Background: Long-acting reversible contraceptives (LARCs) are contraceptive methods that can be used for 3 to 10 years and have a <1% clinical failure rate making them amongst the most effective reversible contraceptive methods. There is increased interest and discourse surrounding LARCs, particularly amongst policymakers and stakeholders in the global public health community who hail LARCs for their efficacy in reducing unintended pregnancy and their potential for realizing demographic and public health goals. Various African governments through initiatives like Family Planning 2020 and 2030 have made commitments to implement LARC promotion and education, create demand, increase human resources for LARC counseling and referrals, and set targets for LARC use. Through multi-donor initiatives such the Implant Access Program, LARCs are also becoming more affordable and accessible.

These commitments and efforts are reflected in increasing proportions of LARC users in many African countries. There has been a strong and sustained uptrend in LARC use compared to other methods in the region. Using Demographic and Health (DHS) survey data; in Kenya, these methods went from 2.3% (IUD) and 7.1% (implant) in 2014 to 4% (IUD) and 19% (implant) in 2022. In Burkina Faso in 2010, the IUD and implant were 0% and 3%, in 2021 they rose to 2% and 16%, respectively. The IUD and implant moved to 2% and 27% (2019/20) (versus 0.4% and 4.7% in 2014/15) in Rwanda.

Despite the increased use of LARCs in Africa, little is known about user's experiences with LARCs compared to other methods. Studies, mainly from the US and Europe, have highlighted concerning trends related to LARCs, including provider bias, a 'method' first approach, undermining patient choice, and refusal to remove these methods (Morison, 20220; Higgins et al., 2016; Burgess et al., 2021; Mann et al. 2019). Some groups are more likely to experience coercion than others, including low-income individuals, people of color, those with physical or intellectual disabilities, drug and alcohol users and incarcerated persons (Dehlendorf et al., 2010; Gomez et al., 2014; Burgess et al., 2021). The few studies in Africa have identified similar trends. Senderowicz (2019) found indications of contraceptive coercion, including target-driven approaches, directive counseling, threats, refusal to remove the method, and LARCs being inserted without the patients consent/ knowledge. In Burkina Faso, Bullington et al. (2023) found that some IUD and implant users were not using the method they originally wanted. In Tanzania, providers were less likely to counsel postpartum women on methods other than the IUD (Senderowicz et al., 2021).

This paper draws on a reproductive justice framework to address knowledge gaps in understanding LARC user's experiences and contraceptive behavior – discontinuation, switching, and failure - when compared to other methods using data from Kenya. As the number of users increases, it is important to understand if LARCs meet user's needs and allow them to achieve their reproductive goals, both in terms of intended and unintended pregnancy. It is also important to understand if some of the troubling findings reported elsewhere are present in the African context. How long do individuals use a method before switching and discontinuing and why do they discontinue? Patterns of early LARC discontinuation can highlight dissatisfaction, negative side effects, potential coercion, or perhaps a lack of knowledge regarding their long-acting nature. What methods LARC users switch to when compared to short-acting users may also inform knowledge and satisfaction with long-acting/ provider-initiated methods versus short-acting/ self-initiated methods. How common is method failure and what are the pregnancy outcomes of failure? Is failure or discontinuation associated with sociodemographic characteristics? Few studies have interrogated whether LARC perfect-use is similar to typical-use and reflects users' likelihood of becoming pregnant while using a LARC (Polis et al., 2016). Understanding typical-use LARC failure can highlight the potential for unintended pregnancy as the number of users increases and inform family planning and maternal health programming. Kenya was chosen due to the recency of the data, its inclusion as an FP2030 focus country, and the increase of LARC users in the past decade.

Methods: This paper uses contraceptive calendar data from the Kenya 2022 DHS. Calendar data includes detailed histories of reproductive use and other sexual and reproductive health indicators in month-to-month calendars. It collects information on pregnancies, births, terminations (miscarriage, abortion, or stillbirth), and episodes of contraceptive use including the method being used and self-reported reason for discontinuation for the previous 5 years (2017-2022). This paper

employs uses both multiple-decrement life tables and a time-discrete event history analysis. Here, life tables act as a descriptive analysis of the data while event history analysis is used to estimate the effects of covariates on failure, discontinuation and switching rates. The life tables measure the cumulative proportion of episodes that are discontinued, fail, or switched from. Event history analysis measures the hazard of failure, discontinuation, and switching.

The period of observation for the contraceptive calendars is months 3 to 62 before the month of the interview. For both methods the data was right-censored and left-truncation was performed, dropping all episodes of use that began before the start of the calendar and methods that were used throughout the observation period. The life tables use self-reported reason for discontinuation. To measure failure and discontinuation in the event history analysis, contraceptive methods were grouped. To measure failure methods were grouped based on effectiveness using Festin et al.'s (2016) typology and to measure discontinuation methods were grouped based on whether they are self- or provider-discontinued.

This paper considers several different spells and events. For the life tables this includes: 1) discontinuation for all methods using self-reported reason for discontinuation at 12, 24, 36 and 48 months 2) failure for all methods at 12, 24, 36 and 48 months and 3) switching for all methods at 12, 24, 36 and 48 months. For the event history analysis it considers: 1) contraceptive failure for all methods grouped by effectiveness 2) discontinuation for all methods grouped based on self vs. provider-discontinued methods 3) switching for all methods and 4) sociodemographic characteristics and their association with failure, discontinuation and switching. Pregnancy outcomes following a contraceptive failure is also analyzed.

When conducting the analysis, there were notable discrepancies when calculating contraceptive failure using the respondents self-reported reason for discontinuation versus identifying when a pregnancy immediately succeeded a month where contraceptive use was reported. 303 respondents self-reported 'became pregnant while using' as the reason for contraceptive discontinuation. When using the raw data to measure the number of pregnancies that immediately followed a month of reported contraceptive use, there were 827 instances when a pregnancy immediately followed a month of contraceptive use. While some of these pregnancies were likely planned and wanted, considering the time needed for fecundity to return after contraceptive discontinuation and the disparity in self-reported reason for discontinuation versus the raw data, it is unlikely so many respondents became pregnant almost immediately after discontinuation. Another failure code that relied on the raw data instead of the self-reported reason, referred to as the derived failure code, was generated. The reported results use the derived failure code.

Results: The sample size of this analysis is 8,334 individuals. The mean number of unique contraceptive methods used per woman is 2.24 and the mean number of spells/transitions per woman, including pregnancies, is 3.36.

Table 1 shows the changes between using the self-reported reason for discontinuation versus the derived failure code when a pregnancy directly follows contraceptive use at 12, 24, and 36-months. There is a notable difference in the self-reported and derived measures of failure. For example, using the self-reported value the IUD does not fail across all time periods, however, using the derived failure code the IUD failed at 8.2 per 100 episodes of use at 36-months. At 36-months, estimates using self-reported discontinuation for many methods ranged from a third of their failure rate using the derived failure variable (i.e., the injectable and male condom) to a five-fold increase for emergency contraceptive and 6-fold increase for the implant.

Table 3. Self-reported versus derived failure rate calculations by method

	12-month Failure		24-month Failure		36-month Failure	
Method	Self-reported	Derived	Self-reported	Derived	Self-reported	Derived
All methods	1.5	3.3	2.6	6	2.9	7.7
Emergency contraceptive	0.8	5.9	1.5	7.5	1.5	7.5
Implant	0.4	1.6	0.9	4.1	1	6.1
Injectable	1.5	3.5	1.9	5.3	2.1	6.7
IUD	0	0.8	0	6.4	0	8.2

Male condom	1.3	3	3.6	5.8	3.8	9.4
Periodic abstinence	5.7	8.7	8.7	12.9	10.1	15.7
Pill	2.5	4.8	3.9	7.3	4.9	8.6
Withdrawal	2.8	3.6	12	15.2	12.2	15.4

Failure. In the life tables, all methods have a higher likelihood of failing as their time in use increases (i.e., 12 months compared to 48 months) though some experience larger increases in failure overtime. Initially, at 12-months, LARCs have the lowest likelihood of failing with the IUD at 0.8 per 100 episodes of use followed by the implant at 1.6 per 100. The male condom (3 per 100 episodes), injectable (3.5 per 100), and withdrawal (3.6 per 100 episodes) have similar failure rates at 12-months. By 36 months, the IUD's likelihood of failing (8.2 per 100) is comparable to the pill (8.6 per 100 episodes). Methods like the emergency contraceptive pill do not have sharp increases in failure overtime. In contrast, the IUD changes from 0.8 per 100 episodes of use at 12-months, the lowest failure rate among all methods, to 12.3 per 100 episodes of use at 48-months – the highest failure rate among modern methods at this duration.

To calculate failure in the event history analysis, methods are grouped based on Festin et al.'s (2016) typology. The likelihood of becoming pregnant for IUD and implant users is 74.4% lower (OR: 0.256, p= < 0.0005) than individuals using traditional methods. The likelihood of becoming pregnant when using a more-effective short-acting method (pill, injectable) is 37.2% lower (OR: 0.628, p= < 0.0005) compared to those using traditional methods. Users of less-effective short-acting methods have a 52.5% lower likelihood of becoming pregnant (OR: 0.475, p= < 0.0005) compared to traditional method users.

Discontinuation. Results from the life tables shows several methods experience a significant increase in discontinuation due to side effects over time. For the implant, 0.8 per 100 episodes discontinue at 12-months. At 48-months, this number rises to 21.1 per 100 episodes reporting discontinuation due to side effects. Other methods like the IUD increase from 0 per 100 episodes to 14.1 per 100 episodes and the injectable from 4 per 100 episodes to 19.7 per 100 episodes over the same time period. The largest increases in discontinuation due to side effects for several methods tend to occur between 12 and 24-months. When it comes to discontinuation due to a desire to get pregnant, LARCs are the least likely to be discontinued at 12-months for this reason. In contrast, at 12-months 6.7 per 100 episodes of injectable use are discontinuing due to a desire to get pregnant. LARCs experience a significant increase in discontinuation for this reason and by 48-months 15.9 per 100 episodes of the injectable and IUD are being discontinued due to a desire to get pregnant. Other short-acting methods like the pill experience less stark discontinuation rates overtime due to a desire to get pregnant with 7.6, 10.5, 13.3, and 16.1 per 100 episodes at 12, 24, 36, and 48-months, respectively.

In the event history analysis methods were grouped by self-discontinued (non-LARC) versus provider-discontinued (LARC) methods. Provider-discontinued method users are 61% less likely (OR: 0.391, p= <0.0005) to discontinue their method compared to users who can self-discontinue, meaning, discontinue their method without a clinician's involvement.

Switching. Across all time periods in the life tables, IUD users are the least likely to switch. This ranged from 2.8 per 100 at 12-months to 5.3 per 100 at 48-months. In contrast, despite also being a provider-discontinued method, switching from the implant increases from 2.5 per 100 episodes of use at 12-months to 12.5 per 100 episodes of use at 28-months. Pill and withdrawal users are the most likely to switch over time. There is a notable increase in switching behavior between 36 months and 48 months for implant users (9.3 vs 12.5 per 100 episodes, respectively) and pill users (17.2 vs 21.1 per 100 episodes, respectively) compared to other methods like the male condom (10.5 vs 11.2 per 100 episodes).

Almost all contraceptive users are more likely to switch when compared to injectable users, including those using the pill (OR: 2.38, p= < 0.0005) and withdrawal (OR: 2.11, p= < 0.0005). The only exception are IUD and implant users who are 67.6% (OR: 0.324, p= < 0.0005) and 48.3% (OR: 0.517, p= < 0.0005), respectively, less likely to switch compared to injectable users.

Sociodemographic characteristics. For contraceptive failure, middle-income (OR: 0.883, p= 0.287) and the rich/richest-income (OR: 0.771, p= 0.006) respondents are less likely to experience failure compared to the poorest/poor-income respondents. Whether a respondent lives in an urban or rural area is significantly associated with failure; respondents living in rural areas are more likely to experience a contraceptive failure (OR: 1. 26, p= 0.009). There is no significant difference in the odds of discontinuing between urban and rural areas (OR: 1.06, p=0.025), however, for LARC users in rural areas compared to urban areas, they are less likely to discontinue (OR: 0.753, p=<0.0005). Total children ever born is significantly associated with failure, discontinuation, switching, and switching to no method. Failure generally increases with the number of total children ever born; compared to individuals with zero births, respondents with 1 birth (OR: 2.01, p= <0.0005) and up to 9+ births (OR: 7.51, p= <0.0005) are more likely to experience contraceptive failure. Discontinuation is also significantly associated with number of births; this is especially the case for LARC vs. non-LARC users. Compared to short-acting users with zero births, LARC users with 1 birth (OR: 0.411, p= 0.002), 2-3 births (OR: 0.431, p= 0.003), 4-5 births (OR: 0.381 p= 0.001), 6-8 births (OR: 0.305, p= <0.0005) and 9+ births (OR: 0.167, p= <0.0005) are less likely to discontinue. Failure is only statistically associated for some ethnic groups in Kenya such as the Maasai who compared to the Kikuyu are more likely (OR: 2.45, p=<0.0005) to experience failure.

Pregnancy outcomes. Pregnancy outcomes – meaning whether a pregnancy resulted in a birth or termination - among respondents whose contraceptive method failed was measured. More-effective short-acting method users are 54.1% less likely (OR: 0.459, p = 0.024) to have a termination compared to IUD and implant users who experienced a contraceptive failure. Less-effective short-acting method users 40.2% less likely (OR: 0.598, p = 0.383) and traditional method users 65.4% less likely (OR: 0.346, p= 0.046) when compared to implant and IUD users.

Conclusions: This study found that at certain durations, LARCs have a failure rate comparable to short-acting methods and that the likelihood of LARC failure increases with use over time. LARC failure rates found in this study are also higher than reported in other studies that assessed typical-use failure (Polis et al., 2016; Cleland & Ali, 2004). This work highlights concerns in the calculation of contraceptive failure due to an under- or mis- reporting of failure. This is also the only identified study that derived an adjusted failure code. Using the self-reported versus derived values of failure significantly increased failure rates. Calendar data, and similar datasets, have been used to measure typical-use failure, specifically in Global Majority countries where longitudinal and/or other sources of calendar data are not always readily available (Cleland & Ali, 2004; Polis et al., 2016). If self-reported responses are not initially verified against calendar data responses and, if necessary, discrepancies are not operationalized, studies that rely on self-reported responses may be underestimating contraceptive failure. As the number of LARC users likely continues to rise, it is important to understand the likelihood of unintended pregnancies so services can better fit people's need, including access to safe abortion services and maternal health services. This study also found that some sociodemographic characteristics are associated with failure and discontinuation, including socioeconomic status, rural vs. urban, ethnicity and total births ever. Notably for total births, LARC users had a significantly lower likelihood of discontinuing their contraceptive method compared to short-acting users. This decreased likelihood became more pronounced as the number of births ever increases. The association between number of births and discontinuation may highlight that users are either using LARCs as a form of 'soft sterilization' to cease childbearing or may be experiencing barriers to removal.

LARC users in Kenya are less likely to switch and discontinue use when compared to other methods. However, it is unclear if this is due to user satisfaction or experiencing barriers to removal as other studies have found (Higgins et al., 2016; Senderowicz, 2019; Burgess et al., 2021). LARC discontinuation is much higher at 36-months than for other methods despite LARCs lasting 3+ years. Research should explore whether contraceptive counseling is being aligned with users' reproductive goals or explore 'early' discontinuation. Though statistically insignificant, it appears there may be method-specific differences in pregnancy outcomes following contraceptive failure. Ensuring individuals are supported when experiencing an unintended pregnancy is paramount after experiencing contraceptive failure.

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