Health Inequalities and Inequities and the Relation to Amputations and Prosthetic Devices

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Introduction

Millions of people do not have access to basic necessities in the United States. Food, shelter, education, and health care are a few examples. Access is not the only issue within health care that prevents people from living a healthy lifestyle. According to the World Health Organization, "health is the state of complete physical, mental, and social well-being and not just the absence of disease" (World Health Organization, 2021). This organization also states that the health of all people is necessary to achieve peace and security of the nation (World Health Organization, 2021). Key factors that need to be reformed to improve an individual's health are access, quality, and cost. Many minoritized groups do not have these key health care qualities leading to health inequality and inequity. Health inequalities are deeply rooted in the history of the United States and can be traced back to the Jim Crow era. These health inequalities are still prominent today and can be seen among amputees and those trying to obtain a prosthetic device. Many in the United States do not believe in this health gap; however, it is a crucial issue.

Imagine an elderly individual living on the third floor of a New York City apartment. Since there is no elevator, the older gentleman must take the stairs daily which equates to at least 40 steps one way. For an elderly man, this task seems very difficult. Now imagine this man had an amputation. Luckily, he was able to afford a prosthetic device to help him with his daily life activities. However, these devices have extremely high costs. Since this man is retired, he does not have a fixed income to help support this additional cost. Therefore, he must use some of his savings. Being retired also means that this man no longer has insurance from his employer and must rely on government funded insurance programs to help cover the cost. These additional costs and stressors led to a negative quality of life for the elderly man. The events seen in this scenario are not uncommon among many people across the United States. Amputations and the

use of prosthetic devices impact minoritized groups differently because of inequality and inequity in healthcare.

The Challenges of Healthcare Inequity

People all over the world face inequality and inequity in healthcare. To understand how this relates to amputations and the ability to obtain a prosthetic device, it is important to recognize the underlying challenges. Inequality is being unequal regarding status, privileges, and opportunities (Afonso et al., 2015). This happens when individuals do not have similar living environments and levels of wealth (Afonso et al., 2015). These inequalities can lead to gaps in education, nutrition, and income (Afonso et al., 2015). Health inequality is also shown in the health of the aging population. These changes are typically not avoidance but occur naturally as an individual ages.

Health inequities refers to the "difference in opportunities groups have to achieve optimal health which leads to unfair differences in health outcomes" (National Academies of Sciences et al., 2017). Inequities have a social and economic impact on both the individual and society. These social conditions affect where an individual is born, grows up, attends school, lives, works, and ages (World Health Organization, 2018). Health inequities could be avoided with intervention from the community. These health inequities are largely seen between wealthy and poor nations. Maternal mortality is an important example. Third-world nations have very high maternal mortality rates and account for 99% of the annual maternal deaths in the world (World Health Organization, 2018). In Chad, women have a risk of maternal death of 1 in 16; however, in Sweden, women have a risk of less than 1 in 10,000 (World Health Organization, 2018). This shows that ethnicity is a large of component health inequity. With an increase in technology, women should not die during childbirth because of their geographical location.

These health inequities also negatively impact children. According to the World Health Organization, 16,000 children die before their fifth birthday every day (World Health Organization, 2018). These children die from pneumonia, malaria, and many other diseases (World Health Organization, 2018). Children in poorer and rural areas are unfairly affected compared to children from rich households. Those children from the poorest 20% of households are twice as likely to die before their fifth birthday than those in the richest 20% of children (World Health Organization, 2018). Access to healthcare and the income level of their parents are two reasons why children are among those who face inequity.

While inequality and inequity seem very similar, there is a slight difference. Inequality is the uneven distribution of essential resources. Inequity refers to the unfair treatment of minoritized people that can be avoided through early intervention and reform. Health inequalities and inequities play a large part in the history of healthcare in the United States leading to health disparities still present in society. These two concepts are still present between different races. Before the 1950s, a majority of the United States population gave little regard to people unless they were heterosexual, white men. This left women and those of different ethnicities and sexual orientations to suffer and be viewed as less equal. During this era, slavery and segregation were major barriers for African Americans (National Academies of Sciences et al., 2017). This resulted in many injustices and prejudices.

Before essential reforms, the African American community suffered injustice during the Tuskegee Syphilis Study in 1932. This study involved 600 African American men, 399 of which had syphilis (Centers for Disease Control and Prevention, n.d.). The men were informed they were being treated, without any cost, for “bad blood” (Centers for Disease Control and Prevention, n.d.). However, these men were not receiving any treatment for syphilis. Instead,

the doctors observed how the disease took over these men's bodies and spread to their wives and children (Centers for Disease Control and Prevention, n.d.). This is extremely unethical. By 1943, researchers learned penicillin was the best way to treat syphilis; however, African American men were not offered the treatment (Centers for Disease Control and Prevention, n.d.). The Tuskegee Syphilis Study of 1932 is just one example of health inequalities and inequities. However, the study has led to a lack of trust between minoritized patients, and their providers still seen today. Without trust, the patient is not getting the best care possible. This creates a further divide increasing the risk of health inequality and inequity.

In the 1960s, many additional reforms occurred through legislation. The Americans with Disabilities Act ended legal discrimination against those with a disability. This was accomplished through increasing access to important government programs, transportation, employment, and accommodation opportunities. The Civil Rights Act of 1964 was a turning point for African Americans. This act prohibited discrimination based on race, color, religion, gender, and ethnicity. Minoritized children benefited because schools worked to desegregate. Children now had an increase in opportunities by gaining access to many resources such as a better education.

Unfortunately, health inequalities and inequities are still present in healthcare today. For example, African American women are more likely to give birth to a low weight baby and have higher rates of infant mortality (National Academies of Sciences et al., 2017). This is partially due to quality of care and health inequities. During the Coronavirus pandemic, these health inequalities became very apparent across the nation. As of April 19, 2022, there have been over 80,526,422 cases of COVID-19 in the United States (Centers for Disease Control and Prevention, 2021B). In the United States, the number of individuals who test positive for

Coronavirus continues to rise daily. Additionally, as of April 19, 2022, there have been over 986,545 deaths from COVID-19 in the United States since the pandemic began (Centers for Disease Control and Prevention, 2021B). These infection and death rates disproportionately affect minoritized people more than the majority population. In the United States, African Americans represent 13% of the population; however, they makeup over 30% of those who tested positive for COVID-19 and are two times as likely to die from this virus (Poteat et al., 2020). No person should be at an increased risk for a disease as a result of their ethnicity.

The Problems of Amputations in an Unequal System

The challenges seen among minoritized groups are still seen in the healthcare setting, especially among those who have had an amputation. Many people of diverse backgrounds and different ages are affected by amputations. According to Shores (n.d.), an amputation is the "loss or removal of a body part such as a finger, toe, hand, foot, arm, or leg." Having an amputation is a life changing event that can affect an individual's ability to move, work, be independent, and continue in daily activities (Shores, n.d.). It is estimated that there are currently 2.1 million people living with limb loss in the United States (Amputee Coalition, n.d.). In addition, 185,000 Americans have an amputation each year which means that about 507 people lose a limb each (Bush & Girijala, 2018). These statistics show how amputations affect a large portion of people in the United States. It is estimated that about 69% of amputees are men and 46% of amputations are of people aged between 45 and 64 (Amputee Coalition, n.d.).

Many presume that amputations are largely seen across those who have served in the military; however, this is an incorrect presumption. There are five main causes of amputations: trauma, vascular disease, cancer, severe infection, and congenital cause (Shores, n.d.). A traumatic amputation happens because of an automobile accident, occupation, or another serious

injury. These types of amputations occur if a limb was torn off in a severe accident or it was injured so badly that it cannot be saved (Shores, n.d.). Roughly, 45% of amputations are caused by trauma (Amputee Coalition, n.d.). Approximately 1,558 military personnel lost a limb during the Iraq and Afghanistan wars (Amputee Coalition, n.d.). Soldiers compose a small portion of the amputee population. Vascular disease and diabetes are another large cause for amputations. Vascular disease affects blood flow and can lead to the death of tissue in feet and legs (Shores, n.d.). About 54% of amputations are caused by vascular disease (Amputee Coalition, n.d.). Unfortunately, almost half the patients who undergo this type of amputation will die within five years (Shores, n.d.). The third type of amputation is caused by cancer. As certain types of cancer spread it might be the best course of action to save a patient's life (Shores, n.d.). It is estimated that 2% of amputations are cancer related. Some amputations are needed because of severe infection. For example, septicemia is a severe type of sepsis which is similar to blood poisoning (Shores, n.d.). These types of infections tend to be antibiotic resistant, so it is hard to control the infection thus resulting in an amputation. The last cause, congenital amputation, is not a procedure but a birth defect. An individual might be missing or have an incompletely formed limb that is presented at birth (Shores, n.d.).

There are many different types of amputations performed on lower and upper extremities. A team of orthopedic, plastic, and reconstructive surgeons along with nurses and surgical technologists work interdisciplinary to ensure the best outcome for the patient. As a team, they work together to remove the damaged limb and use the remaining bone and soft tissue to shape the stump (Shores, n.d.). The team attempts to shape the stump so the patient can obtain a prosthetic device if they wish. The type of surgical approach depends on the affected body part and the damage done. Amputations are very complex surgeries because a surgeon works with

the skin, tendons, blood vessels, muscles, bone, and nerves. They attempt to ensure the use of fine motor skills and of the remaining part of the limb (Shores, n.d.).

About 35% of amputations occur on upper extremities (Amputee Coalition, n.d.). A few types of upper extremity amputations are wrist disarticulation, below-the-elbow amputation, and shoulder disarticulation. According to the Amputee Coalition (n.d.), 65% of amputations are on the lower extremities. Ankle disarticulation, below-the-knee amputation, and hemipelvectomy are a few types of lower extremity amputations. Often after an individual has an amputation, they are in continual pain making recovery difficult. Amputations not only affect an individual's physical health but also their mental health. About 36% of people living with limb loss experience depression (Amputee Coalition, n.d.). Patients suffer with the reality of the physical change their body underwent and how their life will forever be different.

Health inequity and disparities disproportionately impact minoritized groups differently than the majority population. There have been several studies to examine how race impacts amputation rates. African Americans are four times more likely to have an amputation when compared to white Americans (Amputee Coalition, n.d.). When further examining these rates, the African American population represents 25.1% of the amputee population while the white population is 12.6% of the amputee population (Bush & Girijala, 2018). As only representing 13% of the population, African Americans make up a large majority of the amputation population. Geographic location is not a key factor in these rates (Bush & Girijala, 2018). Per 10,000 patients, 5.0 to 6.5 are African American while 1.2 to 2.5 are of the white population (Bush & Girijala, 2018). In addition, the African American race is associated with a higher rate of risk factors (Bush & Girijala, 2018). This means they are more likely to develop a negative health outcome like an infection. High risk factors are connected to a lower quality of care even

when in treatment facilities. This race is not only more likely to get an amputation but also more likely to have an extreme amputation. African Americans have a higher rate of above-the-knee amputations compared to white people (Bush & Girijala, 2018). More extreme measures are taken with the health of African Americans even if it is not necessary.

Bush and Girijala (2018) described a study in which 111,548 individuals underwent an amputation. Of this group, 61% were white while 25.4% were African American. As a result, 240,139 patients suffered from limb ischemia, a blockage of an artery, 62.8% were white and 19.5% were African American (Bush & Girijala, 2018). This means that slightly less than one in five patients suffering from limb ischemia are African American compared to the over one in four African Americans who have an amputation (Bush & Girijala, 2018). African Americans only make up 13% of the general population, but 19% of a large group of ischemia cases. The health inequality and inequity are further present in the fact that African Americans represent 25% of the amputation population. These numbers show that African Americans are trending toward limb disease and amputations at a disproportionate rate. This suggests that African Americans lack adequate health care and other resources to avoid amputations. As a minority group, why does this ethnic group exemplify a large portion of those needing an amputation?

These inequities are also seen in the elderly population. African Americans over the age of 85 are 11.7 times more likely to have an amputation because of vascular causes than younger patients (Bush & Girijala, 2018). Health inequality embodies the different levels of care that the aging population receives. Even through these understandable age-related medical reasons for the higher risk of amputation for elder African Americans, there are holes in the safety net of prevention and care for elderly Americans. This is seen especially compared to countries with universal health coverage and these holes are likely exacerbated for minoritized populations.

Advances in Prosthetics

A prosthetic device, also known as a prosthesis, replaces a missing limb to help restore function and mobility to an individual who survived an amputation (Uustal, 2020). According to Uustal (2020), between 60% to 70% of amputees used prosthetic devices in the United States. This type of device is beneficial because it helps an individual complete their daily tasks and significantly improves their quality of life (Uustal, 2020). This not only helps amputees physically but also emotionally. These individuals will be able to feel more whole and independent (Uustal, 2020). Given these benefits of prosthetics, patients who can benefit from them will want access to them. Improvements in prosthetics over the centuries make them all the more appealing, and in fact, necessary in the modern world.

Prosthetic devices have been in use for centuries in different countries. Ancient prosthetic toes, legs, and noses have even been discovered. Although they look slightly different, they have relatively the same function. The earliest known prosthesis was a fake toe which belonged to an Egyptian woman. This toe was found on a mummy dating back to between 950 and 710 B.C.E. (Bender, 2015). During this time, many Egyptians wore a traditional sandal, so a big toe was very important (Bender, 2015). This big toe was wooden with attachment straps to be comfortable to wear (MacDonald, 2017). The craftsman even constructed the toe in a way so it could flex (MacDonald, 2017).

Throughout the early fifteen hundreds, Doctor Ambroise Paré made many medical advancements and designed a hinged prosthetic hand and a leg with a locking knee (Bender, 2015). Many of these techniques he discovered for attaching limbs are still used today. Advancements in amputation surgery developed during the mid 1800s which allowed doctors to better shape the remaining stump in a way that it would better fit the prosthetic device (Bender,

2015). This betters the life of the individual who was wearing a prosthetic device more comfortable. In 1946, scientists at UC Berkeley designed a suction sock for lower-limb amputees (Bender, 2015). This design created additional comfort to the patient and the technology is still in use today.

Ysidro Martinez made a huge impact on lower-limb prosthesis devices in the 1970s. Martinez developed a prosthetic that improved a person's ability to walk and reduced friction (Bender, 2015). This was different from past prosthetic devices because he did not try to replicate the range of motion of a natural limb; instead, Martinez worked by relieving pressure (Bender, 2015). All these innovations have helped shape the future of prosthetic devices.

Improvements, functionally and aesthetically, are being made to better the lives for amputees. Carbon fiber and 3D printing are being used in the design of prosthetics. This allows the device to be lighter and stronger (Bender, 2015). Many doctors and researchers believe that prosthetic devices are not only about basic daily function but also give the patient a sense of completeness (Bender, 2015). It is important to keep up an amputee's confidence because many often become depressed. An organization, UNYQ, uses 3D technology to create protective prosthetic covers with many different designs (Bender, 2015). This opinion empowers amputees by enabling them to design what they like best, how they want to express themselves, and what makes them feel most wholesome.

There are many types of prosthetic devices used for different purposes. According to Uustal (2020), "there are over 200 different prosthetic feet and 75 different prosthetic knees." This wide variety is because they differ in complexity to allow the user to perform different functions (Uustal, 2020). Many prosthetics are designed for a dynamic response. This means they are made from carbon fiber or fiberglass which allows the device to bend and conform

under the user's weight (Uustal, 2020). The dynamic response helps to push the user forward (Uustal, 2020).

Different prosthetics are designed to perform many unique movements. For example, prosthetic devices with foot and ankle movements, designed for a below the knee amputation, have several different designs. One model has a fixed foot in a position (Uustal, 2020). On the other hand, many high-performance prosthetics are made of carbon fiber to allow for running and even jumping (Uustal, 2020). Another example includes a knee joint created for amputees who have had an amputation above the knee. A simple lock-knee prosthetic device can be locked for standing and walking then the user can unlock it for sitting (Uustal, 2020). Another knee prosthetic mechanism involves computer controlled hydraulic pistons that can sense movement (Uustal, 2020). This allows for the most natural type of walking. Yet all these wonderful advancements in prosthetics come at a cost.

Moving Forward: Prevention and Equal Access

The combined cost of an amputation and prosthetic device can be very challenging for any family, especially those of the minoritized population. According to the Amputee Coalition (n.d.), the average lifetime cost of healthcare for individuals with limb loss is estimated to be $509,275; however, when compared to individuals without limb loss is estimated to be $361,2000. In the 2007 Inter-Society Consensus for the Management of Peripheral Arterial, the typical cost of an amputation was averaged to be $40,000 (Bush & Girijala, 2018). It was noted that these costs rose to $60,650 after 5 years (Bush & Girijala, 2018). However, these costs only apply to the amputation.

Can you imagine spending between $5,000 and $50,000 every 3 to 5 years? This is a very realistic dilemma for amputees trying to obtain a prosthesis. Prosthetic devices can range in

cost. For example, a new prosthetic leg can cost between $5,000 and $50,000 (Hickenbottom, 2013). Unfortunately, these devices only last three to five years because of daily use (Hickenbottom, 2013). This means the additional cost accumulates over a lifetime and is not just a one-time cost.

With the continuation of modern developments, prosthetics are becoming more expensive putting them out of reach for those with low socioeconomic status and less generous insurance plans. Prosthetic devices are not fully covered by insurance. Federal government programs, such as Medicare, often only cover a portion of the prosthetic device. Medicare is a type of health insurance that assists those who are 65 and older and those who are younger with disabilities. This program does provide coverage for prosthetic devices; however, there are some restrictions. First, the prosthetic device must be used in an individual's home or at a long-term care facility (Ledbetter, 2021). Also, these prostheses must be obtained from a Medicare-approved supplier to receive coverage (Ledbetter, 2021). Lastly, in some states, a prior Medicare authorization may be required for some types of lower limb prosthetics (Ledbetter, 2021). Medicare might pay for a replacement prosthetic if a device is destroyed, lost, or declared unusable (Ledbetter, 2021). Then a Medicare-enrolled supplier will provide a replacement prosthetic device (Ledbetter, 2021).

Medicare only covers about 80% of the cost of a prosthetic device (Ledbetter, 2021). This leaves the patient paying the remaining 20% plus the deductible (Ledbetter, 2021). A deductible is the amount a person must pay out of pocket before the insurance company covers their treatment cost (Ledbetter, 2021). A deductible for Medicare is typically about $200 (Ledbetter, 2021).

Although there are government and nonprofit programs to provide assistance with this cost, minoritized groups still do not have access to these necessary organizations. In the United States, there are 31.2 million people under the age of 65 who lack health insurance (Centers for Disease Control and Prevention, 2021A). This equates to roughly 11.5% of the population (Centers for Disease Control and Prevention, 2021A). African Americans are 1.5 times more likely to be uninsured or not have health insurance (Poteat et al., 2020). Therefore, as part of the minoritized population, African Americans do not have the same level of care. This leaves many minoritized groups lacking health insurance and leaving them without access to quality physicians (Bush & Girijala, 2018). Without continuous care, minoritized groups do not have the same quantity of preventive care. This care is important in early detection of disease or other illness. Without preventative care there is a greater likelihood of serious disease (Bush & Girijala, 2018). When minoritized groups receive care without insurance, they will accumulate high costs in a short amount of time. These costs can be a deterrent if an individual has been diagnosed with an illness and needs continual care. With a lack of money, minoritized groups may not prioritize their health. This means that if a minoritized individual receives an amputation then they might not be able to afford continual care after as well as a prosthetic device. The cost of an amputation is very expensive. An additional cost of a prosthetic device might not be practicable. Unfortunately, this can lead to a lower quality of life for the minoritized amputee population.

There are several steps that need to be taken to prevent amputations and create equal access to prosthetic devices. However, the inequalities and inequities seen in healthcare is not a unique problem among amputees and those attempting to obtain a prosthetic device. Before improvement can occur for amputees, basic healthcare reforms must occur at four different

levels. The individual patient must be better educated about preventive care (Purnell et al., 2016). This will enable a patient to attempt certain measures to prevent illness that might be part of their health history. In order to be successful, the patient must have a support system composed of family, friends and other community members (Purnell et al., 2016). Ongoing support will encourage a patient to keep up with their health regiment. Reform among providers could improve affordability and access to health services (Purnell et al., 2016). Through public policy these changes can become permanent. These collaborative efforts among patients, support systems, healthcare providers, community workers, and other stakeholders can lead to many positive health outcomes. By reducing costs, improving the patient's experience, and avoiding hospital admission through preventative care, patient health outcomes can significantly improve and lower inequalities and inequities in healthcare.

Although not all types of amputations are preventable, over half of them can be avoided with early intervention. According to the Amputee Coalition (n.d.), 54% of amputations are caused by vascular disease. This type of disease is caused when there is a blockage in a person's arteries or veins. Through exercising regularly, eating health, avoiding tobacco products, and reducing stress, an individual is taking a few easy steps to lower their risk of vascular disease (Vascular Cures, n.d.). If a patient is diabetic, it is crucial to control their blood sugar levels (Vascular Cures, n.d.). A significant portion of amputees are diabetic and have undergone a lower limb amputation because of uncontrolled diabetes.

Promoting equal access to prosthetic devices is very important to improve the quality of life for all amputees. Roughly 40% of amputees do not have a prosthetic which leads to further inequalities and inequities in healthcare. A key issue is cost. Many prosthetics are built to last for three to five years. To make these devices more affordable, researchers should attempt to

rework and mend the artificial limbs. This would be more affordable than having to purchase a new device every three to five years. In addition, if researchers developed interchangeable parts, this could be cost efficient. This can allow an amputee to only replace the portion that is breaking down rather than having to purchase a new device.

Conclusion

Amputations are a growing concern in the United States. It is estimated that by 2050, 3.6 million people will be living with limb loss (Amputee Coalition, n.d.). Without improving the access and cost of prosthetic devices, amputees will continually be in a difficult balance of choosing between their quality of life and going into debt as a result of these high costs. This constant struggle is mostly seen among minoritized groups as a result of lack of preventative care and generous insurance. As seen in the United States throughout much of history, minoritized groups are continually treated as less equal. This leads to mistrust, inequalities, and inequities that are not only prominent in healthcare but also in daily life. Through essential reforms like increasing access to healthcare, there will be less preventable amputations. This can lead to the gap in care between minoritized groups and the majority population being closed.

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