Inequalities in Infant Mortality Project Briefing Paper 2

Health Inequalities Infant Mortality Target: technical background

Ron Gray[a], Jennifer Hollowell[a], Peter Brocklehurst[a], Hilary Graham[b], Jennifer J Kurinczuk[a]

[a] National Perinatal Epidemiology Unit, University of Oxford

[b] Department of Health Sciences, University of York

June 2009

Summary

This briefing paper explains the technical background to the Health Inequalities Infant Mortality Public Service Agreement (PSA) Target. Its aim is to inform policy development at the Department of Health by supplementing the information available in key Department of Health publications.

The main messages are:

- The higher risk of infant death in poorer communities – evident within countries as well as between them – has long been taken as a barometer of health inequalities.

- Central to the PSA Infant Mortality Target is the concept of 'socioeconomic group': the target is focused on reducing infant death rates in the 'routine and manual' group.

- The infant mortality rate is expressed as the number of deaths under 1 year of age divided by the number of live births. This fraction is multiplied by 1000 to give the number of infant deaths per 1000 live births.

- Population infant mortality rates are derived from vital statistics collected at civil registration of births and of deaths. The father's occupation is recorded on all births within marriage and on births outside of marriage that are jointly registered by both parents. The father's occupation, as stated on the death or the birth certificate, is used to allocate the child to a socioeconomic group.

- The recently introduced National Statistics Socioeconomic Classification (NS-SEC), based on occupation, employment status and size of organisation, seeks to capture structural inequalities in people's socioeconomic position. The NS-SEC has 17 operational categories and 8 analytical classes, which are reduced to a 3-category version used in the Infant Mortality target and in other PSA targets for health.

- There are a two main ways of measuring social inequalities in infant mortality: as a gradient over a number of groups or as a gap between two groups. The target involves measuring the gap in infant mortality rates between the 'routine and manual' group and the whole population. Such a gap between two groups can be expressed as a simple arithmetic difference between the infant mortality rates in the two groups (an 'absolute' difference) or as a ratio of the rates in the two groups (a 'relative' difference). The PSA target focuses on the ratio of rates expressed as a percentage gap. As a consequence, even if the absolute difference in rate between the two groups remains the same, as the rate in both groups continues to fall, the percentage gap will increase.

- Limitations of the target are (1) that it focuses only on socioeconomic inequalities (2) that the gap may not adequately characterise the range of variability in the population (3) that some of the most deprived groups – 'sole registrants', NS-SEC group 8 and 'not classified' – are excluded from the target and (4) that the gap is measured between the 'routine and manual group' and the 'whole population'; the latter includes the 'routine and manual' group, so reductions in infant mortality in the 'routine and manual' group also decrease the rate in the 'whole population'.

1 Introduction

This briefing paper is the second in a series of four commissioned by the Department of Health as part of a project to evaluate the evidence base of interventions to reduce infant mortality and inequalities in infant mortality rates. Its purpose is to explain the technical background to the PSA Target to reduce social inequalities in infant mortality by 10% by 2010. The intended audience is policy team at the Department of

Health, although the subject may also be of interest more broadly to those working to deliver the target at regional and local level.

The technical background discussed in this paper refers to the principles and procedures used to formulate the target on infant mortality. The technical background has two main components. The first is the set of concepts that underpin the target: socioeconomic group, infant mortality and social inequalities. The second component is the way in which these concepts have been applied in order to construct the target. This latter component we term 'operationalising'.

Following this introductory section, this paper discusses:

- The concepts of socioeconomic position, infant mortality and health inequalities which that underpin the infant mortality target (section 2)
- How these core concepts are operationalised (section 3)
- The target itself: what is measured and what is excluded (section 4)

Appendices provide further details of NS-SEC analytical classes (appendix A) and a more technical discussion of the measurement of inequalities with special reference to the target (appendix B).

2   The Infant Mortality Target: core concepts

2.1 Socioeconomic position

Central to the Infant Mortality target is the concept of 'socioeconomic group': the target is focused on infant death rates in the 'routine and manual' group. The concept of socioeconomic group is widely used in policy research to group together people who are broadly similar in terms of life chances and living standards. In the UK, a person's position in the labour market has traditionally been used to allocate them to a socioeconomic group, with children's socioeconomic group based on that of their father. Other measures of socioeconomic position include educational attainment (e.g., highest educational qualification), household income and housing tenure.

Whatever classification system is used, it reveals marked inequalities in people's current circumstances and future prospects. For example, compared to children born to parents in manual occupations, the children of parents in professional occupations enjoy higher living standards in childhood and have a better chance of doing well at school and going on to do well in the labour market.

Socioeconomic position can be regarded as an attribute of the individual, like their gender or age. The problem with conceptualising socioeconomic position in this way is that it may lead to the conclusion that the only way for positive change to occur is for an individual to move up the social ladder. This, in turn, can suggest that policies which promote social mobility are the only solution to social disadvantage. An alternative view sees inequalities in people's socioeconomic position as the outcome of wider social structures. From this perspective, reductions in inequalities are more likely to come about through equity-oriented social and economic policies.

2.2 Infant mortality

Deaths in infancy and early childhood are tragedies for the individuals and families concerned. They are also an indicator of child health and, more broadly, can serve as a proxy for the health of the population.[1] The higher risk of infant death in poorer communities – evident within countries as well as between them – has long been taken as a barometer of health inequalities.[2]

2.3 Health inequalities

It has been clear for over 100 years that infant mortality rates in England[3] and other countries follow a social gradient: rates are lowest in the most advantaged families, highest in the most disadvantaged and lie in between the two for those intermediate families. The fact that health inequalities take the form of a gradient means that it is not only the poorest children whose health chances are compromised by their circumstances: children across society have poorer outcomes than those in the most advantaged circumstances.

However, for the purpose of setting targets, health inequalities are usually represented as a gap between two population groups rather than a gradient across the whole population. This methodology makes the target easier to understand and to measure but it may also convey the impression that inequalities can be reduced by interventions that only target the higher risk group. Such an approach would not address the inequalities in infant mortality rates across other sections of the population. Thus, although the gap may be simpler to measure and to target than a gradient, it is important not to forget the larger population of children whose standards of health fail to match those in the higher socioeconomic groups, who can become 'hidden' in the policy-making process.

3 The Infant Mortality Target: operationalising core concepts

3.1 Operationalising socioeconomic position

Historically, data on the employment status and occupation of the 'head of household' have been used to construct classification schemes for measuring socioeconomic position. Such schemes are applied either to the individual or, by extension, to their family; in 'traditional' heterosexual couple households, the man has been deemed 'head of the household', with the socioeconomic position of his partner and children based on his occupation. With more women in paid employment, the increase in female-headed households and greater diversity of family structures, this convention is increasingly being questioned. However, the mother's occupation does not provide a straightforward way of allocating children to a socioeconomic group. Women with young children often experience downward occupational mobility, and those who move in and out of employment or who do not work can be difficult to classify.

Nevertheless, the two classification systems used in the UK to map socioeconomic inequalities in infant mortality are occupationally based, and we now move on to discuss them. It is important to be aware that occupation-based classification systems lose much of the richness and complexity of the concept of socioeconomic position – which may be vital in understanding the causes of inequalities in child health.

Population infant mortality rates are derived from vital statistics collected at civil registration of births and of deaths. The father's occupation is recorded on all births within marriage and on births outside of marriage that are jointly registered by both parents. The father's occupation, as stated on the death or the birth certificate, is used to allocate the child to a socioeconomic group. Information on the father's occupation is coded from all death certificates but only on a 10% sample of the infant live births. This means that the socioeconomic distribution of the live births (the denominator data for the infant mortality rate) is inferred by multiplying ('grossing up') the numbers falling in each socioeconomic group by a factor of 10. For the deaths (the numerator data) the father's occupation is used in all cases. Note that the mother's occupation is not used to classify infant deaths or live births. As a result, socioeconomic status is not assigned for all births registered solely by unmarried mothers ('sole registrants').

It was in 1913 that the medical statistician T.H.C. Stevenson published the first national statistics for England on infant mortality stratified by occupation (the father's occupation if the child was born within marriage and the mother's occupation if the child was born to unmarried parents).[4] His approach was refined over the next decade or so to produce a hierarchical system used (with modification) up until 2000, which was known as the Registrar General's Social Classification (RGSC). This methodology grouped occupations into five broad social classes that range from professional (social class I) to unskilled manual (social class V). Over the entire 20th century the RGSC revealed marked inequalities in infant mortality, with a stepped increase in death rates from social class I to social class V.

While the RGSC system provided the UK's official socioeconomic schema for most of the 20th century, it had a number of acknowledged weaknesses. It was not theoretically-informed, that is, it was not underpinned by an analysis of how occupations link to life chances and exposure to risks and it increasingly failed to reflect the contemporary labour market.[5] In response to these problems, a new system was developed, called the National Statistics Socioeconomic Classification (NS-SEC). The NS-SEC was based on another socioeconomic classification developed by the sociologist, John Goldthorpe. Full details of how the Goldthorpe Schema was adopted and operationalised as the model for the NS-SEC are available elsewhere[6] and are briefly summarised here.

Goldthorpe argues that the socioeconomic structure is underpinned by the labour market, a system consisting of 'empty places' which people fill and which then determines their economic security and economic prospects, and thus their living standards and their exposure to risks. These 'empty places' are characterised by different conditions of employment; for example, employers exercise control over employees who, through their contract of employment, place themselves under the authority of their employer. Among employees, who make up the vast majority of the working population, working conditions also vary. Some occupations, like higher professional and senior management positions, give the post-holder a high degree of control over their work and considerable job security, with the prospect of higher salaries in the future; inherent features which benefit both them and their families. In other jobs, employees are closely supervised, they have limited job security and real earnings increase little across their working lives. Again, these are features that derive from the job not the person who does it, and these features affect the lives and futures of

the employee's family. The Goldthorpe Schema seeks to capture these structural inequalities in people's socioeconomic position.

The NS-SEC is informed by Goldthorpe's work, and adapts and simplifies the Goldthorpe Schema. The NS-SEC classification is based on occupation, employment status and size of organisation. Data on organisational size are not collected at birth and death registration and hence cannot be used to make the classification. Therefore, technically, it is not the 'full' NS-SEC that is used for vital statistics but the so-called 'reduced' NS-SEC, which is based only on occupation and employment status.[7] However, for ease of presentation, we will simply refer to this as 'NS-SEC'.

The NS-SEC has 17 operational categories which are further reduced to 8 analytical classes. However, the categories can be further collapsed to yield a 5- or a 3-category version. The diagram in Appendix A shows the nested relationship between the 8-, 5- and 3-category versions. It is the 3-category version that is used in the Infant Mortality target and in other PSA targets for health.

As a final point, it is important to be clear about the trade off between what it is ideal to collect and what is practical using routinely collected data at a national level. For example in carefully designed birth cohort studies, it is possible to collect very detailed information from parents on socioeconomic position, including for example, education, occupation, household income, housing tenure, housing conditions and perceived financial distress as well as information on ethnicity and information on socially patterned exposures such as smoking, dietary patterns etc. Such richness is simply not possible with routinely collected total population data.

3.2 Operationalising infant mortality

To produce infant mortality rates, the birth and death registrations in the population, during a given time period, are used. A death can be categorised by the date it occurred (termed 'occurrences') or by the date of the registration (termed 'registrations'). It is possible to operationalise the definition of infant mortality using such data, but with modern techniques of data linkage it has become possible to link death registrations with the original birth registrations, to produce a linked data set. This process is never 100% successful and hence will tend

to underestimate slightly the true number of deaths; however, it appears to produce better estimates than using unlinked data.

The whole population infant mortality rate for a given year is expressed as the number of occurrences[i] of deaths under 1 year of age in that year divided by the number of live births occurring in that year. This fraction is multiplied by 1000 to give the number of infant deaths per 1000 live births.

3.3 Operationalising measure of inequality

There are a two main ways of measuring inequalities in infant mortality. One can measure the social gradient over a number of groups or focus on the gap between any two groups. As the target involves measuring a gap, we focus on this measure of inequality. Details on how to measure social gradients are presented in detail elsewhere.[8] An inequality between two groups can be expressed as a simple arithmetical difference (subtracting one from the other) between the infant mortality rates in the two groups or as a ratio of the rates (dividing one by the other) in the two groups. For example for the three-year period 2004–06, the infant mortality rate in the 'routine and manual' (R&M) group was 4.8 per 1000 births and in the whole population the rate was 5.6 per 1000 births. The arithmetical difference is (5.6 - 4.8) = 0.8 per 1000 births, whereas the ratio of the rates is (5.6/4.8) = 1.17, that is a gap of 17%. All measures require a reference group in order to make a contrast and to measure the gap. In social epidemiology, the rate in the most advantaged group is often used as a reference. This device allows one to compare a disadvantaged group with the most advantaged one, which is desirable where the aim is to bring the health of those worse off up to the level of the best. However, where the aim is to bring up the health of a disadvantaged group to the average for the whole population, then the whole population must be used as the reference group. The latter group has been used in the PSA target. It should be noted that because the gap is measured between the 'routine and manual' group and the whole population, which includes the 'routine and manual' group, reductions in infant mortality in the 'routine and manual' group also decrease the rate in the whole population.

These two broad categories of measure are termed 'absolute' and 'relative'. Broadly, arithmetical differences in rates correspond to absolute measures and ratios of rates to relative

---

[i] From 2006 in the majority of ONS publications, the 'deaths' will consist of those deaths that were registered in the calendar period. However, for the purposes of the main output on child mortality (the DH3 series), figures will continue to be reported on the basis of dates of death and not registration. For further details see: Mortality Statistics: Childhood, infant and perinatal (Series DH3) No. 39 (page xiii)

ones. So, in the example given in the preceding paragraph, 0.8 per 1000 births is an absolute measure and 1.17 a relative measure. Both types of measure, absolute and relative, have advantages and disadvantages: best practice is to present measures of both.[9] The PSA target has been framed as a form of relative gap but expressed as a percentage gap rather than as a ratio.

Figure 1. Infant mortality rates in England and Wales, relative and absolute differences comparing the 'routine and manual' groups with the whole population, 1992 to 2006
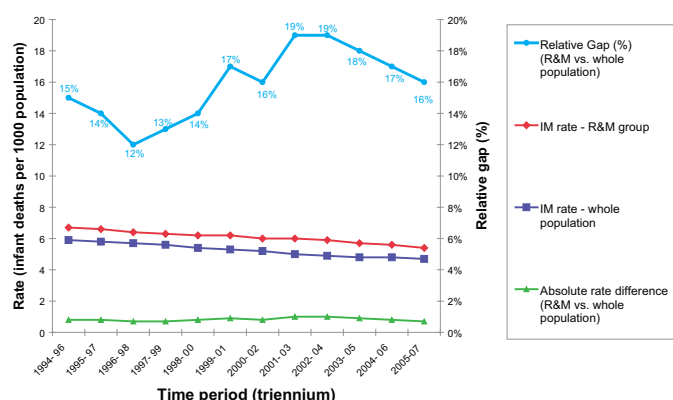
The PSA target is being monitored against the relative gap (top line)

Figure 1 illustrates the relative gap (expressed as a percentage) and the absolute gap in the infant mortality rate between the target group and the 'whole population' from 1994 onwards. During this period, the infant mortality rates in the 'routine and manual' group and the whole population have both declined, but the absolute difference between the two has remained more or less constant at about 1 per 1,000 births. As a consequence, the annual absolute difference has become an increasingly large proportion of a declining number, and thus the relative gap, expressed as a percentage, has increased. Even if the difference in rate between the two groups continues to remain the same, if the rate in both groups continues to fall, then the percentage gap will remain high and will continue to increase. This has important practical implications for monitoring the achievement of the target. The point is further illustrated in Table 1, which compares infant mortality rates in the two time periods 1995–97 and 2004–06. It can be seen that the difference in rates between the 'routine and manual' group and the 'whole population' (the 'absolute' gap) is the same in these two time periods but, because the rate in the whole population fell, the 'relative' gap increased from 14% to 17%.

Table 1: Absolute and relative changes in infant mortality in England and Wales 1995-97 and 2004-06

	1995-97	2004-06	Change in equity
Infant mortality in the 'routine and manual' group (deaths per 1000 live births)	6.6	5.6	-
Infant mortality in the whole population (deaths per 1000 live births)	5.8	4.8	-
Absolute gap	0.8	0.8	No change
Relative gap	14%*	17%**	Increase

* 6.6/5.8 = 1.14 (i.e., 'routine and manual' rate = 114% of rate in whole population)
** 5.6/4.8 = 1.17 (i.e., 'routine and manual' rate = 117% of rate in whole population)

Further details on the strengths and limitations of measuring inequality using a measure of the relative gap between a 'target' group and the whole population are given in Appendix B.

4 The Infant Mortality Target

4.1 The Target: what it measures and what it excludes

The PSA Infant Mortality Target is to reduce inequalities in infant mortality by 10% by 2010. For monitoring purposes, the target has been formulated as the following objective:

> "Starting with children under one year, by 2010 to reduce by at least 10% the gap in mortality between the routine and manual groups and the population as a whole. The baseline is 1997–99."

Formulation of the inequality 'gap' in terms of the relative difference between the 'routine and manual' group and the 'whole population', has a number of important consequences:

• Because the 'routine and manual' group is part of the whole population, as the rate in the 'routine and manual' group decreases, so too will the rate in the whole population. For example, a 2% reduction in infant mortality in the 'routine and manual' group would result in the rate in the whole population decreasing by around 1%, even if infant mortality in the rest of the population remained unchanged.

- Because of the underlying downward trend in infant mortality, the denominator used to calculate the gap is decreasing. A consequence of this process – as illustrated in Table 1 – is that the gap may increase even if the absolute gap between the two groups remains constant (or even decreases). The gap will only decline if the rate of improvement in infant mortality in the 'routine and manual' group is greater than the rate of improvement in the 'rest of the population'.

- Certain particularly disadvantaged groups are wholly excluded from the target, in particular the children of 'sole registrants' (7% of births), and the 'unclassified' group[ii] (5% of births). Both of these groups have a higher infant mortality rate than the 'routine and manual' group. For example, in 2006 there were 6.4 infant deaths per 1000 births in the 'sole registrant' group and 8.8 infant deaths per 1000 births in the 'unclassified' group, compared with 5.7 infant deaths per 1000 births in the 'routine and manual' group.

- Births to teenagers are also disproportionately excluded because of the over-representation of 'sole registrants' and 'unclassifieds' in this group (just under 40% of births to mothers aged <20 years fall in these two categories).

- The target does not take into account all dimensions of inequalities in infant mortality, for example ethnic inequalities.

4.2 Progress towards meeting the target

In 1997–99 (the baseline year for the target), the relative gap in infant mortality between the 'routine and manual' group and the whole population was 13%. The target to reduce the gap by 10% therefore translates to achieving a gap of 12% or less by 2010. As shown above in Figure 1, between 1997–99 and 2001–03 the gap initially increased to 19%, although a steady year-on-year decline has occurred since 2002–04. In 2005–07 (the most recent triennium for which data are available) the gap stood at 16%.

Infant mortality in England is at an all-time low and falling, but significant inequalities persist and achievement of the infant mortality target remains a challenge.

Acknowledgements

References

1. Reidpath DD, Allotey P. Infant mortality rate as an indicator of population health. J. Epidemiol. Community Health, 2003; 57: 344 - 346.

2. Galley C, George Newman - A Life in Public Health In: Garrett E, Galley C, Shelton N and Woods R (eds), Infant Mortality: A Continuing Social Problem, Aldershot and Burlington: Ashgate. 2006.

3. Newman G. Infant mortality: a social problem. London: Methuen, 1906.

4. Registrar General. Registrar General's 74th Annual Report, 1911. London: Registrar General 1913.

5. Szreter SRS. The Genesis of the Registrar-General's Social Classification of Occupations. The British Journal of Sociology 1984; 35(4): 522-546.

6. Rose D, Pevalin DJ. The National Statistics Socio-economic Classification: Unifying Official and Sociological Approaches to the Conceptualisation and Measurement of social class. ISER Working Papers. Paper 2001-4 Colchester: University of Essex 2001.

7. Rowan S. Implications of changes in the United Kingdom social and occupational classifications in 2001 on infant mortality statistics. Health Statistics Quarterly, Spring 2003:33-40.

   Also see http://www.ons.gov.uk/about-statistics/classifications/current/ns-sec/deriving/index.html for information on how the reduced NS-SEC is derived. Note the comment that 'at the eight class level the reduced method correctly allocates 98 per cent of cases compared to the Full method.'

8. Harper S, Lynch J. Measuring Health Inequalities In: Oakes JM, Kaufman JS (eds.) Methods in Social Epidemiology. San Francisco: Josey-Bass, 2006.

9. Keppel K, Pamuk E, Lymch J, et al. Methodological issues in measuring health disparities. National Center for Health Statistics. Vital Health Stat. 2005; 2 (141): 1-16.

ii This includes those who are not classifiable, the long-term unemployed, students and those who have never worked.

Appendix A

NS-SEC eight-, five- and three-class versions (adapted from National Statistics Website)

8 classes	5 classes	3 classes
1. Higher managerial and professional occupations	1. Managerial and professional occupations	1. Managerial and professional occupations
1.1 Large employers and higher managerial occupations		
1.2 Higher professional occupation		
2. Lower managerial and professional occupations	2. Intermediate occupations	2. Intermediate occupations
3. Intermediate occupations	3. Small employers and own account workers	
4. Small employers and own account workers	4. Lower supervisory and technical occupations	
5. Lower supervisory and technical occupations	5. Semi-routine and routine occupations	3. Routine and manual occupations
6. Semi-routine occupations		
7. Routine occupations		
8. Never worked and long-term unemployed	Never worked and long-term unemployed	Never worked and long-term unemployed*

Notes[iii]

1. Although the 'never worked and long-term unemployed' are grouped together with the 'routine and manual' occupations in the three-class hierarchy, for health analyses the 'never worked and long-term unemployed' are generally considered a separate group. In the analyses relating to the infant mortality target, the 'routine and manual' group excludes the 'never worked and long-term unemployed' category.

2. Only the three-class version may be considered to be hierarchical; neither the five- nor eight-class versions can be regarded as ordinal scales, in part because of the recognition of self-employment as a separate class.

Appendix B

Infant mortality

Infant mortality is defined as death before 1 year of age. The infant mortality rate (IMR) for England and Wales for a given year is the number of occurrences of deaths under 1 year of age in that year divided by the number of live births occurring in that year. That is:

$$IMR_e = \frac{Number\ of\ infant\ deaths\ in\ year}{Number\ of\ live\ births\ in\ year} \times 1000$$

where IMR_e is the infant mortality rate in England and Wales as a whole.

And for the 'routine and manual' group we can define:

$$IMR_r = \frac{Number\ of\ infant\ deaths\ in\ year\ in\ the\ Routine\ and\ Manual\ group}{Number\ of\ live\ births\ in\ year\ in\ the\ Routine\ and\ Manual\ group} \times 1000$$

where IMR_r is the infant mortality rate in the 'routine and manual' group,

Therefore the infant mortality rate can be defined as the number of infant deaths occurring during a reference period which is usually a year. However, as the numbers in the routine manual group are correspondingly smaller and subject to year on year variation, for the PSA target these rates are 'smoothed' by aggregating data for the index year, the preceding and following year to give a three year rolling average of the infant mortality rates. For example for the year 2005:

$$IMR_e^{2005} = \frac{Number\ of\ infant\ deaths\ in\ years\ 2004, 2005\ and\ 2006}{Number\ of\ live\ births\ in\ years\ 2004, 2005\ and\ 2006} \times 1000$$

with a corresponding equation for the rate in the 'routine and manual' group.

Note that although the numbers of infant deaths in any one year for England and Wales is around 3500 the number in any particular region or locality will be much smaller. Given that one should be cautious in the interpretation of rates that are based on small numbers, using local data to assess progress against the target may be challenging. For example, at the PCT level a single additional death can make a large difference in the rate from one year to the next.

Note also that there is a potential for misclassification of some neonatal deaths occurring immediately following birth as stillbirths. Such an occurrence leads to an underestimate of the infant mortality rate.

Absolute and relative measures

When comparing two groups, an absolute measure is a simple arithmetical difference between the rate in a group of interest and the rate in a reference group. So the absolute difference between two infant mortality rates can be expressed as:

$$A = IMR_r - IMR_e$$

where A is the absolute difference, IMR_r is the infant mortality rate in the 'routine and manual' group, IMR_e is the infant mortality rate in England and Wales as a whole.

In contrast, a relative measure (more specifically the percentage difference) expresses the difference between rates in terms of the rate in the reference group as a percentage[iv]. That is:

$$R = \frac{IMR_r - IMR_e}{IMR_e} \times 100$$

where R is the relative gap.

Changes in absolute and relative measures over time – trends and the target

Although absolute and relative measures for a given time-point and their comparison is useful, usually the main interest is in tracking them over time, perhaps to monitor the trend or assess the potential effects of policies and interventions.

Table B1. Live births and linked infant deaths by socio-economic classification of father as defined by occupation, England and Wales, 2006 (Source: Table 12, ONS Series DH3, no 39)

Socio-economic group (NS-SEC)	Live births No. (% of total)	Infant deaths No. (% of total)	Rate (IMR) per 1000 live births
1	107710 (16.1)	327 (10.2)	3.04
2	128120 (19.1)	416 (13.0)	3.25
3	36780 (5.5)	200 (6.2)	5.44
4	84420 (12.6)	340 (10.6)	4.03
5	78760 (11.8)	320 (10.0)	4.06
6	69720 (10.4)	478 (14.9)	6.86
7	81110 (12.1)	500 (15.6)	6.16
8	80 (0.01)	3 (0.1)	37.50 } 8.80
Not classified	37890 (5.7)	331 (10.3)	8.74
'Sole registrants'	45455 (6.8)	292 (9.1)	6.42
Total	***670045 (100%)**	**3207 (100%)**	**4.79**
'Routine and manual' (NS-SEC groups 5,6,7)	229590 (34.3)	1298 (40.5)	5.65
'Rest of the population' (NS-SEC groups 1–4) +	357030 (53.3)	1283 (40.0)	3.59
'Whole population' (NS-SEC groups 1–7)**	586620 (87.5)	2581 (80.5)	4.40
Excluded from 'whole population' ++	83425 (12.5)	626 (19.5)	7.50

* Note that the true total number of births in 2006 was 669601 not 670045 – the 'Total' figure shown in this table was calculated by summing the 'grossed-up' figures in the preceding rows.
+ 'Rest of population' = NS-SEC groups 1–4, i.e., whole population excluding 'routine and manual'.
** 'Whole population' = total population excluding 'sole registrants, 'not classified' and NS-SEC group 8 ('Never worked and long-term unemployed').
++ Groups excluded from the infant mortality target (i.e., NS-SEC group 8, 'not classified' and 'sole registrants').

iv This is mathematically equivalent to the ratio of the rates.

Monitoring the indicator for the infant mortality inequality target involves studying the trend in a relative measure because the target is framed as a change over time (10% reduction between 1998 and 2010) in the size of the relative gap between the 'routine and manual' group and the whole population. It was already known that the relative gap for the triennium 1997–99 was 13%. A 10% reduction in this would be around 12%, and therefore the target will be met if the indicator for 2009–11 is less than 12%.

Some limitations of the indicator for the 2010 target

We first consider measuring inequality at one point in time and then go on to consider measuring changes in inequality over time.

The first point to notice is that the gap may not adequately characterise the range of variability in the population (Table B1).

Notice first that 'sole registrants', 'group 8' and 'not classified' are excluded from the target. The variability between the 'routine and manual' (R&M) group and the whole population is a rate of 5.65 compared to 4.40, a difference of 1.25 deaths per 1000 live births. Note then that the variability *within* the R&M group is 2.80 deaths per 1000 live births (group 6 vs. 5), and the variability *within* the whole population (excluding group 8 due to its small numbers) is 3.82 deaths per 1000 live births. Note that the

target indicator measures the relative difference between the risk (of death) to the average member of the R&M group of live births and the risk to the average member of the whole population. From the table this is 100 X (5.65-4.40)/4.40 =28.40%. However, if our interest was in comparing the health of those in R&M with those in the best off group (group 1), the gap increases to 100 X (5.65-3.04)/3.04 =85.86%.

Moving on to consider measuring changes in inequality over time, again we use data from ONS for illustrative purposes. This time the data are those reported (on page 6, Figure 2) of a recent Department of Health publication on the infant mortality target.[10] The data are shown in Table B2 below. Note that, for each triennium, the IMRs in the whole population and R&M groups are reported. The indicator has been expressed as a percentage gap rather than as a ratio.[v] For completeness the absolute difference in IMRs has been calculated from the data reported in this table.

Note that IMRs are falling in the R&M group and in the whole population. There has been a fall of about 1 death per 1000 live births in both groups between 1994–96 and 2004–06. In absolute terms the groups differ by around 1 death per thousand live births, and this has changed little over the 10-year period. However the relative gap has varied much more and seems to show an overall widening of inequality. This situation arises because the same annual

Table B2. Infant mortality rates for the 'routine and manual' group and the whole population, relative measure (% gap) and absolute measure (rate difference) (Source: Department of Heath[12])

Triennium	Whole Pop.	R&M Group	Relative (% Gap)	Absolute (Rate diff)
1994–96	5.9	6.7	15	0.8
1995–97	5.8	6.6	14	0.8
1996–98	5.7	6.4	12	0.7
1997–99	5.6	6.3	13	0.7
1998–00	5.4	6.2	14	0.8
1999–01	5.3	6.2	17	0.9
2000–02	5.2	6.0	16	0.8
2001–03	5.0	6.0	19	1.0
2002–04	4.9	5.9	19	1.0
2003–05	4.8	5.7	18	0.9
2004–06	4.8	5.6	17	0.8

v In Figure 2 of ref. 10 the data are presented as a ratio, but in Figure 3 directly below it they are reported as a percentage gap. For consistency, we have expressed it as a percentage gap by subtracting 1 from the ratio and multiplying by 100%. The two measures (ratio and gap) are mathematically equivalent under this transformation.

absolute difference of about 1 per 1000, becomes an increasing proportion of a fraction with a diminishing denominator over time. This result can be further illustrated by considering the extreme position where the IMR in the whole population, diminished to 0.1 per 1000 and the IMR in the R&M group reduced to 1.1 per 1000. The absolute difference remains 1.1-0.1 = 1 per 1000, but the relative gap becomes 100 X (1.1-0.1)/0.1 =1000%!

This example indicates that absolute and relative measures can lead to different conclusions about trends in inequalities. In fact, in more extreme circumstances, they can lead to opposite conclusions. For example, Harper and Lynch[9] graphed trends in infant mortality rates in White and Black children in the United States from 1900 to 2000. They showed that, between 1900 and 1920 both absolute and relative inequality in rates declined. Between 1920 and 1950 absolute inequality declined while relative inequality remained the same. Finally between 1950 and 2000, absolute inequality decreased while relative inequality increased. These seeming paradoxes and relative strengths and limitations of absolute and relative measures are more fully explored elsewhere.[11,12]

As a final point, note that the R&M group are part of the whole population, that is the numerator (target group) is also part of the denominator (the reference group). Therefore, any reduction in infant deaths in the R&M group will also cause a corresponding reduction in infant deaths in the whole population.

Appendix B references

10. Department of Health. Tackling Health Inequalities: 2004-06 data and policy update for the 2010 National Target. 2007.

11. Low A, Low A. Importance of relative measures in policy on health inequalities. BMJ. 2006; 332(7547):967-9.

12. Messer LC. Invited commentary: measuring social disparities in health--what was the question again? Am J Epidemiol. 2008 Apr 15;167(8):900-4.