Assessing Reproductive Health Trends in Maryland from 2010 to 2017

Maryland Department of Health: Maternal and Child Health Bureau
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Abstract
This report examines trends in reproductive health in Maryland from 2010 to 2017. The report explores teenage birth rate, access to early prenatal care, and babies with low birth weight as it is known that there can be negative consequences associated with these factors, or a lack thereof. The report identifies three counties for the Maternal and Child Health Bureau to place focus on: Prince George's, Garrett, and Somerset Counties. Recommendations for public health initiatives in these counties include access to free contraceptives, improved sex and pregnancy education, increased funding for prenatal care centers and transportation to the centers, and partnerships with local county health departments.

Problem
We chose to explore trends in reproductive health -- specifically teen birth rate, access to early prenatal care, and babies with low birth weight --- in the state of Maryland. We chose to look at these variables as we know that there are negative consequences associated with teenage pregnancy, a lack of access to early prenatal care, and babies with low birth weight.

Business Question
How have teen birth rate, access to early prenatal care, and the number of babies with low birth weight impacted the population of Maryland? How can trends and patterns in these variables inform local and/or state policy?

Background
In an average week in Maryland, 1,406 babies are born, 139 babies are born preterm, 120 babies are born at a low birth weight, and nine babies die before the age of one.[1] Although progress has been made over time in Maryland in regards to these variables, there is still a long way for the state to go.

In 2018, the low birthweight rate in the state, 8.8%, did not meet the Healthy People 2020 objective of a rate of no more than 7.8% of live births. Black babies were about two times as likely as white babies to be born at a low birth weight from 2016 to 2018, on average.[2] In 2018, in Maryland, 74.6% of live births were to women receiving early prenatal care, 18.8% were to women starting prenatal care in their second trimester, and 6.6% were to women who received late or no prenatal care at all. Roughly one in six infants was born to a mother receiving inadequate prenatal care in Maryland in 2018.[3]

Teenage pregnancy has been associated with complications during pregnancy and delivery, health problems from poor perinatal outcomes, increased risk of perinatal death, and lower IQ

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[1] March of Dimes. "Quick Facts: Perinatal Overview in Maryland." March of Dimes. Accessed December 16, 2020. https://www.marchofdimes.org/Peristats/ViewTopic.aspx?reg=24&top=1&lev=0&slev=4
[2] March of Dimes. "Quick Facts: Birthweight in Maryland." March of Dimes. Accessed December 16, 2020. https://www.marchofdimes.org/Peristats/ViewTopic.aspx?reg=24&top=4&lev=0&slev=4
[3] March of Dimes. "Quick Facts: Prenatal Care in Maryland." March of Dimes. Accessed December 16, 2020. https://www.marchofdimes.org/peristats/ViewTopic.aspx?reg=24&top=5&lev=0&slev=4

and academic achievement in the child. Children of teenage mothers also have a greater risk of repeating a grade in school, having greater socio-emotional issues, having a fatal accident before the age of one, and starting a family at an early age.[4] Babies born with low birth weight are more likely than babies born at a normal weight to have many health conditions later on in life including heart disease, diabetes, high blood pressure, intellectual and developmental disabilities, obesity, and metabolic syndrome.[5] Access to prenatal care is key in keeping a mother and baby healthy. Early access to prenatal care is also widely regarded as the key in preventing infant mortality. The babies of mothers who do not have prenatal care are three times more likely to have low birth weight and five times more likely to die. Prenatal care also allows doctors to pick up on any health problems a mother or fetus may have during pregnancy and the doctor can therefore treat these issues early on.[6]

Maryland has acknowledged the severity of these reproductive health issues to an extent by passing several state-wide policies in an attempt to improve health outcomes. For teenage pregnancy, the state developed a goal-oriented comprehensive health education instructional program, specifically focusing on sex education in grades 9-12, which represent the teenage years[7]. For prenatal care, the state had enacted a measure that required prenatal care providers to complete implicit bias training to ensure that all mothers are treated properly and equally during their care[8]. For low birth weight, hospitals across the state have partnered with academic institutions to investigate low birth weight in newborns and develop ideas for lowering its prevalence. In 2017, the Mercy Medical Center in Baltimore partnered with the Johns Hopkins Bloomberg School of Public Health, and have set an aim to reduce low birth weight deliveries by 10% by 2020[9].

Despite these policies and regulations, Maryland continues to struggle with high teenage pregnancy rates, poor prenatal care, and many low birth weight deliveries in 2020. According to America's Health Rankings, Maryland currently ranks 15th in the country for teenage pregnancy and 36th for low birth weight[10]. Rankings for prenatal care in 2020 were not available, but 2018 rankings report that Maryland is 44th in the country for prenatal care[11]. Based on these rankings,

[4] Hofferth, Sandra, and Cheryl D. Hayes. *Risking the Future: Adolescent Sexuality, Pregnancy, and Childbearing, Volume II: Working Papers and Statistical Appendices. Risking the Future: Adolescent Sexuality, Pregnancy, and Childbearing, Volume II: Working Papers and Statistical Appendices*. National Academies Press (US), 1987. https://www.ncbi.nlm.nih.gov/books/NBK219236/
[5] March of Dimes. "Low Birthweight." March of Dimes, March 2018. https://www.marchofdimes.org/complications/low-birthweight.aspx.
[6] U.S. Department of Health and Human Services. "Prenatal Care." Office on Women's Health, February 22, 2017. https://www.womenshealth.gov/a-z-topics/prenatal-care.
[7] "Teen Pregnancy Prevention." Maryland State Department of Education, 2020. http://www.marylandpublicschools.org/about/Pages/DSFSS/SSSP/Teen-Pregnancy/index.aspx.
[8] "Major Developments in Sexual & Reproductive Health." State Legislation Tracker. Guttmacher Institute, December 1, 2020. https://www.guttmacher.org/state-policy.
[9] Harvey, Elizabeth M. "Community-Academic Partnership to Investigate Low Birth Weight Deliveries and Improve Maternal and Infant Outcomes at a Baltimore City Hospital." *National Library of Medicine*, February 2017. https://pubmed.ncbi.nlm.nih.gov/27461023/.
[10] "Annual Report." America's Health Rankings. United Health Foundation, 2020. https://www.americashealthrankings.org/explore/annual/measure/Overall_a/state/MD.
[11] "2018 Health of Women and Children Report." America's Health Rankings. United Health Foundation, 2018. https://www.americashealthrankings.org/learn/reports/2018-health-of-women-and-children-report/state-summaries-maryland.

it is evident that Maryland needs to improve its reproductive health outcomes as it falls behind other states in the country by a significant amount, especially for the measures of low birth weight and prenatal care. The severity of potential adverse health effects is high, and for the sake of the state's reputation and the health of its people, Maryland must focus on reducing the prevalence of these measures.

The Maternal and Child Health Bureau of the Maryland Department of Health has the capability to implement improvements for these reproductive health outcomes[12]. In order to do so, the organization must do a thorough analysis of the three metrics -- teenage pregnancy, prenatal care, and low birth weight -- in order to ideate more complex, effective policies to address the issues. This report serves as an analysis of the three measures from 2010 to 2017 for the Bureau to use.

Data Overview
General Information
This report includes an examination of general trends of these measures through the years, a visualization for percent change of the measures throughout the years, and a cluster analysis to assess which specific areas within the state need the most attention.

Metrics
Teenage pregnancy/birth rate (the two terms were used interchangeably) was measured using the rate of births to female teenagers aged 15-19 years (per 1,000) population. Access to early prenatal care was measured using the percentage of pregnant women who received prenatal care beginning in the first trimester of pregnancy. Babies with low birth weight was measured by looking at the percentage of live births that were at a low birth weight: 2500 grams or less. All metrics were from 2010-2017.

Data Source
We used data from the Maryland Open Data Portal because it was very comprehensive and open to the public[13]. We decided to look at the SHIP – State Health Improvement Process – data sources as they were fairly consistent across variables. There were a variety of datasets related to reproductive health and women in Maryland, but we decided that the data on teen birth rate, babies with low birth weight, and access to early prenatal care would likely be the most straightforward to aggregate. It is important to note that the data appeared to be inconsistent across races when looking at all three data sets, so we chose to only focus on the "all races/aggregated" sections.

Data Analysis Methods
1. Line Graph Visualizations: These graphs depict trends in the three selected variables over time and help understand the severity of the issue.
2. Bar Graph Visualizations: These graphs depict the percent change in the three selected variables over time. They put the line graphs into more context by illustrating how much

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[12] "Maternal and Child Health Bureau." Maryland Department of Health, July 2020. https://phpa.health.maryland.gov/mch/Pages/home.aspx.
[13] Maryland.gov. "Open Data Portal." Open Data Portal. Accessed December 17, 2020. https://opendata.maryland.gov/.

progress counties have made between 2010 and 2017. They help narrow focus by highlighting counties that have not made much progress at all.

3. Cluster Analysis: This analysis categorizes counties in groups based on similar trends. This allows us to determine if the counties identified as needing the most help from the percent change analysis belong to a group of counties with similar trends that also need the most help.

It is important to note that there are 24 counties in Maryland, and while all counties require improvements, the data visualizations with all the counties became complex to interpret. To address this issue, we decided to include **only the five largest and five smallest counties** in our visualizations. The five largest counties will represent the bulk of what the state needs, and the five smallest counties will represent the more forgotten areas that need attention. The cluster analysis will accommodate for the lack of analysis for the other 14 counties, as we group the counties together based on similar trends.

The five largest, in descending order, are Montgomery County, Prince George's County, Baltimore County, Baltimore City, and Anne Arundel County. The five smallest counties in Maryland, in descending order, are Caroline County, Dorchester County, Garrett County, Somerset County, and Kent County[14].

Note: In the visualizations, we refer to counties as "Jurisdictions."

Data Findings and Interpretation
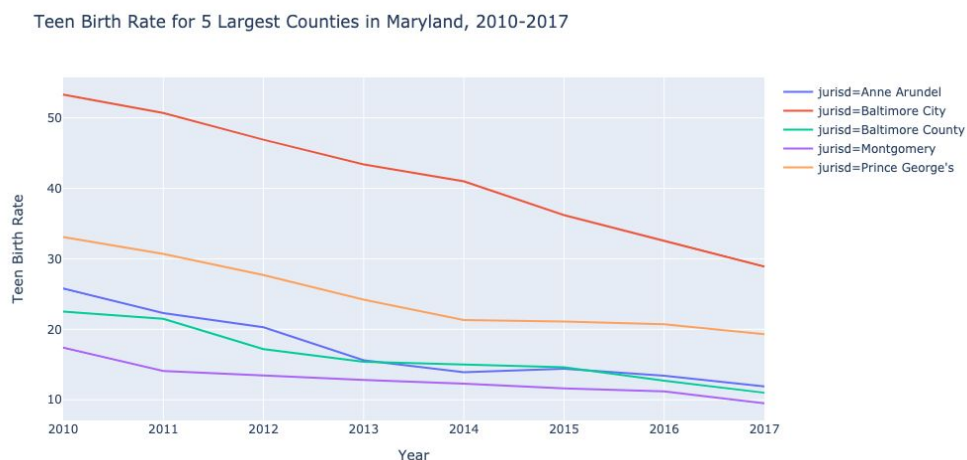*Trends and Percent Change in Teen Birth Rate*

Figure 1: Teen birth rate for 5 largest counties in Maryland, 2010-2017

From the data, we were able to see that teen birth rate has declined significantly in the five largest counties in Maryland from 2010 to 2017. Of the five counties, Baltimore City has the highest teen birth rate, at 53.3 in 2010 and 28.9 in 2017. The second highest teen birth rate was for Prince George's County, which was at 33.1 in 2010, and dropped down to 19.3 by 2017. Anne Arundel and Baltimore County were fairly comparable, at 25.8 and 22.5 in 2010,

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[14] Maryland Demographics by Cubit. "Maryland Counties by Population." Maryland Demographics. Accessed December 16, 2020. https://www.maryland-demographics.com/counties_by_population.

respectively, and eventually falling to 11.9 and 11.0 in 2017 with some overlap in the years between. Montgomery County had the lowest teen birth rate of the five, at 17.4 in 2010 and 9.5 in 2017. There is clearly a large discrepancy here between Baltimore City and Montgomery County, as in 2017, Baltimore City's teen birth rate was roughly three times higher than that of Montgomery's.
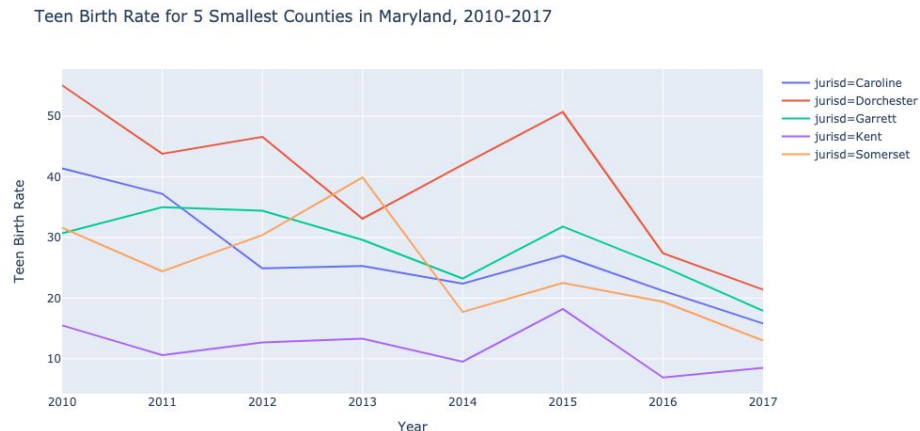

Figure 2: Teen birth rate for 5 smallest counties in Maryland, 2010-2017

There was a lot of variability over the years in teen birth rate for the five smallest counties in Maryland. All five counties ended with a lower birth rate in 2017 compared to when the study began collecting data in 2010 which can be regarded as a positive. Dorchester County had the highest teen birth rate, at 55.1 in 2010– which was higher than even Baltimore City at the time– and 21.4 in 2017. In 2010, Caroline County had the second highest birth rate (41.4), then Somerset County (31.6), then Garrett County (30.7), and finally Kent County at 15.5. From 2010 to 2014, there did not appear to be an overarching trend as teen birth rate fluctuated considerably for all five counties. Something to note here is that Somerset County appeared to have a large spike in teen birth rate from 2011 at a rate of 24.4 to 2013 at 39.9. All five counties presented a spike in 2015, with a rate of 50.7 in Dorchester, 31.8 in Garrett, 27.0 in Caroline, 22.5 in Somerset, and 18.2 in Kent. In 2017, all counties except Kent reached their lowest point, at 21.4 for Dorchester, 17.9 for Garrett, 13.0 for Somerset, and 8.5 for Kent.
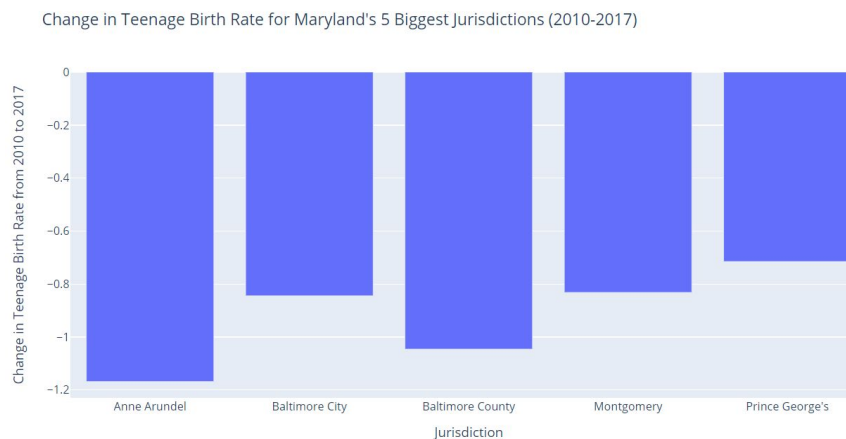

Figure 3: Change in Teen birth rate for 5 biggest counties in Maryland, 2010-2017
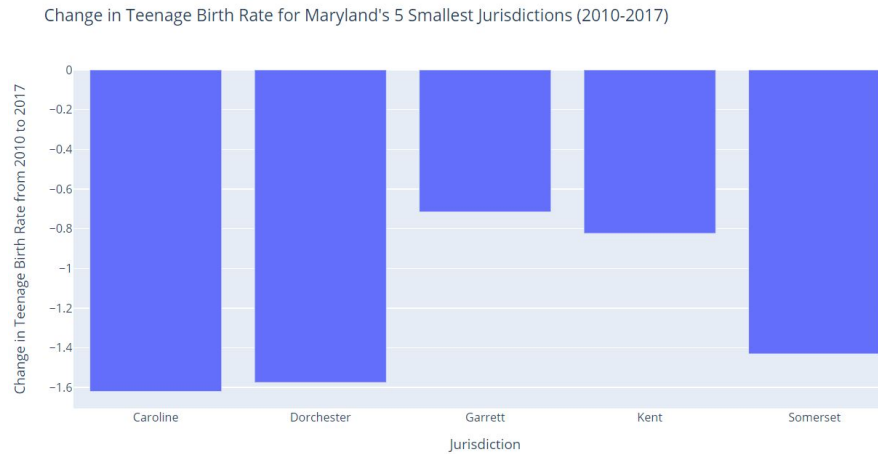
Figure 4: Change in Teen birth rate for 5 smallest counties in Maryland, 2010-2017

These trends can be seen more easily through these percent change visualizations. These charts show the change in teenage birth rates for the five biggest and five smallest counties from 2010 to 2017. All ten counties showed at least a 0.6% decrease in teen birth rates from 2010 to 2017, indicating progress for this particular health outcome. Caroline and Dorchester Counties, which are both among the smallest five, displayed the most decrease, with approximately 1.6% of a drop. The next highest decrease was 1.2%, displayed by Anne Arundel County, which is one of the biggest five counties.

Although all the counties' teen birth rates decreased from 2010 to 2017, the Maternal and Child Health Bureau should still focus on a few counties with the least amount of reduction in rates. These would be Prince George's County (~0.7% decrease), Garrett County (~0.7% decrease), and Kent County (~0.8% decrease).

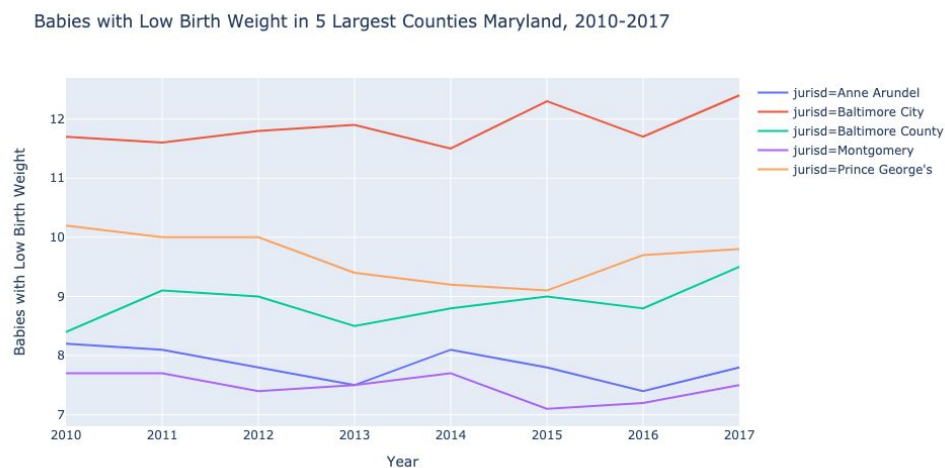*Trends and Percent Change in Babies with Low Birth Weight*

Figure 5: Babies with low birth weight in 5 largest counties in Maryland, 2010-2017

The percentage of babies with low birth weight had less variability for the five largest counties in Maryland. In 2010, the percentages were the largest for Baltimore City (11.7%), then Prince George's County (10.2%), then Baltimore County (8.4%), then Anne Arundel County (8.2%), and finally Montgomery County (7.7%). The percentage of babies with low birth weight were actually higher by 2017 for both Baltimore City (12.4%) and Baltimore County (9.5%). In 2017, the percentage of babies with low birth weight was 12.4% for Baltimore City, 9.8% for Prince George's County, 9.5% for Baltimore County, 7.8% for Anne Arundel County, and 7.5% for Montgomery County.
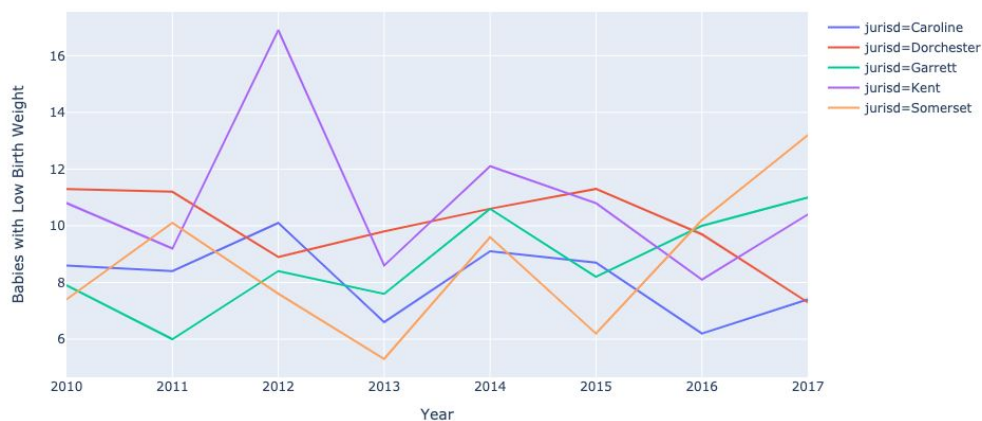
Figure 6: Babies with low birth weight in 5 smallest counties in Maryland, 2010-2017

There was much more variability in babies with low birth weight for the five smallest counties in Maryland. In 2010, the percentage of babies with low birth weight was 11.2% for Dorchester County, 10.8% for Kent County, 8.6% for Caroline County, 7.9% for Garrett County, and 7.4% for Somerset County. There is no clear trend for the five smallest counties for this variable as the percentage of babies with low birth weight fluctuated from year to year. In 2011, Somerset County appeared to have a small spike at 10.1%; Somerset County had its lowest percentage in 2013 at 5.3% but then had its lowest percentage two years later at 8.6%. In 2012, Kent experienced a large spike in the babies with low birth weight at 16.9%. In 2017, the percentage of babies with low birth weight was higher than from when the study started for two counties: Somerset (13.2%) and Garrett (11.0%). The percentage of babies with low birth weight was lower than from when the study started for the remaining three counties: 10.4% for Kent, 7.3% for Dorchester, and 7.4% for Caroline.

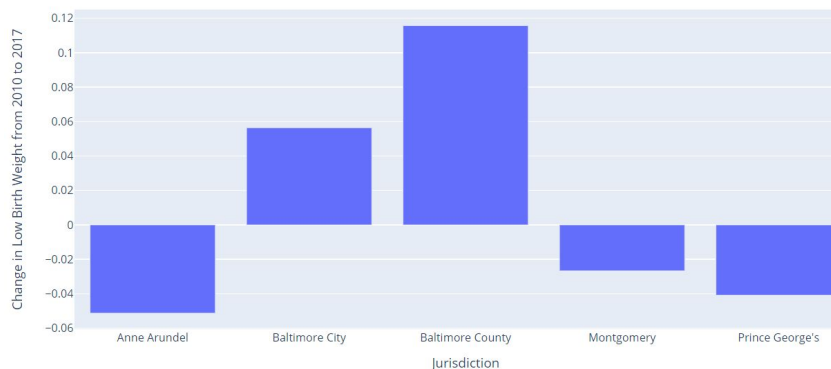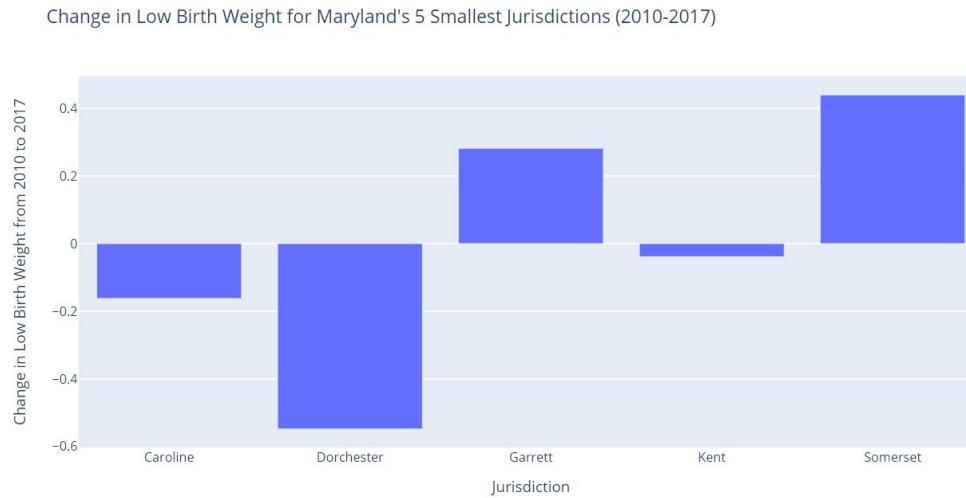Change in Low Birth Weight for Maryland's 5 Smallest Jurisdictions (2010-2017)

Figure 8: Change in Babies with low birth weight in 5 smallest counties in Maryland, 2010-2017

These percent change charts visualize this information more clearly. Four out of the ten counties experienced an increase in low birth weight: Baltimore City (+0.06%), Baltimore County (+0.12%), Garrett County (+0.3%), and Somerset County (+0.4%). It is interesting that it was the smaller counties, Garrett and Somerset, that displayed a larger increase in low birth weight, rather than the larger, more metropolitan areas like Baltimore City and Baltimore County. This suggests that the Maryland Department of Health should focus on Garrett and Somerset Counties when developing solutions for this particular metric.

Trends and Percent Change in Access to Early Prenatal Care

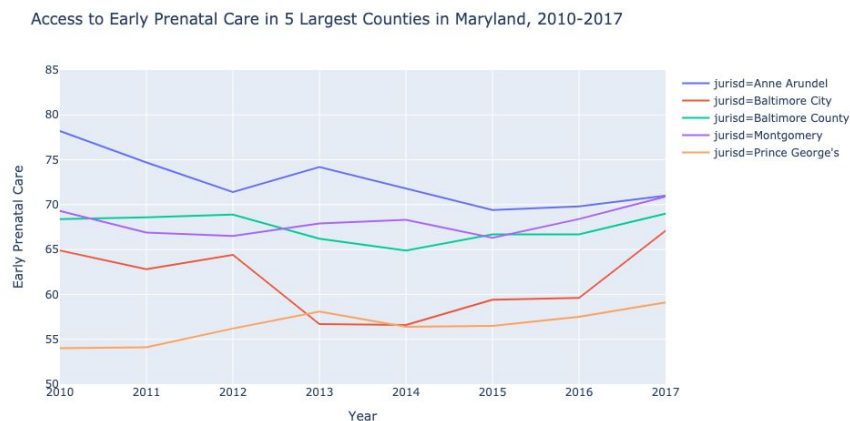Access to Early Prenatal Care in 5 Largest Counties in Maryland, 2010-2017

Figure 9: Access to early prenatal care in 5 largest counties in Maryland, 2010-2017

Access to early prenatal care varied from county to county in the five largest counties in Maryland. In 2010, access was at 78.2% for Anne Arundel County, 69.3% for Montgomery County, 68.4% for Baltimore County, 64.9% for Baltimore City, and 54.0% for Prince George's County. By 2017, access to early prenatal care actually fell for Anne Arundel at 71%. Access to early prenatal care fluctuated over the years considerably for Baltimore City, dropping slightly in

2011, rising slightly in 2012, dropping significantly in 2013 (56.7%), and slowly rising to 67.1% in 2017. Access to early prenatal care rose slightly for the three remaining counties by 2017, at 70.9% for Montgomery, 69.0% for Baltimore County, and 59.1% for Prince George's.
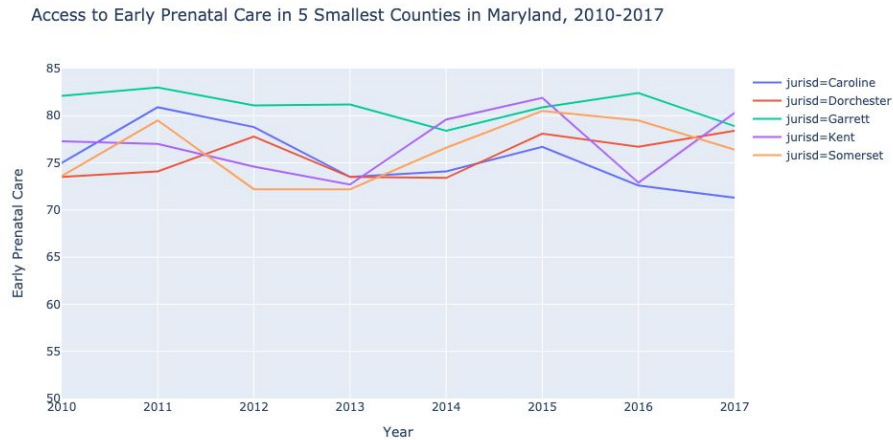

Figure 10: Access to early prenatal care for smallest 5 counties in Maryland, 2010-2017

Access to early prenatal care stayed relatively high for the five smallest counties in Maryland. In 2010, access to early prenatal care was 82.1% for Garrett County, 77.3% for Kent County, 75% for Caroline County, 73.6% for Somerset County, and 73.5% for Dorchester County. Access increased and decreased between 2010 and 2017, but overall, the percentages did not change very much for all five counties. However, Kent did experience a drop in access in both 2013 (72.7%) and 2016 (72.9%), before eventually reaching 80.3% in 2017. In 2017, access to early prenatal care was 80.3% for Kent County, 78.9% for Garrett County, 78.4% in Dorchester County, 76.4% in Somerset County, and 71.3% in Caroline County.
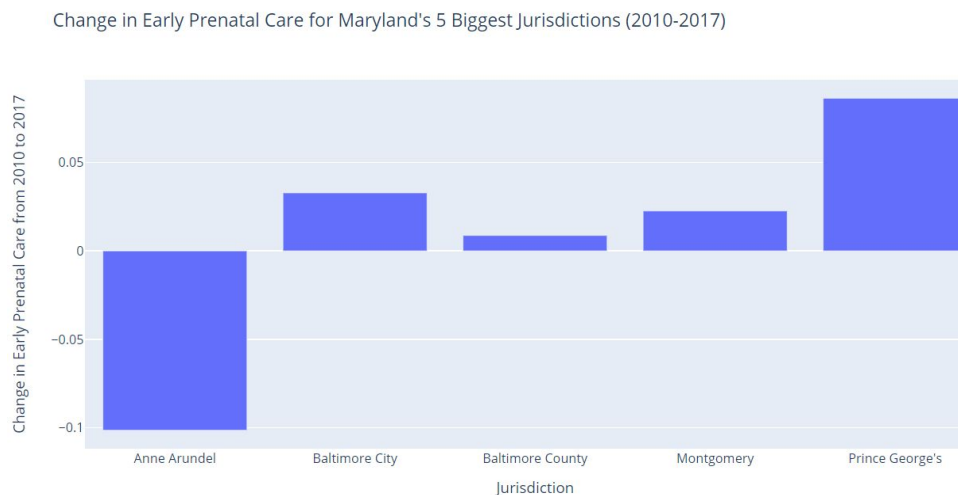

Figure 11: Access to early prenatal care for biggest 5 counties in Maryland, 2010-2017
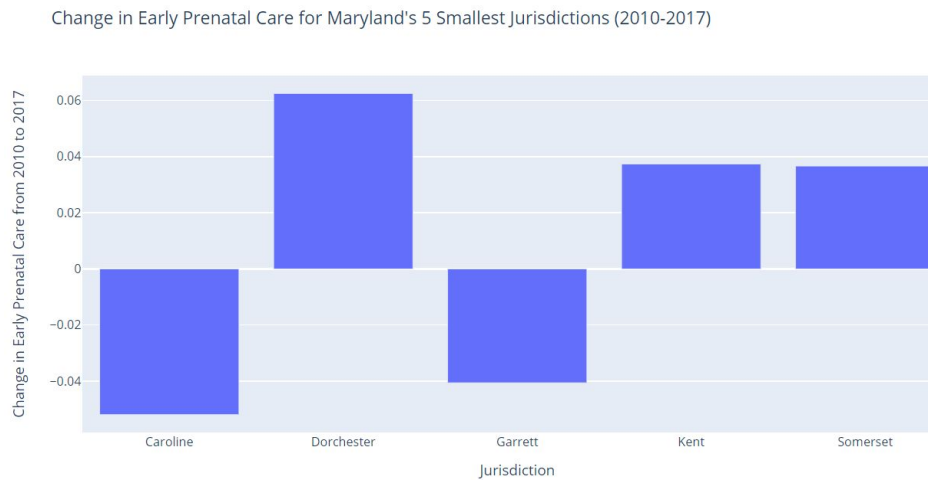
Figure 12: Access to early prenatal care for smallest 5 counties in Maryland, 2010-2017

Looking at the percent change visualizations, it is clear that most of the counties improved their prenatal care services, with seven out of the ten counties having a positive percent change. However, the change was not very large; all seven counties showed less than 0.1% of a change. This suggests that even though the counties had an improvement, they still have more to work to do. While it is still important that they continue to address the issue, the three counties that showed a decrease in early prenatal care (Anne Arundel, Caroline, and Garrett) require the most attention. Caroline and Garrett Counties (among the five smallest counties) decreased by approximately 0.04%, while Anne Arundel County's prenatal care decreased as much as 0.1%.

Cluster Analysis
When the three metrics were examined separately, several counties appeared to be of concern:

Based on General Trends
High Rate of Teenage Pregnancy: Baltimore City and Dorchester County
High Level of Low Birth Weight: Baltimore City, Garrett, and Somerset
Low Level of Prenatal Care: Prince George's

Based on Percent Change
Increased Rate of Teenage Pregnancy: Prince George's, Garrett, and Kent
Increased Level of Low Birth Weight: Garrett and Somerset
Decreased Level of Prenatal Care: Anne Arundel, Caroline, and Garrett

For teenage pregnancy, Baltimore City and Dorchester County had the highest levels by 2017, but it was Prince George's, Garrett, and Kent Counties that displayed the most increase, which also indicates the necessity for improvement. For low birth weight, the analyses showed that Garrett and Somerset both had the highest levels of low birth weight and had increased the most over the years. For prenatal care, Prince George's County had the least amount of prenatal care by 2017, but it was Anne Arundel, Caroline, and Garrett Counties that displayed the most decrease, which also indicates the necessity for improvement.

Based on this, we concluded that Prince George's, Garrett, and Somerset Counties would be interesting to examine further by assessing how these counties fit into categories in comparison to the whole state, calling for a cluster analysis. The cluster analysis indicated that all three of these counties belonged to groups that had relatively poor outcomes for all three metrics.

To elaborate, the cluster analysis highlighted that in 2017, Prince George's County fit into a group of counties with very slightly lower teenage birth rates, significantly higher amounts of low birth weight, and significantly lower amounts of prenatal care than the average for the state. This aligns well with the findings from the trend and percent change analysis. Garrett and Somerset Counties both fit into a group of counties with moderately higher teen birth rates, moderately higher low birth weight levels, and slightly less early prenatal care, which also aligns well with the analyses conducted in this report.

Therefore, we suggest that the Maternal and Child Health Bureau of the Maryland Department of Health focuses its attention on developing solutions for Prince George's, Garrett, and Somerset Counties. After evaluating the effectiveness of the potential solutions, the Bureau can continue developing its solutions for the other counties of concern highlighted in this report.

Recommendations and Impact

We recommend these four initiatives in order to see better progress in the reproductive health outcomes:
1. Free Contraceptives in Public Secondary Schools
2. Strengthened Sex & Pregnancy Education
3. Increased Funding for Building Prenatal Care Centers & Providing Transportation
4. Partnerships with Local County Health Departments

We recommend setting a goal to complete developing these initiatives by December 2025, with check-ins every 6 months.

Initiative #1
This initiative mainly addresses teen birth rate. Teens often struggle to pay for protection because of its price, so providing free contraceptives in schools will relieve them from this financial burden. Vermont, a state that typically has controlled teen birth rates, had signed a measure to provide free contraceptives in public secondary schools, suggesting that this could be effective for Maryland as well.[10]

A bulk 100-pack of condoms will cost about $60 each.[15] Assuming that there are about 3,000 students in each public secondary school, and each student uses 1 condom for each school day, that would cost about $400,000 ([3000 students *180 days of school] / [100 in a pack * $60 per pack]) per school per year. There are about 35 public secondary schools in all three counties combined,[16] so this would come out to about $14 million per school year.

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[15] "Trojan ENZ Lubricated: 100-Pack of Condoms BULK." Condoms. Amazon , 2020. https://www.amazon.com/Trojan-ENZ-Lubricated-100-Pack-Condoms/dp/B0007W7KZO.
[16] "School Directory." PGCPC. Prince George's County Public Schools, 2019. https://schools.pgcps.org/schools/.

A potential goal to get this initiative started is December 2022, and to have it fully developed and running smoothly by December 2024.

Initiative #2
In order to ensure that the teens actually make use of the free contraception, the Bureau should strengthen the sex education programs that already exist in public schools. More informed sex education could release stigma around contraceptives and actually encourage teens to use protection, which would work to decrease the teen birth rate.

The Bureau should go a step further than most programs by including pregnancy-specific education within the curriculum. This would consist of information such as what pregnant women should and should not do, how a mother and father should prepare for when the baby arrives, etc. It is important that both men and women attend these educational programs. A book titled *Preventing Low Birthweight* writes that a healthy pregnancy and baby is not just a woman's responsibility, but rather a shared effort.[17] The book confirms that these kinds of pregnancy education and planning programs can help reduce the levels of low birthweight.

Holding these educational and planning programs will cost money for hiring teachers for these particular classes. The average yearly salary for a teacher in these counties is $60,000, and since there are about 35 public secondary schools in the counties, it would cost $2.1 million per year to hold these programs (assuming there is only one teacher hired per school).[18]

A potential goal to complete this initiative is December 2023.

Initiative #3:
In regards to prenatal care, the Bureau should also allocate more funding towards building prenatal care centers.[17] These centers should include gynecologists, preventive public health specialists, and other relevant healthcare professionals. They should be well-connected with the counties' social workers, mental health resources, hospitals, and other things that could add to a fulfilling, effective prenatal care experience.

Access to prenatal care can be improved significantly with more transportation.[17] In addition to building the centers, funding should be placed into creating stops in public transportation that provide easy access to the centers.

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[17] *Preventing Low Birthweight.* Washington D.C.: National Academies Press (US), 1985. https://www.ncbi.nlm.nih.gov/books/NBK214456/.
[18] "Prince George's County Public Schools Teacher Yearly Salaries in Maryland." Prince George's County Public Schools. Indeed, 2020. https://www.indeed.com/cmp/Prince-George%27s-County-Public-Schools/salaries/Teacher/Maryland.

This would be the costly initiative out of the four suggestions. Building at least one center in each county will cost about $1 million,[19] and employing all the specialists and as well as drivers for the transportation services will cost about $20 million.

This initiative will take the longest to complete; a potential goal is to complete building the centers by December 2024 and develop the transportation program by December 2025.

Initiative #4:

Establishing partnerships with local county health departments will hold the Bureau accountable and help evaluate the initiatives for effectiveness.[17]

This will not be of any cost for the Bureau, but it will take a few months to settle the partnerships. A potential goal is to complete this initiative by June 2021.

Appendix
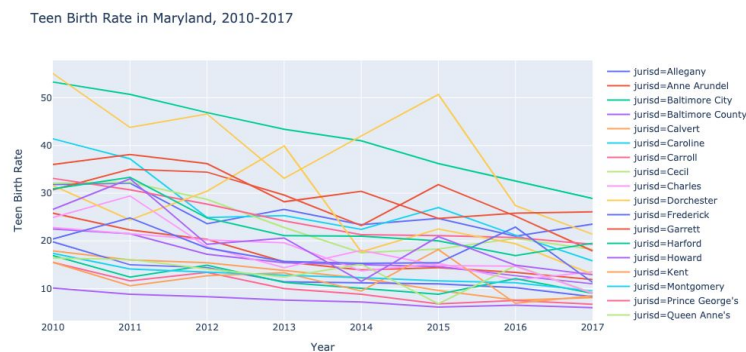
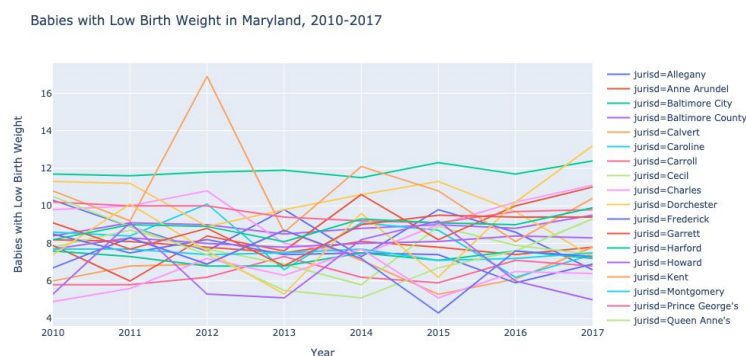*Figure 13 :* Teen birth rate for all counties in Maryland, 2010-2017

Figure 14 : Babies with low birth weight for all counties in Maryland, 2010-2017

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[19]"How Much Does It Cost to Open an Urgent Care?" Experity. Experity Health, 2020. https://tinyurl.com/yae22z73.
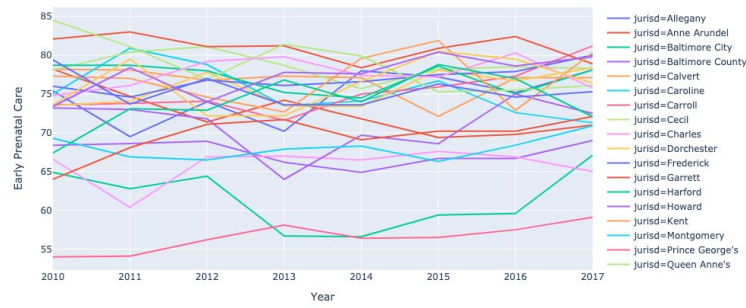
Figure 15 : Access to early prenatal care for all counties in Maryland, 2010-2017
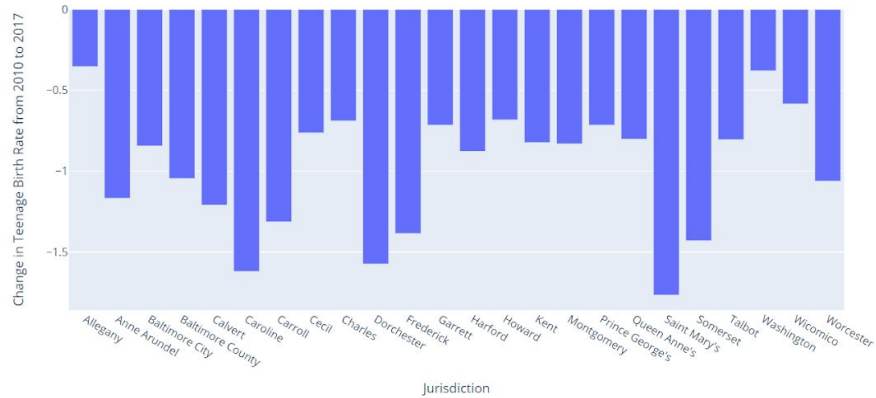
Figure 16 : Change in Teen birth rate for all counties in Maryland, 2010-2017
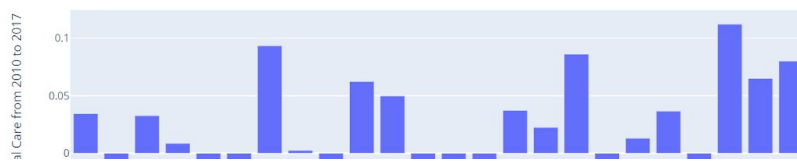

Figure 17 : Change in Low Birth Weight for all counties in Maryland, 2010-2017

Excel Directions:
General
1. Import SHIP data into Excel
2. Only use data on "all races/aggregated" for all three variables

Cluster Analysis
1. Download SHIP data from Maryland Open Portal for teenage birth rate, early prenatal care, and low birth weight for each county in Maryland from 2010-2017.
2. Use VLOOKUP to consolidate the data from the three datasets into one spreadsheet, based on jurisdiction/county name.
3. Add z_tbr, z_epc, and z_lbw columns (tbr = teenage birth rate, epc = early prenatal care, lbw = low birth weight)
4. Calculate the mean and standard deviation for each of the three variables: tbr, epc, and lbw.
5. Calculate the z-scores for each of the variables for each of the counties to measure the distance of each of the values from the mean using the STANDARDIZE function.
6. Number each of the counties 1-24 by adding a column "anchor number" next to the county names.
7. Choose four random counties and write the corresponding number down. These would be anchors 1, 2, 3, and 4.
8. Using VLOOKUP, fill out all of the z-scores for each of the variables for the four selected counties.
9. Calculate the distance squared for each of the 24 counties' z-scores from the z-scores of anchors 1, 2, 3, and 4 using the SUMXMY2 function.
10. Calculate the lowest distance squared among each of the anchors for each county and match that minimum number with the corresponding randomly chosen anchor numbers using the MIN and MATCH functions.
11. Calculate the sum of the minimum distance squared for all of the counties and used that as the objective for the Solver tool.
12. Use the Solver tool to determine what the actual anchors are for the data – anchors that correctly represent the four distinct clusters. Set constraints for the values to be >= 1, <= 24, and an integer.
13. Use the new anchors to analyze and interpret the data.

Python Directions:
Trends Analysis
1. Import data for data analysis (teen birth rate, low birth weight, and prenatal care data)
2. Teen birth rate=TBR; low birth weight=lbw; prenatal care=pnc
3. Rename column values for each data set to reflect variable
4. Use len() function to see how many rows of data there are in each dataset
5. Use pd.merge function to merge TBR and PNC datasets together, name this df_2
6. Drop redundant columns
7. Use info function to see data types
8. Change "Year" column to be the same data type in both datasets
9. Use concat function to merge pnc/tbr datasets with lbw, name this df_all
10. Drop unnecessary columns
11. Rearrange columns so variable columns are at the end
12. Rename columns to desired format
13. Create new df without the "State" values, name this df_all_races
14. Create line graph for all counties tbr
15. Create line graph for all counties pnc
16. Create line graph for all counties lbw
17. Repeat for 5 largest counties, all three variables
18. Repeat for 5 smallest counties, all three variables

https://colab.research.google.com/drive/1rCYgMpQ4OhVQOAhwA8zNrKPrlClOcgUA?usp=sharing

Percent Change Analysis
Annotations for steps included in the Google Colaboratory:
https://colab.research.google.com/drive/1QUmTvWJn7qQ4KBY9saS84pE6xG56tdcX?usp=sharing