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Applied Examples Of Soft Sets In ABO Blood Group System

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Abstract: *The main aim of this article is to carry out a general framework of soft set theory and their applications in practical life, i.e. to introduce some biomathematics applications, for more exactly applied examples of soft sets in ABO Blood Group System. Moreover, some important examples based on selected ideas and related facts are presented. This article is an introduction to Soft set Theory in Human ABO Blood Group System, and other interested individuals will also be able to gain information about current developments and achievements in this rapidly growing field.*

Keywords— Soft set Theory, Soft set, ABO Blood Group System**.**

1. INTRODUCTION

1.1 Soft Set Theory

The classical set theory, which is based on the crisp and exact case may not be fully suitable for handling the problems in practical life. Soft systems provide a very general framework with the involvement of parameters, and the problem of setting the membership function (as in fuzzy sets) does not arise. Thus research works on soft set theory and its applications in various fields are progressing rapidly.

The soft set theory easily applied to many different fields including game theory, operations research, Riemann integration, and Perron integration. After Molodtsov's application work in several directions [1], some operations and application of soft sets were studied by many researchers including Ali et al. [2], Aktaş and Çağman [3], Chen et al. [4], Maji et al. [5,6] presented an application of soft sets in decision making problems, Kovkov et al. [7] have found promising results by applying soft sets to Optimization Theory, Game Theory and Operations Research, A. Kharal and B. Ahmad [8] defined and discussed the several properties of soft images and soft inverse images of soft sets. They also applied these notions to the problem of medical diagnosis in medical systems.

So the application of soft set theory in other disciplines and real life problems are now catching momentum.

Furthermore, the theory of 'soft −tritopology' was first initiated by Asmhan [9] in 2017, and she was presented the foundations and its related properties. And in 2019 she was first initiated the theory of fuzzy − soft −tritopology [10]. Also, Asmhan F. H. and A. H. Abaas introduced some main concepts in soft −tritopological spaces in [11], [12], [13] and [14].

The soft set defined in [1] as follows, Let the set X be an initial universe and $\mathbb{E}$ be a set of parameters. Let $\mathcal{P}(X)$ denotes the power set of X and $\mathbb{A}$ be a non-empty subset of $\mathbb{E}$. A pair $(F,\mathbb{A})$ is said to be a soft −set over X, where F is a mapping given by $F:\mathbb{A}\to\mathcal{P}(X)$.

In other words, a $soft$ −set over X is a parametrized family of subsets of the universe X. For $e\in\mathbb{A}$, $F(e)$ may be considered as the set of e−approximate elements of the soft −set $(F,\mathbb{A})$. Clear that, a soft −set is not a set. And in [5] The complement of soft set defined as follows, the complement (relative complement) of a soft −set $(F,\mathbb{E})$ is denoted by $(F,\mathbb{E})^c$ and is defined by $(F,\mathbb{E})^c=(\mathcal{F}^c,\mathbb{E})$ where $\mathcal{F}^c:\mathbb{E}\to\mathcal{P}(X)$ is a mapping given by $\mathcal{F}^c(e)=X-F(e)$ for all $e\in\mathbb{E}$.

Now, our motivation in the present paper is to present a different than its Common application directions, and to carry out a general framework of soft set theory and their applications in ABO Blood Group System.

1.2 Blood Groups and Compatibilities

Blood is the red fluid that circulates in our blood vessels, i.e. veins and arteries. The main function of blood is to act as the body's transport system, but it also has a major role in the body's defense against infection. There is no substitute for blood. It cannot be made or manufactured. Donors are the only source of blood for patients who need it.

Although all blood is made of the same basic elements, not all blood is alike. In fact, there are eight different common blood types, which are determined by the presence or absence of certain antigens – substances that can trigger an immune response if they are foreign to the body. Since some antigens can trigger a patient's immune system to attack the transfused blood, safe blood transfusions depend on careful blood typing and cross-matching [15].

2. Soft Sets In The ABO Blood Group System

There are many blood groups in the human population including ABO, Rh, Kidd, Kell, Duffy, MNS and Lewis. The most important of these are ABO and RhD. Transfusion with ABO incompatible blood can lead to severe and potentially fatal transfusion reactions. RhD is highly immunogenic and can lead to red cell haemolysis in certain settings.

The ABO blood group is the most important of all the blood group systems. There are four different ABO blood groups (A , B , AB , O). There are very specific ways in

which blood types must be matched for a safe transfusion (as a receive blood and donate blood) [15] . See the chart below:

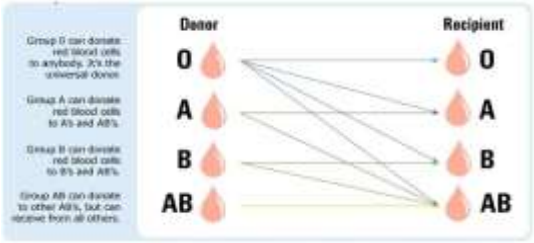

Fig. (1)

Example 2.1. (If the patient have the one of the four blood groups, then which the groups of blood can give the patient and which groups cannot give the patient) this statement represents a soft sets as fellows;
Let X be ABO blood group system of human i.e. $X = \{A, B, O, AB\}$ be an initial universe set, and the set of parameters $\mathbb{E} = \{e_1 = \text{can give}, e_2 = \text{can not give}\}$. Let us take the following cases then then we will obtain the only four soft sets as follows,

If the patient of Blood group AB, then the soft set $(P_1, \mathbb{E})$ is defined as fellows;
$P_1(e_1) = \{A, B, O, AB\} = X \quad , \quad P_1(e_2) = \emptyset$

If the patient of Blood group A, then the soft set $(P_2, \mathbb{E})$ is defined as fellows;
$P_2(e_1) = \{A, O\} \quad , \quad P_2(e_2) = \{B, AB\}$

If the patient of Blood group B, then the soft set $(P_3, \mathbb{E})$ is defined as fellows;
$P_3(e_1) = \{B, O\} \quad , \quad P_3(e_2) = \{A, AB\}$

If the patient of Blood group O, then the soft set $(P_4, \mathbb{E})$ is defined as fellows;
$P_4(e_1) = \{O\} \quad , \quad P_4(e_2) = \{A, B, AB\}$

Example 2.2. (Every person have the one of the four blood groups, then there are some blood groups the person possible receive and possible donate) this statement represents a soft sets as fellows;
Let X be ABO blood group system of human i.e. $X = \{A, B, O, AB\}$ be an initial universe set, and the set of parameters $\mathbb{E} = \{e_1 = \text{receive}, e_2 = \text{donate}\}$. Let us take the following cases then we will obtain the only four soft sets as follows,

If the person of Blood group AB, then the soft set $(P_1, \mathbb{E})$ is defined as fellows;
$P_1(e_1) = \{A, B, O, AB\} = X \quad , \quad P_1(e_2) = AB$

If the patient of Blood group A, then the soft set $(P_2, \mathbb{E})$ is defined as fellows;
$P_2(e_1) = \{A, O\} \quad , \quad P_2(e_2) = \{A, AB\}$

If the patient of Blood group B, then the soft set $(P_3, \mathbb{E})$ is defined as fellows;
$P_3(e_1) = \{B, O\} \quad , \quad P_3(e_2) = \{B, AB\}$

If the patient of Blood group O, then the soft set $(P_4, \mathbb{E})$ is defined as fellows;
$P_4(e_1) = \{O\} \quad , \quad P_4(e_2) = \{A, B, O, AB\} = X$

3. Soft Sets In The Antigens And Antibodies Of ABO Blood Group

There are four different ABO blood groups (see fig.1), determined by whether or not an individual's red cells carry the A antigen, the B antigen, both A and B antigens or neither.
Normal healthy individuals, from early in childhood, make red cell antibodies against A or B antigens that are not expressed on their own cells. These naturally occurring antibodies are mainly IgM immune globulins. They attack and rapidly destroy red cells carrying the corresponding antigen. For example, anti-A attacks red cells of Group A or AB. Anti-B attacks red cells of Group B or AB. In briefly we can say:

- Group A -has only the A antigen on red cells (and B antibody in the plasma)
- Group B - has only the B antigen on red cells (and A antibody in the plasma)
- Group AB -has both A and B antigens on red cells (but neither A nor B antibody in the plasma)
- Group O -has neither A nor B antigens on red cells (but both A and B antibody are in the plasma) . [16]

Now the following example explain how we can consider the antigens and antibodies of ABO Blood Group as a soft set.

Example 3.1. Let $X = \{A, B\}$ be an initial universe set, and the set of parameters $\mathbb{E} = \{e_1 = \text{Antigen}, e_2 = \text{antibody}\}$, Let us take the following cases then we will obtain the only four soft sets as follows,

If the person of Blood group AB, then the soft set $(P_1, \mathbb{E})$ is as fellows;
$P_1(e_1) = \{A, B\} = X \quad , \quad P_1(e_2) = \emptyset$

If the patient of Blood group A , then the soft set $(P_2, \mathbb{E})$ is as fellows;
$P_2(e_1) = \{A\} \quad , \quad P_2(e_2) = \{B\}$

If the patient of Blood group B , then the soft set $(P_3, \mathbb{E})$ is as fellows;
$P_3(e_1) = \{B\} \quad , \quad P_3(e_2) = \{A\}$

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If the patient of Blood group O , then the soft set $(P_4, \mathbb{E})$ is as fellows;

$P_4(e_1) = \emptyset$, $P_4(e_2) = \{A, B\} = X$

4. Soft Sets In The ABO Blood Group Inheritance

It's inherited. Like eye color, blood type is passed genetically from your parents. Whether your blood group is type A, B, AB or O is based on the blood types of your mother and father.

A person's blood type is inherited from their biological parents. A parent with type A blood can either pass on the A antigen or no antigen at all. If the other parent has type B blood, they can pass on the B antigen or no antigen. Depending on the combination, their child could have A, B, AB, or O blood. If both parents have O blood, the child can only have O blood. Also the Rh factor is inherited in the same way [16].

the following table shows the inherited variations and results:

Table (1): Possible blood type of child.

PARENT 1		AB	AB	AB	AB	B	A	A	O	O	O
PARENT 2		AB	B	A	O	B	B	A	B	A	O
Possible Blood Type of Child	O					🩸	🩸	🩸	🩸	🩸	🩸
	A	🩸	🩸	🩸	🩸		🩸	🩸		🩸	
	B	🩸	🩸	🩸	🩸	🩸	🩸		🩸		
	AB	🩸	🩸	🩸			🩸				

In an appendix with supplementary data in the above table The following example show how we can consider the ABO Blood Group Inheritance (Possible Blood group of child) as a soft set.

Example 4.1. Let X be ABO blood group system as initial universe $X = \{A, B, O, AB\}$, and $\mathbb{E} = \{e_1 = \text{Possible blood group of Child}, e_2 = \text{Impossible blood group of Child}\}$be the set of parameters. Let us take the following cases then we obtain the only ten soft sets which are,

If Parent 1 of blood group AB and Parent 2 of blood group AB, then the soft set $(S_1, \mathbb{E})$ is defined as fellows;

$S_1(e_1) = \{A, B, AB\}$, $S_1(e_2) = \{O\}$

If Parent 1 of blood group AB and Parent 2 of blood group B, then the soft set $(S_2, \mathbb{E})$ is defined as fellows;

$S_2(e_1) = \{A, B, AB\}$, $S_2(e_2) = \{O\}$

If Parent 1 of blood group AB and Parent 2 of blood group A, then the soft set $(S_3, \mathbb{E})$ is defined as fellows;

$S_3(e_1) = \{A, B, AB\}$, $S_3(e_2) = \{O\}$

If Parent 1 of blood group AB and Parent 2 of blood group O, then the soft set $(S_4, \mathbb{E})$ is defined as fellows;

$S_4(e_1) = \{A, B\}$, $S_4(e_2) = \{O, AB\}$

If Parent 1 of blood group B and Parent 2 of blood group B, then the soft set $(S_5, \mathbb{E})$ is defined as fellows;

$S_5(e_1) = \{O, B\}$, $S_5(e_2) = \{A, AB\}$

If Parent 1 of blood group A and Parent 2 of blood group B, then the soft set $(S_6, \mathbb{E})$ is defined as fellows;

$S_6(e_1) = \{A, B, AB, O\}$, $S_6(e_2) = \emptyset$

If Parent 1 of blood group A and Parent 2 of blood group A, then the soft set $(S_7, \mathbb{E})$ is defined as fellows;

$S_7(e_1) = \{A, O\}$, $S_7(e_2) = \{B, AB\}$

If Parent 1 of blood group O and Parent 2 of blood group B, then the soft set $(S_8, \mathbb{E})$ is defined as fellows;

$S_8(e_1) = \{B, O\}$, $S_8(e_2) = \{A, AB\}$

If Parent 1 of blood group O and Parent 2 of blood group A, then the soft set $(S_9, \mathbb{E})$ is defined as fellows;

$S_9(e_1) = \{A, O\}$, $S_9(e_2) = \{B, AB\}$

If Parent 1 of blood group O and Parent 2 of blood group O, then the soft set $(S_{10}, \mathbb{E})$ is defined as fellows;

$S_{10}(e_1) = \{O\}$, $S_{10}(e_2) = \{A, B, AB\}$

5. CONCLUSIONS

We have introduced and studied some applications of soft sets and human ABO blood group system concepts on the initial universe set and the set of parameters, and this is viewed in detail with the help of examples in many directions. Hence we expect that some research teams will be actively working on different types of soft open sets and define many basic concepts and properties with respect to these applied soft sets. That to carry out a general framework for soft set theory applications in practical life.

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