Assessing the cost–effectiveness of contraceptive methods in Shiraz, Islamic Republic of Iran

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تقييم مردودية طرق منع الحمل في ريف جمهورية إيران الإسلامية: دراسة في شيراز

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الخلاصة: لتحديد مردودية استخدام سبع طرق لمنع الحمل من وجهة نظر القائمين على إيتاء تلك الوسائل، تم حساب التكلفة مقدّرة بعدد سنوات الزواج المتوقية للحمل ACYP بالنسبة لكل طريقة اعتمادا على عوامل تحويل خاصة بكل منطقة. وقد شملت الدراسة أكثر من 800 74 من عدد سنوات الزواج المتوقية للحمل خلال فترة 12 شهرا بين آذار/مارس 1999 وشباط/فبراير 2000. وقد أعطت اللوالب أعلى المقادير من عدد سنوات الزواج الموقية للحمل؛ كما كانت العوازل الذكرية أغلى الطرق المستخدمة لمنع الحمل، أما قطع الأسهر فقد كان أكثر الطرق مردودية مقابل مكافىء واحد من عدد سنوات الزواج المتوقية للحمل في الوقت الذي كانت الغرسات أكثر الطرق تكلفة وقد أوصى الباحثون بإحداث تغيير كبير في النماذج المتبعة، بتشجيع المراجعين على استخدام طرق طويلة المفعول مثل الغرسات وقطع الأسهر نظراً لقلة الانتفاع من الموارد ونقص انتشار الانتفاع من تلك الطرق.

ABSTRACT To determine the cost–effectiveness of seven contraceptive methods from the providers' perspective, the cost per adjusted couple-years of protection (ACYP) was calculated for each method based on region-specific conversion factors. More than 74 800 ACYPs were provided during March 1999 to February 2000. Intrauterine devices and implants offered the highest and lowest ACYP respectively. Condom was the single most expensive contraceptive method. Vasectomy was the most cost-effective method and implant provided the highest cost per ACYP.

Evaluation du rapport coût-efficacité des méthodes contraceptives en milieu urbain en République islamique d'Iran : étude réalisée à Chiraz

RESUME Afin de déterminer le rapport coût-efficacité de sept méthodes de contraception du point de vue du fournisseur, le coût par couple-années de protection ajusté (CAP) a été calculé pour chacune des méthodes sur la base des facteurs de conversion spécifiques aux régions. Plus de 74 800 CAP ajustés ont été fournis durant la période de mars 1999 à février 2000. Les dispositifs intra-utérins et les implants offraient le CAP ajusté le plus élevé et le plus faible respectivement. Le préservatif était la méthode contraceptive la plus coûteuse. La vasectomie était la méthode la plus rentable et l'implant représentait le coût le plus élevé par CAP ajusté.

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Introduction

The Islamic Republic of Iran's family planning programme is one of the most successful among developing countries. However, the number of people younger than 18 years (approximately 45% of the country's total population) pose a considerable demographic challenge because of population momentum [*1*]. At the same time, the restriction of government resources available to spend on health care increases the problems associated with allocation of resources to family planning programmes. Moreover, as programmes have taken root and gained acceptance socially and politically, the challenge of financing the resources has become greater [*2*].

On health and human rights grounds, the legitimacy of organized support for family planning is now almost universally accepted. Still at issue, however, is the efficiency of government programmes for accelerating a decline in fertility. While primary health care applies the same principles in both rural and urban populations, the urban situation has certain special features, including rapid population growth and a high concentration but limited accessibility to health and family planning services. Thus, because of the tightening of government budgets and rapid urban growth, economic appraisal of existing contraceptive methods merits greater attention [*3*]. Although cost should not be the only factor dictating the methods offered by a programme, it is certainly important to know what the costs of providing various methods are and how programme changes can increase cost–effectiveness.

In the present study, we report the results of an economic appraisal of providing seven contraceptive methods: oral contraceptives, male condom, injectable contraceptive, contraceptive implant, intrauterine devices (IUDs), tubal ligation and vasectomy. The study was conducted to: 1) compare the cost–effectiveness of the seven methods and select the least costly way of providing a given level of contraceptive protection; 2) to assist health administrators in allocating resources to various contraceptive methods.

Methods

Setting

The study was conducted at Shiraz district health centre, located 895 km south of Teheran. The first level for provision of health services in urban Islamic Republic of Iran is the urban health centre which covers between 5000 to 15 000 people and is staffed by a physician and a number of health technicians [*4*]. Family planning services are considered an integral part of primary health care provided by health personnel who work at the urban clinics, and the target population has free access to the services.

Measurement of effectiveness

Although numerous indicators of family planning effectiveness exist [including fertility rates, births averted, contraceptive prevalence, numbers of visits, acceptors and users, and couple-years of protection (CYP)], we used CYP as an output measure because it is probably the best available for comparative purposes [*5*]. One CYP means that one couple does not conceive for 1 year. The study examined the two elements of CYP: 1) the conversion factor, which is the average duration of protection provided by one application of the method, and 2) the number of contraceptives provided to users. Considering the failure rate and age-related relative risk of pregnancy (based on average users' age)

the adjusted CYP (ACYP) was also calculated [6]. Based on the duration of protection of each unit of various contraceptive methods, conversion factors were calculated [7]: to determine the inevitable wastage that occurs with pills and condom, and also to estimate average coital frequency of condom users, structured interviews with randomly selected samples of users were administered; to calculate the average duration of use of implants (Norplant) and IUDs (Copper-T 380A), the life-table method [8] was used; for sterilization, the average age of the wives of the sterilized couples was computed.

Measurement of cost

Between March 1999 and February 2000, data were obtained by examining records, including work statements, inventories, stock cards of commodities, books of account and so on. The costs fall into the following four groups: labour costs; costs of administrative and supervisory personnel; costs of contraceptives and supplies; overheads costs. Although it was of interest to document the level of capital investment used in producing family planning programme outputs, capital costs were not included in the calculation as adequate data were not available [9].

To estimate personnel costs, we obtained information on the time spent on providing each contraceptive method (regarding each staff category) through interviews with providers and supervisors. For salaried staff, salaries were prorated among activities according to time-allocation data [10]. For sterilization and implant where doctors are paid on a fee-for-service basis, costs included the fee itself. Costs of administrative and supervisory staff at the district level (national level data were not included) were allocated across programmes in proportion to labour costs. Contraceptive costs were obtained from the Ministry of Health and Medical Education purchase orders. Supply costs were calculated by meticulously analysing with providers each cost element in order to identify the supplies used for each contraceptive method. The costs of supplies were derived from the purchasing department [9]. Overheads costs (electricity, water, heating, cleaning, etc.), calculated from the cost records of each service delivery unit, were allocated based on the portion of space used by family planning services [11]. Costs were calculated in US dollars; the official exchange rate at the time of the study US$ 1 = 1750 Iranian rials.

Incremental cost–effectiveness

ACYP and costs per ACYP were calculated. Incremental cost–effectiveness was calculated to compare each alternative contraceptive method with the next most effective option and was expressed as the difference in dollar cost incurred per additional ACYP [12].

Sensitivity analysis

To evaluate the dependence of results on underlying assumptions, analyses were performed for critical variables. The greatest uncertainties regarding cost–effectiveness in this study arose from the estimates of effectiveness (i.e. CYP). Using sensitivity analysis, we examined how the cost–effectiveness calculations changed within the limits of our uncertainty about CYP estimates [12].

Results

In our study local data were used to derive appropriate local conversion factors [5]. Based on a structured interview with a representative random sample of 385 users

of oral contraceptive pills (OCPs), 14% wastage was taken into account [*13*]. Another structured, relatively simple interview administered to 385 randomly selected regular condom users showed 33% wastage and an average coital frequency of 60 per year (5.0 acts of intercourse per month) [*14*]. To estimate the CYP conversion factor for IUD a representative sample of records of 1100 IUD users was examined. The cut-off for the analysis was 18 February 2000, at which time all women had completed 8 years of IUD use, had had an earlier termination or had been lost to follow up. For implant, a retrospective review of the records of all 242 clients who had undergone an insertion 5 years before the time of the study was undertaken. By the cut off point for analysis, all women had completed 5 years of use or had had an earlier termination. For female and male sterilization, respectively, we used the difference between age 45 years and the average age at acceptance of all 1278 and 1160 clients who had undergone sterilization between 20 March 1999 and 19 March 2000 [*7*]. To be more realistic, true effectiveness of each method as commonly used [*15*] and age adjustment were taken into account.

Table 1 shows the relevant values for ACYP for the different methods of contraception. More than 74 800 ACYP were provided through family planning services over the 12 months studied. IUDs and implants provided the highest and lowest ACYP scores respectively.

Table 2 shows the total costs and the percentage of these costs that is attributed to variable costs for each contraceptive method. A total of US$ 1 522 122 was spent on contraceptive methods. Condoms were the most expensive method in terms of total costs and IUDs the second most costly. Comparison of the variable costs of the different contraceptive methods shows a wide variation (Table 2). The variable costs contribute to 52% of the total cost of

Table 1 **CYP and ACYP calculations by method of contraception**

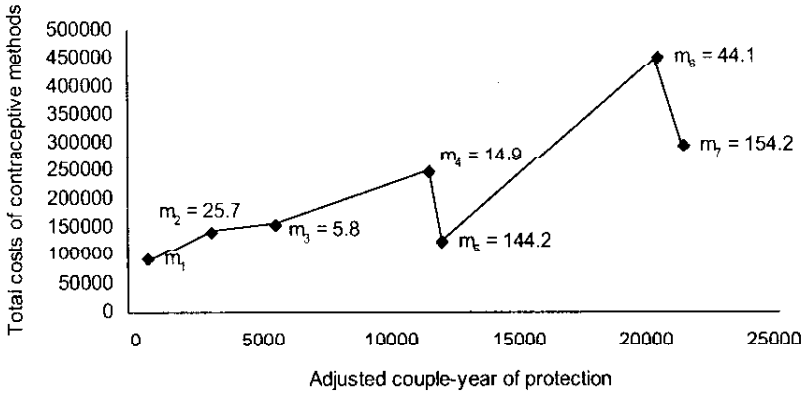
Method	Mean age of acceptor (years)	Acceptors during 12 months (No.)	Conversion factor	Effectiveness	Relative pregnancy risk	Conventional CYP	Adjusted CYP
Oral contraceptives	28.8	196 487	1/15	0.940	0.918	13 099.1	11 303.5
Condoms	29.1	2 077 540	1/80	0.860	0.912	25 969.2	20 368.2
Injectables	30.2	13 036	1/4	0.997	0.899	3 259	2 921.1
Implants	24.0	257	4.3	0.999	0.980	1 105.1	1 081.9
Intrauterine devices	32.6	4 319	6	0.992	0.843	25 914	21 670.7
Tubal ligation	34.2	620	11	0.995	0.796	6 853	5 441.3
Vasectomy	33.2	1 221	12	0.9985	0.826	14 652	12 084.4

Adjusted CYP was calculated as follows: Effectiveness × relative pregnancy risk × conventional CYP.
CYP = couple-years of protection. ACYP = adjusted CYP.

Table 2 **Total costs, variable (% of total cost) costs and cost–effectiveness ratios of the different methods of contraception**

Contraceptive method	Total cost (US$)	Variable costs (% of total cost)	Cost–effectiveness ratio[a] (US$)
Oral contraceptives	238 330	39	21.1
Condoms	490 676	52	24.1
Injectables	136 758	19	46.8
Implants	89 557	8	82.8
Intrauterine devices	289 772	18	13.4
Tubal ligation	151 321	47	27.8
Vasectomy	125 708	28	10.4
Total	1 522 122	35	...

[a]*Calculated as costs per adjusted couple-years of protection.*
... = not applicable.



m_1 = implants; m_2 = injectables; m_3 = tubal ligation; m_4 = oral contraceptives; m_5 = vasectomy; m_6 = condoms; m_7 = intrauterine devices

Figure 1 **Incremental cost-effectiveness ratios of contraceptive methods**

condoms and 8% of implants. The cost–effectiveness ratios of the various contraceptive methods are also presented in Table 2. In terms of effectiveness, IUD and condoms were the most effective method providing 21 670.7 and 20 368.2 ACYP respectively (Table 1). However, because of lower costs, vasectomy, IUDs, and oral contraceptives proved to be more cost-effective. The cost per ACYP for implant was the highest (US$ 82.8), and for vasectomy it was the lowest (US$ 10.4).

Table 3 **Sensitivity analysis results: costs (US$) per CYP and ACYP, and percentage increases/decreases in cost–effectiveness ratio**

Method	Cost of conventional CYP derived from relevant studies (US$)	Cost of adjusted CYP (US$)	Increase or decrease in cost–effectiveness ratio (%)
Oral contraceptives	18.2	21.2	+16
Condoms	35.4	24.1	–32
Injectables	42.0	46.8	+11
Implants	99.6	82.8	–17
Intrauterine devices	19.2	13.4	–30
Tubal ligation	24.3	27.8	+23
Vasectomy	10.3	10.4	+1

CYP = couple-years of protection.
ACYP = adjusted CYP.

Our model yielded the incremental cost-effectiveness ratios shown in Figure 1. The horizontal axis displays ACYP; the vertical axis displays the total cost of each method. On the bottom left, the implant costs US$ 89 557 and provides 1 081.9 ACYP. The injectable increases ACYP by 1839.5 at an additional cost of US$ 47 201. The incremental cost–effectiveness ratios for this method is calculated by dividing the additional cost by the increase in ACYP [US$ 47 201/1 839.5 ACYP = US$ 25.7 per additional ACYP provided] and is shown adjacent to corresponding circle. Changes of the incremental cost–effectiveness ratios show no regular pattern. As is shown in Figure 1 the incremental cost–effectiveness is negative in the cases of vasectomy and IUD, since there are a reduction in cost.

The results of the sensitivity analysis are summarized in Table 3. The cost–effectiveness ratios for condoms, implants and IUDs calculated using ACYP were lower than those calculated using CYP. The greatest impact of such differences is seen with condoms and IUDs, which respectively show a 32% and 30% decrease in the costs of CYP when comparing conventional CYP with ACYP.

Discussion

Although substantial progress towards reducing fertility rates has been made in the past decade in the Islamic Republic of Iran, significant programme constraints still exist and threaten fertility declines. The most important of them are the tightening of government budgets and the very large numbers of potential parents entering the childbearing period [*16*].

Our study gives some useful insights into the efficiency of various contraceptive methods, but before discussing the implications of the results, we should point out the four main limitations of the study that

must be considered when interpreting the results. First, the study did not take into account costs from the clients' perspective, or the side-effects of the different methods and/or unintended pregnancies [*17*]. Second, costs were converted to US dollars at the official exchange rate, which markedly overvalues imported commodities [*18*]. Third, ignoring the capital costs may cause policy-makers to make poor resource-allocation decisions. For example, as capital costs differ clearly between condom provision and sterilization methods, by ignoring equipment costs, sterilization methods may appear less costly to the programme. Fourth, although health outcomes that occur in different time periods may be valued differently, the health effects of the various contraceptive methods (i.e. CYPs) were not discounted since, unlike resources, there is no reason to believe that protection of couples in future years is less desirable with time [*19*].

The fundamental need for careful measurement of effectiveness in cost effectiveness studies motivated us to improve the accuracy of the conversion factors for each method by using local data, since these may vary from country to country [*20*]. Taking into consideration factors such as method effectiveness (effects under usual conditions of practice) and relative risk of pregnancy in relation to mean age of acceptors, ACYP was calculated [*6*]. It may be a more realistic measure than conventional CYP. The sensitivity analysis demonstrated that measuring ACYP rather than conventional CYP, has an apparent impact on cost–effectiveness calculations (Table 3). This endorses our emphasis on precise calculation of CYPs based on regional and sociocultural settings [*2*].

Effectiveness alone, however, is not a sufficient basis to solve the problem of prioritization and resource allocation. To identify opportunities for improving the system's efficiency, we examined total and variable costs of each method and calculated the costs per ACYP. Although methods such as implant and injectables have a high cost per ACYP, this does not mean that they are not efficient methods. The proportions of fixed and variable costs have important implications for the costs of family planning services delivery. Efforts to reduce costs per ACYP must take this into consideration. A fixed cost, which is defined as "the total dollar expense that goes on even when zero output is produced" is most often due to labour, capital and overheads costs [*21*]. For methods with a high proportion of fixed costs, most of the higher cost per ACYP results from the small quantity of that contraception method given to acceptors. In other words, when the capacity of family planning programmes (e.g. implant) is underused, the cost per ACYP is much higher, because the total costs are prorated among a smaller number of contraceptive commodities [*9,22*]. So family planning programme management should endeavour to guarantee an acceptable quantity of use of underused methods in urban areas.

It should be noted that the average cost–effectiveness ratio cannot be used to set priorities for funding decisions in order to maximize the net health benefit (i.e. reducing fertility rates) and care must be taken not to confuse them with incremental ratio (Figure 1). More technically, the incremental cost–effectiveness ratio indicated the additional cost per ACYP of switching from one method to another, whereas average cost–effectiveness gives the cost per ACYP of each method independent of other methods [*11*]. As Figure 1 shows, vasectomy and IUD not only afford additional ACYP but also save costs. In

these cases, the incremental cost effectiveness is negative since there is a reduction in cost. However, the maximum incremental cost-effectiveness ratio was seen with condom (US$ 44.1 per ACYP).

In conclusion, our study shows that the best way to improve the cost–effectiveness of family planning programmes is to increase the prevalence of long-acting methods (i.e. sterilization, IUD, implant) by bringing about a change in the use patterns within government services by moving clients away from methods with high rates of discontinuation and failure (e.g. condoms) to long-acting methods (e.g. vasectomy and implants).

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