ATTRIBUTABLE CHANGE IN NUMBER OF FOOD OUTLETS FAILING FOOD HYGIENE STANDARDS	
GENERAL CONSIDERATIONS	
Issues	Diarrhoeal diseases
Type of indicator	Action
Rationale	Poor food hygiene is a major source of diarrhoeal diseases in children. Problems may occur throughout the food chain, from primary food production, through processing, manufacturing and sale, to storage, preparation and use in the home. A major source of infection – and one of the main points for control – however, are food retail outlets. Problems in this sector often occur because of inadequate or prolonged storage of food, unhygienic preparation and handling and poor packaging. Because individual retailers may serve a large number of people, problems can quickly cause major outbreaks of food-borne illness. By the same token, monitoring and inspection of these outlets, and legislation to improve their practices, can be an important way of reducing risks. This indicator uses information on the changes in the percentage of outlets failing national (or local) food hygiene standards attributable to these interventions.
Issues in indicator design	Construction of this indicator relies upon the existence of clearly defined and recognized food hygiene standards, and a monitoring regime that tests food hygiene in retail outlets. Where either of these is absent, this indicator may not be appropriate. Even where standards and monitoring do exist, problems may be encountered in compiling this indicator because of uncertainties or inconsistencies in the available data. In particular, a large and well-structured monitoring regime is essential if the full range of different food outlets is to be properly inspected and representative information provided. Methods of monitoring and assessment may also vary greatly: for example, between essentially qualitative inspections of premises to quantitative testing of food samples for biological contamination. Comparisons between different countries may thus be difficult. Finally, there is the issue of how to assess the attributable effect of the policy. This can be difficult against a background of other changes, including changes in market conditions, eating habits and food technology. Not all the changes that occur can necessarily be attributed to intervention; in some cases, intervention may be having a bigger effect than immediately apparent, because – without it – the percentage of outlets failing the food standards would have increased. To assess the attributable effects, the indicator should ideally be computed by comparing inspection failures after intervention with the expected numbers of failures, extrapolated from data before the intervention occurred.
SPECIFICATION	
Definition	Attributable change in the percentage of retail food outlets failing national (or local) food hygiene standards.
Terms and concepts	***Retail food outlet:*** a commercial food retailer; includes food shops, supermarkets, street traders, restaurants and take-aways, selling either fresh or processed produce. ***Food hygiene standards:*** legally defined hygiene standards or norms for food retailing. These typically cover the quality and appropriateness of the premises (e.g. storage and handling facilities, availability of washing areas,

	evidence of animal or insect pests) and/or the microbiological safety of the food (e.g. by laboratory testing). Testing regimes may vary both in their frequency and the range of premises and food-stuffs covered. ***Failure of food hygiene standards:*** a reported event (a single occasion at a single retail outlet) of a failure to meet the specified food hygiene standards. Repeat events (i.e. a further failure at a subsequent inspection for the same reason) should usually be counted as a separate event.
Data needs	National (or local) food hygiene standards. Number of retail food outlets inspected. Number of outlets failing on each inspection.
Data sources, availability and quality	Data on food hygiene standards are usually available from the relevant ministries or inspection authorities, at national or local level (in many countries, local authorities are responsible for food hygiene monitoring). Data on the results of inspections are also often available directly from the inspection agencies. Where an established or adequate monitoring and inspection system does not exist, special surveys may be necessary to sample major types of outlet. These need to be carefully designed to ensure proper representation of different types of outlet; as far as possible, sampling should be proportional to the contribution of each type of outlet to total food purchases.
Level of spatial aggregation	Local authority area
Averaging period	Annual
Computation	The indicator can be computed as the percentage change in the proportion of food outlets failing food hygiene standards before and after intervention, over and above any change that would have occurred without intervention. This is done by finding the difference between the rates of inspection failure after intervention and the projected failure rates based on a 'no-intervention' scenario. Three steps are involved in the process of indicator development. First the trend in annual failure rates 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 failure rates 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, the number of failures for the period after policy intervention should then be calculated, by projection of the trendline. Values for each year since intervention should be computed. Finally, the reported number of failures post-intervention are compared with the projected number and the differences calculated. The indicator is expressed as the percentage difference, compared with the projected failures, as follows: $100 * [\Sigma(Ffail_{rpost} - Ffail_{proj}) / \Sigma (Ffail_{proj})]$ where: $Ffail_{proj}$ is the projected number of inspections failed by all food outlets inspected during the post-intervention period; $Ffail_{post}$ is the reported number of inspections failed during the post-

<table>
<tr><td></td><td>intervention period.</td></tr>
<tr><td>Units of measurement</td><td>Percentage change</td></tr>
<tr><td>Worked example</td><td>A worked example is shown in the table below:
<table>
<tr><th rowspan="2">Year</th><th colspan="3">Reported</th><th>Projected</th><th></th></tr>
<tr><th>Total surveyed</th><th>Failures</th><th>Failure rate</th><th>Failure rate</th><th>Failures</th></tr>
<tr><td>1994</td><td>740</td><td>66</td><td>0.089</td><td></td><td></td></tr>
<tr><td>1995</td><td>728</td><td>76</td><td>0.104</td><td></td><td></td></tr>
<tr><td>1996</td><td>760</td><td>73</td><td>0.096</td><td></td><td></td></tr>
<tr><td>1997</td><td>690</td><td>78</td><td>0.113</td><td></td><td></td></tr>
<tr><td>1998</td><td>805</td><td>88</td><td>0.109</td><td></td><td></td></tr>
<tr><td>1999</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2000</td><td>810</td><td>82</td><td>0.101</td><td>0.140</td><td>113.4</td></tr>
<tr><td>2001</td><td>900</td><td>77</td><td>0.086</td><td>0.145</td><td>130.4</td></tr>
<tr><td>2002</td><td>850</td><td>66</td><td>0.078</td><td>0.15</td><td>127.3</td></tr>
<tr><td>2003</td><td>940</td><td>72</td><td>0.077</td><td>0.155</td><td>145.4</td></tr>
<tr><td>2004</td><td>914</td><td>60</td><td>0.066</td><td>0.160</td><td>145.9</td></tr>
<tr><td>Total (post)</td><td>4414</td><td>357</td><td></td><td></td><td>662.4</td></tr>
</table>
In this example, a policy intervention was introduced in 1999, and the indicator is computed for the following five years.

In this case, analysis of the failure rates for the pre-intervention years (1994-1998) gives a small, positive trend, with the formula:

Failure rate = -9.66 + 0.0048*Year

In the fifth column of the table, this rate has been applied to predict the failure rate without intervention, and this is then converted, in the sixth column, to the expected number of failures, taking account of the number of inspections made.

The difference between the projected and reported totals of failures for the intervention period is then calculated and expressed as a percentage of the projected total:

100 *(357 – 662.4) / 662.4 = 46.1% - i.e. a reduction of 46.1% in the expected failure rate.</td></tr>
<tr><td>Interpretation</td><td>In so far as reliable data are available, this indicator provides a measure of the extent to which action to reduce risks to children from poor food standards in retail outlets is being successful. A negative value for the indicator implies that proportionally fewer premises are failing standards, and thus suggests that action is helping to reduce health risks. A positive value of the indicator implies that food hygiene conditions are getting worse, and thus that policies to reduce health risks are inadequate.
For various reasons, the indicator needs to be interpreted with caution. Major problems clearly arise because of possible inadequacies in the inspection and testing regime, or the quality of the data that this produces. In many cases, inspection may fail to cover informal food outlets, such as street traders (often those who pose the greatest risks). Differences in standards and monitoring regimes between different countries may also make comparisons difficult. Changes in the number of food outlets, and the</td></tr>
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	selection of outlets for inspection, may also cause biases in the indicator. In addition, it needs to be recognized that the retail outlets may not be the true source of the problem (contamination may occur further up the supply chain), and equally poor hygiene after purchase (e.g. storage or preparation in the home) may be a major risk for children.
Variations and alternatives	Where food hygiene policies 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 pollution characteristics but in which the policy has not been applied). The indicator can also be specified in various other – for example, by targeting it at other points in the food chain, or at specific types of food or supplier. Where appropriate, separate assessments might be made for inspections of retail premises and for food testing. In some cases, it may also be appropriate to devise an indicator that measures the scope of the inspection and testing regime (e.g. on the basis of the rigour of the national standards, the scope of premises and foodstuffs tested, and the number of tests made).
Examples	UN *Indicators of sustainable development* • **Proportion of potentially hazardous chemicals monitored in food** WHO *Environmental health indicators: framework and methodologies* • **Monitoring of chemical hazards in food**
Useful references	UN 1996 *Indicators of sustainable development. Framework and methodologies*. New York: United Nations. WHO 1999 *Environmental health indicators: framework and methodologies.* Geneva: World Health Organization. (Available at http://www.who.int/docstore/peh/archives/EHIndicators.pdf)