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Meningococcal vaccination in primary care amongst adolescents in North West England: an ecological study investigating associations with general practice characteristics

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ABSTRACT

Background In 2015 the meningococcal ACWY (MenACWY) vaccination was introduced amongst adolescents in England following increased incidence and mortality associated with meningococcal group W.

Methods MenACWY vaccination uptake data for 17–18 years old and students delivered in primary care were obtained for 20 National Health Service clinical commissioning groups (CCGs) via the ImmForm vaccination system. Data on general practice characteristics, encompassing demographics and patient satisfaction variables, were extracted from the National General Practice Profiles resource. Univariable analysis of the associations between practice characteristics and vaccination was performed, followed by multivariable negative binomial regression.

Results Data were utilized from 587 general practices, accounting for ~8% of all general practices in England. MenACWY vaccination uptake varied from 20.8% to 46.8% across the CCGs evaluated. Upon multivariable regression, vaccination uptake increased with increasing percentage of patients from ethnic minorities, increasing percentage of patients aged 15–24 years, increasing percentage of patients that would recommend their practice and total Quality and Outcomes Framework achievement for the practice. Conversely, vaccination uptake decreased with increasing deprivation.

Conclusions This study has identified several factors independently associated with MenACWY vaccination in primary care. These findings will enable a targeted approach to improve general practice-level vaccination uptake.

Keywords immunization, infectious disease, primary care

Introduction

Incidence and mortality from invasive meningococcal disease due to capsular group W (MenW) has been increasing in England since 2009 and in early 2015 MenW was declared endemic.[1–3] Consequently, the Department of Health (DH) introduced a targeted quadrivalent meningococcal ACWY vaccine (MenACWY) programme for school years 9 and 10 (age 13–15 years), replacing the vaccination programme against meningococcal capsular group C (MenC).[3,4] Additionally, an urgent catch-up programme in primary care for children in school year 13 (age 17–18 years) was implemented in primary care, with first-time university students under 25 years also recommended to receive the vaccine in primary care.[4] These age groups were targeted in recognition that adolescents and young adults have the highest carriage rates of meningococcal bacteria, with approximately a quarter asymptomatically colonized.[2,5] As such, although the proportion of invasive meningococcal disease caused by each serogroup varies with age; adolescents have the second highest rates of invasive disease, after infants, and drive population transmission of meningococcal bacteria.[2] Consequently,

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the MenACWY vaccination programme is expected to result in herd immunity.[2]

In the first year of the primary care catch-up programme national vaccine uptake was 38.3% (October 2016), whilst uptake amongst children in school years 9 and 10 vaccinated in schools was 77.2–84.1%.[6,7] Adolescent primary care vaccination programmes consistently have lower uptake than those delivered in schools and those delivered in primary care to other age groups. For example, uptake of the human papilloma virus (HPV) primary care catch-up vaccination between 2008 and 2014 was 49% compared to 86% for the school-based programme in younger girls.[8] These differences have also been observed in Germany, Belgium and the United States (US) and could be related to difficulty in accessing primary care appointments, in contrast to the ease of school vaccination, and low perceived risk of illness amongst adolescents.[9–12]

As the MenACWY vaccination programme in England is relatively new, there is little pre-existing research on its uptake. Across the country, vaccination uptake varied during the first year, with, for example, uptake rates for National Health Service (NHS) clinical commissioning groups (CCGs) in the Yorkshire and Humber region of Northern England ranging from 30% to 48%.[13] Aside from their student populations, the factors behind this variation have not previously been investigated.

In the United Kingdom (UK) uptake of vaccination programmes has been shown to be influenced by several different factors, including deprivation and ethnicity. Several studies have demonstrated that vaccine uptake falls with increasing deprivation and that this association is more pronounced for primary care than school-based vaccination.[14–17] However, other studies have found no relationship between vaccination and deprivation.[18,19] Similarly, some studies suggest that vaccination uptake is higher amongst certain Black and minority ethnic (BME) groups, particularly Asian and Asian British populations.[20–22] In contrast, other studies of measles, mumps and rubella (MMR), HPV and influenza vaccination suggest lower vaccination uptake amongst all BME groups.[15,23] It is essential to elucidate these associations further in the context of new preventative health initiatives, such as the MenACWY vaccination programme, in order to understand their impact on health inequalities. In addition, it is important to evaluate whether differences in vaccination uptake, and other clinical outcomes, arise due to demographics and social determinants of health, such as deprivation and ethnicity, or because of the quality and engagement of local health services. This is currently an under-researched area, with few studies, and none regarding vaccination, exploring how clinical outcomes are associated with indicators of patient satisfaction and primary care quality.

In this study, we investigate associations between various general practice characteristics and MenACWY uptake in the North West of England.

Methods

Sample

The sample consisted of all general practices across 20 NHS CCGs in North West England covering Lancashire, Merseyside, Cheshire, Warrington and Wirral.

These areas represent diverse localities and populations, encompassing rural and urban areas, deprived and affluent populations and differing ethnic compositions. For example, the city of Liverpool is included within this geographical area, as is Blackpool in Lancashire, which, based on the English Indices of Deprivation 2015 rank of average score, is the most deprived local authority in England.[24] Conversely, Cheshire contains some of the least deprived areas of England.[24] In Blackburn with Darwen, Lancashire more than 30% of the population are from BME groups, compared to <2% in Knowsley, Merseyside.[25,26] Asian or Asian British people are the largest BME group in the region.[27] The area contains several universities located within the urban centres of Liverpool, Preston, Lancaster and Chester and the town of Ormskirk. The combined population of the region is ~3.9 million people, accounting for around 7% of the population of England.[28]

MenACWY uptake data

MenACWY uptake data for the 2015/16 year was obtained via ImmForm. This is the data collection tool used by the DH and Public Health England (PHE) to record data from general practices on vaccine uptake, as well as providing vaccine-ordering facilities.[29] For the 20 NHS CCGs, data were extracted for each practice on the number of patients vaccinated and the number of patients eligible for vaccination in the 2015/16 catch-up cohort, which included 17–18 years old and first-time undergraduate students.

Practice characteristic data

Data were gathered on a variety of practice characteristics from the National General Practice Profiles, which is a publicly available data resource compiled by PHE using the most recent data and encompassing several practice-level indicators, including demographics and patient satisfaction[30] (Table 1). Profiles are available for all practices in the Quality and Outcomes Framework (QOF) with a list size of

Table 1 General practice characteristics and performance measures used as independent variables[30,32]

Indicator	*Description*
Index of multiple deprivation (IMD), score	The English Indices of Deprivation 2015 measure multiple aspects of deprivation at the small area level. Estimates for general practices are calculated by building the population-weighted average of the IMD scores for the lower super output areas (LSOAs) where the practice population lives. Higher scores indicate greater deprivation. The most recent scores have been calculated based upon where the practice population lived in 2016
Percentage of patients aged 15–24 years, %	The percentage of the total practice population that is aged between 15 and 24 years. Age data is extracted from the general practice payments system, with the most recent data extracted in April 2016
Percentage of patients from an ethnic minority, %	Estimated percentage of non-White ethnic groups in the practice population, based upon the LSOAs where the population lived in 2016 and the ethnic group of each LSOA according to the 2011 census
Total Quality and Outcomes Framework (QOF) points, %	The percentage of all QOF points achieved in 2015/16 across all domains as a proportion of all achievable points
Percentage of patients that would recommend the practice, %	The percentage of patients (aged 18 years and over) participating in the GP Patient Survey 2015/16, that is conducted on behalf of NHS England, who would probably or definitely recommend their practice to somebody who has moved to their local area
Percentage of patients satisfied with phone access, %	The percentage of patients (aged 18 years or over) participating in the GP Patient Survey 2015/16 who felt that it was fairly easy or very easy to get through to someone at their surgery via telephone
Percentage of patients satisfied with opening hours, %	The percentage of patients (aged 18 years or over) participating in the GP Patient Survey 2015/16 who were fairly satisfied or very satisfied with the opening hours at their surgery
Percentage of patients who saw or spoke to a nurse or doctor the same or next day, %	The percentage of patients (aged 18 years or over) participating in the GP Patient Survey 2015/16 who were able to see or speak to a nurse or doctor on the same or next day when they last contacted their surgery and wanted to speak to a nurse or doctor
Percentage of patients reporting a good overall experience of making an appointment, %	The percentage of patients (aged 18 years or over) participating in the GP Patient Survey 2015/16 who felt that the experience of making an appointment at their surgery was fairly good or very good

800 patients or more.[30] The QOF is the voluntary annual reward and incentive framework for English general practices and forms a significant proportion of practice income.[31]

Ethics

Ethical approval was not required for this study.

Analysis

The initial stage of analysis was to address missing data. Where practices had not reported MenACWY vaccination uptake via ImmForm they were excluded from analysis. The median, interquartile range and range were calculated for the dependent variable (vaccine uptake) and each general practice-level characteristic or performance measure.

To investigate any associations between general practice characteristics and general practice-level uptake, univariable negative binomial regression models were constructed whereby the dependent variable was the number of patients vaccinated against MenACWY in 2015/16, offset against the log of the number of patients eligible for vaccination, and the independent variables were the general practice characteristics detailed above. Finally, multivariable negative binomial regression was used to investigate the effect of independent variables, adjusted for the effect of other variables. Variables were entered into the multivariable model if, upon univariable regression analysis, the P value was ≤ 0.2. Multivariable associations were considered significant if the P value was ≤ 0.05. Negative binomial regression models were used because there was over-dispersion of the vaccination uptake data. All analyses were conducted in IBM SPSS statistics version 22.

Results

Descriptive statistics

Of 611 practices across the 20 CCGs, data on MenACWY vaccination uptake were recorded via ImmForm for 587, representing around 8% of all general practices in England.[33] At NHS CCG level, the median MenACWY vaccination

uptake was 30.9% (interquartile range = 24.9–36.5%) and ranged from 20.8 to 46.8%. Descriptive statistics for practice characteristics are displayed in Table 2.

Univariable regression analysis

The factors that were associated with MenACWY vaccination uptake upon univariable regression analysis were: deprivation, the percentage of patients that would recommend the practice, that were from a non-White ethnic minority and that were aged 15–24 years (Fig. 1). Vaccination uptake increased with increasing recommendation of the practice (risk ratio (RR) = 1.010, 95% confidence interval (95% CI) = 1.003–1.016, $P = 0.001$), percentage of patients from an ethnic minority (RR = 1.008, 95% CI = 1.001–1.014, $P = 0.021$) and that were aged 15–24 years (RR = 1.03, 95% CI = 1.017–1.043, $P < 0.0001$). In contrast, vaccination uptake decreased with increasing IMD score (RR = 0.992, 95% CI = 0.987–0.998, $P = 0.005$), i.e. with increasing deprivation.

Multivariable regression analysis

Six independent variables were identified for inclusion ($P < 0.20$) in the multivariable analysis. Vaccine uptake increased with increasing recommendation of the practice (adjusted risk ratio (aRR) = 1.014, 95% CI = 1.007–1.021, $P < 0.001$), total QOF points (aRR = 1.013, 95% CI = 1.001–1.026, $P = 0.048$), percentage of patients from an ethnic minority (aRR = 1.009, 95% CI = 1.003–1.016, $P = 0.003$) and percentage aged 15–24 years (aRR = 1.034, 95% CI = 1.019–1.049, $P < 0.001$) (Fig. 1). Vaccination uptake decreased with increasing deprivation (aRR =0.991, 95% CI = 0.986–0.995, $P < 0.001$).

Discussion

Main findings of this study

Uptake of the MenACWY vaccination amongst the CCGs examined in this study varied from 20.8% to 46.8%. In relation to indicators of practice satisfaction, vaccination uptake increased with the percentage of patients who would recommend their practice. In addition, as total QOF points, the percentage of the practice population aged 15–24 years and from an ethnic minority increased, MenACWY uptake also increased. Conversely, as deprivation increased MenACWY uptake decreased.

What is already known on this topic

Because the MenACWY vaccine programme in England is new there is limited research on population level factors that influence vaccine uptake. A study by Campbell *et al.*[34] suggested that vaccination uptake is higher amongst students than non-students. This is potentially due to the higher education status of students, their perception as being at increased risk of meningococcal disease and targeted approaches taken by universities and general practices, with some universities routinely offering vaccination on campus to all new students.[34–36]

Although not previously observed for MenACWY, evidence from several other vaccination programmes suggests that, both in the UK and internationally, vaccination rates amongst all age groups fall with increasing deprivation. Studies from the UK, Ireland, Italy, Denmark and the USA have demonstrated that deprivation is associated with reduced uptake of childhood and adult vaccinations, including MMR, influenza and HPV.[14,37–40] These inequalities may arise because of factors such as poorer access to health services and reduced ability to seek help with the vaccination decision-making process.[14,36] Furthermore, considerations such as differing beliefs, concerns regarding side effects and less education about diseases and vaccines may also play a role.[37,38]

As with deprivation, whilst not previously reported for the UK MenACWY vaccination programme, studies from both the UK and USA have shown that people from ethnic minorities are more likely to accept vaccinations such as MMR and influenza than White populations.[20–22,41,42] This association has been found to be independent of deprivation, with deprivation a poor indicator of vaccination coverage amongst ethnic minorities, in contrast to amongst White British groups.[43] This increased acceptance of vaccination is not universal to all BME groups, with Asian populations in the UK and Hispanic populations in the USA showing high levels of vaccine acceptance, whilst Black ethnic groups often have lower levels of vaccine uptake than White cohorts.[21,41] Explanations for this include greater trust in healthcare systems and in health professionals amongst certain ethnic groups, along with a tradition of belief about the safety and protection afforded by vaccination in certain cultures.[20–22]

Although indicators of patient satisfaction, access and general practice quality have not previously been examined in association with vaccination uptake, they have been explored in conjunction with other clinical indicators and disease outcomes. There is a wide body of evidence that higher practice achievement, as measured by the QOF, is associated with better outcomes for chronic diseases such as diabetes, epilepsy and coronary heart disease, as well as higher dementia diagnosis rates and earlier cancer diagnosis.[44–46] Likewise, satisfaction with practice opening hours and with the appointment booking system have been associated with

Table 2 Table showing descriptive statistics for general practice characteristics at general practice level

Independent variable	*Median (interquartile range)*	*Range*
Index of multiple deprivation (IMD) (score)	28.2 (16.6–39.0)	5.7–66.5
Percentage patients who would recommend practice (%)	80.8 (72.4–87.4)	31.2–100
Percentage satisfied with phone access (%)	77.3 (64.6–89.0)	18.1–100
Percentage satisfied with opening hours (%)	78.8 (72.6–84.5)	20.9–97.0
Percentage who saw/spoke to nurse/doctor same or next day (%)	52.5 (41.6–67.2)	17.2–91.3
Percentage reporting good overall experience of making an appointment (%)	77.1 (69.0–85.3)	8.0–100
Total Quality and Outcomes Framework points as percentage of all available (%)	98.1 (95.4–99.7)	66.8–100
Percentage of patients from a non-White ethnic minority (%)	2.7 (2.0–5.3)	0.8–73.8
Percentage of patients aged 15–24 years (%)	11.8 (10.3–12.5)	7.0–55.3

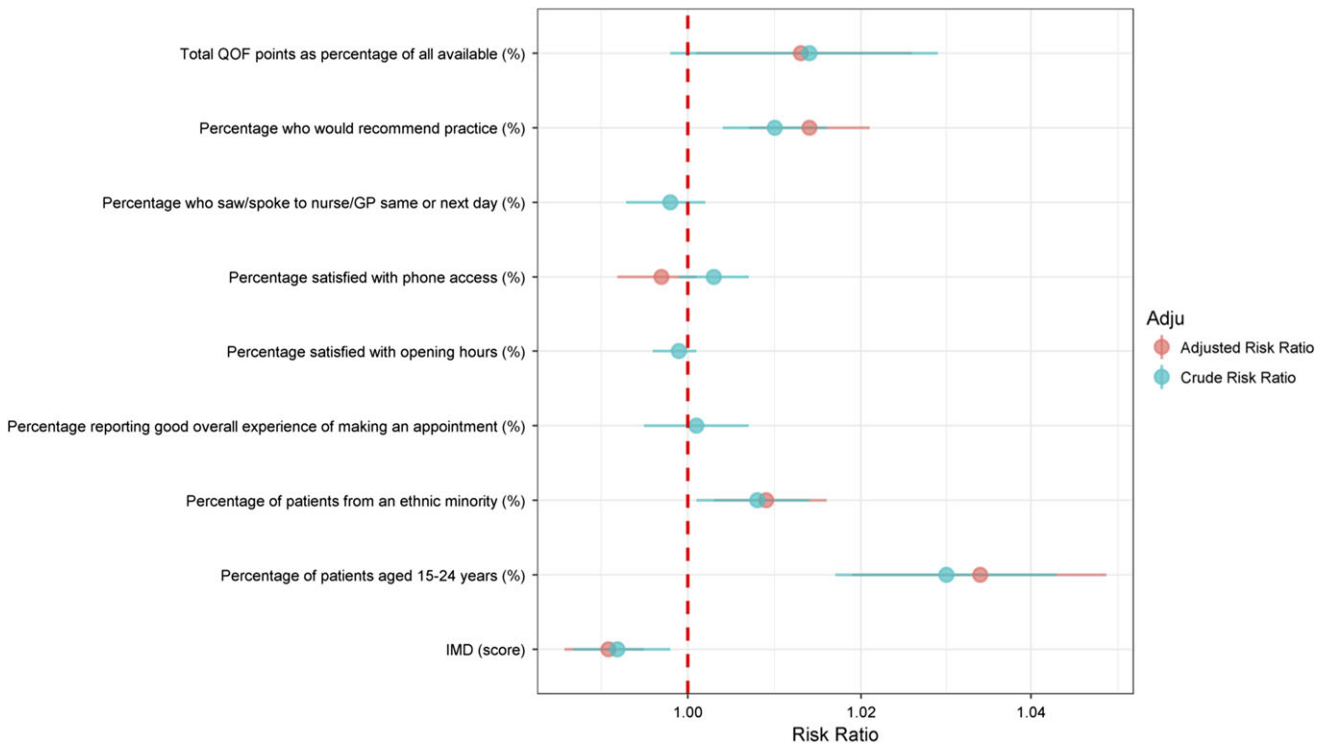

Fig. 1 Univariable and multivariable regression analyses investigating associations between general practice characteristics and MenACWY vaccination uptake (2015/16).

earlier diagnosis of breast and colorectal cancer, whilst self-reported ability to make an appointment and be able to speak to a doctor or nurse the same or next working day have been linked with reduced Emergency Department attendance.[45,47]

What this study adds

This study is one of the first to investigate factors associated with uptake of the MenACWY vaccination programme that was introduced in England in 2015. Through the use of multivariable regression, this study has identified several factors independently associated with MenACWY vaccination in primary care. We have demonstrated that both social determinants of health, such as deprivation and ethnicity, and factors relating to how individuals engage with and perceive their general practice influence vaccination uptake.

Firstly, an association was identified between an increasing proportion of patients aged 15–24 years and increasing vaccination. As the university student population primarily falls within this age-group and those practices with a large number of patients aged 15–24 years are likely to be those with a

large student population, this adds weight the findings of recent work suggesting that students have higher uptake than non-students.[34,35]

Similar to other vaccination programmes, this study has demonstrated for the first time an association between increasing deprivation and lower MenACWY vaccination rates, and ethnic minorities and greater uptake. However, it is not clear whether this increased uptake is universal to all ethnic groups or specific to the Asian and Asian British population, which is the most common BME group within the study region and a group that is consistently shown to have high acceptance of vaccinations.[20,27,41] Additional research is required to elucidate this further and it is essential that ethnic minorities are not considered as one homogenous group when considering public health interventions. However, these findings demonstrate that areas with high levels of deprivation and a predominantly White British population, of which there are many across North West England, are likely to experience lower vaccine uptake and require targeted vaccination efforts. This is important as overcrowded living conditions and higher levels of smoking increase the likelihood of asymptomatic meningococcal carriage and invasive disease and are factors associated with deprivation.[47–52] These findings also display the need for caution and further sub-analysis when evaluating crude vaccination uptake figures, as rates may appear over-inflated due to high uptake amongst sub-populations, such as ethnic minorities, and mask far lower uptake amongst others.

This study has identified that indicators of practice quality and patient satisfaction are associated with vaccination. These are important findings because they demonstrate that indicators of patient satisfaction and quality equate to improved patient outcomes, such as vaccination. This is relevant for clinical practice and quality improvement as it suggests that practices with low levels of patient satisfaction and overall indicators of quality should receive additional focus and targeted interventions to improve both patient satisfaction and outcomes. It is notable that very little previous research had examined the link between patient satisfaction and clinical outcomes, despite the focus in England on patient-centred care and the resource implications of national exercises such as the GP Patient Survey. It is important that this is understood further because, as suggested by our findings, improving patient satisfaction could also improve vaccine uptake.

This study's findings are highly relevant to public health. This is because measures that increase vaccination uptake even by very small amounts at population level are highly effective in reducing disease incidence. This is especially the case given that, even with 38.3% vaccine uptake during the first year of the MenACWY primary care vaccination programme, there is evidence that incidence of invasive meningococcal disease has fallen.[34] Finally, these findings have relevance to all vaccination programmes delivered in primary care that are targeted at adolescents.

Limitations of this study

This study has certain limitations inherent to all ecological studies. Firstly, area-level data has been used, with general practices, rather than individuals, the unit of interest. Consequently, the ecological fallacy is possible, whereby associations at practice level may not persist at the individual level.[53] Secondly, data is not available regarding several confounding variables, which could partially explain some of the associations; for example, although the percentage aged 15–24 years is likely to be a proxy for the student population, it would have been useful to known whether practices were linked to universities that may have had targeted vaccination strategies. It would also have been interesting to have uptake data for the withdrawn MenC vaccination programme, as it is possible that individuals that received this vaccine in schools at age 13–15 years may have mistakenly believed that they did not require MenACWY vaccination in older adolescence.

There were also various study-specific limitations. ImmForm vaccination data have certain drawbacks, for example, relating to missing data, with 24/611 practices across the study region not reporting their MenACWY uptake. It is possible, therefore, that these practices may somehow differ, e.g. if their vaccination uptake was very low, resulting in selection bias. Furthermore, the mobile nature of the study population can complicate uptake data, with many young people moving away to university at this age. Therefore, it is possible that individuals who appear as unvaccinated in a university practice's numerator actually received vaccination at their 'home' practice or vice versa. Whilst a considerable sample of practices was utilized across a large and diverse area, which increases the likelihood that the findings may have wider applicability, data from only a distinct region was used and there is no guarantee of the broader representativeness of the findings.

Although the use of a routine data-set such as the National General Practice Profiles ensures that robust data sources are used and that the data has been checked for errors, with excellent completeness of data, it also has drawbacks. In this instance, ethnicity data was obtained from the 2011 census and applied according to the lower super output areas where the 2015 practice populations were resident.[30] Therefore, although applied to recent practice populations, the ethnicity data was several years old and has the potential to change, especially in urban areas with mobile populations.

Furthermore, there was no sub-categorization of the White population, which may have complicated the association with ethnicity as ~3% of residents in North West England describe themselves as of 'White–Other' ethnicity.[27] In terms of the patient experience aspects derived from the GP Patient Survey, this is a voluntary survey that is routinely offered to a selection of patients from each practice.[32] Therefore, response bias may occur, with, for example, only those patients with very good or very poor experiences motivated to respond.

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Conflicts of interest

The authors have no conflicts of interest to declare.

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