

Costs of running a universal adolescent hepatitis B vaccination programme

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Abstract

In the first UK study to examine feasibility and acceptability of universal adolescent hepatitis B vaccination, the costs associated with the administration and uptake (80.2 and 89.3% for three doses and at least two doses, respectively), of a three-dose regimen in pupils in Glasgow schools (2001/2002) were measured. These data were used to estimate the economic outlay for the delivery of a routine, ongoing three-dose and two-dose hepatitis B vaccine programme in schools. Vaccine, accounting for almost 70% of the overall costs, was the largest cost item for both the pilot and routine programmes, using either regimen. However, the ongoing, two-dose regimen was the cheapest option in this analysis, irrespective of vaccine price. Cost data from this study may be useful for other countries wishing to implement a similar programme. © 2005 Elsevier Ltd. All rights reserved.

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1. Introduction

In 1992, the World Health Organisation (WHO) recommended that all countries should implement universal vaccination against hepatitis B (hepB) regardless of the prevalence of infection [1]. The United States, Canada and most of Europe have complied with the recommendations, adopting approaches involving the universal immunisation of infants and/or adolescents, and the targeting of higher risk populations [2]. In the UK, however, the Joint Committee on Vaccination and Immunisation (JCVI) recommends that vaccination against hepB should be restricted to higher risk populations, although this policy is currently being reviewed. To inform the JCVI of the acceptability, feasibility and cost of

introducing universal adolescent hepB vaccination in the UK, the investigators undertook a study which involved offering three doses of hepB vaccine to all 11–12 year old secondary one (S1) pupils attending schools in the Greater Glasgow NHS Board area during 2001/2002. This paper outlines the costs associated with delivery of the pilot programme and, through the application of these, estimates of the costs that would be incurred if such a programme was routine and ongoing. The pilot programme involved the use of a three-dose regimen (with a paediatric dose at 0, 1 and 7 months); estimated costs, based on costs measured during the pilot, of a two-dose regimen (with an adult dose at 0, 4–6 months) are also reported since this is already available in some countries, for example, the USA.

Little information on the actual costs of delivering universal hepB vaccination, particularly for programmes in Europe, is available and, thus, these data may have utility for other countries that are considering its implementation.

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2. Methods

2.1. Design of the three-dose pilot programme

The pilot programme was undertaken by the following organisations: Greater Glasgow NHS Board, the Scottish Centre for Infection and Environmental Health (now Health Protection Scotland), the Schools Health Service (SHS) of the Yorkhill NHS Trust, Greater Glasgow Primary Care NHS Trust Pharmacy and Transport, and the Education Departments in all participating Local Authorities. Following correspondence with the Education Liaison Group and notification of the vaccination programme to all head teachers, vaccination timetables were arranged by the SHS, information leaflets for both pupils and parents were prepared and printed, and nursing staff were supplied with information to be imparted to pupils through health education lessons prior to vaccination.

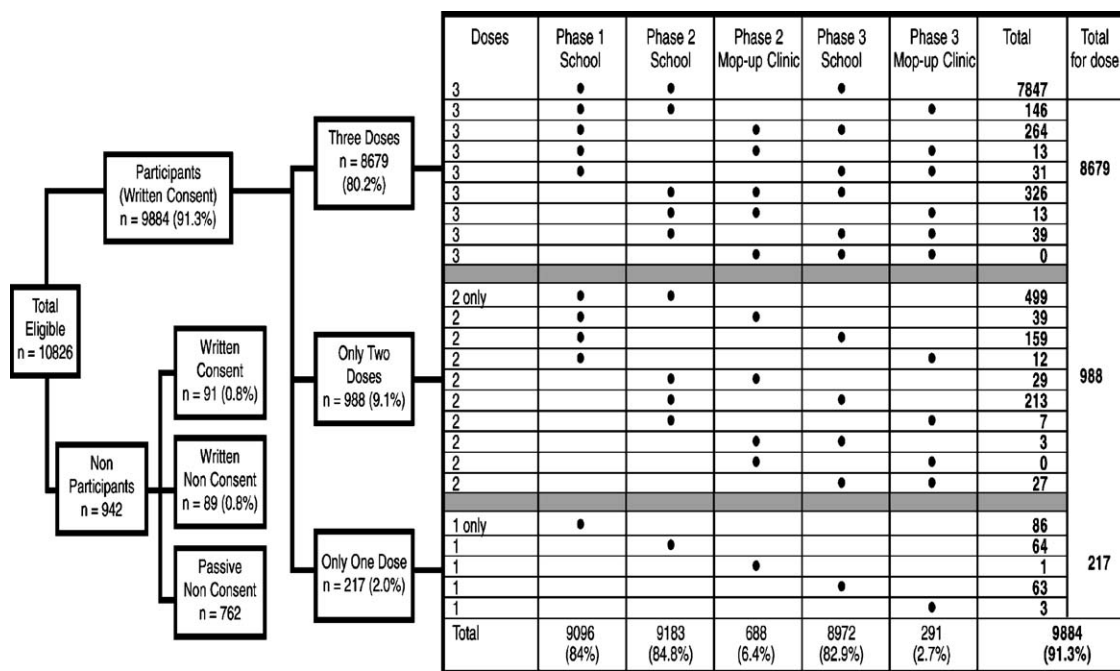
A zero, one and seven month schedule was delivered by the SHS over one academic year to all 11–12 year old S1 pupils, in 81 schools, from whom a signed consent form had been received. Pupils were invited, by appointment, to attend “mop-up” clinics, which were provided in health centres (where the school nurses were based), throughout Greater

Glasgow, one month after the time periods during which the second and third doses were administered. The purpose of these clinics was to accommodate pupils who had never received a dose or had missed their subsequent dose which had been arranged to be given in the school at an assigned time. These clinics were unique to the Glasgow pilot programme; in routine practice, pupils would be invited to attend for catch-up vaccinations in the next scheduled round of vaccination visits or, in certain circumstances, would receive them from their General Practitioner. Of the 10,826 pupils eligible for vaccination, 80.2% received three doses, 89.3% at least two doses and 91.3% at least one dose; uptake rates are fully described in Fig. 1 [3].

2.2. Cost analysis: pilot programme

The pilot programme was designed so that the resource use, and thus cost, of running a universal adolescent hepB vaccination programme across Glasgow could be assessed. The assumed perspective was that of the healthcare provider, the National Health Service (NHS).

Initially, the three-dose pilot vaccination programme was costed. Full details of the identification, measurement and valuation of resources used in the analysis for the pilot pro-



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Phase 1: school visits during September/October 2001.

Phase 2: school visits during October/ November 2001; mop-up clinics during December 2001.

Phase 3: school visits during April/May 2002, mop-up clinics during June 2002.

Note: for the cost analysis, the total eligible population was 10,859, and not 10,826 due to an increase in the number of non-participants on further analysis of the database.

Fig. 1. Participation of Secondary 1 pupils in the hepatitis B vaccination programme and the timing and number of doses received by the 9884 pupils who received at least one dose of vaccine.

Table 1
Identification, measurement and valuation of resource use for three-dose regimen: pilot programme

Item of resource	Measurement	Valuation
Staff time		
Medical time	16 hours	£34.64 per hour ^a
Nursing time	4407 hours	£14.18–16.38 per hour ^a
School nurse assistants	960 hours	£7.40 per hour ^a
Clerical time	2728 hours	£7.48–11.27 per hour ^b
Graphic designer time	25 hours	£11.27 per hour ^b
Pharmacist time	92 hours	£16.78 per hour ^c
Pharmacist technician time	504 hours	£6.59–11.29 per hour ^d
Driver time	542 hours	£7.50 per hour ^c
Website designer	49 hours	£13.88 per hour ^b
Press officer	5 hours	£9.57 per hour ^b
General duties	65 hours	£6.46 per hour ^c
Vaccine and vaccine related		
Vaccine vials	28,230	£9.70/vial ^e
Needles	56,460	£0.02
Syringes	28,230	£0.03
Cotton wool	141 packs ^f	£0.92/pack
Gloves	141 packs ^f	£0.50/pack
Hand towels	141 packs ^f	£1.60/pack
Swabs	141 packs ^f	£1.47/pack
Sharps containers	141 units ^f	£3.36/unit
Adrenaline kits	Number required	Annual equivalent cost
Fridge for vaccine storage	Number required	Annual equivalent cost
Other resources		
Information leaflets	21,718 leaflets	£0.03–0.04/leaflet
Letters	43,436 letters	£0.04–0.06/letter
Envelopes	26,359 envelopes	£0.02–0.05/envelope
Postage stamps	10,859 stamps	£0.19/stamp

^a Netten A. and Curtis L. Unit costs of Health and Social Care 2002 Personal Social Services Research Unit, University of Kent, Canterbury 2002.

^b NHS Pay and Conditions of Service Circular PCS (AC) 2000/2001.

^c NHS Pay and Conditions of Service Circular PCS (PH) 2001/2002.

^d NHS Pay and Conditions of Service Circular PCS2002 (PTB) 02.

^e Paediatric—full course three doses.

^f Packs were made up by pharmacy and each contained vaccine related materials for 200 pupils.

programme are given in Table 1. Fixed costs include the Website designer time, press officer time, the adrenaline kits and the fridge for vaccine storage; medical and graphic designer time were semi-fixed costs. The remaining resources were associated with variable costs in both the pilot and routine programmes. The resources were categorised into three main components: (i) staff time required for clinical and administrative duties; (ii) vaccine and vaccine-related materials, and (iii) resources required for programme preparation, including the production and delivery of information leaflets and letters. To measure the use of resources, information on the quantity and value of each element of resource use was recorded, by the research officer, throughout the pilot study period using data collection sheets. The variable costs for staff time were based on time sheets; vaccine and vaccine related items, and stationery were costed retrospectively on the basis of actual usage. The costs of the pilot programme that were research-specific were excluded: these included the costs of; (i) staff time required to develop a protocol, identify key players and

set up the programme, and (ii) the research officer. Where possible, resources were allocated to the following phases of the programme: preparation, phase one, phase two, phase three and the “mop-up” phases (Fig. 1). In some instances, assumptions had to be made about resource distribution across the different phases of the programme; the total amount of agency nursing hours was recorded but was not related specifically to the phases of the programme. Therefore, we assumed that the proportions of agency nurse input were the same as the relative distribution of non-agency nurse time across the phases of the programme.

Resources were valued, on the principle of opportunity cost, using 2001/2002 prices. Market prices were used as a proxy for opportunity cost.

The cost of a two-dose regimen was estimated by adjusting three-dose compliance and cost data to reflect the processes likely to have been associated with a two-dose programme. To calculate the costs of the two-dose programme, the costs allocated to the preparation, phase one and phase two stages of the three-dose programme were considered relevant but those associated with phase three were excluded. Therefore, it was assumed that the doses administered during phase one (9096), phase two (9183), and phase two mop-up (688) (Fig. 1) were the ones given in the pilot programme. In addition, it was necessary to assume some resource use for mop-up clinics that would arise in the context of a two-dose programme. This was achieved by incorporating 70% of the total mop-up costs; this proportion corresponds to the finding that 70% of all mop-up doses administered in the pilot programme applied to its first two phases.

These costs represent those of providing, for one year only, an adolescent vaccination programme, in Glasgow to be undertaken during a single academic year.

The costs, presented in terms of cost per dose, are based on the observed uptake of vaccine across all phases, including the mop-up ones; the overall cost per course is calculated as three times and two times the cost per dose for the three-dose and two-dose regimen, respectively.

2.3. Cost analysis: routine ongoing programme

The data from the pilot study (Table 1) were then used to estimate the costs of a three and two-dose routine ongoing universal adolescent hepB vaccination programme for two cohorts of pupils; the first cohort which would commence vaccination in year one and the second in year two. This was possible by excluding resource use unique to the pilot programme such as website design time, double mail shots to invite for vaccination and the production of colour graphic materials. Pupil throughput was assumed to be the same as that observed in the pilot programme. It was considered probable that there would be sufficient slack within existing resources to vaccinate the small proportion of pupils who would miss being vaccinated at their allocated times. Accordingly, “mop-up” clinics would not be required and the marginal costs of staffing associated with the routine

catch-up process were considered, in the base case analysis (see below), to be zero. Non-staff resources were estimated using “mop-up” clinic attendance and resource use data.

In costing the ongoing programme, the costs associated with the second year of the programme as well as the first were estimated as it was anticipated that fewer pupils would be vaccinated in the first year of a new scheme since less catch-up doses would be administered during this initial period. Two main assumptions were made regarding staff input in the routine programme: nursing time in the pilot was contributed to by agency nurses, paid an agreed hourly rate, and by NHS Grade F staff; in the routine programme, it was assumed that all the nursing time would be supplied by NHS Grade F nurses. In addition, it was estimated that resource use regarding the general duties was half that required for the pilot programme; this was because a delivery driver was involved in extra duties transporting documents, etc. which would not be required in a routine one. As with the pilot programme costing, the perspective of the analysis was that of the NHS and all resources were valued using 2001/2002 prices. The estimated costs for year 2 were discounted at 6% (the UK Treasury rate at that time).

2.4. Sensitivity analysis

Initial comparisons between the overall costs of the different regimens were based on a set of base case values. Three univariate sensitivity analyses were then conducted to examine how changes in these values affected the overall costs.

The first related to the cost of the vaccines. In the base case analysis it was assumed that vaccines were purchased at their full (undiscounted) manufacturer's price. In the sensitivity analysis, the effect of bulk purchase discounts were factored into the analysis at arbitrary rates of 10, 20, 30 and 40% for two- and three-dose regimens.

The second related to staff time needed for catch-up doses. In the base case model, it was assumed that, since there would be sufficient slack to accommodate catch-up, the staff cost would be zero. The validity of this assumption was tested by adding 10 and 20% of staff costs incurred during the “mop-ups” into the analysis.

The third related to the salary levels of the nursing staff involved. Employing higher (G) and lower (E) grade nursing staff was factored into the sensitivity analysis.

3. Results

The results for both three-dose and two-dose vaccination regimens are presented in terms of (i) the cost of the pilot programme, and (ii) the corresponding estimated costs likely to be associated with an ongoing school vaccination programme, including those generated through the sensitivity analyses. The costs apply to the vaccine uptake rates achieved during the pilot programme (Fig. 1).

Table 2
Comparative three vs. two dose overall costs, costs per dose and per course: pilot programme

Cost component; overall costs	Three dose (% total cost)	Two dose ^a (% total cost)
Staff time	£108,595 (27.4)	£73,648 (22.3)
Vaccine	£273,831 (69.1)	£244,675 (74.2)
Vaccine related materials	£3737 (0.9)	£2570 (0.8)
Other resources	£10,018 (2.5)	£8754 (2.7)
<i>Total</i>	<i>£396,181 (100)</i>	<i>£329,647 (100)</i>
Cost component; cost per dose		
Staff cost per dose	£3.85	£3.88
Vaccine cost per dose	£9.70	£12.90
Vaccine related materials, cost per dose	£0.13	£0.14
Other resources, cost per dose	£0.35	£0.46
Overall cost per dose	£14.03	£17.38
Overall cost per course ^a	£42.09	£34.76

^a Costs for the two-dose pilot were based on the vaccine uptake rate achieved during the three-dose pilot. It was assumed that all phase one school doses (9096), all phase two school doses (9183) and the phase two mop-up doses (688) would be given in the two-dose pilot (Fig. 1). The overall cost per course is calculated as three times and two times the cost per dose for each respective regimen.

3.1. Pilot programme costs

Economic costs of the pilot programme are categorised under three main cost centres (Table 2): staff, vaccine and vaccine-related (e.g. needles, swabs, adrenalin, vaccine storage and delivery) and other resources (e.g. information leaflets, letters, photocopying, etc). If the vaccine costs (at the standard price of £9.70 and £12.90 per dose for the three- and two-dose programmes, respectively) are excluded from the total costs, the figures for the three- and two-dose regimens are £122,350 and £84,972, respectively. Thus, the vaccine alone constitutes 69.1 and 74.2% of the total cost of the programme for the three- and two-dose regimens, respectively; note that the vaccine-related component comprises less than one percent of the combined vaccine and related materials costs.

Figures shown in Table 2 also indicate the running costs of the pilot programme on a per-dose and per-course basis. While the two-dose vaccination cost is higher than that of the three-dose on a per-dose basis, it is lower than the three-dose cost on a per-course basis.

3.2. Routine ongoing programme costs (base case model)

The estimated costs of an ongoing programme are presented in Table 3; this indicates the running costs of the ongoing programme overall and on a cost per dose and per course basis. For both the two- and three-dose programmes, the overall year 1 costs are lower than those for year 2, as it is anticipated that the numbers of pupils receiving catch-up

Table 3
Comparative annual costs, annual costs per dose and costs per course of three-dose vs. two-dose regimens: routine ongoing programme

Cost component; annual costs	Year 1		Year 2	
	Three dose (% total cost)	Two dose (% total cost)	Three dose (% total cost)	Two dose (% total cost)
Staff time	£92,395 (25.3)	£62,081 (20.4)	£92,395 (24.6)	£62,081 (19.8)
Vaccine and vaccine related materials	£267,948 (73.4)	£238,283 (78.3)	£277,568 (74.1)	£247,883 (79.0)
Other resources	£4816 (1.3)	£3846 (1.3)	£4816 (1.3)	£3846 (1.2)
<i>Total</i>	<i>£365,159 (100)</i>	<i>£304,210 (100)</i>	<i>£374,778 (100)</i>	<i>£313,810 (100)</i>
<i>Total (with costs for year 2 adjusted to net present value)</i>			<i>£353,564</i>	<i>£296,047</i>
Cost component; annual costs per dose ^a				
Staff cost per dose	£3.39	£3.40	£3.27 (£3.09)	£3.26 (£3.08)
Vaccine and related materials, cost per dose	£9.83	£13.03	£9.83 (£9.28)	£13.04 (£12.30)
Other resources, cost per dose	£0.17	£0.22	£0.17 (£0.16)	£0.20 (£0.20)
Overall cost per dose	£13.40	£16.64	£13.27 (£12.52)	£16.50 (£15.57)
Overall cost per course ^b	£40.20	£33.28	£39.81 (£37.56)	£33.00 (£31.14)

^a Year 2 costs adjusted to net present value (discounted at 6%) are in parenthesis.

^b Vaccine uptake rates achieved during the pilot programme, illustrated in Fig. 1, were used to estimate the number of doses administered during an ongoing programme and thus, the costs. The overall cost per course is calculated as three times and two times the cost per dose for each respective regimen.

doses in year 1 will be less than those for year 2 (Table 3) and subsequent years. The discounted year 2 costs give the net present value of the resources required to implement the second year programme. The costs of the ongoing programme are lower than those for the pilot one (for reasons described in Section 2). Of particular note are the differences in staff time costs, particularly in the context of choice of programme; those for the two-dose ongoing programme (£62,081) are just over half of those for the three-dose pilot one (£108,595)

and are two-thirds of those for the three-dose ongoing programme (£92,395). The contribution of the staff costs to the overall costs is around 20% for the two-dose and 25% for the three-dose regimens.

The figures shown in Table 3 also indicate the running costs of the ongoing programme on a cost per dose and per course basis. The year 2 costs overall exceed those in year 1, though, on a cost per dose and per course basis, the opposite applies; this is because slightly more doses in year 2 are

Table 4
Sensitivity analyses: routine ongoing programme

Vaccine (A)	Year 1		Year 2 ^a	
	Three dose	Two dose	Three dose	Two dose
Baseline 0% discount	£365,159	£304,210	£374,778 (£353,564)	£313,810 (£296,047)
10% discount	£338,725	£280,630	£347,395 (£327,731)	£289,280 (£272,905)
20% discount	£312,292	£257,050	£320,012 (£301,898)	£264,749 (£249,763)
30% discount	£285,858	£233,470	£292,629 (£276,065)	£240,218 (£226,621)
40% discount	£259,425	£209,891	£265,246 (£250,232)	£215,688 (£203,479)
Staff time (B)			Year 2	
			Three dose ^b	Two dose ^b
Baseline ^c			£374,778	£313,810
10% of mop-up costs arising			£375,625	£314,418
20% of mop up costs arising			£376,507	£315,025
Nursing staff skills mix ^d (C)	Year 1		Year 2 ^a	
	Three dose	Two dose	Three dose	Two dose
Change all nurses from F grade to G grade	£372,601	£309,109	£382,220 (£360,584)	£318,709 (£300,669)
Change all nurses from F grade to E grade	£357,784	£299,355	£367,403 (£346,403)	£308,955 (£291,467)

(A) Comparative annual costs of three-dose vs. two-dose regimens, after applying vaccine discount rates in a 10% stepwise range from 10 to 40%; (B) comparative annual costs showing the effect on total costs in year 2 if additional staff time is required for catch up vaccinations; and (C) comparative annual costs of three-dose vs. two-dose regimens observed when the nursing grades are altered.

^a Year 2 costs adjusted to net present value (discounted at 6%) are in parentheses.

^b Based on 0% discount on vaccine costs.

^c No additional time allocated.

^d Grade G and Grade E nurses are paid at a higher and lower hourly rate, respectively, than Grade F nurses.

Table 5

Summary data comparing the costs of a three-dose vs. a two-dose course of hepatitis B vaccine for the routine ongoing programme using 0, 10 and 40% discounts on the price of vaccine

		Year 1 routine 0% vaccine discount	Year 2 routine 0% vaccine discount ^a	Year 1 routine 10% vaccine discount	Year 2 routine 10% vaccine discount ^a	Year 1 routine 40% vaccine discount	Year 2 routine 40% vaccine discount ^a
Cost per course ^b	Three dose	£40.20	£39.81 (£37.56)	£37.29	£36.93 (£34.83)	£28.56	£28.20 (£26.58)
	Two dose	£33.28	£33.00 (£31.14)	£30.70	£30.42 (£28.70)	£22.96	£22.68 (£21.40)

^a Year 2 costs adjusted to net present value (discounted at 6%) are in parentheses.

^b The costs apply to the vaccine uptake rates achieved during the pilot programme, illustrated in Fig. 1. The overall cost per course is calculated as three times and two times the cost per dose for each respective regimen from the data in Tables 3 and 4A.

being administered by a staffing resource which is unchanged across the two years (as indicated in Section 2.3).

Further analysis (data not shown) indicates that the cost per vaccine dose would have to be 23% lower than the base case value for the three-dose routine programme to be less costly than the two-dose one, i.e. if the price dropped from £9.70 to £7.46 per dose for the three-dose regimen while keeping that of the two-dose one constant.

3.3. Routine ongoing programme costs (sensitivity analysis)

Table 4 shows the impact of a range of arbitrary discounts (10–40%), for the bulk purchase of vaccine on the overall routine ongoing programme costs for years 1 and 2. Ten percent and 40% discounts on vaccine costs reduce the overall programme costs by an average 7.5 and 30%, respectively.

The second sensitivity analysis, undertaken to allow for additional staff time for catch-up vaccination, revealed that changes to the assumption made little difference to the overall cost (Table 4B).

In the third sensitivity analysis, to examine the effect on costs for different salary levels for the nursing staff delivering the routine programme, the percentage change from the base case values is less than 2% in both directions.

3.4. Routine ongoing programme summary costs

The overall costs per course for both a three- and two-dose regimen, with vaccine discount rates of 0, 10 or 40% are summarised in Table 5 (using the information recorded in Tables 3 and 4). The cheaper programme is the ongoing two-dose one, regardless of vaccine price.

4. Discussion

This paper presents the economic costs associated with a three-dose and two-dose universal adolescent hepB vaccination programme in Glasgow. Both the observed costs of the pilot programme and the estimated costs of a routine ongoing programme are presented. The costs are economic ones that may or may not equate to the financial outlay required to routinely operate such a programme; for example, no finan-

cial outlay was needed to employ many of the staff involved in the pilot programme though the opportunity costs associated with the time they devoted to vaccination work were accounted for in the analysis.

In interpreting the results, the following caveats should be noted. Some cost items were not included in the analysis because its perspective was that of the Health Service rather than society; accordingly, neither an opportunity cost relating to the use of accommodation in schools or health centres, nor opportunity costs of time expended by the pupils and their teachers, were included. Also, to estimate the costs of a routine ongoing programme, it was necessary to make some assumptions, for example, about staffing requirements, based on pilot programme observations. In addition, it should be noted that the recorded costs are specific to the vaccine uptake rates: 2, 9.1 and 80.2% for one dose only, two doses only and three doses, respectively, observed among a city-based population receiving vaccination in schools. The assumption was made that the two-dose regimen uptake rates would be similar to those observed for the three-dose regimen; however, it is uncertain what impact the different number of, and length of time between, doses would have on uptake rates for a two-dose regimen—in this study, 95% of pupils who received at least two doses of vaccine received their second dose within 1 or 2 months (and not 4–6 months, a period which would apply in a two-dose regimen) after their first dose.

An analysis of various determinants of pilot programme uptake rates indicated that while only pupils living in medium to high deprivation areas were associated with any appreciable reduction in vaccine uptake, particularly in the context of a three dose schedule [4], the overall uptake rates, in relation to those for other school vaccination programmes, was acceptable; thus, the authors have no reason to believe that the uptake rates experienced in Glasgow would not be replicated in many other UK urban areas if the vaccine was offered in the school setting.

It is possible, however, that uptake rates would be different if programmes were undertaken in rural and/or non school-based settings. Accordingly, caution needs to be taken in extrapolating the costs observed in Glasgow to those which might be incurred if adolescent hepatitis B vaccination was to be rolled out nationally.

The Glasgow cost data, however, are an important contribution to the literature of the UK and other countries which

are considering, or may consider, the introduction of universal hepB vaccination of adolescents. This is the first time that comprehensive, bottom-up cost data have been available for a UK universal adolescent programme and these data may be used to inform future cost-effectiveness studies. Previous studies [5–8] have used approximate costs and made assumptions about uptake rates to model the cost-effectiveness of different universal versus selective hepatitis B vaccination programmes; however, in one study [5] (based on 80% of 11 year olds receiving three doses and becoming protected), the estimated cost per dose, £10.21 in 1993 (for a pre-adolescent strategy using a bulk discount cost of infant vaccine), is equivalent to £13.79 per dose at 2001/2002 prices [9] and, thus, similar to the corresponding cost incurred by the Glasgow pilot. Any future cost-effectiveness analyses would factor in the costs per protected adolescent; note that in this study, it was not considered appropriate to measure the pupils' antibody responses to vaccine as it has been previously documented that this age group respond well to vaccine [10].

Cost data collected from schools-based adolescent programmes in the USA and Canada show that either measured or estimated costs amount to around £19 per dose using the relevant exchange rates for the year of the programme [11–14]. Little detail is available regarding the breakdown across cost centres except for that relating to the Denver programme [11]. For this analysis, using a societal perspective, the vaccine (at a government-based purchase price) and related costs represented 28.4% of the total; high staffing costs of over 50% reflected extra start up (education and outreach) and programme management expenditure, either through increased time spent on these activities or higher grade staff salaries (compared to those for the Glasgow programme), or a combination of both. Clearly several factors, particularly those relating to variable costs, can influence the overall costs of delivering hepB vaccine to adolescents, whether this be in a school-based or health care provider setting. Only limited comparisons can be made to the findings of other studies, especially those for which analyses are from a different perspective and where the set up and design may involve different use of resources.

In the Glasgow study, the largest cost item was the vaccine which, assuming no discount, accounted for 70–80% of the overall costs, depending on the type of programme (pilot/ongoing routine and two-dose/three-dose). It is also clear from previous UK (and North American) studies that vaccine itself is the major economic outlay. As vaccine is such a key cost driver, any variations in uptake rates or in vaccine cost would have a considerable impact on the overall expenditure associated with a programme. In this study, the considerable impact of a range of arbitrary discounts on the purchase price of vaccines is clearly demonstrated. It is impossible to predict how much discount a pharmaceutical company might award though it is reasonable to assume that its size would correlate with the scale of the programme (local/regional/national) and its planned longevity.

In British Columbia [15] for example, the Ministry of Health negotiated a vaccine price that resulted in the overall vaccine expenditure contributing less than 50% of the total cost of the programme. This dynamic could have a major bearing on UK hepatitis B vaccination policy which is currently under review; however, there is, as yet, no information available to date as to whether a policy which promotes universal adolescent immunisation locally in, for example, areas of high drug use prevalence and hepatitis B incidence, would be less costly overall than one which advocated national coverage due to enhanced discounts for national vaccine purchases.

If universal adolescent vaccination is recommended by the UK's Joint Committee for Vaccination and Immunisation for implementation at a restricted or national level, the cost data make a compelling argument for a two-dose regimen which would be less costly overall and, assuming that immunisation effectiveness is not compromised (as demonstrated in the study by Cassidy et al. [16]), more cost-effective than a three-dose one.

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