Estimated disability-adjusted life years averted by free-of-charge provision of the levonorgestrel-releasing intrauterine system over a 9-year period in Brazil

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ABSTRACT

Background The objective was to analyse the contribution of the provision at no cost to users of the 20 µg/day levonorgestrel-releasing intrauterine system (LNG-IUS) towards disability-adjusted life years (DALY) averted over a 9-year period.

Methods We analysed data from 15 030 new users of the LNG-IUS who had the device inserted at 26 Brazilian teaching hospitals between January 2007 and December 2015. The devices came from the International Contraceptive Access Foundation (ICA), a not-for-profit foundation that donates the devices to developing countries for use by low-income women who desire long-term contraception and who freely choose to use this device. Estimation of the DALY averted included live births averted, maternal morbidity and mortality, child mortality and unsafe abortions averted.

Results A total of 15 030 women chose the LNG-IUS as a contraceptive method during the study period. Over the 9 years of evaluation, the estimated cumulative contribution of the Brazilian program in terms of DALY averted consisted of 486 live births, 14 cases of combined maternal mortality and morbidity, 143 cases of child mortality and 410 unsafe abortions.

Conclusions Provision of the LNG-IUS at no cost to low-income Brazilian women reduced unwanted pregnancies and probably averted maternal mortality and morbidity, child mortality and unsafe abortions. Family planning programs, policymakers and stakeholders based in low-resource settings could take advantage of the information that the provision of this contraceptive at no cost, or at affordable cost to a publicly-insured population, is an effective policy to help promote women's health.

Key message points

- According to mathematical modelling, provision of the levonorgestrel-releasing intrauterine system (LNG-IUS) at no cost for low-income Brazilian women averted unintended pregnancies, maternal and child mortality and abortions.
- Universal access to contraceptive methods at no cost, or at affordable cost to the publicly-insured population, is an effective policy to help promote women's health.
- The data could play a role in influencing family planning program planners and policymakers, since compared with copper intrauterine devices there are several non-contraceptive benefits associated with the LNG-IUS that are important for women's health.

INTRODUCTION

Despite the fact that the number of women seeking contraception is increasing year by year, rates of unintended pregnancies still remain high. This can be explained by lack of access to contraception or inconsistent or incorrect use of the chosen contraceptive method.[1 2] Among the 182 million pregnancies that occur annually worldwide, it is estimated that one-third are unintended.[1] Estimates for 2010 in Brazil indicated the occurrence of 1.8 million unwanted pregnancies with 1.58 million live births, almost 49 000 induced abortions, and possibly 312 maternal deaths.[3] Not only do these pregnancies involve consequences to the women and their

families, but they also represent a public health issue in view of the high cost of care that is added to the other indicators.[3 4]

One option to reduce the number of unintended pregnancies is the use of long-acting reversible contraceptive (LARC) methods [intrauterine contraceptives (IUCs), including the 20 µg/day levonorgestrel-releasing intrauterine system (LNG-IUS) and implants] because of their high contraceptive effectiveness and the fact that they do not require the user's constant attention.[1 5] Although LARC methods are an important alternative to reduce the high number of unintended pregnancies, their cost is one of the major barriers to their use.[6 7] Providing these contraceptive methods at no cost or at an affordable cost may be one option to prevent unintended pregnancies and their consequences.[7–9]

Since December 2003, the International Contraceptive Access (ICA) Foundation[10] has provided local service-delivery organisations in developing countries and low-resource settings with the LNG-IUS on a not-for-profit basis. The ICA foundation is a collaborative effort between Bayer Healthcare Pharmaceuticals, the originators of the LNG-IUS, and the Population Council, an international non-profit non-governmental organisation. From the beginning of the program more than 71 000 devices have been donated to organisations in 28 countries, and it has provided the LNG-IUS to our institution in Campinas, São Paulo State (SP), Brazil since 2007.

Despite the reduction of unintended pregnancies with the use of LARC methods, there is still little information about the benefits to women and children, particularly relating to maternal and child mortality and morbidity. One example was our evaluation of the last 10 years' experience at a Brazilian family planning clinic based in Campinas. Our group estimated the contribution of the provision of LARC methods and the depot-medroxyprogesterone acetate injectable contraceptive to averted disability-adjusted life years (DALY; maternal mortality and morbidity, child mortality and abortions) and provided evidence about these indicators.[2] The objective of the present study was to estimate the averted DALY[11] among LNG-IUS users who received the device at no cost at 26 Brazilian teaching hospitals from 2007 to 2015.

METHODS

This was a mathematical modelling study carried out at the Department of Obstetrics and Gynaecology, University of Campinas Medical School (UNICAMP), Campinas, SP, Brazil. The protocol was approved by the Ethical Committee. Informed consent was not needed since we reviewed data collected at the time of placement of the 20 µg/day LNG-IUS (Bayer Healthcare Pharmaceuticals, Turku, Finland) and the data were non-identifiable following collection.

From the ICA Foundation's[10] donations to the University of Campinas we provided the devices on request to 26 universities' teaching hospitals, with the mandate to use them on demand for contraception and for treatment of heavy menstrual bleeding (HMB), free of charge to low-income women. They were required to report all insertions,

removals and complications to the central providing clinic together with details of recipients' age, parity and years of schooling.

For the data analysis, we used the Impact 2 mathematical modelling program developed by Marie Stopes International.[2 11] After inputting information concerning the population to be studied, the program estimates the DALY averted by the interventions under consideration. The program is pre-loaded with national modelled estimated data obtained from different sources for developing countries, including national demographic and health surveys, United Nations (UN) World Population Prospects, UN maternal and child mortality data, the World Heatlh Organization (WHO) Global Burden of Disease and the Guttmacher Institute, USA.

Maternal DALYs are separated into: (i) years of lost life (YLL)—mortality-related DALYs and (ii) years lost to disability (YLD)—morbidity-related DALYs. These two subsets of the maternal DALY are estimated and reported separately in the Impact 2 model. The YLL and YLD calculations use the national maternal mortality ratio, which changes over time. The calculation of child mortality averted is an estimate of the number of deaths averted among children under the age of 5 years due to improved birth spacing, or due to increasing the previous birth interval (PBI). This captures the reduction in risk based on change in birth profiles. The coefficient is multiplied by the estimated number of births averted to give an estimated number of PBI child deaths averted: child deaths averted = live births averted x PBI coefficient. Abortions (mainly unsafe) averted were estimated by multiplying the number of live births averted by the number of abortions per 100 live births, as given by the unsafe abortion ratio. Since abortion is illegal in Brazil, the program used information from the year 2008 registered at the WHO and from the year 2012 registered at the Guttmacher Institute. For the analysis we included only women who had the LNG-IUS inserted for contraception and those who needed contraception concurrently with medical treatment for HMB or control of endometriosis-associated pain. Women who had the LNG-IUS inserted only for control of bleeding or pain and who did not require it for contraception were excluded from the analysis. The Impact 2 program compares the outcomes of women who receive LARCs from any specific program to what might have happened if they did not have access to these methods (i.e. could only use short-term methods instead).[11]

RESULTS

Of all the women who were looking for a contraceptive method, a total of 15 030 women chose the

Table 1 Sociodemographic characteristics of women who received a levonorgestrel-releasing intrauterine system in the International Contraceptive Access Foundation Program during the period 2007–2015, Campinas, Brazil

Characteristics	LNG-IUS users (n=15 030)
Age (years)	n (%)
≤19	426 (2.8)
20–29	4480 (29.8)
30–39	6494 (43.2)
≥40	3630 (24.2)
Pregnancies (*n*)	
0	1931 (12.8)
1–2	9270 (61.7)
≥3	3829 (25.5)
Years of schooling*	
<4	2645 (17.6)
5–8	4730 (31.5)
9–12	2 (0.01)

*Missing value in 7628 cases.
LNG-IUS; levonorgestrel-releasing intrauterine system.

LNG-IUS. The sociodemographic characteristics of the users are shown in Table 1. The women's ages ranged from 12 to 52 years and the mean age [±standard error (SEM)] was 33±3.4 years. The mean (±SEM) parity was 2.0±0.01, the number of nulligravidas was 1931 and the number of adolescents (aged <19 years) was 426.

In this program, LNG-IUS devices were inserted in 1021 women in 2005, rising to 2973 women in 2015. Over the 9 years of evaluation, the estimated cumulative contribution of the Brazilian program to the DALY averted consisted of 486 live births, 14 combined cases of maternal mortality and morbidity, 143 cases of child mortality and 410 cases of unsafe abortion. Table 2 and Figure 1 show the estimated outcomes of the DALY averted.

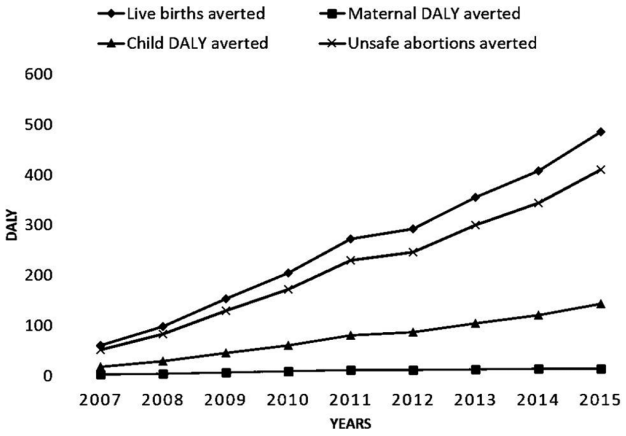

Figure 1 Estimated disability-adjusted life years (DALY; live births, maternal mortality and morbidity, child mortality, and unsafe abortions) averted.

DISCUSSION

Using a mathematical modelling program, we were able to estimate the births, maternal mortality and morbidity, child mortality and unsafe abortions averted due to the provision at no cost of the 20 µg/day LNG-IUS over a 9-year period. We assumed in our analysis that all the births averted were unintended, and that due to the fact that many unintended pregnancies are mistimed or unwanted, they represent a major public health issue. In addition, because abortion is illegal in Brazil in most circumstances, our assumption is that most of the abortions averted would have been unsafe.[4 12]

The provision of efficient and safe contraceptive methods, such as LARC methods including the LNG-IUS, is one important option to help reduce unintended pregnancies and their consequences. A previous study that was part of the US-based contraceptive CHOICE project reported a reduction in abortion rates with the use of LARC methods among participants who were recruited mainly from two abortion facilities in St Louis, MI, USA. At the end of that study, abortion rates in this group were less than half the

Table 2 Number of insertions of the levonorgestrel-releasing intrauterine system by year in the International Contraceptive Access Foundation Program and cumulative disability-adjusted life years averted during the period 2007–2015, Campinas, Brazil

	Years of evaluation								
	2007	2008	2009	2010	2011	2012	2013	2014	2015
LNG-IUS inserted (n)	1021	795	1202	1281	1705	1506	2198	2349	2973
DALY averted (n)									
Live births	60	98	153	204	272	292	355	407	486
Combined maternal mortality and morbidity	3	4	7	9	11	11	13	13	14
Child mortality	18	29	45	60	80	86	105	120	143
Unsafe abortions	51	82	129	172	229	246	300	344	410

DALY; disability-adjusted life years; LNG-IUS; levonorgestrel-releasing intrauterine system.

regional and national rates.[13] According to the results of the present study, an estimated total of 410 unsafe abortions were averted over the 9 years of evaluation.

Since abortion is illegal in Brazil, surgical or medical terminations in many cases are unsafe options and could contribute to maternal mortality, morbidity and 'near misses'.[1 14 15] According to a previous study,[3] of the estimated 1.8 million unwanted pregnancies that would occur in Brazil in 2010, an estimated 48 769 (2.7%) would have resulted in induced abortion and 1.58 million of those pregnancies would have resulted in live births. A total of 312 maternal deaths were expected that year, 10 due to the consequences of induced abortion.

The Brazilian network of hospitals which received the LNG-IUS offered the device at no cost, which may also have contributed to the fact that more women sought the method year by year through the period of the study. The provision of contraceptive methods at no cost is a strategy that has recently been evaluated. The previously cited CHOICE study[6] is an example of the benefits of providing LARC methods at no cost in a developed country; our results demonstrate similar benefits in a developing country, although our study was restricted only to one LARC method.

Universal access to contraceptive methods at no cost or at affordable cost is an important tool to increase use of LARC methods and to reduce the rate of unintended pregnancies, which in turn reduces maternal mortality and morbidity, child mortality and abortion. Recently, the Brazilian Ministry of Health has rejected the provision of the LNG-IUS and contraceptive implants in the public sector, citing the high costs of these methods.[16] As has been shown in this study and in two previous publications,[2 4] the provision of even only one LARC method is sufficient to reduce unsafe abortions, maternal and infant mortality and morbidity and, consequently, the costs to the health system can be reduced significantly.

The strengths of this study are the large number of women included, the 9 years of evaluation, the 26 participating hospitals and the fact that all LNG-IUSs were provided at no cost. The major limitation was that the DALY averted is a mathematical model and is not a measurement of the real-life situation and is therefore not based on the follow-up of the actual women who receive a LNG-IUS. Also, the calculations in the mathematical model used are based on limited data and on available assumptions, principally regarding the number of abortions. For many countries, much information is based on the best statistics available, which in some cases are reported infrequently or are available only as subregional or regional estimates.[11]

In conclusion, our assessment of this mathematical modelling exercise showed that the provision of the LNG-IUS at no cost to low-income Brazilian women is likely to have resulted in the benefit of averting unintended pregnancies and consequently maternal mortality and morbidity, child mortality and unsafe abortions. The contraceptive performance of LARC methods is high and while the data presented here refer to the LNG-IUS, they could equally apply to the copper intrauterine device (IUD) or to contraceptive implants. However, the findings of this study could play a role in influencing family planning program planners and policymakers, since compared with the copper IUD there are several non-contraceptive benefits associated with the LNG-IUS that are important for women's health, such as its ability to control HMB, relieve endometriosis-associated pain and improve anaemia.[17] In low-resource settings, providing this contraceptive method at no cost, or at an affordable cost to publicly-insured populations, represents an effective policy that will help promote women's health.

Correction notice This paper has been amended since it was published Online First. Owing to a scripting error, some of the publisher names in the references were replaced with 'BMJ Publishing Group'. This only affected the full text version, not the PDF. We have since corrected these errors and the correct publishers have been inserted into the references.

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Competing interests LB received honorarium to be member of advisory board and has been an invited speaker at scientific meetings for Bayer Healthcare Pharmaceuticals. Also, he was a member of the ICA Foundation without remuneration. IM received honorarium as speaker at scientific meetings for Bayer Healthcare Pharmaceuticals.

Ethics approval Ethical Committee of the University of Campinas, Campinas, Brazil.

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