Multidisciplinary Team Partnerships to Improve Maternal and Neonatal Outcomes

The Kybele Experience

Cyril Engmann, MD
University of North Carolina
Chapel Hill, North Carolina

Adeyemi Olufolabi, MD
Duke University
Durham, North Carolina

Emmanuel Srofenyoh, MD
Ridge Regional Hospital, Ghana Health Service
Accra, Ghana

Medge Owen, MD
Wake Forest University Medical Center
Winston-Salem, North Carolina

Introduction

An estimated 500,000 women die each year from pregnancy-related causes.[1,2] Pregnancy-related deaths often occur because of delays in recognizing complications that require hospital-based healthcare, difficulties in transportation to medical facilities, and inefficiencies within hospital settings.[3,4] Unfortunately, in resource-constrained settings these deadly delays are compounded by a paucity of trained health professionals.[5,6] In addition, substantial quality gaps exist such as inadequate prenatal screening, knowledge and utilization of evidence-based

REPRINTS: MEDGE OWEN, MD, DIVISION OF OBSTETRIC ANESTHESIOLOGY, DEPARTMENT OF ANESTHESIOLOGY, WAKE FOREST UNIVERSITY MEDICAL CENTER, MEDICAL CENTER BOULEVARD, WINSTON-SALEM, NC 27157. E-MAIL: MOWEN@WFUBMC.EDU

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treatment protocols, medication and blood product availability, prompt access to cesarean delivery, and multidisciplinary interventions, which place young mother's lives at risk.[1,5,7] As a result, 7 million stillbirths and early neonatal deaths occur each year[8] primarily caused by infections, birth asphyxia, and prematurity.[9] More than 99% of these maternal and perinatal deaths occur in low and middle-income countries. Maternal and infant mortality are considered basic health indicators that reflect the overall adequacy of a healthcare system.[10]

In September 2000, a Millennium Declaration was adopted by 189 nations and signed by 147 heads of state and governments during the United Nations Millennium Summit. There are 8 Millennium Development Goals targeted to be achieved by 2015 (Fig. 1) and goals 4 and 5 specifically target reductions in child and maternal mortality by two-thirds and three-quarters, respectively.[11,12] In response to the Millennium Development Goals, the World Health Organization, academic institutions and non-governmental organizations are engineering partnerships with healthcare facilities around the world. This report will highlight the activities of one such organization, Kybele, Inc (www.kybeleworldwide.org) based in North Carolina, USA.

Goal 1: Eradicate extreme poverty and hunger

Goal 2: Achieve universal primary education

Goal 3: Promote gender equality and empower women

Goal 4: Reduce child mortality: target-reduce by two thirds

Goal 5: Improve maternal health: target-reduce maternal mortality by three quarters

Goal 6: Combat HIV/AIDS, malaria and other diseases

Goal 7: Ensure environmental sustainability

Goal 8: Develop a Global Partnership for Development

Figure 1. *Millenium Development Goals*. *AIDS indicates acquired immunodeficiency syndrome; HIV, human immunodeficiency virus.*

Kybele, For Safe Childbirth Worldwide

Kybele, Inc is a 501 (c)(3) non-profit humanitarian organization dedicated to improve childbirth conditions worldwide through medical education partnerships. Multidisciplinary healthcare teams travel at the invitation of host countries to work alongside physicians, nurses, and midwives in their home environments. Local medical licenses and/or practice privileges are obtained as required. Initial site assessments are made and then evidence-based guidelines are used to develop country-specific, medical training programs with consideration of local infrastructure and culture. Programs have included the following: the safe administration of epidural, spinal, and general anesthesia; sterile technique; resuscitation of the bleeding mother; the management of pre-eclampsia; ultrasound diagnosis; laparoscopic surgery techniques; and resuscitation and postpartum care of the newborn.[13–16]

Kybele seeks to improve maternal and child healthcare in countries which have a sufficient medical infrastructure to support and sustain progress after training. The overarching goal is to increase medical and nursing standards of healthcare countrywide, not just within isolated hospitals. Kybele faculty model compassionate healthcare and multidisciplinary teamwork, while working side by side with local colleagues within the existing infrastructure in the labor wards, operating rooms, intensive care units, and wards. This demonstrates to host practitioners that patient care can improve even when resources are limited. In addition, Kybele has spearheaded educational programs to quickly implement sustainable interventions at minimal cost. Integral to this effort, Kybele builds long-term relationships, cultural awareness, and trust with local healthcare teams. The organization also sponsors physicians and nurses from host countries to visit North American and European hospitals for 1 month observation periods of childbirth-related medical care. After the programs, Kybele faculty remain a constant resource for host countries, and improvements in healthcare are monitored.[14]

Kybele has a dedicated and growing volunteer trainer base currently with 235 participants in just 5 years. Assessments of the ideal Kybele team member characteristics include the following: open-mindedness, good listening skills, ability to understand different work and national cultures, team oriented, flexible, and adventurous. Members also are able to engage local partners and colleagues. Kybele faculty come from 53 institutions based in the US, Canada, UK, Europe, and Australia and include anesthesiologists, obstetricians, nurses, midwives, neonatologists, internists, biomedical engineers, and administrators. Kybele has been supported by world and national organizations such as: The World Federation Societies of Anesthesia, Society for Obstetric Anesthesia and Perinatology, Obstetric Anaesthetists' Association, the International Association for the Study of Pain, and the International Anesthesia

Research Society. There have been 32 missions in 5 years to countries as varied as Ghana, Croatia, Turkey, Mongolia, the Republic of Georgia, Romania, Armenia, and Egypt. The activities in Ghana will be described to illustrate the evolution of the partnership between Kybele and the Ghana Health Service.

■ The Kybele-Ghana Health Service Partnership

Ghana is a West African country with 23 million inhabitants. It is English speaking, peaceful and has a stable, democratically elected government. It is famous for gold, cocoa, and historically was a major port for the slave trade. Maternal mortality in Ghana is estimated to be 560 deaths/100,000 live births, although reports vary from 220 to 750 deaths/100,000 live births.[17–19] The leading causes of maternal death are acute hemorrhage, sepsis, pre-eclampsia, obstructed labor, nonhemorrhagic anemia, and unsafe abortion.[17,20] Overall, 92% of women attend at least one antenatal clinic, although only 47% of deliveries are attended by a skilled health professional, such as a midwife or physician.[21] Neonatal mortality rates are 43/1000 live births with the majority caused by infections, asphyxia, and prematurity.[13,14] Despite Ghana leading many other African countries in efforts to improve maternal and child health, interventions to lower maternal and neonatal mortality have yielded slow results.

The First Site Visit

In November 2004, a 3 member team of anesthesiologists representing Kybele, Inc, visited Ghana at the invitation of Dr Frank Boni, a consultant anesthesiologist at the University of Ghana's teaching hospital, Korle Bu, to seek information and identify opportunities for long-term collaboration. Three main referral hospitals were visited and staffing, training standards, facilities, equipment availability, and the conduct of anesthesia were observed. Seminars on maternal mortality and neonatal resuscitation were jointly conducted by a multidisciplinary team of Ghanaian and Kybele faculty, and participants included obstetricians, anesthesia providers, pediatricians, nurses, midwives, hospital administrators, and health ministry representatives. Local, cultural, and operational issues affecting anesthesia care were highlighted (Fig. 2). In addition, the paucity of skilled healthcare providers in the country was noted. As an example, over 50% of locally trained physicians emigrate to other countries.[22–24]

The Transitional Years 2005 to 2006

During this initial collaboration period, Kybele trips and activities in Ghana consisted of several days spent in the operating rooms and labor

- There are fewer than 20 fellowship trained anesthesiologists in practice with a significant number concentrated in the two teaching hospitals.
- Countywide, anesthesia is provided primarily by nurse anesthetists sometimes supervised by doctors with limited post-graduate training.
- Anesthesia equipment such as pulse oximeters, capnographs, and oxygen analyzers are generally limited, with a poor maintenance capability, leading to disuse or dysfunction.
- Staffing shortages lead to underutilization of modern equipment and facilities in the few hospitals which have them.
- Anesthesiologist s are underutilized in the labor ward and obstetric anesthesia involvement occurs primarily in the operating room.
- There is widespread use of general anesthesia (with volatile agent use) for cesarean section and the rate of spinal anesthesia for cesarean section is unknown.
- Regional labor analgesia is rarely provided.
- Neonatal resuscitation training for nurses, midwives and physicians is limited.

Figure 2. *Challenges in anesthesiology-related practice in Ghana*.

wards demonstrating anesthesia techniques and conducting neonatal resuscitation and newborn care training programs. These activities were supplemented by 2 days of lectures by local and Kybele faculty.

As the partnership evolved, it became clear that to improve childbirth conditions for Ghanaian mothers and babies, a more comprehensive strategic plan was required. This included: (1) a shift from an anesthesia-focused to a multidisciplinary team composition, (2) tri-annual visits with smaller teams to promote sustainability, rather than annual visits, (3) a systems improvement approach which emphasized multifactorial analysis that impact perinatal healthcare, (4) the incorporation of definable, quantifiable metrics to measure maternal, neonatal, and systems outcome, mindful that the challenge of many altruistic ventures lies in differentiating emotive euphoria of a presumed benefit to actually measure a permanent improvement, and (5) the concept of centers of excellence, where 2 to 3 targeted hospitals would receive concentrated education and training to improve perinatal care. In other countries, Kybele has deployed a "diffuse" training methodology by sending small teams to visit numerous hospitals. In Ghana, however, the new plan involved limiting involvement to a few carefully selected hospitals where systems could be analyzed and strategically improved, and where the leadership was engaged in making the required changes. If successful, a model could be developed for replication throughout the health service. The Ghana Health Service

supported this approach. Furthermore, alliances were built with other stakeholders in maternal and child health in the country at the national, regional, and institutional level and with other non-governmental organizations working in Ghana.

The Formal Partnership

In January 2007, Kybele entered a 5-year agreement with the Ghana Health Service to establish 3 "Obstetric Centers of Excellence" with the goal of reducing by half the number of maternal and neonatal deaths. The first center, Ridge Regional Hospital, is a main obstetric referral hospital in the capital city of Accra with 7000 to 8000 annual births. Nearly 80% of the deliveries are high risk referrals from other institutions and the catchment area extends beyond Greater Accra to contiguous regions. The maternity wing has limited physical space for the functions served. At the beginning of the program, entitled "Making Obstetric Management Safer," there were 6 labor beds in one room and 2 delivery beds in another. The operating theater is 200 m away from the labor ward. Staffing poses a special challenge in that currently only 2 obstetricians, an average of 4 medical officers/residents, and 3 to 4 midwives per shift manage the labor ward. Despite these challenges, the unit has maintained an open door policy of not turning away any patient who needs maternity care. Ridge Hospital was selected based on interactions with the enthusiastic chief obstetrician in the hospital, who a priori was motivated to create a platform for change to empower all staff to take ownership of problems and find solutions.

In the first year of the formal partnership, Kybele analyzed Ridge Hospital's systems and patient care processes. The year culminated when the chief obstetrician at Ridge was invited to visit 3 US-based institutions of key Kybele faculty. Many ideas and recommendations for Ridge Hospital crystallized as a result of this visit. Twelve specific areas

1. Poor staff motivation
2. Clinical care deficiencies
3. Poor workplace environment
4. Patient care delays
5. Inadequate staffing
6. Inadequate monitoring and equipment
7. Inefficient neonatal resuscitation
8. High perinatal loss
9. Poor anesthesia involvement in the labor ward and delays in the operating room
10. Shortage of blood and blood products
11. Poor data capture
12. Lack of a high-risk unit.

Figure 3. *Twelve areas for improvement at Ridge Hospital.*

for improvement were identified by the visit (Fig. 3). A strategic template, or "live process map" was jointly constructed using the 12 improvement areas and this has helped all staff to realize what aspects of patient care and systems management are being addressed. The template identifies the problems, recommends realistic solutions, and charts progress toward defined goals.

Results

Systems Improvements

Through utilization of the "process map," there has been an explosion of activity in the domains of quality improvement, clinical guideline development, standard operating procedures, teaching and training, advocacy, research, and patient centered care at the first "center of excellence." There has been a 21.7% reduction in maternal mortality in 2008 since the beginning of the program in January 2007 (Table 1). This is in light of higher delivery rates and more complicated patients, particularly those with pregnancy-induced hypertension (Table 2) and without a significant staffing increase or infrastructure improvement. Simply, a framework for teamwork and efficiency has been built and key organizational changes have been made. Results have been achieved through some of the interventions listed in Figure 4.

Anesthesiology at Ridge

Analgesia is poorly managed in the labor ward in underdeveloped countries.[25] Childbirth education is rare, pain medication is not provided during labor, and family members are not allowed.[26] Regional analgesia techniques are the most effective form of pain relief and anesthesia providers can significantly improve the labor and delivery experience for many women. Many parturients have labored for hours to days and are often exhausted on arrival. Regional analgesia must be

Table 1. *Maternal Mortality and Caesarean Rates at Ridge Hospital, 2005 to 2008*

Year	Total Deliveries	Maternal Deaths	Maternal Mortality/ 100,000 Live Births	Cesarean Sections	Cesarean Section Rate (%)
2005	2971	13	473	868	29.2
2006	4793	23	479	1555	32.4
2007	6049	30	496	2161	35.7
2008	7465	29	388	2454	32.9

Table 2. *Case Fatality From Hypertensive-related Diseases at Ridge Hospital, 2005 to 2008*

Year	PIH	Prevalence Rate (%)	Mortality From PIH	Case Fatality Rate
2005	49	1.6	3	6.1
2006	169	3.5	11	6.5
2007	321	5.3	10	3.1
2008	581	7.8	8	1.3

PIH indicates pregnancy-induced hypertension.

encouraged as no woman should be traumatized by the denial of pain relief.[26]

The role of the anesthesiologist in the labor ward goes beyond pain relief. Anesthesiologists in the labor ward can function in the effective resuscitation of both parturients and newborns. Anesthesiologists can

1. Prompt triaging of patients on arrival to the labor ward for early detection of high risk problems. Previously, patients were admitted in the order of arrival often delaying treatment for patients with severe pre-eclampsia and hemorrhage.

2. Reorganization of patient flow in the labor ward including an increase in the delivery bed capacity from two to ten with the acquisition of convertible labor and delivery beds. In addition, uncomplicated patients are discharged earlier to the post natal ward and home vastly improving turnover.

3. Greater physician involvement in medically complicated patients with dialogue between the obstetric and anaesthetic teams in increasing the realization of shared responsibility towards the obstetric patient.

4. Creation of an intermediate care area, or high dependency unit, for high risk patients through the restructuring of existing space. In addition, the surgical recovery room has been utilized to monitor critically ill patients.

5. Improved adherence to treatment protocols such as more judicious use of oxytocin for labor augmentation and post-partum hemorrhage management.

6. Improved fetal surveillance with ultrasound and electronic fetal monitoring.

7. Daily morning staff conference to discuss census, patient management and outcomes in the obstetrics and gynecology ward.

8. Heightened awareness among the staff and improvements in morale. Everyone's voice is important and individual efforts to provide excellent clinical care are publicly acknowledged.

9. Improved data tracking and data collection.

10. Greater engagement with the referral institutions in feedback and quarterly perinatal conferences.

11. An analysis of each maternal and perinatal death to identify key avoidable factors classified as patient-related, staff-related and health system related factors.

Figure 4. *Interventions resulting in a reduction in maternal mortality at Ridge Hospital.*

establish intravenous access in the collapsed patient, assist in aggressive resuscitative procedures and placement of central lines, initiate the use of cardiac resuscitative drugs, and maintain the airway by intubation. The anesthesiologist can also communicate with the operating room staff on the condition of the patient, and supervise the preparation and transport of the critically ill patient to the operating room. For example, in one situation, a critically ill, severely hypertensive parturient collapsed suddenly at Ridge, and the anesthetist secured the airway in the labor ward before transferring the patient to the operating room with subsequent full recovery. Anesthesia providers can also be a useful backup for the midwife in the labor ward and operating room who may be faced with resuscitating a compromised baby. Anesthetist involvement within the labor area is a new concept in obstetric practice in many developing countries and can improve patient safety.

At Ridge Regional Hospital, significant improvements have occurred with respect to anesthesia involvement in the obstetric patient. Regional anesthesia for cesarean section is now provided,[13] there are better response times for emergency and urgent cesarean sections, labor analgesia and other obstetric emergency protocols have been developed and piloted, a 4-bed step down bay created within the labor ward has received anesthesia input in the training of midwives on hemodynamic monitoring, and the use of the recovery room has provided critical care for high risk patient management.

The presence of anesthesia providers in the labor ward should be encouraged and hospital administrators made aware of the benefits that anesthesia providers can bring in reducing maternal and neonatal mortality within their institutions. As anesthesia providers are in short supply, compensation for the added responsibility of covering labor ward should be considered.

■ Perinatology at Ridge

Another area of dramatic improvement noted between 2007 and 2008 has been that of avoidable stillbirths. The term ‘‘institutional avoidable stillbirths’’ was coined to indicate the fetus who on arrival in the hospital had a heart rate on auscultation, and who subsequently was born dead. This was to differentiate the fetuses whose death had already occurred before arrival at Ridge Hospital. Between 2007 and 2008

Table 3. *Institutional Avoidable Stillbirth and Rates at RH*

Year	RH Avoidable Still Births	RH Avoidable Still Birth Rate/1000
2007	55	9.0
2008	40	5.4

RH indicates Ridge Hospital.

the institutional avoidable stillbirth rate improved by 40% (Table 3). Contributing factors include: the prompt assessment for fetal heart tones on arrival in the labor ward by auscultation and/or Doppler, ultrasound scanning to triage high-risk cases, the introduction of intermittent cardiotocography monitoring of the fetus, and better availability of a more prompt operative intervention when required.

In addition, it was noted that "when every case is an emergency, no case becomes an emergency," hence the development of a system of classification for the degree of obstetric emergency was developed. This has ensured quicker responses from all staff (including midwives, obstetricians, theater staffs, and anesthetists) such that fetal distress or maternal emergencies are dealt with more expeditiously than before. A strong culture of triage has also been fostered and operative cases are no longer performed on a first-come first-serve basis. There is now continuous triaging and reclassification of risk status to the mother and fetus.

Within Ridge Hospital, there is only one pediatrician who provides neonatal services primarily within the neonatal intensive care unit. As such, the majority of neonatal resuscitations on the labor wards are conducted by midwives and obstetric trainees. In Ghana, Kybele faculty have contributed to numerous neonatal resuscitation training workshops at a national and local hospital level, resulting in enormous improvements in cognitive knowledge of midwives and nurses—the health professionals who most often interface with the pregnant woman and asphyxiated child.[15] In addition, these faculty have used the train-the-trainer model to develop a cadre of trainers who are now responsible for the training of other trainees. The train-the-trainer model uses active-mode learning and multimodal techniques involving dialogue between participants and instructors and has demonstrated utility as a method of diffusing knowledge, promoting ownership, and increasing local capacity, which makes it an attractive consideration for scale-up in resource-constrained settings.[27] Short and long-term assessments of improvements and retention of resuscitative knowledge is underway and a powered study to assess the impact of these neonatal interventions is in development.[16] Although cause and effect is not claimed, the difference in early neonatal mortality rates between 2007 and 2008 is significant.

■ The Multidisciplinary Team

The role of a multidisciplinary team has been most impressively demonstrated in cases of eclampsia and other complications of hypertensive disorders which were managed in the high-dependency ward with the involvement of anesthesiologists, intensivists, internists, neurosurgeons, and subsequently neonatologists. The morning handover

meeting initiated on the labor ward has brought together different disciplines where collective diagnosis, decisions, and management can be discussed and implemented to the long-term benefit of parturient and baby. Its relevance is particularly demonstrated in the very critically ill patient where back-up support by intensive care has impacted outcome.

■ Future Direction

Improved Customer Care Models

Over the past few years, a key initiative of the partnership has been to focus on improved customer care. This has been in the form of lectures, behavioral modeling, and recognition of staff who demonstrate excellent customer care practices. It bears emphasizing that working conditions remain stressful for the staff at Ridge Hospital. Many of the health workers are inundated with an excessive amount of work not plausible in more developed countries. As an example, the delivery rate exploded from less than 2000 deliveries a year to more than 8000 in 4 years, with no change in staff numbers. Despite this, many of the staff are committed to the principle of improved customer care and are making great strides to achieve this.

Family-centered Care Models

Hospital-based family-centered care models that are common place in the US and other developed countries can improve patient satisfaction. It is important to explore how such models can be adapted in a Ghanaian hospital setting because the majority of nonhospital-based deliveries are attended by family members. A greater degree of family involvement could potentially encourage hospital-based delivery which would help to reduce delay in the event of complication.

Enhancing Data Acquisition Systems

Further innovations that are underway include a computer-based patient record system and database that is in the trial stage of use by the nurse midwives. This program enables midwives to electronically enter patient data and automatically generate statistical reports. Currently, all patient information is handwritten and recopied manually to various reports. Having a more efficient charting process will reduce the paperwork burden on the nurses and encourage more interaction with the patients.

Increasing the Number of Anesthesia Providers

Kybele has participated in the curriculum development for a new nurse anesthesia training program (only the third in the country) that

will begin in October 2009 at Ridge Regional Hospital. One unique aspect of this program will be a special focus on training in the use of regional anesthesia techniques to relieve pain and improve safety for obstetric patients. Owing to the diverse responsibilities and the potential widespread utilization of anesthesia providers, it is important that hospital administrators and governments invest in the training of more anesthesia providers and reexamine the existing remuneration methods. If underfunded countries want to impact mortality and morbidity within institutions, the anesthesia provider must be an integral component in planning toward success. Both nurses and doctors must be trained and investment made in this specialty.

Improved Critical Care Capacity

The critically ill parturient may require intensive care briefly during the peripartum period. It is pertinent that to reduce maternal mortality, a referral hospital should have a functioning intensive care unit with trained nurses and anesthesia providers for care through the critical surveillance period. The labor ward must also have a place for resuscitation with the ability for rapid infusion of fluids, adequate hemodynamic monitoring, and quick patient transfer to the operating room if indicated. Anesthesia providers can use pressure bags and continuous automatic blood pressure monitoring and can train midwives in the use of this equipment. Kybele faculty is working to develop such critical care capacity at Ridge Hospital.

Process Replication

Having spent nearly 5 years understanding and addressing the issues that have impacted maternity care at Ridge Hospital and its referral base, Kybele has created a template for institutional assessment that recognizes problems, offers practical solutions, and measures progress. In 2010, at the request of the Ghana Health Service, Kybele will expand our Ghana program to Sunyani, a city located in the Brong Ahofo region of the country. Separate smaller teams will travel to Sunyani to observe practices and begin development of a second Center of Excellence based on the format at Ridge Hospital. The model that has been developed at Ridge needs to be validated and replicated in other hospital settings. Visits are planned to Ridge and Sunyani in January, May, and September 2010.

■ Conclusions

Many countries have invested significant resources into reducing maternal and perinatal mortality. Despite successful examples in more

affluent countries, this goal continues to elude many low and middle-income countries.[28]

Kybele has partnered with the Ghana Health Service to employ systems improvement methodologies to reduce maternal and perinatal mortality in a hospital setting. Should the model at Ridge Hospital and its referral base prove successful in demonstrating a sustained significant reduction of maternal and stillbirth deaths, replication to other referral centers in the country will be undertaken and studied to lend further credibility to its results. The trend of positive outcomes at Ridge Hospital are encouraging and bode well for other referral centers in Ghana, many of which are smaller, and have fewer complexities in obstetric and perinatal service-provision and systems. The success at Ridge Hospital to date has not been without the strong support of the government, both at the national and local level. This has been crucial to the success of the Kybele partnership.

Ultimately, there is no single silver bullet to dramatically improve maternal and perinatal mortality in Ghana. Kybele believes that in the multitude of the smaller things that are recognized, quantified, corrected, and measured, lasting differences can be achieved. None of these can be achieved without the cohesiveness of multidisciplinary teams committed to the same vision. It is envisaged that Ridge Hospital will not only remain a center of excellence, but a learning and model center for other Ghanaian hospitals to emulate.

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