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Article

Better birth outcomes: The investment that saves lives

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Abstract: This study utilizes CDC data to analyze birth outcomes for at-risk mothers involved in the Pathways HUB Community Action (PHCA) in Summit County, Ohio. The purpose is to understand the cost savings of providing interventions that will result in positive birth outcomes. The data, compared to the Ohio Public Health Data Warehouse and March of Dimes statistics, shows similar rates of singleton births. The study adjusts for inflation using the Producer Price Index from the St. Louis Federal Reserve. Results indicate that reducing prematurity rates among HUB clients could lead to significant cost savings, totaling approximately $1.2 million between 2017 and 2022, with the greatest cost savings for Black at-risk mothers and infants. This manuscript aims to achieve two objectives: first, to highlight the benefits of addressing health disparities affecting at-risk pregnant women; and second, to demonstrate the methodology for calculating cost savings using available birth outcome data.

Keywords: premature births; at-risk mothers; pathways HUB community action

Infant mortality continues to be a major concern in Ohio, especially among Black mothers. Ohio's infant mortality rates have shown complex trends since 2016. While post-2016 data is limited, earlier studies (2008–2015) identified significant geographic clustering of infant mortality in urban areas [1]. Education also plays a role in birth outcomes, as higher high school graduation rates are associated with lower teen birth rates and better infant health outcomes [2] except for some studies among Black women. The COVID-19 pandemic initially increased the risk of preterm births—a major factor in infant mortality.

However, by 2022, this effect had diminished, particularly in areas with early vaccine distribution [3]. Historical data (2003–2005) also indicates that infant mortality risk increases progressively with births between 32 and 38 weeks of gestation, with different causes and timings of death depending on gestational age [4]. These findings underscore the complexity of factors influencing infant mortality in Ohio.

Research shows that minority groups, particularly Black individuals, have been disproportionately impacted by both COVID-19 and non-COVID-19 related mortality since 2016, both in Ohio and across the United States. Historically, Black infants in major Ohio cities have faced significantly higher mortality risks compared to white infants, even when controlling for various maternal and infant characteristics [5]. The COVID-19 pandemic has further exacerbated these disparities, with minority populations experiencing higher rates of infection, hospitalization, and death compared to white populations across many states [6]. In particular, Black non-Hispanic males have faced a disproportionate share of both COVID-19 and non-COVID-19 related

excess mortality [7]. Contributing factors include social vulnerability, healthcare disparities, and reduced access to medical services during the pandemic. Additionally, education levels have been linked to teen birth rates and adverse birth outcomes, including infant mortality, in Ohio [2].

Ohio [2] has implemented several targeted programs to address the high rates of infant mortality among minority populations, particularly Black infants. One of the key initiatives is the Ohio Infant Mortality Reduction Initiative (OIMRI), which focuses on providing support to high-risk pregnant women through community health worker-led home visits. This program specifically targets Black mothers, who are disproportionately affected by infant mortality. The community health workers offer education on prenatal care, help connect women to healthcare services, and provide support throughout pregnancy and early motherhood. Research indicates that early enrollment in OIMRI is associated with increased prenatal care visits, which can potentially reduce the risks associated with infant mortality [8,9] but the overall benefit is unknown.

In addition to OIMRI, Ohio has invested in expanding access to Medicaid and improving healthcare coverage for pregnant women through the postpartum period until an infant turns 1 year old. Programs like Moms and Babies First and Pathways Community HUB model focus on addressing social determinants of health, such as housing and transportation, which are critical for improving birth outcomes among minorities. These programs work to ensure that women receive comprehensive care, including regular check-ups, mental health services, and substance abuse counseling if needed [1,10]. These programs provide Ohio's at-risk mothers with support to navigate their life needs and pregnancy for the best possible birth outcome.

Infant mortality and preterm births impose significant economic burdens on healthcare systems and society. The cost of preterm births alone in the United States is estimated to be around $26.2 billion annually, with an average of $65,000 per preterm infant. These costs include initial hospitalization, long-term medical care, and lost productivity due to disabilities often associated with premature births [11]. Infant mortality further amplifies these costs, as it involves not only the direct medical expenses but also the broader societal impact. For example, the Centers for Disease Control and Prevention (CDC) estimated that the cost of infant mortality in 2001 was around $10.2 billion, a figure that has likely increased in recent years due to inflation and rising healthcare costs. This estimate encompasses direct healthcare costs, loss of future productivity, and the emotional and psychological toll on families and communities [12].

Preterm birth-related expenses are particularly high because premature infants often require extensive care, including prolonged stays in neonatal intensive care units (NICUs), specialized medical equipment, and follow-up care for developmental delays or chronic conditions. These costs are compounded by the fact that preterm infants are at a higher risk for lifelong health problems, such as respiratory issues, neurological disabilities, and learning disorders, which require ongoing medical and educational interventions [13].

Addressing infant mortality and preterm births through preventive measures and improved maternal healthcare can potentially reduce these substantial costs. Programs aimed at reducing these adverse birth outcomes, such as enhancing prenatal care access

and addressing social determinants of health, are not only crucial for improving public health but also for alleviating the economic burden on society.

The current investigation examines the cost savings associated with a Pathway HUB located in Summit County, Northeast Ohio. Established in 2016, this HUB has provided services to over 1000 at-risk women [14]. The primary objective of this research is to assess the financial impact by comparing preterm birth rates among mothers participating in the HUB's programming with the overall preterm birth rates in the county.

1. Methods

This inquiry uses data sourced from the Centers for Disease Control and Prevention (CDC), which provides comprehensive birth statistics categorized by race, prematurity status, and singleton versus multiple births. This data is compared to the birth outcomes for at-risk mothers participating in the Pathways HUB Community Action, located in Summit County, Ohio. Summary data from the March of Dimes (MOD) indicate that approximately 97% of births in Summit County during the study period are singletons. A comparison of the CDC data with aggregated OPHDW data reveals a similar percentage of singleton births as reported by the MOD.

For inflation adjustments, the Producer Price Index by Commodity: Health Care Services (PPI) from the St. Louis Federal Reserve Bank is employed. Twelve monthly PPI values are averaged for each year to estimate the annual PPI. In contrast to a previous study, where only January PPI values were used—leading to slightly higher year-over-year inflation—this approach provides a more accurate reflection of inflation trends.

The MOD Cost of Prematurity research utilizes 2016 health care costs. To adjust these costs to reflect the study period, cost increases since 2016 are calculated and applied to the MOD's differential cost of prematurity for Ohio in 2016. These values are provided in **Table 1**.

Table 1. MOD cost of prematurity with inflation adjustments.

Year	Average health care PPI	PPI inflation vs. 2016	Inflated cost of prematurity
2016	114.442		$62,389
2017	116.175	1.51%	$63,334
2018	118.625	3.66%	$64,669
2019	121.158	5.87%	$66,050
2020	124.425	8.72%	$67,831
2021	128.167	11.99%	$69,871
2022	131.785	15.15%	$71,844

The process to determine prematurity cost savings is as follows:

1) Find the prematurity rate among HUB clients by dividing the number of premature births by the total number of births for the year.
2) Find the prematurity rate in the county, exclusive of HUB clients. To do this, subtract the number of HUB births from the CDC's number of births in the county to obtain the total number of non-HUB births. Subtract the number of premature

HUB births from the CDC's premature births in the county. Divide the non-HUB premature birth count from the total number of non-HUB births.

3) Multiply the expected prematurity rate by the total number of HUB births to obtain the expected number of premature births in the HUB.
4) Subtract the actual number of premature births in the HUB from the expected premature births in the HUB based on the non-HUB prematurity rate.
5) Multiply the expected reduction in premature births by the cost of prematurity for the year.

A hypothetical calculation for 2017 was computed accordingly:

1) HUB prematurity rate = HUB premature births / HUB All births = 10/100 = 10%
2) Non-HUB premature births = CDC premature births − HUB premature births = 610 − 10 = 600
3) Non-HUB all births = CDC all births − HUB all births = 5100 − 100 = 5000
4) Non-HUB prematurity rate = Non-HUB premature births/Non-HUB all births = 600/5000 = 12%.

The outcomes for the hypothetical 2017 example are provided in **Table 2**.

Table 2. Outcomes for 2017 Computations.

	HUB		**CDC**		**Non-HUB**		
Premature births	All births	Prematurity rate	Premature births	All births	Premature births	All births	Prematurity rate
10	100	10%	610	5100	600	5000	12%

Likewise, the expected premature births in the HUB were computed using the Non-HUB prematurity rate multiplied by HUB all births = 12% × 100 = 12.

The reduction in premature birth was computed using the Expected premature births − HUB premature births = 12 − 10 = 2.

The calculated cost savings based on this computation is 2 × $63334 = $126,668 for 2017.

2. Results

Table 3 provides the computation for each year from 2017 through 2022.

Table 3. Expected cost savings due to reduced prematurity by year.

Year	**Expected premature births**	**Actual premature births**	**Difference**	**Cost savings per birth**	**Cost savings for year**
2017	2.02	1	1.02	$63,334	$64,290
2018	12.02	11	1.02	$64,669	$65,973
2019	7.97	9	-1.03	$66,050	($67,907)
2020	16.50	8	8.50	$67,831	$576,559
2021	17.97	13	4.97	$69,871	$347,086
2022	25.98	23	2.98	$71,844	$213,901
Totals	82.45	65	17.45		$1,199,900

Results indicate an overall savings of approximately $1.2 million. Expanding on previously publish research, the expected cost savings were computed by reported race of the mothers. This was accomplished based on the computations provided in

Appendix. Results are presented in **Table 4**.

Table 4. Expected savings by reported race.

Year	Black	White	Other	Total
2017	$40,061	$24,229	$ → -	$64,290
2018	($65,262)	$121,116	$10,119	$65,973
2019	($141,551)	($12,475)	$86,118	($67,907)
2020	$505,484	$174,526	($103,452)	$576,559
2021	$264,665	$81,618	$803	$347,086
2022	$111,282	$89,901	$12,718	$213,901
	$714,679	$478,915	$6306	$1,199,902

Note: Insufficient data available for "Other" in 2017. Parentheses indicated negative balance.

As indicated above, the greatest savings is realized for the Black at-risk mothers participating in the supports provided by the PHCA.

3. Discussion

The greatest savings are realized among Black at-risk mothers, as detailed in the race-specific analysis. Cost savings are highest for Black mothers participating in pregnancy interventions due to the disproportionately high rates of preterm births and associated health complications within this demographic. Black women in the US face significant health disparities, particularly in maternal care, due to structural racism, socioeconomic stressors, and limited access to quality healthcare. They experience higher rates of maternal mortality and morbidity compared to white women [15,16].

These disparities are rooted in historical legacies of racism and sexism, leading to overrepresentation in low-wage, hazardous healthcare jobs [17]. Black women encounter racial discrimination in healthcare settings, including dismissal of pain concerns and unfair treatment based on insurance [18]. Structural barriers, implicit biases, and medical mistrust contribute to reduced participation in health services [19,20]. Addressing these disparities requires comprehensive approaches targeting structural barriers, bias, and socioeconomic factors [21]. These factors contribute to higher healthcare costs related to managing preterm births and their complications.

Interventions like the Pathways HUB Community Action (PHCA) program specifically target these at-risk populations, offering enhanced prenatal care, education, and support that can reduce the incidence of preterm births. In addition, families are partnered with a certified Community Health Worker who is an expert in navigating these complex systems, often learned through their lived experiences. CHWs, often live in the neighborhoods where they work, speaking the common language of the community and understanding the cultural norms in that community. By lowering the preterm birth rate among Black mothers, these programs not only improve health outcomes but also lead to substantial cost savings. The findings of the current investigation underscore the critical importance of culturally competent, targeted interventions in reducing health disparities and associated costs.

Research on the impact of the Pathway HUBs in Ohio needs to continue. Specifically, research on how stress contributes to preterm delivery among minority

women is essential for mitigating these disparities. Also, once the data is available, outcomes beyond the COVID-19 years will likely provide greater cost savings.

4. Conclusion

The HUB creates a network of agencies within communities who replicate an evidenced based model, share data in a unique data system for documentation and tracking, prevent duplication of services, and provide a standard of care which addresses system inequities.

CHWs are the foundation of a PCH. CHWs assess family needs, connect them to resources and services, and provide insight about systemic barriers. Through the documentation of these risk factors, both successfully and unsuccessfully being mitigated, community level data is compiled, providing quantifiable data to create policy and system change. The power of this work allows for communities to work downstream at the individual level to address the factors impacting infant mortality and consequences of preterm/ premature births while working upstream to transform these systems. The cost-savings demonstrated in this analysis provides opportunities for discussions in communities about re- distribution of funds towards upstream efforts or primary prevention such as the PCH.

The model is able to be right sized for individual communities, addressing the health-related social needs in communities beyond infant mortality and preterm births. While much of the Hub work in Ohio began with infant and maternal health, some of the greatest opportunities for cost savings may be in the areas of chronic conditions such as diabetes, hypertension and asthma. Future research could apply the same principles in this study to assess the ROI for individuals with chronic conditions as well as evaluate their most common health related social needs and risk factors in Ohio.

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Appendix

Table A1. Expected cost savings due to reduced prematurity: black infants.

	Expected premature births	Actual premature births	Difference	Cost savings per birth	Cost savings for year
2017	1.63	1	0.63	$63,334	$40,061
2018	8.99	10	−1.01	$64,669	($65,263)
2019	5.86	8	−2.14	$66,050	($141,551)
2020	12.45	5	7.45	$67,831	$505,487
2021	11.79	8	3.79	$69,871	$264,666
2022	18.55	17	1.55	$71,844	$111,282
All years	59.27	49	10.27		$714,682

Table A2. Expected cost savings due to reduced prematurity: white infants.

	Expected premature births	Actual premature births	Difference	Cost savings per birth	Cost savings for year
2017	0.38	0	0.38	$63,334	$24,229
2018	1.87	0	1.87	$64,669	$121,116
2019	0.81	1	-0.19	$66,050	($12,475)
2020	2.57	0	2.57	$67,831	$174,527
2021	4.17	3	1.17	$69,871	$81,618
2022	4.25	3	1.25	$71,844	$89,900
All years	14.06	7	7.06		$478,915

Table A3. Expected cost savings due to reduced prematurity: other infants.

	Expected premature births	Actual premature births	Difference	Cost savings per birth	Cost savings for year
2017	0	0	0	$63,334	$0
2018	1.16	1	0.16	$64,669	$10,119
2019	1.30	0	1.30	$66,050	$86,119
2020	1.47	3	-1.53	$67,831	($103,452)
2021	2.01	2	0.01	$69,871	$803
2022	3.18	3	0.18	$71,844	$12,718
All years	9.12	9	0.12		$6,307

Table A4. Expected cost savings due to reduced prematurity: 2017.

Race	Expected premature births	Actual Premature Births	Difference	Cost savings per birth	Savings
Black	1.63	1	0.63	$63,334	$40,061
White	0.38	0	0.38	$63,334	$24,229
Other	0	0	0	$63,334	$ 0
Total	2.02	1	1.02		$64,290

Table A5. Expected cost savings due to reduced prematurity: 2018.

Race	Expected premature births	Actual premature births	Difference	Cost Savings per birth	Savings
Black	8.99	10	-1.01	$64,669	($65,262)
White	1.87	0	1.87	$64,669	$121,116
Other	1.16	1	0.16	$64,669	$10,119
Total	12.02	11	1.02		$65,973

Table A6. Expected cost savings due to reduced prematurity: 2019.

Race	Expected premature births	Actual premature births	Difference	Cost savings per birth	Savings
Black	5.86	8	-2.14	$66,050	($141,551)
White	0.81	1	-0.19	$66,050	($12,475)
Other	1.30	0	1.30	$66,050	$86,118
Total	7.97	9	-1.03		($67,907)

Table A7. Expected cost savings due to reduced prematurity: 2020.

Black	12.45	5	7.45	$67,831	$505,484
White	2.57	0	2.57	$67,831	$174,526
Other	1.47	3	−1.53	$67,831	($103,452)
Total	16.50	8	8.50		$576,559

Table A8. Expected cost savings due to reduced prematurity: 2021.

Black	11.79	8	3.79	$69,871	$264,665
White	4.17	3	1.17	$69,871	$81,618
Other	2.01	2	0.01	$69,871	$803
Total	17.97	13	4.97		$347,086

Table A9. Expected cost savings due to reduced prematurity: 2022.

Black	18.55	17	1.55	$71,844	$111,282
White	4.25	3	1.25	$71,844	$89,901
Other	3.18	3	0.18	$71,844	$12,718
Total	25.98	23	2.98		$213,901