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Background: The Lives Saved Tool (LiST) estimates the effects of maternal and child health interventions on mortality rates and the number of deaths. The family planning module in Spectrum interacts with LiST by providing estimates of the effects of scaling up family planning use on the number of live births, miscarriages, abortions, and stillbirths.

We use the proximate determinants of fertility framework to estimate the effects of changes in contraceptive use, proportion married, postpartum insusceptibility, abortion and sterility on the total fertility rate. We extend this framework to estimate the number of intended and unintended pregnancies and the resulting live births, abortions, stillbirths, and miscarriages.

We apply the model to four countries (Mali, Kenya, Indonesia, and Ukraine) to demonstrate possible trends with a range of family planning and fertility levels. In high-fertility countries, such as Mali, increases in contraceptive use will partially compensate for the increasing number of women of reproductive age to reduce the annual increases in pregnancies and births. Most unintended pregnancies occur to women defined as having unmet need for contraception. In low-fertility countries, increases in contraceptive use may reduce abortion rates and low levels of unmet need mean that most unintended pregnancies are due to method failure.

Conclusions: The family planning module in Spectrum provides a useful framework to incorporate changes in contraceptive practices and pregnancy outcomes in the LiST calculations of mortality rates and deaths.

: Spectrum, Avenir health, Lives saved tool, Family planning

The Lives Saved Tool (LiST) model is concerned with rates of mortality for neonates, infants, children under five and mothers and the effects of health intervention scale-up on these rates. LiST also produces estimates of the total number of deaths and these are dependent on the number of live births, abortions, and stillbirths. LiST is a part of the Spectrum software package, which has other modules that provide information to LiST. The HIV module (AIM) estimates the effects of HIV interventions (anti-retroviral therapy, cotrimoxazole, and programs to prevent mother-to-child transmission of HIV) on child deaths due to AIDS. The demographic projection module (DemProj) estimates the number of live births, the number of children by single age and the number of deaths to children under 5 [1]. The family planning module (FamPlan) estimates the effects of contraception and other factors on the number of pregnancies and pregnancy outc22(o)0(t2esti998(88e7c0122(tcp9993rates)7

and induced abortion) that is also based on individual data [3].

An aggregate approach was proposed by Davis and Blake [4]. That approach recognized both indirect and direct determinants of fertility. Bongaarts developed these ideas into a useful framework for analyzing the

calculated as the ratio of the average birth interval in the absence of breastfeeding or postpartum abstinence (which Bongaarts estimated at 20 months) to the duration when these factors are taken into account, which is estimated as 18.5 months plus the median duration of postpartum insusceptibility.

$$C_s = (7.63 - 0.11 \times s)/7.3, \text{ where } s$$
is the percentage of women aged 45–49 who have had no live births

The index of sterility is estimated from a regression equation that uses the prevalence of primary sterility (the proportion of women who cannot get pregnant due to biological factors) to estimate the effects of primary and secondary sterility on fertility. Secondary sterility occurs when women of reproductive age who have had one or more births can no longer conceive. This index may be over-estimated in cases of voluntary childlessness.

$$C_a = TFR / (TFR + (0.4 \times (1 + CPR) \times TAR), \text{ where}$$
TFR is the total fertility rate, CPR is the contraceptive prevalence rate, and TAR is the total abortion rate (the average number of abortions per woman during her lifetime)

The index of abortion adjusts fertility for those pregnancies that are terminated by abortion. Each abortion reduces total fertility by less than one birth because it results in a shorter period of gestation and more rapid return of fertility than a full term pregnancy. The net effect is estimated to be 0.4 births averted per abortion in the absence of contraceptive use. Higher rates of contraceptive use lead to larger effects of abortion on fertility since the risk of conception is lower than without contraception. Since the index of abortion is used to calculate the total fertility rate this equation is usually applied using TFR from the previous year.

$$C_c = 1 - 1.08 \times CPR \times e$$

The index of contraception expresses the fertility inhi-

at 8 weeks, etc.). By default, we use a miscarriage rate of 13% as estimated by Bongaarts and Potter [12].

Stillbirths are pregnancy losses later in pregnancy, usually as 20 or 28 weeks of pregnancy. Country-specific estimates of stillbirth rates are available and indicate a global average of about 19 stillbirths per 1000 live births in 2009 [13].

Induced abortion refers to a procedure to terminate a pregnancy. The majority are done in the first 8 weeks of pregnancy and almost all are done before the 13th week. Abortions in the second trimester (13 weeks or later) or third trimester are generally rare. Rates of induced abortion are difficult to measure, in part because induced abortion is illegal in many countries. Estimates of induced abortion rates are available [14] and suggest that worldwide about 25% of pregnancies end in induced abortion, with a variation from about 13% in Middle Africa to 39% in the Caribbean. An induced abortion is a response to an unwanted pregnancy. Some unintended pregnancies are unwanted but not all. Also the rates of unintended pregnancies will change as contraceptive use changes. Therefore, it is preferable to express the induced abortion rate as a proportion of unintended pregnancies.

It is difficult to estimate the proportion of pregnancies that are unwanted, partially because a woman may change her mind once she becomes pregnant. However, we can estimate the number of unintended pregnancies as those resulting from two sources: method failure and pregnancies occurring to women with an unmet need for contraception. Pregnancies due to method failure are calculated using the method failure rates given in Table 1. The annual pregnancy rate among women with an unmet

points per year and only 6% have more than 3 points
per year.

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fertility, low contraceptive use, high unmet need, high pro-
portion married, and long periods of postpartum insuscep-
tibility. The long period of postpartum insusceptibility is

affects maternal mortality. Changes in other proximate determinants – particularly marriage rates, abortion, and breastfeeding practices – can also have important effects on fertility.

The approach used in the Spectrum software package allows the effects of family planning and the other proximate determinants to be included in LiST calculations in a consistent framework that links contraceptive use, fertility desires, abortion practices, and demographic processes to the maternal and child mortality calculations in LiST.

There are several limitations to this approach. The