National Institute for Health and Care Excellence

Draft for consultation

Intrapartum care for women with existing medical conditions or obstetric complications and their babies

[H] Evidence reviews for acute kidney injury or chronic kidney disease

NICE guideline <TBC at publication>

Evidence reviews for women at high risk of adverse outcomes for themselves and/or their baby because of existing maternal medical conditions

September 2018

Draft for consultation

Developed by the National Guideline Alliance hosted by the Royal College of Obstetricians and Gynaecologists

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Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease

This evidence report contains information on 2 reviews relating to intrapartum care for women who develop an acute kidney injury or have chronic kidney disease.

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- Which women who develop an acute kidney injury or have chronic kidney disease should be offered early birth (via induction of labour or elective caesarean section) for reasons specific to kidney disease?

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – fluid management

Review question

What is the most effective fluid management regimen for women who develop an acute kidney injury or have chronic kidney disease and who are in the peripartum period?

Introduction

The aim of this review is to identify whether there is any particular fluid management regimen which produces better outcomes in women with chronic kidney disease or who develop an acute kidney injury during the peripartum period. The committee was aware of the NICE guideline on chronic kidney disease in adults: assessment and management (CG182).

Summary of the protocol

See Table 1 for a summary of the population, intervention, comparison, and outcomes (PICO) characteristics of this review.

Table 1: Summary of the protocol (PICO) table

Population	Women with chronic kidney disease and acute kidney injury, including transplant recipients
Intervention	Renal fluid management plan, especially a plan including furosemide or dopamine
Comparison	• Absence of any renal fluid management plan (either no management or renal fluids managed through dialysis) • Different renal fluid management plans compared with each other
Outcomes	For the woman: • mortality • major morbidity (acute dialysis or other renal replacement therapy, permanent decline in renal function, or end-stage kidney failure) • women's satisfaction with labour and birth (including psychological wellbeing) For the baby: • stillbirth • mortality

For further details see the full review protocol in Appendix A. The search strategies are presented in Appendix B.

Clinical evidence

Included studies

No clinical evidence was identified for this review.

See the study selection flow chart in Appendix C.

Excluded studies

Studies not included in this review with reasons for their exclusion are listed in Appendix D.

Summary of clinical studies included in the evidence review

No clinical evidence was identified for this review (and so there are no evidence tables in Appendix E). No meta-analysis was undertaken for this review (and so there are no forest plots in Appendix F).

Quality assessment of clinical studies included in the evidence review

No clinical evidence was identified for this review (and so no quality assessment was undertaken and there are no GRADE tables in Appendix G).

Economic evidence

Included studies

No economic evidence was identified for this review.

See the study selection flow chart in Supplement 2 (Health economics).

Excluded studies

No full-text copies of articles were requested for this review and so there is no excluded studies list (see Supplement 2 (Health economics)).

Summary of studies included in the economic evidence review

No economic evidence was identified for this review (and so there are no economic evidence tables in Supplement 2 (Health economics)).

Economic model

No economic modelling was undertaken for this review because the committee agreed that other topics were higher priorities for economic evaluation (see Supplement 2 (Health economics)).

Evidence statements

No clinical evidence was identified for this review.

Recommendations

H1. During pregnancy, involve the multidisciplinary team in risk assessment for women with renal impairment. Include a specialist with expertise in managing renal conditions in pregnant women.

H2. Ensure that women with chronic kidney disease stage 4 or 5 are cared for in the intrapartum period by a midwife, obstetrician and obstetric anaesthetist with expertise in managing renal conditions in pregnant women.

H3. Ensure that a physician with expertise in renal conditions in pregnant women is available for consultation during the intrapartum period for women with chronic kidney disease stage 4 or 5.

H4. Manage renal impairment secondary to pre-eclampsia in line with the NICE guideline on hypertension in pregnancy.

H5. For women with chronic kidney disease with or without pre-eclampsia, monitor fluid balance in the intrapartum period. Assessment, at least every 4 hours, should include:

- heart rate and blood pressure
- respiratory rate and chest auscultation
- fluid output and fluid intake
- oxygen saturation
- jugular venous pressure.

After each assessment develop an individualised plan for managing fluid balance, which may involve additional monitoring techniques, with the aim of maintaining normal fluid volume to reduce the risks of dehydration and pulmonary oedema.

H6. For women with chronic kidney disease and pre-eclampsia, manage fluid balance in the intrapartum period according to recommendation 1.8.5, taking account of the particular risk of acute kidney injury and pulmonary oedema.

H7. Assess renal function at least every 24 hours during the intrapartum period in all women with chronic kidney disease because prolonged labour may lead to dehydration and acute kidney injury.

H8. For women with acute kidney injury without pre-eclampsia:

- identify and correct the cause of the acute kidney injury
- monitor fluid balance in the intrapartum period by assessing the following at least every 4 hours:
  - heart rate and blood pressure
  - respiratory rate and chest auscultation
  - fluid output and fluid intake
  - oxygen saturation
  - jugular venous pressure
- develop an individualised plan for managing fluid balance, which may involve additional monitoring techniques with the aim of maintaining normal fluid volume and avoiding both dehydration and pulmonary oedema

- consider giving a single small bolus of fluid (for example, 250 ml) as crystalloid if the woman is dehydrated and review the fluid status and urine output within an hour of giving the first fluid bolus and before considering giving a second
- continue to monitor fluid balance and renal function until the acute kidney injury has recovered.

H9. Do not offer nephrotoxic drugs (for example, non-steroidal anti-inflammatory drugs) in the intrapartum period to women with renal impairment.

H10. For all women with renal impairment during pregnancy:

- monitor the following at least every 4 hours for at least 24 hours after the birth:
  - heart rate and blood pressure
  - respiratory rate and chest auscultation
  - fluid output and fluid intake
  - oxygen saturation
  - jugular venous pressure
- ensure postpartum assessment of renal function and follow-up for women with persistent renal impairment.

Research recommendations

What is the optimal methods of assessment of fluid balance during child birth in women with acute kidney injury or chronic kidney disease?

Rationale and impact

Why the committee made the recommendations

Managing fluid balance in women with renal impairment during pregnancy is extremely difficult – dehydration can cause acute kidney injury, especially in those with underlying chronic kidney disease, but fluid overload can rapidly lead to pulmonary oedema, especially in women with superimposed pre-eclampsia.

Although there was limited evidence on fluid management, its importance has been emphasised by successive confidential enquiries. The committee agreed that fluid management would vary, depending on the clinical condition of the woman and her baby.

The committee knew from their experience that action could often be taken to improve outcomes if the issue was identified in time. Therefore they recommended regular frequent monitoring every 4 hours during the intrapartum period, including monitoring after birth. As oliguria is very common in healthy women in the postpartum period, the assessment of urine output more frequently than every 4 hours can be misleading. Exactly what should be monitored would depend on the clinical condition of the woman, but would include observations to assess fluid status, including blood pressure, chest sounds, fluid intake and output, oxygen saturation and jugular venous pressure.

The committee agreed that it was important to remind professionals caring for women in labour and during birth that commonly used drugs that are known to be nephrotoxic (for

example, non-steroidal anti-inflammatory drugs) should not be offered to women with chronic kidney disease or acute kidney injury.

Impact of the recommendations on practice

Current practice is highly variable. The recommendations will mean more observation of women with renal impairment, with increased work for healthcare professionals. But they should lead to significantly fewer instances of morbidity.

The committee agreed that women with pre-existing chronic kidney disease are particularly vulnerable to both acute kidney injury and pre-eclampsia. By managing fluid balance more effectively, the risk of acute kidney injury in women with chronic kidney disease can be reduced. This will improve short and longer term outcomes for women and benefit healthcare systems with reduced length of stay.

The committee's discussion of the evidence

Interpreting the evidence

The outcomes that matter most

Maternal and neonatal outcomes were prioritised for this review, as the committee was aware that inadequately managed renal conditions in pregnancy could cause long-term health problems for both the woman and the baby.

Maternal and neonatal mortality including stillbirths were considered as critical outcomes because this was a fatal outcome for both the woman and baby if fluid replacement regimens were inappropriate in their management. Moreover, maternal major morbidities such as the need for acute dialysis or other renal replacement therapy, permanent decline in renal function and end stage kidney failure were regarded as an outcome of critical importance because these complications can lead to major interventions during the peripartum period.

Women's experience of labour and birth was considered to be an important outcome because this would inform healthcare professionals when thinking about the choice of different fluid regimens to be offered.

The quality of the evidence

No clinical evidence was identified for this review.

Benefits and harms

In this guideline, the committee decided to use a definition of chronic kidney disease (CKD) on a scale of 1-5, where 5 represents the worst possible kidney function (complete kidney failure) and 1 represents normal kidney function (but with some evidence of kidney disease). This classification is based on a measure of glomerular filtration rate (GFR) (Table 2).

Table 2: Stages of chronic kidney disease as defined by the US National Kidney Foundation kidney disease outcomes quality initiative (NKF-KDOQI)

Stage*	Glomerular filtration rate (GFR) (ml/min/1.73 m^2)	Description	Increasing severity of CKD
1	≥ 90	Kidney damage with normal or increased GFR	
2	60-89	Kidney damage with mild decreased GFR	
3	30-59	Moderately decreased GFR	
4	15-29	Severely decreased GFR	
5	< 15 (or dialysis)	Kidney failure	

CKD: chronic kidney disease; GFR: glomerular filtration rate
**Stages 1 and 2 require the presence of markers of kidney damage; stages 3 to 5 require a finding of a GFR < 60 ml/min/1.73 m^2 on at least 2 occasions separate by at least 90 days.*
Source: Compiled from NKF-KDOQI

The committee were aware of the NICE guideline on chronic kidney disease in adults (CG182) which uses a more nuanced system of measurement, that combines the GFR score with a measure of the albumin:creatinine ratio (ACR), to account for the possibility that, for example, a person has a normal GFR but a very high ACR, which would be indicative of at least a moderate problem. While accepting that the more modern measure in the NICE guideline on chronic kidney disease in adults (CG182) is generally more accurate, the committee agreed it would be inappropriate in the case of pregnant women, since:

- pregnant women are expected to have a high ACR, and so this is normal
- the measure has not been validated in pregnant women
- all major studies using the new measure explicitly exclude pregnant women, meaning that the findings are not tailored to the women of relevance in this guideline.

For these reasons, the committee decided to use only the GFR aspect of the recommendations in the NICE guideline on chronic kidney disease in adults (CG182), and not the ACR aspect.

The committee discussed how fluid management for women with renal disease could be very complex, and had to be tailored to the clinical condition of the individual woman and her baby. Therefore, the committee agreed that the multidisciplinary team (MDT) should include a specialist (usually a nephrologist or obstetric physician) with expertise in managing renal conditions during pregnancy, and the MDT should be responsible for assessing risk and agreeing with the woman a plan of care prior to the intrapartum period (see the guideline evidence review for antenatal care planning involving an MDT [Evidence review B in the consultation draft guideline]). The committee added that women with chronic kidney disease stage 4 or 5 (CKD4 or CKD5) had such complex fluid management requirements that it was important that management in the intrapartum period was provided by a midwife, an obstetrician and an obstetric anaesthetist with expertise in managing renal conditions in pregnancy. They further recommended that a physician with expertise managing in renal conditions in pregnancy should be available for consultation during the intrapartum period.

The committee was aware that the risk of pre-eclampsia was much higher in women with renal impairment, but it was also true that renal impairment (especially pre-existing renal impairment) could be a consequence of pre-eclampsia. Since in the case of pre-existing renal impairment pre-eclampsia is the primary condition, the committee recommended

managing renal impairment secondary to this in line with the existing NICE guideline on hypertension in pregnancy (CG107).

The aim of fluid management in this population is that the woman is 'euvolaemic' (having the optimal amount of fluid so that she remains hydrated without overloading her). This becomes more and more challenging as the kidney function deteriorates, until the extreme management option of dialysis to maintain the correct fluid volume. In clinical practice, it is difficult to know when euvolaemia is achieved. It is sometimes not possible to achieve euvolaemia if the kidneys are sufficiently damaged and dialysis is not seen as an appropriate management option. Clinicians need to make a difficult judgement as to whether to put strain on the woman's kidneys (which can lead to renal failure and death) by tolerating a degree of dehydration in line with the NICE guideline on hypertension in pregnancy or protecting the kidneys with good hydration which tip the woman's condition into pulmonary oedema, which can also lead to serious morbidity or death. Consequently the committee recommended assessing for correct volume status (euvolaemia) at least every 4 hours, by assessing various measures of hydration status. The committee justified 4 hours as the maximum time between checks based on their expert consensus in the absence of published evidence. As women with renal impairment are a clinically heterogeneous group, the plan for managing fluid balance after each assessment should be tailored to the individual.

The committee noted that clinicians needed to be aware that even the condition of women with quite mild renal impairment could worsen during a prolonged labour, as dehydration is a risk factor for acute kidney injury. The committee recommended an assessment of renal function in prolonged labour to prevent this. The justification for a 24-hour timescale was that dehydration due to prolonged labour was unlikely to occur earlier than this.

Although acute kidney injury and chronic kidney disease are very different conditions in terms of general management and prognosis, the committee did not see the need to make substantially different recommendations for each condition in the context of fluid management during labour and birth; the clinical problem of finding the balance between over- and under-hydration is almost the same for both types of renal impairment. The major difference between the conditions is that it may be possible to correct the cause of acute kidney injury in the intrapartum period, whereas this is not possible for chronic kidney injury.

The committee described how it was possible that acute kidney injury might occur because the woman was clinically dehydrated (possibly because of a haemorrhage). The committee described how rehydrating the woman was clinically important, and suggested that a single small bolus of fluid (for example, 250 ml) as crystalloid was least likely to overload the heart (leading to pulmonary oedema) and offered clinicians the most flexible options to respond with more fluid after the initial challenge.

The committee agreed that the risk of negative outcomes would persist after the birth for women with renal conditions, and so the same maternal checks should be carried out in the immediate postpartum period. The committee justified a 24-hour cut-off as this is the time frame that most fluid shifts occur between physiological compartments when the risk of fluid balance misadventures is the highest. They were aware that postnatal follow up is important but this was beyond the scope of this guideline. They therefore recommended that provision for postpartum follow-up should be place, without recommending what this should consist of.

The committee explained how clinicians might want to offer nephrotoxic drugs to women with renal impairment, and clarified on the basis of their experience that this would be medically ill-advised. The committee justified a strong recommendation on the grounds that the obvious

harm of giving nephrotoxic drugs to a woman with renal impairment offsets the beneficial effect of nephrotoxic drugs.

Cost effectiveness and resource use

No clinical evidence was found for this review and the committee made a qualitative assessment of recommendations.

The committee recognised that managing fluid balance during pregnancy is clinically challenging, as dehydration can cause acute kidney injury while fluid overload can rapidly lead to pulmonary oedema. Inappropriate fluid management can result in mortality in either the woman or the baby as well as major morbidities, resulting in large losses in health related quality of life and expensive 'downstream' costs such as acute dialysis or other renal replacement therapy. Therefore, the committee considered the recommendations aimed at achieving optimal fluid management were likely to be cost effective, especially as they considered from their experience, that action could be taken to improve outcomes if the issues were identified in time. In order to achieve the timely recognition of issues they recommended regular frequent monitoring every 4 hours. However, they did not think monitoring urine output more frequently than every 4 hours would be cost effective, as oliguria is also very common in healthy postpartum women.

Maternal and neonatal outcomes were prioritised for the review because the committee was aware that inadequately managed renal conditions in pregnancy could cause long-term health problems for both the woman and the baby.

The committee agreed recommendations that are likely to lead to an increase in both specialist involvement and non-specialist clinical time observing women with renal impairment. These both carry opportunity costs of relevance to the NHS, as the clinical time used in this way cannot be used for anything else. The recommendations will be justified provided the increased frequency and expertise of monitoring prevents significant co-morbidities such as acute kidney injury or pulmonary oedema, as well as preventing the need for dialysis (either during the intrapartum period or afterwards, due to chronic damage to the kidneys).

Overall, the prevalence of chronic kidney disease in pregnancy is approximately 3% but not all of that is disease stage 4 or 5 (CKD4 or CKD 5). The committee thought that there was considerable variation in current practice and they accepted that their recommendations might entail more observation of women with renal impairment, with an increased workload for healthcare professionals. However, they also thought the recommendations would mitigate the risks of morbidity and reduce the duration of hospital stay. Although the committee recognised that there might be a cost impact to the NHS of their recommendation the direction of this impact was not clear. Overall they considered it unlikely that the resource impact would be significant.

Other factors the committee took into account

The committee discussed how many of the examinations they recommended will be helpful only if the woman's condition is already deviating from the ideal euvolaemic state. For example, chest auscultation is only useful in this context for detecting fluid in the lungs, which would indicate that the woman has too much fluid for her kidneys to handle. The committee

described how ‘euvolaemia’ is therefore less a clinical state that one could test for, and rather a conceptual state indicating the absence of any iatrogenic effects of fluid management.

The committee discussed how – in the case of very severe renal failure such as chronic kidney disease stage 4 or 5 (CKD4 or CKD5) – the requirement of a specialist renal unit and round-the-clock specialist cover might be a more important consideration for the woman than her preferred place of birth.

Because only poor quality, non-comparative evidence was available, the committee chose to make a research recommendation about how the woman’s fluid balance should be assessed to guide fluid management. See Appendix L for further details.

As noted above, the committee decided to use only the GFR aspect of the recommendations in the NICE guideline on chronic kidney disease in adults (CG182), and not the ACR aspect. The committee noted that that this was a possible area for future research, although they did not formulate a specific research recommendation in this area.

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – early birth

Review question

Which women who develop an acute kidney injury or have chronic kidney disease should be offered early birth (via induction of labour or elective caesarean section) for reasons specific to kidney disease?

Introduction

The aim of this review is to examine outcomes for women with chronic kidney disease or acute kidney injury and their babies following early childbirth (through caesarean section or induction of labour) compared with later spontaneous birth. This is important because determining whether an early birth should be offered is a decision that is complex in these women), needing to take into account the rate of deterioration in renal function and the severity of the condition. The committee was aware of the NICE guideline on chronic kidney disease in adults: assessment and management (CG182).

Summary of the protocol

See Table 3 for a summary of the population, intervention, comparison, and outcomes (PICO) characteristics of this review.

Table 3: Summary of the protocol (PICO) table

Population	Women with chronic kidney disease or acute kidney injury or who have had a kidney transplant
Intervention	Early birth (via induction of labour or elective caesarean section)
Comparison	No intervention for early birth
Outcomes	For the woman: • mortality • major morbidity (irreparable kidney damage, end-stage kidney failure, hypertension, or cardiovascular disease) • women's satisfaction with labour and birth (including psychological wellbeing) For the baby: • stillbirth • mortality • low birth weight

For further details see the full review protocol in Appendix A. The search strategies are presented in Appendix B.

C Clinical evidence

2 Included studies

3 Two prospective and 5 retrospective case series were included in this review (see 'Summary
4 of clinical studies included in the evidence review').

5 The included studies reported on the incidence of outcomes stratified by the stage of renal
6 disease of the woman (Alsuwaida 2011, Davidson 2015, Khoury 2002, North 2000, Oviasu
7 1991, Piccoli 2011, Singh 2015).

8 Evidence from the studies included in the review is summarised below (see 'Quality
9 assessment of clinical studies included in the evidence review').

10 Data was reported on the critical outcomes, still birth and perinatal mortality, and the
11 important outcomes maternal major morbidity and low birth weight. There was no evidence
12 identified for the following outcomes for the woman: mortality (critical outcome) and women's
13 satisfaction with labour and birth (important outcome).

14 See also the study selection flow chart in Appendix C.

15 Excluded studies

16 Studies not included in this review with reasons for their exclusions are provided in Appendix
17 D.

18 Summary of clinical studies included in the evidence review

19 Table 3 provides a brief summary of the included studies.

20 **Table 4: Summary of included studies**

Study	Population	Intervention/ Comparison	Outcomes
Alsuwaida 2011 Retrospective case series Saudi Arabia, Bahrain, United Arab Emirates	N=98 pregnancies among women with pre-existing primary renal disease who were seen at five centres between 2002 and 2008 Underlying causes of CKD: • primary glomerulonephritis n=23 • lupus nephritis n=26 • diabetic nephropathy n=7 • hypertensive nephropathy n=6 • other causes n=25	Incidence of prioritised outcomes stratified by CKD stage	For the woman: • Pre-eclampsia • Renal deterioration For the baby: • Stillbirth • Low birth weight

Study	Population	Intervention/ Comparison	Outcomes
	CKD stage assigned based on KDOQI guidelines		
Davidson 2015 Retrospective case series Australia	N=55 women with renal disease pre-partum giving birth in the study hospital between 2003 and 2010 Renal pathologies: • SLE n=4 • diabetes mellitus n=9 • chronic glomerulonephritis n=9 • reflux nephropathy n=8 • PCKD n=1 • post-transplant 2° glomerular nephritis n=2 • other n=22 CKD stage was assigned using KDOQI guidelines	Incidence of prioritised outcomes stratified by CKD stage	For the woman: • Renal deterioration • Hypertension • Pre-eclampsia For the baby: • Perinatal mortality • SGA
Khoury 2002 Retrospective case series US	N=72 pregnancies in women with type 1 diabetes and nephropathy Stratification based on enrolment serum creatinine concentrations: Group 1: ≤1.0 mg/dl n=49 Group 2: 1.0-1.5 mg/dl n=13 Group 3: >1.5 mg/dl n=10 Converted to: Groups 1 and 2: mild CKD n=62 Group 3: moderate/severe CKD n=10	Incidence of prioritised outcomes stratified by serum creatinine concentrations	For the woman: • Pre-eclampsia For the baby: • Perinatal death • SGA
North 2000 Prospective case series New Zealand	N=54 women with reflux nephropathy who delivered at a tertiary hospital between 1991 and 1996		For the woman: • Renal deterioration • Hypertension • Pre-eclampsia For the baby:

Study	Population	Intervention/ Comparison	Outcomes
			• SGA
Oviasu 1991 Retrospective case series UK	N=39 pregnant women with pre-existing lupus nephritis seen in a tertiary referral centre for nephrology Renal biopsies from the patients were reviewed and classified according to the lupus nephritis criteria of the WHO classes 2-5: Class 2 n=5 Class 3 n=7 Class 4 n=18 Class 5 n=6 Unknown n=3	Incidence of prioritised outcomes stratified by WHO renal biopsy class	For the baby: • Stillbirth
Piccoli 2011 Prospective case series Italy	N=504 singleton live births among women with cohorts of CKD patients followed-up in pregnancy between 2000 and 2013 CKD stage defined by the KDOQI guidelines: 1 n=370 2 n=87 3 n=37 4-5 n=10	Incidence of prioritised outcomes stratified by CKD stage	For the woman: • Renal deterioration • Hypertension For the baby: • SGA
Singh 2015 Retrospective case series India	N=51 pregnant women with CKD seen between 2009 and 2012 CKD was defined using KDOQI guidelines	Incidence of prioritised outcomes stratified by CKD stage	For the woman: • Pre-eclampsia • End stage renal failure For the baby: • Stillbirth • Low birth weight

CKD: chronic kidney disease; KDOQI: Kidney Disease Outcomes Quality Initiative; PCKD: polycystic kidney disease; SGA: small for gestational age; SLE: systemic lupus erythematosus; WHO: World Health Organization

See also the study evidence tables in Appendix E. No meta-analysis was undertaken for this review (and so there are no forest plots in Appendix F).

Quality assessment of clinical studies included in the evidence review

2 The clinical evidence for this review question are presented in Table 5 and Table 6.

3 **Table 5: Outcomes for the woman according to stage of renal disease**

Study	Number of pregnancies with outcomes/total number of pregnancies (%) By renal disease stage		Quality	Importance
Deterioration of kidney function				
Alsuwaida 2011 Retrospective case series	Stage 1	0/67 (0%)	Very low[1]	Critical
	Stage 2	3/21 (14.3%)		
	Stage 3-4	6/10 (60%)		
	Definition of the outcome: an increment of ≥25% serum creatinine during pregnancy or 6 weeks postpartum			
Davidson 2015 Retrospective case series	Stage 1-2	0/27 (0%)	Very low[1]	Critical
	Stage 3-5	4/28 (14.3%)		
	Definition of the outcome: Commencement of dialysis for renal deterioration			
Piccoli 2015 Retrospective case series	Stage 1	28/370 (0.8%)	Very low[1]	Critical
	Stage 2	1/87 (1.1%)		
	Stage 3	6/37 (16.2%)		
	Stage 4-5	2/10 (20%)		
	Definition of the outcome: Increase of at least 1 CKD stage			
North 2000 Prospective case series	Normal renal function	1/33 (3%)	Very low[1]	Critical
	Mild CKD	5/13 (38.5%)		
	Moderate CKD	3/5 (60%)		
	Definition of the outcome: An increment of ≥25% serum creatinine to at least 110 micromol/L			
End stage kidney failure within 6 weeks after birth				
Singh 2015 Retrospective case series	Stage 1-2	0/32 (0%)	Very low[1]	Critical
	Stage 3	0/13 (0%)		
	Stage 4	3/6 (50%)		
Hypertension				
Davidson 2015 Retrospective case series	Stage 1-2	19/27 (70.4%)	Very low[1]	Important
	Stage 3-5	23/28 (82.1%)		
Piccoli 2015	Stage 1	80/370 (21.6%)	Very low[1]	Important
	Stage 2	36/87 (41.3%)		
	Stage 3	20/37 (53.1%)		

Study	Number of pregnancies with outcomes/total number of pregnancies (%) By renal disease stage		Quality	Importance
Retrospective case series	Stage 4-5	2/10 (20%)		
North 2000 Prospective case series	Normal renal function	8/33 (24.4%)	Very low[1]	Important
	Mild CKD	6/13 (46.2%)		
	Moderate CKD	4/5 (80%)		
Pre-eclampsia				
Alsuwaida 2011 Retrospective case series	Stage 1	9/67 (13.4%)	Very low[1]	Important
	Stage 2	10/21 (47.6%)		
	Stage 3-4	4/10 (40%)		
Davidson 2015 Retrospective case series	Stage 1-2	17/27 (63%)	Very low[1]	Important
	Stage 3-5	20/28 (71.4%)		
Singh 2015 Retrospective case series	Stage 1-2	2/32 (6.2%)	Very low[1]	Important
	Stage 3	3/13 (23.1%)		
	Stage 4	4/6 (66.7%)		
Khoury 2002 Retrospective case series	Mild CKD	20/51 (39.2%)	Very low[1]	Important
	Moderate CKD	4/9 (44.4%)		
North 2000 Prospective case series	Normal renal function	7/33 (21.2%)	Very low[1]	Important
	Mild CKD	2/13 (15.4%)		
	Moderate CKD	2/5 (40%)		

1 *CKD: chronic kidney disease*
2 *1 Descriptive data from a case series study.*

3 **Table 6: Outcomes for the baby according to stage of maternal renal disease**

Study	Number of babies with outcome/total number of babies (%) By renal disease stage		Quality	Importance
Stillbirth				
Alsuwaida 2011 Retrospective case series	Stage 1	2/67 (3%)	Very low[1]	Critical
	Stage 2	3/21 (14.3%)		
	Stage 3-4	1/10 (10%)		
Singh 2015 Retrospective case series	Stage 1-2	6/32 (18.8%)	Very low[1]	Critical
	Stage 3	6/13 (46.2%)		
	Stage 4-5	3/6 (50%)		

Study	Number of babies with outcome/total number of babies (%) By renal disease stage		Quality	Importance
Oviasu 1991 Retrospective case series	Lupus nephritis Class 2	1/5[2] (20%)	Very low[1]	Critical
	Lupus nephritis Class 3	0/7 (0%)		
	Lupus nephritis Class 4	0/18 (0%)		
	Lupus nephritis Class 5	0/6 (0%)		
	Unknown	0/3 (0%)		
Perinatal mortality				
Davidson 2015 Retrospective case series	Stage 1-2	2/27 (7.4%)	Very low[1]	Critical
	Stage 3-5	4/28 (14.3%)		
Khoury 2002 Retrospective case series	Mild CKD	2/51 (3.4%)	Very low[1]	Critical
	Moderate CKD	1/9 (11.1%)		
Low birth weight				
Alsuwaida 2011 Retrospective case series	Stage 1	15/67 (22.4%)	Very low[1]	Important
	Stage 2	10/21 (47.6%)		
	Stage 3-4	7/10 (70%)		
Singh 2015 Retrospective case series	Stage 1-2	5/32 (15.6%)	Very low[1]	Important
	Stage 3	1/13 (7.7%)		
	Stage 4-5	2/6 (33.3%)		
Low birth weight: small for gestational age				
Davidson 2015 Retrospective case series	Stage 1-2	7/27 (26%)	Very low[1]	Important
	Stage 3-5	13/28 (46.4%)		
Piccoli 2015 Retrospective case series	Stage 1	49/370 (13.2%)	Very low[1]	Important
	Stage 2	16/87 (18.4%)		
	Stage 3	7/37 (18.9%)		
	Stage 4-5	5/10 (50%)		
Khoury 2002 Retrospective case series	Mild CKD	4/51 (7.8%)	Very low[1]	Important
	Moderate CKD	3/10 (33.3%)		

Study	Number of babies with outcome/total number of babies (%) By renal disease stage		Quality	Importance
North 2000 Prospective case series	Normal renal function	3/33 (9.1%)	Very low[1]	Important
	Mild CKD	1/13 (7.7%)		
	Moderate CKD	1/5 (20%)		

CKD: chronic kidney disease
1 Descriptive data from a case series study.
2 Preterm, 34 weeks of gestation.

Economic evidence

Included studies

No economic evidence was identified for this review.

See the study selection flow chart in Supplement 2 (Health economics).

Excluded studies

No full-text copies of articles were requested for this review and so there is no excluded studies list (see Supplement 2 (Health economics)).

Summary of studies included in the economic evidence review

No economic evidence was identified for this review (and so there are no economic evidence tables in Supplement 2 (Health economics)).

Economic model

No economic modelling was undertaken for this review because the committee agreed that other topics were higher priorities for economic evaluation (see Supplement 2 (Health economics)).

Evidence statements

<u>Outcomes for the woman</u>

Major morbidity: Deterioration of kidney function

Very low quality evidence from 1 retrospective case series of women with CKD (N=98) showed that 3 out of 21 women (14%) with stage 2 CKD and 6 out of 10 women (60%) with stage 3-4 CKD, developed deterioration of kidney function, defined as an increment of ≥25% serum creatinine during pregnancy or 6 weeks after birth. Kidney function did not deteriorate for any of the 67 women with stage 1 CKD.

Very low quality evidence from 1 retrospective case series of women with CKD (N=55) showed that 4 out of 28 women (14%) with stage 3-5 CKD had to commence dialysis for renal deterioration. None of the 27 women with stage 1-2 CKD had to commence dialysis for renal deterioration.

Very low quality evidence from 1 retrospective case series of women with CKD (N=504) showed that 28 out of 370 women (1%) with stage 1 CKD, 1 out of 87 women (1%) with stage 2 CKD, 6 out of 37 women (16%) with stage 3 CKD and 2 out of 10 women (20%) with stage 4-5 CKD developed deterioration of kidney function, defined as an increase of at least 1 CKD stage.

Very low quality evidence from 1 prospective case series of women with CKD (N=51) showed that 1 out of 33 women (3%) with normal renal function, 5 out of 13 women (39%) with mild CKD and 3 out of 5 women (60%) with moderate CKD developed deterioration of kidney function, defined as an increment of ≥25% serum creatinine to at least 110 micromol/l.

Major morbidity: End-stage kidney failure

Very low quality evidence from 1 retrospective case series of women with CKD (N=51) showed that 3 out of 6 women (50%) with stage 4 CKD developed end-stage kidney failure within 6 weeks after birth. None of the women with stage 1-3 CKD developed end-stage kidney failure.

Major morbidity: Hypertension

Very low quality evidence from 1 retrospective case series of women with CKD (N=55) showed that 19 out of 27 women (70%) with stage 1-2 CKD and 23 out of 28 women (82%) with stage 3-5 CKD developed hypertension.

Very low quality evidence from 1 retrospective case series of women with CKD (N=504) showed that 80 out of 370 women (22%) with stage 1 CKD, 36 out of 87 women (41%) with stage 2 CKD, 20 out of 37 women (53%) with stage 3 CKD, and 2 out of 10 women (20%) with stage 4-5 CKD developed hypertension.

Very low quality evidence from 1 prospective case series of women with CKD (N=54) showed that 8 out of 33 women (24%) with normal renal function, 6 out of 13 women (46%) with mild CKD and 4 out of 5 women (80%) with moderate CKD developed hypertension.

Major morbidity: Pre-eclampsia

Very low quality evidence from 1 retrospective case series of women with CKD (N=98) showed that 9 out of 67 women (13%) with stage 1 CKD, 10 out of 21 women (48%) with stage 2 CKD, and 4 out of 10 women (40%) with stage 3-4 CKD developed pre-eclampsia.

Very low quality evidence from 1 retrospective case series of women with CKD (N=55) showed that 17 out of 27 women (63%) with stage 1-2 CKD and 20 out 28 women (71%) with stage 3-5 CKD developed pre-eclampsia.

Very low quality evidence from 1 retrospective case series of women with CKD (N=51) showed that 2 out of 32 women (6%) with stage 1-2 CKD, 3 out of 13 women (23%) with stage 3 CKD, and 4 out of 6 women (67%) with stage 4 CKD developed pre-eclampsia.

Very low quality evidence from 1 retrospective case series of women with CKD (N=60) showed that 20 out of 51 women (39%) with mild CKD and 4 out of 9 women (44%) with moderate CKD developed pre-eclampsia.

Very low quality evidence from 1 prospective case series of women with CKD (N=51) showed that 7 out of 33 women (21%) with normal renal function, 2 out of 13 women (15%) with mild CKD and 2 out of 5 women (40%) with moderate CKD developed pre-eclampsia.

Outcomes for the baby

Stillbirth

Very low quality evidence from 1 retrospective case series of women with CKD (N=98) showed that 2 out of 67 babies (3%) of women with stage 1 CKD, 3 out of 21 babies (14%) of women with stage 2 CKD, and 1 out of 10 babies (10%) of women with stage 3-4 CKD suffered stillbirth.

Very low quality evidence from 1 retrospective case series of women with CKD (N=51) showed that 6 out of 32 babies (19%) of women with stage 1-2 CKD, 6 out of 13 babies (46%) of women with stage 3 CKD, and 3 out of 6 babies (50%) of women with stage 4-5 CKD suffered stillbirth.

Very low quality evidence from 1 retrospective case series of women with CKD (N=39) showed that 1 out of 5 babies (20%) of women with class 2 lupus nephritis suffered a still birth. There were no stillbirth in babies of women with class 3-5 lupus nephritis.

Perinatal mortality

Very low quality evidence from 1 retrospective case series of women with CKD (N=55) showed that 2 out of 27 babies (7%) of women with stage 1-2 CKD and 4 out of 28 babies (14%) of women with stage 3-5 CKD died perinatally.

Very low quality evidence from 1 retrospective case series of women with CKD (N=60) showed that 2 out of 51 babies (3%) of women with mild CKD and 1 out of 9 babies (11%) of women with moderate CKD died perinatally.

Low birth weight

Very low quality evidence from 1 retrospective case series of women with CKD (N=98) showed that 15 out of 67 babies (22%) of women with stage 1 CKD, 10 out of 21 babies (48%) of women with stage 2 CKD, and 7 out of 10 babies (70%) of women with stage 3-4 CKD were born with low birth weight.

Very low quality evidence from 1 retrospective case series of women with CKD (N=51) showed that 5 out of 32 babies (16%) of women with stage 1-2 CKD, 1 out of 13 babies (8%) of women with stage 3 CKD, and 2 out of 6 babies (33%) of women with stage 4-5 CKD were born with low birth weight.

Small for gestational age

Very low quality evidence from 1 retrospective case series of women with CKD (N=55) showed that 7 out of 27 babies (26%) of women with stage 1-2 CKD, 13 out of 28 babies (46%) of women with stage 3-5 CKD were born small for gestational age.

Very low quality evidence from 1 retrospective case series of women with CKD (N=504) showed that 49 out of 370 babies (13%) of women with stage 1 CKD, 16 out of 87 babies (18%) of women with stage 2 CKD, 7 out of 37 babies (19%) of women with stage 3 CKD, and 5 out of 10 babies (50%) of women with stage 4-5 CKD were born small for gestational age.

Very low quality evidence from 1 retrospective case series of women with CKD (N=61) showed that 4 out of 51 babies (8%) of women with mild CKD and 3 out of 10 babies (33%) of women with moderate CKD were born small for gestational age.

Very low quality evidence from 1 prospective case series of women with CKD (N=51) showed that 3 out of 33 babies (9%) of women with normal renal function, 1 out of 13 babies (8%) of women with mild CKD and 1 out of 5 babies (20%) of women with moderate CKD were born small for gestational age.

Recommendations

H11. Plan intrapartum care for women with renal disease due to acute lupus nephritis, vasculitis or glomerulonephritis with a specialist with expertise in managing renal conditions in pregnant women as early as possible in the antenatal period.

H12. For women with chronic kidney disease stage 1, stable renal function and non-nephrotic range proteinuria (urine protein: creatinine ratio greater than 300 mg/mmol), discuss timing and mode of birth with the woman and her birth companion(s), and base the decision on obstetric indications and the woman's preference.

H13. Consider planned birth by 40+0 weeks of pregnancy for women with:

- chronic kidney disease stage 1 and nephrotic-range proteinuria (urine protein: creatinine ratio greater than 300 mg/mmol), or
- chronic kidney disease stage 2 to 4 with stable renal function.

H14. For women with chronic kidney disease stage 5 or deteriorating stage 4 before 34+0 weeks of pregnancy, discuss the option of dialysis with the woman and the multidisciplinary team in an effort to prolong the pregnancy to at least 34 weeks'.

H15. For women with chronic kidney disease stage 5 or deteriorating stage 4 after 34+0 weeks of pregnancy, discuss the option of planned birth with the woman and the multidisciplinary team and consider birth no later than 38+0 weeks'.

H16. For all women with renal conditions, including those with a renal transplant, discuss mode of birth with the woman and her birth companion(s), and base the decision on obstetric indications and the woman's preference.

H17. If a women with a renal transplant is having a caesarean section, consider involving a renal transplant surgeon in discussion of plans for surgery.

Research recommendations

What is the optimal timing of birth for women with chronic kidney disease (CKD) stage 1 with nephrotic range proteinuria or CKD stage 2 to 4 with stable renal function?

Rationale and impact

Why the committee made the recommendations

No evidence was found for timing of birth for women with renal impairment but the committee agreed that this would depend on the extent of the impairment. Longer gestation leads to

better outcomes for the baby but may lead to worse outcomes for the woman's kidney function. Therefore, when renal impairment is less severe (chronic kidney disease stage 1 or stages 2 to 4 with stable renal function), the balance of benefits and harms favours allowing the baby as long as possible to develop without becoming overdue. The committee agreed that when there is a significant risk to the mother's life in allowing the pregnancy to continue, dialysis should be attempted to prolong the pregnancy until at least 34^{+0} weeks', with a planned birth after this. In the committee's experience, this offers the least risk to mother and baby, and allows as many women as possible to have the birth of their choice.

There was no evidence that any particular mode of birth was better or worse for women with renal impairment and this was in line with the committee's experience, and so decisions about the mode of birth should be based on obstetric indications and the woman's preference. However, the committee recommended that a transplant surgeon be involved if a caesarean section is being considered for a woman with a renal transplant. This is because the transplanted kidney will often be positioned near the usual site of caesarean incision and is therefore at risk of damage. The committee agreed that access to a transplant surgeon, if the caesarean section was complicated, should be recommended.

Impact of the recommendations on practice

The recommendations are likely to lead to a change in practice in many areas. This is because currently some healthcare professionals only offer early birth to women with the most significant renal impairment. However, others recommend early birth to women who could safely carry the pregnancy a few weeks longer.

The committee's discussion of the evidence

Interpreting the evidence

The outcomes that matter most

Maternal and neonatal outcomes were prioritised for this review, as the committee believed that the clinical issue in this case was trading risk to the baby against risk to the woman.

Maternal mortality, neonatal mortality and stillbirth were considered to be critical outcomes. Major morbidities such as irreparable kidney damage, hypertension and cardiovascular disease were considered to be important outcomes because these can have disastrous consequences. Moreover, significant renal failure due to inadequate management in the intrapartum period can lead to long-term health effects such as an earlier requirement for renal replacement therapy, including dialysis or kidney transplantation, than would have been expected in women with chronic kidney disease. The woman's experiences of labour and birth was considered as an important outcome as well. In addition, low birth weight including small for gestational age (SGA) was considered as an important outcome in this review because it can have severe consequences for the baby. These outcomes were prioritised because they would help inform clinicians' decisions as to the correct strategy for preventing avoidable morbidity in pregnant women with renal impairment.

The quality of the evidence

Seven case series studies were included in this review. The quality of the studies was assessed using the Joanna Briggs Institute appraisal checklist for case series. While there

were no major problems in the case series studies overall, evidence from case series studies is considered to be of very low quality as it is only descriptive and non-comparative.

Benefits and harms

As noted above in this guideline, the committee decided to use a definition of CKD on a scale of 1-5, where 5 represents the worst possible kidney function (complete kidney failure) and 1 represents normal kidney function (but with some evidence of kidney disease). The classification is based on a measure of glomerular filtration rate (GFR) (Table 2). The committee were aware that the NICE guideline on chronic kidney disease in adults (CG182) uses a more nuanced system of measurement, which combines the GFR score with a measure of the albumin:creatinine ratio (ACR), to account for the possibility that, for example, a person has a normal GFR but a very high ACR, which would be indicative of at least a moderate problem. While accepting that the more modern measure in the NICE guideline on chronic kidney disease in adults (CG182) is generally more accurate, the committee agreed it would be inappropriate in the case of pregnant women, since:

- pregnant women are expected to have a high ACR, and so this is normal
- the measure has not been validated on pregnant women
- all major studies using the new measure explicitly exclude pregnant women, meaning that the findings are not tailored to the women of relevance in this guideline.

For these reasons the committee decided to use only the GFR aspect of the recommendations in the NICE guideline on chronic kidney disease in adults (CG182), and not the ACR aspect.

The committee noted that there is no specific definition of acute kidney injury in pregnancy but made recommendations on prevention of acute kidney injury based on the definition of this condition for the general population.

The committee agreed that discussions about timing of birth for women with renal disease could be very complex, and had to be tailored to the clinical condition of the individual woman. Therefore, in addition to general considerations impacting on timing of birth in a woman at high risk, the committee believed that a physician with expertise in managing renal conditions during pregnancy should form part of the MDT (see the guideline evidence review for antenatal care planning involving an MDT [Evidence review B in the consultation draft guideline]).

The committee described how chronic kidney disease stage 1 was typically taken to mean renal disease that is clinically detectable but unlikely to cause problems for the woman or the baby. The committee explained that in the absence of any other features which could indicate declining renal function or nephrotic range proteinuria, this condition could effectively be managed in pregnant women in the same way as for a woman with no renal condition, provided this was also the assessment of the renal specialist on the MDT. The committee justified a strong recommendation on the grounds that – in the absence of evidence specific to this group of women suggesting otherwise – the NICE guideline on intrapartum care for healthy women and babies (CG190) was explicit that women should have a high degree of input into the timing and mode of the birth and therefore the committee's recommendation was consistent with other NICE guidance.

The committee described how for all other forms of chronic kidney disease there was a balance to be struck between the baby being born early (with the potential attendant developmental consequences) and the risk to the woman's kidneys. The committee's view

was that in the absence of features suggesting worsening renal function, the balance of benefits and harms favoured letting the baby reach gestational maturity. The committee justified 40^{+0} weeks of gestation as the cut-off time as this is generally considered the latest time at which a baby would be regarded as being 'due' rather than 'overdue'. This was on the basis of their clinical opinion, and therefore not a strong recommendation.

However, in the presence of features suggesting worsening renal function (such as moving from chronic kidney disease stage 2 to 3) or if the woman had chronic kidney disease stage 5 or deteriorating stage 4, the committee explained that the risk to the woman and the baby became significantly greater. Therefore, the clinical question become about what risk to the baby could be tolerated, and this would require a discussion with the woman as well as consideration of how well the woman's kidneys would tolerate continuing pregnancy. In the opinion of the committee, attempting to continue the pregnancy to at least 34^{+0} weeks of gestation before the birth – even if this required dialysis – would be likely to prevent very serious developmental problems for the baby and therefore would be worth considering. However, for women with deteriorating kidney function starting after 34^{+0} weeks, early birth should be considered instead of commencing dialysis as the benefits to the baby of further gestation are unlikely to offset the harms to the woman. The committee explained that these recommendations were made on the basis of their clinical opinion and existing clinical practice.

The committee did not make a recommendation about stage 1-3 deteriorating renal disease, explaining that management of this would depend on idiosyncratic factors upon which it was impossible to offer general guidance.

The committee explained that they had not found any evidence that a particular mode of birth particularly stressed the kidneys, and that therefore mode of birth could be determined as for a woman without kidney disease, all other factors being equal. The committee justified a strong recommendation on the grounds that – in the absence of evidence specific to this group of women suggesting otherwise – the NICE guideline on intrapartum care for healthy women and babies (CG190) was explicit that women should have a high degree of input into the timing and mode of the birth and therefore this recommendation was consistent with other NICE guidance.

However, the committee explained that there were specific risks associated with a caesarean section for a woman with a renal transplant (specifically that the remaining kidney might migrate across the body and therefore be in a position where it could be damaged by the caesarean incision) which could only be mitigated by including a renal transplant surgeon in the MDT (see the guideline evidence review for antenatal care planning involving an MDT [Evidence review B in the consultation draft guideline]).

Cost effectiveness and resource use

No evidence was found for this review and the committee made a qualitative review of cost effectiveness.

The committee agreed the most cost effective timing of birth would depend on the degree of renal impairment. Outcomes for the baby are improved by a longer gestation but this may result in worse outcomes for the woman's kidney function. The committee agreed that the greater the degree of renal impairment the more cost effective early birth would become. They agreed that with CKD stage 1 or stages 2 to 4 with stable renal function that the balance of benefits and harms would favour allowing the pregnancy to continue. Where,

there is a threat to the woman's life the committee considered that it would be cost effective to attempt dialysis in order that the pregnancy could be continued to at least 34 weeks of gestation.

The committee did not consider any particular any mode of birth to be superior in terms of outcomes for women with renal impairment and therefore, in line with other NICE guidance, they agreed that the choice of mode of birth should be based on the woman's preferences and any medical indications.

The committee believed that current practice is varied and that the recommendations were likely to lead to a change in practice in many areas. In any case, any changes to timing of birth are unlikely to have a significant impact on NHS resources because no particular mode of birth is being recommended.

Other factors the committee took into account

The committee discussed how their recommendations should apply equally well to women with and without antenatal care, but that clinicians might be a little more conservative in cases requiring marginal judgement calls. Interpreting kidney function changes requires knowledge of prior kidney function and the pattern of kidney function changes. Without this, a single reading of raised creatinine could lead to changes in management, for example, admission to hospital or earlier birth.

Because only poor quality, non-comparative evidence was available, the committee chose to make a research recommendation about the optimal timing of birth for women with CKD stage 1 with nephrotic range proteinuria or CKD stage 2 to 4 with stable renal function. See appendix L for further details.

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Appendices

Appendix A – Review protocols

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – fluid management

Item	Details	Working notes
Area in the scope	Women at high risk of adverse outcomes for themselves and/or their baby because of existing maternal medical conditions – intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – fluid management	
Review question in the scope	What is the most effective fluid management regimen for women who develop an acute kidney injury or have chronic kidney disease and who are in the peripartum period?	
Review question for the guideline	What is the most effective fluid management regimen for women who develop an acute kidney injury or have chronic kidney disease and who are in the peripartum period?	
Objective	The aim of this review is to identify whether there is any particular fluid management regimen which produces better outcomes in women with chronic kidney disease or who develop an acute kidney injury during the peripartum period	
Population and directness	Women with chronic kidney disease and acute kidney injury, including transplant recipients Acute kidney injury (AKI) defined the following conditions during pregnancy: • acute fatty liver of pregnancy • amniotic fluid embolus • haemorrhage • nephrotoxic drugs, such as non-steroidal anti-inflammatories • sepsis • acute systemic diseases, for example lupus, vasculitis, • rhabdomyolysis • obstruction of renal outflow, for example, kidney stones Chronic kidney disease (CKD) defined as: • >120 micromol/l serum creatinine or explicit diagnosis of CKD in studies under consideration	

Item	Details	Working notes
	Transplant recipient defined as a woman who has had a kidney transplant Note that the above definitions explicitly exclude pre-eclampsia, for which there is no substantial clinical disagreement regarding management	
Intervention	Renal fluid management plan, especially a plan including furosemide or dopamine	
Comparison	Absence of any renal fluid management plan (either no management or renal fluids managed through dialysis) Different renal fluid management plans compared with each other	
Outcomes	Critical outcomes: • for the woman: o mortality o major morbidity (acute dialysis or other renal replacement therapy, permanent decline in renal function, or end-stage kidney failure) • for the baby: o stillbirth o mortality Important outcomes: • for the woman: o women's satisfaction with labour and birth (including psychological wellbeing)	
Importance of outcomes	Preliminary classification of the outcomes for decision making: • critical (up to 3 outcomes) • important but not critical (up to 3 outcomes) • of limited importance (1 outcome)	
Setting	All settings	
Stratified, subgroup and adjusted analyses	Groups that will be reviewed and analysed separately: • mode of birth o planned mode of birth o actual mode of birth • type of disease o acute kidney disease (see below for specific subgroups) - pre-renal failure - intrinsic renal failure, for example: o Acute glomerular nephritis,	

Item	Details	Working notes
	○ systemic lupus erythematosus ○ haemolytic urinic syndrome ○ thrombotic thrombocytopenic purpura ○ pre-eclampsia ○ amniotic fluid embolus ○ acute fatty liver of pregnancy - post-renal failure (blockage, for example kidney stones) ○ chronic kidney injury severity of CKD: - < 120 micromol/l serum creatinine and no diagnosis of CKD (normal) - < 120 micromol/l serum creatinine and explicit diagnosis of CKD (mild) - 120-180 micromol/l serum creatinine (moderate) - >180 micromol/l serum creatinine (severe) - >220 micromol/l serum creatinine or on dialysis (fifth stage – not always reported differently to severe) - nephrotic range heavy proteinuria (>3 g of protein per 24 hours or protein/creatinine ratio (PCR) >3 mg in US studies and >300 µg in studies conducted elsewhere; part of CKD 1) ○ transplant • worsening renal function, rate of decline in renal function as indicated by rise in creatinine • women with no antenatal care • preterm labour	
Language	English	
Study design	• Published full-text papers only • Systematic reviews • RCTs • Only if RCTs unavailable or there is limited data to inform decision making with a minimum sample size of 15 women in each group: ○ prospective or retrospective comparative cohort studies ○ case series studies • Prospective study designs will be prioritised over retrospective study designs • Conference abstracts will not be considered Inclusion/exclusion decisions will proceed separately for AKI and CKD – for example, if an RCT is available for AKI	

Item	Details	Working notes
	this would not preclude using a case series for CKD, and vice versa.	
Search strategy	Sources to be searched: Medline, Medline In-Process, CCTR, CDSR, DARE, HTA and Embase. Limits (e.g. date, study design): All study designs. Apply standard animal/non-English language filters. No date limit. Supplementary search techniques: No supplementary search techniques were used. See appendix B for full strategies	
Review strategy	Appraisal of methodological quality: • the methodological quality of each study will be assessed using checklists recommended in the NICE guidelines manual 2014 (for example, AMSTAR or ROBIS for systematic reviews, and Cochrane RoB tool for RCTs) and the quality of the evidence for each outcome (that is, across studies) will be assessed using GRADE • if studies report only p-values, this information will be recorded in GRADE tables without an assessment of imprecision Synthesis of data: • meta-analysis will be conducted where appropriate • default MIDs will be used; 0.8 and 1.25 for dichotomous outcomes; 0.5 times the SD of the measurement in the control arm (or median score across control arms if multiple studies are included) for continuous outcomes • for continuous data, change scores will be used in preference to final scores for data from non-RCT studies; final and change scores will not be pooled; if any study reports both, the method used in the majority of studies will be adopted	Review questions selected as high priorities for health economic analysis (and those selected as medium priorities and where health economic analysis could influence recommendations) will be subject to dual weeding and study selection; any discrepancies will be resolved through discussion between the first and second reviewers or by reference to a third person. This review question was not prioritised for health economic analysis and so no formal dual weeding, study selection (inclusion/exclusion) or data extraction into evidence tables will be undertaken. However, internal (NGA) quality assurance processes will include consideration of the outcomes of weeding, study selection and data extraction and the committee will

Item	Details	Working notes
		review the results of study selection and data extraction
Equalities	Equalities considerations will be considered systematically in relation to the available evidence and draft recommendations. The guideline scope includes women with cognitive or physical disability as populations for whom there may be equalities issues. Women who have received no antenatal care will be considered as a subgroup for all systematic reviews performed within the medical conditions work stream and a specific question has been included in the obstetric complications work stream for this population	
Notes/additional information	NICE guideline on chronic kidney disease in adults: assessment and management (CG182) NICE guideline on acute kidney injury: prevention, detection and management (CG169) NICE guideline on caesarean section (CG132) NICE guideline on hypertension in pregnancy: diagnosis and management (CG107) NICE guideline on diabetes in pregnancy: management from preconception to the postnatal period (NG3) RCOG. The Investigation and Management of the Small-for-Gestational-Age fetus. Green–top Guideline No. 31. 2014.	
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AKI: acute kidney injury; AMSTAR: Assessing the Methodological Quality of Systematic Reviews; CCTR: Cochrane Central Register of Controlled Trials; CDSR: Cochrane Database of Systematic Reviews; CG: clinical guideline; CKD: chronic kidney disease; DARE: Database of Abstracts of Reviews of Effects; GFR: glomerular filtration rate; GRADE: Grading of Recommendations Assessment, Development and Evaluation; HTA: Health

Technology Assessment; MID: minimally important difference; NG: NICE guideline; NGA: National Guideline Alliance; NICE: National Institute for Health and Care Excellence; PCR: protein/creatinine ratio; RCOG: Royal College of Obstetricians and Gynaecologists; RCT: randomised controlled trial; RoB: risk of bias; ROBIS: Risk of Bias in Systematic Reviews; SD: standard deviation

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – early birth

Item	Details	Working notes
Area in the scope	Women at high risk of adverse outcomes for themselves and/or their baby because of existing maternal medical conditions – intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – mode of birth	
Review question in the scope	Which women who develop an acute kidney injury or have chronic kidney disease should be offered a caesarean section?	
Review question for the guideline	Which women who develop an acute kidney injury or have chronic kidney disease should be offered early birth (via induction of labour or elective caesarean section) for reasons specific to kidney disease?	
Objective	The aim of this review is to examine outcomes for women with chronic kidney disease or acute kidney injury and their babies following early childbirth (through caesarean section or induction of labour) compared with later spontaneous birth. This is important because determining whether an early birth should be offered is a decision that is complex in these women), needing to take into account the rate of deterioration in renal function and the severity of the condition	
Population and directness	Women with chronic kidney disease or acute kidney injury or who have had a kidney transplant Studies of women who had received a kidney transplant published prior to 2005 will be excluded by the reviewer(s) as these would not reflect currently available technology.	
Intervention	Early birth (via induction of labour or elective caesarean section)	
Comparison	No intervention for early birth	

Outcomes	Critical outcomes:
	• for the woman:
	  ○ mortality
	• for the baby:
	  ○ stillbirth
	  ○ mortality	

Item	Details	Working notes
	Important outcomes: • for the woman: o major morbidity (irreparable kidney damage, end-stage kidney failure, hypertension, or cardiovascular disease) o women's satisfaction with labour and birth (including psychological wellbeing) • for the baby: o low birth weight	
Importance of outcomes	Preliminary classification of the outcomes for decision making: • critical (up to 3 outcomes) • important but not critical (up to 3 outcomes) • of limited importance (1 outcome)	
Setting	All settings	
Stratified, subgroup and adjusted analyses	Groups that will be reviewed and analysed separately: • type of disease o acute kidney disease (see below for specific subgroups) - pre-renal failure - intrinsic renal failure, for example: o acute glomerular nephritis o systemic lupus erythematosus o haemolytic uremic syndrome o thrombotic thrombocytopenic purpura o pre-eclampsia o amniotic fluid embolus o acute fatty liver of pregnancy - post-renal failure (blockage, for example, kidney stones) o chronic kidney injury severity of CKD: - <120 micromol/l serum creatinine and no diagnosis of CKD (normal) - <120 micromol/l serum creatinine and explicit diagnosis of CKD (mild) - 120-180 micromol/l serum creatinine (moderate) - >180 micromol/l serum creatinine (severe) - >220 micromol/ serum creatinine or on dialysis (fifth stage – not always reported differently from severe) - nephrotic range heavy proteinuria (>3 g of protein per 24 hours or protein/creatinine ratio (PCR) >3 mg in US studies and >300 µg in studies conducted elsewhere; part of CKD 1) - haematuria	

Item	Details	Working notes
	- hypertension/pre-eclampsia ○ transplant • worsening renal function, rate of decline in renal function as indicated by rise in creatinine • women with no antenatal care • preterm labour	
Language	English	
Study design	• Published full-text papers only • Systematic reviews • RCTs • Only if RCTs unavailable or there is limited data to inform decision making: ○ prospective or retrospective comparative cohort studies ○ case series studies • Prospective study designs will be prioritised over retrospective study designs • Conference abstracts will not be considered	
Search strategy	Sources to be searched: Medline, Medline In-Process, CCTR, CDSR, DARE, HTA and Embase. Limits (e.g. date, study design): All study designs. Apply standard animal/non-English language filters. No date limit. Supplementary search techniques: No supplementary search techniques were used. See appendix B for full strategies	
Review strategy	Appraisal of methodological quality: • the methodological quality of each study will be assessed using checklists recommended in the NICE guidelines manual 2014 (for example, AMSTAR or ROBIS for systematic reviews, and Cochrane RoB tool for RCTs) and the quality of the evidence for each outcome (that is, across studies) will be assessed using GRADE • if studies report only p-values, this information will be recorded in GRADE tables without an assessment of imprecision Synthesis of data: • meta-analysis will be conducted where appropriate • default MIDs will be used; 0.8 and 1.25 for dichotomous outcomes; 0.5 times the SD of the measurement in the control arm (or median score across control arms if multiple studies are included) for continuous outcomes • for continuous data, change scores will be used in preference to final scores for data from non-RCT studies; final and change scores will not be pooled; if any study reports both, the method used in the majority of studies will be adopted	Review questions selected as high priorities for health economic analysis (and those selected as medium priorities and where health economic analysis could influence recommendations) will be subject to dual weeding and study selection; any discrepancies will be resolved through discussion between the first and second reviewers or by reference to a third person. This review question was not prioritised for health economic analysis and so no formal dual

Item	Details	Working notes
		weeding, study selection (inclusion/exclusion) or data extraction into evidence tables will be undertaken. However, internal (NGA) quality assurance processes will include consideration of the outcomes of weeding, study selection and data extraction and the committee will review the results of study selection and data extraction
Equalities	Equalities considerations will be considered systematically in relation to the available evidence and draft recommendations. The guideline scope includes women with cognitive or physical disability as populations for whom there may be equalities issues. Women who have received no antenatal care will be considered as a subgroup for all systematic reviews performed within the medical conditions work stream and a specific question has been included in the obstetric complications work stream for this population	
Notes/additional information	NICE guideline on chronic kidney disease in adults: assessment and management (CG182) NICE guideline on acute kidney injury: prevention, detection and management (CG169) NICE guideline on caesarean section (CG132) NICE guideline on hypertension in pregnancy: diagnosis and management (CG107) NICE guideline on diabetes in pregnancy: management from preconception to the postnatal period (NG3) RCOG. The Investigation and Management of the Small-for-Gestational-Age fetus. Green–top Guideline No. 31. 2014.	
Key papers	Williams D., Davison J. Chronic kidney disease in pregnancy. BMJ 2008; 336:211-5. doi: 10.1136/bmj.39406.652986.BE Nevis et al. Pregnancy Outcomes in Women with Chronic Kidney Disease: A Systematic Review. Clin J Am Soc Nephrol 6: 2587–2598, 2011 Piccoli et al. Pregnancy and Chronic Kidney Disease: A challenge in All CKD Stages. Clin J Am Soc Nephrol. 2010 May; 5(5): 844–855. Namrata Khanal, Ejaz Ahmed and Fazal Akhtar (2012). Epidemiology, Causes and Outcome of Obstetric Acute	

Item	Details	Working notes
	Kidney Injury, Novel Insights on Chronic Kidney Disease, Acute Kidney Injury and Polycystic Kidney Disease, Dr. Soundarapandian Vijayakumar (Ed.), ISBN: 978-953-51-0234-2, InTech, Available from: http://www.intechopen.com/books/novel-insights-on-chronic-kidney-disease-acute-kidney-injury-andpolycystic-kidney-disease/epidemiology-causes-and-outcome-of-obstetric-acute-kidney-injury Machado S. et al. Acute kidney injury in pregnancy: a clinical challenge. JNephrol 2012; 25(01): 19- 30	

AKI: acute kidney injury; AMSTAR: Assessing the Methodological Quality of Systematic Reviews; CCTR: Cochrane Central Register of Controlled Trials; CDSR: Cochrane Database of Systematic Reviews; CG: clinical guideline; CKD: chronic kidney disease; DARE: Database of Abstracts of Reviews of Effects; EGFR: estimated glomerular filtration rate; GFR: glomerular filtration rate; GRADE: Grading of Recommendations Assessment, Development and Evaluation; HTA: Health Technology Assessment; MID: minimally important difference; NG: NICE guideline; NGA: National Guideline Alliance; NICE: National Institute for Health and Care Excellence; PCR: protein/creatinine ratio; RCOG: Royal College of Obstetricians and Gynaecologists; RCT: randomised controlled trial; RoB: risk of bias; ROBIS: Risk of Bias in Systematic Reviews; SD: standard deviation

Appendix B – Literature search strategies

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – fluid management

Database: Medline; Medline EPub Ahead of Print; and Medline In-Process & Other Non-Indexed Citations

#	Searches
1	PREGNANCY/
2	PERIPARTUM PERIOD/
3	PARTURITION/
4	exp LABOR, OBSTETRIC/
5	OBSTETRIC LABOR, PREMATURE/
6	pregnan$.ti,ab.
7	(labo?r or childbirth or partu$ or intra?part$ or peri?part$).ti,ab.
8	((during or giving or give) adj3 birth?).ti,ab.
9	or/1-8
10	exp RENAL INSUFFICIENCY, CHRONIC/
11	((Renal$ or kidney?) adj5 (disease? or insuffic$ or fail$) adj5 (chronic$ or end-stage?)).ab,ti.
12	CKD.ab,ti.
13	ESRD.ab,ti.
14	Frasier syndrome.ti,ab.
15	exp ACUTE KIDNEY INJURY/
16	((Renal$ or kidney?) adj5 (injur$ or insuffic$ or fail$) adj5 acute$).ab,ti.
17	(Kidney adj5 tubular necrosis adj5 acute$).ab,ti.
18	(Nephrosis adj5 nephron adj5 lower).ab,ti.
19	AKI.ab,ti.
20	KIDNEY TRANSPLANTATION/
21	((kidney? or renal$) adj3 (transplant$ or graft$)).ti,ab.
22	or/10-21
23	FLUID THERAPY/

#	Searches
24	fluid?.ti,ab.
25	INFUSIONS, INTRAVENOUS/
26	((intravenous$ or IV or drip?) adj3 infusion?).ab,ti.
27	PLASMA SUBSTITUTES/
28	((Plasma or blood) adj3 (expander? or substitute?)).ab,ti.
29	REHYDRATION SOLUTIONS/
30	(re-hydrat$ or rehydrat$).ab,ti.
31	(type? adj3 (intravenous$ or IV or drip? or fluid?)).ab,ti.
32	((rate? or amount? or volume?) adj3 (intravenous$ or IV or drip? or fluid? or admin$)).ab,ti.
33	or/23-32
34	BODY WATER/
35	WATER-ELECTROLYTE BALANCE/
36	WATER-ELECTROLYTE IMBALANCE/
37	((body or bodies) adj2 water).ti,ab.
38	((fluid? or water$ or electrolyte) adj3 (balanc$ or imbalanc$)).ti,ab.
39	or/34-38
40	FUROSEMIDE/
41	DOPAMINE/
42	DOPAMINE AGENTS/
43	Furosemide.mp.
44	Dopamine.mp.
45	or/40-44
46	9 and 22 and 33
47	9 and 22 and 39
48	9 and 22 and 45
49	or/46-48
50	limit 49 to english language
51	LETTER/
52	EDITORIAL/
53	NEWS/
54	exp HISTORICAL ARTICLE/
55	ANECDOTES AS TOPIC/
56	COMMENT/
57	CASE REPORT/
58	(letter or comment*).ti.
59	or/51-58
60	RANDOMIZED CONTROLLED TRIAL/ or random*.ti,ab.
61	59 not 60
62	ANIMALS/ not HUMANS/
63	exp ANIMALS, LABORATORY/
64	exp ANIMAL EXPERIMENTATION/
65	exp MODELS, ANIMAL/
66	exp RODENTIA/
67	(rat or rats or mouse or mice).ti.
68	or/61-67
69	50 not 68

Database: Cochrane Central Register of Controlled Trials

#	Searches
1	PREGNANCY/

#	Searches
2	PERIPARTUM PERIOD/
3	PARTURITION/
4	exp LABOR, OBSTETRIC/
5	OBSTETRIC LABOR, PREMATURE/
6	pregnan$.ti,ab,kw.
7	(labo?r or childbirth or partu$ or intra?part$ or peri?part$).ti,ab,kw.
8	((during or giving or give) adj3 birth?).ti,ab.
9	or/1-8
10	exp RENAL INSUFFICIENCY, CHRONIC/
11	((Renal$ or kidney?) adj5 (disease? or insuffic$ or fail$) adj5 (chronic$ or end-stage?)).ab,ti.
12	CKD.ab,ti.
13	ESRD.ab,ti.
14	Frasier syndrome.ti,ab,kw.
15	exp ACUTE KIDNEY INJURY/
16	((Renal$ or kidney?) adj5 (injur$ or insuffic$ or fail$) adj5 acute$).ab,ti.
17	(Kidney adj5 tubular necrosis adj5 acute$).ab,ti.
18	(Nephrosis adj5 nephron adj5 lower).ab,ti.
19	AKI.ab,ti.
20	KIDNEY TRANSPLANTATION/
21	((kidney? or renal$) adj3 (transplant$ or graft$)).ti,ab.
22	or/10-21
23	FLUID THERAPY/
24	fluid?.ti,ab.
25	INFUSIONS, INTRAVENOUS/
26	((intravenous$ or IV or drip?) adj3 infusion?).ab,ti.
27	PLASMA SUBSTITUTES/
28	((Plasma or blood) adj3 (expander? or substitute?)).ab,ti.
29	REHYDRATION SOLUTIONS/
30	(re-hydrat$ or rehydrat$).ab,ti.
31	(type? adj3 (intravenous$ or IV or drip? or fluid?)).ab,ti.
32	((rate? or amount? or volume?) adj3 (intravenous$ or IV or drip? or fluid? or admin$)).ab,ti.
33	or/23-32
34	BODY WATER/
35	WATER-ELECTROLYTE BALANCE/
36	WATER-ELECTROLYTE IMBALANCE/
37	((body or bodies) adj2 water).ti,ab.
38	((fluid? or water$ or electrolyte) adj3 (balanc$ or imbalanc$)).ti,ab.
39	or/34-38
40	FUROSEMIDE/
41	DOPAMINE/
42	DOPAMINE AGENTS/
43	Furosemide.mp.
44	Dopamine.mp.
45	or/40-44
46	9 and 22 and 33
47	9 and 22 and 39
48	9 and 22 and 45
49	or/46-48

Database: Cochrane Database of Systematic Reviews

#	Searches
1	PREGNANCY.kw.
2	PERIPARTUM PERIOD.kw.
3	PARTURITION.kw.
4	LABOR, OBSTETRIC.kw.
5	OBSTETRIC LABOR, PREMATURE.kw.
6	pregnan$.ti,ab.
7	(labo?r or childbirth or partu$ or intra?part$ or peri?part$).ti,ab.
8	((during or giving or give) adj3 birth?).ti,ab.
9	or/1-8
10	RENAL INSUFFICIENCY, CHRONIC.kw.
11	((Renal$ or kidney?) adj5 (disease? or insuffic$ or fail$) adj5 (chronic$ or end-stage?)).ab,ti.
12	CKD.ab,ti.
13	ESRD.ab,ti.
14	Frasier syndrome.ti,ab.
15	ACUTE KIDNEY INJURY.kw.
16	((Renal$ or kidney?) adj5 (injur$ or insuffic$ or fail$) adj5 acute$).ab,ti.
17	(Kidney adj5 tubular necrosis adj5 acute$).ab,ti.
18	(Nephrosis adj5 nephron adj5 lower).ab,ti.
19	AKI.ab,ti.
20	KIDNEY TRANSPLANTATION.kw.
21	((kidney? or renal$) adj3 (transplant$ or graft$)).ti,ab.
22	or/10-21
23	FLUID THERAPY.kw.
24	fluid?.ti,ab.
25	INFUSIONS, INTRAVENOUS.kw.
26	((intravenous$ or IV or drip?) adj3 infusion?).ab,ti.
27	PLASMA SUBSTITUTES.kw.
28	((Plasma or blood) adj3 (expander? or substitute?)).ab,ti.
29	REHYDRATION SOLUTIONS.kw.
30	(re-hydrat$ or rehydrat$).ab,ti.
31	(type? adj3 (intravenous$ or IV or drip? or fluid?)).ab,ti.
32	((rate? or amount? or volume?) adj3 (intravenous$ or IV or drip? or fluid? or admin$)).ab,ti.
33	or/23-32
34	BODY WATER.kw.
35	WATER-ELECTROLYTE BALANCE.kw.
36	WATER-ELECTROLYTE IMBALANCE.kw.
37	((body or bodies) adj2 water).ti,ab.
38	((fluid? or water$ or electrolyte) adj3 (balanc$ or imbalanc$)).ti,ab.
39	or/34-38
40	FUROSEMIDE.kw.
41	DOPAMINE.kw.
42	DOPAMINE AGENTS.kw.
43	Furosemide.mp.
44	Dopamine.mp.
45	or/40-44
46	9 and 22 and 33
47	9 and 22 and 39
48	9 and 22 and 45
49	or/46-48

Database: Database of Abstracts of Reviews of Effects

#	Searches
1	PREGNANCY.kw.
2	PERIPARTUM PERIOD.kw.
3	PARTURITION.kw.
4	LABOR, OBSTETRIC.kw.
5	OBSTETRIC LABOR, PREMATURE.kw.
6	pregnan$.tw,tx.
7	(labo?r or childbirth or partu$ or intra?part$ or peri?part$).tw,tx.
8	((during or giving or give) adj3 birth?).tw,tx.
9	or/1-8
10	RENAL INSUFFICIENCY, CHRONIC.kw.
11	((Renal$ or kidney?) adj5 (disease? or insuffic$ or fail$) adj5 (chronic$ or end-stage?)).tw,tx.
12	CKD.tw,tx.
13	ESRD.tw,tx.
14	Frasier syndrome.tw,tx.
15	ACUTE KIDNEY INJURY.kw.
16	((Renal$ or kidney?) adj5 (injur$ or insuffic$ or fail$) adj5 acute$).tw,tx.
17	(Kidney adj5 tubular necrosis adj5 acute$).tw,tx.
18	(Nephrosis adj5 nephron adj5 lower).tw,tx.
19	AKI.tw,tx.
20	KIDNEY TRANSPLANTATION.kw.
21	((kidney? or renal$) adj3 (transplant$ or graft$)).tw,tx.
22	or/10-21
23	FLUID THERAPY.kw.
24	fluid?.tw,tx.
25	INFUSIONS, INTRAVENOUS.kw.
26	((intravenous$ or IV or drip?) adj3 infusion?).tw,tx.
27	PLASMA SUBSTITUTES.kw.
28	((Plasma or blood) adj3 (expander? or substitute?)).tw,tx.
29	REHYDRATION SOLUTIONS.kw.
30	(re-hydrat$ or rehydrat$).tw,tx.
31	(type? adj3 (intravenous$ or IV or drip? or fluid?)).tw,tx.
32	((rate? or amount? or volume?) adj3 (intravenous$ or IV or drip? or fluid? or admin$)).tw,tx.
33	or/23-32
34	BODY WATER.kw.
35	WATER-ELECTROLYTE BALANCE.kw.
36	WATER-ELECTROLYTE IMBALANCE.kw.
37	((body or bodies) adj2 water).tw,tx.
38	((fluid? or water$ or electrolyte) adj3 (balanc$ or imbalanc$)).tw,tx.
39	or/34-38
40	FUROSEMIDE.kw.
41	DOPAMINE.kw.
42	DOPAMINE AGENTS.kw.
43	Furosemide.mp.
44	Dopamine.mp.
45	or/40-44
46	9 and 22 and 33
47	9 and 22 and 39
48	9 and 22 and 45
49	or/46-48

Database: Health Technology Assessment

#	Searches
1	PREGNANCY/
2	PERIPARTUM PERIOD/
3	PARTURITION/
4	exp LABOR, OBSTETRIC/
5	OBSTETRIC LABOR, PREMATURE/
6	pregnan$.tw.
7	(labo?r or childbirth or partu$ or intra?part$ or peri?part$).tw.
8	((during or giving or give) adj3 birth?).tw.
9	or/1-8
10	exp RENAL INSUFFICIENCY, CHRONIC/
11	((Renal$ or kidney?) adj5 (disease? or insuffic$ or fail$) adj5 (chronic$ or end-stage?)).tw.
12	CKD.tw.
13	ESRD.tw.
14	Frasier syndrome.tw.
15	KIDNEY FAILURE, ACUTE/
16	((Renal$ or kidney?) adj5 (injur$ or insuffic$ or fail$) adj5 acute$).tw.
17	(Kidney adj5 tubular necrosis adj5 acute$).tw.
18	(Nephrosis adj5 nephron adj5 lower).tw.
19	AKI.tw.
20	KIDNEY TRANSPLANTATION/
21	((kidney? or renal$) adj3 (transplant$ or graft$)).tw.
22	or/10-21
23	FLUID THERAPY/
24	fluid?.tw.
25	INFUSIONS, INTRAVENOUS/
26	((intravenous$ or IV or drip?) adj3 infusion?).tw.
27	PLASMA SUBSTITUTES/
28	((Plasma or blood) adj3 (expander? or substitute?)).tw.
29	REHYDRATION SOLUTIONS/
30	(re-hydrat$ or rehydrat$).tw.
31	(type? adj3 (intravenous$ or IV or drip? or fluid?)).tw.
32	((rate? or amount? or volume?) adj3 (intravenous$ or IV or drip? or fluid? or admin$)).tw.
33	or/23-32
34	BODY WATER/
35	WATER-ELECTROLYTE BALANCE/
36	WATER-ELECTROLYTE IMBALANCE/
37	((body or bodies) adj2 water).tw.
38	((fluid? or water$ or electrolyte) adj3 (balanc$ or imbalanc$)).tw.
39	or/34-38
40	FUROSEMIDE/
41	DOPAMINE/
42	DOPAMINE AGENTS/
43	Furosemide.mp.
44	Dopamine.mp.
45	or/40-44
46	9 and 22 and 33
47	9 and 22 and 39
48	9 and 22 and 45
49	or/46-48

Database: Embase

#	Searches
1	*PREGNANCY/
2	*PERINATAL PERIOD/
3	exp *BIRTH/
4	exp *LABOR/
5	*PREMATURE LABOR/
6	*INTRAPARTUM CARE/
7	pregnan$.ti,ab.
8	(labo?r or childbirth or partu$ or intra?part$ or peri?part$).ti,ab.
9	((during or giving or give) adj3 birth?).ti,ab.
10	or/1-9
11	CHRONIC KIDNEY DISEASE/
12	CHRONIC KIDNEY FAILURE/
13	END STAGE RENAL DISEASE/
14	((Renal$ or kidney?) adj5 (disease? or insuffic$ or fail$) adj5 (chronic$ or end-stage?)).ab,ti.
15	CKD.ab,ti.
16	ESRD.ab,ti.
17	Frasier syndrome.ti,ab.
18	ACUTE KIDNEY FAILURE/
19	((Renal$ or kidney?) adj5 (injur$ or insuffic$ or fail$) adj5 acute$).ab,ti.
20	(Kidney adj5 tubular necrosis adj5 acute$).ab,ti.
21	(Nephrosis adj5 nephron adj5 lower).ab,ti.
22	AKI.ab,ti.
23	KIDNEY TRANSPLANTATION/
24	((kidney? or renal$) adj3 (transplant$ or graft$)).ti,ab.
25	or/11-24
26	FLUID THERAPY/
27	fluid?.ti,ab.
28	INFUSION FLUID/
29	((intravenous$ or IV or drip?) adj3 infusion?).ab,ti.
30	(fluid? adj3 (intravenous$ or IV or drip?)).ab,ti.
31	PLASMA SUBSTITUTE/
32	((Plasma or blood) adj3 (expander? or substitute?)).ab,ti.
33	REHYDRATION/
34	(re-hydrat$ or rehydrat$).ab,ti.
35	(type? adj3 (intravenous$ or IV or drip? or fluid?)).ab,ti.
36	((rate? or amount? or volume?) adj3 (intravenous$ or IV or drip? or fluid? or admin$)).ab,ti.
37	or/26-36
38	BODY WATER/
39	ELECTROLYTE BALANCE/
40	ELECTROLYTE DISTURBANCE/
41	((body or bodies) adj2 water).ti,ab.
42	((fluid? or water$ or electrolyte) adj3 (balanc$ or imbalanc$)).ti,ab.
43	or/38-42
44	FUROSEMIDE/
45	DOPAMINE/
46	DOPAMINE RECEPTOR STIMULATING AGENT/
47	Furosemide.mp.
48	Dopamine.mp.
49	or/44-48
50	10 and 25 and 37

#	Searches
51	10 and 25 and 43
52	10 and 25 and 49
53	or/50-52
54	limit 53 to english language
55	letter.pt. or LETTER/
56	note.pt.
57	editorial.pt.
58	CASE REPORT/ or CASE STUDY/
59	(letter or comment*).ti.
60	or/55-59
61	RANDOMIZED CONTROLLED TRIAL/ or random*.ti,ab.
62	60 not 61
63	ANIMAL/ not HUMAN/
64	NONHUMAN/
65	exp ANIMAL EXPERIMENT/
66	exp EXPERIMENTAL ANIMAL/
67	ANIMAL MODEL/
68	exp RODENT/
69	(rat or rats or mouse or mice).ti.
70	or/62-69
71	54 not 70

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – early birth

Database: Medline; Medline EPub Ahead of Print; and Medline In-Process & Other Non-Indexed Citations

#	Searches
1	PREGNANCY/
2	PERIPARTUM PERIOD/
3	PARTURITION/
4	exp LABOR, OBSTETRIC/
5	OBSTETRIC LABOR, PREMATURE/
6	pregnan$.ti,ab.
7	(labo?r or childbirth or partu$ or intra?part$ or peri?part$).ti,ab.
8	((during or giving or give) adj3 birth?).ti,ab.
9	or/1-8
10	exp RENAL INSUFFICIENCY, CHRONIC/
11	((Renal$ or kidney?) adj5 (disease? or insuffic$ or fail$) adj5 (chronic$ or end-stage?)).ab,ti.
12	CKD.ab,ti.
13	ESRD.ab,ti.
14	Frasier syndrome.ti,ab.
15	exp ACUTE KIDNEY INJURY/
16	((Renal$ or kidney?) adj5 (injur$ or insuffic$ or fail$) adj5 acute$).ab,ti.

#	Searches
17	(Kidney adj5 tubular necrosis adj5 acute$).ab,ti.
18	(Nephrosis adj5 nephron adj5 lower).ab,ti.
19	AKI.ab,ti.
20	KIDNEY TRANSPLANTATION/
21	((kidney? or renal$) adj3 (transplant$ or graft$)).ti,ab.
22	or/10-21
23	exp GLOMERULONEPHRITIS/
24	glomerulonephriti$.ti,ab.
25	bright$ disease.ti,ab.
26	POLYCYSTIC KIDNEY, AUTOSOMAL DOMINANT/
27	(polycystic adj3 kidney disease? adj3 (autosomal dominant or adult? or type 2)).ti,ab.
28	ADPKD.ti,ab.
29	DIABETIC NEPHROPATHIES/
30	(diabet$ adj3 (glomerulosclerosis or kidney disease? or nephropath$)).ti,ab.
31	((nodular or intracapillary) adj3 glomerulosclerosis).ti,ab.
32	(kimmelstiel Wilson adj3 (disease or syndrome)).ti,ab.
33	(reflux$ adj3 nephropath$).ti,ab.
34	LUPUS NEPHRITIS/
35	(lupus adj3 (nephriti$ or glomerulonephritis$)).ti,ab.
36	or/23-35
37	exp CESAREAN SECTION/
38	(c?esar#an$ or c section$ or csection$ or (deliver$ adj3 abdom$)).ti,ab.
39	LABOR, INDUCED/
40	(induc$ adj3 (labo?r$ or birth$ or born or deliver$ or obstetric$)).ti,ab.
41	exp EXTRACTION, OBSTETRICAL/
42	((extract$ or vacuum$) adj3 (birth$ or born or deliver$ or obstetric$)).ti,ab.
43	(vaccum$ adj3 extract$).ti,ab.
44	ventouse?.ti,ab.
45	OBSTETRICAL FORCEPS/
46	forcep?.ti,ab.
47	*Delivery, Obstetric/mt [Methods]
48	(mode? adj2 (birth$ or born or deliver$)).ti,ab.
49	or/37-48
50	9 and 22 and 49
51	9 and 36 and 49
52	22 and *PREGNANCY OUTCOME/
53	36 and *PREGNANCY OUTCOME/
54	or/50-53
55	limit 54 to english language
56	LETTER/

#	Searches
57	EDITORIAL/
58	NEWS/
59	exp HISTORICAL ARTICLE/
60	ANECDOTES AS TOPIC/
61	COMMENT/
62	CASE REPORT/
63	(letter or comment*).ti.
64	or/56-63
65	RANDOMIZED CONTROLLED TRIAL/ or random*.ti,ab.
66	64 not 65
67	ANIMALS/ not HUMANS/
68	exp ANIMALS, LABORATORY/
69	exp ANIMAL EXPERIMENTATION/
70	exp MODELS, ANIMAL/
71	exp RODENTIA/
72	(rat or rats or mouse or mice).ti.
73	or/66-72
74	55 not 73

Database: Cochrane Central Register of Controlled Trials

#	Searches
1	PREGNANCY/
2	PERIPARTUM PERIOD/
3	PARTURITION/
4	exp LABOR, OBSTETRIC/
5	OBSTETRIC LABOR, PREMATURE/
6	pregnan$.ti,ab,kw.
7	(labo?r or childbirth or partu$ or intra?part$ or peri?part$).ti,ab.
8	((during or giving or give) adj3 birth?).ti,ab.
9	or/1-8
10	exp RENAL INSUFFICIENCY, CHRONIC/
11	((Renal$ or kidney?) adj5 (disease? or insuffic$ or fail$) adj5 (chronic$ or end-stage?)).ab,ti.
12	CKD.ab,ti.
13	ESRD.ab,ti.
14	Frasier syndrome.ti,ab,kw.
15	exp ACUTE KIDNEY INJURY/
16	((Renal$ or kidney?) adj5 (injur$ or insuffic$ or fail$) adj5 acute$).ab,ti.
17	(Kidney adj5 tubular necrosis adj5 acute$).ab,ti.
18	(Nephrosis adj5 nephron adj5 lower).ab,ti.
19	AKI.ab,ti.

#	Searches
20	KIDNEY TRANSPLANTATION/
21	((kidney? or renal$) adj3 (transplant$ or graft$)).ti,ab.
22	or/10-21
23	exp GLOMERULONEPHRITIS/
24	glomerulonephriti$.ti,ab,kw.
25	bright$ disease.ti,ab,kw.
26	POLYCYSTIC KIDNEY, AUTOSOMAL DOMINANT/
27	(polycystic adj3 kidney disease? adj3 (autosomal dominant or adult? or type 2)).ti,ab.
28	ADPKD.ti,ab.
29	DIABETIC NEPHROPATHIES/
30	(diabet$ adj3 (glomerulosclerosis or kidney disease? or nephropath$)).ti,ab.
31	((nodular or intracapillary) adj3 glomerulosclerosis).ti,ab.
32	(kimmelstiel Wilson adj3 (disease or syndrome)).ti,ab.
33	(reflux$ adj3 nephropath$).ti,ab.
34	LUPUS NEPHRITIS/
35	(lupus adj3 (nephriti$ or glomerulonephritis$)).ti,ab.
36	or/23-35
37	exp CESAREAN SECTION/
38	(c?esar#an$ or c section$ or csection$ or (deliver$ adj3 abdom$)).ti,ab.
39	LABOR, INDUCED/
40	(induc$ adj3 (labo?r$ or birth$ or born or deliver$ or obstetric$)).ti,ab.
41	exp EXTRACTION, OBSTETRICAL/
42	((extract$ or vacuum$) adj3 (birth$ or born or deliver$ or obstetric$)).ti,ab.
43	(vaccum$ adj3 extract$).ti,ab.
44	ventouse?.ti,ab,kw.
45	OBSTETRICAL FORCEPS/
46	forcep?.ti,ab,kw.
47	*Delivery, Obstetric/mt [Methods]
48	(mode? adj2 (birth$ or born or deliver$)).ti,ab.
49	or/37-48
50	9 and 22 and 49
51	9 and 36 and 49
52	22 and *PREGNANCY OUTCOME/
53	36 and *PREGNANCY OUTCOME/
54	or/50-53

Database: Cochrane Database of Systematic Reviews

#	Searches
1	PREGNANCY.kw.
2	PERIPARTUM PERIOD.kw.

#	Searches
3	PARTURITION.kw.
4	LABOR, OBSTETRIC.kw.
5	OBSTETRIC LABOR, PREMATURE.kw.
6	pregnan$.ti,ab.
7	(labo?r or childbirth or partu$ or intra?part$ or peri?part$).ti,ab.
8	((during or giving or give) adj3 birth?).ti,ab.
9	or/1-8
10	RENAL INSUFFICIENCY, CHRONIC.kw.
11	((Renal$ or kidney?) adj5 (disease? or insuffic$ or fail$) adj5 (chronic$ or end-stage?)).ab,ti.
12	CKD.ab,ti.
13	ESRD.ab,ti.
14	Frasier syndrome.ti,ab.
15	ACUTE KIDNEY INJURY.kw.
16	((Renal$ or kidney?) adj5 (injur$ or insuffic$ or fail$) adj5 acute$).ab,ti.
17	(Kidney adj5 tubular necrosis adj5 acute$).ab,ti.
18	(Nephrosis adj5 nephron adj5 lower).ab,ti.
19	AKI.ab,ti.
20	KIDNEY TRANSPLANTATION.kw.
21	((kidney? or renal$) adj3 (transplant$ or graft$)).ti,ab.
22	or/10-21
23	GLOMERULONEPHRITIS.kw.
24	glomerulonephriti$.ti,ab.
25	bright$ disease.ti,ab.
26	POLYCYSTIC KIDNEY, AUTOSOMAL DOMINANT.kw.
27	(polycystic adj3 kidney disease? adj3 (autosomal dominant or adult? or type 2)).ti,ab.
28	ADPKD.ti,ab.
29	DIABETIC NEPHROPATHIES.kw.
30	(diabet$ adj3 (glomerulosclerosis or kidney disease? or nephropath$)).ti,ab.
31	((nodular or intracapillary) adj3 glomerulosclerosis).ti,ab.
32	(kimmelstiel Wilson adj3 (disease or syndrome)).ti,ab.
33	(reflux$ adj3 nephropath$).ti,ab.
34	LUPUS NEPHRITIS.kw.
35	(lupus adj3 (nephriti$ or glomerulonephritis$)).ti,ab.
36	or/23-35
37	CESAREAN SECTION.kw.
38	(c?esar#an$ or c section$ or csection$ or (deliver$ adj3 abdom$)).ti,ab.
39	LABOR, INDUCED.kw.
40	(induc$ adj3 (labo?r$ or birth$ or born or deliver$ or obstetric$)).ti,ab.
41	EXTRACTION, OBSTETRICAL.kw.
42	((extract$ or vacuum$) adj3 (birth$ or born or deliver$ or obstetric$)).ti,ab.

#	Searches
43	(vaccum$ adj3 extract$).ti,ab.
44	ventouse?.ti,ab.
45	OBSTETRICAL FORCEPS.kw.
46	forcep?.ti,ab.
47	(mode? adj2 (birth$ or born or deliver$)).ti,ab.
48	or/37-47
49	9 and 22 and 48
50	9 and 36 and 48
51	22 and PREGNANCY OUTCOME.kw.
52	36 and PREGNANCY OUTCOME.kw.
53	or/49-52

Database: Database of Abstracts of Reviews of Effects

#	Searches
1	PREGNANCY.kw.
2	PERIPARTUM PERIOD.kw.
3	PARTURITION.kw.
4	LABOR, OBSTETRIC.kw.
5	OBSTETRIC LABOR, PREMATURE.kw.
6	pregnan$.tw,tx.
7	(labo?r or childbirth or partu$ or intra?part$ or peri?part$).tw,tx.
8	((during or giving or give) adj3 birth?).tw,tx.
9	or/1-8
10	RENAL INSUFFICIENCY, CHRONIC.kw.
11	((Renal$ or kidney?) adj5 (disease? or insuffic$ or fail$) adj5 (chronic$ or end-stage?)).tw,tx.
12	CKD.tw,tx.
13	ESRD.tw,tx.
14	Frasier syndrome.tw,tx.
15	ACUTE KIDNEY INJURY.kw.
16	((Renal$ or kidney?) adj5 (injur$ or insuffic$ or fail$) adj5 acute$).tw,tx.
17	(Kidney adj5 tubular necrosis adj5 acute$).tw,tx.
18	(Nephrosis adj5 nephron adj5 lower).tw,tx.
19	AKI.tw,tx.
20	or/10-19
21	GLOMERULONEPHRITIS.kw.
22	glomerulonephriti$.tw,tx.
23	bright$ disease.tw,tx.
24	POLYCYSTIC KIDNEY, AUTOSOMAL DOMINANT.kw.
25	(polycystic adj3 kidney disease? adj3 (autosomal dominant or adult? or type 2)).tw,tx.
26	ADPKD.tw,tx.

#	Searches
27	DIABETIC NEPHROPATHIES.kw.
28	(diabet$ adj3 (glomerulosclerosis or kidney disease? or nephropath$)).tw,tx.
29	((nodular or intracapillary) adj3 glomerulosclerosis).tw,tx.
30	(kimmelstiel Wilson adj3 (disease or syndrome)).tw,tx.
31	(reflux$ adj3 nephropath$).tw,tx.
32	LUPUS NEPHRITIS.kw.
33	(lupus adj3 (nephriti$ or glomerulonephritis$)).tw,tx.
34	or/21-33
35	CESAREAN SECTION.kw.
36	(c?esar#an$ or c section$ or csection$ or (deliver$ adj3 abdom$)).tw,tx.
37	LABOR, INDUCED.kw.
38	(induc$ adj3 (labo?r$ or birth$ or born or deliver$ or obstetric$)).tw,tx.
39	EXTRACTION, OBSTETRICAL.kw.
40	((extract$ or vacuum$) adj3 (birth$ or born or deliver$ or obstetric$)).tw,tx.
41	(vaccum$ adj3 extract$).tw,tx.
42	ventouse?.tw,tx.
43	OBSTETRICAL FORCEPS.kw.
44	forcep?.tw,tx.
45	or/35-44
46	9 and 20 and 45
47	9 and 34 and 45
48	20 and PREGNANCY OUTCOME.kw.
49	34 and PREGNANCY OUTCOME.kw.
50	or/46-49

Database: Health Technology Assessment

#	Searches
1	PREGNANCY/
2	PERIPARTUM PERIOD/
3	PARTURITION/
4	exp LABOR, OBSTETRIC/
5	OBSTETRIC LABOR, PREMATURE/
6	pregnan$.tw.
7	(labo?r or childbirth or partu$ or intra?part$ or peri?part$).tw.
8	((during or giving or give) adj3 birth?).tw.
9	or/1-8
10	exp RENAL INSUFFICIENCY, CHRONIC/
11	((Renal$ or kidney?) adj5 (disease? or insuffic$ or fail$) adj5 (chronic$ or end-stage?)).tw.
12	CKD.tw.
13	ESRD.tw.

#	Searches
14	Frasier syndrome.tw.
15	KIDNEY FAILURE, ACUTE/
16	((Renal$ or kidney?) adj5 (injur$ or insuffic$ or fail$) adj5 acute$).tw.
17	(Kidney adj5 tubular necrosis adj5 acute$).tw.
18	(Nephrosis adj5 nephron adj5 lower).tw.
19	AKI.tw.
20	KIDNEY TRANSPLANTATION/
21	((kidney? or renal$) adj3 (transplant$ or graft$)).tw.
22	or/10-21
23	exp GLOMERULONEPHRITIS/
24	glomerulonephriti$.tw.
25	bright$ disease.tw.
26	POLYCYSTIC KIDNEY, AUTOSOMAL DOMINANT/
27	(polycystic adj3 kidney disease? adj3 (autosomal dominant or adult? or type 2)).tw.
28	ADPKD.tw.
29	DIABETIC NEPHROPATHIES/
30	(diabet$ adj3 (glomerulosclerosis or kidney disease? or nephropath$)).tw.
31	((nodular or intracapillary) adj3 glomerulosclerosis).tw.
32	(kimmelstiel Wilson adj3 (disease or syndrome)).tw.
33	(reflux$ adj3 nephropath$).tw.
34	LUPUS NEPHRITIS/
35	(lupus adj3 (nephriti$ or glomerulonephritis$)).tw.
36	or/23-35
37	exp CESAREAN SECTION/
38	(c?esar#an$ or c section$ or csection$ or (deliver$ adj3 abdom$)).tw.
39	LABOR, INDUCED/
40	(induc$ adj3 (labo?r$ or birth$ or born or deliver$ or obstetric$)).tw.
41	exp EXTRACTION, OBSTETRICAL/
42	((extract$ or vacuum$) adj3 (birth$ or born or deliver$ or obstetric$)).tw.
43	(vaccum$ adj3 extract$).tw.
44	ventouse?.tw.
45	OBSTETRICAL FORCEPS/
46	forcep?.tw.
47	*Delivery, Obstetric/mt [Methods]
48	(mode? adj2 (birth$ or born or deliver$)).tw.
49	or/37-48
50	9 and 22 and 49
51	9 and 36 and 49
52	22 and *PREGNANCY OUTCOME/
53	36 and *PREGNANCY OUTCOME/

#	Searches
54	or/50-53

Database: Embase

#	Searches
1	*PREGNANCY/
2	*PERINATAL PERIOD/
3	exp *BIRTH/
4	exp *LABOR/
5	*PREMATURE LABOR/
6	*INTRAPARTUM CARE/
7	pregnan$.ti,ab.
8	(labo?r or childbirth or partu$ or intra?part$ or peri?part$).ti,ab.
9	((during or giving or give) adj3 birth?).ti,ab.
10	or/1-9
11	CHRONIC KIDNEY DISEASE/
12	CHRONIC KIDNEY FAILURE/
13	END STAGE RENAL DISEASE/
14	((Renal$ or kidney?) adj5 (disease? or insuffic$ or fail$) adj5 (chronic$ or end-stage?)).ab,ti.
15	CKD.ab,ti.
16	ESRD.ab,ti.
17	Frasier syndrome.ti,ab.
18	ACUTE KIDNEY FAILURE/
19	((Renal$ or kidney?) adj5 (injur$ or insuffic$ or fail$) adj5 acute$).ab,ti.
20	(Kidney adj5 tubular necrosis adj5 acute$).ab,ti.
21	(Nephrosis adj5 nephron adj5 lower).ab,ti.
22	AKI.ab,ti.
23	KIDNEY TRANSPLANTATION/
24	((kidney? or renal$) adj3 (transplant$ or graft$)).ti,ab.
25	or/11-24
26	exp GLOMERULONEPHRITIS/
27	glomerulonephriti$.ti,ab.
28	bright$ disease.ti,ab.
29	KIDNEY POLYCYSTIC DISEASE/
30	(polycystic adj3 kidney disease? adj3 (autosomal dominant or adult? or type 2)).ti,ab.
31	ADPKD.ti,ab.
32	DIABETIC NEPHROPATHY/
33	(diabet$ adj3 (glomerulosclerosis or kidney disease? or nephropath$)).ti,ab.
34	((nodular or intracapillary) adj3 glomerulosclerosis).ti,ab.
35	(kimmelstiel Wilson adj3 (disease or syndrome)).ti,ab.
36	(reflux$ adj3 nephropath$).ti,ab.

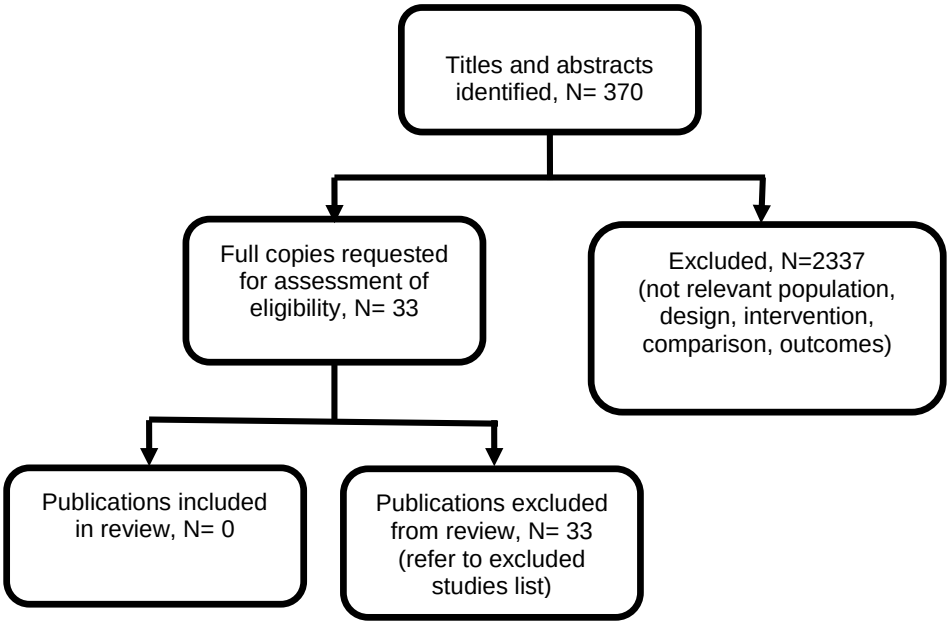
#	Searches
37	LUPUS ERYTHEMATOSUS NEPHRITIS/
38	(lupus adj3 (nephriti$ or glomerulonephritis$)).ti,ab.
39	or/26-38
40	exp CESAREAN SECTION/
41	(c?esar#an$ or c section$ or csection$ or (deliver$ adj3 abdom$)).ti,ab.
42	LABOR, INDUCTION/
43	(induc$ adj3 (labo?r$ or birth$ or born or deliver$ or obstetric$)).ti,ab.
44	VACUUM EXTRACTION/
45	((extract$ or vacuum$) adj3 (birth$ or born or deliver$ or obstetric$)).ti,ab.
46	(vaccum$ adj3 extract$).ti,ab.
47	ventouse?.ti,ab.
48	FORCEPS DELIVERY/
49	OBSTETRIC FORCEPS/
50	forcep?.ti,ab.
51	(mode? adj2 (birth$ or born or deliver$)).ti,ab.
52	or/40-51
53	10 and 25 and 52
54	10 and 39 and 52
55	25 and *PREGNANCY OUTCOME/
56	39 and *PREGNANCY OUTCOME/
57	or/53-56
58	limit 57 to english language
59	letter.pt. or LETTER/
60	note.pt.
61	editorial.pt.
62	CASE REPORT/ or CASE STUDY/
63	(letter or comment*).ti.
64	or/59-63
65	RANDOMIZED CONTROLLED TRIAL/ or random*.ti,ab.
66	64 not 65
67	ANIMAL/ not HUMAN/
68	NONHUMAN/
69	exp ANIMAL EXPERIMENT/
70	exp EXPERIMENTAL ANIMAL/
71	ANIMAL MODEL/
72	exp RODENT/
73	(rat or rats or mouse or mice).ti.
74	or/66-73
75	58 not 74

1

Appendix C – Clinical evidence study selection

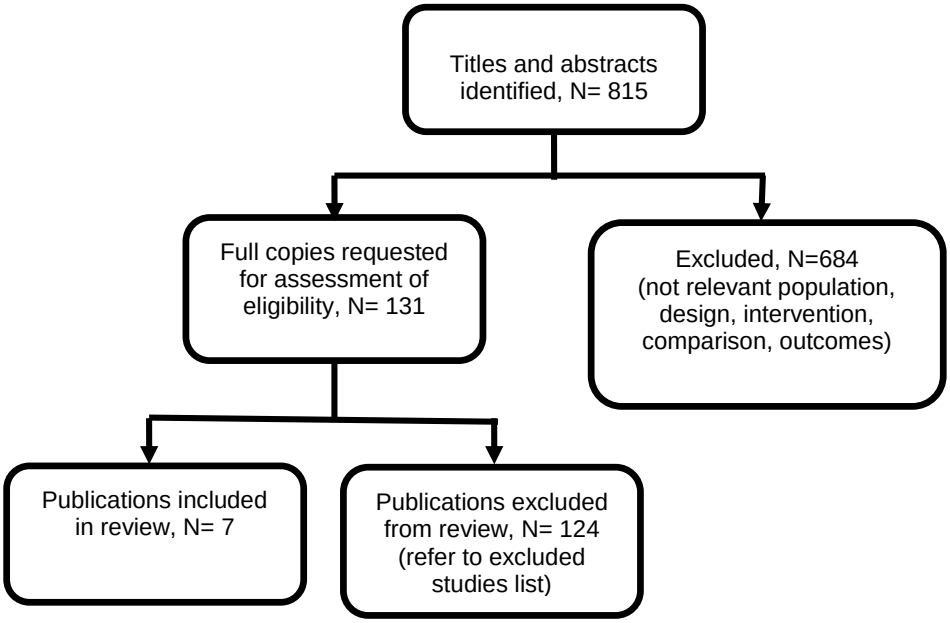
Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – fluid management

Figure 1: Flow diagram of clinical article selection for intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – fluid management



Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – early birth

Figure 2: Flow diagram of clinical article selection for intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – early birth



Appendix D – Excluded studies

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – fluid management

Clinical studies

Study	Reason for exclusion
Ahammed, S. U., Chowdhury, A. A., Roy, A. S., Muqueet, M. A., Rahman, M. A., Kabir, M. S., Rabbani, M. G., Asadujjaman, M., Hossain, M. B., Akhtaruzzaman, M., Das, S. K., Khan, E. H., Islam, M. A., Hasan, M. J., Rahman, M. A., Talukder, R. K., Ara, J., Barman, G. C., Roy, P. P., Saha, M. K., Mondal, D., Outcome of Pregnancy Related Acute Kidney Injury Observed in a Tertiary Care Hospital, Mymensingh medical journal : MMJ, 26, 463-470, 2017	Outcome data were not aggregated by intervention
Anthone, S., Anthone, R., Doyle, J. E., Acute renal failure in obstetric patients: treatment by hemodialysis, Obstetrics and Gynecology, 15, 146-57, 1960	Study design; case reports of haemodialysis in patients with acute renal failure (n=9)
Balofsky, A., Fedarau, M., Renal Failure in Pregnancy, Critical Care Clinics, 32, 73-83, 2016	Study design; non-systematic review
Becker, E. L., PREGNANCY AND CHRONIC RENAL DISEASE, Clinical Obstetrics and Gynecology, 13, 206-18, 1964	Study design; non-systematic review
Bekele, D., Ahmed, M., Ibrahim, A., Kedir, S., Chan, G., Profile and outcomes of women with pregnancy-related acute kidney injury requiring dialysis at a center in Ethiopia, International Journal of Gynecology and Obstetrics, 138, 138-141, 2017	Full text unavailable
Blachley, J. D., The prognosis and complications of pregnancy in women with renal disease, American Journal of the Medical Sciences, 293, 265-273, 1987	Study design; non-systematic review
Camussi, Giovanni, Cantaluppi, Vincenzo, Deregibus, Maria Chiara, Gatti, Emanuele, Tetta, Ciro, Role of microvesicles in acute kidney injury, Contributions to nephrology, 174, 191-9, 2011	Study design; non-systematic review
Cantarovich, F., Fernandez, J. C., Locatelli, A., Perez Loredo, J., Frusemide in high doses in the treatment of acute renal failure, Postgraduate Medical Journal, 47, Suppl-7, 1971	Full text unavailable
Chandra, M., Agarwal, S. S., Mitra, N. K., Gupta, N. N., Massive intravenous frusemide therapy in acute renal failure, Journal of the Indian Medical Association, 64, 47-8, 1975	Study design; case report
Chinnappa,V., Ankichetty,S., Angle,P., Halpern,S.H., Chronic kidney disease in pregnancy, International Journal of Obstetric Anesthesia, 22, 223-230, 2013	Study design; non-systematic review
Chowdhury, G., Acute Renal Failure (ARF) in severe pre-eclampsia & eclampsia (maternal outcome), Journal of Obstetrics and Gynaecology Research, 41, 38-39, 2015	Conference proceedings; no data on management of acute renal failure
De Castro, I., Easterling, T. R., Bansal, N., Jefferson, J. A., Nephrotic syndrome in pregnancy poses risks with both maternal and fetal complications, Kidney International, 91, 1464-1472, 2017	Outcomes were not stratified by different renal fluid management

Study	Reason for exclusion
Emmanouel, D. S., Katz, A. I., Acute renal failure in obstetric septic shock. Current views on pathogenesis and management, American Journal of Obstetrics and Gynecology, 117, 145-59, 1973	Study design; non-systematic review
Gerstner, G., Grunberger, W., Dopamine treatment for prevention of renal failure in patients with severe eclampsia, Clinical and experimental obstetrics & gynecology, 7, 219-22, 1980	Full text unavailable
Grunfeld, J. P., Ganeval, D., Bournerias, F., Acute renal failure in pregnancy, Kidney International, 18, 179-191, 1980	Study design; descriptive study of acute renal failure (n=57)
Hall, M., Brunskill, N. J., Renal disease in pregnancy, Obstetrics, Gynaecology and Reproductive Medicine, 20, 131-137, 2010	Study design; non-systematic review
Huang, C., Chen, S., Acute kidney injury during pregnancy and puerperium: a retrospective study in a single center, BMC Nephrology, 18, 146, 2017	Study design; case series
Huang, Chunhong, Chen, Shanying, Acute kidney injury during pregnancy and puerperium: a retrospective study in a single center, BMC nephrology, 18, 146, 2017	Study design; descriptive study, no relevant interventions included
Knapp, M. S., Burden, R., The recognition and management of renal failure in pregnancy, Clinics in obstetrics and gynaecology, 4, 717-33, 1977	Study design; non-systematic review
Lakshmi, K. S., Gorikhan, G., Umadi, M. M., Kalsad, S. T., Madhavaranga, M. P., Dambal, A., Padaki, S. A., Obstetric acute kidney injury; A three year experience at a medical college hospital in North Karnataka,India, Journal of Clinical and Diagnostic Research, 9, OC01-OC04, 2015	Study design; descriptive study of pregnant women with acute renal failure and renal dialysis therapy
Lightstone,L., Renal disease and pregnancy, Medicine, 35, 524-528, 2007	Study design; non-systematic review
Lindheimer, M. D., Katz, A. I., Pregnancy and the kidney, The Journal of reproductive medicine, 11, 14-8, 1973	Study design; non-systematic review
Machado, S., Figueiredo, N., Borges, A., Pais, M. S. J., Freitas, L., Moura, P., Campos, M., Acute kidney injury in pregnancy: A clinical challenge, Journal of Nephrology, 25, 19-30, 2012	Study design; non-systematic review
Macias, L. O. S., Castellanos, K. I. L., Pacheco, J. A. H., Vega, O. V., Rotter, R. C., Perinatal outcomes of women with advance chronic kidney disease that initiated peritoneal dialysis during pregnancy, Nephrology Dialysis Transplantation, 27, ii478, 2012	Non-comparative study
Maikranz, P., Katz, A. I., Acute renal failure in pregnancy, Obstetrics & Gynecology Clinics of North America, 18, 333-43, 1991	Study design; non-systematic review
Nesler, C. L., Sinclair, S. H., Schwartz, S. S., Gabbe, S. G., Diabetic nephropathy in pregnancy, Clinical Obstetrics and Gynecology, 28, 528-535, 1985	Study design; non-systematic review
Pertuiset, N., Grunfeld, J. P., Acute renal failure in pregnancy, Baillieres Clinical Obstetrics & Gynaecology, 8, 333-51, 1994	Study design; non-systematic review
Podymow, Tiina, August, Phyllis, Akbari, Ayub, Management of renal disease in pregnancy, Obstetrics and Gynecology Clinics of North America, 37, 195-210, 2010	Study design; non-systematic review

Study	Reason for exclusion
Reddy, Sai Subhodhini, Holley, Jean L., Management of the pregnant chronic dialysis patient, Advances in chronic kidney disease, 14, 146-55, 2007	Study design; non-systematic review
Sifontis,N.M., Coscia,L.A., Constantinescu,S., Lavelanet,A.F., Moritz,M.J., Armenti,V.T., Pregnancy outcomes in solid organ transplant recipients with exposure to mycophenolate mofetil or sirolimus, Transplantation, 82, 1698-1702, 2006	Wrong intervention; assessed pregnancy outcomes in women exposed to mycophenolate mofetil or sirolimus
Steyn, D. W., Steyn, P., Low-dose dopamine for women with severe pre-eclampsia, Cochrane Database of Systematic Reviews, no pagination, 2009	Outcomes outside of scope; outcomes reported were blood pressure, pulse, urine output
Toering, Tsjitske J., van der Graaf, Anne Marijn, Visser, Folkert W., Groen, Henk, Faas, Marijke M., Navis, Gerjan, Lely, A. Titia, Higher filtration fraction in formerly early-onset preeclamptic women without comorbidity, American journal of physiology. Renal physiology, 308, F824-31, 2015	comparison outside scope; comparison of renal haemodynamic profile in women with history of early pre-eclampsia versus healthy controls
Webster, P., Lightstone, L., McKay, D. B., Josephson, M. A., Pregnancy in chronic kidney disease and kidney transplantation, Kidney International, 91, 1047-1056, 2017	Study design; non-systematic review

Economic studies

See Supplement 2 (Health economics) for details of economic evidence reviews and health economic modelling.

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – early birth

Clinical studies

Study	Reason for exclusion
Aggarwal, R. S., Mishra, V. V., Jasani, A. F., Gumber, M., Acute renal failure in pregnancy: our experience, Saudi Journal of Kidney Diseases & Transplantation, 25, 450-5, 2014	Outcomes; data were not disaggregated by intervention
Alba, P. B., Otaduy, C., Gobbi, C. A., Alvarez, A., Albiero, A., Albiero, E. H., Propato, M. L., Yorio, M. A., Lupus nehritis and pregnancy: Maternal and fetal outcome, Annals of the Rheumatic Diseases, 76, 1220, 2017	Conference proceedings
Alshohaib, S., Outcome of pregnancy in patients with inactive systemic lupus erythromatosus and minimal proteinuria, Saudi Journal of Kidney Diseases & Transplantation, 20, 802-5, 2009	Outcomes; data were not disaggregated by intervention
Amine, Ben Haj Hassine, Haythem, Siala, Kais, Harzallah, Radhouane, Rachdi, Pregnancy after renal transplantation: a retrospective study at the military hospital of Tunis from 1992 to 2011, The Pan African medical journal, 28, 137, 2017	Intervention unclear; no data on which women received early child birth
Attini,R., Panettella,F., Vasario,E., Mensa,M., Consiglio,V., Deagostini,M.C., Gaglioti,P., Todros,T., Piccoli,G., Pregnancy may	Conference proceedings

Study	Reason for exclusion
be the occasion for early CKD diagnosis: On 35 new diagnoses over 150 pregnancies in the same setting (2002-2010), NDT Plus, 3, iii393-, 2010	
Bagg, W., Neale, L., Henley, P. G., MacPherson, P., Cundy, T. F., Long-term maternal outcome after pregnancy in women with diabetic nephropathy, New Zealand Medical Journal, 116, 1180	No comparative data
Bagon, J. A., Vernaeve, H., De Muylder, X., Lafontaine, J. J., Martens, J., Van Roost, G., Pregnancy and dialysis, American Journal of Kidney Diseases, 31, 756-65, 1998	Publication year <2005 (dialysis paper)
Balofsky, A., Fedarau, M., Renal Failure in Pregnancy, Critical Care Clinics, 32, 73-83, 2016	Study design; non-systematic review
Bar, J., Orvieto, R., Shalev, Y., Peled, Y., Pardo, Y., Gafter, U., Ben-Rafael, Z., Chen, R., Hod, M., Pregnancy outcome in women with primary renal disease, Israel Medical Association Journal: Imaj, 2, 178-81, 2000	No comparative data
Basaran,O., Emiroglu,R., Secme,S., Moray,G., Haberal,M., Pregnancy and renal transplantation, Transplantation Proceedings, 36, 122-124, 2004	Publication year <2005 (transplantation paper)
Bharti, J., Vatsa, R., Singhal, S., Roy, K. K., Kumar, S., Perumal, V., Meena, J., Pregnancy with chronic kidney disease: maternal and fetal outcome, European Journal of Obstetrics, Gynecology, & Reproductive Biology, 204, 83-7, 2016	Outcomes; data were not disaggregated by mode and/or timing of birth
Bharti, Juhi, Vatsa, Richa, Singhal, Seema, Roy, Kallol Kumar, Kumar, Sunesh, Perumal, Vanamail, Meena, Jyoti, Pregnancy with chronic kidney disease: maternal and fetal outcome, European journal of obstetrics, gynecology, and reproductive biology, 204, 83-7, 2016	Indication for early birth was not reported
Blom, K., Odutayo, A., Bramham, K., Hladunewich, M. A., Pregnancy and glomerular disease: A systematic review of the literature with management guidelines, Clinical Journal of the American Society of Nephrology, 12, 1862-1872, 2017	Outcomes; data were aggregated by type of glomerular disease (rather than severity of renal disease)
Bramham, K., Briley, A. L., Seed, P. T., Poston, L., Shennan, A. H., Chappell, L. C., Pregnancy outcome in women with chronic kidney disease: A prospective cohort study, Reproductive Sciences, 18, 623-630, 2011	Outcomes; data were not presented by timing and/or mode of birth
Bramham, Kate, Diabetic Nephropathy and Pregnancy, Seminars in Nephrology, 37, 362-369, 2017	Study design; non-systematic review
Brown, R. A., Kemp, G. J., Walkinshaw, S. A., Howse, M. L. P., Pregnancies complicated by preeclampsia and non-preeclampsia-related nephritic range proteinuria, Obstetric Medicine, 6, 159-164, 2013	Outcomes; data were not aggregated by timing and/or mode of birth
Candido, C., Cristelli, M. P., Fernandes, A. R., Lima, A. C., Viana, L. A., Sato, J. L., Sass, N., Tedesco-Silva, H., Medina-Pestana, J. O., Pregnancy after kidney transplantation: high rates of maternal complications, Jornal brasileiro de nefrologia : 'orgao oficial de Sociedades Brasileira e Latino-Americana de Nefrologia, 38, 421-426, 2016	Indication for induction of labour was not clear
Candido, Cristina, Cristelli, Marina Pontello, Fernandes, Ana Raquel, Lima, Andre Caires Alvino de, Viana, Laila Almeida, Sato, Jussara L., Sass, Nelson, Tedesco-Silva, Helio, Medina-Pestana,	Outcomes; data were not aggregated by severity of renal disease or mode of birth

Study	Reason for exclusion
Jose Osmar, Pregnancy after kidney transplantation: high rates of maternal complications, Jornal brasileiro de nefrologia : 'orgao oficial de Sociedades Brasileira e Latino-Americana de Nefrologia, 38, 421-426, 2016	
Chang, J. Y., Jang, H., Chung, B. H., Youn, Y. A., Sung, I. K., Kim, Y. S., Yang, C. W., The successful clinical outcomes of pregnant women with advanced chronic kidney disease, Kidney Research and Clinical Practice, 35, 84-9, 2016	Study design; case reports
Chao, A. S., Huang, J. Y., Lien, R., Kung, F. T., Chen, P. J., Hsieh, P. C., Pregnancy in women who undergo long-term hemodialysis, American Journal of Obstetrics & Gynecology, 187, 152-6, 2002	Publication year <2005 (dialysis paper)
Choi, J., Choi, D., Kwon, O., Does pregnancy after renal transplantation affect their allograft and pregnancy outcomes?, American Journal of Transplantation, 14, 572, 2014	Indication for caesarean section was not reported
Chopra,S., Suri,V., Aggarwal,N., Rohilla,M., Keepanasseril,A., Kohli,H.S., Pregnancy in chronic renal insufficiency: single centre experience from North India, Archives of Gynecology and Obstetrics, 279, 691-695, 2009	No comparative data
Clowse, Megan E. B., Grotegut, Chad, Racial and Ethnic Disparities in the Pregnancies of Women With Systemic Lupus Erythematosus, Arthritis care & research, 68, 1567-72, 2016	Outcomes; data were not aggregated by severity of renal disease
Davison,J.M., Dialysis, transplantation, and pregnancy, American Journal of Kidney Diseases, 17, 127-132, 1991	Study design; non-systematic review
Debska-Slizien, A., Galgowska, J., Chamienia, A., Bullo-Piontecka, B., Krol, E., Lichodziejewska-Niemierko, M., Lizakowski, S., Renke, M., Rutkowski, P., Zdrojewski, Z., Preis, K., Sledzinski, Z., Rutkowski, B., Pregnancy after kidney transplantation: a single-center experience and review of the literature, Transplantation Proceedings, 46, 2668-72, 2014	Outcomes; data were not disaggregated by intervention
Devresse, A., Jassogne, C., Hubinont, C., De Meyer, M., Mourad, M., Goffin, E., Kanaan, N., Maternal risks and pregnancy outcomes after kidney transplantation: A single center experience, American Journal of Transplantation, 17, 253, 2017	Conference proceedings
Di Loreto, P., Martino, F., Chiaramonte, S., Dissegna, D., Ronco, C., Marchesoni, D., Catapano, P., Romano, G., Montanaro, D., Pregnancy after kidney transplantation: two transplantation centers--Vicenza-Udine experience, Transplantation Proceedings, 42, 1158-61, 2010	Study included data <2005 (transplantation paper)
Dickins, D., Renal transplant patients in Liverpool Women's Hospital renal antenatal clinic, BJOG: An International Journal of Obstetrics and Gynaecology, 124, 15, 2017	Conference proceedings
Dunne,F.P., Chowdhury,T.A., Hartland,A., Smith,T., Brydon,P.A., McConkey,C., Nicholson,H.O., Pregnancy outcome in women with insulin-dependent diabetes mellitus complicated by nephropathy, QJM - Monthly Journal of the Association of Physicians, 92, 451-454, 1999	No comparative data. Data were not stratified by renal function
Egerman, R. S., Witlin, A. G., Friedman, S. A., Sibai, B. M., Thrombotic thrombocytopenic purpura and hemolytic uremic syndrome in pregnancy: review of 11 cases, American Journal of Obstetrics & Gynecology, 175, 950-6, 1996	Study design; case series

Study	Reason for exclusion
Erman Akar, M., Ozekinci, M., Sanhal, C., Kececioglu, N., Mendilcioglu, I., Senol, Y., Dirican, K., Kocak, H., Dinckan, A., Suleymanlar, G., A retrospective analysis of pregnancy outcomes after kidney transplantation in a single center, Gynecologic & Obstetric Investigation, 79, 13-8, 2015	Outcomes; data were not disaggregated by intervention
Espinoza, F., Romeo, R., Ursu, M., Tapia, A., Vukusich, A., Pregnancy during dialysis. Experience in six patients, Revista Medica de Chile, 141, 1003-1009, 2013	Language; full text in Spanish
Eudy, A. M., McDaniel, G., Clowse, M. E. B., Pregnancy in rheumatoid arthritis: a retrospective study, Clinical Rheumatology, 37, 789-794, 2018	Population; unclear whether women had renal abnormality
Fang, E., Nayyar, R., Surgical complications during caesarean section in transplant recipients at atertiary referral hospital in Australia, Nephrology, 21, 160, 2016	Conference proceedings
Fang, Y., A retrospective cohort review of bladder injuries during caesarean sections in transplant recipients at a tertiary referral hospital in Australia, Australian and New Zealand Journal of Obstetrics and Gynaecology, 57, 42, 2017	Conference proceedings
Fatemi,A., Fard,R.M., Sayedbonakdar,Z., Farajzadegan,Z., Saber,M., The role of lupus nephritis in development of adverse maternal and fetal outcomes during pregnancy, International Journal of Preventive Medicine, 4, 1004-1010, 2013	Population outside of scope; women with systemic lupus erythematosus
Feng, Z., Minard, C., Raghavan, R., Pregnancy outcomes in advanced kidney disease, Clinical Nephrology, 83, 272-8, 2015	Full text unavailable
Galdo, T., Gonzalez, F., Espinoza, M., Quintero, N., Espinoza, O., Herrera, S., Reynolds, E., Roessler, E., Impact of pregnancy on the function of transplanted kidneys, Transplantation Proceedings, 37, 1577-1579, 2005	Outcomes; data were not disaggregated by intervention
Gladman,D.D., Tandon,A., Ibanez,D., Urowitz,M.B., The effect of lupus nephritis on pregnancy outcome and fetal and maternal complications, Journal of Rheumatology, 37, 754-758, 2010	Population outside of scope; women with systemic lupus erythematosus a subset of whom had renal impairment
Gul, A., Aslan, H., Cebeci, A., Polat, I., Ulusoy, S., Ceylan, Y., Maternal and fetal outcomes in HELLP syndrome complicated with acute renal failure, Renal Failure, 26, 557-62, 2004	Outcomes; data were not disaggregated by intervention
Gurrieri, C., Garovic, V. D., Gullo, A., Bojanic, K., Sprung, J., Narr, B. J., Weingarten, T. N., Kidney injury during pregnancy: associated comorbid conditions and outcomes, Archives of Gynecology & Obstetrics, 286, 567-73, 2012	Outcomes; data were not disaggregated by intervention
Haase, M., Morgera, S., Bamberg, C., Halle, H., Martini, S., Hocher, B., Diekmann, F., Dragun, D., Peters, H., Neumayer, H. H., Budde, K., A systematic approach to managing pregnant dialysis patients - The importance of an intensified haemodiafiltration protocol, Nephrology Dialysis Transplantation, 20, 2537-2542, 2005	Paper included data <2005 (dialysis paper)
Hall,B.A., Morrison,J., Keeping,J.D., Pregnancy after renal transplantation, Australian and New Zealand Journal of Obstetrics and Gynaecology, 23, 241-243, 1983	Publication year <2005 (transplantation paper)
Hebral, A. L., Cointault, O., Connan, L., Congy-Jolivet, N., Esposito, L., Cardeau-Desangles, I., Del Bello, A., Lavayssiere, L.,	Outcomes; data were not disaggregated by intervention

Study	Reason for exclusion
Nogier, M. B., Ribes, D., Guitard, J., Sallusto, F., Game, X., Parant, O., Berrebi, A., Rostaing, L., Kamar, N., Pregnancy after kidney transplantation: outcome and anti-human leucocyte antigen alloimmunization risk, Nephrology Dialysis Transplantation, 29, 1786-93, 2014	
Hildebrand, A. M., Liu, K., Shariff, S. Z., Ray, J. G., Sontrop, J. M., Clark, W. F., Hladunewich, M. A., Garg, A. X., Characteristics and outcomes of AKI treated with dialysis during pregnancy and the postpartum period, Journal of the American Society of Nephrology, 26, 3085-3091, 2015	Outcomes; data were not disaggregated by intervention
Huang, Chunhong, Chen, Shanying, Acute kidney injury during pregnancy and puerperium: a retrospective study in a single center, BMC nephrology, 18, 146, 2017	Indication for early birth/caesarean section was not reported
Imbasciati, E., Gregorini, G., Cabiddu, G., Gammaro, L., Ambroso, G., Del Giudice, A., Ravani, P., Pregnancy in CKD stages 3 to 5: fetal and maternal outcomes, American Journal of Kidney Diseases, 49, 753-62, 2007	Outcomes; data were not disaggregated by intervention
Imbasciati, E., Pardi, G., Capetta, P., Ambroso, G., Bozzetti, P., Pagliari, B., Ponticelli, C., Pregnancy in women with chronic renal failure, American Journal of Nephrology, 6, 193-8, 1986	Study design; case reports
Imbasciati,E., Tincani,A., Gregorini,G., Doria,A., Moroni,G., Cabiddu,G., Marcelli,D., Pregnancy in women with pre-existing lupus nephritis: Predictors of fetal and maternal outcome, Nephrology Dialysis Transplantation, 24, 519-525, 2009	No stratified data on renal disease
Jain,A.B., Shapiro,R., Scantlebury,V.P., Potdar,S., Jordan,M.L., Flohr,J., Marcos,A., Fung,J.J., Pregnancy after kidney and kidney-pancreas transplantation under tacrolimus: A single center's experience, Transplantation, 77, 897-902, 2004	Publication year <2005 (transplantation paper)
Jones, D. C., Hayslett, J. P., Outcome of pregnancy in women with moderate or severe renal insufficiency.[Erratum appears in N Engl J Med 1997 Mar 6;336(10):739], New England Journal of Medicine, 335, 226-32, 1996	Better quality data available for outcomes by level of renal deterioration
Kabir,M.Z., Chowdhury,M.A.A., Rahman,M.H., Akhter,S., Pregnancy related acute renal failure - Still a major problem, Bangladesh Journal of Obstetrics and Gynecology, 15, 52-58, 2000	Full copy of reference unavailable
Khalil, M. A., Azhar, A., Anwar, N., Aminullah,, Najm ud, Din, Wali, R., Aetiology, maternal and foetal outcome in 60 cases of obstetrical acute renal failure, Journal of Ayub Medical College, Abbottabad: JAMC, 21, 46-9, 2009	No mode of birth data
Kimmerle,R., Zass,R.P., Cupisti,S., Somville,T., Bender,R., Pawlowski,B., Berger,M., Pregnancies in women with diabetic nephropathy: long-term outcome for mother and child, Diabetologia, 38, 227-235, 1995	Outcome data not disaggregated by intervention
Klemetti, M. M., Laivuori, H., Tikkanen, M., Nuutila, M., Hiilesmaa, V., Teramo, K., Obstetric and perinatal outcome in type 1 diabetes patients with diabetic nephropathy during 1988-2011, Diabetologia, 58, 678-86, 2015	No information about birth

Study	Reason for exclusion
Koido, S., Makino, H., Iwazaki, K., Makino, T., IgA nephropathy and pregnancy, Tokai Journal of Experimental & Clinical Medicine, 23, 31-7, 1998	Better quality data for LBW available
Ku, Ming, Guo, Shuiming, Shang, Weifeng, Li, Qing, Zeng, Rui, Han, Min, Ge, Shuwang, Xu, Gang, Pregnancy Outcomes in Chinese Patients with Systemic Lupus Erythematosus (SLE): A Retrospective Study of 109 Pregnancies, PLoS ONE, 11, e0159364, 2016	The study did not aggregate outcomes by severity of renal disease
Kuvacic, I., Sprem, M., Skrablin, S., Kalafatic, D., Bubic-Filipi, L., Milici, D., Pregnancy outcome in renal transplant recipients, International Journal of Gynaecology & Obstetrics, 70, 313-7, 2000	No mode of birth data
Kwek, Jia Liang, Tey, Vanessa, Yang, Liying, Kanagalingam, Devendra, Kee, Terence, Renal and obstetric outcomes in pregnancy after kidney transplantation: Twelve-year experience in a Singapore transplant center, The journal of obstetrics and gynaecology research, 41, 1337-44, 2015	Outcomes were not aggregated by mode and/or timing of birth
Lakshmi, K. S., Gorikhan, G., Umadi, M. M., Kalsad, S. T., Madhavaranga, M. P., Dambal, A., Padaki, S. A., Obstetric acute kidney injury; A three year experience at a medical college hospital in North Karnataka,India, Journal of Clinical and Diagnostic Research, 9, OC01-OC04, 2015	Outcome data not disaggregated by intervention
Li, Y. P., Shih, J. C., Lin, S. Y., Lee, C. N., Pregnancy outcomes after kidney transplantation-A single-center experience in Taiwan, Taiwanese Journal of Obstetrics and Gynecology, 55, 314-318, 2016	Transplant paper with mixed pop <2005 and >2005
Lima, A., Cristelli, M., Teixeira, C., Pietrobom, I., Basso, G., Viana, L., De Paula, M., Candido, C., Tedesco-Silva, H., Pestana, J., Pregnancy in the renal transplant recipient: Pregnancy viability and effects on graft function, American Journal of Transplantation, 16, 783-784, 2016	Conference abstract
Liu, E. L., Zhou, Y. X., Wang, L. Q., Chen, M., Li, J., Wang, Y., Zhang, D. H., Zheng, H. Y., Effects of four different treatments on pregnancy outcome in patients with SLE, Basic and Clinical Pharmacology and Toxicology, 122, 5, 2018	Conference abstract
Liu, Y., Ma, X., Zheng, J., Liu, X., Yan, T., A Systematic Review and Meta-Analysis of Kidney and Pregnancy Outcomes in IgA Nephropathy, American Journal of Nephrology, 44, 187-193, 2016	Systematic review outcomes not disaggregated by intervention
Liu, Youxia, Ma, Xinxin, Zheng, Jie, Liu, Xiangchun, Yan, Tiekun, Pregnancy outcomes in patients with acute kidney injury during pregnancy: a systematic review and meta-analysis, BMC Pregnancy and Childbirth, 17, 235, 2017	Information on renal indication for birth was not reported
Lv, J., Wang, W., Li, Y., Clinical outcomes and predictors of fetal and maternal consequences of pregnancy in lupus nephritis patients, International Urology and Nephrology, 47, 1379-1385, 2015	Wrong population. SLE patients with a subset of LN patients
Majak, Guri B., Sandven, Irene, Lorentzen, Bjorg, Vangen, Siri, Reisaeter, Anna V., Henriksen, Tore, Michelsen, Trond M., Pregnancy outcomes following maternal kidney transplantation: a national cohort study, Acta Obstetricia et Gynecologica Scandinavica, 95, 1153-61, 2016	Reasons for preterm birth in kidney transplant women were not reported

Study	Reason for exclusion
Malik,G.H., Al-Harbi,A.S., Al-Mohaya,S., Al-Wakeel,J., Al-Hozaim,W., Kechrid,M., Shetia,M.S., Hammed,D., Repeated pregnancies in patients with primary membranous glomerulonephritis, Nephron, 91, 21-24, 2002	Case reports
Malik,G.H., Al-Harbi,A., Al-Mohaya,S., Dohaimi,H., Kechrid,M., Shetaia,M.S., Al-Hassan,A.O., Quiapos,L.S., Pregnancy in patients on dialysis--experience at a referral center, Journal of the Association of Physicians of India, 53, 937-941, 2005	Dialysis paper <2005
Maruotti, G. M., Sarno, L., Napolitano, R., Mazzarelli, L. L., Quaglia, F., Capone, A., Capuano, A., Martinelli, P., Preeclampsia in women with chronic kidney disease, Journal of Maternal-Fetal and Neonatal Medicine, 25, 1367-1369, 2012	Wrong population (women with PE)
Mecacci, F., Simeone, S., Cirami, C. L., Cozzolino, M., Serena, C., Rambaldi, M. P., Gallo, P., Emmi, L., Cammelli, D., Mello, G., Matucci Cerinic, M., Preeclampsia in pregnancies complicated by systemic lupus erythematosus (SLE) nephritis: prophylactic treatment with multidisciplinary approach are important keys to prevent adverse obstetric outcomes, Journal of Maternal-Fetal and Neonatal Medicine, 1-7, 2017	The outcomes were not aggregated by severity of renal disease
Misra, R., Bhowmik, D., Mittal, S., Kriplani, A., Kumar, S., Bhatla, N., Dadhwal, V., Pandey, R. M., Pregnancy with chronic kidney disease: outcome in Indian women, Journal of Women's Health, 12, 1019-25, 2003	Outcomes not disaggregated by intervention
Mohamed Hassan, S., Fahmy, R., Omran, E. F., Hussein, E. A., Ramadan, W., Abdelazim, D. F., Outcome of pregnancy after renal transplantation, International Journal of Women's Health, 10, 65-68, 2018	Indication (including renal) for preterm birth was not reported
Moroni, Gabriella, Doria, Andrea, Giglio, Elisa, Imbasciati, Enrico, Tani, Chiara, Zen, Margherita, Strigini, Francesca, Zaina, Barbara, Tincani, Angela, Gatto, Mariele, de Liso, Federica, Grossi, Claudia, Meroni, Pier Luigi, Cabiddu, Gianfranca, Messa, Piergiorgio, Ravani, Pietro, Mosca, Marta, Maternal outcome in pregnant women with lupus nephritis. A prospective multicenter study, Journal of autoimmunity, 74, 194-200, 2016	The aims of the analyses are to identify the predictors
Muirhead, N., Sabharwal, A. R., Rieder, M. J., Lazarovits, A. I., Hollomby, D. J., The outcome of pregnancy following renal transplantation--the experience of a single center, Transplantation, 54, 429-32, 1992	Outcome data not disaggregated by intervention. Published before 2005
Nevis, I. F., Reitsma, A., Dominic, A., McDonald, S., Thabane, L., Akl, E. A., Hladunewich, M., Akbari, A., Joseph, G., Sia, W., Iansavichus, A. V., Garg, A. X., Pregnancy outcomes in women with chronic kidney disease: a systematic review, Clinical Journal of The American Society of Nephrology: CJASN, 6, 2587-98, 2011	Systematic review outcomes not disaggregated by intervention
Normand, G., Xu, X., Panaye, M., Jolivot, A., Lemoine, S., Guebre-Egziabher, F., Decullier, E., Bin, S., Doret, M., Juillard, L., Pregnancy Outcomes in French Hemodialysis Patients, American Journal of Nephrology, 219-227, 2018	Renal related indication for induction of labour was unclear
Oh,H.J., Han,S.H., Yoo,D.E., Kim,S.J., Park,J.T., Kim,J.K., Yoo,T.H., Kang,S.W., Choi,K.H., Reduced pre-pregnancy proteinuria is associated with improving postnatal maternal renal	Outcomes not disaggregated by level of renal function

Study	Reason for exclusion
outcomes in IgA nephropathy women, Clinical Nephrology, 76, 447-454, 2011	
Packham, D. K., North, R. A., Fairley, K. F., Ihle, B. U., Whitworth, J. A., Kincaid-Smith, P., Pregnancy in women with primary focal and segmental hyalinosis and sclerosis, Clinical Nephrology, 29, 185-92, 1988	No mode of birth data
Packham, D. K., North, R. A., Fairley, K. F., Whitworth, J. A., Kincaid-Smith, P., IgA glomerulonephritis and pregnancy, Clinical Nephrology, 30, 15-21, 1988	No mode of birth data
Pajor, A., Lukacsi, L., Bakos, L., Lintner, F., Zsolnai, B., Pregnancy in women with chronic renal disease: a 14-year study, Acta Chirurgica Hungarica, 32, 175-82, 1991	Outcome data not disaggregated by intervention
Perales-Puchalt, A., Vila Vives, J. M., Lopez Montes, J., Diago Almela, V. J., Perales, A., Pregnancy outcomes after kidney transplantation-immunosuppressive therapy comparison, Journal of Maternal-Fetal and Neonatal Medicine, 25, 1363-1366, 2012	Outcome data not disaggregated by intervention
Phansenee, S., Sekararithi, R., Jatavan, P., Tongsong, T., Pregnancy outcomes among women with systemic lupus erythematosus: a retrospective cohort study from Thailand, Lupus, 27, 158-164, 2018	Indication for preterm birth was not reported
Piccoli, G. B., Cabiddu, G., Attini, R., Gerbino, M., Todeschini, P., Perrino, M. L., Manzione, A. M., Piredda, G. B., Gnappi, E., Caputo, F., Montagnino, G., Bellizzi, V., Di Loreto, P., Martino, F., Montanaro, D., Rossini, M., Castellino, S., Biolcati, M., Fassio, F., Loi, V., Parisi, S., Versino, E., Pani, A., Todros, T., Outcomes of Pregnancies after Kidney Transplantation: Lessons Learned from CKD. A Comparison of Transplanted, Nontransplanted Chronic Kidney Disease Patients and Low-Risk Pregnancies: A Multicenter Nationwide Analysis, Transplantation, 101, 2536-2544, 2017	The study included only live birth population and thus the question of whether early birth in deteriorated renal condition can guarantee live birth was not justifiable
Piccoli, G. B., Conijn, A., Consiglio, V., Vasario, E., Attini, R., Deagostini, M. C., Bontempo, S., Todros, T., Pregnancy in dialysis patients: is the evidence strong enough to lead us to change our counseling policy?, Clinical Journal of The American Society of Nephrology: CJASN, 5, 62-71, 2010	Systematic review
Piccoli, G. B., Fassio, F., Attini, R., Parisi, S., Biolcati, M., Ferraresi, M., Pagano, A., Daidola, G., Deagostini, M. C., Gaglioti, P., Todros, T., Pregnancy in CKD: whom should we follow and why?, Nephrology Dialysis Transplantation, 27 Suppl 3, iii111-8, 2012	Data included in Piccoli 2012
Piccoli, Giorgina Barbara, Attini, Rossella, Cabiddu, Gianfranca, Kooij, Isabelle, Fassio, Federica, Gerbino, Martina, Maxia, Stefania, Biolcati, Marilisa, Versino, Elisabetta, Todros, Tullia, Maternal-foetal outcomes in pregnant women with glomerulonephritides. Are all glomerulonephritides alike in pregnancy?, Journal of Autoimmunity, 79, 91-98, 2017	The study did not report indication for preterm birth
Piccoli,G.B., Tavassoli,E., Melluzza,C., Grassi,G., Monzeglio,C., Donvito,V., Leone,F., Attini,R., Ghiotto,S., Clari,R., Moro,I., Fassio,F., Parisi,S., Pilloni,E., Vigotti,F.N., Giuffrida,D., Rolfo,A., Todros,T., Severe diabetic nephropathy in type 1 diabetes and pregnancy--a case series, The Review of Diabetic Studies, 10, 68-78, 2013	Renal decline based on proteinuria, better quality evidence available with creatinine

Study	Reason for exclusion
Rahman, S., Ratan, D. G., Islam, N., Das, A., Shaha, A. K., Khan, M. A. I., Muhibur Rahman, M., Pregnancy related acute renal failure in a tertiary care hospital in Bangladesh, Journal of Medicine (Bangladesh), 13, 129-132, 2012	No mode of birth data
Ravindran, V., Bhadran, S., Improved outcomes in high-risk lupus pregnancies: Usefulness of a protocol-based multidisciplinary approach in Kerala, India, Rheumatology (United Kingdom), 56, 2017	Conference abstract
Reece,E.A., Leguizamon,G., Homko,C., Stringent controls in diabetic nephropathy associated with optimization of pregnancy outcomes, Journal of Maternal-Fetal Medicine, 7, 213-216, 1998	Data not stratified by renal function
Reece,E.A., Leguizamon,G., Homko,C., Pregnancy performance and outcomes associated with diabetic nephropathy, American Journal of Perinatology, 15, 413-421, 1998	Review
Ren, S. X., Liu, E. L., Liu, Z., Yang, Y., A meta-analysis of pregnancy outcomes in patients with lupus nephritis, Basic and Clinical Pharmacology and Toxicology, 122, 5, 2018	Conference abstract
Saliem, S., Patenaude, V., Abenhaim, H. A., Pregnancy outcomes among renal transplant recipients and patients with end-stage renal disease on dialysis, Journal of Perinatal Medicine, 44, 321-7, 2016	Wrong comparison. Renal transplant vs ESRD
Saliem, Sara, Patenaude, Valerie, Abenhaim, Haim A., Pregnancy outcomes among renal transplant recipients and patients with end-stage renal disease on dialysis, Journal of perinatal medicine, 44, 321-7, 2016	Indication for early birth was not reported
Sato, J. L., De Oliveira, L., Kirsztajn, G. M., Sass, N., Chronic kidney disease in pregnancy requiring first-time dialysis, International Journal of Gynecology and Obstetrics, 111, 45-48, 2010	Outcome data not disaggregated by intervention
Shaharir, S. S., Ding, H. J., Maulana, S. A., Hussein, H., Mustafar, R., Pregnancy outcomes among malaysian patients with systemic lupus erythematosus, Rheumatology (United Kingdom), 56, 2017	Conference abstract
Shahir,A.K., Briggs,N., Katsoulis,J., Levidiotis,V., An observational outcomes study from 1966-2008, examining pregnancy and neonatal outcomes from dialysed women using data from the ANZDATA Registry, Nephrology, 18, 276-284, 2013	Dialysed women from 1996-2008 (exclude <2005)
Shimizu, A., Takei, T., Moriyama, T., Itabashi, M., Uchida, K., Nitta, K., Effect of kidney disease stage on pregnancy and delivery outcomes among patients with immunoglobulin A nephropathy, American Journal of Nephrology, 32, 456-61, 2010	Outcome data not disaggregated by intervention
Sibai, B. M., Villar, M. A., Mabie, B. C., Acute renal failure in hypertensive disorders of pregnancy. Pregnancy outcome and remote prognosis in thirty-one consecutive cases, American Journal of Obstetrics & Gynecology, 162, 777-83, 1990	No mode of birth data
Silva Junior, Geraldo Bezerra da, Saintrain, Suzanne Vieira, Castelo, Gabriel de Castro, Vasconcelos, Vanessa Ribeiro de, Oliveira, Juliana Gomes Ramalho de, Rocha, Amanda Maria Timbo, Vasconcelos Junior, Adolfo Gomes, Saintrain, Maria Vieira de Lima, Daher, Elizabeth De Francesco, Acute kidney injury in critically ill obstetric patients: a cross-sectional study in an intensive	Any information on who received early birth was not reported

Study	Reason for exclusion
care unit in Northeast Brazil, Jornal brasileiro de nefrologia : 'orgao oficial de Sociedades Brasileira e Latino-Americana de Nefrologia, 39, 357-361, 2017	
Snowball, O., Hester, E., Clark, K., Kametas, N. A., Bramham, K., Pregnancy outcomes for women with chronic kidney disease, BJOG: An International Journal of Obstetrics and Gynaecology, 124, 147, 2017	Conference abstract
Soubassi,L., Haidopoulos,D., Sindos,M., Pilalis,A., Chaniotis,D., Diakomanolis,E., Antsaklis,A., Zerefos,N., Pregnancy outcome in women with pre-existing lupus nephritis, Journal of Obstetrics and Gynaecology, 24, 630-634, 2004	Data not stratified by renal disease
Souqiyyeh, M. Z., Huraib, S. O., Saleh, A. G., Aswad, S., Pregnancy in chronic hemodialysis patients in the Kingdom of Saudi Arabia, American Journal of Kidney Diseases, 19, 235-8, 1992	No mode of birth data. Published before 2005
Suarez, M. B., Costa, M. L., Parpinelli, M. A., Surita, F. G., Pregnancy in women undergoing hemodialysis: case series in a Southeast Brazilian reference center, Revista Brasileira de Ginecologia e Obstetricia, 37, 5-9, 2015	Outcome data not disaggregated by intervention
Takei, H., Kaneko, Y., Takeuchi, T., Pregnancy outcome and its relevant factors in patients with systemic lupus erythematosus and rheumatoid arthritis, Annals of the Rheumatic Diseases, 76 (Supplement 2), 1227, 2017	Conference abstract
Tan, P. K., Tan, A. S., Tan, H. K., Vathsala, A., Tay, S. K., Pregnancy after renal transplantation: experience in Singapore General Hospital, Annals of the Academy of Medicine, Singapore, 31, 285-9, 2002	Outcomes not disaggregated by intervention. Published before 2005
Tan,L.K., Kanagalingam,D., Tan,H.K., Choong,H.L., Obstetric outcomes in women with end-stage renal failure requiring renal dialysis, International Journal of Gynaecology and Obstetrics, 94, 17-22, 2006	Outcome data not disaggregated by intervention. Published before 2005
Tangren, J. S., Powe, C. E., Ankers, E., Ecker, J., Bramham, K., Hladunewich, M. A., Karumanchi, S. A., Thadhani, R., Pregnancy Outcomes after Clinical Recovery from AKI, Journal of the American Society of Nephrology, 28, 1566-1574, 2017	Outcomes were not aggregated by mode and/or timing of birth
Tangren, Jessica Sheehan, Powe, Camille E., Ankers, Elizabeth, Ecker, Jeffrey, Bramham, Kate, Hladunewich, Michelle A., Karumanchi, S. Ananth, Thadhani, Ravi, Pregnancy Outcomes after Clinical Recovery from AKI, Journal of the American Society of Nephrology : JASN, 28, 1566-1574, 2017	Indication for early birth/cesarean section was not reported
Trevisan, G., Lopes Ramos, J. G., Martins-Costa, S., Guardao Barros, E. J., Pregnancy in Patients with Chronic Renal Insufficiency at Hospital de Clinicas of Porto Alegre, Brazil, Renal Failure, 26, 29-34, 2004	Systematic review: no comparison data
Vannevel, Valerie, Claes, Kathleen, Baud, David, Vial, Yvan, Golshayan, Delaviz, Yoon, Eugene W., Hodges, Ryan, Le Nepveu, Anne, Kerr, Peter G., Kennedy, Claire, Higgins, Mary, Resch, Elisabeth, Klaritsch, Philipp, Van Mieghem, Tim, Preeclampsia and Long-term Renal Function in Women Who Underwent Kidney Transplantation, Obstetrics and Gynecology, 131, 57-62, 2018	Indication for planned birth was not reported

Study	Reason for exclusion
Ventura, J. E., Villa, M., Mizraji, R., Ferreiros, R., Acute renal failure in pregnancy, Renal Failure, 19, 217-20, 1997	Outcome data not disaggregated by intervention
Wagner, S. J., Craici, I., Reed, D., Norby, S., Bailey, K., Wiste, H. J., Wood, C. M., Moder, K. G., Liang, K. P., Liang, K. V., Rose, C., Rozkos, T., Sitina, M., Grande, J. P., Garovic, V. D., Maternal and foetal outcomes in pregnant patients with active lupus nephritis, Lupus, 18, 342-7, 2009	Wrong population: SLE with a subset of LN
Weaver,E., Craswell,P., Pregnancy outcome in women with reflux nephropathy--a review of experience at the Royal Women's Hospital Brisbane, 1977-1986, Australian and New Zealand Journal of Obstetrics and Gynaecology, 27, 106-111, 1987	Wrong population: normal renal function vs impaired renal function
Wei, Q., Zhang, L., Liu, X., Outcome of severe preeclampsia manifested as nephrotic syndrome, Archives of Gynecology and Obstetrics, 283, 201-204, 2011	No mode of birth data
Willis, F. R., Findlay, C. A., Gorrie, M. J., Watson, M. A., Wilkinson, A. G., Beattie, T. J., Children of renal transplant recipient mothers, Journal of Paediatrics & Child Health, 36, 230-5, 2000	Transplant paper 1971-1992, published before 2005
Wu, J., Di, W., Pregnancy outcome in Chinese women with systemic lupus erythematosus: A retrospective study of 255 cases in a single center, International Journal of Clinical and Experimental Medicine, 11, 966-974, 2018	No information renal related indication for early birth
Wu, M., Wang, D., Zand, L., Harris, P. C., White, W. M., Garovic, V. D., Kermott, C. A., Pregnancy outcomes in autosomal dominant polycystic kidney disease: a case-control study, Journal of Maternal-Fetal & Neonatal Medicine, 29, 807-12, 2016	Wrong population: case-control of kidney disease vs simple cyst
Wyld,M.L., Clayton,P.A., Jesudason,S., Chadban,S.J., Alexander,S.I., Pregnancy outcomes for kidney transplant recipients, American Journal of Transplantation, 13, 3173-3182, 2013	Transplant study 1971-2010,exclude <2005 studies. Unable to disaggregate patients 2005-2010
Yogev,Y., Chen,R., Ben-Haroush,A., Hod,M., Bar,J., Maternal overweight and pregnancy outcome in women with Type-1 diabetes mellitus and different degrees of nephropathy, Journal of Maternal-Fetal and Neonatal Medicine, 23, 999-1003, 2010	Outcomes not disaggregated by intervention
You, J. Y., Kim, M. K., Choi, S. J., Oh, S. Young, Kim, S. J., Kim, J. H., Oh, H. Y., Roh, C. R., Predictive factors for adverse pregnancy outcomes after renal transplantation, Clinical Transplantation, 28, 699-706, 2014	Transplant study 1995-2013, exclude <2005, unable to disaggregate women 2005-2013
Zhang, J. J., Ma, X. X., Hao, L., Liu, L. J., Lv, J. C., Zhang, H., A Systematic Review and Meta-Analysis of Outcomes of Pregnancy in CKD and CKD Outcomes in Pregnancy, Clinical Journal of The American Society of Nephrology: CJASN, 10, 1964-78, 2015	Systematic review
Zhang, Jing-Jing, Ma, Xin-Xin, Hao, Li, Liu, Li-Jun, Lv, Ji-Cheng, Zhang, Hong, A Systematic Review and Meta-Analysis of Outcomes of Pregnancy in CKD and CKD Outcomes in Pregnancy, Clinical journal of the American Society of Nephrology : CJASN, 10, 1964-78, 2015	The study compared women with or without CKD

Economic studies

See Supplement 2 (Health economics) for details of economic evidence reviews and health economic modelling.

Appendix E – Clinical evidence tables

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – fluid management

No clinical evidence was identified for this review and so there are no evidence tables.

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – early birth

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Full citation Alsuwaida,A., Mousa,D., Al-Harbi,A., Alghonaim,M., Ghareeb,S., Alrukhaimi,M.N., Impact of early chronic kidney disease on maternal and fetal outcomes of pregnancy, Journal of Maternal-Fetal and Neonatal Medicine, 24, 1432-1436, 2011 **Ref Id** 220804 **Country/ies where the study was carried out** Saudi Arabia, Bahrain and United Arab Emirates **Study type** Case series **Aim of the study**	**Sample size** n=98 pregnancies in 87 women • 9 women were followed during 2 pregnancies • 1 woman was followed during 3 pregnancies **Characteristics** Mean age= 36.2±3.4y CKD stage assigned based on Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines. Underlying causes of CKD: • primary glomerulonephritis n=23 • lupus nephritis n=26	**Interventions** Outcomes stratified by stage of renal disease.	**Details** Women retrospectively reviewed. To evaluate pregnancy-related changes in the kidney function, blood pressure (BP) and proteinuria were measured and their values at the first trimester were used as the baseline values. The following data was gathered: • Glomerular filtration rate (GFR) (preconception): Stage 1 (≥90 ml/min), Stage 2 (eGFR 60–89 ml/min), and Stage 3/4 (eGFR 15–59 ml/min).	**Results** The distribution of various CKD stages among the 98 pregnancies based on pregestational serum creatinine level was: 68% (n=67) in Stage 1, 21.4% (n=21) in Stage 2, and 10.2% (n=10) of pregnancies in Stage 3/4. **Renal function deterioration: (an increment of 25% or more in creatinine during pregnancy and up to 6 weeks post-partum)** 0 CKD Stage 1 3 CKD Stage 2 6 CKD Stage 3/4	**Limitations** Limitations assessed using the Joanna Briggs Institute critical appraisal checklist for case series: 1. Were there clear criteria for inclusion in the case series? Yes 2. Was the condition measured in a standard, reliable way for all participants included in the case series?

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
To assess the impact of early chronic kidney disease utilizing estimated glomerular filtration rate (eGFR) in predicting adverse outcomes in women with chronic kidney disease (CKD). **Study dates** 2002-2008 **Source of funding** Not reported.	• diabetic nephropathy n=7 • hypertensive nephropathy n=6 • other causes n=25 Mean preconception serum creatinine levels: • Stage 1: 60.1 ± 11.2 mmol/L • Stage 2: 81.7 ± 12 mmol/L • Stage 3: 164 ± 38.6 mmol/L **Inclusion criteria** Women with pre-existing primary renal disease who were seen at 5 centres between 2002 and 2008. Women were eligible if they had a baseline serum creatinine measurement taken within 6 months before gestation. **Exclusion criteria** None specifically listed. n=1 for CKD Stage 5		• Proteinuria: Group I (control) with proteinuria <0.5 g/24h and Group II with proteinuria ≥0.5 g/24 h. • BP: (1) <140 mmHg for systolic BP and <90 mmHg for diastolic BP (normal BP) and (2) at least 140 mmHg for systolic BP or at least 90 mmHg for diastolic (elevated BP). • Pre-eclampsia was defined as new onset elevated diastolic BP of ≥90 mmHg after 20 weeks of gestation in previously normotensive women. • Renal function deterioration was defined as an increment of 25% or more in serum creatinine any time	**Pre-eclampsia n=21** 9 CKD Stage 1 10 CKD Stage 2 4 CKD Stage 3/4 **Stillbirth** 2 CKD Stage 1 3 CKD Stage 2 1 CKD Stage 3/4 **Low birth weight (<2500gm)** 15 CKD Stage 1 10 CKD Stage 2 7 CKD Stage 3/4	Yes 3. Were valid methods used for identification of the condition for all participants included in the case series? Yes 4. Did the case series have consecutive inclusion of participants? Yes 5. Did the case series have complete inclusion of participants? Yes 6. Was there clear reporting of the demographics of the participants in the study? No

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
			during pregnancy and up to 6 weeks post-delivery. • Delivery before 37 weeks of gestation was classified as preterm. • Various other complications.		7. Was there clear reporting of clinical information of the participants? Yes 8. Were the outcomes or follow up results of cases clearly reported? No 9. Was there clear reporting of the presenting site(s)/clinic(s) demographic information? No 10. Was statistical analysis appropriate? Yes **Other information** None
Full citation	**Sample size**	**Interventions**	**Details**	**Results**	**Limitations**

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Davidson, N. L., Wolski, P., Callaway, L. K., Barrett, H. L., Fagermo, N., Lust, K., Shakhovskoy, R. E., Chronic kidney disease in pregnancy: Maternal and fetal outcomes and progression of kidney disease, Obstetric Medicine, 8, 92-8, 2015 **Ref Id** 538954 **Country/ies where the study was carried out** Australia **Study type** Retrospective case series **Aim of the study** The aims of this study were to assess outcomes of pregnancy in patients with CKD, as well as to assess the impact of confounding factors. An additional aim was to assess the impact of pregnancy on progression of renal disease in this cohort. **Study dates**	n=55 **Characteristics** Renal pathologies: • Systemic lupus erythematosus (SLE) n=4 (7%) • Diabetes mellitus (DM) n=9 (16%) • Chronic glomerulonephritis n=9 (16%) • Reflux nephropathy n=8(15%) • Polycystic kidney disease (PCKD) n=1(2%) • Post-transplant 2°GN n=2(4%) • Other n=22(40%). CKD stage was assigned using KDOQI guidelines. Control data were chosen to represent outcomes of the general obstetric population. **Inclusion criteria** Obstetric patients admitted to the study hospital who had renal disease prepartum.	Outcomes stratified by stage of renal disease.	Patients were de-identified and a single person chart review was conducted using a proforma of predetermined variables. Control data were collected from the Queensland perinatal statistics database for 2010 and were used for comparison. All patients were also followed-up with renal function assessment one year after delivery. Demographic variables as well as maternal, fetal and obstetric outcome variables were collected. Patients were grouped via CKD stage. Due to the clinical severity and sample size, the groups were collapsed into two groups: CKD Stage 1–2 (Group 1 n=27) and CKD Stage 3–5 (Group 2 n=28). Statistical analysis: T-test and Fischer's exact	**Pre-eclampsia n=37** 17/27 CKD Stage 1-2 20/28 CKD Stage 3-5 **Hypertension n=42** 19/27 CKD Stage 1-2 23/28 CKD Stage 3-5 **Small for gestational age (SGA) n=21** 7/27 CKD Stage 1-2 13/28 CKD Stage 3-5 **Perinatal mortality n=6** 2/27 CKD Stage 1-2 4/28 CKD Stage 3-5 **Dialysis for worsening renal function** n=2 during pregnancy n=2 postpartum Rates of pre-term delivery and intra-uterine growth restriction (IUGR) were significantly increased in women with pre-conception proteinuria. Increased rates of small for gestational age (SGA) infants, caesarean deliveries, and fetal	Limitations assessed using the Joanna Briggs Institute critical appraisal checklist for case series: 1. Were there clear criteria for inclusion in the case series? No 2. Was the condition measured in a standard, reliable way for all participants included in the case series? Yes 3. Were valid methods used for identification of the condition for all participants included in the case series? Yes

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
2003 to 2010 **Source of funding** No specific grant from any funding agency in the public, commercial, or not-for-profit sectors.	**Exclusion criteria** Pregnancies that ended in the first trimester.		test were used for comparison among groups; Group 1 – Group 2, presence or absence pre-conception proteinuria, presence or absence of pre-conception hypertension and both. A general linear model repeated measures analysis of variance (ANOVA) was conducted to determine the difference in the eGFR measurements from pre-conception, six weeks postpartum and 12 months postpartum.	mortality were seen in women with pre-conception hypertension group.	4. Did the case series have consecutive inclusion of participants? Yes 5. Did the case series have complete inclusion of participants? Yes 6. Was there clear reporting of the demographics of the participants in the study? No 7. Was there clear reporting of clinical information of the participants? No 8. Were the outcomes or follow up results of cases clearly reported? Yes

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
					9. Was there clear reporting of the presenting site(s)/clinic(s) demographic information? No 10. Was statistical analysis appropriate? Yes **Other information** None
Full citation Piccoli, G. B., Cabiddu, G., Attini, R., Vigotti, F. N., Maxia, S., Lepori, N., Tuveri, M., Massidda, M., Marchi, C., Mura, S., Coscia, A., Biolcati, M., Gaglioti, P., Nichelatti, M., Pibiri, L., Chessa, G., Pani, A., Todros, T., Risk of Adverse Pregnancy Outcomes in Women with CKD, Journal of the	**Sample size** n= 504 Merge of two cohorts of CKD patients followed up in pregnancy between 2000 and 2013 **Characteristics** **CKD cohort:** 504 singleton live births from 731 pregnancies	**Interventions** Outcomes stratified by stage of renal disease.	**Details** Main baseline and outcome data were gathered prospectively. Two main comparisons made: • CKD patients vs. controls • Across CKD stages	**Results** Data extracted for comparisons across CKD stages. **SGA score <10%** 49/370 CKD Stage 1 16/87 CKD Stage 2 7/37 CKD Stage 3 5/10 CKD Stage 4-5 **CKD deterioration (increase of at least 1 CKD stage) n=37**	**Limitations** Limitations assessed using the Joanna Briggs Institute critical appraisal checklist for case series: 1. Were there clear criteria for inclusion in the case series?

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
American Society of Nephrology, 26, 2011-22, 2015 **Ref Id** 421215 **Country/ies where the study was carried out** Italy **Study type** Prospective case series **Aim of the study** To identify the main determinants of risk for adverse pregnancy-related outcomes in the CKD population, with particular attention to the large Stage 1 CKD subset of patients, in whom pregnancy-related risks are already higher than in the overall population, but whose kidney function is still within the normal range. **Study dates** 2000 - 2013 **Source of funding** Not reported	CKD stage defined by the KDOQI guidelines: Stage 1 n=370 Stage 2 n=87 Stage 3 n=37 Stage 4-5 n=10 **Control cohort:** 836 live births from a low-risk, homogeneously followed-up population. Low-risk cases were defined as pregnancies without hypertension, obesity, diabetes, CKD, cardiovascular disease (CVD), or any other severe disease or condition potentially affecting pregnancy. **Inclusion criteria** Women with CKD with singleton pregnancies and of gestational age >23 completed weeks. **Exclusion criteria** • Ongoing pregnancy • Multiple pregnancy		Comparisons were made across CKD stages using stepwise regression. Maternal • Hypertension • Proteinuria Maternal-fetal outcomes • Caesarean section (CS) • Preterm birth • SGA • CKD stage shift Neonatal • Stillbirth Multivariate logistic regression analysis undertaken to assess the effect of risk predictors (proteinuria, hypertension, systemic disease etc.) on different outcomes for patients with Stage 1 CKD.	28/370 CKD Stage 1 1/87 CKD Stage 2 6/37 CKD Stage 3 2/10 CKD Stage 4-5 **Hypertension n=138** 80/370 CKD Stage 1 36/87 CKD Stage 2 20/37 CKD Stage 3 2/10 CKD Stage 4-5 Progressive worsening of outcomes observed from CKD Stage 1 to CKD Stages 4-5 is significant for all maternal-fetal outcomes except SGA.	Yes (described in Piccoli et al., 2012) 2. Was the condition measured in a standard, reliable way for all participants included in the case series? Yes (described in Piccoli et al., 2012) 3. Were valid methods used for identification of the condition for all participants included in the case series? Yes 4. Did the case series have consecutive inclusion of participants? Yes

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
	• Pre-eclampsia (PE) without evidence of underlying CKD • Miscarriage • Lost to follow-up				5. Did the case series have complete inclusion of participants? Yes 6. Was there clear reporting of the demographics of the participants in the study? Yes 7. Was there clear reporting of clinical information of the participants? Yes (summarised) 8. Were the outcomes or follow up results of cases clearly reported? Yes 9. Was there clear reporting of the presenting site(s)/clinic(s)

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
					demographic information? Yes (also described in Piccoli et al., 2012 further) 10. Was statistical analysis appropriate? Yes **Other information** None
Full citation Singh, R., Prasad, N., Banka, A., Gupta, A., Bhadauria, D., Sharma, R., Kaul, A., Pregnancy in patients with chronic kidney disease: Maternal and fetal outcomes, Indian Journal of Nephrology, 25, 194-199, 2015 **Ref Id** 539126 **Country/ies where the study was carried out** India **Study type**	**Sample size** n=51 **Characteristics** Age, mean ± SD: 27.8±3.52 BMI, mean ± SD: 23.51±3.45 Cause of renal failure: Chronic glomerulonephritis 10/51 Chronic interstitial nephritis 15/51 Immunoglobulin A nephropathy 9/51 Vasculitis 2/51	**Interventions** Outcomes stratified by the stage of renal disease.	**Details** Women were retrospectively observed. Maternal assessment during pregnancy: • hypertensive status • proteinuria • loss of GFR ml/min • creatinine Fetal observation: • pre-term/term delivery • intrauterine fetal death	**Results** Of 51 pregnancies, 15 ended in stillbirth and 36 delivered live births. Eleven (21.56%) of the live-born infants delivered pre-term and 7 (13.72%) infants weighed <2500 g (LBW). Timing of birth (preterm or term for the LBW infants was unclear). **Stillbirth n=15**	**Limitations** Limitations assessed using the Joanna Briggs Institute critical appraisal checklist for case series: 1. Were there clear criteria for inclusion in the case series? No 2. Was the condition

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Retrospective case series **Aim of the study** To analyse the risk of adverse renal, maternal and fetal outcomes in women with CKD **Study dates** 2009 - 2012 **Source of funding** Not reported	Autosomal dominant PCKD 2/51 Stone disease 3/51 SLE 2/51 Nephrotic syndrome 8/51 **Inclusion criteria** Pregnant women with CKD as defined by KDOQI guidelines. **Exclusion criteria** Patients with diabetes, other systemic diseases, acute renal failure, and patients with history of multiple fetal losses before developing CKD.		• low birth weight (LBW) The main outcome was a decline in renal function after pregnancy at 6 weeks post-partum. The other outcome criteria were a doubling in serum creatinine and 50% in GFR or end-stage renal disease (ESRD) 1 year of follow-up.	6/32 CKD Stage 1/2 6/13 CKD Stage 3 3/6 CKD Stage 4 **LBW n=7** 5/32 CKD Stage 1/2 1/13 CKD Stage 3 1/6 CKD Stage 4 **ESRD 6 weeks post-partum n=3** 0/32 CKD Stage 1/2 0/13 CKD Stage 3 3/6 CKD Stage 4 **Pre-eclampsia** 17.6% of patients. Only 2/32 (6.25%) patients with GFR ≥60 ml/min/1.73 m2 developed pre-eclampsia while 7/19 (36.84%) patients with GFR <60 ml/min developed pre-eclampsia. Two women died: 1 in CKD Stage 3 who reached ESRD at 6 months post-partum but did not agree to dialysis, and 1 at CKD	measured in a standard, reliable way for all participants included in the case series? Yes 3. Were valid methods used for identification of the condition for all participants included in the case series? Yes 4. Did the case series have consecutive inclusion of participants? Yes 5. Did the case series have complete inclusion of participants? Yes 6. Was there

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				Stage 4 at 8 months post-partum due to urinary tract infection, sepsis, and multi-organ failure.	clear reporting of the demographics of the participants in the study? No 7. Was there clear reporting of clinical information of the participants? No 8. Were the outcomes or follow up results of cases clearly reported? No 9. Was there clear reporting of the presenting site(s)/clinic(s) demographic information? No 10. Was statistical analysis appropriate? Yes

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
					Other information None
Full citation Khoury,J.C., Miodovnik,M., LeMasters,G., Sibai,B., Pregnancy outcome and progression of diabetic nephropathy. What's next?, The journal of maternal-fetal & neonatal medicine : the official journal of the European Association of Perinatal Medicine, the Federation of Asia and Oceania Perinatal Societies, the International Society of Perinatal Obstetricians, 11, 238-244, 2002 **Ref Id** 177387 **Country/ies where the study was carried out** United States of America **Study type** Retrospective case series **Aim of the study** 1. To assess the association of renal function with	**Sample size** n=72 pregnancies in 58 women **Characteristics** According to enrolment serum creatinine concentrations (Group 1 ≤1.0; Group 2 >1.0 to 1.5; Group 3 >1.5): Age, mean ± SD: Group 1 ≤1.0 mg/dl: 26.3±4.9 Group 2 1.0-1.5 mg/dl: 28.3±4.1 Group 3 >1.5 mg/dl: 29.0±4.4 Chronic hypertension, n (%): Group 1 ≤1.0 mg/dl: 6 (12) Group 2 1.0-1.5 mg/dl: 9 (69) Group 3 >1.5 mg/dl: 9 (90) Nullipara, n (%): Group 1 ≤1.0 mg/dl: 25 (51) Group 2 1.0-1.5 mg/dl: 8 (62) Group 3 >1.5 mg/dl: 6 (60) **Inclusion criteria**	**Interventions** Outcomes stratified by enrolment serum creatinine concentrations: Group 1: ≤1.0 mg/dl n=49 Group 2: 1.0-1.5 mg/dl n=13 Group 3: >1.5 mg/dl n=10 Converted to: Groups 1 and 2: mild CKD n=62 Group 3: moderate/severe CKD n=10	**Details** Participants were enrolled in the Diabetes in Pregnancy Program in the first trimester of their pregnancy. Patients were managed with intensive insulin therapy and glycaemic control was obtained using a split-dosage regimen of short- and intermediate-acting insulin, 3-4 injections/day.	**Results** Mild CKD (Group 1 serum creatinine ≤1.0 mg/dl; Group 2 serum creatinine >1.0 to 1.5); moderate/severe CKD (Group 3 serum creatinine >1.5 mg/dl). Excluded 12 spontaneous abortions: 11 mild CKD and 1 moderate/severe CKD. **Pre-eclampsia n=24** 20/51 mild CKD 4/9 moderate/severe CKD **SGA (<10th centile) n=7** 4/51 mild CKD 3/9 moderate/severe CKD **Perinatal death (stillbirth or neonatal death) n=3** 2/51 mild CKD	**Limitations** Limitations assessed using the Joanna Briggs Institute critical appraisal checklist for case series: 1. Were there clear criteria for inclusion in the case series? No 2. Was the condition measured in a standard, reliable way for all participants included in the case series? Yes 3. Were valid methods used for identification of the condition

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
maternal and fetal pregnancy outcome in women with diabetic nephropathy. 2. To examine the feasibility of a multicentre surveillance program to determine the rates of maternal and fetal pregnancy complications in women with diabetic nephropathy, and to study the effect of pregnancy on the natural history of diabetic renal disease. **Study dates** 1978 onwards **Source of funding** Ohio Board of Regents Grant from University of Cincinnati Medical Center	Diagnosis of diabetic nephropathy before 16 wks gestation and enrolled in the Diabetes Pregnancy Program in the 1st trimester. **Exclusion criteria** None mentioned.			1/9 moderate/severe CKD	for all participants included in the case series? Yes 4. Did the case series have consecutive inclusion of participants? Unknown 5. Did the case series have complete inclusion of participants? Unknown 6. Was there clear reporting of the demographics of the participants in the study? Yes 7. Was there clear reporting of clinical information of the participants?

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
					No 8. Were the outcomes or follow up results of cases clearly reported? Yes 9. Was there clear reporting of the presenting site(s)/clinic(s) demographic information? No 10. Was statistical analysis appropriate? Yes **Other information** None
Full citation North, R. A., Taylor, R. S., Gunn, T. R., Pregnancy outcome in women with reflux nephropathy and the inheritance of vesico-ureteric reflux, Australian &	**Sample size** n=54 pregnancies in 46 women, 55 neonates **Characteristics** Renal details:	**Interventions** Outcomes stratified by renal function.	**Details** Women were prospectively identified and details collated after delivery. Three pregnancies were excluded due to elective	**Results** **Pre-eclampsia n=11** 7/33 Normal 2/13 Mild 2/5 Moderate	**Limitations** Limitations assessed using the Joanna Briggs Institute critical appraisal

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
New Zealand Journal of Obstetrics & Gynaecology, 40, 280-5, 2000 **Ref Id** 551360 **Country/ies where the study was carried out** New Zealand **Study type** Prospective case series **Aim of the study** To investigate the effects of pre-existing maternal hypertension, renal impairment and bilateral scarring on the development of PE, deterioration in renal function and preterm birth. The infants were followed up and investigated for vesico-ureteric reflux (VUR). **Study dates** 1991 - 1996 **Source of funding** Not reported.	• unilateral scarred kidneys n=36 • bilateral scarred kidneys n=12 • previous nephrectomy n=7 • previous ureteric reimplantation surgery n=21 **Inclusion criteria** Women with reflux nephropathy who delivered at a tertiary hospital. Reflux nephropathy required a diagnosis of typical renal scarring or a history of VUR plus previous nephrectomy of a scarred kidney. **Exclusion criteria** Women referred after the development of complications or who had renal transplant secondary to reflux nephropathy (n=7)		termination and 1 maternal death at 15 weeks gestation (n=51). Women were grouped based on early pregnancy serum creatinine mmol/L. Converted to µmol/L: Normal: ≤80 µmol/L n=33 Mild: 90-120 µmol/L n=13 Moderate: 130-350 µmol/L n=5	**Hypertension n=20** 8/33 Normal 6/13 Mild 4/5 Moderate **Deterioration renal function (≥25% increase creatinine to at least 110 µmol/L) n=9** 1/33 Normal 5/13 Mild 3/5 Moderate (irreversible in 2) **SGA n=5** 3/33 Normal 1/13 Mild 1/5 Moderate	checklist for case series**:** 1. Were there clear criteria for inclusion in the case series? Yes 2. Was the condition measured in a standard, reliable way for all participants included in the case series? Yes 3. Were valid methods used for identification of the condition for all participants included in the case series? Yes 4. Did the case series have consecutive inclusion of participants?

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
					Yes 5. Did the case series have complete inclusion of participants? Yes 6. Was there clear reporting of the demographics of the participants in the study? No 7. Was there clear reporting of clinical information of the participants? No 8. Were the outcomes or follow up results of cases clearly reported? Yes 9. Was there clear reporting of the presenting site(s)/clinic(s)

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
					demographic information? No 10. Was statistical analysis appropriate? Yes **Other information** None
Full citation Oviasu, E., Hicks, J., Cameron, J. S., The outcome of pregnancy in women with lupus nephritis, Lupus, 1, 19-25, 1991 **Ref Id** 396150 **Country/ies where the study was carried out** England **Study type** Retrospective case series **Aim of the study** To analyse the outcome of pregnancy in patients with pre-existing lupus nephritis.	**Sample size** n=39 births **Characteristics** Not reported **Inclusion criteria** Biopsy proven lupus nephritis **Exclusion criteria** Patients with established nephritis	**Interventions** Outcomes stratified by the World Health Organization (WHO) classification of lupus nephritis.	**Details** The records of all female with biopsy-proven lupus nephritis seen in the Renal Unit at Guy's Hospital from January 1970 were reviewed. There were 8 spontaneous abortions (Class III n= 2; Class IV n=2; Class V n=4), and 6 therapeutic terminations (Class III n=1 and Class IV n=5) excluded from the analysis. The renal biopsies from the patients were reviewed and classified according to the	Results Stillbirth n=1 1/5 Class II	**Limitations** Limitations assessed using the Joanna Briggs Institute critical appraisal checklist for case series: 1. Were there clear criteria for inclusion in the case series? Yes 2. Was the condition measured in a standard,

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Study dates 1970 - 1989 **Source of funding** Not reported			lupus nephritis criteria of the WHO - classes 2-5: Class II n=5 Class III n=7 Class IV n=18 Class V n=6 Unknown n=3 Premature delivery was defined as before the 36th week and stillbirth was defined as the death of a fetus at more than 28 weeks of gestation.		reliable way for all participants included in the case series? Yes 3. Were valid methods used for identification of the condition for all participants included in the case series? Yes 4. Did the case series have consecutive inclusion of participants? Unclear 5. Did the case series have complete inclusion of participants? Unclear 6. Was there clear reporting of the

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
					demographics of the participants in the study? No 7. Was there clear reporting of clinical information of the participants? No 8. Were the outcomes or follow up results of cases clearly reported? No 9. Was there clear reporting of the presenting site(s)/clinic(s) demographic information? No 10. Was statistical analysis appropriate? Yes Other information None

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments

ANOVA: analysis of variance; BP: blood pressure; CKD: chronic kidney disease; CS: caesarean section; CVD: cardiovascular disease; DM: diabetes mellitus; eGFR: estimated glomerular filtration rate; ESRD: end-stage renal disease; GFR: glomerular filtration rate; IUGR: intrauterine growth restriction; KDOQI: Kidney Disease Outcomes Quality Initiative; LBW: low birth weight; PCKD: polycystic kidney disease; SGA: small for gestational age; SLE: systemic lupus erythematosus; WHO: World Health Organization

Appendix F – Forest plots

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – fluid management

No meta-analysis was undertaken for this review and so there are no forest plots.

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – early birth

No meta-analysis was undertaken for this review and so there are no forest plots.

Appendix G – GRADE tables

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – fluid management

No clinical evidence was identified for this review and so there are no GRADE tables.

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – early birth

Only case series were included in the review so there are no GRADE tables.

Appendix H – Economic evidence study selection

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – fluid management

See Supplement 2 (Health economics) for details of economic evidence reviews and health economic modelling.

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – early birth

See Supplement 2 (Health economics) for details of economic evidence reviews and health economic modelling.

Appendix I – Economic evidence tables

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – fluid management

See Supplement 2 (Health economics) for details of economic evidence reviews and health economic modelling.

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – early birth

See Supplement 2 (Health economics) for details of economic evidence reviews and health economic modelling.

Appendix J – Health economic evidence profiles

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – fluid management

See Supplement 2 (Health economics) for details of economic evidence reviews and health economic modelling.

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – early birth

See Supplement 2 (Health economics) for details of economic evidence reviews and health economic modelling.

Appendix K – Health economic analysis

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – fluid management

See Supplement 2 (Health economics) for details of economic evidence reviews and health economic modelling.

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – early birth

See Supplement 2 (Health economics) for details of economic evidence reviews and health economic modelling.

Appendix L – Research recommendations

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – fluid management

What is the optimal methods of assessment of fluid balance during child birth in women with acute kidney injury or chronic kidney disease?

Why this is important

Fluid management decisions in the intrapartum period in women with renal disease are a frequent source of dispute between obstetricians, anaesthetists and physicians. Clinical evaluation is fraught with inter-clinician variation; fluid balance charts are often incomplete and urine output in the parturient, especially with AKI or CKD, is not a reliable indicator of intravascular fluid status.

Research recommendation rationale

Research question	What is the optimal methods of assessment of fluid balance during child birth in women with acute kidney injury or chronic kidney disease?
Importance to 'patients' or the population	Correct fluid management is an important clinical decision in the intrapartum period. Too much risks fluid overload and potential cardio-respiratory impairment but too little risks worsening kidney injury and potentially causing a permanent decline in renal function. Both of these outcomes are potentially life-threatening for both woman and baby, and therefore it is important to patients to have optimal fluid balance to minimising risk of harm.
Relevance to NICE guidance	The committee searched for evidence on this topic but found none. The committee therefore made broad consensus recommendations, which incorporated a range of possible views. From their experience, the committee knew of several guidelines offering recommendations on this topic which did not agree perfectly with each other. A research recommendation would therefore be appropriate to inform future updates of this guideline, since no definitive guideline on this topic has been published elsewhere.

Research question	What is the optimal methods of assessment of fluid balance during child birth in women with acute kidney injury or chronic kidney disease?
Relevance to NHS	This question is of high priority to the NHS. Since the potential harms of making the incorrect decision are so serious, the overall burden of morbidity and direct NHS costs created by not having a definitive answer to the question are high.
National priorities	This research recommendation has relevance to the maternal and neonatal health safety collaborative, since it supports their objective of "reducing the rates of maternal and neonatal deaths, stillbirths, and brain injuries that occur during or soon after birth by 20% by 2020"
Current evidence base	No discoverable evidence on this topic
Equalities	N/A

1 *N/A: not applicable; NICE: National Institute for Health and Care Excellence*

Research recommendation PICO

Criterion	Explanation
Population	Women during childbirth with AKI or CKD Stratified by: • degree of renal impairment (eGFR < or > 60 ml/min/m^2) • AKI or CKD
Intervention	Bedside ultrasound scan (USS) assisted techniques (ECHO and lung USS) to assess and guide fluid management
Comparator	Standard clinical evaluation for fluid status to guide fluid management
Outcomes	• Highest % rise in creatinine within 24 hours after birth • Incidence of pulmonary oedema • Maternal admission to level 3 critical care
Study design	RCT
Timeframe	Intrapartum and up to 24 hours after birth

3 *AKI: acute kidney injury; CKD: chronic kidney disease; ECHO: echocardiography; RCT: randomised controlled*
4 *trial; USS: ultrasound scan*

Intrapartum care for women who develop an acute kidney injury or have chronic kidney disease – early birth

What is the optimal timing of birth for women with chronic kidney disease (CKD) stage 1 with nephrotic range proteinuria or CKD stage 2 to 4 with stable renal function?

Why this is important

Optimal timing of birth for women with CKD 1 with nephrotic range proteinuria or women with stable CKD 2-4, with otherwise uncomplicated pregnancies remains uncertain. There is general consensus that women should not go beyond 40^{+0} weeks (as per our recommendation) but some have mandated induction no later than 38^{+0} weeks, because of concerns of loss of kidney function and perceived increased risk of pre-eclampsia and adverse fetal outcomes.

Research recommendation rationale

Research question	What is the optimal timing of birth for women with chronic kidney disease (CKD) stage 1 with nephrotic range proteinuria or CKD stage 2 to 4 with stable renal function?
Importance to 'patients' or the population	Optimal timing of birth is an important clinical decision for women and those looking after them in the intrapartum period. Too early risks fetal distress and a greater likelihood of a caesarean section. Too late risks fetal distress and possible AKI in women with pre-existing CKD.
Relevance to NICE guidance	The committee searched for evidence on this topic but found none. The committee therefore made broad consensus recommendations, which incorporated a range of possible views. From their experience, the committee knew of several guidelines offering recommendations on this topic which did not agree perfectly with each other. A research recommendation would therefore be appropriate to inform future updates of this guideline, since no definitive guideline on this topic has been published elsewhere.
Relevance to NHS	This question is of high priority to the NHS. Since the potential harms of making the incorrect decision are so serious, the overall burden of morbidity and direct NHS costs created by not having a definitive answer to the question are high.
National priorities	This research recommendation has relevance to the maternal and neonatal health safety collaborative, since it supports their objective of "reducing the rates of maternal and neonatal deaths, stillbirths, and brain injuries that occur during or soon after birth by 20% by 2020"
Current evidence base	No discoverable evidence on this topic
Equalities	N/A

AKI: acute kidney injury; CKD: chronic kidney disease; N/A: not applicable; NICE: National Institute for Health and Care Excellence

Research recommendation PICO

Criterion	Explanation
Population	Women with • CKD stage 1 and nephrotic range proteinuria (defined as urine protein:creatinine ratio >300 mg/mmol) or • CKD stage 2-4 with stable renal function Stratified by degree of renal impairment (eGFR < or > 60 ml/min/m^2)
Intervention	Induction of labour at 38^{+0} weeks
Comparator	Expectant management and allowed to continue pregnancy until 40^{+0} weeks before induction
Outcomes	• Proportion of women requiring caesarean section • Proportion of adverse fetal outcomes • Incidence of AKI within 24 hours of birth • Proportion of women with significant loss of eGFR at 6 months postpartum
Study design	RCT
Timeframe	Intrapartum and up to 6 months after birth

AKI: acute kidney injury; CKD: chronic kidney disease; eGFR: estimated glomerular filtration rate; RCT: randomised controlled trial