

CHIEF EDITOR'S NOTE: This article is part of a series of continuing education activities in this Journal through which a total of 36 *AMA PRA Category 1 Credits™* can be earned in 2012. Instructions for how CME credits can be earned appear on the last page of the Table of Contents.

Preventing Obstetric Fistulas in Low-Resource Countries: Insights From a Haddon Matrix

L. Lewis Wall, MD, DPhil

Professor of Obstetrics and Gynecology, Department of Obstetrics and Gynecology, Washington University School of Medicine, St. Louis, MO and Professor of Anthropology, College of Arts and Sciences, Washington University, St. Louis, MO

An obstetric fistula is classically regarded as an “accident of childbirth” in which prolonged obstructed labor leads to destruction of the vesicovaginal/rectovaginal septum with consequent loss of urinary and/or fecal control. Obstetric fistula is highly stigmatizing and afflicted women often become social outcasts. Although obstetric fistula has been eliminated from advanced industrialized nations, it remains a major public health problem in the world's poorest countries. Several million cases of obstetric fistula are currently thought to exist in sub-Saharan Africa and south Asia. Although techniques for the surgical repair of such injuries are well known, it is less clear which strategies effectively prevent fistulas, largely because of the complex interactions among medical, social, economic, and environmental factors present in those countries where fistulas are prevalent. This article uses the Haddon matrix, a standard tool for injury analysis, to examine the factors influencing obstetric fistula formation in low-resource countries. Construction of a Haddon matrix provides a “wide angle” overview of this tragic clinical problem. The resulting analysis suggests that the most effective short-term strategies for obstetric fistula prevention will involve enhanced surveillance of labor, improved access to emergency obstetric services (particularly cesarean delivery), competent medical care for women both during and after obstructed labor, and the development of specialist fistula centers to treat injured women where fistula prevalence is high. The long-term strategies to eradicate obstetric fistula must include universal access to emergency obstetric care, improved access to family planning services, increased education for girls and women, community economic development, and enhanced gender equity. Successful eradication of the obstetric fistula will require the mobilization of sufficient political will at both the international and individual country levels to ensure that adequate resources are devoted to this problem and that maternal health becomes a high priority on national political agendas.

Target Audience: Obstetricians & Gynecologists and Family Physicians

Learning Objectives: After participating in this CME activity, physicians should be better able to apply the Haddon matrix, a tool commonly used for injury analysis, to the field of obstetrics and gynecology; analyze the problem of obstructed labor and obstetric fistula formation in low-resource countries using the Haddon matrix, and implement possible strategies for the prevention of obstetric fistulas and the mitigation of harm in cases of obstructed labor that arise from the use of the Haddon matrix.

The authors, faculty and staff in a position to control the content of this CME activity and their spouses/life partners (if any) have disclosed that they have no financial relationships with, or financial interest in, any commercial organizations pertaining to this educational activity.

Correspondence requests to: L. Lewis Wall, MD, DPhil, Department of Obstetrics and Gynecology, Washington University School of Medicine, Campus Box 8064, 660 South Euclid Ave, St. Louis, MO 63110. E-mail: WALLL@wudosis.wustl.edu.

THE OBSTETRIC FISTULA PROBLEM IN LOW RESOURCE COUNTRIES

In classic medical terms, an obstetric fistula is an "accident of childbirth" in which an abnormal opening is formed between the vagina and the bladder or rectum "through which the contents of either may escape."¹ Fistulas resulting from childbirth are exceptionally rare in wealthy industrialized countries, although such injuries still develop occasionally as complications of cancer treatment or pelvic surgery.^{2,3} In the impoverished countries of sub-Saharan Africa and south Asia, obstetric fistulas are very common. Tens of thousands of new cases occur each year, and several million women are afflicted with this condition, languishing in misery because surgical repair is difficult to obtain.^{4,5}

Many Western gynecologists and urologists have seen patients who have developed a vesicovaginal fistula after a hysterectomy, but the vesicovaginal fistula that develops from obstructed labor is a very different kind of injury. The posthysterectomy fistula develops as the result of a discrete injury to otherwise healthy tissues under circumstances in which normal postoperative healing is compromised: a pool of urine forms next to the injured bladder and prevents normal healing of the vaginal cuff. Eventually, the accumulated urine drains into the vagina between the nonhealing edges of the surgical wound to create a vesicovaginal fistula. Obstetric fistulas arise from direct destruction of the vesicovaginal septum by pressure necrosis during prolonged obstructed labor. Here, the bladder and vagina are joined not through a small hole between 2 healthy adjacent organs, but rather because the tissues that normally keep the bladder separate from the vagina have been destroyed by prolonged pressure from the fetal head trapped within its mother's birth canal. The unrelenting pressure of the fetal head pressed against the maternal soft tissues, which are trapped against her pelvic bones, produces a crush injury that eventually cuts off their blood supply, leading to necrosis, sloughing, and fistula formation (Fig. 1). Unless this pathophysiological process is interrupted by prompt delivery (which usually requires cesarean delivery), it may last for several days, generally resulting in the death of the fetus. In a series of 899 obstetric fistula cases seen at Evangel Hospital in Jos, Nigeria, 79% of fistula patients had labors that lasted >2 days, and 21% had been in labor for 4 or more days during the index pregnancy in which their injuries occurred. The fetal fatality rate in these cases was 92%.⁶ If a woman is lucky enough to survive the ordeal of

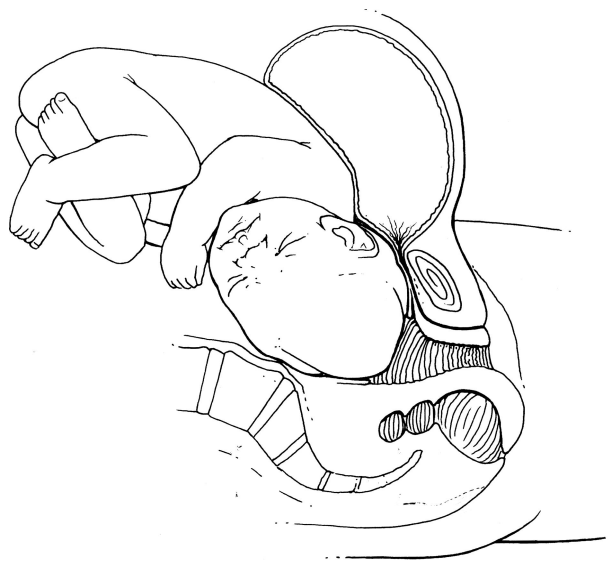


Fig. 1. The pathophysiology of obstructed labor. The fetus is unable to fit through the pelvis and becomes impacted against the pelvic bones. Pressure from the fetal head compresses the urethra and bladder neck, preventing urination, with progressive overdistension of the bladder. The fistula results from pressure necrosis of the vesicovaginal septum caused by this process. Copyright by The Worldwide Fistula Fund, used by permission.

prolonged obstructed labor, she may be left not only with a fistula but also with other devastating pelvic injuries that make up the "obstructed labor injury complex"⁷ (Table 1).

Because obstetric fistulas do not heal without surgical intervention, and because surgical care is largely inaccessible in poor African nations⁸ (the national cesarean delivery rate in Niger is only 0.5%, for example⁹), women with fistulas live with a constant trickle of urine or feces that trails them wherever they go, rendering them unclean, foul-smelling, and miserable. They become stigmatized, separated or divorced from their husbands, often living an outcast existence on the margins of society.¹⁰ Obstetric fistulas were common in the United States 150 years ago,¹¹ but at present, this condition has vanished from both the collective experience of child-bearing women and the physicians who care for them. The obstetric fistula disappeared as obstetric care became scientifically grounded, clinically more effective, and universally accessible. The dual challenge for Africa is not only to repair the huge backlog of accumulated cases but also to develop effective strategies for preventing the occurrence of future fistulas.

TABLE 1
Spectrum of injuries seen in the "Obstructed Labor Injury Complex"

| |
|---|
| Acute obstetric injury |
| Hemorrhage, especially postpartum hemorrhage from uterine atony |
| Intrauterine infection and/or systemic sepsis |
| Deep venous thrombosis |
| Massive vulvar edema |
| Pathological uterine retraction ring (Bandl ring) |
| Uterine rupture |
| Urologic injury |
| Vesicovaginal fistula and complex combinations of other fistulas (urethrovaginal, ureterovaginal, vesicocervical, vesicouterine, etc) |
| Urethral damage, including complete loss of the urethra |
| Bladder stone formation |
| Urinary stress incontinence |
| Secondary hydroureteronephrosis and chronic pyelonephritis |
| Renal failure |
| Gynecologic injury |
| Amenorrhea |
| Vagina scarring and stenosis, often with loss of coital function |
| Cervical damage, including complete loss of the cervix |
| Secondary pelvic inflammatory disease |
| Secondary infertility |
| Gastrointestinal injury |
| Rectovaginal fistula |
| Acquired rectal atresia |
| Anal sphincter injury with resulting anal incontinence |
| Musculoskeletal injury |
| Osteitis pubis and related injuries to the pelvic bones |
| Diffuse trauma to the pelvic floor |
| Neurological injury |
| Foot drop |
| Neuropathic bladder dysfunction |
| Dermatological injury |
| Chronic excoriation of the skin from maceration by urine and feces |
| Fetal/neonatal injury |
| Approximately 95% perinatal case fatality rate |
| Neonatal sepsis |
| Neonatal birth asphyxia |
| Neonatal birth injury, including scalp necrosis, nerve palsies, intracranial hemorrhage, etc. |
| Psychosocial injury |
| Social isolation |
| Divorce |
| Worsening poverty |
| Malnutrition |
| Posttraumatic stress disorder |
| Depression, sometimes leading to suicide |

THE HADDON MATRIX: A TOOL FOR INJURY ANALYSIS

Research on maternal mortality and severe acute maternal morbidity (often referred to as "near miss" obstetrical events), has demonstrated complex interrelationships among biology, culture, economics, and the physical environment in parts of the world where rates of maternal death and obstetric disability are

high.^{12,13} The international community has acknowledged the vast disparities in maternal health that exist between affluent, high-resource countries and impoverished nations, yet progress toward reducing these inequities has been very slow.^{14,15} This is partly because of a lack of political will, but it is also because of the fact that many different factors contribute to maternal death and childbirth injury. These factors are often deeply embedded in the cultures where maternal mortality and obstetric morbidity are problematic.

Obstructed labor is a major contributor to maternal death in developing countries,¹⁶ and it is the principal driving force behind the epidemic of obstetric fistulas in sub-Saharan Africa. Because an obstetric fistula is an "accident of childbirth," it can be evaluated using standard tools of injury analysis. The fundamental paradigm for injury prevention was developed by Haddon, who spent his career as head of the National Highway Traffic Safety Administration and as Director of the Insurance Institute for Highway Safety.¹⁷⁻²³ Haddon contended that "injuries" and "accidents" were not unpredictable, unavoidable acts of fate about which nothing could be done; but rather, that they were discrete events that occurred in specific settings characterized by circumstances in which excessive amounts of energy were transferred to a human subject in harmful ways. The factors that contributed to an accident could therefore be analyzed and understood, and strategies could be devised to reduce or eliminate the occurrence, severity, and consequences of such events. Under Haddon's influence, injury prevention became a truly scientific field of study.

Haddon focused on automobile safety, but his approach has been used successfully in many other areas.²⁴⁻²⁸ With respect to highway accidents, Haddon looked at 3 sets of factors: the "host" (accident victim), the force vector (here an automobile crash), and the environment in which the injury occurred (for example, a winding, poorly maintained highway at dusk in a rainstorm). He then looked at the interactions of these factors over time. He divided the time course of an injury into preinjury, injury event, and postinjury periods. The interactions of the various factors and the time course of events could then be used to create a grid of 9 to 12 cells.

From Haddon's perspective, an obstetric fistula is a birth injury that occurs to a pregnant woman when her labor becomes obstructed, and appropriate obstetrical intervention does not occur in a timely manner. The resulting matrix lists the factors at each point on the timeline that increase or decrease the likelihood of obstructed labor and which promote or

hinder a favorable outcome. Table 2 shows 1 possible way in which such a Haddon matrix might be constructed. As Haddon wrote, "Such matrices provide a means for identifying and considering, cell by cell (*a*) prior and possible future resource allocations and activities, as well as the efficacies of each; (*b*) the relevant research and other knowledge—both that are already available and that are needed for the future; and (*c*) the priorities for countermeasures, judged in terms of their costs and their effects on undesirable injury results, that is, on the problems to be reduced."²²

PREINJURY FACTORS AFFECTING OBSTETRIC FISTULA FORMATION

The first row in Table 2 ("PreEvent" phase) lists the baseline factors that "set the stage" on which the events of labor will take place. The considerable literature on maternal mortality suggests that better pregnancy outcomes for both mother and baby occur in healthy, well-educated communities in which women have good nutrition, adequate economic resources, reliable access to high-quality medical care, and where the contributions that women make to family and community life are acknowledged, respected, and valued.²⁹⁻³¹ Because obstetric fistulas are a complication of obstructed labor, only pregnant women are at risk for this condition. It is notoriously difficult to predict the risk of obstructed labor in any individual pregnancy. The extensive literature on obstetric risk has produced no consensus on how the risk of obstructed labor may be predicted accurately in the antenatal setting, particularly in low-resource environments.³² The best predictor of future obstetric complications appears to be a woman's own reproductive history.³³ Because menarche, with its risk of fertility, occurs before the pelvis reaches its full adult capacity, obstructed labor is more likely to occur in a young teenaged mother than in an older woman³⁴; but any woman, including the older multipara, who has given birth successfully may develop obstructed labor if cephalopelvic disproportion is present or if the fetus presents abnormally.³⁵ Because contraception will reduce a woman's risk of fistula by preventing pregnancy, access to family planning is an important fistula prevention strategy, especially among women in higher reproductive risk groups such as young teenagers or women near the end of their reproductive years.^{36,37}

The risk that obstructed labor will cross the threshold at which compressive forces produce tissue necrosis is influenced directly by a woman's medical

and nutritional status. Healthy pelvic tissues are more resistant to injury than those that are malnourished or poorly oxygenated. A pregnant woman's overall level of health is influenced by her socioeconomic status, including her marital status, level of education, and the position of her community within the larger society. Over 35 years ago, Harrison et al demonstrated the impact of increasing levels of education on maternal deaths in Zaria, Nigeria.³⁸ Higher levels of maternal education were associated with dramatically reduced levels of maternal mortality. The causal link probably involved better general health and improved nutrition, enhanced personal empowerment, and increased use of antenatal care. Antenatal care was probably not important so much for what it did directly, but rather for the fact that by plugging women into an effective system of maternal health care, it allowed "booked" women to access emergency care promptly when complications arose during pregnancy. In Harrison's study of nearly 23,000 deliveries, the maternal mortality ratio for uneducated women unbooked for prenatal care was a stunning 2900 maternal deaths per 100,000 deliveries, whereas the maternal mortality ratio for booked women with some formal education was only 250 maternal deaths per 100,000 deliveries.³⁸ In their study of 899 women with obstetric fistulas from Jos, Nigeria, Wall et al found a similar relationship between increasing educational levels and decreasing prevalence of fistula.⁶ The causal factors here also probably involve higher levels of affluence, nutrition, and personal empowerment, and an increased ability to access medical and social resources when needed among more educated women.³⁹ It should be stressed, however, that knowledge of obstetric complications and individual empowerment to seek care in a timely manner are meaningless unless effective emergency obstetric services are actually available within the community.

A high value on maternal health appears to be closely tied to community wealth and education.^{29,30} In a cross-national study of 148 countries, McAlister and Baskett found that both the Human Development Index and the Gender Development Index were powerful predictors of maternal and infant mortality rates and that female literacy and enrollment in educational programs were moderate predictors of reduced maternal mortality.³¹ A global review that looked at cesarean rates in 42 countries in Africa, Asia, Latin America, and the Caribbean by wealth quintile found that the poorest members of these societies had extremely limited access to cesarean delivery (cesarean delivery rates of <1% for the poorest 20% of the

TABLE 2
A Haddon matrix for obstructed labor and obstetric vesicovaginal fistula formation (copyright worldwide fistula fund, used by permission)

| Timeline | Host | Vector | Physical Environment | Social Environment |
|-------------------------------------|--|---|---|---|
| Pre-event (prior to labor) | <p>Female sex</p> <p>Reproductive age</p> <p>Currently pregnant</p> <p>Reproductive history</p> <p>Pelvic architecture and capacity</p> <p>Medical status</p> <p>Nutritional status</p> <p>Marital status</p> <p>Education</p> <p>Socioeconomic status</p> <p>Personal utilization of health services, e.g. antenatal care</p> | <p>Current pregnancy</p> <p>Risk of fetopelvic disproportion</p> <ul style="list-style-type: none"> •Fetal sex •Fetal size •Fetal lie and presentation • Presence of fetal abnormalities, e.g., hydrocephalus | <p>Presence of accessible clinical facilities</p> <p>Quality and effectiveness of clinical facilities</p> <p>Transportation and communication network</p> <p>Maternity waiting homes</p> | <p>Gender equity</p> <p>Marriage mores</p> <p>Value attached to contraception, family planning, and antenatal care</p> <p>Access to and utilization of antenatal care</p> <p>Specific family constraints/values</p> <p>Community wealth and educational level</p> <p>Community awareness of reproductive health issues in general and of obstructed labor in particular</p> <p>Community preparedness for obstetrical emergencies, such as development of emergency obstetrical plans</p> <p>Political will to promote safe motherhood</p> <p>The 3 phases of delay</p> <ul style="list-style-type: none"> • Delay in deciding to seek care • Delay in arriving at a medical facility • Delay in receiving appropriate care at the facility <p>Indigenous view of prolonged labor</p> <p>Skill level of birth attendants during labor</p> <p>Use of a partograph</p> <p>Economic barriers to emergency obstetrical care</p> <p>Propensity to use harmful traditional practices</p> |
| Event (during obstructed labor) | <p>Maternal medical and nutritional status</p> <p>Hydration</p> <p>Bladder emptying</p> <p>Resilience of affected tissues</p> <p>Anemia</p> <p>Infection</p> | <p>Level and nature of the obstruction</p> <p>Extent of maternal tissues affected</p> <p>Force of uterine contractions</p> <p>Use of tocolytic agents</p> <p>Improper use of oxytocic preparations</p> <p>Duration of obstructed labor</p> <p>Timeliness and nature of operative interventions</p> <p>Operative vaginal delivery with forceps or vacuum extractor</p> <p>Symphiotomy</p> <p>Fetal destructive procedures</p> <p>Cesarean delivery</p> <p>Harmful traditional practices</p> <p>Hysterectomy or repair in cases of uterine rupture</p> <p>Blood transfusions, antibiotics, and supportive medical care</p> <p>Use of oxytocics to prevent postpartum hemorrhage</p> <p>Complete evacuation of uterine contents after labor</p> <p>Neonatal care for surviving infants</p> | <p>Location in which labor takes place (home, village, community health center, hospital)</p> <p>Capacity to provide emergency obstetrical care</p> <p>Transport and communication capabilities</p> | <p>Community preparedness for obstetrical emergencies, such as development of emergency obstetrical plans</p> <p>Political will to promote safe motherhood</p> <p>The 3 phases of delay</p> <ul style="list-style-type: none"> • Delay in deciding to seek care • Delay in arriving at a medical facility • Delay in receiving appropriate care at the facility <p>Indigenous view of prolonged labor</p> <p>Skill level of birth attendants during labor</p> <p>Use of a partograph</p> <p>Economic barriers to emergency obstetrical care</p> <p>Propensity to use harmful traditional practices</p> |
| Post-event (after obstructed labor) | <p>Medical status</p> <p>Nutritional status</p> <p>Effective bladder emptying</p> <p>Wound care</p> <p>Anemia</p> <p>Infection</p> | <p>Access to competent care immediately after delivery</p> <p>Effective transportation</p> <p>Effective communication</p> <p>Access to fistula surgery at either the local level or at a specialist fistula center</p> | <p>Community understanding of the nature of the injury</p> <p>Stigma</p> <p>Social and economic support of the injured woman (especially family and marital support)</p> <p>Public support for fistula care</p> <p>Social and economic rehabilitation for injured women</p> <p>Political will to promote safe motherhood and effective fistula care and prevention programs</p> | |

population in 20 countries and <1% for 80% of the population in 6 countries).⁴⁰ Maternal death and disability are not determined primarily by rising prosperity, however, but rather by access to life-saving technologies during emergency conditions.^{39,41-44} Affluence makes such technologies more widely available, but the more important factor in reducing maternal morbidities such as obstetric fistula is whether or not the political will exists to provide basic emergency obstetric services broadly throughout society. What is valued by the community determines how its resources are distributed. Shiffman has shown that poor countries can reduce high rates of maternal mortality and child-birth injury if they make maternal health a national priority and act accordingly.^{45,46}

FACTORS INFLUENCING THE OUTCOME OF OBSTRUCTED LABOR

Because obstetric vesicovaginal fistulas result from prolonged compression of the bladder wall and vagina by the fetal head, the most critical factors in determining whether or not a fistula develops are the clinical conditions present when labor becomes obstructed. The factors listed in the middle row of Table 2 suggest that the most effective way to prevent obstetric fistulas is through high-quality intrapartum care. Because our ability to predict obstructed labor on the basis of prenatal factors is so poor, obstructed labor will only be detected through careful monitoring of the progress of labor.^{47,48} The general state of maternal health and nutrition obviously sets the background against which the scenario of obstructed labor plays out, but the principal factors contributing to fistula formation are those that prolong labor, prevent the timely diagnosis of obstruction, and interfere with prompt intervention to relieve that obstruction before irreversible tissue injury occurs. The location at which a fistula develops will depend on the level at which labor becomes obstructed (pelvic brim, mid-pelvis, pelvic outlet), the extent of the tissue that is crushed, the force exerted by the uterine contractions, and the length of time this process continues. A fistula will only form if the compressive forces cross the threshold at which maternal tissue death occurs. Because multiple variables are involved (blood flow, oxygen supply, infection, tissue resilience, etc), there is no absolute "time limit" at which fistula formation will occur. Nearly 150 years ago, Emmet showed that labors lasting less than a day could cross this injury threshold.⁴⁹ It is therefore imperative that the progress of every labor be monitored by competent birth attendants and that

women are referred to a higher level of obstetric care as soon as labor stops progressing normally. It is particularly important to monitor urine output during labor because pressure from the impacted fetal head often compresses the bladder neck and urethra so tightly that urine cannot be expelled (Fig. 1). A woman who labors for several days under such conditions will develop a grossly over-distended bladder that is highly vulnerable to ischemic injury. To the pain of unrelenting labor is added the pain of a bladder on the verge of rupture.⁵⁰ The presence of an infection in the urine, in the uterus, in the fetus, or generalized sepsis will also predispose the laboring woman toward an unfavorable outcome.

When labor becomes obstructed, the possibility develops of there being an "energy exchange ... in excess of bodily injury thresholds,"¹⁹ which leads to tissue death, sloughing of the vesicovaginal septum, and fistula formation. The formation of a fistula can only be prevented by interrupting the process of mechanical energy exchange between the contracting uterus (acting through the vector of the impacted fetus) and the affected maternal tissues before the injury threshold is crossed. In theory, this could be done in 3 ways: (1) by somehow making the maternal tissues more resilient, and thus better able to resist the potential negative effects of the compressive forces; (2) by stopping the uterus from contracting, thereby preventing the generation of mechanical energy; or (3) by otherwise relieving the pressure that is being exerted by the presenting fetal part. All of these strategies require the presence of a skilled attendant who has the technical resources to carry out an appropriate intervention. At present, there is no clinically proven technique for making the maternal tissues more resistant to injury, aside from generally supportive medical care. In theory, uterine contractions could be stopped by the administration of a powerful tocolytic agent, but in practice, there are few drugs that are effective in stopping even preterm labor, and there is almost no evidence that tocolysis can stop labor at term. The only cases in which this has been attempted so far have been cases in which there is fetal intolerance to labor. In a few cases, attempts have been made to administer tocolytic drugs with the goal of reducing uterine contractility until delivery can be accomplished by cesarean delivery.⁵¹ This strategy requires an effective drug, the presence of sophisticated medical personnel and facilities, and a level of financial affluence quite different from that found in the impoverished rural areas of developing countries where fistulas are common. Therefore, the only practical strategy for fistula

prevention is relief of the obstruction through surgical intervention.

If surgical intervention is to be successful in preventing a fistula, the operation must occur before the maternal injury threshold has been crossed. Usually, there is no way of knowing this at the time the operation is performed. In intervening in this way, the possibility of causing additional maternal harm must be considered, particularly if the fetus is already dead (as will usually be true in advanced cases of obstructed labor). It is a double tragedy to perform a cesarean delivery on a woman to deliver a dead fetus only to have her develop a major postoperative complication or die thereafter. In many cases of obstructed labor, the fetus can be removed vaginally either by simple mechanical maneuvers if it is long dead and has become macerated, or with the use of obstetrical forceps or a vacuum extractor. If labor is obstructed at the pelvic outlet, a symphysiotomy can sometimes be performed, creating enough space to allow a vaginal delivery.⁵² Alternatively, the impaction can be decompressed by destroying the fetus and removing it piecemeal from below.^{53,54} If the fetus is alive, many practitioners would be loathe to destroy it even to save the mother's life. Even if the fetus is dead, the operation is still unpleasant. However, in many such cases, the morbidity from a destructive procedure is less than that from a cesarean delivery in which the uterus is opened, and its potentially infected contents are spilled into the abdominal cavity. For the most part, transabdominal cesarean delivery that bypasses the vaginal obstruction is the most common surgical approach in obstructed labor.

The location in which obstructed labor is managed is a major factor in its outcome. Obstructed labor cannot be treated adequately or safely in a hut in a rural African village. Successful resolution of obstructed labor depends on moving the laboring woman to a better obstetric environment where needed interventions can be performed. Doing this in an expeditious manner depends on the distribution of emergency obstetric care facilities in the region, communications capabilities, and transportation networks. Because the threshold to injury will vary in any individual case of obstructed labor depending on a multitude of co-factors, the most important variable for injury prevention is timely intervention to relieve the obstruction. Delay in obtaining effective care is influenced primarily by the social environment. In their classic article analyzing maternal mortality, Thaddeus and Maine identified 3 major types of delay that lead to maternal deaths.⁵⁵ These are (1) delay in deciding to seek care; (2) delay in arriving at an appropriate medical facility; and (3) delay

in receiving effective care at such a facility. These same 3 delays are responsible for obstetric fistula formation.

The diagnosis of obstructed labor will probably not be made in a timely manner if those caring for the pregnant woman are obstetrically unskilled. The presence of an attendant who can accurately evaluate the progress of labor is probably the single most important factor in obstetric fistula prevention because delay in diagnosis means that the laboring woman has often already crossed the injury threshold before anyone understands that a problem exists. The World Health Organization has developed a simple graphic representation of labor called a partograph that is highly effective in demonstrating when labor is prolonged. The use of such tools should promote the early transfer of women with prolonged labor to a higher level of care.⁵⁶

Obstructed labor is a mechanical problem, but this fact is often not understood within the local community. A common belief is that prolonged labor is a sign of disfavor from gods or the ancestors rather than a straightforward problem of physical obstruction to delivery. If the delay in delivery is believed to be metaphysical rather than mechanical, the remedy sought will be very different. The presence of such spiritual beliefs often results in attempts to force the laboring woman to "confess" her moral indiscretions (an act which is thought to persuade the unhappy spirits to release their "hold" on her reproductive organs), rather than making efforts to alleviate the mechanical obstruction that is preventing delivery.⁵⁷ Thus, the woman may be transferred to a church, mosque, or other place of spiritual care rather than to an obstetrical clinic.⁵⁸

The determination that labor has lasted too long is, of course, rooted in local perceptions of the "normal" course of labor. Obstetric fistulas tend to be common only in areas where maternal mortality and morbidity are already high, leading to a false (and often tragic) view of what constitutes a "normal" duration of labor. The decision to let a woman linger in childbirth for another day (or 2) in hopes that she will have the baby "on her own" is a major reason that injury occurs. Even if there is a consensus that intervention is needed, the woman may still be unable to seek care unless she has explicit permission from a controlling male authority, who may be absent or unwilling to give his consent, leading to further delay.⁵⁹

The decision to intervene may also involve consequential economic considerations. The costs of seeking advanced obstetric care in low-resource countries are often very high relative to the economic circumstances of subsistence farmers or

poor manual laborers even where the government declares that obstetrical services are “free.”^{60–63} Thus, economic barriers often prolong the delay in accessing care. The economic factors not only involve cash expenditures, but also the opportunity costs that may result from lost wages, lost trade, lost agricultural labor, etc.

Worse still is the decision to utilize directly harmful interventions based on a misunderstanding of the actual clinical situation, such as the administration of medicines (either local herbal remedies or manufactured pharmaceutical products) that make the uterus contract more violently in an attempt to force the baby out^{61–67} or by crude attempts to cut away the obstruction to delivery with razors, knives, broken glass, or other sharp objects. Such actions will often result in increased injury to already compromised tissues and may themselves create a fistula.^{56,59,65–70}

FACTORS INFLUENCING THE AFTERMATH OF OBSTRUCTED LABOR

Obstructed labor always ends. In the best circumstances, it ends because an effective intervention saves the mother’s life and delivers a live-born infant. In low-resource countries, obstructed labor often results in death or significant injury to the mother, her fetus, or both. Where obstructed labor is common and surgical services are poor, uterine rupture is common. High rates of uterine rupture have been reported from eastern Nepal (1 uterine rupture for every 112 deliveries)⁷¹; from Yemen (1 uterine rupture for every 92 deliveries)⁷²; and from Sokoto in northern Nigeria (1 uterine rupture for every 79 deliveries).⁷³ By comparison, rupture of the unscarred uterus occurs at a rate of roughly 1 in 17,000 deliveries in the United States.⁷⁴ When a woman survives obstructed labor only to develop a fistula, fetal wastage generally exceeds 90%. In the series of 899 fistula cases described by Wall et al, fetal mortality was 92% and of the 75 infants who were live-born, an additional 14 died within the neonatal period.⁶

The nature and extent of the injuries that develop in a woman who survives obstructed labor are critically dependent on the quality of care she receives after the event. The ultimate outcome depends on her overall health and nutritional status, whether or not she has developed chorioamnionitis or generalized sepsis during labor, whether or not her bladder was drained or became grossly over-distended during labor, whether or not she had surgery (cesarean delivery, symphysiotomy, hysterectomy, or attempted uterine repair after rupture, etc), and whether or not she

develops postoperative complications. After prolonged obstructed labor, the uterine muscle is often exhausted and poorly contractile; however, it is in just these circumstances that oxytocic medications are often most needed to prevent postpartum hemorrhage.⁷⁵ If the uterine contents have not been evacuated completely after delivery, the risk of postpartum hemorrhage and infection increases. Survival of those infants who are born alive after prolonged obstructed labor depends on prompt resuscitation and ongoing access to competent pediatric care. These perinatal considerations dictate either that delivery take place in an environment where services of this kind are immediately available or that patients be transferred to such a facility as quickly as possible.

To ensure optimal outcomes, women who arrive at hospital in obstructed labor should be treated immediately according to a standardized management protocol. These women often arrive from rural areas dehydrated, exhausted, in pain, febrile, and infected, with bloody urine, edematous external genitalia, and a dead or moribund fetus. All such women should receive an intravenous line and fluids for rehydration, be cross-matched for possible blood transfusion, have their bladders decompressed by inserting an indwelling urinary catheter, and receive broad-spectrum antibiotics while their clinical situation is being assessed. Delivery should be affected promptly to avoid further injury. Rigorous adherence to high clinical standards should improve outcomes, reduce mortality, and lessen the likelihood of subsequent fistula formation in those women whose injuries are not yet fully manifest.⁷⁶

Women who arrive at a health care facility after prolonged obstructed labor having already delivered the fetus must also receive prompt and aggressive supportive care to minimize the damage that has been done. Immediate decompression of an over-distended bladder and prolonged catheter drainage sometimes prevents fistula formation altogether, and in some cases, a fresh fistula will heal spontaneously if such interventions are instituted promptly.^{77,78} Even in cases where profound pelvic injuries are evident, prompt, vigorous, and sustained supportive treatment may facilitate remarkable degrees of healing. John St. George described a striking example of this in a case report over 40 years ago. He wrote⁷⁹:

“The patient, who was aged 18, was brought to the hospital 3 days after delivery, following labor which lasted 7 days. She was incontinent of urine and feces. She was very pale (hemoglobin concentration 3.7 g/100 mL), dehydrated,

toxic, and unable to walk. Vaginal examination revealed a gaping opening with offensive purulent lochia and discharge. The lateral walls of the vagina had sloughed, revealing both pubic rami and the right ischial tuberosity. The perineum was torn, leaving an indefinite anal sphincter. A large vesicovaginal fistula and a small rectovaginal fistula, both with infected edges, were seen. Apart from blood transfusions, parenteral antibiotics and high protein diet were given; the vagina was douched twice daily with warm Dettol solution; this was followed each time by insertion of layers of Sofra-Tulle gauze. After 3 weeks, the local treatment was given once daily for another 3 weeks. When the patient was examined under anesthesia 10 weeks after admission, and before discharge from hospital, the vaginal walls had healed over and returned to normal; the perineum had healed, leaving only a wide vaginal introitus; the rectovaginal fistula had healed, and the vesicovaginal fistula was reduced to 1 cm with mobile surrounding edges. She returned for repair 3 months later, and this was successfully carried out. Prevention of sepsis was the chief factor in such a transformation as occurred in this case, as in many others, and repair would otherwise have failed.”

Successful surgical reconstruction is transformative for women who develop fistulas after obstructed labor. There should be no barriers hindering their access to such services. A successful fistula operation takes a woman whose self-worth has been shattered, who has been scorned by her community as well as abandoned or divorced by her husband, and restores her to dignity and social community.¹⁰ Fistula victims often carry profound psychosocial wounds, which must also be addressed if they are to recover fully from their ordeal.^{80–87} The rehabilitation of these birth-injured women is facilitated by a supportive social environment and special programs tailored to their specific needs. The development of family and community education programs through which the nature, causation, and treatment of obstructed labor can be explained to society at large is very important for overall fistula prevention efforts. Because obstetric fistulas and related injuries are the result of faulty obstetrical mechanics rather than moral misbehavior, all pregnant women are potentially at risk for these devastating reproductive complications. Getting society to understand this will require sustained, effective, and persuasive social marketing campaigns.⁸¹

Full recovery from an obstetric fistula also requires repair of damaged social and economic relationships. Many women will be unable—or unwilling—to return to home communities that have abused them and will need help in developing new life strategies and in forging new social relationships. This will require the acquisition of new social and economic skills so that they can earn an independent livelihood should they be unwilling or unable to reenter family life. Since many women develop a fistula during their first pregnancy, and because many women who develop an obstetric fistula never have another living child, acquisition of new life-skills is crucial for their long-term survival. In the low-resource countries, in which fistulas are common, the social “safety net” consists almost exclusively of kinship and family ties. When these are ruptured by obstetric catastrophe, it is imperative that alternatives be developed for those who are unable to return to the social circumstances that existed before their injuries.

CONCLUSION

Review of the problem of obstructed labor through the use of a Haddon matrix demonstrates that multiple variables influence the development of obstetric fistulas in the preinjury, injury event, and postinjury time frames. The preinjury influences are diffuse and difficult to modify outside of sustained programs to promote social and economic change. Improvements in intrapartum care (particularly universal access to skilled attendants during labor and rapid access to emergency obstetric services) will have the greatest impact in reducing the incidence of obstetric fistulas. The creation of dedicated fistula centers where the special and often complex surgical and social needs of these women can be met should be a high priority in countries where fistulas are commonplace. For any of these changes to be implemented, however, women’s health issues will have to rise higher on the social and political agendas of the countries where these problems are greatest. Even more than being a medical challenge, the obstetric fistula is a moral, political, and socioeconomic challenge. Solving the fistula problem requires competent medical infrastructure, efficient transportation and communication networks, and progressive improvements in the social and legal status of girls and women. Getting men to recognize the important stake that they themselves have in the health of their mothers, wives, sisters, and daughters is of particular importance to the success of such initiatives.^{30,88} The fistula problem will not be solved until the political will to end it develops in those countries

where it is common. This will require a revolution in the way that women's health is regarded in those countries. As Appiah has recently argued, the moral revolutions that led to the eradication of injustices such as dueling, Chinese footbinding or chattel slavery, have been rooted in changing concepts of honor and national shame.⁸⁹ Only when every country in the world recognizes that the presence of obstetric fistula is a stain on its national honor and a shameful accusation of how it treats girls and women will this ancient scourge of childbirth finally be eliminated.

REFERENCES

- Emmet TA. *The Principles and Practice of Gynaecology*. Philadelphia, PA: Henry A. Lea; 1879:614.
- Langkilde NC, Pless TK, Lundbeck F, et al. Surgical repair of vesicovaginal fistulae: a ten-year retrospective study. *Scand J Urol Nephrol*. 1999;33:100–103.
- Goodwin WE, Scardino PT. Vesicovaginal and ureterovaginal fistulas: a summary of 25 years of experience. *J Urol*. 1980;123:370–374.
- Wall LL. Obstetric vesicovaginal fistula as an international public-health problem. *Lancet*. 2006;368:1201–1209.
- Vangeenderhuysen C, Prual A, Ould el Joud D. Obstetric fistulae: incidence estimates for sub-Saharan Africa. *Int J Obstet Gynecol*. 2001;73:65–66.
- Wall LL, Karshima J, Kirschner C, et al. The obstetric vesicovaginal fistula: characteristics of 899 patients from Jos, Nigeria. *Am J Obstet Gynecol*. 2004;190:1011–1019.
- Arrowsmith S, Hamlin EC, Wall LL. "Obstructed labor injury complex:" obstetric fistula formation and the multifaceted morbidity of maternal birth trauma in the developing world. *Obstet Gynecol Surv*. 1996;51:568–574.
- Dumont A, de Bernis L, Bouvier-Colle MH, et al; for the MOMA Study Group. Caesarean section rate for maternal indication in sub-Saharan Africa: a systematic review. *Lancet*. 2001;358:1328–1334.
- AMDD Working Group on Indicators. Program note. Using UN process indicators to assess needs in emergency obstetric services: Niger, Rwanda and Tanzania. *Int J Gynaecol Obstet*. 2003;83:112–120.
- Wall LL. Fitsari 'dan Duniya: an African (Hausa) praise song about vesicovaginal fistulas. *Obstet Gynecol*. 2002;100:1328–1332.
- Wall LL. Thomas Addis Emmet, the vesicovaginal fistula, and the origins of reconstructive gynecologic surgery. *Int Urogynecol J*. 2002;13:145–155.
- van Roosmalen J, Zwart J. Severe acute maternal morbidity in high-income countries. *Best Pract Clin Obstet Gynecol*. 2009;23:297–304.
- Ronsmans C. Severe acute maternal morbidity in low-income countries. *Best Pract Clin Obstet Gynecol*. 2009;23:305–326.
- Weil O, Fernandez H. Is safe motherhood an orphan initiative? *Lancet*. 1999;354:940–943.
- Paxton A, Wardlaw T. Are we making progress in maternal mortality? *N Engl J Med*. 2011;364:1990–1993.
- Neilson JP, Lavender T, Quenby S, et al. Obstructed labour. *Br Med Bull*. 2003;67:191–204.
- Baker SP, Haddon W Jr. Reducing injuries and their results: the scientific approach. *Milbank Mem Fund Q Health Soc*. 1974;52:377–389.
- Haddon W Jr. A logical framework for categorizing highway safety phenomena and activity. *J Trauma*. 1972;12:193–207.
- Haddon W Jr. The changing approach to the epidemiology, prevention, and amelioration of trauma: the transition to approaches etiologically rather than descriptively based. *Am J Public Health*. 1968;58:1431–1438.
- Haddon W Jr. On the escape of tigers: an ecological note. *Am J Public Health*. 1970;60:2229–2234.
- Haddon W Jr. Energy damage and the ten countermeasure strategies. *J Trauma*. 1973;13:321–331.
- Haddon W Jr. Advances in the epidemiology of injuries as a basis for public policy. *Public Health Rep*. 1980;95:411–421.
- Runyon CW. Introduction: back to the future—revisiting Haddon's conceptualization of injury epidemiology and prevention. *Epidemiol Rev*. 2003;25:60–64.
- Eddleston M, Buckley NA, Gunnell D, et al. Identification of strategies to prevent death after pesticide self-poisoning using a Haddon matrix. *Inj Prev*. 2006;12:333–337.
- Barnett DJ, Balicer RD, Blodgett D, et al. The application of the Haddon Matrix to public health readiness and response planning. *Environ Health Perspect*. 2005;113:561–566.
- Conroy C, Fowler J. The Haddon matrix: applying an epidemiologic research tool as a framework for death investigation. *Am J Forensic Med Path*. 2000;21:339–342.
- Peck MD, Kruger GE, van der Merwe AE, et al. Burns and fires from non-electric domestic appliances in low and middle income countries Part II. A strategy for intervention using the Haddon matrix. *Burns*. 2008;34:312–319.
- Runyan CW. Using the Haddon matrix: introducing the third dimension. *Inj Prev*. 1998;4:302–307.
- Filippi V, Consmans C, Compbell OM, et al. Maternal survival 5: maternal health in poor countries: the broader context and a call for action. *Lancet*. 2006;368:1535–1541.
- Harrison KA. The importance of the educated healthy woman in Africa. *Lancet*. 1997;349:644–647.
- McAlister C, Baskett TF. Female education and maternal mortality: a worldwide survey. *J Obstet Gynecol Can*. 2006;28:983–990.
- Dujardin B, Van Cutsem R, Lambrechts T. The value of maternal height as a risk factor of dystocia: a meta-analysis. *Trop Med Int Health*. 1996;1:510–521.
- Kasongo Project Team. Antenatal screening for fetopelvic dystocias: a cost-effectiveness approach to the choice of simple indicators for use by auxiliary personnel. *J Trop Med Hygiene*. 1984;87:171–183.
- Moerman LM. Growth of the birth canal in adolescent girls. *Am J Obstet Gynecol*. 1982;143:528–532.
- Danso KA, Martey JO, Wall LL, et al. The epidemiology of genito-urinary fistulae in Kumasi, Ghana, 1977–1992. *Int Urogynecol J*. 1996;7:117–120.
- Trussell J, Pebley AR. The potential impact of changes in fertility on infant, child, and maternal mortality. *Stud Fam Plann*. 1984;15:267–280.
- Winikoff B, Sullivan M. Assessing the role of family planning in reducing maternal mortality. *Stud Fam Plann*. 1987;18:128–43.
- Harrison KA, Rossitter CE, Chong H, et al. Antenatal care, formal education, and child-bearing. *Br J Obstet Gynaecol*. 1985;92(suppl 5):14–22.
- Campbell OM, Graham WJ; on behalf of The Lancet Maternal Survival Series Steering Group. Maternal survival 2: strategies for reducing maternal mortality: getting on with what works. *Lancet*. 2006;368:1284–1299.
- Ronsmans C, Holtz S, Stanton C. Socioeconomic differentials in caesarean rates in developing countries: a retrospective analysis. *Lancet*. 2006;368:1516–1523.
- Ronsmans C, Etard JF, Walraven G, et al. Maternal mortality and access to obstetric services in West Africa. *Trop Med Int Health*. 2003;10:940–948.
- Loudon I. The transformation of maternal mortality. *BMJ*. 1992;305:1557–1560.
- Loudon I. *Death in Childbirth: An International Study of Maternal Care and Maternal Mortality, 1800–1950*. Oxford: Clarendon Press; 1992.

44. de Brouwere V, Tonglet R, van Lerberghe W. Strategies for reducing maternal mortality in developing countries: what can we learn from the history of the industrialized West? *Trop Med Int Health*. 1998;3:771–782.
45. Shiffman J. Can poor countries surmount high maternal mortality? *Stud Fam Plann*. 2000;31:274–289.
46. Shiffman J. Generating political priority for maternal mortality reduction in 5 developing countries. *Am J Public Health*. 2007;97:796–803.
47. Zaretsky MV, Alexander JM, McIntire DD, et al. Magnetic resonance imaging pelvimetry and the prediction of labor dystocia. *Obstet Gynecol*. 2005;106:919–926.
48. Awonuga AO, Merhi Z, Awonuga MT, et al. Anthropometric measurements in the diagnosis of pelvic size: an analysis of maternal height and shoe size and computed tomography pelvimetric data. *Arch Gynecol Obstet*. 2007;276:523–528.
49. Emmet TA. The necessity for early delivery, as demonstrated by the analysis of one hundred and sixty-one cases of vesicovaginal fistula. *Trans Am Gynecol Soc*. 1879;3:114–134.
50. Allen AM, Lakin T, Shobeiri SA, et al. Transmural vaginal-to-bladder injury from an obstructed labor pattern. *Obstet Gynecol*. 2011;117:468–470.
51. De Heus R, Mulder EJ, Derks JB, et al. Acute tocolysis for uterine activity reduction in term labor: a review. *Obstet Gynecol Surv*. 2008;63:383–388.
52. Sunday-Adeoye IM, Okonta P, Twomey D. Symphysiotomy at the Mater Misericordiae Hospital Afikpo, Ebonyi State of Nigeria (1982–1999): a review of 1013 cases. *J Obstet Gynaecol*. 2004;24:525–529.
53. Arora R, Rajaram P, Oumachigui A, et al. Destructive operations in modern obstetrics in a developing country at tertiary level. *Br J Obstet Gynaecol*. 1993;100:967–968.
54. Marsden DE, Chang AS, Shin KS. Decapitation and vaginal delivery for impacted transverse lie in late labour: reports of 4 cases. *Aust NZ J Obstet Gynaecol*. 1982;22:46–49.
55. Thaddeus S, Maine D. Too far to walk: maternal mortality in context. *Soc Sci Med*. 1994;38:1091–1110.
56. WHO Maternal Health and Safe Motherhood Programme. World Health Organization partograph in management of labour. *Lancet*. 1994;343:1399–1404.
57. Wilson M. *Rituals of Kinship Among the Nyakyusa*. London: Oxford University Press; 1957:144.
58. Udoma EJ, Asuquo EE, Ekott MI. Maternal mortality from obstructed labor in south-eastern Nigeria: the role of spiritual churches. *Int J Gynaecol Obstet*. 1999;67:103–105.
59. Wall LL. Dead mothers and injured wives: the social context of maternal morbidity and mortality among the Hausa of northern Nigeria. *Stud Fam Plann*. 1998;29:341–359.
60. Borghi J, Hanson K, Acquah CA, et al. Cost of near-miss obstetric complications for women and their families in Benin and Ghana. *Health Policy Plann*. 2003;18:383–390.
61. Borghi J, Ensor T, Neupane BD, et al. Financial implications of skilled attendance at delivery in Nepal. *Trop Med Int Health*. 2006;22:228–237.
62. Nahar S, Costello A. The hidden cost of “free” maternity care in Dhaka, Bangladesh. *Health Policy Plann*. 1998;13:417–422.
63. Storeng KT, Baggaley RF, Ganaba R, et al. Paying the price: the cost and consequences of emergency obstetric care in Burkina Faso. *Soc Sci Med*. 2008;66:545–557.
64. Sharan M, Strobino D, Ahmed S. Intrapartum oxytocin use for labor acceleration in rural India. *Int J Gynaecol Obstet*. 2005;90:251–257.
65. Kamatenesi-Mugisha M, Oryem-Origa H. Medicinal plants used to induce labour during childbirth in western Uganda. *J Ethnopharmacol*. 2007;109:1–9.
66. Dujardin B, Boutsens M, De Schampheleire I, et al. Oxytocics in developing countries. *Int J Gynaecol Obstet*. 1995;50:243–251.
67. Onuaguluchi G, Ghasi S. The pharmacological basis for the use of dried sheep placenta in traditional obstetric practice in Nigeria. *J Ethnopharmacol*. 1996;54:27–36.
68. Ampofo K, Omotara BA, Otu T, et al. Risk factors of vesicovaginal fistulae in Maiduguri, Nigeria: a case-control study. *Trop Doct*. 1990;20:138–139.
69. Tahzib F. Epidemiological determinants of vesicovaginal fistulas. *Br J Obstet Gynaecol*. 1983;90:387–391.
70. Tukur J, Jido TA, Uzoho CC. The contribution of Gishiri cut to vesicovaginal fistula in Birnin Kudu, northern Nigeria. *Afr J Urol*. 2006;12:121–123.
71. Chuni N. Analysis of uterine rupture in a tertiary center in Eastern Nepal: lessons for obstetric care. *J Obstet Gynaecol Res*. 2006;32:574–579.
72. Diab AE. Uterine ruptures in Yemen. *Saudi Med J*. 2005;26:264–269.
73. Ekele BA, Audu LR, Muyibi S. Uterine rupture in Sokoto, northern Nigeria: are we winning? *Afr J Med Med Sci*. 2000;29:191–193.
74. Miller DA, Goodwin TM, Gherman RB, et al. Intrapartum rupture of the unscarred uterus. *Obstet Gynecol*. 1997;89:671–673.
75. Winikoff B, Dabash R, Durocher J, et al. Treatment of postpartum haemorrhage with sublingual misoprostol versus oxytocin in women not exposed to oxytocin during labour: a double-blind, randomized, non-inferiority trial. *Lancet*. 2010;375:210–216.
76. Kongnyuy EJ, Mlava G, van den Broek N. A criterion based audit of the management of obstructed labour in Malawi. *Arch Gynecol Obstet*. 2009;279:649–654.
77. Waaldijk K. Immediate indwelling bladder catheterization at postpartum urine leakage—personal experience of 1200 patients. *Trop Doct*. 1997;27:227–228.
78. Bazi T. Spontaneous closure of vesicovaginal fistulas after bladder drainage alone: review of the evidence. *Int Urogynecol J*. 2007;18:329–333.
79. St. George J. Factors in the prediction of successful vaginal repair of vesico-vaginal fistulae. *J Obstet Gynaecol Br Commonwealth*. 1969;76:741–745.
80. Murphy M. Social consequences of vesico-vaginal fistula in northern Nigeria. *J Biosoc Sci*. 1982;13:139–150.
81. Islam AI, Begum A. A psycho-social study on genitor-urinary fistula. *Bangladesh Med Res Council Bull*. 1992;18:82–94.
82. Goh JT, Sloane KM, Krause HG, et al. Mental health screening in women with genital tract fistulae. *Br J Obstet Gynaecol*. 2005;112:1328–1330.
83. Kabir M, Iliyasu Z, Abubakar IS, et al. Medico-social problems of patients with vesico-vaginal fistula in Murtala Mohammed Specialist Hospital, Kano. *Ann Afr Med*. 2004;2:54–57.
84. Bangser M. Obstetric fistula and stigma. *Lancet*. 2006;367:535–536.
85. Alio AP, Merrell L, Roxburgh K, et al. The psychosocial impact of vesico-vaginal fistula in Niger. *Arch Gynecol Obstet*. In press.
86. Ahmed S, Holtz SA. Social and economic consequences of obstetric fistula: life changed forever? *Int J Gynaecol Obstet*. 2007;99:S10–S15.
87. Roush KM. Social implications of obstetric fistula: an integrative review. *J Midwifery Women's Health*. 2009;54:e21–e33.
88. Lefebvre RC, Flora JA. Social marketing and public health intervention. *Health Educ Q* 1988;15:299–315.
89. Appiah KA. *The Honor Code: How Moral Revolutions Happen*. New York, NY: WW Norton; 2010.