

**Design of a Novel Umbilical Venous Catheter with Echogenic Distance
Markers for Increased Placement Accuracy**

(Technical Paper)

**Does Medicare Impact Mortality Rates: An Analysis of the Different
Insurance Coverages and the Impact on Neonatal Mortality Rates**

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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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Introduction and Background

Giving birth is a fundamental part of many humans' lives. In 2020, the United States recorded the birth of over 3.6 million babies, and an estimated 9-13% were admitted to the neonatal intensive care unit (NICU) (Pineda et al., 2023). Once admitted to the NICU, the care offered to the neonate can be limited by the mother's insurance quality. This often leads to disparities in neonatal death rates, a study stating that "uninsured neonates were 2.6 (95 percent CI: 2.4, 2.8) times as likely to die as were those with private insurance, Medicaid, Medicare or other expected primary or secondary payer" (Morriss Jr., 2013). In addition, race often becomes a compounding factor impacting neonatal mortality rates. The health disparity seen between Black and White/Non-Hispanics for the risk of NICU admission is most evident among pregnancies covered by private insurance. This stems from more NICU admissions associated with women using public insurance than private insurance (de Jongh et al., 2012). This disparity is compounded by socioeconomic status (SES), which is influenced by geographic location, employment status, and the neoliberalist economy of the United States. This review is focused on the impacts of health insurance and racial bias on birth outcomes, specifically those that involve admission to the NICU.

There is awareness and advocacy for people who lack health insurance, known as uninsured, but an equally dangerous problem is women who have insurance that does not cover their full needs and who cannot afford to pay out-of-pocket. For many low-income families, full insurance coverage is not affordable, so they fall into a category known as underinsured. These families have insurance plans but lack the funds to acquire more insurance for specialized care, which the Affordable Care Act (ACA) did not fix. The ACA decreased the number of children who lacked insurance but overlooked those who had fallen into the "underinsured" category and

increased this number in some places (Lakshmanan et al., 2021). Low-income families with children with special health needs are also more likely to be underinsured than those with public insurance, which puts a significant financial burden upon them once medical bills begin rolling in, increasing anxiety levels within the family structure. It should be noted that the average cost of an infant born preterm in 2005 was \$51,600, which is equivalent to around \$85,000 as of the end of 2024, according to the U.S. Bureau of Labor Statistics' CPI Inflation Calculator. This amount is insurmountable to most women, especially those without insurance or support, emotional, physical, and financial. If a family cannot afford medical insurance in the first place, how are they expected to cover the out-of-pocket costs of giving birth, especially if the birth is high-risk?

In addition to just looking at the differences in insurance coverage levels, it is vital to address the differences in the stressors of women's lives. Williams et al. (2009) states that external stresses, such as discrimination or racism, have a negative correlation with regard to the health of an individual. While the health of the baby is most often attributed to the health of the mother during pregnancy, other metrics, such as stress levels, should be considered. By looking at the mother holistically, trends suggest that "stressors" impact birthweight and ailments in the baby. These stressors include life in poverty, segregation, or racism experienced throughout life. This shows disparities in mortality rates are influenced by more than the health of the mother or baby, as well as access to health insurance. This stems from a systemic issue that must be addressed outside of health provider offices.

Should insurance coverages address this disparity, and if so, how can they support the women of color on their plan and empower them to take steps that improve their health and the health of their future child? One idea could be utilizing the Special Supplemental Nutrition

Program for Women, Infants, and Children (WIC). Lower-income and uninsured families have the highest incidence rates of infant mortality, but enrollment in the WIC program can help mitigate these effects due to access to social services during and throughout pregnancy, which should be highly considered if a family is underinsured (Moss & Carver, 1998). The services within the United States healthcare system are not designed for women with a lack of funds or insurance. Drawing on an analysis of scientific research on birth outcomes and NICU admissions of diverse populations, I argue that independent research bodies need to discover protective effects for marginalized women and lobby for these to be implemented in all insurance plans, regardless of whether it is public or private insurance.

Insurance: For-the-people or For-profit?

Insurance companies in the United States use their policies to generate profit rather than provide medical care. This is often because of neoliberal ideals in our economy, which advocate for free markets, but in practice, have highly organized markets that require significant bureaucratic oversight (Birch, 2020). Birch (2020) emphasizes that neoliberalism involves deliberately designing quasi-markets to achieve desired outcomes, and in the concept of automated neoliberalism, this incorporates personal data and algorithms. This concept can be applied to insurance premiums, often costing the policyholder more due to comorbidities, further monetizing healthcare. This may lead to mothers not being able to afford insurance, or even making insurance too expensive if they have a high-risk pregnancy, which may lead to a stay in the NICU for the baby. In addition to this, neoliberal societies often discourage women from working due to shifting focus onto profit rather than social and inclusion issues and even privatizing social services, frequently causing women to feel as though they need to fill the gaps

in child and elder care. This limits access to job opportunities, especially high-paying ones in which medical coverage is included.

The discussion of insurance companies and their policies is extremely contentious following the assassination of the United Healthcare CEO, and the further public divide between support and condemnation of the alleged assassin, Luigi Mangione. The notoriety of the event has called into question the practices of many large-scale insurance companies, with many consumers looking further into their coverage. For example, many private insurance companies have higher denial rates than public insurance due to a third-party entity known as prior authorizations. Most major insurance companies contract another company to approve or deny claims, to keep profitable, some even boasting that for every \$1 on approved medical procedures, \$3 less will be paid out of other medical expenses (Miller et al., 2024). One of these companies, EviCore, uses algorithms backed by artificial intelligence to deny insurance claims at rates as high as 20%; to put that into perspective, the denial rate for federal Medicare Advantage plans is about 7% (Miller et al., 2024). The algorithm at EviCore could also be controlled by executives, who would set a threshold for the percentage of approval, which could be made higher or lower depending on the number of claims it would send to medical professionals to approve or deny. The higher the threshold, the more claims are sent to doctors and nurses, and the more denials of service.

In the capitalist society within the United States, most companies prioritize making the largest profit possible, which extends to insurance companies. Teresa Perry and Alexandra Bernasek (2024) analyzed the interplay of corporate capitalism in the American healthcare industry and how this impacts cancer mortality rates. They explain that private insurers operate under a market-based structure, focusing on risk assessment, cost control, and maximizing

shareholder profit rather than ensuring universal coverage. The privatization of insurance increases inequality by allowing wealthier individuals to afford more comprehensive coverage, where lower-income individuals struggle with underinsurance, morphing the healthcare landscape from a public good to a for-profit industry. Since companies are motivated by profit, this leads to denial of coverage, high insurance premiums, and limited services for low-income individuals. If profit motives are reduced, healthcare access and equity should also improve. While there was no causal relationship between corporate capitalism and cancer mortality rates, this does not mean the two are not related; Rather, when financial gain is present, there cannot be equality

To make sure the unique economic principles of the United States were at play, I analyzed a variety of papers from the past 25 years focused on birth outcomes that also included data on race, SES, or insurance levels. I prioritized papers that related to the mortality rate of the neonate, but ultimately broadened my search to include the health outcomes of the mother as well. I accessed medical and public health journals mainly via Google Scholar, but also consulted journals focused on economics to assess the unique relationship between medical insurance and profitability. In the past 10 years, more data has been shown that links poor birth outcomes to racial backgrounds, which highlights that privatized medical insurance does not have the same protective benefits for people of all races. I used terms such as “neonatal/infant mortality rate”, “insurance levels”, and “NICU” in conjunction to find most of the studies below to create the most comprehensive analysis possible.

Texas’ Insurance Shift: A Case Study

The paper, “Does Managed Care Widen Infant Health Disparities? Evidence from Texas Medicaid” by Ilyana Kuziemko, Katherine Meckel, and Maya Rossin-Slater (2018) involves

statistical analysis of large-scale birth records and hospital discharge data. These findings highlight the disparities in neonatal care in Texas. The study analyzes Texas's shift from fee-for-service (FFS) Medicaid to Medicaid managed care (MMC) for mothers residing in Texas between January 1993 and December 2001. In an FFS care structure, providers are reimbursed for each service they provide. However, in an MMC structure, which contracts private insurance companies to provide Medicaid services, the state reimburses the managed care organization (MCO) on a fixed per-member-per-month basis, known as capitation. This dissuades insurance companies from covering expensive specialists that are "out-of-network" (the network they create), causing patients to request their insurance company to see these specialists. Health insurance companies aim to guarantee that high-risk and high-cost patients do not face rationing by providers and insurers, who may prefer to treat low-risk, low-cost beneficiaries since they get reimbursed the same (Kuziemko et al., 2018). The MMC program incentivizes healthy, "low-risk" individuals to join. After enrolling, insurance companies determine who is "healthiest", therefore being a cost-efficient client. Oftentimes, those selected even receive better care, as this generates a returning investment for the company. In addition, lower-cost alternatives are often pushed to patients, and when specialists can see them, they are often reimbursed at a lower rate.

After the transition, it was found that there was "an increase in mortality for children born to US-born Black mothers by 15 percent," whereas "mortality rates for Hispanic infants decreased by 22 percent" (Kuziemko et al., 2018). The MMC plan incentivized plans to prioritize care for the Hispanic patients ("lower-cost clients") since they typically had lower mortality rates and better birth metrics compared to the Black infants ("higher-cost clients"), which had higher mortality rates and poorer birth metrics. This was because of perceived healthcare costs, which led to suboptimal care for Black infants. These infants represent a

financial loss in the capitation payment system, as the same uniform rate is received despite higher risk for patient costs. The implementation of this new Medicaid program increased the Black-Hispanic mortality gap by 69 percent (Kuziemko et al., 2018). In addition, the capitation system loses profits on high-risk, expensive births due to receiving a fixed rate, including a Delivery Supplementary Payment and a newborn premium, which often does not cover the entire cost of these types of births. MMC programs can also use their discretion to tailor non-mandated benefits to each beneficiary to attract clients to sign up with them, which often include free dental services or free diapers for newborns. These “value-added” services are not an extra cost to the state, yet they are only selectively offered to clients, which increases inequalities in medical care by a state-run service.

How Insurance *Actually* Impacts Neonates

Different insurance levels also impact important metrics observed from neonates immediately after birth. A baby's Apgar score is one of the most indicative metrics of how the baby is faring after the birthing process and adjusting to life outside the womb. This score is broken into five categories, each rated on a scale of 0, 1, or 2, for a total score range of 0-10, with higher scores correlating to better adjustment outside the womb. Brandon et al. (2009) studied the different outcomes and care processes neonates received. Dr. Brandon found discrepancies in health at birth and in the instructions given to parents. Babies with similar conditions received different discharge instructions depending on their level of health insurance. The babies on MMC had a much higher percentage of an Apgar score lower than 6 when checked 5 minutes after birth, which, according to The American College of Obstetricians and Gynecologists, is considered moderately abnormal (*The Apgar Score*, 2015).

The study also found that babies born under MMC had higher incidences of certain diseases, such as necrotizing enterocolitis and bacterial sepsis, when compared to babies on private insurance, even when controlled for demographics (Brandon et al., 2009). Necrotizing enterocolitis is inflammation of the intestine that leads to bacterial infection and death of the colon and intestine, and ultimately sepsis (Ginglen & Butki, 2023). It is found almost exclusively in neonates and can have a mortality rate of up to 50%. Bacterial sepsis is not exclusive to neonates but is a life-threatening condition that arises when the body's response to an infection injures other tissues and organs, with a mortality rate between 20%-25% (Bullock & Benham, 2023). Most shocking of all, though, the discharge instructions from the NICU for babies were also recorded and able to be compared based on health insurance coverage type for similar health levels of the babies. Dr. Brandon states that "the infants with private insurance were 2.2 times more likely to be discharged from the hospital using supplemental oxygen and 1.58 times more likely to be discharged from the hospital using a monitor despite having less apnea and no differences in the incidence of bronchopulmonary dysplasia" (2009, p. 125). The notion that babies under private insurance get more supplementary care and monitoring compared to those on MMC should be investigated, especially when the babies are at similar health levels.

Another population in which medical insurance coverage levels are critical is for babies who are born with preexisting health conditions. Dr. Kucik (2014) observed babies born with congenital heart defects (CHD) and their mortality rates to determine the role of health insurance in their outcome. Congenital heart defects are one of the most common ailments of preterm neonates, and there is a significant risk of death associated with CHDs because of the timely need for medical and surgical intervention. Uninsured infants with critical CHDs had 3 times the mortality risk as that of privately insured infants (Kucik et al., 2014). Publicly insured infants

had a 30% reduced mortality risk compared to privately insured infants during the neonatal period, but had a 30% increased risk in the post-neonatal period (Kucik et al., 2014). Adjusting for insurance type reduced the Black–White disparity in mortality risk by 50% (Kucik et al., 2014). Kucik even goes as far as to say that those with no insurance have a barrier to practical and life-saving care due to this status, which no one, let alone someone’s baby, should have to face.

Is This Just an Insurance Inequity?

Many people may look at the statistics comparing babies born on MMC compared to private insurance and decide that we need to get rid of one or the other to fix the inequality. However, it is not that easy, as other underlying issues contribute to the difference in mortality rates. A study by Dr. de Jongh (2012) focused on the interplay between insurance status, socioeconomic status, maternal age, and race/ethnicity on NICU admission rates. They found that private insurance was associated with decreased odds of NICU admission between Hispanic and White/Non-Hispanic infants. However, in contrast, Black/Non-Hispanic mothers with private insurance had increased odds of a pregnancy resulting in a NICU admission (de Jongh et al., 2012). Public insurance was associated with increased odds of NICU admission of the White/Non-Hispanic and Hispanic populations, no matter the maternal age (de Jongh et al., 2012). The Black/Non-Hispanic population with public insurance had lower odds of NICU admission in the teenage and intermediate age group, 19-34, populations than those on private insurance (de Jongh et al., 2012). The disparity between Black/Non-Hispanic compared to the White/Non-Hispanic or Hispanic groups was greatest in the private insurance group (de Jongh et al., 2012). Private insurance does not have the same protective effects across different races.

Dr. de Jongh (2012) attempts to explain this through "weathering". This process states that social inequality may affect the health of population groups differentially. These differences manifest through age or life circumstances that influence a woman's health (2012). Another concept related to this is known as "stress age," which is a linkage proposed between altered birth outcomes through the combined effects of chronic medical conditions and persistent exposure to stress, including racism associated stress. This is validated by the fact that well-educated black women who have access to prenatal care throughout the first trimester of their pregnancy have an increasing neonatal mortality rate, illuminating that physical health is not the only determinant, we must also consider other aspects of life, especially when they put high stress on the mother (de Jongh et al., 2012). There is so much emphasis on the mother's physical health throughout pregnancy that the ecological experiences and life-course stressors are often overlooked, despite them being indicative of a baby's health.

What Does This Mean?

There is no simple answer to protect all women against inequalities in birth outcomes, but there are steps we can take to mitigate outside impacts on this statistic. It is fair to say that the current standard of American Healthcare is not equitable for all, especially those with varying socioeconomic statuses, and it needs to be changed. First, insurance companies should not be making profits off something as fundamental as people's right to healthcare. It is unfair to gamble on the perceived costs of people's healthcare to make a profit, and furthermore, offer more incentives to some groups but not others in order to attract "the right" clients, those who they assume will make the most money off. There should be policy reforms that limit corporate profit seeking in health insurance while prioritizing more equitable healthcare access and equity. One option to uphold this would be creating a hybrid model of health insurance that balances

public oversight with market efficiency. In addition to this, we need to work to lower the cost of insurance to eradicate the issue of underinsurance. The United States could draw from Universal Healthcare Systems in Europe, but those also have flaws, so they must be adapted to work in our economy and society.

Another aspect we need to strengthen in our healthcare system is the public health system. There needs to be more outreach into local communities, highlighting the importance of taking good physical and mental care of yourself, not just for pregnant women. Mental health can be pushed aside by many, but mental health issues can manifest into physical ailments if left unaddressed. Explaining to expectant mothers that there are external factors that can impact their unborn baby's health may allow them to take authority over situations in which they find themselves, or even re-evaluate when the correct time to have a child is. In a perfect world, women, or any individual, would never experience such stresses as racism, discrimination, and poverty. However, this issue will not be fixed overnight; Instead, we can all take steps to dismantle these ideals during this lifetime, as they negatively impact the health of future generations.

Future research should be longitudinal, following women from childhood until mid-50s to more closely assess how their lifetime experiences can be associated with the health of their pregnancy. In addition, these studies should be focused on contemporary stressors such as anti-Asian hate during the height of the coronavirus pandemic and xenophobic ideals that are very prevalent during the last 10 years, especially currently with the increase in illegal deportations of individuals on a valid visa in the United States or those that are still waiting for their citizenship. I believe the tumultuous political scene of the 2020s will impact stress levels, and data may begin to elucidate an association between race-related stress and pregnancy outcomes.

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