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Policy Forum

Coverage of Cervical Cancer Screening in 57 Countries: Low Average Levels and Large Inequalities

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Cervical cancer is the second most common cancer in women and a leading cause of mortality worldwide, with 273,000 deaths estimated in 2002 [1]. Eighty-three percent of cases occur in the developing world, where cervical cancer accounts for 15% of female cancers, as compared to just 3.6% in developed countries [1].

In the 1960s and 1970s, incidence rates in high-income countries were similar to those seen in the developing world today; the subsequent decline in cervical cancer incidence and mortality in high-income countries is largely credited to effective screening programs [2–11]. Considerable debate has arisen about whether such strategies are feasible and cost-effective in the developing world, where most cervical cancer now occurs [12–16].

Country-level data on current levels of screening provide important input into the debate on global cervical cancer policy planning. While there has been extensive research on rates of screening in the United States and other industrialized nations [17–22], data from the developing world are limited to a few countries and sub-national surveys [14,23–27]. In addition, the magnitude of inequalities in screening is virtually unknown in all but a few countries [28–30]. Differences in current levels of access to screening may have implications for designing screening and prevention strategies, particularly given novel approaches for screening and treatment in low-income settings [31–38], as well as for the development and delivery of a vaccine against the strains of human papillomavirus (HPV) that cause cervical cancer [39–52]. While cervical cancer programs also require human resources and laboratory infrastructure, the World Health Organization has identified screening coverage as a crucial component of providing effective prevention [53]. It is also the component of programs least amenable to purely financial solutions, unlike purchasing equipment, training employees, or ensuring laboratory quality control.

In this paper we present estimates of the average level and inequalities in cervical cancer screening from 57 countries across all levels of economic development included in the World Health Surveys (WHS), a set of household surveys implemented by the World Health Organization in 2002 [54]. More details on the surveys are provided in Table S1. We define the population eligible for screening as women aged 25 to 64, although Figure S1 shows that our results are robust across definitions of the eligible population. We show results for two measures: (1) crude coverage, which we define as the proportion of eligible women who report that they have had a pelvic exam (regardless of when the exam occurred), and (2) effective coverage, which we define as the proportion of eligible women who report that they have had a pelvic exam and Pap smear in the past three years. We calculate coverage by global wealth deciles, which are comparable across countries, as well as by a relative wealth index specific to each individual country. More specific details of the

Summary Points

- The large declines in cervical cancer mortality in developed countries have been attributed to widespread screening, but it is unclear whether this success can be replicated in the developing world.
- It is generally assumed that screening coverage in the developing world is low; in this paper we substantiate this claim with evidence from 57 countries, thus contributing to the evidence base for formulation of effective policies.
- Our analysis of population-based surveys indicates that coverage of cervical cancer screening in developing countries is on average 19%, compared to 63% in developed countries, and ranges from 1% in Bangladesh to 73% in Brazil.
- Older and poor women, who are at the highest risk of developing cervical cancer, are least likely to be screened.
- Strategies for improving cervical cancer prevention must be adapted to meet the specific needs of individual countries: expanded screening may be a viable option where sufficient infrastructure and health system access exists, but novel strategies need to be considered in other settings.

The Policy Forum allows health policy makers around the world to discuss challenges and opportunities for improving health care in their societies.

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Abbreviations: HPV, human papillomavirus; WHS, World Health Surveys

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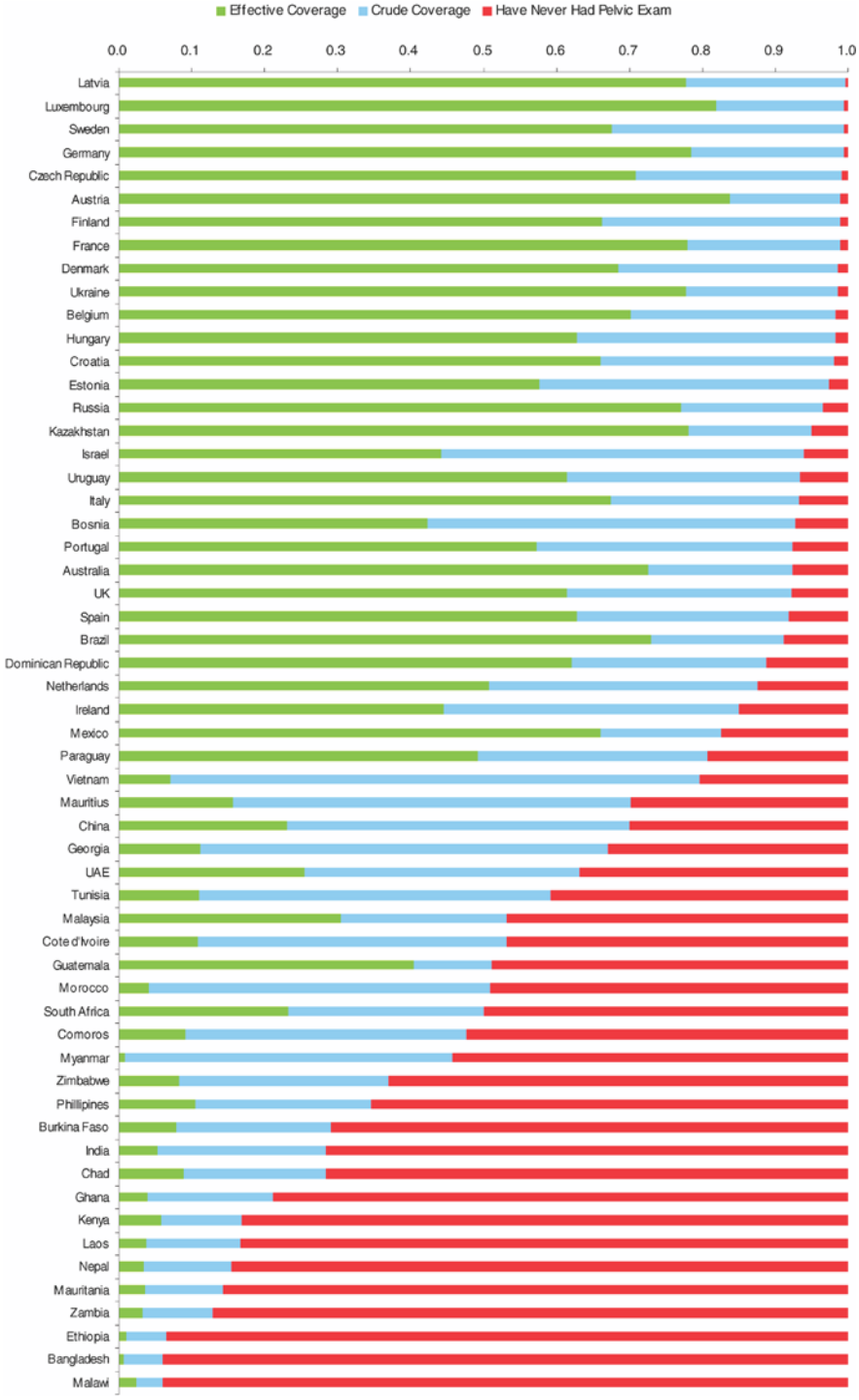

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Figure 1. Crude and Effective Cervical Cancer Screening Coverage for Women Ages 25–64

parameters and methods used for this analysis are provided in Text S1.

For the majority of these countries, these data represent the only information available on coverage of cervical cancer screening. This analysis points to an acute shortage of cervical cancer prevention services across much of the developing world and striking inequalities in access to these services, highlighting the need for new prevention and treatment strategies.

Our Findings

Figure 1 shows levels of coverage of cervical cancer screening for the 57 countries, and Table 1 summarizes these results. The population-weighted means of crude coverage and effective coverage of cervical cancer screening across all included countries are 68% and 40%, respectively. In the 30 developing countries surveyed, these rates are much lower: 45% and 19%, respectively. (Former communist countries are considered developed for purposes of this analysis.) There is wide variation in the level of effective coverage across countries, from over 80% in Austria and Luxembourg to 1% or less in Bangladesh, Ethiopia, and Myanmar. In many countries, a large proportion of women have had pelvic examinations, but the exam was not accompanied by laboratory tests or was not done in the three years preceding the survey. In Georgia, for example, 67% of women have had a pelvic exam, but only 11% had had one in the preceding three years and accompanied by a Pap smear; likewise in China, crude coverage is 70%, but effective screening coverage is only 23%. (Estimates of coverage by age group and wealth quintile for all included countries are provided in Table S2.)

In a large number of countries the majority of women have never had a pelvic exam. This proportion is largest in Malawi, Ethiopia, and Bangladesh, where more than 90% of women report that they have never had a pelvic exam. In 16 of the 57 countries analyzed, more than half of eligible women had never had a pelvic exam. Figure 1 also demonstrates that the relationship between the proportion of women ever having a pelvic exam and the proportion effectively screened is not uniform. Even among high-income countries, which have crude coverage rates at or above 90%, the proportion of women who are effectively screened varies widely.

Figure 2 shows crude and effective coverage of cervical cancer screening across age groups for developed and developing countries. While the age pattern of crude and effective coverage is similar across level of development, coverage is markedly lower in developing countries. Crude and effective coverage rates begin to decline for women over 45 years of age in developing countries and over 55 years of age in developed countries. The age group at which the declines in effective coverage are observed corresponds with the age at which

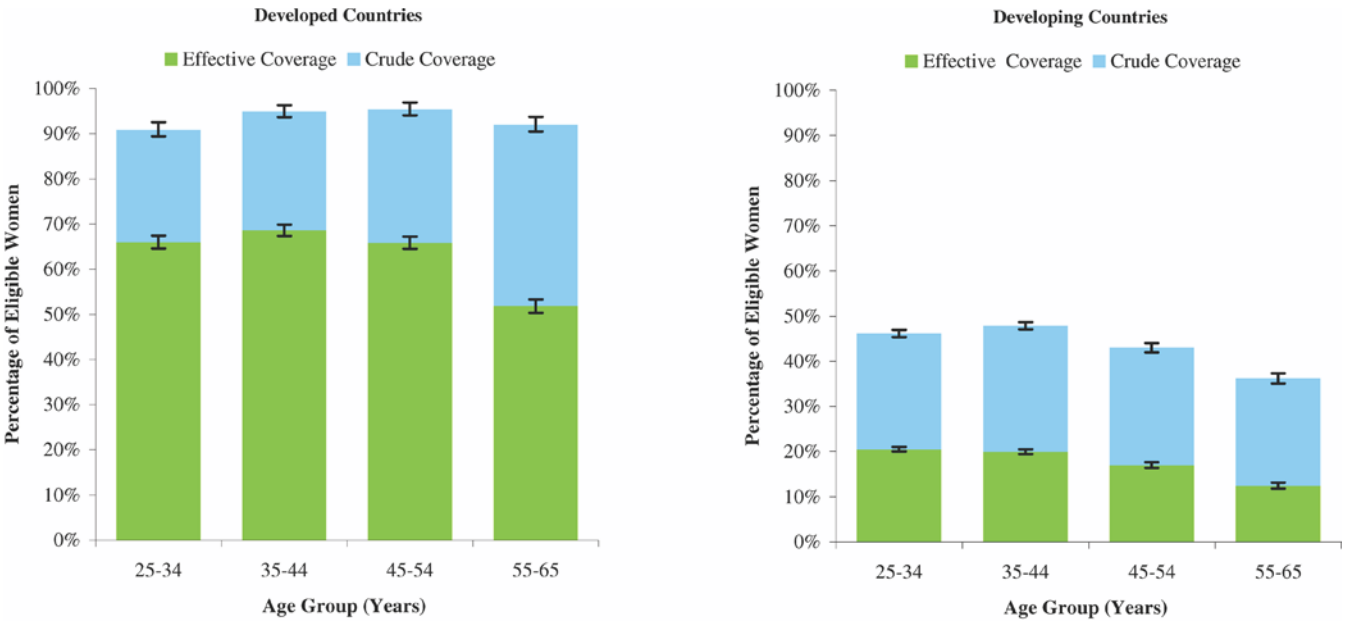

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Figure 2. Coverage of Cervical Cancer Screening, By Age Group, Across Two Development Groups

incidence rates and mortality from cervical cancer have been shown to rise sharply [53].

Figure 3 shows that considerable inequalities in crude and effective coverage of cervical cancer screening exist across global wealth deciles. While the average crude screening rate across the set of countries in the analysis was 68%, only 31% of women in the poorest global wealth decile have ever had a pelvic exam, compared to 91% of women in the richest global wealth decile. The inequalities are even more pronounced for effective coverage of cervical cancer screening, with the poorest women being nearly seven times less likely to have been screened effectively compared to their rich counterparts (9% and 64%, respectively). Even though crude coverage rates are high for women in the richest wealth deciles, effective coverage rates are overall very low: all wealth deciles except the wealthiest have effective coverage rates of lower than 60%, and effective coverage of cervical cancer screening is at or below 10% in the poorest three deciles.

In addition to inequalities across countries, significant wealth-related inequalities also exist within countries. Figure 4 demonstrates inequalities between the poorest and richest quintiles in crude and effective screening coverage for Brazil, China, Germany, and India, four of the most populous countries included in the WHS. We present results using a within-country relative wealth index; while not directly comparable across countries, it is more relevant for within-country inequalities. In India, the rates of coverage are very low for rich and poor women alike. While crude coverage for rich women is higher (36% compared to 22% for poor women), effective coverage for cervical cancer screening is uniformly low, 6% and 4% respectively. By contrast, wealth-related inequalities are very pronounced for both crude and effective coverage in China and Brazil. In Germany, as in several other high-income countries, crude coverage rates are uniformly high, and therefore wealth-related inequalities are mainly observed for effective coverage of cervical cancer screening.

Table 1. Crude and Effective Cervical Cancer Screening Coverage across Development Groups for Women Ages 25–64 (With 95% Confidence Intervals)

Development Group	Crude Coverage	Effective Coverage
Developed countries	93.6% (93.2%–94.0%	18.5% (18.3%–18.8%)
Developing countries	44.7% (44.4%–45.1%	18.5% (18.3%–18.8%
All countries	67.9% (67.6%–68.2%)	39.6% (39.3%–40.0%)

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Policy Implications

The results of this study illustrate that a wide range of current screening practices exists across countries; this makes it unlikely that any one strategy will prove to be effective globally. Choices regarding cervical cancer prevention strategies must be adapted to the current situation and the constraints of individual countries—indeed, multiple strategies may need to be pursued within the same country. In this regard, it may be useful to consider countries in three broad groups, based on current screening coverage rates, each facing different policy choices with regard to cervical cancer prevention.

In developed countries, where high rates of effective coverage have been achieved, focusing on the subgroups of women who are not effectively screened may be a reasonable and cost-effective strategy. It is likely that HPV vaccination would lead to some health gains in these countries; however, the benefits of this strategy should be weighed against its substantial costs.

In some middle-income and former communist countries, a majority of women have had pelvic exams in their lifetime; however, rates of effective screening (i.e., a recent

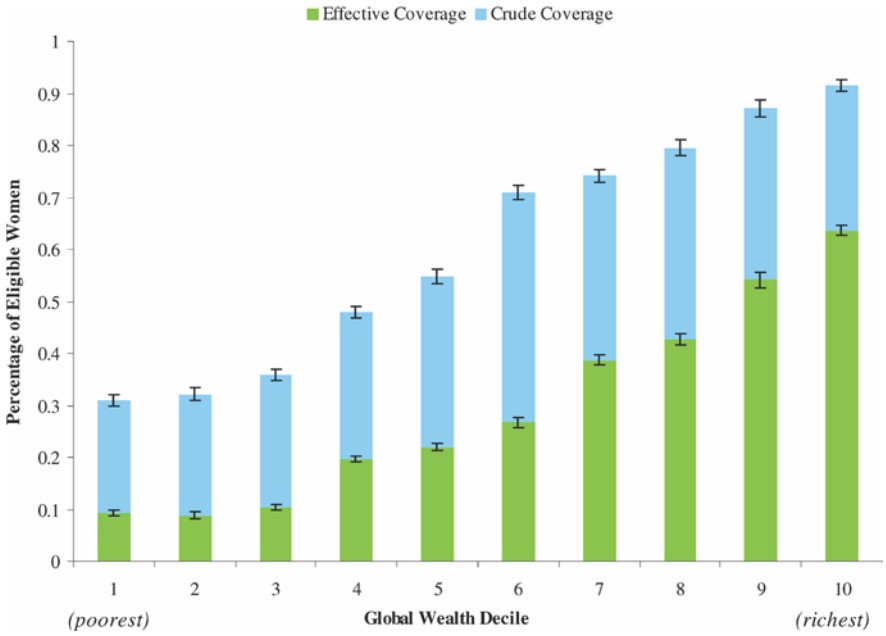

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Figure 3. Cervical Cancer Screening Coverage, By Global Wealth Decile, Across All Countries

exam accompanied by laboratory tests) are low. This indicates that a large proportion of women in these countries have contact with obstetric or gynecologic health services, and that the health system may have the capacity to provide effective screening to a larger number of women. In these countries, it may be possible to build on "missed opportunities"—pelvic exams without laboratory tests or of insufficient frequency—to increase coverage without significant investment in health infrastructure. "Organized" programs, with systematic call, recall, follow-up, and surveillance, hold promise in this regard [13] and could be implemented in the context of existing health services.

This study also identifies a number of countries where the vast majority of women have never had a pelvic exam. In such settings, where the health system is unable to provide even low levels of crude coverage of this basic intervention, improved screening is clearly urgent, especially for women aged over 35 years. Visual inspection with acetic acid has recently shown promise as an appealing alternative to cytological examination in low-income settings: overall cost is lower, and women in need of further intervention can be identified immediately rather than after laboratory results are obtained [55]. It is also clear that improving women's access to the health system should be a high priority, as contact with the health system is a prerequisite for any screening program to succeed.

More radical solutions, however, may be needed, particularly for this latter group of countries. The availability of a vaccine for HPV offers one such solution. Vaccination places considerably fewer logistical demands on a health system than repeated screening, testing, and treatment of precursor lesions. In addition, it may be easier to reach younger women than to systematically screen older women, who are at the highest risk of developing cervical cancer. In some of these countries, for example the Philippines, where school enrolment rates are relatively high, vaccination programs could be implemented in the context of the education system. Such an approach would be substantially less expensive and easier to implement than delivering the vaccine through door-to-door approaches or through primary health care, where population coverage levels are likely to be low. Donors may also be more prepared to pay for targeted interventions like vaccines, which can easily be implemented through vertical programs. Finally, it is possible that vaccination may be more culturally acceptable than vaginal examination in some cultures with the lowest rates of coverage.

However, the benefits of the vaccine must be weighed against its limitations as a prevention strategy as well as its considerable cost. Vaccination will not have an impact for many years, as it has to be directed to adolescents before the onset of sexual activity. The immediate need for cervical cancer screening and control in many developing countries suggests that there should be greater emphasis on strategies to reach women aged 35 or over, while alternatives are being considered and explored. The current version of the HPV vaccine protects against the two strains most commonly implicated in cervical cancer. Since the vaccine is projected to prevent the majority of, but not all, cervical cancer cases, screening will likely still need to be recommended for vaccinated women. There is also the possibility that a new emphasis on a vaccine would divert resources and attention—at the policy level as well as for individual women—from screening [38].

In addition, the cost of purchasing the vaccine may be significant. A recent study showed that vaccination and three screening visits would be very cost-effective, assuming a total cost of vaccination of US$25 per woman.[56]. However, the current cost of the vaccine is very far from this projection: while there may be opportunities for international programs to negotiate discounts through mass purchasing [57,58], the current price of US$300–US$400 per course [59,60] may be prohibitive. Indeed, the real cost may be higher, since women would need to be reached multiple times in order to deliver each dose of a multiple-dose course [56] and since cold-chain infrastructure is currently required. Since vaccination does not obviate the need for screening, the financial burden of both strategies may be too high for already strained health systems to bear. An addition consideration to keep in mind, highlighted by the recent controversy over the vaccine in the US [61], is that vaccinating women against a sexually transmitted infection is by no means universally culturally accepted.

Finally, this study also highlights the urgent need for better monitoring of cervical cancer screening and control and for in-depth evaluations of current strategies implemented in various countries, so that the evidence base of

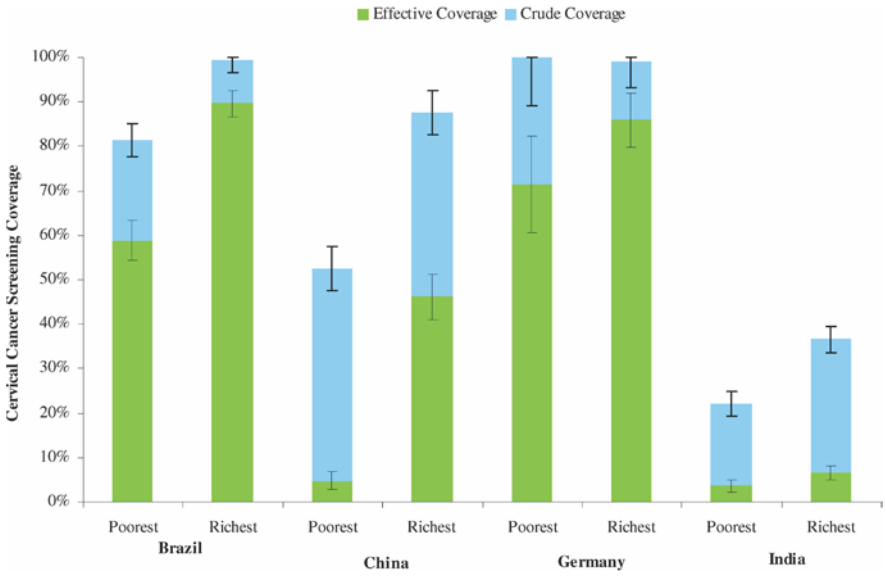

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Figure 4. Cervical Cancer Screening Coverage in Top and Bottom Within-Country Wealth Quintiles, Across Four Selected Countries

what works and what does not can be strengthened. Questions on preventive services, including cervical cancer and breast cancer screening, are often not included in national health surveys in developing countries, thus resulting in a weak global evidence base for cervical cancer screening and control. The World Health Surveys, which were used in this analysis, have several limitations. First, among the limitations of self-reported data is the fact that, for questions on cervical cancer screening, it is difficult to know with certainty whether we are measuring the coverage of a pelvic exam in the context of obstetric or gynecologic care or a screening test for cancer. Also, while it is likely that women would remember a pelvic exam, our estimates of effective coverage are limited by the ability of women to report whether a laboratory test (i.e., a Pap smear) was performed in the context of the pelvic exam. Since it is possible that a number of women were not informed, did not understand, or did not report this test, our numbers may represent a low estimate of effective coverage. It is also possible that women do not report accurately on the timing of the vaginal exam and that our estimates of crude coverage are underestimates, if women do not report vaginal exams that were performed several years before the survey.

We have attempted to correct for bias from missing data by applying a multiple imputation method; however, this technique may not adequately address all the bias in the WHS data. Despite these limitations, the WHS provide the first opportunity to estimate cervical cancer screening rates and inequalities across a large set of developing and developed countries. The findings presented in this paper provide a solid starting point, while highlighting the need to improve the quality and the frequency of monitoring of cervical cancer screening and control efforts worldwide.

Conclusion

Effective coverage rates for cervical cancer screening services are very low outside of developed countries, and women at the highest risk of developing cervical cancer are among the least likely to be screened. Coverage rates decline with advancing age, when cervical cancer incidence rates are the highest. Poor women, who likely have higher exposure to known cervical cancer biological risk factors such as smoking and unsafe sex [62], also show much lower coverage rates. Improving the effective coverage of cervical cancer screening or developing alternative ways to decrease cervical cancer mortality worldwide would have a considerable impact on decreasing the disease's burden as well as overall health inequalities. No one strategy will work everywhere, making it important to consider multiple strategies across—and likely within—countries. ■

Supporting Information

Figure S1. Comparison of proportion of women who have never had a pelvic examination and effective screening coverage between two age-based definitions of the screening-eligible population

Found at doi:10.1371/journal.pmed.0050132.sg001 (13 KB PDF).

Table S1. Sample sizes and percentage of observations missing for eligible women ages 25–64 by WHS country

Found at doi:10.1371/journal.pmed.0050132.st001 (7 KB PDF).

Table S2. Effective coverage and fraction of women who never had pelvic exam by age and wealth group for eligible women ages 25–64, by WHS country

Found at doi:10.1371/journal.pmed.0050132.st002 (12 KB PDF).

Text S1. Description of the analytical methods used

Found at doi:10.1371/journal.pmed.0050132.sd001 (43 KB DOC).

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Author contributions. EG, SN, and ZO designed the analytical framework. SN performed statistical analyses. EG, SN, and ZO drafted the manuscript. EG accepts full responsibility for the work and the conduct of the study, had access to the data, and controlled the decision to publish.

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