Implications of Extracorporeal Support

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The goal of the medical profession is to save as many lives as possible. As technology and research advance, doctors are becoming more capable of saving lives that they would earlier have not been able to save. More specifically, in regard to prenatal care, developers hope to create a technology that will allow premature babies to be placed in a womb-like device sometime in the next five to ten years (Cookson, 2017). Extracorporeal support, otherwise known as an artificial womb, is relatively new to medical development. Extracorporeal support would offer health benefits for both the mother and baby. Coupled with the benefits there are, of course, ethical and legal concerns that arise. The benefits and drawbacks will need to be extensively evaluated to find the proper balance between right and wrong. To use the technology effectively, guidelines need to be put in place so that extracorporeal support is only used when necessary.

Throughout the first month of life, the leading cause of death of newborn babies is premature birth (Partridge, Davey, Hornick, & Flake, 2017). Babies that are born prematurely are at a greater risk of developing infections and diseases because their organs have had less time to fully develop with the needed nutrients provided in the placenta. In hopes of giving the newborn more time to grow and develop, they are placed in an incubator that protects the baby from foreign bacteria. However, the incubator cannot provide the newborns with the same nutrients that would be provided from the mother's womb, as it would if the baby had been born at full-term. Doctors are currently working alongside engineers to develop a technology that will supply the premature newborn with the necessary nutrients to develop their organs and immune system completely. This technology is intended to accurately replicate the mother's womb.

Extracorporeal support of babies has yet to be fully developed. However, developers hope to have a testable prototype within the next five years (Cookson, 2017). Many researchers believe that artificial wombs are a revolutionary advancement regarding complications during pregnancy. Current technology allows a baby to be conceived outside the body with invitro fertilization and be born within an artificial endometrium. By interacting epithelial and stromal cells on matrigel supports, one scientist, Hung-Ching Liu, was able to create a working artificial endometrium (Bulletti et al., 2011). However, Liu's breakthrough, in the field of reproduction, presented a new issue associated with premature babies who are born with medical defects.

One option, if a woman and a man are not able to conceive naturally, is to attempt invitro fertilization (IVF) as previously mentioned. IVF is a process by which medical doctors retrieve eggs from the woman and obtain a sperm sample from the male, and then the egg

and sperm are manually introduced in the lab, resulting in an embryo. After fertilization, the embryo is transferred back into the uterus ("In Vitro Fertilization (IVF): Side Effects and Risks", 2017). Invitro fertilization provides potential parents with an alternative route to conceiving when natural conception is not an option. To help the babies that were conceived naturally, researchers attempted to simulate the mother's womb outside the body, so that the fetus would have more time to develop. After years of development, devices were introduced that would improve respiratory issues on premature newborns so, the development of artificial wombs was put on the back-burner. However, liquid ventilation was attempted in later years, for premature newborns with no chance of survival, and the results led researchers to believe that a technology, like extracorporeal support, is important and in reach (Bulleti et al., 2017).

The goal of an artificial womb is to provide the fetus with the essential nutrients for the baby to develop, if they cannot receive it any other way. The fetus receives nutrients from the mother through the amniotic fluid and the umbilical cord. In the current prototype that is used by lambs, the amniotic fluid is replicated with a similar liquid and placed into a container, and after the birth, the lamb was then placed into the container with its umbilical cord connected to an artificial placenta. The artificial placenta filters out toxins and provides nutrition much like in a real womb. Unfortunately, most lambs in the study did not survive, and the ones that did, had lung issues and other health defects. However, the test provided valuable information needed to improve the technology.

Later, Liu returned to join in the development of the technology with a few of her collaborators. This time, they attempted to develop a formula that would be an exact match to the amniotic fluid, and that it would adjust to the needs of the fetus throughout the pregnancy. However, they found that it was nearly impossible (Reynolds, 2005). It is important that the fluid adjusts to the need of the fetus, otherwise the fetus could potentially receive excessive nutrients in one area and receive too little or none in another. The lack of protein and nutrition in a given area of the body could lead to deformations or other physical and mental defects. It is crucial that the fluid being developed to be used in the artificial womb is very similar, if not the same, as the amniotic fluid in the womb of the mothers. If it is not, the fetus might not react appropriately to the change and could cause infection, permanent damage or even death. The problem with medical research pertaining to humans, is that we can never really know how it effects human bodies until we are able to test human subjects. For instance, Liu's study used mice as test subjects and assumed that the results could be directly correlated to how a human fetus might process the changes. However, this is usually inaccurate and causes complications because human bodies process changes in environment in ways very different from other animals (Reynolds, 2005).

Although the technology is not yet available, there is major debate over whether or not artificial wombs are ethical to the field of science, as well as to the development of

fetuses. The goal of the technology is to give the organs of premature babies' extra nutrients to help develop their organs (Cookson, 2017). Currently, babies are placed in incubators, but the nutrients that the mother's placenta supplied is cut off after the birth. The artificial womb could also remove the strain on the mother if she has underlying medical problems (Bulletti et al, 2011). However, mothers and babies are not the only ones benefiting from this technology: the parental right of the fetus also come into discussion. As of now, woman typically have a greater say in matters regarding the fetus, because she is the one carrying it. With artificial wombs, the baby could survive without the mother, giving equal rights to both the mother and the father over the fetus (Cohen, 2017). This debate leads into the question of when the fetus is considered to be alive and aligns very closely to the parents' rights to abort the pregnancy. As the technology develops, people will join the discussion, because the ethical implications of a technology to this magnitude, could completely change the way we view childbirth.

One of the most controversial topics of this technology is if it is ethical for doctors and researchers to test it on human fetuses. Dena Davis, a bioethicist at Lehigh University argues, "If it's a difference between a newborn dying rather peacefully and a newborn dying under conditions of great stress and discomfort then, no, I don't think it's better" (Stein, 2017). She argues that placing the fetus into an artificial womb would be very stressful, painful and confusing for the fetus; if it could even handle the transition in the first place. She suggests that researchers should not be allowed to test the technology because of the impact it could have on the baby and its sympathetic nervous system. When a baby is born, the contractions and the pressure exerted from the narrow birth canal creates a lot of stress on the baby (Appleton, 2017). Reintroducing the baby into the environment that it felt safe in, after the stress of birth, would confuse the child and create an even greater stress on its system. In *The Journal of Prenatal and Perinatal Psychology and Health*, Matthew Appleton explains how, if a baby's pain is not considered by a caregiver it can create frustration. That is what is occurring in this situation, especially when a baby is immediately taken away from the mother or father (Appleton, 2017). Additionally, reintroducing the baby into the womb would cause pain in the body, specifically the lungs. Fetuses receive their oxygen through oxygenated blood in its mother placenta. After the babies are born, they receive oxygen from the air. The baby's body may not be able to adjust to the difference in how it is receiving its oxygen after removal from the artificial womb, which could lead to respiratory problems within the fetus.

The parental rights of the unborn fetus are often questioned in the abortion debate, but the availability of extracorporeal support could potentially change the court's opinion in favor of the father. The Supreme Court ruled in the Missouri v. Danforth case that if the mother and father disagree on the abortion, the mother's opinion is the one that takes precedence because her body is being directly affected by the pregnancy. However, if extracorporeal support is available to all, the court could allow the pregnancy to be transferred into the artificial womb

if the father objects to the abortion (Cohen, 2017). This means that if the mother is for the abortion, but the father wants to continue the pregnancy, the courts could force the mother to place the fetus in an artificial womb in order to allow the father to raise the child without the mother. The abortion debate itself is widely debated, along with when a fetus is considered to be alive, and with extracorporeal support, a fetus will be able to survive at a smaller gestation period. This could lower the time at which a fetus is considered to be alive and then abortion would no longer be an option. If the amount of time that abortion is considered legal, the parents are forced to decide quicker, and this could lead to regretful decisions. But all of this is only applicable if the technology is available to all.

If and when the technology exists, the question will rise: who should be able to use it and at what cost? Roughly 360,000 babies are born every day, and if everyone is placed in an artificial womb for two months, there will have to be 22 million artificial wombs to accommodate all the babies ("Birth & Death Rates," n.d.). As you can see, it is not practical or economical to have millions of artificial wombs operating at once, let alone accommodate each and every fetus individually. So, who would decide which fetuses get to use the technology and which ones should stay inside the womb of their mothers? Not every fetus is going to thrive under the conditions provided in an artificial womb, so some may not even be good candidates for using the technology, and some may simply not need the extra support which would also make them a less-than-ideal candidate for using artificial wombs.

Another concern of extracorporeal support being readily available is that women might use this technology for their appearance or personal gain. For example, a woman might use this technology, so they do not have to worry about the dreaded inevitable side effects of pregnancy, such as stretch marks or weight gain. In some careers pregnancy could result in job loss, or prevent career growth. For example, in Hollywood, if you are an actress, being pregnant could keep you from getting a role for a couple of months as your body physically returns to normal. Some women also may not be keen to the idea of taking care of a newborn while their body is still recovering. With an artificial womb, they would be able to have the baby, without carrying it long enough to contract stretch marks, and have time to physically and mentally recover before having to care for a fragile new life. With all that being said, there would have to be certain parameters in place that would restrict situations in which a fetus is only placed in an artificial womb so that the parents do not have to bear the weight and responsibility of a pregnancy.

Although the legality and ethical issues arise with the technology, it is capable of saving thousands of babies and the mothers as well. Roughly 25% of babies that are miscarried in the second or third trimester are due to an issue with the mother's cervix, which is known as incompetent cervix. An incompetent cervix occurs when the cervix begins to dilate due to the added pressure on the cervix from the fetus. The mother is typically not diagnosed with this problem until after a second or third trimester miscarriage because it is not routinely

tested for ("Incompetent Cervix: Weakened Cervix", 2015). If diagnosed early, the mother has the option to undergo surgery and have her cervix closed with stitches and later removed when the due date approaches ("Incompetent Cervix: Weakened Cervix", 2015"). The problem, however is that going under anesthesia while pregnant is very dangerous for both the fetus and the mother. Furthermore, the mother is put at risk of contracting an infection while being operated on, and that infection could then travel in to the womb and affect the baby. With extracorporeal support, instead of going under anesthesia twice, upon diagnosis, the mother could elect to have the fetus placed inside an artificial womb. The mother would then not have to worry about adding stress to the baby while going under anesthesia, nor would she have to worry about miscarrying the baby due to an incompetent cervix. As the technology is further developed and advanced, it is likely that supporting a fetus extracorporeally will be far safer than putting the mother and the fetus both under anesthesia risking infection and other complications.

Another advantage to using artificial wombs to help develop premature babies is that it will use less resources. When a newborn is placed in an incubator or receives support in another way, they are hooked up to countless machines to keep them alive. For example, if a baby is placed in an incubator to develop their lungs they are usually connected to a respirator, a monitor that tracks their vitals, and a machine that provides intravenous (IV) fluids and medication. Since the artificial womb is an extension of the mother's womb, the fetus won't receive anything other than the nutrients provided from inside the fluid. That is to say that the fetus will also not require as much one on one care from doctors, because the effects from the extracorporeal support are relatively harmless. Doctors and nurses will still need to monitor the progress of the fetus, but at far less lengths than they are currently going to with incubators and the current technology.

As the artificial wombs begin to develop and enter the medical field, doctors and ethicists will need to come up with a compromise to use this technology safely and beneficially. It is clear that the legal implications of a technology of this magnitude will be outstanding, but the capability to save lives is also evident. To effectively use a technology like this, doctors need to establish how many premature newborns are in need of it, and how many they can afford to care for over a specific time. From there legal professionals can determine if it is feasible to place a fetus in an artificial womb when they have no physical needs, so that an abortion and parental rights debate can be avoided. For instance, if a hospital can only care for one to three babies that are receiving extracorporeal support, then it does not make sense to make the technology available to parents for personal reasons. Additionally, if only three babies at a time get to utilize the technology, doctors must establish a criterion that fetuses must meet to receive the extracorporeal support. Overall, this is a technology that is important to advancements in the medical field and for saving babies that would not otherwise have a chance. However, to avoid ruining the purpose of the technology, it needs to have the sole purpose of saving lives. Peharps, in a couple of decades the technology

might be better developed and more readily available and all mothers and fathers may have access.

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