

generated the largest mean net benefit for perinatal outcomes. For low risk nulliparas the home was the most economical setting, but was associated with significant increases in adverse perinatal outcomes. When maternal outcomes were considered, the home was the optimal birth setting for both multiparas and nulliparas across all thresholds of cost-effectiveness. The study assessed only direct costs to the NHS, and adjusted for confounding factors which included: maternal age, parity, ethnicity, fluency in English, marital status, BMI, socio-economic status, and gestational age at birth.

B) Henderson J, Petrou S. Economic implications of home births and birth centers: A structured review. *Birth* 2008;35(2):136-146.

C) Anderson RE, Anderson DA. The cost-effectiveness of home birth. *J Nurse Midwifery* 1999;44(1):30-35.

III: Legal

A) Dimond B. Is there a legal right to a home confinement? *Br J Midwifery* 2000;8(5):316-9.

B) Hafner-Eaton C, Pearce LK. Birth choices, the law, and medicine: Balancing individual freedoms and protection of the public's health. *J Health Polit Policy Law* 1994;19:813-35.

IV: Ethics

A) De Vries R, Buitendijk S. Science, safety and place of birth: lessons from the Netherlands. *European Obstet and Gynaecol Suppl* 2012;(1):13-17.

B) Plante L. Obstetric Ethics: An essential dimension of planned home birth. *Obstet & Gynecol* 2011; 118; Issue 2, Part 1: p. 357; doi: 10.1097/AOG.0b013e31822678ed.

C) Walsh DJ. Childbirth embodiment: problematic aspects of current understandings. *Sociol Health Ill* 2010;32(3):486-501.

D) Torres J, De Vries RG. Birthing ethics: What mothers, families, childbirth educators, nurses, and physicians should know about the ethics of childbirth. *Perinat Educ* 2009;18(1):12-24.

E) Kluka R, Kuppermann, M, Little M, Drapkin Lyerly A, Mitchell L, Armstrong, EM, Harris L. Finding Autonomy in Birth. *Bioethics* 2009; 23(1): 1-8.

F) Bell AF. Nurse-Midwife and scientist: Stuck in the middle? *J Obstet Gynecol Neonatal Nursing* 2007;36.

F) Bell AF. Nurse-Midwife and scientist: Stuck in the mid-

V: Available After Press

A) Vedam S, Stoll K, Schummers L, Rogers J, Paine LL. Home birth in North America: Attitudes and practice of American Certified Nurse-Midwives and Canadian Registered Midwives. *Journal of Midwifery & Women's Health*, 2013, in press.

B) MacDorman MF, Declercq E, Mathews TJ. Recent trends in out-of-hospital births in the United States. *Journal of Midwifery & Women's Health*, 2013, in press.

C) Minkoff H, Ecker J. A reconsideration of home birth in the United States. *J of Clinical Ethics* 2013; 24(3):207-214.

D) De Vries RG, Paruchuri Y, Lorenz K, Vedam S. Moral science: Ethical argument and the production of knowledge about place of birth. *J of Clinical Ethics* 2013; 24(3):225-238.

E) Wendland C. Exceptional deliveries: Home births as ethical anomalies in American obstetrics. *J of Clinical Ethics* 2013; 24(3):253-265.

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HOME BIRTH:

An annotated guide to the literature ©

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BACKGROUND

This bibliography is offered as a resource for clinicians, researchers, educators and policy makers, who must, within their own context for work, assess the quality of the available evidence on planned home birth. This may be for the purpose of clinical decision making or policy development in response to the international debate on safety, access, ethics, autonomy, or resource allocation with respect to birth place.

This document was originally developed in 1997 for the primary author's personal use in her clinical and academic work. Over time updated versions (2002, 2004, 2007, 2010) informed the development of clinical practice guidelines for various North American maternity professional associations, and served as a resource in midwifery, medical, and nursing educational institutions. As the requests and self-generated distribution of the document expanded, it became clear that a more comprehensive, formalized approach to updating the literature search and reporting results was necessary. In 2011, three co-authors and external reviewers were recruited, and a strategy for annual updates was formulated. To facilitate continued access by those readers who regularly utilize it, the authors decided to self-publish, in both electronic and print formats, and provide open access to the bibliography.

METHODS

Search Strategy

Papers were identified through a comprehensive search of the following databases: EBSCO (Academic Search Complete, Medline & CINAHL), PubMed, and Cochrane, along with citation snowballing, and consultations with content experts and key informants. We included articles that were published in English between 1990-2013. The most recent search (August 2012-September 2013) identified 182 articles for assessment, and resulted in the addition of 13 new citations (see diagram on page 2).

The following search terms were applied: "home birth" or "home + childbirth" and "safety", "risk assessment", "transfer criteria", "outcomes", "screening", "satisfaction", "demand", "preference", and "perception".

SECTIONS A-B

Original studies of outcomes from planned home births in high resource countries were selected for inclusion. Studies describing data from developing nations were excluded because they did not meet the definition of planned home birth used for this review, which specifies access to qualified attendants and the ability to transfer to a hospital when necessary.

Criteria for Assessment

Studies were assessed for appropriate application of analytic tools (statistics), and the extent to which the conclusions were based on the reported data. Differences were resolved by discussion. Prior to publication, the bibliography was reviewed by 5 external reviewers with expertise in perinatal epidemiology, statistics, and research related to midwifery, obstetrics, bioethics, and health care delivery.

CONTENTS

Within each section papers are grouped according to study design and level of evidence, and presented in descending order by most recent publication date.

Section A – Best available studies on planned home birth and maternal fetal outcomes.

Section B – Studies exhibiting problems with the design, analysis or reporting.

Section C – Articles providing critical appraisal of original studies and meta-analyses on planned home birth and maternal fetal outcomes.

Section D – Evaluations of women's choice and satisfaction with home birth.

Section E – A reference list of citations on provider attitudes towards home birth.

Section F – A reference list of citations on policy, economic, legal, and ethical issues related to home birth.

This is an open source document

METHODS BY SECTION

SECTIONS A—B

Criteria for Assessment

Included papers were independently appraised by three authors according to the algorithm to assess the quality of home birth research outlined by Vedam¹.

¹Vedam (2003) *Home versus hospital birth: questioning the quality of the evidence on safety. Birth, 30(1), 57-63.*

Study design should:

- Distinguish between planned home births and unplanned out-of-hospital births
- Discriminate data from different types of providers
- Provide relevant and consistent inclusion criteria for study subjects across comparison groups
- Adjust for differences in selection criteria for home birth and perinatal management
- Control for differences in transfer criteria and method
- Define terms, such as mortality and morbidity
- Select relevant and consistent outcome measures.

Analysis and discussion should examine the impact of:

- Lack of randomization
- Small and homogeneous sample sizes
- Retrospective and incomplete data in birth records
- Differences among community standards of care and/or region specific policies and protocols.

SECTIONS C-F

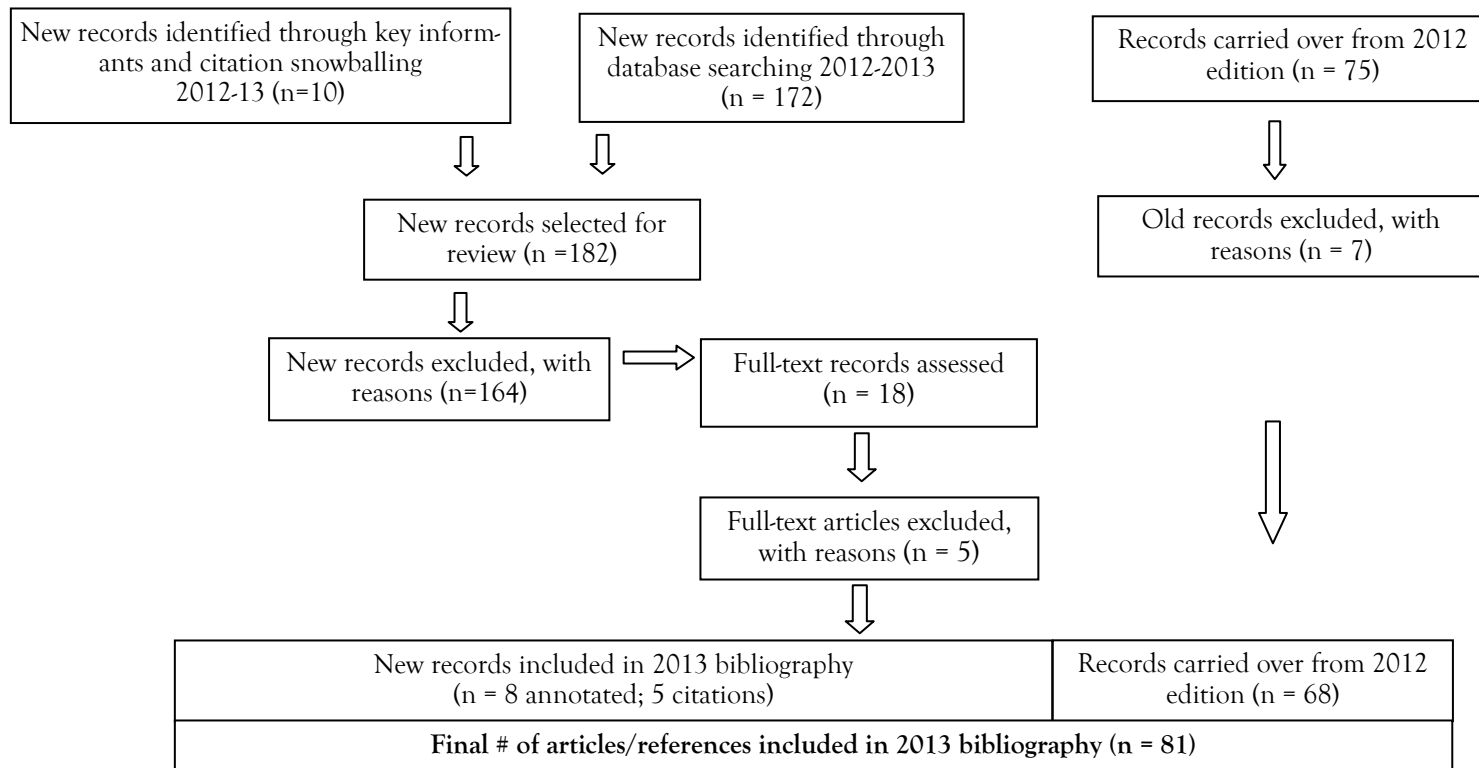
Section C describes articles that provide detailed appraisals of studies that are included in Section B.

Section D presents articles that were reviewed and selected by the authors for abstraction or listing if they describe original research, analyzed data from direct patient interviews, focus groups or surveys, and evaluated outcomes related to women's experience, perception, psycho-social effects or choice with respect to birth place. Publications prior to 2010 were not annotated.

Papers in **Sections E-F** were selected for inclusion if they provide an evidence-based discourse analysis or commentary and have the potential to enhance the reader's understanding of key legal, policy, economic, and ethical issues, and innovative solutions to controversial topics related to home birth. Authorship by academic and maternity professional experts on birth place was a priority for inclusion.

ACKNOWLEDGEMENTS

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SELECTED STUDIES ON PATIENT CHOICE & SATISFACTION

SECTION F: LEGAL, POLICY, ETHICAL & ECONOMIC CONTEXT

I: Policy

A) Vedam S. In search of a common agenda for planned home birth in the United States. *J Perinatal Education, 2012;21(2):67.*

B) Dahlen H, Schmied V, Tracy, SK, Jackson M, Cummings J, Priddis H. Home birth and the National Australian Maternity Services Review: Too hot to handle? *Women and Birth 2010;24(4):148-155.*

C) O'Brien-Pallas L, Baumann A, Donner G, Murphy G, Lochhaas-Gerlach J, Luba M. Forecasting models for human resources in health care. *J Advanced Midwifery 2001;33(1):120-129.*

D) Campbell R, MacFarlane A. Where to be born? The debate and the evidence. 2nd ed. *Oxford: National Perinatal Epidemiology Unit, 1994.*

II: Cost Effectiveness

A) Schroeder E, Petrou E, Patel, N, Hollowell J, Puddicombe D, Redshaw M, Brocklehurst P. Cost effectiveness of alternative planned places of birth in woman at low risk of complications: Evidence from the Birthplace in England national prospective cohort study. *BMJ 2012;344:e2292.*

This is a cost-effectiveness analysis, using data from the Birthplace in England national prospective cohort study. Of the total women recruited (n = 79, 774) only low-risk women at the beginning of labour were included in the analysis (n = 64,538). Costs associated with birth at home, in freestanding midwifery units, and alongside midwifery units were compared to costs incurred in obstetric units per birth. Cost estimates included overhead, midwifery staffing costs, and costs associated with homebirth resources, transfers, procedures after transfers and during labour care, birth related costs, cost of postnatal care, and admissions to higher care for the mother and/or baby. Unadjusted mean costs for these birth settings were as follows: home: £1066 (€1274, \$1701), freestanding midwifery units: £1435 (€1715, \$2290), alongside midwifery units: £1461 (€1747, \$2332) and obstetric units: £1631 (€1950, \$2603). Unit overheads and staffing costs primarily accounted for the higher cost of care in the obstetric units. In addition, the authors analyzed the following outcomes: incremental cost per 1) adverse perinatal outcome avoided, 2) adverse maternal morbidity avoided, and 3) additional normal birth achieved. For low-risk multiparous women, a home birth

SECTION E: STUDIES OF PROVIDER ATTITUDES & EXPERIENCES

A) Vedam S, Schummers L, Stoll K, Rogers J, Klein M, Fairbrother N, Dharamsi S, Liston R, Kaczorowski J. The Canadian Birth Place Study: Describing maternity care practice and providers' exposure to home birth. *Midwifery, 2012, 28(5).*

B) Freeze R. Attitudes towards home birth in the USA. *Expert Rev. Obstet Gynecol 2010;5(3):283-299.*

C) Vedam S, Stoll K, Aaker J, White S, Schummers L. Nurse-Midwives experiences with planned home birth: impact on attitudes and practice. *Birth 2009, 34(4):274.*

D) Klein MC et al. The attitudes of Canadian maternity care practitioners towards labour and birth: Many differences but important similarities. *JOGC 2009;(9):827-840.*

SECTION D: SELECTED STUDIES ON PATIENT CHOICE & SATISFACTION

communication, and a deep mistrust of NHS by some women can lead to a delay in care and poorer outcomes.

F) Hendrix M, Pavlova M, Nieuwenhuijze MJ, Severens JL, Nijhuis JG. Differences in preferences for obstetric care between nulliparae and their partners in the Netherlands: A discrete-choice experiment. *J Psychosom Obstet Gynaecol.* 2010 Dec;31(4):243-51. PubMed PMID:21067473. A prospective cohort study to examine the differences between low-risk pregnant women and their partners' preferences regarding obstetric care and place of birth and the extent to which these preferences are influenced by obstetric care and socio-economic factors. The study employed a method of "discrete choice" to assess preference. Data were collected at 32 weeks from 321 pregnant women and 212 of their partners. This study found that overall women prefer to be assisted by a midwife during birth and they also prefer to give birth in a home-like setting. Women also place importance on having influence over the decision making process and the possibility of pain relief (though the study does not specify what kind of pain relief). Their partners' preferences were similar; high value was placed on a midwifery assisted birth in a home-like setting, and control over decision-making. Partners had a preference for no out-of-pocket payments and a higher preference for access to pain relief.

G) Hildingsson I, Rådestad I, Lindgren H. Birth preference that deviate from the norm in Sweden: Planned home birth versus planned cesarean section. *Birth* 2010;37(4):288-95. Descriptive and comparative study using data from questionnaires of women who had a planned home birth (n=671) and women who had an elective caesarean section (n=126) between 1997 and 2008. In Sweden, the current medical context neither promotes home birth nor elective caesarean section. The study found significant socioeconomic differences between the two groups of women. Compared to women who chose an elective caesarean, women who chose planned home birth were more educated, had a lower BMI, were less likely to smoke, felt less threat to baby's life during the birth, felt more in control, and were more satisfied with their overall birth experience. Women in the home birth group reported a higher intensity of pain, but a more positive experience of that pain than women who gave birth via caesarean.

H) Lindgren H, Erlandsson K. Women's Experiences of empowerment in a planned home birth: A Swedish population-based study. *Birth* 2010;37(4):309-17. Descriptive study using questionnaires of women who had one or more planned home births between 1992 and 2005 (n=735). Birth stories were analyzed using content analysis and descriptive statistics. Women who birthed at home felt empowered by their environment and

and the people who supported them (midwives, partners, family). Birth stories rarely mentioned pain or suffering and stressed the importance of an undisturbed space and sense of control. Surveys highlighted the importance of support, guidance, and trust in their attendants to feel safe. Feeling disempowered was related to a poor choice of attendants and the absence of partner support. The response rate of the study was 99% (70% for the birth story portion of the questionnaire). Limitations: small scale study might not be generalizable to general Swedish population or international context.

I) Lindgren HE, Radestad IJ, Christensson K, Wally-Bystrom K, Hildingsson IM. Perceptions of risk and risk management among 735 women who opted for a home birth. *Midwifery* 2010;26(2):163-72. Using data from a national survey of all women who birthed at home in Sweden between 1992 and 2005, this study aims to describe women's perceptions of risk and risk management related to childbirth. Categories of perceived risk related to hospital and home births emerged. Perceived risks of hospital births included loss of autonomy, impersonal care, and subjection to interventions. Perceived risks of home birth centered around difficulty accessing emergency care in a worst-case scenario. The study found that women avoided discussing risks with care providers (other than their homebirth midwife) as a strategy to manage perceived risks.

Other Relevant Articles

J) de Jonge A, Baron R, Westerneng M, Twisk J, Hutton EK. Perinatal mortality rate in the Netherlands compared to other European countries: A secondary analysis of Euro-PERISTAT data. *Midwifery* (2013), 29 (8): 1011-1018.

K) Hoang H, Le Q, Kilpatrick S, Jona M, Fernando N. The commonalities and differences in health professionals' views on home birth in Tasmania, Australia: A qualitative study. *Women & Birth.* 2013 Mar; 26 (1): 55-9.

L) Jackson M, Dahlen, H, Schmied V. Birthing outside the system: Perceptions of risk amongst Australian women who have freebirths and high risk homebirths. *Midwifery* 2012;28(5):561-567.

M) Murray-Davis B, McNiven P, McDonald H, Malott A, Elarar L, Hutton E. Why home birth? A qualitative study exploring women's decision making about place of birth in two Canadian provinces. *Midwifery.* 2012 Oct; 28(5): 576-81.

N) van Haaren-ten Haken T, Hendrix M, Nieuwenhuijze M, Budé L, de Vries R, Nijhuis J. Preferred place of birth: Characteristics and motives of low-risk nulliparous women in the Netherlands. *Midwifery* 2012 Oct; 28 (5): 609-18.

O) Laurel Merg, A, Carmoney, P. Phenomenological experiences: homebirth after hospital birth. *International Journal of Childbirth Education.* 2012 Oct; 27 (4): 70-5

SECTION A: BEST AVAILABLE STUDIES GROUPED BY DESIGN & LEVEL OF EVIDENCE

I: Meta-Analyses & Systematic Reviews

A) Olsen O, Clausen, J. Planned hospital birth versus planned home birth. *Cochrane Database of Systematic Reviews.* September 12, 2012. An updated systematic review of randomized controlled trials (RCTs) comparing planned home births to planned hospital births among women with uncomplicated pregnancies. The selection criteria were rigorous; only one trial (n=11) met the inclusion criteria. The authors report a continued dearth of evidence from RCTs about the safety of home compared to hospital birth. Authors also conclude that evidence from increasingly well-designed observational studies suggests that low-risk women who plan a home birth experience significantly fewer interventions and complications than low-risk women who deliver in hospital. They provide a detailed discourse analysis of differing approaches to risk assessment, including the ethical application of clinically meaningful evidence, and the interaction of model of care with access to choice of birth place. They recommend that all countries facilitate evidence-based integration of home birth services into the health care system and inform all low-risk women of the option of planned home birth.

B) Leslie MS, Romano A. Appendix: Birth can safely take place at home and in birthing centers. *J Perinat Educ* 2007;16 (Suppl 1):81S-88S.16. A systematic review of home birth and birth center safety studies. The authors followed standard systematic review methods, including reporting levels of evidence, disclosure of inclusion and exclusion criteria and search strategies (detailed in Methods: The Coalition for Improving Maternity Services by Goer: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2409127/>). Drawing on data from 9 studies, the authors compare incidence of interventions and perinatal outcomes between hospital births and home births and between hospital births and birth center births. The evidence for each outcome is graded for quality, quantity, and consistency. This review reported that out-of-hospital births had similar perinatal outcomes to hospital births and fewer interventions.

C) Olsen O. Meta-analysis of the safety of home birth. *Birth* 1997 Mar;24(1):4-13. Meta-analysis of observational, comparative, original studies that met criteria for rigorous methodology and investigated differences in perinatal mortality and morbidity between planned home births and planned hospital births. Multivariate statistical analysis controlled for obstetrical background and perinatal factors. Analysis revealed no statistical difference in mortality between planned home and planned hospital birth and the confidence interval did not allow for extreme excess risks in any of the groups (OR=0.87, 95% CI=0.54-1.41). There were significantly fewer medical interventions, fewer severe lacerations, fewer operative births, and fewer low Apgar scores in the home birth groups.

II: Randomized Controlled Trials

A) Hendrix M, Van Horck M, Moreta D, Nieman F, Nieuwenhuijze M, Severens J, Nijhuis J. Why women do not accept randomization for place of birth: Feasibility of a RCT in the Netherlands. *BJOG* 2009;116:537-544. Based on Dowswell's findings (see II:B) the authors designed a RCT to compare home and home-like hospital births in the Netherlands for the following outcomes: interventions, satisfaction, referral to obstetricians, and costs. After 6 months only one woman had enrolled in the study, therefore the trial was discontinued for lack of feasibility. The research team then re-designed their study to investigate the reasons women declined to participate in the RCT. The four main reasons that women indicated were: 1) they had already decided where to give birth prior to learning about the study; 2) they wished to choose their own place of birth; 3) they wished to avoid delivering in the 'wrong' place for their first child; and 4) they were concerned about receiving an undesired treatment.

B) Dowswell T, Thornton JG, Hewison J, Lilford R. Should there be a trial of home versus hospital delivery in the United Kingdom? Measuring outcomes other than safety is feasible. *BMJ* 1996;312: 753-757. The authors of this small study (n=11) suggested that conducting a trial to assess birth outcomes by birth place (home versus hospital) would be feasible. Eleven subjects were recruited from a pool of 71 women who met the eligibility criteria for a home birth. This ratio suggested that a larger scale trial may be possible. The following outcomes were measured following an intention to treat analysis: mode of delivery, obstetrical interventions, complications, and infant feeding (breast versus bottle feeding). However, the authors note that mortality is not an appropriate outcome to assess the safety of home birth with a randomized controlled trial because of the extremely large number of subjects required to compare such rare outcomes.

III: Cohort and Population-Based Observational Studies – North America

A) Janssen PA, Saxell L, Page LA, Klein MC, Liston RM, Lee SK. Outcomes of planned home births with registered midwife versus planned hospital birth with midwife or physician. *CMAJ* 2009;181(6-7):377-83. A prospective, five-year long cohort study compared outcomes for low-risk women in a midwife-attended planned home birth group (n=2889), planned hospital births attended by the same midwives (n=4752), and a matched cohort of physician-attended hospital births (n=5331). In this intention-to-treat analysis, women in the planned home birth group had significantly fewer intrapartum interventions, including narcotic

SECTION A: BEST AVAILABLE STUDIES GROUPED BY DESIGN

III: Cohort and Population-Based Observational Studies – North America- cont

or epidural analgesia, augmentation or induction of labour, and assisted vaginal delivery or caesarean delivery; and significantly fewer adverse outcomes (e.g. postpartum hemorrhage, pyrexia, and 3rd or 4th degree tears). There were no significant differences between the home birth group and either comparison group with respect to a 5-minute Apgar score of less than 7, a diagnosis of asphyxia at birth, seizures, or the need for assisted ventilation beyond the first 24 hours of life.

B) Hutton E, Reitsma A, Kaufman K. **Outcomes associated with planned home and planned hospital births in low-risk women attended by midwives in Ontario, Canada, 2003-2006: A retrospective cohort study.** *Birth* 2009;36(3):180-89. Data from the Ontario Ministry of Health Midwifery Program (OMP) database to compare outcomes of all women planning home-births from 2003 and 2006 (n=6692) with a matched sample of women planning a hospital birth (n=6692). The primary outcome was a composite measure of perinatal and neonatal mortality or serious morbidity, including: stillbirth or neonatal death -27 days (excluding lethal anomalies); Apgar score of less than 4 at 5 minutes of age; neonatal resuscitation requiring both positive pressure ventilations and cardiac compressions; admission to a neonatal or pediatric intensive care unit with a length of stay greater than 4 days; or birth weight less than 2,500g. No differences were shown between groups for perinatal and neonatal composite outcome measure (2.4% vs 2.8%; relative risk [RR], 95% confidence intervals [CI]: 0.84 [0.68-1.03]). All measures of serious maternal morbidity were lower in the planned home birth group, as were rates for all interventions including caesarean section (5.2% vs 8.1%; RR [95% CI]: 0.64 [0.56,0.73]).

C) Schlenzka PF. *Safety of alternative approaches to childbirth* [Unpublished Dissertation]. Palo Alto, CA: Department of Sociology, Stanford University; 1999. Available from: <http://vbfree.org/docs/schlenzka.htm#download> In order to account for errors associated with relying solely on birth certificate data, Schlenzka merged birth certificate and hospital discharge data for California for 1989 and 1990, and isolated a cohort of nearly 816,000 low risk births by applying a comprehensive risk profile to cases. Outcomes are reported according to planned and actual birth setting. Perinatal mortality was compared with two statistical approaches: indirect standardization using only birth weight, sex, race, age, education, and insurance as risk adjusters; and logistic regression controlling for all risk factors available in the database. No differences in perinatal mortality were found across birth sites, with lower rates of obstetric interventions in out of hospital groups.

IV: Cohort & Population-Based Observational Studies – International

A) Nove A, Berrington A, Matthews Z. **Comparing the odds of postpartum haemorrhage in planned home birth against planned hospital birth: results of an observational study of over 500,000 maternities in the UK.** *BMC Pregnancy & Childbirth*. 2012, 12 (1),1-11. This observational cohort study used data from a computerized records system (SMMIS) that was used by 15 hospitals during the study period, comprising the majority of hospitals in that area. Nove et al. compared the rates of postpartum haemorrhage between women who planned a home birth and those who planned a hospital birth from 1988-2000 (n=585,291). Postpartum hemorrhage (PPH) was defined as a loss of > 1000mL of blood. Excluded were high-risk pregnancies (according to National Institute for Health and Clinical Excellence guidelines), unplanned home births, pre-term births, elective Caesareans, medical inductions, miscarriages, terminations and women who moved out of the area during care. A total of 273,872 pregnancies were included: 5,998 planned home births and 267,874 planned hospital births. Logistic regression models were adjusted for confounders. The odds of postpartum hemorrhage (PPH) were significantly higher among planned hospital births than for planned home births (2.5; 95%,CI:1.7-3.8), regardless of actual place of delivery. Strengths of the study include the large sample size, the quality of the data source, and the ascertainment of planned place of birth at the end of pregnancy. In addition, the SMMIS database contains maternal socio-demographic data that could be adjusted for during analysis. The authors acknowledge that the absence of information about PPH in a previous pregnancy is a major limitation of the study. Women with a previous PPH are more likely to hemorrhage in a subsequent pregnancy. For this reason, they might be more likely to plan a hospital birth with subsequent pregnancies, which would inflate the observed odds of PPH in the hospital group. The authors conclude that, while the overall risk of postpartum hemorrhage was low, the significant increase in odds of postpartum hemorrhage associated with hospital birth should be included in informed choice discussions around place of birth.

B) Davis D, Baddock S, Pairman S, Hunter M, Benn C, Wilson D, Dixon L, Herbison P. **Planned place of birth in New Zealand: Does it affect mode of birth and intervention rates among low-risk women?** *Birth* 2011, 38(2), 111-119.

This population-based, retrospective cohort study compared mode of delivery and selected intrapartum interventions and neonatal outcomes among low risk women who planned to deliver in the following settings: home, primary unit, secondary or tertiary hospital. Planned place of birth was noted at the start of labour. Using the New Zealand Midwifery Maternity Provider

SECTION D: SELECTED STUDIES ON PATIENT CHOICE & SATISFACTION

I: Studies of Patient Demand, Satisfaction, Autonomy & Experience

A) Jackson M, Dahlen H, Schmied V. **Birth outside the system: Perceptions of risk amongst Australian women who have freebirths and high risk homebirths** *Midwifery* 2012. Jan 31. PubMed PMID: 22300611. A qualitative study using open ended questions examined 20 Australian women over 18 years of age who chose to have an unattended home birth (freebirth) or an attended high risk home birth, despite having medically defined risk factors or care provider recommendations for a hospital birth. Of note in this study is the participants' average age (34) and level of education, where more than 70% of the women had tertiary qualifications. All were living in urban settings within 30 minutes of emergency care. 17 of 20 women were multiparous. Researchers found that the women who chose an unattended birth attributed this choice to a previous traumatic hospital birth or because of a belief that the interventions and interruptions of hospitals increase risk. The study found that women who freebirth tend to perceive risk differently, and that these women believe they are making a choice to protect their babies. For these women, birth in the hospital is less safe than birthing at home. The women in this study directly connected their experiences during labour and birth to their experience of mothering both immediately and long term. This study also aims to dispel a belief that women who freebirth are poorly informed and undereducated because study participants were more educated than the Australian public and had attended formalized training in obstetric emergencies and neonatal resuscitation.

B) Blix E. **Avoiding disturbance: Midwifery practice in home birth settings in Norway.** *Midwifery* 2011;27(5):687-692. PubMed PMID: 20637533. Qualitative study of 12 Norwegian midwives to examine how midwifery care promotes and supports normal labour and birth and why home births are associated with lower rates of interventions compared with hospital births. The study highlights the connection between the calm, undisturbed environment available to women at home with fewer interventions in childbirth. Strengths of this study include its detailed discussion of how the home and its particular setting might augment "normal birth".

C) Catling-Paull C, Dahlen H, Homer CS. **Multiparous women's confidence to have a publicly-funded homebirth: A qualitative study.** *Women Birth*. 2011 Sep;24(3):122-8. Epub 2010 Oct 12. Erratum in: *Women Birth*. 2011 Dec;24(4):180. A qualitative study of 10 multiparous Australian women who chose a publicly-funded, planned home birth with the St. George Hospital Homebirth Program. The study found that multiparous women who have had at least one previous nor-

multiparous women who have had at least one previous normal birth feel a strong confidence to birth at home. The women cite hospital back up, trust in the skill of their midwives, and their own personal strength as sources of confidence to have a normal birth at home. None of the women felt that they were at increased risk of birth complications because of planning a home birth.

D) Stramrood CA, Paarlberg KM, Huis In 't Veld EM, Berger LW, Vingerhoets AJ, Schultz WC, van Pampus MG. **Posttraumatic stress following childbirth in homelike and hospital settings.** *J Psychosom Obstet Gynaecol*. 2011 Jun;32(2):88-97. PubMed PMID: 21557681. A qualitative cross-sectional study of 428 Dutch women who completed surveys 2-6 months postpartum to compare the rate of post-traumatic stress disorder (PTSD) in home-like settings to the hospital. The study found that women who had home deliveries had the lowest rate of PTSD symptoms compared to women who were either transferred to care in the hospital during labour but who remained in primary care (under the care of a midwife) or to those who gave birth in secondary or tertiary care (either under the care of an OB/GYN or at a university referral centre). Home deliveries also had a lower rate of PTSD compared to those with pregnancy or delivery complications at the hospital. However, no difference was found in the scores between women who delivered in primary care with a midwife either at home (planned home birth) or the hospital (planned hospital birth). The study also found a strong association between the development of PTSD and the reported intensity of labour pain, leading researchers to speculate whether there is a difference between women requesting pain medication and the role this might play in the development of PTSD for certain women.

E) Symon A, Winter C, Donnan PT, Kirkham M. **Examining autonomy's boundaries: A follow-up review of perinatal mortality cases in UK independent midwifery.** *Birth* 2010 Dec;37(4):280-7. A qualitative review using thematic analysis and grounded theory to examine the case notes of midwives involved in 15 instances of perinatal mortality at home births in the UK between 2002 and 2005. Researchers noted that in 13 of the 15 cases significant antenatal risk factors were present (4 sets of twins, 3 VBAC, 3 singleton breech, 5 maternal illness, one grande multipara, and one older primigravida of small stature with a small baby) and 8 of 15 women had declined some, or all, routine antenatal screening. Strengths of this study are that it provides a detailed examination into perinatal deaths at home and examines why some women might choose high-risk home births even after antenatal risk factors have been identified or care providers have encouraged a transfer to the hospital. It illustrates the challenge independent midwives face to balance informed consent/refusal with providing care. This study also examines how issues regarding transfer of care, inter-professional

SECTION C: EVALUATING THE QUALITY OF HOME BIRTH RESEARCH

I: Critical Appraisal of Studies

A) Nove A, Berrington A, Matthews Z. The methodological challenges of attempting to compare the safety of home and hospital birth in terms of the risk of perinatal death. *Midwifery* 2012, 28(5), 619-626.

Nove et al. provide a comprehensive discussion of methodological challenges that researcher encounter when comparing perinatal outcomes across birth settings. The following methodological challenges were identified and ways to overcome these challenges discussed: 1) whether to include high-risk pregnancies in the comparative analysis and how to define high risk, 2) how intrapartum transfers should be classified, 3) whether intended place of birth is recorded accurately, 4) how to avoid bias due to deaths which would have occurred regardless of place of birth, 5) the rarity of perinatal death and planned home birth and its implications for analysis, 6) separate analyses for different types of hospital birth (e.g. midwife versus obstetrician led hospital units), 7) controlling for confounders, such as parity and obstetric history, 8) differentiating between confounders and mediators (i.e. variables that might be associated with birth setting and a higher likelihood of adverse perinatal outcomes; e.g. Cesarean section), 9) whether the overall results mask any sub-group variations (e.g. are adverse outcomes more common for a subgroup of women who plan a home birth?) and 10) problems with pooling data from different countries (i.e., home birth outcomes might be contingent on factors that vary across countries, such as geography, access to qualified midwives and the way maternity care is organized). The authors compared ten studies in terms of essential and desirable methodological attributes outlined in the paper.

B) Michal CA, Janssen PA, Vedam S, Hutton EK, de Jonge A. Planned home vs hospital birth: A meta-analysis gone wrong. [Internet]. *Medscape: Obstetrics and Gynecology*, 2011; Available at <http://www.medscape.com/viewarticle/739987>

For the full detailed analysis of the findings and inherent problems presented by the 2010 Wax meta-analysis (see Section B.I.A) readers may wish to access this article. The authors include principal investigators for three of the original studies included in the meta-analysis. Each of the significant numerical, statistical, and logical errors, errors in definitions, errors in inclusion/exclusion of data for analysis, and mistaken conflation of association with causation, are delineated. Methodological problems with study design, inclusion and exclusion criteria, interpretation and the use of a faulty computational tool are delineated.

C) Gyte G, Newburn M, Macfarlane A. Critique of a meta-analysis by Wax and colleagues which has claimed that there is a three-times greater risk of neonatal death among babies without congenital anomalies planned to be born at home [Internet]. *NCT 2010* [cited 2011 March 1]:1-8. Available at: <http://www.scribd.com/doc/34065092/Critique-of-a-meta-analysis-by-Wax>. Detailed review of Wax's meta-analysis outlining a range of data reporting errors and methodological weaknesses, which include: insufficient details about choice of included and excluded studies and lack of clarity or consistency about the definition of neonatal mortality, including whether stillbirth data were included. Wax misclassified singleton newborns with a gestational age of 34 wks who were born after transfer from home as 'planned' home birth if birth certificate indicated delivery was initially attempted at home. Gyte argues that the authors' conclusion that "less medication intervention during planned home birth is associated with a tripling of neonatal mortality rate" is unsupported by the poor quality of their data and that the article should not have been accepted by AJOG.

D) Keirse MJ. Home birth: Gone away, gone astray, and here to stay. *Birth* 2010;37(4):341-46. Commentary on Wax JR et al. *Maternal and newborn outcomes in a planned home birth vs. planned hospital birth*. Keirse highlights the weakness and results of Wax et al.'s meta-analysis of home birth. Keirse examines which studies Wax included and excluded from his meta-analysis in order to conclude that home birth is related to a 2.6 increase of maternal mortality and a tripling of neonatal mortality. Keirse also cites statistical or reporting errors of data from the Wax study that contribute to results. Wax's meta-analysis refers only to planned home birth but includes statistics from U.S. birth certificates that do not differentiate between planned and unplanned home birth, and this inclusion significantly contributes to the higher rate of neonatal mortality. Although useful when randomized control trials are unavailable, meta-analyses need to consider the impact culture, geography, and health care systems have on data when consolidating smaller studies.

E) Vedam S. Home versus hospital birth: Questioning the quality of the evidence on safety. *Birth* 2003; 30(1):57-63. Detailed review of Pang's study, including well acknowledged errors in methodology and definitions. Outlines flaws associated with using birth certificate data to study outcomes of planned home births and includes an algorithm for evaluating quality of studies on home birth safety. Studies must adhere the following study design criteria in order to avoid errors and bias: 1) differentiate between planned and unplanned home births, 2) accurately discriminate between provider types, 3) use consistent inclusion criteria across groups, 4) adjust for home birth selection criteria, 5) control for transfer criteria, and 6) select consistent outcome measures. Compares the methodology used by Pang with the methodology of other commonly cited home birth studies, with examples of reliable and unreliable designs.

SECTION A: BEST AVAILABLE STUDIES GROUPED BY DESIGN

Organisation (MMPO) database, the study population was drawn from all births in this database from 2006-2007 (n=39,677, or 32% of total births in NZ). Of these, 16,453 (41.47%) met the low risk inclusion criteria (no medical condition recorded in their past history, and no consultation with another practitioner). This stringent approach likely excluded low-risk women who planned to deliver in all settings. Relative risks were estimated using multinomial logistic regression. Relative risks were adjusted for maternal age, parity, ethnicity, and smoking. Women who planned home births were older and more parous, compared to women who planned to give birth in other settings. Women who planned to give birth in secondary and tertiary hospitals had a higher risk of cesarean section, assisted modes of birth, and intrapartum interventions compared to women planning to give birth at home and in primary units. Women planning to give birth in a tertiary unit had a significantly increased risk (RR:4.62; 95% CI: 3.66-5.84) of emergency cesarean section compared to women planning to give birth in a primary unit. Newborns of women who planned to give birth in secondary and tertiary hospitals also had a higher risk of being admitted to a neonatal intensive care unit (RR:1.40; 95% CI: 1.05-1.87; RR: 1.78, 95% CI: 1.31-2.42) compared to women planning to give birth in a primary unit. This study is able to present the more intuitive and relevant risks ratios (rather than odds ratios) due to using multinomial logistic regression. However, the methods section provides little detail regarding the data analysis plan, and requires some extrapolation and statistical expertise to properly interpret. The sample size was too small to compare very rare outcomes and it was not possible to establish whether the study sample was representative of the population of low risk parturients in NZ, which limits the generalizability of findings.

C) Birthplace in England Collaborative Group. Perinatal and maternal outcomes by planned place of birth for healthy women with low risk pregnancies: the Birthplace in England national prospective cohort study. *BMJ* 2011;343:d7400. A prospective cohort study in England from April 2008-April 2010 compared perinatal and maternal outcomes and interventions by planned place of birth at the onset of care during labour (planned home birth, freestanding midwifery birth centers, alongside midwifery units and obstetric units). The study included 64,538 low-risk women with a singleton pregnancy at term. The primary study outcome was a composite index combining intrapartum stillbirth, early neonatal death, neonatal encephalopathy, meconium aspiration syndrome, and birth related injuries including brachial plexus injury, fractured humerus or clavicle. Stillbirths before onset of labour were excluded. The researchers found that the incidence of the composite outcome measure was low for the entire sample (4.3/1000 births), and there were no statistically significant

differences in the odds of the primary outcome in home, free-standing birth centers, or alongside midwifery units when compared with planned birth in obstetric units. When the sample was split into nulliparous and multiparous women, the adverse outcome measures during planned home birth were higher than for hospital birth for nulliparous, but not for multiparous women. There was no evidence of a difference in adverse outcomes for freestanding or alongside midwifery units as compared to obstetric units. For low-risk women birthing in an obstetric unit, the odds of receiving augmentation, epidural, spinal analgesia, general anesthesia, vacuum or forceps delivery, caesarean section, episiotomy, and active management of third stage were higher than all other settings. Given the rarity of events for any of the included perinatal outcomes, and as some of them typically appear as co-morbidities, a composite index might inflate some differences in outcomes as attributable to place of birth. It is unclear how some of the items selected for inclusion in the composite index relate specifically to place of birth causality rather than skill of provider.

D) van der Kooy J, Peoran J, de Graff JP, Birnie E, Denktas S, Steegers EAP, Gouke JB. Planned home compared with planned hospital births in the Netherlands: intrapartum and early neonatal death in low-risk pregnancies. *Obstet Gynecol* 2011;118:1037-46. In this retrospective cohort study, records of 679,952 low risk women from the Netherlands Perinatal Registry (2000-2007) were analyzed to compare intrapartum and early neonatal mortality rates (0-7 days after birth) of planned home versus planned hospital births attended by midwives. Outcomes for a third group of women, for which the planned place of birth was unknown, were also reported. The hospital cohort was used as the comparison group in all analyses. The authors used two methods for analyzing data: a 'per protocol analysis', or 'perfect guideline approach', which examined outcomes from only those low risk women who were eligible for planned home birth according to Dutch guidelines (n= 602,331), and a 'natural prospective approach', which looked at outcomes for all women who planned a home birth under the care of midwives (n= 679,952). The per protocol analysis excluded midwifery clients with one or more of the following conditions: intrauterine death, prolonged rupture of membranes, gestational ages < 37 weeks and > 41 weeks. Results revealed a significantly decreased risk of intrapartum and early neonatal mortality in the home birth cohort, using the natural prospective approach (RR: 0.80; 95% CI: 0.71-0.91). When the authors calculated RRs using the perfect guideline approach, and adjusted ORs using either approach, they found no increased risk/odds of intrapartum and early neonatal death in the home versus the hospital setting. These findings align with those reported by De Jong et al. (2009) using a similar cohort of women (2000-2006). A problematic secondary analysis of data was also reported (See review: Section B, III, A).

SECTION A: BEST AVAILABLE STUDIES GROUPED BY DESIGN

E) de Jonge A, van der Goes B, Ravelli A, Amelink-Verburga M, Mol B, Nijhuis J, Bennebroek Gravenhorst J, Buitendijk. **Perinatal mortality and morbidity in a nationwide cohort of 529,688 low-risk planned home and hospital births.** *BJOG* 2009; DOI: 10.1111/j.1471-0528.2009.02175.x. Retrospective cohort study of 529,688 low-risk women in the Netherlands who were in primary midwife-led care at labour onset. This study compared perinatal mortality and morbidity between planned home births (321,307; 60.7%), planned hospital births (163,261; 30.8%), and unknown place of birth (45,120; 8.5%), using the national perinatal and neonatal registration data from 2000-2006. The following differences between groups were controlled for using logistic regression: parity, gestational age, maternal age, ethnic background, and socio-economic status. Inclusion criteria ensured the subjects were strictly low-risk. The main outcomes were intrapartum death, intrapartum and neonatal death within 24 hours and 7 days after birth, and admission to a neonatal intensive care unit. No significant differences were found between planned home and planned hospital births for any of the main outcomes. The authors concluded that planned home birth in a low-risk population is not associated with higher perinatal mortality rates or an increased risk of admission to a NICU compared to planned hospital birth.

F) Kennare R, Keirse MJ, Tucker GR, Chan AC. **Planned home and hospital births in South Australia 1991-2006: differences in outcomes.** *Med J Aust* 2009;192(2):76-80. Retrospective population based-study of all births and perinatal deaths from 1991-2006 in South Australia; 1141 planned home births and 297,192 hospital births were included. Planned home birth was defined as any birth that was intended to occur at home at the time of antenatal booking; 30.6% of the planned home births occurred in hospital. Perinatal outcomes studied were: perinatal death, intrapartum death, intrapartum asphyxiation, Apgar of <7 at 5 minutes, and use of pediatric or specialized neonatal care. Post-term pregnancy (≥ 42 weeks) was more common in the home birth group; women in the home birth group had lower rates of caesarean delivery (aOR= .27), instrumental delivery (aOR= .33), and episiotomy (aOR= .14). Perinatal mortality rates (including intrapartum fetal death and stillbirth) were similar between home and hospital groups (7.9 vs. 8.2 per 1000). There was no statistical difference in perinatal mortality between the home and hospital group (4.5 vs. 6.7 per 1000 respectively). Intrapartum fetal death was higher in the home birth group (1.8 vs .8 per 1000), though the absolute numbers were small. Of the 9 perinatal deaths in the home birth group, 3 might have been avoided with a different choice of care provider, location of birth, or timing of transfer to hospital (1 postterm pregnancy, 1 twin pregnancy, and 1 pregnancy inadequate fetal surveillance during labour).

G) Chamberlain G, Wraight A, Crowley P. **Home births: The report of the 1994 confidential enquiry of the National Birth-day Trust Fund.** *Cranforth, UK: Parthenon;1997*. Comprehensive investigation of the characteristics and outcomes of planned home births across the United Kingdom, endorsed by the Royal Colleges of Obstetricians, Midwives, and General Practitioners. A prospective study of 6044 planned home births in Great Britain compared mortality and perinatal outcomes with a low risk hospital group (n= 4724) and found no significant differences in mortality. The home birth group experienced significantly fewer medical interventions and perinatal complications. The study report is published as a book.

H) Wiegers TA, Keirse MJ, van der Zee J, Berghs GA. **Outcome of planned home and planned hospital births in low risk pregnancies: prospective study in midwifery practices in the Netherlands.** *BMJ* 1996;313(7068):1309-13. Prospective cohort study of 1836 women with low risk pregnancies (1140 planned home and 696 planned hospital births). The design controlled for provider type, parity, social, and medical and obstetric background. The authors developed a tool that assigns an overall perinatal outcome index score based on "maximal result with minimal intervention". This tool assigns scores for each of 22 intrapartum variables (indicating risk factors and intervention), 9 items on the condition of the newborn, and 5 postpartum outcomes/conditions to assign an overall perinatal outcome index. The authors point out that this tool allows researchers to evaluate factors that detract from optimal perinatal health as well as to weight each variable's clinical significance and cumulative effect. The optimality index has subsequently been adapted and validated for North American and international contexts with an evidence based rationale for the exclusion or inclusion of each variable. This study found no relationship between planned place of birth and perinatal outcomes in nulliparas when controlling for background variables (more or less favourable background); multiparas had significantly better perinatal outcomes in the home setting, regardless of background.

I) Ackermann-Liebrich U, Voegeli T, Gunter-Witt K, Kunz I, Zullig M, Schindler C, Maurer M, Zurich Study Team. **Home versus hospital deliveries: Follow up study of matched pairs for procedures and outcome.** *BMJ* 1996;313(7068):1313-18. Prospective matched cohort study of 489 planned home and 385 planned hospital births. The study design carefully attended to issues of planning status, transfer criteria, and actual place of delivery. The groups were matched according to age, parity, gynecologic and obstetric history, medical history, partner situation, social class, and nationality. The main outcome measures were need for medication and/or intrapartum intervention, duration of labor, severity of lacerations, hemorrhage, neonatal condition, and perinatal mortality. They found a lower incidence of interventions, medications, lacerations and higher Apgar scores

SECTION B: STUDIES WITH ERRORS IN DESIGN, ANALYSIS OR REPORTING

that links site of birth or planning status to the reported outcomes. Data of a large birth registry database were used and adjustment for confounders, including appropriate referrals from primary to secondary care before the onset of labour, was not possible. Given so many discrepancies from national studies, the authors find that Evers et al.'s conclusion that "the obstetric care system in the Netherlands possibly contributes to the high perinatal mortality rate" is not supportable.

E) Malloy MH. **Infant outcomes of certified nurse midwife attended home births: United States 2000 to 2004.** *J Perinatol* 2010;30(9):622-27. A retrospective cohort study using linked US birth and death certificate files from the National Center for Health Statistics from 2000-2004, to compare the safety of CNM deliveries at home to CNM deliveries in hospital (data also examined delivery outcomes of 'other' midwives in hospital and home). Malloy concludes that neonatal mortality rates of certified nurse midwives and 'other' midwives are higher in out of hospital settings (home/birthing center) compared to deliveries at the hospital attended by CNMs. Method of selection did not distinguish planned from unplanned home birth nor if hospital birth CNMs were actually in attendance at home births or solely appeared on birth certificates as the certifier of the birth having occurred. Analysis does not distinguish between "other midwife" attendant and no attendant.

F) Wax JR, Pinette MG, Cartin A, Blackstone J. **Maternal and newborn morbidity by birth facility among selected United States 2006 low-risk births.** *Am J Obstet Gynecol* 2010;202:152.e1-5. A retrospective population-based cohort study to evaluate perinatal mortality by place of birth (hospital, birth center, home) using 2006 U.S. birth certificate data from 19 states available through the CDC. Of 745,690 total births included, 733,143 occurred in hospital, 4661 in freestanding birth centers, and 7427 at home. Excluded from the study were: multiple gestations, preterm (<37 weeks); smokers, women with Type I, II, or gestational diabetes; either chronic or pregnancy induced hypertension; and prior caesarean section. The authors concluded that home births are associated with less frequent adverse perinatal outcomes (chorioamnionitis, fetal intolerance of labour, meconium staining, assisted ventilation, NICU admissions, and birth weights of <2500g), but more frequent abnormal labours, 5-minute Apgar scores of <7, and birth weight >2500g. The study does not differentiate between planned and unplanned home births, and does not provide data about home to hospital transfers.

G) Pang J, Heffelfinger J, Huang G, Benedetti T, Weiss N. **Outcomes of planned home births in Washington state: 1989-1996.** *Obstet Gynecol* 2002;100(2):253-59. Method of selection did not distinguish between planned home births, out-of-hospital births that had no attendant, or births with unknown or unnamed attendants. Premature births occurring before 37

weeks were incorrectly included in the initial analysis. A higher incidence of congenital heart disease in the home birth population could partially explain the higher neonatal mortality and would reflect a difference in populations.

III: Cohort & Population-Based Observational Studies – International

A) van der Kooy J, Peoran J, de Graff JP, Birnie E, Denktas S, Steegers EAP, Gouke JB. **Planned home compared with planned hospital births in the Netherlands: Intrapartum and early neonatal death in low-risk pregnancies.** *Am J Obstet Gynecol* 2011;118(5):1037-46.

(See review of study: Section A, IV, D.)

In addition to reporting the usual statistics (RRs and adjusted ORs) to compare perinatal outcomes across birth settings, the authors performed additional analyses, e.g. they divided the crude mortality rates of the home and hospital groups by the prevalence of the 'Big 4' (congenital anomalies, IUGR, preterm birth, Apgar < 7; these 4 conditions accounted for 85% of the neonatal mortalities in the sample) to 'obtain case mix adjustment'. The rationale for this adjustment was to remove clinical determinants of neonatal mortality, and focus on 'setting' dependent mortality. Using this approach, the authors reported up to 20% excess mortality in the home setting, leading the authors to conclude that women with certain risk factors (e.g. pregnancy duration more than 41 weeks and having an infant that is small for gestational age) can reduce their risk of intrapartum and early neonatal death by planning a hospital birth. It should be noted that the index does not allow for assessment of statistical significance (and thus more emphasis should be placed on the adjusted ORs reported in tables 2 and 3). As the authors themselves note in post-publication correspondence, "In both RCT and observational designs, post-hoc exclusion of patients or replacement of treatment allocation by the treatment actually received is not allowed under the intention-to-treat principle"; hence, at minimum the analysis and reporting of outcomes should have been limited to their "perfect guideline approach".

SECTION B: STUDIES WITH ERRORS IN DESIGN, ANALYSIS OR REPORTING

NICU, and maternal outcomes (operative vaginal delivery, induction of labour, augmentation of labour, and maternal use of antibiotics in labour). Outcomes of hospital births were compared to those from planned home births attended by CNMs and other midwives. The authors claim, incorrectly, that certified professional midwives were categorized as Certified Nurse Midwives on the 2003 revised birth certificates. Compared to hospital deliveries, planned home births attended by CNMs and other midwives were associated with increased odds of 5-minute Apgar scores of <4 (adjusted OR, 1.87; 95% CI: 1.36-2.58) and neonatal seizure (adjusted OR=3.08; 95% CI: 1.44-6.58), adjusting for parity, maternal age, race/ethnicity, education, gestational age at delivery, number of prenatal care visits, cigarette smoking during pregnancy, and medical/obstetric conditions. In a subset analysis, the authors looked at neonatal outcomes for planned home birth attended by 1) CNMs and 2) Other midwives. They found that adverse outcomes were different for CNMs and other midwives, with a non-significant decreased risk of 5-minute Apgar scores of <4 and neonatal seizures among women attended by CNMs and significant increased risks of these outcomes for women attended by Other midwives. However, the data collection fields on the current form of the US birth certificate do not provide sufficient information to allow comparisons of outcomes between providers, and do not reliably link planned and actual places of birth. Outcomes for other variables were not emphasized in the text. For example, planned home births had significantly lower risk of NICU admission (OR=0.23), and women who planned hospital births were at a higher risk for obstetric interventions, including operative vaginal delivery, induction and augmentation of labour, and maternal antibiotic use.

C) Chang JJ, Macones GA. Birth Outcomes of planned home births in Missouri: A population-based study. *Am J Perinatol.* 2011;28(7):529-536. A retrospective cohort study to compare birth outcomes across three groups: home births attended by non-CNMs (n=2155), home births attended by physicians or CNMs (n=1738) and hospital and birth center births attended by physicians or CNMs (n=853,542). Data was collected from linked Missouri live birth and fetal death files, for the years 1989 through 2005. The study sample included singleton pregnancies, delivered between 36-44 weeks gestation. Pregnancies with major fetal anomalies and breech presentation were excluded. Authors found that planned home birth by non-CNMs, physicians and CNMs was protective against selective obstetric procedures and complications such as fever, moderate to heavy meconium, and dysfunctional labour, but that planned home births attended by non-CNMs were associated with prolonged labour and fivefold increased odds of newborn seizure. Planned home births attended by all three groups (physicians, CNMs, and non-CNMs) held a higher risk of intrapartum death. There are several weaknesses in the design

and interpretation of data in this study. The subset of non-CNM attended home births was too small for meaningful analysis of rare perinatal outcomes and the authors used an unconventional definition of 'low-risk', which includes all births from gestational ages of 36-44 weeks. Further, there are multiple issues of data validity using birth record data related to identification of planned home births and type of attendant. Authors suggest the non-CNM group may include certified professional midwives but there were none in practice in Missouri at the beginning of the study period; and the CPM credential was not accepted for licensure in Missouri until 2008. Even today there are not enough Missouri based CPMs to attend the number of births indicated as attended by 'other midwives'. Prior to legislation families who delivered outside the hospital filled out their own birth certificate record. Several of those births may be misclassified unplanned accidental home births, or attended by someone without credentials. Most importantly, given the sample size and wide confidence intervals, misclassification of even a few records could skew results.

D) Evers A, Browers H, Hukkelhoven C, Nikkels P, Boon J, van Egmond-Linden A, Hillegerberg J, Snuif Y, Sterken-Hooisma S, Bruinse H, Kwee A. Perinatal mortality and severe morbidity in low- and high-risk term pregnant women in the Netherlands: A prospective study. *BMJ* 2010;341:c5639doi:10.1136/bmj.c5639. This was not a study of home birth safety but rather focused on primary and secondary care referrals. This cohort study compared the incidences of perinatal mortality and severe perinatal morbidity between low-risk term pregnancies in primary care with a midwife and high-risk secondary care with an obstetrician. The study found that infants of low risk women who started labour under primary care of a midwife had a significantly higher risk of perinatal death than infants of high risk women whose labour started in secondary care under the care of an obstetrician. While NICU admission rates did not differ between groups, infants who were referred to an obstetrician by a midwife during labour had a 3.66 times higher risk of related perinatal death. Infants of nulliparous women had a significantly higher risk of NICU admission than infants of multiparous women. The most common reason for admission was asphyxia. De Jong et al. (2010) identified several weaknesses in the study's methodology, which include: a retrospective definition of "population of risk" despite claims that the study is a prospective cohort study; all intrapartum deaths were included but not all births; and for midwives whose practices cross boundaries, deaths outside catchments were included in the study but not births, which artificially inflated the mortality rate. The neonatal mortality rates in this region are twice as high as the rates of previous national studies, which requires further investigation. In the Netherlands primary maternity care often is equated with midwifery care. Evers et al. suggest that home birth is the cause of increased perinatal morbidity, but there is no data presented

SECTION A: BEST AVAILABLE STUDIES GROUPED BY DESIGN

in the home birth group and no differences in birth weight, clinical condition, or gestational age between groups. There were no differences in mortality between groups.

V: Descriptive Studies & Registry Reports International

A) Kataoka Y, Eto H, Iida M. Outcomes of independent midwifery attended births in birth centres and home births: A retrospective cohort study in Japan. *Midwifery* 2013; 29 (8): 965-972. This descriptive study examined the perinatal and neonatal outcomes of Japanese women (n = 5477) who gave birth either at home or at a birth centre with 43 independent midwives in Tokyo between 2001-2006. Chart reviews revealed that 83.9% gave birth in birth centres and 16.1% gave birth at home. There were no cases of neonatal mortality. All women had spontaneous vaginal deliveries and there was a notably low rate of perineal trauma, with nearly 60% of women having intact perineums. While still low, the study found a higher than average rate of postpartum blood loss compared to other countries. The authors suggested that this may be due to differential classification of postpartum hemorrhage in Japan (Japanese midwives estimate blood loss by weight, not visually). Nulliparas in the birth centre group had a higher risk of blood loss (> 500ml) compared to nulliparas in the homebirth group (RR: 1.54;95%CI: 1.10-2.16); multiparas had an increased risk of blood loss > 500 ml (RR:1.28;95%CI: 1.07-1.53) and >1000 ml (RR:1.75;95%CI: 1.04 -2.82) compared to women who gave birth at home. The sample reported in this study comprises perinatal data from about half of independent midwives who practice in Tokyo and who volunteered to participate in the chart review, making the results vulnerable to self-selection bias.

B) Blix E, Huitfeldt AS, Øian P, Straume B, Kumle M. Outcomes of planned home births and planned hospital births in low-risk women in Norway between 1990 and 2007: a retrospective cohort study. *Sexual & Reproductive Healthcare* 2012; 3:147-153. This descriptive, retrospective cohort study compared the outcomes of low-risk women who planned a home birth (n=1631) to a random sample of low-risk women (n=16,310) who planned a hospital birth in Norway from 1990-2007. Planned and unplanned home births could not be differentiated prior to 1999, but registry data were used to identify a low risk hospital comparison group. Women who planned a home birth were older and experienced fewer intrapartum interventions and complications compared to women who planned a hospital birth; there were no significant differences in cesarean section rates between groups. Nulliparas in the

the home birth group had reduced risks for assisted vaginal delivery (OR 0.32; 95% CI 0.20-0.48), epidural analgesia (OR 0.21; CI 0.14-0.33) and dystocia (OR 0.40; CI 0.27-0.59). Multiparas had reduced risks for operative vaginal delivery (OR 0.26; CI 0.12-0.56), epidural analgesia (OR 0.08; CI 0.04-0.16), episiotomy (OR 0.48; CI 0.31-0.75), anal sphincter tears (OR 0.29; CI 0.12-0.70), dystocia (OR 0.10; CI 0.06-0.17) and postpartum hemorrhage (OR 0.27; CI 0.17-0.41). Perinatal and neonatal mortality rates were similar between groups; the perinatal mortality rate was 0.6/1000 and neonatal mortality rate 0.6/1000 in the home birth group and 0.6/1000 and 0.9/1000 in the hospital birth group. The small sample size prevented any statistical comparison of these rates. Because homebirth data was collected from midwives who agreed to participate in the study, results are subject to self-selection and possibly disclosure bias.

C) Northern Region Perinatal Mortality Survey Coordinating Group. Collaborative survey of perinatal loss in planned and unplanned home births. *BMJ*1996;313(7068):1306-09. The Coordinating Group collected and analyzed data for 558,691 births over 14 years in the UK (1981-1994), with 2888 booked for home delivery at term. They found perinatal mortality in the planned home birth group was less than half the average for all births even when the cases referred to hospital were included. Mortality for unplanned home births was four times as high as for all registered births. Perinatal mortality for women booked for home delivery was judged mostly unavoidable and not associated with place. Home birth critics often misquote this study as 134 losses in 3466 births, but 97% of those losses occurred in unplanned home births. The remaining losses were due to causes unaffected by birth site. Further analysis comparing data from the planned home birth group to low-risk term hospital births concluded that there were no significant differences in rates of perinatal mortality.

VI: Descriptive Studies & Registry Reports North America

A) MacDorman, M, Declerq E, Menacker, Fay. Trends and characteristics of home births in the United States by race and ethnicity, 1990-2006. *Birth* 2011;38(1):1-7. MacDorman et al. used data from the U.S National Center for Health Statistics to examine the trends and characteristics of home births in the United States from 1990 to 2006 with a focus on race, ethnic and geographic differences. Home birth was more common among non-Hispanic white women, over the age of 30, multigravid, married, delivering a singleton, term baby, and delivering with midwives. While home birth rates steadily increased for non-Hispanic whites, they declined for all other races and ethnic groups. Home births to non-Hispanic white women were mostly attended by midwives and were less likely to be preterm. Home

SECTION A: BEST AVAILABLE STUDIES GROUPED BY DESIGN

births for all other ethnic groups were more likely to be pre-term and delivered by either physicians or 'other' attendants, suggesting that these births were likely 'unplanned' emergency home births. Birth certificates in many states in the US currently do not distinguish between planned and unplanned home births.

B) Declercq E, MacDorman M, Menacker F, Stotland N. Characteristics of planned and unplanned home births in 19 states. *Obstet Gynecol* 2010;116(1):93-9. Declercq et al. used data from the 2006 U.S. vital statistics in 19 states to compare the socio-demographic profiles of women choosing planned home births with women who had unplanned home births. Approximately 83.2% (n= 9,810) of the total home births occurring in the 19 states (n= 11,787) were planned home births. Women in the unplanned home birth group were more likely to be non-white, younger, unmarried, foreign-born, smokers, have no prenatal care, and no college education. Unplanned home births are more likely to be pre-term, and attended by someone who is listed as 'other' or unknown on the birth certificate. The majority of planned home births were attended by "other midwives". Birth certificate data do not include information about planned or unplanned home birth transfer to hospital, nor can they guarantee the accuracy of the planning status variable.

C) Johnson K, Daviss BA. Outcomes of planned home birth with certified professional midwives: Large prospective study in North America. *BMJ* 2005;330;1416. A prospective study of 5418 planned home births in a single year of mandatory data collection for all Certified Professional Midwives (CPMs) in 2000. The authors describe the design as a cohort study; however, the comparison group for rates of intervention was a composite of low risk term hospital births as reported by the National Center for Health Statistics in 2000, and intrapartum and neonatal death rates were compared with those in other North American studies of at least 500 births that were either

planned out of hospital or low risk hospital births. In their sample of planned home births attended by CPMs, the transfer rate was 12.1%, the caesarean section rate was 3.7%, the intrapartum and neonatal mortality rate was 1.7/1000; intervention rates were lower among women who planned a home birth than low risk women who delivered at hospital in the US.

D) Murphy PA, Fullerton J. Outcomes of intended home births in nurse-midwifery practice: A prospective descriptive study. *Obstet Gynecol* 1998;92(3):461-70. Prospective study describing various outcomes of home births attended by CNMs during 1994-1995 (n=1404). Of those beginning labour at home, 102 (8.3%) were transferred to the hospital in labour, 10 (0.8%) were postpartum transfers and 14 (1.1%) infants were transferred. For the whole sample of women beginning labour at home, fetal and neonatal mortality was 2.5/1000. For those actually birthing at home this mortality was 1.8/1000. Intrapartum problems were positively associated with transfer to hospital-based care and overall outcomes were consistent with expected outcomes for low-risk birth.

E) Cawthon L. Planned home births: Outcomes among Medicaid women in Washington State. *Washington Department of Social and Health Services*; 1996. This study described perinatal data for 2,054 Medicaid women who were cared for by licensed midwives between 1989 and 1994. Births were categorized by birth place, maternal characteristics, and prenatal care. Outcomes between planned home births and births in birth centers or in hospitals were compared. Researchers compared all women receiving some care from licensed midwives, women receiving care from certified nurse-midwives, and all other Medicaid women and found no statistically significant differences in mortality rates. Congenital anomalies and SIDS caused the majority of deaths. The number of stillbirths or neonatal deaths among women who delivered at home was zero (0); all women who planned a home birth and who experienced a fetal or neonatal death delivered at the hospital after appropriate transfer.

SECTION B: STUDIES WITH ERRORS IN DESIGN, ANALYSIS OR REPORTING

I: Meta-Analyses and Systematic Reviews

A)Wax JR, Lucas FL, Lamont M, Pinette MG, Cartin A, Blackstone J. Maternal and newborn outcomes in planned home birth vs planned hospital births: A meta-analysis. *Am J Obstet Gynecol* 2010;203:243.e1-8. This article presents a meta-analysis of the safety of planned home versus planned hospital birth. The authors conclude that planned home births are associated with similar maternal outcomes, but with a two-fold increase in neonatal mortality. The methodology and statistical analysis employed in this systematic review were

flawed. This meta-analysis contains calculation and numerical errors, selective and mistaken inclusion/exclusion of studies when analyzing specific outcomes, as well as logical flaws in terms of definitions. Many of the odds ratios (ORs) and confidence intervals (CIs) were calculated incorrectly. In some cases, this was the result of errors apparently made in the extraction of data from the original studies. In addition, the software tool used to calculate the statistics had embedded errors that can dramatically underestimate confidence intervals (CIs), and resulted in at least 1 false statistically significant result.

SECTION B: STUDIES WITH ERRORS IN DESIGN, ANALYSIS OR REPORTING

Wax et al. defined perinatal death as a stillborn of at least 20 weeks or 500 g, or death of a liveborn infant within 28 days of birth. Neonatal deaths were defined as deaths of liveborn infants within 28 days of delivery. This means that neonatal deaths should be reported as a subset of perinatal deaths. However, the paper reports that for planned home births, the neonatal death rates are far higher than the corresponding perinatal death rates. In addition, perinatal death statistics are derived from more than 500,000 births, whereas the neonatal death statistics are drawn from fewer than 50,000 births. Hence the conclusions on comparative neonatal death rates offered by the authors cannot be defended. Most notably, the de Jonge study, which contributed more than 95% of the births used in the analysis, did not define perinatal death according to the same definition. It is unclear why Wax and colleagues excluded this study from the calculations for neonatal mortality but included the study for perinatal mortality. According to Michal et al. "If that study were removed from the calculations for the 2 outcomes for which it was erroneously included, the total number of births included in the meta-analysis would have been reduced from nearly 550,000 to just 65,000. This dramatic reduction in the size of the dataset would have significantly reduced the impact of any findings of the meta-analysis. On the other hand, if Wax and colleagues had defined perinatal death and neonatal death according to definitions used by de Jonge and associates, the conclusions for these outcomes would have been quite different."

The full detailed critique of this article, authored by a team of experts in the field (including the principal investigators of studies included in the meta-analysis), is cited in **Section C.I.B: Michal CA et. Al 2010.**

II: Cohort & Population-Based Observational Studies – North America

A) Grünebaum A, McCullough LB, Sapra KJ, Brent RL, Levene MI, Arabin B, Chervenak FA. Apgar Score of Zero at Five Minutes and Neonatal Seizures or Serious Neurologic Dysfunction in Relation to Birth Setting, *American Journal of Obstetrics and Gynecology* (2013), doi: 10.1016/j.ajog.2013.06.025. In this retrospective cohort study, live birth certificate data from 2007-2010 (n=13,891,274) were used to examine the relationship between place of birth and adverse neonatal outcomes (5 minute APGAR score, neonatal seizures or serious neurologic dysfunction). Births were divided into four groups: hospital physician, hospital midwife, free-standing birth center midwife, and home midwife. Multiple

births before 37 weeks and neonates weighing <2,500 were excluded. Women who gave birth at home attended by midwives were significantly (p <.0001) more likely to be multiparous, non-Hispanic white, >30 years of age, to deliver beyond 41 and 42 weeks, and to have macrosomic infants compared to women who gave birth with physicians at the hospital. Study results suggest that home and freestanding birth centre births attended by midwives were associated with significantly higher risks of 5-minute Apgar scores of zero (RR =10.55 and 3.56 respectively) and neonatal seizures or serious neurologic dysfunction (RR=3.80 and 1.88). Based on their reported Apgar scores of zero the authors concluded that stillbirth is more common among women who gave birth at home or in free standing birth centres. This study has several limitations. The data collection fields on the current form of the US birth certificate do not provide sufficient information to allow comparisons of outcomes between settings or providers, and do not reliably link planned and actual places of birth. Findings are inconsistent with reported rates on the Centers for Disease Control and Prevention's Vital Statistics website that show almost no differences across birth settings for rates of 5-minute Apgar scores <4, which is the commonly used measure of clinical significance. The Apgar score <4 measure is also statistically more robust as the Apgar = 0 measure runs into much more problems with small numbers of events in cells. In addition, stillbirths are not recorded on US certificates of live birth. The data set that the authors examined contains only records of infants born alive. The CDC does produce a separate data set on stillbirths, but the authors did not analyze this data set. Apgar scores of 0 at 5 minutes are extremely rare and have a high probability of being misreported. The study findings bear little or no relationship to actual reported neonatal mortality rates between groups. Another limitation of this study is that the authors were not able to differentiate between certified nurse midwives, certified professional midwives, and lay midwives in their analysis.

B) Cheng YW, Snowden JM, King TL, et al. Selected perinatal outcomes associated with planned home births in the United States. *Am J Obstet Gynecol* 2013;209 (4):325.e1-e8. This retrospective cohort study used birth certificate data from those states that use the 2003 revised birth certificate to compare perinatal outcomes by place of birth (hospital or planned home birth). Low-risk women (including those with a previous cesarean section) with singleton, vertex pregnancies at term who delivered in the US in 2008 were included in the study. Excluded were breech, multiple gestation, those prior to 37 weeks and after 43 weeks, as well as births in freestanding birth centres, accidental home births, and births at home for which intended birth location was unknown. The primary outcome studied was 5-minute Apgar score < 4. Secondary outcomes examined were 5 minute Apgars of <7, assisted ventilation for greater >6 hours, neonatal seizures,