Meningitis C Vaccination Uptake: A Study of Prevalence in Children of Medical and Non-Medical Card Holders

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Abstract

Introduction:*Neisseria menigitidis* causes meningococcal meningitis, with the most commonly seen strains in Ireland being groups B and C. A vaccination programme began in Ireland in October of 2000, being introduced on a phased basis. **Aim:**This study set out to: (1) Estimate the prevalence of meningitis C vaccination uptake in children less than 5 years old. (2) Assess parental attitudes in those receiving and those declining vaccination. (3) Assess the source of vaccine information for parents. (4) Compare vaccine uptake in medical and non-medical card holders. (5) To compare uptake of other childhood vaccines to the meningitis C vaccine. (6) Evaluate the prevalence and type of early vaccine side effects. **Methodology:**An interview-based cross-sectional survey of parents of 100 children aged less than five years, selected at random from a range of departments at the National Children's Hospital in Dublin. **Results:** Six out of every ten children had been vaccinated. Children of parents not holding medical cards were more likely to be vaccinated than those holding medical cards (Odds Ratio 2.4, 95% CI 1.02-5.41). The main source of information about the vaccination programme came from the media (49%) and the general practitioner (39%). The most common reasons for having their children vaccinated was experience of the disease itself (39%) or following GP advice (32%). In those not vaccinating their children, the primary concern was developing meningitis from the vaccine (39%) or inconvenience (22%). There were no reported serious side effects from vaccination and the prevalence of minor side effects was 42%. Fever was the most common minor symptom reported (40%). **Conclusion:** The uptake of meningitis C vaccine is lower than other childhood programmes which may be due to its shorter duration of operation. There is a continuing need for efforts to be directed at improving awareness and to reassure the public about the safety profile of the vaccine. Such messages and issues of access to the healthcare system must take into consideration the differential found between medical and non medical card holders. *TSMJ May 2001, vol 2, 54-58.*

Introduction

Meningococcal Meningitis

The organism responsible for meningococcal meningitis is *Neisseria meningitidis*. This is a gram-negative capsulated diplococcus that is carried in the nasopharynx of 10% of the population, with a high proportion of these carriers in the 15 to 25 year age group. The development of meningitis is largely related to host factors. It has a bi-modal distribution with 50% of cases found in the under five year olds, and a second peak in young adults[1].

The prevalence is increased in the lower social classes, smokers and in areas of overcrowding such as boarding schools and military camps. It shows peaks in the winter months and is spread by respiratory droplet, following which it attaches to the cilia of the nasopharynx. From here haematogenous spread occurs. There are 13 known strains of the organism, 5 of which are responsible for causing disease. These are serotypes A, B, C, Y and W135, with each group being genetically and antigenically diverse. Serotype A is common in Africa and China. Types Y and W135 are rare worldwide but type Y is now on the increase in America. Serotypes B and C are the most commonly found strains in Europe. On a worldwide scale, group B is more common than group C except in Iceland, Greece, Switzerland and Scotland[1].

Meningococcal Meningitis in Ireland

Meningococcal meningitis was first reported in Ireland in 1866 and has been rising ever since. Today, Ireland has one of the highest rates of group C meningitis in the developed world and currently has more than four times the European average of meningococcal disease. Groups B and C account for almost all of the cases of bacterial meningitis in Ireland with group B predominating nationally. From 1997 to 2000, 61% of the meningitis cases reported were group B meningococcus and 35% were group C meningococcus. There is also regional variation seen, eg: the Eastern Health Board in this period reported predominantly group B while the South Eastern Health Board reported mainly group C. Both groups show winter peaks and summer troughs. The overall mortality reported for group B in this three year period was 5.2% and slightly lower in group C with 5.1 %. The mortality in the under five age group is lower than that in the 14 -19 age group. According to the recent surveillance report produced by the Department of Health looking at bacterial meningitis, published in May 2000, the causative organisms were[1]:

N. meningitidis	91.1%
Strep. pneumoniae	3.2%
Mycobacterium tuberculosis	1.2%
Haemophilus influenzae	0.5%

Of all the deaths due to meningitis in 1999, only one of these was not attributed to meningococcal disease and was due to *Strep. pneumoniae*. These figures serve to highlight the extent of meningococcal disease in Ireland as well as the huge importance of the new vaccine against meningococcus group C.

The Vaccine

The vaccine that has been produced is a conjugate vaccine against meningococcal serogroup C polysaccharide. The polysaccharide found on the surface capsule of the bacteria is conjugated with a cross reacting carrier known as CRM-197 which is a non-toxic immunogenic mutant of diptheria toxin. It helps improve the immune response to the vaccine by inducing immunological memory and so provides longterm protection. CRM-197 leads to the production of bacteriocidal antibodies in the recipient. A plain unconjugated polysaccharide vaccine will not elicit immune memory. It is important to be aware that the carrier protein (CRM-197) provides no immunity against diptheria[2].

The meningococcal vaccine is not live and so does not carry the risk of developing meningitis. The vaccine will also reduce the carriage of meningococcus C and it is believed that vaccination of the age groups with the highest rates of carriage could create herd immunity thus protecting age groups that are not yet immunised[3]. The vaccine can be used in babies and young children aged two months and upward. As of yet, no vaccine has been developed to group B, which has a poorly immunogenic capsule.

The Meningitis C Vaccination Programme in Ireland

The most extensive immunisation programme ever in Ireland was announced on 3rd of October 2000 and is to be carried out on a phased basis for everyone up to the age of 22 years inclusive. Those most at risk are to be approached first. Costs are estimated to be close to £25 million for the first year and it is expected to take two years to complete. To ensure maximum uptake, the vaccination programme has been supported by extensive public awareness campaigns including radio, press, provision of help-lines, distribution of literature to places of work and health care facilities, and also by direct notification from the Health Board to those in each phase[4].

The phases are as follows:

Phase One: Autumn 2000

- Babies attending their GP for other vaccines at 2, 4, 6 and 15 months
- Children approaching school age
- Young people in school from Junior Certificate to Leaving Certificate, inclusive
- Young people aged 15–18 years, who are not in full time education

Phase Two: On completion of Phase One

- Children aged 5 –6 in school

Phase Three: On completion of Phase Two

- Children aged 7-14 in school
- Young adults 19-22 inclusive by their GP

Administration of the Vaccine

Each dose of the vaccine contains 10mg of meningococcal C polysaccharide. Three doses are recommended for a child under the age of one year, as their immune systems require greater stimulation. These will be given with the routine 2, 4 and 6 monthly immunisations. All other age groups require one dose of the vaccine.

Before giving the vaccine, a full medical history must be taken and it should be given in the presence of medical supervision in case of anaphylaxis. The vaccine comes in two vials: one containing the meningococcal polysaccharide and the CRM 197 carrier, the other containing aluminium hydroxide onto which the antigens will be adsorbed. These are mixed and the vaccine must then be given immediately. It is given intra-muscularly, deep into the deltoid or, in very young children, into the anterolateral zone of the thigh[5].

Interactions

There are no known drug or alcohol interactions and the vaccine can be given at the same time as all the other paediatric vaccines. However, it must be given in a separate syringe and into a different site. In older children, adolescents and adults, there is insufficient data on the vaccination when given in combination with other vaccines. No interval is required with regard to other vaccines.

Side Effects

It is important to introduce a new vaccination programme in an open, honest and robust manner. Reports of an association between vaccines and adverse outcomes get a great deal of public attention and it often becomes difficult to determine whether the public is receiving appropriate information to make an informed decision. To persuade individuals to continue to be vaccinated when the vaccination programme has successfully reduced the incidence of the disease requires that the vaccine has few adverse effects and that the individuals also value the community benefit. The recurring challenge for public health authorities is to find the best way to communicate with the public so that they are truly informed on the relevant risks and benefits. In other words the vaccine must be safe and effective, and the public must be assured of these facts.

All of the side effects of the meningitis C vaccine are mild and resolve within 24–72 hours. Rare reports of fainting and seizures were thought to be related to the fever that had developed after the vaccine. Paracetamol (Calpol) given to younger children can be recommended after the vaccine for its analgesic and antipyrexic effects. There have also been a small number of reports of photophobia and neck stiffness after the vaccine but no reports of meningitis developing[6].

The Lancet recently published an article in which a 17 year old boy presented two days post-vaccination with a two day history of fever, sore throat, wide spread erythematous non-blanching rash and painful swelling of his left elbow, right knee and left ankle. On examination, he was febrile with an effusion in his right knee. He also had a widespread rash on his back, chest, hands and feet but it was felt to be uncharacteristic of a meningococcal rash. He had no signs of meningeal irritation. He was commenced on benzylpenicillin IV. His blood tests indicated raised white cells and an ele-

vated C-reactive protein. The effusion in his right knee was aspirated and the fluid found to contain neutrophils but grew nothing on culture. He was diagnosed as having suffered a reactive polyarthropathy to the vaccination but was kept on oral benzylpenicillin for 7 days as a precaution. The rash faded over two days, joint symptoms improved during the week after admission and he was discharged after 8 days. The fluid from his joint aspirate which had been sent for PCR testing was returned 17 days post vaccination and showed a high level of antibodies to group C polysaccharide. The antibodies could be due to the body's response to the vaccine but the fluid also contained meningococcal C DNA that is not found in the vaccine and so raises the possibility of a true meningococcal C infection. This is the only report of its kind[7].

Contraindications

Documented contraindications to the meningitis C vaccine include the following:

- Hypersensitivity to any component of the vaccine
- Hypersensitivity to previous administration of any-vaccine
- Acute febrile illness
- Young female who may be pregnant
- Breast feeding

Animal studies have not demonstrated a risk to the foetus, however, it should not be used in pregnancy unless there is a serious risk of meningococcal C infection. The vaccine has not been studied in breast-feeding. HIV is not a contraindication but the vaccine has not been specifically evaluated in the immunocompromised. A minor afebrile illness such as an upper respiratory tract infection is not usually a reason to defer. It has not been evaluated in thrombocytopaenic patients or on those with other bleeding disorders, and in these patients one must weigh up the risk of haemorrhage following the injection, with the benefit of the vaccination.

The Future

Official figures on meningococcal infection have not been published yet for Ireland since the introduction of the vaccine but it is hoped that Ireland will follow the pattern seen in the United Kingdom. The Vaccination Programme was introduced there in November 1999 and initially targeted the most at risk groups. Since then, 19 million doses of the vaccine have been given leading to an 80% reduction in the prevalence of group C meningococcus in the last two years[8]. In the last 6 months, there has been a 90% reduction in meningococcal C infection in the 15 to 17 year old age group. It is estimated that 500 cases of Group C meningitis and meningitis septicaemia have been prevented since the programme began, and 50 deaths avoided. Eradication is now a real prospect in the United Kingdom and it is hoped that Ireland will follow closely behind.

A substantial proportion of meningococcal disease is caused by non-serotype C strains notably serotype B. Also the vaccine does not guarantee 100% protection against meningitis C. Therefore it is important that the public are made aware of this, and that parents should remain vigilant when their children become ill.

Careful surveillance is essential before, during and after the introduction of the vaccine. The vacancy created by elimination of the serotype C may be occupied by meningococcus of another group as the vaccine confers no cross protection and a concern for the future is that other variants may exploit this. A study is currently underway in Ireland that involves obtaining and culturing throat swabs from a number of people (1–2 and 15–19 years old) each year for the next 3 years. During this time an analysis of the major pathogenic organisms will be performed, thus indicating if the strains are changing in response to the vaccination programme[9]. Another important issue to deal with is social deprivation as rates for meningococcal meningitis have been found to be 74% higher in overcrowded areas[10]. It is also important that any side effects that develop are reported and that any long-term side effects that begin to emerge are detected.

Despite the introduction of the vaccine, continued public health education about the importance of early recognition and treatment of meningococcal disease should remain a priority.

Aims

A study was carried out on 100 children in the National Children's Hospital in Dublin. The aims of this study were to:

1. Estimate the prevalence of meningitis C vaccination uptake in a group of children aged 5 years and under.
2. Assess parental attitudes in those receiving and those declining vaccination.
3. Assess the source of vaccine information for parents.
4. Compare the level of vaccine uptake between medical and non-medical card holders.
5. To examine the uptake of the scheduled childhood vaccines in comparison to the meningitis C vaccine.
6. Evaluate the prevalence and type of early vaccine side effects.

Methods

A cross-sectional study was carried out in the National Children's Hospital in Tallaght during January 2001. A total of one hundred children in groups of twenty-five were selected at random from a range of hospital departments as follows: Radiology; Accident and Emergency waiting room; the wards; and Outpatients. In the last, equal numbers (five) were selected from the following outpatient clinics: asthma, developmental, orthopaedic, diabetes and dermatology. Subjects were excluded above the age of five years to capture those most likely to have been involved in the first phase of the vaccination programme.

A questionnaire was designed to collect information to support the aims shown above. A pilot study was performed on twenty parents to determine its usefulness and it was adjusted accord-

ingly. The questionnaire was used to facilitate a structured interview of the child's parent or relative. The purpose of the survey and it's confidential nature was explained before consent to carry out the survey was obtained from the parent or responsible relative.

The face to face interview recorded information about: the child's age; meningitis C vaccination status; reasons for agreeing to or declining vaccination; the presence of early (within six weeks) side-effects in those vaccinated; the uptake of other vaccinations; and, whether the parents were holders of a medical card or not.

Statistical analysis was performed on the comparative data on medical cards using the interactive statistical package SISA[11]. A Pearson chi square test was used and an odds ratio with 95% confidence intervals calculated. Significance was set at the 95% level with $p < 0.05$.

Results

The age profile of the sample comprised just over one third (35%) aged under one year, one fifth (20%) between one and two years, over a quarter (28%) were aged between two and three years and 17 per cent were between three and four years. Medical card holders made up just over one third (37%) with non-medical card holders accounting for the remaining two thirds (63%).

There was a greater proportion of children vaccinated (59%) compared to those unvaccinated (41%). Also, the prevalence of vaccination is greater within the non-medical card holder group (67%) compared to those with medical cards (46%). This relationship was shown to be statistically significant as the odds ratio was calculated to be 2.35 95% CI 1.02-5.41 [$p<0.05$]. A large proportion of those not vaccinated against meningitis C (88%) had received all the other childhood vaccines appropriate for their age.

In those parents whose children had received meningococcal C vaccination, the most common reason given for having their child vaccinated was experience of the disease itself in close relatives or friends (39%). Advice from the family doctor was a close second (32%), with other reasons indicated in Table 1.

Table 2 shows the reasons given for parents deciding not to have their child vaccinated; fear of developing meningitis from the vaccine itself accounted for the largest group (39%). Worryingly in one fifth (22%) inconvenience was recorded as the next highest reason for failure to vaccinate.

In those receiving the vaccine, almost one half (49%) obtained their information from the media. General practitioners also rated highly (39%) as an information source. The remaining 12% had drawn information from a range of other mainly health care and family sources (Table 3).

The prevalence of early side effect within six weeks of vaccination reported by parents was 29% or just over a quarter. There were no major side effects or anaphylactic reactions reported. Of the minor side effects reported, the most common was a fever (40%). Some form of swelling at the site was the next most common (18%) followed in equal frequency (12% each) by a rash; redness/soreness at the injection site; and irritability (Table 4).

Table 1: Men C Vaccinated Group - Reasons for Vaccination Uptake (n = 59)

Reason Given by Parent/Relative	Number (%)
Experience of meningitis in family/friend	23 (39%)
GP Advice	19 (32%)
Media	10 (17%)
Health Board letter	6 (10%)
Pressure from others	1 (2%)

Table 2: Non Men C Vaccinated Group - Reasons for Declining Vaccination (n = 41)

Reason Given by Parent/Relative	Number (%)
Developing Meningitis	16 (39%)
Inconvenience	9 (22%)
Side effects other than Meningitis	6 (15%)
Did not think it would be effective	4 (10%)
Did not know about the vaccine	3 (7%)
Vaccine not available	2 (5%)
Medical contraindications	1 (2%)

Discussion

This study aimed to estimate the prevalence of vaccination in phase one of the meningococcal C vaccination programme. This was found to be 59% and could be regarded as low given the high profile campaigns undertaken by the health authorities and general practitioners. However the programme has of course been running for a relatively short time and this may account for the uptake rates found in this study. Given more time these figures may improve. Of those who had their children vaccinated, almost one half obtained their information from the media

Table 3: Men C Vaccinated Group - Source of Vaccination Information (n = 59)

Source of Information	Number (%)
Media	29 (49%)
General Practitioner	23 (39%)
Community Nurse	3 (5%)
Health Board letter	2 (3%)
Hospital	1 (2%)
From a friend	1 (2%)

Table 4: Men C Vaccinated Group - Side effects experienced (n = 17)

Side Effect	Number (%)
Fever	7 (40%)
Swelling at site	3 (18%)
Rash	2 (12%)
Red & sore at site	2 (12%)
Irritability	2 (12%)
Drowsy	1 (6%)

and over a third more from the general practitioner. Other methods of obtaining advice, such as community nurses were disappointingly low. This suggests that the media and GP sources are relatively effective and should continue. Perhaps other community-based awareness methods need to be improved or enhanced as well.

The holding of a medical card by the parent was a significant determinant of vaccination status. The possession of a medical card could be seen as a proxy measure of social status. The finding of a lower vaccination uptake in the medical card holder group (i.e., lower socio-economic group) may be an example of how health inequality is related to lower social class. The reasons given for not vaccinating showed a large number of parents (over half) worried about side effects, notably of developing meningitis itself. Clearly efforts need to be directed towards reassuring the public about the safety of the meningitis C vaccine.

A disappointing reason given by one fifth of those not vaccinating their children was that of inconvenience arranging to have their child vaccinated. Attention needs to be given to ensuring that the public are not apathetic to this important programme and that problems of access to the healthcare system are not acting as a barrier to vaccination.

A large proportion (88%) that had not been vaccinated for meningitis C had received all the other vaccinations. Thus the question remains; is this merely because the vaccination program has not been completed or is there some concern or barrier to vaccination specifically for meningitis C.

The greatest motivation to be vaccinated was a friend or relative suffering meningitis. There is no way to influence this motivational factor. But a close second was advice from the GP, which was significantly more effective than a letter from the Health Board.

The absence of major side effects is pleasing, however the numbers involved are obviously too small to fully evaluate this aspect of the vaccine. Nevertheless, of the minor symptoms reported, post-vaccination fever is the most common, followed by swelling, redness and soreness at the injection site. Knowing the common minor side effects will allow information to be given to parents on what to look out for and how to use simple measures for symptomatic relief. This will give reassurance and help promote a wider feeling of comfort with the vaccination programme itself.

Conclusion

The uptake of the meningitis C vaccine is lower than that of other childhood programmes and this is more marked in those of lower socioeconomic group. Given that the vaccination programme is relatively new perhaps explains the rate of uptake but not the class difference. There is a continuing need for efforts to be directed at improving awareness and to reassure the public about the safety profile of the vaccine. Such messages and issues of access to the healthcare system must take into account differences in attitude between medical cardholders and non-medical cardholders, as exemplified in this study

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