

# A Framework for Analyzing the Determinants of Obstetric Fistula Formation

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*Obstetric fistula, a devastating complication of prolonged obstructed labor, was once common in the Western world but now occurs almost exclusively in resource-poor countries. Although much has been written about the surgical repair of obstetric fistulas, prevention of fistulas has garnered comparatively little attention. Because obstetric fistulas result from obstructed labor (one of the common causes of maternal death in impoverished countries), this study assesses the obstetric fistula problem using a framework originally developed to analyze the determinants of maternal mortality. The framework identifies and explicates three sets of determinants of obstetric fistulas: the general socioeconomic milieu in which such injuries occur (the status of women, their families, and their communities); intermediate factors (health, reproductive status, and use of health care resources); and the acute clinical factors that determine the ultimate outcome of any particular case of obstructed labor. Interventions most likely to work rapidly in fistula prevention are those that have a direct impact on acute clinical situations, but these interventions will only be effective when general socioeconomic and cultural conditions promote an enabling environment for health care delivery and use. Sustained efforts that impact all three levels of determining factors will be necessary to eradicate obstetric fistula. (STUDIES IN FAMILY PLANNING 2012; 43[4]: 255–272)*

Obstetric fistula is a devastating childbirth injury prevalent in resource-poor countries that have high maternal mortality rates. Fistulas are caused by prolonged labor in which the fetus cannot fit through the mother's birth canal. When labor is obstructed, the vulnerable soft tissues of the woman's pelvis becomes trapped between her pelvic bones and the fetal head. The progress of labor stops but the force of the uterine contractions does not diminish. The fetal head becomes wedged progressively more tightly in the pelvis. Delivery must take place promptly (usually by cesarean section) to avoid fetal death and maternal injury. If delivery does not occur expeditiously, a cascade of pathophysiological processes is set in motion that often causes catastrophic injury. The pressure exerted by the fetal head shuts off the flow of blood to the entrapped tissues, leading first to asphyxiation and then to tissue necrosis of the vesicovaginal and/or rectovaginal septum. These dead tissues slough away, forming a vesicovaginal and/or rectovaginal fistula that renders the

woman completely incontinent of urine, feces, or both. Fistulas rarely heal without surgery, and because access to surgical services is poor in those parts of the world where maternal mortality and obstetric fistulas are common, most of the women injured during obstructed labor cannot obtain the reconstructive operations that will allow them to return to a normal social life (Wall et al. 2005; Wall 2006 and 2012a).

The backlog of birth-injured women with fistulas in the world's poorest countries is steadily growing. These women are social outcasts living lives of unalloyed misery (Islam and Begum 1992; Wall 2002; Goh et al. 2005; Bangser 2006; Yeakey et al. 2009). As many as 3.5 million women suffer from obstetric fistulas in sub-Saharan Africa and south Asia, and as many as 130,000 new cases are added each year (Vangeenderhuysen, Prual, and Ould el Joud 2001; Wall 2006). In addition to the loss of continence produced by a fistula, many women suffer from other co-morbidities of obstructed labor such as foot-drop, vaginal stenosis, infertility, chronic urinary-tract infections, and other conditions collectively known as the "obstructed labor injury complex" (Arrowsmith, Hamlin, and Wall 1996).

The surgical techniques needed to repair obstetric fistulas are relatively well known. Most fistulas (56–98 percent) can be closed successfully without the use of

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high-technology resources (Elkins, Drescher, and Fort 1988; Elkins 1994; Hilton and Ward 1998; Wall et al. 2005; Roenneburg, Genadry, and Wheelless 2006; Raassen, Verdaasdonk, and Vierhout 2008; Lewis et al. 2009; Kirschner et al. 2010; Muleta, Rasmussen, and Kiserud 2010; Singh et al. 2011; Sjoveian et al. 2011). From the standpoint of fistula treatment, the major problem is inadequate surgical capacity to handle the number of existing cases. Capacity is hindered by the lack of adequately trained surgeons, the lack of adequate clinical facilities, and the absence of enabling environments that encourage fistula repair in regions where these injuries are prevalent. But unless the number of new cases is also dramatically reduced, even major improvements in the provision of curative clinical services will fail to solve the fistula problem. Which strategies will work best to reduce the number of new fistula cases that occur each year is not completely understood, but historical experience strongly suggests that dramatic reductions in the number of fistula cases can be achieved. Obstetric fistulas were common in Western countries 150 years ago when maternal mortality was also very high. At the beginning of the twentieth century, maternal mortality was as high in the United States and Europe as it is today in most African countries (Loudon 1992 and 2000; De Brouwere, Tonglet, and Van Lerberghe 1998). As maternal mortality in the industrialized world fell to unprecedented lows, obstetric fistulas declined precipitously. We need to understand how this occurred and how this achievement might be replicated today in countries where the incidence and prevalence of obstetric fistulas is great.

The problem of maternal mortality in resource-poor countries began receiving sustained attention about twenty-five years ago (Rosenfield and Maine 1985; Mahler 1987). Although progress in reducing maternal deaths has been extremely slow (Maine and Rosenfield 1999; Weil and Fernandez 1999; Graham et al. 2008; Maclean 2010), positive results are now starting to be realized, even if Millennium Development Goal 5 (reduction of maternal mortality by 75 percent worldwide by 2015) is not likely to be achieved on schedule (Hogan et al. 2010). Much has been learned about maternal mortality since the launching of the Safe Motherhood Initiative by the World Health Organization (WHO) and other international organizations in 1987. Obstetric fistulas are caused by obstructed labor, and obstructed labor is one of the six major causes of maternal death worldwide (together with hemorrhage, sepsis, hypertensive disorders, HIV infection, and complications of unsafe abortion) (Ronsmans and Graham 2006). Much of what we know about the prevention of maternal mortality is therefore directly applicable to the prevention of obstetric fistulas, because fistula formation is one of the common nonfatal outcomes of obstructed labor. Twenty years ago, McCarthy and

Maine published an important article presenting a framework for analyzing the determinants of maternal mortality. The authors noted that “the framework we propose can also be applied to chronic morbidity that results from pregnancy or childbirth” (McCarthy and Maine 1992: 24). The present article applies McCarthy and Maine’s analytic framework to the specific problem of obstructed labor and obstetric fistula formation.

According to the McCarthy and Maine framework, any factor that reduces maternal mortality will operate through one of three mechanisms: (1) it will reduce the likelihood that a woman will become pregnant, (2) it will reduce the likelihood that a pregnant woman will develop a serious complication of pregnancy or childbirth, or (3) it will improve the outcomes for women who develop complications. Similarly, any factor that reduces the formation of obstetric fistulas will work through one of these same three mechanisms: (1) it will reduce the likelihood that a woman will become pregnant, (2) it will reduce the likelihood that a pregnant woman will develop obstructed labor, or (3) it will improve the outcomes for women whose labor becomes obstructed.

## Overview of Analytic Framework

Obstetric fistulas are caused by prolonged obstructed labor. Although obstructed labor appears to be highly prevalent in resource-poor countries, surprisingly little published data can be found on its distribution and occurrence. WHO estimates that obstructed labor occurs in about 4.6 percent of live births, giving rise to some 6 million cases per year, of which 40,000 result in maternal death (Abou-Zahr 2003). The low case-fatality rate derived from these statistics is misleading, however, because cases of obstructed labor in developed countries are diagnosed early and treated promptly. Prolonged obstructed labor is virtually unknown in the health care systems of wealthy industrialized countries. Obstetric fistula is a problem of the “bottom billion” of the world’s poor and deserves to be classified as a “neglected tropical disease” (Wall 2012a). Table 1 presents historical data on obstructed labor and associated morbidity and mortality resulting from obstructed labor in several resource-poor countries over the past four decades. The reported rate of obstructed labor ranges from 1 to 7 percent, with reported case-fatality rates for obstructed labor ranging from less than 1 percent to almost 17 percent. The reported rates of obstetric fistula range from 0 to almost 7 percent. These data are all derived from hospital studies. Little reliable information regarding outcomes is available at the community level, and the data that do exist are equally bleak (Tahzib 1983 and 1985; Harrison 1985).

**Table 1** Percentage of deliveries characterized by obstructed labor, and percentage of such deliveries resulting in fistula or death, several developing countries, 1960–2003

Date	Source		Country	Total number of deliveries	Percent of obstructed labor deliveries	Percent of	
	Author					obstructed labors developing vesicovaginal fistula	Percent of maternal case fatalities in obstructed labor
1960	Lister		Nigeria	17,230	1.9	6.6	13.8
1966	Banerji		India	2,503	2.4	na	16.6
1972	Dutta and Pal		India	13,474	2.3	na	11.4
1980	Oronsaye and Asuen		Nigeria	6,369	2.1	2.4	0.8
1985;1985	Harrison; Harrison et al.		Nigeria	20,028	5.9	6.7	5.3
1990	Sarkar		India	36,921	2.0	0.4	0.4
1991	Ozumba and Uchegbu		Nigeria	10,202	4.7	2.7	0.2
1991	Randhawa, Gupta, and Kanwal		India	4,621	1.2	3.9	1.0
1992	Konje, Obisesan, and Ladipo		Nigeria	39,456	1.0	6.3	1.1
1993	Kamalajayaram		India	7,508	1.7	na	4.7
1995	Khan and Roohi		Pakistan	1,584	4.0	0	1.6
2002	Gaym		Ethiopia	13,425	7.0	na	9.1
2003	Dafallah, Ambago, and El-Agib		Sudan	16,221	1.3	1.5	na

na = Not available.

Figure 1 presents a framework for analyzing the determinants of obstetric fistula formation. The figure is based upon McCarthy and Maine's original concept for analyzing maternal mortality, but here the framework is focused specifically on obstructed labor and obstetric fistula. The proposed scheme divides influencing factors into three major stages or sets of components (remote, intermediate, and acute clinical determinants) that affect the ultimate outcome. The three outcomes listed in this figure, all mediated by obstructed labor, include maternal death, resolution of obstructed labor without death or obstetric fistula formation (with or without fetal demise), and development of a genitourinary and/or rectovaginal fistula. A woman in obstructed labor may suffer simultaneously from infection, hemorrhage, preeclampsia or eclampsia, thromboembolism, or other direct and indirect complications of pregnancy, although attempting to include all possible eventualities would render the figure overly complicated.

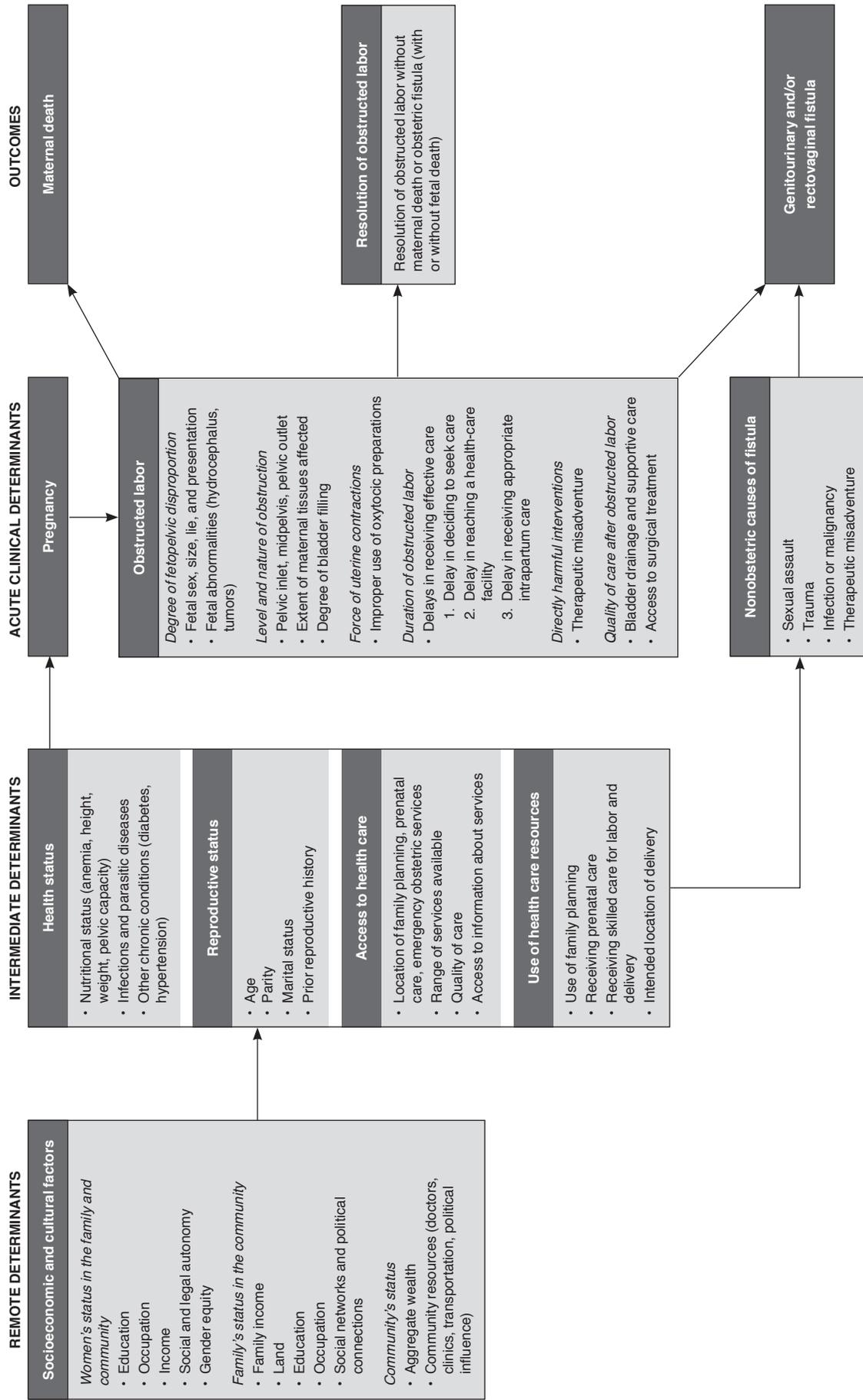
The flow diagram begins with the general socioeconomic and cultural environment of those at risk for a fistula. These remote determinants influence intermediate factors such as women's health and reproductive status, their access to health care, and their use of health care services. The intermediate factors form the background against which the pregnancy at risk for a fistula develops. The factors most directly related to the outcomes of specific pregnancies are referred to as acute clinical determinants. These specific clinical circumstances exist intrapartum and postpartum in any case in which labor becomes obstructed. These circumstances will be the main drivers that determine whether a particular woman in obstructed labor develops a fistula. This article reviews each element of the framework in succession, examining

the factors that determine whether a fistula develops in any particular case of obstructed labor.

## Remote Socioeconomic and Cultural Determinants

Pritchett and Summers (1996) have demonstrated that wealthier nations are healthier nations. As Rosato and colleagues (2008: 967) explain, "health, particularly in marginalized groups, is indirectly but powerfully affected by the social environment in which personal behaviours are embedded." They note that "risk factors (such as isolation, lack of social support, low self-esteem) and risk conditions (such as poverty, discrimination, power hierarchies)" negatively impact maternal and child health. The larger socioeconomic environment in which maternal health is situated is heavily influenced by the interrelated statuses of individual women, the position of their families within the community, and the status of their communities within the country. In developed countries, obstetric fistulas have been essentially eliminated and obstructed labor has vanished as a cause of maternal death, whereas in resource-poor countries with nonindustrial economies and weak infrastructure, obstetric fistulas and maternal mortality from obstructed labor remain important clinical problems (Khan et al. 2006). As Harrison (2009: 18) has written: "dead and damaged mothers and infants make up a cluster of conditions resulting from one thing, very poor obstetric care. But then, very poor obstetric care is one result of the chaotic socio-economic and political systems, which is the major underlying disease." This is the fundamental idea behind the concept of "structural violence" (Farmer et al.

**Figure 1** Framework for analyzing the determinants of obstetric fistula formation



Source: Worldwide Fistula Fund (used by permission).

2006; Mukherjee et al. 2011), which Gilligan (1997: 192) describes as:

the increased rates of death and disability suffered by those who occupy the bottom rungs of society, as contrasted with the relatively lower death rates experienced by those above them. Those excess deaths (or at least a demonstrably large proportion of them) are a function of class structure, and that structure itself is a product of society's collective human choices concerning how to distribute the collective wealth of society.

The global distribution of obstetric fistulas reflects structural violence because the condition today is almost exclusively a disorder of poor women within poor countries (Kabakyenga et al. 2011; Wall 2012a and 2012b).

Wide-ranging evidence exists of the links between socioeconomic conditions and women's reproductive health. Several studies have demonstrated very strong correlations between the United Nations Human Development Index (a composite index of life expectancy, literacy, and per capita gross domestic product) and similar socioeconomic indicators on the one hand, and rates of infant and maternal mortality on the other. High rates of infant and maternal mortality are associated with poverty, lack of education, and poor health care (Hertz, Hebert, and Landon 1994; Lee et al. 1997; Shen and Williamson 1999). Low scores on the Human Development Index and the Gender Development Index are powerful predictors of high levels of maternal and infant death, as are low female literacy and low school enrollment (McAlister and Baskett 2006). General socioeconomic inequality manifests itself in discrepancies in both height and weight in population samples, with shorter stature and lighter weight among the poor and disadvantaged (Subramanian, Ozaltin, and Finlay 2011; Subramanian et al. 2011). Stunted growth, in turn, is strongly correlated with pelvic contracture and an increased risk of obstructed labor among women (Naegle 1939; Harrison 1990). When the large differentials in use of health services, rates of cesarean delivery, and access to emergency obstetric services among wealth quintiles in developing nations are considered (all of which are higher as wealth quintiles increase), obstetric fistula is clearly associated most strongly with reproducing women in the lower social orders of resource-poor countries, who lack access to even minimum levels of acceptable obstetric care (Ronsmans, Holtz, and Stanton 2006; Houweling et al. 2007; Say and Rainse 2007).

Maternal mortality has been dramatically reduced in resource-rich regions such as the United States and Western Europe primarily by targeting the principal causes of maternal death with specific technologies and skill sets: skilled attendance at birth; rapid access to cesarean de-

livery, blood transfusion, and antibiotics; supervised use of oxytocic agents; professionalization of midwifery and obstetrics; contraceptives; removal of economic barriers to maternity care; effective transportation infrastructure; and so forth (Loudon 1992 and 2000; De Brouwere, Tonglet, and Van Lerberghe 1998). Concerted efforts were made in these countries at all levels of society to ensure that such lifesaving interventions were available to all pregnant women rather than simply relying on generally improving economic and social circumstances to accomplish this. At the same time, stable governance, good management, and the wise use of existing resources can undeniably make a dramatic improvement in maternal health, even in countries without great wealth (Shiffman 2000 and 2007; Shiffman and Smith 2007; Harrison 2009).

Careful attention to gradually developing the social and economic infrastructure of a country provides an important framework on which future progress can be built. For example, Sri Lanka and Malaysia have reduced their maternal mortality by 50 percent every 6–12 years since the 1930s through consistent, targeted national policies. As Pathmanathan and colleagues (2003) explain, the governments of Malaysia and Sri Lanka achieved their success by making maternal and child health a national priority and by implementing specific, sustained human development strategies in health, education, and nutrition, such as providing geographical and financial access to education and health services for the rural poor.

## Intermediate Determinants

Intermediate determinants that may affect the likelihood of fistula formation include the health and reproductive status of at-risk women during their pregnancies and their access to and use of health care resources. The intermediate determinants set the stage for the acute clinical factors to exert their final determining influence upon the pregnancy.

### Health Status

Women in better general health are likely to have better outcomes should their labor become obstructed than women who are not as healthy. Healthier tissues are more likely to withstand the compressive forces to which they are subjected during prolonged labor. Stronger, more resilient women are likely to have a better chance of survival and to recuperate faster from injuries than will weaker, less resilient women. Other factors being equal, women who have had good nutrition and good health during childhood and adolescence are likely to have better outcomes when they enter their reproductive years.

Worldwide, 30 percent of nonpregnant women and 42 percent of pregnant women are anemic. The prevalence and distribution of anemia is influenced by a complex interplay of social, economic, biological, and ecological factors, of which poverty, lack of education, and being female are particularly important (Balarajan et al. 2011). Anemia “is a marker of socioeconomic disadvantage, with the poorest and least educated being at greatest risk” (Balarajan et al. 2011: 2124). Risk factors include nutritional deficiencies (iron, folic acid, vitamin B12, vitamin A), infections (hookworm, malaria, schistosomiasis, HIV/AIDS), and inherited disorders of hemoglobin (sickle cell, thalassemia). Adolescent girls approaching reproductive age (and pregnant adolescents in particular) are at high risk for anemia, which can adversely affect fetal health, stunt growth, and lead to health problems later in life for both mother and child. When the diets of pregnant adolescents were supplemented with iron and folate, dramatic changes in their height were observed, compared with the height of their nonsupplemented counterparts (Fleming et al. 1985). Anemic women are less able to fight off infection, and the reduced capacity of anemic blood to carry oxygen would suggest that an anemic woman in obstructed labor would have a lower threshold for tissue injury than a woman with a higher hemoglobin level.

The size and shape of the bony pelvis has obvious and important implications for the development of obstructed labor (Naegle 1939). Any pelvic deformity or abnormality will potentially make labor more difficult. As Myerscough (1977: 219) has noted, “the three principal causes of pelvic deformity are nutritional deficiency, disease or injury of the pelvic bones and joints, and errors of development,” the latter sometimes produced or aggravated by abnormalities in the spine or lower limbs. The most important of these factors is probably poor nutrition (Konje and Ladipo 2000). Women who have reached reproductive age after a childhood plagued by parasitic diseases and poor nutrition are at greater risk of stunted growth, ill health, poor educational attainment, and reduced socioeconomic prospects in later life (Grantham-McGregor et al. 2007; Victora et al. 2008; Dewey and Begum 2011). Growth stunting often results in short stature in adulthood, and the association between short maternal height and difficult delivery is well known. Short women, particularly those whose growth was stunted by nutritional deficiencies during childhood, often have more difficult labor, greater need for cesarean delivery, higher perinatal mortality and morbidity, and an increased risk of dying or being seriously injured either from the obstructed labor itself or from complications of operative intervention (Thomson 1959; Cox 1963; Everett 1975; Camilleri 1981; Adadevoh, Hobbs, and Elkins 1989; Harrison 1990; Tsu 1992; Kwawukume, Ghosh, and Wilson 1993; Merchant,

Villar, and Kestler 2001; Ozaltin, Hill, and Subramanian 2010). As Bernard (1952) observed, a small woman from the poorer classes is likely to have a small pelvis of abnormal shape, which makes labor difficult if the infant is large. The fact that adult height is usually attained well before pelvic growth is complete puts young adolescent mothers at particular risk (Moerman 1982), but even older women who have previously had successful vaginal deliveries may develop bony abnormalities from nutritional factors that lead to obstructed labor in subsequent pregnancies (Chaim et al. 1981). These problems are likely to be exacerbated in communities in which early adolescent marriage is the cultural norm.

## Reproductive Status

The most reliable indicator of future reproductive performance is past obstetric history (Kasongo Project Team 1984). This fact highlights the importance of continuous clinical vigilance when caring for women during their first pregnancy, when the pelvis is unproven as a reproductive pathway. Reproductive performance is generally worse at the extremes of reproductive life. Young primiparous teenagers and older multiparous women approaching the end of their reproductive years are particularly vulnerable to obstetric catastrophe (Geidam, Audu, and Oummate 2011; Santhya 2011). For example, Ujah and colleagues (2005) reviewed maternal mortality in north-central Nigeria and found that the greatest risk of maternal death was among teenagers 15 years of age and younger and women 40 years of age and older. Maternal mortality increased with increasing parity and was highest in grand multipara with five or more deliveries. Most studies show the largest group of women with fistulas to be those who developed this condition during their first pregnancy, but studies also show that many women develop a fistula later in their reproductive lives, after three or more previous births (Danso et al. 1996; Hilton and Ward 1998; Wall et al. 2004; Tebeu et al. 2009; Muleta, Rasmussen, and Kiserud 2010; Sjoviean et al. 2011). This phenomenon likely reflects increasing birth weight with subsequent pregnancies; changes in pelvic architecture resulting from nutritional factors, injury, or deformity; malpresentations; and complacency about pregnancy complications based on earlier successful deliveries.

Where early adolescent marriage is common, fistulas are likely to be a problem. In their investigation of 899 fistula patients in Jos, Nigeria, Wall and colleagues (2004) found that the mean age of menarche was 14.5 years, the mean age of marriage was 15.5 years, 34 percent of women had been married by age 14, 39 percent had not yet menstruated at the time of marriage, and 46 percent of fistulas occurred during first pregnancies. The fact that

growth in pelvic capacity continues for several years after menarche suggests that early marriage practices predispose a population to high rates of obstructed labor and high risk of fistula formation (Moerman 1982).

### **Access to and Use of Health Care Resources**

The principal reason for the occurrence of obstetric fistulas is delay in obtaining competent care after labor becomes obstructed; thus, access to health care services is a critical factor in fistula prevention and treatment. The location of clinical facilities (those providing family planning, antenatal care, and/or emergency obstetric care), the range of services available, the quality of care provided, and high community awareness are critical for preventing and treating obstetric fistulas. These factors are interrelated with one another. Knowing that labor is obstructed and that help is needed is of no benefit if facilities at which competent care can be obtained are not available. Even if such facilities exist, they will not be effective unless they are used by the local population. Studies consistently find poor contraceptive prevalence, low rates of antenatal care, prolonged labor at home, and low rates of institutional delivery or very late presentation for delivery at a hospital after prolonged labor among women who subsequently develop obstetric fistulas (Tahzib 1983; Hilton and Ward 1998; Wall et al. 2004; Melah et al. 2007; Meyer et al. 2007; Tebeu et al. 2009; Muleta, Rasmussen, and Kiserud 2010; Sjoveian et al. 2011). Regular participation in antenatal care programs has been associated with improved maternal outcomes in resource-poor countries, not so much because the programs themselves provide essential services but rather because women already booked for such care are familiar with the health care system and probably get quicker access to emergency services when a problem arises. In Harrison and colleagues' (1985) groundbreaking study of 22,774 consecutive hospital births in Zaria, Nigeria, among women who had no formal education and received no prenatal care, the maternal mortality ratio was 2,900 deaths per 100,000 deliveries, the perinatal mortality was 29 per 1,000 total births, and 26 percent of babies weighed less than 2,500 grams (5.5 pounds), whereas among educated women who received antenatal care, the maternal mortality ratio was 250 deaths per 100,000 deliveries, perinatal mortality was 2.5 per 1,000 total births, and only 8 percent of babies were of low birth weight.

### **Acute Clinical Determinants**

The phrase "acute clinical determinants" refers to the intrapartum factors that arise when labor becomes obstructed,

as well as the factors in play once obstructed labor has resolved. These factors have an immediate impact on patient outcome and the likelihood of obstetric fistula formation.

### **Degree of Fetopelvic Disproportion**

Obstructed labor occurs when the fetus will not fit through the maternal birth canal in spite of adequate, forceful uterine contractions (Neilson et al. 2003). The obstruction is caused by fetopelvic disproportion. Usually, but not always, fetopelvic disproportion is the result of a fetal head that is too large for the space available in the birth canal (cephalopelvic disproportion). The development of fetopelvic disproportion is influenced by multiple factors, among the most important of which is the specific anatomy of the maternal bony pelvis (Naegle 1939). The maternal bony pelvis constitutes the stage upon which any specific scenario of labor plays out, but because the architecture of the maternal bony pelvis is not specific to pregnancy and is itself influenced by other factors that come into play prior to pregnancy, it has already been discussed as an "intermediate" rather than an "acute" determinant.

Disproportion between the fetus and the maternal pelvis is influenced by fetal size, fetal lie (the orientation of the long axis of the fetus to the long axis of the mother), and fetal presentation (the portion of the fetal body that is foremost in the birth canal during labor) (Gardberg, Leonova, and Laakkonen 2011; Maharaj 2010). The sex of the fetus is also important because human fetuses exhibit a sexual size dimorphism that starts in early pregnancy and continues throughout gestation, with males being larger on average than females (Parker et al. 1984; Bukowski et al. 2007; Melamed et al. 2011). As a result, the presence of a male fetus is associated with higher rates of prolonged labor and cesarean section (Lieberman et al. 1997; Eogan et al. 2003). Obstructed labor is more likely to occur when the pregnant woman is carrying a male fetus. In a study of 899 women from Jos, Nigeria, who developed obstetric fistulas, Wall and colleagues (2004) found that nearly 75 percent delivered a male child in the pregnancy in which their fistula occurred. Similar findings were reported in a study conducted in Ethiopia (Muleta, Rasmussen, and Kiserud 2010). In addition to fetal size, lie, and presentation, fetopelvic disproportion may also result from congenital anomalies such as hydrocephalus (Anteby, Cohen, and Sadovsky 1974; Clark, DeVore, and Platt 1985; Diab 2005; Sikka et al. 2011), fetal hydrops (Wei and Chen 2006), conjoined twins (Gaym et al. 2004; Gessessew 2007), or unusual complications such as the entanglement of twins, where the interlocking of two separate fetal bodies in the birth canal precludes vaginal delivery (Nissen 1958).

## Level and Nature of Obstruction

The specific location at which labor becomes obstructed—pelvic inlet, midpelvis, pelvic outlet—during the descent of the fetus through the maternal birth canal has a direct impact on where a fistula will develop (Elkins 1994). For example, a labor that becomes obstructed low in the pelvis will be more likely to affect the urethra and bladder neck than a labor in which the obstruction occurs at the pelvic brim (Browning, Allsworth, and Wall 2010). The surface area and volume of maternal tissues that are compressed will be directly related to the extent of the injury that develops. The degree to which the bladder fills during labor and whether the pregnant woman is able to empty her bladder also has a direct bearing on the likelihood of developing a vesicovaginal fistula. As the bladder distends with urine, it stretches and its walls become thinner. As the bladder walls thin, the capillaries within them become progressively more vulnerable to compression, and the risk of ischemic injury increases. If a woman is unable to empty her bladder during the three or four days that her obstructed labor lasts, the organ will become grossly overdistended and highly vulnerable to injury. This basic observation has been known for centuries (Ramsbottom 1849) but is often neglected by birth attendants to the detriment of the patient.

## Force of Uterine Contractions

The presenting fetal part is driven into the maternal pelvis by the energy of the contracting uterus. The uterine contractions are major determinants of how much force is applied to the fetus and the entrapped maternal tissues during obstructed labor. The amount of force generated will vary with each pregnancy and even from contraction to contraction in any individual labor. Not all prolonged labors are obstructed labors. Some labors are prolonged as a result of inefficient labor: the force, duration, and synchrony of the contractions may not be sufficient to propel a fetus through an otherwise adequate birth canal. Because the damage that occurs in obstructed labor is related in part to the duration of labor, all labors that do not progress to a spontaneous vaginal delivery within a reasonable period of time should be carefully evaluated by a skilled attendant to determine whether obstruction is present.

When used properly and consistently, the WHO partograph (or a similar monitoring tool) is extremely helpful in sorting out which labors are prolonged as a result of inefficient labor and which are prolonged as a result of obstruction (Bosse, Massawe, and Jahn 2002; Mathai 2009). Use of a partograph has been shown to decrease unnecessary interventions by confirming the presence of a normal labor curve as well as identifying those women who

need intervention in a timely fashion (Kwast 1994; Mathai 2009). Serious mismanagement of labor can occur when the birth attendant thinks labor is prolonged as a result of inefficient or inadequate uterine contractions and does not recognize that labor is actually obstructed. This may lead to the administration of oxytocic drugs (either standard pharmaceutical products or indigenous traditional medicines with oxytocic properties), which increase the force of contractions, increase the pressure on vulnerable entrapped tissues, and worsen the ultimate outcome by creating a fistula or causing uterine rupture (Dujardin et al. 1995; Onuaguluchi and Ghasi 1996; Sharan, Strobino, and Ahmed 2005; Kamatenesi-Mugisha and Oryem-Origa 2007; Moran, Wahed, and Afsana 2010).

## Duration of Obstructed Labor

Obstructed labor resolves eventually, but with only a limited number of possible outcomes. In ideal circumstances, obstruction is diagnosed shortly after it develops and delivery is affected promptly (usually by cesarean section), with a positive result for both mother and child. In instances in which obstructed labor is not relieved promptly and continues for several days, the fetus usually dies. Fetal mortality rates of 90 percent or more are common among women whose obstructed labor results in a fistula (Hilton and Ward 1998; Wall et al. 2004; Muleta, Rasmussen, and Kiserud 2010; Sjoveian et al. 2011). If the mother does not die from bleeding, infection, exhaustion, or uterine rupture in the course of obstructed labor, she often delivers the stillborn fetus spontaneously. This is possible because the fetus starts to decompose after death, becomes macerated, and eventually softens enough to slip past the obstruction in the birth canal. In many instances, women labor at home for several days before arriving at a health care facility in search of assistance. Some will deliver spontaneously, some will require operative vaginal delivery (vacuum extraction, forceps delivery, symphysiotomy, or destructive delivery of a stillborn fetus), but many women undergo the ordeal of a cesarean section to deliver a stillbirth. Obstetric fistulas form when the process of obstructed labor lasts long enough for tissue necrosis to occur at the site of impaction, and women in any of these categories may develop a fistula after delivery. From a clinical standpoint, the most important aspect of fistula prevention is recognizing that labor has become obstructed and intervening promptly to address the obstruction before irreversible injury develops. Delay in cases of obstructed labor risks fetal death, maternal death, and obstetric fistula formation.

Thaddeus and Maine (1994) outlined the three delays that lead to maternal death: delay in deciding to seek care, delay in arriving at a health care facility, and delay

in receiving proper care after arriving at a medical facility. In obstructed labor, any or all of these delays may result in an ischemic injury that crosses the fistula-formation threshold of vulnerable pelvic tissues. Avoiding such delays is critical for fistula prevention and for prevention of maternal mortality.

The first phase of delay has two interrelated components: recognition that labor is obstructed, and taking action that resolves the problem before the injury threshold is crossed (Wall 2012b). Recognition that delivery has not occurred within an appropriate amount of time is grounded in local understandings of how long a “normal” delivery should take. Wide variations will exist in the meaning and estimation of time and in an understanding of what are normal parameters for delivery (McCourt 2009). These variations will be heavily influenced by who is present with the laboring woman and who is making such determinations: a family member, a traditional birth attendant with varying levels of experience, or a trained health care worker with obstetric expertise. For example, one study of traditional birth attendants in Uganda determined that they commonly estimated the length of labor from the time when they were called into consultation rather than from the time the labor actually started (Lynch and Derveeuw 1994). Other studies have demonstrated that decisionmaking by traditional birth attendants contending with obstetric complications follows its own internal logic that does not always square with a biomedical understanding of the pathophysiology involved (Anderson et al. 2004). In many instances, a “wait and see” attitude will be adopted, even in cases in which labor has been markedly prolonged, particularly if no one knows what is medically required. In Sokoto and Zaria, Nigeria, and in Bo, Sierra Leone, the Prevention of Maternal Mortality Network (1992) found that prolonged labor was not deemed to warrant modern medical care until two to five days had passed. Moreover, the decision to seek care may not always be one that leads to a satisfactory resolution of the problem. Multiple competing therapeutic pathways can usually be chosen when assistance is sought for a perceived clinical problem (Janzen 1978; Sargent 1982).

In many traditional societies, illness is interpreted primarily within a social rather than a naturalistic context. In such circumstances, obstetric complications may be seen as a reflection of disordered social relationships rather than as specific derangements of bodily physiology. In central Mozambique, for example, prolonged or obstructed labor is believed to be an indication of the sexual infidelity of one or the other partner (Chapman 2010). Similarly, the Esan of southeastern Nigeria view most health problems as arising from sinful behavior; thus, pregnancy complications are often assumed to be an

outgrowth of the woman’s having committed adultery or having bewitched her spouse (Asowa-Omorodion 1997). Anthropological research by Berry (2010: 171) among Mayan women in rural Guatemala provides another illustration of this thinking:

Sandra told me that one of her births had taken more than five days. Why did it take so long, I asked? Probably, she said, because she had been fighting a lot with her sisters-in-law during the pregnancy. As the birth is a family event, if things are not going well within the family, they might not go well with the birth.

And among the Nyakyusa of East Africa, according to a study by Wilson (1957: 144):

A delayed delivery is most commonly attributed to the woman’s adultery, and she is pressed by the midwife to confess the name of her lover or lovers, but it is also believed that it may be the result of *imindu*, or ‘the shades’ (spirits of the ancestors). The husband consults a diviner who indicates whether the *imindu* is on his side or of the side of the woman’s father, and the one who is thus indicated should pray. Sometimes the woman herself tells of a quarrel which would lead to *imindu*, and then her husband or father goes to pray.

The presence of alternative views of causation is linked to the employment of alternative therapeutic pathways that are often ineffective in resolving obstructed labor and other medical problems. *Allah maganin kome* (“God is the remedy for everything”) is a Hausa proverb in northern Nigeria. This is a common attitude in many parts of the world and it often results in seeking religious rather than medical or surgical intervention as the first line of healing for maternal health problems (Wall 2012b). Udoma, Asuquo, and Ekott (1999) described the role of “spiritual churches” in the care of women with obstructed labor in southeastern Nigeria and found that nearly half of the cases of obstructed labor seen at the University of Calabar Teaching Hospital between 1987 and 1996 had first sought assistance from a spiritual church before presenting for help at the hospital. The case fatality rate was more than five times higher among patients referred from a church than among those referred from an outlying conventional health center. Religious groups in the United States that avoid emergency obstetric care in favor of spiritual therapy have levels of maternal mortality comparable to those of developing countries (Kaunitz et al. 1984).

Other forms of intervention springing from erroneous understandings of obstructed labor may be directly harmful. Among the Hausa of northern Nigeria, obstructed labor is often attributed to a condition called *gishiri* (“salt”). This condition is said to develop from an imbal-

ance in body chemistry, which is believed to cause a web or membrane to grow across the vagina and prevent the baby from being born. Treatment often involves attempting to cut away this membrane with a sharp object such as a knife or razorblade, which may injure the urethra or bladder and produce a fistula by direct trauma (Tahzib 1983; Wall 1988; Tukur, Jido, and Uzoho 2006).

In communities in which wife seclusion (*purdah*) is observed, women are not permitted to leave the family compound, even under emergency circumstances, without their husband's permission (Wall 1998). Researchers in northern Nigeria recount the poignant story of a woman in obstructed labor who lived only a ten-minute walk from the hospital, but because her husband was away on business in another state, she had to wait several days before she could obtain permission to seek care. When she finally arrived at the hospital, the baby had died, and she subsequently developed a vesicovaginal fistula (Prevention of Maternal Mortality Network 1992). In their inquiry into the reasons for delay in obtaining emergency obstetric care given by patients with fistulas in Jos, Nigeria, Wall and colleagues (2004) found that nearly 29 percent of patients delayed care because they did not have family permission to travel. More than 12 percent did not have or did not know of a health care facility nearby during labor, 25 percent lacked transportation, and 7 percent wanted to try traditional remedies first.

Even if a problem is recognized, a hospital is identified, and transportation can be arranged, delay may nevertheless ensue as the costs and benefits of traveling to and seeking care at a hospital are analyzed and debated (Wall 2012b). Studies in several countries have documented the high costs of emergency obstetric care, costs that include direct hospital charges and also unofficial, irregular, and indirect costs such as medications, food, bribes, transportation, and "service" charges levied against patients by health care workers and opportunistic hospital staff (Nahar and Costello 1998; Kowalewski, Mujinja, and Jahn 2002; Borghi et al. 2003; Afsana 2004; Borghi et al. 2006a and 2006b; Storeng et al. 2008). In Ghana and Benin, a routine uncomplicated delivery costs about 2 percent of annual household cash expenditures, but an obstetric emergency can incur costs as high as 34 percent of annual household cash expenditures (Borghi et al. 2003), a level of financial demand that would be difficult for members of any society to meet. In addition to these factors must be added the opportunity costs incurred in seeking emergency care; namely, the foregoing of the generation of income from other activities such as agricultural labor, trading, and so forth. Finally, multiple studies have demonstrated that one of the reasons women do not seek timely care in obstetric emergencies

is fear of how they will be treated by staff and lack of confidence (often justified) in the competence of those who work there (Sundari 1992; Jaffre and Prual 1994; Asuquo, Etuk, and Duke 2000; Kilpatrick et al. 2002; Miller et al. 2003; Weeks et al. 2005; Harvey et al. 2007; Kongnyuy, Mlava, and van den Broek 2009a). If the effort it will take to reach a health care facility does not appear justified given the perceived costs, delay will lengthen, with potentially tragic consequences.

Once the decision has been made to travel to a suitable health care facility, a second phase of delay may occur: overcoming the daunting obstacles to reaching a facility where help is available. Analysis from Jos, Nigeria, indicated that 25 percent of women who developed a fistula stated that they had no transportation to seek help when labor became obstructed, and 12 percent said either that there was no health care facility nearby or they did not know where to go to seek care (Wall et al. 2004). In many cases, the distances and travel obstacles that must be overcome are almost insurmountable. Researchers investigating maternal health issues in northern Gambia in the late 1980s, for example, reported that patients with life-threatening obstetric emergencies seen in one particular dispensary would have to travel 125 miles and cross the Gambia River by ferry to receive the care they needed (Greenwood et al. 1987). Not surprisingly, rates of maternal mortality and morbidity are higher in rural than in urban areas, and the risks of severe complications lengthen as the distance away from care increases (Ronsmans et al. 2003; Bartlett et al. 2005; Seljeskog, Sundby, and Chimango 2006; Gabrysch et al. 2011).

Unfortunately, arriving at a health-care facility in obstructed labor does not guarantee that the problem will be solved in a timely, efficient, or competent manner. The operational deficiencies of hospitals in low-resource countries are widespread and well known (Sundari 1992). The signal functions of basic emergency obstetric care (the ability to administer parenteral antibiotics, oxytocic drugs, and anticonvulsants, and to accomplish an assisted vaginal delivery or manually remove a retained placenta or other products of conception) are often not available at hospitals and clinics because of shortages of trained personnel and supplies. And the signal functions of advanced emergency obstetric care (blood transfusion and surgical services such as cesarean delivery or emergency laparotomy for a ruptured uterus) require even higher levels of support and logistics, which are even more frequently lacking (Pearson and Shoo 2005; Paxton et al. 2006; Otchere and Kayo 2007; Al Serouri et al. 2009; Kongnyuy et al. 2009; Gabrysch, Simushi, and Campbell 2011; Oyerinde et al. 2011). Even when well trained and highly motivated personnel are present at health care facilities,

their ability to handle life-threatening emergencies, such as obstructed labor, may be compromised by systems failures (Kilpatrick et al. 2002; Miller et al. 2003). Ensuring that obstetric care is of a high standard and that personnel are adequately trained and equipped to meet emergency needs requires ongoing supervision and continuous quality improvement (Bailey et al. 2006; Nyamtema, Urassa, and van Roosmalen 2011).

### Quality of Care After Obstructed Labor

Obstructed labor resolves eventually, but often with tragic results. Whether the woman develops an obstetric fistula depends, in large part, upon the quality of care she receives after delivery. Prompt decompression of the overdistended bladder by catheterization, administration of antibiotics and blood products, good nutrition, and excellent general care may allow a severely injured bladder to recover before it has crossed the threshold at which tissue necrosis and fistula formation occur (Kongnyuy, Mlava, and van den Broek 2009b). Even in cases in which a fistula does develop, immediate and prolonged catheterization accompanied by excellent medical and nursing care may allow some small fistulas to heal spontaneously, or at least to form much smaller fistulas than would have otherwise been the case in the absence of such treatment (Waldjik 1997; Bazi 2007). For the woman who develops an obstetric fistula, prompt access to competent surgical treatment will greatly lessen the suffering she endures, which may otherwise be prolonged. In the study from Jos, Nigeria, only 27 percent of patients received treatment for their fistula within a year of its occurrence, and more than 30 percent had suffered with their condition for longer than five years (Wall et al. 2004).

### Outcomes

The most severe outcome of obstructed labor is maternal death. As was demonstrated more than 25 years ago, the causes of maternal mortality are multifactorial (Harrison and Rossiter 1985). In many cases of obstructed labor in which maternal death occurs, other pathophysiological processes (such as preexisting anemia, sepsis, hypertension, and so forth) are also contributing factors. A woman who is in labor for four or five days may end up dying from obstructed labor in the presence of hemorrhage, infection, and maternal exhaustion. When this happens, determining a single cause of death is difficult. The most obvious cases of maternal mortality resulting from obstructed labor are those in which the uterus ruptures, expelling the fetus and placenta into the maternal abdomen

with a life-threatening hemorrhage. Such a catastrophic event requires immediate surgical intervention if the mother's life is to be saved. In parts of the world where obstructed labor is common and access to emergency obstetric care is poor, the reported rates of uterine rupture are very high. In Ibadan, Nigeria, one uterine rupture occurred for every 167 deliveries (Konje, Odukoya, and Ladipo 1990). In eastern Nepal, uterine rupture rates of 1 per 112 deliveries have been reported (Chuni 2006). In Yemen, the rate of uterine rupture is as high as 1 per 92 deliveries (Diab 2005). In Sokoto, in northern Nigeria, uterine ruptures occur at the rate of 1 for every 79 deliveries (Ekele, Audu, and Muyibi 2000). Although a previous cesarean delivery increases the risk of rupture resulting from tissue weakness along the uterine scar, most uterine ruptures occur in multigravid patients who have not had a cesarean delivery. In contrast to these statistics, rupture of the uterus unscarred by cesarean section occurs in the United States at a rate of approximately 1 event for every 17,000 deliveries (Miller et al. 1997). Survival in such cases clearly depends on immediate access to lifesaving surgery, but the stark differences in rates of rupture demonstrate vast deficiencies in timely access to quality obstetric care in different parts of the world.

The findings presented in Table 1 indicate that many women who develop obstructed labor survive the event and do so without developing a fistula. Undoubtedly many of these women have other forms of morbidity that are not captured in the existing data. The suffering experienced in the course of two or three days of obstructed labor is clearly profound, and many such women probably suffer from lifelong psychological distress even if they do not develop a fistula. The existence of a syndrome of post-delivery traumatic stress disorder (PTSD) has been postulated by some researchers (Adewuya, Ologun, and Ibigbami 2006; Olde et al. 2006; Sawyer, Ayers, and Smith 2010). Women who have lived through several days of prolonged obstructed labor would seem to be at great risk of developing PTSD. Fetal outcomes are universally poor in cases of prolonged obstructed labor. As noted above, among women whose labor is obstructed severely enough to develop an obstetric fistula, the stillbirth rate is usually greater than 90 percent (Hilton and Ward 1998; Tebeu et al. 2009; Muleta, Rasmussen, and Kiserud 2010; Sjoveian et al. 2011). In a series of 899 obstetric fistula cases from Jos, Nigeria, the rate of fetal loss was 92 percent (Wall et al. 2004) and an additional 14 neonatal deaths were reported among the 79 live-born infants. The overall reproductive history of these women was even more disturbing, however; they had given birth to 2,729 babies in the course of their reproductive lives, of whom only 819 (30 percent) were still living. In Hilton and Ward's study

(1998), only 28 percent of women with an obstetric fistula had had a previous live birth.

Although the vast majority of fistulas that occur in women living in impoverished countries result from obstructed labor, a small number result from other causes. Some are the result of unusual pelvic infections (such as tuberculosis or lymphogranuloma venereum) (Tahzib 1983 and 1985). Others result from malignancy or trauma (motor vehicle accidents, impalement injuries, and so forth) (Wall et al. 2004). A small number result from sexual violence perpetrated against child brides who are not yet physically able (or emotionally ready) to have intercourse, or from complications of unsafe abortion, or as atrocities committed to terrorize civilian populations in areas ravaged by armed conflict (Tahzib 1985; Muleta and Williams 1999; Longombe, Claude, and Rumino 2008). Various forms of female genital cutting (also referred to as “female circumcision” or “female genital mutilation”) and harmful practices such as packing the vagina with salt after delivery can also produce fistulas by direct trauma (Fahmy 1965). In general, however, female genital cutting is likely to be a marker of the low socioeconomic and cultural status of women in areas where fistulas are common and maternal mortality is high, rather than a direct cause of obstructed labor (Browning, Allsworth, and Wall 2010). In some cases, harmful interventions that are carried out during labor and are based on local cultural beliefs (such as improper use of traditional medicines with oxytocic properties or gishiri cutting) can also lead directly to fistula formation.

A small but variable number of vesicovaginal fistulas in low-resource countries result from surgical complications, just as they do in developed countries. Some fistula-producing injuries will occur during cesarean section under circumstances in which it is difficult to know whether the fistula resulted from the obstructed labor that led to the operation or occurred as a direct complication of the cesarean delivery itself (Onsrud, Sjoveian, and Mukwege 2011). As poor countries make the transition from lack of availability to availability of scientifically-based medical care, the number of fistulas resulting from surgical mistakes will inevitably increase. Moreover, as more operations (often difficult ones) are performed—often by surgeons operating in substandard conditions with inadequate training, poor equipment, minimal support staff, and insufficient access to needed drug therapy—the number of surgical complications will increase. For example, in a series of 164 genitourinary fistulas reported from the Komfo Anokye Teaching Hospital in Kumasi, Ghana, between 1977 and 1982, nearly 92 percent of cases were the result of obstetric complications, but 12 women (7.2 percent of cases) developed a fistula during a hysterectomy

performed to remove large uterine leiomyomata (Danso et al. 1996). Without the surgical treatment of such benign uterine tumors, these fistulas would not have developed. Fistulas of this type are “diseases of medical progress”—that is, illnesses or injuries “resulting from sound therapeutic endeavor” that occur “while the patient is being treated for another condition” (Moser 1956: 606). Ultimately, this creates a shift in the type and number of fistulas seen, as obstetric trauma declines and accessibility of other medical and surgical interventions increases.

This history of vesicovaginal fistula in industrialized countries is beginning to be replicated in less developed parts of the world. In a review of 230 cases of vesicovaginal fistula treated at Ramathibodi Hospital in Bangkok, Thailand, between 1969 and 1997, only 10 fistulas resulted from prolonged or difficult childbirth; the rest occurred as complications of hysterectomy, from radiation therapy, from invasive cervical cancer, as a complication of pelvic fractures, or as the result of some other factor (Kochakarn and Pummagnura 2000). A follow-up study from the same institution reported an additional 45 patients with fistulas seen between 1998 and 2005. In this more recent period, most of the fistulas were associated with laparoscopic hysterectomy and none were the result of obstetric trauma (Kochakarn and Pummagnura 2007).

## Conclusion

The framework presented here demonstrates the importance of intervening promptly and effectively during labor and after delivery to rectify acute factors that might result in a fistula. At the same time, the framework also demonstrates the importance of intermediate and remote determinants that create and sustain environments in which acute clinical needs can be met effectively. Understanding the interplay of these factors should help shape the development of the maternal health policies and programs that will ultimately eradicate obstetric fistula in the resource-poor world.

Eradication can be achieved, but doing so will require both the development of increased surgical capacity to treat existing cases and sustained programs to prevent new fistulas from being formed. Prevention programs will have to tackle all of the determinants that together produce obstetric fistulas. The most rapid results in fistula prevention will probably be achieved by first addressing the acute clinical circumstances that affect the outcome of any individual case of obstructed labor. Because obstetric fistula is a manifestation of structural violence—the underlying “disease” of chaotic socioeconomic circumstances that produce these injuries (Harrison 2009)—

long-term strategies to eradicate fistula must include the development of a supportive socioeconomic framework that makes possible the continued provision of effective clinical services. This will necessitate improvements in transportation, communication, and health care infrastructure, as well as changes in cultural values that serve to expand the life choices available to girls and women. The eradication of obstetric fistula will require increased female personal autonomy, enhanced economic status for women, improved educational opportunities at all levels of schooling, elevated attention to women's health issues in national debates concerning policy priorities, and general improvements in gender equity throughout those societies where fistulas are prevalent. These goals will only be attained when safe childbirth is recognized as a fundamental human right and policies are put in place to make it a practical reality for all women everywhere. This will require that physicians, midwives, politicians, educators, administrators, and policymakers embrace this viewpoint and that individuals living in countries where fistulas are prevalent embrace this ideal.

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