

Achievement of the 2015 Millennium Development Goal 5A (Maternal Mortality) by Belize in 2011

Michael Graven, MD, MSc, MPH, FRSPH,^{1,2,3} Peter Allen, DDS, MPH,¹

Victoria M. Allen, MD, MSc, FRCSC,⁴ Ian Smith, BSc,¹ Noni E. MacDonald, MD, MSc, FRCPC^{2,3}

¹Ministry of Health, Government of Belize, Belmopan, Belize

²Department of Paediatrics, Dalhousie University, Halifax NS

³Faculty of Computer Science, Dalhousie University, Halifax NS

⁴Department Obstetrics and Gynaecology, Dalhousie University, Halifax NS

Abstract

Objective: Millennium Development Goal 5A, to decrease the maternal mortality ratio by three quarters between from 1990 to 2015, is proving difficult to achieve in many developing countries, including those in Mesoamerica. In this preliminary report from Belize we describe the major steps taken recently to improve maternal outcomes, leading to the achievement of Millennium Development Goal 5A in 2011, confounding all predictions.

Methods: In mid-2007, Belize deployed the world's first integrated countrywide health information system (BHIS), with eight embedded prevention/management domains. These included one centred on maternal health and covering best practices in prenatal, intrapartum, and postpartum care. The Ministry of Health and local maternal health care leaders used ongoing BHIS maternal data aggressively to detect health care system problems and to intervene to change outcomes. The maternal mortality ratios per 100 000 live births for 2005 to 2011 (i.e., from two years before BHIS deployment to four years after) were calculated from death and live birth data using Belize vital statistics.

Results: The maternal mortality ratio fell from 134.1 in 2005 to zero in 2011, with the major sustained drop occurring from 2008 onwards, coincident with implementation of the BHIS. The annual number of live births did not change over this time.

Conclusion: Exceeding all expectations, Belize achieved Millennium Development Goal 5A in 2011, with a reduction in the maternal mortality ratio of well over three quarters. The drop in maternal mortality ratio was temporally associated with the introduction of the BHIS and its embedded maternal health domain. BHIS data were used aggressively to monitor and continuously improve maternal health care.

J Obstet Gynaecol Can 2012;34(10):913–916

Key Words: Maternal mortality, Millennium Development Goal, health information system, ehealth, artificial intelligence, maternal care guideline, developing country, Belize

Competing Interests: None declared.

Received on July 15, 2012

Accepted on July 18, 2012

Résumé

Objectif : L'atteinte de l'objectif 5A du Millénaire pour le développement, soit celui qui prévoit une baisse du taux de mortalité maternelle de l'ordre de 75 % entre 1990 et 2015, s'avère difficile dans de nombreux pays en développement, y compris ceux de la Méso-Amérique. Dans le cadre de ce rapport préliminaire en provenance du Belize, nous décrivons les principales mesures qui ont récemment été mises en œuvre pour améliorer les issues maternelles, ce qui a eu pour effet de mener à l'atteinte de l'objectif 5A du Millénaire pour le développement en 2011 et de défier toutes les prédictions.

Méthodes : Au milieu de l'année 2007, le Belize a été le premier pays au monde à mettre en œuvre un système d'information sur la santé intégré à l'échelle du pays (BHIS); huit domaines de prévention/gestion ont été incorporés à ce système, dont un qui est axé sur la santé maternelle et qui couvre les pratiques optimales en matière de soins prénatals, intrapartum et postpartum. Le ministère de la Santé et les chefs de file locaux en matière de santé maternelle ont utilisé de façon dynamique les données maternelles continues issues du BHIS en vue de mettre au jour les problèmes du système de santé et d'intervenir pour en modifier les issues. Les taux de mortalité maternelle par 100 000 naissances vivantes pour la période allant de 2005 à 2011 (c.-à-d. de deux ans avant la mise en œuvre du BHIS à quatre ans par la suite) ont été calculés à partir des données sur les décès et les naissances vivantes en faisant appel aux statistiques de l'état civil du Belize.

Résultats : Le taux de mortalité maternelle est passé de 134,1 en 2005 à zéro en 2011, la baisse soutenue importante ayant débuté en 2008, ce qui coïncidait avec la mise en œuvre du BHIS. Le nombre annuel de naissances vivantes est resté le même au cours de cette période.

Conclusion : Défiant toutes les attentes, le Belize a atteint l'objectif 5A du Millénaire pour le développement en 2011, et ce, grâce à une baisse du taux de mortalité maternelle de l'ordre de bien plus de 75 %. Cette chute du taux de mortalité maternelle a coïncidé avec la mise en œuvre du BHIS et du domaine sur la santé maternelle qui lui est incorporé. Les données issues du BHIS ont été utilisées de façon dynamique pour effectuer le suivi et assurer l'amélioration continue des soins de santé maternelle.

INTRODUCTION

The United Nations has estimated that over 350 000 women die annually from complications during pregnancy or childbirth, with more than 99% of these deaths occurring in developing countries.¹ This problem is so serious that maternal health was designated as the target of one of the eight Millennium Development Goals (number 5A): "Reduce by three quarters, between 1990 and 2015, the maternal mortality ratio."² Unfortunately, of the eight MDGs, the reduction in maternal mortality is proving to be the most difficult to achieve, and analysts predict that many developing countries will fall short.³⁻⁶ Among factors cited to explain the shortfall are the inability in many developing countries to measure maternal mortality ratios reliably in order to evaluate trends leading to poor accountability, and the lack of timely review of fatal cases to identify avoidable factors.³ Both lead to inertia, with no actions taken to address problems in care that contribute to maternal mortality.

Belize, like other countries in the region, has had difficulty in accurately calculating maternal mortality ratios per 100 000 live births, resulting in widely varying estimates for the same year in different reports (88, 55.6, and 72 in 1990 and 87, 76.3, and 100 in 2000⁵⁻⁷). Based upon 2008 data estimating maternal mortality ratios for Mesoamerica, Lozano and colleagues predicted that no country in the region (including Belize) would likely achieve MDG 5A by 2015.⁸ However, although it was not clear while Lozano et al. were compiling that report, Belize had not only become able to determine maternal mortality ratios more accurately but was also on its way to achieving MDG 5A, which it did in 2011, five years ahead of the 2015 target. This preliminary report describes the major steps taken by Belize to improve maternal outcomes in order to achieve this MDG.

METHODS

In mid-2007, with the deployment of the first country-wide, fully integrated patient-centred health information system in the world, Belize acquired the capacity to monitor the impact of maternal mortality intervention programs and investigate maternal deaths in a timely fashion. The second benefit of the BHIS was that it provided the platform for country-wide deployment of health promotion, disease prevention, and management protocols through artificial intelligence

prompts built in to help health care professionals provide better and safer care. One of the eight domains embedded in the BHIS is centred on maternal health, covering best practices in prenatal, intrapartum, and postpartum care. The seven other BHIS care domains cover hypertension, serious adverse drug reactions, prevention of mother-to-child HIV transmission, care of those under one year and under five years of age, and management of acute respiratory and gastrointestinal infections in those over five years of age.

Soon after the BHIS was deployed, the maternal-child health leadership for the Belize Ministry of Health began immediately to use the BHIS data to both review and improve maternity care practices. Systematic review of maternity care practice and outcomes became institutionalized at all levels within Belize because BHIS data were available at all levels. Based upon BHIS data findings, a series of targeted initiatives were undertaken, aimed at improving management of preeclampsia, evaluation and management of maternal fever, completeness of prenatal screening, and postpartum maternal support. In-service training could thus be directed where it was most needed. For example, analysis showed that management of eclampsia was not uniform across the country. Closer assessment revealed that there were three different methods of mixing magnesium sulphate for treating preeclampsia in different parts of Belize, two of which were associated with several cases of eclampsia. Targeted in-service training corrected this problem, and BHIS monitoring data showed this led to a decrease in the incidence of eclampsia.

Because of the modest financial resources in Belize, little else changed in the Belize health care system from 2007 to 2011. Additional health care personnel were not hired, the range and accessibility of health care resources did not increase, and no new programs beyond the eight BHIS embedded prevention and management guideline domains were added.

For maternal mortality ratio calculations from 2005 to 2011 (i.e., from two years before BHIS deployment to four years after), maternal mortality data were obtained from the Belize Ministry of Health Epidemiology Unit, since the Belize government requires by law that all deaths be registered. The causes of death, both primary and secondary, are assigned by the attending physician (as required by law in Belize), are consistent with Pan American Health Organization standards, and are coded using the World Health Organization's International Classification of Diseases, 10th revision (2010). The mortality data for the calculations were collected independent of the BHIS system. Population estimates (estimates of the number of pregnant women and estimates of live births) for

ABBREVIATIONS

BHIS	Belize Health Information System
MDG	Millennium Development Goal

Belize for 1990 to 2009 were obtained from the Statistical Institute of Belize. For 2010, data were obtained from the Belize 2010 Census of Population and Housing, and, as is customary in Belize, the 2011 data were estimated. All maternal mortality ratios were expressed per 100 000 live births. All maternal mortality and live birth data from 2008 to 2011 were compared with maternal mortality and live birth data available in the BHIS.

All analyses were carried out using SAS (SAS Institute, Cary NC). Ethics review was conducted in accordance with the Belize Ministry of Health Policy on use of BHIS data. No personally identified data were used in this study.

RESULTS

The BHIS was introduced in mid-2007, and reached full deployment in mid-2008. Regular analyses of the BHIS outcome data, and when indicated directed program interventions in prenatal, intrapartum, and postpartum care, had become routine by late 2008. As shown in Table 1, while the maternal mortality rate had been declining modestly before 2007, a major and sustained drop in maternal mortality began in 2008. By 2011, the rate had dropped by more than 75% (i.e., achieving MDG 5A); in fact, in 2011, no maternal deaths were reported in Belize through either the traditional system of reporting or the BHIS. While there was a drop in the birth rate per 1000 population from 1996 to 2010 from 33.08 to 24.50⁹ (Table 2), the total number of live births did not vary from 2005 (two years before BHIS deployment) to the post-deployment years of 2008 to 2011 (Table 3).

DISCUSSION

While the calculated maternal mortality ratio estimates for Belize from 1990 to 2005 varied in different publications,⁵⁻⁷ they did not substantially change during this time despite efforts to improve access to care, maternal and community education, obstetrical continuing education, and support for the use of maternal care guidelines within Belize. The deployment of the BHIS in mid-2007 supported the real-time monitoring of maternal health care outcomes across the country, and the embedded protocols for prenatal, perinatal, and postnatal care provided guidance for best practice across the entire country. Deployment of the

Table 1. Maternal mortality in Belize expressed as a rate per 100 000 live births from 1990 to 2011

Year	WHO Global Health Observatory Data Repository	Belize data based upon discrete number of deaths and live births
1990	72 (50 to 100)	
1995	32 (22 to 46)	
2000	100 (64 to 140)	
2005	94 (51 to 150)	134.1
2006		83.6
2007		85.3
2008		42.5
2009		53.9
2010		55.3
2011		0

BHIS was associated temporally with a measured decline in maternal mortality over the next few years, such that by 2011 Belize had achieved a greater than 75% decline in maternal mortality, well ahead of 2015 MDG 5A deadline. In fact, in 2011 maternal mortality fell to zero. This fall in maternal mortality was not due to a major change in the denominator, as the number of live births remained relatively unchanged from 2005 to 2011. Evaluation of the component(s) of the BHIS maternal health management program contributing to the drop in maternal mortality is ongoing. However, on initial assessment, the ability to find differences in health outcomes for a specified problem (such as preeclampsia) in a timely fashion using real-time BHIS data allowed Belize to use its limited resources for correction where most needed. With the BHIS, Belize is now able to measure mortality ratios accurately and to detect maternal deaths in a timely fashion, thereby overcoming the inertia that has plagued other developing countries' efforts to address maternal mortality.³ As in all developing countries, health resources are limited in Belize, and the efficiencies associated with having complete electronic health records available at all health care encounters made quality improvement activities in maternal health possible.

There are a number of limitations to this brief report. A causal relationship between the BHIS and the decrease in maternal mortality cannot be verified. While there was a

Table 2. Birth rate per 1000 population in Belize 1996 to 2010

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Rate	33.08	32.20	31.33	30.48	29.68	28.92	28.20	27.53	26.92	26.36	25.87	25.45	25.08	24.77	24.50

Table 3. Total live births in Belize from 2005 to 2011

Year	2005	2006	2007	2008	2009	2010	2011
Rate	7457	7184	7036	7066	7420	7230	7468

strong temporal correlation between deployment of the BHIS with its embedded maternal care protocol, the use of BHIS data to support quality improvement programs, and changes in rates of maternal death, this does not prove causality. However, there were no major changes in types of health care programs or access beyond the BHIS, nor was there any major increase in the standard of living in Belize during this time. This suggests, therefore, that the BHIS played a contributing role through its ability to support and monitor targeted program improvements that were not previously possible.

Belize is a small country, with only 7000 to 7400 births per year, and therefore a limited number of possible maternal deaths. Prior to the introduction of the BHIS, maternal mortality ratios had been static, in the 80 to 100 range,¹⁰ with no sustained downward trend. Time will tell if the current very low maternal mortality ratio in Belize will be sustained. However, the ability to monitor maternal outcomes in real time both across the country and locally means that problems can be detected and interventions targeted early.

The implications of this study are also currently limited to Belize. Whether its BHIS-related success in decreasing maternal mortality ratios can be replicated in other countries remains unknown. However, the drop in maternal mortality ratios associated with the BHIS experience is tantalizing because it occurred over a fairly short period of time, and it might well be replicable in other developing countries.

ACKNOWLEDGEMENT

The Millennium Development Goal 5A would not have been achieved by 2011 without the hard work and devotion

of the many health care and Ministry of Health workers to improving maternal health outcomes. The BHIS, a critical component for this success, would not have been developed without the vision of John Rutter, who passed away in 2008. He served as an untiring advocate for the BHIS, saw its potential, and was proud to serve Belize for over 50 years.

REFERENCES

1. United Nations. High-level Plenary Meeting of the General Assembly, New York, 20 to 22 September 2010. Fact sheet. Available at: http://www.un.org/millenniumgoals/pdf/MDG_FS_5_EN_new.pdf. Accessed June 25, 2012.
2. United Nations. Millennium development goals. Available at: <http://www.un.org/millenniumgoals/maternal.shtml>. Accessed June 25, 2012.
3. Danel I, Graham WJ, Boerma T. Maternal death surveillance and response. *Bull World Health Organ* 2011;89(11):779–779A.
4. Kinney MV, Kerber KJ, Black RE, Cohen B, Nkrumah F, Coovadia H, et al. Sub-Saharan Africa's mothers, newborns, and children: where and why do they die? *PLoS Med* 2010;7(6):e1000294. doi:10.1371/journal.pmed.1000294.
5. Hogan MC, Foreman KJ, Naghavi M, Ahn SY, Wang M, Makela SM, et al. Maternal mortality for 181 countries, 1980–2008: a systematic analysis of progress towards Millennium Development Goal 5. *Lancet* 2010;375(9726):1609–23.
6. Lozano R, Wang H, Foreman KJ, Rajaratnam JK, Naghavi M, Marcus JR, et al. Progress towards Millennium Development Goals 4 and 5 on maternal and child mortality: an updated systematic analysis. *Lancet* 2011;378(9797):1139–65.
7. Index Mundi. Belize—maternal mortality ratio. Available at: <http://www.indexmundi.com/facts/belize/maternal-mortality-ratio>. Accessed June 25, 2012.
8. Lozano R, Gómez-Dantés H, Castro MV, Franco-Marina F, Santos-Preciado JI. Progress on the millennium development goals 4 and 5 in Mesoamerica. *Salud Publica Mex* 2011;53(Suppl 3):S295–S302.
9. Index Mundi. Belize birth rate. Available at: <http://www.indexmundi.com/facts/belize/birth-rate>. Accessed June 25, 2012.
10. World Health Organization. Global health observatory data repository. Maternal mortality ratio. Available at: <http://apps.who.int/ghodata/?vid=250>. Accessed June 25, 2012.