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CLINICAL ARTICLE

Measuring the impact of a quality improvement collaboration to decrease maternal mortality in a Ghanaian regional hospital☆

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ABSTRACT

Objective: To evaluate the performance of a continuous quality improvement collaboration at Ridge Regional Hospital, Accra, Ghana, that aimed to halve maternal and neonatal deaths. *Methods:* In a quasi-experimental, pre- and post-intervention analysis, system deficiencies were analyzed and 97 improvement activities were implemented from January 2007 to December 2011. Data were collected on outcomes and implementation rates of improvement activities. Severity-adjustment models were used to calculate counterfactual mortality ratios. Regression analysis was used to determine the association between improvement activities, staffing, and maternal mortality. *Results:* Maternal mortality decreased by 22.4% between 2007 and 2011, from 496 to 385 per 100 000 deliveries, despite a 50% increase in deliveries and five- and three-fold increases in the proportion of pregnancies complicated by obstetric hemorrhage and hypertensive disorders of pregnancy, respectively. Case fatality rates for obstetric hemorrhage and hypertensive disorders of pregnancy decreased from 14.8% to 1.6% and 3.1% to 1.1%, respectively. The mean implementation score was 68% for the 97 improvement processes. Overall, 43 maternal deaths were prevented by the intervention; however, risk severity-adjustment models indicated that an even greater number of deaths was averted. Mortality reduction was correlated with 26 continuous quality improvement activities, and with the number of anesthesia nurses and labor midwives. *Conclusion:* The implementation of quality improvement activities was closely correlated with improved maternal mortality.

1. Introduction

As 2015 concluded, low-income countries were still working to achieve their Millennium Development Goal targets. Nevertheless, Millennium Development Goal 5, which aimed to reduce maternal mortality by 75% between 1990 and 2015, was difficult to attain for reasons including poor access to quality care [1–3]. In 2007, the WHO Framework for Action [4] identified "quality of health services" as important in improving health outcomes. Some countries have succeeded in reducing maternal mortality, citing strengthened clinical and organizational management, as well as quality improvement mechanisms as contributing factors [5].

Continuous quality improvement (CQI) programs are being increasingly implemented worldwide, with variable effectiveness [6–9]. Primary outcomes can be used to measure health interventions, but outcomes alone do not define quality care. Process indicators may demonstrate that quality improvement precedes change in outcome, but the lack of standardized measurement criteria has limited the ability to assess process methods [10]. The strength of the association between the process indicator and the outcome of interest must be examined when process indicators are being used to measure healthcare delivery.

Kybele, Inc. and the Ghana Health Service began a 5-year collaboration in 2007 at Ridge Regional Hospital (RRH), Accra, to reduce the number of maternal and neonatal deaths by half. Kybele is a nonprofit humanitarian organization that promotes safe childbirth through innovative partnerships (http://www.kybeleworldwide.org). RRH is the largest obstetric referral center within the Ghana Health Service, with a 90-bed maternity unit providing comprehensive care. The role of referral hospitals is to manage complicated pregnancies. As such, approximately 70% of deliveries at RRH are high-risk prenatal or peripartum referrals. Thus, the extent to which these institutions are supported

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and developed to manage complex cases will affect the national effort of reducing maternal mortality.

The present study evaluates the performance of the collaboration at RRH by analyzing maternal mortality and the statistical correlation between implementation of CQI activities, staffing, and clinical outcomes. A conceptual framework for the design, implementation, and evaluation of a CQI program aimed at reducing maternal mortality in referral centers in low-resource settings is proposed.

2. Materials and methods

A full description of the methods used in the present study has been previously published [7]. The collaboration was led by Ghanaian clinicians and supported by triannual visits from healthcare professionals from the USA, Canada, and the UK to provide coaching and direction. Patient care processes were analyzed consecutively by joint RRH-Kybele teams using immersive, interactive, and consultative methods. The initial evaluation revealed numerous systems-level challenges, including poor staff communication, late referrals of high-risk patients, infrequent maternal assessment, limited neonatal resuscitation, few standardized protocols, poorly maintained equipment, treatment delay, and minimal blood product availability. Solutions were proposed by the multidisciplinary team and incorporated into a strategic template or "process map." For each deficiency, assessment metrics and an implementation and advocacy plan were determined and traceable outputs and outcomes were established. The process evolved into an institutional Framework of Change Model for reducing perinatal mortality as previously described [7].

The present evaluation represents a quasi-experimental pre- and post-intervention analysis. The Ghana Health Service directorate granted permission for assessment of interventions conducted during the project. Because no patient-level data were collected, informed consent was not required. Data collection was initially based on manual abstraction from "admission and discharge" and "delivery" ledgers. In 2009, an electronic database was established to support and validate manual abstraction. Data on obstetric outcomes included total deliveries, maternal deaths, and the caseload of obstetric hemorrhage (OH) and hypertensive disorders of pregnancy (HDoP).

HDoP was defined as pregnancy-induced hypertension (≥140/90 mm Hg after 20 weeks of pregnancy without proteinuria), pre-eclampsia (hypertension ≥140/90 mm Hg after 20 weeks of pregnancy with proteinuria ≥1+ on dipstick), superimposed pre-eclampsia (worsening hypertension with new-onset proteinuria), imminent eclampsia (pre-eclampsia with headache, epigastric pain, nausea, or blurred vision), and eclampsia. Cases classified as OH included primary postpartum hemorrhage (≥500 mL for vaginal or ≥1000 mL for cesarean delivery within 24 hours of delivery), secondary postpartum hemorrhage (bleeding >24 hours after delivery), prepartum hemorrhage due to placenta previa, abruption placenta, and ruptured uterus.

The 97 CQI activities were grouped within three bundles (Personnel [P], Quality-communication [Q], and Systems-management [S]), and nine sub-bundles (Table 1). This categorization was based on the broad goals of the various improvement activities. Implementation of these activities was led by local clinicians with support and mentorship from the external collaborators. The implementation strategy included triannual visits of the external teams, prioritization of improvement activities, data collection, and implementation.

Three assessors (E.K.S., A.J.O., and M.D.O.) independently assigned implementation scores for the 97 improvement processes three times per year. Scores were assigned in quartiles ranging from 0% to 100%, color coded, and displayed in the hospital. Objectives that had numerical outcomes could be assessed quantitatively, but other assessments were subjective and based on the evaluators' in-depth knowledge of the system. To limit subjectivity, disagreements between evaluators were resolved through discussion so that one score for each item was recorded. Mean implementation scores for each improvement activity, sub-bundle, and bundle were calculated in addition to an overall "PQS score" that summarized implementation of the entire change model.

Table 1
Classification of bundles of improvement activities.

Bundle and sub-bundle	Activity
P	
P1	Leadership and organizational development
P2	Motivation, empowerment, responsibility, and accountability of staff
P3	Improvement of knowledge and skills
Q	
Q1	Improvement of service quality and standards of clinical care
Q2	Facilitation of communication between and within departments
Q3	Improvement of communication and feedback with referring institutions
S	
S1	Improvement of patient flow processes and timeliness of care
S2	Improvement of physical workspace and maximization of capacity
S3	Improvement of resources (staffing and equipment) and logistics supplies

Abbreviations: P, personnel bundle; Q, quality-communication bundle; S, systems-management bundle.

Two counterfactual clinical scenarios were developed as severity adjustments to account for the evolving case-mix over the study period (Fig. 1). We used prevalence and case fatality rate (CFR) data for OH and HDoP to calculate CFR and prevalence for other contributing conditions using the following calculation:

$$CFR_{total} = (CFR_{hem} \times Prev_{hem}) + (CFR_{htn} \times Prev_{htn}) + (CFR_{other} \times Prev_{other})$$

This assumes that the overall CFR of the total number of cases referred or delivered at the hospital is dependent on the sum of cause-specific CFR and the prevalence of contributing conditions. In the first counterfactual scenario (CF1), all prevalence rates were held constant at their observed 2006 values and paired with observed values for CFR at each timepoint. In the second counterfactual scenario (CF2), CFR values were held constant at those observed in 2006, but paired with time-specific prevalence values. Because the proportions of the most severe forms of the two complications did not change significantly (e.g. eclampsia consistently contributed to 16%–17% of HDoP), further severity adjustments were unnecessary.

It was hypothesized that change could be due to the implementation of improvement activities and/or staffing. To determine which factors most closely correlated with changes in mortality, an ordinary least squares (OLS) linear regression [11] was performed, including CFR for all deliveries, HDoP, OH, and the remaining mortalities for the observed and counterfactual scenarios versus annual mean CQI activity

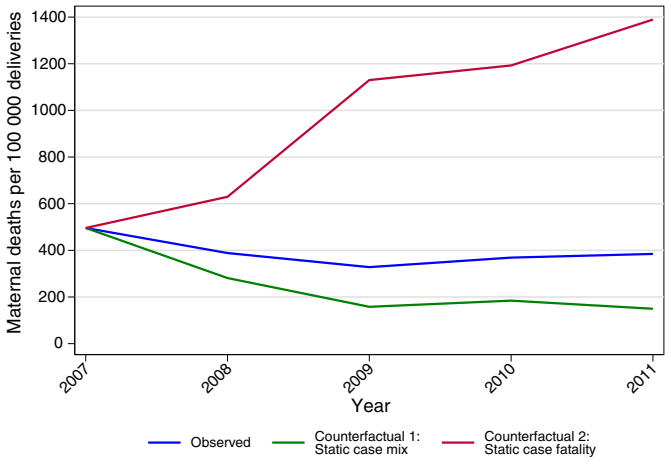

Fig. 1. Maternal mortality at Ridge Regional Hospital, 2007–2011, with counterfactual scenarios.

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