ScotPHO
Deprivation Profiles

Technical Report v1.1

Document Control:

Document Control	
Version	V1.1
Date Issued	07/03/2016
Author(s)	Andrew Gasiorowski
Other Related Documents	
Comments to	andrew.gasiorowski@nhs.net

Document History			
Version	**Date**	**Comment**	**Author(s)**
V1	07/12/2015	Final draft	A.Gasiorowski
V1.1	07/03/2016	Amended error around LE time period aggregation.	A.Gasiorowski

Contents

Introduction

The ScotPHO deprivation profiles is intended to provide service providers, planners and policy makers with nationally comparable information to improve understanding of health issues relating to the people of Scotland, to set these issues in a national context and to take action to improve the health of communities. They provide information for both NHS Boards (based on the revised health board boundaries as at 01 April 2014) and local authorities. The reports currently include: 70 health board spines, 160 local authority spines (one spine per-quintile, per-area), supplementary data as well as a series of online maps to help better identify within area quintiles.

These profiles are designed to make comparison and highlight inequalities within a geographical area. The tool has several features to aid interpretation of any differences seen; for example colour-coding in the spine charts to indicate statistical significance of differences, and confidence intervals in rank charts and time trend graphs.

This document provides technical information to supplement the information contained in the Definitions and Sources table, available in the online profiles tool. It includes extra detail on the spine indicators, their derivation, descriptions of statistics and methods, and caveats about the information.

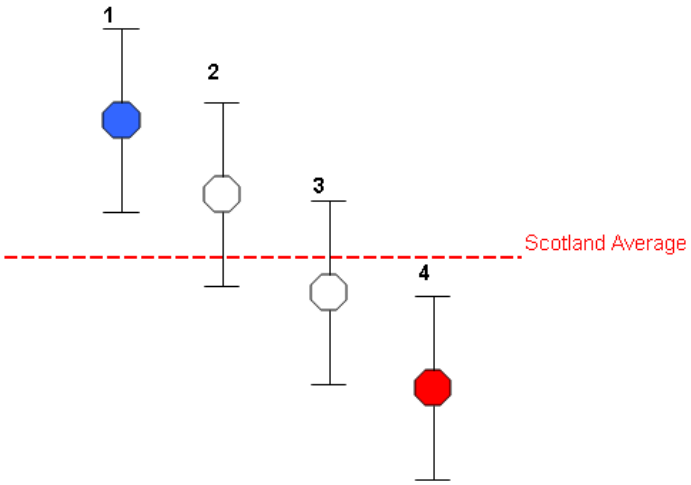
Interpreting the spine charts

Spine charts are commonly used in public health profiles to illustrate graphically a range of complex information in a way which it is intended will be quickly and easily understood. To aid comparison, in these profiles all the indicators are shown against the Scottish mean value (red line) as a reference. A modified 'traffic light' system has been applied to identify areas which are statistically significantly 'better' (blue) or 'worse' (red) than the Scottish average, or not significantly different from the Scottish average (white). In addition, orange circle with white centre, indicates where an area is significantly different from the Scottish average, but no judgement as to 'better' or 'worse' is appropriate. The 95% level of significance is used throughout.

To take some examples: in some cases (such as death rates) a higher level is clearly 'worse' (red) and a lower level 'better' (blue), while in other cases (such as immunisation coverage) a higher level is clearly 'better' (blue) and a lower level 'worse' (red). Four indicators (children looked after by the local authority, single adult dwellings, referrals to the Children's Reporter for violence-related offences and teenage pregnancies among under-20s) are marked with orange circles with a white centre when significantly higher or lower than the Scottish average, as no judgement is made as to whether a higher or lower level is 'better' or 'worse'.

The 95% confidence interval for an indicator value for an area is used to compare that area against the overall Scotland value. The Scotland value is treated as an exact reference value, allowing the confidence interval for an indicator value to be used to test whether the value was statistically significantly different to the Scottish figure. If the interval does not include the Scottish value, the area is assessed as being statistically significantly different from Scotland (perhaps 'better' or 'worse', depending on the indicator); if the interval

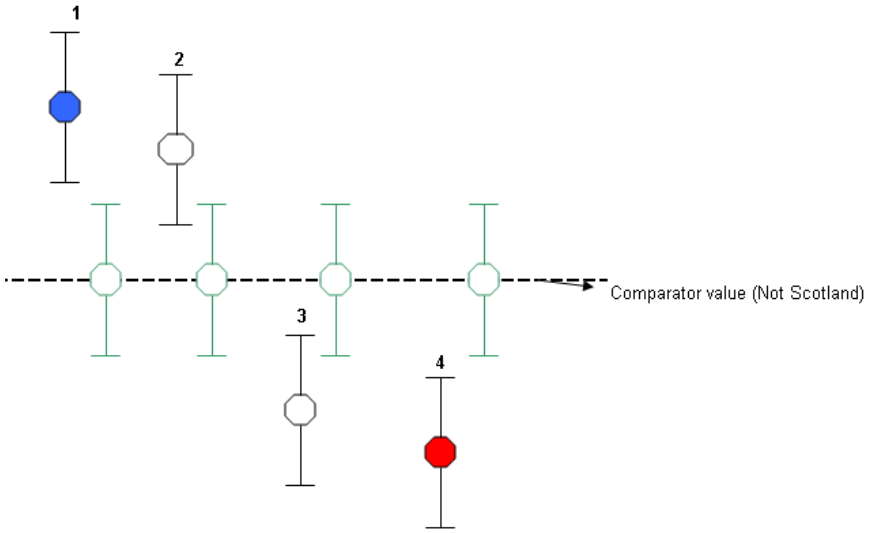
includes the Scottish value, the area is assessed as being similar to Scotland. This is illustrated in the example below.



Area 1: Area is statistically significantly better than the Scotland average.
Area 2: Area is similar to the Scotland average.
Area 3: Area is similar to the Scotland average.
Area 4: Area is statistically significantly worse than the Scotland average.

When the comparator is changed from the Scotland average to another area, the comparator is no longer treated as an exact reference value. Instead the confidence interval for the comparator value is used. Statistical significance is determined if the interval for the indicator value falls out with the interval for the comparator value. This is an approximate approach that has been used for the sake of simplicity; future versions of this tool may use more exact methods.

If the interval for the indicator value includes the comparator value (OR any value within the comparator interval), the area will be assessed as being not statistically significantly different. This is illustrated in the example below.



Area 1: Area is statistically significantly better than the Comparator value.
Area 2: Area is similar to the Comparator value.
Area 3: Area is similar to the Comparator value.
Area 4: Area is statistically significantly worse than the Comparator value.

The 5th, 25th, 75th and 95th percentiles are also included in the spine charts to show the distribution of the indicators.

Different indicators have different lengths of bars representing the distribution, depending on the variability inherent in the data. Note that in some profiles, the illustration of the distribution may exceed the space allowed for the bar, and is therefore truncated. When the distribution is skewed, the light grey bar will be longer on one side of the dark gray bar than the other.

By default, each indicator is based on the most recent of the time periods given in the Definitions and Sources table (included in the online profile tool). These time periods were the most recent for which data were available at a Scotland level in March 2015.

Measures used in the profiles

The measures generally follow the statistics and methods recommended by the Association of Public Health Observatories (APHO).[1] The definitions given below are adapted from the APHO paper.

- **Proportions** are statistics where the denominator is the count of a 'closed' population, and the numerator is the count of members of this population that have a specified characteristic. If *O* is the observed number of individuals in the sample/population having the specified characteristic and *n* is the total number of individuals in the sample/population, then the estimated proportion is given by $p = O/n$. In these profiles, proportions have been multiplied by 100 to obtain **percentages** for presentation purposes.

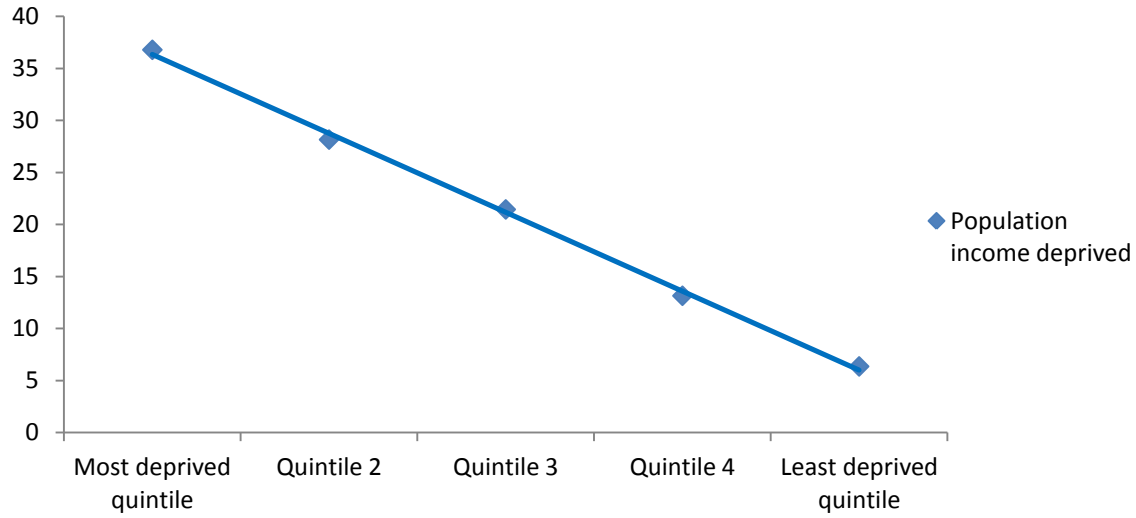
- **Crude rates** are calculated in these profiles as follows. If *O* is the number of people experiencing an event (such as a hospital admission) in a population of size *n* during a period *t*, then the estimated crude rate is given by $r = O/nt$. The crude rates are expressed per 100,000 population or per 1,000 population, per year.

- **Directly age-sex standardised rates** have been calculated for some hospital patient and mortality indicators because the overall rate may vary with the age-sex structure of the populations. The direct standardisation method was used, with the age-sex specific rates of the local population applied to the age-sex structure of a standard population (in this case the European standard population 2013). This gives the overall rate that would have occurred in the local population if it had the same age-sex profile as the standard population. It allows valid comparisons to be made

[1] APHO Technical Briefing paper: http://www.apho.org.uk/resource/item.aspx?RID=48457. Date of publication 1st March 2008.

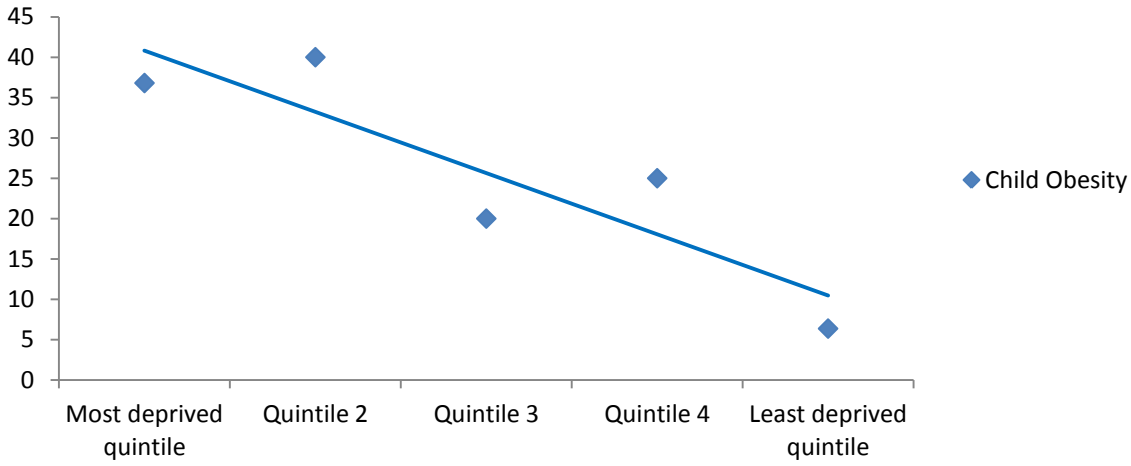
between local areas with differing population age-sex structures. In the profiles, age-sex standardised rates are expressed per 100,000 population per year. The European standard population (ESP), which was first used in 1976, was revised in 2013. European age-sex standardised rates (EASR) using ESP1976 cannot be compared with EASR using ESP2013. See Appendix I for further details.

- **Slope Index of Inequality**
  The SII is defined as the slope of the regression line showing the relationship between a class health status and its relative rank in the socioeconomic distribution, i.e. the steepness of the line between the most and least deprived groups in the population. This line can also be referred to as the inequality gradient, or 'slope' of deprivation. For example, the chart below shows income deprivation in a particular population. Each of the quintiles represents approximately 20% of the population. The steeper the line, the higher the inequality between the groups, and therefore the higher the SII.



Within the Deprivation profiles, this is repeated for each indicator to find the SII. Higher SIIs represent a greater effect on health moving from the most deprived to the least deprived quintile.

- **Relative Index of Inequality**
  One of the limitations of SII is that it does not take into account where there are wide variations in the slope of the outcome being measured between quintiles. Although the most deprived quintile and least deprived quintile may create a linear trend, this can mask variation amongst the other quintiles. Because the SII is based on a line of 'best fit', it will not always fall perfectly through each quintile's value. In the hypothetical example below, the rate of child obesity is actually highest in quintile 2 and the rate in quintile 3 is lower than in quintile 4. This variation would not be reflected in the SII – the RII is one way of accounting for this variation between groups.



The RII is calculated by dividing the SII value for the rate for the whole population. This adds a weighting effect and takes into account the differing values of the outcome across the population of interest. RII values can give an indication of how much variation is present in the population between the deprivation groups: higher RIIs indicate that there is a greater amount of variation between the quintiles. This means that the effect on health moving from one quintile to the next is not straightforward and could affect different groups in different ways: it is therefore useful to consider the SII in conjunction with the RII.

Confidence intervals

A confidence interval is a range of values that is normally used to describe the uncertainty around a point estimate of a quantity, for example a mortality rate. In the case of indicators based on a sample of the population, uncertainty arises from random differences between the sample and the population itself. The stated value should therefore be considered as only an estimate of the true or 'underlying' value. Confidence intervals quantify the uncertainty in this estimate and, generally speaking, describe how different the point estimate could have been if the underlying conditions stayed the same, but chance had led to a different set of data. The wider the confidence interval, the greater the uncertainty in the estimate.

Confidence intervals are given with a stated probability level. In the Scottish Health and Wellbeing Profiles this is 95%, and so there is a 95% probability (i.e. a 19 in 20 chance) that the confidence interval includes the 'true' value of the indicator. The use of 95% is arbitrary, but is conventional practice in medical and public health statistics. The 95% confidence interval for an indicator value for an area is used to compare the area against the overall Scotland exact reference value. When the comparator is changed from Scotland to another area, the comparator is no longer treated as an exact reference value. Instead the confidence interval for the comparator value is used as described in Section 1.

Appendix II comprises a table of the methods used to calculate confidence intervals for the different measures used in the profiles, following APHO recommendations.

Geographies and populations

On 1st April 2014, NHS Board boundaries were changed to align with those of local authorities. This means that all 32 local authorities (1996 configurations) should be coterminous with the 14 NHS Boards based on the 2014 NHS Board boundaries.

All of the population estimates for local authorities presented in the profiles are aggregations of data zone level populations provided by National Records of Scotland (NRS). In all cases 2011 Census based mid-year population estimates have been used.

Scottish Index of Multiple Deprivation (SIMD)

The Scottish Index of Multiple Deprivation is the Scottish Government's official tool for identifying areas in Scotland concentrations of deprivation by incorporating several different aspects of deprivation (multiple-deprivations) and combining them into a single index. Concentrations of deprivation are identified in SIMD at Data Zone level and can be analysed using this small geographical unit. The use of data for such small areas helps to identify 'pockets' (or concentrations) of deprivation that may be missed in analyses based on larger areas such as council wards or local authorities. By identifying small areas where there are concentrations of multiple deprivation, the SIMD can be used to target policies and resources at the places with greatest need. The SIMD identifies deprived areas, not deprived individuals. For more details, please see the Scottish Government's SIMD 2012 publication homepage.

The SIMD is based on small areas called Data Zones. 2001 Data Zones were introduced in 2004 to replace postcode sectors as the key small area geography for Scotland. They were based on 2001 Census Output Areas and were intended to be a stable geography over time, with a reasonably consistent population size, and boundaries set to respect physical boundaries and natural communities as far as possible. Because they are population-based, Data Zones can vary hugely in size. For example, in towns and cities where people live close together, Data Zones can contain only a few streets, while in rural areas that are sparsely populated, they can cover many square miles. Scotland is divided into 6,505 Data Zones each containing around 350 households and mean population size of 800 people. For each Data Zone, a deprivation score is calculated from a large number of indicators in several domains, which is used to determine the ranking for each Data Zone from 1 (most deprived) to 6,505 (least deprived).

There have been SIMD releases in 2004, 2006, 2009 and 2012. Note that only the corrected 'version 2' for the 2009 release, referred to as SIMD 2009v2, is used.

SIMD 2012 was based on the 2001 Data Zones and comprised seven domains (income, employment, education, housing, health, crime, and geographical access). The SIMD has the advantage of being a measure of multiple deprivation. A total of 38 indicators were used in the 2012 release, including indicators relating to geographical access to key services (travel times for driving and public transport) which are the best available indicators to

measure difficulties in accessing local amenities as a problem specific to rural deprivation. SIMD 2012 was published on 18 December 2012 and follows the same domain structure as SIMD 2009, with a few modified/improved indicators.

For any particular SIMD release, each Data Zone is ranked according to the overall score from the range of indicators which put together creates the index. Ranks are grouped into categories (in this case quintiles). SIMD 2012 is based on the 2001 Data Zones. Population-weighted ranks have been based on 2010 mid-year population estimates.

Notes on the use of SIMD

Population Weighting

The deprivation profiles rank Data Zones from most to least deprived using the Scottish Government's un-weighted SIMD and by using the National Records of Scotland population estimates, split this into:

- 5 deprivation quintiles with approximately 20% of the population in each quintile

This differs to the method used by the Scottish Government (SG) who publish SIMD deprivation categories which are NOT population weighted. The SG rank Data Zones from most to least deprived and then split this into:

- 5 deprivation quintiles with 20% of the Data Zones in each quintile

The reason behind population weighting of deprivation quintiles can be found here.

Limitations of SIMD

It is important to note that the SIMD identifies deprived areas, not deprived individuals.

The SIMD cannot be used to determine 'how much' more deprived one Data Zone is than another e.g. it is not possible to say that Data Zone X, ranked 50, is twice as deprived as Data Zone Y, ranked 100. The SIMD can be used to identify Scotland's most deprived small areas on the overall index and each individual domain, commonly by applying a cut off such as 10%, 15% or 20%. The cut off should be informed by whether it aims to target areas with the very highest concentrations of deprivation or to be wider ranging. The SIMD provides a relative measure of deprivation which means that the main output from SIMD - the SIMD ranks - can be used to compare Data Zones by providing a relative ranking from most deprived (rank 1) to least deprived (rank 6,505).

One theoretical criticism of SIMD is that because it includes a health domain, its use to study deprivation patterns in health is invalid because the SIMD and the health indicator being studied are not independent of each other. However, the health domain is weighted to account for a relatively small part of the overall SIMD (14% of SIMD 2009 and 2012), and analyses of health inequalities using SIMD 2004 were found to give similar results whether the health domain was included or excluded, because that domain was so highly correlated with the overall index. Therefore, PHI advice to analysts is that the full SIMD may be used for analysing health data.

Quintiles used have been are obtained by ranking the Data Zones from most to least deprived, then splitting this ranking into 5 deprivation quintiles with approximately 20% of the

all-ages population in each quintile ('population weighted'). Quintiles have been calculated separately for within individual NHS boards and local authorities.

Within NHS Board and local authority SIMD population-weighted quintiles are calculated by ranking all Data Zones in each NHS Board/local authority from most to least deprived and then splitting this into 5 deprivation quintiles with approximately 20% of the NHS Board/ local authority population in each quintile. The use of within-NHS Board and within-local authority level quintiles is necessary in order to:

- Look at health patterns in a local area in detail.
- Ensure there are Data Zones falling into each quintile.

Comparisons between one NHS Board / local authority quintile with another NHS Board / local authority quintile are not valid and should not be made.

Further details on specific indicators

Please note that all the data presented in the Deprivation profiles release are residence-based, to aid public health interpretation. Thus hospitalisation rates are based on a patient's home address (rather than the location of the hospital).

The raw data used to produce the indicators came from a variety of sources (see Definitions and Sources table in all of the profiles products). Where necessary, some indicators are based on more than one year of data. This is because numbers for a single year may be too small to give robust figures. Combining years allows more reliable figures to be produced.

The figures presented in the profiles are aggregations from the 2001 data zones to either within NHS Board quintile or within local authority quintile. Thus there may be some differences between totals presented here and in the other publications, as by design records with missing data zones are excluded from Scotland and NHS Board totals. In addition, where standardised rates are calculated, records missing age and/or gender variable are not accounted for.

Populations income (1) and working age employment deprived (7)

Those indicators show number and percentage of, respectively: a total population classified as income deprived, or working age population (defined here as 16 to 64 year olds) classified as employment deprived within SIMD income domain.

The confidence intervals were calculated using the Wilson method (see Appendix II). Figures for calendar year 2013 are presented in the spine chart and the time trend is available from 2004.

There have been four relevant SIMD releases for the time period covered by the profiles time trend (2004, 2006, 2009 and 2012). To ensure that the SIMD categories are the best available representation of deprived areas at each of the points in the time, we apply index release most pertinent to particular year in trend.

The percentage of working age population for years before the equalisation of male and female state pension age, i.e. 2004 to 2010, is calculated against population estimates for 16

to 64 year old males and 16 to 60 year old females. The 2011 to 2013 figures use the same age cohort, i.e. 16 to 64, for both genders.

No suppression is required for these indicators.

For information on how the SIMD 2012 is calculated please see the SIMD website: SIMD2012 and SIMD2012 Background Data.

Children living in poverty (4)

This indicator shows number and percentage of dependent children under the age of 20 in families that receive Child Tax Credits (<60% median income) or Income Support/ Jobseeker's Allowance.

The total number of children in the area is produced using Child Benefit data held by HMRC which covers around 96% of children. All of the estimates are independently rounded to the nearest 5, therefore aggregating the individual estimates may not sum to the given totals for an area. The estimates are based on the finalised awards tax credits data, and as such are derived from a full set of administrative records rather than a sample. From this data the "sub-period" of the award that spanned the 31st August is selected.

The figures presented here come from HMRC (2012) publication and we recognise that most up-to-date Scottish average could be accessed using different data sources such as FRS. But, due to the nature of analysis (small area) carried out in the profiles; we opted to purposefully not use those data sources. (Latest 2012/13 figures from www.scotland.gov.uk/Resource/0045/00454875.pdf Table A1)

Figures in the spine chart are presented for August 2012, with time trend available from 2009.

Working age population claiming Out of Work benefits (10)

This indicator shows number and percentage of working age population (defined here as 16-64 year olds) claiming 'key out of work benefits'.

'Key out-of-work benefits' is a Department of Work and Pensions (DWP) term which covers the following benefits: Jobseeker's Allowance, Employment and Support Allowance, Incapacity Benefit, Severe Disablement Allowance, Income Support with a child under 16, No partner /lone parent and other Income Support, as well as Pension Credit. Please note that this list is slightly different from 'key benefits', which also include Disability Living Allowance.

The data in the spine chart is presented as point in time snapshot at the end of May 2013, with the time trend available from May 2002. The percentage of working age population for years before the equalisation of male and female state pension age, i.e. 2004 to 2010, is calculated against population estimates for 16 to 64 year old males and 16 to 60 year old females. The 2011 to 2013 figures use the same age cohort, i.e. 16 to 64 for both genders.

No suppression is required for this indicator.

Child obesity in primary 1 (13)

This indicator shows the number and percentage of Primary 1 children whose BMI is within the top 5% of the 1990 UK reference range for their age and sex. Denominator is number and percentage of all children reviewed. Data is not available for all areas.

The Child Health Systems Programme - School Aged Children (CHSP-S), from which these data are derived, was introduced in 1993 and the number of participating boards has increased over the years to all 14 NHS Boards. The body mass index (BMI) statistics cover approximately 92% of children in Primary 1 in Scotland. The recording of this indicator at Data Zone level has vastly improved over time - there were a lot of missing data zones particularly between 2003 - 2007, thus in many cases it looks like there has been a dramatic increase but in fact this could be due to improved recording.

Further information can be obtained from the ISD Primary 1 Body Mass Index (BMI) Statistics Report 2013/14.

Figures presented in the spine chart are for academic year 2013/14 and time trend is available from 2002/03.

No suppression is required for this indicator.

Road traffic accident (RTA) casualties (16)

This indicator is the European age-sex standardised rate (EASR) of patients who were discharged from hospital after an emergency admission or who died as a result of a road traffic accident in Scotland.

The principal data source for this indicator is the SMR01 dataset linked to NRS death registrations. Patient was selected only once per year, based on their RTA admission to hospital that year. Patient's demographic data (age, gender, location of residence) is extracted from the first valid information within that stay.

This indicator is expressed as a three-year rolling average number and EASR per 100,000 population. Figures presented in the spine chart are for 2011-2013 calendar year rolling average and available time trends go back until 2002-2004. The confidence intervals are calculated using the Dobson method (see Appendix II). A list of codes used to identify RTA hospital admission and RTA related death can be found in Appendix IV.

No suppression is required for this indicator.

Crime rate (19)

This indicator shows number of crimes (based on SIMD crimes of violence; drug offences; domestic house breaking; minor assault; and vandalism) and crude rate per 1,000 population.

Figures presented in the spine chart are for calendar year 2013, with time trend available from 2004.

There have been four relevant SIMD releases for the time period covered by profiles time trend (2004, 2006, 2009 and 2012). To ensure that the SIMD categories are the best available representation of deprived areas at each of the points in the time, we apply index release most pertinent to particular year in trend.

No suppression is required for this indicator.

For information on how the SIMD 2012 is calculated please see the SIMD website: SIMD2012 and SIMD2012 Background Data.

The Life expectancy indicators (22 & 25)

The life expectancy (LE) indicators show estimated average life expectancy (for males and females) at birth in years.

LE at birth for an area is the number of years that a newborn baby would live if they experienced the age-specific mortality rates for that area, for the time period used, throughout their life. It is a theoretical measure that reflects recent mortality rates throughout life, rather than a true prediction of the life expectancy of the local population.

The calculations use abridged life tables, with LE calculations based on Chiang (II)[2] methodology. They use NRS mid-year population estimates and death registrations (by year of registration.

For the NHS Board and local authority, LE is calculated over five-year time periods. Please note that the data points indicated on the time trend charts are marked to represent those 5-year aggregates.

Please note that some of these data have large 95% confidence intervals (up to 14 or 12 years). The implications of this are best explained using an example. The lowest remaining male LE at birth (58.4 years) has a confidence interval of 8.0 years, from 54.4 to 62.4 years. This means that there is a 1 in 20 chance that the true LE at birth lies either below 54.4 years or above 62.4 years (although the most likely true value remains at 58.4 years). The wide range of possible values indicates that further caution is required in drawing conclusions about the apparent ranking of small areas.

For further details of LE calculation, including imputation of non-resident deaths, please see the Healthy Life Expectancy topic on the ScotPHO website:

[2] Chiang CL, The life table and its construction, in Chiang CL, Introduction to stochastic processes in Biostatistics. New York, John Wiley 1968.

http://www.scotpho.org.uk/population-dynamics/healthy-life-expectancy/references

All cause mortality among 15-44 year olds (28)

The all cause mortality indicator uses NRS death registrations (by year of registration), and is calculated over a three-year rolling period to ensure reasonably robust estimate. Rates (presented per 100,000 population) are age-sex standardised against the European standard population (ESP2013). This improves the comparability of rates for different areas by taking into account differences in the age structures of the populations being compared.

Data for years 2011-2013 is presented in the spine chart, while time trends go back to 2002-2004. Calculations are based on Dobson methodology.

No suppression is required for this indicator.

Patients (65+) with multiple emergency hospitalisations (31)

This indicator is the European age-sex standardised rate (EASR) of patients aged 65-years and over who had two or more general acute inpatient & day case emergency admissions to hospital in Scotland.

The principal data source for general acute inpatient & day case stays is the SMR01 dataset. If one patient had two emergency continuous spells of care in hospital in a year and another patient had ten emergency stays in hospital in the same year, then they would simply count as two patients with multiple emergency admissions. The Scotland total does not match the sum of the local authorities (LA) as some patients may be resident in more than one LA during one calendar year, and as we had counted as multiple emergency admissions only those that happened while patients resided in the same geography.

This indicator is expressed as a three-year rolling average number and EASR per 100,000 population. Figures presented in the spine chart are for 2011-2013 calendar years and available time trends go back until 2002-2004. The confidence intervals are calculated using the Dobson method (see Appendix II). A list of codes used to identify emergency hospital admission can be found in Appendix IV.

No suppression is required for this indicator.

Patients with emergency hospitalisations indicator (34)

This indicator is the European age-sex standardised rate (EASR) of all patients with a general acute inpatient & day case emergency admissions to hospital in Scotland.

Hospital activity data are collected across the NHS in Scotland and are based on nationally available information routinely drawn from hospital administrative systems across the country. The principal data source for general acute inpatient & day case discharges is the SMR01 dataset. Each individual patient may have more than one stay. However for this

indicator each patient is selected only once per year, based on his or her first related admission to hospital that year. Patient's demographic data (age, gender, location of residence) are extracted from the first valid information within that stay.

This indicator is expressed as a three-year rolling average number and EASR per 100,000 population. Figures presented in the spine chart are for 2011-2013 calendar years and available time trends go back until 2002-2004. The confidence intervals are calculated using the Dobson method (see Appendix II.). A list of codes used to identify emergency hospital admission can be found in Appendix IV.

No suppression is required for these indicators.

Glossary

European age-sex standardised rate (EASR)	All European age-sex standardised rates in Health and Wellbeing profile 2015 release are standardised to the European standard population 2013. Standardised rates are used to allow comparisons across geographical areas by controlling for differences in the age structure of local populations. They give the number of stays (per 100,000 in this case) that would occur in a standard population if that population had the age-specific rates of the area being investigated.
ICD-10	World Health Organisation International Statistical Classification of Diseases and Related Health Problems, tenth revision 4th edition. These national coding standards are used when translating diagnoses and other health related problems recorded in a patient's medical record for morbidity coding. The classification of diagnoses using ICD-10 is a mandatory national requirement for the Scottish Morbidity Record dataset and other datasets.
National Registry of Scotland (NRS)	The National Registry of Scotland (formerly General Register Office for Scotland) collects the medical certificate of cause of death together with any additional information provided subsequently by the certifying doctor.
Scottish Morbidity Record 01 (SMR01)	Is an episode based patient record relating to all inpatient and day cases discharged from specialities other than mental health, maternity, neonatal and geriatric long stay specialities in NHS Scotland. A record is generated for each inpatient and day case episode, of which there are about 1,200,000 each year. Attendances at Accident and Emergency that do not result in an admission are not included. Data collected include inpatient identifiable and demographic details, episode management details and general clinical information. Up to six diagnoses are recorded per admission using the ICD-10 classification.
The Scottish Index of Multiple Deprivation (SIMD)	The Scottish Index of Multiple Deprivation (SIMD) identifies small area concentrations of multiple deprivation across all of Scotland in a fair way. The SIMD is based on small areas called Data Zones.

Appendix I: Changes to the European Standard Population

The appendix explains why European Age-Sex Standardised Rates based on the 1976 and 2013 ESP are not comparable.

Example: General acute inpatient and day case discharges in Scotland with an Alcohol-related diagnosis in any position: 1997/98-2012/13.

Based on the number of discharges observed in each of the financial years, the following rates were calculated:

Crude Rate

In this example the crude rate is the number of people who are admitted to hospital or die from a specific condition in a country or region, divided by the total population of that country or region and the total time at risk. The rate is normally expressed 'per 1,000 per year", ‘per 10,000 per year’ or ‘per 100,000 per year’. Comparing crude rates can be misleading if the age structures of the populations being compared are different. For example areas with larger percentages of younger people may have lower death rates than areas with larger percentages of older people. Differences based on comparisons of crude rates may reflect differences in age structure rather than real differences in the risk of disease. Age-Sex standardised rates take account of differences in age structure and allow comparisons to be made between different geographical areas that reflect real differences in risk rather than differences in age structure.

European Age-Sex Standardised Rate (EASR) using ESP1976

The age-specific rate is calculated for each 5 year age group by dividing the number of cases by the population and time at risk. The weighted average of all the age-specific rates is calculated to give the overall EASR. The weights are based on the population in each 5 year age group in the 1976 European Standard Population. The 1976 European Standard Population has a relatively young age structure. This has the effect of producing higher rates for conditions common in younger ages and lower rates for conditions common at older ages.

European Age-Sex Standardised Rate (EASR) using ESP2013

The age-specific rate is calculated for each 5 year age group by dividing the number of cases by the population and time at risk. The weighted average of all the age-specific rates is calculated to give the overall EASR. The weights are based on the population in each 5 year age group in the 2013 European standard population. The 2013 European standard population has a relatively old age structure. This has the effect of producing lower rates for conditions common in younger ages and higher rates for conditions common at older ages.

Appendix II: Methods used to calculate confidence intervals

For indicator presented as:	Method	Comments/ Assumptions	References
Proportions and Percentages	Wilson Score method	Wilson Score performs well when the numerator and/or denominator is small.	Wilson EB. Probable inference, the law of succession, and statistical inference. *J Am Stat Assoc* 1927;**22**:209-12.
Crude rates	Byar's approximation	Performs well with low rate and large denominator (i.e. the variability in the observed event *O* is described by the Poisson distribution). This method is simple to calculate and gives very accurate approximations to the exact Poisson probabilities even for small counts.	
Directly age-sex standardised rates	Dobson	Rates assume the Poisson distribution.	Dobson A et al. Confidence intervals for weighted sums of Poisson parameters. *Stat Med* 1991;10:457-62.

Appendix III: Method used for calculating SII and RII

Slope index of inequality (SII) and Relative index of inequality (RII) are a way of measuring the inequality gap between the most deprived and least deprived quintile. This method takes into account the inequalities across all deprivation levels instead of concentrating on the most severe differences.

The steps to calculate the slope index of inequality are:

Step 1 – Order the SIMD quintiles in order of decreasing deprivation e.g. most deprived to the least deprived.

Step 2 – Calculate the proportion population for each quintile out of the total population of the overall area. Denoted as *f*.

Step 3 – Next calculate the cumulative proportion of the populations of each quintile. Denoted as c_i.

Step 4 – Calculate the relative deprivation rank. This adjusts quintiles to take into take the difference in population size between each SIMD quintile. It creates a mid-point for each SIMD quintile based on the range in the cumulative proportions. An example of this would be is quintile 1 has 21% of the population with it the mid-point is 21/2 = 10.5. The quintile 2 has 20% of the population then the mid-point is 21 + (20/2) = 31. The formula of this can be given as

$$x = c_{j-1} + (0.5f)$$

Where *x* is the relative deprivation rank.

Step 5 – Calculate a regression line between the SIMD quintiles and use the relative rank as the x-values. The slope coefficient is then use to describe the slope index of inequality. The Deprivation Profile shows the absolute value of the slope coefficient.

To calculate the relative index of inequality the SII is divided by the rate of the overall area e.g. the SII of Glasgow City local authority is divided by the rate for Glasgow City local authority.

Appendix IV: Codes used for death and hospital patient indicators

Indicator number	Indicator	ICD-10 Codes
16	Road traffic accident casualty patients	Type of admission code 32 for hospital admissions (principal diagnosis only) ICD-10: V01-V89 for deaths
34	Emergency admission hospital patients	Old type admission code 4,5,6,7,8
31	Multiple admission hospital patients	Patients aged 65+ with 2 or more emergency admissions (see codes above) in a year. Excludes dental hospital and geriatric long stay admissions.