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**“Humans or Animals?: Analyzing The Human Life and Animal Suffering Tensions
Surrounding Xenotransplantation”**

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I. INTRODUCTION

Today's world is facing a multitude of issues, from small-scale ones, primarily found or situated within a single country, to large-scale ones or those that reach the global level, involving numerous nations. One large-scale pressing issue is the worldwide shortage of viable organs to be used for transplantation. Transplantation is an act involving the replacement of non-functional cells, tissues, or organs with healthy counterparts. Such counterparts are usually obtained from another individual through voluntary donation while they are alive or when they pass away (World Health Organization, 2023). Access to transplantation varies significantly between countries, and the incidence of vital organ failure has risen globally in the past years, consequently prompting the increase in demand for organ transplantation. Unfortunately, adequate organs for transplantation have become challenging to procure, making it difficult for countries to meet the existing demand, resulting in major organ shortage crises (Abouna, 2008). Now, the number of patients on transplant waiting lists has skyrocketed, including the number of people dying while on the waiting list. According to the Health Resources and Services Administration (2025), as of 2024, there are more than 100,000 people on the transplant waiting list in just the United States of America. 13 people are said to die each day waiting for an organ

transplant. Further, every 8 minutes, another individual is added to the waiting list. On the other hand, the Philippines also faces a severe shortage of donated organs, with over 400 patients who are in line, awaiting kidney transplants alone (Paunan, 2025).

Currently, there are a number of solutions that are being tested and initiated in order to alleviate and fix the issue at hand. One such solution is the shifting from an opt-in system, which is the traditional approach involving informed consent, to an opt-out system, which presumes consent unless individuals explicitly and specifically “opt out.” Amidst its implementation in various nations such as Spain and France, this possible solution remains to be the subject of many debates on whether or not it is an ethical and just practice (Etheredge, 2021).

Another possible solution to the issue is to broaden the pool of potential cadaver donors and make donor eligibility expand so as to include not only brain death, but also a “persistent vegetative state,” a decision by a potential donor who is soon to die (death by donation). However, adjusting the criteria for brain death is still risky, and the notion of no donation before death has long been supported by the people. Further, patients in a persistent vegetative state or who may have consented to death by donation are still not “dead” according to cardiopulmonary criteria (Caplan, 2016).

Besides these two, there is another emerging concept that involves the areas of bioengineering and genetic engineering, specifically xenotransplantation. Xenotransplantation, a word coming from the Greek term “xenos” or “foreign” or “strange,” can be understood as the interspecies, or from a non-human animal source into a human recipient, transplantation of cells, organs, or tissues. For xenotransplantation to take place, in the case of pigs, which shall be the focus of this paper, these animals are first raised in a closed, pathogen-free environment, and they would be required to undergo genetic modification to ultimately reduce the risk that organ

recipients would reject the organ or develop an infection post-transplant. Although this is slowly becoming one of the most preferred solutions to the worldwide organ shortage problem, xenotransplantation appears to raise certain concerns revolving around the well-being of both the non-human animals and humans involved in the process. As such, in this paper, I shall analyze xenotransplantation and its ethical tensions. Firstly, I shall provide a brief history of xenotransplantation. Secondly, I shall expound on the positive aspects of xenotransplantation and demonstrate how it may fulfill the bioethical principles of beneficence and non-maleficence. Thirdly, I shall expound on its negative aspects and demonstrate how it may also fail to fulfill the previously stated principle. I shall then discuss how the pains garnered from xenotransplantation's act of breeding various pigs and genetically modifying them may not justify the organ benefits for humans.

II. A BRIEF BACKGROUND ON THE HISTORY OF XENOTRANSPLANTATION

According to Siems et al. (2022), it can be learned that throughout history, there have long been stories of hybrid human and animal, such as Ancient Egypt's Anubis, a man with a canine head, and Ancient Greece's sphinx, which has the head of a woman, body of a lion, and wings of a bird. Coming from these ideas, early conceptions of xenotransplantation arose, and primarily from tissue and cell transplantations rather than organs. Such can be seen in the first documented xenotransfusion in 1667, wherein the blood of a lamb was transfused to the body of a 15-year-old boy, under the supervision of French doctor Jean-Baptiste Denys. Moving on to the early 20th century, there came various attempts at xenotransplantation, primarily from nonhuman primates (NHPs) such as baboons, and mammals such as rabbits and pigs.

The first xenotransplantation attempt took place in 1906 when Mathieu Jaboulay performed a heterotrophic transplantation (where the organ recipient's diseased heart remains while a donor heart is then implanted in a "piggy-back" fashion) of a pig kidney to the elbow of a 48-year-old woman. However, the graft failed due to thrombosis, or a formation of a blood clot within the blood vessels or a heart chamber, and the woman survived for only 3 days. Essentially, early attempts at xenotransplantation showed poor survival due to the absence of immunosuppression, and after the 1920s, there was a hiatus of experiments for about 40 years. It was not until the 1960s that attention to xenotransplantation increased once more as immunosuppression was utilized. In 1963 to 1964, Keith Reemtsma transplanted chimpanzee kidneys to humans. However, most of the transplants failed within 4 to 8 weeks, either from rejection or infection. One of the patients did live for only 9 months, until the patient collapsed and died (Cooper et al., 2015). Meanwhile, in 1965, James Hardy performed the first heart transplant involving a chimpanzee and a human. The operation was initially supposed to be human-to-human; however, due to issues surrounding the time of death of the human donor, the heart of a chimpanzee was utilized, and the procedure turned into a xenotransplant. Here, the heart beat for 90 minutes before it stopped (The University of Mississippi Medical Center, 2025). Come October of 1984, what can be regarded as the most famous case of xenotransplantation took place when Leonard Bailey transplanted an orthotopic baboon heart to a 12-day-old infant born with hypoplastic left heart syndrome (the left part of the heart is greatly underdeveloped). The operation was successful; however, the baby passed away after 20 days due to graft rejection.

Further trial and error led to scientists understanding that improvements in immunosuppression were inadequate, and that something else must be fixed in the system in

order for xenotransplantation to work better. As such, clinical testers turned their attention towards using pig organs, and the increasing number of experiments using these organs made it clear how NHPs were not sustainable sources for organs. As years passed, scientists also started having a better understanding of the underlying molecular network between immune systems (innate and adaptive), complement system, coagulation dysfunction, inflammatory response, and others. This led to the development in 1992, wherein the first genetically modified pig, Astrid, was born. Astrid was modified with what is called the hDAF, or human decay-accelerating factor, which is a protein to inhibit complement activation in humans. Finally, xenotransplantation once again sparked conversation in 2022, when a man named David Bennett Sr. received a genetically modified pig's heart. The procedure was labeled as a "success" as Bennett was able to function well post-surgery. Unfortunately, he died 2 months later, reportedly due to several overlapping factors. Such factors include his poor state of health prior to the operation that made him severely immunocompromised, resulting in limited use of effective anti-rejection regimen used in preclinical studies for xenotransplantation. Furthermore, the utilization of intravenous immunoglobulin, an antibody-containing drug, may have contributed to damage to his heart muscle cells, as such antibodies were discovered to have targeted the pig's heart vascular endothelium layer (Kotz, 2023).

Today, pigs are more preferred to serve as donors for xenotransplantation. Even though NHPs are closer to humans in terms of anatomy, physiology, and immunology, pigs are used as donor organ species for several reasons, including their shorter reproductive maturity, shorter growth time to maturity, and better size matches for humans. Pigs now would appear to bring "unlimited supply of donor organs," which would resolve the issue of human organ shortage. However, native pig organs are, at their core, incompatible with the immune systems of humans,

which mount a hyperacute rejection response. On the upside, recent technology can now manipulate the genes of the animal in order to better match the organ to human anatomy. The ability to genetically alter pigs has also become more efficient due to the increasing technological advancements over the last couple of decades.

III. ANALYZING XENOTRANSPLANTATION

A. XENOTRANSPLANTATION, BENEFICENCE, AND NON-MALEFICENCE

It cannot be denied that such a procedure shows immense medical progress, and it *may* serve as the solution we need to the issue at hand. However, it is imperative that a thorough analysis of xenotransplantation be done in order to arrive at a definitive position as to whether it is ethically acceptable, and whether we can wholly settle on it being the solution we shall take on. Now, further examination of xenotransplantation may reveal that the procedure can fulfill two of the four principles central to bioethics.

Rooting from the Belmont Report of 1978, commissioned by the United States of America government to establish ethical principles for research, Philosophers Tom Beauchamp and James Childress developed the concept of Principlism, which is centered on four prima-facie moral principles, respect for autonomy, beneficence, non-maleficence, and justice, that are to be utilized in order to address various ethical concerns. Here, it is beneficence and non-maleficence that could be fulfilled by xenotransplantation.

Beneficence refers to the principle that places emphasis on doing actions that benefit others and focuses on the maximization of benefits and the minimization of harms. Meanwhile, non-maleficence is the obligation not to inflict any harm; it is related to the prevention of further injury or the reduction of risk (Beauchamp, 2010).

Now, xenotransplantation can fulfill beneficence, as it can actively promote good in the lives of patients or those in need of viable organs; it can preserve the lives of many individuals. As shown in the instances plotted in the history of the procedure, we can see how this form of transplantation is capable of providing patients additional time (i.e., months or years) to live, and this additional time can allow the patients to fulfill their goals and other future plans that they may have. Furthermore, xenotransplantation can also improve the quality of life of the patient; patients who have been unable to live “normally” due to being physically restrained as a result of their sickness could now be able to function better, return to their original way of living, and also may view life as worth living again. This is evident in a physiological observation of the post-pig kidney xenotransplantation status of one individual. According to the study, over a 51-day follow-up, key renal functions were exhibited, including waste clearance, electrolyte, volume, and blood pressure regulation, allowing for the maintenance of physiological homeostasis (Lee et al., 2025).

On the other hand, xenotransplantation may fulfill non-maleficence, but in a more *conditional* way. It can be argued that xenotransplantation may fulfill non-maleficence in the sense that the procedure can reduce and even eliminate the harm that the patient is already experiencing, including the pain, organ failure, and deterioration, by replacing the failing organ with a new one. In addition, the genetic modifications being included in the process of xenotransplantation can now allow for the prevention of organ rejection, as well as the minimization of certain immediate harms, such as thrombosis, which was one of the pressing issues present during the earlier trials. However, it is important to emphasize that amidst all of these, it can still be said that xenotransplantation may also go against the principle of non-maleficence. One reason is that, even though thrombosis is ruled out, the chances of the

human recipient contracting zoonotic infections or pathogens remain. This transmission of zoonotic pathogens has produced a number of diseases in the past, including Ebola virus and influenza (bird flu and swine flu). There are also endogenous retroviruses carried by pigs that can be passed on to humans and make them very sick, although not harming the pigs themselves. According to Sade and Mukherjee (2022), although the chances that such a procedure may result in a novel virus leading to an epidemic have been reduced by today's technological developments, the prospect still exists.

B. XENOTRANSPLANTATION AND THE STATE OF ANIMALS

Aside from the case of non-maleficence, there is also the case of the states of the pigs that are used, which may impact the way we deem xenotransplantation as acceptable or not.

There are important points that can be noted in examining this angle. First is the question of whether the pigs may feel harm and pain through xenotransplantation. Here, various factors make us inclined to say that the pigs do feel such things. One factor is how the pigs—that are expected to serve as organ donors—live. These animals, once again, are placed in a very specific environment in order to be considered as acceptable donors. The pigs' living conditions, how they are housed or raised, are rather peculiar; these pigs are not traditionally kept in what could be considered as their natural habitat. Essentially, pigs are supposed to be free to roam around on pasture, and they must have structures such as barns to shelter them when necessary. However, instead of this happening, the pigs are kept under surveillance in closed environments (confined in laboratories). With this, it is to be noted that although they are kept healthy or fit enough for tests and transplantation, and are maintained in sterile conditions, such a living set-up remains deficient in allowing the animal to act on or live by their biological and psychological natures

and interests, and this deprivation can consequently bring suffering. It can also be regarded that such conditions fail to meet, and also violate, the very modest threshold introduced by philosopher Bernard Rollin that is connected to the minimum moral standing of animals—or basic level of moral protection—wherein animals must be permitted to exist in conditions that let them wholly express at least some of their species-specific behaviors (Rollin, 2010).

It is also noteworthy to add that these pigs used in xenotransplantation are not solely kept in such environments, but are also bred, cloned, and genetically modified. With this, concerns about the animals' instrumentalization arise; this practice appears to treat animals as merely containers for human organs or farms where humans may freely harvest whichever organs they need, and such treatment is wrong. This idea also aligns with the views of Christine Korsgaard, an American philosopher, who states that treating animals merely as means to an end or as instruments for humans is unacceptable (Korsgaard, 2018).

Aside from this, we may also shift our attention to the experiences of the animals in question during the clinical trials and processes of genetic modification. It is important to determine whether the pigs feel pain or discomfort during these events as well, given that clinical trials are ongoing—as xenotransplantation is still a developing procedure—and because of this, these animals continue to be subjected to experiments. According to Rodger et al. (2024), the process of xenotransplantation research can cause these pigs to feel pain, and have very short life expectancies. It has been said that animals suffer significantly during xenotransplantation research, as well as attain trauma from the process, pushing researchers to even consider genetic disenchantment to diminish the suffering from the research; however, such disenchantment has yet to be successfully formulated and become totally effective.

In addition to what has been stated, what makes things more serious is the number of pigs undergoing such negative experiences, compared to the number of lives actually saved. Tens of thousands of pigs undergo trials for researchers to procure the needed organs for certain human beings. It is also not guaranteed that only one pig is assigned for one organ recipient, and in this case, it seems like the number of pigs utilized for the procedure—starting from trials to the main procedure of harvesting organs, and thus, feeling pain—is more than the number of people who are saved from the act at the end. Here, it appears that the suffering of the animals (in this scenario, the pigs) outweighs all the benefits garnered by the human individual. Various thinkers may share the same idea, with one of them being Peter Singer, as he pushes for the equal consideration of all sentient beings. Applying this idea to the topic at hand, it can be said that it is also important to take into account the interests of the pigs involved in xenotransplantation, and not only the interests of the human beings in need of viable organs. Singer may also view that since the scale of the suffering of the animals might be so great that it overpowers human benefits, then xenotransplantation is ethically unjustifiable (Singer, 2023).

IV. CONCLUSION

With everything that has been stated regarding xenotransplantation, from its potential violation of the principle of non-maleficence to the negative impacts it brings to animals, it appears that xenotransplantation carries different serious ethical problems that require attention. Because of this, it is important that we explore other ways in order to address the worldwide organ shortage problem and not decide that xenotransplantation would serve as our final solution. Such alternatives may include the development of bioengineered organs and tissues (patient-derived cells, without any animals involved) and the improvement of organ preservation processes so as

to keep organs viable for a longer period of time, and so it would be better for long-distance sharing. Additionally, it is also important that government institutions around the world contribute to solving the issue, as well as prevent the issue from worsening or happening in the first place. Governments may invest in better health programs in order to minimize the number of citizens who become in need of new organs, and the government may also work to successfully combat illegal organ trafficking.

With the advancement of technology, as well as the increasing commitment to healthcare, addressing the worldwide organ shortage problem—without using animals, while respecting not only the lives of human beings but also non-human animals—does not appear to be impossible, especially if every sector of each country strives to reach for the solution.

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