The Cost of Delivering the Childhood Immunisations at the General Practice Level

Final Report June 2008

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Executive Summary

NZ general practice is integral to the delivery of the childhood immunisation programme, and the current cost of delivering at the practice level is unknown. This study evaluated the full costs of delivering immunisations within the general practice setting.

This report is based on data collected from December 2007 to May 2008 from 24 diverse New Zealand General Practices. Data was collected using a range of different collection tools: a weekly log of activities, a Financial and Total Practice Time Questionnaire (FTPTQ), a GP time questionnaire and a monthly activity questionnaire.

Immunisations follow a natural sequence of activities which have been identified and measured in this report. A cost model was developed based on four levels of activity; the unit level (the whole process delivery activities), the batch level (managing the service activities), the resource capability level and the facility level. This model provides both transparency and visibility. Based on the results a 'typical' practice profile was developed with clearly set out assumptions that can provide a reference point for establishing an agreed cost estimate, and assist in budgeting and planning needs at practice and sector levels.

Noteworthy findings include the following: The immunisation process routinely takes around 24 minutes (median time) with a range from 18 – 29 minutes The longest time commitment is the informed consent process (mean of 4.5 minutes), followed by administering the vaccine (mean of 3.5 minutes) and documentation (mean of 3.4 minutes). The widest variability is the length of time spent in checking registrations. This may be due to a range in practice experience and ability as well as ongoing technical issues around access and use of the National Immunisation Register to check immunisation status. Time spent on opportunistic immunisations is considerably lower than expected.

The immunisation process delivery activities are undertaken mainly by practice nurses (90%), who spend around 12% of their total nursing time on delivery immunisation activities.

The estimated overall cost (excluding GST) for a standard vaccination is $24.50 (median) and $25.89 (mean) with a considerable range from the 1st quartile of $14.38 and the 3rd quartile $32.50. Using estimates based on the current data to date the typical model estimates a cost of a standard vaccination as around $25.67 per vaccination. The cost with the greatest impact is likely to be the estimate of the GP time commitment to immunisation.

New Zealand continues to have mediocre immunisation coverage rates. This preliminary data highlights that current Immunisation Benefit Subsidy funding is not adequate remuneration to support service delivery at the practice level. This in turn may be why important activities such as the time commitment for opportunistic vaccination appears to be a low priority at the practice level.

Background

Immunisation coverage rates in New Zealand are mediocre and well below national targets. New Zealand General Practice is integral to the delivery of the childhood vaccination programme. A cost analysis of the delivery of childhood immunisation was undertaken in New Zealand in 1998, and showed that there was a net cost to the general practice to immunise[1]

Since that time the Immunisation Benefit Subsidy (IBS) has been increased from $11 to $18 (GST inclusive) per vaccination event. Other practice subsidies such as practice nurse subsidy and PHO incentives also contribute. it is unknown however, if this is adequate to cover the costs of immunising the childhood population of a practice, particularly the extra costs required in order to increase immunisation coverage through extra efforts in recalling and tracking children.

Aims and objectives

This study aimed to evaluate the cost to general practices in New Zealand of calling, recalling and immunising children according to the current New Zealand Childhood Immunisation Schedule for children aged 0 – 5 years.

Key objectives

1. Determine the net average cost to a general practice of carrying out childhood immunisations for the national immunisation schedule for their registered child clients.

2. Development of a cost model allowing an activity-based costing approach.

3. Evaluate the time commitment at the practice required to deliver scheduled childhood vaccines to their population.

4. Compare whether costs vary with different practice settings in terms of geographic, ethnic and socioeconomic variations

Methodology

Data has been collected in two phases due to time limitations and recruitment challenges prior to Christmas. This report contains data from phase one collected from 24 practices from December 2007 to May 2008 using the tools described on page 3 (ref Appendix 4).

Practice Recruitment

A range of practices representing a cross section of primary health care were invited to participate by the Immunisation Advisory Centre (IMAC) Director, Regional Immunisation Advisors and District Facilitators. Invitations to participate were also undertaken via the GP Pulse e-news, personal

approach from IMAC staff and district facilitator and local coordinator direct approach to general practices that had expressed interest in participating. Practices were actively recruited with a focus on obtaining a range of practice populations including a socioeconomic range from high deprivation, medium, low deprivation and ethnic diversity.

Data collection tools (refer Appendix 4)

Data collection tools were developed with feedback from key stakeholder groups including general practitioners, practice managers, and practice nurses and tested by three practices.

- A Financial and Total Practice Time Questionnaire (FTPTQ) included practice overheads generally and specific costs relating to immunisation and the total hours worked by all practice staff
- An estimate of GP total immunisation time involvement over an average week
- A manual log completed by practice nurses and administration staff involved in any of the tasks involved in immunisation service delivery when doing tasks for a period of 5 days to assess the time spent by different practice staff
- Questionnaire covering the less common, monthly events were completed once by all staff involved in immunisation tasks

Data collection procedures

The research nurse contacted the practice and:

- Established which staff are involved in the immunisation process
- Briefed each staff member on how to fill out the log and explained the financial questionnaire to the practice manager
- Contacted the practice staff regularly through this time to ensure completion of logs, and collected the logs at the end of the period
- Explained the financial questionnaire to the practice manager

Development of Cost Model

The cost model follows an activity-based costing approach in which the main immunisation related activities are identified and traced to vaccination events via measurement of both resources and activities. Activities and associated resources are classified into a four level hierarchy.

Figure 1 sets out the cost model by showing the resources and activities split into four levels, called the four levels of the activity hierarchy, drivers used for the activities (shown inside the arrows)

1. Unit level: these are activities that vary directly with the product or service. In this study, the unit is the vaccination and unit level activities are those directly involved with the vaccination delivery. These comprise the delivery activities as described in *Figure 2* plus the cost of consumables specific to immunisations (question 9 of the FTPTQ). Examples of these include needles, syringes, plasters, distractions. These costs vary directly with the number of vaccinations delivered. In this report we are calling unit level costs "whole process delivery" as these activities cover the whole process of delivery of each individual immunisation event.

2. Batch level: these are activities that are required to provide a service or product but do not vary directly with the units produced. For example, ordering vaccines and audit procedures must be done irrespective of the number of vaccinations performed each month. Note that these apply within what is called a 'relevant range' of unit level activity so that zero vaccinations performed would impact on this batch level activities. These are activities that are not directly variable with the number of vaccinations delivered and often occur on a periodic (e.g. monthly) basis. In this report we are calling batch level costs "managing the service". Activities included in this category are:

- Claiming from Health Benefits Limited (HBL) for the Immunisation Benefit Subsidy. This is likely to be periodic (e.g. monthly)
- Dealing with opportunistic immunisations. This is more likely to be a function of patients seen than specifically vaccinations arranged. It has therefore been treated as a periodic or batch level item
- GP time per week. As noted earlier, this is an estimate of GP time spent on discussing and delivering immunisations
- Waste removal. This cost relates specifically to sharps removal collected in FTPTQ question 8B
- Printing, postage and stationery (PPS). These costs relate to PPS incurred in making appointments and other correspondence concerning immunisations. While related partially to the number of vaccinations performed, they are more likely to be periodic and in our view are better classified as a batch level cost
- Monthly events. Information on these was collected in section one of the log book. Some of these are clearly periodic (vaccine ordering, audit procedures) whereas others are partially related to the number of vaccinations delivered (generating routine immunisation appointments and reminders, late immunisations and adverse events). They have been classified as batch activities for this interim report

These costs have been aggregated to an annual basis and allocated using the number of vaccinations performed in a twelve month period.

3. Product sustaining level: are associated with providing or delivering a particular product or service. These are not affected directly by the batch or unit levels (bearing in mind the assumption of relevant range). Examples of these would be cold chain accreditation and staff training requirements. In this report we are calling product sustaining costs "resource capability". Some of these activities are one-off or occasional; others can be periodic.

Activities included in this category are:

- Cold chain accreditation. Since this is a three year event, the cost of this activity has been spread over a three year period. This means that the cost represents one-third of what was recorded in the log
- Staff training. This has been treated as an annual event
- Initial vaccination training. An average length of stay of three years has been assumed. This means that the cost represents one-third of what was recorded in the log
- Vaccination training update. This is assumed to last for two years and the cost therefore represents one-half of what was recorded in the log
- CPR update. This also is assume to be over a two year period and the cost therefore represents one-half of what was recorded in the log
- Others: translation services

4. Facility level: this level consists of practice level costs / activities that are required to meet the infrastructure and or organisation requirements to facilitate immunisation provision but are not directly traceable to immunisation activities *per se*. Items included in this category are:

- Administration including rent, utilities, subscriptions, insurance, depreciation
- Finance including interest, bank charges. Note that bad debts have been excluded
- Marketing including advertising
- Operating expenses including consumables, after hours support, cleaning and laundry and training
- Waste removal excluding sharps
- The cost of support staff including receptionists and practice managers

Generally, activity based cost systems should not attempt to allocate non-unit level activity costs to units, in this case vaccinations. This is because the non-unit level activity costs do not vary in the same proportions as units. For the purpose of this study, however, the batch ('managing the service') and product sustaining ('resource capability') costs have been allocated using the annual number of vaccinations. Facility level costs have been apportioned to the immunisation service using annual GP and nurse hours and then allocated to units using the annual number of vaccinations. Other levels are possible (e.g. customer type) but are not considered in this study.

The four level hierarchy can be viewed as ranging from a strict unit marginal cost to a full cost with facility wide overheads included. The vagaries of overhead cost allocations are well documented in the cost management literature (Cooper and Kaplan, 1991) and while activity based costing goes some way to improving costing models, a degree of arbitrariness in overhead allocation remains. Although many costing exercises attempt to measure individual product or service cost, it must be borne in mind that, as higher levels of the cost hierarchy are allocated to units, the degree of arbitrariness increases with consequent possibility for error. This is further compounded by certain items such as depreciation, imputed rent and opportunity costs, where estimates of cost can vary widely and yet be justifiable under conventional accounting and costing principles.

The present study has attempted to reduce these problems in the following way. Firstly, costs are reported for each hierarchy level enabling each stage or level to be considered in terms of its impact on vaccination costs. Secondly, the sample has been selected to provide a representative estimate of a 'typical' practice activities and costs. While variability is to be expected, the sample size (when completed) allows for an estimate of most likely resource consumption patterns. Third, measures of central tendency (mean and median) together with knowledge of GP practices have been used to construct cost profiles for a 'typical practice.

Typical of most professional service organisations, activities measured in time are the main focus and activity driver for tracing consumption to the cost object (Kneckel, Rouse and Schelleman, 2006).[2] (NB An activity driver is a measure of the frequency and intensity of cost demands on an activity and are used in assigning activity costs to cost objects). In this study, the weekly log and questionnaires have been used to identify times spent on activities in the hierarchy. Other costs directly associated with vaccinations have been separately identified and costed in at the appropriate level. Facility level overheads are applied using nurse and GP annual hours.

Key assumptions for the model

The vaccination process has been split into three parts: (i) the sequence of activities directly involved in administering a vaccine (ii) those activities carried out periodically related specifically to vaccinations and (iii) facility level activities and / or resources required to support service delivery.

1. The number of working days per annum is 229 being 45.8 weeks
2. The log represents a typical week of immunisations in each practice
3. Practices have provided their major overhead expenses
4. GP hours have been weighted three times those of nurses results to reflect pay differentials in calculating overhead recovery rates. (see Table 5 for average pay rates)

Based on the data received a 'typical model' has been developed where the authors have used the best estimates at each hierarchy level to create a model that can show the costings at each activity hierarchy level. The model can be used to alter different levels based on different scenarios, to see the overall impact of the total cost when shifting different aspects of the model around.

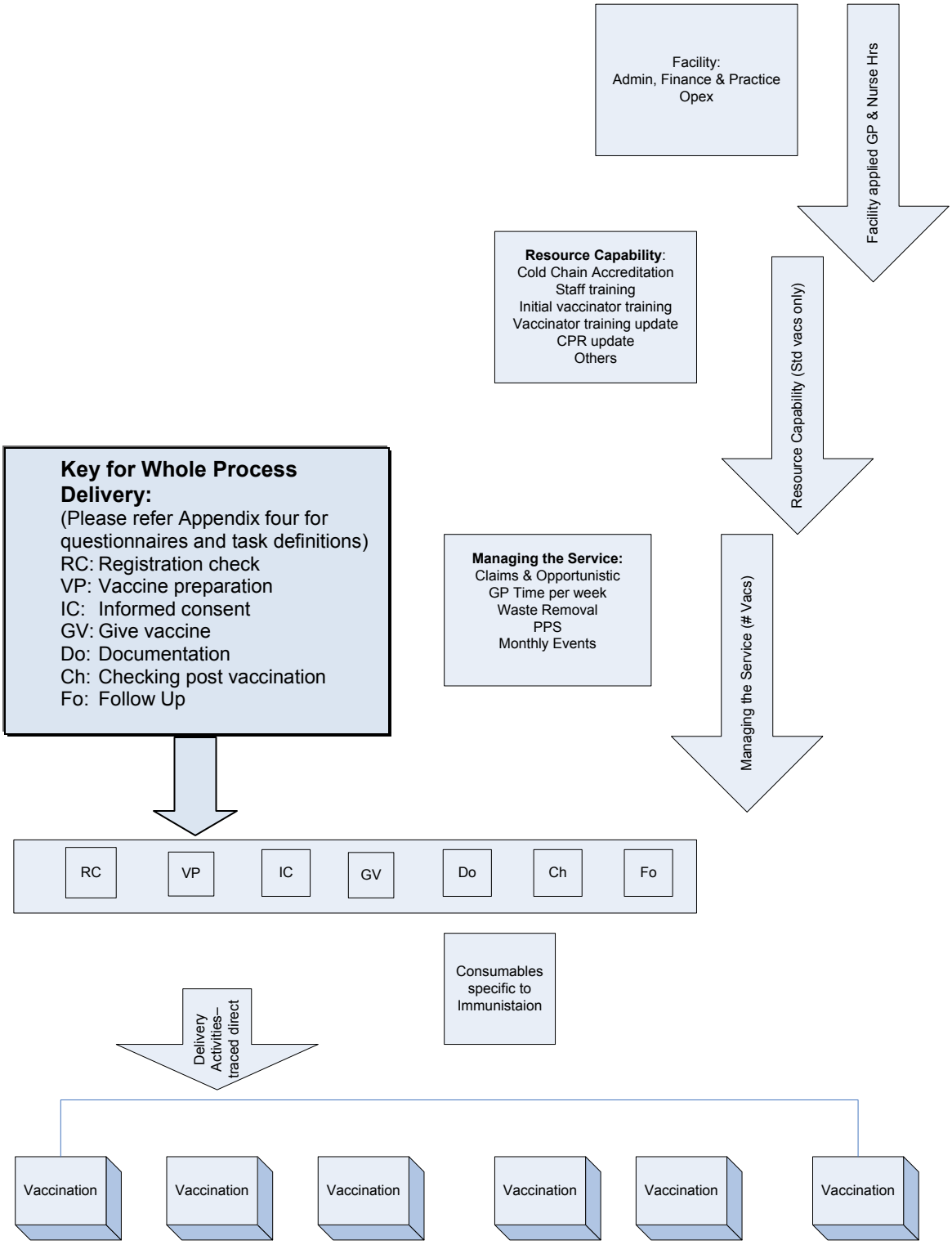

Figure 1: Cost Model Hierarchy

Benchmarking Analysis (Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA) is a method of performance or productivity measurement that provides efficiency scores, target values and best-in-class peers for benchmarking (refer Appendix 3).DEA is designed to answer the following questions:

1. How well are we doing (efficiency scores)?
2. What do we have to do to improve (target values)?
3. Who are our best-in-class peers for benchmarking? (i.e. comparison with other practices in the sample)

A DEA has been included in this analysis as it also provides useful information for benchmarking purposes such as appropriate best practice peer practices to improve efficiencies.

Results

Seventy practices in total were approached over the data collection phase with twenty-seven consenting to participate and then twenty-four actually completing the data collection.

Reasons for not completing the research were many and varied and included: key practice staff away or recently resigned, confidentiality issues with supplying information in the financial questionnaire, the amount of work the questionnaires appeared to represent, influenza season arriving and practice staff being busy.

There is a diverse range of practices providing a reasonable representation of New Zealand general practices including very large to smaller sole practitioners, data is represented from practices in all New Zealand's main cities and provincial towns. Many practices represented diverse ethnic mix; one practice is a pacific provider and one a Maori governance practice.

1. Practices involved in research

				Hours/practice patient		Ownership				Ethnic Breakdown of Total Practice Population				
Practice	Dep. Index	Size	Town or City	GP	Nurse	Sole practitioner	Salaried	Owner operated	Maori & Pacific Governance	European	Maori	Pacific	African	Other
1	3	Large	City	1.1	0.8		Y			77%	6%	17%		
2	1	Small	City	1.2	1.2	Y		Y		89%	5%	3%		3%
3	7	Small	City	1.5	1.5	Y	Y		Y	66%	7%	13%		14%
4	4	Medium	City	0.9	0.7			Y		79%				21%
6	9	Large	City	1.2	1.0			Y		71%	7%			22%
8	8	Small	Town	1.0	1.0		Y			87%	9%			4%
9	4	Large	Town	1.0	1.0			Y		52%	34%			14%
10	9	Small	Town	1.4	1.2					74%	14%	2%		10%
11	8	Large	Town				Y	Y		74%	20%	2%		4%
12	8	Large	Town					Y		72%	7%			21%
14	8	Large	City	1.7	2.3		Y			20%	15%	22%	43%	
15	9	Small	City			Y		Y		81%	8%			11%
16	6	Large	Town	1.2	0.8			Y		90%	10%			
17	9	Large	Town	1.0	0.8			Y		63%	37%			
18	10	Small	City	1.1	0.7	Y		Y		25%	19%		46%	10%
19	6	Large	City	0.7	0.9			Y		83%	5%			12%
20	2	Medium	City	1.4	0.9			Y		86%				14%
21	9	Small	Town	2.2	5.0				Y	9%	88%			3%
22	9	Medium	Town					Y		78%	10%			11%
23	6	Small	Town											
24	3	Large	City	1.0	1.2					82%	6%			12%
25	5	Large	Town	0.9	0.7			1		51%	6%			43%
26	5	Large	City	0.0	0.0					64%	20%			16%
28	4	Medium	City	0.7	0.7					80%	7%			13%

Table 1: Practices involved in phase one by location, deprivation rating, size, type of practice ownership and ethnicity

In addition to the survey data, other information included practice size, ownership type, deprivation scale and ethnicity profiles. Table 1 provides practice size as follows; small practices are classified as less than 3000 patients (8 practices), medium up to 5000 (5 practices) and large as 5000 patients and above (11 practices). City is defined as New Zealand's main population areas of Auckland, Hamilton, Wellington, Christchurch and Dunedin, and Towns are other population areas. A summary of practice hours and immunisation events by size in terms of number of registered patients is shown in column hours per practice patient for GP and Nurse.

The New Zealand Deprivation scale 2006 is an updated version of the NZDep91, NZDep96, and NZDep2001 indexes of socioeconomic deprivation. NZDep2006 combines nine variables from the 2006 census which reflect eight dimensions of deprivation. NZDep2006 provides a deprivation score for each meshblock in New Zealand. Meshblocks are geographical units defined by Statistics New Zealand, containing a median of approximately 87 people in 2006.

The NZDep2006 scale of deprivation from 1 to 10 divides New Zealand into tenths of the distribution of the first principal component scores. For example, a value of 10 indicates that the meshblock is in the most deprived 10 percent of areas in New Zealand, according the NZDep2006 scores.

Data to match practices for NZDep rating was obtained from Statistics New Zealand website based on 2006 census meshblocks, we matched the corresponding practice addresses to the meshblocks and corresponding deprivation scale[4]

Seven practices chose not to supply financial and overhead information as staff were away and could not access the data, or they refused due to confidential nature of information. All twenty four practices provided log data from key practice staff.

2. Time spent on activities directly associated with the immunisation process

NB: for easier flow of the report, all results specific to MeNZB ™ have been placed in Appendix One

2.1 Logged time spent on the immunisation process

Times spent on activities directly associated with immunisations were captured using a daily log. Eighty nine percent of this was undertaken by nurses. For further breakdown of different staff involvement see section 2.4.

Seven of these activities have been classified as delivery and comprise checking registration, vaccine preparation, informed consent, administering the vaccine, documentation, checking and routine follow-up. Time spent on dealing with two other activities, opportunistic immunisations and claiming from HBL, was also recorded.

The delivery activities are classified as unit level as they vary according to the number of vaccinations performed. The other two activities have been classified as batch level. Table 2 reports the times and number of events recorded by the daily logs for the sample GP practices for standard immunisations.

Practice	Reg Check Total Mins	Vaccine preparation Total Mins	Informed consent Total Mins	Giving Vacc Total Mins	Documentation Total Mins	Checking Total Mins	Routine Follow-up Total Mins	Vaccination Delivery Total Total Mins	Opportunistic Total Mins	Claims Total Mins
1	16.5	34.5	36	19	127	6	0	239	0	13
2	34.5	9	13.5	22.5	14.5	43.5	6	143.5	0	6
3	3.5	22.5	7.5	7.5	3	1.5	1.5	47	3	0
4	3	24	30	18	21	63	0	159	7.5	4
6	605	90	91	54	56	22.5	16.5	935	52.5	14
8	9	18	45	33	27	6.5	4.5	143	8.5	6
9	17.5	12	38.5	21	25	6	4	124	4.5	4.5
10	3	2	2	2.5	9	2	0	20.5	4	3
11	15.5	24.5	123	21	48	18	27	277	3	16
12	57	18	27	46	26.5	13.5	18	206	0	8.5
14	358	18	67.5	16.5	139.5	11.5	3	614	7.5	0
15	2.5	4	3	16.5	7.5	3	0	36.5	0	1
16	183.5	30	16.5	40.5	30	36	2.5	339	0	0
17	21	117	163.5	118.5	90	52.5	57	619.5	27	40.5
18	12.5	7.5	7.5	7.5	8.5	1	0	44.5	16.5	9
19	43.5	87	123	256.5	156	60	9	735	0	72
20	17	9	8.5	17	13.5	11.5	4	80.5	0	6
21	85	31.5	42	45	10.5	4	3	221	1	7
22	66.5	26	38.5	31	34.5	26.5	15.5	238.5	0	22
23	8	16.5	11	19.5	21	8	7	91	1.5	12
24	82	81.5	94	68	108	195.5	43	672	22	31.5
25	56.5	85.5	57	71	100.5	34.5	40.5	445.5	6	72
26	13.5	33	69	39	66	18	22.5	261	0	21.5
28	31.5	28	41.5	33	31.5	26.5	22.5	214.5	0	8
	1745.5	829	1156	1024	1174	671	307	6906.5	164.5	377.5
	# Events	# Events	# Events	# Events	# Events	# Events	# Events	# Events	# Events	# Events
1	14	6	6	6	13	6	0	51	0	5
2	6	3	3	3	4	5	3	27	0	5
3	3	2	1	1	1	1	1	10	1	0
4	1	7	6	5	6	6	0	31	1	4
6	68	19	20	20	20	19	6	172	4	8
8	9	6	6	5	6	6	3	41	2	4
9	10	4	8	4	7	4	4	41	2	4
10	2	2	2	2	2	2	0	12	3	2
11	14	16	16	16	16	16	16	110	1	16
12	22	7	7	7	8	7	10	68	0	6
14	59	11	11	11	42	11	3	148	1	0
15	2	3	2	3	3	3	0	16	0	1
16	22	5	6	5	9	5	2	54	0	0
17	12	21	21	21	21	21	21	138	9	21
18	9	1	1	1	2	1	0	15	2	2
19	29	28	28	27	28	28	6	174	0	28
20	7	5	7	7	7	6	4	43	0	6
21	22	13	13	13	4	4	3	72	1	7
22	37	17	17	17	17	17	14	136	0	15
23	7	8	8	8	8	8	7	54	1	8
24	33	32	24	24	23	23	13	172	5	14
25	24	17	15	17	15	15	11	114	2	18
26	10	13	13	13	13	12	3	77	0	13
28	26	10	10	11	10	10	2	79	0	6
	448	256	251	247	285	236	132	1855	35	193

Table 2 Panel A: Total times (in minutes) and events from daily log

Practice	Reg Check	Vaccine prep	Informed consent	Giving Vacc	Documen tation	Checking	Routine Follow-up	Vaccination Delivery Total	Opportun istic	Claims
1	1.2	5.8	6.0	3.2	9.8	1.0		**26.9**		2.6
2	5.8	3.0	4.5	7.5	3.6	8.7	2.0	**35.1**		1.2
3	1.2	11.3	7.5	7.5	3.0	1.5	1.5	**33.4**	3.0	
4	3.0	3.4	5.0	3.6	3.5	10.5		**29.0**	7.5	1.0
6	8.9	4.7	4.6	2.7	2.8	1.2	2.8	**27.6**	13.1	1.8
8	1.0	3.0	7.5	6.6	4.5	1.1	1.5	**25.2**	4.3	1.5
9	1.8	3.0	4.8	5.3	3.6	1.5	1.0	**20.9**	2.3	1.1
10	1.5	1.0	1.0	1.3	4.5	1.0		**10.3**	1.3	1.5
11	1.1	1.5	7.7	1.3	3.0	1.1	1.7	**17.5**	3.0	1.0
12	2.6	2.6	3.9	6.6	3.3	1.9	1.8	**22.6**		1.4
14	6.1	1.6	6.1	1.5	3.3	1.0	1.0	**20.7**	7.5	
15	1.3	1.3	1.5	5.5	2.5	1.0		**13.1**		1.0
16	8.3	6.0	2.8	8.1	3.3	7.2	1.3	**37.0**		
17	1.8	5.6	7.8	5.6	4.3	2.5	2.7	**30.3**	3.0	1.9
18	1.4	7.5	7.5	7.5	4.3	1.0		**29.1**	8.3	4.5
19	1.5	3.1	4.4	9.5	5.6	2.1	1.5	**27.7**		2.6
20	2.4	1.8	1.2	2.4	1.9	1.9	1.0	**12.7**		1.0
21	3.9	2.4	3.2	3.5	2.6	1.0	1.0	**17.6**	1.0	1.0
22	1.8	1.5	2.3	1.8	2.0	1.6	1.1	**12.1**		1.5
23	1.1	2.1	1.4	2.4	2.6	1.0	1.0	**11.6**		4.0
24	2.5	2.5	3.9	2.8	4.7	8.5	3.3	**28.3**	4.4	2.3
25	2.4	5.0	3.8	4.2	6.7	2.3	3.7	**28.0**	3.0	4.0
26	1.4	2.5	5.3	3.0	5.1	1.5	7.5	**26.3**		1.7
28	1.2	2.8	4.2	3.0	3.2	2.7	11.3	**28.2**		1.3
Average time/event	2.7	3.5	4.5	4.4	3.9	2.7	2.6	23.8	4.7	1.9

Table 2 Panel B: Average times for activities per each event collected in daily log: standard immunisations (total times /total events)

The top of panel A on page 10 shows the total time in minutes spent in the sample period on each activity by each practice. The lower part of panel A shows the number of events recorded over the sample period and panel B shows the average time per event.

For example, practice 1 spent 16.5 minutes in total on checking registrations for 14 events which averages out to 1.2 minutes. Column nine shows the totals for the times and events in panel A and the average time per vaccination panel B. Note that this average time is the sum of the delivery activities across each practice.

2.2 Times involved in each step of the vaccination process

Figure 2 depicts the delivery activities identified with the vaccination process commencing with the initial appointment through administering the vaccine to any routine follow-up procedures. Median times in minutes for standard vaccinations and MeNZB™ vaccinations are shown in each activity box. For example, the median time for making appointments is 1.8 minutes for standard and 1.6 minutes for MeNZB™ vaccinations.

The total process times of the *entire vaccination* process from appointment to aftercare are shown in the arrow figure showing the mean, median, first and third quartiles. For standard vaccinations, full process excluding claiming and dealing with opportunistic the mean average time is 23.8 minutes, median time 26.6 minutes, first and third quartiles 17.6 and 28.5 respectively. (Note that the decimal component refers to proportions of a minute, not seconds). The standard vaccinations appear to be positively skewed which means that more than half are greater than the mean whereas the MeNZB™ appear to be more symmetrically distributed. The MENZB™ vaccinations mean average time is 17.8 minutes, median time 16.6 and first and third quartiles 13.4 and 23.0 respectively.

Comparing the two types of vaccination, standard vaccines take longer on average across all activities and in total. The major contributing factor is likely to be due to the fact that standard is often more than one injection and informed consent covers multiple diseases.

There is a lower spread across the first and third quartiles for MeNZB™ and a slightly higher coefficient of variation for MeNZB™ (0.39) than standard (0.33) suggesting that there appears to be more variability in practice times taken to deliver the MeNZB™ than the standard vaccines.

The delivery activities are also unit level as they vary according to the number of vaccinations performed.

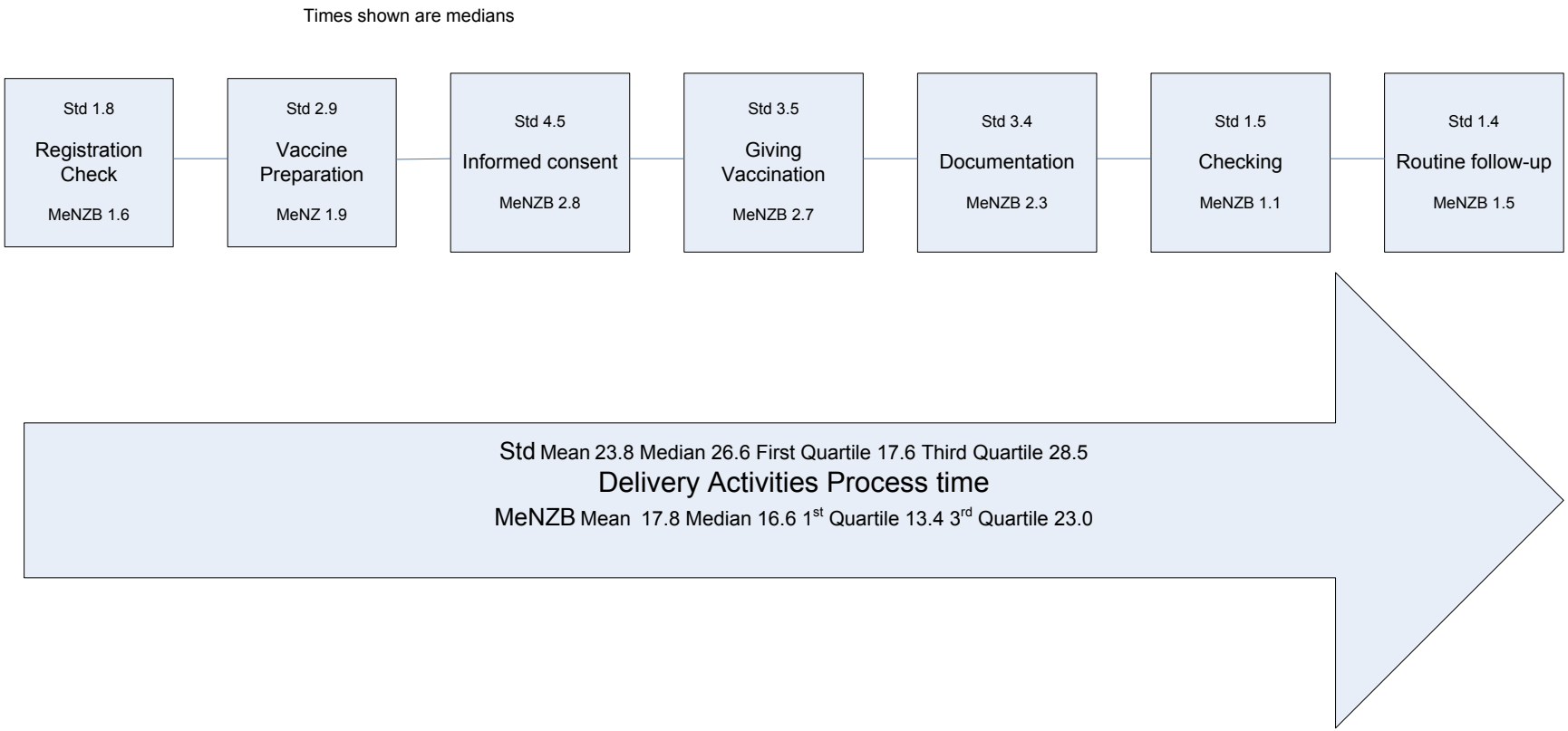

Figure 2: Vaccination Sequence for Delivery Activities Unit Level

2.3 Time spent dealing with opportunistic immunisation

Half the practices spent less than half an hour per month on this task. This data was measured in the daily log with only 14 practices recording any time at all spent on this activity. The median time recorded is 30 minutes per month, first and third quartiles 12 and 58 respectively. Given the variability of the data, the median is recommended as a better estimate of times.

Time spent on opportunistic immunisations was 165 minutes per event for 35 events across all practices. Most practices recorded zero time on this activity with 165 minutes representing just over two percent of the total time recorded in the daily log for the sample period for immunisation activity. Two percent of time on opportunistic immunisations was also the case for MeNZB™.

2.4 Time spent on delivery activities by all personnel

See Table 3. For example, time spent on making appointments was 1745 minutes and there were 448 events in this activity. It can be seen that nurses provided 1301 of the total minutes in this activity representing 74.5% as shown in the lower panel.

Total time across all practices and across all delivery activities was 6906 minutes of which nurses provided 6265 minutes (90.7% of the total time). Overall doctor time across all delivery activities was 69.5 minutes and accounted for only 1% of the total staff time.

Question 3 of the Financial and Total Practice Time Questionnaire (FTPTQ) asked for the time per week spent by GPs in discussing and delivering immunisations. Responses show a maximum of around one hour per week with most around 20 minutes in total per week for standard and even less for MeNZB™.

Standard Vaccinations (total time from weekly logs)	Admin	Doc	Manager	Nurse	Recept	Grand Total
Registration check	3.0	53.0	8.0	1301.0	380.5	1745.5
Vaccine preparation				812.0	17.0	829.0
Informed consent		10.0		1146.0		1156.0
Giving vaccinations				1024.0		1024.0
Documentation		6.5	1.0	1004.0	162.5	1174.0
Checking				671.0		671.0
Routine Follow-up				307.0		307.0
Total	3.0	69.5	9.0	6265.0	560.0	6906.5

	Admin	Doc	Manager	Nurse	Recept	
Registration check	0.2%	3.0%	0.5%	74.5%	21.8%	100.0%
Vaccine preparation				97.9%	2.1%	100.0%
Informed consent		0.9%		99.1%		100.0%
Giving vaccinations				100.0%		100.0%
Documentation		0.6%	0.1%	85.5%	13.8%	100.0%
Checking				100.0%		100.0%
Routine Follow-up				100.0%		100.0%
Total	0.0%	1.0%	0.1%	90.7%	8.1%	100.0%

Table 3 .Total time in minutes by activity and staff role across all sample practices

2.5 Proportion of annual hours spent by nurses and GPs on standard and MeNZB™ immunisation

Table 4 reports the annual hours spent by nurses and GPs on immunisation activities for both standard and MeNZB™ vaccinations. For example, nurses spent a mean average of 588 hours representing around 15 percent of their total mean annual hours. GPs spent considerably less time with a mean average of 0.5 percent of total annual hours spent on immunisation activities.

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		6,616.4	5,129.6	2,713.7	9,114.2
% time on immunisations		0.5%	0.2%	0.1%	0.5%

Table 4: Estimated proportions of total time spent (in hours) by nurses and GPs on immunisation/ annum. (Standard and MeNZB™)

3. Costs

3.1 Paid hourly rates of all practice staff

Table 5 shows the hourly paid rates by staff member. Nineteen practices disclosed this information and there is good consistency particularly for nurses, as shown by the low coefficient of variation (CV).

Paid Hourly Rates	Mean	Median	1st Quartile	3rd Quartile	CV
GP	$ 85.39	$ 86.25	$ 69.00	$ 103.25	0.39
Recep	$ 18.69	$ 18.32	$ 17.50	$ 19.00	0.10
Nurse	$ 25.68	$ 26.00	$ 25.09	$ 27.16	0.10
Manager	$ 24.34	$ 26.35	$ 20.75	$ 30.00	0.45
Admin	$ 19.02	$ 20.96	$ 18.00	$ 22.25	0.26

Note: These were provided by 19 practices. CV (coefficient of variation)

Ave Event Times (minutes)	Mean	Median	1st Quartile	3rd Quartile	CV
Apps	2.7	1.8	1.2	2.7	0.8
Vac Prep	3.5	2.9	2.0	4.8	0.7
Inf Cons	4.5	4.4	3.1	6.0	0.5
Admin Vac	4.4	3.5	2.6	6.6	0.5
Docum	3.9	3.4	3.0	4.5	0.4
Check	2.7	1.5	1.0	2.4	1.1
Followup	2.0	1.4	1.0	2.2	1.3
Time Per Vac	23.8	26.6	17.6	28.5	0.3

Table 5 Hourly pay rates by staff member

The median rates above have been imputed to practices where this data is missing in order to provide as complete cost figures as possible. Given the large proportion of time spent by nurses on immunisations, we believe that using the $26 rate above for missing data on nurse rates is appropriate. Where data is missing for GP rates, we have used the median rate of $86 as above.

The paid rates for holiday pay and ACC have been adjusted by an additional ten percent (eight percent holiday pay and two percent ACC) but we have not incorporated the potential impact of employer contributions to Kiwi Saver. Kiwi Saver is on a sliding scale of 1 percent increasing to 4 percent over the next four years with an initial tax credit in the first year. We experienced some problems with reconciling the times and pay rates with wages and salaries reported in the annual accounts however we believe that the rates used for this cost model are accurate. Some practices reported the cost of relief staff in their annual expenses, others did not. There appears to be some variability in the way practices manage when key personnel are on holiday break, where some may shift workloads around existing staff while others employ relief staff. It is also likely that non-urgent activities can be scheduled around holiday periods and we have assumed

that immunisations fall into this form of discretionary activity. Accordingly no provision for relief staff has been factored into the nurse pay rate apart from the aforementioned ten percent.

	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
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	20	24	15	27	24	17	15	34
Nurse	23	17	21	13	23	21	15	10	24
Recep	3	1	3	1	1	1	1	1	4
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
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	19	22	15	26	23	15	10	34
Nurse	22	16	21	13	22	20	13	7	24
Recep	3	1	1	1	1	1	1	1	4

Table 6: Time in minutes spent each month on managing the service activities

Time spent each month on managing the service activities such as vaccine ordering, audit and generating appointments. Practice nurses carried out most of these activities but in some practices, GPs and receptionist assist. The number of responses relates to the person completing this section of the questionnaire and there can be more than one response for each practice.

Depending on whether the mean or median is used, from three to six hours per month is spent by nurses overall on these activities with the bulk of the time spent on vaccine ordering, generating appointments, and late immunisations and checking Practice Management System (PMS). Using the median, generating appointments took the most time for both standard and MeNZB™ with over an hour per month. Practices were asked to indicate the modes used for generating appointments (letter, email, phone, SMS, other). The responses to this question (25 in total) indicated that letters were the main mode of communication (25) followed by phone (19) and a small number using SMS/txt (4). Email does not appear to be utilised at present.

Dealing with late immunisations can take a large amount of time as indicated by the skewed distribution with the mean of 149.8 minutes compared with a median of 31 minutes. Adverse events were more the exception with some practices indicating that this occurred maybe once in five years.

3.2 Summarising costings by model hierarchy

Table 7 reports summarised statistics for the cost levels across practices. Note that these figures are averages and not all practices provided cost information at all levels. From these, costings for a 'typical' practice model has been developed, and this is discussed further in Section 3.5.

	Mean	Median	1st Quartile	3rd Quartile	CV	Typical
Annual # of Vaccinations	***1166***	***926***	***497***	***1544***	1	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 mean	$14,435.91	$12,825.66	$ 4,413.78	$ 20,070.60	0.9	$ 12,632.93
Batch level mean	$ 2,859.41	$ 2,237.41	$ 1,576.16	$ 3,904.97	0.8	$ 5,967.21
Product sustaining level mean	$ 563.61	$ 382.37	$ 251.58	$ 711.59	1.0	$ 492.50
Facility level mean	$ 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
Mean Cost per vaccination	*$ 24.19*	*$ 23.15*	*$ 15.38*	*$ 28.80*	*0.5*	*$ 25.67*
Unit level mean	$ 12.03	$ 12.66	$ 7.91	$ 15.38	0.4	$ 12.63
Batch level mean	$ 3.67	$ 2.89	$ 1.48	$ 5.42	0.7	$ 5.97
Product sustaining level mean	$ 2.08	$ 0.42	$ 0.18	$ 1.78	2.4	$ 0.49
Facility level mean	$ 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***

Table 7 Summarised statistics of General Practice cost profiles for standard vaccinations

From all results the median number of vaccinations over a twelve month period was 926 with a minimum of 65 and maximum of 4949. Each row calculates the mean, median, first and third quartiles. Subtotals such as the unit level, batch level, are the mean; medians etc of their respective rows, and are not the sum of the preceding rows. The right most columns depict our estimate of the 'typical' practice costs assuming a volume of vaccinations of 1000 per annum.

3.2.1 Unit level (Activity based)costs

Delivery activities cost between $12.03 to $12.66 per vaccination, depending on whether the mean or median is used. The coefficient of variation is 0.4 suggesting that this is a reasonable estimate of time and cost, recalling that nurse hourly rates were fairly stable around $26. The cost of consumables is more variable probably reflecting both the smallness of cost and being an area that practices do not monitor very well. The typical model estimates the unit level cost at just over $12 using the median.

3.2.2 Batch level (Managing the service) costs

The costs of claim and opportunistic activities varies considerably across practices and in this instance, the median appears to be a better estimate than the mean The typical model estimates a higher cost than the survey data for two of these items. The rationale is as follows.

Claims are estimated as averaging one minute per event which for 1000 claims, would cost 16.7 nursing hours at $26 per hour (plus ten percent) being $477. To this we have added two events per week averaging five minutes each for opportunistic time spent by nurses which costs $218 giving our total cost of $694 for claims and opportunistic activities.

GP time is variable with thirteen out of twenty four practices not reporting any time at all per week in response to the question concerning GP time spent on discussing and/or delivering immunisation in an average week. Note that the median cost of GP time is estimated just under $40 per week. The typical model assumes 20 minutes per week for GP time on immunisations and an hourly rate of $85 plus ten percent.

Most practices did not report the cost of sharps removal and printing, postage and stationery separately. The median costs per week for these are $1.85 and $11.70 respectively. For the typical practice, the median cost for sharps removal has been used and an estimate of $1.80 per vaccination for printing, postage and stationery.

	Mean	Median	1st Quartile	3rd Quartile	CV
Monthly Events (monthly costs)					
Vacc ordering STD	$ 23.54	$ 11.51	$ 7.15	$ 32.27	1.18
Audit STD	$ 6.52	$ 5.23	$ 3.45	$ 8.28	0.86
Gen appoints STD	$ 49.92	$ 53.11	$ 13.75	$ 76.54	0.91
Gen PP rems STD	$ 18.03	$ 7.15	$ 3.81	$ 16.50	1.07
Late Imms STD Q5	$ 83.76	$ 22.09	$ 10.05	$ 55.94	1.42
PMS STD Q5	$ 40.34	$ 20.91	$ 7.15	$ 29.70	1.36
Org ORS STDM Q5	$ 9.90	$ 7.22	$ 3.69	$ 8.18	0.95
AES STD adverse events	$ 7.36	$ 7.15	$ 0.99	$ 11.09	1.13
	$ 239.36	$ 134.36	$ 50.05	$ 238.50	

Table 8: Monthly events descriptive statistics (cost per month) for standard vaccinations

Table 8 reports the summarised statistics for the monthly events. Note that these are in monthly amounts in this table whereas Table 7 shows them in annual amounts. There is marked negative skewness due to a very few practices reporting higher than average activity levels for general appointments and late immunisations. Note that these are total costs and not costs per vaccination or event. The underlying times for these activities have been shown in Table 6 above.

3.2.3 Product sustaining (resource capability) level cost description

The costs of these events have all been assigned to the standard vaccinations on the argument that they relate to immunisation generally and are not affected incrementally by additional immunisation services such as MeNZB™. Most of these events have moderate coefficients of variation implying the median is probably a better estimate across practices. The exception is initial staff training where variation is reasonably consistent across the sample practices.

The typical model uses the median for four of the items. Cold chain accreditation is assumed to take three hours and is spread over three years using the nurse pay rate. Initial vaccination training is assumed to take 16 hours at the nurse pay rate and is spread over three years.

3.2.4 Facility level

These activities and costs are required to provide the practice's services, but are not usually easily traceable to individual services such as immunisations. For example, rent or insurance is required for a practice but the cost does not vary with the number of immunisations or event patients (unless the capacity of the premises has been exceeded).

Annual financial expenses were collected from practices and used to calculate the total overhead to be recovered. Some items were excluded such as IRD penalties, bad debts and sharps removal (given that these were costed separately).

3.4 Summarising overheads costs

	Mean	Median	1st Quartile	3rd Quartile	CV
Overhead to be recovered:					
Admin	$ 118,577	$ 86,338	$ 73,272	$ 159,023	0.9
Finance	$ 8,326	$ 3,778	$ 2,809	$ 10,427	1.5
Marketing	$ 2,337	$ 1,909	$ 435	$ 3,244	0.8
Waste removal	$ 3,314	$ 1,124	$ 508	$ 1,320	3.4
Opex	$ 41,072	$ 30,461	$ 12,289	$ 46,236	1.0
Total	$ 173,626	$ 123,610	$ 89,314	$ 220,250	1.0
Support wages	$ 81,531	$ 42,007	$ 41,601	$ 108,821	
Total Overhead to be recovere	$ 255,157	$ 165,617	$ 130,915	$ 329,071	
Recovery Rate - ohd exp	$ 7.88	$ 8.26	$ 5.90	$ 12.28	0.7
Recovery Rate - support wages	$ 5.28	$ 4.95	$ 4.34	$ 6.29	0.2
	$ 13.16	$ 13.21	$ 10.24	$ 18.57	0.5
Recovery rate per nurse hour	$ 12.58	$ 13.47	$ 10.58	$ 15.57	0.5
Recovery rate per GP hour	$ 37.74	$ 40.42	$ 31.74	$ 46.70	0.5

Table 9: Overheads and administration have been included as part of the facility level costs and built into the overhead recovery rates.

Seventeen practices reported annual costs in varying degrees of disclosure; some provided the specific items requested in the questionnaire and others provided the major expense section of their annual accounts. Individual expense items were categorised into broader categories as shown in the Table 9 with substantial negative skewness (as is usually the case in financial cost data). GP hours and nursing hours were used to allocate facility wide overheads since these are the point of contact with patients and most accurately reflect practice demands by patients. Clinical hours shown in Table 9 are estimated based on weekly hours reported by practices using a 229 working day year or 45.8 weeks. GP hours have been weighted by a factor of three to reflect salary differentials to nursing staff. Overhead recovery rates are therefore calculated as follows:

$$\frac{Overhead\$}{(GPhours * 3 + Nursehours)}$$

This calculation provides a base rate used for nurse hours and is adjusted by a factor to obtain the GP overhead recovery rate. Table 9 shows that the overhead recovery rate averages around $13 per hour for nurses and $37 to $40 per hour for GPs. Note that the recovery rates per hour are averages in terms of mean, median etc.

These rates are applied using the hours recorded from the daily log daily times, monthly events from section one of the log, and question 3 from the FTPT questionnaire. The amounts applied

can be seen in Table 7 and average slightly over $8 per vaccination using the median and mean respectively.

3.5 Range of possibilities in a 'Typical Model'

On the basis of the above costings, the estimated cost for a standard vaccination is obtained by dividing each of the non-unit level cost subtotals by the number of vaccinations and adding these to the unit-level(activity based) cost. The lower part of Table 7 shows Mean cost per Vaccination to be around $24 (note that these are GST exclusive). One of the problems with incomplete data where practices did not supply expense information, is that the Mean Cost per Vaccination reported in Table 7 does not include overhead or facility level costs for those practices that did not provide this information. Accordingly the final row of Table 7 may be a better estimate as it adds together the averages from each of the four levels (unit, batch, product and facility). This approach would estimate the cost per vaccination as $24.50 (median) to $25.89 (mean).

Note that these are different for the first ($14.38) and third ($32.50) quartiles. A significant part of this difference is due to the delivery activities at unit level costs of $7 and $15 relative to the mean/median cost of $12. The estimated cost based on developing a mode for the "typical practice" is $25.67 which lies between the median and mean estimated cost from the survey. Table 10 shows that this is particularly sensitive to the involvement of GPs in the immunisation activities. The estimate is based on GP time commitment of only 20 minutes per week. However the three columns show the effect on the batch level costings when GP time changes from 20 minutes per week to 40 minutes and 60 minutes. There are two effects, namely the increase in batch level cost plus the increased overhead allocated to immunisations, resulting in approximately a $2 increase per vaccination.

	Typical	Additional times	
GP time mins per week	**20**	**40**	**60**
Annual # of Vaccinations	***1000***	***1000***	***1000***
Primary activities cost	$ 12.03	$ 12.03	$ 12.03
Consumables	$ 0.60	$ 0.60	$ 0.60
Unit level costs	***$ 12.63***	***$ 12.63***	***$ 12.63***
Claim & opport cost	$ 694.98	$ 694.98	$ 694.98
GP time	$ 1,427.43	$ 2,854.87	$ 4,282.30
Removal	$ 84.60	$ 84.60	$ 84.60
PPS	$ 1,800.00	$ 1,800.00	$ 1,800.00
Other monthly (annualised)	$ 1,960.20	$ 1,960.20	$ 1,960.20
Batch level (annual cost)	***$ 5,967.21***	***$ 7,394.65***	***$ 8,822.08***
Cold Chain Accreditation	$ 28.60	$ 28.60	$ 28.60
Staff training	$ 164.20	$ 164.20	$ 164.20
Initial vaccinator training	$ 152.53	$ 152.53	$ 152.53
Vaccinator training update	$ 57.20	$ 57.20	$ 57.20
CPR update	$ 63.61	$ 63.61	$ 63.61
Others	$ 26.35	$ 26.35	$ 26.35
Product sustaining level	***$ 492.50***	***$ 492.50***	***$ 492.50***
Overhead - nurse hrs	$ 5,915.61	$ 5,915.61	$ 5,915.61
Overhead - GP hrs	$ 659.26	$ 1,276.39	$ 1,893.52
Facility level	***$ 6,574.87***	***$ 7,192.00***	***$ 7,809.12***
Total costs for # of vaccinations			
Unit level	$ 12,632.93	$12,632.93	$ 12,632.93
Batch level	$ 5,967.21	$ 7,394.65	$ 8,822.08
Product sustaining level	$ 492.50	$ 492.50	$ 492.50
Facility level	$ 6,574.87	$ 7,192.00	$ 7,809.12
	$ 25,667.50	$27,712.07	$ 29,756.63
Cost per vaccination	***$ 25.67***	***$ 27.71***	***$ 29.76***
Unit level	$ 12.63	$ 12.63	$ 12.63
Batch level	$ 5.97	$ 7.39	$ 8.82
Product sustaining level	$ 0.49	$ 0.49	$ 0.49
Facility level	$ 6.57	$ 7.19	$ 7.81
Total levels	$ 25.67	$ 27.71	$ 29.76

Table 10: Estimated costs for 'Typical' practice varying with different times per week spent by GPs

4. Analyses of Difference Types of Practices

Total annual hours for GPs and nurses are higher with greater practice size as expected, as are the total number of vaccinations provided. What was not expected was the increase in the delivery activities time spent for both standard (STD) and MeNZB™ as practice size increases. Managing the service costs also increased with size but the main difference is between small and medium/large practices where costs almost double.

Classification Based on Practice Size (number of patients)	Total Annual Hours		# of Vaccinations		Primary Process Mins		Primary Process Cost		Batch Level Costs	
	GPs	Nurses	STD	MeNZB™	STD	MeNZB™	STD	MeNZB™	STD	MeNZB™
Mean										
Small	2153	2198	463	339	21.9	15.0	$ 11.32	$ 8.08	$ 1,953	$ 1,859
Medium	4543	3666	898	327	22.5	17.8	$ 11.48	$ 9.10	$ 3,806	$ 3,261
Large	11260	11339	1800	792	25.8	19.9	$ 12.80	$ 9.99	$ 3,088	$ 3,699
Median										
Small	2038	1832	285	205	21.4	13.6	$ 9.44	$ 5.75	$ 1,799	$ 1,537
Medium	4763	3664	891	281	28.2	16.5	$ 13.92	$ 8.12	$ 2,393	$ 2,778
Large	9252	9515	1554	746	26.9	18.7	$ 12.81	$ 10.69	$ 2,327	$ 2,731

STD Primary Process T	RC	VP	IC	GV	Do	Ch	Fo	Total
Mean								
Small	2.1	3.9	4.3	5.2	3.5	2.0	0.9	21.9
Medium	2.0	3.0	4.1	3.3	3.0	3.8	3.2	22.5
Large	3.4	3.5	4.8	4.4	4.7	2.7	2.3	25.8
Median								
Small	1.3	2.7	3.9	6.1	3.3	1.0	1.0	21.4
Medium	1.8	2.8	4.2	3.0	3.2	2.5	1.1	28.2
Large	2.4	3.0	4.6	3.2	3.6	1.5	1.7	26.9

Table 11: Classification of key items by practice size

The lower part of Table 11 decomposes the delivery process times into the main activities. The difference of about four minutes between the mean times for small compared to large (21.9 compared to 25.8) appears to be due to differences in times spent on registration checks, documentation and follow-up. Small practices appear to take longer to administer the vaccination than larger practices. This is a trend as sample size is insufficient for rigorous statistical testing.

Hours per practice patient are reported in table one and show considerable variability across practices for both GPs and nurses. Information about ownership type and ethnicity of patients is also provided. Using ordinary least squares regression, we regressed the vaccination costs against the variables representing the different ethnic proportions and the deprivation index but found no statistically significant relationships.

5. Benchmarking Analyses

The immunisation process can be viewed as a production model where the number of vaccinations is the output and the annual delivery process time and batch level costs are the main inputs. Figures 3, 4 and 5 show different views of the practices' performance for standard vaccinations. Note that the annual delivery process time is calculated as the time per vaccination multiplied by the number of vaccinations in a year.

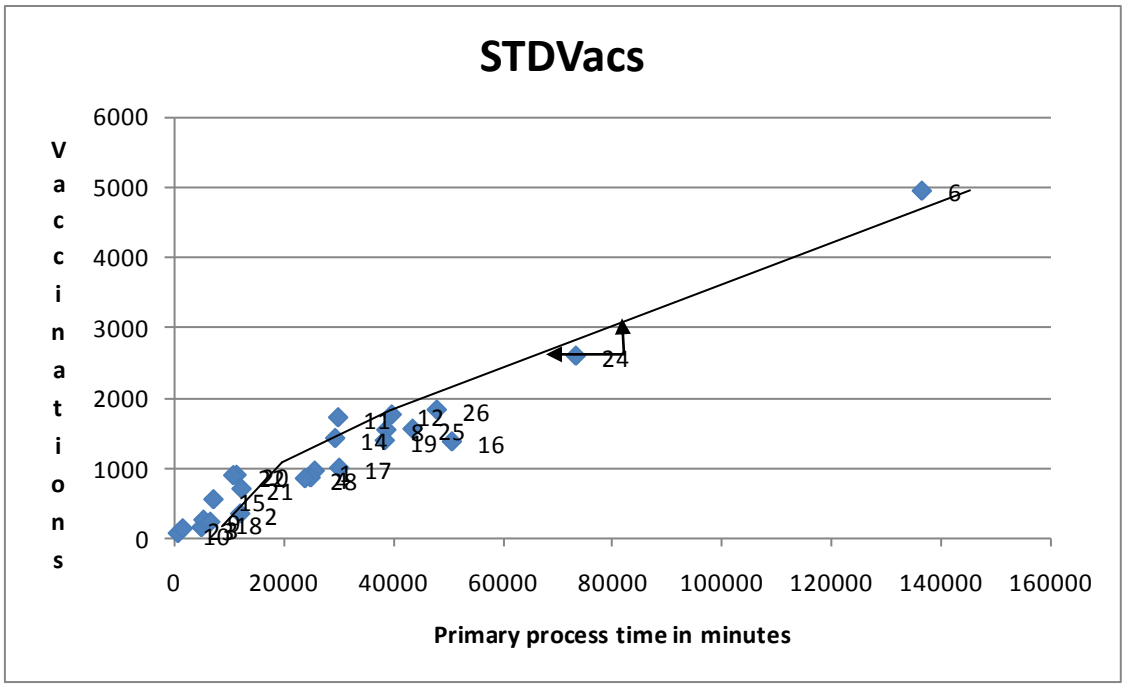

Figure 3: Vaccinations and delivery process time in estimated annual minutes

Figure 3 plots the delivery process time in minutes on the horizontal axis and number of vaccinations in a year on the vertical axis. For example practice 24 did 2596 standard vaccinations over the past year and its total time is estimated as73428 (28.3 minutes from Table 2 multiplied by 2596). The solid line connecting practices 11 and 6 (as well as those practices lying on the line between practice 11 and the origin) depicts a best practice frontier where those practices lying on this frontier produce the most vaccinations for the respective level of delivery process time. Practice 24 lies below this frontier and its performance can be measured either vertically in terms of the additional vaccinations required to reach the frontier (shown by the vertical arrow) or horizontally in terms of the time it needs to reduce to become efficient.

Practice performance can also be evaluated using the other input as shown in figure 4 where the batch level costs are represented on the horizontal axis and number of vaccinations on the vertical axis. Practices 6, 12 and 22 lie on this frontier and again it can be seen that practice 24 can either increase its vaccinations or decrease its batch level costs to become efficient. Note that the vertical distance is greater than the horizontal distance to the frontier (shown by the arrows) and therefore its efficiency score under an output orientation (increasing output while maintaining the same level of input) can be less that its efficiency score under an input orientation (reducing input while maintaining the same level of output). It can also be seen that some practices (e.g. 26) appear to be well out of line with their batch level costs relative to other practices (e.g. 12) with a similar level of vaccinations.

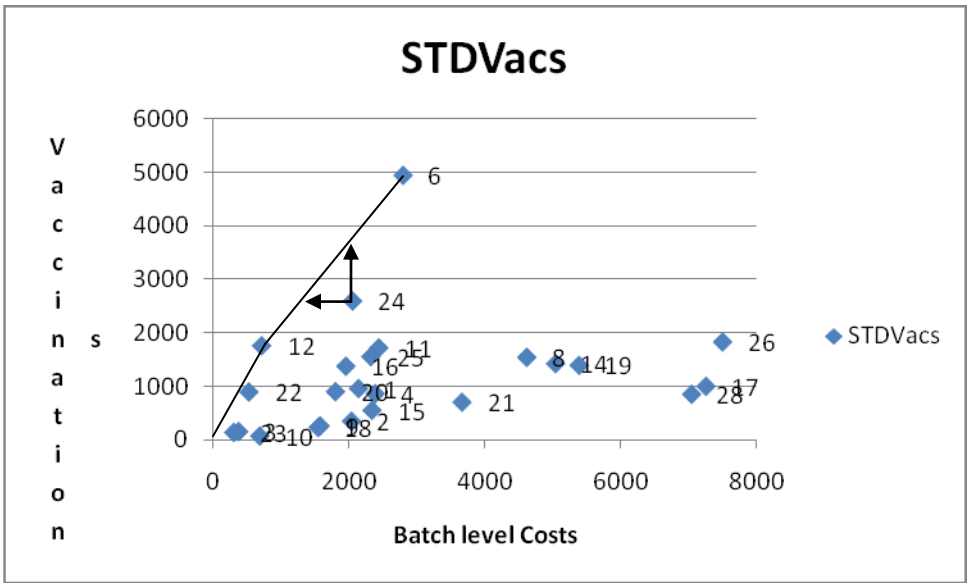

Figure 4: Vaccinations and managing the service costs (batch level costs)

Managing the service costs are represented on the horizontal axis and number of vaccinations on the vertical axis

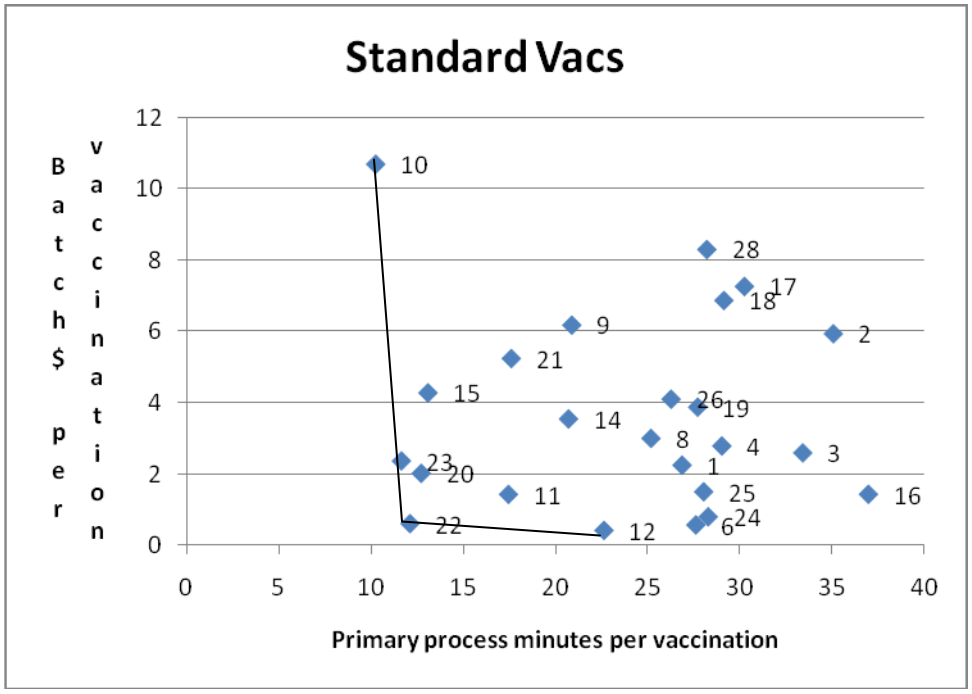

Figure 5: Ratios of primary process minutes and managing the service (batch level $/vaccination)

Finally, Figure 5 shows practice performance combining both inputs in terms of ratios of input to output (i.e. delivery process time per vaccination; batch level costs per vaccination).

The best practice frontier represents the lowest cost per vaccination and practices 10, 23, 22 and 12 lie on this frontier. Obviously it is not always possible or desirable to graph these models and to measure the distances to the frontier. One of the main methods for doing this is called Data Envelopment Analysis (DEA). A general description of DEA is provided in appendix one. It is a mathematical linear optimization method that measures these distances and also provides useful information for benchmarking purposes such as appropriate best practice peer practices for inefficient practices.

Table 12 reports the efficiency scores across the practices. CRS and VRS depict constant and variable returns to scale and represent the effects of size on performance. Under CRS a doubling of input would result in a doubling of output. VRS can be split into increasing or decreasing returns to scale where a doubling of input results in either more than double the output (increasing returns to scale) or less than double the output (decreasing returns to scale).

For example, practice 21 in the first row has an efficiency score of 66% under CRS and 69% or 73% under VRS depending on whether an input or output orientation is adopted. A fuller explanation of what it means to be efficient or inefficient is provided in Appendix one. Practices are grouped by size in Table 12 which reports the mean and median efficiencies by size category. Assuming that size of practice should be considered and taking an input orientation (holding the number of vaccinations constant and measuring how much inputs need to be reduced), the mean and median efficiency scores under the VRS Input column show that small and large practices have higher efficiency than medium size practices.

		STD			MeNZB		
		CRS	VRS		CRS	VRS	
Practice	Size		Input	Output		Input	Output
21	635	66%	69%	73%	54%	60%	78%
3	1193	36%	100%	100%	100%	100%	100%
10	1481	100%	100%	100%	98%	100%	100%
2	1692	34%	34%	36%	39%	43%	44%
15	2298	88%	92%	92%	100%	100%	100%
18	2386	40%	42%	41%	33%	43%	34%
23		100%	100%	100%	56%	91%	65%
8	2963	47%	67%	78%	92%	100%	100%
28	3,402	41%	43%	58%	48%	49%	54%
4	4464	41%	42%	57%	42%	45%	52%
20	4622	93%	96%	98%	57%	99%	87%
17	4700	39%	44%	58%	23%	25%	35%
22		100%	100%	100%	100%	100%	100%
16	5392	39%	49%	60%	31%	31%	52%
9	5393	55%	56%	57%	49%	56%	51%
14	5800	57%	78%	84%	64%	100%	100%
12	7397	100%	100%	100%	51%	74%	58%
1	8347	45%	48%	62%	53%	53%	63%
26	9,711	45%	70%	81%	77%	100%	100%
25	9,777	43%	66%	74%	41%	100%	100%
19	12498	43%	58%	70%	41%	61%	76%
11	13971	69%	100%	100%	57%	67%	80%
24	18,704	63%	85%	88%	34%	63%	80%
6	19000	77%	100%	100%	54%	100%	100%
Mean	small	64%	76%	78%	72%	80%	78%
	medium	54%	56%	68%	43%	55%	57%
	large	61%	76%	81%	54%	75%	80%
Median	small	57%	81%	85%	74%	96%	89%
	medium	70%	72%	79%	62%	63%	68%
	large	56%	74%	83%	52%	71%	80%

Table 12: Table of Data Envelopment Analysis (DEA) efficiency scores for the sample practices

Discussion/Conclusions

New Zealand currently has mediocre immunisation coverage rates, and is failing to meet national targets of 95% fully immunised by the age of 2 years. It is well recognized that a significant contribution to gaining and maintaining high coverage lies with the health system and providers of health systems at the primary care level, and the identification of system barriers has been used to support improvements in immunisation coverage in both Australia and the USA [5, 6].

Previous cost analysis on the cost of delivering the childhood immunisations at the general practice level from 1998 has shown that the cost is not fully covered by the Immunisation Benefit Subsidy. However there is no current research on this issue, in terms of identifying the process of delivering immunisation at the practice level and the full costs of this. This study has been designed to answer that question.

The survey data and analyses provide insights into immunisation delivery as a major service category within general practice. The activity based model and its hierarchy allow distinctions to be drawn between patient level and other organisational support levels. Immunisations follow a natural sequence of activities which have been identified and measured in this report. These have been described as delivery activities and although they are common to every practice providing immunisations, there is considerable variability in times across each activity and across practices.

The activity model provides both transparency and visibility in several ways. First, the hierarchical levels portray a more realistic view of cost behavior that broadens the list of possible cost drivers from simplistic volumes (number of vaccinations) to more complex drivers such as policy and work practices. Second, the model provides a potential 'shared view' of general practice with a structure of common activities and related organisational process requirements. This shared view lends itself to benchmarking and opportunities for practice improvement. Third, the report has developed a 'typical' practice profile with clearly set out assumptions that can not only provide a reference point for establishing an agreed cost estimate, and can be altered with different assumptions eg adding in extra GP time, but also can assist in budgeting and planning needs at practice and sector levels.

While a larger sample size is always preferable, the sample size 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) with a range from the first quartile of 17.6 to 28.5 minutes for the third quartile. This gives us an assessment of how long the immunisation process is routinely taking at the practice level. The longest time commitment is the informed consent process (mean of 4.5 minutes), followed by administering the vaccine (3.5 minutes) and documentation (3.4 minutes). A noteworthy observation is the length of time spent in checking registrations that 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 recognizing small sample size.

Time spent on opportunistic immunisations is considerably lower than expected with only 2% of the total time recorded in daily logs overall being coded as related to opportunistic immunisation activities. It is unclear if this is a limitation of the data collection, or routine general practice is spending a lot less time on opportunistic efforts to improve immunisation collection. This is an important area for further investigation.

Dealing with late immunisations can at times take a disproportionately large amount of time, as show by the considerable range with a mean of 149.8, median of 31 and skewed distribution. This shows that there are times when an individual case can take considerable time and affect the overall times for an individual practice.

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. The practice nurses spent 12 – 15% (a mean of 15% and mean 12%) of their total nursing time on immunisation delivery activities. This provides an indication of the significant time commitment from practice nurses to immunisation within the practice setting. Overall GP time spent on immunisation activities is 0.5% of their time.

The estimated cost for a standard vaccination is between $24.50 (median) and $25.89(mean) with a range from the 1st quartile of $14.38 and the 3rd quartile $32.50. (Note all these figures are GST excl). A significant part of the range in costing here is due to variability of delivery activities with the mean $12 and range for first to third quarter of $7 to $15. Overall however it is clear that from aggregating the data the current Immunisation Benefit Subsidy does not adequately reimburse general practice for the current service delivery of routine immunisations.

A 'Typical Model' has been developed to understand better the costings at the different levels. With the best estimates of the authors based on the data the typical model estimates a cost of a standard vaccination as around $25.67 per vaccination. The greatest variable cost is likely to be the estimate of the GP time commitment to immunisation. The current data is estimating an average of 20 minutes a week, however this may be a significant underestimate as it is based on GP recall and there was considerable range in this. Changing the GP time commitment to 60 minutes a week would shift the cost to almost $30 a vaccination. It could be argued that a higher amount of GP engagement in immunisation is useful to support the immunisation process at the practice level, and hence higher levels of costings to recognize this may be appropriate.

From the Data Envelopment Analysis (DEA) considerable structural inefficiency in these sample practices is highlighted. This type of analysis is presented here as a way of looking at systems and efficiencies. For example it could be used by individual practices to review efficiencies within their systems by using these tables to review where they sit on the line (ie comparing themselves with unidentified other practices) in terms of delivery activities. By doing so they could review how they manage their service costs at the different levels and where they are currently working efficiently in relation to other practices, and where further efficiencies may be made.

This DEA analysis to date shows that for many practices there may be further efficiency gains by considering the following questions regarding immunisation delivery:

1. Why does our practice spend 'x' amount of time in particular aspects of our delivery activities e.g. registration checks, documentation and follow-up.
2. Are we spending too much time in managing the service activities e.g. checking PMS system? And if this is the case what is the inherent underlying issue that is making this time inefficient?

Summary

From these conclusions some clear trends have emerged.

The current level of the Immunisation Benefit Subsidy is considerably lower than the overall estimates of the cost of a standard vaccination event. This is likely to be a significant barrier to increasing focus and effort on immunisation service delivery at the practice level.

Practice Nurses 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. This is a significant proportion of their time and the PN workforce commitment to immunisation delivery is clear from this study.

GPs spend less than 1% of their total time on delivery of the childhood immunisations and hence are likely to be much less engaged in the issues around immunisation service delivery than PNs.

There is considerable variability across practices in efficiencies and opportunities for improvement in resource utilisation associated with immunisation services.

The reasons for why there is such variability particularly in time taken with registrations could be explored further, particularly looking at the challenges with accessing and utilizing NIR data.

The surprisingly low practice time commitment to opportunistic vaccinations needs to be explored further. This may possibly be related to the economic drivers making the extra time commitment not financially feasible.

Conclusions

New Zealand continues to have mediocre immunisation coverage rates. This preliminary data highlights that current funding is unlikely to be adequate remuneration to support service delivery at the practice level. This in turn may be why important activities, particularly the time commitment for opportunistic vaccination appears to be a low priority at the practice level.

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Appendix one:

Cost model for standard immunisations (data from 24 practices)

Practice	1	2	3	4	6	8	9	10	11	12	14
Annual # of Vaccinations	956	344	149	859	4949	1540	256	65	1717	1757	1421
Primary activities cost	$ 12.8	$ 16.7	$ 15.9	$ 15.4	$ 12.8	$ 11.5	$ 10.0	$ 4.7	$ 8.3	$ 10.8	$ 10.3
Consumables		$ 5.4		$ 0.2		$ 0.6		$ 0.8			$ 5.0
Unit level costs	$ 12.8	$ 22.1	$ 15.9	$ 15.6	$ 12.8	$ 12.2	$ 10.0	$ 5.5	$ 8.3	$ 10.8	$ 15.3
Claim & opport cost	$ 283.8	$ 131.0	$ 65.5	$ 280.0	$ 1,414.9	$ 304.4	$ 196.5	$ 146.9	$ 414.8	$ 185.6	$ 171.2
GP time	$ 604.6	$ 428.2	$ 4,408.3	$ 1,847.3				$ 115.5			
Removal		$ 65.5				$ 70.0		$ 84.6			
PPS	$ 1,504.0	$ 51.3				$ 1,125.0		$ 39.1			$ 1,005.0
Other monthly (annualised)	$ 643.5	$ 1,927.4	$ 386.1	$ 2,392.5	$ 2,801.3	$ 3,423.8	$ 1,583.5	$ 572.6	$ 2,445.3	$ 723.6	$ 4,036.2
Batch level (annual cost)	$ 2,147.5	$ 2,044.2	$ 386.1	$ 2,392.5	$ 2,801.3	$ 4,618.8	$ 1,583.5	$ 696.3	$ 2,445.3	$ 723.6	$ 5,041.2
Cold Chain Accreditation	$ 57.2	$ 17.4	$ 18.3	$ 42.5	$ 27.9	$ 1.5		$ 9.2			$ 89.4
Staff training	$ 228.8	$ 717.9	$ 110.0			$ 11.5	$ 66.7	$ 1,036.4			$ 59.6
Initial vaccinator training			$ 55.0		$ 111.5		$ 152.5	$ 192.5			$ 159.0
Vaccinator training update			$ 55.0		$ 27.9	$ 60.5	$ 57.2	$ 27.5			$ 29.8
CPR update	$ 28.6	$ 297.8	$ 13.8	$ 5.5	$ 85.1	$ 46.8	$ 431.2	$ 185.6			$ 44.7
Others								$ 40.3			
Product sustaining level	$ 314.6	$ 1,033.1	$ 252.1	$ 48.0	$ 252.3	$ 120.2	$ 707.7	$ 1,491.5			$ 382.6
Overhead - nurse hrs	$ 4,872.3	$ 4,907.9	$ 584.7	$ 6,923.3	$ 8,957.1	$ 9,040.6	$ 1,535.3	$ 576.7			$ 13,111.3
Overhead - GP hrs	$ 242.3	$ 1,479.1	$ 813.4	$ 635.0			$ 66.9	$ 93.8			
Facility level	$ 5,114.6	$ 6,387.0	$ 1,398.1	$ 7,558.3	$ 8,957.1	$ 9,040.6	$ 1,602.2	$ 670.5			$ 13,111.3
Total costs for # of vaccinations											
Unit level	$ 12,242.0	$ 7,609.0	$ 2,373.4	$ 13,409.4	$ 63,497.9	$ 18,760.8	$ 2,548.4	$ 357.9	$ 14,282.5	$ 18,954.4	$ 21,767.6
Batch level	$ 2,147.5	$ 2,044.2	$ 386.1	$ 2,392.5	$ 2,801.3	$ 4,618.8	$ 1,583.5	$ 696.3	$ 2,445.3	$ 723.6	$ 5,041.2
Product sustaining level	$ 314.6	$ 1,033.1	$ 252.1	$ 48.0	$ 252.3	$ 120.2	$ 707.7	$ 1,491.5			$ 382.6
Facility level	$ 5,114.6	$ 6,387.0	$ 1,398.1	$ 7,558.3	$ 8,957.1	$ 9,040.6	$ 1,602.2	$ 670.5			$ 13,111.3
	$ 19,818.7	$ 17,073.3	$ 4,409.6	$ 23,408.2	$ 75,508.6	$ 32,540.4	$ 6,441.7	$ 3,216.1	$ 16,727.8	$ 19,677.9	$ 40,302.7
Cost per vaccination	$ 20.7	$ 49.6	$ 29.6	$ 27.3	$ 15.3	$ 21.1	$ 25.2	$ 49.5	$ 9.7	$ 11.2	$ 28.4
Unit level	$ 12.8	$ 22.1	$ 15.9	$ 15.6	$ 12.8	$ 12.2	$ 10.0	$ 5.5	$ 8.3	$ 10.8	$ 15.3
Batch level	$ 2.2	$ 5.9	$ 2.6	$ 2.8	$ 0.6	$ 3.0	$ 6.2	$ 10.7	$ 1.4	$ 0.4	$ 3.5
Product sustaining level	$ 0.3	$ 3.0	$ 1.7	$ 0.1	$ 0.1	$ 0.1	$ 2.8	$ 22.9			$ 0.3
Facility level	$ 5.4	$ 18.6	$ 9.4	$ 8.8	$ 1.8	$ 5.9	$ 6.3	$ 10.3			$ 9.2

Practice	15	16	17	18	19	20	21	22	23	24	25	26	28
Annual # of Vaccinations	548	1373	997	226	1389	896	699	891	133	2596	1554	1827	847
Primary activities cost	$ 6.2	$ 18.9	$ 14.7	$ 16.0	$ 13.8	$ 5.9	$ 6.7	$ 6.1	$ 5.5	$ 11.4	$ 12.9	$ 12.5	$ 13.9
Consumables	$ 0.3		$ 0.9		$ 0.5	$ 0.3				$ 0.2	$ 0.6		
Unit level costs	$ 6.5	$ 18.9	$ 15.6	$ 16.0	$ 14.2	$ 6.2	$ 6.7	$ 6.1	$ 5.5	$ 11.6	$ 13.5	$ 12.5	$ 13.9
Claim & opport cost	$ 21.8		$ 1,502.0	$ 642.3	$ 1,638.4	$ 128.5	$ 139.3	$ 506.2	$ 294.7	$ 849.7	$ 1,637.4	$ 469.4	$ 180.8
GP time		$ 1,889.3		$ 1,086.3	$ 5,583.8		$ 1,070.6		$ 543.2	$ 6,650.2	$ 4,155.5		$ 4,534.2
Removal						$ 240.0					$ 150.0		
PPS			$ 675.0		$ 400.0	$ 1,567.5				$ 400.0	$ 768.0		
Other monthly (annualised)	$ 2,345.2	$ 1,960.2	$ 6,576.2	$ 1,554.3	$ 4,987.2		$ 3,667.0	$ 536.5	$ 314.6	$ 1,659.7	$ 1,409.4	$ 7,494.5	$ 7,040.3
Batch level (annual cost)	$ 2,345.2	$ 1,960.2	$ 7,251.2	$ 1,554.3	$ 5,387.2	$ 1,807.5	$ 3,667.0	$ 536.5	$ 314.6	$ 2,059.7	$ 2,327.3	$ 7,494.5	$ 7,040.3
Cold Chain Accreditation	$ 3.2	$ 18.7	$ 29.2	$ 88.0			$ 7.6		$ 186.7		$ 30.2	$ 15.1	$ 79.0
Staff training			$ 192.4	$ 643.5			$ 22.8	$ 241.1		$ 96.8	$ 1,980.0	$ 136.0	
Initial vaccinator training		$ 149.6		$ 44.0			$ 121.6			$ 129.1		$ 145.1	
Vaccinator training update	$ 28.6	$ 87.7	$ 233.2	$ 66.0			$ 102.6	$ 391.8	$ 57.2	$ 24.2	$ 110.0	$ 27.2	$ 29.6
CPR update	$ 28.6	$ 126.2	$ 58.3				$ 364.9	$ 90.4	$ 14.3		$ 330.0	$ 68.0	$ 59.2
Others									$ 12.4				
Product sustaining level	$ 60.4	$ 382.2	$ 513.0	$ 841.5			$ 619.6	$ 723.4	$ 270.6	$ 250.1	$ 2,450.2	$ 391.4	$ 167.8
Overhead - nurse hrs		$ 10,178.3	$ 8,211.0	$ 2,503.9	$ 12,050.7	$ 2,402.6	$ 1,657.3	$ 2,292.6	$ 993.3	$ 7,477.1	$ 12,963.7		$ 12,231.1
Overhead - GP hrs		$ 683.5		$ 489.5	$ 1,597.3		$ 153.6		$ 362.1	$ 799.4	$ 1,737.8		$ 1,962.9
Facility level		$ 10,861.8	$ 8,211.0	$ 2,993.3	$ 13,648.0	$ 2,402.6	$ 1,810.9	$ 2,292.6	$ 1,355.4	$ 8,276.5	$ 14,701.5		$ 14,194.0
Total costs for # of vaccinations													
Unit level	$ 3,579.7	$ 25,966.6	$ 15,519.8	$ 3,622.0	$ 19,792.4	$ 5,565.6	$ 4,677.7	$ 5,420.3	$ 738.1	$ 30,197.8	$ 20,905.2	$ 22,880.4	$ 11,793.1
Batch level	$ 2,345.2	$ 1,960.2	$ 7,251.2	$ 1,554.3	$ 5,387.2	$ 1,807.5	$ 3,667.0	$ 536.5	$ 314.6	$ 2,059.7	$ 2,327.3	$ 7,494.5	$ 7,040.3
Product sustaining level	$ 60.4	$ 382.2	$ 513.0	$ 841.5			$ 619.6	$ 723.4	$ 270.6	$ 250.1	$ 2,450.2	$ 391.4	$ 167.8
Facility level		$ 10,861.8	$ 8,211.0	$ 2,993.3	$ 13,648.0	$ 2,402.6	$ 1,810.9	$ 2,292.6	$ 1,355.4	$ 8,276.5	$ 14,701.5		$ 14,194.0
	$ 5,985.3	$ 39,170.8	$ 31,495.0	$ 9,011.1	$ 38,827.6	$ 9,775.7	$ 10,775.3	$ 8,972.8	$ 2,678.7	$ 40,784.1	$ 40,384.3	$ 30,766.3	$ 33,195.1
Cost per vaccination	$ 10.9	$ 28.5	$ 31.6	$ 39.9	$ 28.0	$ 10.9	$ 15.4	$ 10.1	$ 20.1	$ 15.7	$ 26.0	$ 16.8	$ 39.2
Unit level	$ 15.3	$ 6.5	$ 18.9	$ 15.6	$ 16.0	$ 14.2	$ 6.2	$ 6.7	$ 6.1	$ 5.5	$ 11.6	$ 13.5	$ 13.9
Batch level	$ 3.5	$ 4.3	$ 1.4	$ 7.3	$ 6.9	$ 3.9	$ 2.0	$ 5.2	$ 0.6	$ 2.4	$ 0.8	$ 1.5	$ 8.3
Product sustaining level	$ 0.3	$ 0.1	$ 0.3	$ 0.5	$ 3.7			$ 0.9	$ 0.8	$ 2.0	$ 0.1	$ 1.6	$ 0.2
Facility level	$ 9.2		$ 7.9	$ 8.2	$ 13.2	$ 9.8	$ 2.7	$ 2.6	$ 2.6	$ 10.2	$ 3.2	$ 9.5	$ 16.8

Appendix two:

MeNZB™ immunisation results

	Reg Check Ave Time	Vaccine preparation Ave Time	Informed consent Ave Time	Administer vaccine Ave Time	Document ation Ave Time	Checking Ave Time	Routine Follow-up Ave Time	Primary Activities Total Time Per Vac
1	1.4	2.2	4.9	1.7	4.9	1.0	1.0	17.0
2	4.8	1.5	1.5	3.0	1.7	3.0	2.0	17.5
3	1.5	7.5	5.3	5.3	3.0	2.3	1.5	26.3
4		1.2	2.0	2.1	2.3	9.2		16.7
6	10.6	3.7	4.1	1.9	2.3	1.2	2.3	26.1
8	1.0	1.0	1.5	3.0	1.5	1.0		9.0
9	2.8	2.7	3.0	3.0	2.2	1.5	1.0	16.1
10	1.5	1.0	1.0	1.0	1.5	1.0		7.0
11	1.1	1.5	6.6	1.2	2.6	1.0	1.7	15.7
12	1.5	1.9	4.8	3.3	3.8	1.8	1.8	18.7
14	5.3	1.3	1.9	1.7	1.6	1.1	1.0	13.8
15		1.3	1.5	1.8	1.4	1.0		6.9
16	5.1	3.1	3.0	6.0	4.8	6.3	1.3	29.6
17	1.8	5.2	7.7	5.6	4.6	2.6	2.4	29.8
18	1.6	2.3	8.0	7.5	5.5	1.0		26.0
19	1.0	0.2	3.9	8.4	5.0	2.0	1.5	22.0
20	2.9	7.4	1.5	1.3	1.5	1.0	1.0	16.5
21	3.0	3.0	2.2	3.1	1.6	1.0	1.0	14.9
22	1.0	1.2	1.9	1.3	1.4	1.6	1.0	9.5
23	1.3	1.5	1.5	3.0	3.0	1.0	1.0	12.3
24	3.3	1.9	2.7	2.0	3.6	8.6	4.1	26.1
25	3.4	2.7	3.5	3.1	5.6	1.4	2.5	22.0
26	1.3	2.0	3.5	1.9	1.9	1.1		11.7
28		1.8	1.9	2.4	1.8	1.0	7.5	16.5
Mean	2.7	2.5	3.3	3.1	2.9	2.2	2.0	17.8
Median	1.6	1.9	2.8	2.7	2.3	1.1	1.5	16.6
1st quartinl	1.3	1.3	1.8	1.7	1.6	1.0	1.0	13.4
3rd quartile	3.3	2.8	4.3	3.1	4.0	2.1	2.3	23.0

Table 1: Times of activities collected in daily log MeNZB™ immunisations

Comparing the two types of vaccination, standard vaccines take longer on average across all activities and in total. There is a wider spread across the first and third quartiles for MeNZB™ which is confirmed by a higher coefficient of variation for MeNZB™ (0.56) than standard (0.46).

MeNZB Vaccinations (total time from week logs)

	Admin	Doctor	Man	Nurse	Recep	Grand Total
Appointments	3	13	0	562.5	63.5	642
Vaccine preparation	0	0	0	462.5	0	462.5
Informed consent	0	1.5	0	743	0	744.5
Administer vaccine	0	0	0	629.5	0	629.5
Documentation	0	3.5	0	604	20	627.5
Checking	0	0	0	444.5	1	445.5
Routine Follow-up	0	0	0	244	0	244
Total	3	18	0	3690	84.5	3795.5

	Admin	Doc	Manager	Nurse	Recept	
Appointments	0.5%	2.0%		87.6%	9.9%	100.0%
Vaccine preparation				100.0%		100.0%
Informed consent		0.2%		99.8%		100.0%
Administer vaccine				100.0%		100.0%
Documentation		0.6%		96.3%	3.2%	100.0%
Checking				99.8%	0.2%	100.0%
Routine Follow-up				100.0%		100.0%
Total	0.1%	0.5%		97.2%	2.2%	100.0%

Table 2: MeNZB™ vaccination total times (in minutes) recorded in daily logs by activities and personnel

The cost of MeNZB™ vaccinations has been estimated following a similar process and model to the standard vaccinations. Results are reported in Table 2 – detailed results by practice are provided. A comparison of these costs with the standard vaccination costs in Table 2 reveals a number of differences.

First, unit level costs are higher for standard reflecting the higher number of vaccinations per event and higher times as shown in Figure 1. Second, batch level costs are similar to the standard vaccinations but with more variability at the first and third quartiles. However, these are higher on a unit cost basis given the lower volume of MeNZB™ vaccinations. A similar comment applies to facility level costs.

MENZb	Mean	Median	1st Quartile	3rd Quartile	CV
Annual # of Vaccinations	544.3	429.5	236.8	729.5	0.75
Primary activities cost	$ 8.53	$ 8.12	$ 5.80	$ 10.64	0.40
Consumables	$ 1.39	$ 0.60	$ 0.35	$ 0.97	1.36
Unit level costs	$ 9.17	$ 8.51	$ 5.80	$ 11.95	0.39
Claim & opport cost	$ 368.02	$ 152.82	$ 88.67	$ 355.60	1.20
GP time	$ 1,419.69	$ 604.56	$ 424.15	$ 997.10	1.42
Removal	$ 82.16	$ 84.60	$ 30.00	$ 120.00	0.66
PPS	$ 337.18	$ 375.00	$ 80.00	$ 495.00	0.75
Other monthly (annualised)	$ 1,928.14	$ 1,604.85	$ 972.73	$ 2,531.98	0.75
Batch level (annual cost)	$ 2,994.74	$ 2,474.87	$ 1,175.11	$ 3,792.76	0.80
Cold Chain Accredation					
Staff training					
Initial vaccinator training					
Vaccinator training update					
CPR update					
Others					
Product sustaining level					
Overhead - nurse hrs	$ 2,780.08	$ 1,622.02	$ 1,071.50	$ 3,935.85	0.99
Overhead - GP hrs	$ 590.10	$ 279.90	$ 136.33	$ 555.76	1.45
Facility level	$ 3,090.66	$ 2,584.34	$ 1,111.92	$ 4,274.96	1.06
Total costs:					
Unit level	$ 5,269.35	$ 3,378.46	$ 2,293.58	$ 7,186.54	0.93
Batch level	$ 2,994.74	$ 2,474.87	$ 1,175.11	$ 3,792.76	0.80
Product sustaining level					
Facility level	$ 3,248.24	$ 2,586.51	$ 1,280.58	$ 4,329.42	1.01
Mean Cost per vaccination	***$ 22.30***	***$ 18.33***	***$ 15.56***	***$ 25.54***	0.57
Unit level mean	$ 9.17	$ 8.51	$ 5.80	$ 11.95	0.39
Batch level mean	$ 7.57	$ 5.58	$ 3.57	$ 8.69	0.86
Product sustaining level mean					
Facility level mean	$ 7.41	$ 6.61	$ 4.61	$ 7.79	0.67
Estimated Vaccination Cost	***$ 24.15***	***$ 20.71***	***$ 13.97***	***$ 28.43***	

Table 3. Summarised statistics of GP cost profiles for MeNZB™ vaccinations

COST MODEL	1	2	3	4	6	8	9	10	11	12	14
Annual # of Vaccinations	407	125	657	281	1461	724	178	49	657	319	1016
Primary activities cost	$ 8.13	$ 8.32	$ 12.51	$ 8.85	$ 12.14	$ 4.13	$ 7.68	$ 3.21	$ 7.49	$ 8.90	$ 6.89
Consumables		$ 5.40		$ 0.30		$ 0.64		$ 1.07			$ 5.00
Unit level costs	$ 8.13	$ 13.72	$ 12.51	$ 9.15	$ 12.14	$ 4.77	$ 7.68	$ 4.28	$ 7.49	$ 8.90	$ 11.89
Claim & opport cost	$ 261.98	$ 54.58	$ 65.49	$ 328.73	$ 819.17	$ 115.45	$ 185.57	$ 52.48	$ 371.13	$ 141.90	
GP time	$ 604.56	$ 486.20		$ 923.63			$ 187.00	$ 98.41			
Removal		$ 26.20				$ 30.00		$ 84.60			
PPS		$ 17.10				$ 375.00		$ 39.10			$ 495.00
Other monthly (annualised)	$ 815.10	$ 1,604.85	$ 311.74	$ 2,398.88	$ 2,717.72	$ 2,156.00	$ 1,087.90	$ 539.55	$ 2,359.50	$ 872.30	$ 3,722.30
Batch level (annual cost)	$ 1,681.64	$ 2,188.92	$ 377.23	$ 3,651.24	$ 3,536.89	$ 2,676.45	$ 1,460.47	$ 814.14	$ 2,730.63	$ 1,014.20	$ 4,217.30
Cold Chain Accredation											
Staff training											
Initial vaccinator training											
Vaccinator training update											
CPR update											
Others											
Product sustaining level											
Overhead - nurse hrs	$ 1,622.02	$ 1,605.13	$ 254.19	$ 2,266.85	$ 2,813.53		$ 1,156.12	$ 287.18	$ 4,166.04		
Overhead - GP hrs	$ 242.31	$ 983.56		$ 317.49			$ 80.85	$ 51.86			
Facility level	$ 1,864.33	$ 2,588.69	$ 254.19	$ 2,584.34	$ 2,813.53		$ 1,236.97	$ 339.04	$ 4,166.04		
Total costs:											
Unit level	$ 3,307.05	$ 1,714.73	$ 8,220.71	$ 2,572.49	$ 17,733.04	$ 3,449.86	$ 1,367.45	$ 209.71	$ 4,923.79	$ 2,839.66	$ 12,078.42
Batch level	$ 1,681.64	$ 2,188.92	$ 377.23	$ 3,651.24	$ 3,536.89	$ 2,676.45	$ 1,460.47	$ 814.14	$ 2,730.63	$ 1,014.20	$ 4,217.30
Product sustaining level											
Facility level	$ 1,864.33	$ 2,588.69		$ 2,584.34	$ 2,813.53		$ 1,236.97	$ 339.04	$ 4,166.04		
Cost per vaccination	$ 16.84	$ 51.94	$ 13.09	$ 31.35	$ 16.48	$ 8.46	$ 22.84	$ 27.81	$ 17.99	$ 12.08	$ 16.04
Unit level	$ 8.13	$ 13.72	$ 12.51	$ 9.15	$ 12.14	$ 4.77	$ 7.68	$ 4.28	$ 7.49	$ 8.90	$ 11.89
Batch level	$ 4.13	$ 17.51	$ 0.57	$ 12.99	$ 2.42	$ 3.70	$ 8.20	$ 16.62	$ 4.16	$ 3.18	$ 4.15
Product sustaining level											
Facility level	$ 4.58	$ 20.71		$ 9.20	$ 1.93		$ 6.95	$ 6.92	$ 6.34		

COST MODEL	15	16	17	18	19	20	21	22	23	24	25	26	28
Annual # of Vaccinations	218	452	275	191	850	243	668	505	82	1133	1494	746	332
Primary activities cost	$ 3.28	$ 15.14	$ 14.50	$ 14.28	$ 10.95	$ 7.73	$ 5.67	$ 4.75	$ 5.84	$ 10.54	$ 10.09	$ 5.59	$ 8.12
Consumables	$ 0.27		$ 0.87		$ 0.48	$ 0.39				$ 0.31	$ 0.60		
Unit level costs	$ 3.55	$ 15.14	$ 15.37	$ 14.28	$ 11.43	$ 8.11	$ 5.67	$ 4.75	$ 5.84	$ 10.85	$ 10.69	$ 5.59	$ 8.12
Claim & opport cost	$ 21.83	$ 70.28	$ 1,424.07	$ 340.07	$ 1,228.77	$ 107.06	$ 121.87	$ 276.08	$ 65.49	$ 729.67	$ 1,416.94	$ 152.82	$ 113.02
GP time		$ 874.50		$ 362.11			$ 1,070.58		$ 543.16	$ 6,650.16	$ 3,816.29		
Removal						$ 120.00					$ 150.00		
PPS			$ 338.00		$ 80.00	$ 522.50				$ 400.00	$ 767.95		
Other monthly (annualised)	$ 1,206.92	$ 1,730.03	$ 6,576.24	$ 1,143.45	$ 3,386.42		$ 3,667.04	$ 513.89	$ 274.56	$ 1,073.16	$ 1,402.50	$ 2,122.12	$ 2,665.08
Batch level (annual cost)	$ 1,228.75	$ 2,674.81	$ 8,338.31	$ 1,845.62	$ 4,695.18	$ 749.56	$ 4,859.49	$ 789.97	$ 883.21	$ 8,852.99	$ 7,553.67	$ 2,274.94	$ 2,778.10
Cold Chain Accredation													
Staff training													
Initial vaccinator training													
Vaccinator training update													
CPR update													
Others													
Product sustaining level													
Overhead - nurse hrs	$ 1,411.42		$ 4,619.25	$ 1,341.92	$ 6,654.43	$ 986.87	$ 4,087.39	$ 473.39	$ 306.12	$ 11,494.97	$ 3,784.31	$ 3,490.39	
Overhead - GP hrs				$ 120.57			$ 424.35		$ 183.63	$ 2,896.86	$ 599.57		
Facility level	$ 1,411.42		$ 4,619.25	$ 1,462.48	$ 6,654.43	$ 986.87	$ 4,511.73	$ 473.39	$ 489.75	$ 14,391.83	$ 4,383.88	$ 3,490.39	
Total costs:													
Unit level	$ 773.65	$ 6,841.81	$ 4,225.89	$ 2,726.92	$ 9,714.28	$ 1,971.65	$ 3,787.86	$ 2,400.88	$ 478.81	$ 12,294.09	$ 15,963.53	$ 4,170.81	$ 2,697.33
Batch level	$ 1,228.75	$ 2,674.81	$ 8,338.31	$ 1,845.62	$ 4,695.18	$ 749.56	$ 4,859.49	$ 789.97	$ 883.21	$ 8,852.99	$ 7,553.67	$ 2,274.94	$ 2,778.10
Product sustaining level													
Facility level	$ 1,411.42		$ 4,619.25	$ 1,462.48	$ 6,654.43	$ 986.87	$ 4,511.73	$ 473.39	$ 489.75	$ 14,391.83	$ 4,383.88	$ 3,490.39	
Cost per vaccination	$ 15.66	$ 21.05	$ 62.49	$ 31.60	$ 24.78	$ 15.26	$ 19.70	$ 7.26	$ 22.58	$ 31.37	$ 18.68	$ 13.32	$ 16.49
Unit level	$ 3.55	$ 15.14	$ 15.37	$ 14.28	$ 11.43	$ 8.11	$ 5.67	$ 4.75	$ 5.84	$ 10.85	$ 10.69	$ 5.59	$ 8.12
Batch level	$ 5.64	$ 5.92	$ 30.32	$ 9.66	$ 5.52	$ 3.08	$ 7.27	$ 1.56	$ 10.77	$ 7.81	$ 5.06	$ 3.05	$ 8.37
Product sustaining level													
Facility level	$ 6.47		$ 16.80	$ 7.66	$ 7.83	$ 4.06	$ 6.75	$ 0.94	$ 5.97	$ 12.70	$ 2.93	$ 4.68	

Table 4: Cost model for MeNZB™ (data from 12 practices)

Appendix three:

A General Introduction to Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA) is a method of performance or productivity measurement that provides efficiency scores, target values and best-in-class peers for benchmarking. Since 1978 DEA has been used worldwide in public and private sector applications. Common applications include hospitals, schools, airlines and transport to name but a few. The NZ health sector has used DEA since 1997 at a macro level and also at a micro level in Nelson Marlborough to measure nursing productivity in the early to mid 1990's.

The core of DEA is a production process that consumes inputs (X) to produce outputs (Y) as shown in Figure 1.

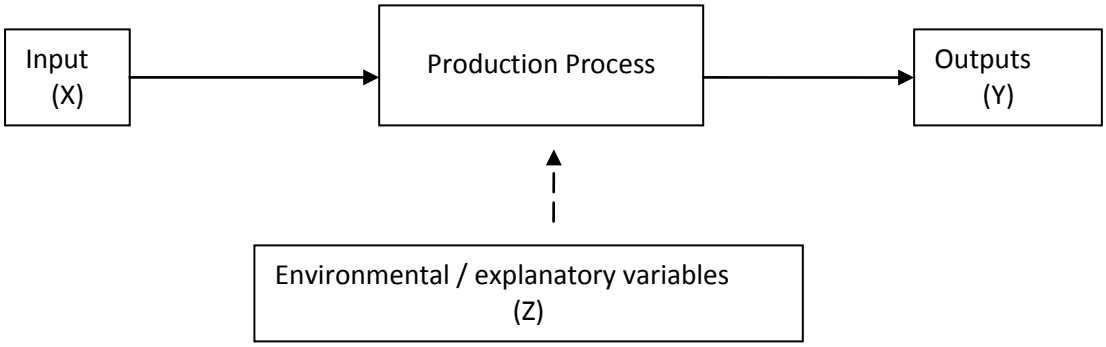

Figure 1: The production process consuming inputs to produce outputs

Performance is measured in terms of decision making units (called a DMU e.g. a hospital, ward, department) and how much output a DMU can produce relative to input consumed. Not all DMUs face the same level playing field and performance may be affected by environmental or explanatory factors (Z's).

Figure 2 graphs six DMUs producing a single output (vertical axis) using a single input (horizontal axis). Rationally we expect higher levels of output to be produced with higher levels of input consumed and we can see an upwards drift in the DMU input-output combinations as input increases. Consider DMU D which consumes the same level of input as DMU C but produces a lower level of output. D is said to be *dominated* by C and is designated inefficient, with the amount of inefficiency shown by the vertical arrow from D to C.

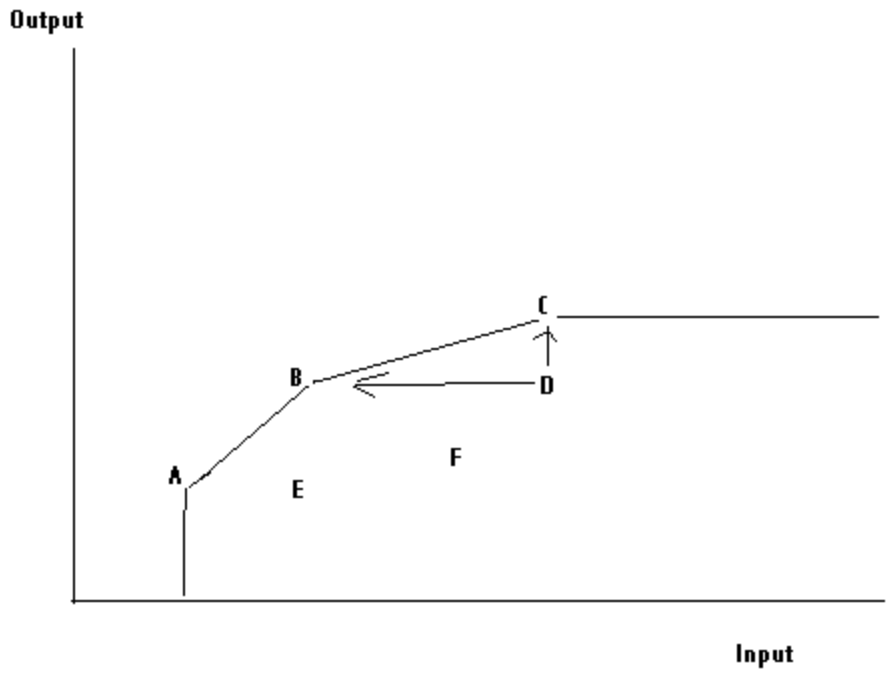

Figure 2: Single input-output process

Notice that this is an *output orientation* as inefficiency is measured in terms of the additional output required by D given its current level of input. Alternatively B produces the same level of output as D but does so using less input. The horizontal arrow from D to B shows the amount of inefficiency on an *input orientation*. It should be clear from Figure 2 and DMU D that inefficiency can be different between an input and output orientation. We can identify an efficiency frontier of non-dominated DMUs being A, B and C that produce either maximum output for their respective level of input, or use minimum input for their respective level of output.

As an extension to this, Figure 3 shows a graph of two outputs produced using a single input. The horizontal axis shows the ratio of output1 to input and the vertical axis shows the ratio of output2 to input. There are eight DMUs in our example. The efficiency frontier consists of those DMUs (1 through 5) that produce combinations of maximum outputs to input and are non-dominated by any other DMU. In contrast, DMUs 6, 7 and 8 lie below this frontier and are said to be dominated by the other five DMUs or combinations thereof.

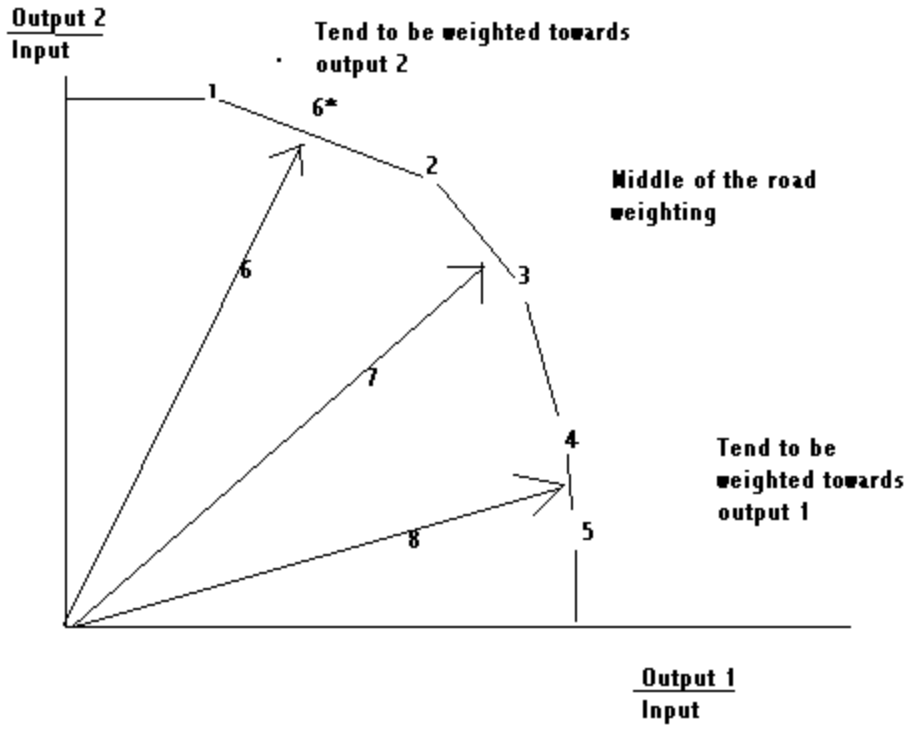

Figure 3: Two outputs and single input process

For example, DMU6 is dominated by DMUs 1 and 2 and its inefficiency is measured by the distance to the frontier along the line emanating from the origin to its point of intersection with the line segment connecting 1 and 2 ie., at point 6*. Looking at unit 6, it appears to lie approximately three-quarters of the distance along this line from the origin. Four key points to note:

1. DMU6's efficiency score is determined by its relative distance to the frontier, approximately 75%;
2. The projected point where the line from the origin passing through 6 intersects the frontier (6*) provides the targets for DMU6 to become efficient
3. The projection to the frontier preserves DMU6's production mix of output 1 to output 2 e.g. DMU6 tends to focus on Output2 over Output1 as do DMUs 1 and 2
4. The most appropriate peer DMUs for 6 are DMUs 1 and 2 for benchmarking purposes

In summary, DEA answers the following questions:

- How well are we doing (efficiency scores)?
- What do we have to do to improve (target values)?
- Who are our best-in-class peers for benchmarking (peer DMUs)?

Additionally, in the main body of the report, scenarios of constant returns to scale (CRS) and variable returns to scale (VRS) were also generated. CRS assumes that changes in input and output are evenly matched so that a 10% increase in input should be exactly matched by a 10% increase in output. VRS relaxes this assumption and allows for diseconomies associated with being either 'small' or 'large'.

Smallness is associated with increasing returns to scale where a 10% increase in input is matched with a greater than 10% increase in output. Largeness is associated with decreasing returns to scale where a 10% increase in input is matched with a less than 10% increase in output.

DEA constructs a frontier of best performing units that are not dominated by others. Since DEA can incorporate multiple inputs and outputs measured in different dimensions, weights are needed to calculate performance scores. In DEA the weights are the unknown variables that are solved by the model. The model searches for a set of weights that will both maximise the efficiency score for each individual unit and not cause any other unit's score to exceed the top score of 100%. Consequently each unit can have different weights in its solution. Units that are dominated by other units are designated inefficient and their scores are calculated in terms of their distance to the frontier.

What does it mean to be efficient in DEA?

In terms of economic theory, the efficiency of production can be determined by three different measures, which have different management implications for the organisation. DEA can also provide each of these three measures, as follows:

- Technical efficiency measures the efficiency of the production of physical quantities of outputs and inputs without requiring or specifically focusing on prices. In these analyses where the single input is expenditure, the efficiency scores measure technical efficiency since there is no indication of the optimal mix of outputs and it should be apparent there is no optimal mix of the single input. For an input orientation, the model could be referred to as a cost minimisation model
- Allocative efficiency incorporates prices and costs of outputs and inputs. This enables the optimal mix of inputs and outputs to be identified. Note that it is possible to be technically efficient but allocatively inefficient. The imposition of weight constraints indicates a move from technical to allocative efficiency where the full move is obtained when prices and quantities are included in the analysis
- Scale efficiency incorporates size into the analysis and measures whether a unit is operating at the optimal productive size (constant returns to scale) or is too big or too small. Scale diseconomies associated with the latter two effects are called decreasing or increasing returns to scale.

Further, for each of the above, DEA can also produce two 'meanings'; that is:

- Output orientation, where the DEA focus is on maximising outputs for a given set of inputs

Input Orientation, where the DEA is focused on minimising inputs for a given set of outputs.

Each of the above, therefore, may be particularly relevant to a practice given its local circumstances (e.g. whether the DHB is over-funded, etc).

Thus, under DEA technical efficiency, a practice that is 'efficient' is an organisation that is, either:

- producing as much output as can be observed, given:
  - its level of inputs
  - its production mix of outputs
  - its current technology
  - and the relative production of the other units in the sample

(Note that this may not be the absolute amount of outputs that can be produced if it changed its technology or other units or time periods were added to the sample)

- using the lowest level of inputs that can be observed, given:
- its level of outputs,
- its production mix of outputs,
- its current technology
- and the relative production of the other units in the sample

(Note that this may not be the absolute minimum level of inputs to produce this level of outputs if it changed its technology or other units or time periods were added to the sample)

In summary, DEA technical efficiency is a *relative measure* based on *observed production* using *current technology* and the measures and units included in the sample set.

What does it mean to be inefficient?

A unit that is technically inefficient is dominated by other units or combinations thereof that produce either more outputs for the same level of inputs, or produce the same level of outputs but use lower amounts of inputs. DEA measures efficiency by calculating weights to be assigned to each output and input. It searches for the best weights for an inefficient unit that will give it the highest possible efficiency score given the data set and technology. The technical efficiency (or inefficiency) is measured in terms of the distance from an inefficient unit to a projected point on the frontier that preserves its production mix.

What does it mean to be a peer?

A peer unit is by definition technically efficient and consequently on the efficient frontier. In addition, a peer unit has other units, which it dominates that have similar production mixes. This similarity in production mix makes the peer unit a good benchmark for these inefficient units in the absence of any other external value criteria. Note that it is possible for an efficient unit not to have any inefficient units for which it is a peer. This usually happens where its production mix is very different from the rest of the sample group or where the sample group is very small.

DEA provides information on the relative importance of a peer unit for an inefficient unit. For example, inefficient unit C might have two peer units A and B. The DEA results might assign 80% to unit A's relative importance and 20% to unit B's. This means that A has a closer production mix to C's than B although the latter still has some but more limited similarity. In general, the variable returns to scale model provides better peer units for inefficient units as it takes size into consideration.

Benchmarking and performance improvement.

In addition to the efficiency scores, DEA provides a substantial amount of information potentially useful for benchmarking and performance improvement. Ten useful features of DEA are:

1. It provides answers to questions concerning how well are we doing, what do we need to do to improve and who are our best-in-class peers for benchmarking.
2. It can incorporate differences in size and measure the effect of scale diseconomies.
3. It provides information on best-in-class performers and identifies which of these is most appropriate for inefficient units.
4. It provides information on the optimal weights for each unit which also provide insights into strategic strengths and weaknesses.
5. It does not require statistical assumptions such as normality and does not impose a rigid functional form across all units e.g. a uniform set of weights.
6. Since the model selects weights that maximise a unit's efficiency score, it represents a bottom up approach as opposed to a top down.
7. If restrictions are required on weight flexibility, these can be incorporated relatively easily.
8. The single efficiency score provided can be used for further analysis to investigate potential performance influences e.g. location, type of service, population mix.
9. If data over time is available, DEA can decompose performance into changes in efficiency and changes due to technological change (i.e. a shift in the frontier).
10. Price and cost data are not required but can be used if available.

Appendix four:

Questionnaires used in Practices

1. Financial and Total Daily Time Questionnaire (FTPTQ)
2. Daily Log
3. Monthly Questionnaire

Financial and Total Practice Time Questionnaire

Immunisation questionnaire aim:

1. To assess total practice time in FTEs by all staff and hourly rates.
2. To assess how much time the GP's spend on discussing childhood immunisations with patients and or delivering vaccine.
3. To find your typical annual accounts in relation to your practice and specific to immunisation.
4. To find out how many immunisation events your practice does per year, childhood immunisation means all the universal immunisations scheduled for children under 5 years e.g. excl influenza, high risk pneumococcal and varicella
5. To find out how many MeNZB immunisations have been done in children under 5 years in your practice in a year

1. Total operating hours worked by all staff in your practice as full time equivalents		**1A) How many FTE's in your practice?**	**1B) What hours does each individual work in an average week?**
Please fill in 1A & 1B for each staff member so that we can work out your total practice time.	➢ General Practitioners	***1.*** ***2.*** ***3.*** ***4.*** ***5.***	***1.*** ***2.*** ***3.*** ***4.*** ***5.***
	➢ Practice Managers	***1.*** ***2.*** ***3.*** ***4.*** ***5.***	***1.*** ***2.*** ***3.*** ***4.*** ***5.***
	➢ Administrators	***1.*** ***2.*** ***3.*** ***4.*** ***5.***	***1.*** ***2.*** ***3.*** ***4.*** ***5.***
	➢ Practice Nurses	***1.*** ***2.*** ***3.*** ***4.*** ***5.***	***1.*** ***2.*** ***3.*** ***4.*** ***5.***
	➢ Receptionists	***1.*** ***2.*** ***3.*** ***4.*** ***5.***	***1.*** ***2.*** ***3.*** ***4.*** ***5.***

1. Pay rates for staff in your practice Please indicate an average please (gross) for each member of staff involved in immunisation tasks		2A) What is the average paid hourly rate or estimate the proportion of weekly payroll for each listed below
Please fill in 2A for each practice member	➢ General Practitioners	*1.* *2.* *3.* *4.* *5.*
	➢ Practice Managers	*1.* *2.* *3.* *4.* *5.*
	➢ Administrators	*1.* *2.* *3.* *4.* *5.*
	➢ Practice Nurses	*1.* *2.* *3.* *4.* *5.*
	➢ Receptionists	*1.* *2.* *3.* *4.* *5.*

3) How many minutes would each GP discuss and or deliver immunisation in an average week?		*(if unsure GP may fill in a daily log for 5 days to accurately assess)*	
		I) Standard Immunisation	II) MeNZB Immunisation
Please fill in for each GP so that we can work out the total time spent by GPs on childhood immunisation	General Practitioner 1		
	General Practitioner 2		
	General Practitioner 3		
	General Practitioner 4		
	General Practitioner 5		

In this section we are trying to get an accurate number of immunisations done in your practice in the last 12 months from your practice management system.

1. How many immunisations has your practice done over past 12 months (1 Dec 2006 – 30 November 2007) for children 5 years and under excluding influenza, MeNZB, high risk Pneumococcal, travel vaccines	
2. How many MeNZB immunisations has your practice done over the past 12 months (1 Dec 2006 – 30 November 2007) for children 5 years and under	
3. What percentage of your capitation formula is for the Practice Nurse?	
4. Will your YTD accounts (1 April – 30 Nov 2007) be a good estimator of your annual accounts for year ended 31 March 2008?	◇ Yes, *Please fill in the accounts below for your practice year to date from (1 April 2007- 30 Nov 2007)* ***GO TO 8*** ◇ No, *Please provide your last years financial accounts below(1 April 06 -31 March 07)* ***GO TO 8***

1. **A typical years annual accounts for apportioning cost to immunisation (GST excl)** *(if you have any questions please contact Stacey/Denise)*	*Please fill in the accounts below for your practice year to date from 1 April 2007- 30 Nov 2007*

Total assets after depreciation	**$**	**Others - CONTD.**	**$**	**Expenses - CONTD.**	**$**
Please list or give us a total		Bad debts written off		Training	
Total	**$**	Locum fees		Wages (including PAYE)	
		Expenses	**$**	**Cleaning**	**$**
		Accident Compensation Levy		Waste Removal (excl sharps)	
				Sharps	
	$	Accounting and Legal Fees		Debt Recovery	
		Advertising		General Expenses	
		Bank Charges		Insurance	
	$	Rates (if applicable)		Light Power, Heating and Water	
		Rent/lease (or imputed)		**Depreciation**	**$**
		Repairs and Maintenance		Plant and Equipment	
Others	**$**	Telephone, Tolls and Internet		Computer Software and Equip	
Interest		Subscriptions and Levies		Office Equipment	
		Relief Staff		Others (give more lines)	

Printing and Stationery	**$**	**% Used in Immunisation**	**Sharps removal**	**$**	**% Used in Immunisation**
Includes general appoint postage, print and envelopes			Sharps removal		

2. **CONSUMABLES SPECIFIC TO IMMUNISATION**	**Cost Per Unit $**		**Cost Per Unit $**
Consumables (cost/unit please)		Plasters	
Needles		Misc (please list)	
Syringes		Distractions e.g. lollies/balloons	

Daily Log: Task definitions and Log example

Date:
Name:
Practice:

Immunisation Log Aim & Instructions:

1. To find out the time taken to complete the routine immunisation activities.
2. To find out who carries out the different immunisation tasks.
3. Please indicate for each task 1-8 how long it takes you and who does each task
4. One log sheet to be complete for each day of research project by each staff member involved (5 in total)
5. Interruptions and events log: patient if interrupted events vs. imms spares in for all days

Please tick the appropriate box to indicate your position

☐ ***Nurse*** ☐ ***Doctor*** ☐ ***Manager*** ☐ ***Receptionist***

Tasks Definitions

Task 1: Check fridge record daily temp,

1. Appointment	2. Routine Follow – up (if this occurs in your practice)
Checking registration and NIR status	Includes phone call/ contact with parent initiated by parent or practice
3. Informed Consent	**4. Dealing with opportunistic immunisations**
Discussion around vaccines and diseases being protected against, side effects, parental concerns	Checking immunisation status of child, discussing options with parent, organising vaccines to administer
5. Vaccine preparation	**6. Claiming from HBL**
Preparing/checking an drawing up vaccine	Includes IBS claims and any GMS related specifically to GMS
7. Administer Vaccine	**8. Checking Child post vaccination**
Including preparation of child, supporting family members, distraction techniques, giving vaccine, wait time between concurrent vaccines, tidying up, disposing of sharps, checking if parent has prescription of paracetamol, obtaining prescription	
	9. Documentation
	Enter PMS Clinical notes, and all immunisation documentation Well child book documentation

vent	Appointment		Routine Follow up		Informed Consent		Dealing with Opportunistic Immunisations	
	Standard	MeNZB	Standard	MeNZB	Standard	MeNZB	Standard	MeNZB
1	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others please specify	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐
2	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐
3	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐
4	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐
5	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐	☐ < 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min ☐ Others: ☐

Monthly Events Questionnaire

Immunisation questionnaire monthly events aim:
1. To find out the time taken to complete the immunisation activities that do not occur every week
2. To find out who carries out the different immunisation tasks
3. Please fill in one questionnaire per staff member involved in these activities

Please tick the appropriate box to indicate your position

☐ ***Nurse*** ☐ ***Doctor*** ☐ ***Practice Manager*** ☐ ***Receptionist***

Section One

Please tick all that apply	**I) Frequency of Tasks**		**II) Estimate time allocated for each time task undertaken**	
	Please specify how many times a month you do this task		Please tick the appropriate box to indicate how long it takes to execute each of the tasks listed	
1. Vaccines Ordering *Manual Ordering & Stock Related Tasks*	**A. Standard**	**B. MeNZB**	**A. Standard**	**B. MeNZB**
Filling in Fax Form: checking stock and PMS, dealing with vaccine delivery, stacking fridge, recording monthly fridge temp logging			☐ 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min **Others, Please Specify** ☐ **min**	☐ 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min **Others, Please Specify** ☐ **min**
2. Generating routine immunisation appointments Generating routine appointments for everyone, precall reminders			☐ 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min **Others, Please Specify** ☐ **min**	☐ 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min **Others, Please Specify** ☐ **min**

➢ Letter ☐ ➢ E-mail ☐ ➢ Phone call ☐ ➢ SMS/txt ☐ ➢ Others ☐				

Please tick all that apply	I) Frequency of Tasks		II) Time Allocated for each time task undertaken	
	Please specify how many times a month you do this task		Please tick the appropriate box to indicate how long it takes to execute each of the tasks listed	
If appropriate to Practice **1. Generating pre appointment reminders**	**A. Standard**	**B. MeNZB**	**A. Standard**	**B. MeNZB**
Making pre appointment reminder calls, discussions with parents and making / or rescheduling appointments			☐ 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min **Others, Please Specify** ☐ **min**	☐ 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min **Others, Please Specify** ☐ **min**
2. *Dealing with late immunisations*				
Including recall for overdue list, checking immunisation status of child, discussing options with parent, organising vaccines to administer			☐ 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min **Others, Please Specify** ☐ **min**	☐ 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min **Others, Please Specify** ☐ **min**
Check PMS system; generate more follow-up depending on immunisation status			☐ 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min **Others, Please Specify** ☐ **min**	☐ 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min **Others, Please Specify** ☐ **min**

Organising an outreach service referral			☐ 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min **Others, Please Specify** ☐ **min**	☐ 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min **Others, Please Specify** ☐ **min**

Please tick all that apply	**I) Frequency of Tasks**		**II) Time Allocated for each time task undertaken**	
	Please specify how many times a month you do this task		Please tick the appropriate box to indicate how long it takes to execute each of the tasks listed	
1. *Dealing with Adverse Events*	**A. Standard**	**B. MeNZB**	**A. Standard**	**B. MeNZB**
Includes full communication with family, care and follow-up, notification of CARM			☐ 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min **Others, Please Specify** ☐ **min**	☐ 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min **Others, Please Specify** ☐ **min**
2. *Audit procedures for PHO quality plans*			☐ 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min **Others, Please Specify** ☐ **min**	☐ 1 min ☐ 1-2 min ☐ 1 ≤ 3 min ☐ 5 ≤ 10 min ☐ 10 ≤ 20 min **Others, Please Specify** ☐ **min**

End of Section One

Section

Extra events over a year		How many times a year do you do this task?	Time Allocated for each time task undertaken please specify in minutes
		I) Frequency of Tasks	**II) Time Allocated for each time task undertaken**
1. Cold chain accreditation			
2. Staff training requirements	***A) Please list activities below:***		
3. Initial vaccinator training course			
4. Vaccinator training update e.g. PMS training			
5. CPR update			
6. Others not listed e.g. translation services			

End of Questionnaire
Thank You