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Big Data As A Systemic Procedure In The Field of Forensic And Legal Medicine

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Abstract

In recent years, Big Data in medicine has become a phenomenon and the field of legal and forensic medicine could not be left aside. The complexity of the data processed in this field is evident and, therefore, requires special treatment.

The characteristics (the V's) with which Big Data is endowed are what define it. The sequence of characteristics continues: 3, 5, 7, 9,.....We will focus on the development of Big Data through seven characteristics (7 V's).

The concept of Big Data must go hand in hand with the growth of the greater computational capacity that is being developed.

The aim of this article is to analyze, from a theoretical point of view, Big Data (BD) within the field of forensic and legal medicine as a systemic procedure with a holistic perspective. It also includes a section dedicated to Artificial Intelligence in the context of legal and forensic medicine.

Keywords: Big Data, Systemic procedure, Characteristics, Forensic medicine, Legal medicine, Artificial Intelligence.

1. Introduction

The systemic procedural approach can be thought of as a general scientific paradigm. It offers a holistic, objective and universally applicable form, providing a framework for complex investigations **[1-3]**. We will address it within the field of legal and forensic medicine.

Systemic management describes a holistic, objective and universally applicable form of management, which provides a framework for addressing grand challenges.

Big Data is a massive set of structured, unstructured and semi-structured data. Big Data has to efficiently deal with very heterogeneous data that evolves rapidly. It is difficult to manage big data using any of the traditional applications. Big Data consists of very large data sets that will be processed by increasingly advanced tools **[4-6]**.

In recent times, the growing importance of data for organizations in general, in medicine, leads to a new paradigm in the collection and management of data (Big Data).

The implementation of Big Data in forensic science is slow, so it is necessary for professionals in the field of legal and forensic medicine to be aware of this fact and to be encouraged to participate by developing and publishing works that broaden horizons in this field **[7-8]**. Creating a development framework in this field would broaden their vision of the future. The field of legal and forensic medicine cannot remain stagnant, so it must participate in the philosophy of Big Data **[9-13]**.

Big Data is not just about the size of data; it is about how we manage, analyze and extract value and, therefore, knowledge from this vast ocean of information.

2. Definition of Big Data (BD)

In the literature, we can find multiple definitions of Big Data **[4-6]**.

We dare to give a definition of Big Data: a set of characteristics that help us obtain value and knowledge of a large volume of very heterogeneous data through models and technologies suitable for decision support.

Big Data is generated through many of the activities that are carried out on a daily basis. The main idea of Big Data is that it allows you to have access to more information. And the more information you have, the greater the understanding and the better you can make decisions or look for solutions. The fundamental problem of BD is todiscover value from large data sets, given the wide variety of data types and the rapid generation of data. The implementation of the concept of Big Data in the field of medicine in general **[14-20]** and inlegal and forensic medicine in particular **[21-22]** requires an effort onthe part of professionals in these areas.

3. Type of data

Within Big Data we can find the following types of data:

Structured, unstructured and semi-structured data

To know the structure of the data (*Structured Data*) we will rely on an autopsy:

Gender: Male

Age: 57

Pathological history of interest: depression, dissociative disorder

Initial cause of death: gunshot wound

Immediate cause of death: destruction of vital nerve centers

Origin of Death: Violent

Medicolegal etiology: suicidal

Histological specimens:

Arteriosclerosis

No microscopic findings of interest

Anthracosis, congestion, inflammation

Anthracosis, congestion, emphysema, inflammation

Congestion, emphysema, inflammation

Fat degeneration

Fat degeneration, inflammation

No microscopic findings of interest

Placing autopsies in such a way that they can be treated as structured data (qualitative variables: coded categories), we have, for example, for five autopsies **(Tables 1, 2 y 3)**. Each row of the tables corresponds to an autopsy:

Table 1

Sex	Age	Arteriosclerosis	Anthracosis	Congestion	Fat_degeneration	Edema	Efisema
1	57	1	1	1	1	2	1
1	61	1	1	1	1	1	1
2	96	1	1	1	1	1	1
1	59	1	2	1	1	2	1
1	91	1	2	1	2	1	1

Table 2.

Sclerosis	Hemorrhage	Inflammation	Necrosis	Other_findings	Pathological_antecedents
2	2	1	--	0	1
1	1	1	--	0	1
2	2	1	--	0	3
1	1	1	--	1	3
1	2	1	--	1	3

Table 3.

Death_initial_cause	Death_immediate_cause	Death_origin	Medicolegal_etiology
4	2	2	2
1	1	1	--
6	8	2	1
7	2	2	1
2	5	1	--

Unstructured data

Figure 1 provides an example of unstructured data.

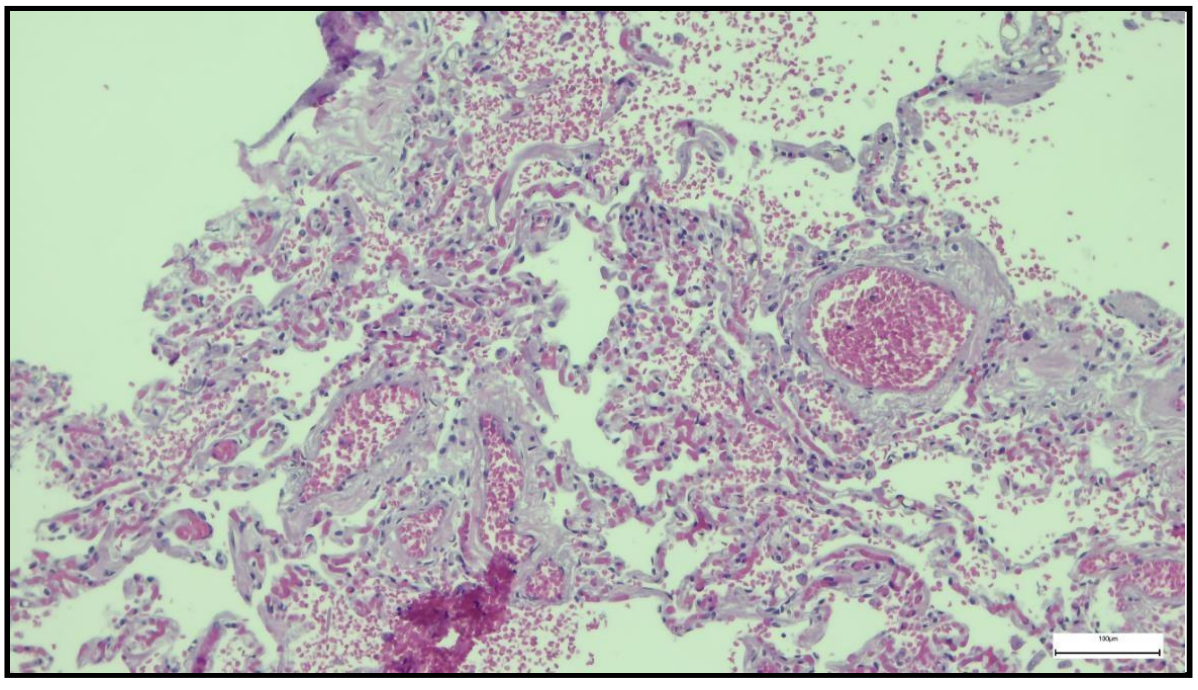

Figure 1: Pulmonary congestion and hemorrhage (autopsy).

The data in an image can be obtained through a convolutional artificial neural network. This data, once processed, becomes information for the medical examiner.

Semi-structured data

They combine features of both types.

4. Characteristics of Big Data

The characteristics (variables in the systemic procedure) called seven V's provide a holistic view of the challenges and opportunities in the world of Big Data. This global vision provides a great tool to improve decision-making in any professional field.

The characteristics of Big Data can be synthesized by 7 V's **(Figure 2)**:

V1. Volume: The amount of data generated of all kinds is increasing.

V2. Speed: The speed at which data is generated and processed to meet the demands and challenges of its analysis for use in the required field.

V3. Variety: it refers to the various types of data being processed: structured, unstructured and semi-structured.

V4. Veracity: it refers to the uncertainty of data, i.e. the degree of reliability of the received information. It is about obtaining quality data that can be used to get closer to the set objectives. Knowledge of the veracity of data, in turn, helps us better understand the risks associated with decision-making.

V5. Variability: it refers to how changing the meaning of data is. Variability represents data that is constantly evolving. This is especially true of natural language processing.

V6. Visualization: we refer to the way in which data is presented. Once data is processed, we need to visually represent it in a way that is readable and accessible, in order to explore patterns, trends and relationships in the research topic.

V7. Value: Data is not value. The ultimate goal of Big Data is to extract meaningful insights from data. Value is obtained from processed data that helps decision-making.

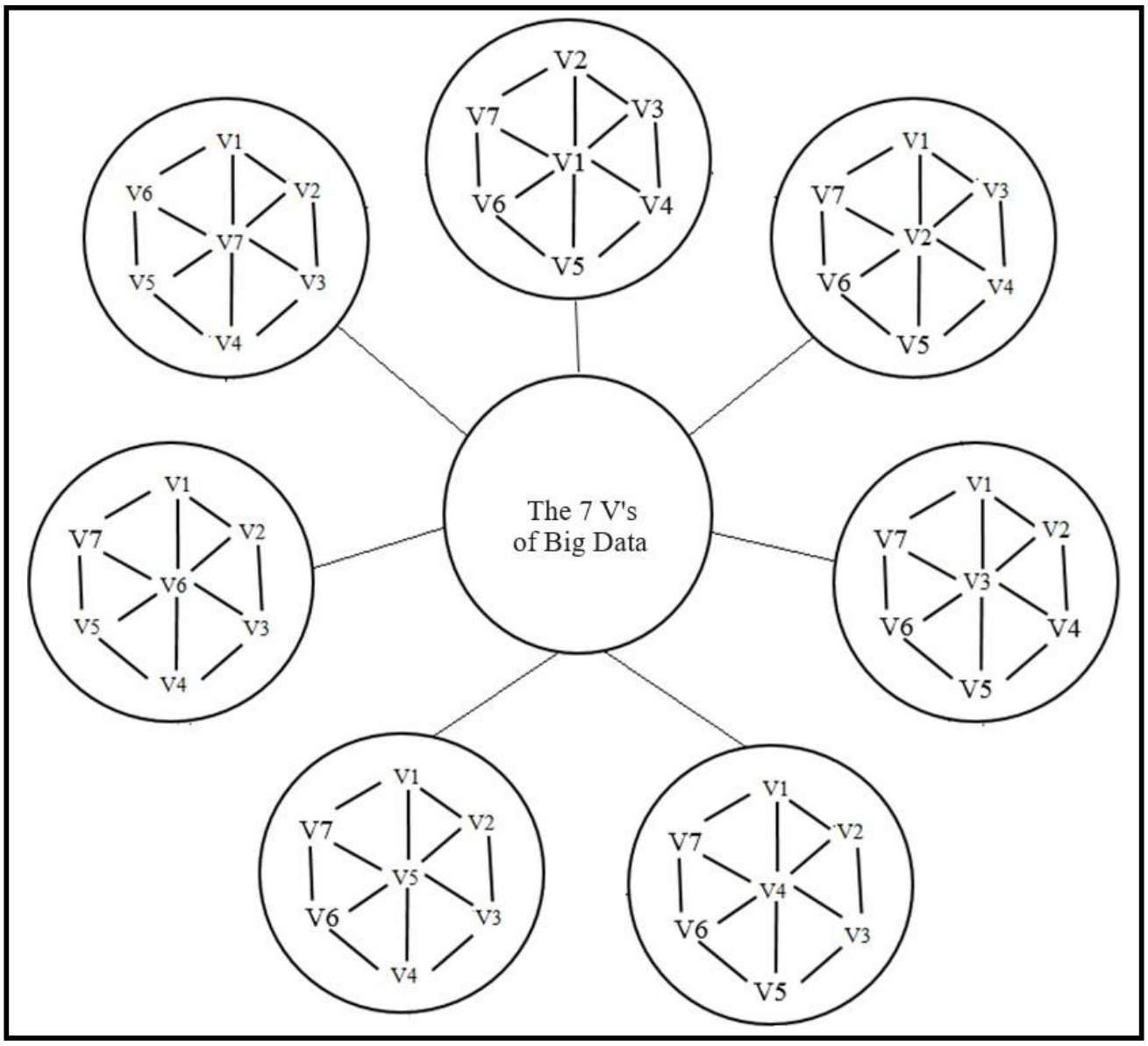

Figure 2. Systemic procedure of Big Data through its characteristics (7 V's).

These characteristics and those that will be considered in the future pose a constant challenge for Big Data.

5. Application of the systemic procedure to Big Data

Once the forensic data has been collected according to type (structured, unstructured and semi-structured), the 7Vs of the BD are configured as a systemic procedure with a holistic perspective, taking into account that the whole is greater than the sum of its parts.

The potentiality of BD is related to the improvement in the knowledge of how the variables (characteristics) have interacted, each and every one of them.

Table 4 shows the relationship between the characteristics that shape the application of the systemic procedure to Big Data.

	V2 *(Velocity)*	V3 (*Variety)*	V4 (*Veracity*)	V5 *(Variability)*	V6 *(Visualization*)	V7 (*Value*)
V1 (*Volume)*	V2/V1	V3/V1	V4/V1	V5/V1	V6/V1	V7/V1
	V1 (*Volume)*	V3 (*Variety)*	V4 (*Veracity*)	V5 *(Variability)*	V6 *(Visualization*)	V7 (*Value*)
V2 *(Velocity)*	V1/V2	V3/V2	V4/V2	V5/V2	V6/V2	V7/V2
	V1 (*Volume)*	V2 *(Velocity)*	V4 (*Veracity*)	V5 *(Variability)*	V6 *(Visualization*)	V7 (*Value*)
V3 (*Variety)*	V1/V3	V2/V3	V4/V3	V5/V3	V6/V3	V7/V3
	V1 (*Volume)*	V2 *(Velocity)*	V3 (*Variety)*	V5 *(Variability)*	V6 *(Visualization*)	V7 (*Value*)
V4 (*Veracity*)	V1/V4	V2/V4	V3/V4	V5/V4	V6/V4	V7/V4
	V1 (*Volume)*	V2 *(Velocity)*	V3 (*Variety)*	V4 (*Veracity*)	V6 *(Visualization*)	V7 (*Value*)
V5 *(Variability)*	V1/V5	V2/V5	V3/V5	V4/V5	V6/V5	V7/V5
	V1 (*Volume)*	V2 *(Velocity)*	V3 (*Variety)*	V4 (*Veracity*)	V5 *(Variability)*	V7 (*Value*)
V6 *(Visualization*)	V1/V6	V2/V6	V3/V6	V4/V6	V5/V6	V7/V1
	V1 (*Volume)*	V2 *(Velocity)*	V3 (*Variety)*	V4 (*Veracity*)	V5 *(Variability)*	V6 *(Visualization*)
V7 (*Value*)	V1/V7	V2/V7	V3/V7	V4/V7	V5/V7	V6/V7

In a systemic procedure, it is necessary to seek that all the relationships (Vi/Vj, i≠j, i= 1, 2, ..., 7; j=1, 2, ..., 7) quantitatively, qualitatively, quantitatively- qualitatively and qualitatively-quantitatively are greater than or equal to one (≥1), which would indicate the positive influence of the characteristic Vi on the Vj (reference characteristic). In other words, the aim is to produce a symbiosis between these relationships. The objective pursued in the application of the systemic procedure to Big Data in the field of legal and forensic medicine is that all the characteristics (V's) of Big Data participate in the improvement of the treatment and use of data to improve decision-making.

6. Artificial Intelligence and Big Data in the forensic field

In the context in which we are working, it would be appropriate to develop algorithms that implement the content of the circles in Figure 2, so that the use of Big Data in the forensic field is more efficient.

Artificial Intelligence (AI) is the technology that allows computers to simulate human intelligence and human capabilities (learning, reasoning, self-correction, etc.) in problem solving. This processing technology receives data (already prepared or collected), processes it, using models and algorithms, and answers questions about forecasting and decision making. AI systems are also capable of adapting their behavior by analyzing the effects of previous actions to subsequently work autonomously.

The combination of AI and Big Data has had and continues having a profound impact on society. AI accompanied by other technologies can perform multiple tasks that free forensic professionals from analyzing large amounts of medical data (Big Data) and discover coincidences and patterns to improve decision making. For example, AI models have been developed to help estimate the biological age of migrants or human remains.

The application of AI to forensic sciences is becoming less and less questionable since reliable, verifiable and reproducible results are obtained. Even so, human work is required to create algorithms that reduce subjectivity, increasing accuracy and, in turn, reducing the time to issue opinions with highly reliable results.

With all this, it must be clear that AI is not intended to replace forensic experts, but to help them in their daily work life. The integration of AI in daily medical-legal practice involves not only forensic doctors, but also legal professionals. All of them must generate confidence in its implementation and use. Proposing to those responsible for the Institutes of Legal and Forensic Medicine a policy for the application and management of AI tools in order to reduce their misuse and legislate regarding their use will avoid greater evils **[23-26]**.

7. Conclusions and future research

The conclusions we reach are qualitative rather than quantitative. The systemic procedure applied to the field of legal and forensic medicine gives us the opportunity to consider a forensic study with a holistic perspective, considering the interrelation between characteristics (variables) implicit in Big Data to improve the process of forensic study. We have to try to maintain as much as possible the relationship between characteristics (≥1). That is, the observed characteristic (Vi) participates in the improvement of the base characteristic (Vj). To do this, it will be necessary to continuously advance all the techniques and technologies that Big Data requires. The characteristic that presents the most difficulty in maintaining this relationship is "Veracity" (V4).

The awareness that a new reality (that of Big Data) is already in our lives and that the future, to a large extent, will be built on it should lead us to take the step of assimilation and implementation of this technology in legal and forensic medicine.

No matter how advanced AI is in the field of legal and forensic medicine, it will never be able to replace experts in this field in their entirety.

The study of practical cases in the field of legal and forensic medicine that combine Big Data, Systemic Procedures and AI will constitute a future line of research.

Conflict of interest: There is no conflict of interest.

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