SHA Planning Tool for H1N1 Pandemic Influenza
Version 2 – September 4th 2009

Brief Introduction and Guidance for Users

Purpose

The aim of this spreadsheet is to help NHS planners explore the consequences of different assumptions about the H1N1 influenza ("Swine Flu") pandemic, in terms of its possible effect on the population of England as a whole, or of any specific SHA or PCT. This will help generate scenarios for the potential demands on NHS services. Much of its earlier development was undertaken by East of England SHA, whose contribution is gratefully acknowledged.

This version supersedes that circulated in August, and differs in two ways:

(a) The population is now split into broad age cohorts, to which different inputs can be applied

(b) The spreadsheet is set up with an initial scenario to replicate the revised Planning Assumptions (designed to set out a "worst reasonable case") issued by Cabinet Office and Department of Health on September 3rd and reproduced in Annex A below.

Overview of inputs

Inputs are entered on the first ("set up") sheet of the spreadsheet. Each of the following variables can be set as an overall average and for each of four age groups (under 5s, 5-15, 16-64, and 65+).

- the Clinical Attack Rate, i.e. the percentage of the population becoming ill with H1N1 influenza during the planning period: these are the *clinical cases*.
- the percentage *of these clinical cases* who may:
    - suffer complications (typically sufficient to require a GP consultation)
    - require hospitalisation, and the percentage *of those hospitalised* who would require intensive care (if capacity existed)
    - die, due directly or indirectly to influenza.

These, and other key factors, are defined in more detail in the Planning Assumptions appended**.**

- In addition, there is the optional facility to input a percentage of clinical cases *identified* during the course of the pandemic. This percentage is not estimated in the Planning Assumptions. However, it is included as a feature in the spreadsheet in case users wish to consider scenarios involving different proportions of cases being identified.

The *assumed start of the (renewed) pandemic curve* must also be specified as "Week 1" in the box provided in the set-up sheet. This is explained further below. The default setting provided in the spreadsheet is the first Monday in September (7th), though this can be changed by the user.

Outputs

Given the above inputs, the model will calculate and show projected numbers of clinical cases, identified clinical cases (if defined) and cases leading to complications, hospitalisation, demand for ICU cases and death due to H1N1 influenza. These can be displayed for each age group or for the overall population covered.

When the output sheet for any given SHA is selected, the user can access results both for the SHA as a whole and for each constituent PCT population (the populations themselves are shown in the grey cells on each line). Graphs for projected timings over the course of the pandemic are also produced. Which projection to display in detail, for which population, can be chosen by clicking on the appropriate menus.

A reminder of the inputs for the scenario being used also appears in a box on all output sheets.

Initial scenario

The model is set up with one initial scenario labelled "Planning Assumptions", corresponding to the "worst reasonable case" within the revised planning assumptions attached. These cover the period up to mid-May 2010 – i.e. the "normal" winter period for seasonal flu.

- *Clinical Attack Rate*: 30% of population overall:
    - 50% in those aged 15 or under
    - 15% in those aged 65 or over
- [The input column for *identified clinical cases* is left blank in this scenario, as explained above.]
- *Complications*: 15% of clinical cases in overall population, with distribution by age compensating for the differential in Clinical Attack Rate, i.e.
    - 9% in those aged 15 or under
    - 30% in those aged 65 or over
- *Hospitalisation rate*: 1% of clinical cases in overall population, with distribution by age compensating for the differential in Clinical Attack Rate *except for* the under-5s, i.e.
    - 1% in those aged under 5
    - 0.6 % in those aged 5-15
    - 1% in those aged 16-64
    - 2% in those aged 65 or over
- *ICU cases (cases requiring Intensive Care):* 25% of those hospitalised, across all age groups (see further note below)
- Case fatality ratio: 0.1% of clinical cases in overall population, with distribution by age compensating for the differential in Clinical Attack Rate, i.e.
    - 0.06% in those aged 15 or under
    - 0.11% in those aged 16-65 and
    - 0.2% in those aged 65 or over

These assumptions are summarised in the table below, which appears as the first scenario in the set-up sheet. Note that some of the values appear directly in the planning assumptions, whereas others are mathematically implied (for example, if the Clinical Attack Rate is specified for the

overall population and for those aged up to 15 and over 65, this implies a value for the remaining population aged 16-64).

Planning assumptions

	Clinical Attack Rate	Identified Clinical Cases	Complications / Extra GP Consultations	Hospitalisation	ICU Cases	Deaths
Age group	% of pop	% of Cases	% of Cases	% of cases	% of hospitalised	% of Clin. Cases
Population average	**30%**		**15%**	**1.00%**	**25%**	**0.1%**
Under 5	50%		9%	1%	25%	0.06%
5-15	50%		9%	0.6%	25%	0.06%
16-64	28%		16%	1%	25%	0.11%
65+	15%		30%	2%	25%	0.20%

These inputs should be read in conjunction with the planning assumptions appended. This scenario **is not a prediction of what will happen.** Rather, it is considered as a "reasonable worst case" against which to plan during the period covered, given evidence available so far from the UK and across the world.

Any planning for future periods should be based on the standard reasonable worst case assumptions promulgated in pre-pandemic planning.[1]

Exploring other scenarios

Because there are many scientific uncertainties, the spreadsheet can also generate up to three further, user-defined scenarios, to explore the consequences of alternative inputs – for example, if the infection is "milder" than assumed in the reasonable worst case, with a lower percentage of cases requiring hospitalisation, and/or a lower case fatality rate. These are generated by adding the necessary figures to the blank tables in the "set up" sheet.

Note that in entering assumptions for any given scenario, the user should:

- enter a value for the population average, and
- enter values for the under 5s, 5-15, and 65+ age groups.

The figure for the remainder of the population (16-64) will then be calculated automatically, so that the required population average is reached. This calculation takes account of the relative numbers in each age group within the national population. For most plausible scenarios, this value will be close to the population average (given that this age group contains a large proportion of the overall population).

Note that results for SHA and PCT populations take account of the age distributions in each area. So, for example, if over-65s are assumed to have a low Clinical Attack Rate, this will reduce case numbers more in SHAs or PCTs whose populations have a higher proportion in this age group.

The results of all calculations are displayed in rounded form, for example to prevent results appearing as fractions of a person. Figures shown may therefore be subject to "rounding errors", so that (for example) adding the number of cases shown for each age group in a population may

[1] http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_080734

give a very slightly different figure to that calculated for the whole population. In addition, certain SHAs have populations that do not exactly correspond to the sum of those in their respective PCTs, due variation in geographical boundaries. (Further details of the population figures used are shown on the sheet in the model labelled PCT Pops (2009 projections".)

All scenarios can be saved and modified at any time. However, the initial scenario is supplied "locked" and should remain unchanged unless and until the advised planning assumptions change.

Points on specific features

Percentage of clinical cases identified

Not all clinical cases will be reported, especially if symptoms are mild. Conversely, it is difficult to distinguish H1N1 cases from other influenza-like illnesses. The percentage of cases likely to be identified is speculative at present, but can be set to any value (or none) in user-defined scenarios. If no inputs are entered, all outputs for "identified clinical cases" will appear as zero, by default. Note that all subsequent calculations for complications, hospitalisations and deaths are based on the actual numbers of cases assumed in the scenario, not identified cases. So specifying the proportion of cases identified is optional, and will have no effect on any other calculations.

Complications /GP consultations

As a rough guide, the advised complication rate (15% of clinical cases) provides an indication of demand for GP consultations: these are patients whose symptoms are severe enough to warrant interventions such as prescription of antibiotics. However, some patients with complications might require more than one consultation. In reality, the interplay between case numbers and demand may also be more complex than allowed for here: for example, demand for GP consultations might go up disproportionately if hospitals became overloaded.

ICU cases

The definition of "Intensive Care" used is explained in the Planning Assumptions. Note that these assumptions specify that up to 25% of those hospitalised at any given time may require intensive care. The initial scenario in the spreadsheet specifies 25% of hospitalised cases requiring intensive care: this is somewhat different. Evidence so far suggests that the minority of hospitalised cases who require intensive care typically have stays in ICU that are rather longer than the overall average stay for those hospitalised. *This means that the 25% in the spreadsheet is likely to be somewhat higher than the rate implied by the Planning Assumptions*. Further data on relative stays should allow a better estimation of this figure.

Local timing and shape of the pandemic

The assumed start date for a renewed and sustained growth in cases must be specified as "Week 1" in the spreadsheet. As noted in the Planning Assumptions, a worst reasonable case is that of "Week 1" happening in early September. However, this may vary locally, and it will not be possible to tell whether "Week 1" has occurred until some while after the event.

Starting from any given "Week 1", the user can specify more or less steeply-peaked pandemic curves, for any given overall Clinical Attack Rate. These are explained in more detail in the Planning Assumptions (under "Peak Clinical Attack Rate"), and the same three graphs shown there are used in the spreadsheet.

Timing of hospitalisations and fatalities

As noted above, the spreadsheet can be used to display graphical projections of clinical cases appearing each week in a given population, or the *number of cases leading to* complications, hospitalisation, ICU cases or deaths. Hospitalisations, ICU cases and deaths will successively "lag" behind the appearance of clinical cases. In particular, deaths will typically occur some significant time after appearance of symptoms – perhaps several weeks. The graphs in the spreadsheet provide projections of when clinical cases leading to death would appear in any given scenario, **not when the deaths themselves would occur**. The peak in deaths would occur significantly after the peak in cases.

Caveats

This spreadsheet is intended as a relatively-simple planning aid. It does not attempt to capture all the key features of a pandemic, or the potential effect of interventions such as vaccination. Some more sophisticated planning tools were developed prior to the current outbreak, and previously circulated to SHA and PCT planners / leads via the Pandemic Flu Virtual Forum.[2]

This planning tool may be updated further as more information becomes available. Comments and suggestions as to how it can be improved are also welcome at any time.

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[2] Other SHA or PCT staff needing to access the Virtual Forum should contact their respective Flu Lead / Flu Planner in the first instance.

ANNEX A
Planning Assumptions for the current A(H1N1) Influenza Pandemic

3 September 2009

Purpose

These planning assumptions relate to the current A(H1N1) pandemic and are appropriate for use until the end of the 2009/10 "seasonal flu" season – i.e. ***until Mid-May 2010****. They provide a common agreed basis for planning across all public and private sector organisations. Working to this common set of assumptions will avoid confusion and facilitate preparedness across the UK.*

These planning assumptions are based on analysis and modelling of data from both inside and outside the UK. They supersede the previous planning assumptions (dated 16 July). ***Modifications reflect the latest evidence on the severity of the current A(H1N1) strain. While considerable uncertainties remain, this evidence is sufficient to exclude some of the most severe possibilities included before.*** *The planning assumptions will be subject to further review and possible change as further new data become available on the current pandemic strain of influenza.*

The assumptions contain a number of parameters, each taken at their 'reasonable worst case' value. In some cases, it has been possible to revise these values downward given the evidence now available. Even despite these reductions, when taken together they continue to represent a relatively unlikely scenario. They should therefore not be taken as a prediction of how the pandemic will develop. Planning against the reasonable worst case will ensure plans are robust against all likely scenarios. Response arrangements must be flexible enough to deal with the range of possible scenarios up to the reasonable worst case and be capable of adjustment as they are implemented.

Because they are based on the reasonable worst case, these Planning Assumptions take no account of the possible effect of vaccination against the pandemic strain until we can be more certain about the timing of delivery and licensing of the vaccine on order. The magnitude of any such effect also depends critically on timing: a large effect on total numbers of cases would only be expected if a substantial proportion of the population could be vaccinated before the pandemic has peaked. Nevertheless, targeted vaccination of at-risk groups may be highly beneficial in preventing more serious illness amongst vulnerable groups.

As further UK and international surveillance data emerge, we will be looking to develop and extend these planning assumptions. ***It is possible that the virus may mutate, becoming more virulent, and it is important to remain prepared for the full range of possibilities.*** *Therefore, any planning for future periods beyond Spring 2010 should be based on the standard reasonable worst case assumptions promulgated in pre-pandemic planning as set out in the 'National Framework for responding to an influenza pandemic' Chapter 3*[3]*.*

General: Timing, duration and geographic spread of the pandemic

[3] Located at: http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_080734

The number of cases over the summer have been relatively small (with an estimated peak of the order of 100,000 clinical cases per week according to HPA calculations),[4] as compared with the numbers that could occur during the course of a full pandemic. It remains possible that case numbers could rise to many hundreds of thousands of cases per week.

Since the last week of July the rate of new cases has slowed considerably. Nevertheless, the exponential growth seen previously may resume, for example, when schools reopen. Transmission may also increase as we enter our normal 'flu season'. It is unclear whether the pandemic would thereafter unfold as a single extended 'wave' or multiple waves separated by periods of reduced case numbers. However, early, sustained exponential growth could lead to a substantial growth in the number of cases. A substantial peak could not, however, happen until October. Such a peak could be much higher than that seen in July. By the end of the planning period (May 2010), up to 30% of the population could have experienced symptoms of pandemic Swine Flu. These are potentially in addition to those experiencing the effects of seasonal flu.

As has already been seen, variations in how the pandemic unfolds from one local area to another is possible, therefore, where appropriate, planning assumptions are shown both across the UK and for local areas where different[5].

Summary of the Planning Assumptions

The table below summarises the key planning assumptions as regards infection with the current A(H1N1) pandemic strain of influenza. As noted above, this represents a "reasonable worst case" for which to plan for the period up to mid-May 2010, not a prediction. The figures shown are explained in more detail in the supporting text below. All apply both across the UK and to local areas except where specific local assumptions are shown.[6] The figures shown can be expected to vary for different age groups within the population: this is also explained in more detail below.

Planning assumptions to mid-May 2010: potential effects of A(H1N1) infection for the general population	
Clinical Attack Rate	up to 30% of population
Peak Clinical Attack Rate	nationally, up to 6.5% of population per week
	locally, 4.5%-8% of population per week
Case Complication Ratio	up to 15% of clinical cases
Case Hospitalisation Ratio	up to 1% of clinical cases, of whom up to 25% could require intensive care at any given time
Case Fatality Ratio	up to 0.1% of clinical cases
Peak Absence Rate	up to 12% of workforce

Clinical Attack Rate

[4] Estimation of the number of A (H1N1) cases in the UK is subject to significant uncertainty and bias due to problems estimating a number of key parameters (such as proportion of those with symptoms accessing the different treatment routes and swab positivity rate).

[5] Throughout this document, a "local area" refers to a population of about 100,000 to 750,000. "National" refers to the UK population of about 62,300,000.

[6] At present, the local assumptions differ from those for the UK only as regards the peak clinical attack rate. However, this may change as more evidence becomes available.

Description: The proportion of the population who *become* ill with influenza, totalled over the period covered. (These are the *clinical cases*.)

Assumption:
In total, up to 30% of the population may experience influenza-like-illness following infection with the A(H1N1) strain within the planning period.

Commentary:
This is an average over all ages in the population. The final Clinical Attack Rate among children under 16 may reach 50% during this period, with significantly lower rates than 30% in older people (of the order of 15% in those over 65).

All the above figures refer to people experiencing symptoms. The proportion of the population infected with the A(H1N1) virus (the serological attack rate) may finally be as high as 60%. This is because in addition to those who develop clinical symptoms, a similar number may be infected but show no or insignificant symptoms.

The peak Clinical Attack Rate

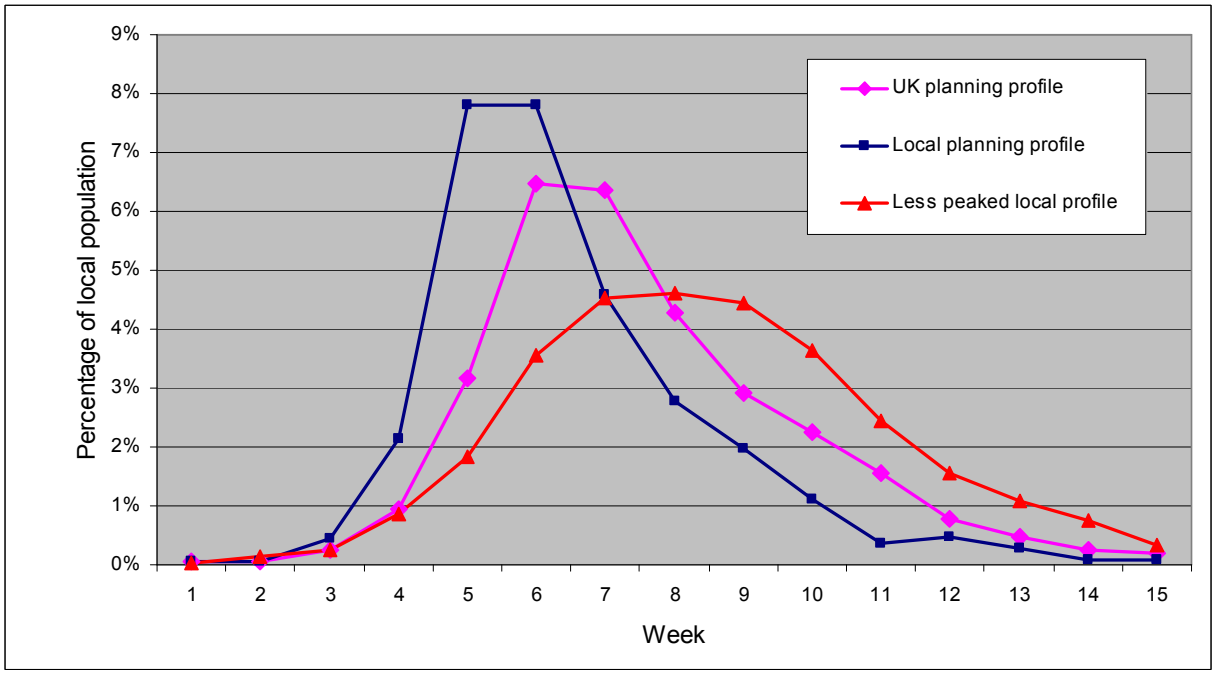
Description: The proportion of the population who *become* ill in the peak week.

Assumptions:
- *Nationally*, up to 6.5% of the UK population may become ill with influenza in the peak week of the pandemic.
- Up to 8% of the population *in any given locality* may become ill with influenza per week in the peak week of a local epidemic.
- These peak rates might be sustained for a fortnight.

Commentary:
The maximum 8% figure for a *local area* is higher than the UK planning assumption of 6.5% because local outbreaks may not be synchronised. Indeed, if the UK epidemic is extended over a relatively long period, local epidemics may have peak Clinical Attack Rates substantially higher than the UK epidemic as a whole. This is due to the UK epidemic curve being a composite of the local curves, which may vary in profile (see below), timing, and to some extent Clinical Attack Rate. As both highly-peaked and more lengthy epidemics pose challenges, planning should take account of the full range of possibilities.

The graph below illustrates three possible profiles for local epidemics, one following the UK planning profile exactly and the others demonstrating possible local variations. Each has a total Clinical Attack Rate of 30% (represented by the area under each curve).

Figure: Local Planning Profiles: Proportion of Local Population Becoming Ill per week



Once again, these should be regarded as illustrative curves to aid planning, not predictions. Forecasting the timing of 'Week 1' of the UK epidemic is not possible at present. Because of the low numbers in early weeks as compared to "background" levels of influenza-like-illness, it will not be possible to tell whether 'Week 1' has been reached from case data alone (except in retrospect).

However, a 'reasonable worst case' at present is that exponential growth in cases might resume when schools re-open (possibly augmented by effects of seasonality). In that case, 'Week 1' could be in early September. Based on the national profile shown, case numbers would then peak in mid to late October. It is also possible that the exponential growth could be more rapid than seen previously, leading to a peak at the start of October. However, 'Week 1' of the local epidemic curve may vary from local region to local region.

Case Complication Ratio

Description: The proportion *of those ill with influenza* who are expected to require additional treatment, such as the prescription of antibiotics (but not necessarily hospitalisation, see below).

Assumption: The complication ratio may be up to 15% of clinical cases (as defined above) during the planning period.

Commentary:
Complication rates appear to be higher, *as a proportion of those who become ill*, in the children under 5, clinical at-risk groups and older people. Conversely, older people may be less likely to become ill with this infection, but are more likely to suffer from complications if they do become ill.

Although evidence on these points is still accumulating, it is reasonable at present to

suggest that with the possible exception of the very young, age differentials in Clinical Attack Rates and Complication Ratios roughly cancel each other out. Thus:

- those over 65 will be about half as likely to become ill with this infection (Clinical Attack Rate of 15% rather than 30%), but have approximately double the complication ratio (30% of clinical cases rather than 15%).
- those under 16 may have a Clinical Attack Rate of up to 50%, but a correspondingly lower complication ratio.

The resulting proportions of all age groups suffering complications from A(H1N1) infection would therefore be comparable.

Case Hospitalisation Ratio and need for Intensive Care

Description:

- the proportion of those ill with influenza who (if capacity exists) should be hospitalised,

and

- the proportion of those hospitalised who would need intensive care[7] (if capacity exists).

Assumption: Up to 1% of clinical cases during the planning period may require hospitalisation. Of these, up to 25% could require intensive care at any given time.

Commentary:
Whilst hospitalisation rates for seasonal influenza are typically in the range 0.5 - 1.0% of those who become ill, current experience in the UK with the A(H1N1) virus suggests that planning should continue on the basis of the assumption given above.

Similar comments apply to age groups as above for complications, *except that* there is some evidence of higher hospitalisation rates amongst children under 5. At present, it is unclear whether this reflects relative severity of symptoms, or a more precautionary approach to hospitalisation. This is a priority area for further investigation, and any further information will be incorporated into planning assumptions when available.

Case Fatality Ratio

Description: The proportion of those ill (*clinical cases*) who die due to influenza, totalled over a complete outbreak of infection.

Assumption: For A(H1N1) infections during the planning period, the eventual Case Fatality Ratio (CFR) could be up to 0.1% of clinical cases.

Commentary:

[7] In this context, "Intensive Care" refers to Level 3 Critical Care, with facilities for mechanical ventilation. To date, it appears that most UK patients requiring Critical Care have required ventilation at some point. Therefore, the assumption that up to 25% of patients hospitalised may require Intensive Care at any given time (rather than only Level 2 Critical Care) is a reasonable worst case. Like all other planning assumptions, this will be reviewed as more evidence becomes available.

This may be regarded as precautionary in the light of what has been seen so far, but the Case Fatality Ratio may increase in the autumn (e.g. due to a higher incidence of bacterial co-infection, viral evolution or host susceptibility factors). The figure of 0.1% is therefore appropriate at present for planning purposes.

Case Fatality Ratios are particularly difficult to estimate. To do so requires knowledge of (a) the total number of cases, including those that are very mild, and (b) the number who die because of influenza but whose deaths have been recorded as due to an underlying condition made worse by influenza. Both these factors are difficult to ascertain. The delay between the onset of illness and report of death must also be taken into account when calculating this ratio. Simply comparing known cases with known fatalities at any given point in a pandemic can give a seriously misleading estimate of the CFR.

To date, the evidence suggests that similar comments with regard to age groups apply as for complication rates. That is, the effects of differing Clinical Attack Rates and Case Fatality Ratios roughly cancel each other out. There is thus no marked difference between any age groups (including the under-5s) in the overall fatality rate due to this infection.

To put the numbers in perspective, the combination of "reasonable worst case" 30% Clinical Attack Rate and 0.1% Case Fatality Ratio would result in a total number of deaths of about 20,000, or about 1/30th of the total expected each year from all causes (about 600,000).

Absence from work due to illness

Description: The proportion of the workforce who may be absent from work at the peak of the local epidemic because they are ill themselves or because they are looking after ill children.

Assumption: Absence rates for illness may reach 12% of the workforce in the peak weeks of the planning period.

Commentary:
This estimate refers to absence over and above that for "normal" holiday leave and non-Swine Flu illness. Current data, and analysis of previous pandemics, suggests an average unavailability for work of approximately 10 calendar days for clinical cases without complications, and 14 for those with complications[8].

Based on analysis of previous pandemics, this includes some allowance for a short period of recuperation following recovery from clinical illness in addition to the period with flu symptoms. The best current estimate of the length of symptoms is an average (mean) of 9 days with 25% having symptoms for more than 10 days.

Also included in the assumption is an estimate for those at home caring for ill children, but *not* for any additional absence due to fear of contracting Swine Flu or the need to look after ill dependent relatives or friends other than children.

[8] The Planning Assumptions issued on the 16th of July 2009 refer to working days. The estimates for average length of absence remains the same, but are now quoted in calendar rather than working days, in the interest of clarity.

If schools are closed due to influenza during term-time (due to lack of availability of staff or planned closure), absence rates may increase as parents may need to stay at home to look after children. It has been estimated that this could cause an *additional* 15% of the workforce to be absent. This is based on the proportion of the national workforce with dependent children at home, as evidenced by survey data. This proportion will clearly differ from case to case, and employers should take account of the characteristics of their own workforce.