THE RISING COST OF HEALTHCARE'S IMPACT ON AMERICAN AMBULANCES

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By

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Many Americans view healthcare as a human right (Bailey, 2017, p.1). Quality healthcare can make an incredibly positive impact on an individual's life. Preventative medicine protects individuals from enduring the cost of illness, both financially and physically. However, not all disease-states can be prevented, especially those formed congenitally or by trauma. In the case of these disease states, such as any sort of medical emergency or birth defect, every American should have the ability to afford and receive quality medical treatment, without any hesitation due to the cost.

Congenital or trauma-induced deformities of the face, especially the mouth and jaw, are life-altering and can be life-threatening malformations (Navicent Health, 2019, p.1). Aside from visual aesthetics, the mouth and jaw serve as a passageway for airflow, food intake, and communication. Any alteration to their structure affects all three of these functions. Maxillo-mandibular distraction osteogenesis (MDO) is a procedure that is used to treat and correct malformations of the face and jaw. The procedure involves breaking the malformed bones and slowly extending the fracture so that bone growth (osteogenesis) occurs, allowing the maxilla and mandible to properly reform. This procedure corrects the structure of these bones and their surrounding soft tissues, allowing them to reacclimate to their intended functions. Furthermore, this procedure typically makes the face more symmetrical and more aesthetically pleasing (AAOMS, 2013, p. 1). However, there is currently no way to measure how far the fracture has been extended in patients. This leads to imperfect asymmetry in the jaw, despite the initial malformity being corrected. If the jaw is not fully symmetrical, dental and respiratory issues can occur (Navicent Health, 2019, p. 1). In order to determine when to halt the fracture distraction, physicians require patients to come in for weekly x-rays and essentially 'eyeball' the x-rays. There is a need for a measurement device to determine how far the fracture has been distended so that physicians can ensure that both sides of the jaw will be as symmetrical as

possible.

The American healthcare system has become extremely business-oriented, with every procedure, device, and service coming with its own price tag. US healthcare expenses are rising, to the extreme where individuals have to prioritize their finances before their health (Bailey, 2017, p. 2). Typically this prioritizing of finances over care like preventative health leads to an increased need for emergency care. Americans have begun refusing ambulances and medical treatment while ill, due to the sheer cost of treatment. This business-minded ideology is actively harming the most vulnerable of Americans during the most vulnerable situations of their life.

Understanding the full amount of potential patients for ambulance transports, patients treated and patients released, is essential in understanding the difference between the amount of patient's an ambulance is called for, and the number of patients who actually accept treatment. The relationship between ambulance costs and patient treatment volume is analyzed via Johnson's Social Construction of Technology (SCOT), with a focus on Technology and Social Relationships (Bijker, Hughes, Pinch, 1987). Then, the relationship between ambulance costs and legislation is then broken down via Actor Network Theory (ANT) (Fioravanti & Velho, 2010, pp 1-2). Finally, a discussion on the ethics of current ambulance billing practices is performed.

There is a clear need for an investigation in how rising insurance and healthcare costs affect American's usage of ambulances. There is also a clear need for the development of a device to determine the distraction length of a fracture in maxillo-mandibular distraction osteogenesis. While these topics seem unrelated, they both center around the need to improve current healthcare practices in the US.

THE RISING COST OF HEALTHCARE'S IMPACT ON AMERICAN AMBULANCES

Medical care costs, including health insurance, in the US continue to rise. "One-in-four

Americans families" refuse preventative and emergency medical care due to the cost (Chin, 2017, p. 1). Many patients refuse to be treated by an ambulance and transported to the hospital out of fear of being burdened with debt for the foreseeable future (Chin, 2017, p. 2). This issue is compounded with the fact that the federal government "does not regulate ambulance fees for patients" (Bailey, 2017, p. 3). Without any federal regulation, ambulance patients are left to the mercy of the ambulance companies (O'Cathain et al., 2018, pp.1-2). If not a local volunteer group, these companies are typically for-profit, and are more concerned with their profit margins than overcharging the patient (Bailey, 2017, p. 1-10). The biggest concern with this issue is that physicians agree that patients needed to be transported by ambulance for the majority of ambulance transports (Jacob et al., 2008, p. 1).

The research question to be answered is: how does the increasing costs of healthcare and health insurance affect the rate of ambulance transports in the US? This topic is significant, as it serves as an indicator of the overall wellbeing of the US (Meisel et al., 2011, pp. 1-2). If Americans cannot afford the cost of emergency care, it is highly unlikely they can afford the cost of day-to-day preventative care. Due to the current political climate, and given the fact that "health care has been a leading issue in the presidential campaign over the past year," it is likely that healthcare and insurance policies will be affected by the outcome of the election (Rovner, 2020, p. 2). As this research will be impacted by the course of the election, it's necessary to limit the scope of the investigation to policies put in place through February, 2021.

SOCIAL CONSTRUCTION OF AMBULANCE TRANSPORTS

A general (SCOT) approach was taken to analyze the social factors that surround ambulance transportation (Bijker, Hughes, Pinch, 1987). This approach is useful due to the way it establishes and highlights all relevant social groups. While obviously, the patient is a relevant social group with regards to ambulances, there are a lot of other social groups involved including

EMTs, paramedics, insurance agencies, and more as displayed in Figure 1, on page 4. It is important to determine all relevant stakeholders in this situation as it may shed light on why the relationship between ambulance costs and patient transport rates are the way that they are (Johnson, 2009, p. 1793). The Technology and Social Relationships model will be used to determine and define the relationships between all of these relevant social groups and the ambulance engineer (Carlson, 2020, p. 3). This model sets parameters on the research methodology, in that it focuses on how the end user, in this case the patient, uses the ambulance technology to manage their relationship with their disease-state, finances, EMTs, bystanders, and

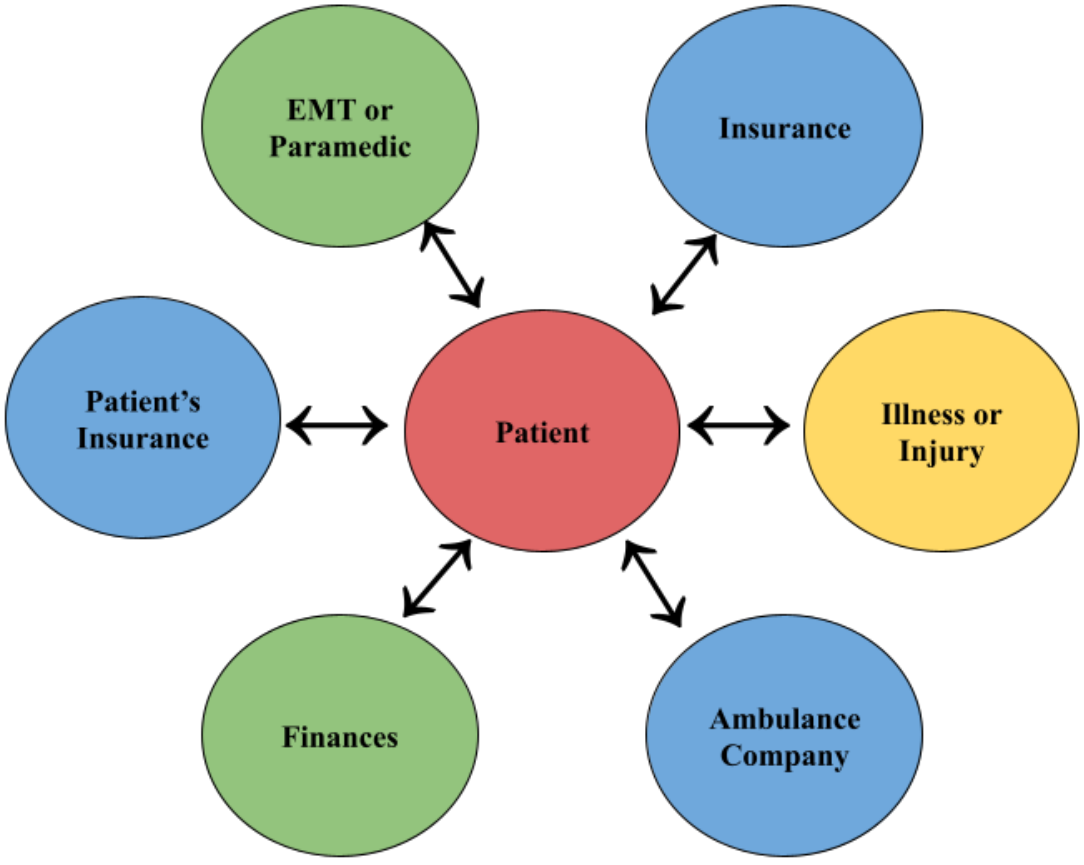

Figure 1: Technology and Social Relationship Model of an Ambulance's Patient. This figure shows the influence the technology and relevant social groups have on the end user, the patient. (Adapted by Sarah Schroter from Carlson, 2009, p.3).

insurance agency. It also focuses on how the patient uses the emergency-response system to enhance their own experience. In this case 'enhance' refers to minimizing the cost of treatment

or the amount of pain one is in. While the end user (the patient) may benefit from the ambulance treatment and transport, they may also incur the debt of the technological cost. So ultimately, although the patient may benefit from the technology, the emergency-response system benefits financially from the patient. Figure 1 is broken down into 4 categories based on color. The red color symbolizes the patient suffering an emergency, yellow symbolizing what the patient has no control over, the illness or injury, blue symbolizing the factors the patient would not know during the incident, and green as the factors that the patient would, in theory, have knowledge of during the incident, assuming they're conscious.

When interacting with a patient, ambulance personnel, like EMTs and paramedics, are going to be looking out for the patient's best interest medically and will encourage the patient to receive medical treatment and be examined by hospital staff. Based on standard economics, the ambulance company that employs this personnel however is going to be looking to maximize their profits from the patient. The patient's insurance, however, is going to be looking to pay the smallest amount out to the ambulance company. Overall, insurance companies are focused on maintaining their own financial status and disregard the patient's. Ultimately this leaves the patient responsible for paying the difference between the ambulance company's cost and their insurance's coverage. According to Bailey (2017), this cost is known as "surprise billing" ("Ambulance trips can leave you with surprising — and very expensive — bills," p. 2). This forces the patient to have to weigh the cost of their illness or injury versus their personal finances when deciding to consent to ambulance treatment and transport.

An indirect relationship between ambulance costs and the number of patient transports is the anticipated outcome, simply based on the economic principle of supply and demand as shown in Figure 2, on page 6, with the green arrows indicating the rising costs of ambulances along with insurance and the red arrow indicating a decline in patients accepting ambulance

assistance. The black arrows represent the cyclical nature of this relationship. If this is proven true, this makes an unfortunate statement about America's healthcare system, in that we treat an individual's health like a commodity that one may or may not be able to afford to purchase, instead of a god-given right. Of course, the hoped-for outcome is that there is no relationship between ambulance transport rates and the price of an ambulance ride, as this would indicate that Americans are not worried about any potential cost incurred and are solely focused on their wellbeing. This hoped-for outcome is far from the truth however, due to the negative impact surprise billing has on patients' physical and mental wellbeing (Bailey, 2017, pp. 3-7).

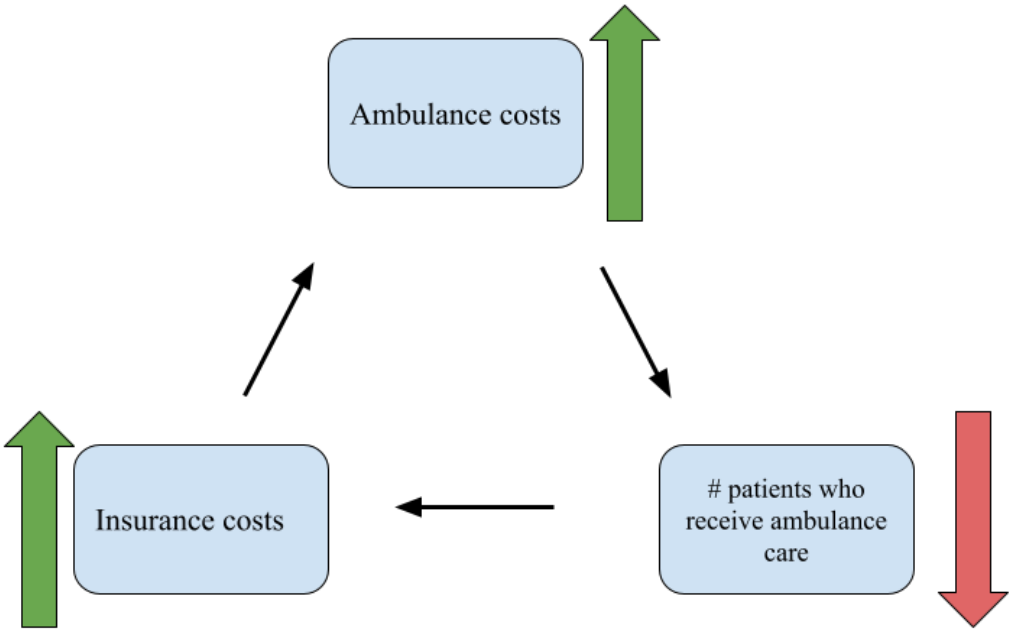

Figure 2: Price versus Quantity. This figure shows the expected indirect relationship between ambulance costs and patients treated and transported. (Sarah Schroter, 2020).

ACTOR NETWORK THEORY ANALYSIS OF LEGISLATIVE SOLUTIONS

Federal and State Regulation of Ambulance Billing

On Tuesday December 21, 2020, Congress passed federal legislation banning "surprise medical bills" (Kliff & Sanger-Katz, 2020, p.1). However ground ambulances were excluded

from this ban. Congress cited that this exemption was due to the fact that ambulances and the rescue squads responsible for staffing the ambulances are unique to each station, making them complicated to break down financially on a national level.

Furthermore "lawmakers have been reluctant to regulate surprise billing among ambulances, citing the diversity of providers, complex layers of state and local regulation, and a dearth of information about precisely what it costs to keep an ambulance stocked and running" (Kliff & Sanger-Katz, 2020, p.3). As discussed, some ambulances are part of local volunteer non-profit organizations and others are part of private for-profit companies. However, this exemption can also be viewed as lawmakers attempting to avoid the effort of breaking down the financials behind ambulance transportation costs simply because they wanted to pass the current legislation as is, without further complicating it.

While it can be viewed that lawmakers were avoiding an in-depth analysis of ground ambulances for this piece of legislation, it appears that ground ambulance billing practices will be regulated in the coming years on a federal level. As of December 2020, Medicare is "reviewing its payment rates. As part of that process, the government is collecting detailed data from ambulance companies about their costs and prices," meaning that the federal government has begun looking into ambulance billing practices and thus Congress would have enough information to develop regulations for ambulance billing once the review is complete (Kliff & Sanger-Katz, 2020, p.3).

On the state level, Maryland and Colorado have both included ambulances in their surprise billing legislation. Colorado requires insurance agencies to "pay private ambulances" rather than "billing patients directly" to inhibit surprise billing (Kliff & Sanger-Katz, 2020, p.4). This methodology protects individual patients as well as ambulance companies by placing the

burden on health insurance. However, this potentially may lead to an increase in overall health insurance cost in Colorado and perhaps leave more individuals without health insurance.

Overall, there is no clear solution to the surprise billing problem that comes with private ambulance agencies. Either the patient, the insurer, or the ambulance company will bear the burden of the cost. Ultimately, it's critical that no individual's wellfare is harmed at the expense of surprise billing; thus it is most important to protect the patient from surprise bills over corporations like health insurances and ambulance companies.

Analysis of the Actors in Healthcare Cost Regulation within the Network of US Legislation

Many healthcare-related federal policies hinged on the 2020 election. Only eight days after his inauguration, its victor, President Joe Biden, signed an executive order to "boost [health insurance] coverage for people who are uninsured" (Cohen, 2021, p.2). While this legislative action may help uninsured individuals have increased access to healthcare, ambulances may still be out of reach for many of these people. Medicare typically only pays a flat percentage fee for ambulance services, typically "80%" leaving patients to pay the rest, making them potential victims for "surprise billing" (Backman, 2019, p.2).

An Actor Network Theory analysis of stakeholders in the 2020 election outcome, with regards to healthcare coverage and cost, was performed (Fioravanti & Velho, 2010, pp 1-2). It was found that the main actors include President Joe Biden in the Executive Branch, Congress, and the 50 US states. All of these actors exist within the network of the United States legislation system regulating how healthcare, including ambulances, may be billed. Notably, this network does not include universal healthcare at either the state or federal level.

The underlying assumption President Biden made in his January 28th executive order, and many Americans make, is that the more people with health insurance the more healthcare

becomes accessible to everyone, and the higher his approval rating would be. Unfortunately this is not always the case, especially with emergency medicine. Many ambulance service providers in the United States are private companies that are considered 'out of network' by the majority of private health insurance companies, leaving the patient to foot the costly "balance bill" even though they are also paying for health insurance (Bailey, 2017, p. 2). So, even though President Biden's executive order may appear to increase ambulance accessibility, its effects on ambulance usage is questionable at best.

As discussed earlier, Congress is passing legislation banning surprise billing, but are hesitant to include ambulances in this legislation due to the complexity of the different types of ambulance providers (volunteer versus private) and local regulations. Protecting Americans from surprise billing is "a rare health policy issue that Democrats and Republicans have both endorsed in theory," hence why the legislation was able to go through both chambers (Goldstein, 2020, p 3). While public support for banning surprise billing is strong, Congress still has to manage the issue and their relationships with health policy lobbyists and insurance groups who oppose the ban with threats of "increased costs and higher premiums" for families and employers (Goldstein, 2020, p 4). Ultimately, Congress walks a fine line in this legislative network between public support and private opposition, especially when regulating ambulances.

At least 25 states are also working on legislation to ban surprise billing or have already done so (Ollove, 2019, p 2). Similar to their congressional counterparts, state legislators are under pressure from their constituents to mitigate, if not fully regulate, high medical costs. However state legislators interact with their constituents at a much more local and direct level, and national lobbyists are less likely to influence them in their decisions. While surprise billing is a topic that "both Democrats and Republicans have both endorsed in theory," local attitudes can be much

more polarized, in either direction (Goldstein, 2020, p 3). This local polarization on surprise billing, and centralized healthcare can have a heavy influence on local lawmakers. While many states have already begun working on surprise billing bans, many still have not due to local attitudes.

ETHICAL DISCUSSION OF SURPRISE BILLING BY AMBULANCES

Given that surprise billing is discussed in newspapers regularly, a newspaper ethics test occurs every time an article on the subject is published (Martin & Schinzinger, 2009, p. 49-75). As discussed earlier, healthcare and centralized health insurance played a massive role in the 2020 election and its newscycle (Backman, 2019, p.2). While surprise billing has been declared unethical by many media outlets, this outrage alone has not been enough to cause change (Kliff & Sanger-Katz, 2020, p.1-4).

From a "mother would approve" ethics test standpoint, one may argue that surprise ambulance billing is taking advantage of Americans who have been down on their luck and that the practice is unfair (Martin & Schinzinger, 2009, p. 49-75). No mother would want to see their child suffer under the weight of the debt surprise billing causes, nor would any mother want to be responsible for her family's surprise medical bills. Furthermore, the majority of mothers would be embarrassed of their children who enable ambulance companies to charge for surprise billing and insurance companies from covering their patients in full.

One may argue from a utilitarian standpoint that keeping surprise billing practices maintains the greatest good for the greatest number of people, as both insurance providers and ambulance companies benefit, both of which employ multiple people, and only the patient suffers (Martin & Schinzinger, 2009, p. 49-75). However it must be acknowledged that insurance companies and private ambulance companies are not people, rather corporations. Since neither

company is an individual person capable of having their wellbeing suffer or prosper, only the patient can be taken into account when practicing a utilitarian ethics test. Given that surprise billing only harms the patient and may perhaps discourage them from calling an ambulance during a medical emergency in the first place, thus preemptively harming the patient, surprise billing practices fail to provide good to the greatest number of people, thus failing the ethics test.

When performing a rights ethics test on this surprise billing scenario, access to healthcare must be considered a right. Utilizing the United States' Declaration of Independence, every individual has "unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness" (Jefferson, 1776, n.p.). Given that an individual's life may be dependent on immediate access to healthcare, access to healthcare is thereby a right (Martin & Schinzinger, 2009, p. 49-75). Since the potential threat of surprise billing discourages individuals from calling 911 and accessing immediate healthcare via ambulance, surprise billing violates that individual's right to healthcare (Bailey, 2017, p 3).

FUTURE REGULATION

Ground ambulances are complicated pieces of technology that can save an individual's life. As mentioned earlier, many Americans believe healthcare to be a basic human right (Bailey, 2017, p.1). However, American usage of ambulances has been on the decline as healthcare expenses rise and patients are forced to prioritize their finances before their wellbeing out of fear that their insurance will not cover their ambulance bill and they will receive a costly surprise bill (Bailey, 2017, p.2). This financial intimidation tactic of surprise billing violates multiple ethical guidelines and has been regulated on the federal level for all healthcare practices excluding ambulances (Kliff & Sanger-Katz, 2020, p.1). Regulating surprise billing for ambulances, while confusing and complicated, should increase ambulance usage as patients would no longer be

concerned about being forced to pay out of pocket for the bill. While it appears that ambulance billing practices will become regulated on a national scale in the near future, there is no guarantee (Kliff & Sanger-Katz, 2020, p.3). Future work on this topic should include an investigation into the effectiveness of state legislature on regulating surprise billing and determining if regulation increases ambulance usage as well as determining if the state method of regulation may be effective on a national level.

WORKS CITED

AAOMS. (2013). *Clinical paper*. 1–6. Retrieved from https://www.aaoms.org/docs/practice_resources/clinical_resources/distraction_osteogenesis.pdf

Backman, M. (2019, June 18). *Does Medicare cover ambulance services? medicareresources.org*. The Medicare Resource Center.

Bailey, M. (2017, November 20). Ambulance trips can leave you with surprising - and very expensive - bills. *The Washington Post*, 1–10.

Bijker, W., Hughes, T.P., Pinch, T.J. (1987). The social construction of technological systems. Cambridge, MA: MIT Press.

Carlson, B. (2020). *STS Frameworks* (p. 3).

Chin, M. (Moneyish). (2017, June 7). 1 in 4 Americans refuse medical care because they can't afford it. *New York Post*, 1–2.

Cohen, J. (n.d.). Biden's healthcare agenda In 2021: Shoring up the Affordable Care Act. *Forbes,* 1-2.

Fioravanti, C., & Velho F. (2020, December 11). Let's follow the actors! Does Actor-Network Theory have anything to contribute to science journalism?. *Journal of Science Communication,* 1-8.

Goldstein, A. (2020, December, 21). Congress shields patients from unexpected medical bills. *The Washington Post,* 1-4.

Jacob, S. L., Jacoby, J., Heller, M., & Stoltzfus, J. (2008). Patient and physician perspectives on

ambulance utilization. *Prehospital Emergency Care*, *12*(2), 176–181. https://doi.org/10.1080/10903120701710058

Johnson, D. G. (2009). Social construction of technology. *Encyclopedia of Science, Technology, and Ethics*, 1791–1795.

Jefferson, T. (1776, July 4). Declaration of Independence, 1.

Kliff, S., & Sanger-Katz, M. (2020, December 22). Why ambulances are exempt from the surprise-billing ban. *The New York Times,* 1-4.

Martin, M., & Schinzinger, R. (2009). *Introduction to engineering ethics* (2nd ed.). McGraw-Hill, 49-75.

Meisel, Z. F., Pines, J. M., Polsky, D., Metlay, J. P., Neuman, M. D., & Branas, C. C. (2011). Variations in ambulance use in the United States: The role of health insurance. *Academic Emergency Medicine*, *18*(10), 1036–1044. https://doi.org/10.1111/j.1553-2712.2011.01163.x

(Navicent Health). (2019). *Bone deformities*. Navicent Health. https://www.navicenthealth.org/oti/deformity-of-bone

O'Cathain, A., Jacques, R., Stone, T., & Turner, J. (2018). Why do ambulance services have different non-transport rates? A national cross sectional study. *PLoS ONE*, *13*(9), 1–20. https://doi.org/10.1371/journal.pone.0204508

Ollove, M. (2019, April 5). Surprise medical billing: Some states ahead of feds. *The Pew Charitable Trusts,* 1-9.

Rovner, J. (KHN). (2020, January 29). No U.S. elections 2020: understanding what's at stake for

health care. *Npr*, 1–19.