The cost of immunising at the general practice level

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ABSTRACT

INTRODUCTION: Childhood immunisation is one of the most cost-effective activities in health care. However, New Zealand (NZ) has failed to achieve national coverage targets. NZ general practice is the primary site of service delivery and is funded on a fee-for-service basis for delivery of immunisation events.

AIM: To determine the average cost to a general practice of delivering childhood immunisation events and to develop a cost model for the typical practice.

METHODS: A purposeful selection of 24 diverse practices provided data via questionnaires and a daily log over a week. Costs were modelled using activity-based costing.

RESULTS: The mean time spent on an immunisation activity was 23.8 minutes, with 90.7% of all staff time provided by practice nurses. Only 2% of the total time recorded was spent on childhood immunisation opportunistic activities. Practice nurses spent 15% of their total work time on immunisation activity. The mean estimated cost per vaccination event was $25.90; however, there was considerable variability across practices. A 'typical practice' model was developed to better understand costs at different levels of activity.

CONCLUSIONS: The current level of immunisation benefit subsidy is considerably lower than the cost of a standard vaccination event, although there is wide variability across practices. The costs of delivery exceeding the subsidy may be one reason why there is an apparently small amount of time spent on extra opportunistic activities and a barrier to increasing efforts to raise immunisation rates.

KEYWORDS: Immunisation; vaccination; patient care management; cost analysis; cost allocation

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Introduction

Childhood immunisation is one of the most cost-effective activities in health care;[1] however, New Zealand (NZ) has failed to achieve immunisation coverage targets[2] resulting in high background rates of vaccine-preventable disease such as pertussis.[3] In a 2005 UNICEF summary of infant immunisation, NZ ranked 101st of 193 countries globally, 31st of 37 industrialised countries.[4] Improving immunisation targets is a priority area and one of the 10 national health targets set in 2007/8.[5] A significant contribution to gaining high immunisation coverage lies with health systems and providers at the primary care level[6] and identification of system barriers has been used to support improvements in immunisation coverage internationally.[7,8]

NZ general practice is the primary site of service delivery for the childhood immunisation programme. Delivery of vaccinations is funded by the government on a fee-for-service basis: practices claim a payment for each immunisation event. An immunisation event is the delivery of vaccinations due according to the NZ immunisation schedule.[9]

A previous NZ analysis in 1998 on the cost of delivering the childhood immunisations in general practice showed that the cost was not fully covered by the Immunisation Benefit Subsidy (IBS).[10] Since that time the IBS has been increased from NZ$11 (GST inclusive) to NZ$18 (GST inclusive) per immunisation event. Other practice subsidies also contribute small amounts towards the cost of delivering immunisations, in particular the

historic practice nurse subsidy which is now part of the capitated funding and Primary Health Organisation performance indicators. However, as these funds are not allocated specifically towards immunisation service delivery, it is not currently possible to ascertain what percentage of these subsidies may also contribute towards immunisation service delivery.

It is unknown if the current subsidy is adequate reimbursement to cover the costs of immunising the childhood population of a practice, particularly the extra costs required to increase immunisation coverage through additional efforts in recalling and tracking children.

This study aimed to evaluate the actual cost to a general practice of calling, recalling and immunising children aged 0–5 with the NZ immunisation schedule vaccines.[9] The objectives were to:

- Determine the average cost to a general practice of carrying out childhood immunisations for the national immunisation schedule for their enrolled children.
- Develop a cost model following an activity-based costing approach.
- Evaluate the time commitment at the practice required to deliver schedule childhood vaccines.
- Compare whether costs vary with different practices' settings in terms of geographic, ethnic and socioeconomic factors.

The study is primarily from a micro-financial perspective as opposed to a societal perspective given the above objectives, i.e. to calculate the financial cost to a general practice for carrying out vaccinations. The social cost of immunisations (e.g. costs of low uptake and costs of vaccination reactions) would indicate a macro view compared to the micro focus of this study on individual general practices.

Methods

A pragmatic purposeful selection of practices was undertaken, chosen for diversity in size, socioeconomic mix, geography and practice management style. Data to match the practice socioeconomic mix was undertaken using the NZ Deprivation scale obtained from Statistics NZ website based on 2006 census meshblocks and matched to the corresponding practices' addresses. Selection and recruitment of practices was achieved using the databases and local knowledge of the Immunisation Advisory Centre and networks. Invitations to participate were issued via the national immunisation networks and the GP electronic news.

WHAT GAP THIS FILLS

What we already know: There is little published data on the components of cost for delivering infant vaccination events at the primary health care level. It is currently unknown in New Zealand if the historical funding of vaccine delivery adequately reimburses the cost of delivering the events.

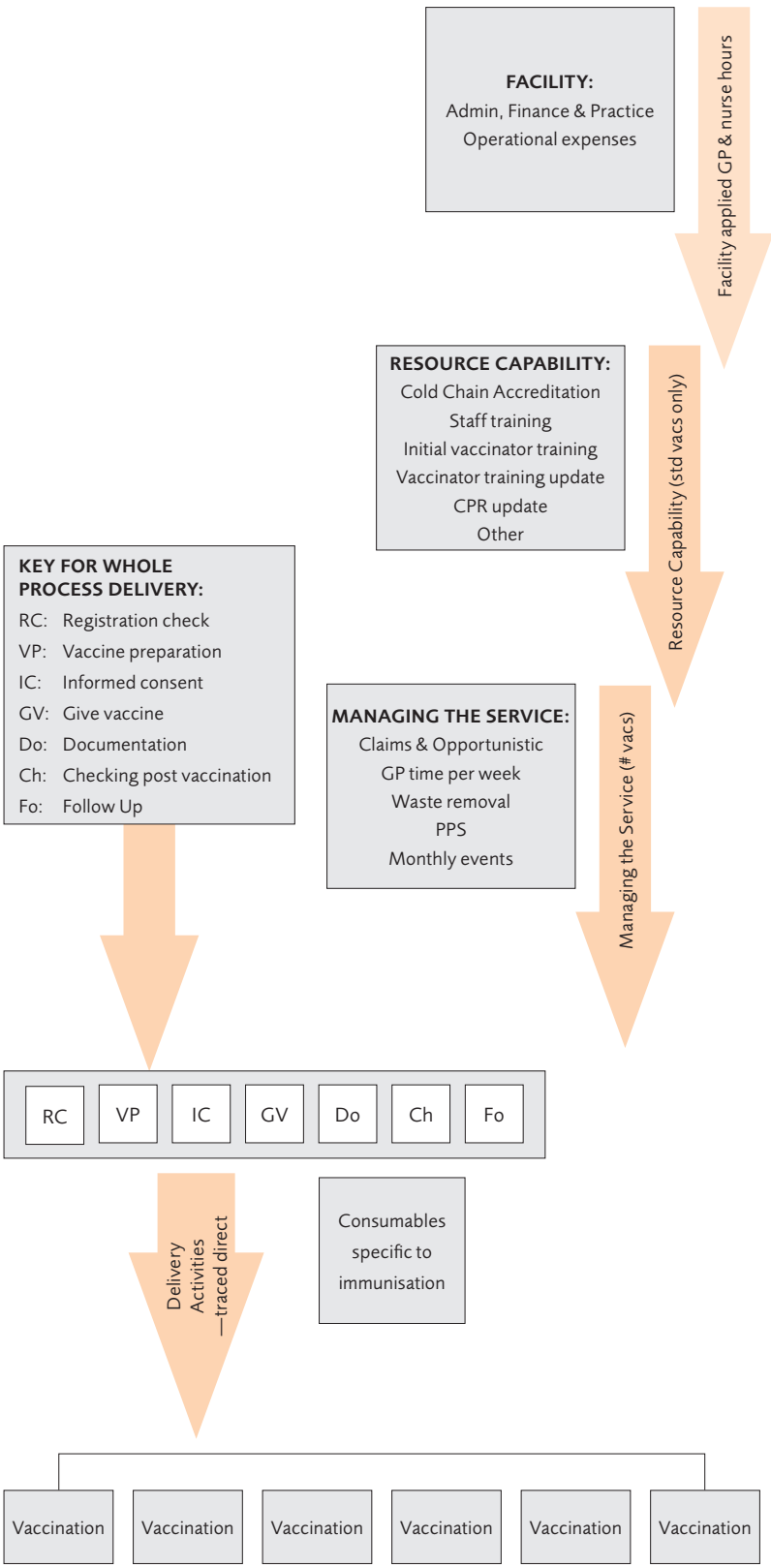
What this study adds: This study uses an activity-based costing approach to develop a model for viewing all components of the cost of delivering childhood immunisations, as well as providing a cost model for the 'typical' practice.

Five separate data collection tools were developed with feedback from key stakeholder groups, including GPs, practice managers and practice nurses, and pre-tested in three practices. These comprised:

- A financial and total practice time questionnaire (FTPTQ), which included major practice overheads and those specifically relating to immunisation, together with the total hours worked by all practice staff. All practices completed one of these.
- An estimate of GP total immunisation time involvement over an average week. All GPs in the practice completed these.
- A five-day log of time per activity, completed daily over five consecutive days of their choosing by all staff members involved in any of the tasks related to immunisation service delivery.
- A questionnaire covering the less common and monthly events completed as a one-off by all staff involved in immunisation tasks.

A research nurse contacted and liaised with practices. Based on the understanding of the activities involved in the process, a cost model was developed in which the main immunisation-related activities were identified and traced to vaccination events via measurements of both resources and activities. The research used activity-based costing (ABC) promulgated by Cooper and Kaplan[11] which is now the accepted method for costing in the cost management literature. ABC focuses

Figure 1. The cost model hierarchy



on activities and resources consumed which are traced to cost objects using activity cost drivers. These drivers can be classified into a four-level hierarchy that depicts different cost behaviour at different levels. Figure 1 describes these levels in the vaccination setting.

1. **Unit level (vaccination delivery-based):** Activities directly associated with vaccination delivery are registration check (including National Immunisation Register details when needed), vaccine preparation, informed consent, giving the vaccine, documentation, checking the child post-vaccination, and follow-up (see Figure 1). These tend to be sequential for each event. In addition to the cost of these activities, there is the cost of consumables specific to immunisations, such as needles, syringes, plasters, distractions. These costs are classified as unit as they vary directly with the number of vaccinations delivered.
2. **Batch level (managing the service):** These are activities that are required to provide the service, but that do not vary directly with the number of vaccinations given; however they are more time related, e.g. ordering vaccines, claiming, precall, recall and audit procedures.
3. **Product-sustaining level (resource capability):** These are activities associated with providing service capability, not directly affected by the batch or unit levels, e.g. cold chain accreditation and staff training costs.
4. **Facility level:** These are practice level costs/activities that are required to meet infrastructure and/or organisational requirements to facilitate immunisation provisions, but are not directly traceable to immunisation activities per se, e.g. administration such as rent, utilities, insurance, depreciation, financing costs, marketing, operational expenses, waste removal and support staff.

Costs are reported for each hierarchy level, enabling each stage to be considered in terms of its impact on vaccination costs. Assumptions used in the development of the cost model are as follows: The log represents a typical week of immunisation in each practice and the number of working days per annum is set at 229 (45.8 weeks). Nurse and GP hours are then annualised using survey data in

order to identify the total time spent on vaccination activities; the 17 practices that provided their major overhead expenses exhibit a reasonable overhead profile of the sample; GP hours are weighted three times those of nurses to reflect pay differentials in calculating overhead recovery rates.

Given the diversity in practice time and cost structures, a model of a 'typical practice' was developed where the best estimates at each hierarchy level were used to estimate the costs at each activity hierarchy level. The model can be used to vary volume levels based on different scenarios, to see the overall impact on total cost and its activity level components. It also provides some reference standards for individual activities within the cost hierarchy. These were derived mainly from the median costs of sample practices, but some were estimated based on knowledge of practice procedures, e.g. the costs of claims were estimated in this model assuming an average time of one minute per claim.

Results for the MeNZB™ vaccination being delivered at the time were separated out from the standard immunisation schedule vaccination. As this was a special event vaccination, it was not considered part of the routine programme.

Ethical approval was not required because this methodology is an audit to scope the costs of the practice, and does not involve patients.

Results

Seventy practices in total were approached over the data collection phase of December 2007 to May 2008. Twenty-eight consented (40%), with 24 (34%) fully completing all the data collection (Table 1). All practices provided information at the unit and batch levels with no information for four practices at the product-sustaining level. One-third of the practices surveyed were either unwilling or unable to supply summarised annual overhead costs. The reasons for not participating, or failing to complete, included staff shortages, confidentiality concerns with supplying financial information and practice staff being too busy to complete questionnaires.

At the facility level, overhead recovery rates were determined for the 16 that did supply this information by dividing total overhead expenses by total estimated GP and nurse annual hours. Median overhead recovery rates were $13.5 per nurse hour and $40.4 per GP hour.

Across the sample, the mean number of vaccination events delivered over a 12-month period per practice was 926, with a minimum of 65 and maximum of 4949.

1. Time spent on activities directly associated with the immunisation process (unit level)

These were captured using the summary of the daily logs (Table 2) and summarised in Figure 2. Note that the average time per activity averaged over practices is shown, as well as the averages across the whole sample data. Although the data is variable, we believe the average (mean) over practices is a reasonable estimate, with a closer similarity to the whole sample statistics than the median. There is a wide range across all activities between practices in how time is spent. Overall, the most time is spent on the informed consent process with a mean time of 4.5 minutes and a range for all practices from 1 to 7.7 minutes. There is wide variability across practices (from 1.1 to 8.9 minutes) on the length of time it takes to undertake the registration check with at least one practice experiencing an event of 60 minutes. Figure 2 also shows the difference in time taken for standard vaccines, particularly for preparation, delivery and documentations versus the MeNZB™ vaccine.

2. Time spent dealing with opportunistic immunisation and overdue immunisations

These data were measured in the daily log. Only 14 practices recorded any time at all spent on this activity. The mean time recorded was 45 minutes per month overall (ranging from 12 to 55 minutes over the 25–75% interval). This represents just over 2% of the total time recorded in the daily logs.

There was a considerable practice range in the time spent on chasing up overdue (late) immunisations across practices (refer Table 5) from 2 minutes per month to 960 minutes per month. To estimate this effect, the costs from the practice that took the most time per month were entered into the typical

Table 1. Practices participating in the project by location, deprivation rating, size, type of practice ownership and ethnicity

							Ethnic breakdown of total practice population				
Practice	**Deprivation level~**	**Practice size ^**	**Town/ city**	**GP hours per patient**	**Nurse hours per patient**	**Salaried or owner/ op**	**European**	**Maori**	**Pacific**	**African**	**Other**
1	3	Large	City	1.1	0.8	S	77%	6%	17%		
2	1	Small*	City	1.2	1.2	O	89%	5%	3%		3%
3**	7	Small*	City	1.5	1.5	S	66%	7%	13%		14%
4	4	Medium	City	0.9	0.7	O	79%				21%
6	9	Large	City	1.2	1	O	71%	7%			2%
8	8	Small	Town	1	1	S	87%	9%			4%
9	4	Large	Town	1	1	O	52%	34%			14%
10	9	Small	Town	1.4	1.2		74%	14%	2%		10%
11	8	Large	Town			S + O	74%	20%	2%		4%
12	8	Large	Town			O	72%	7%			21%
14	8	Large	City	1.7	2.3	S	20%	15%	22%	43%	
15	9	Small*	City			O	81%	8%			11%
16	6	Large	Town	1.2	0.8	O	90%	10%			
17	9	Large	Town	1	0.8	O	63%	37%			
18	10	Small*	City	1.1	0.7	O	25%	19%		49%	10%
19	6	Large	City	0.7	0.9	O	83%	5%			12%
20	2	Medium	City	1.4	0.9	O	86%				14%
21**	9	Small	Town	2.2	5		9%	88%			3%
22	9	Medium	Town			O	78%	10%			11%
23	6	Small	Town								
24	3	Large	City	1	1.2		82%	6%			12%
25	5	Large	Town	0.9	0.7		51%	6%			43%
26	5	Large	City	0	0		64%	20%			16%
28	4	Medium	City	0.7	0.7		80%	7%			13%

* Denotes sole practitioner

** Denotes Maori or Pacific Governance

~ Deprivation based on X data. 1 is least deprived and 10 is most deprived.

^ Small practice <3000 patients; medium practice <5000 patients; large practice > 5000 patients.

City defined as main population areas of Auckland, Hamilton, Wellington, Christchurch and Dunedin

Figure 2. Vaccination sequence for delivery activities unit level

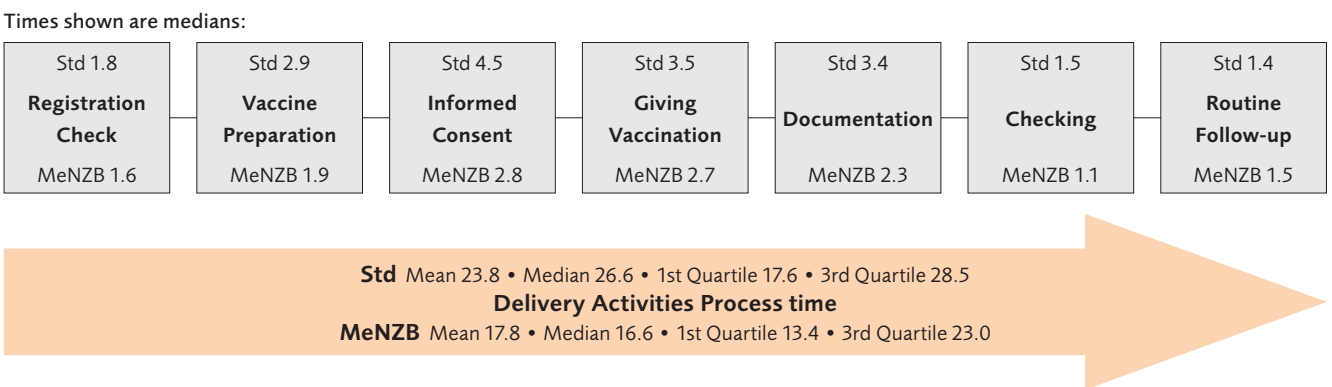


Table 2. Average (mean) times in minutes for activities per event collected in daily log: total times/total events

Average mean times (standard deviation) per event / total monthly times										
Mean time per event/GP	**Reg check**	**Vaccine prep**	**Informed consent**	**Giving vaccines**	**Documentation**	**Checking**	**Routine follow-up**	**Vaccination delivery total**	**Opportunistic**	**Claims**
1	1.2(0.2)	5.8 (2.8)	6.0(2.3)	3.2(2.3)	9.8(10.5)	1.0(0.0)		**26.9**		49.6
2	5.8(2.8)	3.0(0.0)	4.5 (2.6)	7.5(0.0)	3.6(2.8)	8.7(6.0)	2.0(0.9)	**35.1**		22.9
3	1.2(0.3)	11.3(5.3)	7.5(0.0)	7.5(0.0)	3.0(0.0)	1.5(0.0)	1.5(0.0)	**33.4**	11.5	
4	3.0(0.0)	3.4(2.8)	5.0(2.8)	3.6(2.3)	3.5(2.0)	10.5(5.2)		**29.0**	28.6	15.3
6	8.9(8.4)	4.7(3.3)	4.6(2.8)	2.7(1.3)	2.8(1.8)	1.2(0.5)	2.8(0.6)	**27.6**	200.4	53.4
8	1.0(0.0)	3.0(0.0)	7.5(0.0)	6.6(2.0)	4.5(2.3)	1.1(0.2)	1.5(0.0)	**25.2**	32.4	22.9
9	1.8(2.0)	3.0(0.0)	4.8(4.9)	5.3(2.6)	3.6(2.8)	1.5(0.0)	1.0(0.0)	**20.9**	17.2	17.2
10	1.5(0.0)	1.0(0.0)	1.0(0.0)	1.3(0.4)	4.5(4.2)	1.0(0.0)		**10.3**	15.3	11.5
11	1.1(0.2)	1.5(0.4)	7.7(2.3)	1.3(0.5)	3.0(2.3)	1.1(0.2)	1.7(1.6)	**17.5**	11.5	61.1
12	2.6(5.2)	2.6(2.2)	3.9(3.4)	6.6(6.1)	3.3(2.7)	1.9(1.0)	1.8(0.6)	**22.6**		32.4
14	6.1(4.9)	1.6(0.5)	6.1(2.4)	1.5(0.0)	3.3(2.0)	1.0(0.2)	1.0(0.0)	**20.7**	28.6	
15	1.3(0.4)	1.3(0.3)	1.5(0.0)	5.5(3.5)	2.5(0.9)	1.0(0.0)		**13.1**		3.8
16	8.3(13.8)	6.0(5.5)	2.8(0.6)	8.1(4.3)	3.3(2.5)	7.2(4.9)	1.3(0.4)	**37.0**		
17	1.8(0.6)	5.6(2.3)	7.8(4.6)	5.6(3.2)	4.3(2.1)	2.5(0.7)	2.7(1.3)	**30.3**	103.1	154.6
18	1.4(0.2)	7.5(0.0)	7.5(0.0)	7.5(0.0)	4.3(4.6)	1.0(0.0)		**29.1**	63.0	34.4
19	1.5(0.0)	3.1(1.3)	4.4(2.2)	9.5(4.2)	5.6(2.3)	2.1(0.8)	1.5(0.0)	**27.7**		274.8
20	2.4(2.3)	1.8(0.7)	1.2(0.3)	2.4(2.3)	1.9(0.7)	1.9(0.9)	1.0(0.0)	**12.7**		22.9
21	3.9(4.9)	2.4(0.8)	3.2(2.6)	3.5(2.9)	2.6(0.8)	1.0(0.0)	1.0(0.0)	**17.6**	3.8	26.7
22	1.8(0.9)	1.5(0.9)	2.3(2.4)	1.8(1.6)	2.0(2.2)	1.6(0.6)	1.1(0.2)	**12.1**		84.0
23	1.1(0.2)	2.1(0.8)	1.4(0.2)	2.4(0.8)	2.6(0.7)	1.0(0.0)	1.0(0.0)	**11.6**	5.7	45.8
24	2.5(3.5)	2.5(1.5)	3.9(2.5)	2.8(2.3)	4.7(2.3)	8.5(6.4)	3.3(2.0)	**28.3**	84.0	120.2
25	2.4(3.1)	5.0(2.8)	3.8(2.4)	4.2(2.6)	6.7(2.1)	2.3(2.2)	3.7(1.9)	**28.0**	22.9	274.8
26	1.4(0.2)	2.5(0.7)	5.3(3.6)	3.0(1.5)	5.1(2.3)	1.5(0.9)	7.5(0.0)	**26.3**		82.1
28	1.2(0.6)	2.8(1.8)	4.2(3.0)	3.0(1.6)	3.2(1.7)	2.7(4.4)	11.3(5.3)	**28.2**		30.5
Average practice time per event										
Median	1.8	2.9	4.4	3.5	3.4	1.5	1.5	**26.6**	25.8	34.4
Mean	2.7	3.5	4.5	4.4	3.9	2.7	2.6	**23.8**	44.8	68.6
Statistics over whole sample										
Total time	1745.5	829.0	1156.0	1024.0	1174.0	671.0	307.0	**6906.5**	627.8	1438.9
Total events	448.0	256.0	251.0	247.0	285.0	236.0	132.0	**1855.0**	35.0	193.0
Median	1.5	3.0	3.0	3.0	3.0	1.5	1.5	**16.5**	11.5	5.7
Mean	3.9	3.2	4.6	4.1	4.1	2.8	2.3	**25.0**	17.9	7.5
Std Deviation	5.9	2.4	3.2	3.5	3.4	3.7	2.0	**4.1**	16.4	5.4
Maximum	60.0	15.0	15.0	15.0	40.0	15.0	15.0	**85.5**	57.3	28.6
Minimum	1.0	1.0	1.0	1.0	1.0	1.0	1.0	**1.0**	3.8	3.8

practice model, which increased the estimated cost per vaccination event from $25.67 to $30.66.

3. Time spent on delivery activities by all personnel

Table 3 shows a breakdown of the activities by staff roles. Overall, the practice nurse's role takes 90.7% of the total time involved in standard immunisation delivery, the receptionist around 8% and the GP around 1% of the time.

Table 4 shows that around 15% of the total work time of a practice nurse is spent on standard immunisation activities (range of 8–22%) and a GP around 0.5% (range 0.2–0.5%) of their total work time.

4. Managing the service activities and cost model

Nineteen practices disclosed the hourly rates paid to staff members, and there was good consistency of results, particularly for practice nurses as measured by the coefficient of variation (CV 0.25). Table 5 summarises the time spent each month for managing service activities, such as vaccine ordering and dealing with late immunisations. The greatest time commitment is chasing up late immunisations (average time of 150 minutes a month) and making appointments (average of 97 minutes a month).

Table 6 summarises the cost at each level across the practices. Overall, the estimated vaccination cost for standard vaccinations is $25.89 with a wide range from $14.38 to $32.50.

5. Analysis of difference in types of practices

Ordinary least squares regression was used to regress vaccination costs at the unit and batch levels against the practice variables of size, deprivation index, different ethnic proportions and urban rural size. No statistically significant relationships were found. However, on a more aggregated level, time spent on delivery activities increased as practice size increased. Mean times and unit cost per vaccination event delivery were 21.9 minutes and $11.32 for small practices (>3000 patients), 22.5 minutes and $11.48 for medium sized practices (>3000–<5000 patients) and 26.9 minutes and $12.80 for large practices (>5000 patients). Managing the service costs also increased with larger sized practices (the main difference being between small practices to medium and large practices); mean costs per annum were $1,953 for small practices, $3,806 for medium sized practices and $3,088 for large practices.

Discussion

Immunisation service delivery follows a natural sequence of activities which have been identified and measured in this study. The activity-based model and its hierarchy allows distinctions to be drawn between patient delivery level and other organisational support levels. Results show that delivery activities are common to every practice and there is considerable variability in times across each activity and across practices.

The activity model provides a structure of common activities and related organisational process

Table 3. Total time in minutes (and % overall) by activity and staff role across all sample practices for standard vaccinations

(Total time from weekly logs)	Admin	Doc	Manager	Nurse	Receptionist	Grand Total
Registration check	3.0 (0.2%)	53.0 (3.0%)	8.0 (0.5%)	1301 (74.5%)	380.5 (21.8%)	1745.5 (100%)
Vaccine preparation				812 (97.9%)	17 (2.1%)	829 (100%)
Informed consent		10 (0.9%)		1146 (99.1%)		1156 (100%)
Giving vaccinations				1024 (100%)		1024 (100%)
Documentation		6.5 (0.6%)	1.0 (0.1%)	1004 (85.5%)	162.5 (13.8%)	1174 (100%)
Checking				671 (100%)		671 (100%)
Routine follow-up				307 (100%)		307 (100%)
Total	3.0 (0.0%)	69.5 (1.0%)	9.0 (0.1%)	6265 (90.7%)	560 (8.1%)	6906.5 (100%)

Table 4. Estimated proportions of total time spent (in hours) by nurse and GPs on immunisation activities per annum (Standard and MeNZB™)

Practice		Mean	Median	1st Quartile	3rd Quartile
Annual # of vaccinations		1166	926	497	1544
Time spent on immunisations					
Nurse	**Standard**	588	549	200	794
	MeNZB	203	127	50	301
Total nurse available time		6221	3979	2284	6974
% time on immunisations		15%	12%	8%	22%
GP	**Standard**	21.7	15.3	7.6	37.4
	MeNZB	9.5	7.6	2.0	8.8
Total GP available time		6616.4	5129.6	2713.7	9114.2
% time on immunisations		0.5%	0.2%	0.1%	0.5%

requirements, lending itself to benchmarking and opportunities for practice improvement. This study also developed a 'typical' practice profile with clearly set out assumptions that can (i) provide a reference point for establishing an agreed cost estimate, (ii) be altered with different assumptions, e.g. adding in extra GP time, and (iii) assist in budgeting and planning needs at practice and sector levels.

This is not a random sample and there is a considerable range between practices in costings and time commitment of staff, so the results need to be treated with some caution. While a larger sample size is always preferable, the sample of 24 still provides some important findings. Furthermore, there is diversity of geography, size and socio-economic makeup of these practices.

Overall, the median time taken in the immunisation process was 26.6 minutes (mean 23.8 minutes), range 17.6 to 28.5 minutes. This provides an assessment of how long the immunisation process is routinely taking. The longest time commitment is for the informed consent process (mean of 4.5 minutes), followed by administering the vaccine (3.5 minutes) and documentation (3.4 minutes). The length of time spent in checking registrations has wide variability across practices. This may be due to a range in practice ability and ongoing technical issues around access and use of the National Immunisation Register to check immunisation status. It appears that larger practices spend greater time in delivery activities, particularly registration checks, documentation and follow-up. It is unclear why this may be the case and this result needs to be treated with caution, recognising small sample size.

MeNZB™ data has been presented as a separate item as this was an epidemic vaccine delivery programme that is not part of the standard vaccination programme. It is of interest for future reference for epidemic programme delivery. Standard vaccinations take longer, on average, across all activities and in total than delivery of the MeNZB™ vaccine. This is likely due to the fact that standard vaccinations often consist of more than one injection and informed consent covers multiple diseases and vaccines.

Time spent on opportunistic immunisations is only 2% of the total time recorded in daily logs overall. Although subject to the limitations of the data collection, this finding suggests routine general practice is spending little time on opportunistic efforts to improve immunisation coverage. Recent NZ data has shown that missed opportunities are ubiquitous to NZ general practice and, while recognising parental choice and the constraints in a busy practice, there are a range of systematic ways of attempting to address this.[12] Consideration needs to be given to whether funding constraints are one aspect of why NZ general practice appears to be putting little amount of time into this area. This is an area for further investigation.

Dealing with late immunisations can take a disproportionately large amount of time, as shown by the large range (mean 149.8 minutes, median

Table 5. Time in minutes spent each month on managing the service activities

	Vacc ordering	Audit	Gen appoints	Gen PP rems	Late Imms	PMS	Org ORS	AES adverse events	Total Monthly Minutes
Standard vaccinations									
Mean average time in minutes per month:									
Overall	41.9	13.4	96.8	34.0	149.8	76.1	17.9	12.3	311.0
Nurse	47.4	14.0	109.6	38.7	175.2	74.9	20.0	17.5	425.5
Recep	3.8	15.0	7.5	3.0	0.0	240.0	0.0	0.0	68.0
Standard deviation of time in minutes per month:									
Overall	54.7	11.1	97.1	38.1	240.3	111.6	19.7	16.5	367.8
Nurse	57.4	11.9	97.2	38.9	252.3	111.8	20.1	18.3	380.8
Recep	3.8		10.8						127.4
Median average time in minutes per month:									
Overall	22.5	7.5	60.0	15.0	31.0	31.5	15.0	7.5	181.8
Nurse	25.0	7.5	90.0	30.0	60.0	45.0	15.0	13.1	284.5
Recep	4.0	15.0	1.5	3.0	0.0	240.0			5.8
Number of responses to these questions:									
Overall	27.0	20.0	24.0	15.0	27.0	24.0	17.0	15.0	34.0
Nurse	23.0	17.0	21.0	13.0	23.0	21.0	15.0	10.0	24.0
Recep	3.0	1.0	3.0	1.0	1.0	1.0	1.0	1.0	4.0
MeNZB vaccinations									
Mean average time in minutes:									
Overall	26.1	12.7	104.7	29.4	99.7	50.2	13.4	16.9	228.8
Nurse	29.1	13.5	109.6	33.4	117.1	51.1	15.2	23.8	314.9
Recep	2.8	15.0	1.0	3.0	0.0	120.0	0.0	0.0	36.9
Standard deviation of time in minutes per month:									
Overall	27.6	14.5	96.2	38.2	164.3	49.6	11.4	18.9	260.9
Nurse	28.6	15.6	95.7	39.6	173.4	48.9	11.2	18.8	265.9
Recep	4.1								68.2
Median average time in minutes per month:									
Overall	15.0	7.5	75.0	9.8	33.8	45.0	15.0	15.0	147.5
Nurse	22.5	7.5	90.0	15.0	45.0	45.0	15.0	15.0	244.0
Recep	1.0	15.0	1.0	3.0	0.0	120.0	0.0	0.0	4.3
Number of responses to these questions:									
Overall	26.0	19.0	22.0	15.0	26.0	23.0	15.0	10.0	34.0
Nurse	22.0	16.0	21.0	13.0	22.0	20.0	13.0	7.0	24.0
Recep	3.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.0

31 and skewed distribution), indicating that an individual case can take up a considerable amount of practice time, affecting the overall times and hence workload. If the practice that took the most time on late immunisations was used as an example, this increased time load increases the typical practice model costings by an extra $5 per immunisation event. This suggests that a practice that has to put extra effort into chasing up late immunisation events can incur additional costs up to $5 per vaccination event.

The immunisation process delivery activities are undertaken, in the most part, by practice nurses (91%), with GPs contributing overall around 1.0% of the total staff time spent on immunisations. The practice nurses spend 12–15% of their total nursing time on immunisation delivery activities. This provides an indication of the significant time commitment from practice nurses to immunisation. The estimated cost for a standard vaccination is between $24.50 (median) and $25.89 (mean) with a range from the 1st quartile of

Table 6. Summarised data of the general practice cost profiles for standard vaccinations

	Mean	Median	1st Quartile	3rd Quartile	CV	Typical
Annual # of vaccinations	**1166**	**926**	**497**	**1544**	0.9	1000
Primary activities cost	$ 11.41	$ 12.03	$ 7.91	$ 14.12	0.4	$ 12.03
Consumables	$ 1.34	$ 0.60	$ 0.28	$ 0.84	1.4	$ 0.60
Unit level costs	**$ 12.03**	**$ 12.66**	**$ 7.91**	**$ 15.38**	**0.4**	**$ 12.63**
Claim & opport cost	$ 504.56	$ 283.81	$ 159.05	$ 574.25	1.0	$ 694.98
GP time	$ 2,532.06	$ 1,847.27	$ 604.56	$ 4,408.25	0.9	$ 1,427.43
Removal	$ 122.02	$ 84.60	$ 70.00	$ 150.00	0.6	$ 84.60
PPS	$ 753.49	$ 721.48	$ 400.00	$ 1,095.00	0.7	$ 1,800.00
Other monthly (annualised)	$ 2,629.60	$ 1,960.20	$ 1,066.48	$ 3,545.40	0.8	$ 1,960.20
Batch level (annual cost)	**$ 2,859.41**	**$ 2,237.41**	**$ 1,576.16**	**$ 3,904.97**	**0.8**	**$ 5,967.21**
Cold Chain Accreditation	$ 42.41	$ 27.87	$ 15.11	$ 57.20	1.1	$ 28.60
Staff training	$ 395.97	$ 164.20	$ 74.25	$ 542.91	1.4	$ 164.20
Initial vaccinator training	$ 125.99	$ 137.07	$ 114.03	$ 151.80	0.4	$ 152.53
Vaccinator training update	$ 83.29	$ 57.20	$ 28.60	$ 87.66	1.1	$ 57.20
CPR update	$ 126.61	$ 63.61	$ 32.63	$ 170.78	1.1	$ 63.61
Others	$ 26.35	$ 26.35	$ 19.37	$ 33.33		$ 26.35
Product sustaining level	**$ 563.61**	**$ 382.37**	**$ 251.58**	**$ 711.59**	**1.0**	**$ 492.50**
Overhead–nurse hrs	$ 6,173.54	$ 5,915.61	$ 2,133.82	$ 9,324.99	0.7	$ 5,915.61
Overhead–GP hrs	794.04	659.26	272.26	1,312.68	0.8	659.26
Facility level	**$ 6,729.37**	**$ 6,972.66**	**$ 2,172.22**	**$ 9,495.87**	**0.7**	**$ 6,574.87**
Total costs for # of vaccinations						
Unit level	$ 14,435.91	$ 12,825.66	$ 4,413.78	$ 20,070.60	0.9	$ 12,632.93
Batch level	$ 2,859.41	$ 2,237.41	$ 1,576.16	$ 3,904.97	0.8	$ 5,967.21
Product sustaining level	$ 563.61	$ 382.37	$ 251.58	$ 711.59	1.0	$ 492.50
Facility level	$ 6,729.37	$ 6,972.66	$ 2,172.22	$ 9,495.87	0.7	$ 6,574.87
	$ 17,858.93	$ 15,445.44	$ 6,241.53	$ 24,687.16	1.0	$ 25,667.50
Cost per vaccination	**$ 24.19**	**$ 23.15**	**$ 15.38**	**$ 28.80**	**0.5**	**$ 25.67**
Unit level	$ 12.03	$ 12.66	$ 7.91	$ 15.38	0.4	$ 12.63
Batch level	$ 3.67	$ 2.89	$ 1.48	$ 5.42	0.7	$ 5.97
Product sustaining level	$ 2.08	$ 0.42	$ 0.18	$ 1.78	2.4	$ 0.49
Facility level	$ 8.11	$ 8.52	$ 4.81	$ 9.92	0.6	$ 6.57
Estimated Vaccination Cost	**$ 25.89**	**$ 24.50**	**$ 14.38**	**$ 32.50**		**$ 25.67**

$14.38 to the 3rd quartile $32.50. (Note all these figures are GST exclusive). A significant part of this range in cost is due to variability of delivery activities with a mean $12. Based on these results, the Immunisation Benefit Subsidy (IBS) is not adequately reimbursing general practice for the delivery of routine immunisations. There are other practice subsidies that may contribute extra small amounts towards cost recovery, such as practice nurse subsidies and PHO indicator funding. While these are currently unable to be accurately calculated by the authors, they appear unlikely to cover such a considerable shortfall.

A 'Typical Model' has been developed to better understand costs at the different levels. Based

on assumptions of the authors and the data from the survey, the typical model estimates the cost of a standard vaccination to be around $25.67 per vaccination.

NZ continues to have mediocre immunisation coverage rates. This study does not delineate all practice subsidies that may contribute towards immunisation service delivery, but does highlight that the current immunisation benefit subsidy funding, which is the major funder of the immunisation services, is unlikely to provide adequate remuneration to support service delivery at the practice level and hence little incentive towards improving immunisation coverage rates. Furthermore this also may explain why the time commitment for opportunistic vaccination appears to be a low priority at the practice level.

Limitations

Due to the significant time issues involved in data collection, a purposeful, rather than random, selection of practices was undertaken, the sample was small and there was a wide range in results between practices. Hence, these results cannot be taken as representative of the country and need to be seen as an indication, and worthy of consideration, rather than definitive findings.

Conclusions

- The current level of the IBS appears to be significantly lower than the overall estimates of the cost of a standard vaccination event. This could be a significant barrier to increasing focus and effort on immunisation service delivery at the practice level, particularly for the children who may require further effort in recall and follow-up.
- Practice nurses (PN) are the staff with the most involvement in immunisation service delivery in the general practice and spend overall 12–15% of their total time involved in the process of delivery of immunisations. The PN workforce commitment to immunisation delivery is clear from this study.
- GPs spend less than 1% of their total time on delivery of childhood immunisations and hence are likely to be much less engaged in the issues around immunisation service delivery than practice nurses.
- There is considerable variability among practices; some of this may show opportunities for improvement in resource utilisation associated with immunisation service delivery.

Recommendations

The current level of funding for the delivery of the childhood immunisation programme needs to be reviewed. The very low practice time commitment to opportunistic vaccinations needs to be explored further. This may, in part, be related to an inadequate incentive system making the extra time commitment not financially feasible.

The reasons for variability between practices, especially in time taken with registrations, could be explored further, particularly looking at the challenges with accessing and utilizing NIR data.

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COMPETING INTERESTS
None declared.

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