Effective general practice: audit and feedback for the primary series of immunisations

Gary Reynolds BSc(Hons), MBChB, PhD, FRNZCGP;[1,2] **Mareta Timo** RGON, PGCert;[2] **Anjileena Dev** BSc;[1] **Tracey Poole** MRSNZ;[1] **Nikki Turner** MBChB, Dip Obs, DCH, FRNZCGP, MPH(Hons)[1]

[1] Immunisation Advisory Centre, Conectus Centre, The University of Auckland, Auckland, New Zealand

[2] Pasifika Horizon Healthcare, 297 Blockhouse Bay Road, Auckland, New Zealand

ABSTRACT

INTRODUCTION: General practice immunisation audits do not always match the national rates recorded on the New Zealand (NZ) National Immunisation Register (NIR).

AIM: To complete audits at one general practice for infants requiring the primary series of immunisations (6-week, 3-month and 5-month vaccines) over a 12-month period and compare findings with the NIR audit.

METHODS: A manual and electronic practice management system (PMS) audit were compared with identical NIR audit parameters for completion of the 5-month vaccination from 1 February 2011 to 1 February 2012. All three results were then combined with further sub-audits of the total practice newborn population to produce a multifaceted audit, identifying further eligible patients. The NIR database query tool was used to corroborate data on partially immunised and unimmunised patients identified.

RESULTS: All three initial audits produced different results for vaccinated and eligible patients: NIR 31/36; PMS audit 39/43; manual audit 41/48. The multifaceted audit identified 48 eligible infants. All 48 (100%) started their primary series—95.8% (46 of 48) fully immunised; 4.2% (2 of 48) partially immunised, missing only one injection. None were unimmunised, contrary to initial audits. Lower levels of timeliness of delivery were confirmed for this practice, with 52.1% (25 of 48) immunised on time.

DISCUSSION: Results show 9.7% higher levels of immunisation than reported by NIR statistics for this practice (95.8% vs 86.1%), above current NZ government and World Health Organization targets. The multifaceted audit produced the best estimate of eligible patients and identified deficiencies in vaccine delivery.

KEYWORDS: Children; general practice; immunisation schedule; medical audit; New Zealand

J PRIM HEALTH CARE 2014;6(1):40–48.

CORRESPONDENCE TO:
Gary Reynolds
Immunisation Advisory Centre, Conectus Centre, The University of Auckland, PB 92019, Auckland, New Zealand
dr@tfmc.co.nz

Introduction

Immunisation is a highly cost-effective and preventive approach to health care and compares favourably to treatment for acute and chronic disease. Immunisation has saved more lives than any other public health intervention, apart from clean water supplies.[1] Sustained high immunisation rates have been shown to control and potentially eradicate vaccine-preventable diseases. Mass vaccination with high uptake has helped to completely eradicate smallpox, which at its height killed every seventh child in Europe.[2] Immunisation has almost completely eradicated polio.[3] *Haemophilus influenzae*, which previously was the most common cause of bacterial meningitis in children under five years, has decreased in the US by 99% as a result of the Hib vaccine[4] and is now rare in NZ. High uptake with vaccines, such as the pneumococcal vaccine, has reduced disease burden, producing a protective 'herd effect' on the population.[5]

Currently, New Zealand (NZ) has just over 90% of children fully immunised by the age of two years, but lower rates for timeliness of delivery.[6]

The introduction of new government targets of a 95% immunisation rate by age eight months adds momentum to the focus on timeliness as well as coverage of delivery.[7] Almost all children in NZ receive their vaccinations in general practice. International and NZ researchers have demonstrated that there is wide variability between practice behaviour and that this is strongly associated with immunisation coverage and timeliness of delivery.[8] Focusing particularly on practice systems is an effective way to improve coverage and timeliness.[9–11]

The development of an effective audit and feedback tool allows for quality improvements at the practice level.[12] Audit refers to the collection of data regarding clinical performance, in this case immunisation events. Feedback refers to the presentation of such data to the practice, with or without recommendations. International studies suggest that audit and feedback may be an effective strategy for improving immunisation rates.[13] A systematic review, including 12 of 15 studies that met eligibility criteria, found that audit and feedback alone, or in combination with other interventions, was associated with improvements in immunisation rates.[14]

At birth, every child in NZ is entered on the National Immunisation Register (NIR), which was developed to record all immunisation events. When a vaccinator gives a vaccine, it is entered into their electronic patient management system and transferred directly to the NIR. Earlier research noted a discrepancy between NIR numbers eligible for immunisation and the actual numbers of children immunised in many general practices.[15]

This study addresses the need to improve childhood immunisation coverage and timeliness in NZ by focusing on data measurements at the general practice level. Since there is wide variation in vaccine delivery, this audit was undertaken in a single general practice across the primary series of immunisations (6-week, 3-month and 5-month vaccines) to establish audit 'rules'. The study begins by determining the accuracy of current auditing systems and attempts to establish a rigorous audit, which can identify deficiencies in vaccine delivery for feedback to the practice.

WHAT GAP THIS FILLS

What we already know: There is considerable variation in general practice immunisation service delivery. Difficulty counting immunisation events accurately leads to discrepancy in the New Zealand National Immunisation Register and general practice databases.

What this study adds: This study analyses different audit methods in one general practice for the primary series across a 12-month period, using parameters equivalent to the National Immunisation Register audit. An audit tool was developed that produced the best estimate of vaccinated (numerator) and eligible patients (denominator). The audit tool identified deficiencies in service delivery.

Methods

Setting

Pasifika Horizon Healthcare is a general practice in the inner western suburbs of Auckland, NZ with 1640 enrolled patients at the time of the study. The practice caters to the health needs of a rapidly enlarging Pacific community in West Auckland. The practice has high rates of immunisation, but lower rates of timeliness, consistent with other Pasifika general practices.[16] According to the NIR report for this practice, it has 94% coverage by the two-year immunisation milestone, with 76% completing the primary series of immunisations by the six-months' milestone (Figure 1). The practice is fully computerised and uses the practice management system (PMS) Medtech32.

Dataset

The dataset included all infants enrolled (registered) at this practice requiring the primary series of 6-week, 3-month and 5-month immunisations according to the NZ immunisation schedule, within the 12-month period 1 February 2011 to 1 February 2012. The standard query tool in the NIR database was used to corroborate data on patients identified as partially immunised or unimmunised.

Inclusion criteria

All enrolled patients due to complete or who had completed their 5-month immunisation as part of

Figure 1. The working paper of the NIR report on which the NIR data were based*

National Immunisation Register

NIR: Recording immunisation history

NIR BC CI Overview - Milestone Ages PHO/Clinic (Final Dose excluding PCV)

Annual

Immunisation coverage by ethnicity and immunisation coverage by level of deprivation for individuals who have reached the milestone age (6 months, 12 months, 18 months, 24 months, 5 years, 12 years) and who have fully completed their age appropriate immunisations – for the 12 month period 01/02/2011 - 01/02/2012.

MINISTRY OF HEALTH
MANATŪ HAUORA

Report Run Date: 23-Feb-2012

N / D = %

Procare Networks Limited - Pacific Horizon Healthcare

Milestone Age	Total			NZE			Maori			Pacific			Asian			Other			Opt Off		Declined	
	No. Eligible	Fully Immunised for Age	%	No. Eligible	Fully Immunised for Age	%	No. Eligible	Fully Immunised for Age	%	No. Eligible	Fully Immunised for Age	%	No. Eligible	Fully Immunised for Age	%	No. Eligible	Fully Immunised for Age	%	Actual (Provisional)	%	Total	%
6 Month	41	31	76 %	3	3	100 %	9	5	56 %	22	16	73 %	6	6	100 %	1	1	100 %	0 (0)	0.0 (0.0) %	0	0 %
12 Month	36	31	86 %	1	1	100 %	7	3	43 %	25	24	96 %	3	3	100 %	0	0	-	0 (0)	0.0 (0.0) %	0	0 %
18 Month	21	16	76 %	0	0	-	5	4	80 %	13	11	85 %	2	1	50 %	1	0	-	0 (0)	0.0 (0.0) %	0	0 %
24 Month	18	17	94 %	0	0	-	4	4	100 %	11	11	100 %	2	2	100 %	1	0	-	0 (0)	0.0 (0.0) %	0	0 %
5 Year	12	7	58 %	0	0	-	3	1	33 %	5	3	60 %	1	1	100 %	3	2	67 %	0 (0)	0.0 (0.0) %	0	0 %
12 Year	0	0	-	0	0	-	0	0	-	0	0	-	0	0	-	0	0	-	0 (0)	0.0 (0.0) %	0	0 %

Milestone Age	Total			Dep 1-2			Dep 3-4			Dep 5-6			Dep 7-8			Dep 9-10			Dep Unavailable		
	No. Eligible	Fully Immunised for Age	%	No. Eligible	Fully Immunised for Age	%	No. Eligible	Fully Immunised for Age	%	No. Eligible	Fully Immunised for Age	%	No. Eligible	Fully Immunised for Age	%	No. Eligible	Fully Immunised for Age	%	No. Eligible	Fully Immunised for Age	%
6 Month	41	31	76 %	3	2	67 %	2	1	50 %	5	3	60 %	12	11	92 %	10	8	80 %	9	6	67 %
12 Month	36	31	86 %	2	1	50 %	3	3	100 %	6	5	83 %	10	10	100 %	8	7	88 %	7	5	71 %
18 Month	21	16	76 %	1	0	-	1	1	100 %	3	3	100 %	7	5	71 %	8	6	75 %	1	1	100 %
24 Month	18	17	94 %	0	0	-	0	0	-	2	2	100 %	6	6	100 %	9	8	89 %	1	1	100 %
5 Year	12	7	58 %	0	0	-	0	0	-	2	1	50 %	5	3	60 %	2	2	100 %	3	1	33 %
12 Year	0	0	-	0	0	-	0	0	-	0	0	-	0	0	-	0	0	-	0	0	-

NIR BC CI - National Immunisation Register Birth Cohort Childhood Immunisation – this report shows children born after the NIR was implemented in each DHB (from 2005 onwards).
'No Eligible includes all individuals enrolled on the NIR (with a Registration status of Active, Opt Off or Provisional Opt Off) who reached the milestone age (6, 12, 18 or 24 months, 5 or 12 years within the reporting period.
Fully immunised includes children who received the most recently due dose (final) in a vaccine series according to the standard or catch-up schedules or alternatives by the time they reach the milestone age. PCV7, PCV10, and PCV13 doses are not included when calculating milestones.
'Opt Off' is a count of individuals who have opted off the NIR (Provisional and Actual).
'Declined' is a count of individuals who have declined any one vaccination.

The information contained in this Report has been derived from the National Immunisation Register database. While the Ministry of Health has taken all reasonable steps to ensure that the information contained within the report is accurate and complete, it accepts no liability or responsibility for the manner in which the information is subsequently used or relied on.

* This report shows the annual birth cohort childhood immunisation overview for milestone ages for the clinic Pacific (Pasifika) Horizon Healthcare for the final dose 5-month immunisation of the primary series over the 12-month period 1 February 2011 to 1 February 2012.

their primary series during the 12-month period (1 February 2011 to 1 February 2012).

Exclusion criteria

Casual, non-enrolled infants and patients who transferred out of the practice before completing their primary series were excluded.

Timeliness criteria

Timeliness of delivery was defined as all immunisations being given within a certain timeframe. The NIR defined 'on time' as having completed the primary series of immunisations by the six-month milestone. Strict timeliness was defined as all vaccines being given on time within five months.

Study design

A separate manual and PMS-based audit were set up, using exactly the same criteria for counting as the NIR report for this practice.

Step one: obtaining an NIR report

Step one began with obtaining an NIR report (Figure 1) for the practice-enrolled population. The report shows immunisation coverage by ethnicity and deprivation level for individuals who have reached the milestone age (6 months, 12 months, 18 months, 24 months, 5 years and 12 years) and who have fully completed their age-appropriate immunisations for the 12-month period 1 February 2011 to 1 February 2012. This study examined the 12-month milestone data.

Step two: running a manual audit

Step two involved running a manual audit. Since all immunisations were entered into the PMS on the nurse appointment screens, the person responsible for immunisation identified all children on those screens under the age of five years and the immunisation history was confirmed using the NIR query tool. This was done for all days the practice was open over the 12-month period from 1 February 2011 to 1 February 2012.

Step three: running a PMS audit

Step three involved running a PMS audit. Using the PMS 'query builder', an audit was developed with identical parameters to the NIR report (Figure 2). The query identified the National Health Index (NHI) numbers of each patient given the final dose 5-month immunisation over the 12-month period from 1 February 2011 to 1 February 2012.

Step four: comparison of data

Step four involved a comparison of the manual and PMS-based audit information with the NIR report.

Step five: the multifaceted audit

To identify all potential recipients due their 5-month immunisation (the denominator), the results from the previous three audits of the 5-month (final dose) were combined with further sub-audits. These sub-audits identified candidates eligible for the 5-month immunisation as follows:

- Group one: Identified all children who had received their 5-month immunisation during the 12-month period
- Group two: Identified all children not in Group one who had received their 6-week immunisation during the 12-month period
- Group three: Identified all children not in Groups one or two who had received their 3-month immunisation during the 12-month period
- Group four: Identified all children who did NOT receive their 6-week, 3-month or 5-month immunisation during the 12-month period, despite being due these injections
- Group five: Identified all children born into the practice six months before the period to the end of the 12-month period.

These multiple sub-audits were run to identify as many eligible children as possible for the denominator over the 12-month period. Any audit that identified further valid candidates for the period was arranged into the algorithm and any audit that did not identify further eligible children was excluded. Each patient identified was critically examined under the inclusion or exclusion criteria.

Step six: confirmation of immunisation history

Data on all patients with an uncertain immunisation history, those partially immunised or apparently unimmunised, were analysed using the 'status query' in the NIR database to corroborate the immunisation history. All information was 'updated' into the PMS, updating the number

Figure 2. The 5-month PMS query builder audit equivalent to NIR parameters for the 12-month period 1 February 2011 to 1 February 2012, using the PMS system Medtech32

QUERY BUILDER VARIABLES

- The 12 months before 1/2/2012
- Vaccines—primary series receiving the 5-month immunisation

Column (Criteria)

Immunisations—Date of immunisation	Between 1/2/2011 and 1/2/2012
Immunisation—Vaccine code	5-month DTaP-IPV-HepB/Hib 5m*

Select (Output)

Count function
Patient—NHI
Patient—DOB—Age
Immunisation—Date of immunisation

NHI National Health Index number

DOB Date of birth

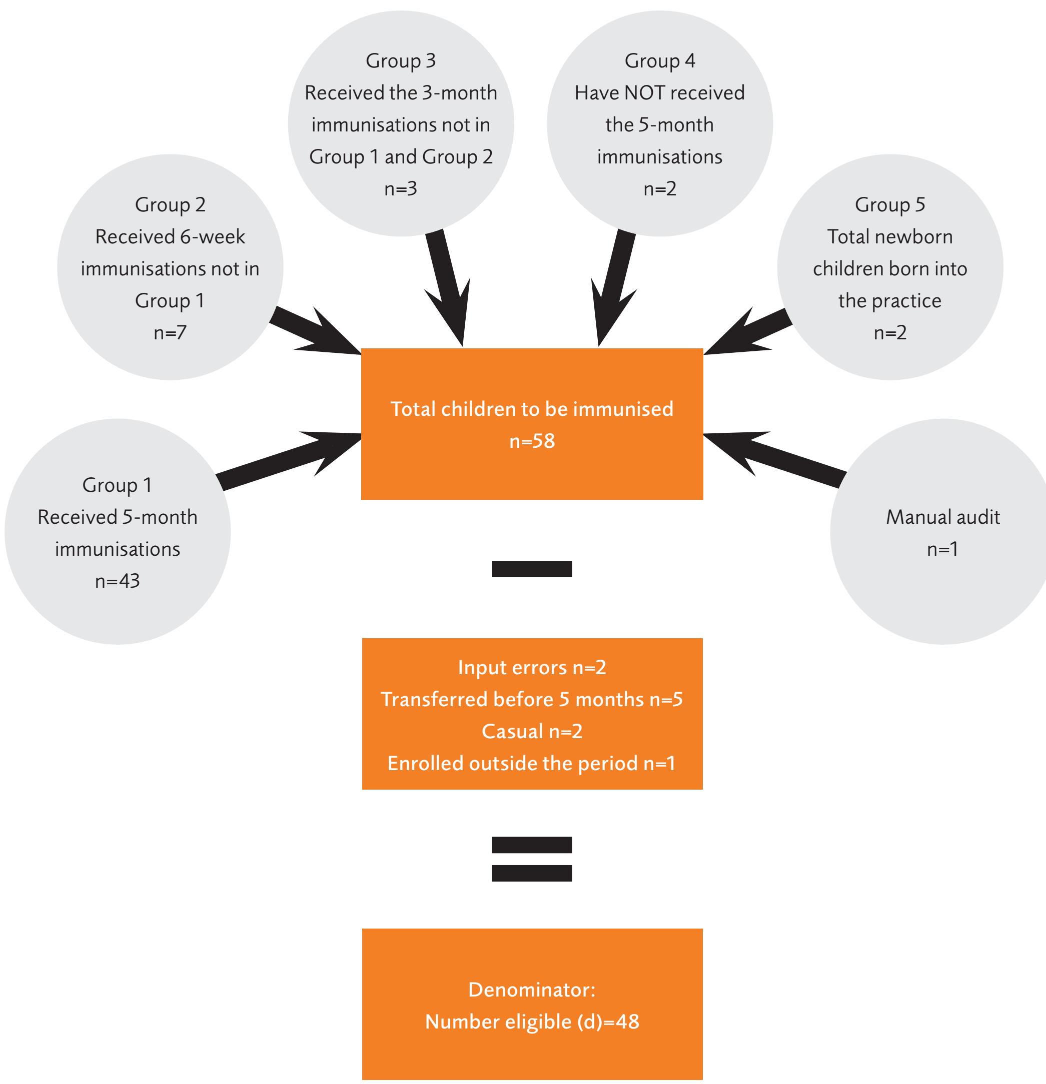
* DTaP-IPV-HepB/Hib 5m is the code for the 5-month vaccine used for the primary series of immunisations: (Infanrix®-hexa) Diphtheria-Tetanus-acellular Pertussis-Inactivated Polio-Hepatitis B-Haemophilus influenzae type b

*Table 1. The results of the multifaceted audit with the total children identified (n=57)**

Sub-audit 1	The patients that received the 5-month immunisation during the 12-month period and equivalent to the 5-month PMS-based audit	Group 1 = 43
Sub-audit 2	The patients that received the 6-week immunisation during the 12-month period not in the 5-month audit	Group 2 = 7
Sub-audit 3	The patients that received the 3-month immunisations during the 12-month period not in the 6-week and 5-month audit	Group 3 = 3
Sub-audit 4	The patients that received NO prima facie immunisations at five months. The 6-week and 3-month NO immunisation groups added no further candidates to the analysis so were excluded from the analysis	Group 4 = 2
Sub-audit 5	Total children born six months before the 12-month period to the end of the period not in the above sub-audits	Group 5 = 2

* One further eligible child was identified on manual audit, giving an overall total of 58

Figure 3. The multifaceted audit algorithm showing the final best estimate of the denominator (d=48)



who had received the primary series of immunisations (the numerator).

Results

All three initial audits produced different results of vaccinated (numerator) and eligible patients (denominator) when compared with each other. The NIR report showed 31 of 36 (86.1%) eligible children were fully immunised, the PMS audit showed 39 of 43 (90.7%) eligible children were fully immunised for their primary series, and the manual audit showed 41 of 48 (85.4%) eligible children were fully immunised for their primary series of immunisations.

The multifaceted audit added a further 15 patients to the total (n=58) infants (Table 1 and Figure 3). Each sub-audit identified further children to the denominator who had not previously been counted.

Sub-audit one identified patients who completed the 5-month immunisations and therefore were fully immunised for the primary series (Table 1). This result was equivalent to the 5-month PMS audit (39 of 43 eligible children).

Sub-audit two identified patients who started the primary series of immunisations (received their 6-week immunisation) but did not complete their 3-month or 5-month immunisation, or were late with these vaccinations.

Sub-audit three identified patients who had their 3-month immunisation at this practice and were subsequently found to have their 6-week immunisations elsewhere and to be late for their 5-month vaccinations.

Sub-audit four identified children who were the prima facie unimmunised. However, NIR corroboration revealed these children were immunised but transferred into the practice without their immunisation status being updated.

Sub-audit five showed patients born into the practice during and six months before the 12-month period of interest. These patients were seemingly unimmunised but, after NIR queries, were identified as either immunised at other practices or casual to this practice, requiring their immunisation status to be updated into the PMS database.

A total of 58 patients were identified using this method. The one patient that appeared in the manual audit and no other audit transferred out before completing the primary series and was excluded. A total of 10 of the total 58 candidates were excluded for the following reasons (Figure 3):

1. Input errors (n=2)
2. Transferred out of the practice before the primary series was complete (n=5)
3. Casual patients seen but enrolled at other practices (n=2)
4. Enrolled after the period of interest (n=1).

Table 2. Feedback from the audit: practice variables affecting the audit for this general practice and requiring remedial action

Practice variable	Action
Received 5-month but no 3-month injection	Give injections sequentially: 6-week, 3-month, then 5-month
Patient transfers out of practice	Advise NIR and new general practice
Patient transferred into practice	Confirm immunisation status using the NIR query tool and update PMS immunisation history
The partially immunised	Need to stay in the 'active' inbox of the person responsible for immunisation until the 'catch-up' injections have happened
Casual patients	Immunise and enter into NIR database. Do NOT count. Complete an NIR status query
Avoiding input errors	Do NOT input all vaccines on the same day. Run NIR status query where appropriate
Shared care patients	Run NIR status query

NIR National Immunisation Register

All eligible 48 remaining patients were examined for their immunisation history in the practice database and by standard query criteria into the NIR database. There were no patients whose immunisations had been declined and none opting off the NIR register. All the 48 (100%) started their primary series, with 95.8% (46 of 48) fully immunised for their primary series. A total of 4.2% (2 of 48) were partially immunised, missing only one of their injections. None were found to be unimmunised, despite the initial sub-audits revealing two unimmunised children at five months.

Using strict timeliness criteria, 52.1% (25 of 48) were immunised on time by five months and a further 43.7% (21 of 48) were late for some or all of their immunisations. Using the NIR six-month milestone, 75.6% (31 of 41) were on time, compared with 66.7% (32 of 48) using the multifaceted audit. A total of 83.3% (40 of 48) would satisfy the new target of completion of the primary series immunisations by the eight-month milestone, using the multifaceted audit.

With all patients identified and confirmed for their immunisation history, a formula was established for the number of eligible patients (denominator) using the audit results (Figure 3). A set of audit rules were developed to establish consistent counting procedures for this general practice and for feedback to the practice (Table 2).

Discussion

New Zealand immunisation rates have improved to around 90% at the age of two years, as a result of better general practice systems application, including auditing techniques. As NZ immunisation rates approach the government and World Health Organization (WHO) target of 95% immunised by age two years, it is important to tackle the enormous variation in service delivery of immunisation in NZ general practice. The variation is due to many factors, including differences in access to services and information; practice variability and organisation; demographics; transient populations; provider knowledge and attitudes; parental concerns and attitudes; and cultural influences, such as shared care within the whanau/extended family.[8]

Standardised best practice baselines within the general practice are required so that all children are accounted for and all vaccination events recorded accurately. The practice in this study was purposely selected because of known high immunisation coverage for the primary series and a high percentage of Pacific people, identified in NZ as having a high and inequitable burden of vaccine-preventable disease.[16] While generalised trends are not directly attainable from this study, auditing a single general practice allows the establishment of auditing rules and highlights variables to inform larger future audits.

Audit and feedback is one of the numerous strategies devised to improve immunisation rates and other preventive care services. While the number of well-conducted audit studies is small, the effect on immunisation coverage is considerable

This analysis identified some causes of practice variability associated with auditing techniques. When auditing was undertaken using a manual and electronic-based audit and compared with equivalent data from the NIR, this resulted in three different numerators and denominators (the NIR report: 31/36, PMS audit: 39/43, and the manual audit: 41/48). Although the exact reasons for this are uncertain, it is likely that the NIR database underestimates actual coverage due to difficulties establishing the eligible population dataset—the denominator[15]—and this analysis would support this observation. While it was not possible to correlate NHI numbers of patients at the practice with the 31/36 in the NIR audit, this would clarify the situation. Certainly, a transient population and NIR patient assignation in error to other practices are major contributors to the discrepancy in this study.

The manual audit identified the largest group of eligible patients of the initial audits, but was time-intensive and prone to errors in counting. The PMS audit at five months was affected by input errors, transferring and casual patients, and failed to identify patients who had their 5-month immunisation event late. Using the NIR status query tool, with its 'update' facility for the practice PMS proved useful and improved the audit's accuracy.

Since each initial audit produced different results, they were combined with a series of other sub-audits to identify other eligible children across the 12-month period (Table 1). Using each sub-audit in the multifaceted audit allowed the development of an algorithm for the best estimate of the denominator for this practice (Figure 3).

Results of the multifaceted audit show the NIR database under-reported coverage by 9.7% for this practice (86.1% vs 95.8%). Using the multifaceted audit tool confirmed numbers immunised were actually above the government and WHO target of 95% coverage for this practice.

Low rates for timeliness of delivery were confirmed across the audits, despite a different denominator—75.6% (31/41) for the NIR, compared with 66.7% (32/48) for the multifaceted audit, using the six-month milestone. This analysis confirms low levels of timeliness at this practice, consistent with other Pacific practices (by Pacific for Pacific services).[16] While the reasons for low levels of timeliness are uncertain, a number of targeted initiatives have been introduced at this practice.

As a result of this analysis, a number of deficiencies in vaccine delivery that occurred at this general practice were identified that affected the immunisation count. Table 2 identifies the variables that occurred and recommendations for the appropriate remedial action. In particular, only registered patients should be counted in audit analysis, as casual patients are being recorded elsewhere. Patients transferred into the practice required extra attention in terms of passing information between practices and ensuring the NIR database is updated. The concept of 'shared care' was identified as important, particularly for Maori, with the child enrolled elsewhere, though potentially receiving immunisations at this practice, or vice versa. An improved infrastructure supporting shared care was recognised as crucial for this general practice.

Audit and feedback is one of the numerous strategies devised to improve immunisation rates and other preventive care services. While the number of well-conducted audit studies is small, the effect on immunisation coverage is considerable. For example, after the implementation of routine audit and feedback to providers in public health clinics in the state of Georgia, USA, the percentage of two-year-olds up-to-date for immunisations increased from 40% to 89% over eight years.[17] While recent reviews show audit and feedback leads to small but potentially important improvements in professional practice over time, this depends on baseline performance and how feedback is provided.[14] Furthermore, the effect of audit and feedback differs according to the specific preventive service for which it is used. As immunisation delivery is generally well accepted and a priority for providers and patients, the effect of feedback on immunisation rates may be greater than with other preventive services not as universally accepted.[14] Such information is helpful in the optimisation of service delivery.

Not only did the multifaceted audit produce the best estimate of eligible patients for immunisation, it also identified deficiencies in immunisation delivery. This multifaceted audit approach is currently being assessed for ease of use, accuracy and systems improvement in other practice settings. The audit and feedback approach could be a powerful tool in the development of immunisation 'best practice' models, providing efficient and standardised data measuring and reporting procedures. This infrastructure could further be utilised in other primary health care initiatives requiring multiple targeted interventions, such as diabetes management.

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ACKNOWLEDGEMENTS

The authors would like to acknowledge the staff and management of Pasifika Horizon Healthcare for assisting access to the patient management system and Leane Els for assisting access to the National Immunisation Register data via the coordinating Primary Health Organisation, Procare Ltd.

FUNDING

This project was part funded by a Research and Educational Charitable Trust Award from The Royal New Zealand College of General Practice.

COMPETING INTERESTS

None declared.