

Visualizing Contraceptive Use Trajectories in Kenya

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Extended Abstract

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Note: The visualization tool is a work in progress and we are hoping to use PAA to understand how useful this method will be.

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Abstract

Objective: Apply a novel approach to visualizing contraceptive histories from the Demographic and Health Surveys (DHS) contraceptive calendar that illuminates trajectories of contraceptive use.

Method: This paper makes use of the contraceptive calendar from the 2014 Kenya Demographic and Health Survey (DHS). We used R and R Shiny and the chorrdiag package to create interactive data visualizations of contraceptive use trajectories.

Results: We find that interactive chord diagrams are visually appealing, easy to understand, and provide greater ability for users to investigate contraceptive trajectories from the DHS.

Conclusion: The chord diagram is a potentially useful way to visualize women's contraceptive trajectories and provides additional insights to a single, static indicator of contraceptive discontinuation.

Introduction

In low-income countries, one-third of women who initiate a modern method of contraception discontinue within the first year, and half discontinue within the first two years, putting them at risk for unintended pregnancies, and maternal morbidity and mortality (Bradley 2009, Castle & Askew 2015).

Data on contraceptive discontinuation is collected through the contraceptive calendar module from the Demographic and Health Surveys (DHS). The contraceptive calendar is a retrospective, monthly reporting of contraceptive use, births and reasons for discontinuation. These data can be difficult to navigate, especially for family planning advocates and practitioners who lack advanced data analysis skills but could benefit from more explanatory data to plan programs and advocacy campaigns directed to the use of family planning.

The goal of this paper is to describe a novel, interactive method for visualizing the DHS contraceptive calendar, the chord diagram.

Data & Methods

Data

The Demographic and Health Survey (DHS) is the gold standard in population health research. Surveys are repeated cross sections of a country's reproductive age female population that is population representative at the national, sub-national and urban and rural level. The DHS has been collected across more than 80 countries. Each survey contains demographic information about women including their level of education, marital

status, fertility preferences and contraceptive use. In this paper, we focus on the contraceptive calendar from the DHS. The contraceptive calendar is a retrospective reporting of contraceptive use and pregnancies in each month for the five years prior to the survey. In more recent surveys, women who say they have stopped using a method of contraception are asked to enumerate the reason for discontinuation. This paper uses the contraceptive calendar from the 2014 Kenya DHS.

Methods

We created event files from the DHS calendar data where each row represents a person-month. We subset the data to include only contraceptive use that is reported after one month of non-use. For example, in January 2014 a woman may report using the pill. She is included in the sample if she reports non-use of any method in December 2013, the month prior. The data is then subsetted to only the person months during the first month of use, 6- and 12-months later. If a women has more than one period of non-use followed by a period of use, each trajectory is included as a separate observation. We take this data and create an adjacency matrix which shows transitions in contraceptive use between the first month of reported use and 6- and 12-months later aggregated across all common trajectories between baseline and 6 months and baseline and 12 months. Only women with reported values at baseline, 6- and 12-months are included in the sample. Women who never report contraceptive use are excluded.

We visualize these trajectories using R, an open source coding platform, with the R Shiny (R Core Team 2013) and chorddiag (Flor 2018) packages loaded to create the interactive chord diagram. A chord diagram is essentially a circular visualization of flows from one

period to another, read from left to right. The chord diagram encodes the beginning period on the left side of the circle and the ending period on the right side of the circle. The starting population and ending population contain the same number of women so the circle is split directly in half by the two periods. To easily find the difference between the starting and ending period, the user can find the place where the labels go in opposite directions around the circle. This should be at the very top and very bottom. The chord diagram encodes the size of flows from one period to the next by the width of the “chord” which connects the starting period to the subsequent analysis period. The color of the chord is set to match the starting period so the user can easily see the direction of flows.

Contraceptive methods are organized in order of effectiveness with typical use from Trussell (2004) with darker colors indicating higher efficacy. In the interactive version of the chord diagram, the user can mouse over a contraceptive method to highlight specific flows to or from that method over time and see both the number of women and the directionality. When a chord arcs to the right of a method, this indicates women who switched to a less effective method. When a chord arcs to the left of a method, this indicates women who switched to a more effective method. If women continued their initial method, the chord draws a line the size of the non-switching population to the same method on the right hand side of the circle.

We present frequencies weighted by the sampling weight given by the DHS.

Results

Figure 1 displays three screen captures of the application. The panel on the top left shows the aggregate contraceptive trajectories between baseline and 6 months. The size of each

curved bar around the circumference represents the number of users of each method. The line for injections is the largest which means they are the most frequently used, though they are not the most effective method available indicated by their medium dark color. The light colored region indicating methods with low efficacy grows from baseline to 6 months making it easy to see that switching tends to be towards less effective methods or, more typically, non-use. The top right of Figure 1 shows a screen capture of hovering the mouse over users of the pill at baseline. Note that while most users are still using the pill 6 months later, more of those who stop using the pill choose methods that are less effective than the pill than those that are more effective than the pill. This pattern of frequency is encoded by the thickness of the chord connecting the pill at baseline to less effective methods at 6 months, shown by the lighter color.

The bottom left of Figure 1 shows the same baseline users 12 months later. Similar patterns emerge as those who switch or quit within the first 6 months. At 12 months, Terminated pregnancy emerges as a category. In the interactive version, the user can hover over each chord to compare values between each time period.

Discussion

We found that a visualization of contraceptive use, switching and discontinuation as flows from one period to the next using a chord diagram shows a richer picture of contraceptive trajectories than failure rates alone.

Chord diagrams are becoming popular for visualizing migration which is another demographic quantity characterized by stocks and flows (Abel & Sander 2014). The similarities between migration and contraceptive trajectories make the application of chord diagrams to contraceptive behaviors particularly useful.

It should be noted that there are documented caveats to using the contraceptive calendar data to track individual contraceptive use (Callahan & Becker 2012). Aggregated statistics appear to suffer from less bias from retrospective reporting (Strickler, et al. 1997), though this may vary across populations. Since we show aggregated statistics, the data should be no more biased than traditional hazard models. In later iterations, we could limit the methods shown to only those with 30 or more users.

Before PAA, we intend to work with additional groups of stakeholders who would use this visualization to understand whether it is intuitive and meets their needs. We also plan to make additional iterations to the visualization including adding reasons for discontinuation.

Conclusion

The chord diagram is a potentially useful way to visualize women's contraceptive trajectories and can provide additional insights to a single indicator of contraceptive

discontinuation. It is still necessary to calculate the hazard of discontinuation using DHS data.

This interactive visualization provides a dynamic rather than static look at contraceptive trajectories that, in the hands of practitioners, researchers and family planning advocates, can help generate new insights into the contraceptive trajectories that women experience throughout their reproductive lives. The ability to visualize a cohort of women's contraceptive decision making in detail has important implications for supply chain, health worker development, budget priorities, and contraceptive guidelines. Better knowledge about country specific trends and questions will allow family planning programmatic investments to reach more women and girls.

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