Starting life smoke-free in NHSGGC

A health needs assessment of infants exposed to tobacco smoke in pregnancy and the first year of life

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Abbreviations

CHS-PS	Child Health Surveillance – Pre-School
CO	Carbon Monoxide
CPIT	Cessation in Pregnancy Incentives Trial
EYC	Early Years Collaborative
GIRFEC	Getting it Right for Every Child
HEAT	National targets measuring the performance of NHS Scotland covering four areas: H – health improvement E – efficiency and governance improvement A –access to services T – treatment appropriate to individuals
ICD-10	International Classification of Diseases – 10
ISD	Information Services Division of NHS National Services Scotland
MCQIC	Maternity & Children Quality Improvement Collaborative
NHSGGC	NHS Greater Glasgow and Clyde
NICE	National Institute for Health and Care Excellence
NRT	Nicotine Replacement Therapy
QALY	Quality adjusted life year
SGA	Small for gestational age
SHS	Second-hand smoke
SIMD	Scottish Index of Multiple Deprivation (2012); 1-most deprived quintile, 5-least deprived
SMR01	Scottish Morbidity Record 01 (Acute inpatient episodes)
SMR02	Scottish Morbidity Record 02 (Maternity inpatient episodes)
SPIMMR	Scottish Perinatal & Infant Mortality and Morbidity Report
SPS	Smokefree Pregnancy Service
SPSP	Scottish Patient Safety Programme
SUDI	Sudden Unexplained Death in Infancy
SWHMR	Scottish Woman Held Maternity Record
PNBS	Pregnancy and Newborn Screening
PHN	Public Health Nurse

Executive Summary

Exposure to tobacco smoke in pregnancy and infancy is an important modifiable cause of ill health in early life. Pursuing the aim of providing all babies with a smoke-free start in life gives us the opportunity to have a positive impact on the health of young children and their families. This report describes the association between smoke and infant health and the impact this has on the health of infants in NHSGGC. With a clear understanding of the local context in terms of population and health services it then seeks to provide a rational basis for identifying service improvements and new approaches that will support the pursuit of a smoke-free start for all.

Giving children the best start is recognised as an important element of our national tobacco control strategy "Creating a tobacco-free generation" (1). New ways of working integral to the "Getting it Right for Every Child" (2) approach and the impetus provided by service improvement collaboratives, such as the Early Years Collaborative (3), offer significant opportunities to develop this area of work. Smoke exposure in pregnancy and infancy is associated with an increased risk of stillbirth, prematurity, low birth weight, sudden unexplained death in infancy (SUDI) and hospital admission in the first year of life with infectious and respiratory illnesses. In NHSGGC 18% of women are current smokers when they book for antenatal care with their midwife, and 23% of partners are smokers shortly after the birth of their baby. Information about the levels of exposure of infants to second-hand smoke is limited, and true exposure probably exceeds the 12% of new babies reported. Approximately 250 low birth weight babies, 40 premature births and 5 stillbirths each year in NHSGGC can be attributed to smoking in pregnancy; around 100 admissions of babies with bronchiolitis are due to mothers smoking after births, and one case of SUDI every two years is likely to be associated with an infant's father smoking.

Three approaches to preventing harm to infant health from tobacco smoke can be identified: encourage and support parents to quit smoking, ensure that infants are not exposed to smoke in the home, and identify and manage complications of smoke exposure in infants when they do occur. The specialist Smokefree Pregnancy Service (SPS) supports a number of women to quit during pregnancy each year. Referrals and engagement have been supported by universal carbon monoxide testing at booking and automatic referral of women who smoke to the SPS, but currently only just over a third of those eligible attend an appointment. Whilst fathers may also attend this service, it appears few currently do, and it is likely we are missing the chance to support these men to quit at time of change and increased motivation in their lives.

Until recently efforts to reduce second-hand smoke (SHS) exposure had focused on the universal

provision of information in written form to expectant mothers and new families. The development of more tailored ways of working with families by providing feedback on air quality in the home and support from third sector partners offers a promising new approach to this issue. Whilst the role of smoking has been recognised in contributing to adverse pregnancy outcomes, there has not, as yet been a consistent approach to managing smoking as a risk factor in the course of antenatal care in NHSGGC. Specific interventions, such as fetal growth monitoring in the third trimester, are not currently offered to all affected. More broadly the adoption of a clear and consistent approach throughout antenatal care would offer the chance to enhance all three of the prevention strategies outlined above. Key elements of such an antenatal care pathway are outlined in the recommendations section.

The place of financial incentives in encouraging smoking cessation in pregnancy is considered as a potential new intervention, given the findings of the recent Cessation in Pregnancy Incentives Trial in NHSGGC. The evidence suggests this approach results in a greater proportion of women quitting in pregnancy than any other specific cessation intervention. It is estimated that their introduction in NHSGGC would result in around 410 women having quit at the end of pregnancy each year, compared to 130 at present. This encouraging finding is tempered by the relatively small scale impact such a change would have on infant health, and by a number of unknown factors, such as which women this intervention is most effective with and how long quits are sustained for after pregnancy.

Box 1: Recommendations:

The recommendations made in Section 8 cover the following areas:

- Key elements of the **antenatal care pathway**:
    - Referrals to the SPS – should maximise engagement and quits
    - Follow-up of smoking status through pregnancy – to encourage and support women and offer additional opportunities for referral
    - Continuity of care – for women by clear communication between SPS, antenatal and postnatal services
    - Fetal growth monitoring – to identify those with growth restriction
- **Partner smoking** – improve identification of and cessation support provided to partners of pregnant women
- Meeting the needs of **disadvantaged women** – in particular those in SIMD 1 and aged <20years
- **Financial incentives** – considerations for decision-making about implementation
- **Training requirements** – midwifery, ultrasonography and cessation services

Contents

Section 1: Introduction

1.1 Aim and objectives

Aim: To improve the health of infants in NHSGGC by describing and quantifying the impact of tobacco smoke exposure upon them, and identifying relevant service improvements which are likely to have a significant impact on infant health.

Objectives and supporting methods:

1. Establish the nature and scale of the impact of smoke exposure on infants in NHSGGC. This will be undertaken through:
    - A literature review to establish the best estimates of the level of increased risk of harmful outcomes associated with exposure to tobacco smoke at various stages of pregnancy and infancy.
    - Description of the population of infants who are currently being exposed to tobacco smoke.
    - Calculation of the contribution of smoke exposure to the incidence of important health outcomes in the perinatal period and the first year of life.
2. Describe the current relevant services in NHSGGC, and assess the potential for service improvements in relation to current national guidance and standards.
3. Identify new interventions and approaches with the potential to have a positive effect on the health of infants. This will be undertaken through:
    - A literature review to identify the evidence for relevant interventions.
    - Discussion with service providers to identify priorities and opportunities.

1.2 Background and context

National policy and targets

The 5 year tobacco strategy of the Scottish Government was presented in the 2013 document "Creating a tobacco-free generation: A tobacco control strategy for Scotland" (1). Within this three themes are identified: prevention of uptake of smoking, protection from second-hand smoke and helping people to quit smoking. Reference is made to the importance of quitting smoking in pregnancy and providing a smoke-free environment before and after birth.

There are two relevant current HEAT targets (for delivery March 2015):

- Smoking cessation – to deliver 12,000 quits nationally, at 12 weeks after quit date among the 40% most deprived within Board populations.
- Antenatal access – 80% of pregnant women in each SIMD quintile to be booked for antenatal care by 12 weeks gestation. This target seeks to allow timely intervention with pregnant women to support improvements in health behaviours (4).

With respect to the wellbeing of children, the key national policy is "Getting it Right for Every Child" (GIRFEC), which describes a child-focused approach to improve outcomes for all children, based on early intervention, service integration and efficiency (2). Elements of this approach, such as the provision of a 'named person' for a child, are statutory duties under the Children and Young People (Scotland) Act 2014. The 'named person' assesses the child and their situation with respect to eight wellbeing indicators and acts as a single point of contact and coordination of care for the family.

National service improvement activity

The Early Years Collaborative (EYC) is a coalition of community planning partners established in 2013 with the aim of translating the principles of GIRFEC into practical and meaningful action. It has four workstreams relating to different stages of early childhood, each with its own aims. Workstream one (conception to one year) is the most relevant to this project and has the overall aim of ensuring that "women experience positive pregnancies which result in the birth of more healthy babies" as evidenced by reduction in the rate of stillbirth and infant mortality by 15% between 2010 and 2015 (3).

The Maternity & Children Quality Improvement Collaborative (MCQIC) is a branch of the Scottish Patient Safety Programme (SPSP), established with the aim of improving maternity care as measured by a reduction in avoidable harm and an increase in the satisfaction of women with their care. Tobacco smoke exposure is associated with the aim to reduce stillbirths and neonatal mortality by 15% and a further three of the aims refer specifically to smoking (5):

- offer all women CO monitoring at antenatal booking appointment
- refer 90% of those who are smokers or have raised CO to cessation services
- provide a tailored package of care for all women who continue to smoke (including follow-up of smoking status, re-referral and monitoring of fetal growth).

Service improvement and research within NHSGGC

The Healthy Mums, Healthy Babies Programme Board has been established in NHSGGC to ensure that maternity services are able to implement the principles of GIRFEC. A subgroup of this board was established to coordinate activity relevant to EYC Workstream 1. Three priority topics have been selected by this group as their focus in the first instance; smoking, alcohol and breast-feeding. In 2012 an evaluation of the NHSGGC Smokefree Pregnancy Service (SPS) was undertaken, with the aim of identifying barriers to service use and other factors influencing women's ability to quit, in order to inform service improvement (6). The recommendations of the evaluation include elements specific to the SPS, but also changes that require a broader overview of our approach throughout health services to pregnant women who smoke.

NHSGGC was the site of the recent Cessation in Pregnancy Incentives Trial (CPIT); this phase II trial sought to establish the feasibility and determine the practicalities of a planned definitive trial investigating the effect of financial incentives upon smoking cessation in pregnancy (7). CPIT was completed in 2013 and has shown that incentives have the potential to increase the proportion of women who successfully quit; the findings have been reported to the funding body and publication is pending. The experience of involvement in this trial and its findings warrant consideration of this intervention within the wider context of smoking and infant health in NHSGGC.

Section 2: Exposure of children to tobacco smoke in pregnancy and infancy – what is the harm?

2.1 Exposure to tobacco smoke is an important modifiable risk factor for stillbirth and infant mortality

Smoke exposure is an important modifiable risk factor for poor infant health. The potential for smoking cessation to have a positive impact on stillbirth and infant mortality rates has been described by two recent publications which present the best overview and appraisal of relevant studies. Flenady et al (2011) (8) identified maternal smoking as one of the five most important potentially modifiable risk factors for stillbirth in high-income countries, alongside high maternal BMI, pre-existing medical conditions, maternal age >35 years and primiparity. They estimated that in the UK 7.1% of stillbirths can be attributed to smoking in pregnancy.

Allen et al (2009) (9) developed an evidence map of studies of interventions addressing modifiable risk factors for infant mortality. Of the three intervention areas identified, two relate directly to smoking; interventions addressing smoking in pregnancy and those targeting infant risk factors for sudden unexpected death in infancy (SUDI), the third area is interventions addressing obesity and overweight.

2.2 What is the nature and scale of harm associated with different types of smoke exposure?

- **Maternal smoking during pregnancy is associated with an increased risk of stillbirth, prematurity and low birth weight. It is also linked to poor health in infancy, including an increased risk of SUDI, meningococcal disease and wheezing illness.**
- **Exposure of mothers to second-hand smoke in pregnancy increases the risk of stillbirth and low birth weight.**
- **Infants who live in a home with someone who smokes have a higher risk of SUDI, meningococcal disease and lower respiratory infection.**

Exposure to tobacco smoke has been linked with a number of harmful effects in pregnancy and early childhood. These include adverse events in early pregnancy, poorer perinatal outcomes, SUDI, and respiratory, ear and infectious diseases in infancy (10). Described here are those outcomes for which the evidence of association is most clear, and which are most closely related to the overarching aims of reducing stillbirth and infant mortality. Understanding these increased risks will inform an assessment of the scale of the impact of smoking on infant health in NHSGGC (see section '3.2 The scale of impact of smoking on infant health in NHSGGC', see page 16).

*Understanding the evidence**

The evidence for the role of smoking in affecting the health of infants is drawn largely from observational studies (case-control, cohort and cross-sectional designs) which demonstrate an association between smoke exposure and the outcome. The findings presented here are largely based on systematic reviews of such studies. Whilst it is not possible to definitively prove a causal role for smoking, the strength, consistency, temporal and dose-response relationships demonstrated are all strongly supportive of such an effect. Studies showing a beneficial effect on infant health of quitting in pregnancy further support this assertion (11).

It is difficult to accurately assess the independent effects of different types of smoke exposure on the infant, as these exposures frequently co-exist, for example, maternal smoking before and after birth, or both mother and father smoking. Therefore it is not always possible for studies to control for the confounding effect of the presence of a given exposure on the impact of another. Other limitations include incomplete adjustment for other confounders such as age and socioeconomic deprivation, and the risk of bias or error introduced by under-reporting of true smoking behaviour by study participants.

Identified health impacts of smoke exposure

Perinatal outcomes:

- Stillbirth (fetal death between 20 weeks gestation and birth)
- Pre-term birth (birth at less than 37 weeks gestation)
- Fetal growth (low birth weight <2500g), small for gestational age (birth weight or estimated fetal weight <10th centile, fetal growth restriction)

Infant health:

- Sudden unexplained death in infancy (SUDI)
- Lower respiratory illness (pneumonia, bronchitis, bronchiolitis, acute respiratory infection)
- Asthma and wheeze
- Invasive meningococcal disease (meningitis and meningococcal septicaemia)

The impact of maternal active smoking in pregnancy

Cigarette smoking in pregnancy is associated with:

- a 36% higher risk of stillbirth (8)
- a 27% higher chance of baby being delivered at less than 37 weeks (12)
- a 50% higher chance of restricted fetal growth (13)

*The methods and details of this literature review are detailed in supporting document 1, please contact the author for details.

- a baby who is on average 182g lighter than one born to a mother who does not smoke (13)

Pre-natal smoking is also linked to an increased risk to the infant of suffering death or illness in the early years of life. Infants born to mothers who smoked during pregnancy have:

- a four times higher risk of dying from sudden infant death syndrome (14)
- a three times higher risk of developing invasive meningococcal disease under the age of five years (15)
- a 41% higher chance of developing wheeze in the first two years of life and an 85% increased risk of developing asthma (16).

The impact of maternal exposure to second hand smoke (SHS) in pregnancy

Exposure of the mother to SHS in pregnancy is associated with:

- a 23% increased risk of stillbirth (17)
- a 32% increased risk of having a low birth weight baby (18).

The impact of any household member of an infant being a smoker

- The risk of developing invasive meningococcal disease under the age of 5 years is 2.5 times higher among children who live in a home where any household member is a smoker (15).
- Any household member smoking places an infant at a 54% higher risk of developing any lower respiratory infection; the risk of bronchiolitis is increased 2.5 times; and the risk of wheezing illness increased by 35% (16).

The impact of an infant's father being the only smoker in a family

- The risk of death due to SUDI is increased by 50% when an infant's father is the only smoker in the household (14).

Section 3: Tobacco smoke exposure and related infant health outcomes in NHSGGC

3.1 How many infants are exposed to tobacco smoke in NHSGGC?

In 2013, among 14,467 booked pregnancies and 12,905 newborns in NHSGGC:

- **18% of pregnant women were current smokers at the time of midwife booking (2,599 women)**
- **14% of mothers were current smokers at 10 days after baby's birth (1,744 women)**
- **23% of partners were current smokers at 10 days after baby's birth (2,931 partners)**
- **12% of mothers report that their newborn babies are exposed to second-hand smoke in the home (1,561 homes)**
- **Levels of smoke exposure have fallen over the past 10 years**
- **The smoking rates in NHSGGC are similar, or slightly lower than the national average**
- **Smoke exposure is strongly associated with socioeconomic deprivation and younger maternal age**

Data sources

Pregnant women are asked at their midwife booking visit (usually at 8-12 weeks gestation) if they currently smoke; the response is recorded in their hand-held record (Scottish Woman Held Maternity Record – SWHMR) and in NHSGGC on the Pregnancy and Newborn Screening (PNBS) database. Since 2010 all women have been offered carbon monoxide (CO) breath testing at their booking appointment, regardless of smoking history. In NHSGGC a level of >4ppm is considered a positive test and prompts a referral to the Smokefree Pregnancy Service (SPS).

For women who are referred to the SPS additional data is recorded within the service database, including their response to referral and the outcome of any input from the service.

After birth all women are visited when baby is aged 10-14 days old by a health visitor (the public health nurse first visit – PHN first visit). Three questions are asked with respect to smoking; if the mother is currently smoking, if her partner is, and if the baby is exposed to second-hand smoke in the home. These data are reported as part of the child health surveillance pre-school (CHS-PS) programme.

Data are collated nationally by ISD and presented within the "Births in Scottish Hospitals" report (19). Relevant national survey data have also been collected through the Scottish Health Survey and Growing up in Scotland birth cohort study (20) (21).

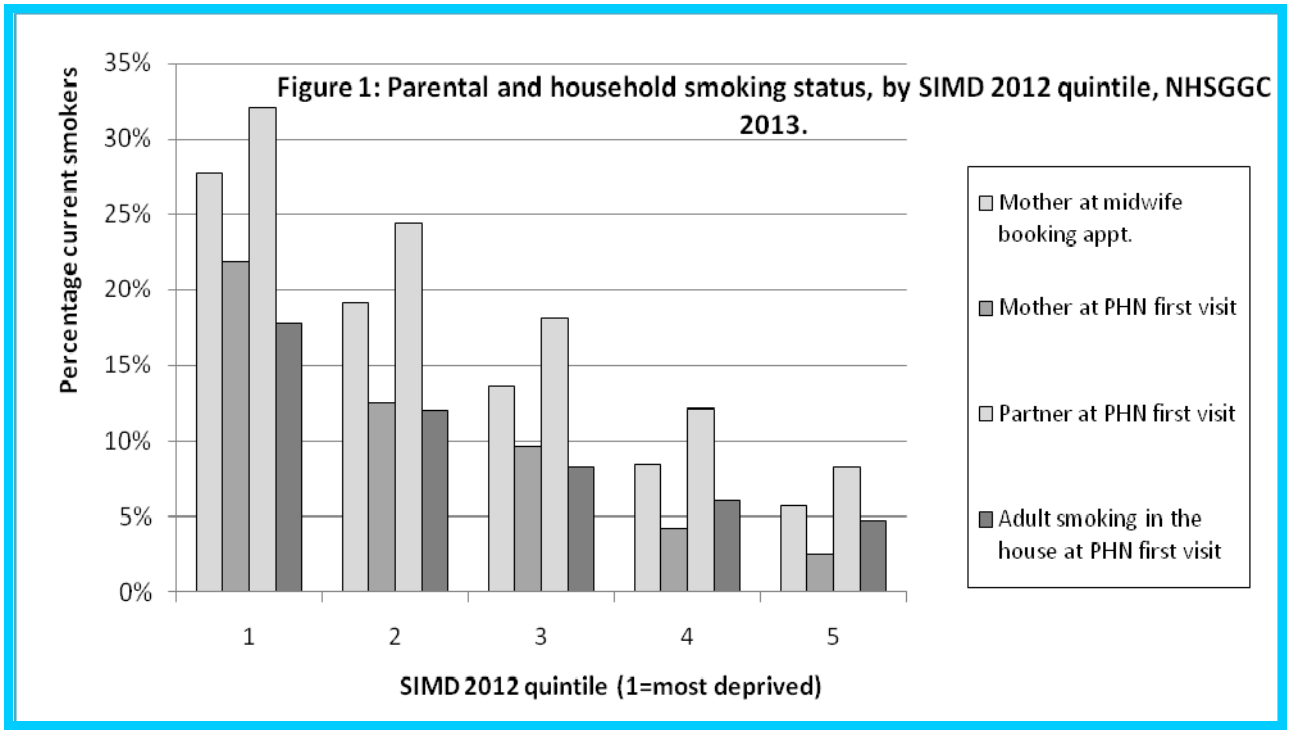
3.1.1 Smoking in pregnancy:

Smoking in pregnancy in NHSGGC has fallen over the past 15 years from 32% in 1998 to 18% in 2013. Levels of former smokers have remained unchanged at around 8%, whilst the proportion of never smokers has increased from 57% to 62%, suggesting that the decrease in smoking in pregnancy is likely to be attributable to young women never taking up smoking, rather than quitting (22). The levels of smoking in NHSGGC are slightly lower than the Scottish average of 19.3%.

In 2013 2,176 women reported being current smokers, and a further 423 did not but tested positive for CO, giving a total of 2,599 of 14,467 pregnancies booked in NHSGGC. Smoking status was not known for 5.1% of women, around half of these did not consent to screening of smoking status, and the other half simply have nothing documented. The likelihood of having a "not known" response did not vary markedly by deprivation or maternal age.

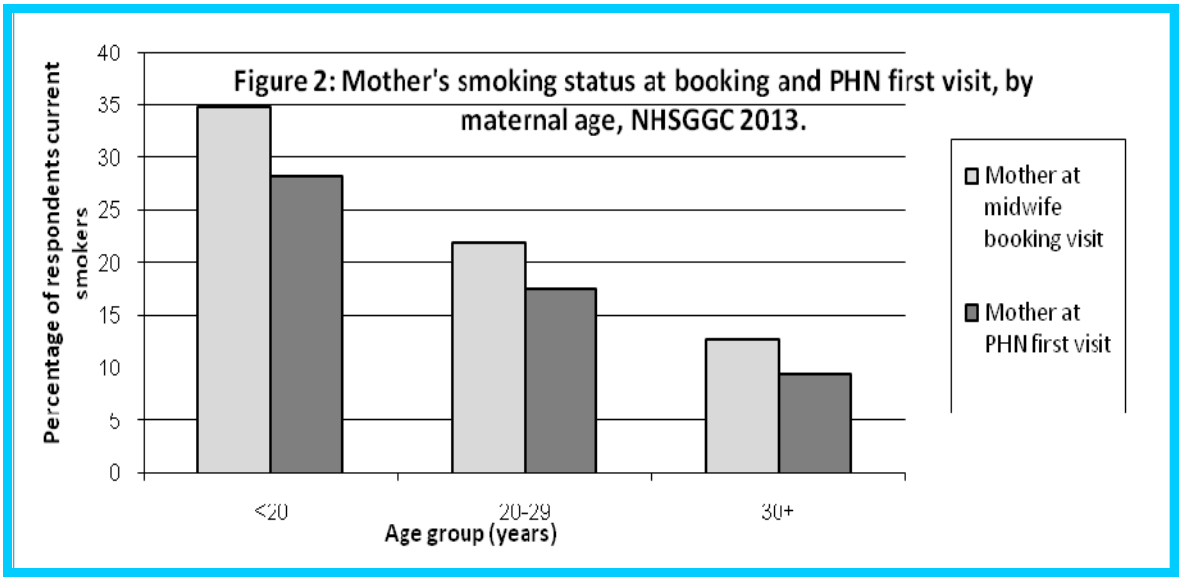
Over 60% of all women who smoke in pregnancy live in areas of high socioeconomic deprivation (SIMD1). The rate of smoking in the most deprived quintile is nearly five times that seen in the least deprived group (see Figure 1).

The majority of women who smoke in pregnancy are aged between 20 and 29 years old, however the most likely group to smoke are those aged less than 20 years with 37% of these young pregnant women being current smokers at the time of booking (see Figure 2).



3.1.2 Exposure of infants to second-hand smoke (SHS)

The proportion of mothers in NHSGGC who report being smokers when first visited by their health visitor (PHN) at 10 days has fallen from 24.3% in 2003 to 13.5% (1,744 mothers) in 2013. The current level is slightly lower than the Scottish average of 17.1%, with levels of unknown data similar to that seen nationally (3.0%) (22). The prevalence of smoking is higher among partners than mothers, with 22.7% (n=2,931) reported as being current smokers. There is again a steep gradient observed with socioeconomic deprivation (see Figure 1) and maternal age (see Figure 2).



Exposure to second-hand smoke in the home is the least well documented exposure, and was not known for 17.8% of babies in 2013. Only 12.1% (1,561 homes) of newborn babies were recorded as being exposed to smoke at home. The discrepancy between this and parental smoking rates may be attributable to uptake of advice to smoke outside the home. It is likely, however, that there is significant under-reporting and the true rates are higher. The Growing up in Scotland study found that among infants born in 2010, 22% of parents reported that at least one adult smoked in the house (23).

3.2 The scale of impact of smoking on infant health in NHSGGC

- **Between a quarter and a third of cases of SUDI, low birth weight, and invasive meningococcal disease in NHSGGC can be attributed to maternal smoking in pregnancy.**
- **Approximately one case per year of SUDI can be attributed to maternal smoking after baby's birth.**
- **Exposure of infants to smoke in the home contributes to a quarter of hospital admissions of those under one year old with bronchiolitis; representing 142 admissions per year.**

For a given child it is not always possible to directly attribute a health outcome to any particular risk factor. For the overall population of NHSGGC, however, we can estimate the proportion and number of cases of child illness that are likely to be due to smoke exposure. The proportion of cases attributable to smoking is known as the population attributable fraction and is determined by taking the effect of smoking reported in the literature and applying this in the context of our local smoking rates[†]. The contribution of each type of smoke exposure is assessed separately; given that these exposures frequently co-exist, they should not necessarily be considered to have a cumulative effect on the outcome.

Health outcomes and information sources

Data on stillbirths and infant deaths are available in the Scottish Perinatal and Infant Morbidity and Mortality Report (SPIMMR 2012) (24). Data on low birth weight and pre-term births are recorded via SMR02 and reported to ISD, where it is collated as part of the Births in Scottish Hospitals Report. Data on hospital admissions due to lower respiratory infection, invasive meningococcal disease, asthma and wheeze of those aged under one year at the time of admission were drawn from SMR01 records, with those admissions where the relevant diagnosis was the primary ICD-10 classification included (see Appendix A).

Maternal smoking in pregnancy (see Table 1)

Smoking in pregnancy is responsible for nearly one third of low birth weight babies in NHSGGC; around 250 babies per year. Given the association of low birth weight with a number of other health problems it can be seen that reducing smoking in pregnancy represents a significant opportunity to have a positive impact on infant health. Over the past three years an average of 76 stillbirths have occurred each year in NHSGGC.

Given our current smoking prevalence, 6% of these can be considered attributable to maternal smoking in pregnancy, representing approximately five cases per year. A sizeable proportion of cases of SUDI (35%) and invasive meningococcal disease (26%) in those under one year are linked to smoking in pregnancy, but as these are fortunately rare events this therefore equates to around one case per year in NHSGGC.

[†]See Appendix A for methods and example calculation.

Table 1: Proportion and number of cases of perinatal and infant health outcomes attributable to maternal smoking in pregnancy, NHSGGC 2011-13

Health event	Percentage of cases due to smoking	Incidence (3 year average 2011-13)	Number of cases per year due to smoking
Stillbirth	6%	76	**5**
Sudden unexplained death in infancy	35%	4	**1**
Low birth weight	31%	754	**249**
Pre-term birth	5%	796	**37**
Admission with invasive meningococcal disease	26%	5	**1**
Admission with lower respiratory infection	4%	592	**25**
Admission with wheeze	7%	13	**1**

Maternal smoking after birth (see Table 2)

Nearly 100 admissions (17%) of infants under one year old in NHSGGC with bronchiolitis (a viral lower respiratory infection) are due to baby's mother smoking after birth. Postnatal smoking also contributes to around one case per year of SUDI and invasive meningococcal disease.

Table 2: Proportion and number of cases of infant health outcomes attributable to maternal smoking postnatally, NHSGGC 2011-13

Health event	Percentage of cases due to smoking	Incidence (3 year average 2011-13)	Number of cases per year due to smoking
Sudden unexplained death in infancy	23%	4	**1**
Admission with invasive meningococcal disease	15%	5	**1**
Admission with bronchiolitis	17%	558	**95**
Admission with wheeze	9%	13	**1**

Household and paternal smoking (see Table 3)

Exposure to smoke in the home is linked to a quarter of admissions of infants with bronchiolitis, representing around 140 admissions per year. Smoking by the father alone contributes to 10% of cases of SUDI, or one case in NHSGGC every two years.

Table 3: Proportion and number of cases of infant health outcomes attributable to any household or paternal smoking postnatally, NHSGGC 2011-13

Health event	Percentage of cases due to smoking	Incidence (3 year average 2011-13)	Number of cases per year due to smoking
Admission with bronchiolitis	26%	558	**142**
Admission with wheeze	7%	13	**1**
Sudden unexplained death in infancy (paternal)	10%	4	**0.4**

Section 4: Health services with the potential to impact infant tobacco smoke exposure in NHSGGC

Health services relating to smoking cessation, reducing second-hand smoke exposure and antenatal care are all relevant to reducing the impact of smoking on infant health. The current operation of these services in NHSGGC is described here.

4.1 Smoking cessation

4.1.1 What are the current services in NHSGGC that support women quitting smoking during pregnancy?

Identification and referral of pregnant women who smoke

At the antenatal booking appointment all women are asked to complete their SWHMR document, which includes questions about whether they and those they share a household with are current smokers. All women are offered a CO breath test at booking; those who are current smokers, have quit in the past 2 weeks, or have CO breath level >4ppm are automatically referred to the Smokefree Pregnancy Service (SPS) via a system using the PNBS database.

Referrals to the SPS may also be made by GPs, pharmacists and directly by midwives, and the service is open to self-referrals by pregnant women. Information about the SPS is available in leaflet form in various healthcare settings.

The process of making a midwife booking appointment in NHSGGC has recently changed and a universal booking line is now in operation. Women can telephone directly and make their own appointment; it is hoped that this will facilitate earlier booking, in keeping with the antenatal care HEAT target. Women can also continue to attend their GP for referral to maternity services.

Stop smoking support and pharmacological therapies

Following referral to the SPS women are contacted via telephone by a smoking cessation advisor and offered a face-to-face appointment at one of 22 clinic locations. The appointment may last up to an hour, during which readiness and preparation to stop smoking is discussed, and a quit date is usually set. Information on the effects of smoking is provided, and there is the opportunity to see a visual representation of the amount of CO reaching the fetus, on the basis of the mother's CO breath test. The use of NRT is discussed, and the advisor can issue a recommendation form for NRT as appropriate.

Follow-up and ongoing support is undertaken by the SPS. Support continues until at least four weeks after the quit date, and is provided by the smoking cessation advisor. It usually consists of telephone

calls or text messages, but a further appointment may be made if necessary. Telephone follow-up is undertaken at four weeks, 12 weeks and 12 months after the quit data by the SPS administrator to enquire about current smoking status.

Many women who quit smoking in pregnancy will do so with the support of the SPS. Others may do so with no input from health services and rely on support from their partners, family and friends, and may self-fund NRT or other substitutes, such as e-cigarettes. Within NHSGGC women may also make use of support from community cessation services and pharmacies. Through these services women can receive information, advice, support and NRT.

4.1.2 What are the current services in NHSGGC that support partners quitting smoking during pregnancy?

Enquiry about partner smoking is made at both midwife booking and health visitor first visit, but it is not clear what information, advice or referral is given on the basis of the response. The partner of a pregnant woman may attend the SPS with them and receive support and NRT through the service; or they may be directed to community cessation services. There is no cessation service designed specifically to take account of the needs and motivations of partners approaching parenthood in NHSGGC at present. Partners may attend antenatal appointments and antenatal parenting classes where there are opportunities to provide health promotion messages regarding smoking, however it is not clear how consistently these opportunities are taken up.

4.2 Reducing exposure to second hand smoke (SHS) in the home

4.2.1 What are the current services in NHSGGC that encourage a reduction in second hand smoke in the home?

Universal information provision

A number of written resources provide information for all families about the potential harm of SHS to babies, and measures that can be taken to reduce it. These are in booklet or leaflet form and are distributed during pregnancy or in the immediate postnatal period, and include:

- "Ready Steady Baby" (24) – This national resource exists as a booklet, website and app, and provides details of the benefits of stopping smoking pregnancy and potential harms of SHS. A locally produced series of bookmarks highlight key health improvement information and reference relevant pages.
- "Reduce the risk of cot death" (25) – This booklet provides information on providing the safest environment to reduce the risk of cot death, including specific tips on having a smoke-free home.

- "Keep your family safe from second hand smoke" (26) – Leaflet produced by NHSGGC to supplement the cot death booklet and provide locally relevant information on the benefits of staying quit and of smoke-free homes.

There is also a national Scottish Government campaign underway - "Take it right outside" (27) - with information being conveyed by a number of different media, including television adverts, billboards, leaflets and via the internet.

Identification of families and homes where infants may be exposed to SHS

Enquiry about smoking in the home is built into the documentation for three key service contacts; midwife booking, postnatal discharge by the community midwife, and the health visitor first visit.

Tailored support to reduce smoke in the home

The REFRESH intervention uses home air quality monitoring in conjunction with motivational interviewing to promote changes in smoking behaviour in the home (28). A pilot based on this approach has recently been undertaken in NHSGGC. In collaboration with a third sector partner (Family Action in Rogerfield and Easterhouse - FARE) Dylos home air quality monitoring machines have been provided to families. The feedback from these supports a discussion with a community worker on the levels of smoke being experienced in the home and practical, realistic measures that families can take to tackle this. Experience of this pilot has been positive and there are plans to extend this approach.

4.3 Antenatal care for women who smoke

4.3.1 What is the current approach to antenatal care for women who smoke in pregnancy in NHSGGC?

The pathway for referral to smoking cessation services has been described above, however at present the majority of women who smoke at booking will continue to do so throughout pregnancy. There is not a consistent approach throughout NHSGGC to the antenatal care of women who smoke, and how this is managed as a risk factor for adverse pregnancy outcomes. Follow-up of smoking status is not built into the routine content of antenatal appointments after booking. In the Inverclyde area women who continue to smoke will have ultrasound scans in the third trimester to monitor fetal growth, but smoking is not a routine indication for such checks in the rest of NHSGGC.

Section 5: Assessment of current services in relation to recognised guidance and standards

5.1 Smoking cessation

NICE Public Health Guidance 26 "Quitting smoking in pregnancy and following childbirth" (29) provides key recommendations on the provision of cessation services in the antenatal and immediate postnatal period. The Maternity and Child Quality Improvement Collaborative (MCQIC) has also detailed care quality aims regarding CO testing, referral to cessation services and antenatal care of those who continue to smoke (see Introduction).

5.1.1 How many women in NHSGGC manage to quit smoking in pregnancy, and how well do services support them in doing so?

- **38% of pregnant women who smoke at booking attend an appointment with the Smokefree Pregnancy Service.**
- **12% of women referred to the service have quit smoking four weeks after their quit date.**
- **Pre-referral discussion, follow-up, continuity of care and how the needs of disadvantaged women are met, could be improved.**

There is no single source of information to assess how many women manage to quit smoking in pregnancy and manage to stay quit. An assessment of the situation is possible using data from PNBS, the SPS database and comparisons with population rates before and after pregnancy.

Quitting pre-conception and in early pregnancy

In 2013, 103 pregnant women (1%) reported having quit smoking in the two weeks prior to midwife booking. A further 1,230 (9%) quit in the 12 months before booking; it is not routinely recorded whether they stopped before or after becoming pregnant. An estimate can be made by examining midwife comments on PNBS; of 13% of women who had comments recorded 47% had quit since finding out they were pregnant. Applying this to the overall group suggests that as many as 681 women (5% of those booking with a midwife) may quit in early pregnancy before seeing their midwife. This would explain in part the difference between prevalence of smoking at booking, and the observed rates of 25-28% in the overall population of women aged 16-44 years (31).

Quitting after midwife booking

In 2012, 286 women attending the SPS quit four weeks after their quit date, representing 2% of all pregnancies, 12% of those referred to the service, and 36% of those who set a quit date. An overview of the prevalence of smoking in pregnancy and outcomes with the SPS is provided in Figure 3. It is likely that a significant proportion of those who quit relapse to smoking both during and after pregnancy (30). No data are available on relapse, or those who may quit via other support mechanisms.

Figure 3: Smoking in pregnancy, NHSGGC 2013: prevalence at booking and outcomes with Smokefree Pregnancy Service

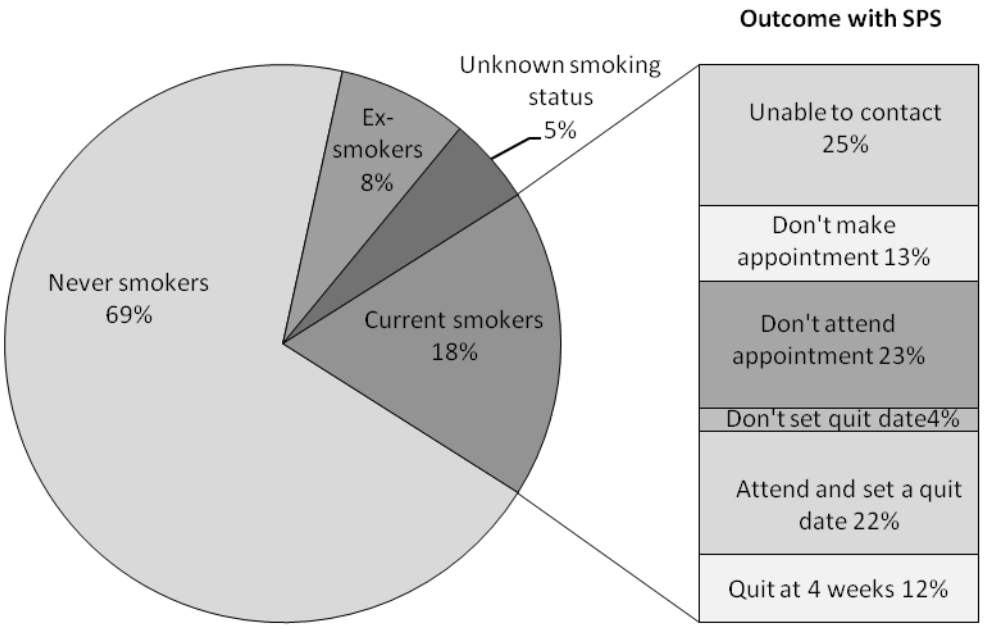


Figure 3 shows that only a small proportion of pregnant women who smoke manage to quit with the support of the SPS. The reasons for this were explored by a service evaluation in 2012 which employed both quantitative and qualitative data (6). Key points of this evaluation are highlighted below, in relation to the NICE guidance (29).

- *Identification and referral of pregnant women who smoke*

The universal use of CO breath testing at booking and automatic referral of women to the SPS meets the recommendations of NICE relating to identification and referral of women by midwives. Only 8% of referrals to the SPS were received from sources outside of maternity services, suggesting that more could be done to encourage direction to the SPS by others involved in the care of pregnant women.

Of those eligible for referral to the SPS, 75% were successfully contacted by a smoking cessation advisor, 61% made an appointment and 38% attended an appointment. Those who were referred automatically via the PNBS system were the least likely to attend an appointment. Interviews with women suggested that the approach of midwives in describing and discussing the referral was variable and was important in determining women's attitude to the service. Those who felt attendance at the service was encouraged and positive elements promoted felt more inclined to attend than those who simply felt they were directed to the SPS, or that referral was an automatic matter of protocol. Ensuring consistent discussion of the risks and benefits of smoking and provision of details of the SPS process would be consistent with NICE recommendations for the actions of midwives.

- *Stop smoking support and pharmacological therapies*

The SPS face-to-face appointments provide opportunities for discussion of smoking, support in quitting, and prescription of NRT in keeping with the NICE guidance. Qualitative data from the service evaluation suggests women found the advisors non-judgmental and friendly which led them to feel comfortable and able to openly discuss their smoking. They also usually found the follow-up encouraging, supporting and motivating.

At present women who receive NRT have CO breath testing at the pharmacy, but for others there is no regular follow-up of women with CO breath tests to provide motivation and feedback on their progress after their initial SPS consultation, and there is no biochemical validation of quit success, as recommended by NICE. There could also be greater continuity of care between the SPS and midwives, as highlighted by the service evaluation. Furthermore NICE suggests that there should be routine follow-up by midwives at subsequent appointments, with opportunities for re-referral and referral to alternative services.

- *Meeting the needs of disadvantaged women*

Two-thirds of the women who attend the SPS are from the most deprived quintile of the population (SIMD 1); however they also represent the majority of those who fail to keep an appointment. Those who live in SIMD quintiles 1, 2 and 3 are all significantly more likely to fail to attend than those in the least deprived two groups. Those aged under 20 years are the least likely to attend their appointment, with half of those who arrange to meet an advisor keeping their appointment.

Those in the most deprived quintile are the least likely to be quit at four weeks, with those who set a quit date having a 60% lower chance of having quit at four weeks than those in the least deprived

group. Those in the youngest age group are also the least likely to quit, although amongst those who set a quit date this did not differ significantly from the other age groups.

Some of the NICE recommendations relating to meeting the needs of disadvantaged women are in place to some extent in NHSGGC, but could be extended. They include involving women in the planning and development of services, ensuring services are accessible, working in collaboration with the Family Nurse Partnership and other organisations and services supporting vulnerable families.

5.1.2 How many partners in NHSGGC manage to quit smoking in pregnancy, and how well do services support them in doing so?

No data are gathered on the number of partners who manage to quit smoking whilst expecting a child. The SPS evaluation found that women did not frequently discuss smoking by other members of the family, or mention partners attending the service. It suggested that a more active approach should be taken to encouraging partners to attend. The NICE guidance suggests that stop smoking services should provide clear information to partners on the risks of smoking around pregnant women and children, and that cessation interventions should be multi-component and tailored to the approach most likely to be successful for a given individual. It is also suggested that enquiry about partner and family smoking and provision of information about quitting should be part of the SPS appointment, even if only the pregnant woman attends.

5.2 Reducing second hand smoke

The prevalence of smoking in the home has fallen over the past 10 years; however this is likely to be largely attributable to wider social and cultural changes related to the legislation on smoking in enclosed public spaces. There are no current national standards or targets related to SHS, but the Scottish Government tobacco strategy highlights the importance of incorporating advice on SHS into antenatal and postnatal care (1). It also suggests that NHS Boards should continue to develop work in the area of specific interventions, such as REFRESH.

5.3 Antenatal care for women who smoke

The Royal College of Obstetricians and Gynaecologists guideline on the management of the small for gestational age (SGA) fetus highlights smoking >10 cigarettes per day as a major risk factor for a SGA neonate. On the basis of this it is recommended that all women who continue to smoke at this level should undergo serial ultrasounds in the third trimester to assess fetal size and umbilical artery blood flow. This recommendation has been adopted by MCQIC as part of the suggested tailored package of care for women who smoke. Other elements of this package include an offer of CO monitoring at

every antenatal visit, in conjunction with further discussion of the risks of smoking and available cessation support, with referral to cessation services as appropriate. The consistent identification and monitoring of high-risk pregnancies also forms part of the wider Growth Assessment Protocol (GAP) programme which is planned for implementation across the UK (31).

Interviews with women as part of the SPS evaluation revealed that midwives varied in their approach to following up smoking status with women at later antenatal appointments. Some sought to find out how women were getting on, but others did not mention smoking again. As referred to in Chapter 4, there is not currently a consistent approach to fetal growth monitoring for women who smoke in NHSGGC.

Section 6: Assessment of the potential benefits of financial incentives for cessation in pregnancy in NHSGGC

6.1 Background

A review of studies using financial incentives for smoking cessation in pregnancy found that they have the potential to help more women to successfully quit (11). Overall it was found that cessation services in general helped 6% of women to quit, whereas when incentives were used 26% of women managed to quit. As these findings were based on only four studies from the USA, NICE made a recommendation in 2010 for UK-based research to be undertaken into the use of incentives for smoking cessation in pregnancy (29). The recent Cessation in Pregnancy Incentives Trial (CPIT) undertaken in NHSGGC has contributed to the understanding of incentives in a UK context (7).

6.2 Current evidence

The most recent review of relevant research was undertaken in 2013, and it identified seven trials with mixed results (34). Most found that incentives increased the proportion of women who quit, but the nature of the interventions was very varied and the number of patients involved generally small, making it difficult to draw an overall conclusion from their findings.

CPIT was planned as a trial to investigate elements of the practicality and acceptability of incentives in order to inform the design of a larger trial. It found a marked positive effect of incentives on smoking cessation; at the end of pregnancy 22.5% of those who received incentives had quit, compared with 8.6% of those who did not (35).

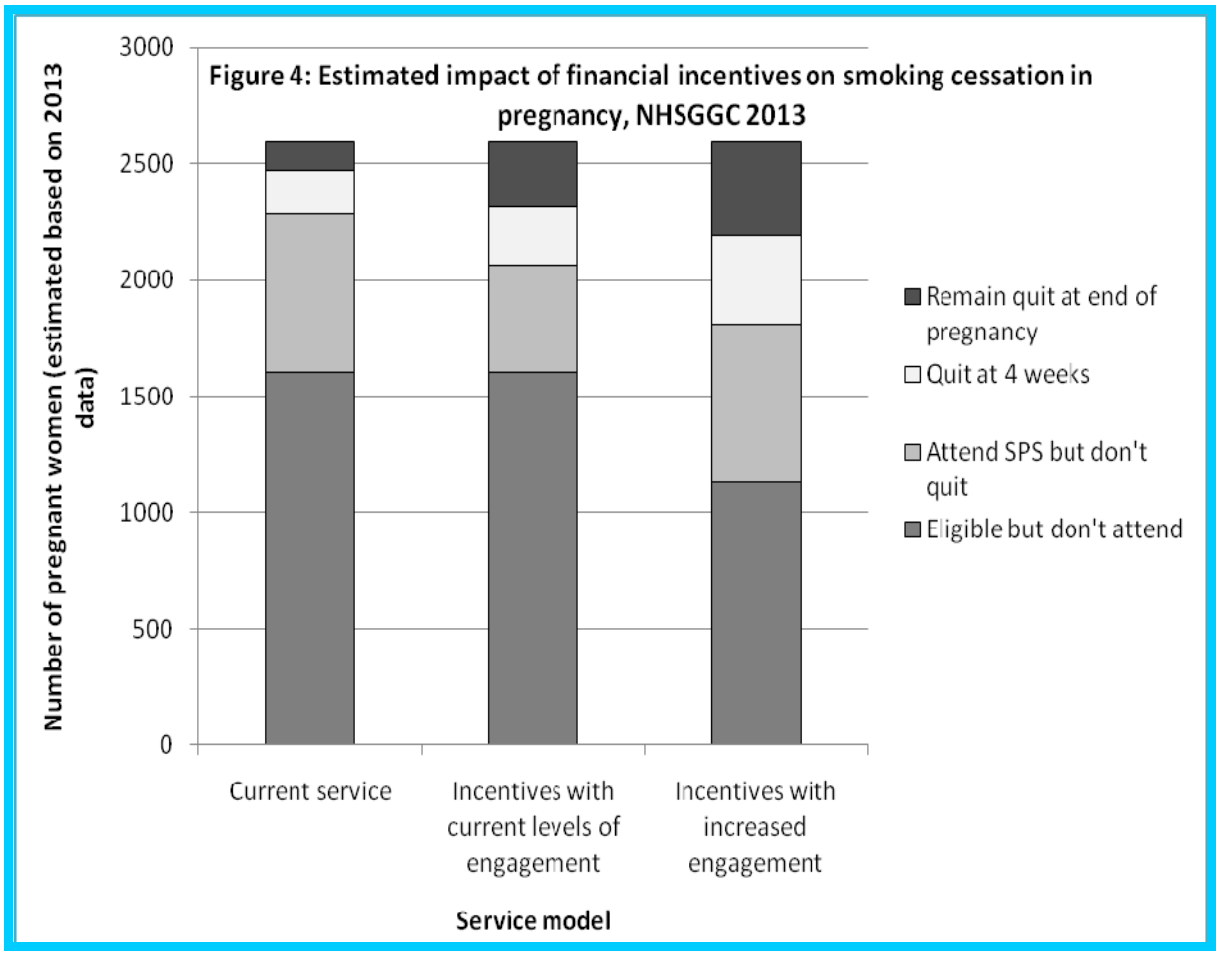
The other source of locally relevant information on incentives comes from NHS Tayside, where the 'Give it up for Baby' scheme has been implemented in three areas of the health board for a number of years. Whilst not designed as a trial, a published service evaluation provides some data that is relevant to the assessment of the potential impact of incentives (36).

6.3 Estimating the potential health benefits of implementing incentives in NHSGGC

An economic evaluation undertaken as part of the trial indicates that the additional cost of implementing incentives for each quality-adjusted life year (QALY) gained would be £482. This is well within the NICE threshold for what is considered a cost-effective intervention (£20,000/QALY) (32). The assessment, however, is sensitive to the levels of postnatal relapse, which were not studied as part of the trial.

Using data from CPIT it is possible to estimate the scale of benefits for our population in terms of number of additional quits in pregnancy, and how this would translate into infant health benefits[‡]. Two estimates have been made of the number of additional quits, one simply employs the increased proportion of quits that is observed at the end of pregnancy, and the other attempts to account for the increased service engagement that might be expected if financial incentives were implemented.

In 2013 there were 2,599 women eligible for referral to the SPS at midwife booking, and an estimated 318 would have quit at four weeks, with 129 remaining quit at the end of pregnancy. With the implementation of financial incentives it would be expected that 535 would quit at four weeks, with 278 remaining so at the end of pregnancy. If the effect of increased service engagement is factored in, then this is increased to 787 quits at four weeks and 408 end of pregnancy quits (see Figure 4).



At present therefore, the SPS reduces smoking prevalence by approximately 1% at the end of pregnancy (falling from 18% at booking to 17.1% at the end of pregnancy). The most optimistic

[‡] See Appendix B for details of methods and data sources.

modelling of incentives would see this fall a further 2% to 15.1% of women who continue to smoke at the end of pregnancy.

Taking 15% as an achievable smoking prevalence in pregnancy with the implementation of financial incentives, it is possible to estimate what the impact on infant health would be, in comparison with the current situation (see Table 4)[§]. It is estimated that 19 incidences of low birth weight and four of pre-term birth would be prevented each year. One stillbirth would be prevented every two years, and one instance of SUDI every 10 years. Admissions in infancy with lower respiratory infection could be reduced by three per year, with a further six admissions per year prevented if the levels of end of pregnancy cessation were carried forward into the postnatal period.

Table 4: Estimated prevented infant health events in NHSGGC with the implementation of financial incentives for smoking cessation in pregnancy

Health event	Incidence (3 year average 2011-13)	Number of events due to smoking in pregnancy	Estimated number prevented by current SPS	Estimated additional number prevented with financial incentives
Low birth weight	754	236	8	**19**
Preterm delivery	796	37	2	**4**
Stillbirth	76	5	0.2	**0.5**
Sudden unexplained death in infancy	4	1	0.05	**0.1**
Admission with invasive meningococcal disease	5	1	0.05	**0.1**
Admission with lower respiratory infection	592	24	1	**3**

6.4 Areas of uncertainty

There are a number of unknown factors that both limit the estimates presented here, and should also be considered in any decisions regarding implementation:

- Equity impact

None of the published trials, nor CPIT, present analysis that allows an assessment of who is most likely to quit with incentives, in terms of age or level of socioeconomic deprivation. Smoking in pregnancy is disproportionately an issue of those in more deprived socioeconomic groups, and therefore any benefits in terms of increased cessation could be assumed to be experienced by those living with greater disadvantage. However, there is a suggestion from the service evaluation in NHS Tayside that those living in the least deprived of the three areas where the service runs are the most

[§] See Appendix B for details of methods.

likely to engage with the service and the most likely to quit at the end of pregnancy (36). It should not be assumed therefore, that financial incentives will necessarily benefit the most disadvantaged women.

- Engagement with services

It is reasonable to assume that the promise of reward will increase engagement with smoking cessation services, and it has been suggested that this is at least partially responsible for the observed effect of incentives (33). The design of CPIT did not measure this effect; if it is greater than that estimated above then the effect on cessation might be greater, and this would also need to be considered in service planning.

- 'Playing the system'

The design of CPIT allowed an assessment of the degree to which women 'gamed' the system by, for instance, withholding from smoking for a short period of time prior to a CO breath test in order to receive their reward. It is thought that such behaviour may account for around 20% of the observed results (35). It is not possible to estimate however, the effect a fully implemented service would have on behaviour in early pregnancy, for example it may act as a disincentive to the considerable proportion of women who currently quit in early pregnancy prior to service contact.

- Relapse and duration of quit

Initial evidence from CPIT suggests that those who received incentives might be more successful in staying quit than those who did not but the numbers are too small to definitively comment. Remaining smoke-free clearly has important implications for the health of women, their current and subsequent children and is an important element in estimating the benefits of the intervention that is currently not known.

Section 7: Conclusions

Tobacco smoke and infants in NHSGGC

Tobacco smoke exposure in pregnancy and infancy remains an important risk factor for a number of infant health outcomes. It contributes to a considerable proportion of low-birth weight babies, SUDI, admissions with invasive meningococcal disease and bronchiolitis. It plays a role in a smaller number of cases of stillbirth, but is one of the few modifiable risk factors for fetal death.

The prevalence of smoking in pregnancy, by new mothers and in family homes has fallen over the past 10 years; however around a fifth of children still do not have a smoke-free start in life. Infants of younger mothers and those living in more deprived areas are more likely to be exposed to tobacco smoke.

It is estimated that 5% of pregnant women give up smoking in early pregnancy, and a further 1% quit with the support of the SPS. No data are available on overall quits in pregnancy, relapse to smoking, or partners who manage to give up. Information on exposure to second hand smoke in the home is incomplete.

Health services, national standards and service improvements

Our current services meet a number of national standards, or are working towards them, such as universal CO testing at booking, levels of referral to cessation services and the expansion of interventions to reduce SHS exposure. There are, however, a number of identifiable gaps that would improve our services and have the potential to positively impact on infant health if implemented. These improvements are detailed in the recommendations below and together describe the key elements of a care pathway to reduce smoking in pregnancy and after birth. Such changes would need to be supported by adequate training, resources and appropriate data collection to allow an assessment of their impact.

In addition to improvements to our current care pathway, there is cause to consider the potential role of new intervention; financial incentives. Research suggests that incentives can help a greater proportion of women quit than any other cessation intervention, and have been shown to work locally in NHSGGC. However, the proportion of women who manage to quit remains relatively small compared to those who continue to smoke, and consequently the impacts on infant health are perhaps smaller than might be expected. It is not known whether incentives are successful in encouraging the most disadvantaged women to quit, or what the effect on smoking behaviour in early pregnancy might be. Conversely, if incentives greatly increase service engagement and quits

are sustained after birth, then the benefits could be greater than predicted.

Challenges and opportunities

Discussions with key staff have been held in the course of this health needs assessment and have raised a number of challenges and opportunities to providing a smoke-free start to life in NHSGGC. Resource constraints are expressed as a concern in many areas of the service, in particular when considering implementing new services, such as ultrasound growth monitoring. The pressing needs of front-line service provision in midwifery have been raised as a challenge when proposing additional activities to be undertaken and in identifying sufficient time for the necessary staff training. The way in which we communicate with patients in order to engage with them and support behaviour change has emerged as a theme in discussions. Concern has been expressed about the risk of alienating women by persistent enquiry about health behaviours, but conversely it is also recognised that there is a responsibility to provide clear information about health risks in a non-judgemental fashion. How staff are trained and supported in undertaking these conversations is both a challenge and an opportunity to develop an approach that will be beneficial for many aspects of health improvement.

The adoption of the "Getting it Right for Every Child" approach in our services offers a significant opportunity to take a holistic approach to child health and wellbeing, starting right from antenatal care. Given the changes that are taking place in service design, communication between professional groups and IT support this is a chance to change the way we work with families to allow them to provide the best start to life for their children. In particular it provides the opportunity to build in a number of the specific recommendations related to smoking detailed below. The work that has taken place with third sector partners in relation to second-hand smoke in the home has demonstrated that this approach can provide an acceptable and mutually beneficial way of working with families. The expansion of similar relationships, not only with respect to SHS, but also smoking cessation and wider family support, offers a way of working that is likely to enable us to have greater reach in improving infant health.

Section 8: Recommendations

8.1 Key elements of the antenatal care pathway (see also Figure 5 below)

8.1.1 Referrals to the Smokefree Pregnancy Service – improve engagement and quit success

- Midwives should discuss the harms of smoking, second-hand smoke, the benefits of quitting and nature of the SPS with all women meeting the criteria for referral.
  Suggested measure: Increase proportion of eligible pregnant women attending an SPS appointment by 2% per year (38% in 2012 to 42% by end 2015).
- Increase referrals to the SPS in early pregnancy from GPs and pregnancy women themselves, by promoting referral in the first trimester from primary care and providing information about self-referral via the universal booking line.
  Suggested measure: Increase proportion of referrals to SPS from GP, self and other sources from 8% in 2012 to 12% by end 2015.

8.1.2 Continuity of care

- Smoking status and progress with quitting in pregnancy should be recorded in the SWHMR document throughout pregnancy (under section "other information/plans/referrals etc").
- A reliable mechanism for feedback regarding progress from the SPS to midwives should be developed.
- Smoking status at booking, and progress with smoking through pregnancy should be reliably communicated by midwives to health visitors.
  Suggested measure: information on smoking status in pregnancy and quit status to be included in handover from midwife to health visitor.

8.1.3 Follow-up of smoking status through pregnancy

- Enquiry about smoking status, supported by the offer of CO testing, should be made at all subsequent antenatal visits for women who continue to smoke.
- A CO breath test should be offered to all women in the second trimester, regardless of smoking status at booking, to facilitate re-referral, or referral of those who may have relapsed to smoking.
- Re-referral to the SPS or direction to alternatives such as community cessation services should be offered to those who continue to smoke in later pregnancy.

8.1.4 Fetal growth monitoring

- Women who continue to smoke should be offered fetal growth monitoring in the third trimester.

8.2 Partner smoking

- Personal enquiry about smoking status should be made of partners where they engage with antenatal services.
- Specific information about the risks of smoking to mother, baby and partner, the benefits of quitting and referral to cessation services should be offered to all partners who smoke (see for example the "News for Dads" leaflet): http://gosmokefree.nhs.uk/downloads/News_for_dads5080CP.pdf.
- Multi-component cessation services that consider the needs and motivations of the partners of pregnant women should be developed, including identification and development of resources for this group in community cessation services, and increased engagement with partners by the SPS.

8.3 Meeting the needs of disadvantaged women

- Women living in the most deprived areas and those aged under 20 years should be involved in the planning and development of the SPS.
- Cessation services should be developed and made available in such a way as to make them accessible and acceptable to disadvantaged women, with the exploration of alternatives to the SPS where appropriate.
- There should be increased liaison and shared learning between the SPS and services supporting vulnerable women, such as SNIPS and the Family Nurse Partnership.
  Suggested measure: Increase the likelihood of attending an SPS appointment and successfully quitting among those in SIMD 1 and aged less than 20 years.

8.4 Financial incentives

- Incentives should only be implemented with a robust evaluation plan to assess their impact on cessation at different stages of pregnancy, equity, engagement and relapse to smoking.

8.5 Training requirements

- Midwifery – training should ensure that midwives feel sufficiently skilled in discussing health behaviours with women throughout their pregnancy in a way that is non-judgemental yet provides clear information, for example through adoption of the "Compassionate Connections" programme (http://www.nes.scot.nhs.uk/education-and-training/by-theme-initiative/maternity-care/about-us/current-projects/compassionate-connections.aspx).

- Ultrasonography – the increased demands that fetal growth monitoring will place antenatal ultrasound services should be modelled and built into plans for staff training, recruitment and overall service capacity.
- Community cessation services – training should ensure that staff feel able to deal with the specific needs of pregnant women and their partners, including provision of relevant information and discussions regarding NRT.

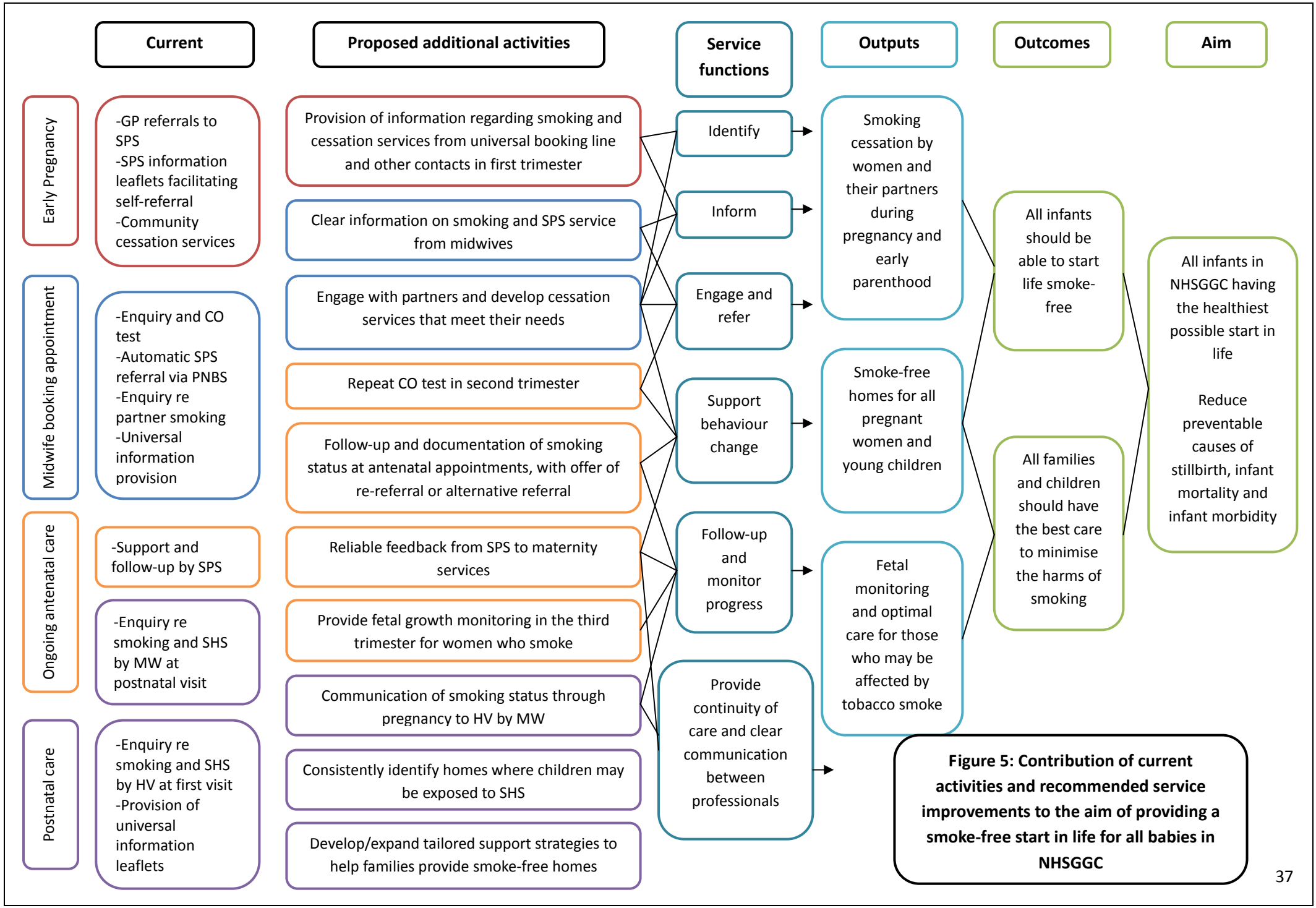


Figure 5: Contribution of current activities and recommended service improvements to the aim of providing a smoke-free start in life for all babies in NHSGGC

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Section 10: Appendices and supporting documents

Appendix A: Calculation of population attributable risk

- The calculation of **population attributable risk** was undertaken using the following formula (10).

$$Population\ attributable\ risk = \frac{P(OR-1)}{[P(OR-1)+1]}$$

P=proportion of children exposed to tobacco smoke in NHSGGC

OR=odds ratio for the health outcome among children exposed to tobacco smoke

- The **number of attributable cases** in NHSGGC was then calculated using the following formula:

Number of attributable cases per year = PAR x annual incidence of health outcome in age group

- **Data sources:**

1. **Proportion of children exposed to tobacco smoke**
   - In pregnancy – smoking history at booking in 2013 from PNBS, women reporting being current smokers or testing positive for CO>4ppm (2013=17.97%)
   - In infancy from mother – maternal smoking history at first PHN visit (6-8weeks) in 2013 from CHS-PS, women reporting being current smokers (2013=13.51%)
   - In infancy from father – partner smoking history at first PHN visit (6-8 weeks) in 2013 from CHS-PS, partners reported as current smokers (2013=22.71%)
   - In infancy from any household member - partner smoking history at first PHN visit (6-8 weeks) in 2013 from CHS-PS, partners reported as current smokers (2013=22.71%); applied as highest smoking prevalence of any household member observed in this group.

2. **Odds ratio for the health outcome among children exposed to tobacco smoke**

   Best estimates extracted from the literature and presented in Section 2.2. Details of the supporting literature review and justification of included figures is available in supporting document 1 (contact author for details).

3. **Annual incidence of health outcome in age group**

In order to reduce the effect of year-to-year variation in outcomes where there may be small numbers of cases, or where there may be outbreaks, such as bronchiolitis, a mean incidence taken from the most recent available three year period was used in calculations.

- Stillbirth, SUDI – Scottish Perinatal and Infant Mortality and Morbidity Report 2012 (34).
- Low birth weight, pre-term birth – Births in Scottish Hospitals Report 2012 (22).
- Admissions to hospital with diseases in infancy – from NHSGGC SMR-01 records of admissions with the ICD-10 codes detailed below as the primary diagnosis, for those aged under 1 year.

Health outcome	ICD-10 code	Included subcategories	Description
Invasive meningococcal disease	A39	All	Meningococcal infection
Wheeze	R06	R06.2	Wheezing
Lower respiratory infection			
Included conditions:			
Pneumonia	J10	J10.0	Influenza with pneumonia, other influenza virus identified
	J11	J11.0	Influenza with pneumonia, virus not identified
	J12	All	Viral pneumonia, not elsewhere classified
	J13	All	Pneumonia due to streptococcus pneumoniae
	J14	All	Pneumonia due to haemophilus influenzae
	J15	All	Bacterial pneumonia, not elsewhere classified
	J16	All	Pneumonia due to other infectious organisms, not elsewhere classified
	J17	All	Pneumonia in diseases classified elsewhere
	J18	All	Pneumonia, organism unspecified
Bronchitis	J20	All	Acute bronchitis
Bronchiolitis	J21	All	Acute bronchiolitis
Non-RSV bronchiolitis	J21	J21.1	Acute bronchiolitis due to human metapneumovirus
		J21.8	Acute bronchiolitis due to other specified organisms
		J21.9	Acute bronchiolitis, unspecified
Unspecified LRI	J22	All	Unspecified acute lower respiratory infection

Example calculation:

Low birth weight babies attributable to maternal smoking in pregnancy = (proportion babies exposed to smoke)

$$= \frac{17.97(3.54-1)}{[17.97(3.54-1)+1]}$$

$$= 0.31$$

→31% of low birth weight babies in NHSGGC can be considered attributable to maternal smoking in pregnancy.

$$\textit{Mean annual incidence of low birth weight babies } 2010-2012 = \frac{\textit{Incidence } 2010 + \textit{Incidence } 2011 + \textit{Incidence } 2012}{3}$$

$$= \frac{752 + 715 + 795}{3}$$

$$= 754$$

$$\textit{Number of cases attributable to maternal smoking in pregnancy} = 0.31 \times 754$$

$$= 236$$

→236 low birth weight babies per year in NHSGGC can be considered attributable to maternal smoking in pregnancy.

Appendix B: Assessment of the potential benefits of financial incentives in NHSGGC

1. Additional quits achieved through implementation of financial incentives:

- **Data sources:**
  - Current performance of the SPS – 2012 service evaluation, providing proportion of eligible women who engage with the service and successfully quit at four weeks post-quit date (6).
  - Potential improvement with incentives – CPIT outcome data, providing proportion of eligible women who quit at four weeks and at the end of pregnancy (35).
  - Population – 2013 midwife booking data, providing number of women eligible for re-ferral to SPS.

NB. End of pregnancy quits – data on end of pregnancy quit is not routinely collected at present and, therefore, not available as a measure of the current service. The end of pregnancy quit rate observed in the control arm of the CPIT was therefore employed, as this group had experienced 'usual care' from the SPS and are therefore the closest approximation available to assess this.

Table B.1: Outcome data from SPS Evaluation (6) **and CPIT** (35) **used to calculate engagement and quit proportions**

	SPS Evaluation	CPIT overall	CPIT control arm	CPIT intervention arm
Number eligible	2338	1026	-	-
Number contacted (% of eligible)	1747 (74.7)	640 (62.7)	-	-
Number appointed (% of eligible)	1432 (61.2)	612 (59.6)	303	306
Number attended (% of eligible)	897 (38.4)	484 (47.2)	236	248
Number quit at four weeks	289	-	64	133
Quits as % eligible	12.2	-	21.1	27.1
Quits % attended	31.9	-	43.5	53.6
Quits % set quit date	35.8	-	-	-
End of pregnancy quit	-	-	26	69
As % of four week quits	-	-	40.6	51.9

- **Calculations**

  Two models were applied to the outcome data above, to assess the likely effect on quit numbers of implementation. The first simply used the predicted end of pregnancy quit rates with current care and incentives, and applied them to our 2013 population (see Table B.2). The second attempted to account for the increased engagement that might be anticipated with the implementation of incentives. Whilst this was not directly measured by CPIT, as women were not randomised until attendance at the appointment, increased engagement was observed in the trial. This may be attributable to the potential for women to receive an incentive, even though this was not guaranteed, and is the best available assessment of what the effect on engagement might be**.**

Table B.2: Model 1 – Estimated effect on outcomes under usual care with SPS and implementation of incentives, employing NHSGGC 2013 population, with no accounting for increased engagement

	SPS	Incentives
Number of women eligible	2599	2599
Proportion of those eligible who would attend appointment	38.4	38.4
Number of women who attend	998	998
Proportion of those who attend who quit at four weeks	31.8	53.6
Number who would quit at four weeks	318	535
Proportion of those who attend who quit at end of pregnancy	Not available – calculated by using 40.6% maintenance of quit rate observed in control group	27.8%
Number who would quit at end of pregnancy	**129**	**278**

Table B.3: Model 1 – Estimated effect on outcomes under usual care with SPS and implementation of incentives, employing NHSGGC 2013 population, with allowance for increased engagement

	SPS	Incentives
Number of women eligible for SPS	2599	2599
Proportion of those eligible who are contacted	74.7	74.7
Number of women would be contacted	1941	1941
Proportion of those contacted who make an appointment	82.0	95.6
Number of women who would be appointed	1592	1856
Proportion of those appointed who attend	62.6	79.1
Number of women who attend	997	1468
Proportion of those who attend who quit at weeks	31.8	53.6
Number who quit at four weeks	317	787
Proportion of those who attend who quit at end of pregnancy	Not available – calculated by using 40.6% maintenance of quit rate observed in control group	27.8%
Number quit at end of pregnancy	**129**	**408**

2. Impact of additional quits on infant health:

The method described in appendix A for calculating population attributable risk was employed. The prevalence of infants exposed to smoke in pregnancy was amended to account for the number of quits that would be expected with the current SPS and with the implementation of incentives.

Table B.3: Prevalence of smoking in pregnancy, accounting for estimated effects of current service and implementation of incentives

	No service	Current SPS	Incentives
Number of smokers at booking	2599	2599	2599
Number of quits at end of pregnancy	0	129	408
Number of smokers end of pregnancy	2599	2470	2191
Prevalence of infants exposed to smoke through pregnancy	**18.0%**	**17.1%**	**15.1%**

- **Example calculation:**

$$Population\ attributable\ risk = \frac{P(OR-1)}{[P(OR-1)+1]}$$

$$Current\ SPS = \frac{17.1(3.54-1)}{[17.1(3.54-1)+1]}$$

$$= 0.30$$

→30% of low birth weight babies in NHSGGC could be considered attributable to maternal smoking in pregnancy.

$$Number\ of\ cases\ attributable\ to\ maternal\ smoking\ in\ pregnancy = 0.30 \times 754$$

$$= 220$$

→228 low birth weight babies per year in NHSGGC can be considered attributable to maternal smoking in pregnancy.

$$Incentives = \frac{15.1(3.54-1)}{[15.1(3.54-1)+1]}$$

$$= 0.28$$

→28% of low birth weight babies in NHSGGC could be considered attributable to maternal smoking in pregnancy.

$$Number\ of\ cases\ attributable\ to\ maternal\ smoking\ in\ pregnancy = 0.28 \times 754$$

$$= 209$$

→209 low birth weight babies per year in NHSGGC can be considered attributable to maternal smoking in pregnancy.

Supporting documents

The following supporting documents are available by contacting the author:

1. **Literature review: What is the evidence of the nature and strength of association between exposure to tobacco smoke and ill-health in infancy?**
2. **Structure evidence summary: Interventions to address infant smoke exposure - what evidence is there to guide improvements?**

Further information on the prevalence of smoking in pregnancy and SHS exposure in NHSGGC, and on the review of financial incentives is also available from the author.