Public Health England

Protecting and improving the nation's health

Childhood Influenza Vaccination Pilot Programme, England 2014/15

End of season report

Covering flu vaccinations administered as part of the school-age pilot programme from 1 September 2014 to 31 January 2015

About Public Health England

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Executive summary

In 2012, the Joint Committee on Vaccination and Immunisation (JCVI) recommended the roll-out of a universal childhood influenza vaccine programme with a newly licensed live attenuated influenza vaccine (LAIV). This programme will ultimately target all children 2-17 years of age with the aim of not only directly protecting the children themselves, but also protecting the remainder of the population (ie elderly) by reducing transmission in the population.

This document describes and reports on the cumulative uptake of influenza vaccine during the 2014/15 pilot programme, with a focus on the results from the final end of season data submitted to PHE at school-level between March-April 2015. The school-level data returns presented in this report include additional analysis on consents, refusals, contraindications, and population level ecological predictors of vaccine uptake.

An overall uptake of 53.2% was achieved for children of primary and secondary school age (4-13 years) vaccinated in 14 geographically discrete pilot areas in England. Uptake varied by programme delivery and year group. Uptake was highest in those areas delivering the programme through schools (54.5%) and lowest in areas delivering through primary care based delivery ie pharmacy and/or GP practice (26.8% and 24.4% respectively). Overall uptake in primary school children (4-11 years) was 56.8%, higher than in secondary school children (11-13 years), where uptake was 49.8%. This difference reflects the increase in refusal and non-response rates with increasing year group age. Ecological population level predictors of uptake found that lower uptake in both primary and secondary school children was significantly and independently associated with both ethnicity and deprivation. The lowest uptake was reported in the most deprived quintiles of deprivation or areas with the largest proportion of black or minority ethnic groups.

Background

Seasonal influenza is a very common infection among infants and children. Healthy children under five years of age have the highest influenza hospital admission rates compared to other age-groups[1]. The UK has a long standing selective influenza vaccination programme targeted at all those 65 years and over, under 65 and in a clinical risk group, and pregnant women. Based on the recommendations of the JCVI in 2012, England is in the process of implementing an universal paediatric influenza vaccination programme to ultimately cover all children 2-17 years of age[2]. The programme is being introduced incrementally across a number of flu seasons.

In 2013/14 vaccination against flu with a newly licensed live attenuated influenza vaccine (LAIV) was first offered nationally across the United Kingdom to all children aged two and three years through GP practices. Additionally PHE commissioned a pilot vaccination programme to cover children of primary school-age (4-11 years). The programme ran in seven geographically distinct pilots areas (Bury, Cumbria, Gateshead, Newham, Havering, South East Essex, and Leicester*). The purpose of the pilots was to undertake an operational evaluation including of different modes of vaccine delivery, specifically school based vs. primary care delivery (GP practice/pharmacy). The pilot achieved a final overall uptake of 52.5%, ranging from 35.8% to 71.5% between individual pilot areas[3].

In 2014/15 the national programme was further extended to include vaccination of all children two to four years of age through GP practices. In addition the 2014/15 season saw the extension of the school-age pilot vaccination programme to 14 areas across England targeting a) primary school age children 4-11 years of age, b) secondary school children aged 11-13 years or c) both groups. Pilot areas primarily delivered the programme through schools with the exception of two areas which used a pharmacy based model with GP involvement (Cumbria and Arden, Herefordshire and Worcestershire). In addition, one local authority (LA) followed a primary care GP delivery model (Leeds). London with the exception of Havering LA, covered special schools only. Pilot regions offered LAIV to healthy and at-risk children in whom the vaccine was not contraindicated. At-risk children contraindicated for LAIV vaccination were offered quadrivalent inactivated intramuscular influenza vaccine.

During the 2014/15 vaccine campaign, cumulative school-level vaccine uptake data was manually submitted through ImmForm by each designated pilot area data provider on a monthly basis. Vaccine uptake was recorded locally at school level and then aggregated by ImmForm by local authority/area team and year group (Annexe A). At the end of the flu season (March-April), final vaccination data collected at school-level within each pilot area was submitted to PHE including additional information on consents, refusals, and contraindications.

*Leicester city, East Leicestershire and Rutland

Methods

End of season data collected at a school-level was submitted to PHE between March-April 2015 by data providers for each pilot area. The end of season collection variables requested are outlined in Annexe B.

Key indicators

Uptake

End-of-season programme uptake was calculated based on the number of children in the target population who were reported to have received at least one dose of influenza vaccine during the campaign period (1 September 2014 until 31 January 2015). Where 2nd doses were recorded as delivered through the pilot scheme, they were not counted to prevent duplication. The target population was defined as the number of primary school age children (4-11 years) born between 2 September 2003 and 01 September 2010 eligible for vaccination in the six primary school pilot areas. The target population for secondary school age children was defined as the number of secondary school age children eligible for vaccination (11-13 years) born between 2 September 2001 and 1 September 2003 in the 12 secondary school pilot areas.

Predictors of uptake

To assess how population level predictors may be associated with vaccine uptake in 4-13 year olds, the postcode of each school was matched to various predictors available at 2011 census Office for National Statistics (ONS)-defined Lower Super Output Area level (LSOA). Each LSOA had a population range of 1,000 – 3,000 and were used to assess potential ecological associations with uptake in 4-13 year olds[4]. The Index of Multiple Deprivation (IMD) is an overall score assigned to each LSOA summarising its relative level of deprivation based on seven topic areas: income, employment, health, education, crime, service access and living environment[5]. As the value of the score increases, the level of deprivation increases.

Information on ethnic constitution of each LSOA is available according to the following categories: White/Mixed/Asian/Black/Other[6]. The proportion of LSOA classified as belonging in a black or minority ethnic group (%BME, defined as non-white British) was calculated and, based on the distribution, categorically grouped into quartiles.

Information on the religious constitution of each LSOA is available with the categories of Christian/Buddhist/Hindu/Jewish/Muslim/Sikh/Other/None[7]. Proportions were analysed, focusing on Jewish and Muslim because of the issues reported the previous season around the use of porcine gelatine in the vaccine. The proportion of LSOA identifying as Jewish was grouped into 0% and >0% and Muslim into 0%, 1-5% and 6%+.

Classification of the LSOA as rural (Town and fringe/Village or hamlet/Isolated dwelling) or urban (Major conurbation/Minor conurbation/City and town) was available from the ONS 2011 census[8].

Vaccine uptake was then calculated by each of these population characteristics. A linear regression analysis was undertaken to find out if any of the population characteristics were significantly related to uptake. Uptake in primary schools in the pilot areas was linearly regressed against the same population-level variables (pilot site, deprivation, ethnicity, religious constitution and rurality) to determine if changes in uptake could be explained. Variables significant in univariable analysis ($p<0.01$) were included in a multiple linear regression model to provide adjusted estimates. Model fit was assessed[8]. If a variable could be modelled in several ways, the version that resulted in the lowest model Akaike Information Criterion (AIC) value was retained. Additionally, stepwise model selection using AIC criteria was used to confirm the final models and test for interactions, including in the adjusted model if biologically plausible and highly significant (tested with likelihood ratio tests and $p<0.005$)[8].

Consent, refusal, and non-responders

Parental consent forms for flu vaccination were sent to parents through schools. The return of these forms was recorded by the school/data providers and information on consents, refusals, and no returns was submitted to PHE at the end of the season. Not all pilot sites returned consent, refusal and no return data and not all schools within each pilot site identified these groups consistently. Additionally, some pilot areas merged consent/refusal/no return data for all vaccinating year groups.

Cumbria and Arden, Herefordshire and Worcestershire were excluded from consent analysis, due to the walk in nature of the pharmacy delivery model.

Consent –calculated from number of consent forms returned by all children in a year group, divided by the final denominator for that year group. Consent is defined as direct parental consent to vaccinate. In some cases consents include children who are contraindicated for vaccination with LAIV.

Refusal – calculated from number of forms returned refusing consent by all children in a year group, divided by the final denominator for that year group. Refusal is recorded as direct refusal to vaccinate. In some cases refusals include children who are contraindicated for the vaccination with LAIV.

No return – calculated from the number of forms not returned in a year group (non-responders), divided by the final denominator for that year group. Non-responders were defined as parents that did not return consent forms whose children were subsequently not vaccinated. Non-responder counts were either provided by the school level data submission or calculated from the final denominator by subtracting the count of consents and refusals. No returns may also include children contraindicated for vaccination with LAIV.

Contraindications

Children contraindicated for vaccination with LAIV (ie children in clinical risk groups) were identified prior to the use of LAIV in the 2014/15 study. Risk groups are clinically outlined in Green Book[9]. The numbers of children contraindicated for vaccination were recorded, and then aggregated by risk group.

Contraindications were split into two groups: Prior Contraindication and On-day Contraindications. The first describes pre-existing contraindications to vaccination that parents were aware of eg previous allergic reaction to a ‘flu vaccine. The second describes contraindications described on the day of vaccination eg a child being congested. Not all pilot sites recorded data for all risk groups, and not all schools within each pilot site identified risk groups consistent with the end of season data return variables. Children contraindicated for vaccination with LAIV were either offered quadrivalent inactivated influenza vaccine on site by providers or referred to their general practice for vaccination.

Results

Uptake

An estimated 381,969 primary and secondary school children aged 4-13 years in the 14 pilot areas received at least one dose of influenza vaccine during the period 1 September 2014 to 31 January 2015. With an estimated total target population of 718,071, this results in an overall uptake of 53.2%. Overall uptake in primary school children (4-11 years) was 56.8% ranging by pilot area from 32.3% to 63.1% (Table 1) compared to 52.5% in the 2013/2014 season, ranging from 31.8 to 71.5% by pilot area. Cumbria had the lowest final uptake in primary school children at 32.2% (37.3% in 2013/14 pilot) in 2014/15. Greater Manchester had the highest uptake at 63.1% (63.5% in 2013/14 pilot)

Table 1. *Estimated proportion of primary school age children (4-11 years) resident in pilot areas who were vaccinated with at least one dose of influenza vaccine. England, 1 September 2014 to 31 January 2015*

Area Team	*Denominator* [a]	*Total Vaccinated*	*% Uptake*
CUMBRIA[b]	35,154	11,356	**32.3**
ESSEX	148,383	91,225	61.5
GREATER MANCHESTER	15,584	9,837	**63.1**
NORTHUMBERLAND, TYNE, AND WEAR	50,479	27,684	54.8
LEICESTERSHIRE AND LINCOLNSHIRE	74,408	44,228	59.4
LONDON (Special Schools)	1,852	795	42.9
LONDON (Havering)	21,102	11,869	56.2
TOTAL	**346,962**	**196,994**	**56.8**

[a] Denominators represent the number of primary school age children (4-11years) eligible for vaccination. Denominators are based on school-roll figures obtained directly from schools unless unavailable then Department of Education January 2014 school census figures were used.

[b] Cumbria pilot was delivered through pharmacy/GP delivery model.

Overall uptake in secondary school children (11-13 years) was 49.8%, ranging by pilot area from 21.2% to 62.0% (Table 2). Arden, Herefordshire, and Worcestershire had the lowest uptake overall at 21.2% and Essex had the highest uptake at 62.0%. The former had their programme delivered through a pharmacy/GP model.

Table 2. *Estimated proportion of secondary school age children (11-13 years) resident in pilot areas who were vaccinated with at least one dose of influenza vaccine, England, 1 September 2014 to 31 January 2015.*

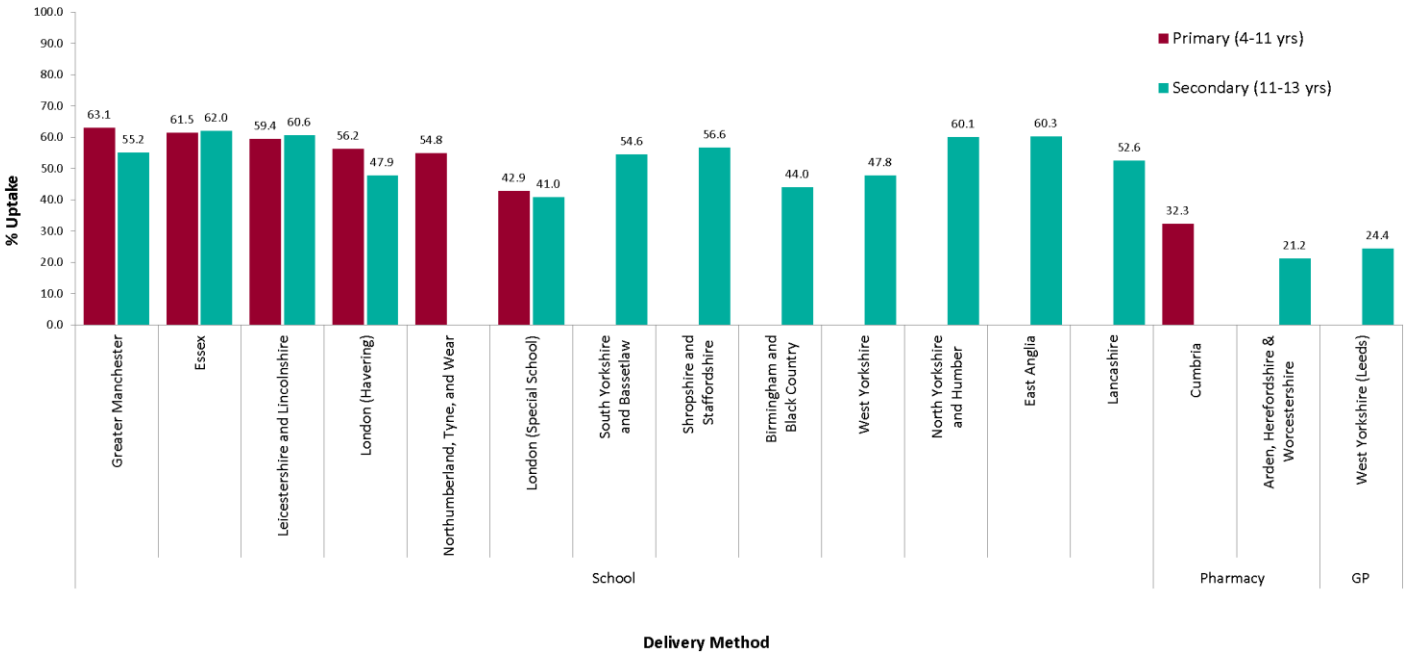
Area Team	*Denominator* [a]	*Total Vaccinated*	*% Uptake*
ARDEN, HEREFORDSHIRE & WORCESTERSHIRE[b]	35,269	7,485	**21.2**
BIRMINGHAM AND THE BLACK COUNTRY	60,024	26,437	44.0
EAST ANGLIA	49,565	29,906	60.3
ESSEX	8,367	5,190	**62.0**
GREATER MANCHESTER	8,898	4,910	55.2
LANCASHIRE	21,588	11,348	52.6
LEICESTERSHIRE AND LINCOLNSHIRE	39,023	23,644	60.6
LONDON (special schools)	652	267	41.0
LONDON (Havering)	3,155	1,510	47.9
NORTH YORKSHIRE AND HUMBER	34,286	20,599	60.1
SHROPSHIRE AND STAFFORDSHIRE	33,006	18,686	56.6
SOUTH YORKSHIRE AND BASSETLAW	25,879	14,131	54.6
WEST YORKSHIRE	51,397	20,862	40.6
Total	**371,109**	**184,975**	**49.8**

[a] Denominators represent the number of secondary school age children (11-13 years) eligible for vaccination. Denominators are based on school-roll figures obtained directly from schools unless unavailable then Department of Education January 2014 school census figures were used.

[b] Arden, Herefordshire, and Worcestershire pilot was delivered through pharmacy/GP based delivery model, denominators are based on all 4-11 year olds registered with a GP within each of the 7 CCG areas.

Overall end of season vaccine uptake of primary and secondary school children (4-13 years) by delivery method was highest for children vaccinated in schools at 54.5% uptake followed by pharmacy and GP delivery, 26.8 and 24.4% respectively (Figure 1).

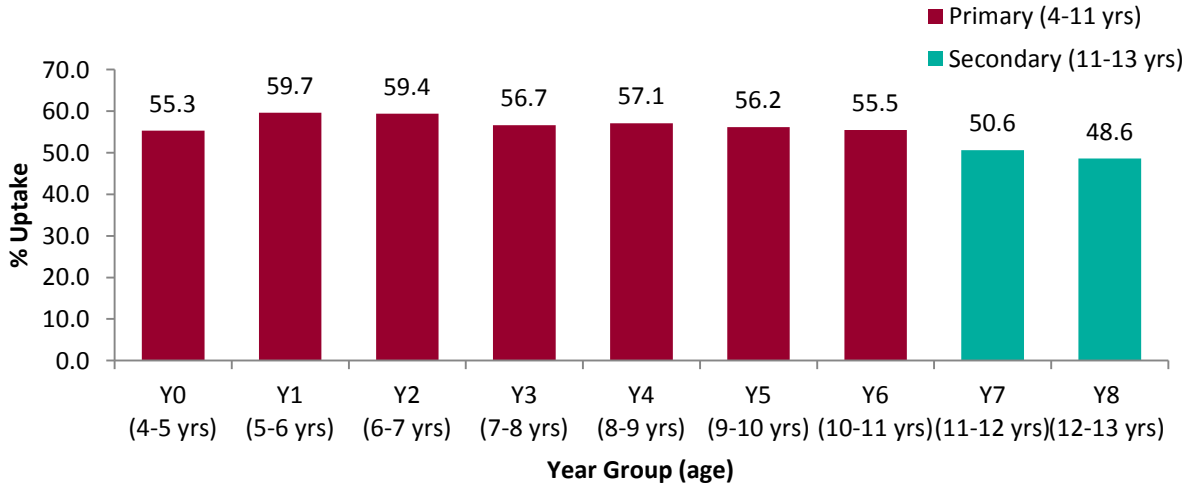
Figure 1. *Estimated proportion of primary and secondary school age children (4-13 years) resident in pilot areas who were vaccinated with at least one dose of influenza vaccine by pilot area and mechanism of delivery, England, 1 September 2014 to 31 January 2015*



Uptake by Year Group

Vaccine uptake by year group ranged from 59.7% in year group 1 (5-6 years) to 48.6% in year group 8 (12-13 years), with an overall pattern of decreasing uptake with increasing age (Figure 2), except in year 0.

Figure 2. *Estimated proportion of primary and secondary school age children (4-13 years) resident in pilot areas who were vaccinated with at least one dose of influenza vaccine by year group, England, 1 September 2014 to 31 January 2015**

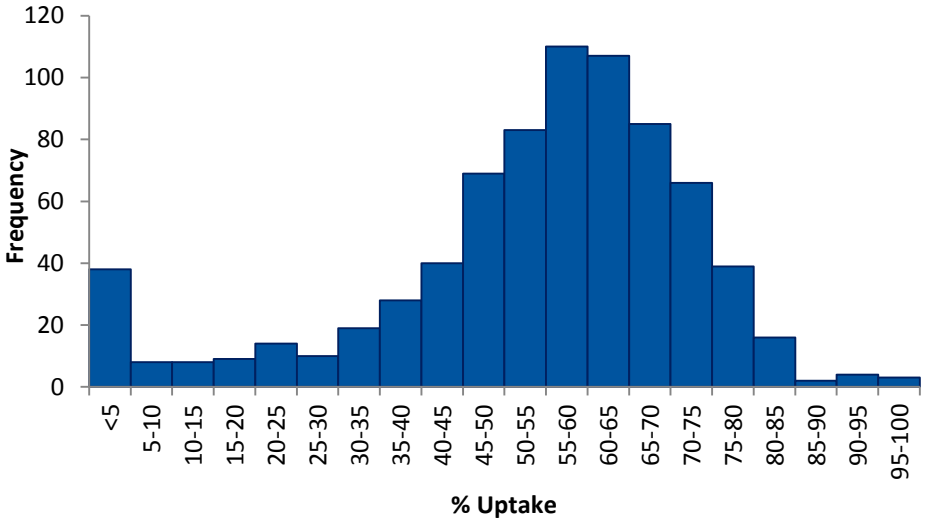


*Excluding three LAs where year groups 7 and 8 were combined

Uptake by PHE Region (school delivery only)

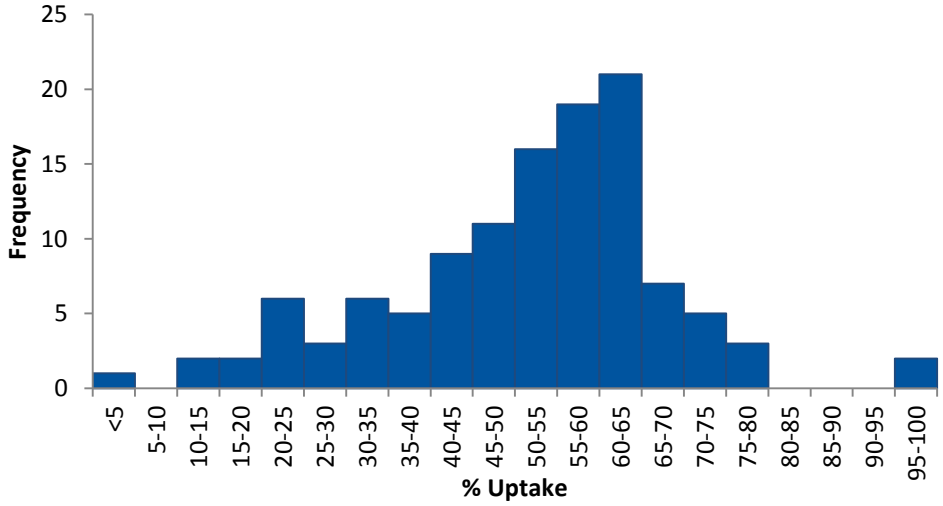
Vaccine uptake in primary and secondary school age children (4-13 years) vaccinated in schools varied across PHE regions of England. Of the 2,676 reporting schools, uptake at school level ranged from 0 to 100%. In the north of England, of the 758 primary and secondary schools reporting vaccine uptake data, median uptake was 57.5% (with interquartile range of 46.3% to 66.7%) (Figure 3). 38 schools reported a vaccine uptake of 5% or less.

Figure 3. *Uptake of influenza vaccination in children aged 4-13 years by schools in the North of England, 1 September 2014 to 31 January 2015*



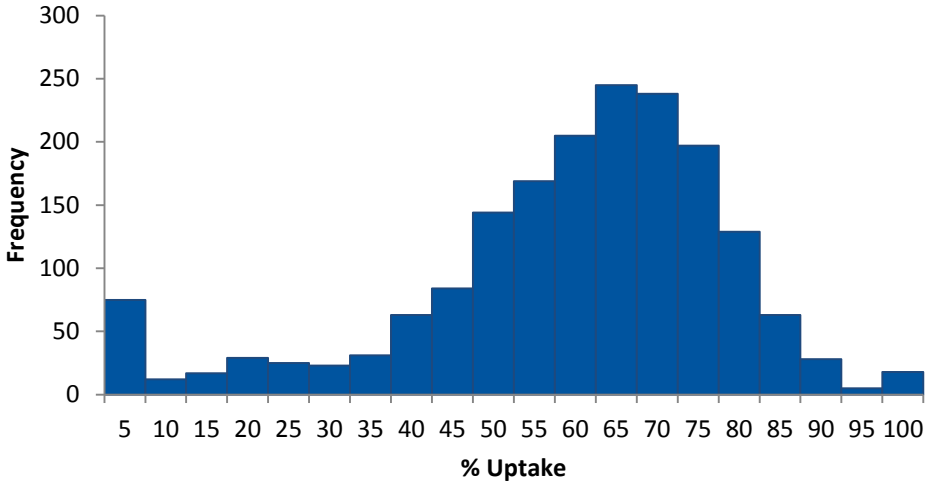
In London, of the 118 primary and secondary schools reporting vaccine uptake data, median uptake was 54.1% (with interquartile range of 43.8% to 61.3%) (Figure 4). Only one school reported vaccine uptake of less than 5%.

Figure 4. *Uptake of influenza vaccination in children aged 4-13 years by schools in London, 1 September 2014 to 31 January 2015*



In Midlands and East of England, of the 1800 primary and secondary schools reporting vaccine uptake data, median uptake was 60.6% (with interquartile range of 48.8% to 69.7%) (Figure 5). 73 schools reported vaccine uptake of less than 5%.

Figure 5. *Uptake of influenza vaccination in children aged 4-13 years by schools in Midlands and East of England, 1 September 2014 to 31 January 2015*



Predictors of uptake (school delivery only)

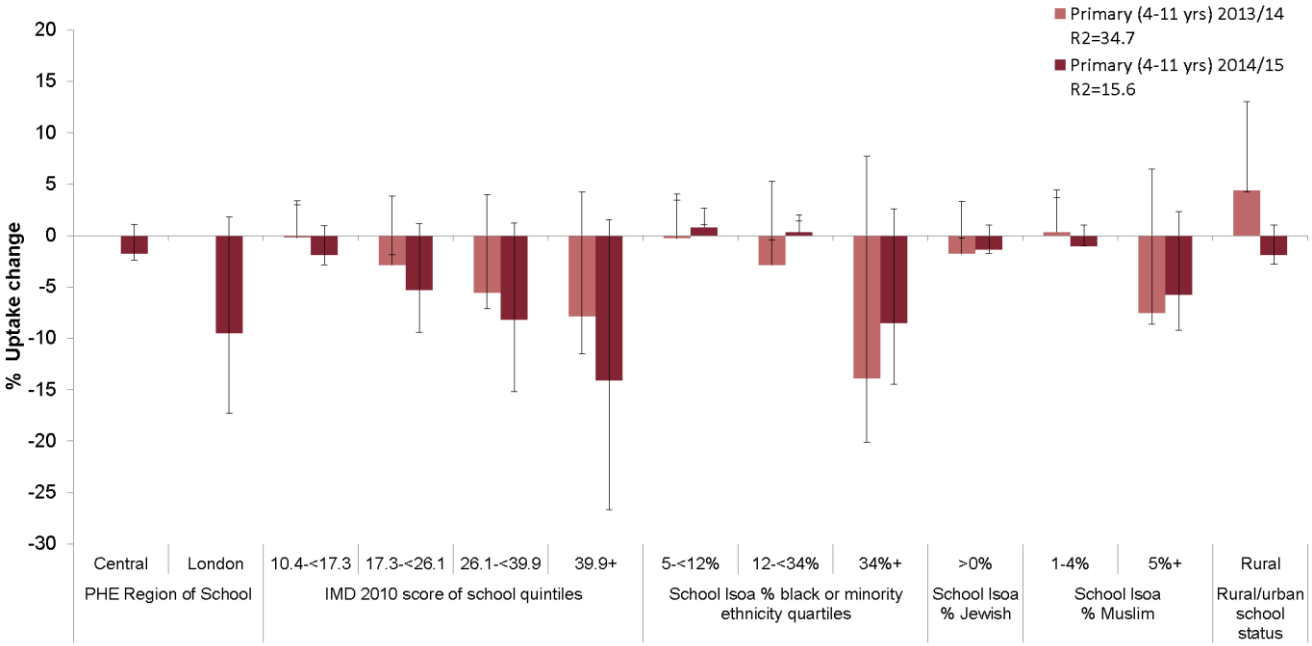
4-11year olds

The results of the unadjusted single variable analysis in 4-11 year olds showed that out of the area level characteristics the largest impact was seen for ethnicity and deprivation (Table 3). The more deprived an area, the lower the uptake, with those in the most deprived quintile of deprivation showing a 17 % lower uptake than those in the least deprived quintile. Areas with an ethnic population of 34% or more had a decrease in uptake of 21% compared to areas with a minority population of <5%. In terms of religious beliefs, uptake was 20% lower when 6%+ of the LSOA population identified as Muslim relative to 0%, and 4% lower if the LSOA contained Jewish residents compared to none. A decrease was seen in urban relative to rural areas, with a difference in uptake of 7%. Finally, uptake by PHE region compared to the North indicate uptake was significantly higher in Midlands and East of England and lowest in London region (Table 3).

After adjusting for all area level characteristics in the multivariable regression analysis (Figure 6), region, ethnicity and deprivation remained significant predictors of low vaccine uptake. The association was strongest for those in the most deprived quintile. Areas in most deprived quintile of deprivation had a 14 % lower uptake than those in the least deprived quintile. Areas with a black or minority ethnic population of 34% or more had 9% lower uptake compared to areas with a black or minority ethnic population of <5%.The association with Muslim populations decreased but remained significant. Areas with a Muslim population of 6%+ had an uptake almost 6% lower than those with 0% Muslim population. Similarly, a significantly lower uptake persisted in urban areas compared to rural (2% lower). And finally, after adjusting for area-level characteristics relative to the North, uptake in Midlands and East of England and London regions was significantly lower, with 2% and 10% lower uptake respectively.

These results are similar to those seen in the first year of the pilot vaccination programme in 2013/14[8] (Figure 6), where deprivation, areas with BME >34% and muslim population >5% were all independently associated with low vaccine uptake in children.

Figure 6. *Adjusted linear regression % uptake change values with corresponding 95% confidence intervals for population-level predictors for 4-11 year olds resident in 2013/14 vs. 2014/15 pilot areas, England*



11-13 year olds

As seen for the 4-11 year olds, the results of the unadjusted single variable analysis in 11-13 year olds showed that the largest impact in area level characteristics was seen for ethnicity and deprivation (Table 4). The more deprived an area, the lower the uptake, with those in the most deprived quintile of deprivation having 21% lower uptake than those in the least deprived

quintile. Areas with a black or ethnic minority population of 34% or more had almost 23% lower uptake than those with a black or ethnic minority population of <5%. Additionally, uptake was 22% lower when 6%+ of the LSOA population identified as Muslim relative to 0%. Finally by region (relative to the North) uptake was only significantly lower in London.

After adjusting for all area level characteristics in the multivariable regression analysis (Figure 7) deprivation and ethnicity remained significant factors along with Muslim religious beliefs. Areas in the most deprived quintile of deprivation had an 11% lower uptake than those areas in the least deprived quintile. Areas with a black or minority ethnic population of 34% or more had 8% lower uptake compared to areas with a black or ethnic minority population of <5%. The association with Muslim populations remained significant, areas with a Muslim population 6%+ had almost 12% lower uptake than those with 0% Muslim population. Though initially insignificant, after adjusting for predictors the impact of Jewish residents became significant. Areas with a Jewish population had almost 6.5% higher uptake than those with no Jewish population. After adjustment, none of the regions showed significant differences in uptake.

Figure 7. *Adjusted linear regression % uptake change values with corresponding 95% confidence intervals for population-level predictors for 4-13 year olds resident in pilot areas, England, 2014/15*

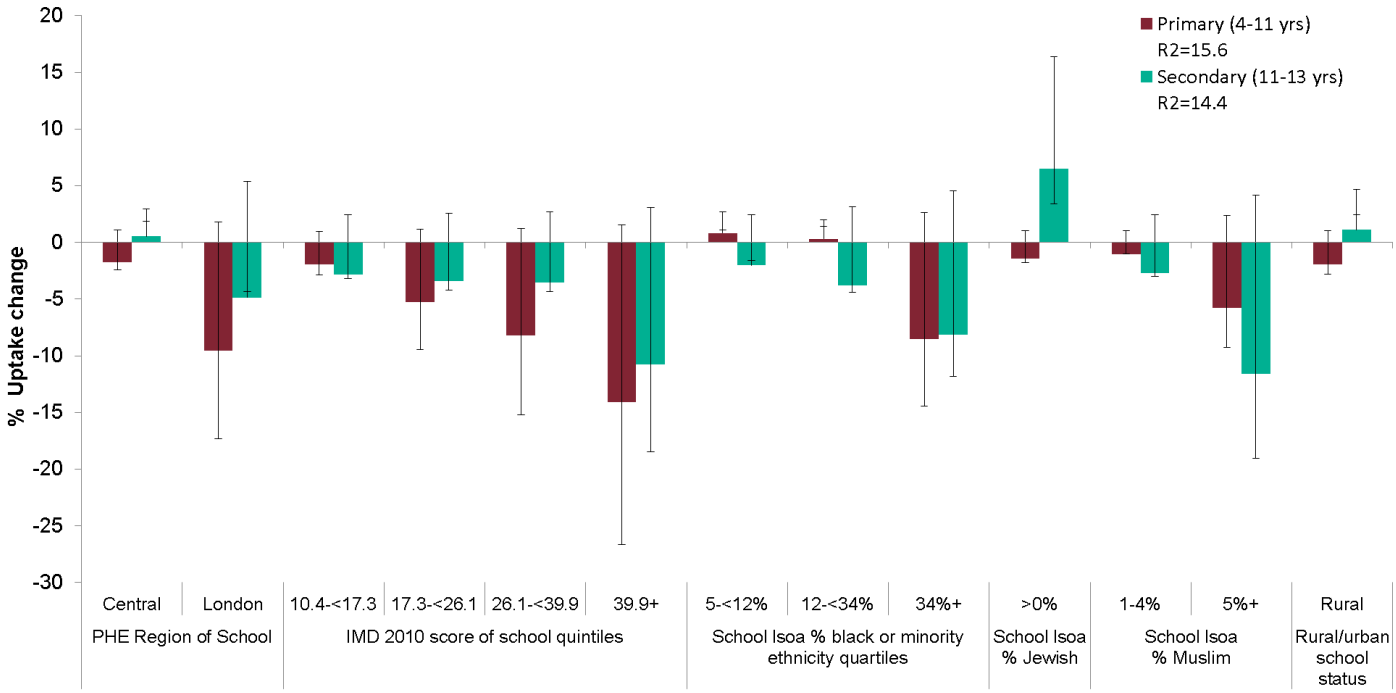


Table 3. *Vaccine uptake unadjusted/adjusted impact on uptake determined through linear regression population level predictors, 4-11 year olds, England, 1 September 2014 to 31 January 2015*

Covariate		Number of Children	Crude Uptake (%)	Unadjusted		Adjusted (R2=15.6%)	
				Estimated % uptake change (95% CI)	p-Value[a]	Estimated % uptake change (95% CI)	p-Value[a]
PHE Region of School	**North**	63,452	59.12	Baseline		Baseline	
	Midlands & East	222,508	60.86	2.91 (1.98 to 3.85)	**<0.001**	-1.76 (-2.85 to -0.66)	**0.002**
	London	22,330	55.11	-8.94 (-10.63 to -7.26)	**<0.001**	-9.53 (-11.31 to -7.76)	**<0.001**
IMD 2010 score of school	**<10.4**	100,176	65.41	Baseline		Baseline	
	10.4-<17.3	69,021	62.67	-2.24 (-3.25 to -1.23)	**<0.001**	-1.92 (-2.89 to -0.96)	**<0.001**
	17.3- <25.9	54,479	58.82	-6.82 (-7.97 to -5.67)	**<0.001**	-5.29 (-6.42 to -4.15)	**<0.001**
	25.9 -<39.9	54,551	55.2	-10.05 (-11.21 to -8.90)	**<0.001**	-8.21 (-9.41 to -7.01)	**<0.001**
	39.9+	31,045	47.41	-17.41 (-18.77 to -16.05)	**<0.001**	-14.09 (-15.61 to -12.58)	**<0.001**
School lsoa % black or minority ethnicity	**<5%**	106,056	63.4	Baseline		Baseline	
	5- <12%	102,594	62.46	-0.94 (-1.84 to -0.03)	**0.043**	0.81 (-0.26 to 1.88)	0.139
	12 -<34%	73,665	57.91	-6.16 (-7.18 to -5.14)	**<0.001**	0.30 (-1.12 to 1.72)	0.677
	34+%	26,917	43.31	-20.67 (-22.17 to -19.17)	**<0.001**	-8.52 (-11.13 to -5.92)	**<0.001**
School lsoa % Jewish	**0%**	257,768	60.19	Baseline		Baseline	
	>0%	51,464	59.26	-3.91 (-4.98 to -2.84)	**<0.001**	-1.41 (-2.46 to -0.36)	**0.008**
School lsoa % Muslim	**0%**	111,107	63.9	Baseline		Baseline	
	1-5%	166,268	60.51	-4.08 (-4.88 to -3.28)	**<0.001**	-1.02 (-2.04 to -0.01)	**0.048**
	6+%	31,857	44.04	-19.77 (-21.14 to -18.40)	**<0.001**	-5.79 (-8.14 to -3.45)	**<0.001**
Rural/urban school	**Rural**	48,550	65.61	Baseline		Baseline	
	Urban	259,740	59.05	-7.38 (-8.27 to -6.48)	**<0.001**	-1.91 (-2.94 to -0.88)	**<0.001**

[a] Estimates are bold if p<0.05

Table 4. *Vaccine uptake unadjusted/adjusted impact on uptake determined through linear regression population level predictors, 11-13 year olds, England, 1 September 2014 to 31 January 2015*

Covariate		Number of Children	Crude Uptake (%)	Unadjusted		Adjusted (R2=15.6%)	
				Estimated % uptake change (95% CI)	p-Value[a]	Estimated % uptake change (95% CI)	p-Value[a]
PHE Region of School	**North**	122,967	54.3	Baseline		Baseline	
	Midlands & East	192,692	54.16	0.98 (-0.92 to 2.88)	0.313	0.54 (-1.31 to 2.39)	0.568
	London	3,807	46.68	-8.00 (-13.55 to -2.45)	**0.005**	-4.86 (-10.26 to 0.54)	0.078
IMD 2010 score of school	**<10.4**	85,234	59.8	Baseline		Baseline	
	10.4-<17.3	70,263	57.25	-3.01 (-5.57 to -0.44)	**0.021**	-2.82 (-5.29 to -0.35)	**0.025**
	17.3- <25.9	63,169	54.98	-5.70 (-8.31 to -3.10)	**<0.001**	-3.39 (-5.93 to -0.85)	**0.009**
	25.9 -<39.9	55,086	52.66	-7.26 (-10.44 to -5.01)	**<0.001**	-3.51 (-6.22 to -0.80)	**0.011**
	39.9+	47,341	39.49	-21.46 (-24.13 to -18.79)	**<0.001**	-10.76 (-13.84 to -7.69)	**<0.001**
School lsoa % black or minority ethnicity	**<5%**	119,237	60.77	Baseline		Baseline	
	5- <12%	90,374	57.12	-3.2 (-5.39 to -1.00)	**0.004**	-2.01 (-4.45 to 0.43)	0.106
	12 -<34%	67,695	50.1	-9.41 (-11.75 to -7.07)	**<0.001**	-3.77 (-6.92 to -0.63)	**0.019**
	34+%	43,787	35.7	-22.59 (-25.06 to -20.12)	**<0.001**	-8.17 (-12.72 to -3.62)	**<0.001**
School lsoa % Jewish	**0%**	301,854	54.02	Baseline		Baseline	
	>0%	19,239	54.92	-3.11 (-6.26 to 0.03)	0.052	6.49 (3.10 to 9.88)	**<0.001**
School lsoa % Muslim	**0%**	118,827	60.84	Baseline		Baseline	
	1-5%	139,174	55.46	-4.58 (-6.51 to -2.66)	**<0.001**	-2.70 (-5.11 to -0.30)	**0.028**
	6+%	63,092	38.29	-21.90 (-24.15 to -19.65)	**<0.001**	-11.62 (-15.80 to -7.44)	**<0.001**
Rural/urban school	**Rural**	50,470	62.05	Baseline		Baseline	
	Urban	268,996	52.64	-7.47 (-9.71 to -5.23)	**<0.001**	1.10 (-1.35 to 3.55)	0.378

[a] Estimates are bold if p<0.05

Consents/refusals/non-responders

Data was returned on 84.1% of primary schools (1061/1261) with complete information on consents, refusals, and no returns (Table 5). The overall primary school pilot consent rate was 63.4%, compared to 55.5% in 2013/14, ranging from 58.3% to 65.3%. Overall consent rates aggregated by year group showed a downward trend with increasing year group (Table 7) from 66. 1% in Year 1 to 61.3% in Year 6. The overall parental refusal rate was 9.2% compared to 9.2% in 2013/14, with variation between pilot areas from 6.6% to 10.8%. Refusal rates were highest in year 0 (reception) at 11.9% but remained between 8.5-8.9% for year groups 1-6. The overall non return rates (ie consent form not returned) for primary school pilots was 27.4%. This ranged from 23.9 to 32.7%. Non-return rates generally increased with increasing age group from 24.9% in year group 1 to 29.9% in year group 6.

Table 5. *Proportion of primary school children aged 4-11 years consenting, refusing and not responding to vaccination, within each pilot area, England, 1 September 2014 to 31 January 2015.*

Area Team[a,b]	No. of schools returned with complete consent data (%)[c]	Denomaintor[d]	Consented[d] (%)	Refused[d] (%)	No Return[d] (%)
Essex	396 (67.1)	97,821	65.3	10.8	23.9
Leicestershire & Lincolnshire	375 (100.0)	74,177	62.9	8.8	28.3
London	86 (93.5)	22,457	58.3	9.0	32.7
Northumberland, Tyne & Wear	207 (100.0)	47,868	62.9	6.6	30.5
Average	**1,061 (84.1)**	**242,323**	**63.4**	**9.2**	**27.4**

[a] Cumbria was excluded from this analysis due to the walk-in nature of the pharmacy programme model
[b] Greater Manchester was unable to return data on parental consent, refusal and no return, therefore excluded from this analysis
[c] Excluding schools with missing or incomplete consent form data (ie school denominator≠ (sum of consents+refusals+no return)
[d] Including children contraindicated for vaccination with live attenuated influenza vaccine (LAIV)

Data was returned on 71.6% of the secondary schools (981/1371) with complete information on consents, refusals, and no returns (Table 6). The overall secondary school pilot consent rate was 56.4%, ranging from 48.1% to 68.2% Overall consent rates aggregated by year group decreased from 57.4% in Year 7 to 54.1% in Year 8 (Table 7). The overall parental refusal rate was 11.0%, varying between pilot areas from 5.8% to 15.3%.

The overall non return rates (ie consent form not returned) 32.6%. This ranged from 22.7% to 41.7%. Non-return rates increased to 34.9% in year group 8.

Table 6. *Proportion of secondary school children aged 11-13 years consenting, refusing and not responding to vaccination, within each pilot area, England, 1 September 2014 to 31 January 2015*

Area Team[a,b]	No. of schools returned with complete consent data[c] (N, %)	Denomaintor[d]	Consented[d] (%)	Refused[d] (%)	No Return[d] (%)
Birmingham & The Black Country	241 (99.2)	59,840	48.1	15.3	36.6
East Anglia	150 (60.2)	29,782	61.0	8.1	30.9
Essex	28 (100)	8,367	62.3	8.3	29.4
Lancashire	71 (98.6)	21,454	56.4	13.9	29.7
Leicestershire & Lincolnshire	171 (100)	38,916	64.0	8.6	27.3
London	32 (66.7)	3,363	49.1	9.2	41.7
North Yorkshire & Humber	39 (27.3)	9,536	68.2	7.9	23.9
Shropshire & Staffordshire	54 (30.2)	10,734	66.9	10.3	22.7
South Yorkshire & Bassetlaw	93 (95.9)	24,246	57.0	5.8	37.2
West Yorkshire	102 (72.3)	26,940	48.7	13.3	38.0
Average	**981 (71.6)**	**233,178**	**56.4**	**11.0**	**32.6**

[a] Arden, Herefordshire, and Worcestershire was excluded from this analysis due to the walk-in nature of the pharmacy programme model

[b] Greater Manchester was unable to return data on parental consent, refusal and no return, therefore excluded from this analysis

[c] Excluding schools with missing or incomplete consent form data (ie school denominator≠ (sum of consents+refusals+no returns)

[d] Including children contraindicated for vaccination with live attenuated influenza vaccine (LAIV)

Table 7. *Proportion of children consenting, refusing and not responding to vaccination, by year group, England, 1 September 2014 to 31 January 2015*

Year Group[a]	Denominator	Consented[b] (%)	Refused[b] (%)	No Return[b] (%)
0	21,611	62.1	11.9	26.0
1	34,336	66.6	8.5	24.9
2	34,550	65.0	8.9	26.0
3	34,035	64.1	8.6	27.3
4	32,575	63.4	8.6	28.0
5	32,055	62.8	8.6	28.6
6	32,313	61.3	8.7	29.9
7	111,209	57.4	11.7	30.9
8	104,938	54.1	11.0	34.9
Average	**437,622**	**59.8**	**10.2**	**30.0**

[a] Excluding 755/2,676 schools (280,449 children) where consent, refusal and no return data was either merged across year groups or not provided/complete (ie school denominator≠ (sum of consents+refusals+no returns)

[d] Including children contraindicated for vaccination with live attenuated influenza vaccine (LAIV)

Contraindications

Contraindications and precautions were reported by parents and/or guardians prior to or on the day of vaccination. As a percentage of all contraindications (prior and on day) in primary and secondary school children (63.5%) of total contraindications were contraindications made on the day of vaccination session and (36.5%) defined prior to vaccination (Table 9). Children contraindicated prior to vaccination may either have been referred to their general practice for vaccination or received the quadrivalent inactivated influenza vaccine (Fluarix Tetra) on site. The most common prior contraindications were 'confirmed egg allergy (n=571)' and 'severe asthma' (n=487) representing 12.6% and 10.8% of all contraindications respectively. Of contraindications noted on the day of vaccinations the highest percentage of children contraindicated were reported as 'child not well' at 35.5% of all contraindications.

Table 9. *Total prior and on day contraindications to LAIV vaccination in primary and secondary school children (5-13 years)*

Contraindication	Number of children contraindicated[a]	% of total contraindications
Prior	**1,642**	**36.5%**
Confirmed egg allergy	571	12.6%
Severe asthma	487	10.8%
Immunosuppression (family)	383	8.5%
Immunosuppression (personal)	99	2.2%
Previous anaphylactic reaction to vaccine	67	1.5%
Another vaccine given/due	35	0.8%
Cardiac disease/Salicylate therapy	32	0.7%
On Day	**2,853**	**63.5%**
On day: Child not well	1,594	35.5%
On day: Asthma	116	2.6%
On day: Allergies	28	0.6%

[a] Excluding 2,337 "contraindications" marked as "other" or "undefined"

Non-medical reasons for children not being vaccinated on the day of vaccination such as child absent or child refused were also recorded by a subset of teams of which approximately 7,327 primary and secondary school children were reported as being absent and 1,168 primary and secondary school children refused vaccination on the day of the session.

Discussion

The 2014/15 flu season saw the successful implementation of the second year of the childhood influenza vaccination pilot programme in England. Promising uptake levels were achieved across most pilot areas in children of primary and secondary school age (4-13 years), demonstrating the feasibility of rolling out the programme to further year groups nationally. Uptake was consistently higher in those areas that delivered the programme through schools as compared to pharmacy and GP settings. Refusal and non-response rates increased with increasing age and were higher in certain geographical areas, in particular London. Lower vaccine uptake was found to be significantly associated with increasing deprivation and proportion from a Black and Minority Ethnic group.

It is important to note uptake varied by programme delivery and year group. As seen in 2013/14, uptake was lowest in areas delivering their vaccination programme through primary care based delivery ie pharmacy and/or GP clinics[8]. This mirrors the experience of other programmes that target children of school age such as the HPV vaccine programme, where a school-based delivery model has achieved high levels of coverage in the UK. This highlights the importance of this being the recommended future approach to vaccinate these age-groups.

Consent, refusal and non-response rates indicate that decreasing uptake appears to be linked mainly to an increase in non-response rates as school year group age increases. Refusal rates were stable across primary school year groups with the exception of the reception class (four year olds) while they increased for secondary school years 7 and 8. These differences in response and refusal rates may be a reflection of parental perceptions of the importance of flu vaccination for older children. Younger children are typically more likely to suffer complications from flu than older children, and are therefore a higher risk group[12,13]. Further work is required to understand and address these differences.

Analysis on the ecological predictors of uptake suggest that uptake in primary and secondary school children is significantly and independently associated with ethnicity and deprivation, with the lowest uptake being reported in the most deprived quintile of deprivation or areas with a larger black or ethnic minority population. Additionally, areas identifying with the Muslim faith reported significantly lower uptake in both primary and secondary school children. Being in the highest Muslim population tertile had almost the same impact as being in the most deprived quintile. These results are similar to those found in the first year of the pilot vaccination programme in 2013/14, [8]. Comparing the 2013/14 and 2014/15 primary school pilot adjusted linear regression analysis, it appears the impact of ethnicity and Muslim population on lower vaccine uptake may have reduced albeit still significant, however it appears the impact of deprivation on vaccine uptake may have increased since 2013/14. It is important to note however that 2013/14 and 2014/15 pilot areas are not identical, with 2014/15 primary pilot areas including additional local authorities. The findings highlight the importance of developing strategies to tackle these differences.

Data on contraindications was variable across pilot areas. However, the most common contraindications reported prior to the day of vaccination were severe asthma and egg allergy followed by immunosuppression of a family member. An effort should be made during future vaccination programmes to collect information on vaccination in a standardised fashion.

In summary, despite the circulation of drifted A and B influenza strains in the 2014/15 season, the childhood flu vaccination programme continues to show a promising population level impact. With a significant reduction in disease incidence in pilot vs. non-pilot populations where primary school children were not vaccinated[11]. These findings are similar to those reported in the first year of the vaccination programme[3]. Indicators are continually strengthened through the further roll out of the programme, which is seeing a further extension in the 2015/16 season. From October 2015 all children of school years 1 and 2 age in England have been offered LAIV vaccination mainly through a school-based programme. As seen in previous years, all children aged two, three, and four years on 31 August 2015 have been offered flu vaccination through GPs. Additionally the five pilot areas that have been piloting the primary school vaccination programme over the past two seasons have continued to offer LAIV to all primary school-age children. The evaluation of the season will continue to inform the best strategy to roll out influenza vaccination to all target ages in seasons to come.

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Annexes

Annexe A: Year Group Cohort Definitions

Academic Year Group		Age range 1st Sept. 2014	Birth Date Range	
			Born From	Born To
Primary	Reception	Age 4-5	02/09/2009	01/09/2010
	1	Age 5-6	02/09/2008	01/09/2009
	2	Age 6-7	02/09/2007	01/09/2008
	3	Age 7-8	02/09/2006	01/09/2007
	4	Age 8-9	02/09/2005	01/09/2006
	5	Age 9-10	02/09/2004	01/09/2005
	6	Age 10-11	02/09/2003	01/09/2004
Secondary	7	Age 11-12	02/09/2002	01/09/2003
	8	Age 12-13	02/09/2001	01/09/2002

Annexe B: End of season data collection variables

Generic Fields (required)
Alternative Fields for Pharmacy/GP
Additional Fields (optional, but highly recommended)

CATEGORY	DATA TYPE	DESCRIPTION
Date of visit	dd/mm/yyyy	Date of vaccine session (ie date of vaccination w/ LAIV or TIV)
School Name (*Pharmacy/GP Delivery name)*	Categorical (School Name)	LA Registered School Name
School Code	String (integer)	Schools unique reference number (URN)
School Year	Categorical (0-8) [*Year 0 = Reception]	Year group cohorts as defined in Annexe A.
Starting denominator/children sent consent letters *(Pharmacy/GP delivery- sum of all children in the targeted year groups)*	Count (integer)	The school roll number for each year group or for *pharmacy/GP delivery the sum of all registered children in the targeted year groups.*
Parental consent total	Count (integer)	Consent forms/parental attendance on the day
Parental refusal total	Count (integer)	Consent forms returned indicating refusal for consent
No. forms returned total	Count (integer) [where not provided, calculated (Denom – (Consent +Refusal))	The number of non-responders through no form returned/non-attendance
Total no. of Males	Count (integer)	Total number males for each year group
Total no. of Females	Count (integer)	Total number of females for each year group
Total vaccinations of Fluenz (LAIV)	Count (integer)	Total doses of nasal LAIV vaccine given on the day for each year group
Total 1st Dose		Total first doses of nasal LAIV vaccine given for each year group
Total 2nd Dose		Total second doses of nasal LAIV vaccine given for each year group
Total vaccinations of Fluarix Tetra (quadrivalent inactivated influenza vaccine)	Count (integer)	Total does of Fluarix Terta given on the day for each year group
Total no. of GP referrals	Count (integer)	Total number of children in each year group referred to GP for vaccination.

No. of Yellow Cards issued	Count (integer)	Total number of children in each year group receiving yellow cards.
PRIOR CONTRAINDICATIONS (CI):		
Total no. of contraindications (c.i.)	Calculated Field, =SUM (all ci and on day CIs).	Total of all CIs, prior and on day for each year group
Previous anaphylactic reaction to vaccine	Count (integer)	
Confirmed egg allergy	Count (integer)	
Severe asthma	Count (integer)	
Another vaccine given/due	Count (integer)	
Immunosuppression (personal)	Count (integer)	
Immunosuppression (family)	Count (integer)	
Cardiac Disease/Salicylate therapy	Count (integer)	
Other	Count (integer)	
ON-DAY CONTRAINDICATIONS		
On day: child not well	Count (integer)	Congested, cough, fever, generally feeling unwell
On day: asthma	Count (integer)	Wheezing on the day
On day: child absent	Count (integer)	Absent on day of vaccination
On day: refused	Count (integer)	Child wouldn't receive the vaccine, total or partial refusal
On day: allergies	Count (integer)	Allergic reaction to vaccine on the day
On day: other	Count (integer)	
ADVERSE EVENTS (AE)		
Total AE	Calculated Field=SUM(all AE)	Total of all AEs for each year group
Shortness of breath/asthma	Count (integer)	
Reduced appetite	Count (integer)	
Weakness	Count (integer)	
Headache	Count (integer)	
Fever	Count (integer)	
Muscle ache	Count (integer)	
Rash at vaccine site	Count (integer)	
Rash elsewhere	Count (integer)	
Anaphylaxis	Count (integer)	
Other	Count (integer)	