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Phased introduction of a universal childhood influenza vaccination programme in England: population-level factors predicting variation in national uptake during the first year, 2013/14

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ABSTRACT

Introduction: Through a phased rollout, the UK is implementing annual influenza vaccination for all healthy children aged 2–16 years old. In the first year of the programme in England in 2013/14, all 2–3 year olds were offered influenza vaccine through primary care and a primary school age programme was piloted, mainly through schools, in geographically distinct areas. Equitable delivery is a key aim of the programme; it is unclear if concerns by some religious groups over influenza vaccine content have impacted on uptake.

Methods: At the end of the 2013/14 season, variations in uptake for 2–3 year olds and 4–11 year olds were assessed and stratified by population-level predictors: deprivation, ethnicity, religious beliefs and rurality. GP practice or school level uptake was linearly regressed against these variables to determine potential predictors and changes in uptake, adjusting for significant factors.

Results: Uptake varied considerably by geographic locality for both 2–3 year olds and 4–11 year olds. Lower uptake was seen in increasingly deprived areas, with an adjusted uptake in the most deprived quintile 12% and 8% lower than the least deprived areas by age-group respectively. By ethnicity, the highest non-white population quartile had an adjusted uptake 9% and 14% lower than the lowest non-white quartile by age-group respectively. Uptake also varied according to religious beliefs, with adjusted uptake in 4–11 year olds in the highest Muslim population tertile 8% lower than the lowest Muslim population tertile.

Conclusion: In the first season of the childhood influenza vaccination programme, uptake was not uniform across the country, with deprivation and ethnicity both predictors of low uptake in pre-school and primary school age children, and religious beliefs also an important factor, particularly the latter group. With the continued rollout of the programme, these population-level factors should be addressed to achieve sustained successful uptake, along with assessment of contribution of individual and household-level factors.

1. Introduction

Until recently, the United Kingdom (UK) has employed a selective influenza immunisation programme, with vaccination targeted at those individuals who are more likely to develop severe disease following infection together with their carers to reduce the risk of transmission. This included 65+ year olds, under 64 year olds in a pre-defined clinical risk group, pregnant women and frontline healthcare workers. However, a considerable burden of disease due to influenza continued to occur in the population in both vaccinated and non-vaccinated groups [1–3] and evidence is accumulating of the key role that children play in driving influenza transmission each winter [4]. Mathematical modelling work has demonstrated that vaccinating healthy children could potentially provide both direct protection to the targeted groups and indirect protection to other groups by reducing transmission in the population [5,6]. On this basis, the UK Departments of Health recommended extending the programme to all children aged 2–16 years of age [7,8].

This programme extension will primarily utilise a newly licensed intra-nasally administered live attenuated influenza vaccine (LAIV), with a phased rollout over a number of seasons. In England in 2013/14, all children aged 2–3 years were offered LAIV through primary care, together with primary school aged children

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aged 4–11 years old in seven geographically distinct pilots where vaccine was delivered predominantly in school settings [7]. Uptake of influenza vaccine through primary care reached 41.4% in 2–3 year olds [9], 42.6% in 2 year olds and 39.5% in 3 year olds, with a higher uptake reported in at-risk groups (56.5%) relative to healthy children (40.6%). An overall uptake of 52.5% was reached in 4–11 years [10], increasing to 56.3% when considering the six pilot sites where the vaccine was delivered through schools (LAIV was delivered through community pharmacies in the other pilot area).

While these figures appear encouraging in the first year of the programme, there was uncertainty about acceptability and equitable delivery - key requirements of a national vaccination programme. Evidence suggests several factors can have an impact on influenza vaccine uptake. Deprived areas have been shown to have lower uptake across age groups [11–13] and uptake has also been associated with ethnic diversity, with lower uptake observed in communities with a higher proportion of non-White residents [12]. Lower uptake has also been seen in urban relative to rural areas, though this was largely explained by other factors [13]. Specific concerns were raised during 2013/14, particularly amongst Muslim and Jewish religious groups, regarding the porcine origin gelatin component of LAIV [14]. Despite support for use of the vaccine from groups such as the Muslim Council, the issue received considerable media attention. It is currently unclear what the effect of this might have been on the influenza vaccine programme in 2–3 and 4–11 year olds as religious beliefs have previously been associated with increasing likelihood of under-immunisation for several vaccines [15–18].

While the majority of studies have assessed predictors of uptake at the individual level, uptake will also be influenced by factors at the level of household and community [19,20]. Although more limited in the causal inferences that can be drawn, ecological analysis can use routinely collected data to help rapidly identify potential factors associated with low uptake, which can inform subsequent rollout of a vaccination programme. Therefore the key aims of this manuscript were to:

- Assess the variation in influenza vaccine uptake across England in 2–3 year olds in primary care and 4–11 year olds in primary schools in the first year of the programme in 2013/14 by key population-level factors such as deprivation, ethnicity and religious beliefs.
- Identify at an ecological level predictors of vaccine uptake in 2–3 year olds and 4–11 year olds to ascertain if inequalities are apparent.

2. Methods

2.1. Data

2.1.1. Uptake

The collection of influenza vaccine uptake data has previously been described [12,13]. Uptake in 2–3 year olds, available stratified by year of age and by predefined clinical risk group, was collected at GP practice level across England through the Public Health England (PHE)-commissioned website, ImmForm [21]. This collection process is mandatory, and predominantly undertaken via automated extraction (>80% of practices). Uptake was calculated by dividing the number of GP-registered 2–3 year olds who received at least one dose of influenza vaccine by the number of 2–3 year olds registered at that practice and eligible to be vaccinated from 1 September 2013 to 31 January 2014. Uptake was aggregated by Clinical Commissioning Group (CCG) and PHE Region (North of England, Midlands & East of England (Central), London and South of England). CCG-level data was mapped using ArcGIS (ArcMap 10.2, ESRI, Redlands, CA).

Uptake in 4–11 years was collected at school level from each of the six pilot sites where the vaccine was delivered in schools, corresponding to 5% of the primary school age population in England [10]. Uptake was calculated by dividing the total number of children in the target age-group that received at least one dose of influenza vaccine by the number of children eligible for vaccination during the period the influenza vaccine was available based on the school roll population.

2.1.2. Population-level characteristics

The postcode of each GP practice and school was matched to various predictors available at 2011 census Office for National Statistics (ONS)-defined Lower Super Output Area level (lsoa, each with a population range of 1000–3000 [22]) to assess potential ecological associations with uptake in 2–3 year olds and 4–11 year olds.

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 [23]. As the value of the score increases, the level of deprivation increases. The most recently available scores were developed in 2010 based on lsoa boundaries defined in 2001. To ensure comparability with 2011 census indicators following lsoa boundary changes in 2011, PHE-developed corrections were utilized [24]. Scores were analysed both continuously and, based on the distribution, categorically through the calculation of quintiles.

Information on ethnic constitution of each lsoa is available according to the following categories: White/Mixed/Asian/Black/Other [25]. The proportion of lsoa classified as belonging in a black or minority ethnic group (%BME, defined as non-white British [20]) 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 [26]. Proportions were analysed, focusing on Jewish and Muslim because of the issues reported during the season with the use of porcine gelatin in the vaccine. Based on numbers in each category, the proportion of lsoa identifying as Jewish was grouped into 0% and >0% and Muslim into 0%, 1–4% and 5%+.

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 [27].

2.2. Analysis

2.2.1. Descriptive

Influenza vaccine uptake was calculated for all 2–3 year olds, healthy 2–3 year olds, 2–3 year olds in a clinical risk group, 2 year olds, 3 year olds and 4–11 year olds, each stratified by key predictors to assess potential ecological associations. Continuous and categorical variables were compared to uptake through calculation of Spearman correlation coefficients with 95% bootstrap confidence intervals and chi square tests respectively.

To look at validating the ecological population-level relationship, the methodology was applied to the uptake of another vaccine recently introduced into the UK childhood immunisation programme which is also not administered via injection and where individual-level information on %BME was available. Since July 2013, rotavirus vaccine has been offered orally to all babies at two and three months of age, with an upper administration limit of 23 weeks [28]. Monthly vaccine uptake (i.e. the proportion of babies aged 25 weeks in the evaluation month who had completed a two dose course of rotavirus vaccine by 24 weeks of age) data was