earlier, around 1941. A similar birth cohort effect is seen in incidence.⁸ There is little evidence for this particular effect in our study perhaps because Scottish women are less at risk than their English and Welsh contemporaries or perhaps because the risk can be largely negated by an effective screening programme.

Women reaching the age of 50 may welcome release from the cervical screening programme as they embark on the breast screening programme. It is not known whether the increasing uptake of hormone replacement therapy will maintain the higher incidence of cervical intraepithelial neoplasia seen in younger women by rejuvenating the cervix and a prospective randomised trial would be warranted.

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Antibody persistence after accelerated immunisation against *Haemophilus influenzae* type b

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Haemophilus influenzae type b is a leading cause of bacterial meningitis in young children. As maternal antibodies decline infants become more susceptible to disease, and the peak incidence is at age 6-12 months.¹ Routine primary immunisation against *H influenzae* type b was introduced in Britain in October 1992, with an accelerated schedule at 2, 3, and 4 months of age. A booster dose is not planned. Schedules for primary immunisation against *H influenzae* type b in Europe and the United States are not completed until 5 or 6 months of age, and a booster dose is recommended in the second year of life.

We had previously immunised 107 infants according to the accelerated schedule with the conjugate vaccine polyribosylribitol phosphate-tetanus (PRP-T) (a polymer of ribosylribitol phosphate covalently linked to tetanus toxoid, Pasteur-Merieux) and established its immunogenicity.² To determine if protective concentrations of antibody persist we followed up 95 infants until 1 year of age. The study was approved by the Central Oxford Research Ethics Committee.

Patients, methods, and results

The recruitment method was described previously.² Polyribosylribitol phosphate-tetanus and diphtheria-pertussis-tetanus immunisations were given separately by intramuscular injection at 2, 3, and 4 months. Venous blood was obtained for serological examination at 2 months, 5 months, and, in 95 infants, 1 year.

The concentration of total IgG antibody to polyribosylribitol phosphate was measured by enzyme linked immunosorbent assay (ELISA).² Each sample taken at 1 year was assayed on the same plate as a previously collected sample from the same infant. The lower limit of sensitivity of the assay was 0.16 µg/ml. Values below this were arbitrarily assigned the value 0.08 µg/ml for calculation of geometric mean titres.

At 1 year 89 infants had a serum polyribosylribitol phosphate antibody concentration >0.15 µg/ml (figure). In 43 the concentration was >1.0 µg/ml. The geometric mean titre was 0.83 µg/ml. Compared with

Serum concentrations of antibodies to polyribosylribitol phosphate in infants immunised at 2, 3, and 4 months (horizontal bars are geometric means)

the antibody concentrations measured at 5 months of age five infants showed at least a twofold rise and two of these showed more than fourfold rises at 1 year. None had clinical disease. One infant did not respond to primary immunisation (antibody concentration <0.16 µg/ml at 5 months). A booster dose of the vaccine was given at 16 months, and one month later the antibody concentration was 3.4 µg/ml.

Comment

We found that nearly all 1 year old infants immunised with polyribosylribitol phosphate-tetanus at 2, 3, and 4 months of age had serum antibody concentrations that are likely to be protective (>0.15 µg/ml). Without immunisation nearly all children of this age have antibody concentrations below 0.15 µg/ml despite likely exposure to *H influenzae* type b.³ The infant who failed to respond to primary immunisation was tested for immunodeficiency, but none was found and she responded well to a booster dose.

Immunisation of older infants—for example, according to the previous British schedule at ages 3, 5, and 9 months—produces higher antibody concentrations³ and therefore prolongs protection if indeed prevention of disease depends on concentrations being maintained above a threshold. A booster in the second year of life is recommended in most countries with routine immunisation against *H influenzae* type b. Our findings suggest that this may not be necessary.

Since conjugate vaccines induce T cell dependency and thereby prime for a secondary immune response, immunised infants may be protected against *H influenzae* type b irrespective of the concentration of circulating antibodies. In our study five infants had natural rises in their antibody concentrations in the absence of clinical disease. These and other results⁴ suggest that infants are primed by immunisation for a mature for age response to either the organism or cross reactive antigen.

In an open controlled prospective trial in the Oxford region we have shown the vaccine to be highly protective.⁵ Nationwide postmarketing surveillance (in collaboration with the British Paediatric Surveillance Unit) is examining the long term efficacy of the conjugate vaccine given to children at 2, 3, and 4 months without a booster dose in their second year.

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Clinical coding: completeness and accuracy when doctors take it on

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To allow decentralisation of coding the Central Middlesex Hospital NHS Trust has purchased a hospital wide information technology system. We conducted a study to evaluate completeness and accuracy of clinical coding in the paediatric department before and after its installation.

Materials and methods, and results

Medical records of children admitted to the paediatric ward between 1 September and 31 October 1990 and 1991 were reviewed, respectively six months before and six months after coding was decentralised and responsibility transferred to medical staff. Diagnoses independent of that registered in hospital records were allocated by CY for 1990 and HD for 1991. Twenty from each year were checked by both of us; in these cases attributed codes agreed. Diagnoses were then compared with those allocated by coding clerks (1990) or those entered by medical staff on the computer (1991).

A total of 152 children were admitted in 1990 and 167 in 1991; notes of 127 (84%) and 117 (70%) respectively were reviewed. Thirty seven (29%) had been coded in 1990, and all 117 in 1991. Twenty (54%) of the 1990 and 99 (85%) of the 1991 diagnoses were accurate. Twelve (32%) were partially correct (correct but inexact) in 1990 compared with 17 (15%) in 1991. Five (14%) in 1990 and one (1%) in 1991 were classified as incorrect. Attributing more than one diagnosis was commoner in 1991 (table).

Study samples and results

		1990		1991	
No of admissions		152		167	
No (%) analysed		127 (84)		117 (70)	
No (%) coded		37 (29)	p<0.001	117 (100)	
No accurate	20		p<0.001	99	
No partial	12			17	
No inaccurate	5			1	

		1990		1991	
No with diagnosis	Coded	Assessed by reviewer (No of diagnoses)	Coded	Assessed by reviewer (No of diagnoses)	
1	29	54	80	74	
2	8	51	31	37	
3	0	13	4	5	
4	0	9	2	1	

Comment

Although only 70% of admissions in 1991 were analysed compared with 84% of admissions in 1990, the large difference in coding levels could not be ascribed to this. Overall coding level in the children's ward in 1991 was 95% (Central Middlesex Hospital information department). The low level of coding in 1990 and its inaccuracy would prevent rational planning. The accuracy of coding in 1990 before medical staff took on responsibility for coding (20/37; 54%) was slightly worse than that reported by Smith (71%).¹ There were many reasons for the improvement. Medical staff are aware of the importance of accurate coding, and information technology has simplified the process as it is performed contemporaneously on the ward. It can also be attributed to greater clinical knowledge of medical staff.

The transfer of responsibility required motivating medical staff to change. There was initially reluctance and resentment, yet after training these problems resolved. Two problems emerged: the rapid turnover in children's wards, and training new or locum staff. To overcome the first problem the process had to respond rapidly. This was accomplished by using a second copy of the admission sheet to record diagnoses and procedures. These are taken on ward rounds to allow initial coding at the bedside. Information is transferred to the computer at the end of the ward round, obviating the need for notes, which are not always to hand. The second problem was solved by a program that provided a list of uncoded admissions. Even with that system uncoded admissions occasionally accumulated, particularly in neonatology. At those times a concerted effort by the whole team was required to bring the coding up to date.

Each department or hospital will need to develop its own solutions. We have used a large and comprehensive hospital system whereas others have designed their own for departmental use.² Small may be beautiful, but we have shown that with energy and enthusiasm a department can exploit the possibilities of a much larger system and yet have "ownership." It is not our aim to supplant coding officers; their skills are needed to improve coding details. It must be recognised that fewer may be needed.

We conclude that participation of doctors in coding leads to greater accuracy, the benefit of case review, and creation of an accurate database for audit, research, and planning.

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