International Journal of Gynecology and Obstetrics (2007) **98**, 66–69

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International Journal of GYNECOLOGY & OBSTETRICS

SPECIAL ARTICLE

Reducing maternal mortality due to elective abortion: Potential impact of misoprostol in low-resource settings

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Received 2 November 2006; received in revised form 2 March 2007; accepted 15 March 2007

KEYWORDS
Maternal mortality;
Misoprostol abortion;
Medical abortion

Abstract Over 99% of deaths due to abortion occur in developing countries. Maternal deaths due to abortion are preventable. Increasing the use of misoprostol for elective abortion could have a notable impact on maternal mortality due to abortion. As a test of this hypothesis, this study estimated the reduction in maternal deaths due to abortion in Africa, Asia and Latin America. The estimates were adjusted to changes in assumptions, yielding different possible scenarios of low and high estimates. This simple modeling exercise demonstrated that increased use of misoprostol, an option for pregnancy termination already available to many women in developing countries, could significantly reduce mortality due to abortion. Empirical testing of the hypothesis with data collected from developing countries could help to inform and improve the use of misoprostol in those settings.

1. Introduction

Unsafe abortion is a preventable public health threat in developing regions, where over 99% of deaths due to abortion occur [1]. This article assesses the potential of misoprostol (Cytotec®, Pfizer, New York, NY) to induce elective abortion as a simple intervention to reduce maternal mortality. To explore this hypothesis, estimates of the mortality reductions possible if misoprostol were to replace riskier abortion techniques are presented.

Medical abortion has been shown to be safe and effective in developing countries [2–4]. It does not require anesthesia or a hospital setting, and holds promise to increase access to safe abortion where surgical abortion is unsafe or unavailable. The World Health Organization (WHO) added mifepristone and misoprostol to its Essentials Medicines List for developing countries [5]. Mifepristone is expensive and is not approved in many countries. Misoprostol, a prostaglandin E_1 analogue, is inexpensive, stable at room temperature, widely

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0020-7292/$ - see front matter
doi:10.1016/j.ijgo.2007.03.009

Table 1 Estimates of deaths due to abortion in developing regions

Number unsafe abortions [1]	Number maternal deaths to unsafe abortion	Proportion attempting medical abortion (%)	Estimated mortality to medical abortion (deaths per 100,000 abortions) [a]		Estimated number deaths to medical abortion [b]	Estimated number maternal deaths to all abortions	Estimated percent reduction maternal deaths
			1st trimester	2nd trimester			
Developing regions							
18,400,000	67,500						
		20	20	200	1781	57,266	15.2
		20	10	100	891	56,376	16.5
		40	20	200	3562	47,032	30.3
		40	10	100	1781	45,251	33.0
		60	20	200	5343	36,798	45.5
		60	10	100	2672	34,127	49.4
		80	20	200	7124	26,564	60.6
		80	10	100	3562	23,002	65.9
Africa							
4,200,000	29,800						
		20	20	200	407	24,902	16.4
		20	10	100	203	24,699	17.1
		40	20	200	813	20,004	32.9
		40	10	100	407	19,598	34.2
		60	20	200	1220	15,106	49.3
		60	10	100	610	14,497	51.4
		80	20	200	1626	10,209	65.7
		80	10	100	813	9396	68.5
Asia [c]							
10,500,000	34,000						
		20	20	200	1016	28,964	14.8
		20	10	100	508	28,456	16.3
		40	20	200	2033	23,929	29.6
		40	10	100	1016	22,912	32.6
		60	20	200	3049	18,893	44.4
		60	10	100	1525	17,369	49.8
		80	20	200	4066	13,858	59.2
		80	10	100	2033	11,825	65.2
Latin America							
3,700,000	3700						
		20	20	200	358	3400	8.1
		20	10	100	179	3220	13.0
		40	20	200	716	3000	16.2
		40	10	100	358	2714	25.9
		60	20	200	1074	2799	24.4
		60	10	100	537	2261	38.9
		80	20	200	1433	2498	32.5
		80	10	100	716	1782	51.8

[a] 80% of all abortions assumed to occur in 1st trimester and 20% in 2nd trimester.
[b] 10% of medical abortions in 1st trimester and 15% in 2nd trimester assumed to "fail" and were given prevailing mortality rates for unsafe abortion.
[c] Excluding Japan, Australia, and New Zealand.

available and used off-label for many obstetric/gynecologic conditions. Although not as effective as mifepristone–misoprostol, misoprostol-alone has been studied for first and second-trimester abortions [6,7].

Misoprostol abortion regimens of varying doses and routes of administration have been tested in developing regions [8–10]. Efficacy of misoprostol-alone for first-trimester abortion ranges from about 88–96%, but may be lower in legally restricted

settings [11]. A consensus regimen has been published for early abortion (through 9 weeks gestation), consisting of 800 mcg vaginal misoprostol, repeated after 24 h [12]. Misoprostol regimens for second-trimester abortion have shown effectiveness from approximately 85–91%, although a consensus regimen does not yet exist [6]. Studies in China have shown success using 400 μg vaginal misoprostol every 3–6 h, up to 5 doses in 24 h [13,14].

Little research has been conducted on the safety and effectiveness of misoprostol used in less controlled settings [15]. Misoprostol was used, however, outside of clinics in Brazil and the Dominican Republic before a consensus regimen was reached, and was associated with fewer infections and abortion complications [16,17]. The paucity of mortality data, particularly where abortion is legally restricted, necessitates an estimation approach in measuring the impact of misoprostol abortion. Estimates can be used to inform maternal health interventions. This article uses a simple modeling approach with high and low mortality rates and varies an assumption that is amenable to intervention, the proportion of women choosing medical abortion. The model yields eight different scenarios per region, ranging from minimal to maximum impact.

2. Materials and methods

Maternal deaths due to abortion in developing regions are estimated as a whole and then separately for Africa, Asia and Latin America. The model assumed that factors influencing pregnancy, abortion, and mortality rates remain at current levels (e.g. women in reproductive age, contraceptive prevalence, pregnancies, poverty and urbanization rates, women at risk of unsafe abortion).

2.1. Mortality rates, by trimester

Mortality rates for mifepristone–misoprostol are estimated at 0.8–1.5 deaths per 100,000 abortions in the U.S.,[18,19] and mortality in the second trimester is approximately 10-fold higher [20]. Almost 90% of abortions are first trimester,[21] but in low-resource settings, delays are likely longer. Mortality associated with misoprostol abortion will be higher where access to emergency medical services is poor, particularly for second-trimester abortions, which account for most abortion deaths [22,23]. The model assumed two different sets of mortality rates, low and high, for misoprostol abortion in developing regions, and varied the rates by trimester. The low series is 10 deaths per 100,000 abortions in the first trimester and 100 deaths per 100,000 abortions in the second trimester. The high series is 20 deaths per 100,000 abortions (first trimester) and 200 per 100,000 (second trimester). First-trimester rates were applied to 80% of medical abortions.

2.2. Proportion of women using medical abortion

The proportion of women at risk of unsafe abortion who choose medical abortion was varied to assess the impact on mortality. The proportion varies widely and is likely to continue to change over time as awareness and practice change. Estimates started at 20% and ranged to an outside figure of 80% of abortions. In the U.S. about 25% of women choose medical abortion, in France and Scotland 60–70%, and in China 30–70% [24,25]. A study in India showed a range of 0–80%, depending on the provider [26].

2.3. Mortality rates for medical abortion failures

An estimated 10% of first-trimester and 15% of second-trimester medical abortions are assumed to fail. Failures were assigned prevailing mortality rates for unsafe abortion, taken from WHO estimates (18.4 million unsafe abortions, 67,500 maternal deaths) in developing regions [1]. Corresponding WHO mortality rates are: 366.8 per 100,000 unsafe abortions in developing regions, 709.5 in Africa, 323.8 in Asia, and 100.0 in Latin America/Caribbean.

In sum, the model assumed a low and high series of mortality rates, by trimester, and varied the proportion of women choosing medical abortion to assess the impact on mortality. The remaining procedures, along with medical abortion failures, are subject to prevailing mortality rates for unsafe abortion. The total number of deaths was compared to deaths currently attributed to unsafe abortion. The final column of Table 1 shows the estimated percent reduction in maternal deaths.

3. Results

Results show that under conditions of high mortality rates, there is a 15% reduction in mortality if 20% of procedures are misoprostol-induced; 30% reduction in mortality if the proportion of procedures rises to 40%; and a 45% reduction with 60% misoprostol-induced, which represents 30,500 lives saved annually. Relying on the low series of mortality rates, with 20% of abortions misoprostol-induced, the improvements are similar at 16.5%; at 40% misoprostol-induced a 33% mortality reduction; and at 60% misoprostol-induced, a 49% mortality reduction. Improvements depend heavily on the proportion using medical abortion, rather than on whether low or high estimates for mortality are used.

While the higher mortality estimates would be more likely in Africa and Asia, the low rates of 10 per 100,000 for first trimester and 100 per 100,000 for second trimester are more likely for Latin America. At low mortality in Latin America with 40% of abortions misoprostol-induced, a 26% reduction in maternal deaths can be achieved, and in Africa and Asia, 33% and 30% respectively, using the high series of mortality rates.

4. Discussion

These estimated mortality reductions are notable, whether high mortality rates, as might occur in Africa or parts of Asia, or low, are used as the basis of the estimate. While countries where mortality rates are highest stand the most to gain, these simple estimates show that even in Latin America, more widespread use of misoprostol-induced abortion could lead to a large reduction in maternal mortality. The more widespread misoprostol abortion is, the greater the gains.

Abortion-related mortality has decreased in Latin America where some abortions are already misoprostol-induced, and acceptability of misoprostol was found to be high [27]. However, neither women nor health practitioners have widespread knowledge of the consensus regimen nor of the abortion process itself [28]. Informed use of misoprostol, particularly

knowledge of the consensus regimen and where to seek post-abortion care, is necessary to realize the full benefits.

Given higher mortality with second-trimester termination, initiating the regimen early in pregnancy could dramatically affect mortality. Women seeking abortion have shown themselves capable of calculating pregnancy duration, although rural women may present at later gestational ages [29,30]. For misoprostol abortion to have the greatest impact on mortality, timely access to post-abortion care at hospitals or clinics is necessary. Women may not recognize when they require care for bleeding, and post-abortion care, including urgent care for complications and treatment of incomplete and unsafe abortion, is not always available [31]. Current estimates of abortions and maternal deaths are likely underestimates [32]. The model here used conservative numbers where data are scarce. Research is needed to document actual mortality rates as misoprostol use increases in developing regions.

Acknowledgments

We would like to acknowledge support from the Richard and Rhoda Goldman Fund and from the Population Council.

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