PURSUING PERFECTION IN THE ROMANIAN HEALTHCARE SYSTEM WHILE APPLYING LEAN SIX SIGMA METHODOLOGY

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ABSTRACT
Lean Six Sigma demonstrated itself a methodology worth of being applied in every industry, no matter the field sector. Thus, one industry that retrieved this methodology and applied it with successful outcomes is the healthcare system. The American and European healthcare industry took the Lean Six Sigma methodology and applied it in hospitals and clinics where there were cases of high variation level and waste of resources (including financial waste, human resources waste, time waste, etc).
Therefore, taking examples from European and American hospitals, we have decided to apply Lean Six Sigma tools in the Romanian healthcare system as well. One of the biggest issues that our clinics and hospitals are confronting today, is represented by the waiting time in front of the cabinet, even if we are talking about the waiting time in front of a generalist's cabinet or at the emergency department. Thereby, striving to eliminate as much as possible the waste and reduce the variability level, our research will highlight the specific Lean Six Sigma tools that could help us in our debate.

KEYWORDS: *Lean Six Sigma, healthcare system, patients, regression*

JEL CLASSIFICATION: *H111, H115, M11*

1. INTRODUCTION

In the past few years, the Romanian healthcare system confronted with different deadlocks, one of them with repercussions for patients and the others with repercussions for medical staff. Seeing and assisting in the same time, somehow at the decay of the sanitary industry, we arrived at the conclusion that the healthcare system needs a methodology which will be able to revive it. In this terms and with the thought of improving the healthcare system, we have chosen Lean Six Sigma methodology.
Though, before we start a campaign for improving our hospitals, clinics or simply some of their departments, we should first ask ourselves what are we trying to accomplish and also, what is required to get us there (Larson, 2003). Starting an improvement plan just for the sake of applying some theoretical models, will result in waste of time, financial resources, human resources and so on, exactly what we are trying to avoid.
This is why, before implementing a methodology like this, first of all we have to create a plan. Fixing a problem doesn't imply only to find it and then solving it by patching it up. In the Lean Six Sigma culture, solving a problem means creating a brainstorm, find out the main causes that

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determine it until reaching at the root cause and then, based on concrete data, starting the improvement process. But before that, medical employees have to understand that all their efforts are, on the one hand, for themselves, for a proper working environment, for a more efficient activity, and on the other hand, for their patients. Treating a patient in a superficial manner and in unsafety conditions materializes in a bad reputation for that hospital and its employees and sometimes, in worst cases, in repercussions for that patient.
Per se, using Lean Six Sigma methodology could improve a hospital's daily activities and processes and most of all, could increase its profitability and patients' satisfaction.

2. THE ANALOGY BETWEEN LEAN AND SIX SIGMA

The relation between Lean and Six Sigma appeared in the early 90s (at AlliedSignal and Maytag), then it became easily popular, especially due to Michel Georges, under the name of *Lean Six Sigma*. In table 1 we have made a comparison, by identifying the characteristics for each method, between Lean management, Six Sigma and the Theory of constraints:

Table 1. Comparisons between Lean, Six Sigma and Theory of constraints

Program specifications	Six Sigma	Lean	Theory of constraints
Applicability indications	1. Define 2. Measure 3. Analyze 4. Improvement 5. Control	1. Value identification 2. Value flow identification 3. Flow 4. "Pull" system 5. Perfection	1. Identifying constraints 2. Exploitation of constraint 3. Processes' subordination 4. Lifting the constraint 5. Repeating the cycle
"Label" or indication	Reducing variability	Elimination of waste	Managing constraints
Focus on:	Problems	Flow	Constraints
Main benefits	Procedures' stability	Flow' acceleration	Increase flow
Secondary benefits	Less waste; Accelerated flow; Less stocks; Better quality.	Less variability; Less stocks; Better quality.	Less waste and stocks; Better quality.
Assumptions	A problem exists. Figures and numbers are exploited. System's outputs are improved if the process' variation is reduced.	Waste's removal will improve business performance. More small improvements are important.	Less inventory or waste. Improved quality.
Critics	Lack of interaction between systems. Processes are independently improved.	Statistics or system analysis are unused.	Analytical data unused.

Source: Nave (2002)

Inspecting each of these 3 methods, from their applicability, benefits, critics, etc. we can see which one suits best our process. We can easily observe that by combining Lean with Six Sigma the result will conclude in an improvement method which will allow us to accelerate process flow, to decrease variability level and stocks, all by creating a better quality in our healthcare institution.
In order to choose correctly an improvement program, the easiest way is to use a model that identifies a causal hierarchy and also causality relationships. In the first place, we can identify a primary theory and then, we can identify the relationship between the primary theory and the chosen methodology.

Table 2. Analogy between Lean and Six Sigma

Why does Lean need Six Sigma?	Why does Six Sigma need Lean?
The culture and infrastructure needed for achieving and sustaining results are not explicitly prescribed by Lean.	For identifying and copping with waste (even if process mapping represents a Six Sigma tool, it does not indicate the data collection necessary for quantifying which steps contribute the most to the non-value-added activities).
The Critical-to-Quality needs of customers are not centered (for example, in Lean approach, when a person creates a value stream map, he also makes the decision as to whether a certain activity adds value or not; in contrast, Six Sigma provides numerous places in improvement methods where the voices of suppliers and customers must be included).	For improving process speed/cycle time (even if Six Sigma deals with tools for improvement in cycle time, it does not use, nor institutes, the Pull system).
The impact of variation is not recognized by Lean methodology (tools for reducing variation are not included in Lean methodology. On the contrary, for Six Sigma the variation's elimination represent a primary key and therefore it uses several tools for controlling variation).	Lack of specific speed tools (Lean methodology could contribute to Six Sigma methodology by adding some speed-accelerations tools in order to avoid limiting the process performance).
	If Lean approach eliminates non-value-added steps, Six Sigma quality could be approached much faster.

Source: adapted from *George (2003)*, pg.46

Basically, if we combine Lean and Six Sigma methodology in any industry, including the healthcare industry, besides the fact that we would be able to eliminate some steps in the improvement process, we could also improve quality levels to almost 5σ, which would lead us to a rate of perfection of 99.8%.

3. LEAN SIX SIGMA IN THE ROMANIAN HEALTHCARE SYSTEM

Why does the Romanian healthcare system need Lean Six Sigma methodology? Well, this is a question that has several answers. First of all, because in the Romanian clinics and hospitals there is a lot of waste. For example, due to laboratories and referral notes to different specialists, there is a waste of financial resources. Then, due to deficiencies in the appointment system, there is a huge amount of waiting time for patients, etc.
Second of all, the Romanian healthcare system provokes disruptive waves of variation. This doesn't mean that the system produces natural variation (which exists in every process from every industry

and it is considered as normal), but the system produces a specific variation (meaning that certain values from different processes exceed the established limits approved in the trust interval by the patients and in this way, that certain process becomes uncontrolled by changing the approved/admitted values agreed by the patients, causing them dissatisfaction).
The methodology brings value to the many industries that apply it, thus, even the General Electric's CEO, Jack Welch describes the methodology as being one of the most challenging and rewarding initiative that they have undertaken (Lowe, 1998). And therefore, they have chosen to list in their annual report the benefits of Six Sigma in the sanitary field, more exactly at Medical Systems, presenting the fact that with this methodology's help they have increased the "uptime" of CT scanner x-ray tubes, increasing as well the profitability and level of patient care given by hospitals (Breyfogle, 2003).
Romanian healthcare needs a methodology easy to understand by the managers and as well by the medical staff, and that kind of methodology is Lean Six Sigma.
In the below picture, we have created a Fishbone diagram (part of one of the seven basic quality tools) to better illustrate the causes (inputs) that determine the patients' dissatisfaction (effect-output) and implicitly, why do we need to apply the methodology to the healthcare system:

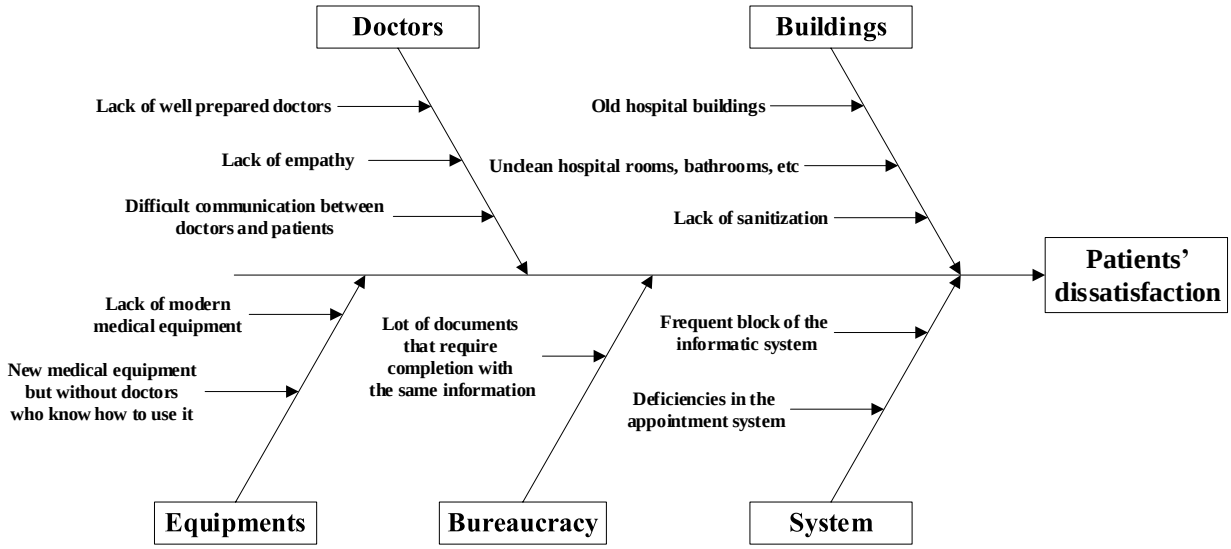

Figure 1. Fishbone diagram presenting the main causes for patients' dissatisfaction
Source: Author

In the above figure we have highlighted only the most important and significant actions that bother the patients. In reality, the Romanian healthcare system is filled with many other deficiencies that result in patients' dissatisfaction.
When trying to work on the root cause, the desired outcome is to brainstorm, along with medical staff, a large list of possible *X*s that affect *Y*s (Eckes, 2003).
In other words, the mathematical formula $Y=f(X)$ is just a way of saying that the changes or variables representing the system's inputs along with the process flow from the system's interior will mostly determine the way the final score will be created (the Ys). We should also remember that in this equation the inputs are represented by the Xs and the outputs, by the Ys (Pande, 2000).
Basically, what the Fishbone diagram shows us are one of the main reasons why our healthcare system needs a methodology like Lean Six Sigma. Those type of problems need special attention and until jumping and trying to solve directly the main problem (patients' dissatisfaction), medical staff, along with the manager, should try and solve (more exactly, arrive at the problem's root) each cause, by asking why that problem occurs and how it could be fix (a Lean management tool, good

for using in this case, is represented by the "5WHY" tool – when a problem occurs, it is recommended to ask five times the question "why" in order to arrive at the problem's root cause).
All in all, as long as we can use, on the one side, a methodology that balances the work flow, focuses on value-added steps and eliminate waste, and on the other side, another methodology that improves efficiency in departments and eliminates the defects and variation level, and in plus, both being patient oriented, we should apply Lean Six Sigma in our improvement process.

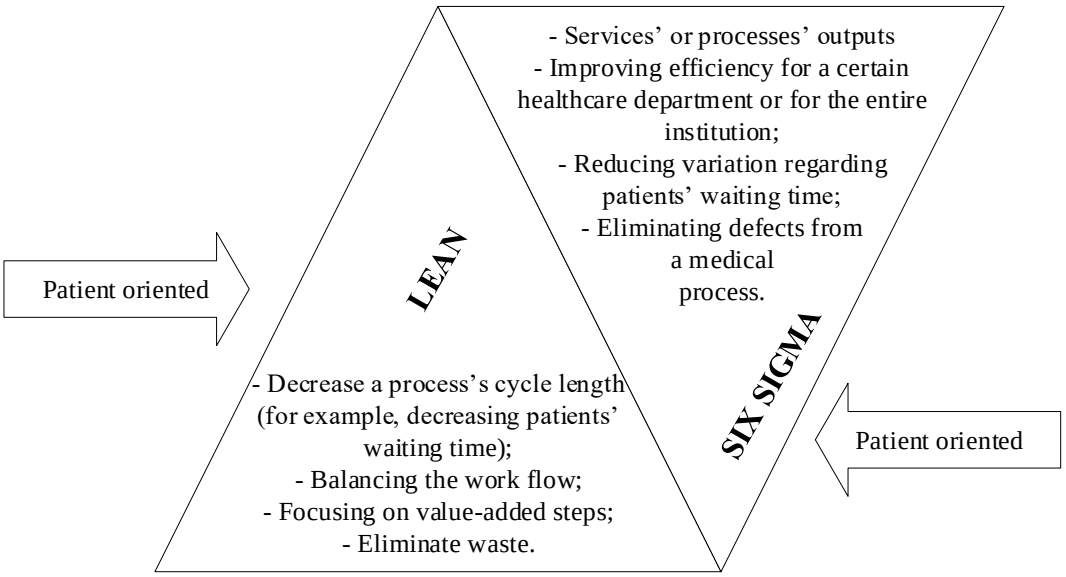

Figure 2. Lean and Six Sigma methodology
Source: Author

4. APPLYING LEAN SIX SIGMA TOOLS IN THE ROMANIAN HEALTHCARE SYSTEM – CASE STUDY FOR A BUCHAREST PUBLIC CLINIC

As we have mentioned, in Romanian healthcare system Lean Six Sigma tools would be a possibility to demonstrate and understand how deficiencies happen and what solutions can we offer, in order to achieve the patients' satisfaction.
Our research continues in a public clinic from Bucharest. Here, there are a number of deficiencies, some of them more important than others, but from the interviews and discussion held with patients over time, we found out that one of the most annoying part for them is to wait in front of the cabinets, even if, before arriving at the family doctor, they have made an appointment and were given a certain hour to arrive at (since there is an appointment system, one could think that the idea of waiting time is eliminated).
Therefore, from conducting interviews with doctors as well, we have arrived at the conclusion that one of the main reasons why patients wait in front of the family doctors' cabinets is created by the deficiencies existent in the informatics system. More exactly, every doctor uses an informatics system to register each patient that came in a certain day, to register the diagnostic and the treatment given and, in the end, to issue the electronically receipt.
Unfortunately, this informatics system get blocked several times per day, moment in which the doctor can't give the patient his electronic receipt and therefore, they both have to wait until the system unlocks again.
Analyzing these information, we have conducted a study in which we have registered the patients' waiting time, as well as the informatics system blocking duration.
Taking into consideration the values expressed in minutes, we have realized the following correlation diagram, which clearly indicates that between the patients' waiting time and the system's blocking duration, there is a positive correlation, as seen below:

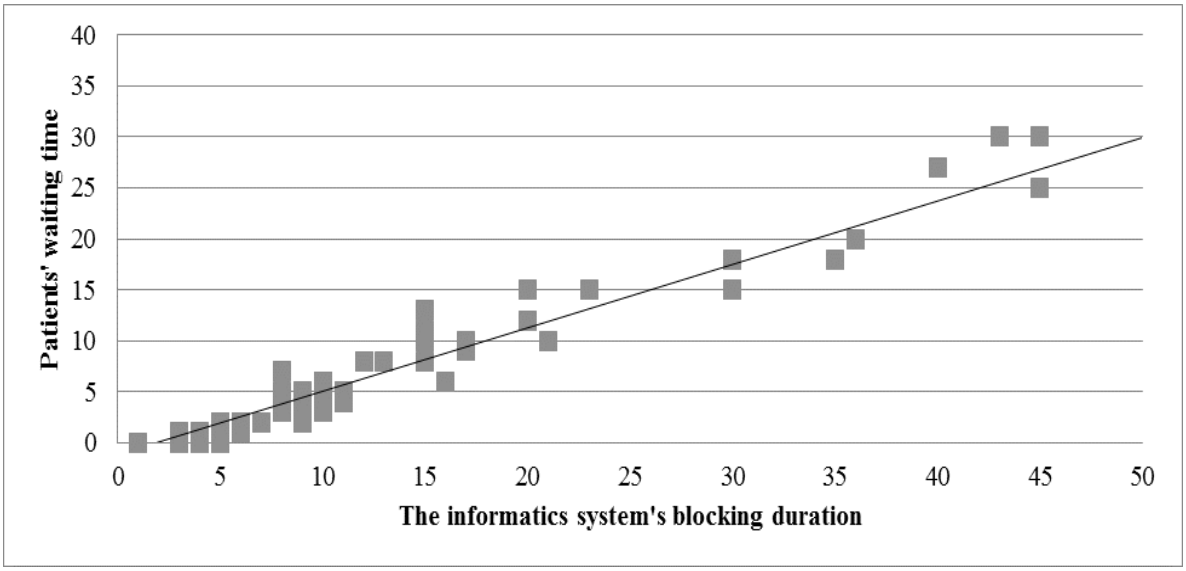

Figure 3. Relation between patients' waiting time and the informatics system
Source: Author

The above chart indicates a direct proportional relation between the 2 variables. This means that the more the system blocks, the more the patient outside the cabinet will have to wait before seeing the doctor. Basically, these 2 variables influence each other.
After constructing the Scatter diagram, we have created, with the help of Excel program, a regression analysis. This analysis will help us predict the result of a variable when we already know the result of the first variable. With other words, based on this analysis, if we know how much time the informatics system will be blocked, we can predict how many minutes the next patient will have to wait in front of the cabinet.
Therefore, we have used as the *independent* variable (the variable whose value is known), the informatics system, and as *dependable* variable (the variable whose value is unknown), the patients' waiting time. We have taken the simplest type of regression, which is the linear regression and its equation is presented below **(**Isaic-Maniu, 1995):

$$Y=b*X+a \quad (1)$$

Where: Y represents the dependable variable and X the independent variable, a represent the intercept and b represents the regression's slope.
Based on these information we have obtained the following ANOVA analysis (table 3).
We will take into consideration only the values for the two indices which are:
a = -1.23
b = 0.62
In this way, our regression function will be Y = 0.62*X + (-1.23).
Thus, based on the resulted regression, we can now estimate how long the patient will have to wait before entering the cabinet, knowing the blocking duration of the informatics system:

- For X=21 minutes, Y=0.62*21+(-1,23), which is Y=11.79 minutes
- For X=38 minutes, Y=22.33 minutes
- For X=13 minutes, Y= 6.83 minutes, etc.

In conclusion, our regression analysis can help us predict how many minutes the patients will wait and with the help of other Lean Six Sigma tools, try and improve this deficiency.

Table 3. ANOVA analysis

Regression Statistics	
Multiple R	0.969760621
R Square	0.940435662
Adjusted R Square	0.939408691
Standard Error	2.00011604
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	3663.373078	3663.373	915.7370043	3.20506E-37
Residual	58	232.0269221	4.000464		
Total	59	3895.4			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	-1.232206336	0.397171903	-3.10245	0.002963616	-2.027232278	-0.43718	-2.02723	-0.43718
X Variable 1	0.62692492	0.020717157	30.26115	3.20506E-37	0.585455025	0.668395	0.585455	0.668395

Figure 4. Regression function
Source: Author

5. CONCLUSIONS

Changing an entire hospital or clinic, removing it and then building it again it's not possible. However, adapting the medical process and improving them, while introducing a new organizational culture based on efficiency and value-added processes is possible. This is what Lean Six Sigma is about: listing problems or deficiencies after creating a brainstorming with the medical staff, finding the root cause of these issues and then, with the proper algorithms and tools, removing waste and decreasing variation level, all for increasing patients' satisfaction.
Romanian healthcare system, nowadays, applies some basic efficiency rules, most of them being more or less accepted by the employees. Therefore, if the rules imposed do not comply with medical staff's ideas, the result not only will not bring any benefit for the institution but also will discourage patients and will urge them to head to another hospital, maybe a private one, where costs are above average, determining, in the end, the patients to come to a hospital or clinic only when they are in need.
We have sum up what a clinic looks like before and after introducing Lean Six Sigma methodology:

***Before* Lean Six Sigma**	***After* Lean Six Sigma**
Medical staff are "mechanically" fulfilling their professional duties	Medical staff think about more efficient methods for executing tasks
Medical employees work individually	Medical employees will work as part of a team
Each department works individually	Departments will cooperate
The attention is internally focused	The attention will be externally focused
Medical staff will respect patients' contractual needs	Medical staff will fulfill patients' needs
Patients accept the offered medical services	Patients are happy and pleased with the medical services offered
Quality is controlled from the inside	Quality is built from the inside
Hospital employees adopt most of the decisions following some opinions	Hospital employees take decisions based on concrete data
Profit's level is normal	Profit's level is maximized

In conclusion, creating a Lean Six Sigma culture might be hard at the beginning, the improvement process might not be realized within at least 1 year, but in the end, the results will put in evidence all the work, by revealing an efficient and organized environment, with satisfied employees and patients.

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