11	Novembro	253	125	152	140	207	187	56	55	2	2	2	52	0	15	0
	12	Dezembro	255	150	201	161	258	238	81	79	17	7	7	44	3	32	3
		TOTAL	2646	1243	1817	1697	2212	1867	648	645	97	38	54	106	6	171	5
2020	1	Janeiro	290	209	253	208	268	252	78	76	8	5	6	57	0	13	0
	2	Fevereiro	225	161	344	146	203	192	56	56	66	0	8	72	0	18	0
	3	Março	224	138	178	164	229	217	60	60	20	5	6	27	1	17	0
	4	Abril	205	114	136	134	193	186	51	50	5	3	7	5	0	8	0
	5	Maio	24	17	19	22	31	29	4	4	0	0	0	0	0	0	0
	6	Junho	1	7	11	0	0	0	9	9	0	0	0	3	0	0	0
	7	Julho	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	8	Agosto	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	9	Setembro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10	Outubro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	11	Novembro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	12	Dezembro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		TOTAL	969	646	941	674	924	876	258	255	99	13	27	164	1	56	0
		TOTAL GERAL	3615	1889	2758	2371	3136	2743	906	900	196	51	81	270	7	227	5

Figure #61 – Detail's statistic report

ESTATÍSTICA DO LABOR

Resultados validados

Data: De 2019/01/18 a 2020-06-28 10:51:03 - HB23284

Ano: 2019/2020

			Hematologia	Imunologia				Parasitologia			Microbiologia						
		Meses / Exames	1	390	20	25	35	537	39	40	84	197	10	927	82	1041	1044
			Hemograma	Helicobacter Pylori - Ac IgG	PROTEÍNA C-REACTIVA (PCR)	Toxoplasma IgG (Quimioluminescência / doseamento)	Toxoplasma IgM	Pesquisa de Plasmodium	Ex. Directo / Parasitológico de fezes	Ex. Parasitológico de fezes - 3A	Fezes	Ex. Directo do Exsudado Vaginal	URINA	Ex. Bacteriológico de pûs de ouvido	Ex. Bacteriológico do exsudado vaginal	Ex. Bacteriológico do exsudado da faringe	Ex. Bacteriológico do exsudado uretral
2019	1	Janeiro	254	3	0	0	0	139	6	1	0	6	0	1	0	0	0
	2	Fevereiro	821	0	20	1	0	405	3	0	0	0	3	0	0	1	0
	3	Março	1000	0	4	0	0	507	5	0	0	0	10	0	0	0	0
	4	Abril	758	0	4	1	1	391	2	0	0	0	14	0	0	0	0
	5	Maio	923	0	1	0	0	383	1	0	0	0	5	0	0	0	0
	6	Junho	1115	0	2	0	0	471	1	0	0	0	1	0	0	0	0
	7	Julho	971	0	1	0	0	417	3	0	0	0	3	0	0	0	0
	8	Agosto	1173	0	0	0	0	679	1	0	0	1	0	0	1	0	0
	9	Setembro	1124	0	1	4	4	610	6	0	7	0	15	0	2	0	1
	10	Outubro	1574	0	46	16	21	709	6	0	100	0	36	4	6	9	0
	11	Novembro	1182	0	0	3	3	616	179	4	79	14	41	3	33	9	2
	12	Dezembro	1014	0	0	3	5	465	174	7	107	16	44	3	20	5	3
		TOTAL	11909	3	79	28	34	5792	387	12	293	37	172	11	62	24	6
2020	1	Janeiro	1166	0	0	8	8	411	175	11	95	7	27	4	25	6	1
	2	Fevereiro	1096	0	0	20	20	330	168	11	107	9	20	3	19	4	0
	3	Março	1101	0	0	1	1	208	148	3	78	28	21	3	26	5	3
	4	Abril	975	0	0	2	2	179	102	3	56	17	12	2	10	8	1
	5	Maio	181	0	0	0	0	33	16	0	12	1	3	1	6	2	1
	6	Junho	13	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	7	Julho	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	8	Agosto	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	9	Setembro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10	Outubro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	11	Novembro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	12	Dezembro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		TOTAL	4532	0	0	31	31	1162	609	28	348	62	83	13	86	25	6
		TOTAL GERAL	16441	3	79	59	65	6954	996	40	641	99	255	24	148	49	12

Figure #62 – Detail's statistic report

ESTATÍSTICA DO LABOR

Resultados validados

Data: De 2019/01/18 a 2020-06-28 10:51:03 - HB23284

Ano: 2019/2020

		Microbiologia		Hematologia				Serologia Manual						Urina	Total
		43	924	18	19	23	312	22	59	208	467	633	643	209	
Meses / Exames		BK Directo	Ex. Bacteriológico de pús de feridas	Transferrina	FERRITINA - IC	Grupo Sanguineo + RH + CDE	Velocidade Sedimentação	VDRL	Widal	TPHA	PCR pesquisa	TASO	Factor Reumatóide	Urina Tipo II	
1	Janeiro	0	0	0	0	6	15	4	28	0	6	5	2	25	501
2	Fevereiro	1	0	1	1	11	45	14	92	1	69	8	11	122	1630
3	Março	0	1	0	1	5	87	28	166	0	74	9	7	169	2073
4	Abril	7	0	0	0	11	0	10	103	0	257	13	12	122	1706
5	Maio	2	0	0	0	18	6	19	162	1	312	8	15	178	2034
6	Junho	0	0	0	0	16	73	14	258	0	375	10	14	194	2544
7	Julho	0	0	0	1	13	19	13	229	0	374	7	15	207	2273
8	Agosto	2	0	1	1	7	81	9	183	0	472	6	19	189	2825
9	Setembro	4	0	1	0	17	33	12	204	0	450	19	22	202	2738
10	Outubro	13	2	0	0	25	187	16	379	0	14	20	18	232	3433
11	Novembro	12	1	1	0	56	91	24	255	1	1	30	16	145	2801
12	Dezembro	17	0	0	0	40	73	17	249	0	4	31	12	144	2453
TOTAL		58	4	4	4	225	710	180	2308	3	2408	166	163	1929	27011
1	Janeiro	21	3	0	0	17	155	12	191	0	99	32	21	144	2639
2	Fevereiro	17	0	2	0	25	85	21	228	0	61	20	17	146	2429
3	Março	19	5	0	0	11	239	21	215	0	31	25	23	152	2367
4	Abril	12	3	0	0	11	33	17	137	0	0	12	10	74	1678
5	Maio	0	1	0	0	1	12	2	30	0	0	1	2	13	318
6	Junho	0	0	0	0	0	1	0	0	0	0	0	0	1	16
7	Julho	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Agosto	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	Setembro	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Outubro	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	Novembro	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Dezembro	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL		69	12	2	0	65	525	73	801	0	191	90	73	530	9447
TOTAL GERAL		127	16	6	4	290	1235	253	3109	3	2599	256	236	2459	36458

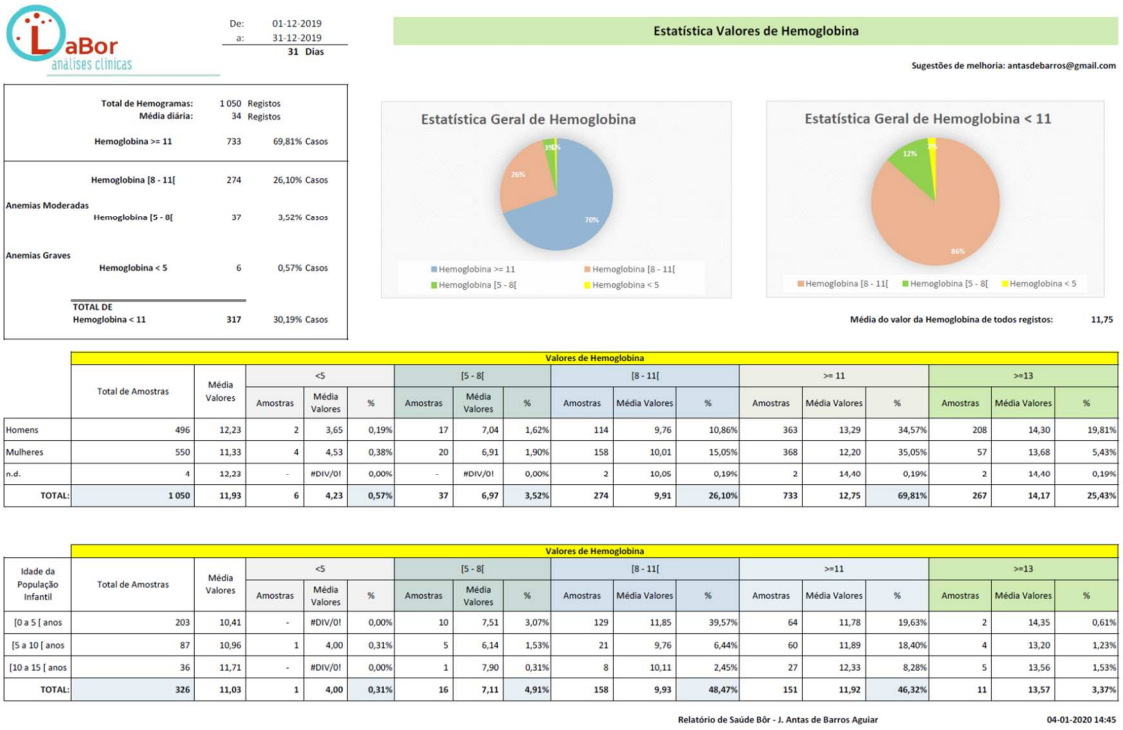
Figure #63 – Detail's statistic report.

ESTATÍSTICA DO LABOR

Ano 2000

Análises	Total	Total
Bioquímica	8.559	44%
Coagulação	63	0%
Endocrinologia	71	0%
Hematologia	5.124	26%
Imunologia	62	0%
Marcadores	-	0%
Marcadores	26	0%
Marcadores	34	0%
Microbiologia	704	4%
Parasitologia	1.799	9%
Serologia	1.228	6%
TDR - Testes	1.213	6%
Urina	530	3%
Total Global	19.413	100%

Figure #64 – Statistic by analytic group.



De: 01-12-2019
a: 31-12-2019
31 Dias

Estatística Valores de Hemoglobina

Sugestões de melhoria: antasdebarros@gmail.com

	Total de Hemogramas:	1 050	Registos
	Média diária:	34	Registos
	Hemoglobina >= 11	733	69,81% Casos
	Hemoglobina [8 - 11[	274	26,10% Casos
Anemias Moderadas	Hemoglobina [5 - 8[	37	3,52% Casos
Anemias Graves	Hemoglobina < 5	6	0,57% Casos
	TOTAL DE Hemoglobina < 11	317	30,19% Casos

Estatística Geral de Hemoglobina

Estatística Geral de Hemoglobina < 11

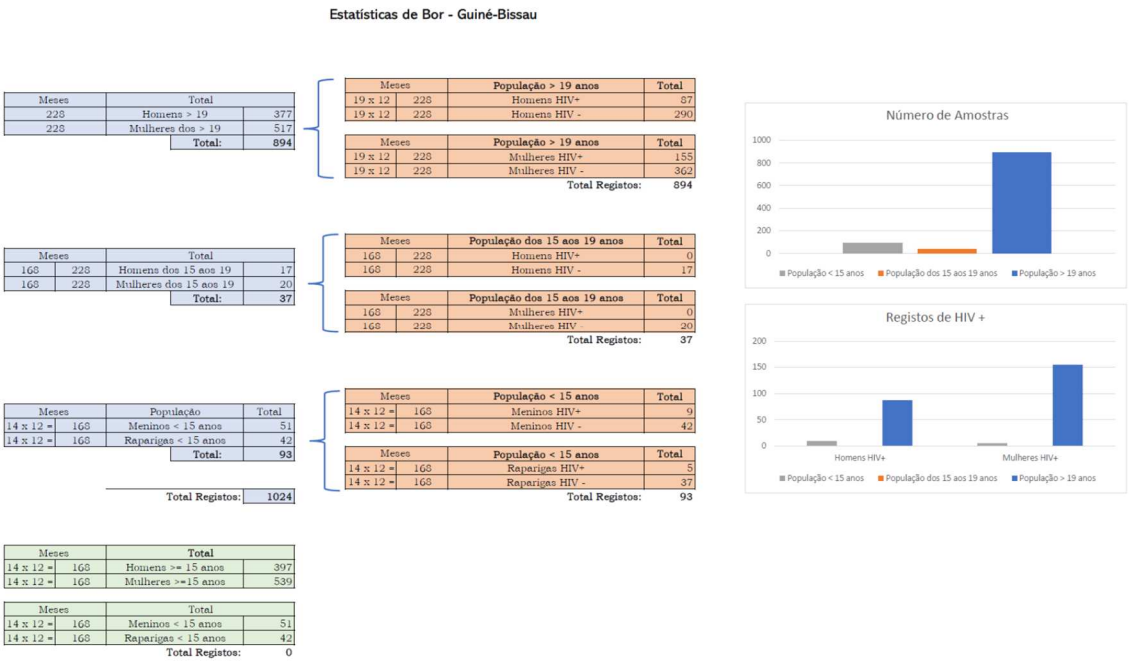
Média do valor da Hemoglobina de todos registos: 11,75

Valores de Hemoglobina																	
	Total de Amostras	Média Valores	<5			[5 - 8[			[8 - 11[			>= 11			>=13		
			Amostras	Média Valores	%	Amostras	Média Valores	%	Amostras	Média Valores	%	Amostras	Média Valores	%	Amostras	Média Valores	%
Homens	496	12,23	2	3,65	0,19%	17	7,04	1,62%	114	9,76	10,86%	363	13,29	34,57%	208	14,30	19,81%
Mulheres	550	11,33	4	4,53	0,38%	20	6,91	1,90%	158	10,01	15,05%	368	12,20	35,05%	57	13,68	5,43%
n.d.	4	12,23	-	#DIV/0!	0,00%	-	#DIV/0!	0,00%	2	10,05	0,19%	2	14,40	0,19%	2	14,40	0,19%
TOTAL:	1 050	11,93	6	4,23	0,57%	37	6,97	3,52%	274	9,91	26,10%	733	12,75	69,81%	267	14,17	25,43%

Valores de Hemoglobina																	
Idade da População Infantil	Total de Amostras	Média Valores	<5			[5 - 8[			[8 - 11[			>=11			>=13		
			Amostras	Média Valores	%	Amostras	Média Valores	%	Amostras	Média Valores	%	Amostras	Média Valores	%	Amostras	Média Valores	%
[0 a 5 [anos	203	10,41	-	#DIV/0!	0,00%	10	7,51	3,07%	129	11,85	39,57%	64	11,78	19,63%	2	14,35	0,61%
[5 a 10 [anos	87	10,96	1	4,00	0,31%	5	6,14	1,53%	21	9,76	6,44%	60	11,89	18,40%	4	13,20	1,23%
[10 a 15 [anos	36	11,71	-	#DIV/0!	0,00%	1	7,90	0,31%	8	10,11	2,45%	27	12,33	8,28%	5	13,56	1,53%
TOTAL:	326	11,03	1	4,00	0,31%	16	7,11	4,91%	158	9,93	48,47%	151	11,92	46,32%	11	13,57	3,37%

Relatório de Saúde Bôr - J. Antas de Barros Aguiar 04-01-2020 14:45

Figure #65 – Hemoglobin Statistic by gender and age



Estatísticas de Bor - Guiné-Bissau

Meses		Total
228	Homens > 19	377
228	Mulheres dos > 19	517
	Total:	894

Meses		População > 19 anos	Total
19 x 12	228	Homens HIV+	87
19 x 12	228	Homens HIV -	290

Meses		População > 19 anos	Total
19 x 12	228	Mulheres HIV+	155
19 x 12	228	Mulheres HIV -	362

Total Registos: 894

Meses		Total
168	228	Homens dos 15 aos 19	17
168	228	Mulheres dos 15 aos 19	20
		Total:	37

Meses		População dos 15 aos 19 anos	Total
168	228	Homens HIV+	0
168	228	Homens HIV -	17

Meses		População dos 15 aos 19 anos	Total
168	228	Mulheres HIV+	0
168	228	Mulheres HIV -	20

Total Registos: 37

Meses		População	Total
14 x 12 =	168	Meninos < 15 anos	51
14 x 12 =	168	Raparigas < 15 anos	42
		Total:	93

Total Registos: 1024

Meses		População < 15 anos	Total
14 x 12 =	168	Meninos HIV+	9
14 x 12 =	168	Meninos HIV -	42

Meses		População < 15 anos	Total
14 x 12 =	168	Raparigas HIV+	5
14 x 12 =	168	Raparigas HIV -	37

Total Registos: 93

Meses		Total
14 x 12 =	168	Homens >= 15 anos	397
14 x 12 =	168	Mulheres >=15 anos	539

Meses		Total
14 x 12 =	168	Meninos < 15 anos	51
14 x 12 =	168	Raparigas < 15 anos	42
		Total Registos:	0

Número de Amostras

Registos de HIV +

Figure #66 – HIV Statistic by gender and age