

**Supplementary file 1:**

PICO Eligibility Criteria

*Table S1: PICO Eligibility Criteria for Digital health, Biomarker feedback and Nurse-led Counselling Interventions Systematic Review.*

	<b>Inclusion Criteria</b>	<b>Exclusion Criteria</b>
<b>Study</b>	Evaluation studies, published studies, quantitative studies, surveys, systematic reviews, peer reviewed, published, full text available, English language, no date limit.	Program design, development or implementation, Non evaluative studies, feasibility or acceptability, health professional surveys, qualitative studies, epidemiological, other languages, grey literature, not peer reviewed or not published.
<b>Problem</b>	Cigarette, tobacco, pipe smoking.	Smoking or use of other substances, second hand/environmental smoke exposure, electronic cigarettes and vaping.
<b>Population</b>	Pregnant women at any stage of pregnancy, older than 16 years or younger than 48 years and recent quitters for pregnancy.	Female children, older women, men, general population, family/partners/friends/community, health professionals, women undergoing assisted reproduction.
<b>Intervention</b>	<p><i>Digital health</i> Short text message (SMS) cessation, smartphone application, social media, Whatsapp messaging service, other chatting applications or service, computer/desktop or tablet programs or applications.</p> <p><i>Biomarker Feedback</i> Urine cotinine, saliva cotinine, serum cotinine, breath carbon monoxide. When used as motivator.</p> <p><i>Midwife/Nurse-led counselling</i> Coaching, face-to-face, home visit, brief or more intensive, can be partly delivered over telephone.</p> <p>Multicomponent interventions that measured effect of any of the above intervention types.</p>	Non-Digital health intervention, technology targeting health professionals, technology targeting health interventions not including smoking, or targeting other substances, old technology that is no longer usable (e.g. videotape), pharmacotherapy, doppler ultrasound, telephone counselling only (e.g. Quitline), counselling by others/other health professionals (where nurses or midwives were not likely to be involved or able to deliver this type of counselling), relapse prevention.
<b>Comparator</b>	Usual care, wait list, other interventions.	No comparator, pre-post studies.
<b>Outcome</b>	Smoking abstinence, self-report, biochemically validated, point prevalence abstinence or continuous abstinence.	Reduced smoking, reduced cigarettes smoked, smoking behaviour change, change in psychological state for smoking cessation, feasibility, acceptability, adherence, health improvements other than abstinence from smoking.

## Search Strategy.

*Medline Search:*

1. Smoking Prevention/ or smoking Cessation Agents/ or Smoking Cessation/
2. smoking reduction.mp. or Smoking Reduction/ or Smoking Prevention/ or "Tobacco Use Disorder"/
3. exp "Tobacco Use Cessation"/ or "Tobacco Use Disorder"/ or exp "Tobacco Use Cessation Devices"/
4. pregnant\*.mp. or exp Pregnancy/ or exp Pregnant Women/ or Pregnancy Complications/
5. communication\*.mp. or exp Communication/ or Persuasive Communication/ or exp Health Communication/
6. exp Communications Media/ or exp Health Education/ or exp Information Services/ or exp Social Media/
7. exp Wireless Technology/ or exp Biomedical Technology/ or exp Technology/
8. Software Design/ or Software/
9. 5 or 6 or 7 or 8
10. exp Carbon Monoxide/
11. Motivation/
12. exp Biomarkers/
13. Breath Tests/
14. Nicotine/
15. Cotinine/
16. biofeedback.mp. or exp Biofeedback, Psychology/
17. 10 or 11 or 12 or 13 or 14 or 15 or 16
18. exp Nurse's Role/ or exp Nurses, Neonatal/ or exp Nurses, Community Health/ or exp Nurses/ or exp Practice Patterns, Nurses'/
19. Nurse Clinicians/ or Nurse Practitioners/ or Nurse-Patient Relations/ or exp Nurse Midwives/ or exp Nurse Specialists/
20. exp Midwifery/ or exp Prenatal Care/ or exp Postnatal Care/
21. exp Delivery, Obstetric/
22. exp Education, Nursing/ or exp Advanced Practice Nursing/
23. exp Directive Counseling/ or exp Counseling/
24. health professional.mp.
25. exp Patient Education as Topic/
26. 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25
27. 9 or 17 or 26
28. 1 or 2 or 3
29. 4 and 9 and 28
30. smoking.mp.
31. 28 or 30
32. 4 and 9 and 31
33. 32 not 29
34. ((smoking or tobacco) adj6 (cessation or stop\* or quit\* or reduction or prevention)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
35. 1 or 2 or 3 or 34

36. 4 and 9 and 35

38. ((biomarker or biofeedback or carbon monoxide or nicotine or cotinine) adj6 motivat\*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]

39. ((biomarker or biofeedback or carbon monoxide or nicotine or cotinine) adj6 (motivator or motivation or intervention)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]

40. 10 or 11 or 12 or 13 or 14 or 15 or 16 or 39

41. 4 and 35 and 40

42. ((nurse\* or midwives\* or modwife or health professional) adj6 (counselling or coaching or intervention or led or managed or program or "patient education")).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]

43. 18 or 19 or 20 or 22 or 23 or 25 or 42

44. 4 and 36 and 43

45. from 44 keep 1-527

46. (("nurse-led" or "midwife-led" or "midwives-led" or "nurses-led" or "nurse-managed" or "midwife-managed" or "midwives-managed") adj6 (counsel\* or "patient-education" or "patient-counselling" or coaching)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]

47. 4 and 35 and 46

#### *Medline IP Search:*

1. smoking reduction.mp. or Smoking Reduction/ or Smoking Prevention/ or "Tobacco Use Disorder"/

2. pregnant\*.mp. or exp Pregnancy/ or exp Pregnant Women/ or Pregnancy Complications/

3. communication\*.mp. or exp Communication/ or Persuasive Communication/ or exp Health Communication/

4. exp Communications Media/ or exp Health Education/ or exp Information Services/ or exp Social Media/

5. biofeedback.mp. or exp Biofeedback, Psychology/

6. health professional.mp.

7. smoking.mp.

8. ((smoking or tobacco) adj6 (cessation or stop\* or quit\* or reduction or prevention)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]

9. ((biomarker or biofeedback or carbon monoxide or nicotine or cotinine) adj6 motivat\*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]

10. ((biomarker or biofeedback or carbon monoxide or nicotine or cotinine) adj6 (motivator or motivation or intervention)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism

supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]

11. ((nurse\* or midwives\* or midwife or health professional) adj6 (counselling or coaching or intervention or led or managed or program or "patient education")).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]

12. ("nurse-led" or "midwife-led" or "midwives-led" or "nurses-led" or "nurse-managed" or "midwife-managed" or "midwives-managed") adj6 (counsel\* or "patient-education" or "patient-counselling" or coaching)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]

13. 1 or 8

14. ("tobacco cessation device" or "communications media" or "telemedicine" or "mobile telephone" or "cell phone\*" or smartphone\* or "smart phone" or "mobile applications" or "mobile apps" or "text messag\*" or "SMS" or "wireless technology" or "email" or "electronic mail" or "social media" or "facebook" or "whatsapp" or "twitter" or "instagram" or "software program").mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]

15. 2 and 13 and 14

#### *Embase Search:*

1. Smoking Prevention/ or smoking Cessation Agents/ or Smoking Cessation/
2. smoking reduction.mp. or Smoking Reduction/ or Smoking Prevention/ or "Tobacco Use Disorder"/
3. exp "Tobacco Use Cessation"/ or "Tobacco Use Disorder"/ or exp "Tobacco Use Cessation Devices"/
4. pregnant\*.mp. or exp Pregnancy/ or exp Pregnant Women/ or Pregnancy Complications/
5. communication\*.mp. or exp Communication/ or Persuasive Communication/ or exp Health Communication/
6. exp Communications Media/ or exp Health Education/ or exp Information Services/ or exp Social Media/
7. exp Wireless Technology/ or exp Biomedical Technology/ or exp Technology/
8. Software Design/ or Software/
9. 5 or 6 or 7 or 8
10. exp Carbon Monoxide/
11. Motivation/
12. exp Biomarkers/
13. Breath Tests/
14. Nicotine/
15. Cotinine/
16. biofeedback.mp. or exp Biofeedback, Psychology/
17. 10 or 11 or 12 or 13 or 14 or 15 or 16
18. exp Nurse's Role/ or exp Nurses, Neonatal/ or exp Nurses, Community Health/ or exp Nurses/ or exp Practice Patterns, Nurses'/
19. Nurse Clinicians/ or Nurse Practitioners/ or Nurse-Patient Relations/ or exp Nurse Midwives/ or exp Nurse Specialists/
20. exp Midwifery/ or exp Prenatal Care/ or exp Postnatal Care/

21. exp Delivery, Obstetric/
22. exp Education, Nursing/ or exp Advanced Practice Nursing/
23. exp Directive Counseling/ or exp Counseling/
24. health professional.mp.
25. exp Patient Education as Topic/
26. 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25
27. 9 or 17 or 26
28. 1 or 2 or 3
29. 4 and 9 and 28
30. smoking.mp.
31. 28 or 30
32. 4 and 9 and 31
33. 32 not 29
34. ((smoking or tobacco) adj6 (cessation or stop\* or quit\* or reduction or prevention)).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
35. 1 or 2 or 3 or 34
36. 4 and 9 and 35
38. ((biomarker or biofeedback or carbon monoxide or nicotine or cotinine) adj6 motivat\*).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
39. ((biomarker or biofeedback or carbon monoxide or nicotine or cotinine) adj6 (motivator or motivation or intervention)).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
40. 10 or 11 or 12 or 13 or 14 or 15 or 16 or 39
41. 4 and 35 and 40
42. ((nurse\* or midwives\* or modwife or health professional) adj6 (counselling or coaching or intervention or led or managed or program or "patient education")).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
43. 18 or 19 or 20 or 22 or 23 or 25 or 42
44. 4 and 36 and 43
45. from 44 keep 1-527
46. (("nurse-led" or "midwife-led" or "midwives-led" or "nurses-led" or "nurse-managed" or "midwife-managed" or "midwives-managed") adj6 (counsel\* or "patient-education" or "patient-counselling" or coaching)).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
47. 4 and 35 and 46

*PsychINFO Search:*

1. Smoking Prevention/ or smoking Cessation Agents/ or Smoking Cessation/
2. smoking reduction.mp. or Smoking Reduction/ or Smoking Prevention/ or "Tobacco Use Disorder"/
3. exp "Tobacco Use Cessation"/ or "Tobacco Use Disorder"/ or exp "Tobacco Use Cessation Devices"/
4. pregnant\*.mp. or exp Pregnancy/ or exp Pregnant Women/ or Pregnancy Complications/

5. communication\*.mp. or exp Communication/ or Persuasive Communication/ or exp Health Communication/
6. exp Communications Media/ or exp Health Education/ or exp Information Services/ or exp Social Media/
7. exp Wireless Technology/ or exp Biomedical Technology/ or exp Technology/
8. exp Carbon Monoxide/
9. Motivation/
10. exp Biomarkers/
11. Nicotine/
12. biofeedback.mp. or exp Biofeedback, Psychology/
13. exp Nurse's Role/ or exp Nurses, Neonatal/ or exp Nurses, Community Health/ or exp Nurses/ or exp Practice Patterns, Nurses'/
14. exp Midwifery/ or exp Prenatal Care/ or exp Postnatal Care/
15. exp Directive Counseling/ or exp Counseling/
16. health professional.mp.
17. 1 or 2 or 3
18. smoking.mp.
19. 17 or 18
20. ((smoking or tobacco) adj6 (cessation or stop\* or quit\* or reduction or prevention)).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh]
21. 1 or 2 or 3 or 20
22. from 36 keep

Web of Science Search:

# 8	184	#7 AND #1 <i>Indexes=SCI-EXPANDED, SSCI, A&amp;HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years</i>
# 7	44,591	TS=((nurse* OR midwife OR midwives OR "health professional" OR clinician OR "prenatal professional" OR "perinatal professional" OR "postnatal professional" OR prenatal OR perinatal OR postnatal) NEAR/6 ( led OR managed OR run OR program OR counselling OR counsel* OR coach* OR communication OR "face to face" OR "patient education" OR "health education" OR operated)) <i>Indexes=SCI-EXPANDED, SSCI, A&amp;HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years</i>
# 6	80	#5 AND #1 <i>Indexes=SCI-EXPANDED, SSCI, A&amp;HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years</i>
# 5	5,733	TS=("carbon monoxide" OR biomarker OR biomarkers OR biofeedback OR "biochemical confirmation" OR cotinine OR nicotine) NEAR/6 ("expired breath" OR saliva OR urine OR motivation OR motivator OR motivate) <i>Indexes=SCI-EXPANDED, SSCI, A&amp;HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years</i>
# 4	1,114	TS=((smoking OR tobacco) NEAR/6 (stop* OR cessation OR quit* OR control* OR program* OR reduction OR prevention)) AND TS=(pregnancy OR "pregnant women" OR pregnant*) AND TS=("carbon monoxide" OR biomarker OR biofeedback OR "biochemical confirmation" OR cotinine OR nicotine OR "expired breath" OR saliva OR urine biomarkers) <i>Indexes=SCI-EXPANDED, SSCI, A&amp;HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years</i>
# 3	174	TS=((smoking OR tobacco) NEAR/20 (stop* OR cessation OR quit* OR control* OR program* OR reduction OR prevention)) AND TS=(pregnancy OR "pregnant women" OR pregnant*) AND TS=(technology OR iphone OR "social media" OR "smart phone" OR telemedicine OR "wireless technology" OR mHealth OR email OR "text messaging" Or SMS OR messag* OR "mobile phone" OR "mobile telephone" OR "mobile apps" OR "mobile applications" OR "smartphone apps" OR "smartphone applications" OR facebook OR "communications media") <i>Indexes=SCI-EXPANDED, SSCI, A&amp;HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years</i>
# 2	54	TOPIC: ((smoking OR tobacco) NEAR/6 (stop* OR cessation OR quit* OR control* OR program*)) AND TOPIC: (pregnan*) AND TOPIC: (technology OR iphone OR "social media" OR "smart phone") <i>Indexes=SCI-EXPANDED, SSCI, A&amp;HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years</i>
# 1	3,280	TOPIC: ((smoking OR tobacco) NEAR/6 (stop* OR cessation OR quit* OR control* OR program*)) AND TOPIC: (pregnan*) <i>Indexes=SCI-EXPANDED, SSCI, A&amp;HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years</i>

*CINAHL Search:*

(Digital health search strategy included as an example).

Search Terms	Search Options	Actions
S10	S3 AND S6 AND S9	<b>Expanders</b> - Apply equivalent subjects <b>Search modes</b> - Boolean/Phrase
S9	S7 OR S8	<b>Expanders</b> - Apply equivalent subjects <b>Search modes</b> - Boolean/Phrase
S8	iphone OR "smart phone" OR "mobile phone*" OR "mobile application*" OR "mobile apps*" OR "cell phone*" OR "social media"	<b>Expanders</b> - Apply equivalent subjects <b>Search modes</b> - Boolean/Phrase
S7	(MH "Wireless Communications") OR (MH "Communications Media+") OR (MH "Communications Software+")	<b>Expanders</b> - Apply equivalent subjects <b>Search modes</b> - Boolean/Phrase
S6	S4 OR S5	<b>Expanders</b> - Apply equivalent subjects <b>Search modes</b> - Boolean/Phrase
S5	(MH "Expectant Mothers") OR (MH "Pregnancy in Adolescence")	<b>Expanders</b> - Apply equivalent subjects <b>Search modes</b> - Boolean/Phrase
S4	(MH "Pregnancy+") OR (MH "Pregnancy Complications+") OR "pregnancy"	<b>Expanders</b> - Apply equivalent subjects <b>Search modes</b> - Boolean/Phrase
S3	S1 OR S2	<b>Expanders</b> - Apply equivalent subjects <b>Search modes</b> - Boolean/Phrase
S2	(smoking OR tobacco) N6 (cessation OR stop* OR quit* OR control*)	<b>Expanders</b> - Apply equivalent subjects <b>Search modes</b> - Boolean/Phrase
S1	(MH "Smoking Cessation") OR (MH "Tobacco Use Cessation Products+") OR (MH "Smoking Cessation Programs") OR (MH "Smoking Cessation Assistance (Iowa NIC)")	<b>Expanders</b> - Apply equivalent subjects <b>Search modes</b> - Boolean/Phrase

*Google Scholar Search:*

Google Scholar	search strategy	search keywords:	Initial Results	initial screening
technology	technology	"smoking cessation" + pregnant + "mobile application"	623	280
	technology	smoking cessation + "stop smoking" + "quit smoking" + pregnant + SMS + "text message"	130	52
	technology	smoking cessation + pregnant + "social media" + "youtube" + "facebook" - SMS	474	59
	counselling	smoking cessation + pregnant + "nurse-led" + coach + "patient education"	203	38
	counselling	smoking cessation + pregnant + "nurse-managed" + counselling	514	167
	biomarker feedback	carbon monoxide + biomarker + biofeedback + "smoking cessation" + pregnant	173	8

biomarker feedback	expired carbon monoxide + feedback + motivator + intervention + "smoking cessation" + pregnant	375	18
biomarker feedback	biomarker feedback + motivation + "smoking cessation" + pregnancy	91	23

### PubMed Search:

#### Counselling

((("Smoking Prevention"[MeSH Terms] OR ("Smoking Cessation"[MeSH Terms] OR "Smoking Cessation Agents"[MeSH Terms] OR "Smoking Reduction"[MeSH Terms] OR "Tobacco Use Disorder"[MeSH Terms] OR "Tobacco Use Cessation"[MeSH Terms] OR "Tobacco Use Cessation Devices"[MeSH Terms] AND 2019/08/01:2021/11/30 [Date - Publication]) AND (2019/8/1:2021/11/30 [pdat])) AND (((("pregnant\*" [All Fields] AND 2019/08/01:2021/11/30 [Date - Publication]) OR (("Pregnancy"[MeSH Terms] OR "Pregnant Women"[MeSH Terms] OR "Pregnancy Complications"[MeSH Terms]) AND 2019/08/01:2021/11/30 [Date - Publication]))) AND (2019/8/1:2021/11/30 [pdat])) AND (((((((("Nurses"[Mesh] OR "Nurse-Patient Relations"[Mesh] OR "Nurse Practitioners"[Mesh] OR "Nurse Midwives"[Mesh] OR "Family Nurse Practitioners"[Mesh] OR "Pediatric Nurse Practitioners"[Mesh] OR "Nurse Clinicians"[Mesh] OR "Nurse Specialists"[Mesh] OR "Nurses, Community Health"[Mesh] OR "Practice Patterns, Nurses"[Mesh] OR "Nurses, Public Health"[Mesh]) OR ( "Nurse's Role"[Mesh] OR "Nurses, Neonatal"[Mesh] OR "Nurses, Pediatric"[Mesh] )) OR "Midwifery"[Mesh]) OR "Education, Nursing"[Mesh]) OR "Advanced Practice Nursing"[Mesh]) OR "Prenatal Care"[Mesh]) OR "Postnatal Care"[Mesh]) AND (2019/8/1:2021/11/30 [pdat])) OR (((("Counselling"[Mesh] OR "Directive Counselling"[Mesh]) OR "Patient Education as Topic"[Mesh]) OR "Health Personnel"[Mesh]) AND (2019/8/1:2021/11/30 [pdat])) OR (((("Counselling"[Mesh] OR "Directive Counselling"[Mesh]) OR "Patient Education as Topic"[Mesh]) OR "Health Personnel"[Mesh]) AND (2019/8/1:2021/11/30 [pdat])) OR ((("nurse counselling" OR "midwife counselling" OR "midwife counselling" OR "health professional counselling" OR "nurse coaching" OR "midwife coaching" OR "nurse led counselling" OR "midwife led counselling" OR "nurse-led counselling" OR "midwife-led counselling" OR "nurse led education" OR "midwife-led education" OR "patient education" AND (2019/8/1:2021/11/30 [pdat])) AND (2019/8/1:2021/11/30 [pdat])) AND (2019/8/1:2021/11/30 [pdat])) AND (2019/8/1:2021/11/30 [pdat]))

#### Digital health

(((((("Smoking Prevention"[Mesh]) OR ( "Smoking Cessation"[Mesh] OR "Smoking Cessation Agents"[Mesh] )) OR "Smoking Reduction"[Mesh]) OR "Tobacco Use Disorder"[Mesh]) OR ( "Tobacco Use Cessation"[Mesh] OR "Tobacco Use Cessation Devices"[Mesh] )) AND (2019/8/1:2021/11/30 [pdat])) AND (((("pregnant\*") AND (2019/8/1:2021/11/30 [pdat])) OR (((("Pregnancy"[Mesh]) OR "Pregnant Women"[Mesh]) OR "Pregnancy Complications"[Mesh]) AND (2019/8/1:2021/11/30 [pdat]))) AND (2019/8/1:2021/11/30 [pdat])) AND (((("communication\*") AND (2019/8/1:2021/11/30 [pdat])) OR (((((((("Communication"[Mesh]) OR "Persuasive Communication"[Mesh]) OR "Health Communication"[Mesh]) OR "Communications Media"[Mesh]) OR "Health Education"[Mesh]) OR "Information Services"[Mesh]) OR "Social Media"[Mesh]) OR "Wireless Technology"[Mesh]) OR "Biomedical Technology"[Mesh]) OR "Software Design"[Mesh]) OR "Software"[Mesh]) AND (2019/8/1:2021/11/30 [pdat])) OR ((("tobacco cessation device" OR "communication media" OR telemedicine OR "mobile telephone" OR "cell phone" or smartphone or "smart phone" or "mobile app\*" OR "test messag\*" OR SMS OR "wireless technolog\*" OR email OR "electronic mail" or "social media" OR facebook OR whatsapp OR twitter OR instagram OR "software program" OR "computer program\*") AND (2019/8/1:2021/11/30 [pdat])) AND (2019/8/1:2021/11/30 [pdat]))

#### Biomarker feedback

(((((biomarker OR biofeedback OR cotinine OR nicotine OR "biomarker as motivator" OR "biofeedback as motivator" OR "urine cotinine as motivator" OR "breath carbon monoxide as motivator" OR "carbon monoxide as motivator" OR "serum cotinine as motivator" OR "nicotine\* as motivator" NOT ultrasound) OR ((biomarker OR biofeedback OR cotinine OR nicotine OR "biomarker as motivator" OR "biofeedback as motivator" OR "urine cotinine as motivator" OR "breath carbon monoxide as motivator" OR "carbon monoxide as motivator" OR "serum cotinine as motivator" OR "nicotine\* as motivator" NOT ultrasound) AND (2019/8/1:2021/11/30 [pdat])) AND (2019/8/1:2021/11/30 [pdat])) AND (((("Smoking Prevention"[MeSH Terms] OR ("Smoking Cessation"[MeSH



Terms] OR "Smoking Cessation Agents"[MeSH Terms] OR "Smoking Reduction"[MeSH Terms] OR "Tobacco Use Disorder"[MeSH Terms] OR "Tobacco Use Cessation"[MeSH Terms] OR "Tobacco Use Cessation Devices"[MeSH Terms] AND 2019/08/01:2021/11/30[Date - Publication]) AND (2019/8/1:2021/11/30[pdat])) AND (((("pregnant\*" [All Fields] AND 2019/08/01:2021/02/27[Date - Publication]) OR ("Pregnancy"[MeSH Terms] OR "Pregnant Women"[MeSH Terms] OR "Pregnancy Complications"[MeSH Terms]) AND 2019/08/01:2021/11/30[Date - Publication]))) AND (2019/8/1:2021/11/30[pdat])) AND (2019/8/1:2021/11/30 [pdat]))

Search results of studies included in review

Table S2: Summary number of studies from various databases.

Database	Digital health	Biomarker Feedback as motivator	Nurse/Midwife Counselling
Medline*	1616	681	553
Medline IP*	10	4	32
Pubmed	54	56	25
Embase	1148	1224	590
PsychINFO	1204	283	389
CINAHL	432	471	408
Google Scholar	1269	653	739
Web of Science	218	94	224
<b>Total</b>	<b>5951</b>	<b>3466</b>	<b>2960</b>
<b>Initial screening after duplicate removal</b>	<b>3567</b>	<b>1445</b>	<b>1208</b>
<b>Full text screening</b>	<b>81</b>	<b>47</b>	<b>186</b>
<b>Selection after applying PICO</b>	<b>16</b>	<b>6</b>	<b>35</b>

\*Results from updated search (i.e. 2019-2021) were from Pubmed database as Medline and Medline IP databases merged with Pubmed.

Table S3: Studies measuring the effect of digital health interventions to assist pregnant smokers quit.

Study	Number & Type of participants	Number allocated to intervention	Intervention	Number allocated to comparator	Comparator	Outcome		
						Abstinence Type	Follow-up	Validation
Coleman et al 2021 (RCT)	988	493	U0028177usual Care + 12-week MiQuit Program: personalised text messages at a user-driven frequency	495	Usual Care ( UC -information, advice and support within National Health Service, including information booklet)	Self-report 7-day PPA Continuous abstinence (from 4 weeks post randomisation to 36 weeks gestation)	7-day PPA: - Four weeks post randomisation: INT = 37 vs. CTL = 24; OR = 1.58 (95%CI 0.93-2.69) (self report) - Thirty six weeks gestation: INT = 76 vs. CTL = 59; OR = 1.34 (95% CI 0.93-1.93) (self report) INT = 38 vs. CTL = 29; OR = 1.34 (C95%CI 0.81-2.20) (validated) - Four weeks post randomisation and 36 weeks gestation: INT = 27 vs. CTL = 16; OR = 1.73 (95%CI 0.92- 3.25) (self report) INT =14 vs. CTL = 10; OR =1.41 (95%CI 0.62-3.21) (validated)  Continuous abstinence: INT = 54 vs. CTL= 47; OR = 1.17 (95%CI 0.77-1.76) (self report) INT = 26 vs. CTL = 23; OR = 1.14 (95% CI 0.64-2.02) (validated).	Breath CO <=9ppm, saliva cotinine or anabasine
Joyce et al 2021 (RCT)	a: 27 b: 8 (6 out of 27 + 2)	a:18 b: 4	a: Participation incentives + weekly check and cotinine test + SmokeBeat app linked to smartwatch + program (12 weeks) b: pay to wear smartwatch + pay-to-quit (pay contingent on not recording any smoking events) (4 weeks)	a:9 b: 4	a: no watch and no program b: pay-to-wear (pay contingent to wear smartwatch for 16 hours/day) (4 weeks)	Negative cotinine test at end of pilot	a: end of 12 weeks: INT = 1 out of 18 vs. CTL = 1 out of 9 had negative cotinine test b: end of 4 weeks: INT = 0 out of 4 vs. CTL = 0 out of 4 had negative cotinine test	Saliva cotinine and urine cotinine
Balmumcu & Unsal Atan 2021 (RCT)	56 pregnant smokers	29	Trans-theoretical-Model-based (TTM) involved motivational interviews with follow up supportive WhatsApp text messages for 8 sessions including 7 follow ups during pregnancy and up to 2 weeks postpartum	27	UC (Interviews at first and final follow up during pregnancy and at postpartum were conducted to ask if they were smoking)	Self-report abstinence	Thirty six to 38 weeks gestation: INT = 15 of 29 vs. CTL =9 of 27.	Breath CO <6.5ppm

Table S3: Studies measuring the effect of digital health interventions to assist pregnant smokers quit.

Study	Number & Type of participants	Number allocated to intervention	Intervention	Number allocated to comparator	Comparator	Outcome		
						Abstinence Type	Follow-up	Validation
Kurti et al. 2020 (RCT)	61 pregnant smokers	31	DynamiCare Rewards app notify when biochemical tests are due for staying smoke free and deliver financial incentive on confirmation of abstinence + UC (i.e. receive smoking cessation counselling and referral to quit lines)	30	UC (i.e. receive brief 5A smoking cessation counselling and referral to quit lines)	Self-report 7-day PPA	One Month follow up: INT = 46.7% vs. CTL = 20.0%; OR = 3.50 (95%CI 1.11-11.02). Late Pregnancy: (28 weeks gestation) INT = 36.7% vs. CTL = 13.3%; OR = 3.76 (95%CI 1.04-13.65). One month postpartum: INT = 36.7% vs. CTL = 10.0%; OR = 5.21 (95%CI 1.28-21.24). Two months postpartum: INT = 40.0% vs. CTL = 6.7%; OR = 9.33 (95%CI 1.87-46.68). Three months postpartum: INT = 23.3% vs. CTL = 10.0%; OR = 2.74 (95%CI 0.63-11.82). Six months postpartum: INT = 20.0% vs. CTL = 6.7%; OR = 3.50 (95%CI 0.65-18.98)	Breath CO (<=4ppm for those on NRT) and saliva cotinine
Tombor et al. 2019 (Randomised factorial trial)	565 pregnant smokers	About 50% for the 5 components	SmokeFree Baby application containing 5 different Behaviour Change modules	About 50% for each of the 5 components	Minimal version of each of the 5 components - A combination of minimal and full	Self-report smoke-free days 4 weeks after quit date	Smoke free days up to 4 weeks from quit date: F-ratio for app components: identity = 0.077 (p = 0.782) Health information = 0.014 (p = 0.905) Stress management = 2.668 (p = 0.103) Face2face support = 0.719 (p = 0.397) Behavioural substitution = 0.005 (p = 0.945). Interaction between identity and behavioural substitution significant F = 6.368 p = 0.012	NA
Pollak et al. 2019 (RCT)	314 pregnant smokers	154	SMS-delivered scheduled gradual reduction program + SMS support messages	160	SMS support messages alone	Self-report 7-day PPA	End of pregnancy INT: 9% (95%CI 5-14) vs. CTL: 9% (95%CI 5-13). Three months postpartum: INT: 5% (95%CI 2-8) vs. CTL: 5% (95%CI 2-8)	Saliva cotinine
Marin-Gomez et al. 2019 (RCT)	42 pregnant smokers	21	Tobstop mobile app serious game for 3 months + UC	21	UC (counselling by midwife in first trimester)	Continuous abstinence at delivery	At Delivery: INT: 57% (12/21) vs CTL: 14% (3/21); HR = 4.31 (95%CI 1.87-9.97 P = 0.001)  Total days of abstinence during pregnancy until delivery: Mean 139.75 days (SD 21.75) VS.33.28 days (SD 13.27 P < 0.001)	Breath CO

Table S3: Studies measuring the effect of digital health interventions to assist pregnant smokers quit.

Study	Number & Type of participants	Number allocated to intervention	Intervention	Number allocated to comparator	Comparator	Outcome		
						Abstinence Type	Follow-up	Validation
Forinash et al. 2018 (Randomised prospective intervention study,)	49 pregnant smokers.	23	SMS program (prior quit date, during and after until delivery) + Usual Care	26	UC (pharmacist-led education + nicotine patch or bupropion)	Self-report abstinence (2 weeks since quit date)	Two weeks after quit date: CO <8ppm: INT = 57.1% vs. CTL = 31.3%; OR = 2.93 (95%CI 0.66-13.09 p = 0.153). CO <5ppm: INT = 35.7% vs. CTL = 12.5%; OR = 3.89 (95%CI 0.62-24.52 p = 0.204)	Breath CO
Abroms et al. 2017 (RCT)	497 pregnant smokers	250	Quit4baby (around before and during quit date and for 6 months postpartum) and Text4baby SMS program	247	Text4baby only	Self-report of 7-day PPA and 30-day PPA	Three months follow up: - 7-day PPA: INT = 15.6% vs. CTL = 10.93%; RR = 1.51 (95%CI 0.89-2.55). - 30-day PPA: INT = 12.8% vs. CTL = 10.53%; RR = 1.12 (95%CI 0.83-1.52). Late Pregnancy: (no validation) - 7-day PPA: INT = 34.4% vs. CTL = 21.46%; RR = 1.35 (95%CI 1.14-1.61). - 30-day PPA: INT = 27.6% vs. CTL = 18.62%; RR = 1.27 (95%CI 1.06-1.52). Postpartum: (no validation) - 7-day PPA: INT = 16.4% vs. CTL = 17%; RR = 0.98 (95%CI 0.77-1.24). 30-day PPA: INT = 14% vs. CTL = 15.38%; RR = 0.95 (95%CI 0.73-1.22)	saliva cotinine for 30 days (3 months follow up indicated no sig difference but only in older smokers and those enrolling in 2 <sup>nd</sup> /3 <sup>rd</sup> trimester)
Naughton et al. 2017 (RCT)	407 pregnant smokers	203	MiQuit 12-week SMS program + smoking cessation leaflet	204	Smoking cessation leaflet	Self-report abstinence (no more than 5 cigarettes in last 4 weeks), and 7-day PPA Continuous abstinence	Four weeks post-randomization: Not validated: 7-day PPA: INT = 7.39% vs. CTL = 3.43%; aOR = 2.11 (95%CI 0.89-5.46). 36 weeks gestation: 7-day PPA: INT = 7.39% vs. CTL = 4.41%; aOR = 1.67 (95%CI 0.72-4.03). Continuous abstinence: INT = 5.42% vs. CTL = 1.96%; aOR = 2.70 (95%CI 0.93-9.35)	Breath CO or saliva cotinine at hospital visits or via post
Harris & Reynolds 2015 (RCT)	17 pregnant smokers	7	Motiv8 – a Web-based Contingency Management ( 6 weeks sessions then 2 more follow up before birth)	10	Phone delivered Smoking cessation Counselling program (5 telephone calls throughout pregnancy)	Self-report abstinence	At peak abstinence: INT: 2/7 or 28.57% (4.87 months) vs. CTL: 3/10 or 30% (6.45 months). At end of pregnancy: INT (web) = 14% vs. CTL (phone)= 30%.	Breath CO & urinary cotinine
Herbec et al. 2014 (RCT)	200 pregnant smokers	99	Automated Smoking cessation website "MumsQuit"	101	Information only website	Self-report 4 weeks continuous abstinence	Eight weeks follow up: INT = 28/99 (28.3%) vs. CTL = 21/101 (20.8%); OR = 1.50 (95%CI 0.80-2.90) p = 0.220; aOR = 1.50 (95%CI 0.7-3.4) p = 0.315.	NA

Table S3: Studies measuring the effect of digital health interventions to assist pregnant smokers quit.

Study	Number & Type of participants	Number allocated to intervention	Intervention	Number allocated to comparator	Comparator	Outcome		
						Abstinence Type	Follow-up	Validation
Pollak et al. 2013 (RCT)	31 pregnant smokers	16	Support + Scheduled Gradual Reduction (SGR) SMS program (for 5 weeks)	15	Support SMS (5 weeks)	Self-report 7-day PPA	Six weeks post randomization: INT = 13.4% vs. CTL = 7.5%	Saliva cotinine
Ondersma et al. 2012 (RCT)	110 pregnant smokers	84: CD-5A = 26 CM = 28 CD-5A + CM = 30	- Computer-delivered 5A brief Intervention (CD-5A) - Computer assisted low intensity Contingency Management (CM) - CD-5A + CM	26	UC + computer program watching videos on musical preference	Self-report 7-day PPA and 30-day abstinence	Ten weeks post randomization: CD-5A: - 7-day PPA + breath CO: INT = 30.4% vs. CTL = 8.7%; OR = 4.6 (95%CI 0.84-25.2). - 7-day PPA urine cotinine: INT = 43.5% vs. CTL = 17.4%; OR = 3.7 (95%CI 0.94-14.2). CM: - 7-day PPA + breath CO: INT = 9.1% vs. CTL = 8.7%; OR = 1.1 (95%CI 0.1-8.2). - 7-day PPA urine cotinine: INT = 13.6% vs. CTL = 17.4%; OR = 0.8 (95%CI 0.2-3.8). CD-5A + CM: - 7-day PPA + breath CO: INT = 19.2% vs. CTL = 8.7%; OR = 2.5 (95%CI 0.4-14.4). - 7-day PPA urine cotinine: INT = 15.4% vs. CTL = 17.4%; OR = 0.9 (95%CI 0.2-3.9) CD-5A vs. No CD-5A: - 7-day PPA + breath CO: INT = 28.6% vs. CTL = 15.6%; OR = 2.2 (95%CI 0.8-6.0). - 30-day abstinence: (no confirmation) INT = 22.4% vs. CTL = 6.7%; OR = 4.1 (95%CI 1.1-15.6)	Urinary cotinine or breath CO (<4ppm)
Naughton et al 2012 (RCT)	207 pregnant smokers	102	MiQuit (tailored self-help leaflet + 11 week SMS program) on smoking abstinence	105	Non-tailored self-help leaflet	Self-reported 7-day PPA and 4-week PPA	Three months follow up: 7-day PPA: INT = 12.5% vs. CTL = 7.8%; OR = 1.68 (95%CI 0.66-4.31). 4-week PPA: INT = 13.5% vs. CTL = 13.7%; OR = 0.99 (95%CI 0.44-2.22)	Salivary cotinine

Table S3: Studies measuring the effect of digital health interventions to assist pregnant smokers quit.

Study	Number & Type of participants	Number allocated to intervention	Intervention	Number allocated to comparator	Comparator	Outcome		
						Abstinence Type	Follow-up	Validation
Lawrence et al. 2003 (Cluster RCT)	918 pregnant smokers	629: a = TTM = 305 b = TTM + C 324	a: Transtheoretical Model of Behaviour change (TTM) + assessment + self-help manual. b: a + computer program (TTM + C)	289	UC (Standard advice by midwives + education leaflet)	Self-report PPA & continuous abstinence (previous 10 weeks abstinence)	<p>Thirty weeks gestation:</p> <ul style="list-style-type: none"> <li>- PPA: INT = (b) 5.6% vs. CTL = 1.7%; OR = 5.6 (95%CI 1.22-9.11).</li> <li>- Continuous abstinence: INT = (b) 3.1% vs. CTL = 1.4%; OR = 2.27 (95%CI 0.70-7.31).</li> </ul> <p>Ten days postpartum:</p> <ul style="list-style-type: none"> <li>- PPA: INT = (b) 8.1% vs CTL = 3.5%; OR = 2.42 (95%CI 1.05-5.57).</li> <li>- Continuous abstinence: INT = 2.8% vs. CTL = 1.0%; OR 2.72 (95%CI 0.73-10.17)</li> </ul>	Urine cotinine
Windsor et al. 2011 (quasi experimental evaluation trial)	1093 + 96 pregnant smokers	449 + 97 LFU	Ask, advice, assess, arrange + assist procedures: Commit to Quit Video + guide to quit + interview/counselling	96 historical controls 452 + 95 LFU	- Historical comparison: UC brief counselling - Ask, advise, assess and arrange procedures	Self-report 7-day PPA (>1 cigarette in 7 days)	Sixty to 90 days postpartum: INT = 12% vs. CTL = 10%, P = 0.31	Saliva cotinine
Ershoff et al. 1999 (RCT)	390 pregnant smokers	133	UC + Self-help booklet + Interactive voice response on computerized phone.	257: a- 131 b- 126	a- UC (tailed stage of change advice) + Self-help booklet b- tailored stage of change advice + self-help booklet + nurse phone counselling (MI)	Self-report abstinence	Thirty-four weeks gestation: INT = 16.7% vs. CTL = 22.5% (a), 20.8% (b), p = 0.57	Urine cotinine

Note: 5A: Ask, Advise, Assess, Assist, Arrange brief intervention; aOR: Adjusted odds ratio; CO: Carbon Monoxide; CTL: Control; INT: Intervention; F: Bayes factor; LFU: Lost to follow up; NRT: Nicotine Replacement Therapy; PPA: Point-prevalence abstinence; ppm: part per million; OR: Odds ratio; RCT: Randomised control trial; RR: relative risk; SMS: Short message service (i.e. text message); UC: Usual care.

Table S4: Studies measuring the effect of biomarker feedback interventions to assist pregnant smokers quit.

Study	Number & Type of participants	Number allocated to intervention	Intervention	Number allocated to comparator	Comparator	Outcome		
						Abstinence Type	Follow-up	Validation
Patten et al. 2019 (RCT)	60 pregnant smokers	30	personal urine cotinine measurement + information about effect on infant. + UC	30	Contact control: 5A counselling	Self-report 7-day PPA	At delivery: INT = 20% vs. CTL = 20%, p = 1	Urinary cotinine
Cope et al. 2003 (RCT)	856 pregnant women (280 smokers)	447 (164 smokers)	Cotinine urine testing at point of care and providing numerical and visual results to participants for each visit up to 36 weeks gestation	409 (116 smokers)	UC of antismoking counselling	Self-report abstinence	Thirty-six weeks gestation follow up: INT = 22.2% vs. CTL = 6.8%	Urine cotinine
Hajek et al. 2001 (RCT)	1120 pregnant women (249 recent smokers and 871 smokers)	545: 431 (smokers) 114 (ex-smoker)	One off 10-15 minutes tailored brief counselling + written material + self-help support + breath CO biofeedback	575: 440 (smokers) 135 (ex-smokers)	UC (usual antismoking advice and antismoking leaflet)	Self-report PPA and 3 and 6 months postpartum continuous abstinence	End of pregnancy: - PPA: INT = 65% vs. CTL = 53%, p ,0.05 (one tailed); OR = 6.11 P<0.05. Three months postpartum: - Continuous abstinence: INT = 58% vs. CTL= 50%. Six months postpartum: - Continuous abstinence: INT = 23% vs. CTL = 25% (non-significant)	Breath CO
Thornton et al. 1997 (RCT)	418 pregnant women (including recent quitters)	209	1:1 counselling at first visit + support + education material + follow up + breath CO monitoring as motivation + support group (3 months)	209	UC 1:1 counselling at first visit	Self-report abstinence.	During Pregnancy and at delivery: INT = 11.7% vs. CTL = 12.6%; RR = 1.01 (95%CI0.94-1.09), p = 0.803	Breath CO (4ppm)
Burling et al. 1991 (RCT of a 2-component study)	139 pregnant smokers	70	UC + Brief letter with CO elevation feedback & smoking cessation recommendation. 3 times weekly for 18 months	69	UC (provision of health behavior by nurse including smoking)	Self-report abstinence	Second antenatal visit: INT = 11.6% vs. CTL = 1.4%, p<0.01 Third antenatal visit: INT = 13.0% vs. CTL = 5.7%, p <0.10.	Breath CO (9ppm)
Bauman et al. 1983 (RCT)	170 pregnant women (79 smokers)	36	Breath CO measurement with a script with explanation of CO level and effect on pregnancy	43	Reading script with explanation of CO level and effect on pregnancy	Not clearly stated: based on CO cut off of 9ppm	Six weeks after intervention: INT = 93% vs. CTL = 87%	Breath CO (9ppm)

Note: 5A: Ask, Advise, Assess, Assist, Arrange brief intervention; aOR: Adjusted odds ratio; CO: Carbon Monoxide; CTL: Control; INT: Intervention; F: Bayes factor; LFU: Lost to follow up; PPA: Point-prevalence abstinence; ppm: part per million; OR: Odds ratio; RCT: Randomised control trial; RR: relative risk; SMS: Short message service (i.e. text message); UC: Usual care.

Table S5: Studies measuring the effect of nurse or midwife-led counselling interventions to assist pregnant smokers quit.

Study	Number & Type of participants	Number allocated to intervention	Intervention provider	Intervention	Number allocated to comparator	Comparator	Outcome		
							Abstinence Type	Follow-up	Validation
Loukopoulou et al. 2018 (RCT)	92 pregnant smokers	45	nurses	High intensity counselling: 30 min cognitive behavioural counselling (5A based) + tailored self-help booklet	47	Minimal contact: 5 minutes face to face communication + brief advice + leaflet	Self-report 7-day PPA	Thirty-two weeks gestation: INT = 28.6% vs. CTL = 16.7%, p = 0.090	Urine cotinine
Zhang et al. 2017 (Real life controlled trial)	12434 pregnant smokers	866	Program staff	Baby Me and Tobacco Free: 4 Prenatal face to face counselling sessions + 12 postpartum follow up visits + breath CO + reward diaper vouchers	11568	Pregnant women eligible but did not participate	Abstinence validated by breath CO (<=6ppm at 2 of 4 prenatal visits)	During and post intervention: INT = 68.1% (high session attendance participants) vs. low session (1-2) attendance or non-attending participants. Comparator levels not documented	Breath CO
Robling et al. 2016 (RCT)	1645 pregnant women (870 smokers)	547	nurses	UC + Family Nurse Partnership Home visiting intervention. (64 structured home visits for 2 years through pregnancy and early childhood involving MI + parenting coaching + support)	545	UC (public health nurse, and professional prenatal care)	Self-report abstinence /tobacco use. 3-day PPA	Thirty-four to thirty-six weeks gestation: INT = 56% vs. CTL = 56%, risk difference = -0.6% (97.5%CI -7.3-6.2)	Urine cotinine
Althabe et al. 2016 (Cluster RCT)	3333 pregnant women from deprived communities	1562	50% nurses 50% doctors	2-day workshop for providers in 5A + implementation strategy + 5A intervention, + self-help print + waiting room posters and reminders (18 months long)	1771	Brief seminar to providers on importance of cessation in pregnancy + UC	Self-report abstinence	Eighteen months post intervention: Abstinence during pregnancy (change from baseline) INT: -3.8% vs. CTL = -5.9%; ROR = 1.29 (95%CI 0.84-1.97), p = 0.239	Saliva cotinine
Wesselink et al. 2015 (Quasi experimental trial)	851 pregnant smokers	206	midwives	Quit smoking counselling (minimal intervention strategy V-MIS) up to 7 steps. (8-18 weeks)	645	Those not counselled	Self-report abstinence at end of pregnancy	End of pregnancy or last consultation: Those completing V-MIS: INT = 16.0% vs. CTL = 10.0%; OR = 1.43 (95%CI 0.45-4.55). Those completing 1 step of V-MIS: INT = 10.1% vs. CTL = 10.3%; OR = 1.02 (95%CI 0.58-1.78)	NA
Mejdoubi et al. 2014 (RCT)	460 pregnant smokers	237	nurses	VoorZorg nurse home visitation for 2.5 years + UC	223	UC	Self-report abstinence (if no cigarettes smoked at 32 weeks and over last 48 hours)	Thirty-two weeks gestation: change in proportion of smokers from baseline: INT = -12% vs. CTL = -10%; difference OR = 0.9 (95%CI 0.5-1.5).  Two months postpartum: INT = 18% vs. CTL = 5%; difference OR = 0.5 (95%CI 0.3-1.1)	Urine cotinine



Table S5: Studies measuring the effect of nurse or midwife-led counselling interventions to assist pregnant smokers quit.

Study	Number & Type of participants	Number allocated to intervention	Intervention provider	Intervention	Number allocated to comparator	Comparator	Outcome		
							Abstinence Type	Follow-up	Validation
Hayes et al. 2013 (Quasi experimental trial)	1000 pregnant or new mothers smokers or recent quitters	500	Nurses + hospital and community personnel	Brief intervention using MI (3-10 minutes)	500	UC	Self-report continuous abstinence	<p>Twenty-eight to thirty-two weeks gestation: Proportion of abstainers: INT = 8.2% vs CTL = 8.8%, p = 0.73;</p> <p>One week postpartum: INT = 8.6% vs. CTL = 11.4%, p = 0.14;</p> <p>Three-four months postpartum: INT = 5.8% vs CTL = 4.8%, p = 0.48;</p> <p>Seven-nine months postpartum: INT = 5.2% vs CTL = 4%, p 0.36</p>	Urine cotinine
Eades et al, 2012 (RCT)	263 pregnant ATSI smokers & recent quitters	148	GPs + AHWs + midwives	Advice by GP to quit on first visit + reminder appointment + partner/support involvement + follow up appointment by AHW or midwife in 3-10 days + NRT option if continue to smoke	115	UC (advice to quit + future GP advice)	Self-report PPA or smoking	Thirty-six weeks gestation: Smoking rates INT = 93% vs. CTL = 97%; RR = 0.95 (95% CI 0.90-1.01), p = 0.207	Urine cotinine
Everett-Murphy et al. 2010 (Quasi experimental trial)	949 pregnant smokers	519	Midwives	Self-help material: brief counselling by midwives and peer counselling	430	UC (ask and advise to quit).	Confirmed PPA (urinary cotinine <100ng/ml)	Thirty-six to thirty-nine weeks gestation: PPA: INT = 5.8% vs. CTL = 0.5%; risk difference: 5.3% (95% CI: 3.2-7.4%), p <0.0001	Urinary cotinine
Windsor et al. 2011 (Quasi experimental trial)	1093 + 96 historical pregnant smokers	1093: 452 + 95 LFU (a) 449 + 97 LFU (b)	Coordinators, nurses and social workers	a- Ask, advise, assess and arrange procedures b- a + assist procedures: Video + guide to quit + interview/counselling	96 historical controls	96 historical controls	7-day PPA (<1 cigarette in 7 days)	<p>Sixty to 90 days postpartum: INT = 10% (a), 12% (b) vs. CTL = 4.2%.</p> <p>Difference between (a) and (b) non-significant, p = 0.31. Difference between (a) and CTL significant, p = 0.03</p>	Saliva cotinine
Joseph et al. 2009 (RCT)	1044 pregnant African American or Latino women	521	Trained staff included 2 registered nurses	DC-HOPE: individualized counselling with elements of SCRIPT + a form of a CBT, containing 4-8 sessions 35-45 min each) + incentives.	523	UC	Self-report 7-day PPA or smoking	Second and Third trimester follow up: Risk of smoking: OR = 0.57 (95% CI 0.38-0.87), p <0.01	NA (validated Audio-computer-assisted-self-interview)

Table S5: Studies measuring the effect of nurse or midwife-led counselling interventions to assist pregnant smokers quit.

Study	Number & Type of participants	Number allocated to intervention	Intervention provider	Intervention	Number allocated to comparator	Comparator	Outcome		
							Abstinence Type	Follow-up	Validation
Edwards et al. 2009 (Prospective intervention study)	13,285 pregnant smokers	7494	Nurses + nutrition staff + clerk + educators	Self-help quit guide + SMART Moms Project ( 5A Best Practice counselling program + individual treatment plan + educational material + incentives.) for last year	5791	SMART Moms Project (5A Best Practice counselling program + individual treatment plan + educational material + incentives.) for 4 years	Self-report abstinence or smoking	Postnatal follow-up visit: Abstinence: INT = 24.2% vs. CTL = 20.9%, p <0.05	NA (survey data)
Bullock et al. 2009 (RCT)	695 low income rural pregnant smokers	345: a=175 b= 179 a + b = 170	nurses	a- Baby Beep – Nurse telephone social support b- 8 prenatal smoking cessation booklets a + b	171	UC (with quit smoking pamphlet)	PPA (saliva cotinine 30ng/ml)	End of pregnancy: INT = 17% (a + b); 22% (a); 19.2% (b) vs CTL = 17.2% p = 0.72  Six weeks postpartum: INT = (a + b) 12.4%; (a) 11.4%; (b) 13.59% vs CTL = 12.0% p = 0.71	Saliva cotinine
Ruger et al. 2008 (RCT)	302 low income pregnant smokers	156	nurses	3 home visits with MI for smoking cessation and relapse prevention + information + feedback on home nicotine + self-help manual	146	UC (at prenatal clinic with 5 min intervention + self-help material)	Self-report 30-day PPA	Six months postpartum: INT = 7/110 vs. CTL = 8/100	Saliva cotinine
Oien et al 2008 (Real life controlled trial)	3839 pregnant smokers	2051	Midwives, nurses and General Practitioners	PACT office brief intervention: counselling in addition to lifestyle counselling for 8-10 consultations. To participant and her partner	1788 historical controls	UC (common lifestyle counselling, including smoking cessation)	Self-report 7-day PPA	Six weeks postpartum: proportion of smokers INT = 5.8% vs. CTL = 7.6%; aOR = 0.72 (95% CI 0.46-1.06), p = 0.09	NA
De Vries et al. 2006 (Quasi experimental trial)	318 pregnant smokers	141	midwives	Brief (MIS) counselling sessions + self-help material + partner booklet during pregnancy and early postpartum	177	UC (no specific counselling given but a folder) with material in it)	Self-report 7-day PPA and continuous abstinence	Six weeks post intervention: 7-day PPA: INT = 19% vs CTL = 7%; OR = 1.08 (95%CI 1.03-8.40), p = 0.044.  Six weeks postpartum: 7-day PPS: INT = 21% vs. CTL = 12%. Continuous abstinence: INT = 12% vs. CTL = 3%; OR = 1.83 (95%CI 1.16-33.61), p = 0.033	Urine cotinine (random sampling)
Britton et al. 2006 (Quasi experimental trial)	194 pregnant smokers	101	nurses	Smoke Free Baby & Me Program (5A TTM) with monthly follow up meetings+ self-help quitting magazine	93 historical controls	UC	Self-report abstinence or smoking	Sixteen weeks gestation: Proportion of abstainers: INT = 20.8% vs. CTL = 18.3%.  Twenty-eight weeks gestation: INT = 19.2% vs. CTL = 18.5%.	Urine cotinine

Table S5: Studies measuring the effect of nurse or midwife-led counselling interventions to assist pregnant smokers quit.

Study	Number & Type of participants	Number allocated to intervention	Intervention provider	Intervention	Number allocated to comparator	Comparator	Outcome		
							Abstinence Type	Follow-up	Validation
								Postpartum visit: INT =25.0% vs. CTL = 15.6%	
Albrecht et al. 2006 (RCT)	142 adolescent pregnant smokers	92: a =47 – TFS b = 45- TFS-B	nurses	a- Teen Fresh Start (CBT based) 8-week program (TFS) b- TFS –Buddy (TFS-B) for social support	50	UC (teen educational material in first prenatal visit)	Self-report smoking status	Eight weeks post randomisation: Abstinence status: INT (a) vs. CTL: OR = 2.106 (99%CI 0.542 - 8.191), p = 0.158. INT (b) vs. CTL: OR = 3.730 (99%CI 1.001- 13.893), p = 0.010.	Saliva cotinine
Tappin et al. 2005 (RCT)	762 pregnant smokers	351	midwives	Standard health promotion information + MI at home (2-5 visits, 30 minutes)	411	UC (standard health promotion information)	Self-report abstinence (cotinine < 13.7ng/ml for plasma or <14.2ng/ml for saliva)	One- year follow up: INT (a) vs. CTL: B = 1.260 (99%CI 0.296 - 5.370), p = 0.681. INT (b) vs. CTL: B = 0.599 (99%CI 0.108- 3.312), p = 0.440 Late pregnancy: INT = 4.8% vs. CTL = 4.6%; RR =1.05 (95%CI 0.55-1.98), p = 0.34	Plasma or saliva cotinine
Ferreira-Borges et al 2005 (Quasi experimental trial)	57 pregnant smokers	33	Medical directors and nurses	2 x Counselling and behavioural brief intervention (8 min by nurse and 4 min by clinician and follow up) + written material	24	UC	7-day PPA	Two months follow-up after first visit: INT = 33.3% vs. CTL = 8.3%; OR = 5.5 (95%CI 1.09-27.75), p = 0.026	Breath CO
Lawrence et al. 2005 (Cluster RCT)	918 pregnant smokers	629: a = 305 b = 324	midwives	a- assessment and TTM based self-help manuals b- a + Interactive computer program	289	UC (standards smoking cessation advice by midwives + education leaflet)	Self-report PPA and continuous abstinence	Ten days postpartum PPA: INT = 4.6% (a), 4.6% (b) vs. CTL = 4.2%; (a) OR = 1.11 (95%CI 0.51-2.44), (b) OR = 1.12 (95%CI 0.56-2.22), p = 0.95  18 months postpartum continuous abstinence: INT = 0.47% (a),1.2% (b) vs. CTL = 0.7%; (a) OR = 0.47 (95%CI 0.04-5.23), (b) OR = 1.12 (95%CI 0.56-2.22), p = 0.95. OR 1.79 (95%CI 0.33-9.87), p = 0.46	Saliva or urinary cotinine (not successfully used)

Table S5: Studies measuring the effect of nurse or midwife-led counselling interventions to assist pregnant smokers quit.

Study	Number & Type of participants	Number allocated to intervention	Intervention provider	Intervention	Number allocated to comparator	Comparator	Outcome		
							Abstinence Type	Follow-up	Validation
McLeod et al. 2004 (Cluster RCT)	297 pregnant smokers	237: a= 69 b= 60 c =108	midwives	a-Smoking Education and support (counselling + flip chart + videotape) b- Breastfeeding education and support c- a + b	60	UC (asking & advice to quit)	Self-report abstinence	Twenty-eight weeks gestation: OR = 2.61 (95%CI 1.13-6.04). Thirty-six weeks gestation: OR = 2.71 (95%CI 1.17-6.28); At discharge (1-44 days postpartum): OR = 1.32 (95%CI 0.60-2.93).  Six weeks postpartum: OR = 1.81 (95%CI 0.72-4.51).  Four months postpartum: OR = 1.95 (95%CI 0.72-5.28)	Serum cotinine for 28 gestation self-report
Lawrence et al. 2003 (Cluster RCT)	918 pregnant smokers	629: a =TTM = 305 b = TTM +C 324	midwives	- a: Transtheoretical Model of Behaviour change (TTM) + assessment + self-help manual. b: a + computer program (TTM +C)	289	UC (Standard advice by midwives + education leaflet)	Self-report PPA & continuous abstinence (previous 10 weeks abstinence)	Thirty weeks gestation: - PPA: OR = 2.92 (95%CI 1.42-6.03). - Continuous abstinence: OR = 2.09 (95%CI 0.90-4.85).  Ten days postpartum: - PPA: (a + b) OR = 1.85 (95%CI 1.00-3.41). Continuous abstinence: (a + b) OR 2.81 (95%CI 1.11-7.13)	Saliva or urinary cotinine
Hegaard et al. 2003 (Prospective intervention study)	647 pregnant smokers	327	midwives	Individual counselling + join a smoking cessation program (cognitive behavioural modification based 9 appointments in 14 weeks + breath CO measure) + NRT	320	UC (routine information about smoking risks and general advice)	Self-report abstinence	Thirty-seven weeks gestation: INT = 7.0% vs. CTL = 2.2%, p = 0.004; OR = 4.14 (95%CI 2.13-8.0) P<0.0001	Saliva cotinine and breath CO (intervention only)
Valanis et al. 2001 (Quasi experimental trial)	3903 pregnant smokers and recent quitters	2055	Nurses or medical assistants	Stop Smoking for Our Kids program (low intensity TTM based program)	1024 historical control 824 control.	UC (smoking risk information discussion and advice to quit)	Self-report abstinence, 7-day PPA and continuous abstinence (6-months)	During pregnancy:7-day PPA: INT = 38.8% vs. CTL = 28.9%, p = 0.001.  One year postpartum: Continuous abstinence: INT = 18.4% vs. CTL = 14.9%, p = 0.0045	NA
Hajek et al. 2001 (RCT)	1120 pregnant women (249 recent smokers and 871 smokers)	545: 431 (smokers) 114 (ex-smoker)	midwives	One off 10-15 minutes tailored brief counselling + written material + self-help support + breath CO biofeedback	575: 440 (smokers) 135 (ex-smokers)	UC (usual antismoking advice and antismoking leaflet)	Self-report PPA and 3 and 6 months postpartum continuous abstinence	End of pregnancy: PPA: INT = 65% vs. CTL = 53%, p ,0.05 (one tailed); OR = 6.11 P<0.05.  Three months postpartum:	Breath CO

Table S5: Studies measuring the effect of nurse or midwife-led counselling interventions to assist pregnant smokers quit.

Study	Number & Type of participants	Number allocated to intervention	Intervention provider	Intervention	Number allocated to comparator	Comparator	Outcome		
							Abstinence Type	Follow-up	Validation
Lancaster et al. 1999 (RCT)	497 pregnant smokers	249	General Practitioners then nurses	Brief verbal or written advice by a General Practitioner + extended counselling and follow up visit(s) by trained nurse	248	UC (brief advice by General Practitioner)	Self-report 3 and 12-months continuous abstinence	Continuous abstinence: INT = 58% vs. CTL= 50%.  Six months postpartum: Continuous abstinence: INT = 23% vs. CTL = 25% (non-significant)  Three-months post randomisation: INT = 9.2% vs. CTL = 8.1 % (non-significant)  Twelve months post randomisation: INT =6.8% vs. CTL = 11.3 % (non-significant)  Twelve months post randomisation: Continuous abstinence at both points: INT =3.3% vs. CTL = 4.0 %, difference = -0.8% (95%CI -4.3%-2.6%)	Breath CO (baseline) and saliva cotinine (follow up)
Ershoff et al. 1999 (RCT)	390 pregnant smokers	259 a- 133 b- 126	Nurses	a- UC + Self-help booklet + Interactive voice response on computerized phone b- tailored stage of change advice + self-help booklet + nurse phone counselling (MI)	131	UC (tailored stage of change advice) + Self-help booklet	Self-report abstinence	Thirty-four weeks gestation: INT = 19.9% vs. CTL = 19.9%.  Follow up at end of pregnancy showed no statistical difference between 3 groups p = 0.57	Urine cotinine
Wisborg et al. 1998 (Prospective intervention study)	3156 pregnant women	527	Midwives	Individual advice + leaflet	2629	UC	Self-report abstinence	Thirty weeks gestation: INT = 2% vs. CTL = 2%, p = 0.80. (NB: 1% started smoking in both groups)	Saliva cotinine (random sampling from both groups)
Gebauer et al. 1998 (Quasi experimental trial)	178 pregnant smokers	84	Nurses	Individualised 15-minute intervention (based on 4As) + education material + telephone contact 7-10 days follow-up	94 historical controls	UC	Self-report 7-day PPA. (saliva cotinine confirmed <14ng/ml).	At follow-up visit: INT = 15.5% vs. 0%, p <0.001	Saliva cotinine
Walsh et al. 1997 (RCT)	252 pregnant smokers	127	Doctors and midwives	3 minutes doctor's advice (first visit) + 14 minutes videotape + 10 minutes midwife counselling + self-help manual + lottery incentives + social support + chart reminder + 5-minute midwife counselling at follow up visits	125	Doctor and midwife advice + anti-smoking package.	Self-report 7-day PPA and continuous abstinence (consecutive visits cessation)	Thirty-four weeks gestation: PPA: INT = 6% (95%CI2-11) vs. CT: =13% (95%CI 8-21), p = 0.0353;  Six-twelve weeks postpartum: PPA: INT = 10% (95%CI 6-17) vs. CTL = 1% (95%CI 0-4), p = 0.0011.	Urine cotinine

Table S5: Studies measuring the effect of nurse or midwife-led counselling interventions to assist pregnant smokers quit.

Study	Number & Type of participants	Number allocated to intervention	Intervention provider	Intervention	Number allocated to comparator	Comparator	Outcome		
							Abstinence Type	Follow-up	Validation
								Continuous abstinence: INT = 6 % (95%CI 3-12%) vs. CT: = 0 %, p = 0.0037	
Belizan et al. 1995 (RCT)	2235 pregnant smokers	1115	Female social workers and obstetrics nurses	Psychological support and education home visiting program (4-5 visits) + poster + booklet	1120	UC	Self-report Abstinence	Thirty-six weeks gestation: Proportion of smokers: INT = 19.3% vs. CTL = 20.2%, (not significant).	NA
Kendrick et al. 1995 (Cluster RCT)	5572 pregnant smokers or recent quitters	2508: 876= Colorado 694= Maryland 938= Missouri	Nurses	Information + counselling + social support: At Colorado: printed material At Maryland: self-help material At Missouri: patient brochures	3064: 865 = Colorado 1242 = Maryland 957 = Missouri	UC	Self-report 7-day PPA.	Thirty-two to Thirty-six weeks gestation: INT = 6.1% vs. CTL = 5.9%; OR = 1.0 (95%CI 0.69-1.6)	Urine cotinine
Petersen et al. 1992 (RCT)	317 pregnant smokers or spontaneous quitters	146 a = 71 b = 75	Obstetricians and nurses	a- UC + self-help material b- UC + self-help material + brief clinician counselling	78	UC + smoking cessation resources	Self-report abstinence	Six-months gestation: difference in % of non-smokers: CTL to (a) =: 2.5 (95%CI -0.146-0.196); CTL to (b) = 7.4 (95%CI -0.100-0.248); (a) to (b) = 9.9 (95%CI -0.075-0.273).  Eight-weeks postpartum: difference in % of non-smokers: CTL to (a) = 19.3 (95%CI 0.023-0.365, p = 0.05); CTL to (b) = 25.9 (95%CI 0.090-0.425, p = 0.05); (a)to (b) = 6.6 (95%CI 0.134-0.267)	Urine cotinine
O'Connor et al. 1992 (RCT)	224 pregnant smokers	115	Nurses	a- UC + 2-hour group guidance on self-help + telephone follow up call if needed. b- UC + 20-minute individual prenatal guidance on self-help + telephone follow up call if needed	109	UC (3-5-minute explanation of smoking hazards) + pamphlet	Self-report abstinence	One- month follow-up: INT = 14.9% vs. CTL = 5%; RR = 3.00 (95%CI 1.20-7.50) p = 0.02.  Thirty-six weeks gestation: INT = 13.3% vs. CTL = 6%; RR = 2.24 (95%CI 0.85-5.89) p = 0.10.  Six weeks postpartum: INT = 13.8% vs. CTL = 5.2%; RR = 2.66 (95%CI 1.03-6.84) p = 0.04.	Urine cotinine

Note: 5A: Ask, Advise, Assess, Assist, Arrange brief intervention; aOR: Adjusted odds ratio; AHW: Aboriginal Health Worker; ATSI: Aboriginal and Torres Strait Islander people (i.e. indigenous Australians); CO: Carbon Monoxide; CTL: Control; INT: Intervention; LFU: Lost to follow up; MI: Motivational interviewing; PPA: Point-prevalence abstinence; ppm: part per million; OR: Odds ratio; RCT: Randomised control trial; RR: relative risk; TTM: Transtheoretical model of change; UC: Usual care.

## Narrative Synthesis for Digital health and biomarker feedback interventions

### *Digital Health*

One study on a text messaging intervention reported a positive effect(1) but was limited by a small sample size. Five other text messaging intervention studies reported increased abstinence, however, results were not significant, or unvalidated (2-6). These studies involved either a quitting text messaging program in addition to usual care/information leaflet or in addition to a behaviour intervention component. In comparison, a recent study by Pollak et al, which involved text messaging as part of a gradual smoking reduction program, indicated that this intervention did not produce a better effect when compared to a support based text message program (7).

Tombor et al indicated that only two of the five psychology-based components of a mobile telephone application had some influence on increasing smoke free days. These were ‘fostering a positive non-smoking identity’ and ‘promoting behaviour substitution (to smoking)’. The identity component increased smoke free days although the increase was not significant but a combination of the identity with the behavioural substitution component produced a significant effect (8). On the other hand, a pilot study reported that a rewards mobile application, DynamiCare, led to an increased abstinence at follow up (OR = 3.50), late pregnancy (OR = 3.76) and postpartum (3 months OR = 2.74; 6 months OR = 3.50)(9) but the significance was not reported. Similarly, a mobile gaming application found a significant and positive effect (HR = 4.31, p =0.001) but had a small sample size (10). Another pilot study that involved an incentive to wear a smart watch, with a SmokeBeat application and pay to quit program reported no increase in abstinence when compared to control(11). A website based intervention did not show better effect on smoking cessation when compared with information only website or telephone counselling as shown in two studies (12, 13).

When compared to usual treatment and a “placebo” or a contingency management computer program, the 5As based computer program was shown to have a larger effect on several abstinence measures but was only significant for the 30-day PPA (not biochemically validated) (14). Alternatively, the smoking cessation computer program in a study by Lawrence et al indicated that when combined with TTM behaviour intervention and a self-help manual, it increased the abstinence rate compared to usual care but was only significant for PPA at 30 weeks gestation and 10 days postpartum (15).

When combined with the 5As brief counselling and a guide to quit, a Commit to Quit video resulted in a slightly higher quit rate when compared to historical usual care (12% vs. 10% quit rate) but this effect was not significant (p = 0.31) (16). On the other hand, an interactive voice response, when combined with self-help booklet and usual care, did not improve abstinence rate when compared to either usual care and booklet alone or MI counselling by a nurse (16.7% vs. 22.5% and 20.8% quit rates respectively, p = 0.57) (17).

### *Biomarker Feedback*

Patten et al compared urine cotinine as feedback to pregnant mothers with 5As counselling and found no difference in effect size (i.e. 20% quit rate in each arm) (18). However, when urine cotinine as feedback was compared to usual care and anti-smoking counselling, it produced a higher abstinence rate (22.2% vs. 6.8%) (19).

All four studies measuring the effect of breath carbon monoxide (CO) as a motivator reported a better quit rate against different comparators. When compared to anti-smoking counselling and leaflet as usual care, breath CO (combined with self-help material and brief counselling) produced higher PPA rate at the end of pregnancy, and a continuous abstinence rate at 3 months, but not at 6 months postpartum (20). Similarly, Burling et al indicated a positive and significant effect on abstinence when breath CO was added to usual care at both the second and third antenatal visit post intervention (21). Further, Bauman et al also demonstrated an increase in abstinence six weeks post intervention when breath CO results were provided to the pregnant mother in addition to information about CO's harmful effect on pregnancy. (22). When compared to one on one counselling alone, breath CO did not increase the abstinence rate during or at delivery (RR = 1.01, p = 0.803) (23).

### *Nurse or midwife-led counselling*

#### *Counselling face to face*

When compared with 3-5 minutes of smoking advice in usual care, face to face counselling with follow up and self-help material was found to increase abstinence that was significant at one month (p = 0.02) and at six weeks postpartum (p = 0.04), however was not significantly increased at 36 weeks gestation follow up (p = 0.10) (24). In contrast, brief advice provided by a doctor and follow up counselling by a nurse, when compared to usual care, did not produce a significant increase in abstinence at three months (9.2% vs. 8.1%) nor at 12 months follow-up (6.8% vs. 11.3%) (25). Further, Zhang et al assessed face to face counselling with follow up and rewards and found that those who attended more sessions achieved higher abstinence. However, they did not report the rate in low attendance or comparator (26).

When counselling was combined with self-help material and compared to usual care (i.e. supplying resource material), counselling produced a significant increase in 7-day PPA at six weeks after the intervention (p = 0.044), and a significant increase in continuous abstinence at six weeks postpartum (p = 0.033) (27). No significant increase was noted in 7-day PPA at six weeks postpartum. Additionally, when counselling, combined with self-help material and peer counselling, was compared to usual care, it resulted in a highly significant increase in PPA at 36-39 weeks gestation follow-up (p < 0.0001) (28). In their study, Petersen et al compared a combination of brief counselling, self-help material and usual care with self-help material only or usual care only. They reported a significant increase in the percentage difference in non-smokers by counselling when compared to self-help only (difference = 9.9%) or usual care only (difference was 7.4%) at six months gestation and a significant difference (6.6% and 25.9%) at eight weeks postpartum, respectively (29).

Counselling with the provision of educational material and support was investigated in three studies. In a study conducted by McLeod et al, compared to usual care, this intervention produced a significant increase in abstinence at 28 and 36 weeks gestation, but a non-significant increase at two postpartum timepoints (30).



However, neither Wisborg et al nor Kendrick et al found a difference in abstinence rates when compared to usual care (31, 32).

Other interventions involving counselling varied further in components and outcomes. A counselling intervention involving a behavioural component produced a significant increase in abstinence at two months follow-up ( $p = 0.026$ ) (33). Similarly, when counselling was part of a multi-component intervention that also included BF and self-help material and support, a significant increase in PPA and continuous abstinence at end of pregnancy resulted which was an increase in continuous abstinence at three months postpartum but not at 6 months (34). In the study of Wesselink et al, a 7-step counselling intervention found among participants who attended all seven steps, a trend in the increase in abstinence rate at end of pregnancy or last consultation. No increase in abstinence was found among those who did not complete all seven steps (35). Further, when combined with lifestyle and partner counselling, Oien et al reported that there was a non-significant decrease in abstinence in the intervention arm when compared to usual care ( $p = 0.09$ ) (36). Finally, the addition of automated computerised voice messages to tailor stage of change counselling including a self-help booklet, led to no difference in abstinence compared to the counselling with self-help book alone at both 34 weeks gestation and end of pregnancy follow-up ( $p = 0.57$ ).

#### Counselling as part of nurse home visiting program

Five studies evaluated the effect of home visiting programs, which included counselling to increase abstinence amongst other measures. The longest visiting program studied was 2.5 years which resulted in a non-significant increase in abstinence at both 32 weeks gestation and 2 months postpartum (37). Another 2-year home visiting program also indicated no difference in abstinence rates compared to usual care (38). Similarly, other studies with less intensive visiting programs found no significant differences in abstinence rates when compared to usual care at different timepoints post intervention, in late pregnancy or postpartum (39-41).

#### Counselling based on the Ask, Advise, Assess, Assist and Arrange (the 5As)

Two of four studies evaluating the 5As based counselling interventions found a significant or highly significant increase in abstinence when compared to usual care (at 60 to 90 days postpartum or follow up visit) (16, 42) and two found a non-significant increase in abstinence in late pregnancy or 18 months postpartum (43, 44). One study found that adding a self-help guide to the 5As counselling significantly increased abstinence rate at postpartum follow-up (45).

#### Counselling based on the Trans-Theoretical Model (TTM)

Studies using TTM behaviour change based counselling as the intervention had mostly an increase in abstinence rates compared to usual care. Lawrence et al demonstrated a significant increase in PPA at 30 weeks gestation and 10 days postpartum but a non-significant increase in continuous abstinence at both timepoints (15). However, in their subsequent and larger study, Lawrence et al demonstrated a non-significant increase in abstinence for continuous abstinence at 18 months postpartum when the interactive computer program was included in the intervention ( $p = 0.46$ ) (46). Another study found highly significant increases in 7-day PPA during pregnancy ( $p = 0.001$ ) and continuous abstinence at 12 months postpartum ( $p = 0.0045$ ). However, these outcomes were not biochemically validated (47). Britton et al found in their study increases in abstinence at 16

and 25 weeks gestation as well as at the postpartum visit, however the statistical significance of these findings was not stated (48).

#### Counselling based on cognitive behavioural theory (CBT)

There were three studies that involved CBT based counselling as the intervention. One study demonstrated a highly significant increase in abstinence as a result of the intervention when compared to usual care ( $P = 0.004$ ) at 37 weeks gestation (49). The other two studies reported non-significant increases (or reduced risk of smoking) due to the CBT intervention compared to usual care when measured at several follow-up timepoints (50, 51).

#### Other Counselling interventions involving nurses or midwives

One study evaluating midwife counselling in addition to doctor's advice as well as other components (i.e. 14 minutes videotape + self-help manual + lottery incentives + social support + chart reminder) reported a highly significant increase in PPA ( $p = 0.0011$ ) and continuous abstinence ( $p = 0.0037$ ) 6-12 weeks postpartum. The same study did not observe an increase in PAA at 34 weeks gestation due to the intervention when compared to midwife counselling with doctor's advice and supply of anti-smoking package and this finding was significant ( $p = 0.0353$ ) (52). Another study that assessed midwife counselling in addition to advice by a general practitioner did not find any increase in abstinence when compared to usual care (53).

Hayes et al studied the effect of motivational interviewing based brief counselling and reported no difference in continuous abstinence when compared to usual care at all follow-up measurements in late pregnancy and postpartum period (54). In addition, Bullock et al found a non-significant increase in PPA (22% vs. 17.2%,  $p = 0.72$ ) as a result of nurse telephone social support at end of pregnancy but this increase was not observed at six weeks postpartum (11.4% vs. 12.0%  $p = 0.71$ ) (55).

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