RESEARCH NOTE

Cost per insertion and couple year of protection for post-partum intrauterine devices and implants provided during service scale-up in Kigali, Rwanda [version 1; referees: 1 approved with reservations]

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Abstract

Introduction: In two high-volume government hospitals, their two affiliated health facilities, and two additional health facilities, we developed and implemented post-partum intrauterine device (PPIUD) and post-partum (PP) implant promotions and service delivery procedures between May and July 2017 in Kigali, Rwanda. Between August 2017 and July 2018, 9,073 pregnant women received PPIUD/PP implant promotions who later delivered in one of our selected facilities. Of those, 2,633 had PPIUDs inserted, and 955 had PP implants inserted.

Methods: Here, we detail the expenditures during the implementation from the payer perspective (including both the implementation costs and the cost of contraceptive methods) and estimate the cost per PPIUD insertion, PP implant insertion, and couple years of protection (CYP) for PPIUD and PP implant users. Research costs for formative work were excluded.

Results: A total of $74,147 USD was spent on the implementation between August 2017 and July 2018. The largest expense (34% of total expenses) went toward personnel, including doctoral-level, administrative, data management and nurse counseling staff. Training for PPIUD and implant providers and promoters comprised 8% of total expenses. Recruitment and reimbursements comprised 6% of expenses. Costs of implants to the government comprised 12% of the expenses, much higher than the cost of IUDs (1%). Costs per insertion were $25/PPIUDs and $77/PP implant. Costs per CYP were $5/PPIUDs and $20/PP implant.

Conclusion: The PPIUD/PP implant service implementation provided services at a low cost per insertion and CYP. Understanding the cost per PPIUD/PP implant inserted and CYP can help to inform the cost of scaling up PPIUD/PP implant service implementation activities and resource allocation decision-making by the Rwandan Ministry of Health.

Keywords
Couple year of protection, post-partum, intrauterine device, contraceptive implant, Rwanda
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Author roles: Wall KM: Conceptualization, Data Curation, Formal Analysis, Funding Acquisition, Investigation, Methodology, Project Administration, Supervision, Writing – Original Draft Preparation, Writing – Review & Editing; Ingabire R: Data Curation, Investigation, Methodology, Project Administration, Supervision, Writing – Review & Editing; Allen S: Conceptualization, Funding Acquisition, Methodology, Project Administration, Resources, Writing – Review & Editing; Karita E: Conceptualization, Investigation, Methodology, Project Administration, Supervision, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

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Introduction
Voluntary family planning (FP) is one of the most cost-effective public health interventions, reducing both maternal and child mortality and improving national economies. However, there is high unmet need for family planning in the developing world. In post-partum periods, 50–90% of women experience unmet need, while 95% of women desire to avoid pregnancy for at least 1 year after delivery. In Rwanda, although only 2% of post-partum women report a desire for another child within 2 years of delivery, the unmet need in the post-partum period is 51%.

To meet women’s post-partum fertility goals and improve maternal-child health via birth spacing or limiting, the Rwandan government has made post-partum family planning a key objective of the Rwandan Family Planning 2020 Commitment (Objective 2: ‘Scale up the post-partum family planning (PPFP) in all health facilities in Rwanda to increase method choice including access to long term methods...’) with the goal of preventing 250,000 unintended pregnancies annually.

Long-acting reversible contraceptive (LARC) methods (the copper intrauterine device (IUD) and hormonal implant) are not only the most effective reversible methods (lasting 10 and 3–5 years, respectively, with typical use failure rates <1%/year), but are very cost-effective. A post-partum IUD (PPIUD) can be inserted immediately after delivery of the placenta, during a cesarean delivery, up to 48 hours after childbirth, or beginning at 4 weeks after delivery. A post-partum (PP) implant can be inserted any time after delivery. However, IUDs and implants make up a relatively small share of method use in Rwanda.

To address this issue, funding from a Bill and Melinda Gates Grand Challenge Award was received to improve PPIUD supply and demand in Kigali, Rwanda, with supplementary funding from Emory University to provide PP implant services. Briefly, in two large health centers (providing antenatal care (ANC), family planning, and infant vaccination services), their two adjoining referral hospitals (providing routine and complex labor and delivery), and two additional large health centers (providing ANC, family planning, routine labor and delivery, and infant vaccination services), Emory-based non-governmental organization Projet San Francisco (PSF) developed and implemented PPIUD and PP implant promotions and service delivery procedures in August 2017. By July 2018, 9,073 pregnant women received PPIUD/PP implant promotions who later delivered in one of our selected facilities. Of those, 2,633 had PPIUDs inserted, and 955 had PP implants inserted. This represented a significant increase in PPIUD and PP implant uptake versus the 6 months prior to our implementation (p<0.001). Here, we detail expenditures during the implementation and estimate the cost per PPIUD insertion, PP implant insertion, and couple years of protection (CYP) for PPIUD and PP implant users to inform decision-making by the Ministry of Health and to estimate the cost of scaling up activities.

Methods

Ethical considerations and consent
The Emory University Institutional Review Board (IRB) and the Rwanda National Ethics Committee (RNEC) approved the research component (focus group discussions and surveys) of the project (IRB 00001497). Written informed consent was obtained from all participants prior to enrollment. The Emory University IRB determined the programmatic service delivery component of the project (PPIUD promotions and insertions performed in government clinics) was exempt from review.

PPIUD/PP Implant program development and operations
The PPIUD/PP implant intervention (described in detail previously) was developed with input from stakeholders, providers, community health workers (CHW), and couples/clients. Stakeholders included the Rwanda Ministry of Health, the District Mayors, the Rwandan Family Planning Technical Working Group, and clinic directors. Through formative work between May and July 2017, we evaluated knowledge, attitudes, and practices regarding PPIUD/PP implant services among community health workers and providers and clients/couples. This formative work led to the development of intervention operational procedures and a promotional flipchart to be delivered to women or couples. Promotions were conducted primarily by counselors during ANC, labor and delivery, and infant vaccination services or within the community by CHW. In August of 2017, nurses and midwives working in labor and delivery and family planning departments began training in PPIUD insertions (implant insertion training had been previously provided). Clinic staff and CHWs were trained to promote the PPIUD/PP implant services. Follow-up appointments for PPIUD clients were between 10 days and 6 weeks after PPIUD insertion.

PPIUD/PP Implant program costs

We used a standard, comprehensive micro-costing approach as recommended to calculate the net cost of the PPIUD/PP implant intervention from the payer perspective. Using standardized data collection tools, resource use data was collected from expenditure records, study case report forms, and interviews with program implementers.

Part-time salaries and fringe were provided for three Emory researchers and the PSF Director. PSF-based personnel included a dedicated physician with part-time support from two project physicians, two study coordinators, a senior nurse counselor, a data manager, and two promotions managers. Per diems were provided for trainees during training activities. Training costs included the costs of training providers to insert PPIUDs during a 2-day didactic training and mentored practical certification process, and the costs of training PPIUD/PP implant promotional agents. Field travel included travel for Emory-based researchers and transportation for local staff. Other field expenses included wire transfer fees, transcription and translation services, and meals during trainings. Recruitment/reimbursement expenses began in February/March 2018 and included: PPIUD client transport reimbursement for follow-up visits ($2.29 United States
Dollars (USD)/client), reimbursements for CHW promoters ($0.57 USD/client presenting their referral when requesting a PPIUD or PP implant), reimbursements for providers ($1.20 USD/PPIUD and $0.57 USD/PP implant insertion), and reimbursements to the selected facilities for administrative costs associated with implementing the PPIUD/PP implant program ($57 USD/facility/month). CHW and clinic provider reimbursements used the Rwandan performance-based-financing (PBF) system as a guide\(^1\). Communications expenses included internet and phone airtime for staff. Field consumables/office supplies included specula, forceps, batteries, logbooks, chargers for tablets, PPIUD kits and various office supplies.

We also included the cost of methods (estimated from the prices incurred by the United Nations Population Fund (UNFPA) in 2015 of $0.37 USD per copper T380 IUD and $8.93 USD per Jadelle levonorgestrel rod implant (http://mshpriceguide.org/en/home/), and converted to 2018 USD ($0.39 and $9.49 USD, respectively). Expenditures are reported by activity in 2018 USD.

Only implementation costs related to service provision were included (i.e., we did not include research costs for formative work conducted between May and July 2017). Thus, the expenses presented represent the frontline implementation costs required to implement the program between August 2017 and July 2018 from the payer’s perspective. No discounting of costs was performed given the short time horizon. We follow the Consolidated Health Economic Evaluation Reporting Standards\(^1\).

### PPIUD/PP implant program outcomes

Outcomes of interest include the number of PPIUDs and PP implants inserted and the cumulative couple years of protection (CYP) for PPIUD and PP implant users. CYP is a commonly used estimate of the length of contraceptive protection against pregnancy provided per unit of that method and is estimated at 4.6 for the Copper T380 IUD and 3.8 CYP for Jadelle (5 year) implant\(^1\) (https://www.usaid.gov/what-we-do/global-health/family-planning/couple-years-protection-cyp). Using the cost measures and outcomes of interest, we calculated the cost per PPIUD inserted, cost per PP implant inserted, cost per CYP for PPIUD users, and cost per CYP for PP implant users. No discounting of outcomes was performed given the short time horizon of the 12-month implementation.

### Results

Raw data for this study are available in Dataset 1\(^1\).

### PPIUD/PP implant program costs

Program costs are summarized in Table 1. A total of $74,147 USD was spent on the implementation between August 2017 and July 2018. The largest expense (34% of total expenses) went toward personnel, including doctoral-level (MD and PhD) researchers, and administrative, data management and nurse counseling staff. Trainings for PPIUD and implant promoters and PPIUD providers comprised 8% of total expenses. Recruitment and reimbursements comprised 6% of expenses. Costs of implants to the government comprised 12% of the expenses, much higher than the cost of IUDs (1%).

### Table 1. Allocation of costs for the PPIUD/PP implant implementation by activity (August 2017–July 2018). Only direct costs included; all costs in 2018 USD.

<table>
<thead>
<tr>
<th>Costs incurred by implementation team</th>
<th>USD</th>
<th>Percentage of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries and fringe: PSF and clinic staff</td>
<td>$25,051</td>
<td>34%</td>
</tr>
<tr>
<td>Salaries and fringe: Emory employees</td>
<td>$14,225</td>
<td>19%</td>
</tr>
<tr>
<td>Trainings</td>
<td>$6,099</td>
<td>8%</td>
</tr>
<tr>
<td>Field travel</td>
<td>$5,363</td>
<td>7%</td>
</tr>
<tr>
<td>Other field expenses</td>
<td>$5,820</td>
<td>8%</td>
</tr>
<tr>
<td>Recruitment/reimbursement</td>
<td>$4,510</td>
<td>6%</td>
</tr>
<tr>
<td>Communication</td>
<td>$1,427</td>
<td>2%</td>
</tr>
<tr>
<td>Field consumables/office supplies</td>
<td>$1,129</td>
<td>2%</td>
</tr>
<tr>
<td>Field facilities</td>
<td>$433</td>
<td>1%</td>
</tr>
<tr>
<td><strong>Cost of methods</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of implants*</td>
<td>$9,063</td>
<td>12%</td>
</tr>
<tr>
<td>Cost of IUDs*</td>
<td>$1,027</td>
<td>1%</td>
</tr>
<tr>
<td><strong>Total Expenses</strong></td>
<td><strong>$74,147</strong></td>
<td></td>
</tr>
</tbody>
</table>


### PPIUD/PP implant program outcomes

Program outcomes are summarized in Table 2. Costs per insertion were $25/PPIUDs and $77/PP implant. Costs per CYP were $5/PPIUDs and $20/PP implant.

### Discussion

The PPIUD/PP implant implementation provided services at a low cost per insertion and CYP. Understanding the cost per PPIUD/PP implant inserted can help to inform decision-making by the Ministry of Health and to estimate the cost of scaling up PPIUD/PP implant service implementation activities. Since cost per CYP is a standard and commonly used measure, our estimates of cost of CYP also help the government to determine contraception funding priorities.

For comparison, in a previous study conducted in Rwanda, 478 PPIUDs were inserted over 15 months in 12 sites at an incremental cost of $95,004 USD. After amortization of training costs over three years, investigators estimated outcomes of $110/PPIUD inserted and $24/CYP for the PPIUD\(^5\).

Several other studies have made estimates of method cost per CYP, though not specifically in post-partum periods. The World Bank estimated that the cost per CYP for reversible modern methods in Ethiopia, Uganda, Burkina Faso, and Cameroon was lowest for the IUD ($4.14-$23.35), while the costs per CYP for oral contraceptive pills (OCPs) ($17.00-$31.45) and implants and injectables ($19.84-$58.54) were much higher\(^6\). Using data from 13 USAID tier one priority reproductive health countries and service delivery costs, researchers estimated that the cost per CYP was <$2.00 for the IUD and roughly $4.00 for Sino-Implant, $7.00 for DMPA and OCPs, and $8.00 for...

Table 2. Outcomes of interest for the PPIUD/PP implant implementation (August 2017–July 2018). All costs in 2018 USD.

<table>
<thead>
<tr>
<th>IUD outcomes</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPIUDs inserted (N)</td>
<td>2,633</td>
</tr>
<tr>
<td>Cumulative CYP for PPIUD users*</td>
<td>12,112</td>
</tr>
<tr>
<td>Cost per PPIUD inserted (N)</td>
<td>$20</td>
</tr>
<tr>
<td>Cost per PPIUD users (N)</td>
<td>$77</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Implant outcomes</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PP Implants inserted (N)</td>
<td>955</td>
</tr>
<tr>
<td>Cumulative CYP for PP implant users*</td>
<td>3,629</td>
</tr>
<tr>
<td>Cost per PP implant inserted</td>
<td>$77</td>
</tr>
<tr>
<td>Cost per PP implant users (N)</td>
<td>$20</td>
</tr>
</tbody>
</table>

*Assumes CYP for IUD is 4.6 and for the Jadelle implant is 3.8. PPIUD, post-partum intrauterine device; PP, post-partum; CYP, couple years of protection; USD, United States Dollars.

Jadelle17. Finally, a study in Zambia estimated costs per CYP were $8.69 for the IUD and $15.15 for the implant18.

Although it is difficult to compare estimates of cost per CYP across studies because of different approaches to measuring and including costs, these studies all indicate that the IUD has the lowest cost per CYP versus other reversible methods, and that estimated costs per CYP are consistently higher for the implant versus the IUD, largely because of difference in commodity costs (http://mshpriceguide.org/en/home/).

Limitations

Similar to the other studies cited here, we included costs from the payer perspective only; however, we recognize that more detailed costing analyses including the societal perspective would be informative and would likely strengthen evidence to increase LARC services (since women are saved time traveling to clinic for OCP refills or 3-monthly injectables). It would also be informative to estimate the cost per promotional method employed (e.g., promotions occurring during ANC, labor and delivery, infant vaccination, or delivered in the community by CHW), but as many women received multiple promotions from several places and our promotional strategies evolved over time, this was not possible in the present study. Given our short time horizon, we did not amortize our training costs as in another PPIUD/PP implant implementation, though the education provided during trainings may translate into service provision over several years in the future; amortization would have decreased our estimated costs per insertion and CYP. Finally, our results are most generalizable to sub-Saharan African countries.

Conclusions

There is consensus in the international community that greater investment in postpartum family planning, and the IUD in particular, is needed. We have developed a successful, multi-level intervention that increases PPIUD and PP implant uptake that has low costs per insertion and CYP. Future analyses will explore whether the intervention is cost-effective (or potentially cost-saving).

Data availability

Underlying data are available from Harvard Dataverse. Dataset 1: Replication Data for an interim evaluation of a multi-level intervention to improve post-partum intrauterine device (PPIUD) services in Rwanda (https://doi.org/10.7910/DVN/WLZ7PC)44.

Data are available under a Creative Commons Zero (‘‘CC0’’) Public Domain Dedication Waiver.

Grant information

This work was supported by the Bill & Melinda Gates Foundation [OPP1160661]. Additional support came from the Emory University Research Council Grant [URCGA16872456], Emory Global Field Experience Award, the Emory Center for AIDS Research [P30 AI050409], the National Institutes of Health [K01 MH107320; NIAID R01 AI51231; NIAID R01 AI64060; NIAID R01 AI64060; NIAID R01 AF64060; NIAID R37 AI51231], Centers for Disease Control and Prevention [CDC GH15-1616; 5NU2GGH001443], Emory AITRP Fogarty [5D43TW001042], and the International AIDS Vaccine Initiative (IAVI) [SOW2166] with the support of the United States Agency for International Development (USAID).

The contents of this manuscript are the responsibility of the authors and do not necessarily reflect the views of USAID or the US Government.

The funder had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

References


4. USAID, MCHIP: Family planning needs during the first two years postpartum in Rwanda. 2010; [cited 2018 August 3]. Reference Source
   PubMed Abstract | Publisher Full Text


Open Peer Review

Current Referee Status: ?

Katherine Tumlinson
Department of Maternal and Child Health, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA

Overall: This is a well-written paper that makes a valuable contribution to the current body of literature by describing the cost per couple year of protection of LARC methods in Rwanda, after factoring in the cost of activities/materials designed to increase demand for these methods.

I would encourage the authors to be more explicit about why such promotional activities are necessary for LARCs and why it is important to factor in the cost of promotional/demand-creation activities when calculating CYP for LARCs.

I would also encourage the authors to include the cost of labor and supplies required for LARC insertion in their calculation of LARC CYPs (or to make this more explicit if they have already done so).

Additionally, in the discussion section, I would encourage the authors to present the data comparing the CYP of other methods in a visual format so that readers can more easily interpret the results presented in this paper relative to the CYPs of shorter-acting methods or other LARC + promotion CYP calculations.

These recommendations are described in more detail below, along with more minor suggestions. Once these concerns are addressed, I strongly recommend indexing. Thank you for the opportunity to review this paper.

Abstract:
1. The introduction presents the results of the parent study/intervention which was designed to increase demand for LARCs within a small number of facilities in Kigali. I encourage the authors to re-write this paragraph to better lay the foundation for the specific goal of this current paper. The authors may want to consider a short statement of the high unmet need during the postpartum period and the low prevalence of LARCs and the value of better understanding CYP for LARCs after factoring in the cost of promotional/demand-creation activities.

2. Similarly, the methods section of the abstract falls a little bit short; it would be helpful to indicate that the authors utilized a standardized method for calculating net cost of the intervention.

Introduction:
1. Overall the introduction is very well written and pleasantly concise. However, I would recommend insertion of a short paragraph that helps the readers to understand a key challenge of LARCs: promotional or demand creation activities are often necessary to increase uptake. Few prior
1. Studies (to my knowledge) have been able to calculate a CYP for a LARC that includes the cost of these demand creation activities. This is an important strength of this paper and should be highlighted.

2. An additional recommendation for the introduction involves the description of the parent study/intervention. In the second sentence of paragraph four, the authors briefly describe the results of the parent study in terms of the enormous increase in uptake. This is important information; however, it feels as if the authors have cut and paste from the abstract of the prior paper and – on first glance – it was confusing as I didn’t realize the authors were describing the intervention study and I mistakenly thought the results of the current paper were being summarized in the introduction. I recommend revisions so that this paragraph does a better job of explaining that there was a parent study/intervention that was found to be enormously successful in increasing the uptake of LARCs in select Kigali facilities and now the authors are writing this paper with the goal of understanding the CYP of LARCs, factoring in the cost of these very effective promotional activities.

Methods:
1. I would consider moving the first paragraph (ethics) to the end of the methods section, if possible. I was confused to read about focus group discussions in the first sentence, since I didn’t yet understand that formative research was done prior to designing effective promotional activities, neither of which are the real focus of this paper.

2. Are there available data on the cost of the supplies needed for insertion and the cost of provider’s time for insertion? For example, in a paper I wrote (which the authors cite, reference #17) that included CYP of various methods, we included the cost of supplies ($1.24) and labor (2.91) when calculating CYP for Sino-Implant ($12.10 total direct cost). I see the authors include “reimbursements for providers” but it’s not clear if this is the cost of labor (and, if so, it seems low). I also see consumables and supplies which appear to include specula and forceps, but I imagine there may be other supplies needed, for example alcohol pads, gauze/bandage, etc. It should not be difficult to obtain this data if not currently in hand.

Results: Excellent and concise presentation of exciting results!

Discussion: Again, well written and compelling. I have just a few suggestions for improvement:
1. The authors discuss data from a prior study in Rwanda and also recent World Bank data collected across multiple countries. Is it possible to present any of these data in a visual format alongside the results of this paper? It appears that the promotional approach used in the intervention study represents an improvement over prior efforts to increase LARC uptake in Rwanda – 3500 LARCs were inserted within one year in just 6 facilities and the total cost was under $75k. Can the authors create a graph that compares CYP from this study to the CYP from the FHI study so that readers can quickly see/digest that the CYP in this study was about one-fifth of the prior FHI study?

2. Can the authors present their calculated CYP for LARCs in a graph alongside the current CYP for shorter-term methods in Rwanda? This could help to highlight important differences in CYP across methods and make the case for larger investment in LARCs (or, at least, IUDs) as well as scaling up of the promotional flip-chart and training activities incorporated in the parent intervention.

3. When discussing the World Bank and USAID data, the authors should also indicate whether these prior studies included the cost of any demand generation activities (probably not).
4. In the last paragraph, prior to discussing limitations, the authors discuss the overall finding that IUDs represent significant cost savings over implants, largely due to the difference in the cost of the commodities. Some may argue, however, that IUDs represent a more difficult “sell” because they are more invasive (and painful?) to insert. Yet numerous women in the current study opted for the IUD over the Implant. Could the authors include data that might explain the comparative popularity of the IUD over the Implant among women in this study and discuss any implications?

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.