

**OUTCOMES OF PRETERM INFANTS DISCHARGED EARLY FROM A SOUTH AFRICAN KANGAROO MOTHER CARE UNIT**

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## **Abstract**

Background: Over 15 million preterm babies are born annually and are the leading contributor to neonatal deaths. Kangaroo Mother Care (KMC), incorporating skin-to-skin care, breastfeeding, early discharge and close follow up, decreases morbidity and mortality in preterm and low-birth-weight infants. Few recent South African studies have looked at outcomes of KMC beyond the neonatal period.

Aim: The primary objective was to describe the post-discharge clinical course of KMC infants over six months. The secondary objectives were to correlate neonatal and maternal characteristics pre-discharge to outcomes – mortality and morbidity.

Setting: George Hospital is the regional hospital for the Eden and Central Karoo districts, with its tertiary referral centre 400km away in Cape Town. In these areas, poverty and teenage pregnancies result in more than a quarter of learners dropping out of school before completing Grade 12. The hospital has intensive care, high care and KMC units.

Methods: This was a **retrospective descriptive** study which reviewed folders of neonates discharged from KMC in 2013. Neonates with birth weights of 2000g or more and neonates referred out were excluded. Hospital readmissions were used as a proxy for morbidity and a descriptive analysis was done.

Results: Fifty-two infant records were reviewed. Thirteen infants (25%) accounted for 21 readmissions. Six readmissions occurred in winter. There were significant associations between being readmitted and birth weight and breastfeeding. Thirty-five of the 52 infants were alive at six months. None were known to have died.

Conclusion: Larger prospective studies on KMC infant outcomes are needed in South Africa.

## **Acknowledgements**

I would like to thank my supervisors for the major role they played in this work. Specifically, I would like to thank Ilse Els for the inspiration to do the study after the time I spent at George Hospital as well as the logistic assistance of accessing folders after I had left. A special thank you to my UCT-based supervisor, Natasha R. Rhoda, for her commitment to me and this work and the motivation to push through in spite of many challenges.

I would like to thank my colleague, Vashini Pillay for the statistical (and moral) support.

## **Contributions**

First author: Sadeeka Williams – data collection and analysis, all draft formulations and write-up.

Second author: Ilse Else – assistance with drafting of protocol and submission to ethics board, review of final draft.

Final author: Natasha Rhoda – revision of all drafts, mentorship of article direction, review of final draft.

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## **Abbreviations**

BPD Bronchopulmonary dysplasia

EBF Exclusive breastfeeding

Hb Haemoglobin

KC Kangaroo Care

KMC Kangaroo Mother Care

LBW Low birth weight

LRTI Lower respiratory tract infection

RDS Respiratory distress syndrome

SGA Small for gestational age

SSC Skin-to-skin contact

RCT Randomised controlled trial

## **Chapter 1: Introduction and Literature review**

### **Outcomes of preterm infants discharged early from a South African Kangaroo Mother Care unit**

Preterm babies, defined as babies born at less than 37 completed weeks gestation, are at increased risk of becoming sick and dying [1,2]. At 15 million births, they account for more than 10 percent of all newborns born every year in the world [3]. Increased maternal ages and maternal chronic health conditions as well as infertility treatments and earlier deliveries via caesarean section have been cited as reasons for preterm birth rates increasing over the past 20 years [4].

Prematurity is the main driver of neonatal mortality globally. The burden is high in low-income countries with 60% of preterm births occurring in Africa and South Asia [4]. High-income countries have better survival as a result of more resources in infrastructure, equipment and human capacity to care for this vulnerable population. Preterm babies account for 35% of all neonatal deaths (deaths before the age of 28 days) and 15.9% of all child deaths under the age of five, making prematurity the leading cause of both neonatal and child under-five deaths [5]. For physiological reasons, babies born at lower gestational ages are at highest risk of death [6]. Newborns at less than 28 weeks gestation may have a mortality risk of as much as 30-50 % [7].

The neonatal period is the most dangerous period for a child as the risk of dying is highest, and more so for a child born in low- and middle-income countries, where 99% of all neonatal deaths occur [8]. Seventy-five percent of neonatal deaths occur within the first week of life. However, increased mortality risks for preterm, low-birth-weight (LBW) and small-for-gestational-age (SGA) babies continue into the post-neonatal period. In a pooled analysis of over 2 million live births in low- and middle-income countries, preterm babies were shown to have a relative risk of post-neonatal mortality (death between 28 and 364 days of life) of 2.5 (95% CI 1.48-4.22) compared to term babies [9]. The authors showed that the risks were higher for preterm babies who were small-for-gestational age compared to appropriately-grown preterm babies, with relative risks of 5.77 and 2.2, respectively. Upadhyay and colleagues' Indian study did not look at gestational ages [10]. They found post-neonatal-

mortality relative risks of 1.92 (95% CI 1.71-2.15) and 3.38 (95% CI 2.71-4.12) in low-birth-weight babies and babies with birth weights of less than 2000g respectively (compared to babies with normal birth weights). The same study, in which the outcomes of over 10 000 low-birth-weight infants were analysed, also found that these babies had an increased risk of hospitalisation (RR=1.13) (95% CI 1.05-1.21) and suboptimal breastfeeding (no breastfeeding) at six months (RR=1.34) (95% CI 1.23-1.46).

In South Africa the child death review study conducted in 2014 recorded 711 deaths at two pilot mortuary sites. Fifty-three percent of the child deaths recorded was due to natural causes, 43% due to unnatural causes and the causes of the remaining deaths were undetermined. Forty-four percent (n=313) of the natural child deaths occurred in infancy and lower respiratory tract infections (LRTIs) was the commonest cause of natural deaths [11]. Forty-four percent (n=85) of the LRTI infant deaths were associated with prematurity.

Besides the contribution of preterm births to neonatal, infant and under-five mortality, preterm babies may suffer significant morbidity. Morbidity, however, is not as clearly defined as mortality. In a 2015 systematic review of preterm outcomes, Gladstone and colleagues found that the majority of publications focussed on outcomes in the immediate newborn period and that only 16% of studies reported population-based data using standardised mortality definitions [12]. Furthermore, community-based studies used a range of measures as proxies for morbidity, which included need for hospitalisations and number of routine and additional clinic visits in the post-natal period. Even specific morbidities with well-defined outcome tools were not systematically used across studies. The authors concluded that there was no agreed set of criteria for neonatal or infant morbidity and made recommendations on which standardised measurements to report for studies on neonatal outcomes. For example, they recommended using Bancalari criteria for bronchopulmonary dysplasia (BPD) [13].

Lassi and colleagues' 2015 overview of systematic reviews identified kangaroo care (KC) for preterm infants, antenatal corticosteroids, early initiation of breastfeeding, hygienic cord care, use of insecticide treated bed nets for children and vitamin A supplementation for infants - as clearly effective interventions for reducing neonatal, infant or child mortality [14]. Their pooled analysis of 11 Kangaroo Mother Care (KMC) studies (2167 infants)

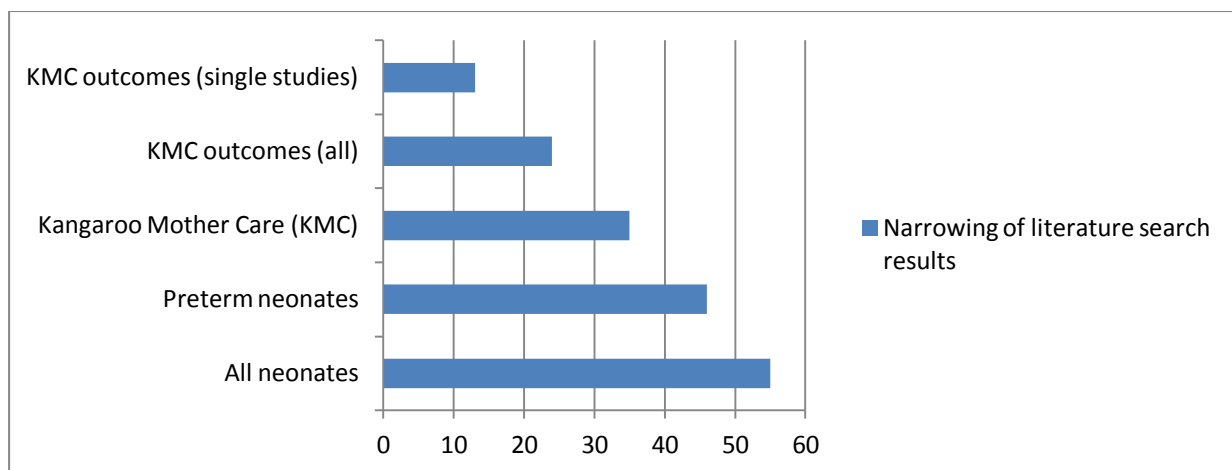
showed a 33% reduction in mortality at latest follow up (RR 0.67) (95% CI: 0.48-0.95) compared to infants that received standard care.

In the South African public health system, a well term baby may be discharged as early as six hours after birth from the maternity unit. A preterm baby, however, depending on the circumstances, may spend time in an intensive care (ICU) or high care unit before staying in a KMC ward, the ultimate point of discharge for the majority of preterm babies. Length of stay in KMC varies in the literature. An average length of stay of 13 days in the KMC unit was reported in a South African audit where 47% of infants admitted weighed 1500grams or less [15].

A substantial investment is made in saving preterm babies until they are discharged from a KMC unit, however post-discharge follow-up data is largely lacking. In South Africa it is not known what happens to KMC babies post discharge, nor how many survive to infancy or beyond. The postnatal care package is not routinely or uniformly implemented across the country.

The objective of this literature review is to study post-discharge outcomes of premature babies who have been cared for through the Kangaroo Mother Care method, with an emphasis on the influence of discharge and follow-up policy.

A literature-seeking strategy was undertaken using the Pubmed and Scopus databases. The following terms were searched: (preterm OR premature) AND (kangaroo mother care OR KMC) AND (discharge OR outcome OR follow up OR readmission OR morbidity OR mortality). This search found 197 articles on Pubmed with 152 articles published in the last ten years. Eighty articles were found on Scopus, totalling 232. The majority of these 232 articles did not look at post-discharge outcomes. This criterion was needed for the objective of this literature review. A final number of 55 articles focussing on post-discharge outcomes were analysed.



Graph 1: Narrowing of literature search results

As shown in Graph 1, the 55 articles were narrowed down to 12 articles with studies which focussed on outcomes of KMC. One of the 12 articles, was only accessible in Spanish and excluded, leaving 11. Before reviewing the outcomes of KMC presented in the articles, defining KMC is pertinent.

### **The definition of KMC**

According to the 2003 World Health Organisation (WHO) guidelines, KMC incorporates skin-to-skin contact (SSC), breastfeeding, early discharge and follow up [16]. The Western Cape Province guidelines, also published in 2003, attribute similar aspects to KMC. It refers to the Kangaroo position (SSC), Kangaroo nutrition (breastfeeding), Kangaroo support (in and outside of hospital) and Kangaroo discharge (early discharge) [17].

A 2016 systematic review looked at the use of the term KMC in 299 studies [18]. Chan et al found that 29% of studies did not actually define KMC. While 71% alluded to skin-to-skin contact (SSC) in their KMC study, only 16% included breastfeeding, 7% included early discharge criteria, and 12% included follow up after discharge.

The SSC component is often used synonymously with KMC in the literature. Its role is significant, and one may even view SSC as the method of providing KMC and the other three, namely exclusive breastfeeding, early discharge and follow up (a well infant), are seen as adjuncts to ensure successful KMC implementation. While SSC is the major component of KMC, the danger of limiting the definition of KMC to SSC only, is three-fold: 1) a preterm

or LBW baby may lose out on essential holistic care which is implicit in the four-component definition, 2) a term baby may lose out on SSC if thought of as only indicated for small or preterm babies and 3) breastfeeding, a significant independent factor against morbidity and mortality, will be affected. In the eleven studies reviewed in this literature review, six describe KMC as being SSC only, with only three defining KMC as having all four components.

### **KMC outcome 1: Breastfeeding**

Tully et al. analysed three breastfeeding outcomes in a randomised controlled trial (RCT) which followed American infants up to 12 months corrected age [19]. They found that 33% of KMC infants breastfed while in hospital. The average duration of post-discharge breastfeeding was 12.8 weeks. The third breastfeeding outcome was breastfeeding exclusivity after discharge, where they found that only 2.2 % of infants across the KMC and control groups were exclusively breastfeeding at two months corrected age. Much higher rates of breastfeeding exclusivity was found in an Indian study by Gathwala and colleagues [20]. This RCT study found a significant difference between KMC and control groups, with 88 % of KMC infants exclusively breastfed at three months. Another Indian RCT showed that 73 % of infants who started on early KMC (within four days of life) were exclusively breastfed at one month post discharge [21]. This was more than double the number of the infant group in which KMC was delayed. In Brazil, Menezes et al. [22] found that 40.7% of their KMC cohort were breastfed and 14.4% exclusively breastfed at six months of age.

### **KMC outcome 2: Maternal perception and practice**

Two studies looked at maternal satisfaction with the KMC intervention and two studies looked at the practice of KMC in the community.

Gathwala et al. [20] used maternal questionnaires at day seven of KMC initiation while Holditch-Davis et al. [23] administered questionnaires at discharge and at two months of the babies' corrected age. Both studies concluded that mothers were highly satisfied with the KMC intervention. In addition, Holditch-Davis et al also showed that satisfaction was related to maternal demographics as well as maternal depression and anxiety.

In a Ghanaian study by Nguah and colleagues, nearly 99% of babies discharged from a mother-baby unit were practising KMC at first follow up (day 7 post discharge) [24]. The study involved four follow-up visits at weekly intervals. Household chores did not affect the practice of KMC. In a similar Indian study by Raajashri et al., 82.5% of the mothers continued to practice KMC after 45 days post discharge [25]. The authors concluded that lack of privacy and family support may have been factors that led mothers to discontinue KMC.

### **KMC outcome 3: Weight gain and readmissions**

Three studies which reported weight gain at 28, 45 and 84 days after discharge, showed average weight gain of 23.7, 22.2 and 21.92 grams/day, respectively.

In a Malawian study by Blencowe and colleagues, six percent of KMC babies discharged required readmission to hospital before they reached 2.5kgs [26]. In Menezes' Brazilian study, 16.2% of KMC infants in which information was available at six months, were readmitted [22].

### **KMC outcome 4: Mortality**

In Blencowe's study, 32 of 256 (11.8%) patients died after discharge from a Kangaroo ward [26]. Babies who were discharged at less than birth weight did not have an increased risk of dying, but babies with a discharge weight of less than 1500g did have a higher mortality. The mean time to outpatient death was 31.2 days. In the Brazilian study, 3% of KMC infants who had information available at six months died [22]. The mean discharge weight in the Malawian study was 1598g while it was 1780g in the Brazilian study.

There were no outcome data in 9% of the Malawian study and almost a third (27.7%) of the Brazilian study.

### **Quality of the evidence**

This literature review looked at only two databases and then summarised the main findings of single studies conducted on KMC outcomes in the last ten years. It also excluded Spanish literature which is rich in KMC data, especially from the Canguro Fundacion where the leaders of KMC are in Columbia. The most obvious flaw in the quality of evidence presented is that the definition of KMC differs among the studies, making it difficult to compare

outcomes. The randomised controlled studies showed the most robust results, yet the cohort studies, with high lost-to-follow-up rates reflect a more real life scenario. Furthermore, the study outcome points in all the studies differ with regard to corrected age or a specific weight or a specific time after discharge being used. Other than a single study of KMC at twenty years, the longest outcome point in the rest of these studies was six months of age.

### **Implication for practice and research**

None of the articles reviewed were South African and one may conclude that evidence for South African KMC outcomes, beyond the initial neonatal period, is lacking or as yet unpublished at the time that this literature review was conducted. There is also a need for uniformity in KMC research globally. Firstly, KMC definitions need to be standardised, secondly there should be specific reportable outcome points and thirdly, there needs to be consensus on what constitutes morbidity in an infant.

### **Summary or interpretation of literature**

This literature review showed that

- KMC improves exclusive breastfeeding after hospital discharge, especially if commenced soon after birth
- Exclusive breastfeeding decreases with infant age
- Maternal perception and practice of KMC is generally good but is influenced by maternal psychological well-being as well as environmental factors such as family support
- Readmissions increase with infant age (likely because period of evaluation is longer)
- Discharge weights of less than 1500g was associated with increased mortality in a single study where the mean date of death was more than a month after discharge

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## **Outcomes of preterm infants discharged early from a South African Kangaroo Mother Care unit**

### **Abstract**

Background: Over 15 million preterm babies are born annually and are the leading contributor to neonatal deaths. Kangaroo Mother Care (KMC), incorporating skin-to-skin care, breastfeeding, early discharge and close follow up, decreases morbidity and mortality in preterm and low-birth-weight infants. Few recent South African studies have looked at outcomes of KMC beyond the neonatal period.

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Conclusion: Larger prospective studies on KMC infant outcomes are needed in South Africa.

## Introduction

Preterm babies, defined as babies born at less than 37 completed weeks gestation, are at increased risk of becoming sick and dying [1,2]. At 15 million births, they account for more than 10 percent of all newborns born every year in the world [3]. Increased maternal ages and maternal chronic health conditions as well as infertility treatments and earlier deliveries via caesarean section have been cited as reasons for preterm birth rates increasing over the past 20 years [4].

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A 2016 systematic review looked at the use of term kangaroo mother care (KMC) in 299 studies [17]. Chan et al found that 29% of studies did not actually define KMC. While 71% alluded to skin-to-skin contact (SSC) in their KMC study, only 16% included breastfeeding, 7% included early discharge criteria, and 12% included follow up after discharge. The 2016 Cochrane review entitled “Kangaroo mother care to reduce morbidity and mortality in low birth weight infants” describes KMC as having only three components (follow up is excluded) [18].

KMC is one of the major neonatal and infant mortality interventions and there is a need to review more post-discharge outcomes.

This study aimed to describe clinical observations made at hospital outpatient clinic and ward contact of KMC infants during a six month post-discharge period. The primary objective was to assess post-discharge morbidity and mortality and identify any correlations with routinely recorded neonatal and maternal factors, as well as any seasonal variations.

## **Methods**

### Study design

This was a retrospective folder review conducted of routinely-documented data.

### Setting

Patient data of George Hospital neonatal unit was analysed. George Hospital is a secondary-level health facility situated in the Western Cape province of South Africa, approximately five hours drive and 400km from Cape Town. It has a dedicated neonatal service staffed by a team of two paediatric specialists, a neonatologist and one postgraduate paediatric registrar. The unit has seven neonatal intensive care beds, eight high care and six KMC beds. It is the direct

referral centre for 2 districts; Eden and Central Karoo, with approximately 10 000 deliveries per annum. In these areas, poverty and teenage pregnancies are rife and result in more than a quarter of learners dropping out of school before completing Grade 12. The referring district hospitals and clinics are mostly run by non-specialist and junior staff with limited neonatal care expertise.

The George Hospital KMC unit was established in 1995. This was a consequence of the global and local movement towards providing a more natural but safe alternative to traditional incubator care for otherwise healthy, growing neonates, who lack temperature control and are at risk for developing sepsis.

KMC has strong appeal for developing countries where incubators and specialised care and resources are limited. Similarly, George Hospital is less well-equipped and has less specialised nursing staff than other neonatal units in the Western Cape. The early discharge component of KMC is thus advantageous to both the hospital and infant-mother pair. At George Hospital, neonates are discharged at a weight of 1500g or more, a weight which is lower than the prerequisite weight in most other KMC units in the Western Cape province of South Africa. The other ten KMC discharge criteria include aspects of the mother's theoretical and practical knowledge of preterm care (Appendix 2). The decision to discharge neonates at 1500g was a departmental policy implemented by previous management at George Hospital in response to increasing bed pressure (viz the inability of the hospital to meet demands for hospital beds for patients). After discharge, infants are routinely seen weekly for the first month, and thereafter monthly, at the hospital's outpatient department. Infants are admitted to hospital directly at the outpatient visit if medically warranted.

#### Study population and sampling strategy

As this was a descriptive study, all subjects were identified from the KMC register, a book maintained by the neonatal nursing staff which recorded all patients admitted and discharged from the KMC unit. The KMC register was used to identify eligible and ineligible neonates and the relevant folders were drawn. Since the study was descriptive and described novel data at the site, a powered sample size had not been calculated. All neonates discharged from the KMC unit in 2013 were included, except those with a birth weight of 2000g or more, and those referred to other hospitals for further care. During the study period, George Hospital switched

over from a paper-based to electronic-based record system. Thus the electronic records were available for some participants while the remaining physical folders had to be drawn.

#### Data collection

Relevant data in the neonatal period and subsequent 6 month post-discharge period was captured onto data sheets (Appendices 3-5). Data was recorded as written in the doctors' or nurses' notes. Clinical notes were not independently corroborated. For example, a gestational age was recorded as is; no investigation was done to see if it was derived from an antenatal ultrasound or a postnatal gestational scoring system.

#### Data management

Each eligible KMC graduate was allocated with a unique study code. All the coded data sheets were kept in a file accessible to study staff only. After all the information was completely captured onto the paper data sheets, it was entered anonymously onto Excel.

#### Data analysis

Continuous variables were compared using the paired t-test and Wilcoxon Signed Rank test, for normally distributed and non-normally distributed data, respectively. Frequencies and proportions were used to describe categorical variables at baseline and at follow up. Hospital readmissions were used as a proxy for morbidity and the chi square test of association was used to analyse maternal, infant, discharge and follow-up factors. Due to the small sample size, logistic regression could not be performed. Maternal factors included age, HIV infection and distance from home to hospital. Infant factors included sex, birth weight and whether a baby was small for gestational age. Discharge factors included gestational age and weight, as well as discharge under birth weight and exclusive breastfeeding. Follow-up factors included weight gain under 10 grams per day and exclusive breastfeeding. A p-value of 0.05 was used to assess significance. Quantitative data was analysed using the STATA Release 12.0 statistical software package (STATA Corp, College Station, USA).

#### Ethical considerations

This was a retrospective study and therefore no new procedures were done on participants. All the procedures already done are considered standard of care. The overall risk of the study was minimal and informed consent was waived by the ethics committee. Although there are no

direct benefits for participants, information from the study may help to develop future policy guidelines. These policy guidelines will include KMC discharge criteria, parameters found necessary to be taken at follow-up visits and timing and number of such visits. The research staff has no conflicts of interest and the investigators on this study are employees of the Western Cape Department of Health, South Africa. Ethics clearance for this study was granted by the University of Cape Town Health and Research Ethics Committee (HREC ref no. 298/2015, Appendix 6). At local level, the superintendent of George Hospital gave permission to perform this record review.

## **Results**

### Summary of discharges

A total of 80 infants were discharged from the George Hospital KMC unit in 2013. Eleven infants were excluded from the study as each of their birth weights was more than 2000 grams. A further 12 infants were excluded as they were discharged from the George KMC unit to other KMC units closer to their parents' homes (from which their discharge and follow up took place). Two infants were placed into foster care and could not be included. A search was conducted for the records of the remaining 55 infants that were eligible to participate in the study. Fifty-two records were found (a response rate of 95%) and the information found in the records was used to complete the three data capture sheets specifically designed for the study (Figure 1).

Fifty-two infants were discharged at a median weight of 1640 (1600; 1710) grams after a median of six and a half days in KMC. There was one set of twins. Ten infants (19%) weighed less than their birth weights on discharge (four of the ten met full discharge criteria). Twenty-three infants (44%) were small for gestational age at birth and the median corrected gestational age at discharge was 36.7 (34.6; 38.05) weeks. Thirty-nine infants (75%) were exclusively breastfed at the time of discharge. The majority of the formula-fed infants (12 of 13) were HIV-exposed with just one HIV-unexposed infant given formula top-ups in addition to breast milk. Five HIV-exposed infants were breastfed. Thirty-eight infants (73%) had a KMC discharge score equivalent to 100%. In the folders of two infants, no record of a KMC discharge score was found.

### Follow-up visits

Cumulatively, the cohort of 52 children was responsible for 183 visits to George Hospital in the six months that followed their discharges. Twenty-six visits (14%) were unscheduled and 22 visits (12%) resulted in readmissions to the hospital. The median number of visits was 3 (1; 6). Six infants did not attend the hospital at all in the six months following their discharges and only 14 infants followed up completely until six months or more. Approximately half of the cohort (25 infants) was seen up until less than three months after their discharges. The remaining seven infants followed up until between three and six months.

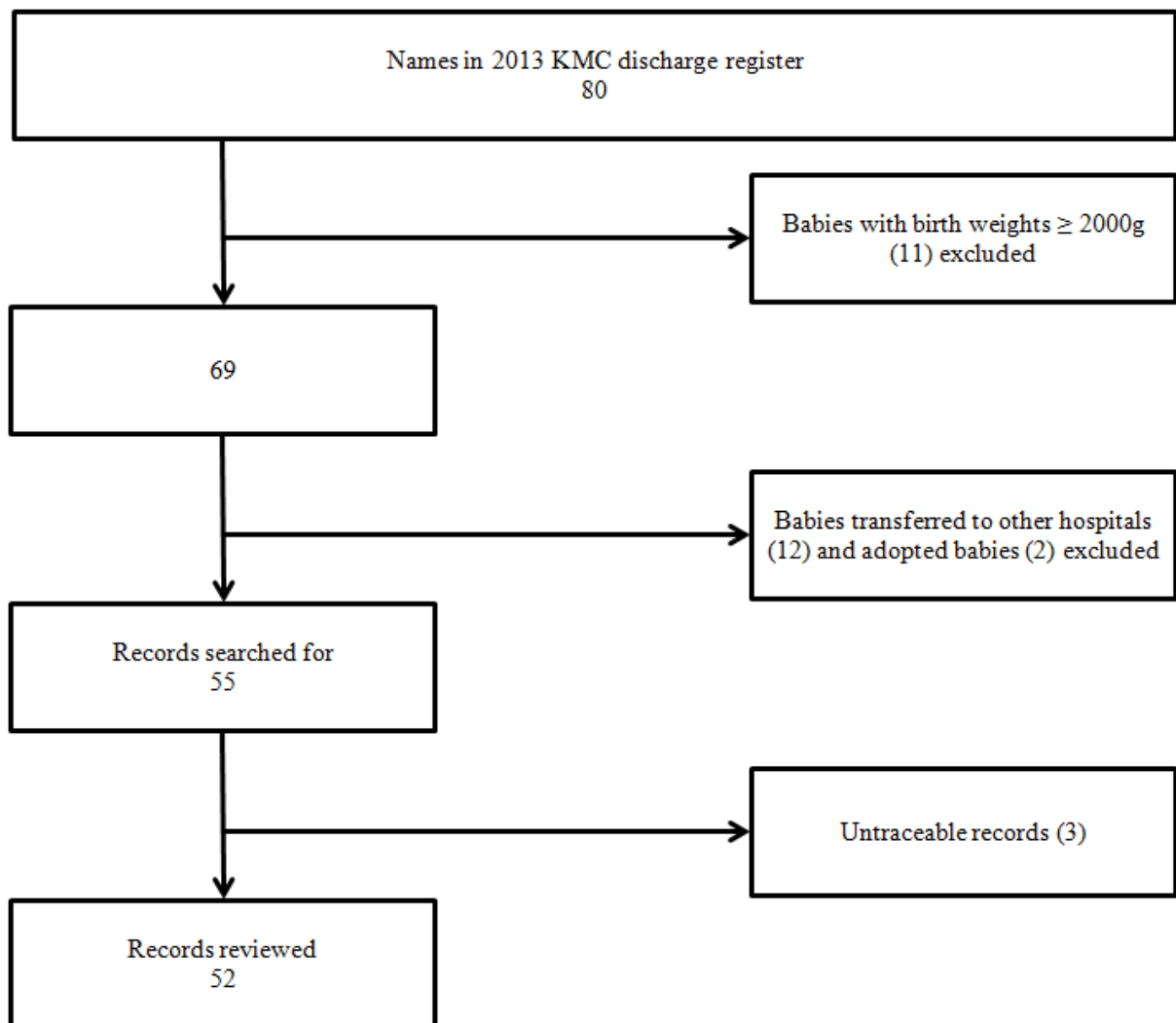


Figure 1: Folder selection process

### First follow-up visits

The first follow-up data was analysed for 46 infants. The majority of first visits occurred within the first 10 days after the infants were discharged (35 of 46). The median weight gain per day was 25.35 (17.2; 33.3) grams, with five infants gaining less than 10g per day. The median head circumference percentile was 14 (3; 33), with one infant having a head circumference above the 95<sup>th</sup> percentile. This infant was admitted with meningitis. The median finger prick haemoglobin (Hb) was 12.1 (10.1; 14.8) grams/decilitre, with two infants having Hb's of less than 8g/dl. One infant met the hospital's criteria and received a blood transfusion, while the other one's iron supplement dose was increased. Both subsequently improved. One infant who was seen at the hospital's emergency unit department did not have her head circumference or haemoglobin measured at her single follow-up contact after she was discharged.

Of the 46 infants whose follow-up data was analysed, 10 had no note of which milk they were being fed. The milk choice remained the same from discharge to first follow-up for the remaining 36 infants in which feed choices were noted. Thus 27 infants (75%) were still exclusively breastfed, eight were still being formula-fed and one infant was breastfeeding and receiving formula (mixed feeding).

### Readmissions

Thirteen infants (25% of the cohort) were readmitted to George Hospital within six months of being discharged from the KMC unit and accounted for 21 admissions. Of the 21 admissions, 13 admissions lasted three days or less. Six out of the 21 readmissions occurred in the winter months of June, July and August. One infant, who was **admitted four times** in the six months following discharge, was admitted to the intensive care unit (ICU) on three occasions. No other infants were admitted to ICU. As shown in Table 1, a respiratory illness was the cause for two-thirds of all admissions. The median number of days from discharge to first admission was 18 and the median corrected gestational age at first admission was 40 weeks. Approximately half (six) of the readmitted infants were HIV-exposed. All the HIV-exposed babies who were tested were still HIV negative at latest follow up.

Hospital readmissions were used as a proxy for morbidity and the chi square test of association was used to analyse maternal, infant, discharge and follow-up factors. There were

significant associations with the infants' birth weights and methods of feeding as shown in Table 2. In terms of seasonal association, only three of the 17 infants born in winter and three of the 19 infants discharged in winter were readmitted.

<b>No</b>	<b>Readmission Month</b>	<b>Diagnosis</b>	<b>Duration (days)</b>	<b>Ward</b>
1	January	Jaundice	1	SSW
2	January	Jaundice	3	GW
3	January	Acute upper respiratory infection	1	SSW
4	April	Bronchiolitis	1	SSW
<b>5</b>	<b>April</b>	<b>Septic arthritis</b>	<b>14</b>	<b>ICU</b>
<b>6</b>	<b>April</b>	<b>Viral pneumonia</b>	<b>7</b>	<b>ICU</b>
7	April	Bronchiolitis	1	SSW
8	May	Bronchiolitis	1	SSW
<b>9</b>	<b>May</b>	<b>Lobar pneumonia</b>	<b>6</b>	<b>GW</b>
10	June	Acute lower respiratory infection	3	GW
11	June	Bronchiolitis	1	SSW
<b>12</b>	<b>July</b>	<b>Viral pneumonia</b>	<b>17</b>	<b>ICU</b>
13	July	Acute lower respiratory infection	1	SSW
14	August	Acute lower respiratory infection	1	SSW
15	August	Viral meningitis	3	GW
16	October	Gastroenteritis	6	GW
17	October	Viral pneumonia	5	GW
18	November	Bronchiolitis	1	SSW
19	November	Neonatal skin infection	1	SSW
20	November	Viral pneumonia	30	GW
21	November	Severe malnutrition	38	GW

Table 1: Description of readmissions

(SSW= Short-stay ward, GW=General ward, ICU= Intensive Care Unit)

<b>Factors associated with readmissions</b>	<b>p-value</b>
<b>Maternal factors</b>	
Age	0.932
HIV infection	0.313
Distance from home to hospital	0.154
<b>Infant factors</b>	
Sex	0.736
Birth weight	<b>0.028</b>
Small for gestational age	0.142
<b>Discharge factors</b>	
Gestational age at discharge	0.711
Weight at discharge	0.256
Discharge under birth weight	0.223
Exclusively breastfed at discharge	<b>0.006</b>
<b>Follow-up factors</b>	
Weight gain under 10g/day	0.664
Exclusively breastfed at follow up	<b>0.04</b>

Table 2: Readmissions associations (p=<0.05 significant)

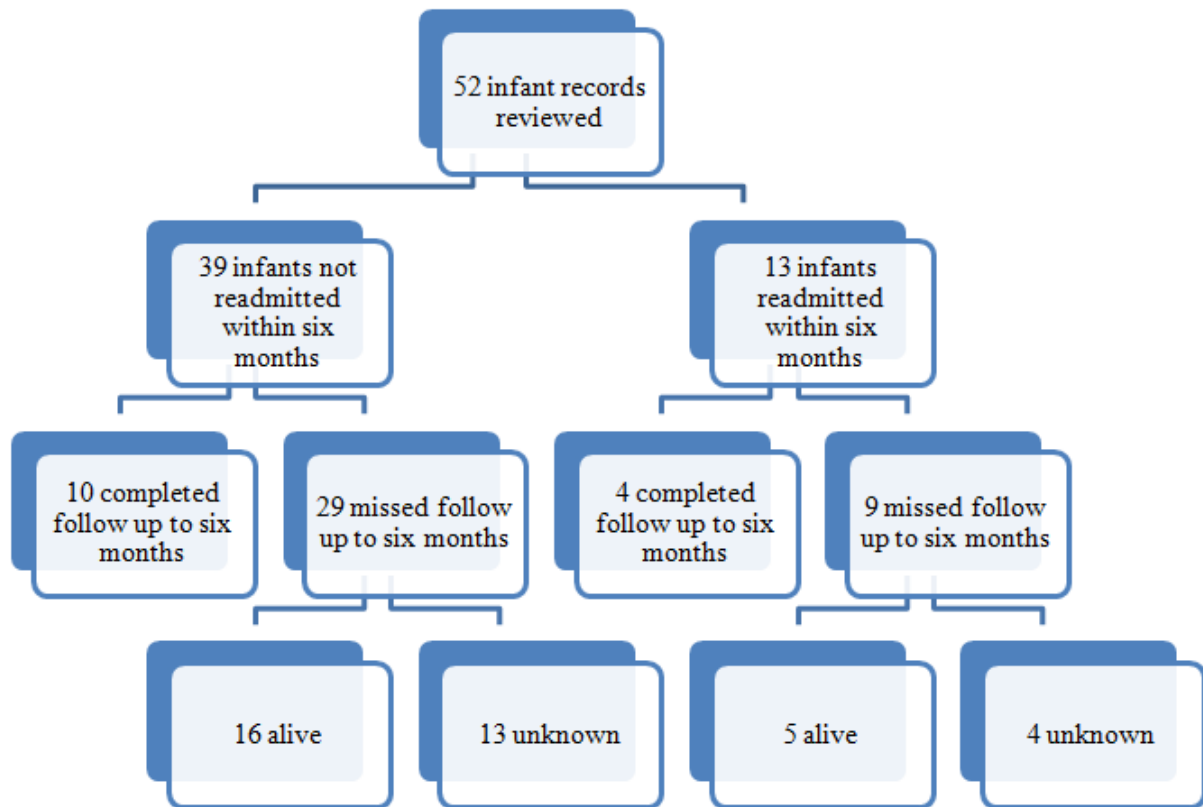


Figure 2: Outcomes of KMC babies at six months

### Survival status

At six months after discharge from hospital, 35 of the 52 in the infant cohort were known to be alive (Figure 2). The survival status of the remaining 17 was unknown.

### Discussion

This study looked at the outcomes of premature babies from a secondary level hospital KMC unit situated 400km from Cape Town. It showed that premature babies remain vulnerable beyond the neonatal period, with 25% showing significant morbidity warranting hospital readmission within the six months after discharge. This proportion of readmissions was higher than described in the literature. The majority of these readmissions were for three days or less. Therefore, the readmission itself may not have been a suitable measure of how sick the infants were. Rather, this may reflect that staff had a lower threshold to admit these infants given their background vulnerability. Staff may have also considered the mother's ability to manage her infant's illness at home or resources to bring the infant back to hospital

should the infant's condition worsen. Readmissions were not associated with discharge gestational age or weight, but rather birth weight and exclusive breastfeeding. Forty-four percent of the cohort was small for gestational age at birth but the underlying cause of SGA was not explored in this study. This is significant as maternal factors such as poor nutrition and health which could account for the SGA remain when the infant is discharged home after the initial hospital care. Raajashri et al. [19] showed that the mother's resources: her education, her environment and her decision-making will largely affect the infant's outcome in the months following discharge as KMC practice was influenced by these factors. A Malawian study by Blencowe et al. [20] found that over 40% of women did not recognise danger signs in their babies before they died.

Unsurprisingly, exclusive breastfeeding had a major protective effect against hospital readmissions. Of note is that being formula-fed was associated with higher risk of being admitted while being HIV-exposed was not. The authors expected the study to show that morbidity was higher in the HIV-exposed group but this could be explained by the high morbidity in the rest of the cohort (premature babies) or small sample size.

Holditch-Davis et al. [21] showed that involving mothers in infant care while in NICU improved maternal satisfaction. This time in NICU serves as a perfect opportunity for KMC education. Mothers need to know the four components of KMC well. They need to know the benefits of skin-to-skin care, how to provide it and how long it needs to be practised. They need to know how to breastfeed, how often to breastfeed, have plans for going back to work, how to express and store breast milk and the advantages of exclusive breastfeeding. They need to know that early discharge comes with the proviso that certain hospital practices are continued at home, that a certain amount of SCC hours and breastfeeding ensure that weight and temperature is maintained. Mothers need to know that close follow up is required, that conditions are better treated when picked up early and that clinicians are able to detect these early signs. They also need to know that their babies remain at risk and that a set weight that was required for discharge was only the beginning of expectations required from the infant to not only survive but thrive.

### Limitations of study

This study had a number of limitations. There was no control group as KMC is the standard of care at George Hospital. Furthermore, it did not measure SSC and did not determine what proportion of mothers continued SSC at follow up and whether there were significant correlations with morbidity. Another limitation is that the cohort was small and the associations seen in this descriptive study may not be reproducible on a larger scale. In nearly a third of the cohort, survival status at six months was unknown. There was no review of maternal records or local mortality information to correlate which may have provided more insight into the findings of this study.

Lastly, this study did not explore interventions to reduce post discharge morbidity. Interventions would include maternal education on environmental factors that could make the infant sick or training the mother on danger signs that need early medical attention. These interventions could be explored in a future study.

### **Conclusion**

Lower birth weights and breastfeeding rates were significantly associated with increased infant morbidity after discharge from a KMC unit in this study. Larger prospective studies on KMC infant outcomes are needed in South Africa.

### **Acknowledgements**

I would like to thank my supervisors for the major role they played in this work. Specifically, I would like to thank Ilse Els for the inspiration to do the study after the time I spent at George Hospital as well as the logistic assistance of accessing folders after I had left. A special thank you to my UCT-based supervisor, Natasha R. Rhoda, for her commitment to me and this work and the motivation to push through in spite of many challenges.

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## **Appendices**

1. Author guidelines
2. KMC score chart
3. Data collection A: KMC discharge
4. Data collection B: Outpatient visits
5. Data collection C: Hospital admission
6. Ethics letter

## Appendix 1: Author guidelines

The *African Journal of Primary Health Care & Family Medicine* (PHCFM)

### Original Research Articles

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An original article provides an overview of innovative research in a particular field within or related to the focus and scope of the journal, presented according to a clear and well-structured format. Systematic reviews should follow the same basic structure as other original research articles. The aim and objectives should focus on a clinical question that will be addressed in the review. The methods section should describe in detail the search strategy, criteria used to select or reject articles, attempts made to obtain all important and relevant studies and deal with publication bias (including grey and unpublished literature), how the quality of included studies was appraised, the methodology used to extract and/or analyse data. Results should describe the homogeneity of the different findings, clearly present the overall results and any meta-analysis.

Word limit	3500-7000 words (excluding the structured abstract and references)
Structured abstract	250 words to cover a Background, Aim, Setting, Methods, Results and Conclusion
References	60 or less
Tables/Figures	no more than 7 Tables/Figure
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Compulsory supplementary file	ethical clearance letter/certificate
Language	only manuscripts presented in English or French will be considered

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- Source(s) of support: These include grants, equipment, drugs, and/or other support that facilitated conduct of the work described in the article or the writing of the article itself.
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Anyone that has made a significant contribution to the research and the paper must be listed as an author in your cover letter. Contributions that fall short of meeting the criteria as stipulated in our policy should rather be mentioned in the 'Acknowledgements' section of the manuscript. Read our [authorship](#) guidelines and [author contribution](#) statement policies.

**Title:** The article's full title should contain a maximum of 95 characters (including spaces).

**Abstract:** The abstract, written in English, should be no longer than 250 words and must be written in the past tense. The abstract should give a succinct account of the objectives, methods, results and significance of the matter. The structured abstract for an Original Research article should consist of six paragraphs labelled Background, Aim, Setting, Methods, Results and Conclusion.

- **Background:** Summarise the social value (importance, relevance) and scientific value (knowledge gap) that your study addresses.
- **Aim:** State the overall aim of the study.
- **Setting:** State the setting for the study.
- **Methods:** Clearly express the basic design of the study, and name or briefly describe the methods used without going into excessive detail.
- **Results:** State the main findings.
- **Conclusion:** State your conclusion and any key implications or recommendations.

Do not cite references and do not use abbreviations excessively in the abstract.

**Introduction:** The introduction must contain your argument for the social and scientific value of the study, as well as the aim and objectives:

- **Social value:** The first part of the introduction should make a clear and logical argument for the importance or relevance of the study. Your argument should be supported by use of evidence from the literature.
- **Scientific value:** The second part of the introduction should make a clear and logical argument for the originality of the study. This should include a summary of what is already known about the research question or specific topic, and should clarify the knowledge gap that this study will address. Your argument should be supported by use of evidence from the literature.

- **Conceptual framework:** In some research articles it will also be important to describe the underlying theoretical basis for the research and how these theories are linked together in a conceptual framework. The theoretical evidence used to construct the conceptual framework should be referenced from the literature.
- **Aim and objectives:** The introduction should conclude with a clear summary of the aim and objectives of this study.

**Research methods and design:** This must address the following:

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- **Setting:** A description of the setting for the study; for example, the type of community from which the participants came or the nature of the health system and services in which the study is conducted.
- **Study population and sampling strategy:** Describe the study population and any inclusion or exclusion criteria. Describe the intended sample size and your sample size calculation or justification. Describe the sampling strategy used. Describe in practical terms how this was implemented.
- **Intervention (if appropriate):** If there were intervention and comparison groups, describe the intervention in detail and what happened to the comparison groups.
- **Data collection:** Define the data collection tools that were used and their validity. Describe in practical terms how data were collected and any key issues involved, e.g. language barriers.
- **Data analysis:** Describe how data were captured, checked and cleaned. Describe the analysis process, for example, the statistical tests used or steps followed in qualitative data analysis.
- **Ethical considerations:** Approval must have been obtained for all studies from the author's institution or other relevant ethics committee and the institution's name and permit numbers should be stated here.

**Results:** Present the results of your study in a logical sequence that addresses the aim and objectives of your study. Use tables and figures as required to present your findings. Use quotations as required to establish your interpretation of qualitative data. All units should

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**Discussion:** The discussion section should address the following four elements:

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- Discussion of key findings: Explain how the key findings relate to previous research or to existing knowledge, practice or policy.
- Strengths and limitations: Describe the strengths and limitations of your methods and what the reader should take into account when interpreting your results.
- Implications or recommendations: State the implications of your study or recommendations for future research (questions that remain unanswered), policy or practice. Make sure that the recommendations flow directly from your findings.

**Conclusion:** Provide a brief conclusion that summarises the results and their meaning or significance in relation to each objective of the study.

**Acknowledgements:** Those who contributed to the work but do not meet our authorship criteria should be listed in the Acknowledgments with a description of the contribution. Authors are responsible for ensuring that anyone named in the Acknowledgments agrees to be named.

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## Appendix 2: KMC score chart



### GEORGE HOSPITAL KMC Pre-discharge Readiness Scoring Sheet

Name: .....  
Folder Number: .....  
Date of Birth: .....

Done by: .....

Date:.....

Evaluation	Score			Started 24hr KMC	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
	0	1	2								
Positioning and latching baby onto breast	Always needs assistance	Occasionally needs assistance	No assistance needed								
Production of mother's milk	Expresses 0 - 10 mls breastmilk	Expresses 10 - 20 mls breastmilk	Expresses 20 - 30 mls breastmilk								
Confidence in handling baby i.e. feeding, bathing, changing	Always needs assistance	Occasionally needs assistance	No assistance needed								
Confidence in caring for baby at home	Does not feel sure or able	Feels slightly unsure and unable	Feels confident								
Socio-economic support	No help or support	Occasional help or support	Good support system								
Baby's weight gain per day	0 - 10 g	10 - 20 g	20 - 30 g								
Baby's ability to suckle on the breast	Gets tired very quickly	Gets tired infrequently	Takes all feeds well								
Knowledge of KMC	No knowledge	Some knowledge	Knowledgeable								
Confidence in administering vitamin and iron drops	No confidence	Some confidence	Fully confident								
Acceptance and application of KMC	Does not accept or apply KMC	Partly accepts and applies KMC	Fully accepts and applies KMC method								

**Discharge if baby and mother score 20 and baby's weight is at least 1500g**

Appendix 3: Data collection A: KMC discharge

*Data Sheet 1: KMC discharge details*

**Study code:**

**Baby's details:**

Date of birth		(dd/mm/yyyy)
Sex		(male or female)
Birth gestational age		(in weeks)
Birth weight		(in grams)
Birth head circumference		(in centimetres)
Birth length		(in centimetres)
Weight: KMC admission		(in grams)
Duration in KMC		(in days)
Weight: KMC discharge		(in grams)
Feed at KMC discharge		(breast or formula)
FM 85 supplied at discharge		(yes or no)
KMC score at discharge		(value over value)

**Mother's details:**

Mother's age:

Mother's HIV status:

Mother's race:

Booked: 0-19w ( ) 20-40w ( ) Unbooked ( )



*Hospital admission details*

Study code:

Date of admission (dd/mm/yyyy):

Chronological age at admission (months):

Weight on admission (grams):

Haemoglobin on admission (g/dl):

Feed on admission (breast/formula/both):

Admission to ICU (yes or no):

Admission to general ward (yes or no):

Admission to short-stay ward (yes or no):

Date of discharge (dd/mm/yyyy):

Discharge diagnosis (on discharge letter):

Appendix 6: Ethics letter



**FHS017: Annual Progress Report / Renewal**

**Record Reviews/Audits/Collection of Biological Specimens/Repositories/Databases/Registries**

HREC office use only (FWA00001637; IRB00001938)			
This serves as notification of annual approval, including any documentation described below.			
<input checked="" type="checkbox"/> Approved	Annual progress report	Approved until/next renewal date	30/11/2019
<input type="checkbox"/> Not approved	See attached comments		
Signature Chairperson of the HREC		Date Signed	28/11/2018

Principal Investigator to complete the following: *Thank you for devoting time*

**1. Protocol information**

Date (when submitting this form)	17 <sup>th</sup> October 2018		
HREC REF Number	298/2015	Current Ethics Approval was granted until	30/05/2018
Protocol title	Outcomes of neonates discharged early from George Hospital		
Principal Investigator	Dr Natasha Rhoda		
Department / Office Internal Mail Address	Neonatal Department, H-floor Old Main Building, GSH		
1.1 Does this protocol receive US Federal funding?		<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No

**2. Protocol status (tick ✓)**

<input type="checkbox"/>	Research-related activities are ongoing
<input checked="" type="checkbox"/>	Data collection is complete, data analysis only
Please indicate (in the block below) the titles and HREC reference numbers of any projects currently making use of the Database/registry/repository.	

**3. Protocol summary**

Total number of records or specimens collected, reviewed or stored since the original approval	
Total number of records or specimens collected, reviewed or stored since last progress report	52
Have any research-related outputs (e.g. publications, abstracts, conference presentations) resulted from this research? If yes, please list and attach with this report.	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

**4. Signature**

Signature of PI		Date	17/10/2018
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