Risk of invasive meningococcal disease in university students in England and optimal strategies for protection using MenACWY vaccine

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A B S T R A C T
Purpose: In August 2015, in response to increasing group W invasive meningococcal disease (IMD) nationally, a MenACWY vaccine programme was introduced in the UK for 13–18 year olds. We reviewed the epidemiology of IMD in young adults and university-associated cases in England during 2014–15 academic year and assessed the potential impact of different immunisation strategies.

Methods: Public Health England national enhanced surveillance data were used to describe the epidemiology of IMD cases in 15–24 year olds in England during 2014/15. Relative risks for IMD were calculated overall and by capsular group in students compared with non-student peers for 2014 and 2013 school leavers. Assuming stable future incidence and vaccine efficacy of 90% for five years, we estimated cases averted and numbers needed to vaccinate (NNV) for different MenACWY immunisation programmes: school-based adolescent, GP-based school leaver, and targeting freshers.

Results: Between July 2014 and June 2015, 112 IMD cases were diagnosed in those born between 01/09/1991 and 31/08/2001 (15 to 24 year-olds). During the 2014/15 academic year (September to June), 49 IMD cases were reported among students attending English universities, including 22 among 2014 school leavers. In this cohort, the relative risk of IMD was higher among students compared to non-students for all capsular groups (RR 11.6; 95% CI 4.7–28.7) and for groups A/C/W/Y (RR 14.8; 95% CI, 4.3–51.5). A school-based programme could potentially have averted 14 cases in 2014/15 and 24 cases over five years with a lower NNV (18,000) than other programmes.

Conclusions: University students, particularly first years entering direct from school, are at higher risk for IMD than non-students. With high vaccine coverage and timely completion, an adolescent school-based MenACWY programme has the greatest potential to prevent cases with the lowest NNV, but population impact through indirect (herd) protection could take longer.

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1. Introduction

In the United Kingdom, the meningococcal C conjugate (MenC) vaccination programme since 1999 has led to a rapid and sustained decline in group C meningococcal disease across all age groups [1]. Consequently, capsular groups B, W and Y are responsible for nearly all invasive meningococcal disease (IMD) cases in England [2]. In 2013, to maintain long-term population control of group C IMD, a routine adolescent MenC vaccine programme was introduced for 13–14 year-olds. Temporary catch-up MenC vaccination was also offered to freshers starting university in September 2013 and again in 2014.

Since the 2009/10 epidemiological year (running from 1 July to 30 June), England has experienced a marked increase in capsular group W (MenW) IMD with a high proportion of cases in young adults [2,3]. In August 2015, as an emergency public health response to this increase, a meningococcal A,C,W,Y conjugate (MenACWY) vaccine directly replaced the existing MenC school-based vaccine programme for adolescents and the GP-based programme for freshers. A phased catch-up programme was also launched for 13–18 year olds, starting with 17–18 year olds who left school in the summer of 2015 (those born between 01/09/1996 and 31/08/1997) [4]. This group was considered a
priority and could realistically only be offered timely vaccination through their GP.

We reviewed the epidemiology of IMD cases in young adults in England during the 2014/15 epidemiological year, prior to the emergency introduction of the MenACWY immunisation programme. To assess the relative contribution of age and university status among IMD cases in the 2014/15 academic year (1 September 2014 to 30 June 2015), we calculated the relative risk of IMD among two school leaver cohorts (summer of 2014 and summer of 2013) compared to their non-university peers. We also estimated the potential number of cases averted using three different strategies of MenACWY immunisation; replacing the school-based MenC programme in 13–14-year olds with MenACWY vaccine, offering MenACWY vaccination to school leavers through primary care during the summer, or targeting fresher with MenACWY vaccine upon entry to university.

2. Materials and methods

Public Health England (PHE) conducts enhanced national surveillance of IMD using clinical and laboratory reporting systems. PHE’s Meningococcal Reference Unit (MRU) provides a national service for characterisation of all invasive Neisseria meningitidis isolates, as well as polymerase chain reaction (PCR) testing of clinical specimens submitted by hospitals in England. Isolates are grouped using monoclonal and polyclonal antibodies for A, B, C, E, W, X, Y, Z as previously described [5]; those negative for these groups are classified as non-groupable. Samples undergo an initial PCR screen which includes a specific assay for group B; screen negative and group B negative samples are then tested on specific PCR assays for C, W, Y (and A if indicated); those negative on these assays are classified as ungrouped [5].

PHE also receives statutory notifications of clinically diagnosed cases from physicians and electronic reports of IMD confirmations from National Health Service (NHS) and private microbiology laboratories in England. Since 01 July 2014, all suspected, probable and confirmed IMD cases associated with universities in England were flagged by the Health Protection Teams in PHE Centres using HPZone, a national, web-based case management tool in which all meningococcal cases reported to PHE are captured. HPZone case data includes full personal identifiers (name, date of birth, and address with postcode). University-associated cases identified from HPZone were matched using these personal identifiers with laboratory-confirmed cases in the national surveillance dataset for 2014/15; those recorded as probable or possible IMD cases on HPZone (i.e., without laboratory confirmation) were excluded from further analysis.

University students were defined as those attending an English university or college registered with the University and Colleges Admission Service (UCAS); otherwise, they were classified as non-students. Because the year of study for university students is rarely recorded on HPZone and to control for age when estimating relative risk, IMD rates were compared between students and non-students born between 1 September 1995 and 31 August 1996 and diagnosed between September 2014 and June 2015 (the academic year for most universities). This cohort was due to leave school in summer 2014 and is referred to as 2014 school-leavers throughout. Those attending university in this cohort were assumed to be full-time, new university entrants in their first year, England-domiciled undergraduates unless the HPZone records specified otherwise. A similar analysis was then conducted for cases born between 1 September 1994 and 31 August 1995; university students in this cohort would have left school in summer 2013 and would, therefore, include both first (e.g. those taking a gap year and starting university a year later) and second year students. This cohort is referred to as the 2013 school-leavers.

In the 2014/15 academic year, there were 562,345 English-domiciled first year students (including full time, part time, undergraduate and postgraduate) attending English universities (Higher Education Statistics Agency (HESA) Student Record 2013/14–2014/15) including 157,290 first year, full-time undergraduates aged 18 years on entry (2014 school leavers) and 87,180 aged 19 years (2013 school-leavers); only -500 UK students (<1%) enter university below 18 years of age (HESA Student Record 2013/14–2014/15).

The student denominator for 2014 school leavers (n = 157,290) was then subtracted from the English population estimate for 18-year-olds in mid-2014 (N = 655,753) to determine the non-university population in this age group (N = 498,463) [6].

Of the 2013 school leavers, 153,150 entered university in the 2013/14 academic year and 87,180 in 2014/15, giving a total of 240,330 students. This was then subtracted from the English population estimate for 19 year-olds in mid-2014 (N = 659,877) to determine the denominator for their non-university student peers (N = 419,547) [6]. Incidence rate ratios (IRR) and 95% confidence intervals (CI) were calculated for overall and capsular group-specific IMD in students compared with non-university student peers using Stata v.13.0 (Statacorp, TX).

The potential numbers of cases that might have been averted in 2014/15 by introducing a MenACWY vaccination programme were calculated for each immunisation strategy. The mid-2014 English population denominator for 13 year olds (N = 592,716) was used for the adolescent programme calculations [7]. Vaccine coverage estimates for each potential strategy were applied to cases observed in the relevant academic year. Vaccine coverage for the school-based adolescent programme in year 9 (13–14 year-olds) was assumed to be 75%, which is a conservative estimate [8], whereas we assumed only 35% of school-leavers aged 17–18 year-olds would be vaccinated, mainly during the months of August and September [9]. Coverage achievable in new university entrants was assumed to be 50% based on coverage seen in practices attached to universities [10]. The number needed to vaccinate (NNV) to prevent a single case was then estimated over a five-year period assuming the 2014/15 age-specific incidences and a sustained but conservative 90% protection from vaccine.

3. Results

During the 2014/15 epidemiological year, there were 724 confirmed IMD cases across all age groups, including 418 group B (58%), 176 group W (24%) and 93 group Y (13%). A total of 112 cases were diagnosed in those born between 01/09/1991 and 31/08/2001. Groups B, W and Y accounted for 53% (n = 59), 28% (n = 31) and 14% (n = 16) of all cases, respectively, in this 10-year age cohort. The highest number of cases occurred in the age group that left school in summer 2014 (Table 1).

3.1. University-associated IMD cases in England in 2014/15

During the 2014/15 academic year (from September to June inclusive), there were 73 laboratory-confirmed IMD cases linked to a university/college on HPZone; 19 were reclassified because the institution was not UCAS-registered and five were reclassified because the case was confirmed as not studying at the university (staff or visitor).

Of the remaining 49 IMD cases among students attending UCAS-registered institutions in England, the median age was 19.9 years (range, 18.2–28.8 years) and 26 (53%) were female. Group B IMD was responsible for 20 cases (41%) followed by group...
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