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Unification of concepts by Paraconsistent Logic and Rescheduling, Pre-scheduling of Surgeries (Queue of Elective Orthopedic Surgeries) for decision making

Unificação de Conceitos por Lógica Paraconsistente e Reagendamento, Pré-agendamento de Cirúrgias (Fila de Cirúrgias Ortopédicas Eletivas)

Unificacíon de conceptos por Lógica Paraconsistentes y Reprogramación, Pre-programacíon de Cirugias (Cola de Cirugías Electivas Ortopédicas)

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Abstract
During the Surgery Scheduling process, there is a need to request materials and shipments, as those involved are supplying companies, as well as confirmation and understanding of what was requested. The lack of an item can lead to cancellation, causing a rescheduling, a new allocation of the surgical team. The problem raised continues in the inconvenience to the patient, hospital, and to health insurance, as there is a constant need for a new release for surgery. The analyzed process study refers to elective (scheduled) orthopedic surgeries. In this context, Logic Eτ concepts are studied for decision- making in the Elective Orthopedic Surgery Agenda problem, mainly because in the cancellation due to lack of instruments and consigned material, measures are taken before anesthetizing the patient. It is understood because of the unification of concepts to meet the decision-making in the procedure for canceling elective orthopedic surgery.
Keywords: Elective orthopedic surgery scheduling process; Elective orthopedic surgery rescheduling cost; Logic Eτ; Paraconsistent logic.

Resumo
Durante o processo de Agendamento de Cirurgias, há necessidade de solicitação de materiais e embarques, pois os envolvidos são empresas fornecedoras, bem como confirmação e entendimento do que foi solicitado. A falta de um item pode levar ao cancelamento, ocasionando um reagendamento, uma nova alocação da equipe cirúrgica. O problema levantado continua na inconveniência ao paciente, ao hospital e ao plano de saúde, pois há necessidade constante de nova liberação para cirurgia. O estudo de processo analisado refere-se a cirurgias ortopédicas eletivas (agendadas). Nesse contexto, estudam-se os conceitos da Lógica Eτ para a tomada de decisão no problema da Agenda de Cirurgia Ortopédica Eletiva, principalmente porque no cancelamento por falta de instrumental e material consignado, são tomadas medidas antes de anestesiar o paciente. Entende-se pela unificação de conceitos para atender a tomada de decisão no procedimento de cancelamento de cirurgia ortopédica eletiva.
Palavras-chave: Processo de agendamento de cirurgia ortopédica eletiva; Custo de reagendamento de cirurgia ortopédica eletiva; Lógica Eτ; Lógica paraconsistente.

Resumen
Durante el proceso de Programación de Cirugía, es necesario solicitar materiales y envíos, ya que los involucrados son empresas proveedoras, así como la confirmación y comprensión de lo solicitado. La falta de un ítem puede llevar a la cancelación, provocando una reprogramación, una nueva asignación del equipo quirúrgico. El problema planteado continúa en la incomodidad para el paciente, el hospital y el seguro de salud, ya que existe una necesidad constante de una nueva habilitación para la cirugía. El estudio de proceso analizado se refiere a cirugías ortopédicas electivas (programadas). En este contexto, se estudian conceptos de Lógica Eτ para la toma de decisiones en el problema de Agenda de Cirugía Ortopédica Electiva, principalmente porque en la cancelación por falta de instrumental y material consignado, se toman medidas antes de anestesiar al paciente. Se entiende como resultado de la unificación de conceptos para atender la toma de decisiones en el procedimiento de cancelación de cirugía ortopédica elective.
Palabras clave: Proceso de programación de cirugía ortopédica electiva; Costo de reprogramación de cirugía ortopédica electiva; Lógica Eτ; Lógica paraconsistente.

1. Introduction

During the cancellation of an elective orthopedic surgery, when the patient is already inside the operating room with the allocated team, it is necessary to open the materials (instrumentals) and consignments to be used, at this moment a material conference is carried out (instruments) and consigned materials (such as suture threads, etc.); depending on its importance, the surgery can be canceled, with the need to reschedule, causing an inconvenience to both the Hospital and the Surgical Team.

1.1 Material Conference

The material to be used for the surgical procedure arrives at the Hospital on the eve of the procedure, where it undergoes a conference process upon receipt by the employee of the CME (Material and Sterilization Center), who conducts the conference and forwards it to the washing process, sterilization, packaging and labeling with the name of the patient and company.

At this moment, it may be that when receiving the material due to the lack of knowledge of the recipient, it may go unnoticed or even due to the error of the one who sent the lack of some instruments.

The lack of material for the surgical procedure only occurs when it is opened, already in the operating room.

1.2 Removal of Material by the Room Circulator.

The material is removed from the CME by the circulating room, who can be a Nursing Assistant or even a Nursing Technician.

There are other materials that are also used in surgery that come from another OPME department (Orthoses, Prostheses and Special Materials) used in a medical intervention, surgery, dentistry, for diagnosis or therapy.

2. Objectives

In this work, the lack of instrumental and consigned material is analyzed, which may cause the cancellation of an Elective Orthopedic Surgery in case there is an intercurrence in these.

In Brazil, many of the Public and Private Hospitals adopt different procedures for opening materials in the operating rooms.

In one of these categories, the procedure consists of the following: the opening of the materials takes place before the application of anesthesia to the patient, and when all the material is opened, the technician from the company (which supplies the material) check the circulating verses of the room (nursing technician or nursing assistant, sometimes being the nurse responsible for the shift) is released for the anesthesia procedure, while in others the opening is done concomitantly with the opening of the materials and the application of anesthesia to the patient.

In this case, which is of interest to this work, if there is a cancellation, it will take time to use the operating room until the patient recovers from the anesthetic and is referred to the RPA (Post-Anesthetic Recovery). In addition, the work of the entire team involved is lost, causing a high cost and a significant inconvenience for the patient and family.

To analyze the cost of the complications discussed, data were collected in a private hospital in the city of São Paulo, Brazil, referring to elective orthopedic surgeries performed from January to December 2020.

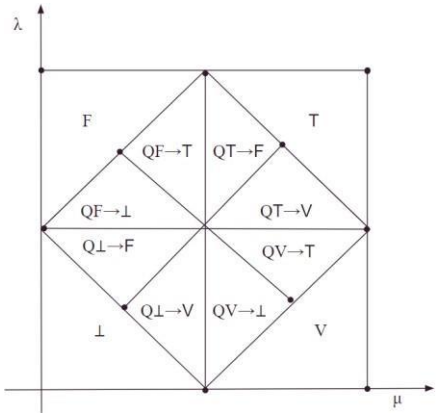
3. Lógica Paraconsistente Anotada Evidencial Eτ.

The logic for Aristotle is a tool for right thinking. The propositions raised as an argument and inferred in the conclusion are based on observations. Therefore, the conclusion and the propositions cannot be treated as only truth or falsehood, but always observe, seeking to feed the reasoning to knowledge. The propositions raised from reality must follow three Fundamental Principles of Logic: Principle of identity (X is equal to itself and unlike all the rest); Principle of noncontradiction (no statement can be true and false at the same time); Principle of excluded third (there is no third possibility, besides true and false). Paraconsistent Logic is among the nonclassical logical calla [1] since it contains provisions contrary to some of the basic principles of Aristotelian Logic, such as the principle of contradiction. From the Aristotelian point of view, the three principles of logic prevail. The predecessors of the Paraconsistent Logic were the Polish logician J. Łukasiewicz Lvov in 1878 and the Russian philosopher N.A. Va- silév. Vasilév baptized a logic that became known as imaginary. Łukasiewiczanounced the trivalent Logic: True, False, Possible. The first logical to structure a paraconsistent propositional calculation was the Polish S. Jaśkowski, the disciple of Łukasiewicz. The term "Paraconsistent" literally means 'next to consistency'. However, 1976 the philosopher scientist Francisco Miró Quesada, called the logic of "Paraconsistente". According to the Paraconsistent Logic, a sentence and its negation may both be true (Newton C. A., et al., 1999). In the mid-1950s, the Polish S. Jaskowski and the logical mathematician Newton C. A. da Costa proposed the contradiction in the logical structure and became known as the founders of Paraconsistent Logic.

Logic Eτ in the day-to-day of our reality in front of innumerable sources of information, the contradiction constantly occupies a space, bringing uncertainties that will culminate soon or future contestations. In activities such as analysis of clinical exams, in politics, in the analysis of legal processes, in the measurement of software, technical support, in the care of insurers, where at least two specialists are involved, there will always be different points of view. In the case of a system with artificial intelligence, neural networks, also known as "machinelearning" , which starts from the study of pattern recognition, the appearance of contra- diction in logical reasoning is inevitable when we try to reflect human behavior. In response to the contradiction, we have the Logic Eτ. The Logic Eτ is a class of Paraconsistent Logic that works with propositions of type p (μ, λ), where p is a proposition and (μ, λ) indicate the degrees of favorable evidence and contrary evidence, respectively. The pair (μ, λ) is called the annotation constant, with the values of μ and λ being limited, between 0 and 1. The evidence is reflected in the collection of the value or degree, which is a number found in the set of real with an interval between 0 and 1. Given the characteristics to meet an analysis in a given proposition, we were able to extract that degree or value. The source of information can be a specialist in software measurement, where the value extracted is based on the level of knowledge of this specialist, the experience of count counts or even the experience gained in his profession of function point analyst. So, thinking about the paraconsistent analysis system that addresses uncertainties, one must start with repository modeling containing knowledge of the information collected from the specialists in function point analysis. One way of representing the Logic Eτ that allows to perceive the real reach and thus extract results to support in the decision-making, is faced with the understanding of the diagram and its degrees of certainty and uncertainty, grouped in extreme states identified in the results (1 to 4) and non-extreme states displayed in the results (5 to 12), with adjustable control values representing limit values: C1 = C3 = ½ e C2 =

C4 = -½; C1: Vcve = maximum value of certainty control; C2: Vcfa = minimum value of certainty control; C3: Vcic = maximum value of the uncertainty control; C4: Vcpa = minimum value of the uncertainty control;

Figure 1 Extreme and Non-extreme states that represents table 1 and 2.



Fonte: Autores.

In the representation of the diagram the following understandings with symbols and their 12 possible results were used, being 1 to 4 extreme states and 5 to 12 non- extreme states:

Table 1 – Extreme States [3].

Extreme States	Symbol
1-True	V
2-False	F
3-Inconsistent	T
4-Paracomplete	⊥

Non-extreme

	Months 2020													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Canceled**	**Total**
Doctor A	16	6	5	4	14	18	14	14	12	8	5	3	2	119
Doctor B	14	10	6	6	2	6	13	11	6	10	6	16	3	106
Doctor C	0	0	0	0	0	0	1	6	10	7	6	9	0	39
Doctor D	5	8	7	4	6	8	6	18	11	14	10	15	1	112
Doctor E	1	12	5	0	5	7	3	3	9	4	1	1	3	51
Total Months	36	36	23	14	27	39	37	52	48	43	28	44	9	427

Source: Authors.

Table 2: Non-extreme states [3].

Non-extreme States	Symbol
5-Quasi-true tending to Inconsistent	QV⟶T
6-Quasi-true tending to Paracomplete	QV⟶⊥
7-Quasi-false tending to Inconsistent	QF⟶T
8-Quasi-false tending to Paracomplete	QF⟶⊥
9-Quasi-inconsistent tending to True	QT⟶V
10-Quasi-inconsistent tending to False	QT⟶ F
11-Quasi-paracomplete tending to True	Q⊥⟶V
12-Quasi-paracomplete tending to False	Q⊥⟶ F

Source: Authors.

4. Analyze

For the creation of Table 1, the elective orthopedic surgeries performed in the period from January to December 2020 were monitored, grouped by surgeons, totaling by the number of surgeries performed within the month, having in the yellow cell its total for the year subtracting canceled if any.

In the blue line, we have the total number of surgeries performed in the month, ending with the total number of surgeries performed by the team.

4.1 Surgeries Performed

Table 2. Number of Surgeries performed and canceled in 2020

The Figure 2 shows the number of elective orthopedic surgeries performed from January to December 2020, with a month-to-month and year-to-date total. Elective Orthopedic Surgery means: 4.1shoulder and knee prostheses, ligament reconstructions, etc.

Figure 2 Surgeries Performed.

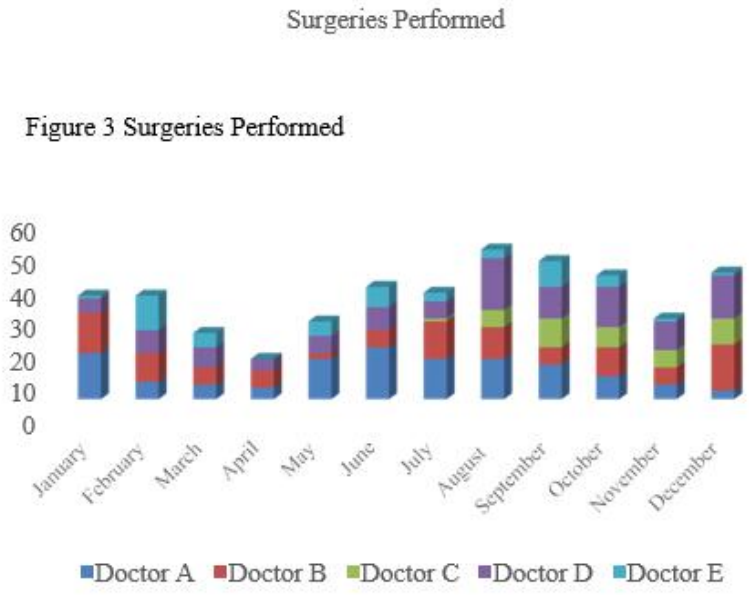


Figure 3 Surgeries Performed

Source: Authors.

4.2 Calculation of costs in US$ (dollar) for using the operation room

Dealing specifically with Orthopedic Surgeries.

In this value of US$ 38, talking into account a surgery with an average time of 1:30 hours (90 minutes).

Table 4 – Calculation of costs in US$(dollar).

The Amount Surgeries	Surgery Time	Value US$
1	90 minute surgeries	3,420.00
9	90 minute surgeries	30,780.00

Source: Authors.

4.3 Application of Paraconsistent Logic

It was analyzed after scheduling that at the time of opening the instruments and conferences of the consigned inside the operating room, the lack of one or the other of these was detected, which could cause the cancellation of the surgery, at this point we will be studying the Human Factors in the beginning. regarding the Choice of Material by the Physician and Logisticians in the Requests Made Section.

Initially, factors and sections were studied to meet the proposition “Elective orthopedic surgery must be canceled”.

Table 5 – Factor and Section.

Factor (0,00 until 1,00)	Section
Medical Human	Choice of Material by the Doctor
Logistics	Medical request Company Request Agreement approval Supply of Material Material Reception Conference - Operating Room
Quality	Non-standard cutting guides Non-standard drill bits dead punch

Source: Authors.

4.4 Conclusion

According to conceptual research, it is concluded that the use of Paraconsistent Logic as use in decision-making and attending to the problem is of great help because in this sense it helps in the search for the answer to canceling the surgery before refer- ring the patient to the surgical center, resulting in savings and unnecessary expenses with rescheduling and work for the family. Therefore, the current process needs to hap- pen before the application of an anesthesia to the patient, the opening of all the material, the conference by the company technician (who supplies the material), staff circulating in the room (nursing technician or assistant of the nurses), thus ensuring that the room is available for use as quickly as possible. Therefore, the unification of concepts be- comes necessary as support in decision-making in "Elective orthopedic surgery must be canceled".

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