Research project

U R HOPE: The importance of raising awareness about transplants and donations among teenagers

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Resum

Avui dia, milers de vides són salvades per tot el món gràcies als trasplantaments, però hi ha un problema arreu del món i aquest és la gran diferència entre el nombre de donants i la seva demanda. Molts pacients moren mentre estan en la llista d'espera i amb objectiu de trobar una possible solució per aquest problema s'ha fet aquest treball de recerca.

Per això, es va crear una campanya com a experiment per saber l'impacte de conscienciar els adolescents, en aquest cas els estudiants de batxillerat del meu institut , sobre els trasplantaments i les donacions amb presentacions i una enquesta, juntament amb un estudi sobre els mètodes que Espanya i altres països han utilitzat per a la sensibilització de la gent, per comparar-los més endavant.

Els resultats de l'experiment han mostrat un bon impacte en el subjecte de l'experiment del qual el coneixement i l'acceptació sobre el tema van incrementar en un curt període de temps. L'estudi sobre els mètodes ha mostrat dues opcions accessibles relacionades amb joguines de peluix per augmentar la sensibilització entre els nens petits i amb les sèries de televisió, una gran influència sobre la gent actual, dues opcions que Espanya no ha provat encara.

En conclusió, l'ús de campanyes de sensibilització amb presentacions i la incorporació dels mètodes mencionats anteriorment per captar l'atenció del públic i educar-lo des de petit va ser la solució proposada per solucionar l'obstacle juntament amb la proposta de crear una xarxa amb tots els països per compartir les idees i els resultats dels projectes de conscienciació amb l'objectiu comú de salvar més vides tots junts.

Paraules clau: **trasplantaments**, **donacions**, **conscienciar** i **campanyes de sensibilització**.

Abstract

At the present time, thousands of lives are saved around the world thanks to transplantations, but there is a problem which every country faces, and it is the big discrepancy between the number of donors and the demand for transplants. Lots of patients die while waiting for a potential donor and thus this research project was made with the aim of finding a possible solution to this problem.

With this idea in mind, a campaign was created as an experiment to get to know the impact of raising awareness among teenagers, in this case, my high school's baccalaureate students, with some presentations and a questionnaire along with research about the actual methods Spain and other countries have used for sensitizing people, in order to compare them later.

The results of the experiment showed a good impact in a short term on the target increasing both knowledge and acceptance for transplants and donations and the study about the methods showed two approachable ways related to soft toys for raising awareness among children and TV series, which have a high influence on the actual people, that Spain has not tried yet.

In conclusion, the use of sensitization campaigns with presentations and the incorporation of the aforementioned methods for catching people's attention and educating them since a young age was the solution proposed for solving the issue presented, alongside the creation of a network with all the countries for sharing ideas and results of their awareness projects with the common goal of saving more lives together.

Keywords: **transplants**, **donations**, **raising awareness** and **sensitization campaigns**.

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Introduction

Nowadays, when it comes to organ and tissue donation, Spain ranks first at being the country with the highest number of donations in the world, even though the majority of donors are elderly people. After attending a cardiology class at Hospital Clínic as part of a group of teenagers that aims to learn more about Medicine at Bojos per la Medicina program, I started to be interested in transplants and many questions crossed my mind such as how long does a new heart last? Is there a big difference when the transplantation is done on a child, an adult, or an older person? Which factors influence the duration of this new organ? After attending an orientation session about the structure of a TR organised by my high school, I came up with the idea of doing my research about the immune system, a topic that fascinates me as it is complex and profound, and as this system has an important role at transplantations I decided to do it about heart transplants and the immune system's reaction with the idea of making an app for patients as the practical part, but many aspects showed me that it was too difficult to be carried out.

As a result, I made the decision to talk with my mentor and my biology teacher. Their help led me to the current theme of this research work and it is the immune system and transplants. Talking only about one type of organ transplant is too specific and there is not enough information, but if the research is about different types of transplantations, there can be comparisons and innovative aspects can be found. Thinking about this topic, some questions come to my mind such as which is the role of the immune system in transplantations, what is the degree of dependency of transplants to this system and thus which elements of this system are the most related ones to transplantations? Which are the factors that need to be considered when physicians try to find an organ or a tissue for a patient? Do younger donors' organs or tissues suppose a lower risk of failure after the operation than the elderly's? Which is the best donor profile? The main questions I would like to answer are: are teenagers likely to change their minds after attending a conference organised within a campaign with the aim of enhancing their awareness to become organ or tissue donors? What about adults?

From my point of view, if teenagers and adults are well-informed about the current situation and what donations truly suppose, maybe they will have a better opinion and will consider it more seriously, so in order to refute my theory, I will organise a campaign and I will also compare the reaction of these two groups of the society that donate less than elderly after giving the conference. The target of this experiment will be my high school's baccalaureate students and teachers as they are more mature for this type of explanation. Therefore, the objectives that I want to achieve with this research are to inform people about the process that they need to follow to become donors and the factors that influence the pairing process between a patient and an organ or tissue. Another objective is to discover the proportion of the different organs and tissues transplanted in a year with the intention of

knowing the most and the less transplanted ones lately in Spain and also the best donor profile. The main objectives of this research work are to foster awareness about transplant and donations in adults and young adults and find a good way for doing it. Thinking about the possibility of helping others in the future giving information about transplants really motivates me to do this investigation.

Before starting the practical part, I will make a thorough study in order to know what is important about transplants. For this reason, I will start explaining the immunologic system and its components related to transplants, then I will present the transplantations, followed by what links these two parts, the study about donors and donations around the world and last but not least, the current situation in Spain. With all this information, I will organise my presentations and then show all the materials such as flyers, and posts on the school social networking sites and then make them fill in a questionnaire for measuring the impact of the campaign.

Immunologic system

The group of cells, molecules and tissues whose purpose is to identify and face alien substances, which are named **antigens**, is known as the immunologic system. It protects us from different unknown organisms that try to invade our body and cause different diseases. Whatever that is identified by this system as a foreigner is attacked, which makes them antigens.

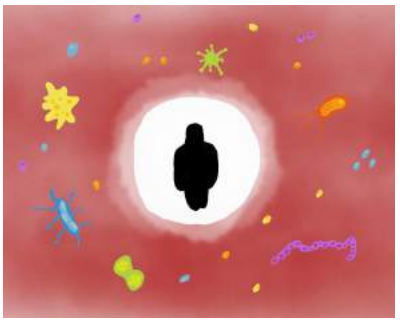


Figure 1. The immune system.

Antigens

Antigens activate the immune system and they usually are from microorganisms, but there are cases in which there is rejection towards members of the same species such as in transplants or towards oneself like in autoimmune diseases. They can have a proteic, glycidic or lipidic nature and be present as part of the bacterial wall or capsule or part of the viral capsid or simply they were released into the medium by a pathogen. Some molecules present only one region that acts as an antigen, known as univalent, and some others present more than one region, multivalent.

Antigens can be classified according to their origin and the following ones are the main classes involved in immune system activation. Their diversity is similar to the immense disease diversity that overcomes the immune system.

- **Exogenous antigens**, the most common ones come from the outside by inhalation, ingestion or injection and include pollen or food. They might cause allergies or in the case of the molecular components of bacteria and other pathogens, they might cause an infection.

- **Endogenous antigens**, these are produced by cells that were normal previously due to normal cell metabolism or due to viral or intracellular bacterial infection.

- **Autoantigens**, normal self-proteins or nucleic acids that are attacked by the immune system, generating an autoimmune disease due to the loss of the normal immunological tolerance for such antigens caused by genetic and environmental factors.

- **Tumour antigens or neoantigens**, they can be found on the surface of tumour cells and are the result of a mutation during malignant transformation of common cells into cancer ones.

- **Native antigens**, this kind of antigens has not been processed by antigen-presenting cells (APC), an immune cell that boosts immune responses, to smaller parts.

The following ones are essential components of the immune system:

Antibodies

The antibodies or immunoglobulins (Ig) are a group of glycoproteins that has the function of identifying and then attaching themselves to the antigens. With this action, they mark them and an immune response starts. They are formed by four chains, two of them are light (L) and the other two are heavy (H), united by disulphide bridges and have a carbohydrate attached to them.

Antibodies have a Y form, in which the amine group is above and carboxyls are below, and each one can bind to only one specific antigen. This variability is possible due to the chains H and L paired part of the molecule that can change as it corresponds to the fragment antigen-binding (Fab) and it has two union points to antigens which are the tips of the fork.

Immunoglobulins can be classified depending on their H in five types:

- **IgG**, the most important as it is the most abundant type and they can go through the placenta and they can give passive immunity to the fetus.
- **IgM**, it is used in the first stages of an invasion.
- **IgA**, it can be found at glandular secretions such as tears and saliva.
- **IgE**, it intervenes in allergies' process.
- **IgD**, its location is on B lymphocytes' membranes and it acts as an antigen receptor.

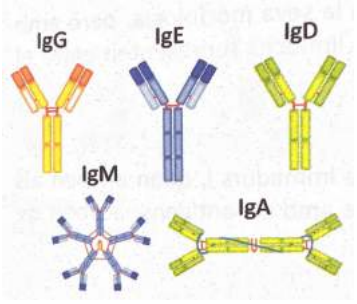


Figure 2. Types of Immunoglobulins.

Lymphocytes

Lymphocytes are a type of white blood cells that are made in the bone marrow and are found in the blood and lymph tissue. There are **B lymphocytes** or **B cells** that make antibodies and participate in

the humoral response, and **T lymphocytes** or **T cells** that help kill tumour cells, help in the humoral response, participate in cellular response and also help control immune responses.

Figure 3. Lymphocyte.

B lymphocytes can be classified and two main types are **plasma cells** or **plasma B cells** that produce the antibodies and **memory B cells** that store the information to face specific antigens and are the basis of vaccine functioning.

Other cells that constitute the immune system

All the blood cells of the immune system originate from a pluripotent stem cell that can produce two different lines that are myeloid line and lymphoid line. Lymphocytes are part of the lymphoid line, other cells are:

- **Natural killing cells** or **NK cells.** They are part of the lymphoid line and their function is to break tumoral cells, cells infected by virus and cells of a transplanted organ.

- **Phagocytic cells.** Part of the myeloid line and they can ingest a cell or a substance in their cytoplasm to destroy them. The cells that come from this line are **monocytes**. They can move directly to the bloodstream and they become **macrophages**, cells with an enormous phagocytic capacity when they arrive in tissues, and **dendritic cells (DCs)**, cells that present antigens and material associated with inflammation to lymphocytes in order to activate the immunologic response. DCs also link innate and adaptive immune systems.

- **Polymorphonuclear leukocytes (PMN cells) or granulocytes.** They are **neutrophils** that are the most abundant leukocytes in the blood and fight bacteria, **eosinophils** that are less abundant than the previous one and fight parasites, fungus and helminths, and **basophils** that are the less abundant and fight parasites.

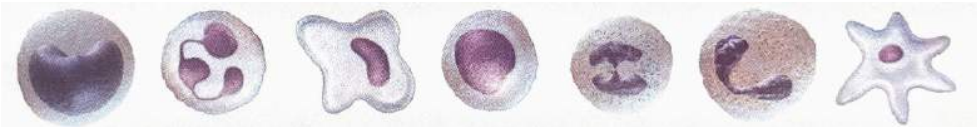


Figure 4. Monocyte, Neutrophil, Macrophage, NK cell, Basophil, Eosinophil and DCs respectively.

Immunologic responses*

According to the intervention of the elements of the immune system, there are two types of responses. On one hand, there is the **humoral response** that creates **antibodies** and other substances, and, on the other hand, there is the **cellular response** that activates **lymphocytes**.

*Complementary information in Annex I.

Humoral response

In this process, antibodies cause the destruction of microorganisms that are outside the cells and prevent the spread of the infections inside the cells. Antigens trigger the activation of B cells and also their differentiation. T cells usually participate as helpers. It starts when an antigen enters in contact with a B cell, which internalises it and presents it to T cells that activate B cells. These increase in size very fast producing plasma cells, the ones that liberate antibodies into the bloodstream, and memory B cells.

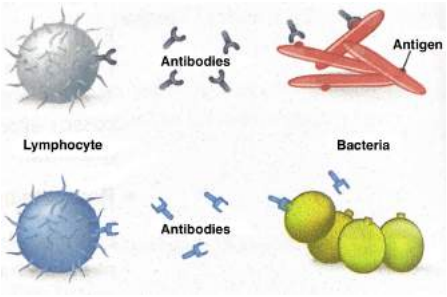


Figure 5. Humoral response.

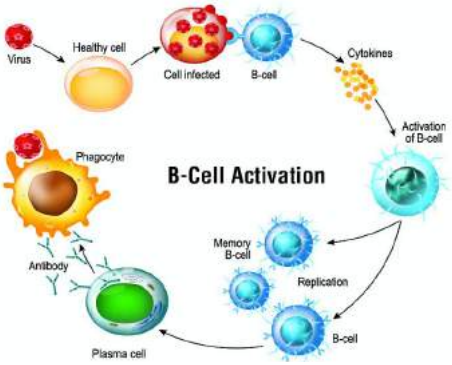


Figure 6. B cell activation.

A system that is also involved in this process is the **complement system** or **complement cascade**. It is a group of plasmatic proteins that also takes part in the inflammatory process. They flow in an inactive state and their activation is sequenced and is caused by some immunoglobulins associated with an antigen and the presence of some microorganisms.

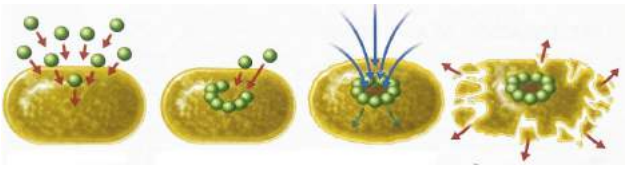


Figure 7. The complement system in action.

Cellular response

Despite the humoral response, in the cellular response, the elements that participate are cells. It is in charge of the defence against microorganisms that are inaccessible for antibodies. T cells participate in this process and they combat cells that were infected by pathogens or that are carcinogenic cells or transplanted cells, killer T cells are the ones that help in the elimination of these cells liberating toxins into them that induce **apoptosis**, programmed cell death. Meanwhile, helper T cells activate other immune cells. This response represents a big limitation to transplantations as it is the main mechanism involved in their rejection.

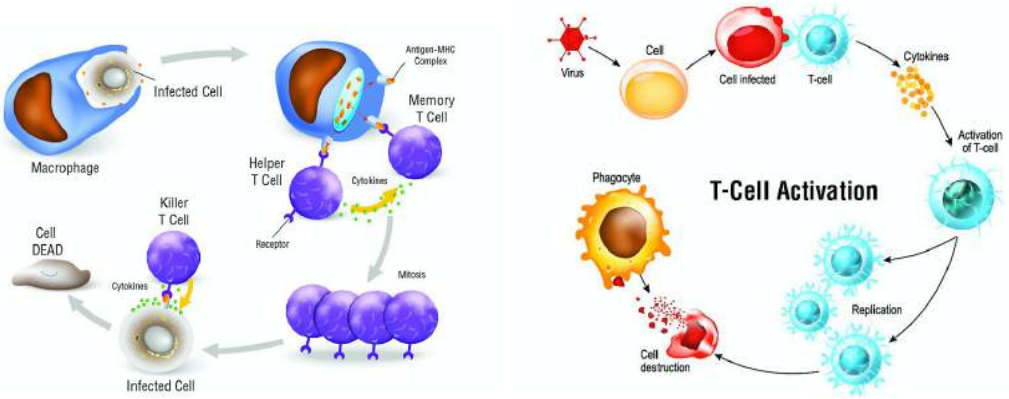


Figure 8. Cell-mediated immunity.

Another important element that takes part in the immune system is the following one:

Histocompatibility system (HLA)

The human leukocyte antigen or HLA is a sequence of genetically codified glycoproteins that are expressed on the surface of all the cells that have a nucleus in the body that are called MHC class I and II. Their duty is to act as self cells markers to prevent our own cells from being attacked by our immune system.

The presence of these glycoproteins is responsible for the rejections of transplants as they act and are recognised as antigens by the immune system of the graft's receptor. They mediate the interactions of leukocytes and they also determine the compatibility between donors and recipients.

The major histocompatibility complex or MHC is the large locus that is on vertebrate DNA and it codes for HLA, which means that it is a region of the genome that encodes for HLA. Any two individuals, who are not identical twins, will express different MHC molecules as each human cell expresses six MHC class I alleles of the 20,597 possible ones and six to eight MHC class II alleles of the 7,723 possible types, indicating that there is a high variation of MHC in the human population. Nowadays, as the latest report that is from October 2020 indicates, there are 28,320 HLA alleles that have been discovered and named.

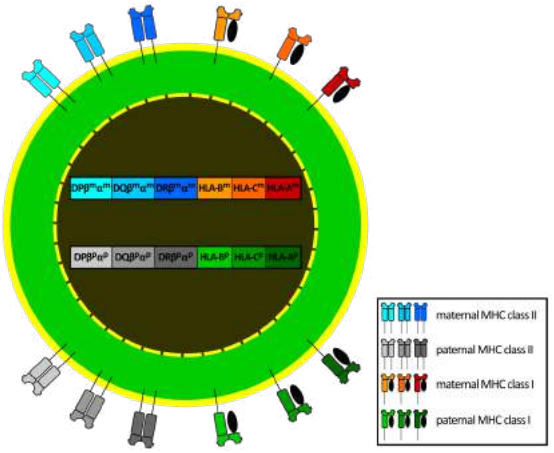


Figure 9. Codominant expression of HLA genes.

An important concept related to the immunologic system is **immunity.**

Immunity

Immunity refers to the capacity of not developing an infectious disease, it is studied by immunology and it is specific. It can be acquired in a natural way after overcoming the disease and also in an artificial way.

Innate immunity

Innate immunity is present since we were born and it is permanent. It is the first line of defence as it is the first response to intruders, so it faces infections since they begin and during the first stages. Innate immunity acts immediately when it detects an antigen, but it does not have a specific recognition of antigens, which means that it attacks every antigen that it finds with the same response and it does not have a memory. It is formed by physical barriers, defence mechanisms and general immune responses that are the first and the second lines of defence of our immune system*.

Acquired immunity

Acquired immunity starts to work when microorganisms pass innate immunity's barriers. Unlike the previous type of immunity, it is specific as it gives a particular response to a specific antigen because it has memory. It can be classified into two groups:

- **Active acquired immunity.** It is produced after making contact with an antigen. It can be natural or artificial. The one that is more related to transplants is the **natural** one, in which our body works to create a defence after being attacked by an infectious antigen and it can be long-term or it can even be permanent.*

- **Passive acquired immunity.** In this case, there is no contact with antigens and the immunity is given as the immune system does not work. As the active acquired immunity, it can be natural or artificial. *

*Complementary information in Annex I.

Transplantations

First of all, it is important to know the meaning of transplantation and why a new organ does not last forever once transplanted. 'Transplantation is the process of moving cells, tissues or organs from one site to another in order to replace or repair damaged or diseased organs and tissues that cannot be healed'. [3] Thousands of lives are saved due to transplants as there are different types of them and the techniques have improved a lot.

Types of transplants

Besides the possibility of differentiating transplants according to the organ or tissue that is going to be transplanted, there is a classification based on the relation between the donor and the recipient.

Autotransplantation

Autotransplantation consists of transplanting cells, tissues or organs that come from the same person. Donor and recipient, a patient that receives cells, tissues or organs from the donor, are the same person. This type of transplant has lower risks of rejection as what is donated is not from another individual and thus does not provoke a response from the immune system, but it requires a second surgery that adds pain, risk and possible longer aftercare. One example is skin graft. When it comes to bone graft, this type of transplantation is the standard option for replacements and its main source is the iliac crest, but other options are the proximal tibia, the fibula and ribs.

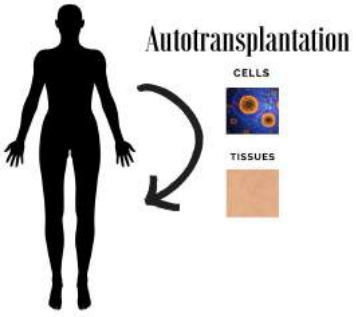


Figure 10. Autotransplantation.

Isotransplantation

Isotransplantations are the transfers of cells, tissues or organs that are from a person that is genetically identical to the recipient. It is only possible with a donor that is syngeneic to the recipient, in this case, monozygotic twins. This type of twins are immunologically compatible and hence transplantation does not provoke an immune response as in autotransplantations. It is possible because monozygotic twins have the same MHC and that means that there are low instances of tissue rejection.

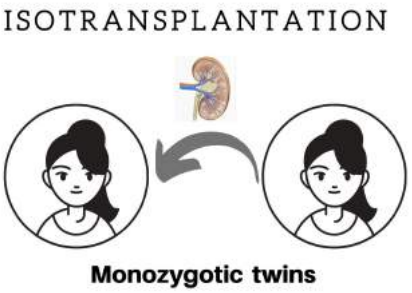


Figure 11. Isotransplantation.

Allotransplantation or Homotransplantation

Allotransplantation consists of the transference of tissues or organs from a donor that is not genetically identical to the recipient but is from the same species. It is the most common type of transplant and the main type of transplant that will be studied in this research work.

Most of the human transplants that are done are allotransplantations, but contrary to autotransplantations and isotransplantations, it provokes rejection as the graft is not from the same person or an identical twin. Donor and recipient have different HLA and that can result in an immune attack on the recipient that is called graft-versus-host disease.

This option is chosen as sometimes there are not enough tissues that can be harvested from the recipient's body and synthetic implants do not have the properties that tissues have. Tissues or organs from another species suppose a higher risk compared with the ones from the same species and not everybody in the world has a monozygotic twin.

Figure 12. Allotransplantation.

Xenotransplantation or Heterotransplantation

Xenotransplantation is the transplantation of tissues or organs that come from another species. The transplantations of whole organs are not a viable option at the present time, but there is a huge scientific interest in it as it can be a potential solution for the critical lack of adequate organs. This type of transplantation has one problem though, it is the fact that animals that are good candidates like pigs have a shorter life and that means that their cells age at a quicker rate. Other problems are the possibilityof transmissions of diseases or xenozoonosis and permanent alteration to the genetic code of animals and other ethical issues about animal testing.

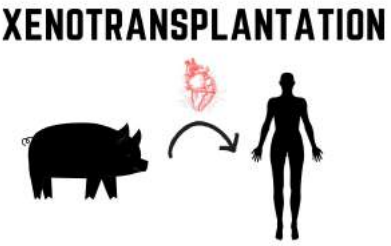


Figure 13. Xenotransplantation.

ABO incompatible or ABOi transplant

Usually in transplants, matching the blood group of the donor and the recipients is an important part as it can reduce rejection risk, but at the present time, it is possible to perform transplantations in which blood type compatibility is not a requirement. In the case of 'very young children, this type of transplant can be done with less rejection risk as their immune system is immature' according to West et al. (2001). [1] Its focus is on heart transplants, but the principles can be applied to other organs. A study by Saczkowski et al. (2010) shows that 'graft survival and recipient mortality is more or less the same between ABOi and ABO compatible transplantation'(p.1026-1033). [2] It supposes a solution to the problem of undersupply and graft ischemia as the time to transport the graft can be reduced. Infants in the most critical category are likely to be listed for ABOi transplantations.

Stem cell transplant

Stem cell transplant is a type of transplantation that is done to treat certain types of cancer like leukaemia and blood diseases in which the bone marrow is damaged as stem cells can be harvested from there and from the cord blood that comes from the placenta and the umbilical cord. It replaces damaged or destroyed blood cells of the body. Stem cell transplant can also be called **bone marrow transplant** as stem cells are produced by the bone marrow. They are normally carried out because other treatments haven't helped and they are complicated procedures with significant risks. The best chance of getting a match in this type of transplant is from close family members. In urgent cases and with children, the transplantation of the cells of the blood of the umbilical cord has more advantages than bone marrow one as there is a reduction of complications and it increases the survival of the recipient. According to a study, 'the younger a stem cell donor is, the better survival rates for patients' as it seems that after HLA matching the age is the most important. Apparently, blood stem cells from older donors are susceptible to inflammation, they produce more myeloid cells, but less quantity of lymphocytes. Apart from this, they are more likely to be affected by mutations like clonal haematopoiesis that increases the risk of blood cancer and overall mortality. Recipients with older donors are more likely to have graft-versus-host diseases as the cells have more experience for identifying antigens.

[1] *'**ABO-Incompatible Heart Transplantation in Infants**'* [online]. The New England Journal of Medicine. March 15, 2001. Retrieved in June 2020. From: <https://www.nejm.org/doi/full/10.1056/NEJM200103153441102#article_citing_articles.>

[2]'***Does ABO-incompatible and ABO-compatible neonatal heart transplant have equivalent survival?***' [online]. ***Interactive CardioVascular and Thoracic Surgery***, Volume 10, Issue 6. June 1, 2010. Retrieved in June 2020. From <https://academic.oup.com/icvts/article/10/6/1026/773374.>

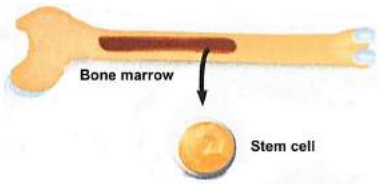


Figure 14. Stem cells' location.

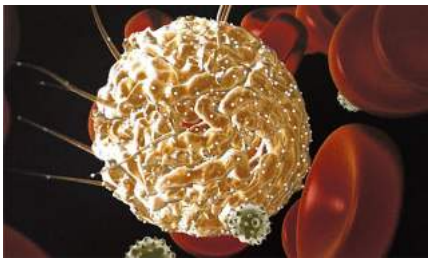


Figure 15. Adult stem cell.

Transplants' process

As transplantations involve high risk of possible immune system responses that can result in graft-versus-host diseases, they are not the first option when patients have problems with tissues or organs. Only patients with diseases in which their organs are in an irreparable state are considered candidates for transplants. Thus, patients have to go through an evaluation. If they are accepted as candidates, they will be registered in the national waiting list. Then if a donor is found after doing some evaluations, the team that will carry out the surgery will be organised and in some cases, as it depends on the country, a financial strategy will be developed. After the surgery, there is posttransplantation care.

After explaining all the important parts of transplantation, it is important to mention that when it comes to transplants, grafts never last forever as they are formed by the cells of the donor. The recipient's immune system has a huge role in transplantation as the system and the process have a really close relationship.

Donor-recipient matching process

The process of matching cells, tissues or organs from a donor with a recipient is rigorous as a lot of factors need to be considered to lower rejection risk. Medical teams screen the following factors as they may affect the likelihood of success in transplants before the surgery as the better matched the donor and recipient are the more successful the transplantation is likely to be.

Tissue compatibility

Recipients and donors have to be tested for HLA and ABO antigens. Recipients have also to be tested for presensitization to donor antigens as it is important to know the recipients' response.

When it comes to HLA, its **tissue typing** is the most important for kidney and hematopoietic stem cell transplants. For other ones such as heart, liver, pancreas and lung transplantations, the surgery is so urgent that the matching process is not as well established as mentioned previously. HLA tissue typing is complicated as MHC molecules have more than 1250 alleles that can determine them. Matching as many HLA antigens as possible improves significantly grafts' survival. Related donors' graft survival is higher than unrelated ones as there are multiple undetected histocompatibility

differences in the last one. Thanks to the improvement of the effectiveness of immunosuppressive therapy, HLA mismatches do not directly disqualify patients for transplantation.

ABO compatibility is also important as ABO mismatches can precipitate one type of rejection, which is called hyperacute rejection, of vascularized grafts as on the endothelial surfaces there are ABO antigens. This compatibility test is the first that is carried out as in the case that the result is negative the transplantation is rejected except the cases in which the recipients are not infants and the transplant is not the bone marrow one.

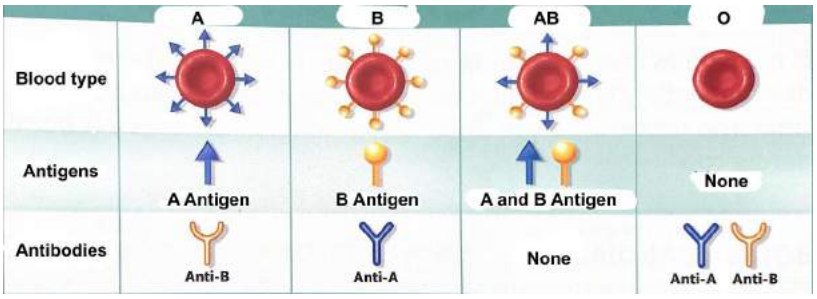


Figure 16. Table to understand blood type compatibility.

Talking about the presensitization or **cross-matching**, if the lymphocytotoxic test, a test to know if there are HLA and ABO antibodies, shows a positive result it means that recipients have them and it is possible due to prior transfusions, transplantations or pregnancies. In these cases, some expensive processes can be done to suppress HLA antibodies. Even if the test shows a negative result, the risk is still there as in the case of ABO antigens, when antigens are compatible, but they are not identical, the graft can produce antibodies which attack the recipient.

Figure 17. Cross-matching test.

A test that is also undertaken is the **panel reactive antibody (PRA)** one. It is similar to cross-matching as patients are tested for reactive antibodies against a random panel of cells and the results depend on the quantity of HLA antibodies present for previous cases. The more HLA antibodies present, the higher the PRA level denoted to the patient and the higher risk of rejection they have. If PRA levels are high, it may be difficult to find a good match and the recipient has to be treated with a higher dosage of immunosuppressive drugs after the transplantation.

Figure 18. Panel reactive antibody test.

Infection

Latent infections, infections that are present but do not manifest, must be detected before the transplantation. It is important to minimize the possibility of transmitting the infection from the donor and worsening or reactivating existing infections in the recipient as after the surgery, recipients use immunosuppressants and as their name indicates, they suppress the immune response. For detecting the presence of infections, serology screening is done. It consists of detecting the immune status of both the donor and the recipient against a number of clinically significant infectious organisms. If there is an infection in that moment the results can be fatal as the immune system is suppressed and it cannot defend the body properly. Therefore, the screening process usually includes history and tests for detecting possible viruses in the organism in order to give posttransplantation antiviral treatment if the result is positive.

Figure 19. Serology screening.

Other aspects to take into account

Apart from all these tests for the matching process, another important fact to consider in case of organ transplantations are organ size or **body surface** as for example, someone that is big cannot keep his routine with the small quantity of energy that a heart from a small person gives and vice versa, and the time the patient has been on the waiting list as those who have been waiting longer have priority. Another aspect is what is called **'old for old'** when it comes to matching a donor with a recipient in some specific organs like kidneys, an elderly donor's organ is matched with an order recipient and the same with younger ones. It is this way because giving an older person a young kidney may be too much energy for the recipient and in the case of giving a young patient, an old kidney may be insufficient for the recipient. In order to prevent that, the 'old for old' condition is taken into account during the matching process. However, there are organs such as the liver, an organ that has a greater

tolerance to age as it grows old slower than the kidney, that give the possibility to match for example an organ from an 80-year-old donor with a 50-year-old recipient without difficulty.

Contraindications to transplantations

In the case of detection of the following situations, the transplantation shouldn't be carried out. These situations are classified into two groups:

- **Absolute contraindications.** They are the presence of an active infection if the infection is not in the recipient and it is not confined to the part that is going to be replaced, the presence of cancer if it is not hepatocellular carcinoma confined to the liver and certain neuroendocrine tumours in the recipient, and a positive result in the lymphocytotoxic testing.

- **Relative contraindications.** If the recipient is more than 65 years old, a poor functional or nutritional status including severe obesity, HIV infection and multiorgan insufficiency. In this case, the eligibility for their decisions differs by the medical centre as immunosuppressants are well-tolerated by and effective in HIV-positive transplant recipients.

Psychological and social factors are also important for success in transplants as patients who abuse drugs and are unstable psychologically are less likely to adhere to the long term regimen of treatments and follow-up visits. In many countries, patients have to pay a lot of money for all the process so people in a bad economic situation cannot afford posttransplantation treatments.

Transplants' future

Progress in regenerative medicine and technology has allowed the development of a potential solution for transplantation that is the **synthetic organ transplant**, a new type of transplant that was first done in Sweden and proved to be successful. It is still developing, but the doctor that made the surgical operation thinks that it might be done with other organs.

Transplantations are an essential part of medicine that can save many lives if the rejection is under control, so many scientists study transplantation immunology. Thanks to technologic regenerative medicine and other branches of science's progress, more solutions for transplants' issues are being developed without forgetting the importance of the study of the immune system of the recipients and the grafts' reaction in this development. One example of progress is the possibility to perform a transplant on a patient that has controlled HIV with the organ of another person with controlled HIV.

The connection between the Immune system and transplants

The immune system rejects what it identifies as foreign and it does it by triggering a response that will definitely destroy the transplanted organs. To prevent an attack on our own cells and tissues, the immune system must be able to differentiate between our own healthy tissues and the foreign invaders. Our own cells have self-markers, HLA, that tells the immune system not to trigger a response, so any cell without these specific HLA proteins will be attacked. This is the situation of non-autografts and non-isografts as HLA is not identical.

The relationship that the immune system and transplants have is that the immune system's reaction to the graft is the big barrier to successful transplantations. The response is named **rejection** and it consists of the mounting of an attack against the foreign organism to protect the body from infection.

Rejection

As rejection is a response, it has a mechanism. Unless the donor and the recipient are the same person or genetically identical, monozygotic twins, there will always be some degree of rejection as not all the HLA is alike and that means that the ones that are not identical can be attacked and that means that there can be rejection. The intensity of the rejection due to HLA incompatibility is a consequence of the high frequency of cells that react with allografts present in healthy people. As well as nonself HLA proteins, there are other surface proteins on the graft that can also be identified as a foreign antigen and provoke an immune response.

In some cases, there are **graft-versus-host** reactions where mature immune cells that are present in the graft begin attacking recipients' healthy cells and what is responsible for this reaction is the difference between MHC class II. These types of reactions suppose a particular risk to stem cell transplants that can also be present in blood transfusions.

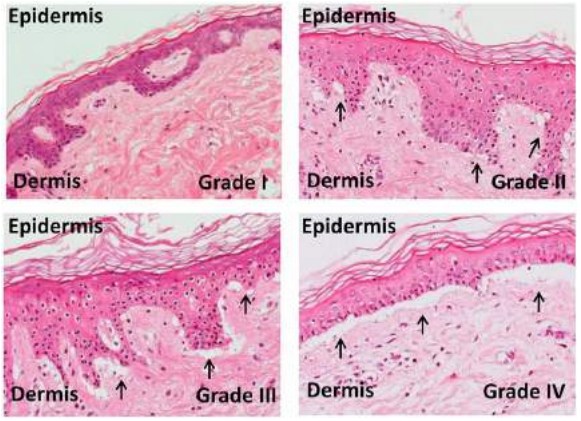


Figure 20. Micrographs of grades of skin graft-versus-host-disease.

Types of rejection

Talking about transplant rejection, there are different types that can be mediated by HLA.

- **Hyperacute rejection.** It occurs when the recipient has preformed anti-HLA antibodies before the transplant. The response is triggered within minutes or hours after the surgery. According to Deathridge 'the antibodies react with cells in the blood vessels of the graft that causes the formation of blood clots that prevents blood supply from reaching the graft'. [3] It is a critical stage as it is immediate.

- **Acute cellular rejection.** It happens when the recipient's T cells are activated by the graft. It causes damage via mechanisms such as direct cytotoxicity from CD8 cells to the graft cells which MHC antigen expression is stimulated by interferon γ, a cytokine that plays an important role in inducing and modulating an array of immune responses.

- **Acute humoral rejection.** It occurs when the recipient's anti-HLA antibodies form directly at HLA molecules present on endothelial cells of the transplanted tissue.

- **Chronic rejection.** Repeated episodes of acute rejection can lead to chronic rejection of the graft. Deathridge explained that 'it normally manifests by scarring the graft'. [3] Nowadays there is no solution for this type of rejection apart from removing the graft.

To reduce the risk of rejection, some drugs were created to dampen the recipients' immune system. These drugs are called i**mmunosuppressive drugs** or **immunosuppressants.**

Immunosuppressive drugs

These drugs are part of the posttransplantation treatment and they are given in two phases. 'The first one is an initial induction that involves a high dose of them and then it follows a later maintenance phase involving the long term use of the drug at a lower dose' as Deathridge reported. [3]

Figure 21. Immunosuppressive drugs.

[3] ***Transplant immunology*** [online]**.** *British Society for Immunology*. Retrieved in June 2020. From: <https://www.immunology.org/policy-and-public-affairs/briefings-and-position-statements/transplant-immunology.>

Types of immunosuppressants

- **Calcineurin inhibitors.** Drugs that block T-cell transcription processes required for the production of cytokines. Some of them are **cyclosporine** commonly used in heart and lung transplant, and **tacrolimus** used in kidney, liver, pancreas, and small-bowel transplantation.

- **Purine metabolism inhibitors.** They inhibit purine synthesis by blocking the metabolism of folic acid, an element that helps make DNA and other genetic material. Examples are **azathioprine** and **mycophenolate mofetil**.

- **Rapamycin.** A drug that blocks a key regulatory kinase in lymphocytes, provoking an arrest of the cell cycle and an inhibition of lymphocyte response to cytokine stimulation. Some examples are **sirolimus** and **everolimus** that are used for preventing kidney and liver transplant rejection.

- **Immunosuppressive immunoglobulins**. Fractions of animal antisera directed against human cells: lymphocytes and thymus cells. They suppress cellular immunity while preserving humoral immunity and their use to control acute episodes of rejection improves graft survival rates. Examples are **anti-lymphocyte globulin (ALG)** and **anti-thymocyte globulin (ATG)**.

- **Monoclonal antibodies (mAbs)**. They provide a higher concentration of anti-T-cell antibodies. An example is the **anti–IL-2 receptor monoclonal antibodies** that inhibit T-cell proliferation by blocking the effect of IL-2, secreted by activated T cells. Interleukin-2 or IL-2 is a type of cytokine signalling molecule in the immune system that regulates the activities of leukocytes.

'The combination of drugs and the dosage varies from case to case as it depends on the type of transplant and the treatment regimen that was chosen' according to Deathridge.[3] If there are episodes of acute rejection, the drug combination changes and the dosage increases. As recipients may have **side effects**, their emergence can suppose the use of alternative drugs.

In the past, steroids were the most commonly used immunosuppressive drug, but adverse side effects are associated with them so their use was reduced with time. 'All current immunosuppressants come with **limitations**, one of them is immunodeficiency and it is one of the major limitations as they are not specific and that means that they reduce overall immune system function. Immunosuppressants are associated with adverse side effects such as high blood pressure, impaired renal function, diabetes mellitus and increased risk of cancer.' As patients have to take a large number of those each day for the rest of their lives, 'immunosuppressive drugs can have a major impact on their health and lifestyle' as Deathridge explained. [3]

[3] ***Transplant immunology*** [online]**.** *British Society for Immunology*. Retrieved in June 2020. From: <https://www.immunology.org/policy-and-public-affairs/briefings-and-position-statements/transplant-immunology.>

Thus, researchers are trying to find a good balance and due to that, nowadays there are new immunosuppressants with increased specificity and fewer side effects.

Another option to weaken the immune system is to inject allogeneic bone marrow to induce toleration, but successful bone marrow transplants in adults require treatments that need to be restricted according to malignancy conditions.

Transplants' techniques, pretransplantation tests and posttransplantation therapy have improved with time, but even though there is an improvement, if there are no donors, transplants cannot be done as with the current technology it is not possible to create an entire organ or a lot of tissues.

Donors and donations

As mentioned before, not every patient has enough tissues or organs to do an autotransplantation, nor a monozygotic twin with the same DNA and xenotransplantation involves more risks as there can be cases of xenozoonosis and the donor's organ or tissues can attack the host.

As science has not developed to the point of being able to create lots of tissues or organs that meet recipients' needs, the way of solving the lack of potential grafts for them is to increase the number of donations and therefore the variety and hope for saving more lives.

People who donate are **donors** and they are essential for transplantations.

Donors

Donors are people who allow donations and they are big contributors to the process of saving lives as without them allotransplants cannot be done.

Types of donor

If donors have to be sorted there are two main types:

- **Dead donors.** Most of the transplants are done with the organs and tissues from this type of donor. They are people that had a brain death or a cardiac death. When physicians detect a potential donor that has severe brain damage which does not respond to medical or surgical treatments, they contact transplant coordinators to let them know the donor's existence in order to proceed with the brain death diagnostic, the general evaluation of the donor with some tests such as ABO and HLA samples and the programmation of an interview with the family to discuss the allowance of the donation. If the family agrees and the results of the tests show that the patient is a potential donor, the following steps are the maintenance of the patient's stability until the extraction.

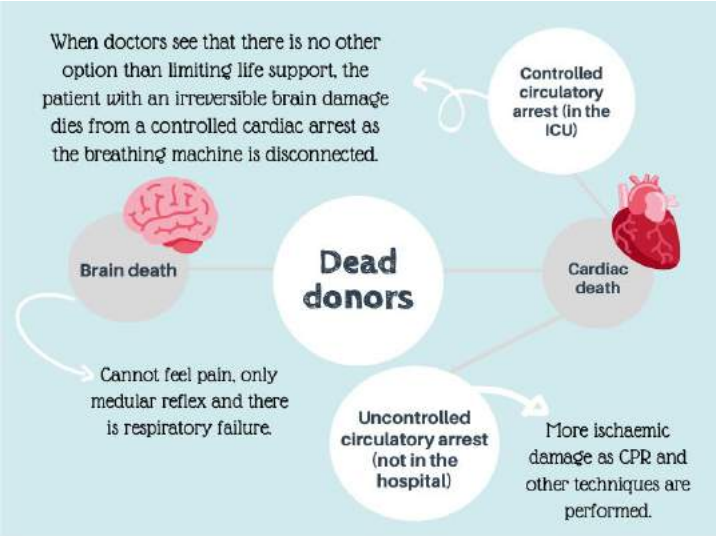


Figure 22. Dead donors' map.

- **Living donors.** There are less living donors, but they are also necessary or essential for transplants. The donation of this type of donor is done only when it does not suppose a risk for the donor's health. Thus a **big amount of tests** are done to the candidates in order to determine the possibility of becoming one or not. The tests are blood and urine analysis, radiographs, ultrasound scans and sometimes biopsies and they are done to ensure the good condition of the elements that can be transplanted and also to verify the absence of transmissible diseases. Most living donors donate a kidney or stem cells.

Other classifications are related to age, health and precedents and they are mentioned in the following part.

Donors' profile

There is not a specific profile of donor, everyone can become a donor regardless of the age, the previous diseases or the current treatments that they are given. Doctors decide whether the person is a potential donor or not. The only situations in which someone cannot become one are those in which the candidate has an infectious disease like AIDS or very aggressive cancer that can be transferred to the patient.

Nevertheless, there is a **perfect type of donor** that is a healthy young person without any precedents of diseases that has died due to a trauma, a physical injury, and has the organs in a good state, but this type of donor is really difficult to find as there is more security at the present time and over the years people start to have more health problems as they are growing old. The **ideal donor** is someone healthy without precedents, the **standard donor** is someone at the age of 40 or 50 and the **expanded donor** is someone over 75 years old or someone who has a factor of risk like diabetes, having high blood pressure or having a precedent of cancer.

So the main characteristics that potential grafts should have are to be in perfect conditions and that they must not present any agent that can be detrimental for the recipient. Even though a candidate has a particular problem with an organ if the rest of the organs or the tissues are in a perfect state and can be donated, the candidate can become a donor, but only for the material that can be transplanted.

When it comes to living donors, they should be of legal age and possess good mental and physical health and they also should know all the things that donations involve. There are cases in which minor children can be donors only with the permission of their parents.

Around the world, there are different policies for donors about transplants and one of them is about the consent of the donors. The consent is the act of giving permission to do (**an action)** and when it comes to transplants there are two types.

Types of consent

In different countries, the laws allow potential donors to decide whether to donate or not or to leave the decision to their relatives. The consent can be:

- **Explicit or opt-in.** The countries that chose this type of consent as policy, choose the option of letting people become donors only when they express that they want to become one. People have to go through proper registration in order to be donors. Some countries that have this type of policy are the United States, Australia, the UK, Denmark, Morocco, Germany and Algeria.

- **Presumed or opt-out.** The countries that chose this policy, choose the option of making all citizens donors until they express the opposite. It means that everyone is a donor unless they register to be on the non-donation list. Some countries that have this policy are Argentina, Spain, Portugal, France, Tunisia, Russia and Turkey.

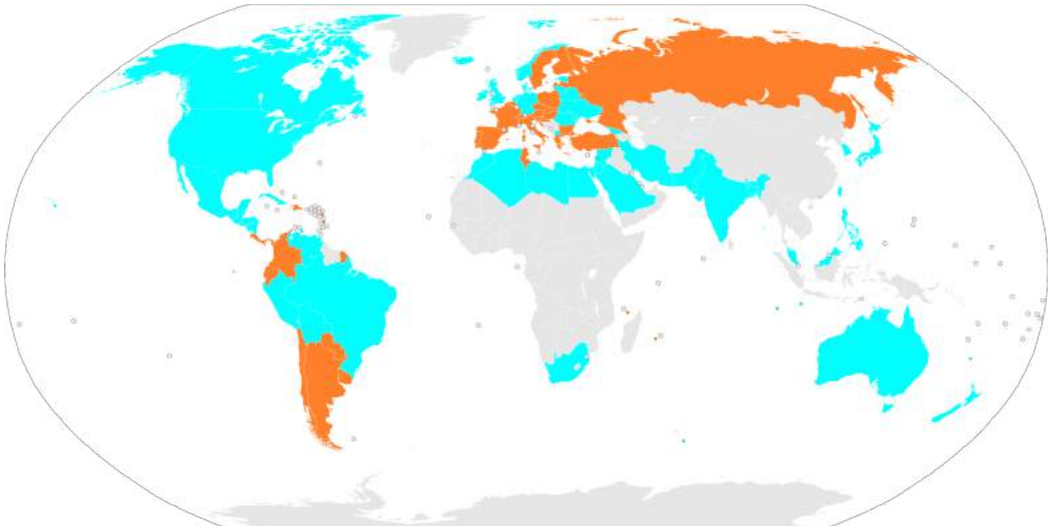


Figure 23. Organ donation policy by country.

After talking about the people who donate, it is important to talk about the process of donation.

Donations

Donation in transplants is the process of allowing tissues or an organ to be removed and transplanted to another person, in a legal way, either by consent while being alive or dead with the assent of the next of kin. It is a really altruistic gesture. There are different types of donations and they are sorted by what is transplanted.

Types of elements that can be donated

There are four and they are the following ones:

- **Cells.** Such as stem cells.
- **Tissues.** Such as bones' tissues, corneas, skin and cardiac valves.
- **Parts or segments of an organ.** Such as parts of the liver, the pancreas, the lungs and the intestines.
- **Entire organs.** Such as kidneys, livers, hearts, pancreas, stomachs, intestines and lungs.

Figure 24. Kidney prepared for transplantation.

In donations, after testing the donors, comes the removal part if candidates' test results show that they can be donors.

Types of removing process

The process of removal that is carried out depends on the donor, so there are two.

- **Removing process for dead donors.** It just consists of the extraction of the organs and tissues that can be donated in an operating room right after the death. The objective is to obtain all the material possible for needed patients. Many surgeons are in the room as all the organs and tissues are different and specialists know how to remove them correctly and the process can last from three to six hours.
- **Removing process for living donors.** The extraction is done in an operating room and the process is like any surgery. In this case, it is programmed and in the room, there are the surgeons that are specialists of the tissues or organs. This process can last from three to six hours depending on the number of tissues and organs that are going to be donated. In the case of the donation of corneas or bones, after the extraction, an internal prosthesis is placed to maintain the volume and the firmness before the operation.

After the extraction the organs and the tissues go to different destinations, organs have to be transplanted hours after the removal to prevent them from **ischemia**, when blood is not getting in a particular part of the body or deterioration, but in the case of the tissues, they go to tissue banks. They

have to be analysed, preserved and saved in order to be used according to implant teams in the following weeks, months or years depending on the tissue.

Dead donors' grafts are transplanted to the best recipient match for them in the waiting list that is managed by the organisation or institution decided by the country. Living donors' grafts normally are for their relatives, but donors can also donate them to the organisation or institution that is in charge of transplants' management and then go through the same procedure as dead donors' grafts.

Deceased donors have helped reduce the disparity between the demand and supply of the elements of the body that can be donated. However, as new technologies and techniques for transplantations are developing, the chance of success in these operations is also growing resulting in the increment of the demands for material for transplantations and the extension of the large gap between the number of registered donors and those awaiting donations.

The current situation in Spain

Spain has had the highest number of donations for 25 years with a current donation rate of 48.9 donors per million of inhabitants. But an important event has happened and it is the change of donors' profile. Years ago, most of the donors were young people who died in traffic accidents and due to the positive change of security and life conditions, populations' life expectancy has grown and with that the age of donors'. Nowadays the number of young and adult donors is decreasing, unlike elderly ones.

Spanish system for donations and transplantations

When it comes to donations and transplants the **National Transplant Organisation** in Spain is a key concept as it is the organisation that manages these processes and due to its creation, Spain increased the number of donations and shifted from having a medium-low index to having the highest index by far in the world. The ONT, in Spain, is an organism that is part of the Department of Health, which is in charge of the functions related to the collection and the clinical use of organs, tissues and cells.

The president of the ONT has acknowledged that the policy for donors that the country adopted is not the primary reason for the increasing success in donor rates. Other factors are also important for the good results such as the need for well-equipped intensive care units (ICUs) of doctors to maximize the recognition of potential donors and the maintenance of the material for transplants, and the presence of transplant coordinators at each hospital.

A big characteristic of the Spanish system is the fact that all the fees of the donation and transplantation process are covered by the National Health System, giving higher possibilities for getting a transplant when it is needed. But even though this system is the most successful in the world, it cannot meet the material demand as 10% of the waiting list for transplants die while waiting. Nevertheless, a network for communication and transplant allows fast extraction and transplant across the country, thus, more options for transplantations.

The donation and transplant process in Spain is regulated by the Law of transplants, which ensures the following two aspects:

- **Altruism** as no one can donate or receive if the intentions or mediums are not selfless.
- **Equity** in the process as everyone has the same rights and possibilities of receiving transplantation regardless of their personal situation or the place where they reside. It is possible, as the national network of coordination and transplants is under rigorous controls, to ensure equality for all citizens.

After defining the fundamental aspects of the Spanish Law for transplants it is important to know the criteria for choosing a match for the grafts obtained from donors in the long waiting list.

Criteria for the matching process in Spain

In Spain, there are territorial and clinical criteria in order to ensure a higher probability of success in the transplantation process.

- **Territorial criteria.** They permit the organs generated in a specific area to be transplanted in the same area in order to minimise as much as possible the time of ischemia, the maximum time that can pass between the obtention of the organ and its implant. With tissues, it is different as the period of their preservation is longer.

- **Clinical criteria.** The main aspects that are part of the criteria are the donor-recipient compatibility and the severity of the patients.

Urgency 0 is a clinic criterion that is above the territorial criteria. A patient in this situation has an absolute priority in all the national territory. When there are no urgency 0 cases, organs are assigned depending on the territorial criteria. The transplants team decides the patients in their waiting list according to the best match for the organs following the clinical criteria.

After explaining about the Spanish systems and process of transplantations, it is also important to talk about donors as they are an irreplaceable element for transplants.

Donors in Spain

As mentioned before, most of the donations are from deceased donors and the majority of them died from brain death, but the number of cardiac deaths is increasing at the present time. Proceeding with the donors in Spain, the policy in this country is the opt-out one and normally doctors ask the family of the deceased if they refuse to do the donation process.

How to become a donor

In this country, the process of becoming a donor is done by telling relatives and close people the will of becoming a donor after death as they will be the first ones to be asked about it. In addition, it is also possible to fill in a donor card that is free and can be found in public institutions, like on ONT's website and can be cancelled whenever the donor wishes, or to compose an anticipated wills document. In the case of Catalonia, an autonomous region of Spain, the card can be found at the Autonomous Government of Catalonia's website for donations and transplants and an additional option is to activate the donation checkbox in 'La Meva Salut'. Living donations are done only when there is a very high chance of success. Donors have to be informed about all the process and the

implications of doing a living donation, after that the donor has to give written consent in front of the civil registry's judge in charge. When it comes to umbilical cord blood transplant, if a pregnant woman wants to donate, she has to go to a Cord blood bank, where she will be given information about the process and will sign a consent. This blood can also be saved for autologous use, but the scientific community does not agree with this action.

Figures 25 and 26. Ways to become a donor.

Donors' profile

The current Spanish donors' profile is the following one according to the data collected from 2019, a year in which there were 2,302 donors that enabled 5,449 organs to be transplanted, as there is not enough information about 2020.

As said before, the number of deceased donors that died from cardiac death or **asystolic donors** have increased, more specifically a total of 744 donors that represents an 18% more and organ extraction of 32 % of donors is practised after the circulatory death. More than 120 hospitals in Spain are already accredited to perform this type of donation. The number of deceased donors that died from a traffic accident has dropped to 4.4% giving the information that there are fewer donors of this type.

In terms of donor age, 1.5% of donors under 15, 4% between 16 and 29, 8.6% between 30 and 44, 29.5% between 45 and 59, 24.4% between 60 and 69, 23.5 % between 70 and 79 and 8.5 over 80.

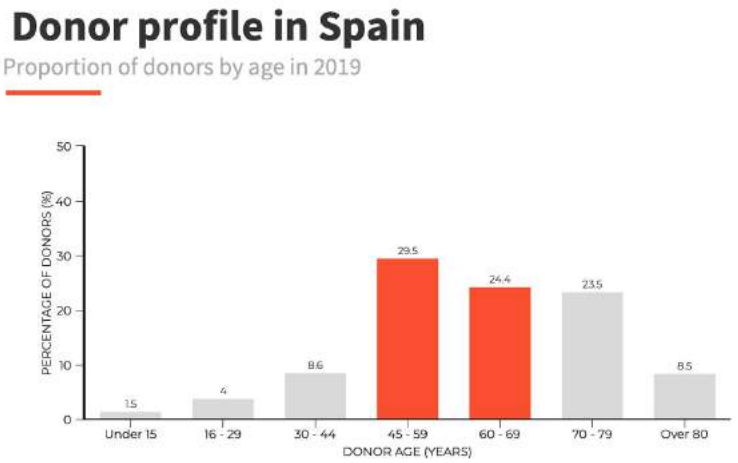


Figure 27. Proportion of donors by age in 2019.

Meaning that 43.6% of donors are under 59 and 56.4% are over 60. Even though there are 43.6% of donors under 59, most of them are over 45, an age in which people are more mature. Without this group, only 14.1% under 44 years donated in 2019.*

In terms of gender, 59% are male and 41% female. And last but not least, the good news is that not only Spanish people donate, people from other countries that reside in Spain also do it and in 2019 they were 10.6% of donors. *

As it is shown in the graph and the information, there is no maximum age for donors, even people over 80 can become one. It is doctors who decide if they can become a potential donor, so this means that in Spain the donors' profile has no maximum age and everyone can become a donor if physicians say that an organ or a tissue or some of them are in good condition and can be donated.

Retaking the topic of the number of organ transplants, from those 5,449 transplants 3,423 were kidney transplants, 1227 liver transplants, 300 heart transplants, 419 lung transplants more or less 330 of which were lungs and the rest just one lung, 76 pancreas transplants and 4 intestine transplants. With this information, the current proportion of the transplants that were made is the following: the most transplanted organ was the kidney that was a 62.8% of all the transplants, then comes liver transplant with a 22.5%, lung transplant in general with 7.7%, heart transplant with 5.5%, pancreas transplant with 1.4% and the least transplanted organ the intestine with 0.1%.

*Complementary information in Annex I.

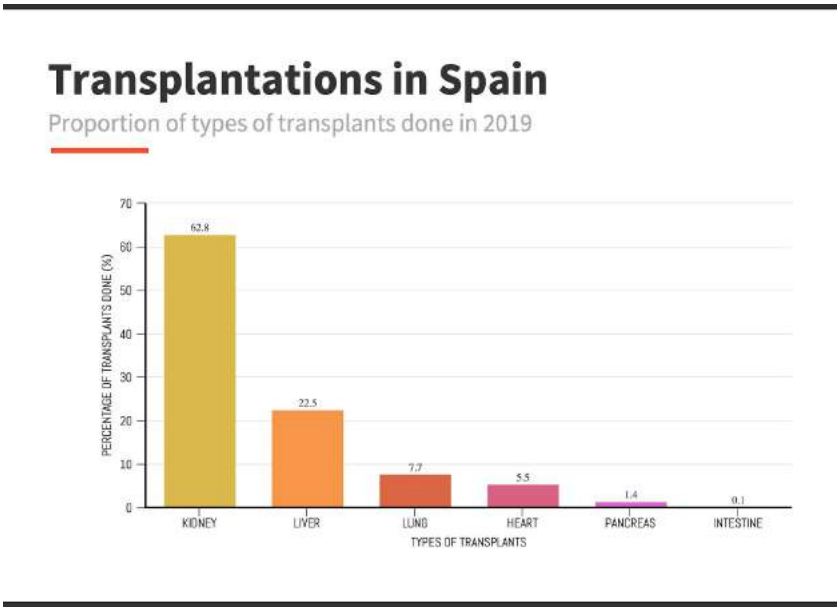


Figure 28. Proportion of types of transplants done in 2019.

At the present time, what is known about 2020 is that during COVID-19 there were 127 donations that enabled 274 transplantations of which 148 were kidney transplants, 77 liver transplants, 34 heart transplants, 11 lung transplants, 3 pancreas-kidney transplants and one liver-kidney transplant.

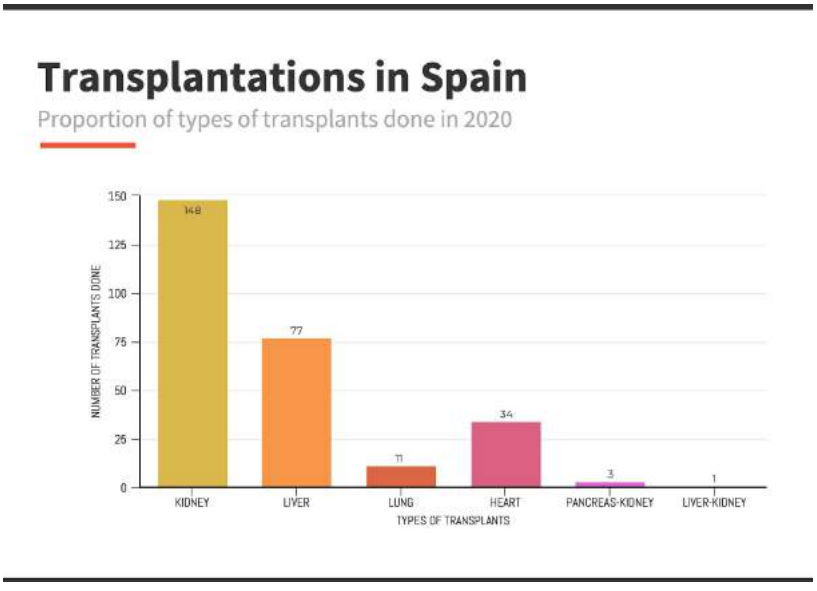


Figure 29. Proportion of types of transplants done in 2020.

Main goal

In spite of reaching such a high number of transplants, there are still a lot of patients waiting for a matching graft. On 31 December 2019, this number stood at 4,889 patients of which 93 were children. Even though it is important to be proud of all the transplants achieved, the gap between the demand and the supply should be treated lightly. It is of high importance since the objective is to shorten this

difference that can be done with the increment of donations, therefore the material available for people in the waiting list. Donations can improve survival, can increase organ demand and more patients can benefit from transplants.

In order to achieve the goal of shortening the large gap and save more lives, a potential solution to face the scarcity issue is to increase living donors' knowledge about donations and transplant. People tend to reject what they consider unknown, even more, when there are surgeries involved, but if they are educated about the topic and they learn about the implications, it is more likely that they will change their minds and accept it. For this purpose, some methods like campaigning and giving conferences about transplants can be viable.

Finally, with all this information gathered, I can move on to my practical part that is the analysis of the effect of a campaign and a presentation on teenagers and adults, particularly teenagers' reaction as it is important to educate them as early as possible for the future.

Campaign, experiment and comparison

For the campaign, I will use the website of my high school and I will post information with messages that encourage people to become donors and also all the information that is needed to become one. I will use the Instagram account of the high school to promote the campaign targeting students and teachers of my high school before and after a conference to engage them to transplants and donations. In order to know the result, all the participants will have to answer a questionnaire also before and after the explanation. In this process, there is also a creative part that is the design of the campaign. Another important part is to contact and ask for the support of a specialist who works in a hospital's transplantation coordination unit in order to give more consistency to the message focussing on donating more.

Campaign

As the practical part could only be done once the school year started, I began designing and organizing the campaign to have everything prepared. First of all, I thought about the message that I wanted to deliver to the public and 'telling people that they are hope' was the idea that came to my mind. With that in mind, I created a poster* with the help of a tool called Canva. After that, I continued with the Instagram post* in English and then I did the same with the campaign's flyer*. Once I finished them, I came up with the idea of translating them into Spanish and Catalan to better inform the students and their families and so I did. All the content that I put in all these documents is relevant information that I selected from my theoretical framework for people to know and thus achieve the goal of my campaign. The following things I did were the presentations' PowerPoint in English and the questionnaire in Spanish to make it easier for people to express their opinion.*

At the same time, I was doing the most creative tasks, I contacted a doctor of the transplant coordination unit of the Clínic hospital through a coordinator from a program I take part related to medicine at that hospital that is called 'Bojos per la Medicina'. What I was planning at first was to send a link with some questions that I had about transplants and donors, but doctor David Paredes accepted to help me instead. He read my theoretical framework and gave his opinion about it including some advice such as using graded answers rather than open questions for the questionnaire as data can be analysed in an easier way. He told me about using information that OCATT, the organisation about transplants in Catalonia, has on its website and also recorded a video encouraging teenagers for my campaign that I planned to play during the presentations.*

*Campaign materials can be found in Annex II.

Experiment

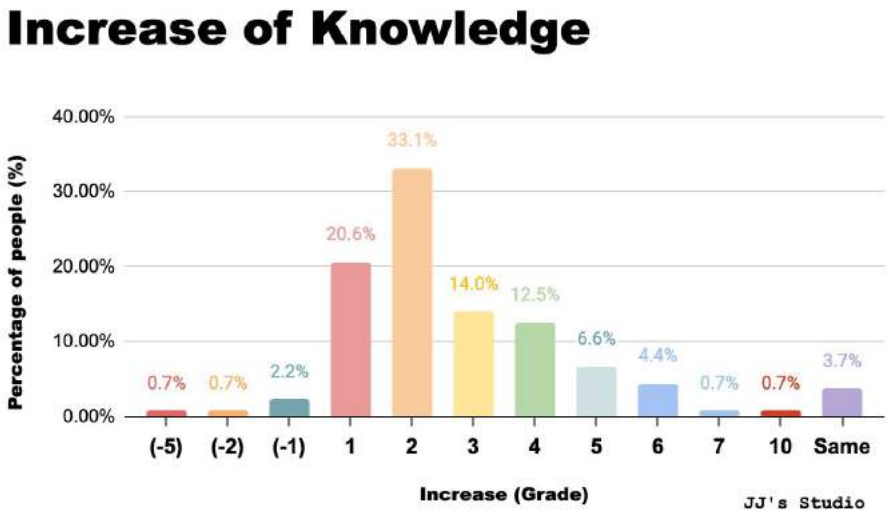
With all the material prepared for the presentations I talked with my mentor and we decided to do this part only with baccalaureate students because of the given situation there cannot be a lot of people gathered in one place, I could not do it with adults. So I talked with some teachers to ask for their permission to use one of their lessons with a group of students as it is a more covid-friendly option. All of them agreed, but choosing the time for the conferences was difficult as I had to skip some classes and most of the options were specific subjects, but finally thanks to my counselor I could choose to skip two more general subjects.

The presentations took place between the 23rd and 28th of September, there were some technical problems for projecting the powerpoint in some classrooms, but all the content that I planned was explained successfully and 136 people answered the forms. Doing all this was easier with 2nd baccalaureate as they are not strangers to me, but 1st baccalaureate gave me all their attention and I am very grateful for that.

I had a talk with my mentor and he helped me concreting a better way for achieving my main objective and it was by adding research about the way other countries encourage people to become donors and also the way they foster awareness about this topic among teenagers with the purpose of comparing it with the results of my campaign to have an idea of whether campaigning and giving presentations can be a good option or not when it comes to making changes and solving actual problems.

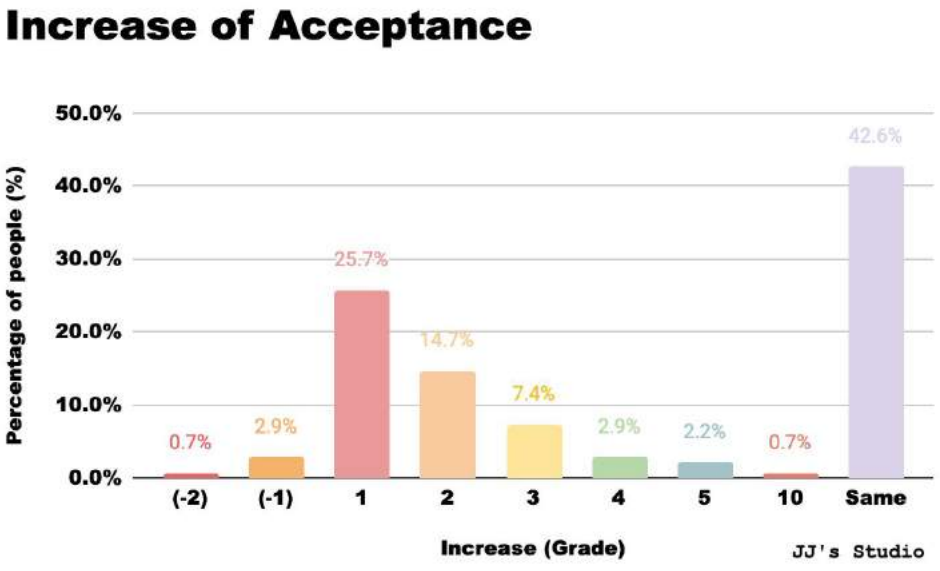
With that in my mind, the first thing I did after changing my plans was to analyse the responses of the questionnaire in which the information I asked for was the degree of acceptance they had for transplants and donations before the presentation, given a scale from 0 to 10, being 0 a definite no for being a donor and 10 a determined yes for becoming one. Other questions were about the knowledge people think they had about that topic and then the reason for choosing those options and the same, but after the exposition and instead of asking for the reasons of choosing one specific grade, I asked for the reasons for changing or not their mind and also the arguments that made them doubt about the position they took. Finally, the last questions were about whether they would share the material they had seen with their acquaintances given a scale from 0 to 10 and the reasons why they've chosen those answers and here are the results represented in charts:

Results



The main objective of this practical part is to know the impact of this type of campaign, so the increase of knowledge people have had is important and what can be seen in the chart is that except for 7.5%, the rest of the people learned more things about transplants and donations. One third of them increased 2; one fifth 1; three-twentieths 3 and also 4, and the rest was less than 10% each. An interesting fact is that one person increased 10, which means that it was a change from 0 to 10. *

Regarding the degree of acceptance, the next chart shows that more or less half of the people kept their initial acceptance and in 3.6 %, it decreased slightly, but a quarter of the people increased 1, 14.7% increased 2, the increase of 3 to 5 was less than 10% each and what is surprising is that there is one person that increased from 0 to 10, a complete change of mind.



The variation is really important, but without a reference, it can be meaningless, so I also analysed the initial grade to have an idea of the final choice of the target and the following pies represent the result.

*Complementary information, charts and pies can be found in Annex III.

After analysing all the responses, the most answered initial option was 6 (22.8%) followed by 7 (19.1%), 5 (16.9%) and 4 (16.2%), and the less answered one was 0 (1.5%), followed by the numbers from 1 to 3, 8 and 9. None of them answered 10, but 13.2% of all the answers ended up with a 10. Most of the people ended up with an 8 (27.9%) and a 9 (25%) followed by a 7 (20.6%). It means that the presentation increased people's knowledge about transplants and donations as at the beginning the numbers were from 4 to 7 and they ended up being numbers from 7 to 10.*

In the case of the degree of acceptance, the most answered option chosen initially was 10 (19.1%), followed by 8 (18.4%), 9 (14%), 5 (14%) and 7 (12.5%), and the less answered one was 0 (1,5%), followed by the numbers from 1 (2.2%) to 4 (5.1%) and 6. After the presentation, the option 10 was still the most chosen option but in this case, with a 30.9%, followed by 9 (19.1%), 7 (14.7%) and 8 (14%) and the less chosen option was 1 with a (0.7%), followed by 4 (1.5%), 2 (2.2%), 5 (5.1%) and 6. It means that even though the most answered options are similar, the number of people who chose 10, 9 and 7 increased and the number of people who were neutral and negative lessened to the point of not having any 0 as an option. *

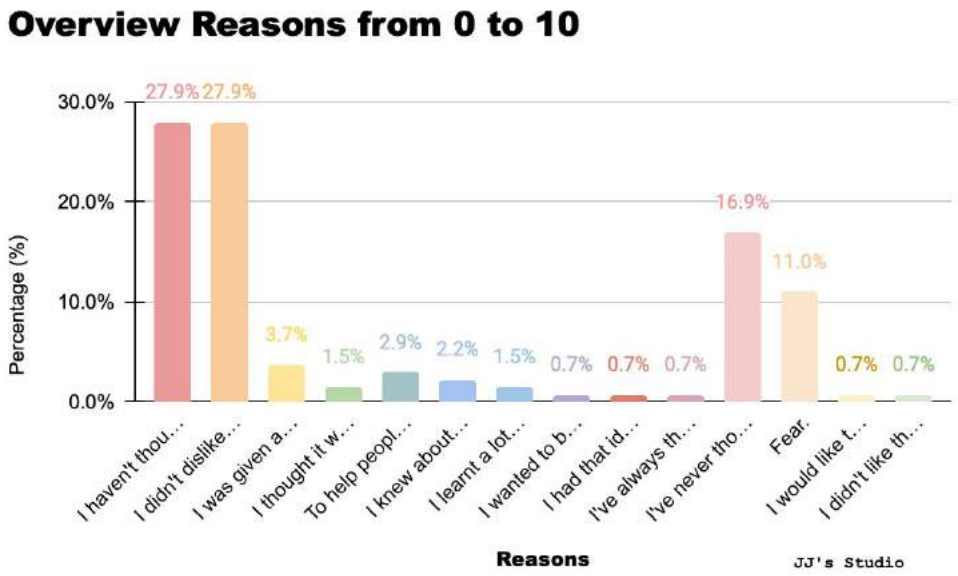
After making an analysis about the real impact on people's knowledge and degree of acceptance for transplants and donations I moved on to do the same but in this case with the reasons for choosing those grades of acceptance.

People who chose from 0 to 5 at first, did it mostly because they never thought about it. A third of the people did it due to fear and similar to this one there are two more reasons and they are due to the dislike of the idea and the impossibility of finding themselves doing it even though they would like to become donors and these two options represent 2.5% each. *

In the case of people who chose from 6 to 10, there is more variety, but the most dominant reasons that represent 40% each are the fact of not disliking the idea and the fact of not having thought about it before. There are eight more reasons which represent 5% or less each and they are more about being informed about transplants and donations before or cases in which a member of the family needed a transplant, just because they had that idea in mind.*

As a result, the main reason is that people have never thought about this important subject as it is represented in the overview chart, and the second and third most chosen options give a better vision of the other two groups of people who feel fear or who do not dislike the idea of becoming a donor.

*Complementary information, charts and pies can be found in Annex III.



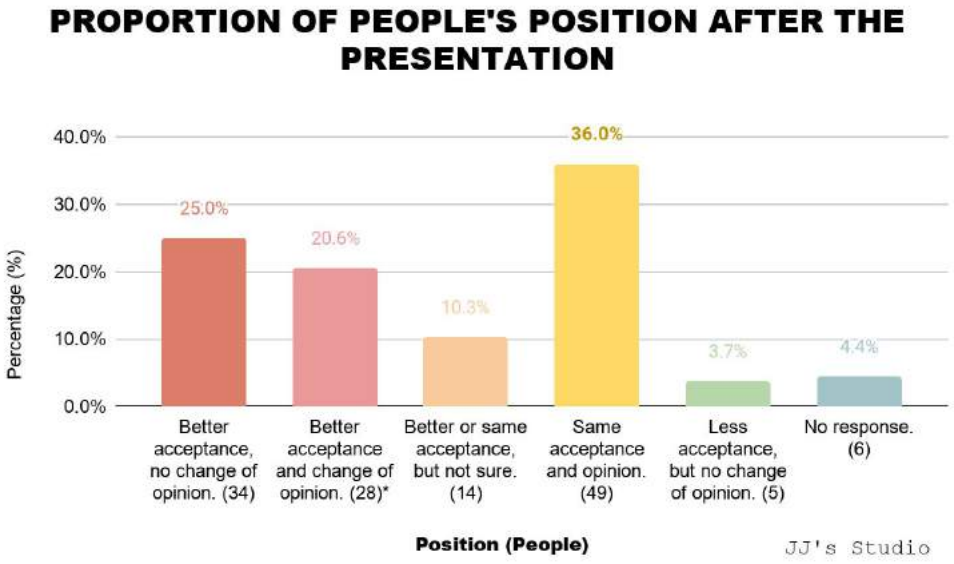
Legend:

I've never thought about that.
Fear.
I would like to become one, but I can't find myself doing it.
I didn't like the idea.

I haven't thought about that, but I can be a donor without any problems.
I didn't dislike the idea.
I was given a presentation before and I liked the idea better.
I thought it was morally correct.
To help people that need it.
I knew about this before and I had in mind become a donor.
I learnt a lot with Grey's anatomy and it gave me the idea of becoming a donor.
I wanted to become a donor after I die.
I had that idea in mind as my grandpa needed a kidney transplant some years ago.
I've always thought: why not help others and give a second opportunity to my body?

Knowing their initial position, I was able to compare it with their position after the presentation and what can be seen is that two-fifths of all the people have not changed their mind, followed by a quarter that has a better acceptance without changing their mind, a fifth that have better acceptance and a different position, 10.3% who is not sure and the last group whose acceptance lessened, but their opinion remained the same. As I marked the option of answering obligatorily to those questions involving a scale, in this part there were 6 people who did not answer.

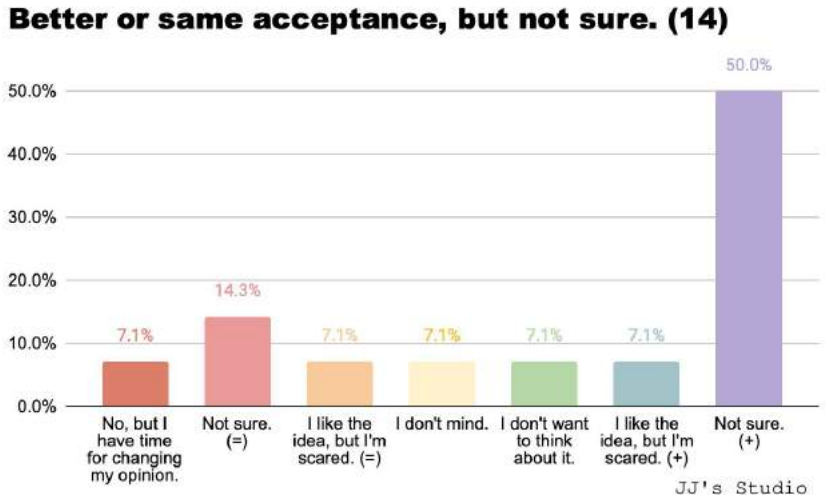
*Complementary information, charts and pies can be found in Annex III.



The information that was given with this chart needed to be complemented because the opinion and the acceptance are not indicated and that is why I will expose the results and also some charts which contain more detailed data.

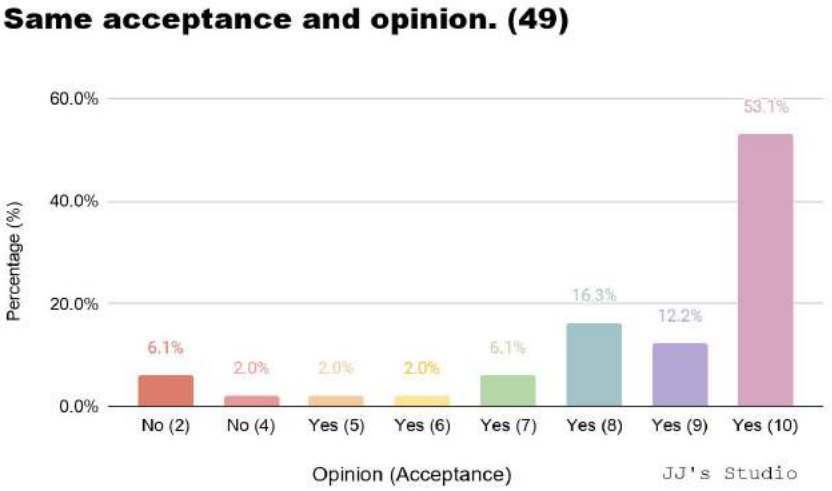
The percentages indicate that a quarter of people with better acceptance, but no change of opinion, four-fifths are positive answers and the rest are negative answers. An impressive result as more than four-fifths of the 34 people kept their positive initial position and also increased their acceptance for becoming a donor.*

In the group of people who were not sure, half of them have a better acceptance, one is a negative answer that expresses a possibility of a change of opinion, one does not mind about it, one does not want to think about it and the last two responses say that they like the idea, but they are scared, but one of them has a better acceptance, and the other keeps the initial answer. It means that half of the people better accept the option of becoming a donor after the presentation, even though they are not sure.



*Complementary information, charts and pies can be found in Annex III.

Among the people that maintained the same acceptance and opinion, more than half of them want to become donors for sure, only 8.1 % have a negative answer and apart from the people who keep the 10, the two most chosen acceptances are 8 and 9. This means that a lot of people decided to become a donor in the future, a really good result.



In the case of the people who lessened their acceptance, but the opinion has not changed, 80% of them remain positive and only one person changed to negative. As expected, there are people who lessened the acceptance, but it is a big surprise that only one person did it and kept a negative response and the same with the other 4 positive ones as the normal thought when someone lessens his acceptance is a change to a negative response. *

After analysing their position, I analysed the reasons for changing their opinion, in total there are 166 responses because 30 people answered twice showing a change of acceptance, but not of opinion.

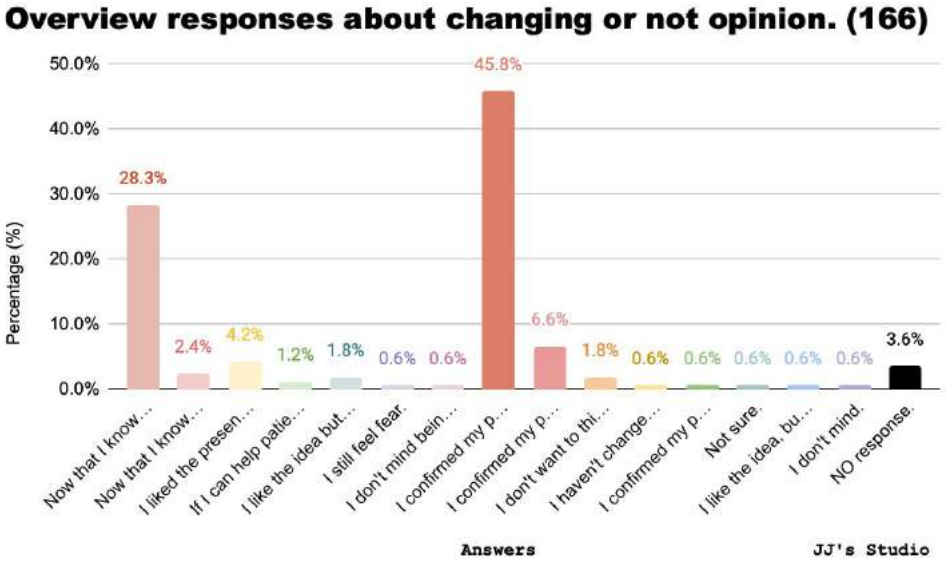
From the 65 people who answered that they changed their opinion, nearly three quarters did it because they were conscious about the implications of being a donor and thus they want to become one. The next most answered option was the unsure one as they liked the presentation, but needed time to consider it. The other five different answers suppose less than 10% each, but they are also important as for example, 6.2% decided not to become donors, two similar answers liked the idea, but felt scared and a positive answer that shows people's will for helping others if it is needed. A surprise is that one person answered with 'I don't mind', something I did not expect to happen. Seeing the results, a lot of people changed their mind in a positive way, showing a good impact and also showing minimal other responses like being unsure, feeling fear and not wanting to donate.*

A significant part of the target thought in a different way after the presentation, but more people maintained their position. After an analysis of those answers, I discovered that four-fifth of the 95 people who answered this part, did not change their opinion because they were more certain about being a donor and 12% did not do it for the same reason but instead of being certain about being one,

*Complementary information, charts and pies can be found in Annex III.

they were certain that they did not want to. There are other 6 different responses that represent 3% or less of the 95 people that express an uncertain position, except for one that expresses that he would do it if it is needed for helping patients.*

To know the final result it is important to compare all the reasons and the overview chart shows clearly the good impact of doing presentations for fostering people's knowledge about transplants and donations, even though there is also a percentage of negative responses. However looking at the bigger picture, the number of positive responses for becoming a donor is 8.4 times higher than negative responses meaning that for each negative response, there are between 8 and 9 positive responses. In total, 11.4 % is not sure, more or less 1.2 times more than negative responses.



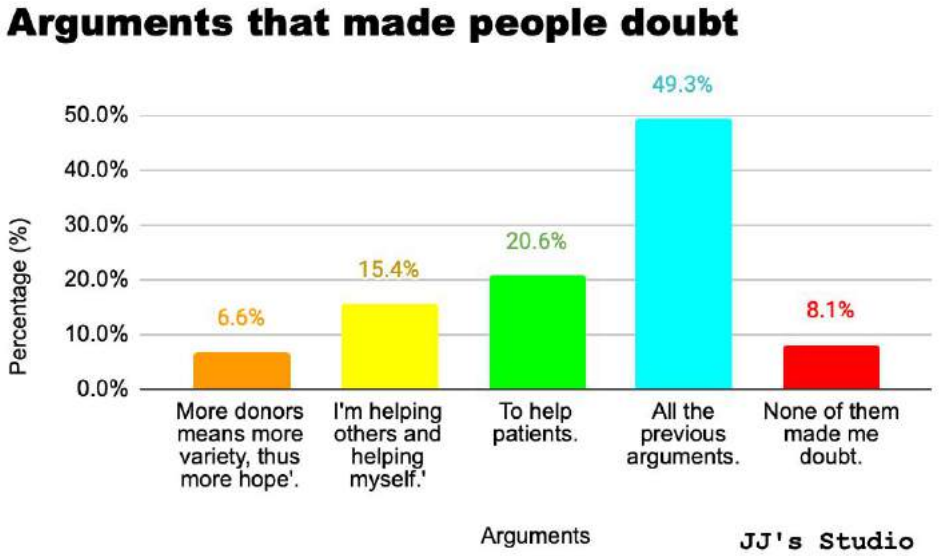
Legend:

Now that I know the implications of being a donor I want to be one.
Now that I know the implications of being a donor I don't want to be one.
I liked the presentation, but I am not sure and need time for making this decision.
If I can help patients, I'll become a donor.
I like the idea, but I can't find myself doing it.
I still feel fear.
I don't mind being one or not.

I confirmed my previous idea, I want to become a donor.
I confirmed my previous idea, I don't want to become a donor.
I don't want to think about it now, I'll decide later on.
I haven't changed my mind (-), but I have plenty of time for doing it.
I confirmed my previous idea, if I need to become one, I'll do it.
Not sure.
I like the idea, but I'm not convinced.
I don't mind.

*Complementary information, charts and pies can be found in Annex III.

Once I finished analysing the position of people after the presentation, I started with an analysis of the arguments presented in the explanation that made people reconsider their decision. So I can have an idea of what makes people be more interested in donating for patients as the way things are presented to make them feel more captivated is essential for sensitization campaigns.



As the chart indicates, more or less half of the people was touched by all the arguments that were said in the presentations, a fifth considered that helping patients did it, 15.4% was touched by the argument 'I'm helping others and helping myself' and 6.6% by the argument that 'More donors means more variety, thus more hope'. However, 8.1% was not touched by any argument. In order to know which group chose the last option and also to know how to get to people who answered with a negative response to becoming a donor previously, I studied the answers of the same groups of the last part and the results are shown on the next pies.

Looking at the pies that can be found in annexe 3*, only two groups answered 'None of them made me doubt' and they were the people who kept their previous answer, three out of eleven people that still do not want to become a donor and eight out of forty-five people who kept their positive acceptance. Only three people who answered stating a negative response were not touched and from the eight positive answers, six were answered by people who had an acceptance rate of 10 and one of 7 and 8, an astonishing result.

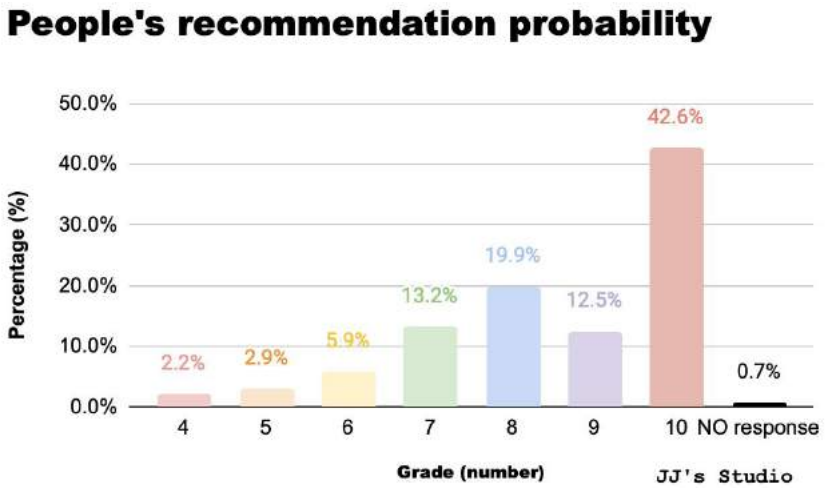
In the case of people who changed their opinion, the predominant answer is all the arguments with 75% followed by helping patients with 17.9%. Among the people who still do not want to become a donor apart from the 'None of them' response, there are others, and the predominant one is helping patients with 36.4%,, and the person who lessened his acceptance chose the 'Helping others and help myself' option. In the group of people who were more sure about their positive answer, 'All the arguments' has the leading role with 46.4% and it is followed by helping patients with 32.1%.

*Complementary information, charts and pies can be found in Annex III.

Analysing the biggest group formed by people who kept their positive answer, I discovered that the 'All arguments' was the most answered option with 46.7%, followed by 'Helping others and myself" with 20%, . Among those who lessened their acceptance but kept their positive response, only two options were chosen and they were 'All arguments' and 'More hope' with 50% each. The last group analysed previously, the ones who were not sure, got a 35.7% for 'All the arguments', 28.6% for 'Helping others and helping myself', and 21.4% for 'Helping patients' ', which means that for those who are doubting, all the arguments got them, but especially the helping idea was responsible for that result.

As I marked this arguments question as obligatory, the six people who did not answer previously answered and the result is that 'All the arguments' is the most chosen option with 50%, followed by 'Helping patients' with 33.3% and finally 16.7% for the 'Helping others and myself' option, meaning that all the arguments touched them and especially the helping idea as the last group.*

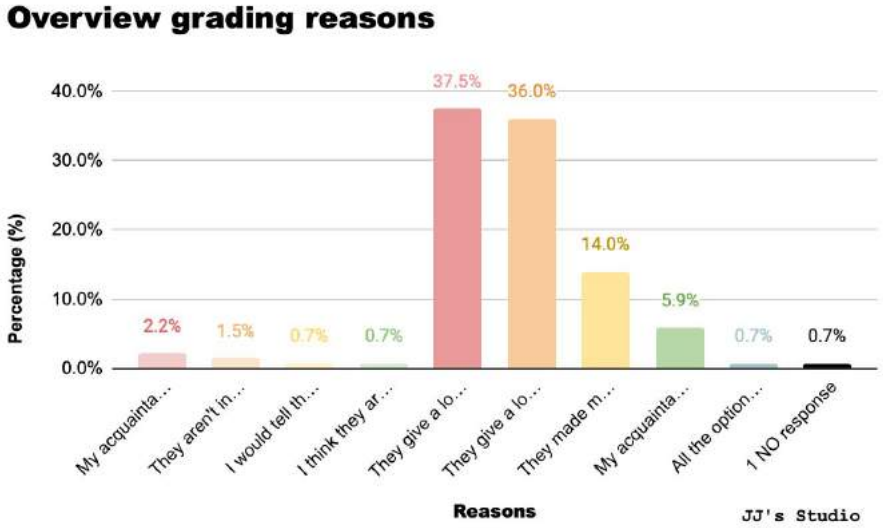
After a thorough study about the opinion and reasons for positioning in some specific positions about transplants and donations, I also wanted to study whether the target would share and recommend the presentation and the materials given with their acquaintances or not, to know if this campaign can get to more people in order to determine if the idea of raising awareness among people can be successful as the more people who know about it, the highest chance for spreading the real face of transplants and donations, a topic that is not obvious for everyone.



As the chart shows, two-fifths of the people would certainly recommend the materials, followed by one third who is not as certain as the previous one, but they are really likely to do it. Then there is one fifth that would do it, but not as likely as the earlier responses; 2.9% who is neutral and 2.2% who is a little bit unlikely to do it. These results show that three quarters of the people would share and recommend the campaign and presentations, a really impressive result as only 2.2% would not do it and nearly one quarter is in a neutral and likely position. This part was not marked as obligatory and that is why one person did not answer it.

*Complementary information, charts and pies can be found in Annex III.

In order to know what made people choose those options, I studied all the answers and classified them in groups with the same grade. But before that I analysed all the reasons and discovered that the most frequent answers were 'They give a lot of useful information' with 37.5%, followed by 'They give a lot of interesting information' with 36%, 14% answered that the materials made them be more interested in transplants and donations and 5.9 % said that it was because their acquaintances would be interested. The results show the prominence of good opinions about the presentations and the campaign as only 1.5% thought they were not interesting, 2.2% said that their acquaintances will not be interested, one person said that she would recommend them, but she thinks that no one would do something and, finally, one person thought that the materials are incomplete.

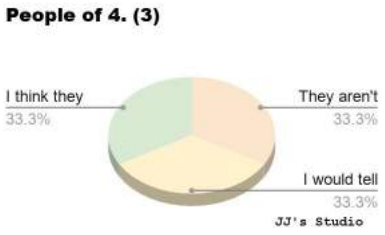


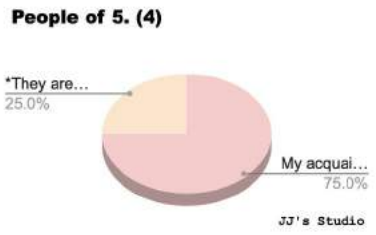
Legend:

My acquaintances won't be interested.
They aren't interesting.
I would tell them, but they won't do anything.
I think they are incomplete materials.

They give a lot of useful information.
They give a lot of interesting information.
They made me be interested in transplants and donations.
My acquaintances will be interested.
All the options except for 'My acquaintances will be interested'.

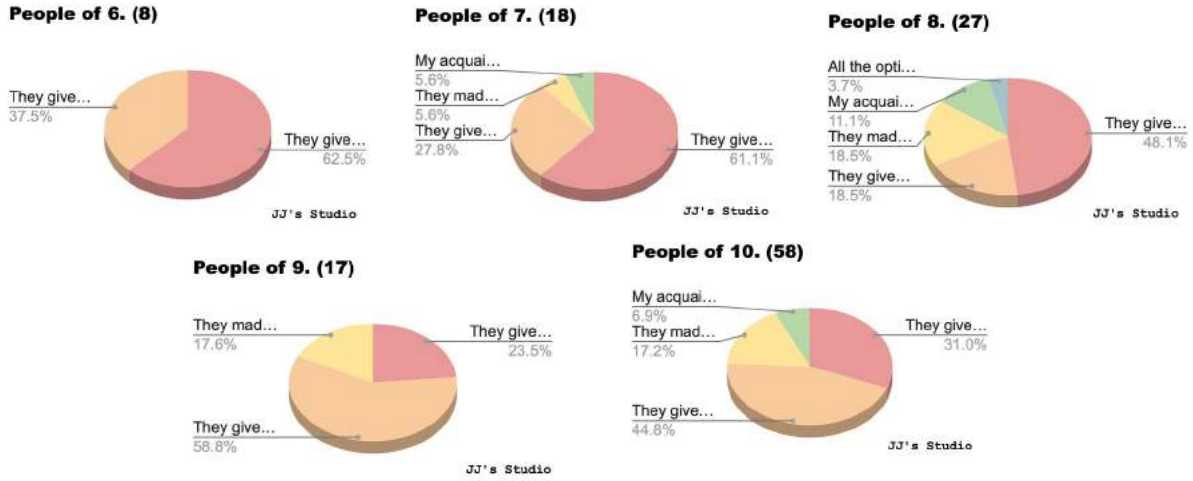
After the overview comes the deep analysis and the results are the following ones:





*Complementary information, charts and pies can be found in Annex III.

Among the people who answered with a more negative response or a neutral one, the most answered option was that their acquaintances would not interest, followed by the answer that they do not think the materials are interesting, but one surprising thing was that one of them said that even though they chose that option, his relatives and friends would be interested. The last option was the one who chose the incomplete option, it is a surprise that only one person thought that as it means that all the rest think that the materials are complete.



Finally, after the negative and neutral answers, come the positive ones and these pies express that among the people who answered from 6 to 8, the main reason was that they found the materials useful, followed by the fact that it was interesting for them. But in the case of answers from 8 up to 10, the 'useful' factor lost importance and in contrast the interesting one got more, up to the point that people got interested in the subject.

Comparison

Once I have finished with all the data analysis of the forms I proceeded researching about what other countries do for donations in order to compare it with what Spain does and also with the results of my campaign, and thus try to discover whether it can be widespread and a viable option for raising the number of donors in Spain in a long term period and do more research about the way of getting to people with this type of issues.

I started looking for Spanish campaigns and ways to sensitize about transplants and donations, and there are some campaigns I have found which are promoted by an organism about transplants and donations like OCCAT (Catalan organism of transplants) and ONT. Both of them have a lot of interesting materials and, for example, ONT collaborated with Mediaset a mass media company and it appeared on TV, but the problem is that there are a very few advertisements on TV for attracting people's attention on the subject so people who have never seen one will not know about them at all unless the idea of transplants and donations come to their minds or they are told about them.

I also found a project called 'Transplanting smiles' in which the Donation and Transplantation Institute collaborated in order to raise awareness among professionals and to thank all the people and professionals who take part in all the process of donation and transplantation. The project consisted in filming a documentary with interviews of the different people who take part in transplants and donations such as physicians, donors and their families, patients and their families and research groups from nine hospitals in Spain and thus show it to the employees of Inditex and raise awareness among adults who are working.

In the case of other countries, I found two innovative and interesting ways Japan and Peru use to raise social awareness. In the case of Japan, the advert I found is a metaphor of the transplantation and donation process between donors and recipients done with second-hand toys. Japan is the country with the strictest laws for donations, and due to that brain death donors' organs' donations were not legalised until October 1997 and fully effective in July 2010. Thus, there is a big difference between the number of donors and patients who need a transplant, actually, in 2020 there are 14.481 patients who need a transplant, 67 donors and only 268 had a transplant. In Japan, donation is a topic regarded as something bad because people link it with death and thus the attitude is negative and even worse when it comes to children's donation. In order to approach Japanese children and therefore their families, Akira Suzuki and Togo Kiba created the 'Second Life Toys' in 2016, a project in which soft toys from children who do not want them anymore are used as 'donors' for broken ones to have their owners still want them. Before the donation, a photo is sent to the family of the broken toy and once it is approved the transplant is carried out and recipients send a note to the donor's family in gratitude for the donation that gives a second opportunity to the broken toys. One example is:

Figure 30. Transplanted Giraffe.

The other mentioned country is Peru, which has the lowest rate of donors per citizen in Latin America, concretely 1.6 donors per million of citizens. With the purpose of raising those numbers, Circus Grey and the Peruvian Ministry of Health decided to create a sensitization campaign using what people love the most, soap operas. The project is called 'The Life Saving Soap Operas' and it consisted of using two characters from different tv series in order to create a fiction organ donation and transplantation process, thus making people be more immersed in the plot and at the same time

spotting the importance of organ donation. The result of that campaign was stunning as the number of donors increased by 200% and got to over 8.5 million women, showing how successful it was.

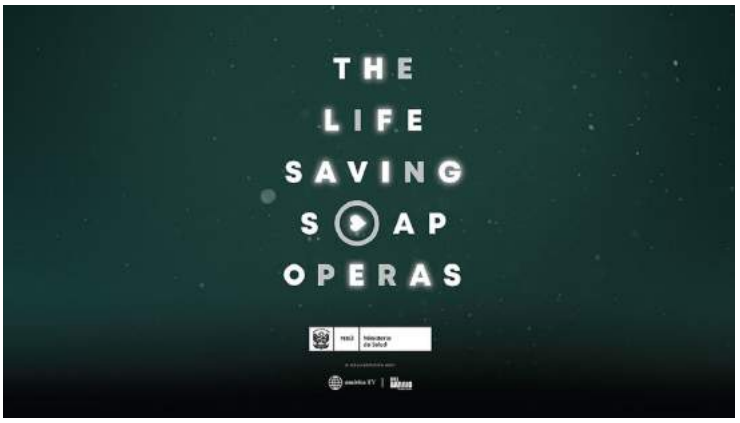


Figure 31. The Life Saving Soap Operas.

With all the information from the study done on both the theoretical and the practical part of this research work, I've drawn the ensuing conclusions:

Conclusions

After a thorough study, I've arrived at the conclusion that the immune system has a big role to play in transplants. Successful transplantations' biggest barrier is rejection and it is triggered by the immune system as a response to the unknown component transplanted into the body. What provokes and makes rejection possible are some specific components of that system and they are the HLA, a self-marker, the cells and antibodies that constitute the humoral response and cellular response, and the antigens, some alien substances. Another conclusion is that HLA, blood type, body surface, precedent diseases and in some cases the age are the factors considered by doctors when they try to find a good match for the patient who needs a transplant.

The next conclusion I've arrived at is that all the allotransplantation have a high risk of rejection, but doctors can match donors and patients taking the previous factors into account in order to lower the cases in which the graft can be detected as an enemy. Younger donors' organs and tissues do not suppose 100% lower risk of failure after the operation than the elderly's as both of them were considered good for donation and it is also possible that the elderly's are healthier than the young donors'. However, it is true that normally young people's organs are less exposed to the risks faced by elderly people. Thus, the best donor profile is the healthy young donor without precedents, but it does not mean that someone who does not meet this profile cannot become a donor, the most important thing is that there is no social, gender, religious or age limitation for becoming one. It is the physicians who determine whether one person is a potential donor or not.

Studying Spain's current situation, I discovered that the most transplanted organ by far is the kidney, followed by the liver, lungs and heart. Less frequent transplantations are the pancreas and the intestine ones. In Spain, most donors are dead donors and people over 45 years old. In 2019, only 14.1% of the donors were under 44 years old.

The conclusions I have drawn about the practical part are that the presentation of the campaign was able to increase people's knowledge about transplants and donations from low numbers to higher ones , and in the case of the degree of acceptance, even though the initial numbers were high, it also increased up to the point of not having any 0 as an option. People made those choices mostly because they had not thought about it, followed by feeling fear for the topic among the low answers and not disliking the idea among the highest ones.

Related to the position people took after the presentation, the acceptance of the different groups at the end was positive regardless of the initial opinion, only a few people chose a negative option, but most of them increased their acceptance after the presentation.

The conclusions of the reasons for changing or not their opinion are that in both cases there are more than three quarters in both cases which decided and confirmed their decision of becoming donors and that the number of negative responses is low as in general the number of positive responses is 8, nearly 9 times higher than the negative group, showing a good impact on people.

Related to the arguments given in the expositions, mostly all the people were touched by them, especially the idea of helping patients' and others'. The option 'None of them' was also chosen, but only the ones who were certain about their position chose it, most people with a 10 for acceptance.

The last conclusions about the experiment are that the materials of the campaign are considered very useful and interesting as three-quarters of the people graded them with a mark from 8 to 10, meaning that they would recommend them to more people and proving that the materials are really likely to be shared and can get to more people; and even though the real impact on the number of donors can only be measured long-term, the conclusion is that the campaign was successful at the short period of time as it increased people's knowledge and awareness about transplants and donations. There were also negative opinions, but they only supposed 5.1% and the reasons for choosing those options were mostly due to their acquaintances' lack of interest in the topic.

Proving that the hypothesis I formulated about the fact that if teenagers are educated about the topic, they can have a better opinion and can consider more seriously the option of becoming a donor was true.

In the investigation I've done, I found that Spain has many sensitization campaigns and all those actions show all the efforts people from the organisations, which created them, make for reaching people and helping patients who are suffering in Spain, what along with all the altruist people who become donors and its opt-out policy, make Spain the country who ranks first in organ donation around the world. Altruism can also be appreciated in my experiment as there was the prominence of high grades for donation acceptance even before the expositions.

Compared to Spain, the other two countries I've studied have a way fewer donations, but both of them came up with fascinating projects like using transplants in soft toys for increasing awareness among children and their families in Japan; and using what at the present time has a gigantic influence on people, especially teenagers, the TV series in the same way in Peru.

Spain has not used these types of methods before, and my conclusion is that a good method for increasing the number of donors in Spain is to try the aforementioned methods for catching people's attention and also for raising their awareness about transplants and donations since their young age in order to make the topic something known instead of unknown, as it mostly is now. After that,

presentations like the ones of the campaign can be given when they are older for refuting myths people believe as the results of the experiment show a good impact on the target.

My final conclusion is that all the countries should share their ideas for increasing the numbers of donors as the material that each country has does not meet the demand of them worldwide. If instead of doing the same research I've done, there was a network in which all the projects and the results are uploaded and shared for the purpose of saving more lives, not only in their own countries but also in other parts of the globe. It can be a really good way for finding a solution and thus doing actions for the well-being of all the human beings on the Earth as our actual technology and knowledge about rejection and our complex body are not enough for creating a big amount of artificial cells and tissues and the same with just a whole organ.

This research work made me realise how important the immune system and the donors are, as at the beginning, I just thought that the system just had a little bit of importance and in the case of the donors more than the immune system, but less than what it really is. I've also realised that medical and technological advances are not the only factors for improvement in specific treatments, prevention and raising awareness among people are also important factors even though they are more social and last but not least, I've also discovered how interesting the world of transplants and donations can be. The experience was stressful sometimes, but nothing compared to all the knowledge I've acquired and the pride and happiness I feel now that I see all the things I've done.

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Annex:

- Figure 1. Medi-Mation (Doshi, Rajeev), Antbits Ltd (Tibbitts, Richard), Dotnamestudios (Kerr, Andrew) and Maizels, Deborah. '***The first line of defence***' [PNG]. From the book '***El gran libro del cuerpo humano***'. Page 360. ISBN: 978-0-2413-3196-5. <https://drive.google.com/file/d/15qrtmt41tQO60RHd716V-HVqXMEdVxNE/view?usp=sharing.>

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Appendix

Annex I

For a better understanding of the concepts mentioned in the theoretical framework about the immune system, the immunosuppressant and the current donors' profile in Spain, there are some complementary information and definitions:

Lines of defence

The immunologic response has three defensive lines:

- **1st line.** Superficial defences like the skin, mucose, saliva, etc.
- **2nd line.** Defences that act when there is an infection focus. Inflammation, PMN, the complement system, NK cells, the **interferon** that is a natural substance that helps to fight infections and diseases like cancer, and systemic responses like fever participate in this line.
- **3rd line.** In this line participate mechanisms like antigen recognition, T and B cells' activation and B cells' stimulation and selection for a specific antigen.

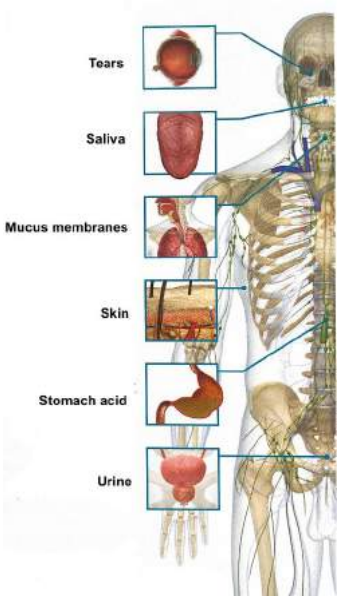


Figure 1. The first line of defence.

Lymphoid organs

The immune system is also formed by organs and they are lymphoid organs and these can be classified into two groups primary and secondary lymphoid organs:

Primary lymphoid organs

Lymphopoiesis, the process of production, distinction and maturation of T cells and B cells, is produced in these organs.

- **Thymus.** A unique bilobed organ situated at the thorax and above the heart. It doesn't produce lymphocytes, but it intervenes in their maturation. T cells maturate there. This organ begins to atrophy since puberty and it ceases being functional.

- **Bone marrow.** It is situated in the spongy bone tissue of some bones. Hematopoiesis, the formation of blood cells, takes place in this organ. All the cells that are part of the immune system origin in the bone marrow as the pluripotent stem cell produces them.

Secondary lymphoid organs

Lymphocytes produced by the primary lymphoid organs and antigens have contact in these organs with the purpose of starting the immunologic response.

- **Spleen.** A unique organ that is situated in the left hypochondria, after the stomach and near the diaphragm. It has two functions that are the immune and the filter function. The first one consists in catching antigens that come from the bloodstream and making them have contact with the lymphocytes. The second one is to filter and to destroy old or defective red blood cells.

- **Lymph nodes**. Organs that contain lymphocytes and filter lymph. They are found throughout the body, especially in the neck, the armpits, the groins and near the ears, and they are connected by lymph vessels.

Figure 2. Lymph node.

- **Mucosa-associated lymphoid tissues.** They are clusters of lymphoid tissues that are dispersed throughout the body such as **tonsils** and **adenoids** of the respiratory system, **Peyer's patche**s at the intestinal mucosa or the **genitourinary tract**. Their duty is to protect our body from antigens that enter through the mucosa via the air, the digestive tract or the genitourinary tract.

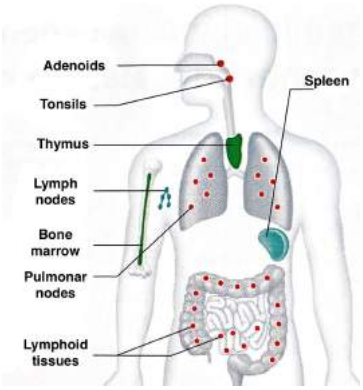


Figure 3. Lymphoid organs.

Immunologic responses

According to whether it is the first time an antigen has contact with our organism or not, there are two types of responses:

Primary immune response

This response is given when it is the first time a specific antigen is detected. It takes more time as it is a complete immune response. It takes time to recognise the antigen, to study it and to produce specific antibodies to destroy it. The organism has to go through the disease that is generated.

Secondary immune response

If the immune system stores the method to cope with a specific antigen in its memory after the primary immune response comes the secondary one. Contrary to the primary response, this response takes less time and it is more intense as the immune system has the information to create the antibodies that face the antigens and it can start attacking them as fast as the antigens are recognised. In this case, the organism doesn't go through the disease at all.

Immunity

Innate immunity

At first, there is an inflammatory response and the different immunity cells start working, NK cells can deal with intracellular infections as they control the receptors that cells have on their surface that can give information about their internal medium. If NK cells detect a decrease of the receptors, they activate and destroy the cell.

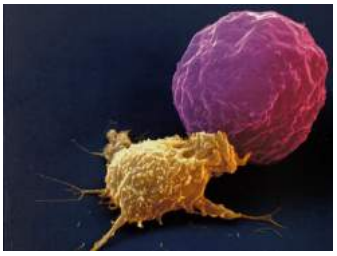


Figure 4. NK cell (yellow) attacking a cancerous cell (pink).

In this type of immunity, phagocytes like macrophages and neutrophils are essential as they deal with extracellular infections. They engulf and destroy bacteria and viruses, a process that is named **phagocytosis**.

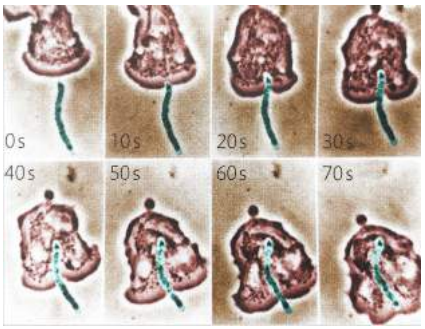


Figure 5. Phagocytosis, a phagocyte (red) engulfing a bacterium (green).

Active acquired immunity

If it is **artificial**, the process is induced by the implantation of an antigen that is inactive or dimmed in order to wake the immunity in our body. In this case, the artificial one is acquired due to **vaccination** and it prevents the development of the disease that causes the implanted antigen as the immunologic response is the secondary one. It can last some years or it may even be permanent.

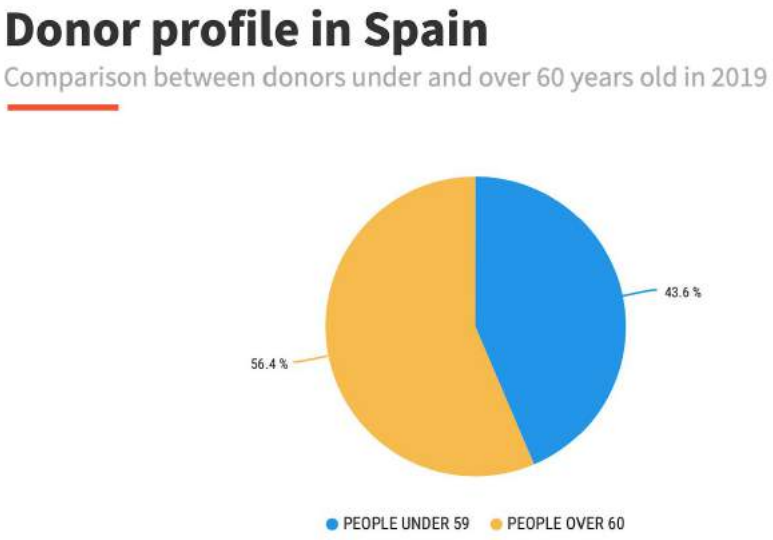
Passive acquired immunity

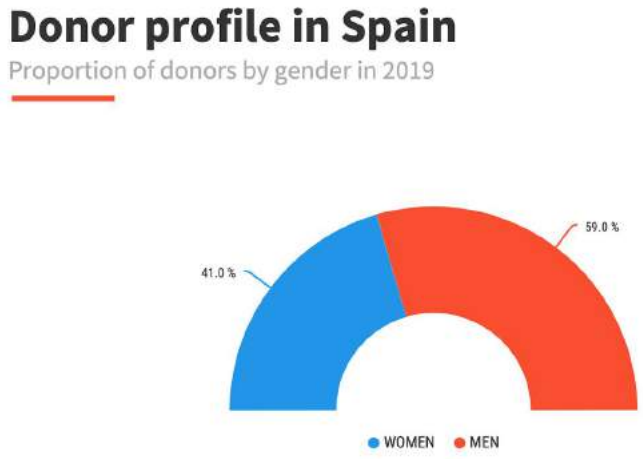
If it is **natural**, it is via maternal-fetal or transplacental and it lasts from six months to one year. If it is **artificial**, it is the administration of antibodies that were prepared previously in a serum and it lasts from two or three weeks to some months.

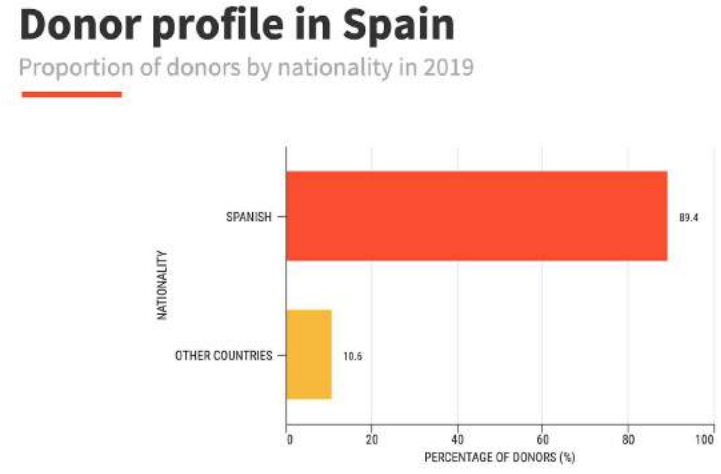
Figure 7. Passive acquired immunity - Natural (maternal-fetal).

Donor profile in Spain

The following graphics represent the percentages of the different proportion of donors in Spain in a clearer way.







Annex II

The material shared with the targets and their families are the following ones:

Posters:

Flyers (example in Catalan):

Instagram post (English version):

I've also created an Instagram story:

At the presentations, the pdf that was presented is the following one and I was also played a video that contains Dr Paredes' message for people:

(Presentation)

(Video)

Questionnaire:

U R Hope! (Trasplantes y donaciones)

Después de escuchar la presentación nos gustaría saber tu opinión. Al ser una parte subjetiva, os pedimos la máxima sinceridad posible al responder. No hay ninguna respuesta incorrecta, tu opinión nos es de mucha ayuda!

*Required

1. CURSO: *

- ◯ 1º Bachillerato.
- ◯ 2º Bachillerato.

ANTES DE LA PRESENTACIÓN

2. Del 0 al 10: ¿Cuánto crees que sabías sobre trasplantes y donaciones? *

	0	1	2	3	4	5	6	7	8	9	10	
Nada.	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Sabía mucho.

3. Del 0 al 10: ¿Qué grado de aceptación tenías por ellos? *

	0	1	2	3	4	5	6	7	8	9	10	
No podía ni pensarlo.	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	¡Ya tenía pensado ser donante!

4. En caso de haber escogido del 0 al 5 en la pregunta anterior: ¿Por cuál de los siguientes motivos has escogido esa opción?

- ◯ Miedo.
- ◯ No me gustaba la idea.
- ◯ Simplemente nunca había pensado en ello.
- ◯ Other: _____

5. En caso de haber escogido del 6 al 10: ¿Por cuál de los siguientes motivos has escogido esa opción?

- ◯ No me disgustaba la idea.
- ◯ No había pensado en ello, pero sería donante sin problemas.
- ◯ Ya me hicieron una presentación como esta antes y me gustaba más la idea.
- ◯ Other: _____

DESPUÉS DE LA PRESENTACIÓN

6. Del 0 al 10: ¿Cuánto crees que se te ha quedado sobre los trasplantes y las donaciones? *

	0	1	2	3	4	5	6	7	8	9	10	
Nada. Todo es muy complicado.	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Sé muchísimo más que antes.

7. Del 0 al 10: ¿Qué grado de aceptación tienes ahora por ellos? *

	0	1	2	3	4	5	6	7	8	9	10	
Sigo sin poder pensar en ello.	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	¡Quiero ser donante!

8. Si tu opinión ha cambiado tras la presentación, ¿por cuál de los siguientes motivos ha sido?

- ◯ Ahora que sé lo que implica, no quiero ser donante.
- ◯ Ahora que sé lo que implica, quiero ser donante.
- ◯ Other: _____

9. Si tu opinión no ha cambiado, ¿por cuál de las siguientes razones ha sido?

- ◯ He confirmado mi idea anterior: no quiero ser donante.
- ◯ He confirmado mi idea anterior: quiero ser donante.
- ◯ Other: _____

10. Tanto si has cambiado como si no de opinión, ¿cuál de los siguientes argumentos mencionados en la presentación te han hecho replantearte tu opinión: *

- ◯ La idea de ayudar a los pacientes.
- ◯ 'Estoy ayudando a los otros y me estoy ayudando a mi mism@'.
- ◯ 'Más donantes significa más variedad y por lo tanto más esperanza'.
- ◯ Todos los argumentos anteriores.
- ◯ Ningún argumento me ha hecho dudar.

11. Independientemente de tu opinión, del 0 al 10: ¿recomendarías o compartirías los materiales de esta campaña a tu familia, tus amigos y tus conocidos? *

	0	1	2	3	4	5	6	7	8	9	10	
No los recomendaría.	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Los recomendaría a todos mis conocidos.

12. Si la respuesta es del 0 al 5: ¿Por qué?

- ◯ No los veo útiles.
- ◯ No me parecen interesantes.
- ◯ Mis conocidos no se interesarían.
- ◯ Me parecen materiales incompletos.
- ◯ Other: _____

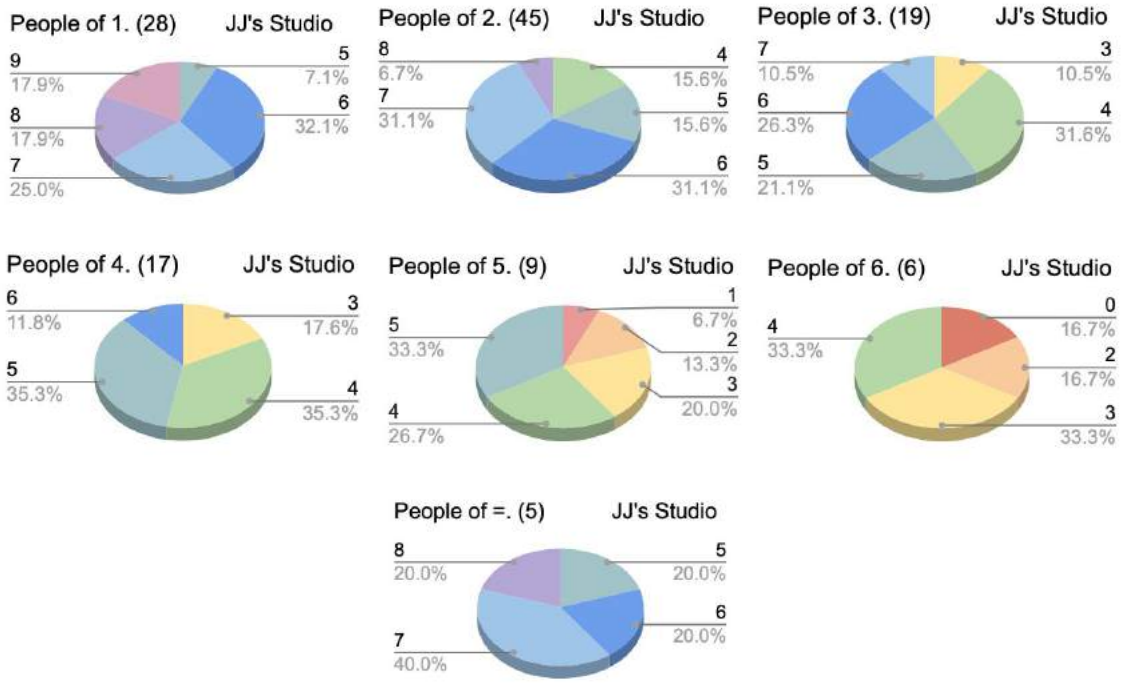
13. Si la respuesta es del 6 al 10: ¿Por qué?

- ◯ Proporcionan información interesante.
- ◯ Les interesarían a mis conocidos.
- ◯ Dan mucha información útil.
- ◯ Me han hecho interesarme por los trasplantes y las donaciones.
- ◯ Other: _____

Annexe III

Some data analysis in the practical part are not very relevant but they complement the study:

Thorough study about the increase of knowledge:

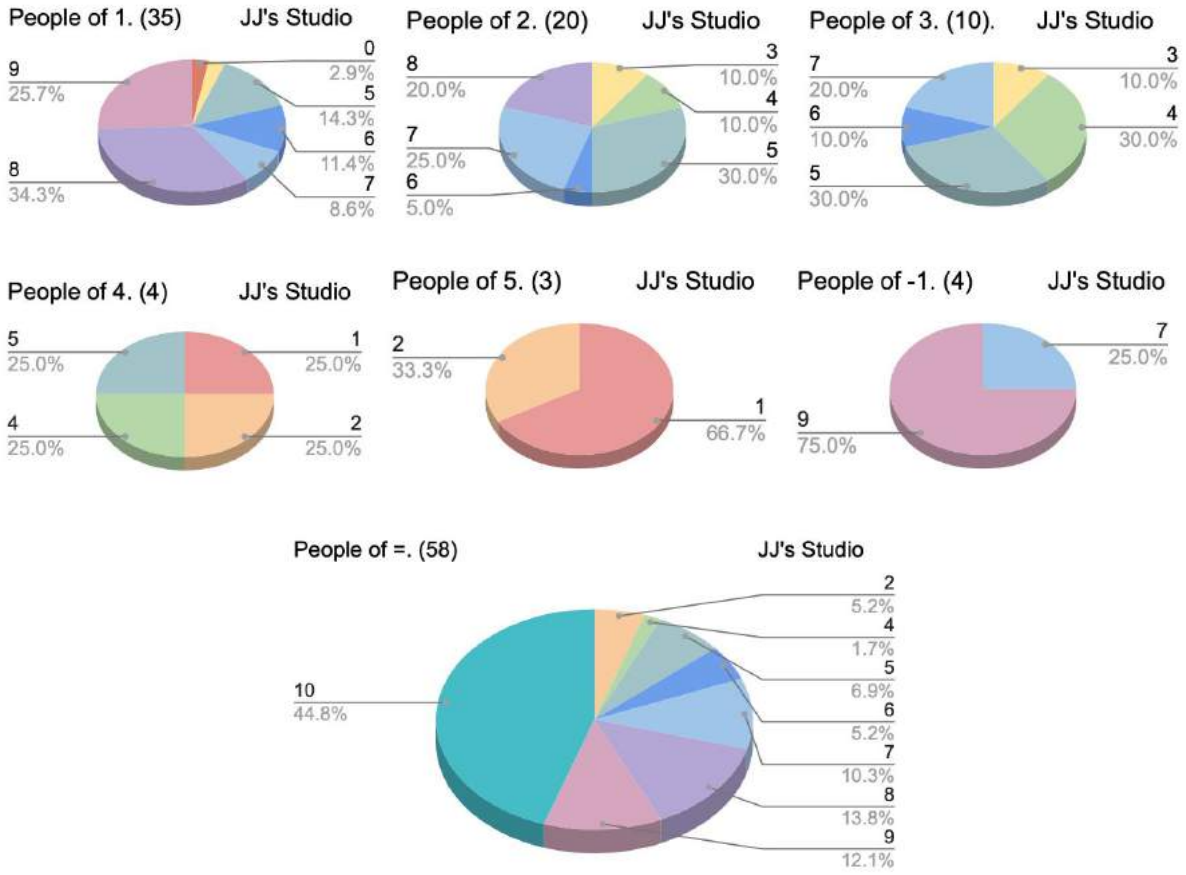


Increase of 7, 1 person from 2 to 9; Increase of 10, 1 person from 0 to 10; Increase of -1, 3 people from 9 to 8; Increase of -2, 1 person from 7 to 5; and Increase of -5, 1 person from 8 to 3.

Initial knowledge	Total number (136).	
0	2	1.5%
1	2	1.5%
2	3	2.2%
3	9	6.6%
4	22	16.2%
5	23	16.9%
6	31	22.8%
7	26	19.1%
8	10	7.4%
9	8	5.9%
10	0	0.0%

Final knowledge	Total number (136).	
0		
1		
2		
3	1	0.7%
4		
5	2	1.5%
6	15	11.0%
7	28	20.6%
8	38	27.9%
9	34	25.0%
10	18	13.2%

Thorough study about the increase of acceptance:

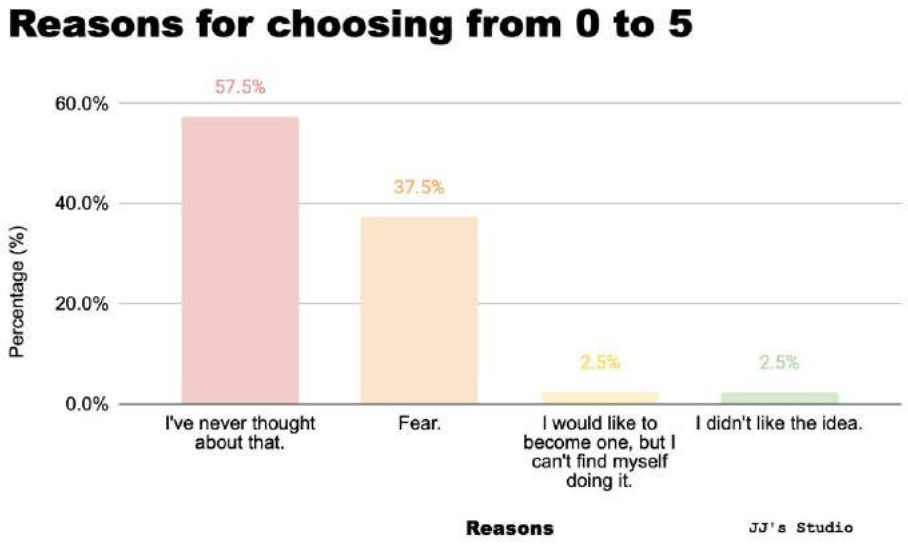


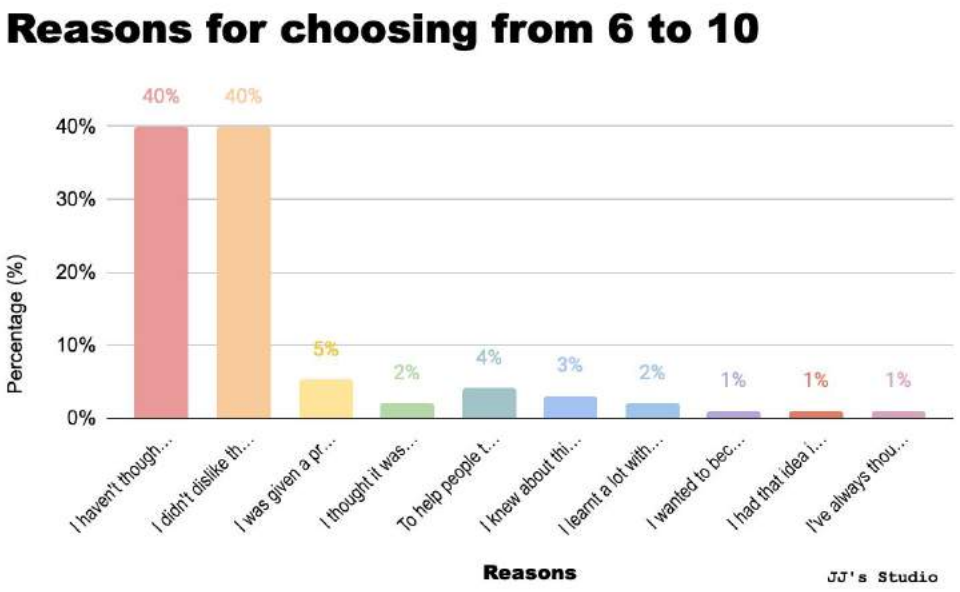
Increase of 10, 1 person and increase of -2, 1 person from 8 to 6.

Initial acceptance	Total number (136).	
0	2	1.5%
1	3	2.2%
2	5	3.7%
3	4	2.9%
4	7	5.1%
5	19	14.0%
6	9	6.6%
7	17	12.5%
8	25	18.4%
9	19	14.0%
10	26	19.1%

Final acceptance	Total number	
0		
1	1	0.7%
2	3	2.2%
3		
4	2	1.5%
5	7	5.1%
6	16	11.8%
7	20	14.7%
8	19	14.0%
9	26	19.1%
10	42	30.9%

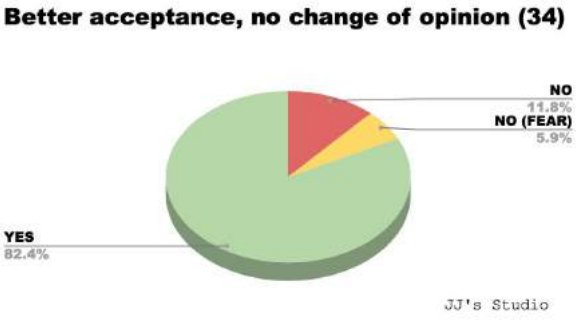
Reasons for choosing the acceptance grade:

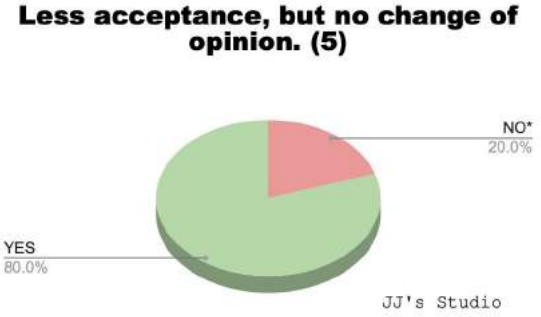




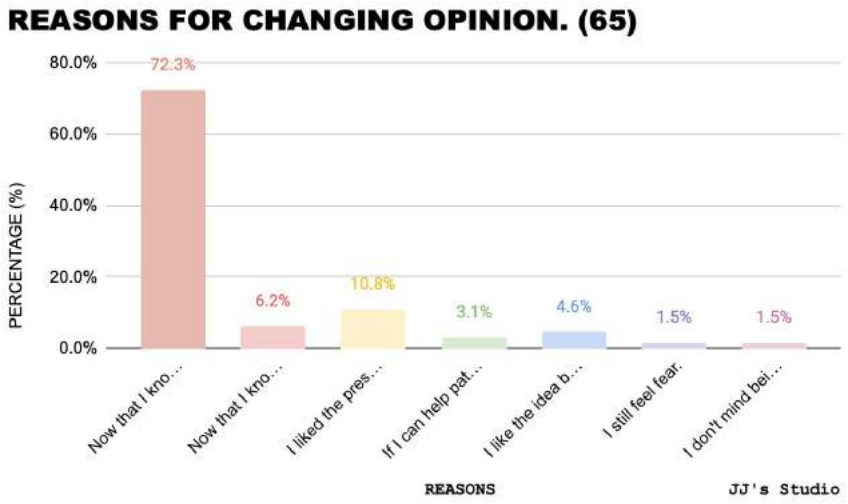
I haven't thought about that, but I can be a donor without any problems.
I didn't dislike the idea.
I was given a presentation before and I liked the idea better.
I thought it was morally correct.
To help people that need it.
I knew about this before and I had in mind become a donor.
I learnt a lot with Grey's anatomy and it gave me the idea of becoming a donor.
I wanted to become a donor after I die.
I had that idea in mind as my grandpa needed a kidney transplant some years ago.

The proportion of the different group's with different positions after the presentation:



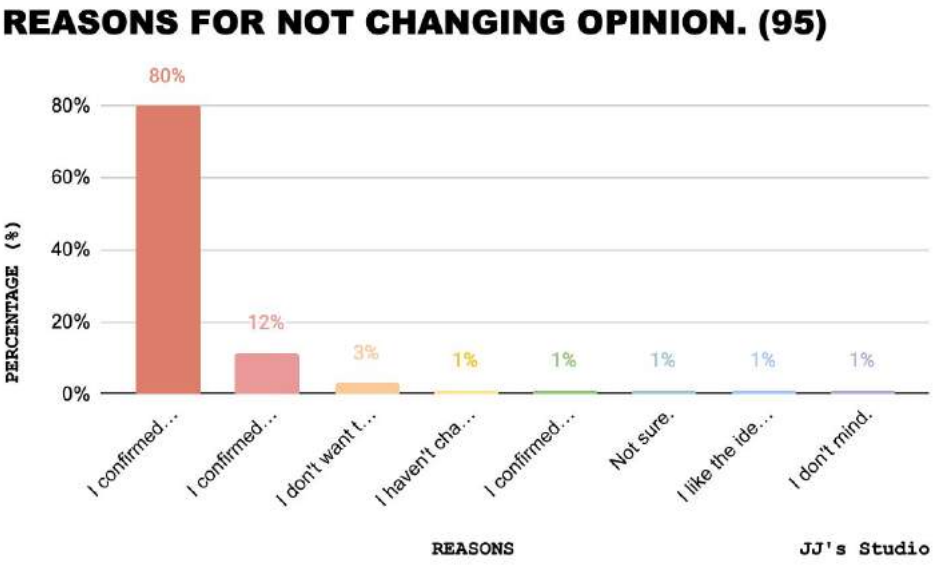


Reasons for changing or not their position:



Legend:

Now that I know the implications of being a donor I want to be one.
Now that I know the implications of being a donor I don't want to be one.
I liked the presentation, but I am not sure and need time for making this decision.
If I can help patients, I'll become a donor.
I like the idea, but I can't find myself doing it.
I still feel fear.
I don't mind being one or not.

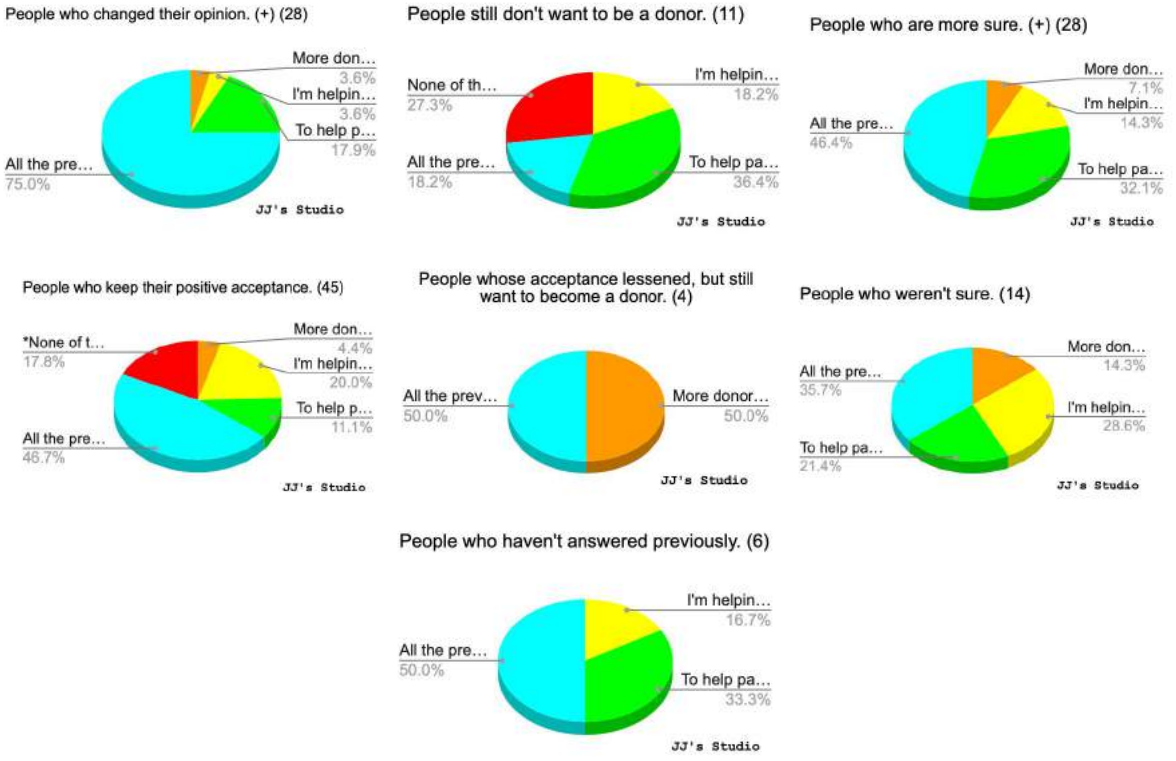


Legend:

I confirmed my previous idea, I want to become a donor.
I confirmed my previous idea, I don't want to become a donor.
I don't want to think about it now, I'll decide later on.
I haven't changed my mind (-), but I have plenty of time for doing it.
I confirmed my previous idea, if I need to become one, I'll do it.
Not sure.

I like the idea, but I'm not convinced.
I don't mind.

The proportion of the arguments that touched the different groups analysed before:



Link to the excel document with all the responses and the calculations:

- https://docs.google.com/spreadsheets/d/1K4r-eRM-H3xEVDSjTrxB4vSl4QAX6pf3xdmE0QNfH4g/edit?usp=sharing