

Health Inequalities Intervention Toolkit

Infant Mortality Tool

Technical Document

Version April 2010

1 Introduction

This paper describes the data and methods used in the HIIT Infant Mortality Tool.

The Tool itself can be accessed here:

http://www.lho.org.uk/LHO_Topics/Analytic_Tools/HealthInequalitiesInterventionToolkit.aspx

A set of Frequently Asked Questions is also available here:

<http://www.lho.org.uk/viewResource.aspx?id=15812>

The document summarising the research underpinning the Infant Mortality Tool is:

[*Factors contributing to the gap in infant mortality: The evidence.*](#)

2 Infant mortality Tool: Data

Table C at the end of this document contains information on the main sources of data that are used in the Infant Mortality Tool, including time period covered and, in most cases, links to the data. Additional estimates and measures used in the infant mortality gap calculations are described in Section 4: Estimation of factors contributing to the infant mortality gap.

3 Basic calculations and definitions, abbreviations and notation

3.1 Infant mortality rate - Routine and manual occupation group

In England and Wales, the father's occupation recorded on the birth certificate is used to assign a socioeconomic group to the child. Similarly, in the event of an infant death, it is the father's details on the death certificate that determine the socioeconomic group. Infants who are registered solely by their mothers are not assigned a socioeconomic or group. Therefore the routine and manual group comprises only infants born within marriage or registered jointly by both parents.

$$IMR_{rm} = \frac{\text{Infant deaths among births in routine and manual group}}{\text{Live births in routine and manual group}} * 1000 \quad (1)$$

3.2 Infant mortality rate - All births within marriage and joint registrations

Infant deaths per 1,000 live births within marriage or jointly registered by both parents (WMJR):

$$IMR_{wmjr} = \frac{\text{Infant deaths among wmjr births}}{\text{Live births within marriage and joint registrations}} * 1000 \quad (2)$$

(The data for these calculations are provided in the Infant Mortality Tool downloadable file: IMdl1_Trends09.xls.)

3.3 Infant mortality gap

The infant mortality gap referred to in the IM Tool is the gap between the infant mortality rate for the routine and manual (RM) group and the infant mortality rate for all births within marriage and joint registrations (WMJR). The definitions and notation for absolute and relative gaps are:

3.3.1 Absolute gap - National

Absolute difference between the infant mortality rate for the routine and manual group in the SHA and the infant mortality rate for all births within marriage and joint registrations in England:

$$\text{absGap}_{\text{Nat}} = \text{IMR}_{\text{rm}}(\text{SHA}) - \text{IMR}_{\text{wmjr}}(\text{England}) \quad (3)$$

3.3.2 Relative gap - National

Relative difference between the infant mortality rate for the routine and manual group in the SHA and the infant mortality rate for all births within marriage and joint registrations in England:

$$\text{relGap}_{\text{Nat}} = \frac{\text{IMR}_{\text{rm}}(\text{SHA}) - \text{IMR}_{\text{wmjr}}(\text{England})}{\text{IMR}_{\text{wmjr}}(\text{England})} * 100 \quad (4)$$

3.3.3 Absolute gap - Local

Absolute difference between the infant mortality rate for the routine and manual group in the SHA and the infant mortality rate for all births within marriage and joint registrations in the SHA:

$$\text{absGap}_{\text{Loc}} = \text{IMR}_{\text{rm}}(\text{SHA}) - \text{IMR}_{\text{wmjr}}(\text{SHA}) \quad (5)$$

3.3.4 Relative gap - Local

Relative difference between the infant mortality rate for the routine and manual group in the SHA and the infant mortality rate for all births within marriage and joint registrations in the SHA:

$$\text{relGap}_{\text{Loc}} = \frac{\text{IMR}_{\text{rm}}(\text{SHA}) - \text{IMR}_{\text{wmjr}}(\text{SHA})}{\text{IMR}_{\text{wmjr}}(\text{SHA})} * 100 \quad (6)$$

4 Estimation of factors contributing to the infant mortality gap

Factors contributing to IM gap

During the preparation of the *Review of the Health Inequalities Infant Mortality PSA Target*, the Department of Health conducted an analysis of factors contributing to the gap in infant mortality between the routine and manual group and all births in England. The research focused on the impact of the Government's health-related inequality indicators (e.g. teenage conceptions, children living in poverty), evidence for differentials between the routine and manual and other (higher) socioeconomic groups, and the availability of data. (See also: *Implementation Plan for Reducing Health Inequalities in Infant Mortality: A Good Practice Guide*).

The England investigation highlighted the contribution of five factors: teenage conceptions, Sudden Unexplained Death in Infancy (combined with the effect of overcrowding on SUDI), smoking in pregnancy, obesity and poverty. Subsequent analysis assessed the impact of not initiating breastfeeding. (See: *Factors contributing to the gap in infant mortality: The evidence*.)

This section of the Technical Document provides details of the data and estimates used and the calculations required to account for the gap between the infant mortality rate for the routine and manual group in one SHA and the infant mortality rate for all births within marriage and joint registrations in England.

4.1 Estimates and data used in the infant mortality gap calculations

Each of the figures listed below is used in either or both of section 4.2 and section 5. Unless otherwise stated, the estimates have been derived by the Health Improvement Analytical Team at the Department of Health. See: *Factors contributing to the gap in infant mortality: The evidence*.

- 1) Estimated Population Attributable Risk Fraction for infant deaths among children born within marriage or jointly registered by teenage mothers in England – $PARF_{tp\ wmjnr}$ (England) = 0.0028.
- 2) Estimated proportion of teenage conceptions that occur in the routine and manual group = 0.45.
- 3) Estimated mortality rate of infants born to teenage mothers in the RM group = 7.3 per 1,000 live births.
- 4) Estimated relative risk of SUDI death for births in the RM group compared to those in the managerial, professional and intermediate groups = 1.85.
- 5) Estimated England SUDI mortality rate 2006-08 for births within marriage and joint registrations – 0.42 per 1,000 live births.
- 6) Infants born to obese mothers (approximated from obesity in women of reproductive age) 2005 – $Prev_{obes}(All)$ = 0.187.
- 7) Relative risks of dying in infancy
 - a. Infants of mothers who smoke during pregnancy – RR_{smok} = 1.4
 - b. Infants born to obese mothers – RR_{obes} = 1.46
 - c. Infants born in poverty – RR_{pov} = 1.1
 - d. Infants who are not breastfed – RR_{Notbf} = 1.06
- 8) Prevalence in England population. *Sources, see Table C item (#)*
 - a. Mothers smoking during pregnancy 2008/09 – $Prev_{smok}(All)$ = 0.144 (4)
 - b. Infants living in poverty 2005 – $Prev_{pov}(All)$ = 0.224 (5)
 - c. Proportion of mothers not initiating breastfeeding 2007/08 – $Prev_{Notbf}(All)$ = 0.301 (6)

Note: (1) In some cases, it is necessary to assume that a measure for the total population is the best proxy available for the within marriage and jointly registered population.

(2) In the derivation of the relative risks, efforts were made to control for socioeconomic characteristics and other obvious associations. However, although the Tool assumes that the impact of the included factors are additive, it is unlikely that all confounding between the factors has been eliminated.

9) Table A. Estimates for routine and manual group (source: DH)

	North East	North West	Yorkshire and The Humber	East Midlands	West Midlands	East of England	London	South East Coast	South Central	South West
Deaths among infants of teenage mothers Population Attributable Risk Fraction – $PARF_{tp\ rm}(SHA)$	0.0056	0.0052	0.0041	0.0049	0.0038	0.0059	0.0049	0.0067	0.0067	0.0070
<i>Synthetic modelled estimates of Prevalence</i>										
Smoking in pregnancy – $Prev_{smok}(RM)$	0.36	0.32	0.30	0.26	0.25	0.27	0.15	0.27	0.22	0.26
Infants born to obese mothers – $Prev_{obes}(RM)$	0.24	0.22	0.22	0.21	0.26	0.23	0.24	0.24	0.24	0.22
Infants born in poverty – $Prev_{pov}(RM)$	0.25	0.31	0.27	0.24	0.33	0.29	0.80	0.30	0.27	0.25
Infants not breastfed – $Prev_{Notbf}(RM)$	0.49	0.47	0.38	0.31	0.40	0.28	0.16	0.22	0.22	0.19

4.2 Calculations for estimating the contributions of investigated factors and partitioning the infant mortality gap

4.2.1 Stage1 Estimation of unscaled contributions to the absolute gap

4.2.1.1 Sudden unexplained death in infancy (SUDI)

(a) The SHA SUDI mortality rate per 1,000 live births for the RM group is calculated using the estimated relative risk of SUDI death for births in the RM group compared to those in the managerial, professional and intermediate groups of 1.85:

$$\text{SUDI_rate}_{\text{rm}}(\text{SHA}) = \frac{\text{SUDI_rate}(\text{SHA}) * \text{Births}_{\text{wmjr}}(\text{SHA})}{\text{Births}_{\text{rm}}(\text{SHA}) + (\text{Births}_{\text{wmjr}}(\text{SHA}) - \text{Births}_{\text{rm}}(\text{SHA}))/1.85} \quad (7)$$

(b) The contribution of SUDI to the absolute gap between the infant mortality rate for the routine and manual group in the SHA and the infant mortality rate for all births within marriage and joint registrations in England is calculated by subtracting the England 2006-08 SUDI mortality rate for births within marriage and joint registrations – 0.42 per 1,000 live births – from the result of equation (7).

$$\text{Contrib}_{\text{SUDI}} = \text{SUDI_rate}_{\text{rm}}(\text{SHA}) - \text{SUDI_rate}_{\text{wmjr}}(\text{England}) \quad (8)$$

4.2.1.2 Teenage pregnancy

The contribution of teenage pregnancy to the absolute gap in infant mortality is estimated as the infant mortality due to teenage pregnancies in the SHA minus the infant mortality due to teenage pregnancies in England as a whole.

$$\text{Contrib}_{\text{tp}} = \text{IMR}_{\text{rm}}(\text{SHA}) * \text{PARF}_{\text{tp rm}}(\text{SHA}) - \text{IMR}_{\text{wmjr}}(\text{England}) * \text{PARF}_{\text{tp wmjr}}(\text{England}) \quad (9)$$

4.2.1.3 Smoking in pregnancy

The contribution of smoking in pregnancy to the absolute gap in infant mortality is estimated as the population attributable risk of infant mortality due to smoking among mothers in the RM group minus the reduction in their attributable risk that would result if they had the prevalence of smoking in pregnancy of the national population.

$$\text{Contrib}_{\text{smok}} = \frac{\text{IMR}_{\text{rm}} * (\text{RR}_{\text{smok}} - 1) * (\text{Pre v}_{\text{smok}}(\text{RM}) - \text{Pre v}_{\text{smok}}(\text{All}))}{\text{RR}_{\text{smok}} * \text{Pre v}_{\text{smok}}(\text{RM}) + (1 - \text{Pre v}_{\text{smok}}(\text{RM}))} / \text{absGap}_{\text{Nat}} * 100 \quad (10)$$

4.2.1.4 Obesity

The contribution of maternal obesity to the absolute gap in infant mortality is estimated as the population attributable risk of infant mortality due to obesity among mothers in the RM group minus the reduction in their attributable risk that would result if they had the prevalence of obesity of the national population.

$$\text{Contrib}_{\text{obes}} = \frac{\text{IMR}_{\text{rm}} * (\text{RR}_{\text{obes}} - 1) * (\text{Pre v}_{\text{obes}}(\text{RM}) - \text{Pre v}_{\text{obes}}(\text{All}))}{\text{RR}_{\text{obes}} * \text{Pre v}_{\text{obes}}(\text{RM}) + (1 - \text{Pre v}_{\text{obes}}(\text{RM}))} / \text{absGap}_{\text{Nat}} * 100 \quad (11)$$

4.2.1.5 Poverty

The contribution of poverty to the absolute gap in infant mortality is estimated as the population attributable risk of infant mortality due to poverty among the RM group minus the reduction in their attributable risk that would result if they had the prevalence of poverty of the national population.

$$\text{Contrib}_{\text{pov}} = \frac{\text{IMR}_{\text{rm}} * (\text{RR}_{\text{pov}} - 1) * (\text{Pre v}_{\text{pov}}(\text{RM}) - \text{Pre v}_{\text{pov}}(\text{All}))}{\text{RR}_{\text{pov}} * \text{Pre v}_{\text{pov}}(\text{RM}) + (1 - \text{Pre v}_{\text{pov}}(\text{RM}))} / \text{absGap}_{\text{Nat}} * 100 \quad (12)$$

4.2.1.6 Breastfeeding

The contribution of not being breastfed to the absolute gap in infant mortality is estimated as the population attributable risk of infant mortality due to not being breastfed among the RM group minus the reduction in their attributable risk that would result if their mothers had the prevalence of initiating breastfeeding of the national population.

$$\text{Contrib}_{\text{Notbf}} = \frac{\text{IMR}_{\text{rm}} * (\text{RR}_{\text{Notbf}} - 1) * (\text{Prev}_{\text{Notbf}}(\text{RM}) - \text{Prev}_{\text{Notbf}}(\text{All}))}{\text{RR}_{\text{Notbf}} * \text{Prev}_{\text{Notbf}}(\text{RM}) + (1 - \text{Prev}_{\text{Notbf}}(\text{RM}))} / \text{absGap}_{\text{Nat}} * 100 \quad (13)$$

4.2.1.7 Factors not modelled

The contribution of unspecified factors to the absolute gap in infant mortality is estimated as 1 minus the sum of the contributions of the six included factors.

4.2.2 Stage 2 Negative results from Stage 1 set to zero (see example in the table)

4.2.3 Stage 3 Results from Stage 2 scaled to 100 per cent (see example in the table)

Table B. Partitioning the infant mortality gap: Illustration of Stages 2 and 3, London

	Unscaled contributions to the absolute gap (from Stage 1)	Stage 2 Negatives set to zero	Stage 3 Scaled to 100%
Teenage pregnancy	0.03	0.03	2.2
SUDI	0.35	0.35	26.9
Smoking	0.01	0.01	0.6
Obesity	0.27	0.27	20.9
Poverty	0.65	0.65	49.4
Not breastfed	-0.10	0.00	0.0
Other (1–sum of above)	-0.21	0.00	0.0
sum		1.31	100.0

5 Calculations for estimating the impact of user-specified modifications on the current infant mortality gap

Modify contributing factors

The calculations presented in this section are for estimating the impact of user-specified modifications on the *Relative gap - National*, that is the difference between the infant mortality rate for the RM group in the SHA and the infant mortality rate for WMJR births in England. For calculating the impact on the *Relative gap - Local*, WMJR data for England is replaced by WMJR data for the SHA.

5.1 Teenage pregnancy

5.1.1 Step 1

Using the Department of Health estimate of 0.45 for the proportion of teenage conceptions that occur in the routine and manual group and the latest three-year figure for under 18 conceptions in the SHA, calculate the number of teenage conceptions in the routine and manual group in the SHA:

$$u18_Conceptions_{\text{rm}}(\text{SHA}) = 0.45 * \text{Conceptions}(\text{SHA})/3 \quad (14)$$

5.1.2 Step 2

Using the latest three-year estimate of the proportion of under 18 conceptions in the SHA that lead to abortion, calculate the number of teenage births in the routine and manual group in the SHA:

$$u18_Births_{rm}(SHA) = u18_Conceptions_{rm}(SHA) * Proportion_concpntns_leading_to_abortion(SHA) \quad (15)$$

5.1.3 Step 3

Using the Department of Health estimated mortality rate for infants born to teenage mothers in the RM group of 7.3 per 1,000 live births, calculate the absolute reduction in the SHA RM infant mortality rate for the given user-specified (user-input) percentage reduction in under 18 conceptions (UI_{tp}):

$$rednUI_{tp}IMR_{rm}(SHA) = IMR_{rm}(SHA) - \frac{Deaths_{rm}(SHA) - (UI_{tp}/100 * u18_Births_{rm}(SHA) * 7.3/1000)}{Births_{rm}(SHA) - UI_{tp}/100 * u18_Births_{rm}(SHA)} * 1000 \quad (16)$$

5.1.4 Step 4

Calculate the absolute reduction in the National WMJR infant mortality rate for the given user-specified percentage reduction in under 18 conceptions in the RM group in the SHA:

$$rednUI_{tp}IMR_{wmjr}(Eng) = IMR_{wmjr}(Eng) - \frac{Deaths_{wmjr}(England) - (UI_{tp}/100 * u18_Births_{rm}(SHA) * 7.3/1000)}{Births_{wmjr}(England) - UI_{tp}/100 * u18_Births_{rm}(SHA)} * 1000 \quad (17)$$

5.1.5 Step 5

Calculate the relative difference between the new infant mortality rate for the routine and manual group in the SHA and the new infant mortality rate for all births within marriage and joint registrations in England:

$$NewrelGap_{Nat} = \frac{IMR_{rm}(SHA) - rednUI_{tp}IMR_{rm}(SHA) - (IMR_{wmjr}(England) - rednUI_{tp}IMR_{wmjr}(England))}{IMR_{wmjr}(England) - rednUI_{tp}IMR_{wmjr}(England)} * 100 \quad (18)$$

5.1.6 Step 6

Calculate the percentage reduction in the relative gap that results from the user-input modification:

$$\%redn_relGap_{Nat} = \frac{relGap_{Nat} - NewrelGap_{Nat}}{relGap_{Nat}} * 100 \quad (19)$$

5.2 Sudden unexplained death in infancy (SUDI)

5.2.1 Step 1

Using the formula for the routine and manual SUDI rate given in equation (7), calculate the absolute reduction in the SHA RM infant mortality rate for the given user-specified percentage reduction in SUDI (UI_{SUDI}):

$$rednUI_{SUDI}IMR_{rm}(SHA) = UI_{SUDI}/100 * SUDI_rate_{rm}(SHA) \quad (20)$$

5.2.2 Step 2

Calculate the absolute reduction in the National WMJR infant mortality rate for the given user-specified reduction in SUDI in the RM group in the SHA:

$$rednUI_{SUDI}IMR_{wmjr}(England) = rednUI_{SUDI}IMR_{rm}(SHA) * Births_{rm}(SHA) / Births_{wmjr}(England) \quad (21)$$

5.2.3 Step 3

Calculate the relative difference between the new infant mortality rate for the routine and manual group in the SHA and the new infant mortality rate for all births within marriage and joint registrations in England:

$$NewrelGap_{Nat} = \frac{IMR_{rm}(SHA) - rednUI_{SUDI}IMR_{rm}(SHA) - (IMR_{wmjr}(England) - rednUI_{SUDI}IMR_{wmjr}(England))}{IMR_{wmjr}(England) - rednUI_{SUDI}IMR_{wmjr}(England)} * 100 \quad (22)$$

5.2.4 Step 4

Calculate the percentage reduction in the relative gap that results from the user-input modification – See equation (19).

5.3 Smoking in pregnancy

5.3.1 Step 1

Calculate the proportion of infant deaths in the routine and manual group in the SHA that is attributable to smoking in pregnancy – this is the Population Attributable Risk Fraction (PARF):

$$PARF_{smok\ rm}(SHA) = \frac{(RR_{smok} - 1) * Prev_{smok}(RM)}{RR_{smok} * Prev_{smok}(RM) + (1 - Prev_{smok}(RM))} \quad (23)$$

5.3.2 Step 2

Calculate the absolute reduction in the SHA RM infant mortality rate for the given user-specified (user-input) percentage point reduction (UI_{smok}):

$$rednUI_{sm}IMR_{rm}(SHA) = \frac{IMR_{rm}(SHA) * PARF_{smok\ rm}(SHA) * UI_{smok} / 100}{Prev_{smok}(RM)} \quad (24)$$

5.3.3 Step 3

Calculate the absolute reduction in the National WMJR infant mortality rate for the given user-specified percentage point reduction in smoking in the RM group in the SHA:

$$rednUI_{sm}IMR_{wmjr}(Eng.) = rednUI_{sm}IMR_{rm}(SHA) * Births_{rm}(SHA) / Births_{wmjr}(England) \quad (25)$$

5.3.4 Step 4

Calculate the relative difference between the new infant mortality rate for the routine and manual group in the SHA and the new infant mortality rate for all births within marriage and joint registrations in England:

$$NewrelGap_{Nat} = \frac{IMR_{rm}(SHA) - rednUI_{sm}IMR_{rm}(SHA) - (IMR_{wmjr}(England) - rednUI_{sm}IMR_{wmjr}(England))}{IMR_{wmjr}(England) - rednUI_{sm}IMR_{wmjr}(England)} * 100 \quad (26)$$

5.3.5 Step 5

Calculate the percentage reduction in the relative gap that results from the user-input modification – See equation (19).

5.4 Obesity

5.4.1 Step 1

Calculate the proportion of infant deaths in the routine and manual group in the SHA that is attributable to maternal obesity – this is the Population Attributable Risk Fraction (PARF):

$$PARF_{obes\ rm}(SHA) = \frac{(RR_{obes} - 1) * Prev_{obes}(RM)}{RR_{obes} * Prev_{obes}(RM) + (1 - Prev_{obes}(RM))} \quad (27)$$

5.4.2 Step 2

Calculate the absolute reduction in the SHA RM infant mortality rate for the given user-specified (user-input) percentage point reduction (UI_{obes}):

$$rednUI_{ob}IMR_{rm}(SHA) = \frac{IMR_{rm}(SHA) * PARF_{obes\ rm}(SHA) * UI_{obes} / 100}{Prev_{obes}(RM)} \quad (28)$$

5.4.3 Step 3

Calculate the absolute reduction in the National WMJR infant mortality rate for the given user-specified percentage point reduction in maternal obesity in the RM group in the SHA:

$$\text{rednUI}_{\text{ob}}\text{IMR}_{\text{wmjr}}(\text{Eng.}) = \text{rednUI}_{\text{ob}}\text{IMR}_{\text{rm}}(\text{SHA}) * \text{Births}_{\text{rm}}(\text{SHA}) / \text{Births}_{\text{wmjr}}(\text{England}) \quad (29)$$

5.4.4 Step 4

Calculate the relative difference between the new infant mortality rate for the routine and manual group in the SHA and the new infant mortality rate for all births within marriage and joint registrations in England:

$$\text{NewrelGap}_{\text{Nat}} = \frac{\text{IMR}_{\text{rm}}(\text{SHA}) - \text{rednUI}_{\text{ob}}\text{IMR}_{\text{rm}}(\text{SHA}) - (\text{IMR}_{\text{wmjr}}(\text{England}) - \text{rednUI}_{\text{ob}}\text{IMR}_{\text{wmjr}}(\text{England}))}{\text{IMR}_{\text{wmjr}}(\text{England}) - \text{rednUI}_{\text{ob}}\text{IMR}_{\text{wmjr}}(\text{England})} * 100 \quad (30)$$

5.4.5 Step 5

Calculate the percentage reduction in the relative gap that results from the user-input modification – See equation (19).

5.5 Poverty

5.5.1 Step 1

Calculate the proportion of infant deaths in the routine and manual group in the SHA that is attributable to poverty – this is the Population Attributable Risk Fraction (PARF):

$$\text{PARF}_{\text{pov rm}}(\text{SHA}) = \frac{(\text{RR}_{\text{pov}} - 1) * \text{Pr ev}_{\text{pov}}(\text{RM})}{\text{RR}_{\text{pov}} * \text{Pr ev}_{\text{pov}}(\text{RM}) + (1 - \text{Pr ev}_{\text{pov}}(\text{RM}))} \quad (31)$$

5.5.2 Step 2

Calculate the absolute reduction in the SHA RM infant mortality rate for the given user-specified (user-input) percentage point reduction (UI_{pov}):

$$\text{rednUI}_{\text{po}}\text{IMR}_{\text{rm}}(\text{SHA}) = \frac{\text{IMR}_{\text{rm}}(\text{SHA}) * \text{PARF}_{\text{pov rm}}(\text{SHA}) * \text{UI}_{\text{pov}} / 100}{\text{Pr ev}_{\text{pov}}(\text{RM})} \quad (32)$$

5.5.3 Step 3

Calculate the absolute reduction in the National WMJR infant mortality rate for the given user-specified percentage point reduction in poverty in the RM group in the SHA:

$$\text{rednUI}_{\text{po}}\text{IMR}_{\text{wmjr}}(\text{Eng.}) = \text{rednUI}_{\text{po}}\text{IMR}_{\text{rm}}(\text{SHA}) * \text{Births}_{\text{rm}}(\text{SHA}) / \text{Births}_{\text{wmjr}}(\text{England}) \quad (33)$$

5.5.4 Step 4

Calculate the relative difference between the new infant mortality rate for the routine and manual group in the SHA and the new infant mortality rate for all births within marriage and joint registrations in England:

$$\text{NewrelGap}_{\text{Nat}} = \frac{\text{IMR}_{\text{rm}}(\text{SHA}) - \text{rednUI}_{\text{po}}\text{IMR}_{\text{rm}}(\text{SHA}) - (\text{IMR}_{\text{wmjr}}(\text{England}) - \text{rednUI}_{\text{po}}\text{IMR}_{\text{wmjr}}(\text{England}))}{\text{IMR}_{\text{wmjr}}(\text{England}) - \text{rednUI}_{\text{po}}\text{IMR}_{\text{wmjr}}(\text{England})} * 100 \quad (34)$$

5.5.5 Step 5

Calculate the percentage reduction in the relative gap that results from the user-input modification – See equation (19).

5.6 Breastfeeding

5.6.1 Step 1

Calculate the proportion of infant deaths in the routine and manual group in the SHA that is attributable to not being breastfed – this is the Population Attributable Risk Fraction (PARF):

$$PARF_{Notbf\ rm}(SHA) = \frac{(RR_{Notbf} - 1) * Prev_{Notbf}(RM)}{RR_{Notbf} * Prev_{Notbf}(RM) + (1 - Prev_{Notbf}(RM))} \quad (35)$$

5.6.2 Step 2

Calculate the absolute reduction in the SHA RM infant mortality rate for the given user-specified (user-input) percentage point reduction (UI_{Notbf}):

$$rednUI_{Nb}IMR_{rm}(SHA) = \frac{IMR_{rm}(SHA) * PARF_{Notbf\ rm}(SHA) * UI_{Notbf} / 100}{Prev_{Notbf}(RM)} \quad (36)$$

5.6.3 Step 3

Calculate the absolute reduction in the National WMJR infant mortality rate for the given user-specified percentage point reduction in mothers not initiating breastfeeding in the RM group in the SHA:

$$rednUI_{Nb}IMR_{wmjr}(Eng.) = rednUI_{Nb}IMR_{rm}(SHA) * Births_{rm}(SHA) / Births_{wmjr}(England) \quad (37)$$

5.6.4 Step 4

Calculate the relative difference between the new infant mortality rate for the routine and manual group in the SHA and the new infant mortality rate for all births within marriage and joint registrations in England:

$$NewrelGap_{Nat} = \frac{IMR_{rm}(SHA) - rednUI_{Nb}IMR_{rm}(SHA) - (IMR_{wmjr}(England) - rednUI_{Nb}IMR_{wmjr}(England))}{IMR_{wmjr}(England) - rednUI_{Nb}IMR_{wmjr}(England)} * 100 \quad (38)$$

5.6.5 Step 5

Calculate the percentage reduction in the relative gap that results from the user-input modification – See equation (19).

Table C. Measures, data sources and links

See also, Infant Mortality Tool downloadable file: IMdl2_Background09.xls

Data	Time period	Source and additional details
(1) Infant mortality rates	2002-04 to 2006-08	Source: Office for National Statistics (ONS) For live birth and infant death data, see Infant Mortality Tool downloadable file: IMdl1_Trends09.xls
(2) SUDI mortality rates	2005-07	Sudden unexplained death in infancy (SUDI) Mortality rates by SHA estimated from birth and infant death data and SUDI deaths given in: http://www.statistics.gov.uk/pdfdir/uinfmort0809.pdf
(3) Under 18 conceptions	a) 2005-07 b) % change 1998-2000 to 2005-07	i) Under 18 conceptions per 1,000 women aged 15-17 ii) Percentage change in under 18 conception rate - The denominator for the rate is women aged 15 to 17, the numerator is conceptions to all women aged under 18. - The 2005-2007 rates for South East Coast and South Central SHAs are calculated from the constituent Local Authorities. The percentage change from the baseline period is not available for the two SHAs. LINK TO: Department for Children, Schools and Families, Every Child Matters, Resource page for under 18 conception statistics , See file: LA under 18 conception statistics
(4) Per cent of mothers smoking during pregnancy	2008/09	Source: PCT data. - Data are for the 12-month period ending in March 2009. - Figures are for PCTs apart from that for Birmingham which is the weighted average for the three PCTs in Birmingham. (Of the 31 other Local Authorities covered by the Infant Mortality Tool, 29 are wholly coterminous with PCTs, the overlap between LA population and PCT population for Stoke-on-Trent is 97%, and the overlap for Milton Keynes is 98%.) LINK TO: Department of Health quarterly report, 'Smoking at time of delivery – 2009/10 quarter 2'
(5) Children living in poverty	2005	Per cent of children living in families receiving means-tested benefits, 2005 The measure originates from the Indices of Deprivation 2007 produced by Department for Communities and Local Government. - The population is children under age 16. LINK TO: Data on APHO website
(6) Per cent of mothers initiating breastfeeding	2007/08	Source: PCT data. - Data are for the 12-month period ending in March 2008. - Figures are for PCTs apart from that for Birmingham which is the weighted average for the three PCTs in Birmingham. (Of the 31 other Local Authorities covered by the Infant Mortality Tool, 29 are wholly coterminous with PCTs, the overlap between LA population and PCT population for Stoke-on-Trent is 97%, and the overlap for Milton Keynes is 98%.) - The figure for Bristol is for 2008/09 as that for 2007/08 is not available. LINK TO: Department of Health quarterly report, 'Mothers initiating breastfeeding – NHS Feedback 2009/10 Quarter 2'

Data	Time period	Source and additional details
<p>(7) Deprivation</p>	2005	<p>Per cent of people in the area living within the 20% most deprived areas of England</p> <p>The measure originates from the Indices of Deprivation 2007 produced by Department for Communities and Local Government.</p> <p>LINK TO: Data on APHO website</p>
<p>(8) Overcrowding</p>	2001	<p>Per cent of households that are overcrowded</p> <p>Source: 2001 Census</p> <ul style="list-style-type: none"> - Not available for South East Coast and South Central SHAs. <p>LINK TO: 2001 Census Table KS19</p>
<p>(9) Immunisation DTaP/IPV/Hib MenC PCV</p> <p>Protection against:</p> <ul style="list-style-type: none"> 1) Diphtheria, tetanus, pertussis, polio, haemophilus influenzae type b 2) Meningitis C 3) Pneumococcal infection 	2008/09	<p>Per cent of children immunised by their 1st birthday</p> <p>Source: PCT data.</p> <ul style="list-style-type: none"> - The denominators are the total number of children for whom the PCTs are responsible on 31/03/09 reaching their 1st birthday. - Figures are for PCTs apart from that for Birmingham which is the weighted average for the three PCTs in Birmingham. (Of the 31 other Local Authorities covered by the Infant Mortality Tool, 29 are wholly coterminous with PCTs, the overlap between LA population and PCT population for Stoke-on-Trent is 97%, and the overlap for Milton Keynes is 98%.) - Haringey Teaching PCT experienced data quality issues as a result of a recent migration to a new Child Health system or problems with their existing Child Health system, leading to a lack of confidence in data reported. - Newham and Leeds PCTs experienced data quality issues and thus may not present an accurate reflection of actual uptake. - Oldham PCT submitted data based upon quarter data due to problems with the reporting of an annual figure. <p>LINK TO: NHS Information Centre for health and social care, Immunisation Statistics, 2008-09</p>
<p>(10) Per cent of live births that are low birthweight</p>	2007	<p>Source: Office for National Statistics, Neighbourhood Statistics</p> <ul style="list-style-type: none"> - Low birthweight is defined as less than 2500 grams. - The figures for South East Coast and South Central are calculated from those for the constituent Local Authorities. <p>LINK TO: Neighbourhood Statistics, Low birthweight statistics</p>

Data	Time period	Source and additional details
<p>(11) Infant mortality by ethnic group</p>	<p>2005-06</p>	<p>Infant deaths per 1,000 live births by ethnic group and SHA Source: Office for National Statistics, commissioned table. (The source dataset is created from linked routine birth and death registration records and NHS Numbers for Babies Service data*).</p> <ul style="list-style-type: none"> - The Estimate for England and Wales includes births and death registration records that were not linked to an NHS Numbers for Babies record. - The Estimates for England and the SHAs do not include births and death registration records that were not linked to an NHS Numbers for Babies record. - White group: White British, White Irish and White Other - Asian or Asian British group: Bangladeshi, Asian/Asian British; Indian, Asian/Asian British; Pakistani, Asian/Asian British; Other Asian - Black or Black British group: African, Black/Black British; Caribbean, Black/Black British; Other Black - Other group: Chinese, all Mixed groups and Other <p>* For more information on these data, see: Hilder L, Moser K, Dattani N, and A Macfarlane (2007) Pilot linkage of NHS Numbers for Babies data with birth registrations. <i>Health Statistics Quarterly</i> 33, 25–33. http://www.statistics.gov.uk/downloads/theme_health/HSQ33.pdf</p> <p>Oakley L, Maconochie N, Doyle P, Dattani N and K Moser (2009) Multivariate analysis of infant death in England and Wales in 2005-06, with focus on socio-economic status and deprivation. <i>Health Statistics Quarterly</i> 42, 22–39. http://www.statistics.gov.uk/downloads/theme_health/HSQ42.pdf</p>
<p>(12) Distribution of the population by ethnic group</p>	<p>2007</p>	<p>Per cent distribution of women aged 16-59 by ethnic group Source: Estimated from: Office for National Statistics, experimental statistics Local Authorities: LINK TO: Tables EE1-EE6 2007.xls Strategic Health Authorities: LINK TO: Tables EE1-EE6 PCO2007.xls - Percentages may not add exactly due to rounding.</p>