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Title:
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Date:
2020-04-01

Citation:
De Silva, M., Panisi, L., Maepioh, A., Mitchell, R., Lindquist, A., Tong, S. & Hastie, R. (2020). Maternal mortality at the National Referral Hospital in Honiara, Solomon Islands over a five-year period. Australian and New Zealand Journal of Obstetrics and Gynaecology, 60 (2), pp.183-187. https://doi.org/10.1111/ajo.13050.

Persistent Link:
https://hdl.handle.net/11343/286406

Maternal mortality at the National Referral Hospital in Honiara, Solomon Islands over a 5-year period.

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This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/AJO.13050

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Conflicts of interest: The authors declare no conflicts of interest.

Acknowledgements

R. Hastie was supported by a Melbourne Medical School, Department of Obstetrics and Gynaecology Fellowship, S. Tong (#1136418) was supported by NHMRC Fellowships. M. De Silva and R. Mitchell were supported by the Australian Government Department of Foreign Affairs and Trade Australian Volunteers Program through volunteer placements at the National Referral Hospital. M. De Silva was also supported by the Royal Australian and New Zealand College of Obstetricians and Gynaecologists through the Miriam O'Connor Travelling Fellowship for ongoing research-related travel. No additional external funding was obtained for this manuscript.

The authors also wish to thank the Obstetrics and Gynaecology medical team, midwives, nurses and junior doctors at the National Referral Hospital, and The Solomon Islands Ministry of Health.

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Article type : Original Manuscript

Maternal mortality at the National Referral Hospital in Honiara, Solomon Islands over a 5-year period.

Short title: Maternal mortality in the Solomon Islands

Word count abstract: 212
Word count main text: 2499

Figures: 1
Tables: 2
Supplementary Table: 1

Keywords: Maternal mortality, Solomon Islands, death

Abstract:

Background: The Solomon Islands is a developing country facing significant barriers to the provision of quality antenatal and obstetric care. The maternal mortality rate is 114/100,000 live births, ranking the Solomon Islands 113th globally. Investigating maternal mortality may yield valuable insight into improving these numbers.

Aim: The objective of this study was to review all cases of maternal mortality at the National Referral Hospital, Solomon Islands over a 5-year period.

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Materials and methods: This was a retrospective review of maternal deaths occurring at the National Referral Hospital, Solomon Islands from 2013-2017. Data on maternal demographics, characteristics and cause of death were collected.

Results: There were 39 maternal deaths at the National Referral Hospital from 2013 to 2017. The maternal mortality rate of the National Referral Hospital (139/100,000) is higher than the national rate (114/100,000). Most deaths were direct, with 28% attributed to haemorrhage. Overall, 79% of the total maternal deaths had elements that may be considered preventable, with laboratory delays present in 54% and medication shortages present in 29% of cases.

Conclusion: Maternal mortality is high in the Solomon Islands, with many potentially preventable deaths occurring at the National Referral Hospital. Continued focus on improving data collection, access to resources, and training is vital to reduce maternal mortality in the Solomon Islands.

Introduction

Maternal death globally effects approximately 800 women daily, with much of this burden within low and lower-middle-income countries (LMICs) [1-3]. The Confidential Enquiries into Maternal Deaths in the UK, launched in 2015, sets the global standard of practice for assessing maternal mortality through individual case review[4]. More recently the Global Burden of Disease Study provided detailed estimates of maternal mortality and morbidity [3]. Following introduction of the Millennium development goals, maternal mortality has been estimated to have been reduced by 45%, however the global maternal mortality rate (MMR) remains high, at an estimated 216 per 100,000 live births [1, 3]. The United Nations Sustainable Development Goals aims to further reduce global MMR to 70 by 2030 [5].

The Solomon Islands is a LMIC with a population of approximately 600,000 spread across an archipelago of 993 islands. The current official MMR of 114/100,000 live births ranks the Solomon Islands 113th out of 216 globally (the 1st having the lowest MMR) [1, 6]. Vital registration of births and deaths in the Solomon Islands may be unreliable in remote areas, making this MMR an estimate. In contrast, the non-Indigenous and Indigenous MMR in Australia is 8 and 13/100,000 live births, respectively [1], and the MMR in New Zealand is 9.4/100,000 [7]. Many Solomon Islanders live in remote areas, with high poverty rates and limited access to health services with a recent civil war exacerbating many of these issues. The National Referral Hospital (NRH) of Solomon Islands is located in the capital of

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Honiara, on the island of Guadalcanal. Approximately 5000-6000 women deliver at NRH per year. The country faces significant geographical, economic, cultural and logistical barriers which impact the availability and use of family planning services, with less than 40% of women of reproductive age using any family planning [8]. Furthermore, these barriers can delay the access of quality antenatal and obstetric care. Thaddeus and Maine [9] developed a model describing 3 categories of delays contributing to maternal mortality; the first is in seeking care, the second is in transfer to an appropriate health facility, and the third is in receiving adequate care at the health facility.

We aimed to perform a detailed review of maternal mortality at NRH over a 5-year period. The only other review of maternal mortality in the Solomon Islands was performed in 1994 using an indirect technique [10] Improving the characterisation of maternal mortality in the Solomon Islands with individual case review may help elucidate areas for improvement and ultimately reduce maternal mortality.

Materials and methods:

Maternal deaths have been recorded at NRH for many years, however formal documentation and regular audits of maternal mortality began in 2013 and 2015, respectively. Maternal mortality audit records and cases files from January 2013 – December 2017 were reviewed. The population included all pregnant women attending for care during any stage of pregnancy at NRH within the study period. Cases included were those who fit the WHO definition of a maternal death, which is defined as "the death of a woman while pregnant or within 42 days of delivery or termination of a pregnancy from any cause related to, or aggravated by, the pregnancy or its management, but not from accidental or incidental causes" [2]. Information was recorded for audit purposes by authors LP, AM, MD and RM. Limited data was available for 9 cases, with missing case files. Data on these cases were obtained from audit data. Data was further extracted from the remaining case files by MD and RH and recorded in the electronic data collection platform, RedCap. Data was collected regarding maternal demographics, causes of death, contributing factors and neonatal outcomes. Informed consent was not needed as participants were deceased and only case files were reviewed. Cause of death was ascertained from case files only, as post-mortem examination facilities are not routinely available in the Solomon Islands. Ethical approval

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was obtained through the Solomon Islands Ministry of Health Ethics Board prior to commencing the study (Ethics number HRE017/18). The data was analysed using STATA version 15.1.

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Results:

During 2013 – 2017 a total of 28,037 mothers delivered at NRH, with the annual average number of births being 5,644. During this time, 39 maternal deaths were identified, giving an institutional MMR of 139/100,000. This is higher than the national recorded MMR of 114/100,000 [2]. Between 2013 - 2017 the yearly maternal mortality remained stable with no evidence of a decline, with 7-9 deaths per year (Figure 1).

Table 1 shows the demographic characteristics of the 39 maternal deaths. The median age was 31 (range: 15-41). Educational attainment was recorded for 22 women, of these 14 had completed primary school (35.9%), 4 had completed secondary school (10.3%) and only 2 women completed or were completing tertiary study (5.13%). The majority were homemakers (53.9%), which may contribute to type 1 delays in seeking care.

Nineteen of the women had type 1 delays to seek care. The majority of women were multiparous (58.3%), with 3 grand-multiparous (5 or more previous deliveries) with most residing outside of Guadalcanal, having been referred for care at the NRH during their antenatal course (n=22). Nine of these cases were referred in an emergent fashion from clinics and area health centres with significant delays in transfer, although exact times were unknown (type II delay). Twenty-six of the 39 cases were booked for antenatal care, however the median number of antenatal visits was only 3 (Table 1). None of the women received an ultrasound scan prior to presentation at NRH, and 23 women received ultrasounds after this. Gestational age was documented for 23 cases, and from these, the median gestational age at maternal demise was 36 weeks of gestation.

Notably, maternal death was deemed to be preventable in 79% of cases involving type III delays at NRH. As seen in Table 2, the leading primary cause of maternal death was haemorrhage (28.2%). The majority of these cases (72%) were post-partum, with blood loss greater that 1000mls reported in 6 women (Table S1). Two cases had molar pregnancies and 4 were complicated by abruptions and antepartum haemorrhage.

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Hypertensive disorders of pregnancy were the second largest cause of maternal death in our cohort, as well as infection and medical co-morbidities (each comprising 20.5% of maternal deaths overall). Of those secondary to hypertensive disorders, 5 suffered from preeclampsia and suspected intracerebral haemorrhage or renal failure. Two women were diagnosed with HELLP syndrome (a syndrome characterized by haemolysis, elevated liver enzymes and a low platelet count) and 1 woman had eclampsia. Of these women, only 5 received magnesium sulphate, which has been established as the mainstay in prevention and treatment of eclampsia by reducing the risk of seizures [11, 12]. The remaining deaths were due to suspected venous thromboembolisms and amniotic fluid embolism followed by sudden cardiac arrests (Table 2).

Indirect maternal deaths were mainly related to medical co-morbidities (n=7 or 58.3%) and infection (n=5 or 41.2%). Of 17 women screened for Hepatitis B, 6 were positive, all of whom were newly-diagnosed at NRH. Three of these women died of hepatic failure with evidence of hepatic encephalopathy. Similarly, only one woman was screened for HIV (which was negative). Twenty women (51.3%) were tested for syphilis where all results available were negative. Haemoglobin levels were documented among 26 cases, with anaemia present in 22 (84.6%) women with a median lowest haemoglobin of 83g/L. The majority only had haemoglobins checked on arrival at NRH and only 4 patients had a haemoglobin over 100g/L.

Of the remaining deaths relating to medical co-morbidities, causes included cardiac failure secondary to undiagnosed rheumatic heart disease and one case of a suspected space-occupying cerebral lesion. Communicable diseases were also a significant contributor to maternal death, with infection present among 33.3% of all deaths (the primary cause of death in 8 women). There was 1 case of concurrent tuberculosis, 1 case of acute dengue infection and 1 case of suspected cerebral malaria. The majority of infections occurred postpartum, with 5 cases of puerperal sepsis and one septic miscarriage.

The majority of maternal deaths occurred postpartum (n=23 or 74.4%), with 1 intrapartum and 9 antenatal deaths. Neonatal outcomes were poor among these women, with only 15 liveborn babies and 14 (48.3%) stillbirths, eight of which were intrapartum. Of the live

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births, 12 were discharged home, 1 suffered a neonatal death in hospital and 2 neonatal outcomes were unknown.

A senior member of staff (consultant, senior registrar or senior midwife) was present for only 10 out of 29 deliveries (34.5%). An obstetric consultant was present at the time of death for 25 cases (64.1%), however 11 cases lacked staffing documentation. Emergency Obstetric Care (EmOC) training was commenced in 2016 at NRH, with 15 maternal deaths occurring after this time. Ten (66.7%) of these women had a staff member present who had attended EmOC training but only 4 women (10.3%) received active resuscitation with cardiopulmonary resuscitation. All the cases after January 2015 were discussed in a structured unit audit meeting.

Laboratory delays secondary to shortages of appropriate resources, equipment or staff were present in 21 cases (53.8%) and medication shortages contributed to 8 (20.5%) cases. In the cases of maternal haemorrhage, blood or laboratory delays were present in an alarming 80% (9 out of 11) of cases, the majority of which were secondary to inability to contact technicians or lack of blood. (Table S1). Additionally, delays in access to theatre were present in 30% of all cases (and in all cases of haemorrhage), mostly due to a delay in the decision for theatre, anaesthetic delays and theatre being occupied.

Discussion:

Maternal mortality at NRH is high, with 39 cases identified over a 5-year period and an institutional MMR of 139 per 100,000 live births. Close to 70% of these deaths were direct, with haemorrhage the leading cause, followed by hypertensive disorders and infection and medical comorbidities in equal proportions. Many of the deaths were deemed preventable and, despite institutional efforts, the yearly maternal mortality did not decline. Additionally, perinatal mortality was high among these women, with just under half experiencing a stillbirth.

There is strong evidence that quality maternal mortality surveillance and audits can reduce MMR[1, 13, 14] . Monthly perinatal death audits have occurred at NRH since 2015, however the mortality rate has not declined. Poor documentation and lack of formal autopsies may lead to inability to accurately address underlying causes [13, 15] which may be improved by a verbal

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autopsy tool. Additionally, the majority of these cases were referred to the NRH and there is poor knowledge of events prior to referral. Furthermore, the audit meetings have inconsistent engagement of healthcare professionals from referral sites. Thus, strengthening of current audit frameworks, reporting of recommendations and improved engagement of other facilities may improve the translation of these findings.

Despite established interventions to treat and prevent postpartum haemorrhage [6, 16, 17], haemorrhage was the primary cause of death in our study, in keeping with global data [1, 5, 18, 19]. EmOC training emphasises the timely management of haemorrhage, however, this data emphasises the need to continue to strengthen this training. Importantly, many of these cases involved a lack of blood products (secondary to laboratory delays) and prompt surgical care (type III delays), indicating that increased access to blood, reliable access to after-hours laboratory staff and the operating theatre would significantly reduce deaths [1, 6, 20, 21].

A high proportion of maternal deaths were secondary to hypertensive disorders of pregnancy (20.5%). Magnesium sulphate is recommended for all women diagnosed with severe preeclampsia in order to prevent eclampsia [11]. Despite this recommendation, 37.5% of cases related to hypertensive disorders did not receive magnesium sulphate due to treatment gaps across sites. A recent study demonstrated that even if availability and use of magnesium sulphate is high, mortality due to hypertensive disorders was not reduced [21]. Thus, prompt treatment needs to be emphasised at all facilities (type III delay), but there is also a need for early diagnosis and improved treatment of hypertension (reducing type 11 delay) [21].

There was a large proportion of deaths secondary to indirect causes, all of which were due to infection (including puerperal sepsis) and medical co-morbidities. Infection control is difficult in LMICs and communicable diseases, such as dengue and malaria, are common [2, 19]. Additionally, there are difficulties in diagnosing, assessing and managing severe infections due to lack of diagnostics and an intensive care unit [21]. Efforts to reduce deaths secondary to infections will need to focus on early diagnosis, prevention with improved sanitation and access to essential resources, with 20.5% of the cases experiencing shortages of essential antibiotics (type III delays).

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Many maternal deaths in LMICs are preventable with the provision of adequate and timely antenatal care, enabling prevention, diagnosis and early referral. The median number of antenatal visits was only 3, which is below WHO recommendation of 8 visits[1, 22, 23], perhaps influenced by low levels of education (type I delay). Furthermore, the quality of antenatal care received was suboptimal [23]. In particular, the majority of women were first seen in their second or third trimester and none received an ultrasound scan prior to presentation at NRH, which may have enabled early detection of life-threatening complications. Similarly, hepatitis B screening (which is recommended in national antenatal care protocols) may have led to earlier diagnosis in cases complicated by liver failure. HIV and syphilis testing are also recommended [23, 24], however only 1 woman was screened for HIV in our study and only just above half were screened for syphilis. Furthermore, the national recommendation of routine haemoglobin testing was only performed for 13 women (all within NRH). These gaps reflect the need to strengthen bedside testing resources and training in external facilities to improve antenatal care.

Most cases were referred from other healthcare facilities and 9 of these cases were transferred in an emergent fashion from remote locations, highlighting the need to improve standard referral pathways and type II delays[24]. Our study also demonstrated the limited number of senior staff available at NRH to manage many complex cases referred, indicating that continued EmOC training, increasing staff and an early warning system for emergencies needs to be prioritised.

Our study was limited by its retrospective design and limited data available for 9 cases, leading to potentially incomplete data available for statistical analysis. Additionally, not all causes of death can be confirmed without routine autopsy. Finally, this study only included maternal deaths at NRH, which is a fraction of total maternal deaths in the Solomon Islands due to many maternal deaths occurring within the community and at smaller facilities.

In conclusion, this is the first detailed review of maternal mortality within the Solomon Islands utilising detailed case review. Maternal mortality at NRH is high, likely due to the complexity of cases managed at this site. Most deaths were deemed preventable. Continued focus on improving access to resources, blood products, operating theatre and training is vital to reduce maternal mortality in the Solomon Islands. Furthermore, improving and driving

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research capacity in this setting may continue to interrogate barriers and ultimately reduce mortality.

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Table 1. Maternal and demographic characteristics of 39 maternal deaths

Variable	Frequency (%)
Age (years)	
Age <19	4 (10.2)
Age 20-34	22 (56.4)
Age >35	13 (33.3)
Median age (min-max)	31 (15-41)
Parity	
Nulliparous	16 (41.0)
Multiparous (<4)	20 (51.2)
Grand-multiparous (>5)	3 (7.7)
Marital status	
Single	5 (12.8)
Married	31 (79.5)
Co-habiting	1 (2.6)
Unknown	2 (5.1)
Education level	
None	2 (5.1)
Primary	14 (35.9)
Secondary	4 (10.3)
Tertiary	2 (5.13)
Unknown	17 (43.6)
Ethnicity	
Melanesian	37 (94.9)
Polynesian	2 (5.1)
Employment	
Employed	5 (12.8)
Unemployed/homemaker	21 (53.9)
Unknown	13 (33.3)
Region of residence	
Main island*	17 (43.6)

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Other	22 (56.4)
Antenatal booking	
Booked	26 (66.7)
Unbooked	13 (33.3)
Number of antenatal visits (if booked)	
< 4	15 (38.5)
≥ 4	24 (61.5)
Median number of antenatal visits (min-max)	3 (0-13)

*"Main island" refers to Guadalcanal, where the National Referral Hospital is located.

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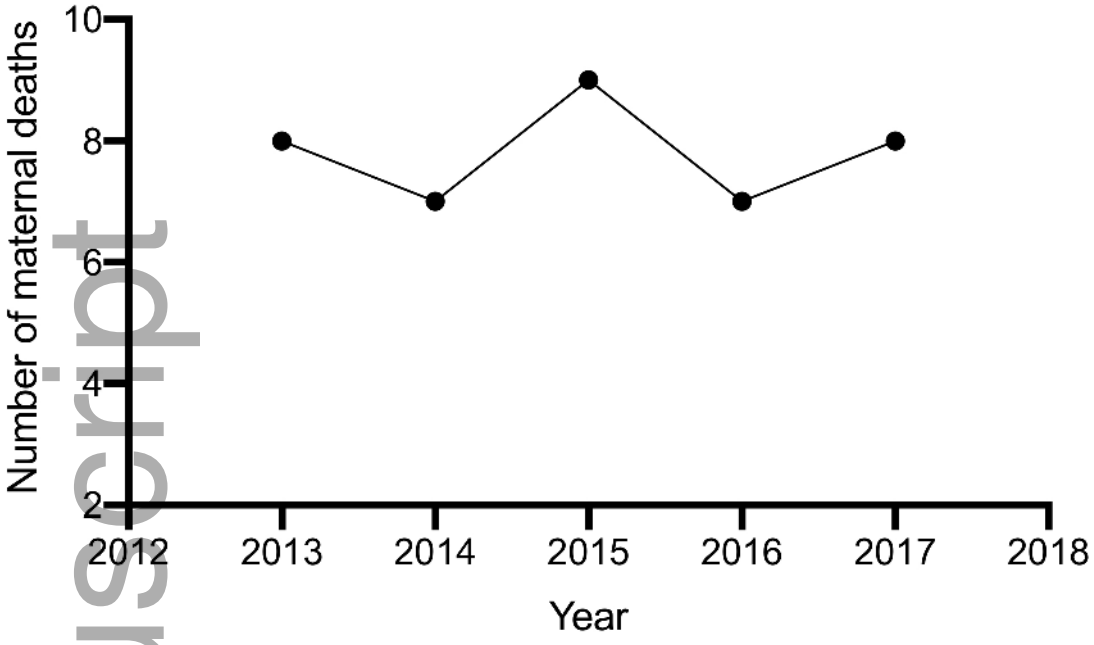
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Table 2. Primary causes of maternal death

Primary cause of death	**Total deaths N=39 (%)**
Haemorrhage	11 (28.2)
Hypertensive disorder	8 (20.5)
Infection	8 (20.5)
Medical co-morbidities	8 (20.5)
Suspected venous thromboembolism	2 (5.1)
Suspected amniotic fluid embolism	2 (5.1)

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