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Burden of unintended pregnancy in the United States: Potential savings with increased use of long-acting reversible contraception

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Abstract

Background—This study evaluated the total costs of unintended pregnancy (UP) in the United States from a third -party health care payer perspective and explored the potential role for long-acting reversible contraception (LARC) in reducing UP and resulting health care expenditure.

Study Design—An economic model was constructed to estimate direct costs of UP as well as the proportion of UP costs that could be attributed to imperfect contraceptive adherence. The model considered all US women requiring reversible contraception: the pattern of contraceptive use and rates of UP were derived from published sources. The costs of UP in the United States and the proportion of total cost that might be avoided by improved adherence through increased use of LARC were estimated.

Results—Annual medical costs of UP in the United States were estimated to be $4.5 billion, and 53% of these were attributed to imperfect contraceptive adherence. If 10% of women aged 20–29 years switched from oral contraception to LARC, total costs would be reduced by $288 million per year.

Conclusions—Imperfect contraceptive adherence leads to substantial unintended pregnancy and high, avoidable costs. Improved uptake of LARC may generate health care cost savings by reducing contraceptive non-adherence.

Keywords

Unintended pregnancy; Long-acting reversible contraception; Intrauterine system; Contraception; Cost savings; Medication adherence

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1. Introduction

Despite intense focus on reducing unintended pregnancies (UP) in the United States (US) in recent years, nearly half (49%) of all pregnancies are unintended [1]. UPs are associated with adverse consequences for both mother and child [2], and with a high rate of abortion [3, 4]. Total costs to US taxpayers from UP have been estimated to range from $9.6 to $12.6 billion a year [5], whilst annual direct medical costs have been estimated to be $5 billion [6]. These costs are theoretically avoidable.

Available methods of contraception are effective when adherence is high [7–9], but during real world usage imperfect adherence contributes to contraceptive failure, with an estimated 48% of all UPs in the US occurring in women who are using contraception [4]. Long-acting reversible contraception (LARC), which includes implants and intrauterine contraceptives, is the most effective type of reversible contraception [8] because adherence is not required. In this analysis, an economic model was used to estimate the cost to third-party payers associated with UP and to estimate the proportion of this cost attributable to imperfect contraceptive adherence. The model also estimated cost savings that might be generated by women switching to LARC from other contraceptive methods.

2. Materials and methods

2.1. Model design and population

A cost model was constructed as follows: first, the annual number of UP-related events and associated cost were estimated; next, utilization and cost of contraceptive methods in the US were evaluated and the proportion of UP events in the US associated with imperfect adherence estimated; finally, the change in UP and cost impact that might result from increased use of LARC were derived. The framework follows the structure of an earlier analysis [6].

The model considered women aged 15–44 years who are sexually active and of child-bearing age but who currently neither seek pregnancy nor wish to be permanently sterilized. Separate calculations were performed by 5-year age groups. The analysis represents an average one year period of use, to allow comparability between reversible methods that are short acting (SARC) and long acting (LARC).

2.2. Unintended pregnancy-related events

Four possible pregnancy outcomes were considered: live birth, induced abortion, spontaneous abortion, and ectopic pregnancy. The annual number of these events (resulting from both planned and unplanned pregnancy) occurring in each age group was obtained from the National Survey of Family Growth (NSFG), a large survey conducted by the US Centers for Disease Control and Prevention which collects data on pregnancy, childbearing, men's and women's health, and parenting from a national sample of women and men 15–44 years of age in the United States [10]. Spontaneous abortions and ectopic pregnancies were reported together in a single category of fetal losses. Consequently, ectopic pregnancy rates were taken from an analysis of a large administrative claims database of US commercial health plans [11] and applied to the total number of pregnancies in each age group [10] to estimate ectopic pregnancy numbers . Subtracting ectopic pregnancies from all fetal losses in each age group then provided an estimate of the number of spontaneous abortions.

The total numbers of live births and induced abortions that result from UP only were estimated by multiplying the total numbers of these events by the estimated proportions of these events that result from UP [4, 12]. No data were identified to estimate the proportion of ectopic pregnancies and spontaneous abortions that result from UP; we assumed that 50%

resulted from UP in the US , in line with the proportion of all pregnancies that are unintended [1].

2.3. Costs of unintended pregnancy-related events

Costs associated with UP outcomes in the US in inpatient, outpatient, and non-hospital settings were obtained from the Medicare Fee Schedule 2011 [13], and a weighted average cost for each UP outcome derived.

A proportion of live births resulting from UP in the US are mistimed rather than unwanted; costs were adjusted downward as in prior work [6]. This adjustment is described in full in the Technical Appendix.

The cost of each event was multiplied by the annual number of events to generate an estimate of total UP costs.

2.4. Utilization of contraceptive methods

In addition to no method, 10 reversible contraceptive methods were considered in this analysis. SARC included the oral contraceptive pill (OC), male condom, patch, injectables and vaginal ring. LARC included implant, intrauterine device (IUD) and hormonal intrauterine system (IUS). Other methods were withdrawal and periodic abstinence. Permanent contraceptive methods were not considered.

The distribution of use of the various contraceptive methods was determined from the NSFG [14], and multiplied by the total population in each age group to estimate the number of women using each method. Contraceptive discontinuation or switching was not considered; women allocated to a contraceptive method were assumed to stay on the intervention for the full duration of product efficacy. In reality, given their changing preferences and situations, individuals do switch between different methods. There are, however, no nationally representative data from which to estimate probabilities of switching among all methods. Moreover, allowing switches precludes a pure comparison of different contraceptive methods; if all switches are assigned an average cost of a mix of contraceptive methods, then the costs of the different methods will converge over time.

2.5. Costs of contraceptives

Contraceptive costs included both product costs and associated health care resources (e.g., consultation, device insertion/removal). For product costs, IMS MIDAS [15] market share data were used in conjunction with price data from the Medi-Span Master Drug Database [16] to construct weighted average costs for each contraceptive method.

Medical consultation costs were obtained from the Medicare Fee Schedule [13]; consultation frequency was assumed for each method in the absence of literature estimates.

To permit comparability between contraceptives with varying durations of use, product costs incurred over an average one year period were calculated. For products with a duration of product efficacy exceeding one year (implant, IUD, and IUS), total costs incurred over the product duration of efficacy were divided by this duration to derive average annual costs. For all other contraceptives, average annual costs were assumed equivalent to the first year of product use. A more detailed description of cost annualization may be found in the Technical Appendix.

2.6. Unintended pregnancy due to imperfect adherence

For each contraceptive method, pregnancy rates for 'perfect use' (efficacy during correct and consistent use) and 'typical use' (effectiveness during actual 'real world' use including inconsistent or incorrect use) were taken from the literature [8]: the difference between them was assumed to represent UP attributable to imperfect adherence for each contraceptive method. The percentage of UP attributable to imperfect adherence was determined in this way for each method.

2.7. Effects of increased use of long-acting reversible contraceptives

The potential cost impact of increased uptake of LARC methods was examined among a sub-set of women aged 20–29 years. Our analysis focused on this cohort as it contributes the major portion of annual UP [17]. Three scenarios were explored:

1. 10% of women aged 20–29 who are currently using OC switched to LARC
2. 10% of women aged 20–29 who are currently using any SARC method switched to LARC
3. 10% of women aged 20–29 who are currently using either SARC or no method switched to LARC.

Note that the population switching within the three scenarios differs; the OC switch analysis represents the smallest cohort of women switching because only those women currently using OC are included in the calculation; the SARC plus no method analysis represents the largest cohort as 10% of all SARC and no method users switch. The projected cost of UP and contraception in each scenario was compared to the estimated current cost. The calculation is described in detail in the Technical Appendix.

2.8. Sensitivity analysis

Sensitivity analysis explored the impact of increased use of LARC on potential savings when costs of implant, IUD, and IUS were not annualized. Full first year contraceptive costs were applied in the model and the change in cost estimated based on a one year time horizon.

An additional sensitivity analysis estimated the duration of time that LARC methods would need to be used following a switch to achieve cost-neutrality, defined as a net cost impact to the payer of zero . This analysis was undertaken to address concerns that LARC methods may not be used for the full duration of product efficacy, and hence may not be able to realize the potential cost savings arising from low annualized costs.

3. Results

3.1. Unintended pregnancy-related events and costs

The estimated annual number of UPs is 3.11 million, resulting in 1.48 million live births, 1.11 million induced abortions, 539,000 spontaneous abortions and 19,000 ectopic pregnancies. Over half (53%) of UPs in the US occurred in women 20–29 years of age (Table 1).

The weighted average cost for each UP in the US outcome is shown in Table 2. The estimated annual cost of UP outcomes is $4.6 billion.

3.2. Contraceptive costs and effectiveness

Annual contraceptive costs ranged from $22 for condoms to more than $1,000 for the patch (Table 3). Pregnancy rates for perfect use and typical use are shown in Table 4. All SARC and LARC methods considered are associated with UP rates of 2 or less per 100 women within the first year of perfect use. SARC methods are, however, associated with higher rates of UP in typical use, with a high proportion of UP attributable to imperfect adherence

3.3. Implications of imperfect adherence

We estimate that 1.64 million UP in the US occur due to imperfect adherence. The highest number of UP events occur in women aged 20–24 and 25–29 years. The total cost of UP due to imperfect adherence is $2.47 billion (Table 5), 53% of the total cost of UP. Estimated costs due to imperfect adherence are $762 million in women aged 20–24 years, the highest in all age groups assessed.

3.4. Impact of increased long-acting reversible contraceptive utilization

In all three scenarios examined in women aged 20–29, higher LARC uptake generated cost savings. The largest savings were achieved when 10% of the cohort currently using any SARC or no method switched to LARC, reaching $436 million (Table 6).

3.5. Non-annualized costs and cost-neutrality analysis

When costs are not annualized, in the 20–29 year age group, switching from non-LARC to LARC methods results in net cost increases, rather than the savings observed in the base case. 10% of women switching to LARC from OCs, SARC, and SARC & no method results in net cost increases of $52 million, $273 million, and $334 million, respectively.

Among women currently using OC, assuming a 10% switch to LARC , cost neutrality is achieved after 1.33 years in women aged 20–24 and after 1.39 years in women aged 25–29; among women currently using any SARC, cost neutrality is achieved after 1.62 years (age 20–24) and 1.82 years (aged 25–29); among women currently using any SARC or using no method, cost neutrality is achieved after 1.63 years (age 20–24) and 1.90 years (aged 25–29).

4. Discussion

The total direct medical cost of UP was estimated to be greater than $4.6 billion annually, consistent with previous estimates [6]. Our results suggest that greater than half of UP costs in the US may be attributed to imperfect contraceptive adherence, with a particularly high cost in women aged under 35 years. Our analysis also indicates that significant costs savings may be generated among women aged 20–29 years by switching from SARC to LARC.

There are several limitations to the analysis. Only first year failure rates were available for contraceptive methods; these may be higher than failure rates for subsequent years [18]. Consequently, the estimated number of UP may be overstated, as may cost savings generated from switching to LARC methods. For live births, only the direct cost of delivery was included in the model; pre-natal costs were omitted, as were any long-term economic, social or health impacts of UP. The cost of unintended pregnancy is thus likely to be underestimated, as are cost savings when switching from SARC to LARC methods.

In the switching analysis, the assumption of a 10% switch to LARC methods may be conservative. With improved access and information a larger proportion of women using SARC could conceivably switch to LARC methods [19], and may include a broader age

group than the 20–29 year group considered here. Potential costs savings arising from this switch may therefore be underestimated.

Medicare data were used to calculate the cost of UP outcomes. These prices are likely to be lower than costs incurred by private third-party payers , as the most recent report to the US Congress on Medicare payment policy by the Medicare Payment Advisory Commission suggests that Medicare physician fee costs are deemed to be 83% of private-payer costs [20]. The cost of a UP, and consequently the cost savings generated from switching to LARC, may therefore be higher in a private-payer setting.

Cost annualization permitted comparability between contraceptive methods with differing durations of use over the one year time horizon of the model. The impact of using non-annualized costs was assessed in sensitivity analysis. In this analysis, upfront costs were assigned to LARC without consideration of the duration of product efficacy for the method. Non-annualized costs bias against LARC, where upfront costs are higher than SARC but where benefits continue to accrue beyond year one. However, the cost-neutrality analysis indicates that despite higher initial costs, LARC methods require use for only a little over 1 year before cost savings are generated in the switch from OC to LARC and a little under 2 years in the switch from SARC to LARC. Given that LARC methods have a minimum 3 year duration of product efficacy, it is reasonable to assume that in most women the potential cost savings from LARC uptake would be realized.

The cost of side effects and the impact of contraceptive method discontinuation and switching beyond a one year period were not evaluated and merit additional research. Wholesale acquisition costs (WAC) for contraceptives used in the analysis may not reflect actual costs faced by third - party payers, who may obtain discounts or rebates.

In conclusion, the total cost of UP in the US estimated in this study is similar to previous estimates [6] and further substantiates the economic burden stemming from UP in the US. Additionally, a substantial proportion of UP in the US and resulting costs may be attributed to imperfect adherence. In women aged 20–29 years, increasing the use of LARC methods at the expense of SARC was estimated to result in cost savings. Improving access and uptake of LARC methods may thus represent a tool for reducing unintended pregnancy and associated health care expenditures.

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Technical Appendix: detailed cost calculations

Cost of pregnancy outcomes

For each of the four pregnancy outcomes, relevant procedures were identified by matching ICD-9 codes with corresponding procedure codes from the DRG 2008 Codebook or the CPT 2008 Codebook [13]. Medical tariffs were derived from the Medicare Physicians Fee Schedule [13].

For live births, the calculated cost per birth was additionally reduced to account for the proportion of births that were mistimed rather than unwanted (Table A1). The full cost of mistimed events should not be regarded as avoidable as these births would otherwise occur, albeit at a later date. The National Survey of Family Growth (NSFG) reported the percentages of all births that were intended, unwanted, or mistimed [12]. The fraction of UPs that were mistimed (f) was determined from the ratio of mistimed births to the sum of unwanted and mistimed births for each age band. Assuming a discount rate of 5% and using NSFG reported data on the average number of years a birth is mistimed (d), live birth costs were adjusted as follows for each age group:

$$\text{Adjusted Cost of Live Birth} = \text{Cost of Live Unwanted Birth} * (1 - f / 1.05^{d})$$

Cost of contraception

To determine the annualized costs of each contraceptive method, unit costs were multiplied by the annual utilization of that medical resource item required. For example, for OCs, the cost associated with one 28-day pack was multiplied by 13 to generate the cost over one year. For IUDs, the cost of one unit lasting 10 years was multiplied by 0.1 (1/10) to generate the annualized resource cost.

Detailed calculations for the various components are presented in Table A2. The last column of the table summarizes the total average annual cost for each contraceptive.

Cost impact of switching

To evaluate the cost impact of a switch in contraceptive utilization, the proportion of women expected to have an UP given the current distribution of contraceptive usage was compared with a hypothetical situation where some women switched to LARC from other methods.

The model estimates the proportion of women expected to fail given current distribution of contraceptive usage and the proportion of women expected to fail given increased LARC usage. In each scenario, contraceptive utilization distributions were multiplied by the corresponding contraceptive failure rates for each method and then summed to determine the overall expected rate of UP for this population. By comparing the overall population UP rates before and after switching, it was possible to estimate a relative reduction in UP rate in the US given a switch to LARC. Applying this relative reduction in UP rate post-switch to the raw number of UPs in the base case produced an estimate of the reduction in UPs, and hence UP costs, that could be achieved from increased LARC uptake.

An example based on the OC to LARC switch demonstrates this methodology. The 20–29 year age group was broken down into two cohorts, 20–24 years and 25–29 years. In the 20–24 years cohort, the relative reduction in UP rate was estimated as 0.022, based on an estimated cohort failure rate of 10.1% in the ‘current’ scenario and 9.9% in the switch scenario: 1 - (9.9%/10.1%) = 0.022 (numbers are rounded). This figure was applied to the estimated cost of UP in this cohort of $1,415 million, to generate estimated cost savings of $31.5 million. Repeating this process for the 25–29 years cohort generated UP cost savings of $19.3 million, therefore producing total cost savings of $51 million for the 20–29 years age group (Table 6).

In addition to the impact on the numbers and costs of UP, the impact on the cost of contraception was also evaluated. This was achieved by multiplying the number of contraceptive users by the corresponding costs of each contraceptive method in both the pre and post-switch scenarios. The total cost impact of a switch comprised changes to both the cost of UP and cost of contraception.

Table 1

Annual number of unintended pregnancy outcomes in the United States

Pregnancy outcome	**15–19 years**	**20–24 years**	**25–29 years**	**30–34 years**	**35–39 years**	**40–44 years**	**All ages**
Live births [10]	435,000	1,052,000	1,196, 000	957,000	489 ,000	114,000	4,230,000
Proportion due to UP [12]	0.71*	0.44	0.27	0.22*	0.22*	0.22*	
Live births resulting from UP	310,590	464,984	322,920	208,626	106 ,602	24,852	1,483 ,574
Induced abortion [10]	192,000	397,000	298,000	177,000	10,6000	370,00	1,207 ,000
Proportion due to UP [4]	0.92	0.92	0.92	0.92	0.92	0.92	
Induced abortion resulting from UP	176,640	365,240	274,160	162,840	97,520	34,040	1,110,440
Ectopic pregnancy‡ [10;11]	2,111	7,414	9,249	10,057	8,108	1,980	38,918
Proportion due to UP†	0.5	0.5	0.5	0.5	0.5	0.5	
Ectopic pregnancy resulting from UP	1,056	3,707	4, 624	5,028	4,054	990	19,459
Spontaneous abortion and ectopic pregnancy [10]	128,000	237,000	251,000	225,000	224 ,000	52,000	1,117 ,000
Spontaneous abortion§	125,889	229,586	241,752	214,943	215,892	50,020	1,078 ,082
Proportion due to UP†	0.5	0.5	0.5	0.5	0.5	0.5	
Spontaneous abortion resulting from UP	62,944	114,793	120,876	107,472	107 ,946	25,010	539,041

UP – unintended pregnancy.

*The values reported were for the age groups 18–19 yrs, 20–24 yrs, 25–29 yrs and 30–44 yrs; therefore, those reported for 18–19 yrs were applied to the 15–19 yrs group in this model and similarly, those reported for the aggregate age group of 30–44 yrs were applied to the individual age groups of 30–34 yrs, 35–39 yrs and 40–44 yrs [12].

‡Calculated by applying the ectopic pregnancy rate reported in Hoover et al, 2012 [11] to the total number of pregnancies reported by Ventura et al, 2008 [10].

†Assumption, see text.

§Calculated by subtracting the number of ectopic pregnancies from the number of spontaneous abortions.

Table 2

Costs of pregnancy outcomes in the United States by setting

Pregnancy Outcome	Hospital inpatient	Hospital outpatient	Non-hospital	Weighted average
Live birth, cost per event ($) [13]	$4,729	-	-	$4,729[§]
Proportions by setting of care (%) [*]	100	0	0	
Induced abortion, cost per event ($) [13]	$3,524	$1,712	$303	$725
Proportions by setting of care (%) [3]	0	30	70	
Spontaneous abortion, cost per event ($) [13]	$2,869	$1,765	$365	$895
Proportions by setting of care (%) [*]	10	20	70	
Ectopic Pregnancy, cost per event ($) [13]	$4,511	-	-	$4,511
Proportions by setting of care (%) [*]	100	0	0	

[*] Assumption.

[§] See Technical Appendix and Table A1.

Table 3

Annual cost of contraceptive methods in the United States

Contraceptive method per woman per year, $, annualized	Ingredient cost [15;16] (A)	Initial consultation & procedure [13] (B)	Follow-up consultation [13] (C)	Removal consultation & procedure [13] (D)	Total annual cost (A+B+C+D)
SARC methods					
Pill	$612.85	$41.45	$0.00	$0.00	$654.30
Male condom	$21.77	$0.00	$0.00	$0.00	$21.77
Patch	$982.41	$41.45	$0.00	$0.00	$1,023.86
Ring	$945.49	$41.45	$0.00	$0.00	$986.94
Injection	$223.84	$41.45	$125.24	$0.00	$390.53
LARC methods					
Implant IUD	$219.81 $59.80	$55.61 $14.10	$0.00 $6.90	$61.84 $16.55	$337.25 $97.34
IUS	$140.61	$28.20	$13.79	$33.09	$215.70
Others	None				

SARC – short-acting reversible contraception ; LARC – long-acting reversible contraception.

Note: numbers may not sum due to rounding.

See technical appendix for derivation of cost components.

Table 4

Contraceptive failure rates and proportion of pregnancies due to imperfect adherence in the United States

Contraceptive method	UPs per woman per 100 years in perfect use (A)	UPs per woman per 100 years in typical use (B)	Proportion of UP rate attributable to imperfect adherence (B–A)/B
SARC methods			
Pill [8]	0.3	9.0	0.967
Male condom [8]	2.0	18.0	0.889
Patch [8]	0.3	9.0	0.967
Ring [8]	0.3	9.0	0.967
Injection [8]	0.2	6.0	0.967
LARC methods Implant [8]	0.05	0.05	0.000
IUD [8]	0.6	0.8	0.250
IUS [8]	0.2	0.2	0.000
Other			
Withdrawal [8]	4.0	22	0.818
Periodic abstinence [8]	5.0	24	0.792
No method [9]	46	46	NA

SARC – short-acting reversible contraception ; LARC – long-acting reversible contraception.

Table 5

Annual number and cost of unintended pregnancies and proportion attributable to imperfect adherence in the United States

Results	15–19 years	20–24 years	25–29 years	30–34 years	35–39 years	40–44 years	All ages
Number of UPs	551,230	948,724	722,580	483,966	316,122	84,892	3,107,514
Number UPs due to imperfect adherence	255,887	510,993	396,488	294,798	148,786	36,332	1,643,283
Cost of UP ($ millions)	$754	$1,415	$1,006	$846	$497	$124	$4,642
Cost of UP due to imperfect adherence ($ millions)	$350	$762	$552	$515	$234	$53	$2,466
As a % of total UP	46%	54%	55%	61%	47%	43%	53%

UP – unintended pregnancy.

Table 6

Impact of increased use of long-acting reversible contraceptives in the United States over average one year period

Impact of 10% of women aged 20–29 years using LARC in place of specified SARC methods	Cost of UP (millions)	Cost of contraception (millions)	Total cost impact (millions)
Current practice	$2,421	$4,460	$6,881
10% of OC users switch to LARC			
Cost of new contraceptive practice	$2,370	$4,223	$6,593
Cost savings (vs. current practice)	$51	$237	$288
10% of SARC users switch to LARC			
Costs of new contraceptive practice Cost savings (vs. current practice)	$2,303 $117	$4,203 $257	$6,506 $375
10% of SARC/no method users switch to LARC			
Costs of new contraceptive practice	$2,207	$4,238	$6,445
Cost savings (vs. current practice)	$214	$222	$436

SARC – short-acting reversible contraception; LARC – long-acting reversible contraception; UP – unintended pregnancy

Note: numbers may not sum due to rounding.