One-year evaluation of the impact of an emergency obstetric and neonatal care training program in Western Kenya

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ABSTRACT

Objective: To determine the impact of introducing an emergency obstetric and neonatal care training program on maternal and perinatal morbidity and mortality at Moi Teaching and Referral Hospital, Eldoret, Kenya. Methods: A prospective chart review was conducted of all deliveries during the 3-month period (November 2009 to January 2010) before the introduction of the Advances in Labor and Risk Management International Program (AIP), and in the 3-month period (August–November 2011) 1 year after the introduction of the AIP. All women who were admitted and delivered after 28 weeks of pregnancy were included. The primary outcome was the direct obstetric case fatality rate. Results: A total of 1741 deliveries occurred during the baseline period and 1812 in the post-intervention period. Only one mother died in each period. However, postpartum hemorrhage rates decreased, affecting 59 (3.5%) of 1669 patients before implementation and 40 (2.3%) of 1751 afterwards (P = 0.029). The number of patients who received oxytocin increased from 829 (47.6%) to 1669 (92.1%; P < 0.001). Additionally, the number of neonates with 5-minute Apgar scores of less than 5 reduced from 133 (7.7%) of 1717 to 95 (5.4%) of 1745 (P = 0.006). Conclusion: The introduction of the AIP improved maternal outcomes. There were significant differences related to use of oxytocin and postpartum hemorrhage.

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1. Introduction

Maternal morbidity and mortality are of paramount concern in most resource-poor settings. The aim of the fifth Millennium Development Goal is to reduce maternal mortality [1]. Overall, 33.9% of maternal deaths in the African region are caused by hemorrhage [2].

The most recent estimate of the maternal mortality ratio in Kenya was 488 maternal deaths per 100 000 live births, which accounts for 15% of all deaths of women aged 15–49 years [3]. Although 92% of pregnant women in this country attend at least one prenatal clinic, only 43% deliver in a health facility [3]. Overall, only 44% of births are attended by a skilled attendant, most often a nurse or midwife. This lack of skilled care at delivery has been acknowledged as a key contributor to poor maternal health outcomes [4]. In addition, the adequacy of existing skills has at times been called into question, further undermining the need for consistent teaching and retraining of key provider skills [5,6].

Previous efforts to improve the safety of motherhood in resource-limited settings in the past few decades have focused on improving the skills of traditional birth attendants; however, to date, the efficacy of these efforts has not been clearly demonstrated [7]. Current initiatives are focused on improving the skills of healthcare professionals involved in obstetrics and care of the neonate (e.g. nurse-midwives and physicians) to improve the safety and outcomes of obstetric services as well as increasing the proportion of deliveries performed by a skilled attendant, which has been associated with improved outcomes [8]. To date, tests to evaluate knowledge before and after a training intervention have shown that performance improved after training [9], staff who received training reported improved comfort in dealing with acute scenarios [10], and there was some short-term improvement in the rates of postpartum hemorrhage [11], which is a major contributor to maternal mortality. Despite the availability of numerous training courses on emergency obstetric and neonatal care (EmONC), there is an overall lack of adequate evaluation of existing programs in terms of their clinical performance, and a paucity of evidence of any long-term benefit with regard to maternal and neonatal outcomes [6]. A recent cluster-randomized large-scale trial performed in West Africa [12] showed a significant reduction in maternal mortality (P = 0.0299) after the introduction of a
multifaceted strategy of EmONC training, outreach visits, and maternal
death review committees at district and capital hospitals; however,
this effect was not seen at hospitals outside the capital.

The Advances in Labor and Risk Management International Program
(AIP) is a product developed, owned, and implemented by the Society
of Obstetricians and Gynecologists of Canada. The AIP is a capacity-
building 5-day course for all health professionals (i.e. physicians, physi-
cians in training, nurses, and midwives) responsible for the delivery of
emergency obstetric and newborn care, addressing the five main causes
of maternal mortality and morbidity (obstructed labor, hemorrhage,
sepsis, hypertensive disorders, and complications owing to unsafe abor-
tion). Newborn health outcomes are addressed in a component on new-
born resuscitation and care. The AIP further sensitizes participants to
the social, economic, cultural, and legal factors that may impede
women from accessing reproductive health services and information,
and it advocates for the improvement of women’s reproductive and
sexual health as a matter of social justice. Finally, it also exposes health
professionals and administrators to the monitoring and evaluation
methodologies necessary in all initiatives aimed at increasing access
and quality of maternal and newborn health services. The AIP is taught
within a framework of sexual and reproductive rights [13].

The AIP has become a well-studied measure of EmONC training: for
example, Dumont et al. have previously reported the findings of a
QUARITE (quality of care, risk management and technology in obstet-
rics) cluster-randomized trial conducted in Senegal and Mali that used
the AIP [12,14]. To address the lack of existing evaluation of EmONC
training courses, the aim of the present study was perform a before-
and-after prospective chart review evaluation of the program to deter-
mine whether introducing the AIP improved the safety of obstetric
and neonatal care provided at a low-resource tertiary care center in
Kenya.

2. Materials and methods

A prospective study was undertaken involving chart review of all de-
deliveries at the Moi Teaching and Referral Hospital (MTRH), Eldoret, Kenya,
in the 3-month period (November 1, 2009, to January 31, 2010) prior
to introducing the AIP, and in the 3-month period (August 1–November
30, 2011) 1 year after 80% of the maternity ward staff had completed AIP
training. The threshold of 80% was agreed upon in the study design as
representing most of the labor and delivery staff; staffing attrition and
hiring meant that maintaining a level of 100% trained staff for the dura-
ton of the study was not possible. All women who were admitted and
delivered at MTRH and all neonates who were born at MTRH during
the study periods were included in the study. Pregnancies of less than
28 weeks and mothers or neonates transferred to MTRH after delivery
elsewhere were excluded from the study. Ethics approval for the study
was obtained from both the Research Ethics Board at the University of
Toronto and the Institutional Research Ethics Board at Moi University
School of Medicine (protocol numbers 24371 and 000435, respectively).

Moi University School of Medicine and MTRH have been partnered
with the Department of Obstetrics and Gynecology at the University of
Toronto, Canada, since 2007. MTRH is a 700-bed hospital serving over
11 million people in Western Kenya and is the clinical site of Kenya’s
second-largest medical school. Between 2009 and 2011, approximately
7000 deliveries per year were performed at MTRH. To consolidate the
training and experience of the labor ward staff at MTRH, staff were
not transferred to other wards or facilities to maintain the impact of
training interventions and the team environment.

Research assistants were present on the labor ward 24 hours per
day, 7 days per week during the study data collection periods. Delivery
information was collected from charts immediately following the deliv-
ery on a data collection sheet and later entered into an electronic data-
base. Although research assistants could approach staff for clarification
of chart information there was no direct patient contact and therefore
informed consent was not required. Data were collected for a month
prior to the initiation of the study to pilot the use of the forms and to
train the research assistants in data collection.

The primary outcome was the direct obstetric case fatality rate (di-
rect obstetric deaths or women with direct obstetric complications).
Secondary outcomes were maternal and neonatal morbidity, including
rates of admission to intensive care units and neonatal intensive care
units, hemorrhage, transfusions, neonatal mortality rate, and an Apgar
score of less than five at 5 minutes.

All chart abstraction data were entered into Microsoft Access 2007
software (Microsoft Enterprise, Redmond, WA, USA) and checked for
consistency using SPSS version 19 (IBM, Armonk, NY, USA). Any dis-
crepancies in data were checked against hard-copy data collection
forms to ensure accurate data entry. Data from the baseline period
prior to the AIP training intervention were merged with the post-AIP
training intervention period to allow for before-and-after cross-
sectional comparison of the AIP.

Data were collected on the demographic characteristics of the partic-
ipating mothers (i.e. age, marital status, occupation, and maternal edu-
cation) and clinical parameters (i.e. height, weight, and gravidity). The
mean was calculated for continuous variables. Clinical and delivery
characteristics of participants were also dichotomized to reflect the
number of women above or below a threshold clinical value. The gesta-
tional age of the neonate was characterized as preterm, at term, or post-
term if gestation at delivery was less than 37 weeks, 37–41 weeks, or
more than 41 weeks, respectively.

Data were collected on the labor characteristics of participants, in-
cluding method of induction, labor augmentation, and type and dura-
tion of labor, for the baseline and post-AIP training intervention
periods. Delivery and pregnancy complications, such as episiotomy,
tearing, and lacerations, were measured by dichotomous variables
with yes or no responses. Data were also collected on neonate charac-
teristics at birth, sex, and Apgar score at 5 minutes.

All statistical analyses were conducted using SPSS version 19. Cate-
gorical variables were compared using a χ² test and continuous vari-
able were compared using a Student t test to determine whether
there were any significant differences between the baseline and post-
AIP training intervention periods. When appropriate, the Fisher exact
test was used to compare proportions for expected cell counts less
than five. P < 0.05 was considered statistically significant.

3. Results

The demographic and obstetric characteristics of the study popula-
tion are shown in Supplementary Material S1 and S2. A similar number
of deliveries occurred during the two periods of data collection: 1741
in the baseline period and 1812 after the training intervention. The
mean maternal age of the participants was similar for both data collec-
tion periods: 26.4 ± 5.8 years and 26.7 ± 5.9 years (P = 0.137). The
only significant differences between the two study populations were
for occupation, how many had completed secondary education, and
weight. A higher proportion of students and businesswomen were ad-
dmitted during the postintervention period (P < 0.01), perhaps re-
flecting the higher proportion with secondary education; however, signifi-
cantly fewer participants were self-employed (P = 0.015). The weight of par-
ticipants admitted during the postintervention period (68.4 ± 12.1 kg)
was significantly greater than that of those admitted before the interven-
tion (65.5 ± 11.9 kg; P = 0.001). In total, 748 (43.1%) of 1735 patients in
the preintervention period and 725 (40.2%) of 1804 patients in the post-
intervention period were primigravidae (P = 0.078). The two groups of
patients were not significantly different in terms of their previous ob-
stetric history, including prior live births and prior preterm births.

Clinical characteristics of the patients are shown in Table 1 and labor
characteristics are shown in Table 2. Mean length of pregnancy and pro-
portion of twins delivered were similar before and after the intervention
(Table 1). In total, 83 (5.0%) of 1676 and 113 (6.5%) of 1750 patients
were HIV positive before and after the intervention period, respectively.
Oxytocin was used to augment the labor of significantly more patients in the baseline period than during the post-AIP period ($P < 0.001$), and the first and second stages of labor in the baseline period were also significantly shorter than during the postintervention period ($P \leq 0.001$) (Table 2). The number of episiotomies performed was significantly reduced ($P < 0.001$), but the number of women who experienced lacerations increased significantly ($P > 0.001$) (Table 5).

The number of neonates with Apgar scores of less than 5 at 5 minutes was significantly reduced from 133 (7.7%) of 1717 before implementation to 95 (5.4%) of 1745 afterwards ($P < 0.001$). Some outcome measures did not occur at a sufficient frequency to note a difference: for example, there was only one peripartum maternal death in each of the two periods.

### 4. Discussion

Only two maternal deaths occurred during the present study—one before the AIP training intervention was implemented and one after the training intervention—meaning that there was insufficient power to determine a difference in the direct obstetric case fatality rate, the primary outcome. Nonetheless, there were significant differences in postpartum hemorrhage, administration of oxytocin, administration of oxytocin after delivery of the placenta, and management of postpartum hemorrhage, which were topics addressed in the AIP training curriculum. Significantly more women received oxytocin augmentation in the baseline period than during the postintervention period, which may be related to the significantly shorter first and second stages of labor before implementation of the intervention. Although estimated blood loss increased, this might have been because estimated blood loss was assessed more carefully following AIP training.

The maternal weight of participants admitted during the postintervention period was significantly greater than that of women who...
The present study was conducted over a period of more than 2 years. During the study period, the mother/baby ward moved to a new location, a separate intervention was introduced to increase availability of emergency medications on the labor ward [15], and an increasing number of protocols were introduced on the maternity ward. However, the AIP was the only training intervention carried out during the study.

Training is a realistic and feasible means of knowledge translation in resource-limited settings, and evidence-based programs such as AIP are available internationally. The AIP specifically allows all health

routine episiotomy and performing it only as a matter of best practice in a mother-friendly environment is part of the AIP training and was the only intervention during the study that addressed episiotomy.

Audits of maternal deaths at MTRH were performed following the baseline and postintervention periods to determine whether the one recorded maternal death in each time frame was accurate. These audits revealed a few additional maternal deaths, but these deaths were not included in the analysis because they did not occur on the maternity ward: they were due to septic abortions on the gynecology ward, deaths of mothers transferred to MTRH after delivery at another facility, or deaths of pregnant prepartum mothers on the prepartum ward before labor. Interventions are needed to reduce the number of these preventable maternal deaths; however, the focus of the AIP is peripartum morbidity and mortality. Further studies are needed to evaluate the effectiveness of EmONC courses in community and population-wide settings and to assess referral practices and the impact on prepartum deaths.

A limitation of the present study was that it was not a randomized controlled trial. A randomized controlled trial—was used to evaluate the AIP in the QUARITE trial [12,14]—is considered the gold standard to determine cause and effect. However, they can be challenging to implement for large-scale training programs in real-world environments because environments do not stay static over time. Taking into account the time involved in program implementation and follow-up, the present study was conducted over a period of more than 2 years. During the study period, the mother/baby ward moved to a new location, a separate intervention was introduced to increase availability of emergency medications on the labor ward [15], and an increasing number of protocols were introduced on the maternity ward. However, the AIP was the only training intervention carried out during the study.

were admitted before the intervention, but, this finding was not thought to have clinical relevance. There was a significant difference in the number of episiotomies performed in the two periods. Reducing the number of episiotomies performed is not an intervention that will save lives; however, avoiding

we shall skip the next two lines because they are not relevant to the image.

Table 3

Table 3

<table>
<thead>
<tr>
<th>Complications of pregnancy and delivery. a</th>
<th>Baseline (n = 1741)</th>
<th>Postintervention (n = 1812)</th>
<th>P value b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-eclampsia</td>
<td>99 (5.3)</td>
<td>106 (6.0)</td>
<td>0.352</td>
</tr>
<tr>
<td>Maternal seizures or eclampsia</td>
<td>12 (0.7)</td>
<td>9 (0.5)</td>
<td>0.485</td>
</tr>
<tr>
<td>Preterm rupture of membrane</td>
<td>81 (4.7)</td>
<td>75 (4.2)</td>
<td>0.467</td>
</tr>
<tr>
<td>Chorioamnionitis</td>
<td>110 (6.6)</td>
<td>70 (4.4)</td>
<td>0.19</td>
</tr>
<tr>
<td>Sepsis</td>
<td>3 (0.2)</td>
<td>3 (0.2)</td>
<td>0.99</td>
</tr>
<tr>
<td>Deep vein thrombosis or pulmonary embolism</td>
<td>13 (0.8)</td>
<td>3 (0.2)</td>
<td>0.011</td>
</tr>
<tr>
<td>Placental abruption</td>
<td>12 (0.7)</td>
<td>8 (0.4)</td>
<td>0.330</td>
</tr>
<tr>
<td>Anemia</td>
<td>246 (15.3)</td>
<td>184 (13.4)</td>
<td>0.154</td>
</tr>
<tr>
<td>Prepartum hemorrhage</td>
<td>26 (1.5)</td>
<td>19 (1.1)</td>
<td>0.236</td>
</tr>
<tr>
<td>Postpartum hemorrhage</td>
<td>59 (3.5)</td>
<td>40 (2.3)</td>
<td>0.029</td>
</tr>
<tr>
<td>Ruptured uterus</td>
<td>5 (0.3)</td>
<td>7 (0.4)</td>
<td>0.775</td>
</tr>
<tr>
<td>Maternal death</td>
<td>1 (0.1)</td>
<td>1 (0.1)</td>
<td>0.99</td>
</tr>
</tbody>
</table>
| a Values are given as a number (percentage) unless otherwise indicated. b χ² test or Fisher exact test (when cell counts <5). c Missing data for pre-eclampsia for 70 participants: 20 at baseline and 50 postintervention. d Missing data for eclampsia for 81 participants: 20 at baseline and 60 postintervention. e Missing data for preterm rupture of membrane for 28 participants: 11 at baseline and 17 postintervention. f Missing data for sepsis for 26 participants: 11 at baseline and 15 postintervention. g Missing data for deep vein thrombosis and pulmonary embolism for 19 participants: 8 at baseline and 11 postintervention. h Missing data for placental abruption for 20 participants: 5 at baseline and 16 postintervention. i Missing data for anemia status for 570 participants: 132 at baseline and 438 postintervention. j Missing data for prepartum hemorrhage for 64 participants: 31 at baseline and 33 postintervention. k Missing data for postpartum hemorrhage for 133 participants: 72 at baseline and 61 postintervention. l Missing data for ruptured uterus for 41 participants: 25 at baseline and 16 postintervention. m Missing data for maternal death for 101 participants: 55 at baseline and 46 postintervention.

Table 4

Table 4

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Baseline (n = 1741)</th>
<th>Postintervention (n = 1812)</th>
<th>P value b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxytocin use</td>
<td>829 (47.6)</td>
<td>1609 (92.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>1 dose</td>
<td>671 (38.2)</td>
<td>1277 (77.3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>&gt;1 dose</td>
<td>89 (11.7)</td>
<td>369 (22.3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total dose, µg</td>
<td>11.0 ± 15.5</td>
<td>16.5 ± 19.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Oxytocin use before placental delivery a</td>
<td>1427 (91.7)</td>
<td>1500 (99.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total dose, units</td>
<td>18.9 ± 31.9</td>
<td>13.5 ± 14.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Oxytocin use after placental delivery a</td>
<td>98 (6.5)</td>
<td>123 (84.8)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total dose, units</td>
<td>36.9 ± 50.8</td>
<td>35.2 ± 61.4</td>
<td>0.824</td>
</tr>
<tr>
<td>Magnesium sulfate</td>
<td>36 (2.1)</td>
<td>76 (4.8)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
| a Values are given as mean ± SD or number (percentage), unless otherwise indicated. b Mean values compared with t test, and numbers compared with χ² test. c Data for 2413 participants: 761 at baseline and 1652 postintervention. d Missing data for oxytocin use before placental delivery for 492 participants: 185 at baseline and 307 postintervention. e Data for 1625 participants: 1500 at baseline and 125 postintervention. f Data for 205 participants: 97 at baseline and 108 postintervention. g Missing data for magnesium sulfate for 302 participants: 62 at baseline and 240 postintervention. h Baseline and postintervention proportions were significantly different when compared using a Z test for proportions.
professional who work in obstetric care to train together in a multidisciplinary fashion and to be trained by a diverse, multidisciplinary group of trainers, fostering collegiality. Further studies are warranted to evaluate the effectiveness of training in other areas of healthcare provision, and prospective studies, with randomized methodology when possible, are needed to further evaluate the benefit of emergency obstetric training.

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.ijigo.2014.05.023.

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Conflict of interest

The authors have no conflicts of interest.

References