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## CLINICAL ARTICLE

## Advancing obstetric and neonatal care in a regional hospital in Ghana via continuous quality improvement

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## ABSTRACT

**Objective:** To reduce maternal and neonatal death at a large regional hospital through the use of quality improvement methodologies. **Methods:** In 2007, Kybele and the Ghana Health Service formed a partnership to analyze systems and patient care processes at a regional hospital in Accra, Ghana. A model encompassing continuous assessment, implementation, advocacy, outputs, and outcomes was designed. Key areas for improvement were grouped into “bundles” based on personnel, systems management, and service quality. Primary outcomes included maternal and perinatal mortality, and case fatality rates for hemorrhage and hypertensive disorders. Implementation and outcomes were evaluated tri-annually between 2007 and 2009. **Results:** During the study period, there was a 34% decrease in maternal mortality despite a 36% increase in patient admission. Case fatality rates for pre-eclampsia and hemorrhage decreased from 3.1% to 1.1% ( $P<0.05$ ) and from 14.8% to 1.9% ( $P<0.001$ ), respectively. Stillbirths were reduced by 36% ( $P<0.05$ ). Overall, the maternal mortality ratio decreased from 496 per 100 000 live births in 2007 to 328 per 100 000 in 2009. **Conclusion:** Maternal and newborn mortality were reduced in a low-resource setting when appropriate models for continuous quality improvement were developed and employed.

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## 1. Introduction

Maternal mortality remains an unrelenting challenge in Africa, largely due to the disparity between best practice and the care that is typically available. Issues of access compound the problem, owing to poor transportation and late recognition of complications [1]. In several African countries, citizens avoid hospital care because of the perception of poor quality [2–4]. Healthcare systems often suffer from inadequacies in trained staff, prenatal screening, knowledge and use of evidence-based protocols, medication and blood availability, prompt cesarean delivery, multidisciplinary care, and lack of quality improvement (QI) support; inadequacies that place patients and fetuses at risk [1]. In 2007, the WHO Framework for Action identified “quality of health services” as a key component in improving outcomes [5].

Maternal and infant mortality are basic health indicators that reflect the adequacy of a healthcare system. A recent mortality survey found that 60% of maternal deaths in Accra, Ghana, occurred within

hospitals [6]. In addition, the Ghana Health Service (GHS) reported a 36% increase in institutional maternal deaths from 1997 to 2007 [7]. The maternal mortality ratio (MMR) in Ghana was estimated at 350 (range 210–600) per 100 000 live births in 2008 [8], but underreporting is likely. The Accra-based survey determined an underreporting rate of 44% [6], which was substantiated by a separate review that found the MMR to be 699 per 100 000 live births [9]. Recent data indicate a perinatal mortality rate of 45 per 1000 deliveries, with 19 stillbirths and 26 early neonatal deaths per 1000 deliveries [10]. It is imperative to improve maternal and perinatal care by strengthening healthcare institutions.

Collaborative approaches to improving healthcare quality have been described; these have been focused in the United States and the United Kingdom, with few in low-resource countries [11–14]. Studies on QI collaboration are generally positive, but limited, and the effects of QI are unpredictable [11–15]. In January 2007, Kybele, a North Carolina-based NGO and the GHS began a 5-year collaboration to establish “obstetric centers of excellence” to reduce maternal and neonatal deaths. Kybele is a non-profit humanitarian organization founded in 2001 to promote safe childbirth worldwide via collaboration; it is a multinational, interdisciplinary organization with teams comprising nurses, midwives, engineers, public health practitioners,

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organizational specialists, and physicians in obstetrics, anesthesia, and neonatology. Joint identification of challenges and responses is focused at the local level to improve care in countries with sufficient infrastructure to sustain progress after training.

The first obstetric center of excellence, Ridge Regional Hospital, is a flagship obstetric referral center in Accra, which at the outset of the study had 5000 annual births, over half of which were high-risk referrals. The unit had limited capacity: namely, 6 labor and 2 delivery beds, an operating theatre 200 meters away, and vastly overcrowded wards. There was 1 consultant obstetrician, the local champion, 4 medical officers/residents and 3–4 midwives per shift.

The aim of the present study was to provide evidence regarding the effectiveness of a hospital-based QI collaboration in a low-resource country. The study model was congruous with key tenets offered by authoritative quality experts, and incorporated an interdisciplinary approach, high-level sponsorship, establishment of guidelines, measurement, feedback, leadership and teamwork coaching, training including QI training, and a multimodal focus on patients, providers, and systems [11–14].

**2. Materials and methods**

In 2004, Kybele was invited to consider program development with the GHS. Needs assessments were made in 6 hospitals over 2 years, and local, cultural and operational issues were determined. Multiple challenges were identified including poor communication/teamwork, scant neonatal resuscitation training, lack of emergency supplies, late referrals, minimal interdisciplinary coordination,

excessive documentation, poor knowledge/use of evidence-based protocols, numerous delays, and more. In December 2006, a 5-year partnership was signed between the GHS and Kybele. In 2007, patient care processes at Ridge Regional Hospital were analyzed consecutively by 2 Kybele teams using immersive, interactive, and consultative methods. System deficiencies were jointly identified, and solutions were incorporated into a strategic template or “process map”.

The process map evolved into a model encompassing continuous assessment, implementation, advocacy, outputs, and outcomes (Fig. 1). It identifies problems, recommends solutions, and charts progress by using a color-coded scoring system with numeric correlates. Scores are assigned in quartiles, such that red (0%) represents start or no progress, yellow represents intermediate (50%), and green (100%) represents full implementation. A printout of the process map is posted in the labor ward, updated yearly, providing feedback on progress to staff.

Primary outcomes include maternal and perinatal mortality, and case fatality rates (CFRs) for hemorrhage and hypertensive disorders. Data are collected via manual abstraction by physician and senior midwives. The model identifies 5 key outputs: appropriate referrals, patient monitoring, standardized treatments, timely interventions, and improved client responsiveness as determinants of high-quality and/or primary outcomes (Fig. 1).

The model emphasized system failures. A systems-oriented approach to QI was undertaken, in which key focus areas were grouped in bundles (Fig. 1). Interventions, changes in process, and outcomes were monitored. Data were analyzed with  $\chi^2$  or Fischer exact test, as appropriate, using SAS 9.2 (SAS Institute, Cary, NC, USA). A P value of less than 0.05 was taken to be statistically significant.

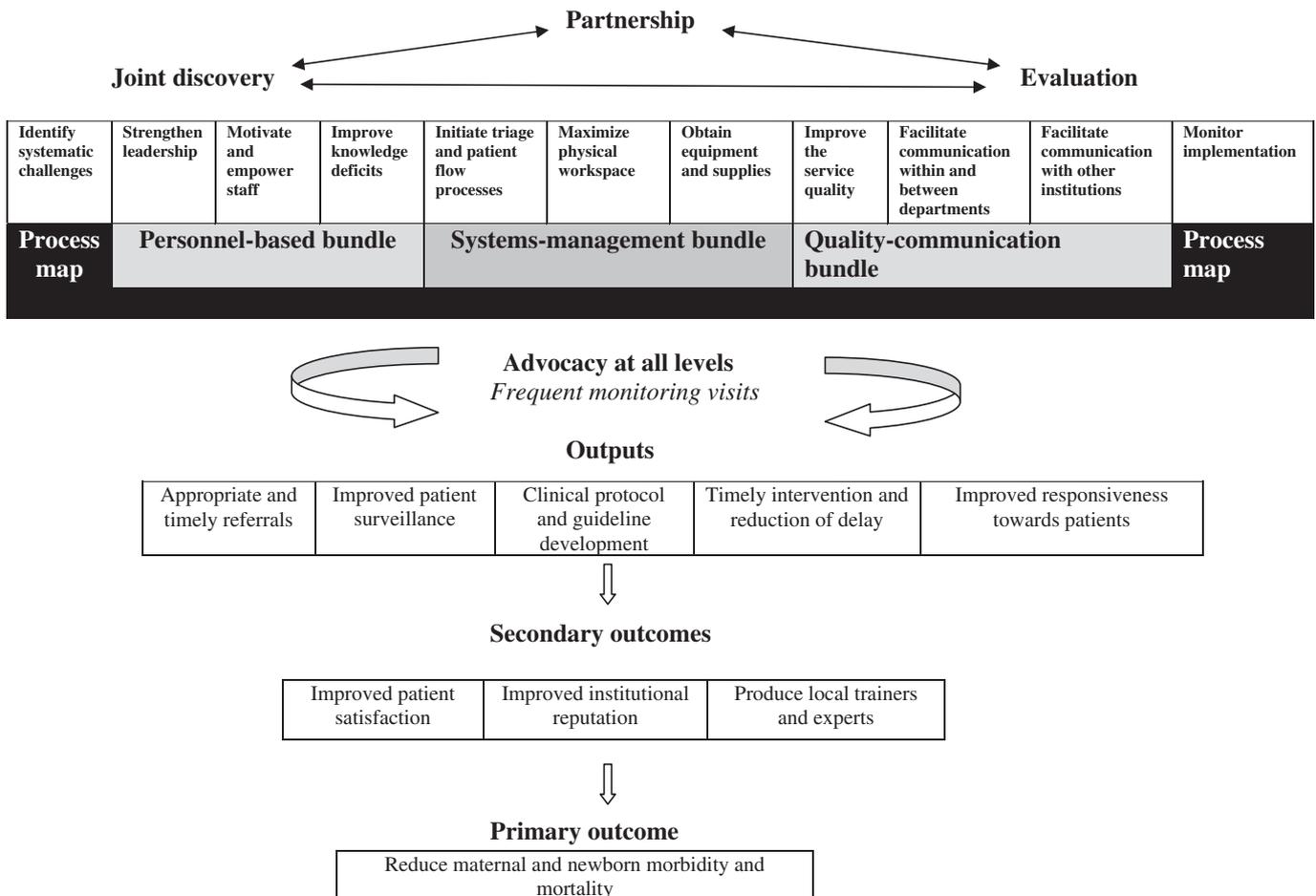


Fig. 1. Essential components of the Kybele–Ghana Health Service systems model.

### 3. Results

Leadership is crucial for strengthening health systems [5], and was addressed at several levels by the Kybele–GHS systems model. The chief obstetrician made learning visits to US institutions, and ongoing coaching was provided by team members and a leadership consultant. Mentoring activities emphasized effective delegation, continuous QI methodologies, giving feedback and team building. Similar efforts were undertaken with several key midwives.

Low levels of morale, motivation, and empowerment were noted among frontline staff, yet their input is a key determinant of quality. Corrective measures were instituted, including an annual midwifery award, dinner meetings, sponsorships to US hospitals, “on the spot” commendations, and positive debriefings. Staff satisfaction surveys were conducted, and data related to quality and mortality reduction were shared. Dialog regarding patient safety was encouraged and staff were empowered in clinical decision-making and process improvements. The expertise gained enabled several midwives to receive promotion and to become coaches to other institutions.

Deficits in staff knowledge were an ongoing challenge. An obstacle to maintaining quality services was the common practice of unit rotation and reassignment. Staff had limited time to acquire necessary expertise and then moved on as their skills were developed. Through collective goal-setting and negotiation with administrators, this policy was changed.

Numerous training modules were instituted, such as neonatal resuscitation training led by US-based neonatologists, which included didactics, simulation training, observation, and coaching. Written and practical assessments were performed before and after training. Other modules included ultrasound and evidence-based management of obstetric complications.

Poor patient flow and ineffective triage were identified. For example, emergency cases first went to the outpatient department where delay was encountered; patients in labor waited in queue for a bed before assessment; patients were admitted 2–3 days before elective surgery; and prolonged stays followed simple surgery. Several process changes were implemented: first, a triage area was created for initial assessment and prioritization of all cases within 30 minutes of arrival; second, the admission desk was placed close to triage; third, referrals from other institutions were immediately assessed; fourth, “first” and “second” stage rooms were consolidated and convertible beds were purchased to increase the delivery bed capacity from 2 to 10. Hallways were used to increase capacity by means of temporary mattresses. Other measures included same-day surgery admission, expedited discharge of stable postoperative patients, and discharge of low-risk postnatal patients by midwives.

Collaborative efforts resulted in the development of evidence-based guidelines for routine and complicated patient care. After a rigorous review of published data, context-appropriate adaptations were made to protocols addressing hypertensive emergencies, pre-eclampsia, labor induction, and peripartum hemorrhage.

The administration at Ridge Regional Hospital supported aesthetic improvements including paint, curtains, fans, and flooring. A 4-bed high-dependency unit was established for patients with high-acuity conditions such as eclampsia, severe pre-eclampsia, sepsis, malaria, ketoacidosis, and hemorrhage. The unit is a unique QI “training incubator”, using checklists, standardized charting, clinical care protocols, and algorithms. The high-dependency unit enables focus to be concentrated on the sickest patients, fostering teamwork and collaboration between numerous specialists.

At the study outset, basic equipment and supplies were lacking. There were few blood pressure devices, resuscitation bags, or handheld Doppler devices. Frequently, only 1 theatre was operational owing to the unavailability of an anesthesia machine, producing long delays. Kybele and the GHS worked collaboratively with several

organizations to obtain donated equipment; in addition, the hospital administration acknowledged deficits and purchased equipment.

Patient satisfaction is largely determined by the subjective experience of “service quality” or the “caring process” [16]. Thus, despite a good clinical outcome, there may be perceptions of quality. Customer service was addressed including a patient’s right to respect, privacy, emotional support, pain relief, communication, and timely access to care. These elements have been promoted through lectures, informal discussion, and bedside example. Satisfaction surveys are conducted to monitor progress. Staff members who demonstrate excellent customer care are recognized.

Departmental communication has been enhanced via a daily morning-handover meeting for medical officers, midwives and consultants to discuss patient care plans. Weekly academic and monthly perinatal meetings have also been established. Better communication has led to improved data capture, primarily via data analysis and dissemination, which enhances staff awareness of the importance of documentation. Logbooks are now audited monthly by senior midwives and consultants.

Communication has enhanced teamwork between physicians and midwives, and has improved collaboration with the blood bank, administration, pharmacy, supply departments, and anesthesiology. Greater teamwork with anesthesiologists has led to labor analgesia, assistance with IV lines, patient resuscitation and monitoring, critical patient transport, increased use of regional anesthesia, improved response time for cesarean deliveries, and use of the recovery room as a critical care venue.

To improve the referral system, collaboration was sought with facilities within the region. Activities included referral protocol development, site visits to mentor staff, rotational attachments for visiting staff, and quarterly regional mortality conferences attended by the GHS directorate. Meetings focus on systems issues, which have fostered collective responsibility for improvement and enhanced collaboration.

Many altruistic ventures in low-resource countries fail because the engagements are not deep enough, frequent enough, or prolonged enough to affect change, or they assume a strictly research- or service-oriented approach, incapable of sustainable systematic improvement. A foundational element of the Kybele–GHS systems model is frequent, brief, and intensive incursions by an interdisciplinary team for immersive coaching and mentoring in the improvement model and evidence-based practice. The brevity of visits encourages the host institution to take ownership of the process and sustain implementation. Buy-in and support from the hospital administration and GHS have also been critical to success, inclusive of collective decision-making and formalizing systems changes at key administrative and policy levels.

In terms of study outcomes, implementation of the model has resulted in a 34% reduction in maternal mortality (Table 1) and a 36% reduction in stillbirth (Table 2) between 2007 and 2009. These reductions occurred despite a 36% increase in patient volume and an increased prevalence of obstetric complications (Table 3), without an increase in staff. Rather, a framework for teamwork and efficiency was initiated, and key organizational changes were made around 3 principle activity bundles.

**Table 1**

Five-year summary of births and maternal mortality at Ridge Regional Hospital, Accra, Ghana.

| Year | Total deliveries | Maternal deaths | Maternal deaths per 100 000 live births | Cesarean delivery |            |
|------|------------------|-----------------|---|-------------------|------------|
|      |                  |                 |   | Number            | Percentage |
| 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       |
| 2009 | 8230             | 27              | 328                                     | 2826              | 34.3       |

**Table 2**  
Trend in stillbirth at Ridge Regional Hospital, Accra, Ghana.

| Year | Total SBs <sup>a</sup> | SBs per 1000 deliveries | Ridge SBs <sup>a</sup> | Ridge SBs per 1000 deliveries | Neonatal admissions | Neonatal death |      |
|------|------------------------|-------------------------|------------------------|-------------------------------|---------------------|----------------|------|
|      |                        |                         |                        |                               |                     | Number         | %    |
| 2007 | 348                    | 57.5                    | 55                     | 9.0                           | No data             | No data        | –    |
| 2008 | 292 <sup>b</sup>       | 39.1                    | 40 <sup>c</sup>        | 5.4                           | 1072                | 220            | 29.5 |
| 2009 | 307 <sup>b</sup>       | 37.3                    | 48 <sup>c</sup>        | 5.8                           | 1048                | 213            | 20.3 |

Abbreviation: SB, stillbirth.

<sup>a</sup> Total stillbirths include women admitted to Ridge Regional Hospital with fetal heart tones present and absent. Ridge stillbirths include only those women who were admitted with fetal heart tones present.

<sup>c</sup>  $P < 0.05$  versus 2007 using  $\chi^2$  analysis with Yates correction.

<sup>b</sup>  $P < 0.001$  versus 2007 using  $\chi^2$  analysis with Yates correction.

Case fatality rates for pre-eclampsia and hemorrhage, the leading causes of maternal death, were significantly reduced (Table 3). In 2009, the CFR was 1.1% for pre-eclampsia and 1.9% for hemorrhage, values that are approaching the maximum acceptable level of 1% recommended by the United Nations [17]. Stillbirths also decreased between 2007 and 2009, including those attributable to Ridge Regional Hospital, deemed avoidable, and those presenting with demise on arrival (Table 2). Contributing factors may include more timely referrals, ultrasound for high-risk patients, intermittent cardiotocograph, protocol adherence for hypertension management and labor induction, and prompt assessment of fetal heart tones on arrival.

Training programs have also been effective. Neonatal resuscitation scores improved significantly after training [18]. Written and practical examination scores increased from 56% and 58% pre-training to 71% and 81% post-training, respectively ( $P < 0.01$ ). These results were sustained 9–12 months after training [18]. An important component was the establishment of local trainers for sustainability. In the theatre, a program was undertaken to train and coach in the use of spinal anesthesia, leading to a decrease in the use of general anesthesia for cesarean delivery. In 2006, general anesthesia was used for 94% of the 1555 cesarean deliveries. In 2009, it was provided in only 11% of the 2826 cesarean deliveries.

#### 4. Discussion

Many countries and organizations have invested heavily in reducing maternal and perinatal mortality. Despite successful examples of collaborative QI programs in more affluent countries, this goal continues to elude many low- and middle-income countries [14]. The QI methods used in the present collaboration have effectively reduced maternal and perinatal mortality. Similar success has been seen for CARE's work with the Rwandan Health Ministry, which deployed an intervention package focused on physical improvements, staff, and management training [4]. Their resulting decrease in CFR for obstetric complications from 2.2% to 1.2% reinforces the idea that strengthening health systems is important for mortality reduction [4]. Improvements in CFR were also realized at Birnin Kebbi Specialist Hospital in

Nigeria by using such a package [2]. Similarly, a QI program conducted at Juaben Teaching Health Center in Ghana increased hospital utilization for patients with complications, and incurred no deaths among 700 deliveries [3]. However, each of those programs lacked emphasis on long-term sustainability, for which evidence remains scant, and predominantly focused on smaller, community-based health centers.

A primary goal of the present program was to establish local accountability to provide sustainability after the inevitable departure of outside experts and staff attrition. Tri-annual visits lasting 1–2 weeks focus on education, coaching, detailing, and feedback that is continually updated and adapted to evolving needs; however, ongoing implementation is carried out by local staff. Researchers in Argentina similarly found that behavioral interventions led to sustainable practice change, whereby postpartum hemorrhage was reduced by improving third stage labor management and reducing episiotomies [19]. This strongly suggests the need for a greater investment in strategic implementation programs relative to investment in new clinical trials.

The Kybele–GHS program of intermittent immersion focusing on QI methods demonstrates that meaningful progress can be realized in reducing maternal and perinatal mortality. Several key elements probably underlie the program's effectiveness, including (1) long-term commitment and relationship building; (2) formal support from GHS; (3) training in and use of QI tools and methods; (4) an interdisciplinary approach; (5) local champions; and (6) prospective measurement of outcomes and processes. The trend of positive outcomes at Ridge Regional Hospital is encouraging for other regional hospitals in Ghana, many of which are smaller with fewer system complexities in obstetric and perinatal service provision. Through 5 years of experience at Ridge Regional Hospital and its region, a model has been created for the initial assessment of institutions that determines relevant needs and processes of change. In 2010, services were expanded to Sunyani, in the Brong Ahafo region. The model developed at Ridge Regional Hospital should be validated and replicated in other hospitals.

Although significant progress has been made, many challenges remain. It is likely that the early successes will have been easier to achieve and further mortality reduction may present a formidable challenge. Similarly, only limited early efforts were undertaken toward community spread, and so far they have primarily focused on the referral process. Other limitations include the lack of control groups and difficulty in knowing which specific interventions led to mortality reduction. For reliable attribution, an experimental study design is required; however, this is rarely feasible or applicable to multifaceted programs delivered in a real-world context.

The increased utilization of Ridge Regional Hospital for deliveries and referrals suggests improvement in the referral process and consumer confidence in the institution, as demonstrated in other studies [3,4]. National Health Insurance with delivery coverage, adopted in 2005, may have contributed to the increases; however, delivery numbers at other centers within Accra have not increased as rapidly. Higher utilization could have resulted in poorer outcomes, given

**Table 3**  
Prevalence of and maternal mortality from hypertensive and hemorrhagic disorders at Ridge Regional Hospital, Accra, Ghana.

| Year | Total no. of deliveries | Hypertension |                 |                |         | Hemorrhage   |                |                |         |
|------|-------------------------|--------------|-----------------|----------------|---------|--------------|----------------|----------------|---------|
|      |                         | No. of cases | No. of deaths   | Prevalence (%) | CFR (%) | No. of cases | No. of deaths  | Prevalence (%) | CFR (%) |
| 2005 | 2971                    | 49           | 3               | 1.6            | 6.1     | No data      | –              | –              | –       |
| 2006 | 4793                    | 169          | 11              | 3.5            | 6.5     | No data      | –              | –              | –       |
| 2007 | 6049                    | 321          | 10              | 5.3            | 3.1     | 54           | 8              | 0.1            | 14.8    |
| 2008 | 7465                    | 581          | 8               | 7.9            | 1.3     | 99           | 5              | 1.3            | 5.1     |
| 2009 | 8230                    | 994          | 11 <sup>a</sup> | 12.1           | 1.1     | 319          | 6 <sup>b</sup> | 3.9            | 1.9     |

Abbreviation: CFR, case fatality rate.

<sup>a</sup>  $P < 0.05$  versus 2007 via Fisher exact test.

<sup>b</sup>  $P < 0.001$  versus 2007 via Fisher exact test.

that there was no concomitant increase in personnel or infrastructure; yet, the reductions in CFR for hemorrhage and pre-eclampsia are encouraging. Indeed, earlier referrals and higher utilization of health services are linked to the quality of services provided and consumer confidence in those services [4,20].

There is no single intervention that can markedly improve maternal and perinatal care in Africa. Sustainable improvements are possible, however, by comprehensively addressing the multitude of factors that comprise such complex systems. Doing so will critically depend on interdisciplinary teams committed to a unified vision. We envisage that Ridge Regional Hospital will remain a center of excellence and a model for other Ghanaian hospitals.

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### Conflict of interest

The authors have no conflicts of interest.

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