NICE National Institute for Health and Care Excellence

Decision support approaches and toolkits for identifying midwifery staffing requirements

Evidence review 1

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Contents

Evidence Review: determining midwifery staffing requirement and skill mix

The National Institute for Health and Care Excellence (NICE) was asked by the Department of Health and NHS England to develop an evidence based guideline on safe staffing of maternity settings.

A scope was developed which defines what the guideline will and will not consider. It also outlines the 7 review questions that will be addressed to inform the development of the guideline.

This report is one of a series of evidence reviews that cover the review questions outlined in the scope. This report focuses on the following review questions:

> *What approaches for identifying midwifery staffing requirements and skill mix at a local level, including tool kits, are effective and how frequently should they be used?*
>
> - *What evidence is available on the reliability and/or validity of any identified toolkits?*

1.1 Introduction

Determining midwifery staffing requirement can be challenging. This is because the number and skill mix of midwives required to provide care to women and neonates is influenced by a multitude of factors. These can include: the number of women and neonates requiring care, the type of care needed, and the amount of time taken to provide the required care; the knowledge and experience of the midwife; the setting in which care is taking place (e.g. in hospital settings or home settings), as well as a host of other factors.

The challenge facing providers of midwifery care is ensuring that the right staff, with the right skill mix are available in the right place and at the right time[1]. The use of systematic approaches, frameworks, toolkits or models (collectively referred to as 'approaches and toolkits' throughout this document) have been recommended[2,3] to support staffing decision making. However, currently there are uncertainties about their use, including which approaches or toolkit leads to optimal outcomes, whether their effectiveness varies depending on when and where they are used and who is using them, and how often they should be used for optimal results. Therefore it is currently unclear whether the use of some approaches or toolkits are preferable to others.

1.2 Review question

What approaches for identifying midwifery staffing requirements and skill mix at a local level, including tool kits, are effective and how frequently should they be used?

- What evidence is available on the reliability and/or validity of any identified toolkits?

1.3 Aims

The aim of this systematic review was to establish whether different approaches and toolkits for identifying midwifery staffing requirements and skill mix at a local level are effective. That is, does the use of a particular approach or toolkit to support decision making about number and mix of midwives lead to changes in the estimated number and skill mix of midwives required, and does that lead to changes in outcomes for women, neonates and staff?

The review question did not aim to simply identify and describe the ways in which midwifery staffing requirement and skill mix can be determined on a local level, since this would not provide evidence about whether the use of a particular approach or toolkit is effective or not.

1.4 Methods

This systematic review was conducted in accordance with the draft *Developing NICE guidelines* manual.

A search strategy and review protocol were developed to identify primary studies comparing the use of a particular approach to another approach or to standard methods for estimating midwifery staffing and skill mix (see appendix A and B).

A date restriction was imposed on all the systematic reviews that were conducted for the midwifery staffing guideline, including this review, as it was deemed inappropriate to include all evidence. This is because midwifery practices have advanced over the years, making older studies of limited relevance to midwifery practice today. A cut-off date of 1998 was chosen following advice from a topic expert, and studies published before this date or which used data from before this date were excluded.

The systematic search identified 1799 references. An additional 37 references were identified through screening the searches for other review questions included in the related evidence reviews.

As an additional check, topic experts appointed to the NICE Safe Staffing Advisory Committee for Maternity Services and the NICE Accreditation team were also contacted and asked if they were aware of any other evidence which should be considered in the review. The developers of known toolkits for midwifery staffing decision making were also contacted and asked if they had any unpublished research or data that could be used in this review. No additional evidence was identified using these checks.

A screening checklist was developed with the purpose of enabling non-relevant references to be excluded rapidly (see appendix C). One reviewer applied the screening checklist to all identified references. A second reviewer performed a consistency check by screening the title and abstracts of 10% of the references which were selected at random against the same checklist. Any disagreements between the two reviewers were discussed and resolved. Overall there was 100% agreement between the two reviewers.

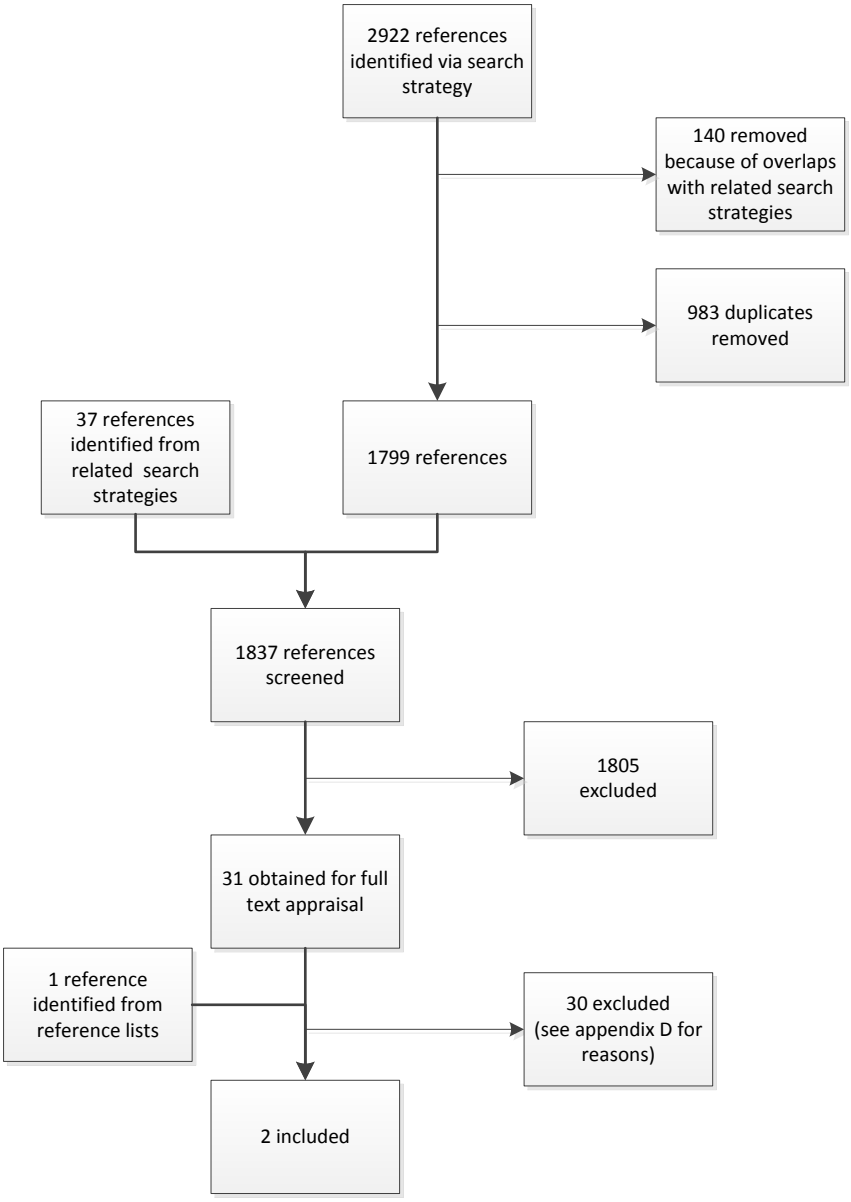
Overall, 31 references were selected and retrieved for full text appraisal. All full texts were independently reviewed against the review protocol by two reviewers, and the reviewers had 100% agreement. The reference lists and full text of these 31 studies were also screened to identify potentially relevant additional studies. An additional reference[4] was identified from screening of the reference list and full text bringing the total number of studies that were considered to 32.

All 32 studies were appraised and two articles (Allios et al 2014[4]; Allen and Thornton 2013[5]) met the criteria for inclusion in this review (**Figure 1**).

Most of the retrieved full text references related to studies that were purely descriptive in nature which described the evidence base for the development of toolkits (e.g. Ball et al series of papers on Birthrate Plus[6,7,8,9,10,11]). However, these studies did not provide evidence about whether the use of a particular approach or toolkit resulted in changes to midwifery staffing requirement, or to changes in outcomes. Thus these studies were excluded from the evidence review.

Other references related to policy documents or guidance provided by other organisations (e.g. National Audit Office[12]; National Quality Board[1]; Royal Colleges Report[13]; Kings Fund Reports[14,15]; Scottish Government Report[16]). Whilst these documents recommend the use of various toolkits to support staffing decision making, the documents do not provide evidence about whether the use of a particular toolkit resulted in changes to midwifery staffing requirement, or to changes in outcomes. Thus these references were also excluded from the evidence review. A full list of excluded studies and reasons for exclusion is provided in appendix D.

Figure 1: Review flow chart



1.4.1 Results

Two simulation studies conducted in the UK (Allen and Thornton, 2013; Allios et al, 2014) were identified that examined the extent to which one-to-one midwifery midwife care can be provided.

1.4.1.1 **Allen and Thornton (2013):** quality score [-]

This study used a simulation model that was developed on routinely collected data from a UK hospital maternity unit which had approximately 6,000 deliveries per annum. The model was used it to replicate different clinical scenarios and different sized maternity units.

The main focus of the study was to compare actual trust midwifery staffing levels determined using Birthrate Plus calculations to different simulated scenarios. The main study outcomes were the percentage of time where there were more women on the labour ward than midwives available (i.e. the ward was “overloaded”), and when ‘Workload Index’ (a

calculation of the total time women spend on the labour ward multiplied by each of five categories relating to the level of intervention the woman received during labour) exceeded the number of midwives present.

There were clear patterns of activity on the labour ward; peak activity was on Monday to Friday when 20% more deliveries occurred than on the weekend, and between 09:00 and 12:00 when the number of deliveries were 60% higher than the average for the rest of the day (weekdays only). This was attributed to activity related to caesarean sections.

For this particular trust Birthrate Plus staffing calculations suggested a staffing ratio of 1.4 midwives to every woman. This ratio left the maternity unit with more women than midwives for 65% of the time between 09:00 and 13:00, but on nights and weekends this 'overloading' only occurred 5-10% of the time.

Using model simulations the study found that the ratio of midwives to women needed to be increased to 1.8 to 1 in order to ensure that there were enough midwives to provide one to one care for 95% of the time or more. If the estimate of 'Workload Index', rather than the number of women was used the simulation model further increased this ratio to 2.2 midwives per woman.

Using model simulations the study found that the Birthrate plus calculations would lead to more women than midwives on the unit 15% of the time for small units (2000 births per year), 13% of the time for medium units (6000 births per year) and 10% of the time for large units (8000 births per year).

1.4.1.2 **Allios et al (2014):** quality score [-]

This study also developed a simulation model based on routinely collected data from a UK hospital maternity service which had approximately 6,000 deliveries per annum. The model was used to evaluate the resource implications of changes in maternity care provision and demand.

The study tested various scenarios, one of which was the trusts ability to provide one-to-one midwifery care throughout the process of giving birth.

It was unclear how the trust's actual midwifery staffing requirement had been determined, but contact with the authors of the paper indicated that it is highly likely that Birthrate plus would have been used in the majority of organisations where the data underpinning the study was collected from. Modelling work in the study revealed that for about 25% of the time there were more women in labour and in theatre than midwives available. For this particular trust, the modelling indicated that an additional 3 midwives would be required to allow one-to-one care for 95% of the time.

Results for the Alongside Midwifery Unit (AMU) revealed that there was a greater ability to provide one-to-one care at all times, not just during labour. During the day there were more women than midwives for 4% of the time. During the night there was one fewer midwife which resulted in more women than midwives 11.8% of the time. Thus if the target of one-to one-care during labour only is considered, the AMU probably meets this objective most of the time.

Table 1: Summary of included evidence

Reference	Country	Design	Approach to determining midwifery staffing requirement	Comparison	Outcome	Quality
(Allen and Thornton	UK	Simulation	Birthrate Plus	Simulated model	• % time more women	[-]

Reference	Country	Design	Approach to determining midwifery staffing requirement	Comparison	Outcome	Quality
2013)		study			than midwives • % time workload index exceeded number of midwives	
Allios et al (2014)	UK	Simulation study	Unclear	Simulated model	• % time more women than midwives	[-]

1.4.2 Evidence Statements

Two studies[4,5] (quality score [-]) conducted in the UK found that methods for determining midwifery staffing requirement (including Birthrate Plus) underestimate the number of midwives required to provide one-to-one care to all women in labour in comparison to predictions made by computer simulation models. Methods for determining midwifery staffing requirement (including Birthrate Plus) had less of a short fall in the predicted number of midwives required in Alongside Midwifery Units[4] and maternity services serving larger populations (over 8,000 births per annum)[5] than for other maternity settings[4] and for services serving smaller populations (less than 8,000 births per annum)[5].

No evidence was found about determining staffing requirement for other midwifery activities.

2 Gaps in the evidence

Currently, Birthrate Plus is widely used throughout maternity services as a decision support tool for determining midwifery staffing requirement, and is endorsed for use by the Royal College of Anaesthetists, Royal College of Midwives and Royal College of Obstetricians and Gynaecologists[3], and by the Department of Health[2]. However, there is no evidence to validate the methodology that Birthrate Plus uses, or to demonstrate that the tool has an effect on outcomes.[14,17,18] In 2011 the Kings Fund called for more research on Birthrate Plus to be done to evaluate its effectiveness.

This evidence review identified a single study[5] that addressed the King's Fund call for research that specifically focused on Birthrate Plus. This limited amount of evidence is insufficient to determine whether the effectiveness of Birthrate Plus varies depending on when and where it is used and by whom, and how often it should be used.

A small amount of evidence was found demonstrating that computer simulated models[4,5] could be used to monitor and predict the number of midwives required to provide one-to-one care to women in labour, but it is unclear if some simulation models are more effective than others.

No evidence was found for other decision support approaches, frameworks, methods or toolkits, and no evidence was found about outcomes other than providing one-to-one care during labour.

Further research is therefore needed to establish what method should be used for determining midwifery staffing requirement in a variety of maternity settings in the UK. An example review protocol for future research is provided in table 2.

Table 2: Review protocol for future research

Question	**What method(s) should be used for determining midwifery staffing requirement in maternity settings in the UK?**
Objectives	To investigate whether there is an accurate method for determining midwifery staffing requirement, To determine whether the most accurate method varies by setting (such as alongside midwifery units, free standing midwifery units, obstetric units, community settings).
Study design	Comparative evidence, ideally cluster randomised controlled trials but prospective cohort studies are acceptable.
Population	Women and neonates accessing maternity services for pre natal, antenatal or postnatal care
Method	Any method that aims to predict staffing requirement • Birthrate Plus • Computer simulation models • Clinical judgement • Etc.
Comparator	Any other method that aims to predict staffing requirement • Birthrate Plus • Computer simulation models • Clinical judgement • Etc.
Outcomes	• Number of midwives predicted • Resource use and costs • Woman, neonatal, or midwife outcomes such as (but not limited to): o Serious preventable events/never events (e.g. death, haemorrhage, perineal tears) o Delivery of midwifery care (e.g. one-to-one midwife support during labour, completion of observations and paperwork, drug errors, readmission) o Completion and maintenance of staff training

	○ Staff retention and sickness rates ○ Closure to admission due to staffing capacity

3 References

N.B. Excluded studies, and reasons for exclusion are in appendix D

[1] National Quality Board (2013) How to ensure the right people, with the right skills, are in the right place at the right time: a guide to nursing, midwifery and care staffing capacity and capability

[2] Maternity Matters (Department of Health, 2007)

[3] Royal College of Anaesthetists, Royal College of Midwives, Royal College of Obstetricians and Gynaecologists, Health RCoPaC (2007) Safer childbirth: minimum standards for the organisation and delivery of care in labour. London: RCOG Press.

[4]Allios M, Cozzi E, McBride T, Palmer W (2014) Modelling of maternity services in England. London. National Audit Office

[5] Allen M, Thornton S (2013) Providing one-to-one care in labour. Analysis of 'Birthrate Plus' labour ward staffing in real and simulated labour ward environments BJOG: An International Journal of Obstetrics & Gynaecology 120 (1) 100-107

[6] Ball J, Bennett B, Washbrook M (2003) Birthrate Plus programme: a basis for staffing standards? British Journal of Midwifery 11 (5) 264-

[7] Ball J, Bennett B, Washbrook M (2003) Further issues in deciding staffing needs British Journal of Midwifery 11 (7) 416-

[8] Ball J, Bennett B, Washbrook M et al. (2003) Birthrate Plus Programme. Factors affecting staffing ratios British Journal of Midwifery 11 (6) 357-360

[9] Ball J, Washbrook M (2010) Birthrate Plus: using ratios for maternity workforce planning British Journal of Midwifery 18 (11) 724-

[10] Ball J, Washbrook M (2010) Developing a real-time assessment of staffing needs in delivery suites British Journal of Midwifery 18 (12) 780-

[11] Ball J, Washbrook M (2010) Workforce planning in midwifery: an overview of 8 years British Journal of Midwifery 18 (8) 527-

[12] National Audit Office (2013) Maternity services in England.

[13] Royal College of Anaesthetists, Royal College of Midwives, Royal College of Obstetricians and Gynaecologists, Health RCoPaC (2007) Safer childbirth: minimum standards for the organisation and delivery of care in labour. London: RCOG Press.

[14] Sandall J, Homer C, Sadler E et al. (2011) Staffing in maternity units: getting the right people in the right place at the right time. London: The King's Fund

[15] Thomas V, Dixon A (2012) Improving safety in maternity services: introduction to The King's Fund's maternity toolkit. London: The King's Fund

[16] Scottish Government (2004) Nursing & Midwifery: Workload & Workforce: Planning Project. Edinburgh: Scottish Executive

[17] National Institute for Clinical Excellence (NICE) (2007) Intrapartum Care: Care of healthy women and their babies during childbirth. London: National Institute for Clinical Excellence

[18] Yelland A, Winter C, Draycott T et al. (2013) Midwifery staffing: Variation and mismatch in demand and capacity British Journal of Midwifery 21 (8) 579-589

4 Appendices

4.1 Appendix A Search strategy

This appendix outlines the searches carried out for this review in order to inform NICE's safe staffing guidance for Midwifery staffing in maternity settings. It should be read in conjunction with the protocol for this review, and with the appendices for the associated reviews.

References which were identified during each of the associated reviews were shared with the other (midwifery staffing) review groups if they were thought to be relevant to their review questions. No additional citation searching or website searching was carried out specifically for this review.

4.1.1 Database search strategies

4.1.1.1 Medline and Medline-in process

Platform: Ovid
Search date: 17/6/2014

1 Midwifery/
2 midwi*.tw.
3 Nurse Midwife/
4 maternity.tw.
5 (intrapartum or postnatal or antenatal or prenatal or perinatal).tw.
6 (birth* or childbirth*).tw.
7 ((delivery or labour or labor) adj (ward* or suite* or room* or unit*)).tw.
8 *Delivery Rooms/ or *birthing centers/
9 exp *Perinatal Care/ or *Prenatal Care/
10 (msw* not "municipal solid").tw.
11 or/1-10
12 (care adj3 pathway*).tw.
13 "score card*".tw.
14 scorecard*.tw.
15 (acuity adj3 (tool* or score* or system*)).tw.
16 "bench mark*".tw.
17 benchmark*.tw.
18 "tool kit*".tw.
19 toolkit*.tw.
20 "dash board*".tw.
21 dashboard.tw.

22 ((planning or staffing or acuity or severity or need*) adj3 (approach* or model* or system* or tool*)).tw.
23 "Personnel Staffing and Scheduling Information Systems"/
24 "Safer Nursing Care Tool".tw.
25 snct.tw.
26 (shelford adj3 tool*).tw.
27 aukuh.tw.
28 "association of UK university hospitals".tw.
29 "patient care portfolio".tw.
30 or/12-29
31 11 and 30
32 birthrate plus.tw.
33 "birth rate plus".tw.
34 (birthrate adj3 tool).tw.
35 or/32-34
36 31 or 35
37 limit 36 to (english language and yr="1998 -Current")
38 limit 37 to (comment or editorial or news or letter)
39 37 not 38
40 Animals/
41 Humans/
42 40 not 41
43 39 not 42

4.1.1.2 Embase

Platform: Ovid
Search date: 17/6/2014

1 exp midwife/
2 midwi*.tw.
3 maternity.tw.
4 (intrapartum or postnatal or antenatal or prenatal or perinatal).tw.
5 *intrapartum care/ or *postnatal care/ or *prenatal care/ or *perinatal care/
6 (birth* or childbirth*).tw.
7 ((delivery or labour or labor) adj (ward* or suite* or room* or unit*)).tw.
8 *delivery room/
9 *maternity ward/
10 (msw* not "municipal solid").tw.
11 or/1-10
12 (care adj3 pathway*).tw.
13 "score card*".tw.
14 scorecard*.tw.
15 (acuity adj3 (tool* or score* or system*)).tw.
16 "bench mark*".tw.

17 benchmark*.tw.
18 "tool kit*".tw.
19 toolkit*.tw.
20 "dash board*".tw.
21 dashboard.tw.
22 ((planning or staffing or acuity or severity or need*) adj3 (approach* or model* or system* or tool*)).tw.
23 clinical pathway/
24 "Safer Nursing Care Tool".tw.
25 snct.tw.
26 (shelford adj3 tool*).tw.
27 aukuh.tw.
28 "association of UK university hospitals".tw.
29 "patient care portfolio".tw.
30 or/12-29
31 11 and 30
32 birthrate plus.tw.
33 "birth rate plus".tw.
34 (birthrate adj3 tool).tw.
35 or/32-34
36 31 or 35
37 limit 36 to (english language and yr="1998 -Current")
38 human/
39 nonhuman/
40 39 not 38
41 37 not 40
42 limit 41 to (editorial or letter or note)
43 41 not 42
44 limit 43 to embase

4.1.1.3 Health Management Information Consortium

Platform: Ovid
Search date: 19/6/2014

1 Midwifery/ or exp Midwives/ or maternity support workers/
2 midwi*.tw.
3 Midwifery services/
4 maternity.tw.
5 (intrapartum or postnatal or antenatal or prenatal or perinatal).tw.
6 (birth* or childbirth*).tw.
7 ((delivery or labour or labor) adj (ward* or suite* or room* or unit*)).tw.
8 exp maternity units/ or delivery rooms/
9 maternity care/ or antenatal care/ or postnatal care/ or perinatal care/

10 (msw* not "municipal solid").tw.
11 or/1-10
12 (care adj3 pathway*).tw.
13 "score card*".tw.
14 scorecard*.tw.
15 (acuity adj3 (tool* or score* or system*)).tw.
16 "bench mark*".tw.
17 benchmark*.tw.
18 "tool kit*".tw.
19 toolkit*.tw.
20 "dash board*".tw.
21 dashboard.tw.
22 ((planning or staffing or acuity or severity or need*) adj3 (approach* or model* or system* or tool*)).tw.
23 care pathways/ or benchmarking/ or exp Dependency scoring/
24 "Safer Nursing Care Tool".tw.
25 snct.tw.
26 (shelford adj3 tool*).tw.
27 aukuh.tw.
28 "association of UK university hospitals".tw.
29 "patient care portfolio".tw.
30 or/12-29
31 11 and 30
32 birthrate plus.tw.
33 "birth rate plus".tw.
34 (birthrate adj3 tool).tw.
35 or/32-34
36 31 or 35
37 limit 36 to yr="1998 -Current"

4.1.1.4 Cochrane Database of Systematic Reviews; Database of Abstracts of Reviews of Effects; Cochrane Central Register of Controlled Trials; Health Technology Assessment Database

Platform: Wiley
Search date: 19/6/2014

ID Search
#1 MeSH descriptor: [Midwifery] this term only
#2 midwi*:ti,ab
#3 MeSH descriptor: [Nurse Midwives] this term only
#4 maternity:ti,ab
#5 (intrapartum or postnatal or antenatal or prenatal or perinatal):ti,ab
#6 (birth* or childbirth*):ti,ab

#7	((delivery or labour or labor) near/2 (ward* or suite* or room* or unit*)):ti,ab
#8	MeSH descriptor: [Delivery Rooms] explode all trees
#9	MeSH descriptor: [Birthing Centers] this term only
#10	MeSH descriptor: [Perinatal Care] explode all trees
#11	MeSH descriptor: [Prenatal Care] this term only
#12	(msw* not "municipal solid"):ti,ab
#13	#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12
#14	(care near/4 pathway*):ti,ab
#15	"score card*":ti,ab
#16	scorecard*:ti,ab
#17	(acuity near/4 (tool* or score* or system*)):ti,ab
#18	"bench mark*":ti,ab
#19	benchmark*:ti,ab
#20	"tool kit*":ti,ab
#21	toolkit*:ti,ab
#22	"dash board*":ti,ab
#23	dashboard:ti,ab
#24	((planning or staffing or acuity or severity or need*) near/4 (approach* or model* or system* or tool*)):ti,ab
#25	MeSH descriptor: [Personnel Staffing and Scheduling Information Systems] this term only
#26	"Safer Nursing Care Tool":ti,ab
#27	snct:ti,ab
#28	(shelford adj3 tool*):ti,ab
#29	aukuh:ti,ab
#30	"association of UK university hospitals":ti,ab
#31	"patient care portfolio":ti,ab
#32	#14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31
#33	#13 and #32
#34	birthrate plus:ti,ab
#35	"birth rate plus":ti,ab
#36	(birthrate near/4 tool):ti,ab
#37	#34 or #35 or #36
#38	#33 or #37 Publication Year from 1998

4.1.1.5 Cumulative Index to Nursing and Allied Health (CINAHL)

Platform: Ebsco
Search date: 19/6/2014

Search Terms	Search Options	Actions

S38	S33 OR S34 OR S35 OR S36	Limiters - Published Date: 19980101-20141231 Search modes - Boolean/Phrase
S37	S33 OR S34 OR S35 OR S36	Search modes - Boolean/Phrase
S36	TI (birthrate N3 tool) OR AB (birthrate N3 tool)	Search modes - Boolean/Phrase
S35	TI "birth rate plus" OR AB "birth rate plus"	Search modes - Boolean/Phrase
S34	TI birthrate plus OR AB birthrate plus	Search modes - Boolean/Phrase
S33	S10 AND S32	Search modes - Boolean/Phrase
S32	S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31	Search modes - Boolean/Phrase
S31	(MH "Personnel Staffing and Scheduling Information Systems")	Search modes - Boolean/Phrase
S30	(MH "Benchmarking")	Search modes - Boolean/Phrase
S29	(MH "Patient Classification/MT")	Search modes - Boolean/Phrase
S28	(MH "Critical Path")	Search modes - Boolean/Phrase
S27	TI "patient care portfolio" OR AB "patient care portfolio"	Search modes - Boolean/Phrase
S26	TI "association of UK university hospitals" OR AB "association of UK university hospitals"	Search modes - Boolean/Phrase
S25	TI aukuh OR AB aukuh	Search modes - Boolean/Phrase
S24	TI (shelford N3 tool*) OR AB (shelford N3 tool*)	Search modes - Boolean/Phrase
S23	TI snct OR AB snct	Search modes - Boolean/Phrase
S22	TI "Safer Nursing Care Tool" OR AB "Safer Nursing Care Tool"	Search modes - Boolean/Phrase
S21	TI (((planning or staffing or acuity or severity or need*) N3 (approach* or model* or system* or tool*))) OR AB (((planning or staffing or acuity or severity or need*) N3 (approach* or model* or	Search modes - Boolean/Phrase

	system* or tool*)))	
S20	TI dashboard OR AB dashboard	Search modes - Boolean/Phrase
S19	TI "dash board*" OR AB "dash board*"	Search modes - Boolean/Phrase
S18	TI toolkit* OR AB toolkit*	Search modes - Boolean/Phrase
S17	TI "tool kit*" OR AB "tool kit*"	Search modes - Boolean/Phrase
S16	TI benchmark* OR AB benchmark*	Search modes - Boolean/Phrase
S15	TI "bench mark*" OR AB "bench mark*"	Search modes - Boolean/Phrase
S14	TI ((acuity N3 (tool* or score* or system*))) OR AB ((acuity N3 (tool* or score* or system*)))	Search modes - Boolean/Phrase
S13	TI scorecard* OR AB scorecard*	Search modes - Boolean/Phrase
S12	TI "score card*" OR AB "score card*"	Search modes - Boolean/Phrase
S11	TI (care N3 pathway*) OR AB (care N3 pathway*)	Search modes - Boolean/Phrase
S10	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9	Search modes - Boolean/Phrase
S9	TI ((msw* not "municipal solid")) OR AB ((msw* not "municipal solid"))	Search modes - Boolean/Phrase
S8	TI (((delivery or labour or labor) N1 (ward* or suite* or room* or unit*))) OR AB (((delivery or labour or labor) N1 (ward* or suite* or room* or unit*)))	Search modes - Boolean/Phrase
S7	TI ((birth* or childbirth*)) OR AB ((birth* or childbirth*))	Search modes - Boolean/Phrase
S6	TI ((intrapartum or postnatal or antenatal or prenatal or perinatal)) OR AB ((intrapartum or postnatal or antenatal or prenatal or perinatal))	Search modes - Boolean/Phrase
S5	TI midwi* OR AB midwi*	Search modes - Boolean/Phrase
S4	(MH "Delivery Rooms+")	Search modes - Boolean/Phrase
S3	(MH "Perinatal Care") OR (MH "Postnatal Care+") OR (MH "Intrapartum Care+") OR (MH	Search modes - Boolean/Phrase

	"Prenatal Care")	
S2	(MH "Midwifery+")	Search modes - Boolean/Phrase
S1	(MH "Midwives+")	Search modes - Boolean/Phrase

4.1.1.6 British Nursing Index (BNI)

Platform: HDAS
Search date: 19/6/2014

1. BNI; MIDWIFERY/
2. BNI; (perinatal AND care).ti,ab
3. BNI; prenatal.ti,ab
4. BNI; exp ANTENATAL CARE/
5. BNI; exp POSTNATAL CARE/
6. BNI; midwi*.ti,ab
7. BNI; MATERNITY SERVICES/
8. BNI; (intrapartum OR postnatal OR antenatal OR prenatal OR perinatal).ti,ab
9. BNI; (birth* OR childbirth*).ti,ab
10. BNI; (((delivery OR labour OR labor) ADJ (ward* OR suite* OR room* OR unit*))).ti,ab
11. BNI; ((msw* NOT "municipal solid")).ti,ab
12. BNI; 1 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11
13. BNI; ((care adj3 pathway*)).ti,ab
14. BNI; "score card*".ti,ab
15. BNI; scorecard*.ti,ab
16. BNI; ((acuity adj3 (tool* OR score* OR system*))).ti,ab
17. BNI; "bench mark*".ti,ab
18. BNI; benchmark*.ti,ab
19. BNI; "tool kit*".ti,ab
20. BNI; toolkit*.ti,ab
21. BNI; "dash board*"
22. BNI; dashboard.ti,ab
23. BNI; (((planning OR staffing OR acuity OR severity OR need*) adj3 (approach* OR model* OR system* OR tool*))).ti,ab
24. BNI; "Safer Nursing Care Tool".ti,ab
25. BNI; snct.ti,ab
26. BNI; ((shelford adj3 tool*)).ti,ab
27. BNI; aukuh.ti,ab
28. BNI; "association of UK university hospitals".ti,ab
29. BNI; "patient care portfolio".ti,ab
30. BNI; 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23 OR 24 OR 25 OR 26 OR 27 OR 28 OR 29

31. BNI; 12 AND 30
32. BNI; (birthrate AND plus).ti,ab
33. BNI; "birth rate plus".ti,ab
34. BNI; ((birthrate adj3 tool)).ti,ab
35. BNI; 32 OR 33 OR 34
37. BNI; 31 OR 35
38. BNI; 37 [Limit to: Publication Year 1998-2014]

4.2 Appendix B Review protocol

	Details
Review question	**What approaches for identifying midwifery staffing requirements and skill mix at a local level, including tool kits, are effective and how frequently should they be used?** **What evidence is available on the reliability and/or validity of any identified toolkits?**
Objectives	To identify evidence on approaches used to identify staffing requirements and skill mix, and establish how effective, reliable and valid the approaches are.
Language	English
Study design	Any study with a comparator group e.g. Controlled trials (randomized, quasi randomized, cluster randomized), cross sectional, cohort, before and after
Status	Published papers (full papers only)
Setting	Maternity settings
Perspective	NA
Intervention	Any approach/method/process/toolkit for identifying midwifery staffing requirements such as birth rate plus, Scottish tool, professional judgement
Comparator	• Professional judgement • Any approach/method/toolkit used for determining staffing requirement
Evaluation/ outcome	Any midwifery sensitive outcome, such as: - Serious preventable events (maternal death, stillbirth, neonatal death etc.) - Delivery of midwifery care (Women offered minimum set of antenatal tests etc.) - Reported feedback (experience/satisfaction of woman, partner or staff - Any other outcome (costs, litigation, training, sickness etc.)
Other criteria for inclusion/ exclusion of studies	**Include:** • English language, primary research in full text • Case-control **Exclude:** • Non-comparative evidence (e.g. case report) • Conference abstracts • Studies published before 1998 • Toolkits/processes evaluated in non-maternity settings
Review strategies	• The appropriate NICE methodology checklist will be used as a guide to appraise the quality of individual studies • Data on all included studies will be extracted into evidence tables • Where statistically possible, a meta-analytical approach will be used to give an overall summary effect

4.3 Appendix C Title and Abstract Screening checklist

Studies not addressing midwife staffing

Studies not addressing an approach/framework/model/toolkit for determining staffing requirement

Non-English language studies

Non-primary study publications e.g. editorials

Studies not performed in OECD countries

4.4 Appendix D Excluded studies

Ball J, Bennett B, Washbrook M (2003) Birthrate Plus programme: a basis for staffing standards? British Journal of Midwifery 11 (5) 264-
EXCLUDE: not primary research, description only

Ball J, Bennett B, Washbrook M (2003) Further issues in deciding staffing needs British Journal of Midwifery 11 (7) 416-
EXCLUDE: not primary research, description only

Ball J, Bennett B, Washbrook M et al. (2003) Birthrate Plus Programme. Factors affecting staffing ratios British Journal of Midwifery 11 (6) 357-360
EXCLUDE: not primary research, description only

Ball J, Washbrook M (2010) Birthrate Plus: using ratios for maternity workforce planning British Journal of Midwifery 18 (11) 724-
EXCLUDE: not primary research, description only

Ball J, Washbrook M (2010) Developing a real-time assessment of staffing needs in delivery suites British Journal of Midwifery 18 (12) 780-
EXCLUDE: not primary research, description only

Ball J, Washbrook M (2010) Workforce planning in midwifery: an overview of 8 years British Journal of Midwifery 18 (8) 527-
EXCLUDE: not primary research, description only

Byrne G, Macgregor C, Brady A et al. (2004) Effective tool for managing workload Nursing in the Community 5 (1) 7-8
EXCLUDE: Not primary research, narrative summary only

The Kings Fund (2012) Improving safety in maternity services: introduction to The King's Fund's maternity toolkit
EXCLUDE- not primary research, description only

Flynn B, Kellagher M, Simpson J (2010) Workload and workforce planning: tools, education and training... second of five articles Nursing Management - UK 16 (10) 32-35
EXCLUDE: not primary research, description only

Hamid R, Mahadevan N, Khoo C (2013) Developing clinical care pathways in response to the new maternity pathway payment system: Our experience at Ealing Hospital BJOG: An International Journal of Obstetrics and Gynaecology 120 461-
EXCLUDE: Doesn’t assess midwifery staffing on patient outcomes

Hurley J, Dickson K (1998) Clinical. Assessing midwifery workload on a labour ward British Journal of Midwifery 6 (7) 444-449
EXCLUDE: doesn’t separate midwives from auxiliary staff

Jenkin-Cappiello E (2000) Oh baby!... a labor and delivery staffing system measures patient census and acuity Nursing Management 31 (2) 35-37
EXCLUDE: not primary research, description only

Kellagher M, Simpson J, Flynn B (2010) Workload and workforce planning: developing a learning toolkit Nursing Management 17 (1) 32-

EXCLUDE: not primary research, description only

Koblinsky M, Matthews Z, Hussein J et al. (2006) Maternal Survival 3 - Going to scale with professional skilled care Lancet 368 (9544) 1377-1386
EXCLUDE: not primary research and paper focusses on non-OECD countries.

Ksykiewicz-Dorota A, Adamska-Kuzmicka I (2001) Method of Patient Classification System in obstetric staff scheduling. II. Demand for direct nursing in the delivery room among mothers who deliver by natural birth Annales Universitatis Mariae Curie-Sklodowska - Sectio d - Medicina 56 301-306
UNAVAILABLE FROM ALL SOURCES

Lankford D (2013) The Art of Staffing in Labor and Delivery: A Tool to Quantify Staffing Demands JOGNN: Journal of Obstetric, Gynecologic & Neonatal Nursing 42 S64-S64
EXCLUDE: conference abstract only

Lockhart K, Simpson J, Kellagher M et al. (2010) Workload and workforce planning: devolving the programme Nursing Management (Harrow) 17 (3) 24-27
EXCLUDE: not primary research, descriptive only

Loper D, Hom E (2000) Creating a patient classification system: one birth center's experience in the triage process Journal of Perinatal & Neonatal Nursing 13 (4) 31-49
EXCLUDE: Description only, no data on outcomes provided

Mathew D, Dougall A, Konfortion J et al. (2011) The Intrapartum Scorecard: Enhancing safety on the labour ward British Journal of Midwifery 19 (9) 578-586
EXCLUDE: pilot of scorecard and its useability, no data on outcomes provided

McIntosh B, Cookson G, Sandall J (2012) A call to arms: the efficient use of the maternity workforce British Journal of Midwifery 20 (2) 122-127
EXCLUDE: not related to toolkits

Mejia A (1998) Planning midwifery services to deliver continuity of care Journal of the Operational Research Society 49 (1)
EXCLUDE: does not describe number of midwifery staff

National Audit Office (2013) Maternity services in England - National Audit Office (NAO).
EXCLUDE- not primary research, description only

National Quality Board (2013) How to ensure the right people, with the right skills, are in the right place at the right time: a guide to nursing, midwifery and care staffing capacity and capability. S.I. National Quality Board, 2013.
EXCLUDE- not primary research, description only

NHS Education for Scotland (1-1-2013) Nursing and midwifery workload and workforce planning: learning toolkit - second edition. Scottish Government.
EXCLUDE- not primary research, description only

O'Sullivan S (1999) Working to plan: workforce planning in midwifery... Birthrate Plus... workforce planning tool RCM Midwives Journal 2 (7) 216-217
EXCLUDE- not primary research- narrative summary

Royal College of Anaesthetists, Royal College of Midwives, Royal College of Obstetricians and Gynaecologists, Health RCoPaC (2007) Safer childbirth: minimum standards for the organisation and delivery of care in labour. London - 27 Sussex Place, Regent's Park, London NW1 4RG: RCOG Press

EXCLUDE- not primary research, description only

Scottish Government (2004) Nursing & Midwifery: Workload & Workforce: Planning Project.
EXCLUDE- not primary research, description only

Tolofari M (2014) Counting midwives Midwives 17 (1) 60-61
EXCLUDE: not primary research

Wallis AB, Chereches R, Oprescu F et al. (2007) An international model for staffing maternal and child health research: The use of undergraduate students Breastfeeding Medicine 2 (3) 139-144.
EXCLUDE- not primary research, description only

Yelland A, Winter C, Draycott T et al. (2013) Midwifery staffing: Variation and mismatch in demand and capacity British Journal of Midwifery 21 (8) 579-589
EXCLUDE- not primary research, description only

4.5 Appendix E Evidence tables

Allen (2013)

Reference	**Reference:** Allen & Thornton (2013) Providing one-to-one care in labour. Analysis of 'Birthrate plus' labour ward staffing in real and simulated labour ward environments. **Aim:** to establish how well birth rate plus supports the provision of 1-1 midwifery care during labour **Design:** Computer simulation **Funding:** NIHR and CLAHRC **Study dates:** Not stated **Country:** UK **Quality assessment**: [-]
Population	**Setting:** A labour ward in a city hospital **Sample size:** Not stated, hospital provides support for approximately 6,000 births per year. **Stage of care:** Labour **Characteristics**: Not stated
Approach used to determine midwifery staffing requirement	**Birthrate plus** Birthrate Plus is a retrospective midwife workforce planning tool. It is applied when the mother and baby are ready to leave the delivery suite. It is based upon a classification system which uses clinical indicators to place mother and baby in one of five outcome categories. The time spent in the delivery suite is recorded. Staffing need is determined by calculating a mean time per category. Extra allowances of midwife time are given to women in higher need categories, thus allowing for the fact that woman and infant may need the attention of more than one midwife at times. The tool is based on the principle of midwives providing one-to one care during labour The tool focuses on the intrapartum period but all aspects of midwives' roles are considered from outpatient clinics and ante-natal services to birthing units and post-natal services.
Comparison	Simulated scenarios
Methods	A simulation model was developed based on the hospitals birth data collected over a 1 year period: • Women are categorised as either spontaneous birth or elective caesarean and adjustments are made for day of the week (since birth data revealed that deliveries were 20% higher during the week than the weekend, due to caesarean sections) • Time of arrival for caesarean section can be set (since elective caesareans are performed tended to occur between 9am and 12pm on weekdays, and number of births were 60% higher than the average of the rest of the day) • Women are then be assigned to a BR+ category. The length of stay in the model depends only on the BR+ category and whether they were undergoing elective

<table>
<tr><td></td><td>
section; no other data were used.
• The model runs an audit of the virtual labour ward every hour; total number of women on the ward are counted and the current workload index calculated using BR+ formula.

The simulation model was validated against 3 months worth of actual data collected previously for the calculation of staffing levels using BR+ formula.

The model was used to investigate the potential of alternative staffing schedules, and how a changing number of births per year affects the ability to provide one to one care during labour. The main outcome measure was labour ward overloading (when either the number of women or the BR+ Workload Index exceeded the scheduled midwife availability).
</td></tr>
<tr><td>Results</td><td>
Birthrate Plus data compared to ideal simulation for the hospital
<table>
<tr><th></th><th>Actual BR+ calculations</th><th>Simulation</th></tr>
<tr><td>Midwife to woman ratio</td><td>1.4 to 1</td><td>1.8 to 1</td></tr>
<tr><td>Percentage of time number of women exceeded number of midwives :</td><td></td><td></td></tr>
<tr><td>• Nights/Weekends</td><td>5-10%</td><td>5% or less</td></tr>
<tr><td>• Day during weekdays</td><td>25-30%</td><td>5% or less</td></tr>
<tr><td>• 09:00 to 13:00 weekdays</td><td>65%</td><td>5% or less</td></tr>
<tr><td>Midwife to workload index ratio</td><td>n/a</td><td>2.2 to 1</td></tr>
</table>
Birthrate Plus data for alternative sized labour wards (simulated)
<table>
<tr><th>Size of unit (number of births)</th><th>% time more women than midwives</th><th>% time workload index exceeded number of midwives available</th><th>Probability of workload index rising to twice the number of allocated midwives</th></tr>
<tr><td>Small (2000)</td><td>16%</td><td>45%</td><td>6%</td></tr>
<tr><td>Med (6000)</td><td>13%</td><td>36%</td><td>na</td></tr>
<tr><td>Large (8000)</td><td>10%</td><td>30%</td><td>0.1%</td></tr>
</table>
Probability of labour ward overload is higher during the day on weekdays
As the number of midwives increase, the probability of overload decreases
</td></tr>
<tr><td>Authors conclusions</td><td>
BR+ formula allows for 15% extra resource for coping with fluctuations in workload. We found that in practice workload index exceeded planned resource 35% of the time, and the number of women exceeded the number of midwives 13% of the time.

BR+ recommends the number of midwives should remain constant throughout the day and week, but we identified a clear pattern of increased workload on weekdays which was associated with the scheduling of caesarean sections on weekdays.
</td></tr>
<tr><td>Limitations</td><td>
Analysis was focused on one hospital (although the model was used to simulate other labour wards)
Midwife staffing for other work is not considered
Model is not adequately described
</td></tr>
</table>

Allios et al (2014)

Reference	**Reference:** Allios M, Cozzi E, McBride T, Palmer W (2014) Modelling of maternity services in England. London. National Audit Office **Aim:** to evaluate the trusts ability to provide one-to-one midwifery care throughout the process of giving birth. **Design:** Computer simulation **Funding:** **Study dates:** 2011-12 and 2012-13 **Country:** UK **Quality assessment**: [-]
Population	**Setting:** A hospital with a maternity service comprising an obstetric led maternity unit, an alongside midwifery led unit, and a free standing midwifery unit **Sample size:** Not stated, hospital provides support for approximately 6,000 births per year (less than 1% of births are home births). **Stage of care:** Labour **Characteristics**: 11 midwives cover the labour ward and theatre, 4 cover the alongside midwifery unit in the day (3 at night). Number of midwives in the freestanding unit not stated.
Approach to determining midwifery staffing requirement	Unclear Plausible that Birthrate plus was used since this is widely used throughout maternity units in the UK
Comparison	Simulated scenarios
Methods	A simulation model was developed based on the hospitals Patient Administration System, Evolution IT system, and the hospitals theatre dataset. A discrete event simulation was used to model the provision of services by replicating the current care pathway. This was based on clinical guidance and consultation with staff at the trust. The model was used to evaluate the resource implications for changes in maternity care provision and demand. Several assumptions were made which were discussed and agreed with healthcare and modelling experts: • Birth and non-birth were treated as two separate cases (therefore the model can account for the same woman more than once) • Cases with 6 or more episodes were removed from the analysis • Non-maternity wards with low usage were removed from the analysis • Antenatal and postnatal rooms were considered as a single ward pooling both resources and the demand for these resources • Rare methods of delivery were removed from the analysis (e.g. breech) Clinical specialists reviewed the model during its development.
Results	

<table>
<tr><td></td><td>
<table>
<tr><th></th><th colspan="3">Setting</th></tr>
<tr><th></th><th>In labour or theatre</th><th>In AMU during day *</th><th>In AMU during night *</th></tr>
<tr><td>Percentage of time number of women exceeded number of midwives:</td><td>23.5%</td><td>4%</td><td>11.8%</td></tr>
<tr><td>Planned number of midwives</td><td>11</td><td>4</td><td>3</td></tr>
<tr><td>Simulated number of midwives needed to provide 1-1 care for 95% of time</td><td>14 (3 extra midwives required)</td><td>Target is currently met</td><td>Target is likely to be met if post labour care is removed from calculations</td></tr>
</table>
*Calculations were based on one to one midwifery care being delivered during labour and for post labour care in the Alongside Midwifery Unit (AMU)
</td></tr>
<tr><td>Authors conclusions</td><td>In the labour ward, one-to-one care was achievable for around three quarters of the time, which is broadly in line with the national average. Three extra midwives on the ward (an increase of a third) would be required to provide one to one care for 95% of the time.</td></tr>
<tr><td>Limitations</td><td>Analysis was focused on one hospital
Midwife staffing for other work is not considered</td></tr>
<tr><td>Comments</td><td>This study was referenced by the National Audit Office report on Maternity Services in England as providing evidence that Birthrate Plus is insufficient for one-to-one midwifery care to be provided for every woman during established labour.

This study does not state that Birthrate plus was used in the trust providing the data, and so the statement made in the NAO report is based on an assumption that BR+ was used, and contact contact with the authors who indicated that it is highly likely that Birthrate plus would have been used in the majority of organisations where the data was collected from.</td></tr>
</table>