ATTRIBUTABLE CHANGE IN TOBACCO CONSUMPTION	
GENERAL CONSIDERATIONS	
Issues	Respiratory disease
Type of indicator	Health outcome
Rationale	Exposure to environmental tobacco smoke – perhaps more than any other single factor – is a major threat to children's health. Tobacco smoke contains over 4000 contaminants, many of which are known or suspected carcinogens. Risks come not only as a direct and acute result of inhalation (e.g. respiratory symptoms), but also in the longer term because of increased risks of pulmonary damage, cardiovascular illness and cancer. Smoking in the home also increases the probability that the children themselves will take up the habit, thereby increasing their long-term health risks. Action to reduce smoking is therefore one of the most important and potentially effective ways of improving children's respiratory health – as well as reducing other longer-term health risks.
Issues in indicator design	In so far as action to reduce smoking is successful, it is likely to be reflected in a reduction in tobacco and cigarette sales and smoking habits (e.g. number of smokers or number of cigarettes smoked). Reliable information on smoking habits is difficult to acquire, but data on tobacco and cigarette sales and on population numbers can be used to track changes in the level of tobacco consumption. Comparing sales after policy intervention with predicted sales derived by extrapolating data from before the policy was introduced gives an indicator of the success of the policy.
SPECIFICATION	
Definition	Attributable changes in tobacco sales per adult
Terms and concepts	***Tobacco sales:*** number of cigarettes (or equivalent in tobacco) sold by year ***Total number of adults:*** number of people aged 15 years or more
Data needs	Tobacco sales Number of people aged 15 years or more
Data sources, availability and quality	Data on tobacco sales can be obtained from a number of sources, including tobacco companies, taxation agencies or retailers. These data are likely to be broadly reliable, though some under-reporting is likely due to sales on the informal market. Where sales data are not available, estimates may be made on the basis for surveys either of consumers or retailers. Data on population numbers should be available from national censuses and should then be reliable. Estimates for inter-censual years (or where census data are not available) may be made using population.
Level of spatial aggregation	Region
Averaging period	Annual

Computation

The indicator can be computed as the percentage change in the sales of tobacco per adult before and after intervention, over and above any change that would have occurred without intervention. This is done by finding the difference between tobacco purchases after intervention and the projected sales based on a 'no-intervention' scenario. Three steps are involved in the process of the indicator development.

First the trend in annual sales per head of population should be computed for the pre-intervention period. This is best done using regression analysis methods (as available in most statistical packages and spreadsheets such as Excel). This provides a formula that can be used to predict sales in the post-intervention period. If no trend is observable (i.e. if the association with time is statistically not significant at the 95% level), then the arithmetic average from the pre-intervention period should be used. Alternatively, it may be possible to derive a trend 'by eye' by graphing the data as a scattergram and interpolating a trend line. Whichever method is used, attention should be paid to the nature of the relationship; in the event of a strongly non-linear trend, for example, an appropriate curvilinear trendline should be fitted, either by transforming the data or by using polynomial curve-fitting functions.

Using the fitted trend, sales for the period after policy intervention should then be calculated, by projection of the trendline, and taking account of any population change. Values for each year since intervention should be computed.

Finally, the reported sales post-intervention are compared with the projected sales per adult and the differences calculated. The indicator is expressed as the percentage difference, compared with the projected sales, as follows:

$$100 * \Sigma(Sales_{rpost} - Salesl_{proj}) \; / \; \Sigma\,(Salesl_{proj})$$

where: $Sales_{proj}$ is the projected volume of tobacco sales during the post-intervention period;

$Sales_{post}$ is the reported volume of tobacco sales during the post-intervention period.

Units of measurement

Percentage change

Worked example

A worked example is presented in the table below. In this case, an intervention in the year 1999, aimed at reducing sales, is assessed using an indicator of sales over the following five years.

Year	Actual			Projected	
	Volume	Pop (million)	Sales rate	Post-sales rate	Volume
1994	47	14	3.36		
1995	50	14.1	3.55		
1996	48	14.2	3.38		
1997	54	14.3	3.78		
1998	53	14.4	3.68		
1999					
2000	51	14.5	3.52	3.91	56.70
2001	49	14.6	3.36	4	58.37
2002	50	14.7	3.4	4.09	60.06
2003	49	14.8	3.31	4.17	61.76
2004	50	14.9	3.36	4.26	63.49
Total (post)	**249**				**300.36**

	In this case, analysis of the sales rate (per head of population) for the pre-intervention years (1994-1998) gives a positive trend, with the formula: *Sales rate = (0.0877*Year) – 171.49* In the fifth column of the table, this rate has been applied to predict the sales rate without intervention, taking account of the number of inspections made, and this is then used to recalculate the total expected sales in each of these years, allowing for the population size (column 6). The differences between the total actual sales over the post-intervention period and the total projected sales for the same period (as a percentage of the projected sales) is then calculated to represent the indicator: i.e. 100 *(249 – 300.36) / 300.36 = -17.1% - i.e. a reduction of 17.1% in the expected tobacco sales.
Interpretation	This indicator provides a measure of the rate of change in cigarette and tobacco consumption by adults. It thus indicates the success, or otherwise, of policies aimed at reducing cigarette and tobacco consumption. A negative value of the indicator implies that policies are effectively reducing average levels of consumption; a positive value implies that policies are not reducing consumption levels. Several factors nevertheless need to be kept in mind in interpreting the indicator. Changes do not only reflect the effects of policy: other factors, such as population numbers, changing age or gender profiles, and changes in levels of disposable income may also affect consumption. Problems of data reliability also need to be considered, especially where there is a significant informal market for cigarettes and tobacco. Care is therefore needed in attributing changes to specific policy measures.
Variations and alternatives	Where policies to reduce tobacco consumption are introduced in only part of the area of interest, this indicator can be improved, by comparing trends before and after intervention in the intervention area (i.e. where the policy has been applied) with trends before and after intervention in a matched control area (one with similar consumption characteristics but in which the policy has not been applied).
Examples	None known
Useful references	Cunningham, J., O'Connor, G.T., Dockery, D.W. and Speizer, F.E. 1996 Environmental tobacco smoke, wheezing, and asthma in children in 24 communities. *American Journal of Respiratory and Critical Care Medicine* 153, 218-24. DiFranza J.R. and Lew, R.A. 1996 Morbidity and mortality in children associated with the use of tobacco products by other people. *Pediatrics* 97, 560-8. Etzel, R.A. 2001 Indoor air pollutants in homes and schools. *Children's Environmental Health* 48, 1153-65. Etzel, R.A. 1990 A review of the use of cotinine as a marker of tobacco smoke exposure. *Preventative Medicine* 19, 190-7. Forastiere, F., Corbo, G. M. Michelozzi, P., Pistelli, R., Brancato, G., Ciappi,

	G. and Perucci, C. A. 1992. Effects of environment and passive smoking on the respiratory health of children. *Journal of Epidemiology 21:66-73.* Hamahan, J. P., Tager, I.B., Segal, M. R. , Stile, R. G., van Vunakii, H. V., Weiss, S. T., and Speizer, F. E. 1992. The effect of maternal smoking during pregnancy on early infant lung function. *American Review of Respiratory Diseases* 145, 1129-1135. Martinez, F.D., Cline, M. and Burrows, B. 1992 Increased incidence of asthma in children of smoking mothers. *Pediatrics* 89, 21-6. Gergen, P.J. 2001 Environmental tobacco smoke as a risk factor for respiratory disease in children *Respiration Physiology* 128, 39-46.