Editors' Summary. Voluntary female sterilization is the most widely used contraceptive method in the world. About 95 million women depend on it to control their fertility. The rapid spread of voluntary female sterilization over the last decade has been made possible by the surgical methods of minilaparotomy and laparoscopy, which are quick, highly effective, and safe. A major program challenge now is making high-quality services readily available to the many women who want them.

Female sterilization is widely used in diverse countries by couples who do not want more children. More than 15 percent of married women are sterilized for contraceptive reasons in Panama (29%), China (27%), South Korea (23%), Thailand (19%), Brazil (18%), El Salvador (18%), Fiji (18%), the United States (17%), Sri Lanka (17%), and Costa Rica (17%). Among married women in the US, voluntary sterilization is now by far the most widely used contraceptive method, having nearly doubled from 9.5 percent in 1976 to 17.4 percent in 1982.

Improved Methods

Minilaparotomy and laparoscopy, developed since 1960, have transformed female sterilization into a quick, safe outpatient procedure that can and should be performed under local anesthesia. Minilaparotomy, sometimes called "minilap," involves a small abdominal incision of less than 3 cm. Each fallopian tube is gently pulled to this incision, blocked by cutting and tying the cut ends or by applying clips or rings, and allowed to slip back into place. Laparoscopy involves inserting a telescope-like instrument into the abdomen, through which a doctor can see the internal organs and block the tubes by electrocoagulation or by applying rings or clips. Either procedure can be performed on most women in about 10 to 20 minutes, without an overnight hospital stay.

Both minilaparotomy and laparoscopy are highly effective. Pregnancy rates after one year are usually less than one per 100 women. The most common reasons for pregnancies after sterilization are a pregnancy already conceived but too early to recognize, a surgical error in identifying a fallopian tube, spontaneous rejoining of a severed tube, or formation of a new passage in the tube that allows sperm and ovum to meet. In the rare cases when pregnancies occur after sterilization, they are more likely to be ectopic (implanted outside the uterus) and therefore require prompt medical attention.

Minilaparotomy can be performed in various settings by doctors with basic surgical skills, using simple, inexpensive instruments. Also, minilaparotomy is the most appropriate method for use after childbirth. Laparoscopy is best suited to large urban hospitals with specially trained surgeons and many clients.

Women's Lives Saved

Minilaparotomy and laparoscopy are safe procedures. Most complications are minor, such as wound infection or slight bleeding, and they resolve easily and quickly. Major complications occur in less than one percent of cases. Sterilization is much safer than childbirth, which averages 400 deaths per 100,000 births in developing countries. By comparison, deaths associated with female sterilization are extremely rare—from 2 to 20 per 100,000 procedures. In Bangladesh, for example, female sterilization is so much safer than childbirth that an estimated 1,000 maternal deaths are prevented by every 100,000 sterilizations. In other words, sterilization saves the life of one in every 100 women who choose this family planning method.

There is no evidence that voluntary female sterilization causes long-term complications. Recent studies following women for up to two years suggest that menstrual cycles do not change as a result of sterilization. Women who previously used oral contraceptives (OCs) or IUDs will probably experience changes because they have stopped using these methods.

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Female sterilization is not easily reversed. Specially trained surgeons using delicate microsurgical techniques report that 50 to 70 percent of women undergoing reversal procedures become pregnant. Microsurgery is costly, however, and not readily available. Moreover, women are carefully selected for these procedures, and only those with the least tubal damage are selected. Reversal is most successful if less than 3 cm of the tube was damaged during sterilization. Clips and rings damage the tubes least, and these techniques appear to be the most easily reversed.

Sterilization research is focusing on nonsurgical methods such as the use of chemicals and plugs inserted through the cervix to block the tubes. Some of these new methods may be reversible without surgery, while others may be less reversible than surgical sterilization.

Expanding High-Quality Services

In many places the demand for female sterilization far exceeds the availability of services. For example, in Guatemala, Panama, and 10 states of Brazil, about half to three-quarters of married women not already sterilized who want no more children are interested in sterilization. In Kenya women may wait as long as 18 months for sterilization. Long waiting lists are common elsewhere, too.

To make high-quality services fully available to all women who are interested in voluntary sterilization requires a broad range of actions, including:

1. Clarifying any ambiguous laws or amending any restrictive medical policies. These deny women sterilization until they have had a specific number of children or until further pregnancies would threaten their health. Such policies, once common in the US and Europe, are now being dropped in recognition of the basic human right of individuals and couples to control their own fertility.

2. Providing full, accurate information to policy-makers and health personnel about voluntary sterilization. They should be made aware of the high level of demand for sterilization, couples' satisfaction with the procedure, and resulting better health and lower birthrates.

3. Training surgical teams so that they can provide high-quality services, including either minilaparatomy or laparoscopy. Short-term training, training in medical schools, and refresher courses have expanded greatly, but there is a need for more trained practitioners.

4. Encouraging many channels for services. These include private physicians, large urban referral centers, smaller or rural clinics, and, in some areas, mobile teams.

5. Insuring women opportunities for both postpartum sterilization and interval sterilization (sterilization more than six weeks after delivery). Then women do not need to become pregnant first or undergo cesarean section in order to be sterilized.

6. Providing financial support for sterilization services, either directly or through health insurance. Thus women would not be denied sterilization because they are too poor to pay. In South Korea, for example, the number of female sterilizations each year increased more than 20-fold after the government started covering the full cost.

7. Using mass media as well as personal communication to inform people about voluntary sterilization. Couples usually take several years to reach a decision on sterilization. They need information well ahead of time that answers their specific questions and concerns.

8. Guaranteeing voluntary and informed consent before sterilization is performed. Couples need sympathetic counseling, including information about vasectomy and other methods. Pressure should be avoided, especially in times of stress such as childbirth.

9. Regularly evaluating the quality and availability of services. Any deaths, serious complications, or clients' complaints should be investigated immediately so that problems, such as lack of sterile technique or inappropriate use of anesthesia, can be promptly resolved.

The rapidly growing number of voluntary female sterilizations shows that many women welcome this method of contraception. Therefore family planning programs and health professionals should take the necessary steps to see that high-quality services are made widely available in a manner that fully respects the rights of individuals and couples to determine their own family size.
Approximately 95 million couples are currently protected from unwanted pregnancy by voluntary female sterilization (see Table 1). Thus female sterilization is by far the most widely used contraceptive method in the world. This estimate is based on survey data and family planning program statistics. More than 15 percent of married women of reproductive age rely on female sterilization in countries as diverse as Brazil, China, Panama, South Korea, Thailand, and the United States (see Table 2).

Male sterilization protects about 40 million couples from unwanted pregnancy, according to an update of a 1983 Population Information Program estimate (119, 324). Thus a total of 135 million couples, or about one of every six couples worldwide, rely on sterilization for contraception.

Over the past decade the use of voluntary female sterilization has increased dramatically in many Latin American and Asian countries and in the US (see Figure 1). In many countries the use of female sterilization is growing faster than use of other contraceptive methods. Most dramatically, in South Korea all of the 66 percent growth in contraceptive prevalence between 1974 and 1983 can be attributed to increasing female sterilization (85, 538). In Thailand increasing use of female sterilization accounted for half of the growth in contraceptive prevalence between 1975 and 1981 (85, 271). In fact, among 11 developing countries where data from successive surveys show rising rates of overall contraceptive use, the use of female sterilization rose markedly faster than use of other methods in eight, rose at about the same rate in two, and rose somewhat slower in only one (see Table 2). In three countries—Costa Rica, the Netherlands, and the US—where virtually all married women who want to avoid pregnancy are using contraception and there has been little change in overall contraceptive prevalence between surveys—increases in the use of female sterilization indicate that women are shifting from other methods. The rapid growth of female sterilization in many countries suggests that the estimate

Table 1. Estimated Number of Married Women of Reproductive Age (MWRA) Voluntarily Sterilized for Contraceptive Purposes Worldwide, 1984

<table>
<thead>
<tr>
<th>DEVELOPING COUNTRIES</th>
<th>% of MWRA</th>
<th>Number of MWRA (in 1,000s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFRICA (sub-Saharan)</td>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>ASIA &amp; PACIFIC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>27</td>
<td>46,400</td>
</tr>
<tr>
<td>India</td>
<td>14</td>
<td>20,000</td>
</tr>
<tr>
<td>Other Asia</td>
<td>6</td>
<td>7,300</td>
</tr>
<tr>
<td>All region</td>
<td>17</td>
<td>73,700</td>
</tr>
<tr>
<td>LATIN AMERICA &amp; CARIBBEAN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>18</td>
<td>3,200</td>
</tr>
<tr>
<td>Mexico</td>
<td>14</td>
<td>1,500</td>
</tr>
<tr>
<td>All other</td>
<td>10</td>
<td>2,700</td>
</tr>
<tr>
<td>All region</td>
<td>14</td>
<td>7,400</td>
</tr>
<tr>
<td>MIDDLE EAST &amp; NORTH AFRICA</td>
<td>1</td>
<td>700</td>
</tr>
<tr>
<td>Subtotal</td>
<td>14</td>
<td>82,300</td>
</tr>
<tr>
<td>DEVELOPED COUNTRIES</td>
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</tr>
<tr>
<td>United States</td>
<td>17</td>
<td>6,000</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>10</td>
<td>900</td>
</tr>
<tr>
<td>All other</td>
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<td>5,900</td>
</tr>
<tr>
<td>Subtotal</td>
<td>7</td>
<td>12,800</td>
</tr>
<tr>
<td>WORLD</td>
<td>12</td>
<td>95,100</td>
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</tbody>
</table>

Figure 1. Increases in Prevalence of Voluntary Female Contraceptive Sterilization Among Married Women of Reproductive Age (MWRA), Survey Results in Selected Countries

*Survey field work continued into following year.

Sources: Anderson (14), Carrasco (85), Colombia (124), Ford (185), Hueso (237), Kannanuansija & Chumathiri (271), Lightbourn et al. (321), Mexico (355), Mitra & Kamal (362), Morris (366), Morris et al. (367), Nepal (384), Peru (415), Pratt et al. (436), Sri Lanka (515), United Nations (538), Van de Giessen (660).
of 95 million couples, which is based partly on surveys several years old, is a conservative one.

Developed Countries
Among developed countries, the popularity of voluntary sterilization in the United States stands out. As of 1982 female voluntary sterilization was the most widely used contraceptive method among married women of reproductive age (MWRA) in the US, employed by over 17 percent. Oral contraceptives were second at about 14 percent, and vasectomy, third at 10 percent (436). Female sterilization has long been an important means of preventing pregnancy among US women. A survey of women born between 1900 and 1910 —women who had children in the 1920s and 1930s—found that 15 percent had been sterilized by age 40, and 27 percent, by age 50. It is not clear how many of these sterilizations were primarily

Table 2. Reliance on Female Sterilization and Vasectomy Among Currently Married Women of Reproductive Age, as Reported in Representative Sample Surveys, 1973-1983

<table>
<thead>
<tr>
<th>Region, Country &amp; Year (Ref. No.)</th>
<th>% Using</th>
<th>% Using</th>
<th>% Using</th>
<th>% Using</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female Sterilization</td>
<td>Female Sterilization</td>
<td>Female Sterilization</td>
<td>Female Sterilization</td>
</tr>
<tr>
<td></td>
<td>Any Method</td>
<td>Vasectomy</td>
<td>Any Method</td>
<td>Vasectomy</td>
</tr>
<tr>
<td>AFRICA</td>
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<tr>
<td>Ghana 1979 (193)</td>
<td>10</td>
<td>0</td>
<td>1</td>
<td>0</td>
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<td>Kenya 1977 (231)</td>
<td>8</td>
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<td>0</td>
</tr>
<tr>
<td>Lesotho 1977 (321)</td>
<td>7</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>ASIA &amp; PACIFIC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bangladesh</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Nepal 1975 (85)</td>
<td>35</td>
<td>3</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>1979 (367)</td>
<td>54</td>
<td>6</td>
<td>15</td>
<td>11</td>
</tr>
<tr>
<td>1982 (538)</td>
<td>58</td>
<td>5</td>
<td>23</td>
<td>9</td>
</tr>
<tr>
<td>Nepal 1978 (85)</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>67</td>
</tr>
<tr>
<td>1981 (340)</td>
<td>7</td>
<td>3</td>
<td>2</td>
<td>41</td>
</tr>
<tr>
<td>Pakistan</td>
<td></td>
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<tr>
<td>Philippines</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Sri Lanka 1975 (85)</td>
<td>32</td>
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<td>9</td>
<td>2</td>
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<td>1982 (515)</td>
<td>55</td>
<td>4</td>
<td>17</td>
<td>7</td>
</tr>
<tr>
<td>Thailand</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1978 (367)</td>
<td>33</td>
<td>2</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>1981 (271)</td>
<td>58</td>
<td>4</td>
<td>19</td>
<td>7</td>
</tr>
<tr>
<td>LATIN AMERICA &amp; CARIBBEAN</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Barbados</td>
<td></td>
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<tr>
<td>1980-81 (379)</td>
<td>46</td>
<td>0</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>Brazil</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1982 (14, 366)</td>
<td>54</td>
<td>0</td>
<td>34</td>
<td>0</td>
</tr>
<tr>
<td>4 northeast states</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>1980 (14, 237, 366)</td>
<td>37</td>
<td>0</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>Pará state</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1980 (14)</td>
<td>62</td>
<td>0</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>Piauí state</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1979 (367)</td>
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<td>0</td>
<td>15</td>
<td>0</td>
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<tr>
<td>São Paulo state</td>
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<tr>
<td>1978 (367)</td>
<td>64</td>
<td>0</td>
<td>16</td>
<td>0</td>
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<tr>
<td>1979 (367)</td>
<td>64</td>
<td>0</td>
<td>16</td>
<td>0</td>
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<tr>
<td>Colombia</td>
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<tr>
<td>1976 (85)</td>
<td>42</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>1978 (354)</td>
<td>46</td>
<td>0</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>1980 (124)</td>
<td>49</td>
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<td>11</td>
<td>1</td>
</tr>
<tr>
<td>Costa Rica</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1976 (85)</td>
<td>65</td>
<td>1</td>
<td>13</td>
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</tr>
<tr>
<td>1981 (237)</td>
<td>65</td>
<td>1</td>
<td>13</td>
<td>1</td>
</tr>
</tbody>
</table>

9 = <0.5
NA = not available
Percentage of contraceptors relying on female sterilization was found to be less than 0.5 percent by surveys in Bulgaria 1976 (321), Haiti 1977 (321), Nigeria 1981-82 (441), Senegal 1978 (321), Spain 1977 (348), Sudan 1978 (353), Syria 1978 (353), Turkey 1978 (321), and North Yemen 1979 (602).

*Women surveyed are currently in union (Latin America & Caribbean) or married (elsewhere), age 15-44 or 15-49. Exceptions are: Costa Rica 1976 and Panama 1976: women currently in union age 20-49; Belgium and England & Wales: women in first marriage, age 16-44; Czechoslovakia, Finland, Italy, and Norway: women in first marriage, age 18-44; France: women in first marriage, age 20-44; Hungary: women in first marriage less than age 40; Netherlands 1982; all women married between 1963 and 1973 irrespective of age; women age 18-37 married or in union; Sudan: Secund, nonpregnant, married women under age 51.

*Respondents were asked about use only if they spontaneously mentioned method in knowledge section of survey.
for family planning purposes and how many were for medical reasons (141, 453).

Between 1955 and 1970 the percentage of women sterilized for contraceptive reasons in the US remained fairly constant at about 4 to 5 percent (476, 562, 569). By 1976, however, the use of voluntary female sterilization for contraception had doubled, reaching 9.5 percent (369). These figures do not include hysterectomies (removal of the uterus) reportedly performed for medical reasons, some of which may actually have been performed for contraceptive purposes.

By 1982 use of voluntary female sterilization in the US had nearly doubled again: 17.4 percent of MWRA were relying on the method (436). These women accounted for nearly one-quarter of all married fertile women who wanted to avoid pregnancy. Among married women age 35 to 44, almost 40 percent rely on female sterilization (29). The increase in female sterilization between 1976 and 1982 was partly the result of a shift away from oral contraceptives, especially among older women (29). In Puerto Rico, where voluntary female sterilization had become common as early as the 1960s without any government support for services (523, 648), by 1982 some 39 percent of ever-married women age 15-49 were relying on the method (651).

Up-to-date survey data are not available on the use of female sterilization in most other developed countries. In the UK a 1976 survey found that 9 percent relied on female sterilization (165). The percentage is estimated to be at least 10 currently (95). In the Netherlands in 1982 about 9 percent of women age 18 to 37 who were married or in union relied on female sterilization, while about 11 percent relied on vasectomy (660). Surveys in other European countries, most from the mid or late 1970s, reported lower percentages (see Table 2). 

Asia and the Pacific

Among countries of Asia and the Pacific, female sterilization is a major contraceptive method in China, South Korea, Thailand, Sri Lanka, Fiji, and India. In these countries and others the use of female sterilization has spread rapidly in recent years.

In China about 27 percent of married women of reproductive age are sterilized for contraceptive reasons, according to the China State Family Planning Commission. The only method more widely used in China is the IUD, reportedly used by about 29 percent of MWRA (119). The Chinese family planning program has emphasized IUDs and sterilization—both male and female—since the early 1970s. In the early and mid-1970s two to three million procedures were performed each year (611). In 1979 the government began the current “one-child campaign” intended to hold population growth to no more than 1.2 billion people by the year 2000. In 1983, 16.4 million female sterilizations and 9.3 million male sterilizations were performed (119). The government offers substantial incentives for sterilization (119), and there have been reports that in the last few years officials in some regions of China have applied extreme pressure to assure that couples are sterilized (560).

At 23 percent of MWRA, South Korea has the second highest level of female sterilization in Asia, as reported in a 1982 Contraceptive Prevalence Survey (538). This is a dramatic increase over the last decade. In 1974 only 2 percent of married women of reproductive age had been sterilized (85). Five years later, in 1979, the percentage had risen to 15 percent (367).

Between 1977 and 1982, the last year for which service statistics are available, between 160,000 and 200,000 female sterilizations were performed each year in South Korea, compared with fewer than 6,000 each year in the early 1970s (394). The major reasons for this dramatic increase appear to be the introduction of laparoscopy for female sterilization in 1976 and, in the same year, an increase in government reimbursement of doctors that effectively eliminated any charge to clients (292). In 1976 the Korean government also began to introduce incentives to encourage male and female sterilization. In 1981 these incentives were increased (429).

In Thailand 19 percent of married women of reproductive age rely on female sterilization, as recorded in a 1981 survey (271). This is a rapid increase from about 6 percent in 1976 (85). Currently almost one-third of contraceptive users in Thailand rely on female sterilization.

There has long been a demand for female sterilization in Thailand, but until the mid-1970s services were limited to urban areas. A national survey in 1969-70 found that 18 percent of women in Bangkok were sterilized, but only 2 percent in rural areas. In the mid-1970s the National Family Planning Program began increasing the number of voluntary sterilization service points (311). By the early 1980s the national program, which concentrates on rural areas, was performing as many as 150,000 female sterilizations annually (471).

Female sterilization is an important contraceptive method in several other Asian countries. According to a 1982 Con-
trceptive Prevalence Survey, 17 percent of MWRA in Sri Lanka relied on female sterilization (515). This is almost twice the 1975 figure (85). In the Pacific island nation of Fiji, in 1974 18 percent of married women of reproductive age had been sterilized for family planning reasons (85). More recent data are not available. In India, where female sterilization is one of the major methods of contraception in the government family planning program, about 14 percent of MWRA have been sterilized for family planning purposes. This estimate is based on service statistics (406, 510).

In several other Asian countries the use of female sterilization has been growing rapidly in recent years. These include Bangladesh, where the prevalence of female sterilization grew from virtually zero in 1975-76 to about 6 percent of MWRA in 1983 (85, 362). The number of procedures performed annually grew fivefold between 1976 and 1981 (217, 281). Substantial increases in the number of female sterilizations also have occurred in Indonesia and Nepal, although prevalence is still low (363, 383, 394, 401, 608). In Nepal three-fourths of the 7 percent of MWRA using some family planning method rely on either vasectomy or female sterilization, with vasectomy somewhat more common (384) (see Table 2).

Latin America and Caribbean

Latin American countries have some of the highest rates of female sterilization in the world, despite great differences in culture, in the legal status of voluntary sterilization, and in the extent of services available. The highest prevalence of voluntary female sterilization in any country is reported in Panama, where, according to a 1979-80 survey, 29 percent of married women of reproductive age had been sterilized. This amounted to nearly half of all women using contraception (367). Panama was the first country to pass statutes specifically legalizing voluntary sterilization, in 1938 and 1941 (516). Prevalence rates for voluntary female sterilization are high in several other Central American countries as well, including El Salvador and Costa Rica (367) (see Table 2).

Elsewhere in Latin America and the Caribbean, voluntary female sterilization is a major family planning method in the Dominican Republic, Barbados, Colombia, and Brazil. Among Caribbean nations, in the Spanish-speaking Dominican Republic, in 1975 some 14 percent of MWRA relied on female sterilization (85), while in English-speaking Barbados, the figure was 13 percent in 1980-81 (379). In Colombia, where voluntary female sterilization has been available for many years chiefly through PROFAMILIA, a private association, 11 percent of MWRA relied on female sterilization in 1980 (124), up from 4 percent in 1976 (85). The number of procedures performed each year by PROFAMILIA grew dramatically in the mid-1970s and has remained roughly constant since 1977, averaging about 41,000 per year (260, 399).

In Brazil about 18 percent of married women of reproductive age have been voluntarily sterilized, according to estimates based on surveys of 10 Brazilian states (366). Female sterilization is equally common in a rich, largely urban state such as Sao Paulo and in a poor, largely rural state such as Piaui (see Table 2). Voluntary female sterilization has become widespread even though, until 1984, Brazil's Code of Medical Ethics required that three doctors declare an "exceptional" therapeutic need before sterilization could be performed (516). Many women had cesarean-section deliveries since sterilization after cesarean section did not require formal statements and was eligible for coverage under various health insurance plans (262, 263, 468).

Africa and the Middle East

Among most North African and Middle Eastern nations, voluntary sterilization—female or male—is uncommon. The highest rate of female sterilization may be in Tunisia, which has had a comprehensive family planning program since the 1960s and introduced sterilization in 1973 (634). In 1978, 8 percent of married Tunisian women of reproductive age relied on female sterilization (538). In one province, Jendouba, in 1979 over 16 percent of MWRA had been sterilized (367).

Data for other African nations are scarce, but, based on World Fertility Survey results for Kenya, Lesotho, and Sudan, female and male sterilization appear to be rare (277, 312, 525). African doctors attending the Conference on Reproductive Health Management in Sub-Saharan Africa, in November 1984, expressed growing interest in voluntary sterilization, however. They recommended more attention to training, counseling, and the provision of facilities for voluntary sterilization, as well as other family planning methods, in order to help reduce high rates of maternal and infant mortality in sub-Saharan Africa (333, 358). (Abstracts of the papers delivered at the conference, which was sponsored by the World Federation of Health Agencies for the Advancement of Voluntary Surgical Contraception, are available on request.)

DESCRIPTION OF FEMALE STERILIZATION METHODS

Female sterilization consists of two steps:

1. Reaching the fallopian tubes and
2. Blocking, or occluding, the tubes so that sperm and ovum cannot meet.

To reach the fallopian tubes, doctors can use an abdominal, vaginal, or cervical approach. To block the tubes, doctors can use simple ligation (tying with a surgical thread) and excision (removal of part of the tube), electrical methods, or mechanical devices (rings or clips). Both minilaparotomy and laparoscopy are abdominal approaches. They involve a small abdominal incision to approach the tubes and, with laparoscopy, an optical instru-

Minilaparotomy requires only a small incision and simple instruments. It is suited to settings ranging from urban hospitals to rural health posts, and it is the preferred postpartum procedure.
ment. With minilaparotomy, now widely used in developing countries, the fallopian tubes are usually blocked by ligation or mechanical devices. With laparoscopy, either electrocoagulation or mechanical devices can be used. Both procedures can usually be performed with local anesthesia on an outpatient basis.

**Approaches to the Fallopian Tubes**

For years the only method of sterilization was the traditional laparotomy, involving a 5 to 10 cm incision in the abdomen. Technological advances and the need for simpler methods to be used in developing countries led to the development of other abdominal approaches—minilaparotomy and laparoscopy. These procedures have markedly reduced complications and shortened recovery time.

**Minilaparotomy.** Minilaparotomy (also called mini lap) is a safe and simple procedure. Developed in the 1970s, minilaparotomy requires only a small transverse incision, no more than 5 cm long and usually much smaller, made just above the pubic hairline. Using an instrument inserted through the cervix, the doctor moves the uterus to bring each fallopian tube into the abdominal incision. Part of the tube is pulled out of the abdomen with a clamp, hook, or the doctor's finger, where it is blocked by ligation, clips, or rings, and then replaced in the abdomen (see photo, p. C-130). The abdominal incision is closed with either absorbable or nonabsorbable sutures. The operation takes an average of 10 to 20 minutes, although some doctors can perform a minilaparotomy in less than 10 minutes. Women can usually leave the clinic or hospital two to three hours after surgery (100, 249, 285, 341, 403, 512, 558).

Minilaparotomy can be performed at any time including the period after childbirth or abortion. In the first few days postpartum, when the uterus and tubes are high in the abdomen, a slightly different procedure is used. A one to 3 cm curved incision is made in the lower half of the umbilicus. The doctor can easily move the tube with a finger to bring the tube to the incision. The tubes are usually blocked by ligation and excision (100, 285). The simplicity, safety, and effectiveness of minilaparotomy make it an ideal method for most women. Because the incision is smaller, minilaparotomy causes far fewer complications than laparotomy, and the two methods are equally effective. Minilaparotomy may be difficult when the woman is obese. It also may be difficult when her tubes have been damaged by infection or surgery and are immobilized by pelvic adhesions—abnormal bands of connective tissue that form after injury or disease involving the pelvic organs. In such cases the doctor can complete the sterilization either by enlarging the incision slightly or by using a different approach to the tube.

**Laparotomy.** Because a laparotomy incision is larger than a minilaparotomy incision, general or spinal anesthesia is usually necessary. Instead of bringing the tubes to the incision, as with minilaparotomy, the instruments are introduced into the abdominal cavity to reach the tubes. Any type of occlusion technique can be used. For nearly all women minilaparotomy or laparoscopy is preferable since these approaches require less operating and recovery time and cause fewer complications, mainly because general anesthesia is not needed. Laparotomy may be necessary if other approaches have failed or if there are complications requiring additional surgery.

**Laparoscopic sterilization can be done quickly, complications are rare, and the procedure leaves only a very small scar.** (P. Coleman)

**Laparoscopy.** First widely used for female sterilization in the early 1960s (407, 517), laparoscopic sterilization involves inserting a laparoscope into the abdomen. The laparoscope is a slender stainless-steel tube containing fiber-optic cylinders that transmit light into the abdomen and a set of lenses that enables the doctor to see inside the abdominal cavity. Two types of laparoscopes are used. With one type, the doctor can insert forceps or clip or ring applicators through a channel of the laparoscope. Only one abdominal incision is necessary—the one-puncture, or one-incision, technique. With the other standard type, the doctor can see the fallopian tubes but has to make a second abdominal puncture to insert instruments for blocking the tubes—the double-puncture, or double-incision, technique. Applying clips properly—at a 90° angle on the tube—is easier with the double-puncture technique (57, 206).

After anesthesia is administered, the first step in laparoscopy is inserting a needle into the abdomen and inflating the abdomen with one to 3½ liters of gas—carbon dioxide, nitrous oxide, or room air. This insufflation separates the abdominal wall from the abdominal organs, making space for safe introduction of the laparoscope, and provides a clear view of pelvic organs. A trocar, a pointed surgical instrument, encased in a metal sleeve called a cannula, is inserted through a superficial skin incision of about one to 1.5 cm in the lower rim of the umbilicus or just below. The trocar is then removed, and the laparoscope is inserted through the cannula. The second incision, if required, is usually made midway between the umbilicus and the pubic bone, either to the left or right of the midline. Alternatively, the trocar may be inserted into the abdomen and the peritoneum insufflated through the laparoscope. This technique is particularly useful with obese women because the insufflation needle may not reach through the layers of fat to the peritoneum (156, 241, 480). Proper insertion of the insufflation needle and the trocar is critical. Because the doctor cannot see into the abdomen, he or she may puncture a blood vessel or abdominal organ during insertion. This complication is rare but serious. Electrocoagulation, clips, or rings can be used to occlude the tubes. After occlusion the gas is allowed to leave the abdomen. The instruments are removed, and the incision is closed with one or two absorbable sutures. Scarring is minimal.

**Open laparoscopy.** Open laparoscopy, which combines the minilaparotomy and standard laparoscopy ap-
Vaginal approaches. Use of vaginal approaches has declined with the development of minilaparotomy and laparoscopy. Two types of vaginal sterilization have been used—colpotomy (also called culdotomy) and culdoscopy. With both techniques a 3 to 5 cm incision is made in the vaginal wall behind the cervix. The tubes are located, pulled through the incision into the vagina, and occluded by ligation, clips, or rings. Culdoscopy involves a culdoscope, which is passed through the incision to help the doctor find the tubes. Colpotomy is done without the culdoscope.

Vaginal approaches are not as safe or effective as minilaparotomy or laparoscopy. Pelvic infection after vaginal sterilization is more common because bacteria from the vagina enter the pelvic cavity. Also, men often will not abstain from intercourse for the recommended 2- to 4-week period after the procedure. Moreover, vaginal approaches cannot be used postpartum because the enlarged uterus makes it difficult to reach the tubes. Vaginal methods are generally more difficult to perform and so require more training than minilaparotomy and laparoscopy. Subsequent pregnancy rates are slightly higher. Technical failures—inability to complete the sterilization with the chosen procedure—occur more often. In addition, the knee-chest position required for culdoscopy is very uncomfortable for most women (5, 53, 70, 103, 231, 274, 285, 343, 472, 591, 596, 600).

Transcervical methods. Nonsurgical sterilization—occluding the fallopian tubes through the cervix—is still experimental (see pp. C-148–150).

Occlusion Techniques: Ligation

Ligating, or “tying,” is the oldest and most common technique for blocking the tubes. It is safe, inexpensive, and does not require special equipment or extensive surgical training. Ligation is not used with laparoscopy, however.

Pomeroy technique is the most widely used ligation technique because it is simple and very effective. First described in 1930 (63), the Pomeroy technique involves using absorbable catgut sutures to tie the base of a loop of tube near the midportion (ampulla) and cutting off the top of the loop (see Figure 2). The suture material is absorbed rapidly, reducing the chances of inflammation and formation of fistulas (openings) in the tubes. After the sutures are absorbed, the ends of the tube pull apart. The Pomeroy technique destroys about 3 to 4 cm of tube.

Pritchard’s technique, also known as the Parkland technique, involves separating a small segment of the tube from the mesosalpinx (the broad ligament surrounding the tube). Each end of the segment of tube is ligated with chronic suture, and the portion of tube between the sutures is removed (437). This technique is widely used in the UK (78).

Irving technique is more difficult to perform than Pomeroy ligation. The tube is severed, and the proximal (uterine) end is buried in the muscle wall of the uterus. The other end is buried in the mesosalpinx (285). The technique is extremely effective but difficult to reverse.

Cook’s technique involves severing the tube and burying the proximal end in the round ligament (100, 460, 486).

Uchida technique involves severing the tube and burying the proximal end in the broad ligament (100, 285, 537). The Uchida technique is widely used in Japan, where it was developed in the mid-1940s (285), but little used elsewhere (486).

Macleaver technique involves lifting up the tube into a loop, crushing the base of the loop with a clamp or forceps, and ligating the tube with nonabsorbable suture material (486). This technique has a high failure rate and is now seldom used (285).
**Fimbriectomy** involves complete removal of the fimbriae (finger-like projections at the ovarian end of the fallopian tubes) (352, 519). Some studies report high pregnancy rates, but at the same time the method is very difficult to reverse. In a similar procedure, salpingectomy, all of the tube is removed. This technique requires laparotomy, has more side effects than other ligation techniques, and cannot be reversed (265).

**Occlusion Techniques: Electrocoagulation and Thermocoagulation**

Electrocoagulation involves the use of high-frequency electrical current to coagulate and block the tubes. This method is generally used with laparoscopy. The first technique available, **unipolar coagulation**, was developed in the 1960s (188, 407). Electric current passes from the laparoscopic forceps through the woman's body to a ground plate placed under her lower back, thigh, or buttocks. Unipolar electrocoagulation damages 20 to 50 percent of each fallopian tube (330, 487, 609). Thus it is very effective, but reversal is unlikely. Because the woman is part of the electrical circuit, burns to other organs, especially the bowel, can occur. This is a rare but serious complication (328, 422).

Concern about bowel burns led to the development of **bipolar coagulation** in the early 1970s as well as to clips and rings. With bipolar coagulation (459), electric current passes between the two jaws of the forceps, and only a small portion of the tube is exposed to the current. Accidental burns occur only if the physician touches the bowel or other organ with the forceps. Bipolar coagulation destroys less tubal tissue than unipolar coagulation does. To be sure of complete occlusion, however, some doctors burn the tube in three or four places (229, 474, 505).

**Thermocoagulation** destroys the tube with heat rather than electricity. Thus shocks and electrical burns to other organs cannot occur. Thermocoagulation has not been widely used, and its effectiveness is not established (454, 517, 518, 544).

With both electrocoagulation and thermocoagulation, the tube can be occluded by coagulation only, by coagulation and severing of the tube, or by coagulation with removal of a segment of tube.

**Occlusion Technique: Tubal Ring**

The tubal ring, trade-named the Falope-Ring, is the most widely used mechanical occlusion device (see photo, below). Also known as the silastic band and the Yoon band, the ring was developed in 1973 by In Bae Yoon of the Johns Hopkins School of Medicine and other researchers (306, 430, 604, 605, 607).

The ring can be used with minilaparotomy, laparoscopy, and vaginal approaches (605). With all approaches the ring is applied in the same way, using a special applicator. A loop of fallopian tube is lifted up, drawn into the cylinder of the applicator, and the ring is slipped onto the base of the loop. A special laparoscope, the Laprocator, has been designed to apply rings. The Laprocator is less expensive to buy and maintain than other laparoscopes (397, 398). The ring is usually applied to the ampulla or ampullary-isthmic junction of the tube, 2 to 3 cm from the uterus (486, 604, 606).

A ring destroys about one to 3 cm of the tube (285). Restoring fertility is more likely than with electrocoagulation or the more complex ligation techniques. The rings usually are not difficult to apply unless the woman has pelvic adhesions or enlarged tubes. Transection (severing) or tearing of the tubes and short-term postoperative pain are the most common complications (see p. C-142).

**Occlusion Technique: Clips**

The first female sterilization with clips was performed in the US in 1953 (175). Research and repeated modifications led to the spring-loaded and the silicone-titanium clips, both of which are safe, effective, and easy to apply. A clip is placed on the isthmus of each tube, 2 to 3 cm from the uterus, with a special applicator. Although originally designed for laparoscopic use, clips can be used with minilaparotomy and vaginal approaches (244, 247, 318, 320).

Clips cause considerably less damage to the tubes than most other occlusion techniques. Less than one cm of the tube is destroyed, compared with approximately one to 3 cm with rings, 3 to 4 cm with Pomeroy ligature, and 3 to 6 cm with electrocoagulation (178, 180, 486). Thus the potential for reversing clip sterilization is greater (see box, p. C-148).

**Spring-loaded clip.** The original spring-loaded clip, designed by Jaroslav F. Hulka and George Clemens, was first used in 1972. The current model consists of two plastic jaws with interlocking teeth. The jaws are held together by a stainless-steel spring, which is pushed forward to lock the clip in place over the tube (see photo, below).

![Silastic tubal rings are stretched, placed over a loop of fallopian tube, and released. The ring contracts, blocking the tubal opening.](image1)

![Two types of clips are currently being used for female sterilization. The spring-loaded clip consists of two plastic jaws that are locked over the tube by a stainless-steel spring (top). The Filshie clip is made of titanium lined with silicone rubber (bottom).](image2)
Filshie clip. G. Marcus Filshie began working on the Filshie clip (also known as the Nottingham clip) in 1973. The clip is made of titanium, with inner surfaces lined by silicone (see photo, p. C-133). When the clip is closed, the upper jaw closes over the tube and latches under a hook in the lower jaw. The silicone is compressed. As the enclosed tubal tissue atrophies, the silicone expands, keeping the tube blocked. Six models of the clip have been tested in over 10,000 women. The latest models have hinged jaws that open and close easily. This allows the doctor to remove incorrectly placed clips easily and reposition them (179). The Filshie clip is big enough to occlude tubes that are enlarged after pregnancy or pelvic infection (177, 178, 180).

Other clips have been used for sterilization. One of the earliest, a tantalum hemoclip, was originally designed to occlude blood vessels during surgery. Tantalum clips did not block the fallopian tubes completely, and pregnancy rates were high (114, 343). Another plastic clip, developed by W. Bleier, is no longer manufactured (65). Some researchers have reported high pregnancy rates with the Bleier clip (2, 309) and problems with the applicator (137, 138).

Hysterectomy

Hysterectomy, the removal of the uterus, has been used in the past for female sterilization. The operation can be performed through a laparotomy or a vaginal incision. General anesthesia is usually required. Hysterectomy is more difficult, risky, and expensive than other methods of female sterilization. It should not be used unless the woman has a gynecological disease that requires removal of the uterus (26, 168, 228, 533, 570).

EFFECTIVENESS

Female sterilization is a very effective contraceptive method. With the most widely used techniques, fewer than one woman in 100 will become pregnant in two years after surgery. This compares with pregnancy rates between 2 and 20 per 100 in the first year of use of various other methods, according to large surveys in the US and the Philippines (204, 297).

Differences Among Methods

Differences in effectiveness among the widely used sterilization methods are slight. Comparing them is difficult, however. Both the approach to the tubes—mini-laparotomy or laparoscopy—and the technique of occluding the tubes can affect failure rates. Also, studies differ. Some do not distinguish among postpartum, postabortion, and interval sterilizations (more than six weeks after childbirth or abortion); others do. Rates and lengths of follow-up vary (108, 421).

Mini-laparotomy may be slightly more effective than laparoscopy. With laparoscopy, equipment problems and surgical errors, especially by doctors just learning the technique, account for the slightly higher pregnancy rates (103). In four recent large comparative studies, pregnancy rates have ranged from 0.2 to 0.8 per 100 women for mini-laparotomy and from 0.2 to 1.3 for laparoscopy (see Table 3) (114, 375, 376, 535, 550).

The most widely used tubal occlusion techniques—Pomeroy ligation, electrocoagulation, clips, and rings—have similar failure rates (see Table 3). A large multicenter study of laparoscopy reported failure rates of 0.2 for the spring-loaded clip, 0.2 for unipolar coagulation, and 0.4 for the ring (567). Similarly, in a South Korean survey of over 390,000 laparoscopies, pregnancy rates were 0.15 for unipolar coagulation and 0.12 for the ring (567).

Clips

With the current model of the spring-loaded clip (marketed in the UK as the Rocket clip and in the US as the Wolf clip), pregnancy rates are lower than 0.5 per 100 women (58, 192, 212, 320). Due to manufacturing errors, some earlier versions of this clip did not block the tube completely (245, 247), and pregnancy rates were high as 27 per 100 women were reported (114).

With various models of the Filshie clip, pregnancy rates in different studies have ranged from 0 to 8.6 per 100 women. Overall, more than 10,000 women worldwide were sterilized with early models of the Filshie clip, with a pregnancy rate of 0.6 per 100 (177, 178, 180, 253, 291, 350, 439). With the latest design, the Mark 6, pregnancy rates are low. In two recent studies involving a total of almost 1,200 women, only one pregnancy has been reported (227). Since January 1983, 43,000 sterilizations have been performed with the Mark 6 clips. Only 20 pregnancies have been reported to the manufacturers (621).

Electrocoagulation

While bipolar electrocoagulation is safer than unipolar (see p. C-142), some evidence suggests that it may be less effective. With unipolar coagulation, most studies report pregnancy rates under one percent (see Table 3). With bipolar electrocoagulation a South Korean study of over 36,500 women and a smaller Swiss study reported pregnancy rates of 0.4 per 100 women or lower (229, 567). Two smaller studies report much higher rates—4 and 10 per 100 (21, 212).

Pregnancies after bipolar coagulation may occur because the tube is not completely blocked. The doctor may have to burn each tube in three or four places, for a total of at least 3 cm, to close it completely (505, 507). Also, placing the forceps directly across the tube, rather than on the mesosalpinx (the upper part of the broad ligament) is important. Some researchers suspect that, even when the forceps are correctly applied, complete obstruction of the tube may not occur until scar tissue forms, 8 to 12 weeks after surgery (28).

Reasons for Pregnancies

Pregnancies after sterilization occur for various reasons, primarily because:

- the woman is already pregnant at the time of the operation,
- surgical errors are made, usually by confusing another pelvic structure with the fallopian tube,
- equipment fails,
- the ends of the fallopian tube reconnect spontaneously (anastomosis),
- fistulas (abnormal openings) develop in the tube, allowing sperm and ovum to meet.

Pregnancies unrecognized at the time of sterilization account for 8 to 45 percent of reported failures (58, 79, 107, 114, 168, 212, 240, 245, 359, 409, 492, 535). These pregnancies...
<table>
<thead>
<tr>
<th>Author &amp; Date (Ref. No.)</th>
<th>Place</th>
<th>No. of Women</th>
<th>Years Since Sterilization</th>
<th>Timing of Sterilization</th>
<th>Life-Table Rate at One Year</th>
<th>Pregnancies per 100 Women</th>
</tr>
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<tbody>
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<td><strong>MINILAPAROTOMY</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>With Pomeroy or Modified Pomeroy Ligation</td>
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<td>Interval</td>
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<td>0.3</td>
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</tr>
<tr>
<td>Pattinson et al. 1983 (409)</td>
<td>South Africa</td>
<td>8,509</td>
<td>Up to 3 years</td>
<td>NA</td>
<td>NA</td>
<td>0.3</td>
</tr>
<tr>
<td>Polachetti et al. 1978 (430)</td>
<td>US</td>
<td>1,576</td>
<td>Up to 3 years</td>
<td>NA</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Trias 1984 (533)</td>
<td>Colombia</td>
<td>42,135</td>
<td>Up to 10 years</td>
<td>NA</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Whang 1980 (567)</td>
<td>South Korea</td>
<td>91,970</td>
<td>Up to 3 years</td>
<td>NA</td>
<td>NA</td>
<td>0.1</td>
</tr>
</tbody>
</table>

NA = not available
*Includes 106 procedures with other tubal occlusion techniques
†12-month Pearl rate
‡24-month life-table rate
§Technical failures excluded
∥Includes unspecified number of fimbriectomies
cies, called "luteal phase pregnancies," are most likely when sterilization is performed in the luteal (post-ovulatory) phase of a woman's menstrual cycle after a fertilized ovum already has implanted in the uterus. Carefully questioning all clients about the timing of their last menses and coitus and about their use of contraception can reduce the rate of such pregnancies. Timing sterilization with the preovulatory phase of the menstrual cycle would also help but is not always possible. The small risk that a woman has just become pregnant—0.12 per 100 procedures in one study (58)—must be weighed against the chances that she will become pregnant if she must wait for sterilization. Routinely performing a dilation and curettage or vacuum aspiration at the time of sterilization to be sure that the woman is not pregnant (207, 298, 316) is not recommended. It increases the risk of infection as well as the time and cost of the operation (207). Moreover, some fertilized ova may be in the fallopian tubes and would not be affected by evacuating the uterus (207, 210).

Surgical errors also cause some pregnancies—from 30 to 50 percent of later pregnancies in most studies (79, 112, 152, 180, 240, 245, 430, 527, 535). Most often, the round ligament or ovarian suspensory ligament is mistaken for the fallopian tube (239, 591) (see Figure 3). If the doctor would not be affected by evacuating the uterus (207, 210).

Figure 3. Anterior View of the Right Side of the Female Reproductive Tract

Technical Failures

Inability to complete the planned sterilization procedure—called technical failure—occurs in 2 percent or less of all sterilizations by minilaparotomy or laparoscopy. Usually the doctor can complete the sterilization by switching to another approach to the tubes or to another occlusion technique. Sterilizations cannot be completed by any method in well under one percent of all procedures (342, 375).

Technical failures have various causes. In minilaparotomy, characteristics of the woman—such as obesity, which makes it more difficult to locate the tubes, or adhesions, which make it more difficult to lift the tubes through the incision—may make a larger incision necessary (376). In laparoscopy, equipment malfunctions, such as fogging of a laparoscope lens or jamming of clip or ring applicators, may make another approach necessary (116). With both approaches, surgical complications, particularly tears or lacerations of the tubes, may prevent completion of the procedure (116).

Rates of technical failure in minilaparotomy and laparoscopy are similar, ranging from none to 3.7 percent in various series (32, 39, 58, 71, 114, 115, 116, 122, 139, 245, 342, 376). When a minilaparotomy cannot be completed, the doctor can widen the incision by a few centimeters and perform a laparotomy. The woman may need additional anesthesia, and the risk of complications increases. With laparoscopy, the doctor can often switch to another occlusion technique—for example, from rings to electrocoagulation—and complete the sterilization. If equipment for another occlusion technique is not available, however, a minilaparotomy or laparotomy must be performed. This requires a second incision, a second set of sterile instruments, and longer operating time (106, 342).

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While the overall incidence of ectopic pregnancy is low because female sterilization is highly effective, a substantial percentage of pregnancies in sterilized women is ectopic. The percentage ranges from 4 to 64 percent in various studies (58, 114, 115, 139, 240, 332, 528, 550) compared with 0.8 percent among women not sterilized (76, 223). Ectopic pregnancies can occur at any time after sterilization—from two months to eight years, according to several studies (50, 284, 408, 521). The rate of ectopic pregnancies does not change with time since sterilization, whereas the rate of intrauterine pregnancies decreases (113, 316). Whether they are sterilized or not, women who have had pelvic or abdominal surgery or pelvic infections are more likely to experience ectopic pregnancy (111, 113, 199, 245, 528, 566).

What causes ectopic pregnancy after sterilization? A widely accepted theory is that the fallopian tube opens

Other factors account for some pregnancies. Equipment failures occurred with early versions of the spring-loaded and Fishie clips (180, 245). Occasionally, clips and rings break during insertion or, even when properly applied, do not block the tube (192, 483, 506). Clips and rings can slip off the tube, especially if it is unusually thick (604). Spontaneous recanalization—rejoining of the tubes—also occurs. F. Hulka and colleagues reported one recanalization among 25 pregnancies in 1,079 sterilizations with the spring-loaded clips (245). In another study of 42 sterilization failures, 12 were caused by recanalization of the tubes. Nine of these followed hysterecetomy (506). The formation of fistulas (abnormal openings in the tubal wall) also leads to both intrauterine and ectopic pregnancies.

Ectopic Pregnancy

Ectopic pregnancy, the implantation of a fertilized ovum outside the uterine cavity, is an infrequent but life-threatening complication of tubal sterilization. In recent large studies the incidence of ectopic pregnancy within two years after sterilization ranged from 0.02 to 0.31 per 100 sterilized women. In most studies the rate is 0.15 or lower (58, 111, 114, 139, 240, 376, 550).
partially, either because occlusion was incomplete or because the two ends of the tube reconnected after surgery. This opening is wide enough for sperm to pass through but not wide enough for the fertilized ovum. Another possibility is that fistulas form through the tubal wall. Sperm may pass through these openings into the peritoneal cavity and fertilize the ovum, which then implants in the ovarian end of the fallopian tube.

It is not clear whether any one technique of tubal occlusion is more likely to lead to ectopic pregnancies than another. On one hand, a large South Korean study and a number of smaller studies reported higher ectopic pregnancy rates after electrocoagulation than after other techniques. On the other hand, a study reporting life-table rates found no significant differences among 23,600 sterilizations by electrocoagulation, Pomeroy ligation, or ring. Ectopic pregnancy is a life-threatening condition. Women must be aware of the need for immediate medical attention if they experience any of the symptoms of ectopic pregnancy—amenorrhea, vaginal bleeding, or abdominal pain. Also, doctors must consider the possibility of ectopic pregnancy in sterilized women with any of these symptoms.

**ANESTHESIA**

Local anesthesia and mild sedation are now recommended for sterilization with minilaparotomy and laparoscopy. Local anesthesia makes female sterilization possible on an outpatient basis and is much safer, cheaper, and less likely to delay recovery from surgery than general, spinal, or epidural anesthesia. Local anesthesia carries some risks, however, and women must be monitored carefully during and after sterilization. Family planning programs should promote the use of local anesthesia and establish standard regimens. Training programs may be necessary in some areas to ensure that doctors are using local anesthesia regimens correctly and safely.

Complications associated with anesthesia, like other sterilization complications, are rare, ranging in frequency from 0.04 to 0.75 per 100 procedures. Nevertheless, anesthesia is by far the most common cause of serious complications and deaths attributed to female sterilization. In the US, for example, general anesthesia was responsible for 11 of 29 sterilization-attributed deaths in the period 1977 to 1981. Using a local anesthetic and sedatives in correct doses can virtually eliminate anesthesia complications and related deaths.

A large study in India found that local anesthesia was 10 times safer than general anesthesia. Among 32,000 women sterilized in 13 teaching hospitals, the rates of anesthesia-related complications per 100 procedures were:

- **General anesthesia**: 0.2
- **Spinal anesthesia**: 0.1
- **Local anesthesia**: 0.02

In a US study women sterilized with local anesthesia were one-fifth as likely to experience a major complication—i.e., one requiring hospitalization or laparotomy—as women sterilized with general anesthesia. Minor complaints—headaches and nausea and vomiting—also are much less common with local than with general anesthesia.

Not only is local anesthesia safer, it also is less expensive and more convenient. Administering general, spinal, or epidural anesthesia requires special personnel and monitoring equipment. Administering spinal or epidural anesthesia is time-consuming—20 to 30 minutes even for an experienced anesthetist. Recovery from general or spinal anesthesia takes an average of about four hours. Throughout this period the woman must be carefully watched. In contrast, local anesthesia can be administered and monitored by the doctor performing the procedure. The effects of the drugs, if given in proper doses, wear off quickly, and the woman spends less time in the health care facility.
Local Anesthesia Regimens

Local anesthesia regimens usually consist of three types of drugs: (1) systemic agents that sedate the woman and block pain, (2) local analgesics that relieve pain at the incision site, and (3) systemic drugs that prevent nausea or disturbances of heart function. No single regimen is universally appropriate (195, 587). The choice of regimens will vary according to the skill and availability of health care personnel, the safety and satisfaction of clients, the preferences of doctors, and the availability and cost of drugs (587). Various regimens have been used safely.

The most widely used regimen consists of the sedative diazepam (trade-named Valium), the narcotic meperidine (pethidine, or Demerol), and the local anesthetic lidocaine (lignocaine, or Xylocaine) (295). Atropine is sometimes given to prevent slowing of the heartbeat (bradycardia), and promethazine (Phenergan), to prevent nausea. The Expert Committee convened in 1983 by the World Federation of Health Agencies for the Advancement of Voluntary Surgical Contraception recommends the following regimen, which has been used safely for minilaparotomy and laparoscopy:

- Diazepam 10 mg by mouth 30 to 60 minutes before surgery; 5 mg for women weighing under 35 kg (75 lb);
- Atropine 0.6 mg injected just before surgery; 0.4 mg for women under 35 kg;
- Meperidine 50 mg injected just before surgery; 25 mg for women under 35 kg;
- Promethazine 25 mg injected just before surgery;
- Lidocaine, one percent solution, 15 to 20 cc injected into the abdominal wall and applied to the fallopian tubes and uterus (587).

Atropine, meperidine, and promethazine can be given either intramuscularly or intravenously. When administered intravenously, however, the drugs take effect very rapidly. In rare instances a woman's breathing may slow markedly. Therefore these drugs should not be given intravenously unless resuscitation equipment is available (182). Naloxone (Narcan), a drug that counteracts the effects of anesthesia, should always be available at the time of surgery (208, 209, 443).

Health professionals must take care not to exceed the recommended doses. Doses of sedatives and narcotics that are too large, too frequent, or too rapidly administered can stop breathing and cause death. Overdoses of lidocaine have caused convulsions, coma, and cardiovascular collapse (142, 181). Particular caution is required in double-puncture laparoscopy, when the doctor must inject the lidocaine at two incision sites. The maximum safe total dose is 4.5 mg per kg of body weight. With a one percent solution of lidocaine, this is 0.5 cc per kg (181, 587). In addition, even at recommended doses local anesthetics containing para-aminobenzoic acid, such as chloroprocaine, may cause severe allergic reactions (142, 181). If promethazine is accidentally injected into an artery, blood flow can be blocked. Promethazine also can lower blood pressure (183).

Women should be regularly monitored before, during, and after surgery. The woman's pulse, blood pressure, and respiration must be checked every 15 minutes from the time preoperative medication is administered. During surgery vital signs should be checked every 5 minutes and, after surgery, every 15 minutes for at least one hour or longer, until they return to normal (182, 587).

Under local anesthesia women remain conscious. Thus they must be counseled thoroughly before the procedure so that they will not be frightened and will not disrupt the procedure. Also, for many women local anesthesia does not block pain completely. As many as one-half experience mild to moderate pain during surgery, particularly when the doctor moves the pelvic organs (509). The doctor has to work as gently as possible. Medical personnel, including doctors, should talk with patients during sur-

Contraindications to Female Sterilization

There are few absolute contraindications to minilaparotomy or laparoscopy. Women with current peritoneal infections should not undergo either procedure because surgery can spread the infection. In addition, peritoneal infection can cause bowel distention, increasing the risk of bowel perforation during surgery (74, 241). Women with infections should be treated and given a temporary method of contraception (587). Once the infection is cured, surgery can be performed. Women with severe chronic heart or lung disease should not undergo laparoscopy (74, 241, 316, 328, 433, 591). Both the intra-abdominal pressure from insufflation and the Trendelenburg position used in laparoscopy (the woman is tilted 30 to 40 degrees from horizontal, head down) can interfere with blood flow to the heart, causing fatal arrhythmias (irregularities in heartbeat) and congestive heart failure (316, 591).

Relative contraindications to both procedures include obesity and pelvic adhesions. Inserting a trocar and insufflation needle through the abdominal wall and making a small abdominal incision are more difficult in obese women. Manipulating the uterus and identifying the tubes also are more difficult in obese women. Nonetheless, with extra care the procedures can be performed successfully. Women who have had pelvic surgery or pelvic infections are likely to have adhesions that may partially or completely immobilize the uterus and tubes. A minilaparotomy is difficult or impossible under these circumstances, and the larger laparotomy incision may be necessary (591). Adhesions also interfere with insufflation of the abdomen during laparoscopy and increase the risk of bowel perforation (316, 591).

Some health conditions can increase the risk of complications during surgery. These include: heart disease, irregular pulse, hypertension, pelvic masses, uncontrolled diabetes, bleeding disorders, severe nutritional deficiencies, severe anemia, and umbilical or hiatal hernia (316, 328, 587). The doctor should evaluate each woman before surgery and balance the risks of sterilization against the risk of pregnancy. If the health facility is in a remote area and is not well-equipped to handle emergencies, the doctor should refer these women to a larger facility (587).
Local anesthesia is clearly preferable in the great majority of female sterilization procedures. In some circumstances, however, general anesthesia may be necessary. Women who are extremely frightened of surgery may not want to be conscious during the procedure. Women with severe pelvic adhesions and obese women also may need general anesthesia since these conditions increase operating time and require additional manipulation of pelvic organs, which can be very painful (181, 514). General anesthesia also may be advisable when a doctor is first learning sterilization procedures.

Other Methods of Local Anesthesia

In some areas other methods of local anesthesia are being used with promising results. A method called "conscious sedation" has been developed by Sylvan Shane, formerly of the Johns Hopkins University. Conscious sedation combines a local anesthetic with several drugs that cause amnesia. The following regimen is used: alphaprodine hydrochloride (Nisentil) 24 mg; hydroxyzine hydrochloride (Atarax) 50 mg; and methohexital (Brevital) one percent solution 20 mg. The alphaprodine and hydroxyzine are administered intravenously. One-and-a-half to two minutes later the methohexital is injected with a separate syringe (499). Women are conscious during the procedure and experience only mild pain. Once the procedure is over, they do not remember the pain. The effects of the drugs wear off rapidly, and some women can walk unassisted from the operating room to the recovery room (272, 498, 572). The Johns Hopkins Program for International Education in Gynecology and Obstetrics (JHPIEGO) has trained physicians who are now using this technique in Morocco and Tunisia. JHPIEGO plans to conduct training seminars in conscious sedation for doctors in Cameroon and Nigeria (552).

In China acupuncture and a local anesthetic are routinely used during female sterilizations (417). Acupuncture is a technique of inserting needles into the skin at specific places to relieve pain from surgery or disease. Doctors performing minilaparotomy in Sri Lanka also have used acupuncture along with lidocaine. Acupuncture needles were administered 30 minutes before surgery, and lidocaine was injected into the abdomen just before the operation. Among 78 women sterilized with this regimen, 62 percent required no additional anesthesia. These women were able to leave the operating table and walk into the recovery room without help. They could leave the clinic one hour after surgery. The rest of the women required diazepam and meperidine before the doctor could complete the sterilization, but only half of the usual dose was needed (154).

Training Health Workers

Training programs are needed to encourage practicing doctors to use local anesthesia and to ensure that proper regimens are followed. Despite the advantages of local anesthesia, many doctors do not use it. In the US, for example, most doctors working in hospitals perform female sterilizations with general anesthesia. Trained anesthesiologists are available, and the doctors prefer operating on women who are unconscious. Most gynecologists first learned sterilization techniques using general anesthesia, and they continue to operate in the same way (412). A different problem arose in Bangladesh, where some doctors were using such high doses of systemic sedatives with local anesthetics that women were completely unconscious (183, 208).

Training should cover all aspects of using anesthesia:

- Pharmacology of drugs used for anesthesia and their antagonists,
- Clinical use of drugs,
- Side effects of anesthetics,
- Monitoring of anesthetized women,
- Resuscitation, including use of air bag and mask to aid breathing, techniques for maintaining an open airway, external heart massage, and use of anesthesia antagonists (182).

Some doctors as well as other members of the surgical team also may need to develop their communication skills so that they can talk comfortably with the patient during sterilization.

National family planning programs should ensure that safe anesthesia techniques are practiced. If drugs and facilities are available, these programs should promote standard anesthesia regimens to be used by all doctors (587). If possible, programs should monitor all facilities. A health worker specially trained in anesthesiology should visit facilities to observe anesthesia techniques and patient monitoring and to inspect supplies and resuscitation equipment (182).

**COMPLICATIONS**

Female sterilization is a safe procedure, and few women experience complications. Major complications occur in less than 2 percent of all procedures (149). Most problems are minor, such as wound infections or slight bleeding (see Table 4), and they are resolved easily and rapidly.

Two indications of the severity of complications are prolonged hospitalization and the need for laparotomy to resolve complications. By both measures, major complications after sterilization are rare. Among 18,000 women in...
Table 4. Surgical and Postoperative Complications Within Two Weeks of Voluntary Female Sterilization, Selected Studies, 1976-1985

<table>
<thead>
<tr>
<th>Author &amp; Date (Ref. No.)</th>
<th>Place</th>
<th>Occlusion Technique</th>
<th>No. of Women</th>
<th>Major Complications per 100 Women</th>
<th>Event Rates (per 100 Women)</th>
<th>Injuries to:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total</td>
<td>Bleeding/Infection/Infection/Incision/Problem</td>
<td>Tube/Mezo-</td>
</tr>
<tr>
<td>Minilaparotomy</td>
<td>Bangladesh Fertility Research Program 1979 (59)</td>
<td>Bangladesh Ligation 25% Ring 75% Other &lt;1%</td>
<td>2,597</td>
<td>0.3</td>
<td>0.0</td>
<td>0.1</td>
</tr>
<tr>
<td>Domenzain et al. 1982 (159)</td>
<td>Mexico</td>
<td>Pomeroy 97% Ring 3%</td>
<td>800</td>
<td>0</td>
<td>0.8</td>
<td>2.1</td>
</tr>
<tr>
<td>Mumford et al. 1980 (376)</td>
<td>23 countries</td>
<td>Pomeroy</td>
<td>4,965</td>
<td>NA</td>
<td>0.9</td>
<td>NA</td>
</tr>
<tr>
<td>World Health Organization 1982 (377)</td>
<td>10 countries</td>
<td>Modified Pomeroy</td>
<td>791</td>
<td>1.8</td>
<td>4.2</td>
<td>2.3</td>
</tr>
<tr>
<td>Laparotomy</td>
<td>Bhatt et al. 1978 (55)</td>
<td>India</td>
<td>Modified Pomeroy</td>
<td>1,960</td>
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<td>NA</td>
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<td>Bhatt et al. 1983 (53), Indian Council of Medical Research 1982 (252)</td>
<td>India</td>
<td>Ligation</td>
<td>27,695</td>
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<td>0.2</td>
</tr>
<tr>
<td>Laparoscopy</td>
<td>Baggish et al. 1979 (32)</td>
<td>US</td>
<td>Electrocoagulation Ring</td>
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</tr>
<tr>
<td></td>
<td>Bhathena et al. 1985 (49)</td>
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<td>Electrocoagulation Ring</td>
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<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Bhatt 1980 (51)</td>
<td>India</td>
<td>Ring</td>
<td>5,287</td>
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<td>0.6</td>
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<td>Electrocoagulation Ring</td>
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<tr>
<td></td>
<td>Brenner et al. 1976 (71)</td>
<td>US</td>
<td>Electrocoagulation Prototype spring clip Rocket clip</td>
<td>8,777</td>
<td>0.5</td>
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<td>Chamberlain &amp; Brown 1978 (93)</td>
<td>UK</td>
<td>Electrocoagulation Ring</td>
<td>29,661</td>
<td>3.1</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>Cole et al. 1979 (122)</td>
<td>6 Latin American countries</td>
<td>Electrocoagulation Prototype spring clip Ring</td>
<td>5,877</td>
<td>NA</td>
<td>3.7</td>
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<tr>
<td></td>
<td>Cunanan et al. 1980 (139)</td>
<td>US</td>
<td>Electrocoagulation</td>
<td>4,992</td>
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<td>0.1</td>
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Table 4 (Continued)

<table>
<thead>
<tr>
<th>Author &amp; Date (Ref. No.)</th>
<th>Place</th>
<th>Occulsion Technique</th>
<th>No. of Women</th>
<th>Major Complications per 100 Women</th>
<th>Event Rates (per 100 Women)</th>
<th>Injuries to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hulka et al. 1976 (245)</td>
<td>El Salvador, UK, India, Singapore, Thailand, US</td>
<td>Prototype spring clip</td>
<td>1,079</td>
<td>0.1*</td>
<td>0.1*</td>
<td>NA NA 0.4 0 0</td>
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<tr>
<td>Lee &amp; Hagen 1984 (310)</td>
<td>US</td>
<td>Electrocoagulation</td>
<td>1,092*</td>
<td>NA</td>
<td>1.2*</td>
<td>NA 0 0 0.1</td>
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<tr>
<td>Mumford &amp; Bhiwandiwala</td>
<td>23 countries</td>
<td>Ring</td>
<td>6,976</td>
<td>0.2*</td>
<td>0.2*</td>
<td>NA 1.8 0.9 0.3 0.1</td>
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<td>Poliakoff et al. 1978</td>
<td>US</td>
<td>Ring</td>
<td>1,976*</td>
<td>0.1*</td>
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<td>Unipolar electrocoagulation</td>
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<td>Bipolar electrocoagulation</td>
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<td></td>
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<td>Ring</td>
<td>92,099</td>
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<td>Electrocoagulation</td>
<td>819</td>
<td>0.9*</td>
<td>2.0</td>
<td>2.8 2.4 NA 0 0.4</td>
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<td>World Health Organization</td>
<td>10 countries</td>
<td></td>
<td></td>
<td></td>
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<td>1982 (597)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

0.0 = < 0.05
0 = no cases
NA = not available
*Complications reported in this column also are reported in the columns to the right.
*Includes all incision problems except bleeding, including extensive incision, herniation, infection or abscess, local phlebitis, discharge, wound gaping, and unspecified
*Includes bowel injuries
*Women requiring additional hospitalization
*Reported as serious or major by investigators
*Includes hematomas
*Women are counted twice if complication occurred both during surgery and postoperatively
*Women requiring laparotomy
*Includes 1,004 who had open laparoscopy
*Only mesosalpingeal bleeding rate reported
*Calculated by Population Information Program
*66.1% had open laparoscopy
*Includes hemorrhagic shock

24 countries, only 64 women, or 0.3 percent, had complications requiring hospitalization of three or more nights after surgery (117). The need for laparotomy to resolve complications also is rare. Rates range from 0.02 to 1.2 percent in large studies (32, 93, 117, 139, 149, 245, 430, 600). Delayed complications that require readmission to the hospital occur after less than one percent of procedures (109, 149).

**Minilaparotomy and Laparoscopy**

Minilaparotomy and laparoscopy seem to have similar complication rates, although comparisons between studies are difficult because of different definitions, lengths of follow-up, and levels of surgical expertise. Small randomized studies comparing the two approaches generally report that minilaparotomy has a somewhat higher rate of minor complications as well as a longer average operating time, a slightly longer postoperative convalescence, and more postoperative pain (314, 357, 373, 597). In a WHO comparative trial, for example, about 12 percent of the women sterilized by minilaparotomy experienced minor complications compared with 7 percent of the women sterilized by laparoscopy (597). In contrast, two large, non-randomized studies of data from Family Health International (FHI) cooperating centers found that minilaparotomy with Pomeroy ligation had half as many complications as laparoscopy with electrocoagulation or rings (375, 376). Under difficult operating conditions—particularly in rural areas with doctors who have received little training in
laparoscopy—very high complication rates have been reported for laparoscopy (53, 97).

Most minilaparotomy complications are not serious (163, 341, 558). They include minor wound infections, slight blood loss, and perforations of the uterus by the instrument used to move the uterus. Because the minilaparotomy incision is made directly above the bladder, doctors sometimes perforate the bladder. This complication is usually recognized immediately and can be easily repaired during surgery (163, 558).

Laparoscopy can cause certain complications that do not occur with minilaparotomy. Insufflation of the abdomen can lead to gas embolism, subcutaneous emphysema (dissention of tissues by gas or air), or cardiac arrest. These events are rare, occurring in less than one-tenth of one percent of procedures (139, 328). Lacerations of blood vessels or abdominal organs can occur when the insufflation needle or the trocar is inserted blindly into the abdomen. These events also are rare and can be almost eliminated if the doctor inserts instruments carefully (132).

Open laparoscopy was developed to avoid these complications, but to date studies on open laparoscopy have been too small to determine whether it is safer than standard laparoscopy. In open laparoscopy the doctor inserts the laparoscope under direct vision. Theoretically, the risk of blood vessel and bowel lacerations should be eliminated. An FHI study comparing open and closed laparoscopy in about 1,400 women found similar rates of complications, surgical difficulties, and technical failures with the two approaches (62), as did a study in Pakistan involving 620 women (338).

Among the different mechanical and electrical techniques of tubal occlusion used with laparoscopy, complication rates are similar, according to most reports. In four large studies complication rates ranged from one to three percent for all techniques (58, 71, 122, 342). A UK survey of over 29,000 laparoscopies reported a complication rate for the ring of 4.3 percent, slightly higher than the rates of 3.1 percent for electrocoagulation and 3.0 percent for clips (93).

Transsection (severing) or tearing of the tubes occurs in one to five percent of ring sterilizations (32, 43, 71, 90, 144, 226, 297, 349, 356, 380, 409, 430, 606). These injuries are more likely when: (1) the tubes are drawn into the applicator too quickly; (2) tubes are thickened by pregnancy or infection; (3) the ring is placed on the tube close to the uterus; or (4) the tube is immobilized by adhesions (90, 226, 316, 604, 606). Most tubal tears can be managed by applying a second ring to the tube to stop bleeding or by cauterying the torn end (606).

Unipolar coagulation carries a small risk of burns to the abdominal organs, particularly the small bowel. These burns are reported in only 0.05 to 0.3 percent of procedures (32, 93, 97, 139, 316, 328, 340, 532). A recent study suggests, however, that some of these reported burns may actually have been traumatic injuries that occurred when the trocar was inserted into the abdomen (317). Bowel burns and lacerations are particularly dangerous because up to two-thirds are not recognized at the time of surgery (139, 341, 532). Pain and other symptoms may not occur for several days or longer (328, 340, 422). If untreated, bowel burns sometimes cause serious bleeding or peritoneal infection. Laparotomy and bowel resection are usually necessary (316).

Burns occur during unipolar laparoscopy in several ways. The doctor may accidentally touch the bowel with the coagulation forceps. Also, it is possible that sparks jump from the forceps to other organs, although this has not been proved (147). Skin burns can occur if contact between the ground plate and the woman is inadequate (328, 422). These burns can be eliminated by using a unipolar generator with an output of less than 100 watts and 600 peak volts and using metal trocar sleeves (157, 505, 506). Bipolar electrocoagulation, which does not make the woman part of the electric circuit, is much less likely to cause burns (139, 242, 316, 422, 459).

Pain

Some discomfort is common after surgery. Women undergoing laparoscopy may feel chest and shoulder pain for one to two days because of insufflation of the abdomen and trapped gas afterwards. Lower abdominal pain is also common. The minilaparotomy incision causes moderate discomfort in up to 40 percent of women (18, 55, 597). Standard pain relievers such as aspirin usually ease the discomfort.

Among tubal occlusion techniques, the ring appears to cause more postoperative pain than the others. In FHI's randomized trials, 29 to 51 percent of the women sterilized by rings reported moderate to severe pain after surgery, compared with 14 to 18 percent of women sterilized by electrocoagulation and 24 to 29 percent sterilized by clips (104). Short-term pain may occur with rings because the ring shuts off the blood supply to a loop of tube but nerve endings in the tube do not die for several days (226, 410, 604). Applying lidocaine to the tubes during ring sterilization reduces pain temporarily (288, 410). If the woman is given the prostaglandin inhibitor indomethacin before the procedure, postoperative pain may be less (73).

Risk Factors

The risk of complications depends not only on the type of procedure, but also on the experience of the doctor and the characteristics of the woman. Adequate training, surgical skill, and continuous practice are important, particularly in laparoscopy (53, 361, 469, 517). For example, the
1975 survey of the American Association of Gynecologic Laparoscopists found that the complication rate for doctors performing between one and 20 laparoscopic sterilizations per year was almost one per 100 cases. Doctors performing over 100 procedures per year reported only 0.5 complications per 100 cases (424). Certain women may be at higher risk of complications than others. In a US study of 3,500 women, those who had undergone previous abdominal or pelvic surgery were almost four times as likely to develop complications requiring laparotomy as women who had not. Other risk factors were a history of diabetes mellitus; lung disease such as asthma, bronchitis, or emphysema; and obesity (149).

**Mortality**

Female sterilization causes very few deaths. Most recent large surveys around the world report 3 to 19 deaths per 100,000 procedures. Three studies report higher mortality rates—over 70 per 100,000 procedures (see Table 5). Many of these deaths could have been prevented by proper use of local anesthesia and careful aseptic techniques during surgery.

### Table 5. Mortality Attributed to Voluntary Female Sterilization, Selected Studies, 1975-1984

<table>
<thead>
<tr>
<th>Author &amp; Date (Ref. No.)</th>
<th>Place</th>
<th>Source of Data</th>
<th>Sterilization Method</th>
<th>Date</th>
<th>No. of Procedures</th>
<th>No. of Deaths</th>
<th>Deaths per 100,000 Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aubert et al. 1980 (27)</td>
<td>Over 150 centers in 60 developing countries</td>
<td>International Project/Association for Voluntary Surgical Contraception reporting system</td>
<td>All methods</td>
<td>1973–79</td>
<td>255,812</td>
<td>19*</td>
<td>7</td>
</tr>
<tr>
<td>Bangladesh 1984 (35)</td>
<td>Bangladesh</td>
<td>National reporting system</td>
<td>NA</td>
<td>1979</td>
<td>135,791</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>Chamberlain &amp; Brown 1978 (93)</td>
<td>UK</td>
<td>Prospective survey of hospitals</td>
<td>Laparoscopy</td>
<td>1976–77</td>
<td>29,661</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Chaturachinda 1980 (97)</td>
<td>34 centers in rural Thailand</td>
<td>Center reports and survey of doctors</td>
<td>Laparoscopy</td>
<td>6/74–12/77</td>
<td>5,632</td>
<td>4</td>
<td>71</td>
</tr>
<tr>
<td>Indian Council of Medical Research 1982 (252)</td>
<td>India</td>
<td>Prospective survey of 13 teaching hospitals</td>
<td>All methods</td>
<td>9/76–6/78</td>
<td>32,177</td>
<td>23*</td>
<td>72</td>
</tr>
<tr>
<td>Peterson et al. 1982 (418)</td>
<td>US</td>
<td>National discharge survey and hospital records review</td>
<td>Laparoscopy</td>
<td>1977–78</td>
<td>414,513*</td>
<td>15*</td>
<td>4</td>
</tr>
<tr>
<td>Phillips et al. 1978 (427)</td>
<td>US</td>
<td>Retrospective survey of 964 members of the American Association of Gynecological Laparoscopists (AAGL)</td>
<td>Laparoscopy</td>
<td>1976</td>
<td>77,103</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Phillips et al. 1977 (426)</td>
<td>US</td>
<td>Retrospective survey of 4,354 AAGL members</td>
<td>Laparoscopy</td>
<td>1975</td>
<td>201,565</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Rosenberg et al. 1982* (469)</td>
<td>Bangladesh</td>
<td>Follow-up of women sterilized in 41 centers</td>
<td>Minilaparotomy</td>
<td>1980</td>
<td>5,042</td>
<td>5</td>
<td>99</td>
</tr>
<tr>
<td>Ross et al. 1984 (472)</td>
<td>Over 150 centers in developing countries</td>
<td>Association for Voluntary Sterilization reporting system</td>
<td>All methods</td>
<td>1973–83</td>
<td>705,418</td>
<td>38</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Minilaparotomy</td>
<td></td>
<td>340,024</td>
<td>23</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Laparoscopy</td>
<td></td>
<td>281,498</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Other</td>
<td></td>
<td>99,537</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

NA = not available

*Sterilization method not reported for 4 deaths

*May include deaths reported in other entries of this table concerning Bangladesh

*Includes 11 deaths of women who had undergone cesarean sections and were already seriously ill

*Includes only sterilizations performed without concurrent abortion, cesarean section, or nongynecologic procedure

*Nine deaths attributed to sterilization from 36 verified hospital records of deaths plus an estimated six deaths among 25 unverified hospital records of deaths
The three major causes of death are anesthesia overdose, infection, and hemorrhage. In various studies the proportion of deaths related to anesthesia ranges from 20 to 80 percent. In most of these cases doses were too high or too frequent. Rarely, a woman will experience a fatal allergic reaction to the anesthetics even in appropriate doses (419).

Infection, particularly tetanus infection, accounts for 10 to 50 percent of deaths. Tetanus has been a problem in Asia after both female sterilization and, to a lesser extent, vasectomy (208, 209, 443, 522). Injuries to the bowel often lead to peritonitis, an infection of the abdominal cavity. Bowel injuries are caused mainly by electric burns or by lacerations during surgery (27, 91, 97, 419).

The third major cause of death, excessive bleeding, accounts for 6 to 25 percent of deaths. The most common reason for fatal hemorrhage is perforation of a major blood vessel, which can occur during laparoscopy when the insufflation needle or the trocar is inserted (419, 420). Also, tying sutures on the tubes too loosely can allow continuous slow bleeding that can be fatal (209).

How can sterilization deaths be prevented? The use of appropriate doses of local anesthesia and light sedation will prevent most anesthesia-related deaths. The importance of better anesthesia techniques has been demonstrated in Bangladesh. A new anesthesia regimen, involving greater use of local anesthesia, lower doses of narcotic agents, and better patient monitoring, was adopted in 1983 (35). Anesthesia-related deaths dropped from 2.3 per 100,000 procedures in 1982 to 0.7 per 100,000 in 1983 (35).

Scrupulous use of sterile technique can prevent many deaths from infection. Proper equipment for sterilizing instruments and sterile drapes and towels for each patient can reduce the spread of infection. Except for laparoscopes (see box, p. C-154), instruments and surgical linens should be sterilized in an autoclave. The Sterilization Surveillance Team in Bangladesh suggests refresher courses in aseptic techniques for all practicing doctors and recommends more emphasis in medical school on asepsis (35). Tetanus immunizations should be given whenever possible (206, 522). Three inoculations are necessary for complete protection, however, and tetanus toxoid is expensive and requires refrigeration. Thus tetanus immunization is not always possible.

Mortality rates after sterilization are far lower than after childbirth. Maternal mortality in 1977 is estimated to have ranged from 11 deaths per 100,000 live births in North America to over 500 in Asia. The average in developing countries is estimated at about 400 deaths per 100,000 (462). Death rates may be considerably higher in rural areas (see Population Reports, Healthier Mothers and Children Through Family Planning, 1-27, May-June 1984). By contrast, death rates for female sterilization range from 2.5 to 99 per 100,000 procedures. Moreover, sterilization presents a one-time risk, whereas women otherwise may face the risks of childbirth repeatedly.

Particularly in countries with high maternal mortality rates, female sterilization offers a significant health benefit. David Grimes and colleagues compared the mortality rate from female sterilization in Bangladesh in 1979 and 1980—19 deaths per 100,000 procedures—with the maternal mortality rate—570 deaths per 100,000 live births. They estimated that for every 100,000 female sterilization procedures, more than 1,000 maternal deaths were prevented (206).

**POSTPARTUM STERILIZATION**

Postpartum sterilization is safe and convenient. While the physiological changes that occur with pregnancy may lead to slightly higher surgical complication and failure rates, risks are still very slight. For postpartum sterilization mini-laparotomy with tubal ligation is safest, and laparoscopy is not recommended.

Postpartum sterilization is common. For example, in the US in 1980 almost half of all female sterilizations were postpartum (368). In four Latin American countries the World Fertility Survey found that 49 to 71 percent of all sterilized women underwent postpartum procedures (344).

Postpartum sterilization offers a number of advantages. For many women childbirth is their major contact with health services and thus their best opportunity to obtain sterilization. Furthermore, after delivery many women are highly motivated to avoid having more children. The woman faces only one hospitalization and, when sterilization is performed shortly after delivery, only one exposure to anesthesia. Also, costs are lower (101, 285, 461, 593, 591).

The disadvantages are that physiologic changes in the pelvis during pregnancy make the sterilization procedure slightly more difficult, increasing somewhat the risk of complications, errors, technical failures (inability to com-
were similar—7.7 and 6.1 percent (55). A smaller study in medical records review involving almost 22,000 women during the postpartum period as at other times. In an FHI sterilized by laparoscopy, the rate of hospital readmission was 2.4 percent compared with 1.6 percent for interval sterilization and 0.6 per 100 for postabortion sterilization. 

Complications

Minilaparotomy is the safest sterilization method in the postpartum period—nearly as safe as interval sterilization (sterilization performed at least six weeks after childbirth or abortion). Among 2,000 women sterilized by minilaparotomy in Indian sterilization camps in the 1970s, the surgical complication rate for postpartum sterilization was 2.4 percent compared with 1.6 percent for interval sterilization. Rates of early postoperative complications also were similar—7.7 and 6.1 percent (55). A smaller study in Bangladesh also reported a low rate of surgical complications—1.3 percent for postpartum and postabortion sterilizations and 0.4 percent for interval sterilizations (39).

In contrast, laparoscopy does not appear to be as safe during the postpartum period as at other times. In an FHI medical records review involving almost 22,000 women sterilized by laparoscopy, the rate of hospital readmission for complications was 0.5 per 100 for postpartum sterilization and 0.6 per 100 for postabortion sterilization compared with 0.1 per 100 for interval sterilization (109, 122). In six Latin American countries surgical complications with laparoscopy occurred in 4.9 percent of women sterilized postpartum compared with 2.5 percent after interval sterilization—a statistically significant difference (122). In an Indian study of laparoscopic sterilization, injuries to the uterus were twice as common postpartum as in postabortion or in interval sterilizations (53). Some smaller studies have found no differences, however (55, 138, 234, 273, 294, 375).

Effectiveness

Postpartum or postabortion sterilization appears to be somewhat less effective than interval sterilization (115, 240, 375), although some studies report no difference (58, 114, 139, 212, 527, 591) (see Table 3). One of the largest comparative studies involved 9,400 women in 33 centers worldwide. Among women sterilized with electrocoagulation or rings, the rate of pregnancies per 100 women was 0.4 after interval sterilizations, 0.8 after postabortion sterilizations, and 1.4 after postpartum sterilizations (115).

Counseling

While postpartum sterilization is convenient, it is not advisable for all women. Childbirth and abortion are stressful. Some women may later regret decisions if they are made at these times (see p. C-159). Whenever possible, women should receive counseling during pregnancy and make their decisions before delivery. Doctors and other health workers should routinely discuss postpartum contraception during prenatal visits (4, 587, 591). Women who have not spoken to health workers before delivery should receive counseling before undergoing sterilization. In all circumstances women must not be made to feel pressured into making quick decisions. Health workers must also reassure clients that, if they do not choose sterilization, other health services will not be withheld (461).

LONG-TERM SIDE EFFECTS

Voluntary female sterilization does not cause adverse long-term side effects, according to most recent research. After sterilization, women do not seem to face any greater risk of gynecological problems or to require more pelvic surgery. Satisfaction with the operation is high, and few women experience psychological problems later. Studies observing women's menstrual patterns for up to two years after the procedure find that, if there is any consistent change, it is on average a positive one—an increase in menstrual regularity. Women with irregular cycles before sterilization, however, are likely to continue to have irregular cycles after sterilization. Also, women who used oral contraceptives (OCs) or IUDs before sterilization will see menstrual changes because they discontinued those methods.

For at least two decades there has been debate over the long-term effects, if any, of female sterilization. Some researchers have suggested that a wide range of symptoms, such as abnormal menstrual bleeding, abdominal and pelvic pain, various gynecological complaints, and even weight gain and benign breast disease, may develop in about 15 percent of women after sterilization (163, 239,
331,337,374,382,385,434,457,479,551,574). Some have called this "post tubal ligation syndrome." Others consider it a "medical myth" (131, 421, 477).

To explain how sterilization could theoretically cause later problems, some clinicians hypothesize that damage to the fallopian tubes disturbs blood supply to the ovaries, causing changes in hormone production or diffusion that in turn cause these problems (12, 94, 161, 239, 360, 441, 442). Evidence is contradictory, however. Some studies have found significantly lower levels of serum progesterone (161, 218, 335, 441, 442), serum estradiol, and luteinizing hormone in sterilized women than in control groups of unsterilized women (12, 89). Others have not (12, 134, 335, 351, 442). None of these studies examined hormone levels in the same women before and after sterilization (421). Most did not involve control groups matched for age or parity—factors related to ovarian function (239).

Menstrual Patterns

Studies in over 25 developed and developing countries, involving almost 17,000 women, report that 50 to 90 percent experience no change in any aspect of menstruation in the first two years after surgery. Among the women who do see differences after surgery, about half observe increased menstrual problems, such as irregular cycles or more bleeding, and about half observe improvements (59, 60, 61, 94, 123, 150, 187, 192, 293, 305, 438). This suggests that many changes represent normal random variation in the menstrual cycle and are not related to sterilization.

This reassuring evidence comes from large prospective studies controlling for factors known to affect menstrual patterns, such as age, prior contraceptive use, prior menstrual patterns, and medical history. In the multicenter US Collaborative Review of Sterilization (CREST) study conducted by the Centers for Disease Control, most of the 2,500 women reported no marked change after sterilization in any of the six characteristics of the menstrual cycle. For example, only 10 percent of the women reported a change of three or more days in the duration of bleeding. Just over half of these women noted a decrease in the number of days, and just under half reported an increase. A total of 39 percent reported changes in the amount of menstrual bleeding, but the changes were almost equally divided between more bleeding and less (150).

A World Health Organization (WHO) study of 142 women that actually measured menstrual blood loss by a standard procedure (389) found no change on average for sterilized women or controls. The sterilized women were followed for two months before and for up to two years after the procedure, and controls were followed for a comparable time (575, 595).

Changes in menstrual patterns after sterilization may benefit some women. In the CREST study, for example, 15 percent reported irregular cycles before sterilization compared with only 7.8 percent two years later. Overall, more than 50 percent of women with irregular cycles showed an improvement by two years after sterilization (150). Studies sponsored by Family Health International (FHI) yielded similar results—a shift toward less pain, more regular cycles, and less bleeding (187).

Many reported changes in menstrual patterns after sterilization are actually caused by discontinuing OCs or IUDs (293, 319, 476, 477, 520). While using OCs, women have shorter, more regular menstrual periods (289). While using IUDs, they have longer, less regular periods (323). Thus, after sterilization, former OC users report more irregular cycles and increases in cycle length, duration, and amount of menstrual flow. Former IUD users report more regular cycles and decreases in menstrual flow, intermenstrual spotting, and pain. Most of these changes occur in the first six months after sterilization as women's cycles revert to their previous patterns (60). Women using OCs and IUDs should be counseled in advance about these changes.

La operación no afecta su salud. Los óvulos, que se siguen produciendo, los absorbe el cuerpo sin causar ninguna molestia. Esta operación no cambia su regla o menstruación, está segura como antes... La seguridad de no quedarse embarazada, permitirá que usted y su pareja puedan disfrutar más su vida sexual. A Mexican booklet that explains vasectomy and female sterilization answers people's common questions: "The operation does not affect her health" (top); "This operation does not change her menses" (middle); "Knowing that you won't get pregnant will let you and your partner enjoy your sexual life more" (bottom).
Two prospective studies following sterilized women for four or more years suggest that some may eventually experience menstrual problems, but results are inconclusive. In the Oxford University/Family Planning Association (Oxford/FPA) study, which followed women for six years after sterilization, rates of hospital admissions and of referrals for menstrual disorders were slightly but not significantly higher for the sterilized women than for controls (550). In the US Walnut Creek Contraceptive Drug Study, sterilized women were compared with wives of vasectomized men. Four to seven years after surgery sterilized women were slightly more likely to have irregular cycles, "adverse bleeding," and menstrual cramps (148). As in other studies (123,150,187), women with menstrual problems before sterilization were more likely to experience problems after surgery (148).

No one sterilization technique in particular appears to affect menstrual function (59,60,123,150,170,293,305). In several studies, electrocoagulation, particularly unipolar electrocoagulation, which damages more tubal tissue than other techniques, appeared to cause more menstrual problems later or more pain than other techniques (150,454,550). Randomized clinical trials in five countries as well as several nonrandomized studies do not bear this out, however (59,60,187,293,305).

**Later Gynecological Problems**

Several early studies suggested that, after sterilization, women were prone to a variety of gynecological problems leading to a high rate of hospitalization and surgery, including hysterectomy. A few researchers even have recommended that women undergo hysterectomy rather than tubal occlusion to avoid having a second surgical procedure (374,545,574). Recent large, well-controlled prospective studies suggest, however, that sterilization does not cause any such long-term side effects.

In one of the largest prospective studies to date, the Oxford/FPA study, there were no significant differences after six years between 2,243 sterilized and 3,551 unsterilized women in rates of hospital referral for uterine prolapse, menstrual disorders, pelvic inflammatory disease (PID), cervicitis or cervical erosion, hysterectomy, or dilation and curettage. Hysterectomy was infrequent in both groups—5 per 100 sterilized women and 4.3 per 100 controls (550). Studies that have reported excessively high rates of hysterectomy and of gynecological problems among sterilized women often did not control for pre-existing health problems (128,313,374,382,431,454,490,530). These problems are the major reasons for surgery. A 2-year follow-up of 8,100 sterilized women, for example, found that only 26 had undergone hysterectomy within two years after sterilization, and 16 of these had cervical dysplasia, cancer, fibroids, or ovarian tumors—conditions that probably developed before sterilization (105). Rates of hysterectomy may sometimes be higher for sterilized women because they may be more willing to undergo hysterectomy and doctors may be more willing to recommend it to them.

**Psychological Adjustment**

Sterilized women are no more likely to experience severe psychiatric problems than unsterilized women (33,64,550) or women in the general population (127,129,504). In the...
have had psychological problems before sterilization are much more likely to be unhappy afterwards (34, 64, 129, 158).

It is not clear whether women are particularly likely to regret sterilization performed after childbirth or abortion. Some researchers find regret or mild mental illness more common after postpartum or postabortion sterilization than after interval sterilization (34, 40, 46, 64, 66, 57, 308, 377, 601). Others find no difference (19, 592). Women sterilized after childbirth may regret the operation if the child dies. In developing countries infant or child death is the most common reason for requesting sterilization reversal (19, 405).

While concern has been raised that some women will suffer marital discord and sexual dysfunction after sterilization (15, 173, 283), most women in both developed and developing countries report either no change or an improvement in their marriages. The percentage of women experiencing sexual or marital problems such as loss of libido or reduced frequency of intercourse varies widely, ranging from less than 5 percent to 20 percent in various cultures (37, 601).

Some researchers (19, 59, 173, 283) find regret or mild mental illness more common after postpartum or postabortion sterilization than after interval sterilization (34, 40, 46, 64, 66, 57, 308, 377, 601). Others find no difference (19, 592). Women sterilized after childbirth may regret the operation if the child dies. In developing countries infant or child death is the most common reason for requesting sterilization reversal (19, 405).

Researchers have been working for many years to develop techniques of female sterilization that do not involve surgery. A satisfactory nonsurgical technique could eliminate some risks, leave no scar, and reassure women who are afraid of surgery. Several techniques have been tested, including liquid chemicals that solidify or that scar the

**Factors Affecting Success**

The longer the section of undamaged tube remaining after sterilization, the more likely that reversal surgery will succeed (169, 224, 315, 450, 464, 503). In one study, for example, 12 women with more than 5 cm of tube remaining conceived after reversal surgery compared with 18 percent of 24 women with less than 3 cm (503). Most surgeons will not operate if there is less than 3 cm of viable tube remains (169, 414).

Because clips and rings damage the smallest length of tube, these occlusion techniques are most easily reversed. In fact, a few studies have reported over 80 percent success in reversing clip or ring procedures (179, 246, 404). Tubal ligations using the Pomeroy, Irving, or Uchida techniques are somewhat more difficult to reverse. Pregnancy rates of 45 to 70 percent have been reported (130, 190, 211, 404, 489, 579) (see Table 6).

Unipolar electrocoagulation, which usually causes extensive tubal damage and multiple adhesions, is the most difficult to reverse (201, 211, 243, 404, 455, 559). In recent reports pregnancy rates have ranged from 25 to 68 percent (224, 404, 464, 489, 579) (see Table 6), but only women with minimal tubal damage ever undergo surgery (489, 529). After reversal surgery, women sterilized by electrocoagulation often have a higher ectopic pregnancy rate than women sterilized by other methods (329, 489). In recent studies the ectopic pregnancy rate after reversal of electrocoagulation averaged 5 percent compared with 2 percent or less for other methods (see Table 6).

The site of occlusion also affects pregnancy rates. Occlusions in the isthmus are easiest to reconnect (243, 404, 455). The cut ends of the tube are of approximately the same diameter, and there are fewer folds in the mucosa (tissue lining the tubes) than there are in the ampulla, closer to the ovary (455).

Age and time since sterilization also are considered in screening women for reversal procedures. Some physicians will not attempt reversal surgery on women over age 35 or 40 because fertility declines with age, and the risk of complications during pregnancy increases. Apart from age, the chances for successful reversal may decline with the passage of time, possibly because of gradual changes in the tubal mucosa, including loss of folds, loss of cilia, and growth of polyps (546, 577).

Reversal procedures are best performed in well-equipped regional centers where an experienced surgical team maintains its skills by operating frequently (52, 577). Surgeons trained in microsurgical techniques at the Johns Hopkins University have now established centers in 25 developing countries. These centers maintain data registries to evaluate results of reversal surgery (225, 463, 465, 466). Training is now offered also in Egypt, Thailand, and several countries in Latin America (86).
tubes. The reversibility of these new methods has not been tested. Because they cause extensive tubal damage, they may be less reversible than surgical sterilization.

**Chemical Compounds**

To date, the most promising chemical compounds tested for female sterilization are:

- phenol compounds,
- quinacrine,
- methyl-cyanoacrylate (MCA).

The chemicals are delivered to the fallopian tubes through a cannula or tube inserted through the cervix and uterine cavity. In liquid, paste, or solid form, the chemicals are pushed into the tubes by a pushrod or by a specially designed pump. The chemicals damage the lining of the tube, causing the growth of scar tissue, which blocks the tubal opening. Up to three applications are usually necessary, however, before the tubes are completely blocked, and women must use another method of contraception for several months until the procedure is complete.

**Phenol (carbolic acid) compounds** are employed in the only nonsurgical techniques in actual use. In China two compounds have been tested—phenol-atabrine paste (PAP) and a phenol mucilage. PAP consists of equal parts of phenol and atabrine (quinacrine hydrochloride) plus a radiopaque substance. In a 2-year study of almost 10,000 women in the Shanghai area, PAP blocked both tubes in 98 percent (610).

The second phenol preparation—a mucilage that does not contain atabrine—works similarly but contains thickening agents to make the substance more adhesive and thus prolong contact with the tubal lining (612). In the latest Chinese series reported, almost 98 percent of 448 women treated with this mucilage had both tubes blocked (98, 286, 612). Pregnancy rates have not yet been reported.

Between 1975 and June 1983 the phenol mucilage technique was used in an estimated 50,000 to 100,000 sterilizations in China (598). Two hundred medical units offered the procedure in 1983 (598), and training programs are underway all over China (202, 286, 610). Phenol compounds are rarely used outside of China.

**Quinacrine**, a sclerosing (hardening and thickening) agent that rapidly damages the tissues of the tubal lining, is administered in pellets. Research is underway to try to reduce the number of quinacrine applications needed from three to one (199, 213, 278, 279, 303, 568, 615).

In several small studies one-year pregnancy rates after three applications of quinacrine ranged from 1.2 to 3.1 per

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### Table 6. Pregnancy Outcomes Following Reversal, Using Magnification or Microsurgery, of Various Techniques of Female Sterilization, Selected Studies, 1980-1984

<table>
<thead>
<tr>
<th>Author &amp; Date (Ref. No.)</th>
<th>Place</th>
<th>% of Women Experiencing:</th>
<th>Term Pregnancy</th>
<th>Spontaneous Abortion</th>
<th>Ectopic Pregnancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reversal of Sterilization by Spring-Loaded Clip</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noble &amp; Letchworth 1982 (246)</td>
<td>UK</td>
<td>12</td>
<td>75%</td>
<td>NA</td>
<td>0</td>
</tr>
<tr>
<td>Owen 1984 (404)</td>
<td>Australia</td>
<td>24</td>
<td>96%</td>
<td>NA</td>
<td>4</td>
</tr>
<tr>
<td>Wheless 1982 (246)</td>
<td>UK</td>
<td>12</td>
<td>83%</td>
<td>NA</td>
<td>0</td>
</tr>
<tr>
<td>Winston 1982 (246)</td>
<td>UK</td>
<td>15</td>
<td>100%</td>
<td>NA</td>
<td>0</td>
</tr>
<tr>
<td>Others* 1982 (246, 464)</td>
<td>TOTAL</td>
<td>89</td>
<td>88%</td>
<td>NA</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Reversal of Sterilization by Giffie Clip</td>
<td>Filshie 1984 (179)</td>
<td>UK</td>
<td>15</td>
<td>93%</td>
</tr>
<tr>
<td>Reversal of Sterilization by Ring</td>
<td>Owen 1984 (404)</td>
<td>Australia</td>
<td>37</td>
<td>95%</td>
<td>NA</td>
</tr>
<tr>
<td>Rock et al. 1982 (464)</td>
<td>US</td>
<td>22</td>
<td>77%</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Rock et al. 1984 (466)</td>
<td>Indonesia, South Korea, Thailand</td>
<td>25</td>
<td>56%</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Others* 1983 (489, 579)</td>
<td>TOTAL</td>
<td>93</td>
<td>75%</td>
<td>NA</td>
<td>2</td>
</tr>
<tr>
<td>Reversal of Sterilization by Pomeroy Ligation</td>
<td>Owen 1984 (404)</td>
<td>Australia</td>
<td>120</td>
<td>70%</td>
<td>NA</td>
</tr>
</tbody>
</table>

Note: For earlier studies, see Population Reports, C-8, Reversing Female Sterilization, September 1980.
NA—not available

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*Includes all intrauterine pregnancies
*Combines data from reports of fewer than 10 cases each
*Includes stillbirth
Although repeated applications of silicone may be required (126, 233, 326, 327, 447, 448, 449). The pregnancy rate is less than one percent (603). There have been few complications (326, 447). A small number of women who want sterilization can obtain it. In surveys conducted in Guatemala, Panama, and 10 states of Brazil since 1978, 44 to 72 percent of women who were not sterilized or subject to the procedure were on female sterilization for family planning. Yet officials estimate that, because of the shortage of facilities, only half of the women who want sterilizations can obtain it. (World Bank)

**Program Issues**

Many women want voluntary sterilization. While about 95 million women currently of reproductive age have obtained sterilizations, many others have been unable to obtain procedures because personnel and facilities are in short supply. Thus a major issue facing family planning programs is meeting the demand for voluntary sterilization with services of the highest quality.

**Unmet Demand**

The fact that female sterilization is the most widely used method of family planning (see pp. C-127-130) indicates the worldwide demand for the procedure. Evidence suggests, however, that many women who want sterilization have not been able to obtain it. In surveys conducted in Guatemala, Panama, and 10 states of Brazil since 1978, 44 to 72 percent of women who were not sterilized or subject to the procedure were on female sterilization for family planning. Yet officials estimate that, because of the shortage of facilities, only half of the women who want sterilizations can obtain it. (World Bank)
in voluntary sterilization, regardless of whether they were using another contraceptive method at the time (365). The percentages of interested women are listed below:

<table>
<thead>
<tr>
<th>Country</th>
<th>Year (Ref. No.)</th>
<th>Duration</th>
<th>Procedure</th>
<th>Number of Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guatemala 1983</td>
<td></td>
<td></td>
<td></td>
<td>61</td>
</tr>
<tr>
<td>Panama 1979</td>
<td></td>
<td></td>
<td></td>
<td>72</td>
</tr>
<tr>
<td>Brazil</td>
<td></td>
<td></td>
<td></td>
<td>59</td>
</tr>
<tr>
<td>Amazonas 1982</td>
<td></td>
<td></td>
<td></td>
<td>69</td>
</tr>
<tr>
<td>Bahia 1980</td>
<td></td>
<td></td>
<td></td>
<td>59</td>
</tr>
<tr>
<td>Bahia 1980</td>
<td></td>
<td></td>
<td></td>
<td>55</td>
</tr>
</tbody>
</table>

In a 1978 survey in Bangladesh, among women who were not sterilized, 11 percent wanted to undergo the procedure (9). If applied nationwide, this would have amounted to nearly 600,000 procedures (9) and would have raised the prevalence of female sterilization in 1979 from 3 to 14 percent of MWRRA (see Table 2). Even women who have not yet had all the children they want are interested in sterilization for the future. In Paraiba state, Brazil, for example, 45 percent of women who wanted more children said that they would be interested in sterilization after they had all the children they wanted (467).

Even in Africa, where the percentage of women who want no more children is usually lower than elsewhere (590), the number of women interested in sterilization is not negligible. In Sudan, for example, where services for voluntary sterilization are quite limited, a survey of 500 female clients at two prenatal, antenatal, and family planning clinics found that 51 percent of the 356 women who knew of female sterilization were interested in having the operation themselves (3). In a small survey at Rubaba Hospital in Uganda, 65 percent of women said that they would want voluntary sterilization (333).

Furthermore, sterilization is often the contraceptive method preferred by women who are not now using any contraception but want to. In 11 Latin American and Caribbean areas, Jordan, and a province of Tunisia, sterilization was the preferred method of between 8 and 38 percent (see Table 7). Sterilization often ranked second, after oral contraceptives.

Waiting lists for voluntary female sterilization further indicate the unmet demand for services. In Kenya, for example, at one family Planning Association clinic, which is able to perform 10 to 12 procedures a week, there was a 6-month waiting time in 1984. Public hospitals have waiting times as long as 18 months (625). At a Kenyan general hospital in late 1983 three Indian doctors were invited to help the chief of obstetrics and gynecology reduce the list of 500 women waiting for voluntary sterilization. Together they performed 150 procedures. Yet within several months the waiting list had again reached 500 names (21, 236). Also in Kenya, when a maternity hospital in Nairobi began offering voluntary sterilization services, most of the maternity ward and recovery ward beds were soon occupied by voluntary sterilization clients. Because of lack of resources, the hospital had to limit services to postpartum procedures for high-risk clients. Hospital staff have estimated that 20 women a day would come for sterilization if services were available (21). The district hospital in Kisii, Kenya, currently performs 30 procedures a day but could perform at least 40 if operating rooms were available (642).

Shortages of female sterilization services lead to waiting lists—and unwanted pregnancies—in many other countries. For example, in 1963 Jamaican officials estimated that half of the demand for female sterilization procedures remained unmet because of lack of facilities (339). Among women later said that they wanted the pregnancy (629). A group of Brazilian women who wanted to be sterilized postpartum but were not sterilized—mostly because doctors refused them or they did not have cesarean deliveries—18 percent became pregnant within a year following delivery (261). In Honduras, among women who wanted to be sterilized but were not, over 40 percent became pregnant within two years, although half of these women later said that they wanted the pregnancy (629).

Making Services Available

The rapidly growing prevalence of voluntary female sterilization (see Figure 1 and pp. C-127-130) reflects the progress that health care providers are making toward meeting the demand for sterilization services. Female sterilization has become more available for various reasons:

- technological advances,
- law and policy changes,
- changing attitudes among doctors,
- more training for health care personnel,
- more services delivered through a variety of channels,
- lower costs to clients, and
- improved communication.

Much remains to be done in many areas, however.

### Technological Advances

The development of minilaparotomy and laparoscopy have made female sterilization more widely available. With minilaparotomy and laparoscopy female sterilization can be performed quickly, safely, with local anesthesia, on an outpatient basis, and in free-standing facilities. The result-

### Table 7: Preference for Method of Contraception Among Currently Married Nonusers of Reproductive Age Who Want to Use Contraception or Who Express a Preference

<table>
<thead>
<tr>
<th>Region, Country &amp; Year (Ref. No.)</th>
<th>Sterilization</th>
<th>Oral Contraceptives</th>
<th>IUD</th>
<th>Intrauterine Devices</th>
<th>Other Methods</th>
<th>Do Not Know</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latin America &amp; Caribbean</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brazil 1978 (14)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amazonas state 1982</td>
<td>22 37 2 1 11</td>
<td>24 28 1 7 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 northeast states 1980</td>
<td>26 39 3 1 7</td>
<td>15 36 1 7 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piaui state 1982 (367)</td>
<td>15 39 6 5 4</td>
<td>5 15 2 3 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 southern states 1981</td>
<td>24 37 2 5 5</td>
<td>17 15 1 4 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colombia 1978 (367)</td>
<td>25 27 5 1 3</td>
<td>7 15 2 1 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>El Salvador 1978 (367)</td>
<td>30 39 1 1 3</td>
<td>10 15 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guatemala 1978 (367)</td>
<td>19 28 3 4 2</td>
<td>10 15 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jamaica 1979 (367)</td>
<td>12 22 6 1 3</td>
<td>10 10 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panama 1979-80 (367)</td>
<td>12 22 6 1 3</td>
<td>10 10 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle East &amp; North Africa</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jordan 1983 (269)</td>
<td>8 33 3 1 1 1</td>
<td>10 6 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tunisia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jendouba 1979 (367)</td>
<td>16 22 6 1 1</td>
<td>10 6 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Anderson (14); Morris et al. (367)
ing savings in time and cost and the independence from the hospital setting make it possible to serve many more women (446). The development of various options in laparoscopy has further increased its availability: the single-puncture approach as an alternative to double-puncture; bipolar electrocoagulation as an alternative to unipolar; tubal rings as a less expensive and safer alternative to electrocoagulation; and room air for insufflation as an alternative to carbon dioxide, which can be difficult to obtain (652).

Further technological advances can be expected to increase both the demand for and the opportunities to provide female sterilization services. Clips, not yet widely used, currently appear to offer the best chances for surgical reversal of sterilization (see p. C-148), and thus might appeal to some women. Much research is now focusing on nonsurgical methods of female sterilization (see pp. C-148-150). Nonsurgical methods could broaden the appeal of female sterilization, since fear of surgery is a major reason that women do not choose sterilization (9, 333, 365, 468, 502). Also, some nonsurgical methods could be safely performed by trained nurses and paramedical personnel.

Law and Policy

Voluntary sterilization is now legal in nearly all countries. Since 1973 at least 24 countries have taken action to establish the legality of voluntary sterilization (see Population Reports, E-7, Laws and Policies Affecting Fertility: A Decade of Change, November 1984). Many countries have special provisions of law—that is, statutes, ministry regulations, or presidential decrees—that specifically permit voluntary sterilization for family planning. Among these are Denmark, the Dominican Republic, Ecuador, Finland, New Zealand, Panama, the Philippines, Spain, Sweden, Tunisia, and Turkey. In many other countries voluntary sterilization is legal because no law prohibits it. These countries include China, Bangladesh, Ghana, India, Kenya, Mexico, Nigeria, the UK, and the US. Voluntary sterilization is explicitly illegal in only a few countries, for example, Burma, Iran, and Saudi Arabia (256).

In a number of countries, however, the legal status of voluntary sterilization has not been clarified. In particular, most French-speaking African countries and some countries of Latin America still have laws dating from colonial rule that once were interpreted as banning voluntary contraceptive sterilization. Also, in some countries where Islamic law governs, the legal status of voluntary sterilization may not be clear (256, 516). Prosecutions of doctors are virtually unknown in any of these countries, however, and the actual availability of voluntary sterilization varies greatly (256).

Policies limiting sterilization to cases of substantial therapeutic need may be a more widespread barrier to services than blanket restrictions or ambiguous laws. For example, until 1983 the medical code in France limited voluntary sterilization to “very serious” medical reasons (72). The Venezuelan medical code of 1977 permits sterilization only for eugenic or therapeutic reasons (539). Until 1984, the Brazilian Medical Ethics Code required three doctors in conference to declare an “exceptional” need for sterilization. Doctors interpreted exceptional need to include cases of women who would be at high risk if they became pregnant (264). The requirement for a conference of three doctors, however, was bypassed in cases of emergency surgery such as cesarean section. Perhaps as a result, most sterilizations in Brazil were performed along with cesarean section, and the rate of cesarean deliveries was one of the highest in the world (468). In 1984 the code requirement was eliminated. The new code requires doctors to follow existing legislation, which does not prohibit sterilization. Voluntary female sterilization is now more available and is increasingly performed as an interval procedure (628).

Restrictive policies sometimes require that a woman be a minimum age, have a minimum number of children, or a combination of the two. In Honduras, for example, voluntary sterilization is legal (516), but the Ministry of Health has required women who want to be sterilized to meet the “rule of 80”: a woman's age times the number of her living children must equal or exceed 80 (265). Hospitals or individual doctors, as well as governments, may impose such restrictions or other requirements that discourage clients, such as requirements to produce a marriage license and other documents or to use a specified contraceptive method temporarily to be sure that they will not become pregnant at the time of sterilization (176, 300). These requirements may be designed to help protect programs or institutions against damage to their reputations if a woman later regrets sterilization or discovers that she is pregnant. In many places, however, such requirements have been eliminated or reduced (516). In the Dominican Republic, for example, an age requirement was dropped after a study discovered that the average woman sterilized in 1977-78 was about 31 years old but already had six children (481). When women receive thorough counseling and their decisions are fully informed and voluntary, arbitrary restrictions are not necessary (654). Because policy-makers in government and the medical profession can have a major influence on the availability of services, they need to be aware of the demand for sterilization services and to understand the benefits.

Attitudes of Health Care Providers

Even more important than law and policy may be the attitudes of doctors and other health care providers. Often
doctors have been more reluctant to perform female sterilizations than women have been to seek them out (523). Recent surveys in eight areas of Brazil, for example, found that 12 to 28 percent of women who wanted to be sterilized had been refused by doctors. Generally, only cost was a more common deterrent (468). Similarly, in Kenya the chief of obstetrics and gynecology at a major hospital noted that the chief barrier to more extensive services was not facilities or training, but the attitudes of many doctors (21). In several African countries there have been reports of nurses discouraging women who wanted sterilization from having the procedure (624).

Doctors are reluctant to perform female sterilization for various reasons. Some may refuse because of personal beliefs. Some may think that voluntary sterilization is illegal, even when it is not (523). Others may think that sterilization is against women's best interests and fear that women will regret sterilization later. In Africa, in particular, doctors and nurses are concerned that women will be abandoned by their husbands or suffer social disapproval if they can no longer have children (333, 402). Thus they are highly protective of women's fertility. Still others may approve of voluntary sterilization in principle but are forced to give it low priority because of the immediate demands of curative health care and emergencies (333, 523).

Information about voluntary sterilization that can help to meet the concerns of health care personnel includes:

- Findings from surveys about high rates of satisfaction and low rates of regret among sterilized women (see p. C-147);
- Information about the health benefits of sterilization, not just for women at especially high risk, but for any woman who has had all the children she wants (see Population Reports, J-27, Healthier Mothers and Children Through Family Planning, May-June 1984);
- Data on the safety of modern sterilization techniques for both women and men (see pp. C-139–144 and Population Reports, D-4, Vasectomy—Safe and Simple, November-December 1983).

**Training**

Progress over the last decade in training health personnel has contributed greatly both to meeting the existing demand for female sterilization and to informing potential users. International training programs have played a leading role, training some of the foremost practitioners throughout the world. Many of these doctors in turn are training others.

For example, the Johns Hopkins Program for International Education in Gynecology and Obstetrics (JHPIEGO) provided clinical training in reproductive health care to over 2,900 doctors and supplied over 1,620 laparoscopes between 1973, when the program started, and 1983. Surveys answered by 757 former participants found that each of them trained an average of one person each month. Among those who taught, almost 80 percent were teaching postpartum sterilization and about two-thirds were teaching interval minilaparotomy, diagnostic laparoscopy, and/or laparoscopic sterilization (88).

In one country, South Korea, more than 100 doctors were trained just before laparoscopic sterilization was introduced into the national family planning program in 1976 (292, 446). By the end of 1978 over 560 laparoscopes had been imported. All but 100 of these were privately purchased. By 1979 the Korean government had named 12 institutions to provide in-country training in sterilization techniques (292).

Training can be of three types: (1) short-term special courses to provide initial training for practicing health care personnel, (2) training incorporated into medical school curricula, and (3) refresher courses. An Expert Committee on Training convened by the World Federation of Health Agencies for the Advancement of Voluntary Surgical Contraception concluded that full initial training requires 5 days of classroom instruction plus either 5 days of practical training for minilaparotomy or 7 to 10 days of practical training for laparoscopy. Training can be conducted in almost any facility capable of accommodating procedures and with a caseload that provides surgical teams with enough practical experience. Mobile units and camps, however, are not usually suitable training sites. Ideally, surgical teams should be trained in a facility like the one where they will practice. Whenever possible, the entire surgical team should be trained together (589). Various experts conclude that each trainee should perform a minimum of 10 minilaparotomies or open laparoscopies (589) or 15 laparoscopies under supervision (88, 589). When training is incorporated into medical school curricula, students usually need to perform a greater number of supervised procedures to become fully competent.

Refresher courses and follow-up of former trainees help to maintain the quality of services and to ensure that new findings and improvements are incorporated in ongoing services. For example, refresher courses on anesthesia have been recommended to make sure all surgical teams are using local anesthesia and using it in proper regimens (see p. C-139). The World Federation Expert Committee on Training has called on training institutions to follow up trainees for at least one year, including a visit within six months to see the former trainees at work (589).

Where doctors cannot meet the demand for sterilization services, nurses and nurse-midwives have been trained to perform interval or postpartum minilaparotomies. In pilot studies comparing doctors' and nurses' performance in Bangladesh, Thailand, and Uganda, nurses have performed procedures as safely as doctors (121, 164, 166, 186, 194, 482). In 1985 Thailand began training nurses to perform female sterilizations on a regular basis.

**Service Delivery Through a Variety of Channels**

Ultimately, substantial progress toward meeting the demand for voluntary female sterilization in developing countries has usually depended on organized programs, public or private. Nevertheless, in many developing countries independent private doctors and autonomous medical institutions such as medical schools have been the first to offer sterilization services (84, 267, 586). They remain major providers of services in some areas (155, 363, 445, 466, 586). In other countries private doctors now play an important role by working with organized programs. For example, private nonprofit organizations in Thailand and the Dominican Republic and the government in South Korea reimburse private doctors for performing voluntary sterilizations (84, 267).

Private family planning associations have often been the first to organize services as well as to encourage govern-
Laparoscopes are delicate and costly. With proper care, they can be used for at least 10 years. Without proper cleaning and maintenance, however, laparoscopes will develop problems and may spread infection.

Cleaning and Disinfecting the Laparoscope

The laparoscope should be disassembled, washed, and disinfected after every procedure. The equipment should be washed in warm water and a mild liquid soap—not saline solution (10, 172). The equipment, especially the insides of the channels, should be scrubbed with brushes to remove any blood or tissue. Dried blood on the laparoscope may spread infection and can cause equipment problems (10, 325). The equipment should be rinsed thoroughly and dried with a soft cotton cloth or left to air-dry. The lenses should be cleaned with cotton swabs soaked in alcohol or acetone (10).

Once cleaned, the laparoscope must be disinfected. Chemical disinfectants are the most practical and effective. They do not kill all bacterial spores in a short time, as heat or gas sterilization does (206, 238, 325). In the US CREST study, however, the rates of incision and pelvic infections were the same whether laparoscopic equipment was disinfected with a chemical solution or sterilized with ethylene oxide gas (230). Heat sterilization has been used for parts of the laparoscope, but heat can damage rubber, plastic, fiber optics, and lenses (325). Ultraviolet light sterilization is not recommended because it has not been proven effective (387).

The most widely recommended chemical disinfectants are a 2 percent solution of glutaraldehyde (trade-named Cidex) and a 2 percent solution of alkaline glutaraldehyde (trade-named Sporicidin) (10, 133, 241, 325, 540, 587). The disinfectant solution should be changed regularly according to the manufacturer’s recommendations.

After the instruments are disinfected, they must be rinsed thoroughly in sterile water to remove disinfec-
works to inform and follow up clients in surrounding rural areas. Minilaparotomies—interval or postpartum—can be performed in rural health posts and doctors' offices. Where there are no doctors, or until local doctors can be trained, mobile teams can use the operating facilities of a local health post or set up temporary facilities (396, 583). Arranging mobile services can be complex and expensive, however, and overemphasizing them could slow development of permanent local facilities (267, 586).

Cost

Ability to pay, whether personally or through private insurance or through full government funding of services, often determines whether a woman can obtain voluntary sterilization. For women who can afford private doctors' fees, which in 1980 ranged anywhere from $35 to $2,000 (US) (484), services can usually be obtained, at least in large cities. For poor women, however, cost can be the major barrier to voluntary sterilization. This has been well documented in Latin America. In Honduras, for example, 20 percent of a group of women who had wanted to be sterilized, but had not been, cited cost as the reason (265). In nine Brazilian states 20 to 59 percent of women who were interested in sterilization, and who knew where to find information about it, cited cost as the major reason that they had not been sterilized. Cost was the barrier most often cited in seven of the nine Brazilian states (365). Among Brazilian women who want to be sterilized postpartum, those whose medical care was covered by private insurance or public social security systems were much more likely to obtain sterilization, although usually along with cesarean section (262, 264).

Lowering costs to clients can increase use dramatically. In South Korea before 1976, government reimbursement to doctors who performed female sterilization procedures covered only one-third of the cost, and clients had to pay the rest. In 1976 the government started covering the entire cost of female sterilization (292). Chiefly as a result of this change and the simultaneous introduction of laparoscopy, the number of voluntary female sterilizations increased from an average of 7,000 per year between 1972 and 1975 to 100,000 or more per year between 1977 and 1980 (292, 394). In the Netherlands coverage of the cost of sterilization by national and private health insurance started in 1973. This change, as well as the introduction of minilaparotomy and laparoscopy, is credited with an increase in both male and female sterilizations from a few thousand each per year in the early 1970s to over 50,000 each per year in the late 1970s (280).

Many national family planning programs provide voluntary sterilization services free of charge. These countries include Bangladesh, China, India, Malaysia, the Philippines, South Korea, Thailand, Jamaica, and Tunisia (394). Others, such as Hong Kong and Taiwan, offer services free to women who cannot pay but charge others (394). Still others charge some fee covering at least part of the cost. In surveys of program charges around 1980, among 29 developing countries, 16 provided services free, and 13 charged fees to at least some users. The fees ranged as high as $50 (US) but in 6 of the 13 countries were less than $10 (394, 484). A few countries—China, India, Singapore, South Korea—promise substantial long-term benefits to men and women who choose sterilization (256). In a number of other countries, programs offer services free of charge and provide clients with a small payment in compensation for lost wages, transportation costs, or other expenses incidental to surgery (256).

Private doctors' services cost much more than any program fees. In 14 of the same countries where program costs were surveyed, the average cost of sterilization privately performed was about $240 (US). In most of these countries the minimum cost was at least $100 (484).

How much does it cost family planning programs to provide female sterilization services? Estimates from three programs are roughly comparable. In Colombia from 1977 through 1980, sterilizations (over 98 percent of which were female) cost PROFAMILIA between $38 and $59 each, measured in 1980 US dollars (267, 400). In Nepal in 1979-80 the cost of a female sterilization procedure was about $45 (US). By comparison, a vasectomy cost about $38; an IUD insertion, $28; a year's supply of oral contraceptives or condoms, $13 (531). In Kenya rough estimates of costs in 1984 ranged from $28 for female sterilization procedures performed in mission hospitals to $35 for procedures performed through public programs or private organizations to $48 for procedures performed by private doctors (625). (Capital costs are not included in any of these estimates.)

While the cost of sterilization may seem higher than the cost of other methods, it is a one-time expense that provides long-term protection. Thus in the long term sterilization is often one of the most cost-effective contraceptive methods. In Nepal, for example, the estimated average age of women who chose voluntary sterilization in 1979-80 was 32 years. Assuming that these women receive 13 years of contraceptive protection (through age 45), the cost of one couple-year of contraceptive protection (CYP) averaged $3.46 (US). By comparison, the cost per CYP of vasectomy averaged $2.92; of oral contraceptives or condoms, $13 (531).

A woman who has chosen voluntary sterilization meets a family planning worker who has come to give her a ride to the clinic. In a number of countries, especially in Asia, national family planning programs provide voluntary sterilization without cost to the woman. Elsewhere cost is often the major obstacle for women who want voluntary sterilization services. (Pathfinder Fund)
Reducing costs and increasing financial self-reliance are important goals for all family planning programs. While seeking to expand services as much as possible, programs must keep cost per procedure low. Choices of minimally invasive procedures and of service delivery channels need to be made with unit cost in mind (267). Certainly out-patient procedures performed with local anesthesia are far less expensive than hospitalization and general anesthesia. Planning the location, size, and staffing of facilities so that all can operate at high volume will maximize the use of resources and personnel and also contribute to greater safety. Cost accounting should be a part of routine record-keeping so that the efficiency of every aspect of the program can be evaluated (481). Some programs minimize costs by obtaining volunteer help with day-to-day operations from doctors, community residents, and service organizations (364).

Achieving greater financial self-reliance reduces dependence on international and foreign donors (267). For government programs, increased reliance on national funds requires the full commitment of political leaders based on their understanding of the need and demand for services (586). For privately operated programs, diversification of income sources can help to assure financial security (267). In addition to receiving support from national governments and international donors, private associations have generated income from charitable donations by businesses and individuals, as in Panama (304); donations of services, land, buildings, and money by the community or local residents, as in Kenya (364); and charges to clients, as in Colombia (83). Charges to clients will inevitably reduce the number who can obtain services, as occurred when PROFAMILIA in Colombia had to raise its fees in 1980 (400). Nonetheless, when funds are short, a balance may have to be found between revenue and availability of services. Charges can be made less burdensome if clients can make installment payments and charges are varied according to ability to pay (83, 267). PROFAMILIA helps to support sterilization services with income from other medical services such as diagnostic laparoscopy, infertility treatment, and obstetrics and gynecology clinics (83).

Communication About Sterilization

Information, education, and communication (IEC) should be an integral part of all family planning programs. In many countries there has been a natural progression of IEC activities related to voluntary sterilization (653). The first stage involves public demonstration services and training programs for doctors in hospitals, clinics, and often in university-based teaching centers. Clients are recruited by personal contact from the current clientele of the facility. IEC activities rarely extend beyond the hospital. Counseling and word-of-mouth recommendations from satisfied users are the major forms of communication. Long since achieved in Asia, this stage was reached about a decade ago in many Latin American countries and more recently in some African countries.

The second stage involves doctors communicating with policymakers and opinion leaders, government officials, other doctors, and selected media. Private voluntary agencies may be organized. They can prepare printed matter for sophisticated readers or organize meetings to inform influential people about the impact of voluntary sterilization on fertility and health. This stage has been reached in most non-Muslim Asian countries and in some parts of Latin America.

The third stage occurs as sterilization services become more widely available and secure government support. Public mass media campaigns, designed and carried out with professional help, are added to existing communication efforts. IEC programs of this nature on voluntary sterilization have been developed in a number of Asian programs, including India, South Korea, Thailand, and Hong Kong, and also in El Salvador. They are under consideration in other areas.

Whatever the stage of effort, effective IEC activities require attention to a number of factors, usually classified as purpose, audience, message, media, and source (636).

Purpose. The purpose of communication about sterilization should be carefully defined, with clear, measurable objectives (636, 647, 650). For example, the purpose of a communication effort directed at health personnel may be to encourage use of local anesthesia or to improve counseling of clients. The impact of the effort can be measured by observing clinic practices and examining records. The purpose of a communication effort directed at high-risk older women with many children may be to encourage them to consider voluntary sterilization. Results can be measured simply in terms of an increased requests for procedures or, eventually, in terms of less maternal mortality as a result of fewer pregnancies among high-risk women.

Audience. The audience for IEC regarding sterilization ranges from doctors and other health personnel to political leaders and couples of all ages. While one important audience is older couples who want no more children,
most people think about sterilization for several years before making a decision (47, 638). Also, women rarely become sterilized without discussing the issue with their husbands (631). Therefore information about voluntary sterilization should be included in all posters, brochures, and appropriate discussion or counseling on family planning (6). At the same time, it is important to identify subgroups that require special messages, such as religious and political leaders.

**Message.** Messages vary greatly, depending on the audience. Some potential users want to know only where the service is available, how it can be paid for, and whether it is available on request or only after childbirth. Others need messages that address such specific concerns as fear of adverse physical and sexual side effects or fear of surgery. Terminology is important in sterilization messages (6). In particular, IEC programs need to make clear that voluntary sterilization does not mean castration or loss of femininity. To develop messages that satisfy the audience's needs requires investigation. This can be done through small group discussions, surveys, or other market research. It possible, representatives of the intended audience should help develop messages and should certainly be involved in pretesting materials before they are produced (647).

**Media.** Research in many family planning programs has found that interpersonal contacts are most effective for influencing attitudes, whereas mass media are best for providing factual information and establishing social legitimacy among large numbers of people (6, 630, 631, 645, 652). Field workers have played a major role in Asian countries in informing women about sterilization (637, 646), whereas in Latin America, the use of charlas, or small discussion groups, has been less effective (627, 656). Using multiple channels of information helps to reinforce the message (626, 649). Nonliterate women who received illustrated booklets during oral counseling sessions, for example, gave more correct answers to later questions than women who were counseled orally but did not receive illustrated booklets (626, 649). Illustrated booklets on sterilization for clients have been developed in a number of countries, including Bangladesh, Mexico, Nepal, Nigeria, the Philippines, Sri Lanka, and Thailand (665) (see photos, pp. C-137, 142, and 146). Broadcast media, especially radio, reach the largest audiences in most developing countries, but, with the exception of El Salvador, broadcasting on female sterilization has so far been largely confined to Asia. In El Salvador a 1977-78 mass media campaign including radio spots substantially increased the demand for female sterilizations (617, 623). Other experience in Latin America suggests that publicity about sterilization, even where it is hostile or critical, may encourage people to seek services (657). In South Korea, where the mass media are now widely used to promote male and female sterilization, the initial reaction was quite critical but became much more favorable over time (645).

**Source.** The credibility of information depends heavily on its source. One of the most influential sources of information for women and men considering sterilization is a person already sterilized (6, 47, 635, 638, 639, 644, 646). Satisfied users have served both officially and unofficially to recruit others. Educated people find medical personnel and mass media highly credible, but less educated people tend to rely more on interpersonal contacts (635, 655). Traditional birth attendants and other village women, for example, can be a potent source of information either for or against any method of family planning, especially in rural areas of developing countries where doctors and nurses are scarce (see Population Reports, J-22, Traditional Midwives and Family Planning, May 1980) In all groups the influence of knowledgeable peers is generally greater than that of outsiders (620, 652).

Since communication about sterilization can be either positive, emphasizing safety, effectiveness, and simplicity, or negative, spreading rumors and fears, programs offering sterilization need to give serious attention to the quality of IEC work. Spending sufficient time and effort to develop good print and broadcast materials about sterilization will be more cost-effective than hasty efforts to develop materials that will not reach, inform, or influence the intended audiences.

**Providing High-Quality Services**

Not only the availability of voluntary sterilization services and relevant information about sterilization, but also a high quality of service is essential. Maximizing safety and clients' satisfaction is, of course, a paramount goal in itself. In addition, satisfied clients are convincing communicators, whose support will help programs serve more people.

In addition to meeting established medical standards, providing high-quality services requires:

- procedures appropriate to the woman, the available trained personnel, and the facility;
- thorough, accurate, and supportive counseling; and
- careful record-keeping, evaluation, and monitoring.

**Choosing Appropriate Methods**

Both minilaparotomy and laparoscopy have a role in voluntary sterilization services, but they should be used in appropriate settings. Minilaparotomy can be used in almost any setting. It is safe, simple, and inexpensive. The procedure is easy to learn and can be performed by general practitioners with basic surgical skills. Only inexpen-
A woman's decision to use voluntary sterilization should be well-informed and freely made. To assure a well-informed decision, voluntary sterilization with the assistance of the US Agency for International Development (USAID) are required to obtain the consent of each client either by signature or some other mark after the client has been informed of all the points listed above. Both the client and the doctor or the doctor's authorized assistant must sign the consent form, and if the client is nonliterate, a witness of the same sex who speaks the same language as the client must sign the form testifying that the client received an oral explanation. In addition, USAID funds cannot be used to pay potential acceptors of sterilization to induce their acceptance of sterilization or to create a financial incentive for sterilization over another contraceptive method.

**Advantages and Disadvantages of Minilaparotomy**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Easy to learn.</td>
<td>1. Takes slightly longer to perform than laparoscopy, about 10 to 20 minutes on average.</td>
</tr>
<tr>
<td>2. Can usually be performed by any doctor with basic surgical training and skills.</td>
<td>2. Difficult in obese women and in women with pelvic scarring and adhesions.</td>
</tr>
<tr>
<td>3. Requires only inexpensive instruments, chiefly standard surgical equipment.</td>
<td>3. Leaves small but visible scar.</td>
</tr>
<tr>
<td>4. Most complications are minor.</td>
<td>4. Short-term abdominal pain from incision in about half of women.</td>
</tr>
<tr>
<td>5. Can be performed after childbirth.</td>
<td>5. Higher rate of wound infections than laparoscopy.</td>
</tr>
</tbody>
</table>

Laparoscopy is best suited to a more specialized setting, usually large city hospitals. Doctors performing laparoscopy should have experience in abdominal surgery or be specialists in obstetrics and gynecology or in general surgery. In addition, laparoscopic equipment is costly—$4,000 to $6,000 (US) for a laparoscopy kit (397). This investment is cost-effective only for facilities with large caseloads. A high volume of procedures also is necessary for doctors to maintain their skills. In Colombia PROFAMILIA recommends that facilities or doctors performing fewer than 10 sterilizations per week use minilaparotomy (583).

In different countries different methods have been emphasized. Indian programs have encouraged laparoscopy (510, 616). In contrast, in Bangladesh minilaparotomy is emphasized because there are few specialists and few training facilities (616). In many countries the appropriate choice may be a mix of the two methods. In Thailand, for example, laparoscopy is offered in cities and high-volume facilities (573). Minilaparotomy is provided elsewhere through a network of decentralized services (44). Focusing on only one method may limit the availability of sterilization. Nepal, for example, at first emphasized laparoscopy. This restricted the delivery of female sterilization to a very small number of trained surgeons. Minilaparotomy is now being introduced to expand services (267).

**Assuring Voluntarism**

A woman's decision to use voluntary sterilization should be well-informed and freely made. To assure a well-informed, voluntary decision, counseling before the procedure should include information and discussion about:
- the specific surgical procedure to be performed, emphasizing what the woman will experience during and after surgery;
- the permanence of voluntary sterilization;
- the small risk of pregnancy after sterilization;
- other possible risks;
- alternative contraceptive methods, including vasectomy and temporary methods, and where they can be obtained;
- a woman's right to change her mind at any time before the procedure;
- the fact that no penalties will be imposed or any other benefits withheld if a woman decides against sterilization (24, 48, 146, 500, 581, 584, 619).

**Advantages and Disadvantages of Laparoscopy**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Very low complication rate.</td>
<td>1. Risk that complications which do arise may be serious.</td>
</tr>
<tr>
<td>2. Can be performed quickly, in about 5 to 15 minutes on average.</td>
<td>2. Usually requires insufflation of abdomen with accompanying risks of postoperative chest and shoulder pain, and, rarely, gas embolism or cardiopulmonary distress.</td>
</tr>
<tr>
<td>3. Small incision leaves very small scar.</td>
<td>3. Difficult to learn.</td>
</tr>
<tr>
<td>4. Equipment can be used for diagnosis of pelvic disease and infertility, aspiration of ovarian cysts, biopsies, and cutting of adhesions. Also, during sterilization pelvic organs can be checked for signs of disease such as ovarian cancer.</td>
<td>4. Doctor should be trained in obstetrics and gynecology or in abdominal surgery.</td>
</tr>
<tr>
<td>5. Less painful than minilaparotomy.</td>
<td>5. Equipment is expensive and can be difficult to maintain and repair.</td>
</tr>
<tr>
<td>6. Good for clinics with large numbers of patients.</td>
<td>6. Not recommended after childbirth.</td>
</tr>
</tbody>
</table>

In most family planning programs, counseling is followed by the signing of an informed consent form—a formal document signed by the client stating that she or he understands the nature of sterilization and has chosen it voluntarily (516). For example, programs offering voluntary sterilization with the assistance of the US Agency for International Development (USAID) are required to obtain the consent of each client either by signature or some other mark after the client has been informed of all the points listed above. Both the client and the doctor or the doctor's authorized assistant must sign the consent form, and, if the client is nonliterate, a witness of the same sex who speaks the same language as the client must sign the form testifying that the client received an oral explanation. In addition, USAID funds cannot be used to pay potential acceptors of sterilization to induce their acceptance of sterilization or to create a financial incentive for sterilization over another contraceptive method.
In some situations special care must be taken to ensure that women are able to make carefully considered decisions about sterilization. In particular, women interested in sterilization immediately postpartum should receive counseling early in pregnancy, if possible. The World Federation of Health Agencies for the Advancement of Voluntary Surgical Contraception recommends that a woman should not receive initial counseling nor be asked to give informed consent when she is in labor, under sedation, or during the first 48 hours after delivery (582). In addition, a doctor should not sterilize a woman during a cesarean section unless she has been counseled beforehand and has signed a consent form (582). Sometimes women cannot be counseled early in pregnancy, however. If these women choose sterilization, counselors must make sure that they are fully informed and not under stress. Some programs require a waiting period between counseling and undergoing the procedure to give clients time to reconsider their decision (48, 146, 543, 584). In areas where access to sterilization is limited, however, waiting periods could prevent many women from obtaining services (582). To minimize the need for waiting periods and to give couples as long as possible to think about voluntary sterilization and alternatives, family planning workers should mention voluntary sterilization when discussing other methods, even with young couples or those who want more children.

To provide a double-check on the voluntary nature of decisions, recently sterilized women in El Salvador and men and women in Guatemala were interviewed. All the men and women said that they had freely chosen sterilization. While over 90 percent of the 648 women surveyed in El Salvador had discussed sterilization with health workers before the procedure, none thought that these workers were pressuring them to choose sterilization rather than another contraceptive method. In fact, 79 percent of the women cited themselves as the single most important person in their decision to be sterilized; 14 percent cited their husbands; and only 3 percent cited doctors or nurses. For most men and women in the two countries, the decision to be sterilized followed a long period of talking with friends, acquaintances who had been sterilized, and health workers. Almost all of the men and women had been counseled about sterilization before the operation. In El Salvador about 4 percent of the women did not understand, however, that sterilization was permanent (47, 618).

Counseling must be planned and organized as carefully as other aspects of sterilization services. A survey of 39 voluntary sterilization services in 22 countries, conducted by the World Federation, suggests that some sterilization services need additional resources to establish comprehensive counseling programs with fully trained counselors (640). To assure voluntarism and informed consent, counseling requires:

- trained staff specifically responsible for counseling;
- space for counseling that ensures the privacy and comfort of clients;
- established policies on the content and format of counseling, on informed consent, and on referral to other services;
- evaluation of counseling procedures and of individual counselors (640).

Evaluating Services

To assure the high quality of services and to identify possible improvements, evaluation should be built into all voluntary sterilization services. The goals of evaluation are minimizing morbidity and mortality, maximizing clients' satisfaction, and improving efficiency within the context of service delivery goals. Data collected for these purposes can also be used for broader evaluations of program impact on fertility and on maternal and child health. An Expert Committee convened by the World Federation has recommended simple guidelines for monitoring and supervision of voluntary sterilization services (587).

A fundamental requirement for evaluation is a standard system of record-keeping that is conscientiously followed. The minimum information that should be collected is the number of clients served; clients' ages, marital status, parity, and other characteristics; and the medical record of the sterilization and pre- and postdischarge complications (587). Of course, the signed informed consent form also must be kept.

In addition to regular analysis of these records, evaluation methods include direct observation, interviews with clients and personnel, and surveys of clients (296, 372, 555, 662). A combination of approaches is best. In the Dominican Republic, for example, every month client records are tabulated to determine whether the program is providing the anticipated services and whether the age and parity of clients are changing over time. In addition, every year 5 to 10 percent of clients are randomly selected and contacted to confirm medical records, to determine the total cost to the client, and to evaluate pre-operative counseling and client satisfaction (64).

Any reported death attributed to or associated with sterilization should be fully investigated at once so that any harmful practices can be corrected (584, 587). Also, a death can damage the reputation of an entire program and thus deny services to many people (586). In Bangladesh, after several deaths were attributed to vasectomy and female sterilization, teams of evaluators visited medical facilities throughout the country. The major cause of mortality—misuse of anesthesia—was identified. New local anesthesia regimens were introduced, and the number of anesthesia-related complications and deaths dropped markedly (see p. C-144).
On another plane, evaluation may be designed to assess the impact of voluntary sterilization within a national family planning program, including effects on both fertility and health (see Population Reports, J-27, Healthier Mothers and Children Through Family Planning, May-June 1981, and J-29, The Impact of Family Planning on Fertility, January-February 1985). One measure of the impact of sterilization on fertility is births averted per woman. Estimates from various countries range from .25 to 2.75 births averted per woman sterilized (344, 393, 472, 643). The overall number of births averted of course depends chiefly on a woman's age at the time of sterilization and the number of years until she reaches menopause. Since women who choose sterilization are usually older and therefore already less fecund than women using temporary contraceptives (393, 472, 564), in a single year the impact of a voluntary sterilization on the birthrate may be less than the impact of a temporary method used by a younger woman (393). Over a number of years, however, the impact of voluntary sterilization may be greater, depending on continuation rates for temporary methods. Another measure of the impact of sterilization is the estimate that sterilization averted 0.54 abortions per woman in South Korea. In other words, one abortion was averted for every two women who chose sterilization (561). In El Salvador it was estimated that sterilizations played a major role in reducing by half the number of hospital admissions for illegal abortion (658).

The impact of voluntary sterilization on women's health is greater precisely because the women who choose this method are older and have had more children. Pregnancies after age 35 and after four or more children are high-risk pregnancies (456). Based on data from Bangladesh (622), it has been estimated that avoiding all births after the fourth and limiting childbearing to ages 20 to 34 would reduce maternal mortality rates in developing countries by 12 percent (659). Another study estimated that in Bangladesh one woman's life is saved for every 100 female sterilization procedures performed (208). In Kenya data suggest that, if each sterilization averted 1.5 births, one woman's life would be saved for every 185 female sterilization procedures (654).

Voluntary female sterilization services can have substantial impact on health and fertility rates. As evidence from around the world shows, when trained personnel make mini-laparotomy and laparoscopy available in appropriate facilities, this approach to family planning is safe, effective, and in great demand among couples who want no more children. The challenge to health care providers and family planning programs is to meet the growing demand for voluntary female sterilization in ways that conform to both medical standards assuring safety and to ethical standards assuring voluntary and informed individual choice.

Asterisk (*) designates an article that was of particular value in the preparation of this issue of Population Reports.


laparo scopy and mini­
346. MCCAUSLAND, A. High rate of ectopic pregnancy fol­
303. MCDANIEL, E.B. Use of operating room nurses as sur­
TON. A report to the World federation on the position relative to the family planning movement in some South American countries. Presented at the Fifth International Conference on Voluntary Family Planning, Vienna, Austria, October 12-17, 1962.


ADDENDA


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ORAL CONTRACEPTIVES—Series A
- A-6, Oral Contraceptives in the 1980s (A, F, P, S)

INTRAUTERINE DEVICES—Series B
- B-4, IUDs: An Appropriate Choice for Many Women (A, F, P)

STERILIZATION, FEMALE—Series C
- C-8, Reversing Female Sterilization (f, P)
- C-9, Minilaparotomy and Laparoscopy: Safe, Effective, and Widely Used

STERILIZATION, MALE—Series D
- D-3, Vasectomy Reversibility—A Status Report
- D-4, Vasectomy—Safe and Simple (f, F, P)

LAW AND POLICY—Series E
- E-6, Legal Trends and Issues in Voluntary Sterilization (f, P, S)
- E-7, Laws and Policies Affecting Reproductive Rights: A Decade of Change

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- H-5, Spermicides—Simplicity and Safety are Major Assets (s)
- H-6, Update on Condoms—Products, Protection, Prevention (f, P, S)
- H-7, New Developments in Vaginal Contraception (f, P, S)

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- I-3, Periodic Abstinence: How Well Do New Approaches Work? (f)

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