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Couple-years of protection (CYP) is one of several commonly used indicators to assess international family planning efforts. It has been the subject of much debate, relating in part to the specific conversion factors used to translate the quantity of the respective contraceptive methods distributed to a single measure of protection. This article outlines a comprehensive effort to revisit those conversion factors based on the best available empirical evidence. In most instances, the analysis supports previously established standard conversion factors. However, there are two notable departures. Fewer condoms and spermicides are recommended for each CYP (120 vs. 150), primarily because coital frequency among condom users is lower than previously assumed. Furthermore, for sterilization, the authors recommend the use of country or region-specific conversion factors. Every program evaluation indicator has strengths and weaknesses, and the best program evaluation efforts use a variety of indicators. If CYP is used to evaluate programs, however, the authors believe that the conversion factors presented reflect the best available evidence.

EMPIRICALLY BASED CONVERSION FACTORS FOR CALCULATING COUPLE-YEARS OF PROTECTION

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RATIONALE FOR THIS STUDY

THE PURPOSE OF COUPLE-YEARS OF PROTECTION

A wide range of indicators can and should be used to evaluate family planning (FP) programmatic performance (Bertrand, Magnani, and Knowles

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1994). One that is widely used is couple-years of protection (CYP). It is calculated by multiplying the quantity of each contraceptive distributed to clients by a conversion factor that describes the duration of contraceptive protection provided per unit of that method (Wishik and Chen 1973; Centers for Disease Control [CDC] 1993).[1] The number of CYP is then aggregated over a given time. It can be used to monitor program results on a quarterly or annual basis, make comparisons by regions within a country, and calculate cost-effectiveness (e.g., cost per CYP).[2]

This indicator was first proposed by Wishik and Chen (1973) as a practical means of addressing the fact that different contraceptive methods offer varying degrees of protection to individuals wishing to prevent pregnancy. Prior to that time, the main indicator of output in FP programs had been the number of acceptors. Yet it was clear to evaluation specialists that this output indicator was unsatisfactory, in that a client who purchased a dozen condoms (good for perhaps 1 to 2 months of sexual activity) counted for as much in terms of output as a client who underwent female sterilization (which generally confers approximately a decade of protection before menopause).

As an example of the use of CYP, consider a program that distributes contraceptives through outreach workers. Assume that last year the program distributed 5,000 cycles of pills and 100,000 condoms and that this year it distributed 7,500 cycles of pills and 50,000 condoms. Has program performance improved or declined? How does this program compare with a clinic that inserts 300 intrauterine devices (IUDs) a year and performs 200 female sterilizations? If the outreach program costs $20,000 a year to operate and the clinic costs $70,000 a year, which is more cost-effective? We can begin to answer these questions by calculating the number of CYP provided in each case. If we use conversion factors of 14 cycles per CYP for pills, 105 condoms per CYP, 3.7 CYP per IUD insertion, and 8.9 CYP per female sterilization, then we can compare the various programs. The outreach program provided 1,310 CYP last year but only 1,012 CYP this year. The clinic provides 2,890 CYP per year, more than double the outreach program. The cost per CYP provided is $20 for the outreach program this year, whereas the clinic costs $28 per CYP. Thus, the concept of CYP provides a simple way to compare programs that offer a mix of contraceptive methods. Without CYP, such comparisons would be impossible for most family planning programs.

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Today, national surveys provide estimates of national prevalence that, in many ways, are the best indicators of overall family planning use. Although national surveys are an essential source of information, they do not eliminate the need for measures of output. Most surveys are national in scope and a few have large enough samples to provide reliable estimates of prevalence at the provincial level as well. However, they do not provide estimates for smaller geographic areas. Because national surveys generally take place every 5 years, they do not satisfy the need for annual indicators. Most important, they cannot be used to measure the progress of donor-funded projects that serve special populations that are too small to be analyzed with national survey data. These surveys usually do not have sufficient detail about source of supply to distinguish between various central business district (CBD) programs or to separate nongovernmental organization (NGO) clinics from government or private clinics. In these cases, CYP is used to measure and compare the performance of different projects. For example, the Service Expansion and Technical Support (SEATS) project uses CYP to measure the performance of its subprojects that provide family planning services to populations of 1 to 2 million in countries around the world (Miller et al. 1996). Also, most studies of the cost-effectiveness of different projects rely on CYP to measure the annual effectiveness of family planning projects (Stover and Heaton 1997).

ADVANTAGES AND LIMITATIONS

There are several advantages of CYP as one measure of family planning program output. First, the data needed to calculate CYP are readily available; most organizations routinely collect statistics on the quantity of each contraceptive dispensed from a given service delivery point (SDP). Second, the calculation of CYP is relatively simple, once the underlying principle is understood of converting the amount of contraception dispensed to a measure of protection from unwanted pregnancy. Third, CYP tends to focus on an output (contraceptives distributed) rather than process (activities conducted to promote contraceptive use). Finally, the indicator is now well known and widely used in many programs (Wishik and Chen 1973; Bertrand, Magnani, and Knowles 1994; CDC 1993; Shelton 1991).

There have been various efforts in the past to improve CYP as a measure of impact by moving it closer to a measure of births averted or replacing it with births averted. A number of approaches have been proposed to calculated births averted (Wolfers 1975) or standard CYP (Gorosh and Wolfers 1979). The approaches outlined in the previous paragraph consider

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adjustments to basic CYP measurements by including considerations of expected fertility, method effectiveness, and overlap with postpartum amenorrhea. Laing and Walker (1987) used data from the 1974 Philippines National Acceptor Survey to calculate method-specific continuation rates, effectiveness rates, and overlap with postpartum amenorrhea. In this study, they calculated couple-months of protection (CMP) associated with the acceptance of a contraceptive method. This corresponds to the current application of CYP for long-term methods (where commodities distributed is a good proxy for the number of acceptors), but differs from current practice for temporary methods (which calculate CYP based on commodities distributed) due to the difficulty of determining acceptors of temporary methods. Laing and Walker calculated the number of months of protection associated with acceptance from the continuation rates. They then adjusted these figures for method effectiveness and removed any double coverage caused by overlap with postpartum amenorrhea to determine months of effective protection. They calculated CYP factor of 5.1 for IUDs, considerably higher than current estimates, and 7.4 for sterilization, somewhat lower than current estimates. They also calculated CYP factors of 2.4 for pills acceptors, 2.2 for rhythm acceptors, and 0.9 for condom acceptors. These estimates for temporary methods are not comparable to current figures, because they are based on acceptors and not commodities distributed.

The data required to apply these approaches are substantially greater than the requirements to calculate the basic CYP. As a result, few applications of these adjusted approaches are reported in the literature (Ross and Lloyd 1992), and the basic CYP definition is still widely used by international projects and donor agencies.

There are, however, a number of limitations of CYP, and its strengths and weaknesses have been a lively topic in the literature for many years (Shelton 1991; Fort 1996). We do not propose to recreate that discussion here. Clearly, CYP does not reflect some of the key qualitative aspects of service delivery. Another important concern about CYP is that its use might detract from optimal contraceptive choice for clients. Specifically, if program personnel feel pressured to achieve certain target levels of CYP, they might aggressively promote (some have argued with undue pressure) the use of all methods but in particular of high-scoring methods, including sterilization and Norplant (Murphy 1997). Clearly, clients and programs are best served when clients can truly choose from a wide variety of contraceptive methods. It is true that CYP gives more overall credit to clinical methods (sterilization, Norplant, IUD) than supply methods (the pill, condoms, spermicides). However, clinical methods generally require more effort to provide, they protect women

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longer on the average than supply methods, and the chance for wastage is lower for clinical methods. In any case, provider performance targets that would impair individual client choice are inappropriate whether or not they use CYP. An additional concern about CYP is the validity of the assumptions underlying the conversion factors—the subject of this article.

CYP calculations remain important for evaluating program performance. However, due to the limitations of CYP, this indicator cannot be the sole measure of the impact of a project. For example,

- some essential activities, such as policy reform, Information, Education, and Communications (IE&C), and logistics, do not directly generate CYP but are necessary components of a successful program;
- as programs strive to improve all aspects of reproductive health, the delivery of family planning cannot be the sole criterion to judge performance; and
- the recruitment of young users of temporary methods may generate few CYP compared to programs focused on permanent methods for older couples, but the young users may be very important for the long-term success of the program.

For these and other reasons, most programs are evaluated on a variety of indicators. For example, the U.S. Agency for International Development (USAID)-funded global social marketing program (SOMARC) evaluates its country programs not only on the number of CYP it provides but also on its ability to serve a mid- to low-income population segment, to generate demand, to improve the quality of service, to stimulate commercial sector participation, and to build sustainable programs. Most donor-funded projects today have multiple objectives that involve improving both access and quality for a number of reproductive health services. Few, if any, projects today are evaluated solely on the number of CYP provided.

No matter how much the CYP factors are refined, this indicator will never capture the true net effect of programs. First, because we have little information on substitution, we will not know what contraceptive users would have done if a particular program did not exist. Second, the fertility that would have been experienced by women in the absence of contraceptive use is not known and probably varies significantly for users of different ages and different methods. Third, because there is substantial variation in use characteristics across populations, the use of global conversion factors means that CYP will only be an approximation of the local situation. The information and modifications proposed here will not make CYP a perfect indicator of program impact, but they do make the best use of the volume of data now available to refine CYP as far as practicable.

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RECONSIDERING THE CYP CONVERSION FACTORS

In the early 1990s, a subcommittee of the Task Force for Standardizing Family Planning Program Indicators (consisting largely of members from USAID cooperating agencies) examined the issue of conversion factors and supported the idea of changing the values used throughout the 1980s to take into account wastage, use-effectiveness, inconsistent usage (e.g., of condoms), and the noncontraceptive use of condoms (with commercial sex workers or homosexuals), among others (Johnson 1991). The Task Force recommended new CYP factors; however, the empirical basis of the new factors—though presumably known by the experts involved—was not clear to the larger international population community.

The purpose of this study was to conduct an exhaustive review of existing literature, including published studies, service statistics, and other information relevant to factors used in calculating CYP. This exercise was undertaken to give fair credit to all methods of contraception based on their actual contribution to pregnancy prevention (that is, to provide a level playing field). The findings confirm the previously recommended conversion factors for some methods, whereas they suggest the need for modification in others.

METHODOLOGICAL APPROACH

ALTERNATIVE BASES FOR ESTABLISHING CONVERSION FACTORS

The CYP indicator can be interpreted in different ways, depending on the assumptions used in establishing the conversion factors. First, it can be a measure of the amount of services provided by the program, which was the original intent of Wishik and Chen (1973). In this case, CYP is based on the volume of service, that is, the number of cycles of pills distributed, the number of condoms distributed, the number of IUDs inserted, and so forth. The key information needed to calculate CYP in this case is average duration of use, coital frequency (for condoms and spermicides), and, if possible, wastage. There would be no consideration of whether clients actually use the methods or whether they use them effectively. This is the simplest approach, requires the least amount of data, and is perhaps the easiest to understand.

Second, CYP can be further refined to measure the protection provided by family planning services. In this case, the amount of service provided is

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TABLE 1: Characteristics Needed to Determine Couple-Years of Protection (CYP) Conversion Factors (by type of CYP definition)

Factor	*Services Provided*	*Protection Provided*	*Adjusted CYP*
Duration of use	X	X	X
Use-effectiveness		X	X
Coital frequency	X	X	X
Wastage		X	X
Misreporting	X	X	X
Age			X
Consistency of use			X
Noncontraceptive use			X
Overlapping coverage			X

adjusted to reflect use-effectiveness of the method and wastage. The advantage of this approach over the services provided definition is that it provides credit to programs that promote effective and consistent method use.

A third approach to calculating CYP takes into consideration several other factors that influence the prevention of pregnancy by a given quantity of contraception, such as age of the client, consistency of use, noncontraceptive use, and overlapping coverage. Under this approach, credit is given only for services that provide needed protection. For example, there would be very little credit for sterilization of a 45-year-old client, because her need for protection is likely to be low.

It is recognized that CYP will never be a perfect measure of fertility impact, because it does not consider such issues as substitution of one method or source for another or the timing of coitus or temporary method use. Whereas CYP is useful as a simple monitoring tool (calculated on the basis of service provided or protection provided), it should also reflect to the extent possible the ability of different methods to prevent pregnancy. Thus, we recommend an adjusted CYP factor that takes into account the series of factors listed in the final column of Table 1.

ASSUMPTIONS OR VARIABLES UNDERLYING THE CALCULATION OF CYP

The characteristics or factors that one needs to take into account in calculating CYP vary depending on the type of contraceptive and approach used (service provided, protection provided, or adjusted for fertility impact), as shown in Table 1.

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Duration of use (primarily for long-term methods). The underlying idea of CYP is to estimate the length of protection that one unit of the method protects a couple on the average. Thus, for methods that are not coital-dependent, this factor largely defines the conversion factor to be used.

Use-effectiveness (for all methods). Use-effectiveness is important to determine how much actual protection is provided by the use of the method. Less protection is provided by 13 cycles of pills if the woman does not understand how to use the pill correctly or is insufficiently motivated.

Coital frequency (coitus-dependent methods). This factor is relevant for barrier methods that are used just once. Fifty condoms may provide 1 year of protection for a couple who has intercourse 50 times a year but would provide only a half year of protection for a couple who has intercourse 100 times a year.

Wastage (temporary methods). If commodities are wasted (lost, destroyed, discarded, not used) by clients after they receive them, they provide no protection to the client, even though they were distributed by the program.

Misreporting (all methods). If the number of commodities or amount of services is misreported, it will not be a true indicator of the amount of protection provided to clients.

Age. A woman's fecundity generally declines as she ages into her late reproductive years. Protection provided to 100 women in their late 40s would avert fewer births than protection provided to 100 women in their 20s, even if both groups use the same type of protection for the same period of time.

Consistency of use. A person inconsistently using a method (such as condoms) will run a greater risk of pregnancy than a person using the same method consistently; however, the number of acts of intercourse that are protected will be the same for a given number of condoms.

Noncontraceptive use of condoms. Even when condoms are used for noncontraceptive purposes, such as the prevention of the transmission of HIV or other sexually transmitted diseases (STDs), they may still provide protection against pregnancy. However, some condom use may have little or no contraceptive value, such as use when males have sex with males or use with a commercial sex worker who may be subfecund or protected from pregnancy through another method.

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Overlapping coverage. Overlapping coverage occurs when a couple uses two methods of contraceptives (e.g., sterilization and condoms) or when a woman uses a method, such as the IUD, even though she is protected by postpartum amenorrhea.

DATA COLLECTION

The first step in this study was to locate and review all data from empirical research published in the family planning literature on each of the factors listed directly above. References identified through POPLINE were supplemented with direct inquiries to the organizations working on contraceptive technology (AVSC International, Family Health International, the Population Council, the World Health Organization) for additional leads or unpublished materials on these topics. The researchers also contacted a number of experts who have worked on topics relevant to the study (e.g., the validity of sexual history data) to gain further insights into these issues. In addition, special analyses of Demographic and Health Surveys (DHS) data were conducted to determine information on coital frequency, age at sterilization, and overlap to supplement the literature search. A special analysis was undertaken to calculate the impact of inconsistent use on fertility. Finally, efforts were made (unsuccessfully) to obtain estimates of contraceptive wastage at either the program or client level.

The results section summarizes the information available on each of the factors influencing the underlying assumptions for calculating CYP. The empirical evidence available on each factor is presented in a series of tables in the appendix. This information is then used to derive estimates of the most approximate conversion factor, taking into consideration multiple factors simultaneously.

EMPIRICAL EVIDENCE ON FACTORS RELEVANT TO CALCULATING CYP[3]

DURATION OF USE

Mean duration of use is the main factor in assessing the amount of protection conferred by for six contraceptive methods: IUD, the Norplant implant, voluntary sterilization, the diaphragm, natural family planning (NFP), and the lactational amenorrhea method (LAM).

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Mean Duration of Use of the IUD

There are two potential sources of data on average duration of IUD use: large-scale, population-based surveys of women of reproductive age (e.g., DHS) and follow-up studies of acceptors in a given program. Generally, DHS surveys are preferred to program data (including survey data for a sample of clients) because they are representative of the larger population and not subject to selection bias. However, the number of countries for which DHS data are available is limited, and thus, it is useful to supplement this data source with follow-up studies of acceptors. Both types of studies lend themselves to life table analysis that yields the median duration of use.

Studies designed specifically to follow IUD users fall into two categories: randomized clinical trials and follow-up studies among a cohort of IUD users under naturalistic conditions (i.e., women who were not aware that they would be asked to participate in a follow-up study). For a variety of reasons, women enrolled in clinical trials may use the IUD more successfully than women in the general public. In fact, the percentages of the original users continuing to use the IUD at 5 years postinsertion are surprisingly similar for the randomized clinical trials (48.6%) compared to the follow-up studies (48.7%) that we reviewed. However, the percentages still continuing to use the method at the 12-, 24-, 36-, and 48-month time points are higher for randomized clinical trials than for follow-up studies, which is consistent with the hypothesis above (these data are shown in Table A1). In light of this, we have chosen to exclude the data from randomized clinical trials from our calculation of median duration of IUD use. Rather, our final calculations of duration of IUD use are based on two sources of data only: the six DHS studies with data on duration of IUD use (Kirmeyer and Suchindran 1995) and the three follow-up studies among IUD acceptors conducted under naturalistic conditions (see Table A1).

Based on the aggregated data from the six DHS studies, the median duration point (at which 50% of the users have discontinued IUD use) is at 35 months, or just under 3 years. By contrast, for the follow-up studies under naturalistic conditions (Table A1) combined, the median use of IUD use is 53 months or 4.4 years.[4] For all 10 studies combined, the median is 42 months or 3.5 years.

These results indicate the median duration of use. The mean was calculated by fitting an exponential decay curve to the duration data; the result was a mean duration of IUD use of 3.9 years.[5]

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Mean Duration of Use of the Norplant Implant

The Norplant implant was first introduced for use in developing countries in 1975 and then only on an experimental basis in a few locations. The first available data on the average duration of Norplant were from a multisite study including Chile, Scandinavia, Indonesia, Egypt, and the Dominican Republic (Sivin 1983). The mean duration for these sites ranged from 2.8 to 4.5 years, for an overall mean of 3.5 years (see Table A2).[6] This number was adopted in the 1991 conversion factors as the best estimate for the average duration of Norplant use.

Subsequently, data have become available for studies conducted between 1985 and 1991 in six additional developing countries (Singapore, Nepal, Philippines, Sri Lanka, Bangladesh, and Nigeria), which yield a slightly longer mean duration of use for Norplant (3.8 years, ranging from 3.4 to 4.2), as shown in Table A2. (Data from developed countries are excluded from this review on the basis of being irrelevant to CYP calculations.)

In early 1997, preliminary data on 5-year continuation rates became available from Family Health International (FHI) for 4 new countries: El Salvador, Ghana, Haiti, and Senegal (FHI 1997). The percentage still using the method 5 years after insertion was slightly lower in these 4 new countries (48.0%) than for the 6 countries reported in Table A2 (56.5%). The results from the new countries will have the effect of reducing the mean duration of Norplant use from 3.8 (from the 6 additional countries) to a slightly lower figure. Complete data on continuation rates by year were not available for the 4 new countries, and thus, it was not possible to include them in Table A2 or to calculate the mean for the total of these 10 countries.

Our best estimate for the mean duration of use of Norplant based on (a) the 1988 study by Sivin, (b) the complete data on 6 of 10 countries for the FHI study, and (c) the preliminary data via personal communication with FHI (1997) on the four additional countries is 3.6 years.

Mean Duration of Use of Voluntary Sterilization

Because discontinuation generally is not an issue with respect to tubal ligation or vasectomy, the approach to calculating mean duration of use is somewhat different—one subtracts the mean age of the woman at the time of the operation from 45, the upper limit of fecundability for most women. For example, if the average age of women at the time of sterilization (their own or their partners') were 30, the average duration of use would be 15 years (45 to

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30). (The fact that fecundity drops sharply after 40 is addressed below in the section on age of users.)

There are three main sources of data on the average age of the woman at the time of (male or female) voluntary sterilization: program statistics, DHS surveys, and follow-up studies of voluntary sterilization clients.[7] Usually where both program statistics and DHS data are available, the DHS data are preferred for evaluation purposes, given the known shortcomings of program statistics (nonrepresentative samples, duplication or underreporting of cases, purposeful inflation of the results, etc.). In the current case, however, program statistics are of considerable importance. The large number of cases available from multiple countries adds confidence to the estimates; moreover, there is little perceived benefit in misreporting the age of the women at the time of the voluntary sterilization procedure.

Results from program statistics. AVSC International (1992) compiled data on mean age at the time of operation for 18 countries in Africa, 6 countries in Asia, 4 countries in North Africa/Mideast, and 12 countries in Latin America (see Table A3). For many of these countries, the data are available for 3 consecutive years (1989 to 1991). The large number of cases used for these calculations tends to increase the reliability of the estimates, as is reflected by the consistency in the data throughout the 2- to 3-year periods. In short, the AVSC data are an excellent source of information on this topic.

The mean duration of use of female sterilization (i.e., the average age at the operation, subtracted from 45) shows marked regional variations. In sub-Saharan Africa and in North Africa/Mideast, the mean duration is 9 years. This contrasts sharply with Asia and Latin America, where the mean duration is 14 years, reflecting the fact that women tend to get the operation at an earlier age in these regions. Whereas some variation is found within region (especially in Asia, where the mean duration is 11 for Pakistan compared with 17 for Nepal), there are clear patterns by region. In 11 of the 19 sub-Saharan countries, the mean duration of protection is less than 10 years. By contrast, all the Asian and Latin American countries have a mean duration of 10 years or greater.

Results from DHS/CDC surveys. The DHS and CDC reproductive health surveys ask women who report to be sterilized their age at the time of the operation. The advantage of survey data is the representativeness of the sample. The limitation of survey data in this case is that in countries with low acceptance of voluntary sterilization, few respondents may have undergone the operation. For example, in the 1992/1993 DHS in Senegal, only 19 respondents of 6,310 interviewed had undergone sterilization.

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The results obtained from DHS data in 22 countries are generally consistent with the AVSC figures (see Table A3). The results differ by more than 1 year in only a few countries (Indonesia, Bolivia, Mexico, Paraguay, Peru, Morocco, and Tunisia). The mean age of the woman at the time of her operation was 31 years for countries in Asia and Latin America, 35 years in North Africa/Mideast, and 36 years in sub-Saharan Africa.

Vasectomy. In the case of vasectomy, the relevant statistic is the age of the wife at the time of the husband's vasectomy, because the wife's age has more bearing on the fertility of the couple. Data from AVSC indicate little difference between the average age of the wife at the time of her husband's vasectomy and the age of the women at the time of female sterilization (31.6 vs. 30.9 for Asia and 30.6 vs. 31.4 for Latin America). Therefore, in most cases it is sufficient to use the average age at female sterilization to compute the CYP factor for both female sterilization and vasectomy.

In sum, both AVSC program statistics and DHS data show that the mean duration of use for voluntary sterilization is 14 years for Asia and Latin America, in contrast to 9 years for North Africa/Mideast and sub-Saharan Africa.

Mean Duration of Use of NFP

To calculate CYP for NFP, one must (a) distinguish between the number of acceptors who are learners and those who are autonomous and (b) estimate the duration of use by each type of acceptor, based on a review of client records accompanied by a follow-up study of users and dropouts. The duration of use is then determined through use of life tables or event calendars.

Facility-based statistics can provide the number of learners versus autonomous users. However, the definitions used by various NFP providers tend to vary. Current literature defines a learner as a person who registers in a program, attends instruction sessions, charts a certain number of cycles, and remains in the program for a given number of months. An autonomous acceptor is a person who has successfully completed the course of instruction and who is able to practice the method without further assistance (Cuervo 1991).

Several studies have looked at CYP conversion factors for NFP. For example, a retrospective study in Mauritius was conducted to determine duration of use among 507 autonomous NFP users who were married, ages 19 to 35, with at least one pregnancy (Kambic et al. 1990). Mean duration of the autonomous use throughout the observation period of 3 years was 2.2 years. Another NFP study was conducted in Liberia and Zambia (Gray et al.

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1991); it evaluated use-effectiveness and cost-effectiveness of demonstration NFP projects in both countries between 1983 and 1988. The number of women who registered for NFP instruction was 1,277 in Liberia and 3,701 in Zambia. In this study, the mean duration of use for learners was 0.71 years for Liberia and 1.1 for Zambia; the mean duration of use for autonomous users was 3.1 years for Liberia and 2.7 for Zambia.

In sum, the mean duration of use for natural FP methods, based on limited empirical evidence, ranges from 0.7 to 1.1 years for learners and from 2.2 to 3.1 years for autonomous users.

Mean Duration of Use of LAM

LAM is based on the use of lactational infertility for protection from pregnancy. The efficacy of this method depends on three criteria: that the breastfeeding infant be less than 6 months old, that the woman be amenorrheic, and that she be fully or nearly fully breastfeeding (Labbok 1992).

The duration of use of LAM has been studied recently in Chile (Labbok et al. 1994) and Ecuador (Wade, Sevilla, and Labbok 1994). These studies found that duration of use among different groups of women averaged 3.5 to 6 months.

Mean Duration of Use of the Diaphragm

There is very little literature on use of the diaphragm and no published information on duration of use. In general, diaphragms can be used for 1 to 3 years before needing replacement. The major U.S.-based manufacturers of diaphragms (Ortho Pharmaceuticals, Luish, and Milex) could not provide any information on average duration of use. They recommend that women using the diaphragm have an annual checkup and have the diaphragm replaced in the event of vaginal surgery, a pregnancy, or a significant weight gain or loss. Other factors affecting the useful lifetime of a diaphragm include the amount of use, the degree of wear and tear, and the quality of care in cleaning and storage.

USE-EFFECTIVENESS

Use-effectiveness is an important consideration for calculating CYP for all methods, because contraceptives that have high failure rates will provide less than 1 year's worth of protection for each year of use. A method that is only 50% effective would have to provide 2 years' worth of use to equal 1

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year of protection. In addition, poor quality of care (e.g., inadequate counseling on method use) may increase failure rates for specific methods.

There is a large amount of literature on use-effectiveness; however, different studies use different definitions of use-effectiveness. Therefore, we have examined the raw data provided in each report and recalculated use-effectiveness according to a standard definition. The United Nations (UN) publication titled *The Methodology of Measuring the Impact of Family Planning Programmes on Fertility* defines use-effectiveness as "effectiveness of contraception under conditions of ordinary use, allowing for unintended conceptions due to incorrect or careless use as well as for method failures" (Gorosh and Wolfers 1979, 35). This definition is useful because it considers the effectiveness of methods under conditions of actual use rather than theoretical use.[8]

Three studies of use-effectiveness were particularly relevant for this review. The UN (1991) publication *Measuring the Dynamics of Contraceptive Use* contains a review of published studies. Moreno and Goldman (1991) calculated first-year failure rates for pills, IUDs, and barrier methods for a number of different countries from DHS data. Curtis (1994) used later DHS surveys to calculate failure rates for a number of other countries. The DHS studies calculate a failure rate based on births, not pregnancies, and are therefore underestimates of the true failure rate. However, they represent the most complete and consistent set of estimates available. These studies indicate method-specific failure rates of 8% for oral pills, 4% for IUDs, and 19% for barrier methods (see Table A4). In contrast, the failure rates for injectables and Norplant are nearly zero (see Table A5).[9]

Two studies have indirectly investigated the use-effectiveness of NFP (Vernon, Rocuts, and Medina 1987; Trussell and Grummer-Strawn 1990). They found failure rates of 36% and 20%, respectively.

COITAL FREQUENCY

Coital frequency affects the conversion factors for two coitus-dependent methods: condoms and spermicides. Conventional wisdom in the 1980s pegged coital frequency at 100 acts per year (approximately 2 acts per week).

The primary source of data on coital frequency is the DHS. Blanc and Rutenberg (1991) reported on 11 countries from DHS I. Data for an additional 5 countries are available for all sexually active married women and for married women using coitus-dependent methods (see Table A6). Because this information serves to determine the number of units required to protect users of coitus-dependent methods, we have used the frequency among users

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of coitus-dependent methods as the most appropriate measure. Coital frequency ranged from 25 to 109 acts per year, with a mean of 61 acts.

DHS II provided coital frequency data for another 16 countries; in the aggregate, they are similar to those for the DHS I countries. The mean annual frequency for both sets of data is 64 acts per year, which represents our recommended number to be used in calculating CYP.[10,11]

Doubts remain regarding the validity of sexual history data (Pickering 1987; Hornsby and Wilcox 1989; Catania et al. 1990; Becker and Begum 1994); however, there is virtually no alternative means of collecting such information.[12] In an effort to obtain additional insights into the validity issue, the authors contacted a number of researchers who had collected sexual history data. In the interviews with six researchers in this area, there was no consensus as to the bias to be expected on recall of coital frequency in large sample surveys. In short, although the authors recognize that possible problems exist with the data, we have learned little about the extent or direction of possible bias in self-reported coital frequency in the survey context.

WASTAGE AND MISREPORTING

Wastage and misreporting can affect the amount of commodities distributed that is actually used. Misreporting may be a particular problem in countries that establish numerical targets for family planning workers. Wastage could be a problem with any method but is thought to be particularly important for condoms. We undertook a thorough review of the literature on wastage and conducted some special analyses of DHS and commodities-distributed data but were unable to develop any convincing evidence that could form the basis for an estimate of average levels of wastage or misreporting (for details, see Stover et al. 1977). Therefore, we recommend ignoring wastage and misreporting in the calculation of CYP factors (except for condoms and spermicides; see below), although we recognize that this may inflate the CYP estimates for some methods and country programs.

CONSISTENCY OF USE

It has been argued that the number of condoms considered sufficient to protect against unwanted pregnancy should be higher than the mean number of sexual acts, because condom use is inconsistent (Shelton 1991). According to this argument, 100 condoms reduce fertility more if they are used

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TABLE 2: Couple-Years of Protection (CYP) Conversion Factors for Condoms by Consistency of Use

	Consistency of Condom Use			
Average Monthly Coital Frequency	*Always (100%)*	*Most of the time (75%)*	*Sometimes (50%)*	*Infrequently (25%)*
Low (1-4)	29	32	35	39
Low to moderate (5-6)	65	80	98	120
Moderate to high (7-8)	100	141	198	275
High (9-10)	136	217	344	537

consistently by a single couple than if 100 couples each use only one condom. The extent of inconsistent use and the impact of such use on fertility will affect the protection provided by condoms and, therefore, the CYP conversion factors.

In connection with this study, Rutenberg's *The Fertility Impact of Inconsistent Use of Contraception* (1993) calculated the fertility impact of inconsistent condom use. Rutenberg calculated the number of condoms that would be needed to protect a couple per annum based on coital frequency, probability of condom failure, and consistency of use of the condom (based on commonly used categories in condom surveys such as *always*, *most of the time*, *some of the time*, and *infrequently*). Consistency of use becomes more important at higher levels of coital frequency. Rutenberg estimated that the number of condoms needed to protect a couple from pregnancy increases with higher coital frequency and with less consistent use, as shown in Table 2.

According to this estimate, 100 condoms per year would be sufficient to protect against pregnancy for a couple that has sex 7 to 8 times a month and always uses condoms. However, if consistency of use dropped to 75% of relations, then a greater number of condoms (141) would be required to achieve the same level of protection. However, there is little reliable data on the consistency of condom use. The question is not asked systematically in DHS surveys, and AIDS Knowledge-Attitude-Practice-Behavior (KAPB) surveys sponsored by the World Health Organization have not been officially released. Qualitative and anecdotal evidence suggest that condom use may be consistent in some situations and highly sporadic in others. Thus, the authors recommend some adjustment for consistency of use and have based the default values for the condom factor on the assumption that condoms are used for 50% of sexual acts among those reporting themselves to be users.

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AGE OF USERS

There are differing views on whether CYP should be adjusted for age of the user; methods have been developed to do so (Gorosh and Wolfers 1979; Stover et al. 1991).[13] Because we advocate using the form of CYP that reflects impact to prevent pregnancy, it is appropriate to discount for age. The effect of doing so can be dramatic. For example, a woman sterilized at age 30 would normally produce 15 CYPs without discounting (for the 15 years of protection she receives until she reaches age 45). With age discounting, the number of CYPs could be reduced to as low as 8.8, depending on the approach used to discount by age. A woman at age 20 using the pill for 1 year would equal 1 CYP, whereas a women at age 45 using the pill might equal about 0.5 CYP.

In fact, discounting for reduced fertility with age is only important for sterilization. For all other methods, women who are not in union or are infecund are unlikely to use contraception. There may be some women who use methods (particularly the IUD or Norplant) when their probability of contraception is quite low, but it is unlikely that this accounts for a significant proportion of use.

Theoretically, it is possible to discount for age on the basis of (a) the portion fecund by age or (b) the expected fertility by age in the absence of contraception. In the current study, we used the latter approach. First, we determined age-specific fertility rates in high-fertility countries (total fertility rate [TFR] = 7), where contraception is minimal based on the UN model tables of the distribution of fertility by age (UN 1977). These rates serve as a basis for developing age discount factors for women at each 5-year age grouping from 15 to 49, as shown in Table 3.

Second, we calculated age-adjusted CYP per sterilization for every age from 25 (the reference year for peak fertility) to 40 by summing the discount factors for all ages from the age at sterilization until age 49. Thus, a woman sterilized at age 25 would receive 14 CYP compared to only 2 CYP for a woman sterilized at 40 (as shown in Table 4).

Third, we adjusted for the fact that women who accept sterilization are more likely to have higher fertility than those who use another or no method. Under this assumption, we postulate that women accepting sterilization have fertility similar to the average fertility of women at age 25 but that their fertility will decline (like all women) in response to aging, divorce, widowhood, and so forth. Accordingly, the woman is given full credit (a CYP credit of 1.0) for the first 5 years after sterilization, but fertility is estimated to decline linearly during the next 5 years (years 6 to 10 after sterilization) until it reaches the fertility for that age by year 10 poststerilization. The final column

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TABLE 3: Age Discount Factors for Fertility in the Absence of Contraception

Age	*Discount Factor*
15 to 19	1.0
20 to 24	1.0
25 to 29	1.0
30 to 34	0.8
35 to 39	0.6
40 to 44	0.3
45 to 49	0.1

TABLE 4: Adjustments for Age of Users at Time of Sterilization in the Calculation of Couple-Years of Protection (CYP) for Sterilization

Age	*Age-Adjusted CYP for Sterilization, Based on Age Discounting (only)*	*Age-Adjusted CYP for Sterilization, Adjusted for Higher Fertility Among Women Who Seek Sterilization*
25	14.0	14.4
26	13.0	13.2
27	12.0	12.6
28	11.0	12.0
29	10.0	11.4
30	9.0	10.8
31	8.2	9.6
32	7.4	9.3
33	6.6	9.0
34	5.8	8.7
35	5.0	8.4
36	4.4	7.7
37	3.8	7.6

of Table 4 reflects both age discounting and adjustment for the higher postulated fertility of women who opt for sterilization.[14]

In summary, we recommend that CYP for sterilization be based on the mean age at sterilization, discounting for age but adjusting for the purported higher fertility of women opting for sterilization, as shown in the final column of Table 4.[15]

NONCONTRACEPTIVE USE OF CONDOMS

Condoms can be used for different purposes—prevention of unwanted pregnancies and prevention of sexually transmitted diseases. In addition,

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there is anecdotal evidence that they are used as balloons or toys. For purposes of CYP calculations, it would be desirable to separate out the proportion of condom use that has little or no contraceptive value. To this end, we attempted to track down studies or other sources of information on noncontraceptive use of condoms.[16] Despite the substantial number of studies on condom use, there is no comprehensive data source that can be used to provide guidance on the magnitude of condom use with little contraceptive effect. Thus, adjusting CYP for noncontraceptive use would be mere speculation. Because condoms used to prevent STDs achieve important related program objectives and simultaneously prevent pregnancy, we have given full credit for condoms used for STD prevention as well as pregnancy prevention.

OVERLAPPING COVERAGE

Overlapping use of contraception occurs when periods of contraceptive use coincide with periods of reduced fecundity, such as postpartum amenorrhea, subfecundity due to older age, or where more than one method of contraception is used. This redundant use is of particular interest when efforts are devised to determine the fertility impact of contraceptive use because the impact will be less when overlap occurs.

With the spread of HIV/AIDS, programs increasingly promote dual method use (e.g., pills and condoms) to maximize protection against both pregnancy and STDs. On one hand, one would want programs to get full credit for this practice; however, on the other hand, it does represent overlapping coverage in the context of the current analysis. However, in practical terms, this practice of using two contraceptive methods simultaneously is very rare, based on evidence from the DHS. On average, 2% or less of women report using two methods concurrently. This double use tends to occur more with coitus-dependent methods such as vaginal methods or the condom overlapping with traditional methods. Therefore, it is not considered here.

Relatively few studies have examined the extent of redundant use of contraception during postpartum amenorrhea. A study of nine high-prevalence DHS II countries focused on the impact of redundant contraceptive use—defined as use during postpartum amenorrhea—on the estimation of contraceptive failure rates (Curtis 1994).

Other studies have addressed redundant use or contraceptive overlap, including Laukaran et al. (1994), Thapa et al. (1992), and Laukaran and Winikoff (1985), but they do not address the issue of the impact of redundant use on CYP.

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TABLE 5: Percentage of Current Users of a Specific Method Who Are Currently Amenorrheic, Demographic and Health Surveys (DHS) 1985 to 1994

Method	*Number of Countries*	*Percentage Amenorrheic*
Pill	18	1.7
Intrauterine device (IUD)	14	2.6
Injection	12	5.4
Condom	19	5.9
Female sterilization	20	3.2

In the current analysis, we attempted to measure the protection that is redundant because of amenorrhea. Most DHS surveys contain data on current use of a specific contraceptive method and amenorrheic status of women. These data provide the necessary information to estimate the proportion of women currently using a contraceptive who report that they are currently amenorrheic. Because the use of some hormonal methods can induce amenorrhea, we restricted the definition of overlap to those women who were amenorrheic, using a contraceptive method, and not more than 6 months postpartum. Table 5 shows the results of these calculations for a number of DHS data sets.[17]

We used a fairly simple approach to estimate unneeded protection—the CYP factor is multiplied (or divided) by the proportion of use that does not overlap with amenorrhea. Thus, if 10% of pill users overlap, the CYP factor for pills would be adjusted by dividing it by 0.9. This assumes that amenorrhea provides 100% effective protection for any postpartum period and that method use does not interact with amenorrhea.

The results of this analysis indicate that the percentage of users who are also postpartum amenorrheic does not exceed 6% for any of the methods. Therefore, this factor will have relatively little effect on the final CYP factors, although it is taken into account in calculating them, as described below.

RECOMMENDED APPROACH TO DETERMINING CYP CONVERSION FACTORS

The preceding sections present empirical evidence on a series of variables (assumptions) underlying the calculation of CYP conversion factors, one at a time. In this section, we consider all relevant variables simultaneously in arriving at recommended CYP conversion factors.

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Traditionally, a single set of CYP conversion factors (a global default value) has been used by all countries, programs, and projects. The advantage of this approach is that it is easy to apply, and the conversion factors are consistent across countries. However, a major disadvantage is that the global default value does not take into account variations from one program (country) to another; this is particularly important in terms of sterilization, where the average age at sterilization differs markedly by country. Under the current system, a program that provides sterilization primarily to older women would be credited with as many CYP per procedure as a program that had younger clients.

For this reason, we recommend that program-specific conversion factors be used for sterilization (only) and that a single global factor be used for each of the other methods. There are enough country-specific data on sterilization that good conversion factors can be calculated for most countries. Although this approach has the potential to introduce some confusion into the interpretation of CYP data, it provides the major advantage of taking into account real differences between programs in terms of the age of acceptors and thus producing CYP reports that are more indicative of achievements than is the case with the current system.

For methods other than sterilization, global factors are recommended instead of country-specific values, for the following reason. With respect to IUD, the variation in the CYP factor across countries is too small to be worthwhile. For the condom and pill, the uncertainty associated with country-specific data (coital frequency for condoms, failure rates for pills) is large compared to the differences among countries. For the other methods, few country-specific data are available.

Thus, taking into account the multiple factors that affect the calculation of CYP simultaneously, we arrive at final estimates for each method as follows.

CYP CONVERSION FACTORS FOR STERILIZATION

The calculation of CYP should reflect the following four factors:

- the average age of the woman at sterilization (which varies by country),
- age discounting (as shown in Table 3),
- adjustment for the purported higher fertility among women who seek sterilization (see Table 4), and
- use-effectiveness (calculated to be 100%).

Because the conversion factor for sterilization is to be country-specific, one takes the average age at sterilization for the country and adjusts for age

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discounting and the purported higher fertility of women who opt for sterilization, as shown in Table 4. (The factor is not affected by use-effectiveness because it is considered to be 100%.) The country-specific factors obtained in this manner are listed in Table 6. Countries not listed in Table 6 for which data on age at sterilization are available can use the logic shown in Table 4 to calculate a country-specific conversion factor for CYP for sterilization. Those with no data on age at sterilization are recommended to use the regional default option, listed in Table 6.

CYP CONVERSION FACTORS FOR REVERSIBLE METHODS

For reversible methods, it is recommended that global (default) values be used instead of country-specific factors. The variables used in calculating these factors differ by method. Table 7 is designed to summarize which factors are taken into account for each method and the value used to arrive at the recommended conversion factor.

In contrast to most of the reversible methods, very little information is available on the duration of use or effectiveness of NFP, LAM, or the diaphragm. Therefore, we see no reason to change the previous default factors of 2.0 CYP per trained person for NFP and 0.25 CYP per identified LAM user. Finally, with respect to the diaphragm (rarely used in developing country programs), we recommend the conservative guesstimate of 1 CYP per device, reflecting discontinuation, wastage, and our assumption that climatic and storage conditions may reduce the useful lifetime of the diaphragm.

We recognize that adjusting the CYP factors for wastage and effectiveness through a multiplicative process has the potential to compound the errors associated with each individual estimate. However, the database for calculating effectiveness and overlapping coverage is quite extensive and yields useful estimates of the effects of these factors. The adjustment for inconsistent use of condoms is much more speculative but is so large that it needs to be applied to avoid giving condoms too much weight in comparison to other methods.

The effort leading to this article was conducted under a USAID-funded project revised to improve the measurement of this widely used indicator of output in its family planning programs worldwide. Based on the results of this study, but also taking into account practical considerations at the field level, USAID has recommended conversion factors (see Table 8).

The purpose of this study was to review the empirical evidence regarding the variables (assumptions) underlying the calculation of CYP. Although the

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TABLE 6: Recommended Couple-Years of Protection (CYP) Factors for Sterilization by Country

Country	*Voluntary Surgical Contraception (CYP per procedure)*
Africa	
Ethiopia	8
Gambia	8
Ghana	8
Guinea	8
Kenya	9
Liberia	9
Madagascar	8
Malawi	8
Mali	7
Mauritius	9
Namibia	7
Nigeria	8
Rwanda	8
Sierra Leone	8
Tanzania	8
Uganda	8
Zaire	8
Zambia	8
Zimbabwe	8
Regional default	8
Asia	
Bangladesh	11
India	13
Indonesia	9
Nepal	12
Pakistan	9
Philippines	11
Sri Lanka	11
Thailand	10
Regional default	10
Latin America	
Bolivia	10
Brazil	10
Colombia	11
Dominican Republic	12
Ecuador	10
El Salvador	12
Guatemala	11
Mexico	8
Nicaragua	11
Paraguay	11
Peru	9

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TABLE 6 Continued

Country	*Voluntary Surgical Contraception (CYP per procedure)*
Trinidad and Tobago	9
Venezuela	9
Regional default	9
North Africa and Near East	
Egypt	7
Jordan	8
Morocco	9
Tunisia	9
Turkey	9
Regional default	8
Global default	9

TABLE 7: Basis for Recommendations of Global (default) Conversion Factors for Reversible Methods

Method	*Conversion Factor*	*Result*
IUD	CYPs per insertion = average duration of use × effectiveness × proportion not overlapping (3.9 years × 96.4% × 97.4%)	3.7 CYP per insertion
Pills	Cycles per CYP = number required (biological basis) ÷ effectiveness ÷ proportion not overlapping (13 cycles per year ÷ 92.4% ÷ 98.3%)	14 cycles per year
Norplant	CYPs per insertion = average duration of use × effectiveness (3.6 years × 100%)	3.6 years per insertion
Injectables	Injections per CYP = average duration (biologically determined) ÷ effectiveness ÷ proportion not overlapping (DepoProvera = 4 ÷ 100% ÷ 94.6%; Noristerat = 6 ÷ 100% ÷ 94.6%)	4.2 DepoProvera injections per CYP, 6.3 Noristerat injections per CYP
Condoms and VFT	Units per CYP = condoms required (coital frequency = 5.6, consistency = 50%) from Table 2 ÷ proportion not overlapping (98 ÷ 94.1%)	105 condoms per CYP
NFP	Limited available data are consistent with previous estimate; no change recommended	2 CYP per trained user
LAM	Limited available data are consistent with previous estimate; no change recommended	0.25
Diaphragm	No empirical data available; value proposed is an educated guess	1 CYP per diaphragm

NOTE: IUD = intrauterine device, CYP = couple-years of protection, VFT = vaginal foaming tablet, NFP = natural family planning, and LAM = lactational amenorrhea

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TABLE 8: Recommended Default Couple-Years of Protection (CYP) Conversion Factors by Method

Method	*Empirical CYP Factor*	*1997 USAID[a] Recommended CYP Factor*
Voluntary Surgical Contraception (CYP per procedure)		
Global	8.9	9
Africa	7.8	8
Asia	9.7	10
Latin America	9.5	10
North Africa/Near East	7.7	8
IUD (CYP per insertion)	3.7	3.5
Norplant (CYP per implant)	3.6	3.5
Pill (cycles per CYP)[b]	14	15
Injectable (injections per CYP)		
Depo-Provera	4.2	4
Noristerat	6.3	6
Condoms/foam (units per CYP)	105	120
NFP (CYP per trained person)	2.0	2
Diaphragm (CYP per diaphragm distributed)	1.0	1
LAM (CYP per identified user)	0.25	0.25

NOTE: USAID = U.S. Agency for International Development, IUD = intrauterine device, NFP = natural family planning, and LAM = lactational amenorrhea method.
a. The USAID–recommended figures differ slightly from the values obtained in the study, which reflects the USAID's interest in simplicity (rounding), continuity (with previously used values), and adjustment for suspected wastage.
b. One use of oral pills for emergency contraception is equivalent to one cycle of pills.

study focused on a particular quantitative measure, clearly qualitative considerations are also important. It should be stressed that CYP is only one of numerous indicators that can be used to monitor performance of an FP program. Given its widespread use, it is important to make it as methodologically sound as possible. However, CYP is not the only indicator of program performance, and programs should strive to use a variety of qualitative and quantitative indicators. Likewise, voluntary choice is a fundamental tenant of quality family planning efforts, and neither CYP nor other similar quantitative measures are appropriate as targets at the provider level.

The field of international family planning will be best served by (a) accepting CYP for what it is—a simple, easy-to-collect measure of program output that is useful in tracking trends over time; (b) avoiding the use of CYP in the context of provider performance targets or in such a manner that would impair individual client choice; and (c) using CYP data in conjunction with

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other indicators, including demand for services, access to facilities, quality of care, and related issues, in deciding how best to allocate resources and improve programs.

APPENDIX

The tables in the appendix summarize data compiled from other sources on factors affecting the calculation of couple-years of protection (CYP) for specific methods.

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TABLE A1: Duration of Intrauterine Device (IUD) Use

						Cumulative Continuation Rate (months)						
Study Dates	*Source*	*Country*	*Study Duration*	*Type of IUD*	*Sample Size*	*12*	*24*	*36*	*48*	*60*	*72*	*84*
Demographic and Health Surveys (DHS) studies												
May to August 1990		Colombia	NA		887	.80	.65	.45	.33	.27		
July to September 1994		Indonesia	NA		2,218	.87	.77	.65	.55	.50		
October to December 1990		Jordan	NA		1,675	.80	.56	.33	.20	.11		
January to April 1992		Morocco	NA		287	.81	.59	.45	.29	.20		
October 1991 to March 1992		Peru	NA		135	.88	.81	.64	.53	.23		
July to November 1991		Dominican Republic	NA		208	.59	.40	.18	.11	.06		
Total			NA			.82	.66	.49	.38	.30		
Median = 35 months												
Randomized clinical trials												
1981 to 1986	Apelo et al. (1989)	Philippines	3 years	TCu380A	92	85.6	80.8	74.3				
				Cu-7	106	81.6	74.3	64.9				
1980 to 1984	Champion et al. (1988)	Yugoslavia, Panama, and Brazil	3 years	TCu380A	441	89.5	79.7	67.4				
				MLCu375	444	87.6	76.6	61.4				
1982 to 1990	Sivin et al. (1990)	Multiple	7 years	LNg20	1,125					33.0		24.9
				Tcu380A	1,121					40.6		29.4
1978 to 1981	Trussel and Grummer-Strawn (1990)	Multiple	3 years	TCu220C	1,032			60.5				
				ML250	1,011			61.5				
1984 to 1989	Trussel and Grummer-Strawn (1990)	Multiple	5 years	TCu220C	1,881			66.7		55.1		
				Nova T	1,847			65.2		49.6		

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1982 to 1989	Trussel and Grummer-Strawn (1990)	Multiple	7 years	TCu220C	1,396			67.4		52.9		43.7
				Tcu380A	1,396			67.8		53.3		43.7
1986 to 1989	Sastrawinata et al. (1991)	Indonesia	2 years	TCu380A	947	90.3	85.5					
				LLD	946	90.0	85.0					
				MLCu375	952	91.6	85.4					
1977 to 1989	Randic et al. (1991)	Yugoslavia	10 years	LLD	184	78.3	72.6		56.7			
				LLCu	187	90.2	80.6		67.2			
1990 to 1993	UNDP/UNFDP/WHO (1994)	Multiple	3 years	MLCu375	1,832	89.1	82.2	77.7				
				Tcu380A	1,823	88.2	82.0	77.9				
1988 to 1992	Sivin et al. (1990)	Multiple	4 years	Gyne T	697				57.0			
				Slimline	608				44.8			
1988 to 1991	Wilson (1992)	New Zealand	3 years	Nova T	608	89.1	71.8	63.7				
				MLCu375	586	89.6	79.4	70.7				
				MLAgCu25	598	88.7	78.5	67.0				
Average cumulative continuation rate Median = 48 months						89.0	81.3	68.5	49.9	48.6	36.3	36.3
Follow-up studies												
1979 to 1982	Diaz et al. (1992)	Brazil	5 years	TCu200B	1,708	83.6	71.0	60.9	53.5	46.1		
				Tcu380A	288	84.0	74.5	64.7	57.7	49.3		
1977 to 1987	Batár (1988)	Hungary	10 years	MLCu250	1,446	83.7	71.9	64.4	57.8	51.3	44.5	40.9
1992 to 1993	Rob et al. (1993)	Pakistan	1 year	Copper-T	1,194	72.0						
Average cumulative continuation rate Median = 53 months						80.8	71.6	62.8	55.8	48.7	44.3	40.5

NOTE: NA = not applicable, WHO = World Health Organization, UNDP = United Nations Development Programme, and UNFDP = United National Population Fund. Type of IUD is not available in the DHS studies.

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TABLE A2: Mean Duration of Norplant Use

	Percentage Still Using by Years of Use						
Country	*1*	*2*	*3*	*4*	*5*	*Median*	*Mean*
Singapore	97.0	78.9	67.8	64.8	59.7	5.0	3.88
Nepal	89.7	78.1	72.1	65.3	61.6	5.0	3.86
Philippines	95.3	90.2	80.5	74.1	67.2	5.0	4.24
Sri Lanka	99.2	84.3	67.4	59.0	52.3	5.0	3.86
Bangladesh	93.9	72.3	54.7	46.2	41.2	3.3	3.38
Nigeria	91.4	82.5	72.0	63.6	57.7	5.0	3.88
Combined							3.8
Chile	90.0	82.0	72.0	63.0	55.0	5.0	3.85
Scandinavia	76.0	60.0	53.0	37.0	33.0	3.2	2.93
Dominican Republic	79.0	60.0	44.0	33.0	25.0	2.4	2.79
Indonesia	96.9	92.0	88.0	82.0	78.0	5.0	4.48
Egypt	90.0	69.0	63.0	59.0	58.0	5.0	3.60
Combined							3.5

SOURCE: The top section of countries is from Family Health International (1997), and the bottom section of countries is from Sivin (1988).

TABLE A3: Mean Duration on Voluntary Sterilization Use Based on AVSC Program Data and Demographic and Health Surveys (DHS) Data

Region	*Mean Duration AVSC Data*[a]	*Mean Duration DHS Data*[b]
Africa		
Ethiopia	10	
Gambia	9	
Ghana	8	
Guinea	8	
Kenya	12	12
Liberia	11	
Madagascar	10	
Malawi	10	
Mali	6	
Mauritius	12	
Namibia		6
Nigeria	9	
Rwanda	10	
Sierra Leone	7	
Tanzania	8	
Uganda	9	
Zaire	9	

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TABLE A3 Continued

Region	*Mean Duration AVSC Data*[a]	*Mean Duration DHS Data*[b]
Zambia	8	
Zimbabwe	9	
Regional average	9.2	9.0
Asia		
Bangladesh	16	
Indonesia	11	13
Nepal	17	
Pakistan	11	12
Philippines	15	15
Sri Lanka	15	15
Thailand		16
Regional average	14.1	14.2
Latin America		
Bolivia	10	14
Brazil	13	14
Colombia	14	15
Dominican Republic	17	17
Ecuador	13	14
El Salvador	18	17
Guatemala	14	15
Mexico	14	9
Nicaragua	15	
Paraguay	10	15
Peru	11	13
Trinidad and Tobago		13
Venezuela	13	
Regional average	13.6	14.1
North Africa and Near East		
Egypt	7	6
Jordan		10
Morocco	9	12
Tunisia	10	12
Turkey	11	
Regional average	9.1	10.0

NOTE: Mean duration of use calculated as the mean age of the woman at time of sterilization, subtracted from 45 years (e.g., 45 – 30 = 15).
a. Mean duration for AVSC program data based on average of years 1989, 1990, and 1991.
b. Mean duration of use from DHS data calculated for those countries that had more than 100 cases of voluntary sterilization.

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TABLE A4: First-Year Failure Rates for Pills, Intrauterine Devices (IUDs), and Barrier Methods

	Source			
Country	*Moreno and Goldman (1991)*	*Curtis (1994)*	*United Nations (1991)*	*Country Estimate*
Pills				
Bangladesh			11.0	11.0
Bolivia	10.5			10.5
Brazil	5.4			5.4
Colombia	7.7	8.3		8.3
Dominican Republic	11.8	10.0		10.0
Ecuador	5.8			5.8
Egypt	6.9	12.7		12.7
Guatemala	9.8			9.8
Indonesia	2.7	3.7	18.5	3.7
Jordan		13.9		13.9
Mexico	5.4		3.6	5.4
Morocco	8.6	7.7	7.0	7.7
Northeast Brazil		9.3		9.3
Paraguay		4.9		4.9
Peru	5.9	6.3		6.3
Philippines			5.2	5.2
Sri Lanka	7.2			7.2
Trinidad and Tobago	5.9			5.9
Thailand	2.8		0.6	2.8
Tunisia	5.4		4.0	5.4
Default				7.6
IUDs				
Bangladesh			0.8	0.8
Bolivia	3.0			3.0
Brazil	13.0			13.0
Chile			2.3	2.3
Colombia	5.3	4.6		4.6
Dominican Republic	3.6	5.0		5.0
Ecuador	4.6			4.6
Egypt	1.8	1.7		1.7
Guatemala	7.7			7.7
Indonesia	1.9	2.9	4.8	2.9
Jordan		3.1		3.1
Mexico	1.5		4.6	1.5
Morocco	1.1	2.3	2.0	2.3

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TABLE A4 Continued

	Source			
Country	*Moreno and Goldman (1991)*	*Curtis (1994)*	*United Nations (1991)*	*Country Estimate*
Paraguay		2.7		2.7
Peru	4.2	1.3		1.3
Philippines			2.9	2.9
Sri Lanka	3.4			3.4
Trinidad and Tobago	4.2			4.2
Thailand	2.5		1.2	2.5
Tunisia	2.7			2.7
Default				3.6
Barrier methods				
Bangladesh			24.0	24.0
Colombia		17.5		17.5
Dominican Republic		20.6		20.6
Egypt		14.5		14.5
Indonesia		15.0	21.6	15.0
Jordan		36.6		36.6
Morocco		14.4		14.4
Northeast Brazil		20.2		20.2
Paraguay		11.7		11.7
Peru		18.8		18.8
Philippines			11.2	11.2
Default				18.6

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TABLE A5: Case Studies Regarding Use-Effectiveness of Depo-Provera, NET-EN, and Norplant/Norplant-2 Contraceptives

Country	*Source*	N	*Woman-Months*	*Pregnancy Rate (%)*[a]	*Use-Effectiveness Rate (%)*[b]	*Method*	*Remarks*
Depo-Provera studies							
Bangladesh	Akbar et al. (1982)	4,405			99	DMPA	Authors give first year failure rate
Thailand	McDaniel, Gray, and Pardsthaisong (1984)		12,840 10,181		99 99.8	Pheno-M Depo-Provera	15-month rate; authors give PPI 0.33/100 women per year, 0.14/100 women per year
Nigeria	Ojo (1979)	400	4,580	0.0	100	DMPA	1- to 4-year rate
Bangladesh	Huber, Rahman, and Chakraborty (1977)	103 70			100 100	DMPA	First-year rate
Thailand	Koetsawang et al. (1974)	866	24,399	2.89	99.8	DMPA	Overall
Singapore	Pakshong, Yung, and Hu (1969)	750	4,127	0.0	100	DMPA	First-year rate
NET-EN studies							
International study[c]	Grubb et al. (1989)	65 66	532 540	0.0 0.76	100 99.81	NET-EN: 100 mg NET-EN: 65 mg	First-year rate
Bangladesh	Chowdhury (1985)	382		0.37		NET-EN Norethisterone	2-year rate
India	Banerjee et al. (1984)	2,388		First year: 2 months = 0.0, 3 months = 1.1		Norethisterone	Compares 2- and 3-month injections over 2 years
Peru	Kesseru (1976)	1,844	21,730	1.46	99.8	Norethisterone enanthate (NEE)	Overall rate
Mexico	Meade et al. (1984)	5,792		0.16		NET-EN	1.5-year rate
Comparison studies of Depo-Provera and NET-EN							
Thailand	Virutamasen (1987)		275,000			DMPA, NET-EN	Authors give PPI 0-1.2/100 women per year
Pakistan	Janjua (1983)	283 271		0.0 0.37	100	DMPA NET-EN	3-year rate

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WHO Multinational study[d]	Toppozada et al. (1983)	1,587	20,550	0.19	99.99	DMPA	Overall rate
		789	10,361	0.38	99.97	NET-EN 60 days	
		796	10,331	0.75	99.94	NET-EN 84 days	
Mexico	Ramos et al. (1991)	246	2,326	0.0	100	Implants	First-year rate
Chile	Croxatto, Diaz, and Sivin (1991)		145,596			Norplant, Norplant-2	Authors give PPI first-year 0.2
Cross-country analysis[e]	Sivin (1988)	992		0.3		Norplant trials	First-year rate
		4,100		0.6		ICCR central, noncentralized	
China	Sujuan et al. (1988)	10,710	7,797	0.009	98.7	Norplant	First-year rates; authors give pregnancy rate 0.1 with *SE* .03, 0.03 with *SE* .1
		1,208	1,174	0.0	100	Norplant-2	
Singapore	Singh et al. (1988)	100	1,118	0.0	100	Norplant-2	First-year rate
Chile	Diaz et al. (1987)	108	4,194	0.0	100	Norplant	First-year rate
Colombia	Lopez et al. (1986)	389	7,128	0.0	100	Norplant	First- and second-year rate compares to IUD
	Lopez, Rodriguez, and Rengifo (1984)	381	2,767	0.0	100	Norplant	First-year rate
Egypt	Hefnawi et al. (1983)	601		0.67		Norplant	First-year rate
Chile	Diaz et al. (1984)	176	9,816	0.0	100	Norplant	First-year rate
Chile, Dominican Republic, and Finland	Sivin et al. (1984)	324	2,997 first year	0.0	100	Norplant	First- and second-year rate
India	Chaudhury et al. (1988)	1,466	29,669	0.0	100	Norplant-2	First-year rate

NOTE: DMPA = Depot Medroxy Projesterone Acetate, PPI = postpartum infecudability, and WHO = World Health Organization. Woman-months of use are for the entire duration of the study, unless noted differently. If a cell is blank, authors do not provide this (or the necessary information to compute the rates) in the enclosed study.

a. Pregnancy rate = number of pregnancies/number of women in study.

b. Use-effectiveness rate = number of pregnancies/number of woman-months of use.

c. International study centers were located in the United States, Italy, Mexico, and Chile, with a maximum enrollment of 20 women in each clinic.

d. World Health Organization study includes Egypt, Thailand, Nigeria, Pakistan, Zambia, Philippines, Mexico, Brazil, Chile, Yugoslavia, Luxembourg, Italy, and the Netherlands.

e. Cross-country analysis countries include Chile, Brazil, Jamaica, Denmark, Dominican Republic, Thailand, Egypt, Indonesia, and Ecuador.

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TABLE A6: Coital Frequency in Selected Countries Based on Demographic and Health Surveys (DHS) Data

Country	*Monthly Frequency*		*Equivalent (number of acts per year)*[a]
	Sexually Active Married Women	*Users of Coitus-Dependent Methods*	
DHS I data			
Brazil	8.9	8.8	106
Bolivia	3.6	3.6	43
Burundi	8.1	—	—
Colombia	5.8	5.0	60
Dominican Republic	5.8	6.2	74
Ecuador	5.7	5.8	70
Ghana	2.6	2.1	25
Guatemala	5.6	5.6	67
Indonesia	4.1	4.2	50
Kenya	4.4	4.5	54
Mexico	5.4	5.4	65
Peru	5.7	5.6	67
Sri Lanka	5.3	5.0	60
Sudan	6.5	—	—
Thailand	4.1	4.2	50
Uganda	7.2	—	—
Mean	5.5	5.1	61
DHS II data			
Northeast Brazil	6.5	6.9	83
Cameroon	4.4	5.2	62
Colombia	4.7	4.4	53
Dominican Republic	7.1	7.1	85
Indonesia	4.2	4.6	55
Kenya	4.4	5.1	61
Madagascar	5.5	6.1	73
Morocco	5.7	6.1	73
Namibia	4.6	—	—
Niger	4.1	—	—
Nigeria	4.4	3.3	40
Paraguay	6.5	5.5	66
Peru	5.8	6.4	77
Rwanda	8.1	—	—
Tanzania	5.1	4.8	58
Zambia	7.5	5.7	68
Mean	5.5	5.5	66

NOTE: A dash indicates that *n* was 10 or fewer women.
a. Based on married women using coitus-dependent methods.

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NOTES

1. In the case of social marketing programs, the calculation may be based instead on numbers shipped to a specific warehouse or retailer.

2. It is important to recognize that such comparisons, though informative, are affected by differences in the size and characteristics of the target population. A program operating in a densely populated urban area would be expected to generate more clients and grow more quickly than a program directed to a rural population with lower levels of education, less disposable income, and more traditional values.

3. The large volume of information gathered for this analysis makes it impractical to present all relevant data in the text. Rather, most of the tables summarizing information from other studies are contained in the appendix.

4. The average cumulative continuation rate is calculated for each 12-month interval by averaging the continuation rates for each interval over all studies with available data for the interval.

5. The mean duration of intrauterine device (IUD) was calculated by fitting an exponential decay curve to the duration of use data:

$$R = ae^{-rt},$$

where R is the retention rate at time t, a is a constant that allows for immediate expulsion, r is a constant that measures the annual rate of discontinuation, and t is time expressed in years. The resulting formula can be used to calculate the proportion of acceptors still using by month. We assumed that no use continues past 10 years. Using this equation, we found that the annual continuation pattern from these nine studies implies a mean duration of use of 3.9 years.

6. It is important to note that the median duration for Norplant was 5.0 years in a number of studies, due to the fact that more than 50% of acceptors reached the 5-year mark, at which time the implant was removed as part of the study or service protocol. Thus, this eliminates the possibility of a value higher than 5.0 for Norplant.

7. With regard to follow-up studies of male and female voluntary sterilization clients, numerous studies have been conducted (Philliber and Philliber 1985), many of which were done to learn more about the social and psychological antecedents and consequences of undergoing the procedure, especially in the years prior to its widespread adoption in numerous developing countries. The data from such studies, though interesting in a historical perspective, are less informative to the current question because many of these studies date back 15 to 25 years and are based on small, nonrepresentative samples. Thus, they are not taken into consideration in the current review.

8. In many cases, researchers actually calculate the failure rate rather than the effectiveness rate. Often it is the first-year failure rate that is calculated because of the problems of follow-up. The failure rate is calculated as the number of pregnancies in a specified time divided by the number of woman-years of use of a particular method. Some studies report the pregnancy rate rather than the failure rate. The pregnancy rate is the number of pregnancies in a specified time period divided by the number of women using the method.

When articles reported only the pregnancy rate, we converted these to failure rates. When both gross and net pregnancy rates are given, we used the gross rates. The difference between the two relate to the denominator—the gross rates use as the denominator the number of women entering the study, whereas the net rates use the average of the number of women starting the study and the number still in the study at the conclusion.

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9. In Tables A4 and A5, the recommended value is taken from the Curtis (1994) source if available, or from the Moreno and Goldman (1991) source, or lastly from the United Nations (UN) (1991) source. This order is based on the assumption that the two multicountry studies are more likely to provide a consistent set of data than the individual country studies reported in the UN source.

10. Of note, for the five countries where two Demographic and Health Surveys (DHS) are available, there is a considerable difference between the two surveys in the monthly frequency (Colombia: 5.0 in DHS I vs. 4.4 in DHS II; Dominican Republic: 6.2 vs. 7.1; Indonesia: 4.2 vs. 4.6; Kenya: 4.5 vs. 5.1; and Peru: 5.6 vs. 6.4).

11. DHS male questionnaires also were examined (where they existed) to determine coital frequency reported by males. Unfortunately, the question on coital frequency was only included in three male modules for DHS II: Brazil, Kenya, and Tanzania. For users of coitus-dependent methods, the reported monthly frequency was 12.6 for Brazil (vs. 6.9 for women), 3.5 for Kenya (vs. 5.1 for women), and 3.0 for Tanzania (vs. 4.8 for women). Because the amount of DHS data for males was so small, only the female-reported figures are used. For the Tanzania survey, a comparison of responses from monogamous couples found variation in individual-level responses, but at the aggregate level the mean values were consistent. There is the same overall picture of sexual behavior regardless of whether the data are used from the wives or the husbands (Rutenberg, Blanc, and Kapiga 1994).

12. Until the mid-1980s, there was little empirical data on coital frequency; moreover, the few existing studies were conducted among small, nonrepresentative populations. Two major changes in this respect have been (a) the interest in questions on sexual behavior generated by the AIDS epidemic and (b) the inclusion of coital frequency in DHS surveys. The research community now has more experience with asking about sexual behavior; however, the question remains: Do people give true answers?

There is some evidence to suggest at least subtle biases in the data. Blanc and Rutenberg (1991) found that the responses on coital frequency varied depending on whether the respondent was alone, was accompanied by a female relative (which depressed the average), or was interviewed in the presence of her husband (which increased it).

Some studies have employed a diary approach, where the respondent agrees to record coital frequency in addition to related events over a period of several weeks or months (e.g., Udry 1980; Hornsby and Wilcox 1989; Tsui, de Silva, and Marinshaw 1991). It might be expected that this approach would yield more accurate data; however, there is no gold standard against which to test the different methods. Moreover, the diary method requires a special study and cannot be achieved by simply adding one or two questions to a larger survey.

13. The rationale for adjusting for age is to give more credit to family planning (FP) programs that recruit younger than older users because a given amount of contraception will avert more births among a cohort of 20 year olds than 40 year olds. Others have argued against the notion that programs should get more credit for serving younger clients, for the following reasons:

1. From the perspective of preventing births, providing contraception to younger women will avert more births. However, the maternal and child health benefits of averting a birth to an older mother may be much greater than for a woman in her 20s.
2. The family planning program may have limited control over the age of its acceptors. FP programs may target younger users, but they should not be turning away older users or leaving them underserved. Providing services to older users requires just as much, if not more, effort as servicing younger users, and programs should get equal credit for doing so.
3. Women who accept sterilization may have higher potential fertility than those who do not. One of the factors that may lead a couple to choose sterilization is the number

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of births they have already had. Thus, it may be more appropriate to adjust for parity at the time of sterilization rather than age.

14. A woman accepting sterilization at age 37 would be credited with 1 couple-years of protection (CYP) each for age 37, 38, 39, 40, and 41. The CYP credit for age 46 would be 0.1 (see Table 3). CYP credit for ages 42 to 45 are a linear interpolation from 1.0 at age 41 to 0.1 at age 46. After age 46, CYP credit follows the schedule in column 2 of Table 4. In this example, the CYP credit for a woman sterilized at age 37 would be 7.6 (1 + 1 + 1 + 1 + 1 + .82 + .64 + .46 +.28 + .1 + .1 + .1 + .1).

15. Ideally, one should know the age distribution of all sterilization acceptors, not just the mean age at sterilization. However, in a separate analysis we examined the results for 20 countries using both systems and found only a 2% difference in the CYP factor between the two.

16. Examples of such noncontraceptive use include (a) double protection, that is, use of condoms in conjunction with another modern method; (b) use with commercial sex workers (commercial sex workers and bar girls who are using another form of contraception or are subfecund); and (c) use among men who have sex with men. Ideally, the proportion of condom use that has no contraceptive value should be subtracted from the total distribution before calculating CYP.

It should be noted that some condom use may have a contraceptive value even when it is not intended. On many surveys, men often report the primary motivation for condom use as protection from sexually transmitted diseases. However, if they are using the condoms with steady or casual partners and no other method of contraception is used, there will be a contraceptive effect even if it is not intended. This type of condom use should be included in the calculation of CYP.

The issue of the noncontraceptive use of condoms has become more important in recent years because of the spread of AIDS. In several African countries, condom shipments have increased to levels 10 times as high as just a few years ago. Because shipments of other methods have not increased at a similar pace, it seems obvious that the primary motivation for increased condom use is disease protection. In Latin America, a nontrivial number of condoms are being used by men who have sex with men, also for disease protection. Thus, it is possible that a significant portion of condom use in many countries has little contraceptive effect.

The studies of potentially greatest interest in addressing our question are the series dealing with AIDS, sponsored by the World Health Organization (WHO). These include two different types of surveys—a Knowledge-Attitudes-Practice-Behavior (KAPB) survey and a partner relations survey. These surveys are nationally representative and contain questions on sex and condom use with commercial sex workers. Although some 30 surveys were conducted between 1988 and 1991, none of the results have been officially released.

Three U.S. Agency for International Development (USAID)–funded AIDS projects—AIDSCOM, AIDSTECH, and AIDSCAP—also conducted several surveys that dealt with issues of condom use. However, they focus primarily on individuals with high-risk behaviors rather than members of the general population; thus, they cannot be used to determine the proportion of overall condom use that gives little or no contraceptive value. Other organizations that have conducted surveys on condom use among the general public are MACRO International (DHS), Centers for Disease Control and Prevention, and the Futures Group International. In surveys that do ask about the purpose of condom use, most users report using condoms for both pregnancy and disease protection.

17. Table 5 shows the percentage of contraceptive users of a specific method who are currently amenorrheic. Contraceptive use refers to use of a method at the time of the survey. A woman is classified as amenorrheic if at the time of the survey she reported that her period had not returned since the birth of her last child and the birth of her last child took place within 6

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months of the survey date. The 6-month restriction is intended to eliminate women who may be amenorrheic because of their method use. This is primarily a problem for injectables.

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