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CLINICAL ARTICLE

Pilot community-mobilization program reduces maternal and perinatal mortality and prevents obstetric fistula in Niger

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ABSTRACT

Objective: To assess the impact of a pilot community-mobilization program on maternal and perinatal mortality and obstetric fistula in Niger. **Methods:** In the program, village volunteers identify and evacuate women with protracted labor, provide education, and collect data on pregnancies, births, and deaths. These data were used to calculate the reduction in maternal mortality, perinatal mortality, and obstetric fistula in the program area from July 2008 to June 2011. **Results:** The birth-related maternal mortality fell by 73.0% between years 1 and 3 ($P < 0.001$), from 630 (95% confidence interval [CI] 448–861) to 170 (95% CI 85–305) deaths per 100 000 births. Early perinatal mortality fell by 61.5% ($P < 0.001$), from 35 (95% CI 31–40) to 13 (95% CI 10–16) deaths per 1000 births. No deaths due to obstructed labor were reported after the lead-in period (February to June 2008). Seven cases of community-acquired fistula were reported between February 2008 and July 2009; from August 2009 to June 2011 (23 months; 12 254 births), no cases were recorded. **Conclusion:** Community mobilization helped to prevent obstetric fistula and birth-related deaths of women and infants in a large, remote, resource-poor area.

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1. Introduction

According to global estimates [1,2], 500 000–600 000 maternal deaths (from conception to 42 days after termination of pregnancy) occurred per year between 1980 and 2005, although the number has substantially decreased since, to 342 900 in 2008 [3] and 287 000 in 2010 [4]. In Niger, 15-year-old girls had a one in seven lifetime risk of pregnancy-related death in 2005, which was the highest risk of any country [2].

Obstructed labor causes 4%–30% of maternal deaths worldwide [5,6], and 15% of maternal deaths in Niger's hospitals [7]. It causes obstetric fistula among many survivors: WHO estimates that 73 000 obstetric fistulas occur annually worldwide [8], but other estimates are as high as 130 000 per year [9]. Only 10 000–11 000 fistulas are repaired annually [9], and 5%–25% of fistula surgeries are unsuccessful [10–13]. Prompt identification of women in prolonged labor and rapid access

to emergency obstetric care can prevent both maternal death and obstetric fistula.

In February 2008, Niger's Ministry of Health began implementing a community-based pilot project to rapidly prevent obstetric fistula and deaths from obstructed labor in one area of the country, with assistance from Health and Development International and the United Nations Population Fund [10]. The project aims to reduce the mortality from obstructed labor by 75% and the incidence of obstetric fistula by 50% within 2 years in a high-incidence area. The aim of the present study was to assess developments in the first 41 months of this ongoing health program.

2. Materials and methods

The community-based pilot program serves the Bankilare and Gorouol subdistricts in the district of Téra, which were chosen because of poor geographic access, little external assistance, and frequent obstructed labor complications including obstetric fistula. The size of the multiethnic, agricultural, and pastoral population is estimated at 100 000 people (22 000 women of childbearing age) living in 305

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communities across 4650 km² of Sahelian terrain [14]. The area has one unpaved road, no piped water, and almost no electricity. At the start of the program in 2008, the area had only one midwife, no doctor, and eight health centers, with one ambulance stationed in Bankilare town, more than 60 km away from many villages. Obstetric care is free in Niger, but the district's hospital is up to 140 km away for many people in Bankilare and Gorouol (Fig. 1). Furthermore, this hospital has unreliable electricity and no running water, and, when the program started, had only one doctor who performed all cesarean deliveries for the district. In his absence, the nearest emergency obstetric surgery was in Niamey, which is another 3 hours away by ambulance.

Health service improvements occurred in the program area during the first 41 months of implementation, but the program neither influences, funds, nor knows in advance about government improvements. Another doctor joined the district hospital in April 2008, and a third arrived in early 2011. A ninth health center was established in Amarsingué (Amarassindé) in January 2011. Mobile phone service expanded from limited coverage to coverage of 80% of the area by

June 2011. The program added a midwife, who was based in Dolbel, and added two supervisors when 94 villages proved too much for one person to oversee. A politician procured an additional ambulance that was stationed in Dolbel. No other health service improvements were identified during the period.

Five concepts underlie the program (Box 1). The key intervention is to evacuate women in obstructed labor from their home to a midwife, health center, or hospital. The program uses community volunteers to ensure the sun never rises twice over a woman in labor. An online toolkit [15] describes the program in detail, including how community members are taught.

Informed community consent is obtained through civic and traditional leaders. Villages select a male and a female volunteer who implement key program activities. Topics of conversation are segregated by sex in Niger, so male and female volunteers have different tasks. Female volunteers speak with pregnant women and their families, encourage prenatal consultation and delivery in a facility, and seek verbal permission in advance in case evacuation to the hospital becomes

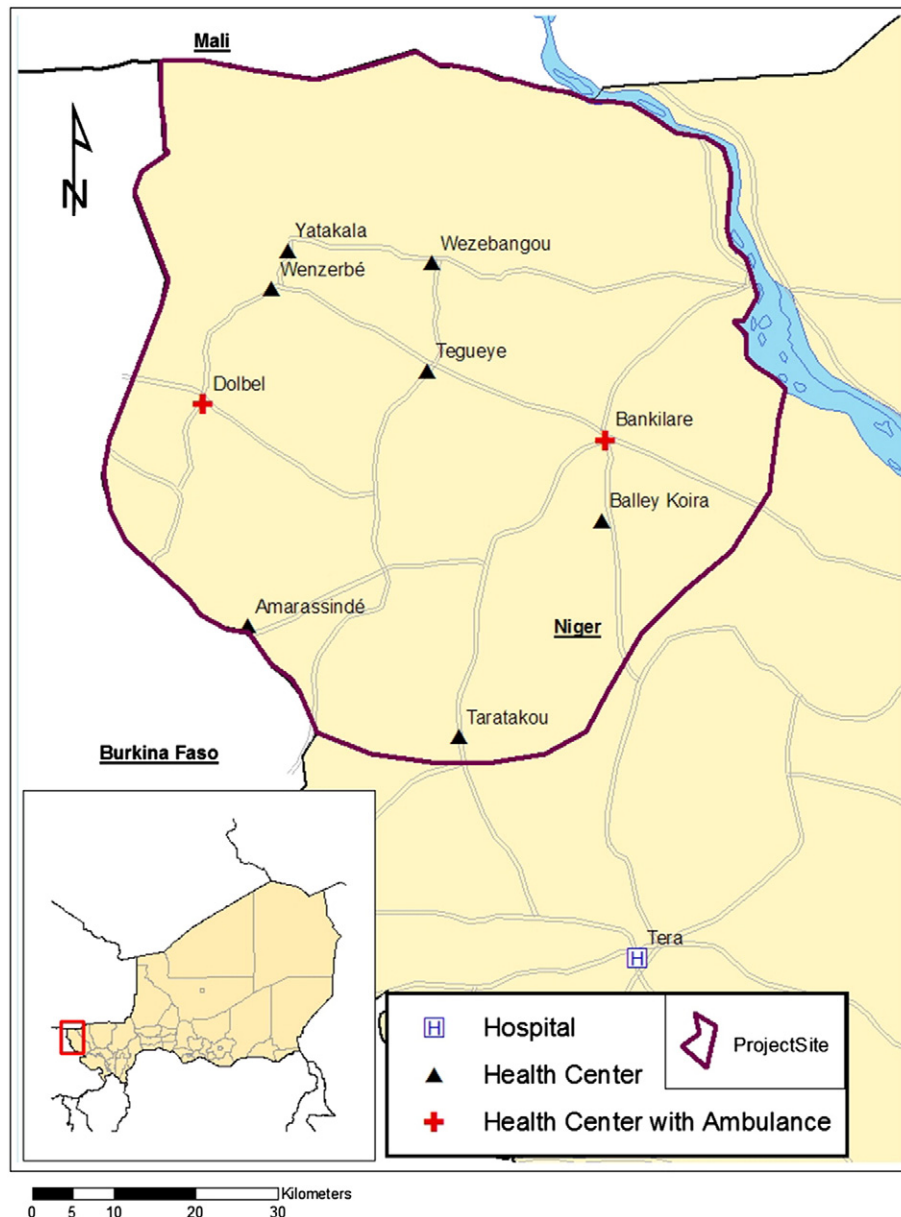


Fig. 1. Map of the program area in Niger. The map shows the location of the district hospital, the two ambulances, and government health centers as of June 2011.

Box 1

Concepts that underlie the program

- 1 Every female volunteer can diagnose sunrise reliably
- 2 The sun must never rise twice over a women giving birth; evacuation to a place where cesarean delivery or expert emergency obstetric care can be provided must occur before the second sunrise
- 3 If a woman in obstructed labor can be brought to a cesarean delivery facility within 2 days, her life can be saved; if she can get there within 12–24 hours of obstructed labor, fistula can often be prevented
- 4 Even in low-income countries, some resources do exist that can save a woman's life and dignity if she can be brought to a hospital where a surgical delivery can be performed; in the study area, cesarean deliveries can be performed at the Téra district hospital; both Téra and the capital city of Niamey are reachable within the relevant time limits
- 5 In many countries including Niger, women can die of obstructed labor within sight of a hospital if absence for seasonal agricultural work or other reasons prevent the husband giving permission for hospital admission

necessary (Box 2). Male volunteers discuss the same topics with men and participate in data registration. Volunteers initiate evacuation by phoning the midwife where the ambulance is stationed or arranging transport to the health center by other means (e.g. donkey cart) if they are unable to reach the midwife. Transportation from health centers to the hospital is free for pregnant women and children younger than 5 years; the program pays the modest cost of fuel for the ambulance for transfers from villages to health centers.

The village volunteers record data on ten variables on picture-based village data forms (Fig. 2). The principal outcome indicators are birth-

Box 2

Responsibilities of female volunteers

- 1 Register each new pregnancy in the community
- 2 Speak with pregnant women and family members who make decisions in a birthing situation; inform them about the program; explain the importance of evacuating a woman if the fetus is not born within 24 hours of regular contractions; seek permission in advance to evacuate the woman if necessary
- 3 Every time a fetus is not born within 24 hours of regular contractions, contact the nearest ambulance to have the woman evacuated; use a mobile phone if possible; if there is no phone coverage, use a donkey cart or whatever is available to get the woman to the nearest health post, where two-way radios are normally available
- 4 Encourage each pregnant woman to go for prenatal consultation
- 5 Encourage each woman to give birth in a facility attended by a trained health worker (i.e. at the local health clinic)
- 6 Register each birth in the community
- 7 Encourage women to go for a postnatal consultation
- 8 Hold health education sessions with individual women and groups in the community, and register these sessions
- 9 Identify women who have an old or new obstetric fistula and refer them for free surgical treatment
- 10 Register any new fistula case, and any death of a woman or neonate in childbirth

related maternal death (maternal death between onset of labor and 42 days postpartum) by cause, obstetric fistula, and early perinatal death (stillborn and neonatal death within 3 days of birth). The principal indicators are noted and recorded by community volunteers at the village level; consequently all principal outcome measures are community-based figures. Secondary indicators, collected by health center nurses, include prenatal consultations, facility-based delivery, and postnatal consultations. The local health center nurse visits the village volunteers monthly to supervise, confer with volunteers, and collect data.

A physician conducts a verbal autopsy for each maternal death. Deaths at or within 42 days of birth are ascribed to one of five causes: prolonged labor (>24 hours), hemorrhage, eclampsia, infection, or other (indeterminate cause). Constant leakage of urine and/or fecal material even during sleep, starting after a birth, is considered to be indicative of obstetric fistula until proven otherwise. Women with a fistula are referred to a university hospital for free evaluation and treatment.

The program's methodology was reviewed in advance by Niger's Ministry of Public Health, and Niger's Ethics Committee retrospectively concurred that they had no ethics objections.

Reliable baseline data on obstetric fistula and maternal and early perinatal mortality were unavailable [16–18]. No community vital statistics existed; official numbers agreed poorly with those found by inspection of health center logbooks, and logbooks were generally unavailable. Maternal mortality and early perinatal mortality estimates in Niger were insufficient to serve as baselines. Niger's official maternal mortality ratio was 590 maternal deaths per 100 000 live births in 2010, although higher (1800 deaths per 100 000 live births in 2005; range 840–2900) and lower (range 360–1100 deaths per 100 000 live births in 2010) estimates exist [3,4,19]. To our knowledge, no estimate of the birth-related maternal mortality rate exists for Niger, even in hospitals. Niger's perinatal mortality rate (fetal deaths and neonatal deaths during the first 7 days of life) was 56 per 1000 births according to the 1998 Demographic and Health Survey [20]. The range and rural–urban differences were not provided, limiting the utility of that number as a baseline.

Therefore, a retrospective survey was conducted of maternal deaths and obstetric fistulas occurring in the year before implementation. From February 1 to March 31, 2008, a convenience sample of residents in each community was asked how many women died at childbirth or within the 40 days of their traditional postpartum confinement and how many developed obstetric fistula in 2007. A physician verified each reported fistula or death, determined the cause of death by verbal autopsy, and brought women with fistula to treatment. However, uncertainty surrounding the literature-derived and retrospectively collected baseline estimates led to the use of year 1 of implementation as the comparator when assessing the effect of the program.

The picture-based village data collection forms and the health facility data were collected monthly and the numbers were entered into Excel 2007 (Microsoft, Redmond, WA, USA). The mortality rates were calculated by dividing the number of maternal or neonatal deaths by the total number of births (home births from village volunteer forms plus facility-based births). The χ^2 test, corrected by the Mantel–Haenszel technique, was applied using Epi Info StatCalc version 6 (Centers for Disease Control and Prevention, Atlanta, GA, USA). $P < 0.05$ was considered statistically significant.

When analyzing the data on obstetric fistula, pre-existing cases and those in nonparticipating communities were registered, investigated, and brought for treatment, but not included in the present analysis. Similarly, when investigation showed that an obstetric fistula occurred because of delays within the health system—e.g. when a woman in obstructed labor was brought to hospital in a timely manner but not treated promptly—these fistulas were not included as failure of the community program.

Start-up problems for some volunteers reduced the data reliability from February to June 2008. Consequently, this was designated the










	Number of new pregnancies
	Women going for prenatal consultation
	Home births
	Evacuations for obstetric emergencies
	Women going for postnatal consultation
	Health education sessions held
	Obstetric fistula cases detected (prevalent + incident cases)
	Obstetric fistula cases referred to treatment
	Deaths of women from childbirth through 42 days post partum Babies born dead or dying within three days after birth

Fig. 2. Variables registered each month by village volunteers. Village volunteers used tally marks to record each event.

lead-in period. Year 1 is July 2008 to June 2009, year 2 is July 2009 to June 2010, and year 3 is July 2010 to June 2011. Only physician-verified maternal deaths and fistula cases were considered accurate during the lead-in period.

3. Results

There were 36 maternal deaths and 5717 births in year 1 (630 deaths per 100 000 births; 95% confidence interval [CI] 448–861), 14

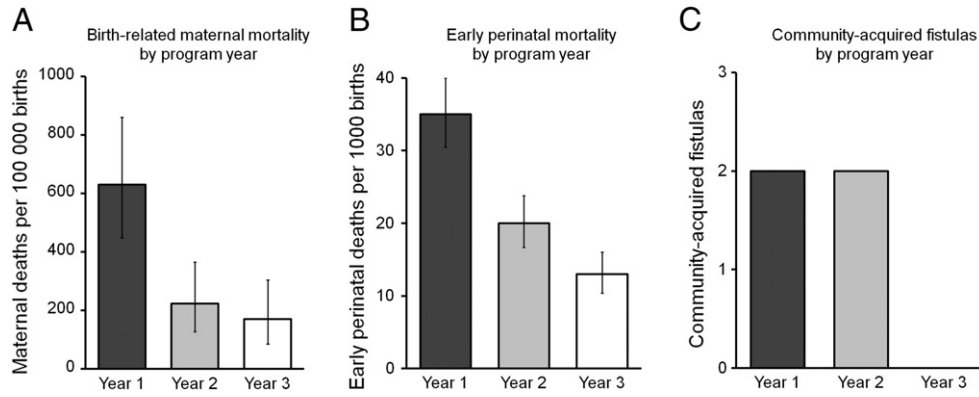


Fig. 3. Impact of the community-based program on (A) birth-related maternal mortality, (B) early perinatal mortality, and (C) obstetric fistula incidence. Year 1, July 2008 to June 2009; year 2, July 2009 to June 2010; year 3, July 2010 to June 2011. Vertical lines on bars indicate 95% confidence intervals.

maternal deaths and 6274 births in year 2 (223 deaths per 100 000 births; 95% CI 127–365), and 11 maternal deaths and 6458 births in year 3 (170 deaths per 100 000 births; 95% CI 85–305) (Fig. 3). Birth-related maternal mortality decreased by 73.0% between years 1 and 3 ($P < 0.001$). No deaths due to obstructed labor were recorded after the lead-in period (Table 1); none occurred in 18 977 births between June 2008 to June 2011, even though 14 627 (77.1%) of these births were not attended by a health professional.

During years 1–3, 1179 (6.4%) of 18 449 women who had been in labor were evacuated from villages for obstetric emergencies (314 [5.5%] of 5717 women in year 1, 462 [7.4%] of 6274 women in year 2, and 403 [6.2%] of 6458 women in year 3). Of the 1179 women who were evacuated, 1007 (85.4%) successfully delivered at a health center; 172 (14.6%) women were taken to hospital (59 [18.8%] of the women evacuated in year 1, 58 [12.6%] in year 2, and 55 [13.6%] in year 3), representing 0.9% of all women in labor.

Seven community-acquired fistula cases (those which occurred because the woman did not reach a hospital where a cesarean delivery could be performed within 18 hours of commencing obstructed labor) occurred during the 41 months: three during the 5-month lead-in period, two in year 1, two in year 2 (both in July 2009), and none in year 3 (Fig. 3). One additional fistula case in March 2009 and two in May 2011 occurred because of delay within the health system after early evacuation of the women from their villages. The fetus died in all ten cases. From August 2009 to June 2011 (23 months with a total of 12 254 births, of which 8954 [73.1%] were not attended by a trained health worker), there was no occurrence of community-acquired obstetric fistula. Four obstetric fistula cases from 2007 were identified through the retrospective survey; medical records searches at Niamey hospitals that treat obstetric fistula uncovered no additional cases in 2007.

There were 200 early perinatal deaths among 5717 live births in year 1 (35 deaths per 1000 births; 95% CI 31–40), 127 early perinatal deaths among 6274 live births in year 2 (20 deaths per 1000 live births; 95% CI 17–24), and 87 early perinatal deaths among 6458 live births in year 3 (13 deaths per 1000 live births; 95% CI 10–16) (Fig. 3). Early perinatal

mortality decreased by 61.5% between years 1 and 3 ($P < 0.001$). Of all births, 900 (15.7%; range across health centers 6.2%–38.6%) in year 1, 1477 (23.5%; range 8.5%–46.6%) in year 2, and 1904 (29.5%; range 16.7%–58.9%) in year 3 occurred in health facilities. The proportion of facility-based births increased by 87.3% between years 1 and 3 ($P < 0.001$).

Initially, 263 (86.2%) of the 305 invited localities participated in the program; 42 (13.8%) declined, which shows that villagers understood that participation was voluntary. The number of participating communities decreased to 252 in the first year because volunteers in 11 villages moved away and were not replaced. Some of the villages that had initially declined joined later, and by the end of the third year, 274 villages were participating. The data were not adjusted for changes in the number of participating villages. On average, 250 (94.0%) of the 266 communities completed monthly reporting during the 41 months of the study period (222 [84.7%] of 262 during the lead-in period, 235 [90.4%] of an average of 260 in year 1, 261 [96.7%] of an average of 270 in year 2, and 266 [97.8%] of an average of 272 in year 3).

4. Discussion

The present analysis demonstrates that community-based approaches can substantially reduce maternal and perinatal mortality while increasing use of health services. Traditional health-systems approaches are essential, yet may require decades to bring the improvements aimed for in programs such as the present one. The mortality from obstructed labor was eliminated within 4 months and sustained at zero for 37 months and 18 977 live births, surpassing the 2-year goal of a 75% reduction. The 61.5% reduction in early perinatal deaths occurred without neonate-specific interventions. Achievement of the goal of a 50% reduction in obstetric fistula could not be statistically proven because of small numbers and unavailable baseline data, but the trend is encouraging.

Two infrastructure changes occurred that could have affected the progress made. First, the district hospital initially had one doctor, but two additional doctors joined during implementation (one in 2008

Table 1
Causes of maternal death as determined by verbal autopsy.^a

Cause of maternal death	Preimplementation (2007)	Lead-in period (February 2008–Jun 2008)	Year 1 (July 2008–June 2009)	Year 2 (July 2009–Jun 2010)	Year 3 (July 2010–June 2011)
Obstructed labor	11 (42.3)	2 (20.0) ^b	0	0	0
Hemorrhage	6 (23.1)	2 (20.0)	18 (50.0)	6 (42.9)	6 (54.5)
Eclampsia	0	3 (30.0)	3 (8.3)	1 (7.1)	0
Infection	2 (7.7)	1 (10.0)	3 (8.3)	5 (35.7)	3 (27.3)
Other	7 (26.9)	2 (20.0)	12 (33.3)	2 (14.3)	2 (18.2)
All causes	26	10	36	14	11

^a Values are given as number (percentage).

^b The last obstructed labor death occurred in May 2008.

and one in 2011). The addition of doctors who perform cesarean deliveries may improve maternal or newborn survival for patients in hospital. However, strengthening hospital resources alone seems unlikely to improve maternal mortality because women with obstructed labor must first get to the hospital. More importantly, less than 1% of women in the present program ultimately delivered in hospital, and the proportion delivering in hospital decreased over the 3 years, indicating that it is unlikely that the addition of hospital physicians can explain the reduction of maternal and neonatal mortality.

The second change was that mobile-phone coverage improved. Although the proportion of women evacuated from villages remained fairly constant, the evacuation time may have decreased because cellular service for arranging ambulance evacuation became more widely available.

Maternal deaths are not differentiated by cause in Niger's health information system. The 2006 Demographic Health Survey [7] reports 15% of maternal hospital deaths as attributable to obstructed labor (range not provided). No previous community-based estimates for deaths due to obstructed labor from rural Niger have been identified. For the preintervention year, verbal autopsy found that 42% of maternal deaths were due to obstructed labor and 23% to hemorrhage. Although these figures may be correct, hemorrhage is usually the leading cause of maternal mortality [2,3,6,8], and hemorrhage deaths seem to be under-reported in the retrospective survey. When obstructed labor mortality was eliminated, hemorrhage definitively became the most common cause of maternal mortality (30 [49%] of 61 birth-related deaths between July 2008 and June 2011). The apparent rise in birth-related deaths from before implementation to year 1 was probably attributable to under-reporting in the preintervention year, chance, or both.

The small number of obstetric fistulas and the unavailability of baseline data make it impossible to determine whether the program's apparent effect on the rate of obstetric fistula is statistically significant. Nevertheless, it is impressive to see no community-acquired case of fistula over a 23-month period with 12 254 births in a setting known for a high incidence of obstetric fistula.

Data allowing comparison with other areas were unavailable. The use of a control area was ruled out because not to disseminate simple, life-saving information while collecting data from a control area would be unethical. The resulting lack of decent preintervention or control-area comparison data arguably constitutes the greatest weakness of the present analysis. However, Demographic and Health Survey estimates [7,21] indicate that overall maternal mortality decreased from 648 deaths per 100 000 live births in 2006 to 535 deaths per 100 000 live births in 2012; this reduction is much smaller than that of birth-related maternal mortality under the present program. Additionally, although the use of year 1 as the baseline is methodologically sound, it probably underestimates the program's impact because substantial improvement was already being achieved during year 1.

In short, a community-mobilization, logistics, and communication approach eliminated a major cause of maternal mortality within 4 months, sustained this result for 37 months and 18 977 additional births, reduced birth-related maternal mortality by 73.0% and early perinatal mortality by 61.5% between years 1 and 3, and sustained the incidence of community-acquired obstetric fistula at zero for 23 months in a large high-incidence area. Furthermore, the number of facility-based births increased significantly. The present community-based approach may usefully supplement traditional health-system improvements where obstructed labor mortality and obstetric fistula incidence are high, to help to achieve Millennium Development Goals 4 and 5 more rapidly than would otherwise be possible.

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Conflict of interest

A.R.S. is founder and executive director of HDI Inc and HDI-Norway. Z.A. has been employed by Health and Development International in Niger since November 1, 2008. R.N.B. is employed part-time by Health and Development International as medical epidemiologist. A.A.M. was employed by Health and Development International in Niger from September 2007 to December 2008. J.L.J. received hourly consulting compensation from Health and Development International for time spent on the program. Y.A.G. was Niger's Director of Reproductive Health during the period discussed here.

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