Background: Long-acting reversible contraceptives (LARCs) are contraceptive methods that can be used for 3 to 10 years and have a <1% 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 (FP2020/30) have made commitments to implement LARC promotion and education, create demand, increase human resources for LARC counseling and referrals, and set targets for LARCs as a percentage of the contraceptive method mix. Through multi-donor initiatives such the Implant Access Program, LARCs are also becoming more affordable and accessible. Under this program, the annual procurement of implants in the 69 FP2020 focus countries increased 10-fold, from 1.7 million units in 2010 to 10.8 million units in 2018 without evidence of overstocking (Braun & Grever, 2020).

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. In some countries the proportion of implant users increased 6-fold in less than a decade, as illustrated by a few countries 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 sub-Saharan African, little is known about user's experiences with LARCs compared to other methods. Studies have highlighted concerns related to LARCs, including provider bias, a 'method' first approach, undermining patient choice, and refusal to remove these methods, but these studies are mainly from the US and Europe (Morison, 20220; Higgins et al., 2016; Burgess et al., 2021; Mann et al. 2019).

This paper aims 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. 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. 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 sub-Saharan context and if the data can shed insight into whether users are well-informed and satisfied with LARCs. How long do individuals use a method before switching or discontinuing? Why do they discontinue a method? Which methods do they choose to switch to? How common is method failure and what are the pregnancy outcomes? Patterns of early LARC discontinuation can highlight dissatisfaction, negative side effects, or potentially a lack of knowledge regarding their long-acting nature. What methods LARC users switch to when compared to short-acting method users may also inform knowledge and satisfaction with long-acting/ provider-initiated methods versus short-acting/ self-initiated methods. 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.

Methods: This paper uses contraceptive calendar data from the Kenya 2022 DHS. Calendar data includes detailed histories of contraceptive 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 two quantitative approaches to calculating contraceptive failure, discontinuation, and switching: multiple-

decrement life tables and a time-discrete event history analysis. By using two different methodological approaches, the results can be compared, increasing analytic robustness. Multiple-decrement life tables use the entire duration of an episode (contraceptive method, pregnancy, birth, and/or termination) as the event, or unit of analysis. Time-discrete event history analysis uses each month as the contraceptive event. In the literature, studies have either used life tables (Polis et al., 2016) or event history analysis (Steele et al., 2004) but no studies identified used both methods on the same data to compare results.

Individuals were included in the analysis if they reported using at least one contraceptive method for one month at any point in the calendar. The event history analysis required left-truncation, dropping both individuals who had used the same method throughout the calendar and dropping methods that were already in use at the start of the calendar since their start date could not be extrapolated. For the event history analysis, methods were grouped into permanent (sterilization), LARCs (implant and IUD), more-effective short-acting methods (pill, injectable, lactational amenorrhea), less effective short-acting methods (condom, emergency contraception, standard days, other modern methods), and least effective methods (withdrawal, periodic abstinence/ rhythm, other traditional methods) based on Festin et al.'s typology (2016). For the life tables each contraceptive was analyzed individually. The sample size for the event history analysis is 7,613 and for the multiple-decrement life table it is 16,156.

Results: Table 1 displays discontinuation, switching, and failure by method at 12-months and Table 2 at 36-months. When constructing the life tables, there were notable data quality discrepancies in calculating contraceptive failures. 303 respondents reported 'became pregnant while using' as their discontinuation reason, however, after recoding for when a pregnancy appeared the month after reporting contraceptive use, 827 respondents became pregnant while using a contraceptive method. Most of the discrepancies had been coded as 'desire to become pregnant' instead of 'became pregnant while using.' This significantly changed failure calculations. For example, at 12-months using self-reported failure data, the implant failed at 0.4 per 100 episodes of use. Using re-coded failure data, this increased to 1.6 per 100 episodes. The results use the failure re-code.

Table 1. Contraceptive failure, discontinuation and switching at 12-months per 100 episodes of use in Kenya (2017-2022), DHS Calendar Data

Method	Method Failure	Desire to become pregnant	Other fertility related reasons	Side effects/ health concerns	Wanted more effective method	Other method related reasons	Other/Don't know	Switching
All methods	3.3	4.6	5.2	7.9	6.2	2.3	5.1	7.8
EC*	5.9	3.4	24.4	16	10.9	6.4	4.2	9.1
Implant	1.6	1.7	0.4	0.8	0.8	0.4	2.6	2.5
Injectable	3.5	6.7	4.7	4	4	2.8	8.5	7.4
IUD	0.8	2.9	0	0	0	0.5	2.4	2.8
LAM**	4	2.2	6	53.5	53.5	2	5.7	41.8
Male condom	3	3.7	13.1	5.7	5.7	1.6	3.4	6.5
Periodic abstinence	8.7	4.9	5.8	8.2	8.2	0.4	3.1	5.4
Female sterilization	0	0	0	0	0	0	0	0
Pill	4.8	7.6	8.7	11	11	6.4	4.8	14.4
Withdrawal	3.6	2.6	7.1	18.6	18.6	1.7	4	17.8

*EC = emergency contraception; **LAM = lactational amenorrhea

At 12-months, with the exception of female sterilization, the IUD has the lowest failure (0.8 per 100 episodes of use) followed by the implant at 1.6 per 100. The male condom (3 per 100), injectable (3.5 per 100), and withdrawal (3.6 per 100) have similar failure rates at 12-months. At 12-months, IUD and implant users are the least likely to switch (2.5 and 2.8 per 100, respectively) when compared to other methods which range from 5.4 per 100 (periodic abstinence) to 41.8 per 100 (lactational amenorrhea). At 36-months, the implant and injectable have the lowest likelihood of failing (6.1 and 6.7 per 100, respectively). The IUD's likelihood of failing (8.2 per 100) is comparable to the pill (8.6 per 100). This is

compared to traditional methods such as withdrawal and periodic abstinence which fail at 15.4 and 15.7 per 100, respectively.

Table 2. Contraceptive failure, discontinuation and switching at 36-months per 100 episodes of use Kenya (2017-2022), DHS Calendar Data

Method	Method Failure	Desire to become pregnant	Other fertility related reasons	Side effects/ health concerns	Wanted more effective method	Other method related reasons	Other/Don't Know	Switching
All methods	7.7	11.6	7.5	14.4	9.2	3.8	8.2	12.2
Emergency contraceptive	7.5	3.4	24.4	16.1	10.9	6.4	8.4	9.1
Implant	6.1	11.2	1.7	18.5	4.2	1.6	6.4	9.3
Injectable	6.7	13.5	8.2	18.3	6.6	5.3	12.3	11.4
IUD	8.2	9.3	0	11.6	0.1	0.5	3.5	4.4
Lactational amenorrhea	10.4	7.1	6.2	0.5	58.8	2	11.1	45.1
Male condom	9.4	13.2	17	3.9	10	3.5	4.1	10.5
Periodic abstinence	15.7	12.3	9.1	0	13.2	0.7	3.8	8.7
Female sterilization	0	0	0	0	0	0	0	0
Pill	8.6	13.3	10.1	14.8	13.9	7.2	6.9	17.2
Withdrawal	15.4	4.8	14.3	1.3	24.8	2.6	9.8	26.8

*EC = emergency contraception; **LAM = lactational amenorrhea

At 36-months, IUD users are still the least likely to switch at 4.4 per 100 episodes of use. At 36-months, the implant (18.5 per 100) and injectable (18.3) have the highest discontinuation rates due to side effects and health concerns. Desire to become pregnant is more likely to be cited as a reason for discontinuation at 36-months than 12-months for all methods, however, the difference is especially stark for the male condom (3.7 vs. 13.2 per 100) and the IUD (2.9 vs. 9.3 per 100) which had a 3-fold increase from 12-months to 36-months. The implant had a 6-fold increase, with a 1.7 per 100 discontinuing due to desire to become pregnant at 12-months compared to 11.2 at 36-months.

Calculating failure in the event history analysis revealed that, compared to contraceptive non-users, long-acting users are 95% less likely to experience a contraceptive failure. More effective short-acting method users are 87% less likely and less effective short-acting method users are 90% less likely to experience failure. Traditional method users are 71% less likely to experience failure than non-users. Female respondents who have been sterilized do not experience any failure. All p-values are significant at the 1% level. Compared to LARC users, all contraceptive group users are less likely to switch to a less effective method group. Withdrawal, periodic abstinence, and other traditional method users are 28% less likely (p=<0.0005) to switch to a less effective method while condom, emergency contraceptive, standard days method, and other modern method users are 76% less likely (p=0.007) to switch to a less effective contraceptive method. Pill, injectable, and LAM users are considerably less likely (OR: 0.99, p=<0.0005 to switch to a less effective method compared to IUD and implant users. All method groups are more likely to switch to a more effective contraceptive method when compared to LARC users. This includes more-effective short-acting contraceptive users (OR: 1.54, p=<0.0005), less-effective short-acting contraceptive users (OR: 1.80, p=<0.0005), and least effective/ traditional contraceptive users (OR: 1.43, p=0.002). Sociodemographic characteristics were included to understand how switching, discontinuation, and failure vary by age, urban/ rural status, highest educational attainment, and history of abortion. The results from these regressions were inconclusive and insignificant. Figure 1 uses a Sankey to visually depict the contraceptive switching patterns of users.

Figure 1. Contraceptive switching of respondents
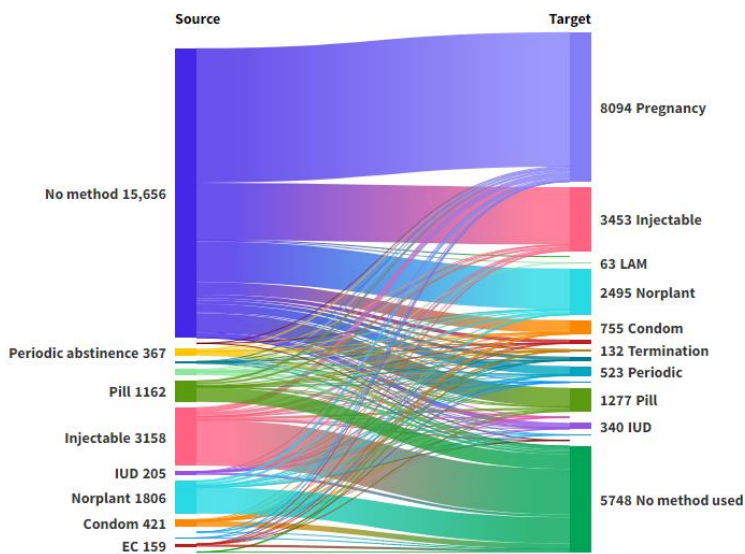
The analysis assessed the pregnancy outcomes for users who experienced contraceptive failure and whether there was a difference in births versus terminations by method that failed. There was a total of 481 pregnancy outcomes for contraceptive failures; 375 resulted in birth, 41 in termination, and 65 where the outcome is unknown as the calendar ended before a birth or termination could be reported. LARC users were 1.8 times (p=0.034) more likely to terminate a pregnancy and less-effective short-acting users 1.1 times (p=0.880) more likely to terminate a pregnancy when compared to those who gave birth. More-effective short-acting users (OR: 0.86, p=0.499) and traditional contraceptive users (OR: 0.66, p= 0.495) were less likely to terminate compared to those who gave birth. However, the insignificant p-values should be noted.

Conclusions: This work highlights the potential for both life tables and event history analysis to be used to study contraceptive switching, discontinuation, and failure. Both quantitative methods show that typical-use LARC failure is higher than perfect-use as reported in clinical studies. LARC failure rates are also higher than reported in other studies that assessed typical-use failure (Polis et al., 2016) and in Kenya the likelihood of LARC failure increases over time, often having a failure rate comparable to shorter-acting methods. The discrepancies in perfect versus typical-use LARC failure should be used to inform contraceptive counseling. 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. Both analyses found that LARC users 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; 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 after a contraceptive failure is paramount. Finally, this work highlights potential concerns in the calculation of contraceptive failure due to an underreporting/ misreporting of failure. The discrepancy detected is likely a quantitative showing of how recollection bias influences data quality, especially as it relates to contraceptive failure and the recollection of pregnancy intendedness (Chamberlin et al., 2022).

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