THE NEW ZEALAND MEDICAL JOURNAL
Journal of the New Zealand Medical Association

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THE NEW ZEALAND MEDICAL JOURNAL
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This Issue in the Journal

Paediatric spina bifida inpatient treatment at Wellington Regional Hospital: a cost analysis of sequential patients
Brendon Bowkett, Eamonn Deveral

This study found inpatient costs for paediatric spina bifida patients were significantly higher than the only previous estimate carried out in NZ. This study also shows the burden on patients and their families/whānau in the high numbers of admissions, major operations, long periods spent as inpatients and the high number of radiological investigations.

Air transport by the Wellington Flight Service: a descriptive analysis of interhospital transfers over a 5-year period in the Wellington region of New Zealand
Julia A Myers, Alex Psirides, Karyn Hathaway, Peter D Larsen

In NZ it is routine for seriously ill patients to be transferred from one hospital to another by dedicated flight services using air ambulances, so they can receive specialised medical care. We reviewed 5 years of records from the Wellington Flight Service who completed on average just over two interhospital transfers a day, each taking around 4.5 hours from start to finish but a smaller proportion (9%) taking 8 hours or more. Fixed wing aircraft were used most often, with helicopter use gradually declining except in the transfer of critically ill patients. Most people being transported are under the care of cardiac, neurology and intensive care services. The trend showed that increasingly the patients being transferred are critically ill and are transferred by an expert flight doctor and nurse around the clock.

Difficulties with defining lymphoedema after axillary dissection for breast cancer
Muhammad Asim, Alvin Cham, Sharmana Banerjee, Rachael Nancekivell, Gaelle Dutu, Catherine McBride, Shelley Cavanagh, Ross Lawrenson, Ian Campbell

Breast cancer is one the most common cancers in the women and is the leading cause of death. Axillary lymph node dissection(operation to remove lymph glands in axilla) is a common treatment for breast cancer and it is associated with the development of lymphoedema(build-up of lymphatic fluid in the arm caused by damage to arm lymphatics). Lymphoedema is a disabling complication and best way of prevention is early detection and start of therapy by referral to lymphoedema specialist. This study has identified an easy and convenient office procedure to detect lymphoedema by clinicians.

The epidemiology of serious skin infections in New Zealand children: comparing the Tairawhiti region with national trends
Cathryn O'Sullivan, Michael G Baker, Jane Zhang, Anna Davies, Geoffrey Cramp

Serious skin infections, those skin infections that are severe enough to require hospitalisation, are an increasing problem for NZ children with rates steadily rising between 1990 and 2007. The highest national incidence of these infections is in the Gisborne (Tairawhiti) region, where rates are double that found elsewhere in NZ. On average in NZ, Māori children are just under twice as likely to be hospitalised with a serious skin infection, but in the Gisborne region this risk is even greater, at over two and a half times. The Gisborne region does have a large number of children in 'high risk' groups for serious skin infection (children under 5 years), Māori children, children from deprived neighbourhoods), but even after accounting for these differences, the rates in the region are still much higher than expected, suggesting the involvement of other factors.

Serious skin infections in children: a review of admissions to Gisborne Hospital (2006–2007)
Cathryn O'Sullivan, Michael G Baker

The Gisborne (Tairawhiti) region has the highest rate of childhood hospitalisations for serious skin infections in NZ, double that of the NZ average. We studied all children admitted to Gisborne Hospital with a skin infection over 2006 and 2007 to start to look at why rates are so high in this region. In general we found that the types of infection and the bacteria causing them were the same as in other areas of NZ. However, differences in Gisborne were that a higher number of infections were preceded by skin injuries such as cuts, insect bites, or sports injuries, and there were longer delays to seeking initial medical care, with more children being admitted straight to hospital from their GPs than in other areas. Further research in this area is needed to identify ways of reducing these extremely high infection risks.

Skin infections in children in a New Zealand primary care setting: exploring beneath the tip of the iceberg
Cathryn O'Sullivan, Michael G Baker

There has been a well documented rise in the incidence of hospitalised serious skin infections in NZ children over the last two decades. NZ infection rates are double that of the USA and Australia. However, hospitalised cases of skin infection are only the the 'tip of the iceberg' as the majority of children are seen by their general practitioners, a group that has not been researched before in NZ. This study looked at children with skin infections who presented to a group of general practitioners in the Gisborne region during 2008. It found that an estimated 10.7% of children (or 1 in 9) saw their GP with a skin infection during a one year period. Three-quarters of these children were Māori, a similar proportion to that admitted to hospital with a serious skin infection. For every one child admitted to hospital with a serious skin infection, another 14 children were seen by their GP with a more mild skin infection.

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Public health initiatives: science versus politics. What will the outcome be?

Andrew Marshall

The article in this issue of the *NZMJ* by Bowkett and Deverall,[1] on the surgical costs of spina bifida patients, delivers important evidence at a critical time; the decision whether New Zealand will join the 63 countries who already have mandatory folic acid in the food chain. The research method used is conservative and suggests hospital costs alone in spina bifida patients by age 21 are nearly 1 million dollars. Add the adult surgical costs, the lost family income, the community, special education and disability sector costs, and the price could easily be doubled for each individual with a neural tube defect (NTD) who survives to adulthood. However the financial costs are just one aspect of this disorder.

Consider the quality of life for those individuals who live with spina bifida. They experience ongoing pain, disrupted home and school life from frequent infections and hospitalisations, physical limitation, lost opportunities, and stress on their families and themselves. Consider too the grief of perinatal loss of a baby with anencephaly, or the agonising decision to terminate in mid-pregnancy. Cumulatively, the total burden of neural tube defects overwhelms financial analysis alone.

Yet we can prevent many of these cases. An easy and safe public health initiative offers the likelihood of reducing neural tube defects. The science proving effectiveness of mandatory fortification in reducing NTDs is confirmed in all countries where it has been studied.[2] The safety of such an approach has been more controversial, at least to opponents, although scientific consensus was growing and is now established. The largest meta-analysis,[3] pooling data from 37,485 adults randomised to folic acid supplementation, confirms no increased cancer risk with supplementation at doses many times higher that that proposed to be added to bread.

So if adding folic acid to the food chain is safe, effective, and financially sound, why is the Government continuing to delay implementing the 2007 agreement to fortify? New Zealand (NZ) after all signed the (Mandatory Fortification of Bread with Folic Acid) Food Standard 2007 as a joint agreement with Australia, who introduced mandatory fortification of flour with folic acid in 2009 as planned.

A voluntary regime was introduced instead in NZ, with up to a third of breads being fortified with folic acid. This has been partially effective. Blood folate levels in the female child-bearing age population in NZ have risen between 2008/2009 and 2011; more than double the number of women had red blood cell folate levels in the optimum range for preventing neural tube birth defects (from 26% to 59% having RBC folate 906 nmol/L or above).[4] However, this improvement probably reflects increased folic acid in breakfast cereals more than an effect of bread fortification, given that during the 2011 survey period, 93% of women ate bread that week, but only 18% had eaten brands known to be fortified. A voluntary regime is unlikely to deliver the full benefits seen in countries with a mandatory programme.

The political right is opposed to public health initiatives which are perceived to restrict consumer autonomy and choice, and the doctrine of individual rather than collective responsibility has little interest in society's responsibility to the disabled. Factions within the environmental movement appear to be opposed to any additives in food. No matter that we are talking about replacing a natural and essential vitamin stripped from our diets by poor choices and excess processing!

During media debate and government deliberation in 2009, public opinion was able to be deliberately misinformed and frightened by a few well-placed individuals. While the voice of reason and robust science responded, it was not enough to deter the government from delaying this important health initiative. Currently, a second, shorter deferment is planned for more consultation.

The current New Zealand Government is presented with a choice; prevent significant numbers of NTD pregnancies each year safely and effectively, or respond to the voice of industry and to public mistrust fuelled by misinformation, bearing in mind that a responsible public information campaign has the power to reassure almost all of the population.

Competing interest: The author is a Paediatric Society of NZ representative on the Food Standards Authority Folic Acid Working Group (an expert advisory role, unpaid).

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Interhospital and emergency transfers in New Zealand

New Zealand's geography and unique population distribution provides a barrier to the provision of tertiary health care services. Over 1.5 million or well over a third of the population reside more than 1 hour from a tertiary hospital and the "home to tertiary hospital" transit time for the average New Zealander is 89.5 minutes.[1]

For many, hospital care is provided by local primary and secondary hospitals and although the Ministry of Health has prioritised the bringing of health services closer to home, the interhospital transfer of the acute and semi-acute patients to gain the benefit of centralised tertiary facilities will an unfortunate necessity into the foreseeable future.[2]

Myers and colleagues in this issue of the *NZMJ* describe the Wellington Hospital Flight Team experience in providing these interhospital transfers, noting the absence of other consistent and reliable data on the subject.[3]

The transport of an in-hospital patient, particularly of the critically ill patient, is a rapacious consumer of health resources. In the current environment, transports need to be as cost efficient as possible. Efficiency can be created by the total volume and by organisational structure. Backloads, utilising the otherwise wasted "dead leg" of flight have risen to now comprise 25% of the Wellington workload, suggesting that there has been a growth in organisational efficiency, and contrasts favourably to the situation described by Flabouris at the end of the last century.[4] However the subset of critically ill and ventilated patients transported by the Wellington team also experienced a greater than 50% relative increase over the 5 years.

Two previous studies of clinical outcomes of critically ill patients transferred to tertiary Intensive Care Units in New Zealand suggested that transported patients had a different case mix, a higher severity of illness, mortality, length of ICU stay and associated costs than the non transported patients.[4,5] Increases numbers of critically ill patients being transferred are likely to incur more cost, offsetting any total gains made by the efficiency of transport system.

In contra-distinction to the previous New Zealand studies, the bulk of the transports described by Myers and colleagues are of less critically ill patients, for which little New Zealand data has been available. The Wellington transport team's risk stratification is based on actual severity and likely complications to determine staffing, resulting in a doctor being present for only a third of the flights.

This model of care, and workload distribution is not dissimilar to that in other district health boards (DHBs) offering higher volume co-ordinated transport systems, and offers a high quality but cost and resource efficient service. Their data is important, but while increased understanding of the workload may help in future planning, prediction of future health systems transport demands is a complex and fickle business.

Subtle changes in in recommended best practice, or changes in available local resources may significantly influence utilization of transports.

A obvious example is the provision of therapy for acute coronary syndromes. In New Zealand percutaneous coronary intervention PCI is traditionally performed in tertiary centres with onsite cardiac surgery.[6] The revascularisation with PCI rate in acute coronary syndrome rose from 7% in 2002, to 19% in 2007.[7]

A quarter of the Wellington transports are for either cardiology or cardiothoracic patients, and the increased PCI rates have certainly affected demand for acute cardiology transfers from non cardiac intervention centres to Wellington.

The median waiting time for cardiac angiography for patients at non-intervention centres a twice as long as those admitted to an intervention centre.[6]

In response to the delays, access block and additional cost, from 2007 the Nelson Marlborough DHB began trialing onsite access to PCI. Since then several hundred PCI have been carried out in Nelson, without significant problems. Not only has the need to transfer these Nelson patients to Wellington largely disappeared, patient satisfaction has increased and the cost incurred by the DHB significantly reduced. The impact of the PCI service, initiated half way through the period studied, on Wellington's overall transport volumes, is not clear.

What impact future developments in recommended standard of care or options for invasive intervention will have upon the transport system will never be entirely clear, but when planning for development, curtailing or reconfiguring any hospital services the cost and resource implications for transport need to be identified and provided.

Transports services need to efficient enough to meet acute demand, robust enough to adapt to the changes in clinical need over time, and able to maintain the very highest patient care. While neither clinical outcomes nor the adverse events were reported in the Myers paper, the increased experience within a high volume and organised transport teams such as theirs is likely to enhance patient safety.

The majority of long-distance patient transports are done in aircraft. Irrespective of the risk to clinical safety to the patients, the aviation environment exposes to both patients and the attending staff to additional hazards.

An Australian study quantified the risk of aeromedical transport accident rate was 4.38 per 100,000 flying hours, or one accident per 16,721 missions.[8] This accident rate is similar to rates from other countries. However the current New Zealand fatality or serious injury rate for non-public commercial aircraft is 10.8 for helicopter and 6.03 for fixed wing aircraft per 100,000 hours.[9]

Fortunately to date New Zealand has not suffered a fatal aeromedical accident, although there have been some very near misses.[10] The Wellington experience of the need for after-hours and overnight transfer, would be common to all NZ aeromedical transport services and is driven by both the urgency and duration of the transfers. Providing the service in the hours of darkness in New Zealand's frequently inclement weather and over our challenging topography can only add increased risk when compared to Australia.

To mitigate this risk it is essential therefore that the only operators that can provide to the highest standard of flight and patient safety that is reasonably possible, are engaged in providing these service, and that patient transports are screened as being clinically essential.

Interhospital transport is the single most expensive nontherapeutic intervention available to hospital clinicians, with potential to bedevil both patient and staff safety, as well as health funders. Although there is insufficient relevant data to draw firm conclusions regarding the mortality, morbidity, or risk factors associated with the transport of patients, consensus opinions recommend transport by establishing an organised, efficient process supported by appropriate equipment and personnel.[11] This is best achieved by eschewing historical ad hoc bargain-basement solutions and supporting the further development of well resourced, properly trained and organised transport services, that are dedicated to the provision of interhospital retrievals and transfers.

Support for a co-ordinated model of transport care similar to that described in Wellington, and that have also been developed in several other DHBs, will permit safe ongoing access to tertiary care for the many of us that live some distance from the madding crowd.

Competing interest: The author has an association with this topic as Trustee and Medical Advisor for the Hawke's Bay Rescue Helicopter Trust.

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Evaluation of thermography as a screening and diagnostic tool for breast cancer

Belinda Scott

Over the last 2 years there has been considerable debate about the use of breast thermography in New Zealand. Thermographs do not involve any radiation and are easy to undertake as there is also no compression of the breast. However its efficacy is unclear.

In 2010, a position statement was produced on the use of thermography as a breast cancer screening or diagnostic tool.[1] It concluded that there was insufficient evidence to support the use of thermographs either in diagnosis or screening for breast cancer. Following publication of this statement there was an outcry from the thermal imaging industry in New Zealand.

The systematic review[2] by the New Zealand Guidelines Group (NZGG) in this issue of the *NZMJ* is therefore welcome and timely as it answers many questions and allows women and health professionals to make better decisions regarding breast cancer imaging, either for diagnosis or screening. The NZGG review reports that thermography has a sensitivity for screening of 25% (compared to mammography of 89.45%), and specificity of 74% (compared to mammography of 91% initial screen and 97.7% subsequent screens).

As a diagnostic tool when women had symptoms, an abnormal mammogram or suspicious findings, the sensitivity ranged from 25% to 97% and specificity ranged from 12% to 85%. This compares to mammography for diagnosis where sensitivity is 85.8% and specificity is 87.7%.

In the NZGG review, only one study reported on screening and five studies reported on diagnosis. Unfortunately the design of the screening study was poor thus leading to bias and limiting the usefulness of the data. The review concludes that thermography was not sufficiently sensitive to be used as a screening tool. The diagnostic studies were also problematic as they were considered only of average quality and there were many false-positive results leading to the possibility of incorrect diagnosis in many of the studies.

So what do we use? What is the best screening tool we have available in 2012?

Eight randomised controlled trials have evaluated the benefits of screening mammography. Seven of these trials have been designed to evaluate screening in women 40 to 74 years. These trials show a benefit to screening women in this age group with reductions in mortality of 16% to 29%.

With early detection and treatment improvements we can now say that over 80% of our patients diagnosed with breast cancer are alive at 10 years, and this trend is increasing, even though we have more women being diagnosed.

At present the use of regular mammography remains the single best means of reducing the risk of dying from breast cancer, because although having a mammogram does not stop a woman developing the disease, it increases the chance that it will be picked up early if it is present.

Under the Breast Screen Aotearoa programme, a free mammogram is available every 2 years to women aged 45–69 years. Outside the programme, a screening mammogram usually costs about $150—a bit less than the $200 for a thermogram.

Looking forward, do I see a place for thermographs as a scientifically proven tool?

Any new technology, whether pharmaceutical or surgical or radiological, always requires careful evaluation (including benefits and harms and costs in the case of screening programmes) and this means randomised controlled trials. Enthusiasts of thermographs need to seek this sort of evaluation in order to prevent harm to patients.

The NZGG review concludes that there is insufficient evidence showing that thermography provides benefit to patients as an adjunctive tool to mammography or to suspicious clinical findings in diagnosing breast cancer.

In conclusion, in the future there may be other imaging modalities that we at present do not know about: these will also require scrutiny and scientific study to determine their place in our armamentarium.

It is vital that we offer our patients correct information with supporting statistical, scientific, reproducible evidence so that they and their physicians can make informed decisions regarding their health.

For now I believe we should put thermography to rest.

Competing interests: None declared.

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Paediatric spina bifida inpatient treatment at Wellington Regional Hospital: a cost analysis of sequential patients

Brendon Bowkett, Eamonn Deverall

Abstract

Aims To sample and analyse the number, type, length of stay and costs of admissions for children with spina bifida, and to review operations requiring general anaesthesia and radiological investigations of patients undergoing surgical management for spina bifida.

Methods Six sequential adolescents with spina bifida managed through the paediatric surgical services at Wellington Regional Hospital (Wellington, New Zealand) from November 2008 to November 2009 were sampled for retrospective analysis. One neonatal case was also chosen. All hard copy notes, radiology packets, electronic notes and radiological studies were requested and reviewed for these seven patients covering all lifetime admissions. Inpatient length of stay and operation costs were also analysed.

Results Six adolescent patients(10–21 years) had undergone a total of 124 operations requiring general anaesthesia—average 20.67 (19–28). There were 125 admissions in total for this group—average 20.83 (14–34) with an average length of stay of 8.53 days per admission and an average cumulative length of stay of 177.67 days. As a group, the adolescents had spent 1066 days as inpatients. Adolescents received an average of 75.33 (36–164) radiological procedures, including an average of 7.5 CT scans (4–13). The neonate had 10 operations, four admissions, 67 radiological investigations and a total length of stay of 194 days. The average cumulative cost per adolescent was NZ$944,000 ($472,000–$1,202,000) with a total cost of NZ$5,664,000. The cost for the neonate was NZ$678,340.

Conclusions This study found inpatient costs for paediatric spina bifida patients were significantly higher than the only previous estimate carried out in New Zealand. This study also shows the burden on patients and their families/whānau in the high numbers of admissions, major operations, long periods spent as inpatients and the high number of radiological investigations.

In this study, conducted at Wellington Regional Hospital (Wellington, New Zealand), we aimed to sample and analyse the number, type, length of stay and costs of admissions for children with spina bifida.

Methods

To obtain the most representative sample possible of the patient base, it was decided to choose six sequential contacts with the paediatric surgical service at Wellington Regional Hospital from November 2008 to 2009 (admissions and outpatient visits). Ethics approval was obtained. Hard copy notes and radiology were reviewed, as well as electronic, notes and radiological procedures.

Admissions, length of stay, radiological procedures and, frequency, nature and durations of surgical operations were calculated. An operation was defined as a procedure requiring general anaesthesia

(GA). Therefore, MRI or CT scans requiring GA were included in the operations tally. Sample size was restricted to 7 patients because of the enormous time resource required to analyse large volumes of records.

Costings (inpatient only) were analysed. These were calculated by average daily inpatient cost multiplied by length of stay. Operative costs calculated by theatre utilization time and disposables cost per procedure.

Results

The numbers of operations requiring GA on each adolescent are summarised in Table 1, showing an average of 20.67 operations (17–28) and a total of 124.

Table 1. Number of operations on adolescent patients

Adolescent	Number of operations (requiring general anaesthesia)
1	25
2	28 (+1c)
3	17
4	18
5	17
6	19
Total	**124**
Average	**20.67**

Note: +1c refers to one cancelled operation, which was not included in the final tally.

Table 2. Neonatal operations

Neonate	Number of operations (requiring general anaesthesia)
1	10

Table 3 summarises the admissions and total lengths of stay as hospital inpatients. As a group, the six adolescents in this study had cumulatively spent 1066 days in hospital as inpatients, averaging 177.67 days (75–272). There had been a total of 125 individual admissions to Wellington Regional Hospital, with an average of 20.83 (14–34). The average length of stay per admission was 8.53 days (5.36–12.36).

Table 3. Adolescent admissions and lengths of stay (LOS)

Adolescent	Number of admissions	Cumulative LOS (d)	LOS per admission (d)
1	34	252	7.41
2	23	155	6.74
3	14	75	5.36
4	15	184	12.27
5	22	272	12.36
6	17	128	7.53
Total	**125**	**1066**	
Average	**20.83**	**177.67**	**8.53**

Admission details for the neonate are shown in Table 4. There were four admissions overall, with a total length of stay of 194 days. It is important to highlight that this is longer than the average length of stay for the adolescent patients reviewed.

Table 5 and 6 summarise the radiological procedures undergone by the patients in our study. The most important findings are the high number of procedures with radiation exposure. Adolescent patients had had on average 55.67 X-rays (23–141), 7.5 CT scans (4–13) and four nuclear medicine investigations (0–9). The neonate had had 34 X-rays, but no CT or nuclear medicine investigations.

Table 4. Neonatal admissions and length of stay (LOS)

Neonate	Admissions	NICU (d)	HDU (d)	Total LOS	LOS per admission
1	4	5	21	194	48.5

Table 5. Adolescent radiological procedures

Patient	X-ray	USS	CT	MRI	Nuclear med	Total
1	141	10	9	1	2	164
2	20	5	5	3	3	36
3	46	0	13	4	2	65
4	38	1	4	3	0	46
5	66	7	5	6	9	93
6	23	8	9	0	8	48
Total	**334**	**31**	**45**	**17**	**24**	**452**
Average	**55.67**	**5.17**	**7.5**	**2.83**	**4**	**75.33**

Table 6. Neonatal radiological procedures

Neonate	X-ray	USS	MRI	Total radiology
1	34	23	3	67

Table 7. Adolescent costing

Adolescent	Total cost ($NZ)
1	1,202,000
2	902,000
3	472, 000
4	956,000
5	1,070,000
6	1,062,000
Total	**5,664,000**
Average	**944,000**

Table 8. Neonatal costing

Neonate	Total cost ($NZ)
1	678,340

Tables 7 and 8 show the cumulative costs of adolescent and neonatal inpatient treatment inpatient at Wellington Regional Hospital. The average cost of adolescent treatment—including operative costs and inpatient stay—was NZ$944,000 ($472,000–$1,202,000). Costs for the neonate amounted to NZ$678,340.

Discussion

This is a pilot study, carried out in one New Zealand paediatric tertiary surgical centre.

The results demonstrate the enormous morbidity faced by these children and their families. Six of the seven patients are paraplegic. Children can expect to spend almost half a year in hospital by the time of their late adolescent years. Almost all will (in addition to initial spinal cord closure) require repeated neurosurgical procedures for shunts as well as major bladder, bowel and orthopaedic spine surgery. These procedures prevent deterioration of disability levels rather than restoring normal function.

The vast majority of admissions were for surgical reasons and intensive, skilled nursing is required.

It is to be noted we did not analyse costs outside the Wellington paediatric inpatient service. Four patients came from provincial towns but admissions to their local hospitals were not included.

The costings in this study are likely to significantly underestimate the true costs of treating inpatient paediatric spina bifida patients for this and other reasons. The study was conservative in its estimates in order to avoid ‘double dipping’. Although during the data collection all laboratory investigations were accounted for, the costs for same were not calculated, rather they were seen to be included in the costs for a day of stay.

Secondly the inpatient ward costs for these children would be at the higher end of a range but average inpatient case mix costs were used.

There were many costs that were outside of our scope, for which we did not gather data. These include costs incurred to peripheral hospitals, as well as costs associated with prenatal and obstetric care, district nursing, social work, special education, transport, wheelchairs and mobility aids, orthotics, physiotherapy, occupational therapy and outpatient consultations. Social costs to the family such as loss of parental employment were also not calculated.

All children with spina bifida undergoing surgery are treated with full latex-free theatre precautions which lengthens theatre times considerably.

Overall, therefore, our measured costs despite being considerable represent the tip of an iceberg.

Even with this highly conservative estimate, the cost analysis still showed that paediatric spina bifida inpatient management is significantly more expensive than the only previous New Zealand estimate.

In an unpublished study that has been quoted in reports by the Food Standards Australia New Zealand (FSANZ),[1] Singh & Elliot indicated that the cost of patient care for spina bifida in New Zealand up to the age of 20 was NZ$355,060. A US study, similarly quoted by FSANZ,[1] estimated that the direct and indirect costs of treating patients with spina bifida over their lifetime was NZ$565,000. Our series shows that the average cost to date for an adolescent (inpatient care alone) under 21 is $944,000. This is far higher than previously thought.

The neonatal case reviewed demonstrates the high cost and morbidity of management that may occur during the neonatal period (NZ$678,340). Of this care, the earned case weight to the unit was NZ$245,000, which creates a shortfall of $433,340 for one patient.

It is not the aim of this study to portray these patients as simply economic costs, and our data also gives an indication of the disruption to these patient's lives through the high number of admissions, and the long cumulative lengths of stay in hospital. It is simply not possible to quantify the distress to the child and family, nor the loss of opportunity as a result of spina bifida-associated disability. Our inability to cost this dimension does not indicate that we discount its importance.

A qualitative study of faecal incontinence in children with disability including those with spina bifida demonstrates the dismal quality of life many of these children face when limited access to a benchmarked tertiary services is available.[2]

Two other aspects of these patients' care require further discussion: the high radiation exposure and the number of ventriculoperitoneal shunt revisions undergone by patients.

Our data showed that adolescent patients had had on average 55.67 X-rays (23–141), 7.5 CT scans (4–13) and 4 nuclear medicine investigations (0–9). It is known that CT scans are associated with an increased cancer risk. A 2007 US review states that there is an estimated 1 fatal cancer per 1000 paediatric CT scans, which leads to 500 deaths a year in the US.[3]

Six of the seven patients have undergone bladder augmentation surgery which requires lifelong cystoscopic urological screening to monitor cancer risk.[4]

Recent research has suggested all neurogenic bladders have an increased risk of malignancy in these children even if not augumented.[5]

Hydrocephalus is often associated with spina bifida, and of our seven patients, four required VP shunts initially. Due to infection, these four patients required on average 3.75 VP shunt surgical revisions (range 1–6). This is concerning due to the recognised negative cognitive outcomes associated with multiple shunt revisions. A study found mean IQ has shown to decrease with increasing shunt revisions.[6]

A mean IQ of 86 was found in patients who had had one or no VP shunt revisions, while for those who had had over five, the mean IQ was 77. This was statistically significant.[6] Given the need for shunts is life-long further revisions are likely.

This review encountered particularly difficulty in accessing files across several DHBs with some records lost and the data from patient interviews suggests the multiple DHB model has not worked well for the care of these disabled children. Many have for social reasons been domiciled in several DHBs.

This study gives a conservative analysis of the high costs of inpatient paediatric spina bifida surgical management in one New Zealand paediatric surgical service. The enormous morbidity that these children suffer and high cost to paediatric services with poor resources emphasises the importance prevention if at all possible. The review only looked at care in the first 21 years of life.

Given the estimate of the overall cost of managing neural tube abnormalities per year in NZ (39 million dollars/yr)[1] the authors believe these results provide evidence to the benefits that could be achieved in the health sector by preventative measures.

One example is the mandatory supplementation of folate in bread. This has been estimated to prevent 4 to 14 live births of children with neural tube defects in NZ every year.[1]

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Air transport by the Wellington Flight Service: a descriptive analysis of interhospital transfers over a 5-year period in the Wellington region of New Zealand

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Abstract

Aim To describe and characterise the interhospital transport workload of a New Zealand based flight service over a 5-year period.

Method Wellington Flight Service database records from 1 November 2005 to 31 October 2010 were reviewed. Details of mission purpose, timings, transport type, severity of illness, clinical service requesting the transfer, and medical crew in attendance, were examined.

Results The Flight Service completed 4046 transport missions over 5 years. The median mission duration was 4.5 hours, but 9% of missions took 8 hours or more. Fixed wing aircraft were used for most transports (70%) with the trend for helicopter use decreasing steadily (from 23% down to 13%). High proportions of transfers were requested by cardiac services (25%), neurosurgery (14%) and ICU (9%), and 72% of those transported were critically (Category A) or seriously ill (Category B). A doctor accompanied a specialist flight nurse for Category A transports but for only 14% of Category B transports. 26% of missions began after 4pm and a further 6% began after midnight. Missions undertaken during the night were usually transfers of the critically or seriously ill (90%), with most (70%) being retrieved to Wellington Hospital for tertiary care.

Conclusion The Wellington Flight Service undertakes 2.2 interhospital transfers per day. Further examination of clinical outcomes in this cohort of patients transported to tertiary care is required to fully evaluate these services.

Air transport is used routinely in New Zealand for transfer of patients with serious illness or injury who require retrieval to a tertiary centre for definitive care. It is also sometimes used to return more clinically stable patients to their local hospital for ongoing care, or in rare circumstances to transport a patient back to their home for withdrawal of treatment and palliative care.[1]

Interhospital transfer refers specifically to transports between medical facilities, as distinct from primary retrieval which denotes the transport of patients from an initial scene of accident or illness to the primary medical care facility.

The Wellington Flight Service (WFS) is based in the Wellington Regional Hospital and works in conjunction with Life Flight Trust, Air Ambulance and Wellington Free Ambulance primarily to provide interhospital transport in the lower North Island and upper South Island of New Zealand. Wellington Hospital is the tertiary referral hospital for this area providing tertiary level neurosurgical, cardiothoracic, vascular, paediatric, intensive care, oncological and haematological services.

Burns and plastic surgery services are provided in an adjacent smaller hospital in the Wellington region. A comprehensive database is maintained to record details of all secondary or interhospital transfers undertaken by the Wellington Flight Team.

There is inherent risk associated with air transport of patients with most patients acutely ill and requiring high levels of clinical care in what is an extremely challenging environment.[2–6] The recommendation is that dedicated transfer teams should be used for interhospital transport of patients,[6–8] and this is the role that the WFS undertakes.

To date, the workload characteristics for the WFS or other similar services around New Zealand have not been examined. Developing an understanding of current service utilisation and workload patterns would inform planning for future service and care delivery, both regional and tertiary, as well as contributing towards research evidence for Air Transport practice in New Zealand, and is an important prelude to examining patient outcomes.

A 2008 report of the New Zealand Air Ambulance Reference Group highlighted both the absence of consistent and reliable data on which to base service planning long-term, and the limited New Zealand research evidence available to inform their work on clinical matters,[9] suggesting a clear need for this type of work to be undertaken.

This study aimed to describe and characterise the workload for the Wellington Flight Service over a 5-year period, and to identify any trends over that time.

Method

All missions undertaken by the WFS during the 5-year period from 1 November 2005 to 31 October 2010 were retrospectively reviewed. For each mission we extracted the time of mission, duration of mission, type of transfer, category of patient, service the patient was being transferred to/from and the medical crew in attendance. The study protocol was reviewed by the Central Regional Ethics Committee and found to conform to the New Zealand standards for observational health research.

The WFS operates out of Wellington Hospital, which provides tertiary cover for public hospitals at Blenheim, Nelson, Masterton, Kenepuru, Hutt, Whanganui, New Plymouth, Hastings and Palmerston North.

The current population for this region at June 2010 was 1,108,230 people.[10] Transports are undertaken by fixed wing aircraft or helicopter though in some circumstances road ambulance, or very occasionally commercial flights, will be employed. At times aircraft are unavailable due to maintenance or mechanical failure, or in adverse weather conditions due to airport closure.

Road transports are undertaken by the flight service over relatively short geographic distances when patients are critically ill and requiring advanced clinical care during the transfer, for example between Hutt and Wellington intensive care units (ICUs). Sometimes a transport started by air may be diverted and completed by road into Wellington.

Very occasionally situations occur where tertiary care is required but emergent air retrieval is not possible, so a road retrieval with an expert tertiary team is initiated despite the associated time delays. The goal in this situation is retrieval to Wellington as soon as possible because the risk of significant morbidity or death is high if they stay where they are, meaning the relative risk of transfer is less in context.

For the purposes of this review, the missions analysed in detail were those where it was the Wellington flight team who transported the patient from origin to destination, and where this was the primary purpose of their mission. A mission was designated to the 2006 review period if it occurred during 1 November 2005and 31 October 2006, or designated to the 2007 period if it occurred during 1 November 2006 and 31 October 2007 and so on. Missions were defined as “retrievals” when the patient was being transported to Wellington Hospital, or “transfers” where they were being transported away from Wellington Hospital or between two other hospitals.

Mission time was calculated from "start mission" to "finish mission" times as entered in the flight service database. 'Start mission' referred to the time that the Flight Nurse began direct preparation for that specific retrieval such as phone calls co-ordinating Life Flight, ambulance, hospitals, calling in a doctor (out-of-hours), checking equipment and obtaining necessary paperwork. 'End mission' referred to the time that the retrieval team had handed over the patient to the receiving team, completed their paperwork and equipment restocking, and were available to commence another mission.

Missions excluded from the review were those for which the WFS was involved in a more logistic capacity, including missions where a non-acute patient was transported on the empty leg when an aircraft was already assigned to an acute transport (*backload*), the mission was referred on to another flight service *(refer on)*, it was an elective transfer under the National Travel Assistance policy (*NTA assist)*, assistance was provided to arrange transport (*assistance*), or the mission was aborted (*aborted*) for reasons which might include death of the patient before the transport team arrived, weather changes or irretrievable mechanical failure.

Illness severity was categorised in order of severity from A to D. Category A patients were those in critical condition requiring invasive ventilation or other means of advanced life support such as pacing, vasoactive medication or an intra-aortic balloon pump: these patients required both an ICU flight nurse and a doctor with full and continuous monitoring during transfer.

Category B patients had generally undergone an acute incident requiring intensive care or specialist treatment but would not be ventilated or on advanced life support, but at risk of deterioration to the level where these may be required. Examples include patients with acute myocardial infarction, subarachnoid haemorrhage, spinal injury or multi-trauma. This group of patients required an ICU or specialist flight nurse although use of a doctor was viewed as discretionary.

Category C patients were usually post-treatment or investigation and not requiring intensive clinical care during flight. This patient group were usually accompanied by a Transit Care flight nurse. Category D would essentially be repatriation patients, accompanied by a flight nurse but only because they were with another patient.

Results

Over the 5-year period reviewed the WFS completed 4046 transport missions, although they were contacted regarding a total of 7635 missions, averaging 1527 per year (Figure 1).

On average 2.2 missions a day were completed, with the proportion of missions for which the flight service were contacted but not primarily involved in transport increasing from 40% in the 2006 review period to 51% in the 2010 period. The proportion of retrievals to transfers was equal overall, with the trend for lower rates of retrievals from 2006 to 2009 reversing in 2010 when 58% of transports were retrievals to Wellington Hospital.

Fixed wing aircraft were used to transport 70% of all patients, helicopters 18% and road ambulances for 11% of all completed transports. Commercial flights were used less than 1% of the time. Over the 5-year period reviewed, helicopter transports steadily decreased from a high of 23% of all transports undertaken for the 2006 period down to 13% for 2010 (Figure 2).

Figure 1

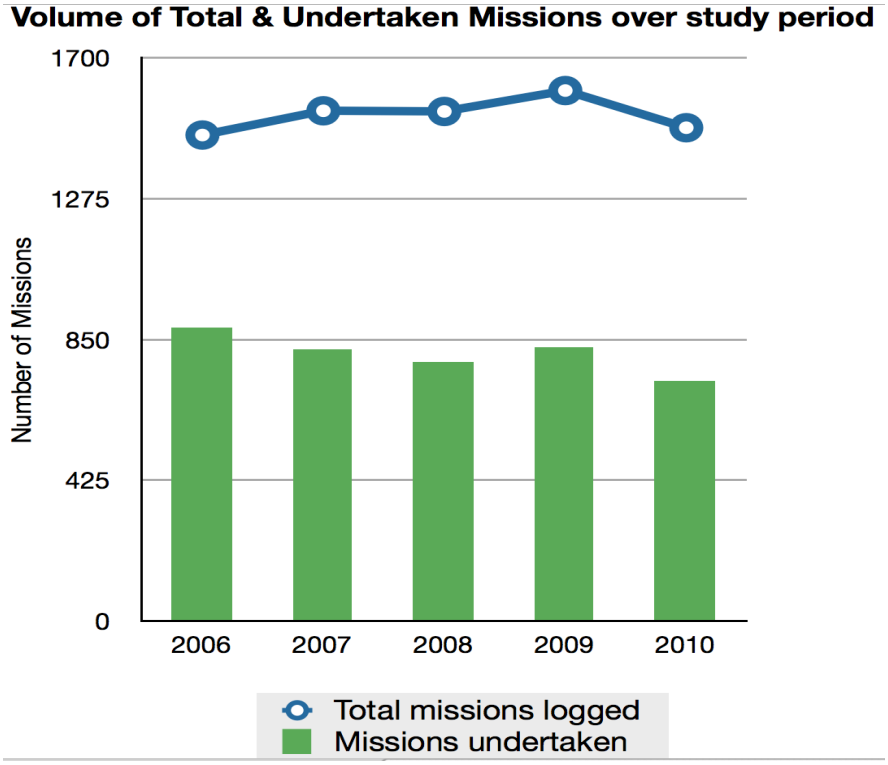
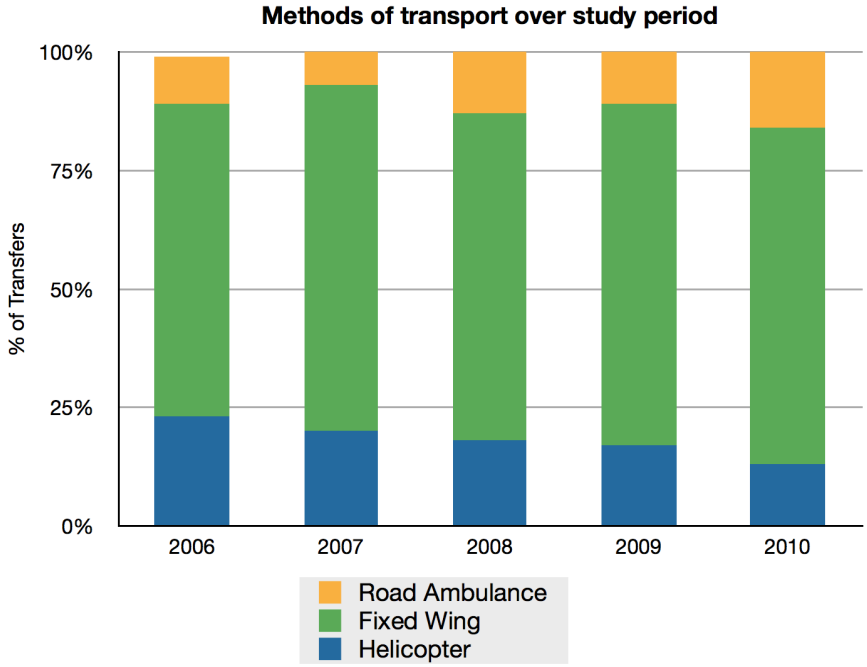


Figure 2



*In the 2006 period commercial transports accounted for 1% of overall transports.

For logged missions where it was not a WFS primary transport the numbers were fairly consistent, except for missions carried out as a backload, with 5% of missions aborted, 17% elective transfers carried out by someone else under a national travel assistance policy and 5% referred on to another service. Missions that were designated as backloads increased steadily going from 9% in the 2006 period up to 25% for 2010.

The characteristics of the transported patients are outlined in table 1. Most patients were 25 years or older (81% in total). They were residents of the greater Wellington area and adjacent regions (96% in total) with the single largest transported group being those usually domiciled in the Nelson/Marlborough region (44%).

Cardiology services requested 16% and cardiothoracic 9% of transports, with transfers and retrievals in fairly even proportions. Other services had high proportions of retrievals including ICU which accounted for 9% of transported patients overall (71% were retrievals), neurosurgery at 14% of transports (64% were retrievals); and obstetrics with 7% of transports (65% were retrievals).

Table 1.

Age range		DHB domicile		Service/DRG (transfers and retrievals)	% of overall transports	% for the service which were retrievals
< 12 months	3%	Taranaki	5%	Cardiology	16%	53%
1 – 4 years	3%	Hawke's Bay	2%	Cardiothoracic	9%	50%
5 - 17 years	5%	Whanganui	4%	Gen Medicine	7%	28%
18 - 24 years	7%	Mid Central	7%	Gen Surgery	6%	48%
25 – 49 years	23%	Capital Coast	13 %	Intensive Care	9%	71%
50 – 74 years	42%	Hutt Valley	9%	Obstetrics	7%	65%
75 years plus	16%	Wairarapa	11 %	Neurosurgery	14%	64%
		Nelson-Marlborough	45 %	Orthopaedics	6%	31%
		Canterbury	1%	Paediatrics	6%	50%
		South Canterbury	1%	Other	19%	37%

Twenty-one percent of transported patients overall were in critical condition (category A), 17% requiring invasive ventilation, and 51% not classified as critical but nonetheless requiring intensive clinical care (category B). The trend for category A critical transports and ventilated patients gradually increased over the 5 years reviewed from 16% up to 26% and 13% up to 21% respectively, while proportionately it was the category C non intensive clinical care transports decreasing from 34% down to 19% over the 5-year period

Category A: Most Category A transports were retrievals (81%) under the care of intensive care (33%) or neurosurgery (26%), with other services represented including cardiology (5%), cardiothoracic (7%), general medicine (6%) and general surgery

(6%). Compared to the figures for all transports, a higher proportion of critically ill patients were transported by helicopter (28% versus 18% overall) and road (29% versus 11% overall), and only 43% by fixed wing aircraft (versus 70% overall).

Category B: The highest proportions of Category B patients (59% retrievals) were under the care of cardiology (24%), obstetrics (12%), neurosurgery (10%), cardiothoracic (8%) and paediatrics (8%). The mode of transport was similar to the proportions for overall transports at 71% fixed wing, 20% helicopter and 9% road.

The median mission time for all transports was four hours and 30 minutes (IQR 3h29m to 6h). A higher proportion of transports occurred on weekdays (between 14 and 17%) than weekends (10 and 11%) and this trend remained constant over the 5 years reviewed. A high proportion of missions (69%) started between the hours of 7am and 4pm, but 26% started between 4pm and midnight, and 6% between midnight and 7am. Of those starting after midnight a high proportion (71%) were retrievals to Wellington Hospital, and most (90%) were critically ill or requiring intensive care (category A or B patients).

Overall 9% of missions took 8 hours or longer from the logged start time to logged final completion. 11% of the missions undertaken by fixed wing aircraft lasted 8 hours or more compared to only 3% of road transports and 1% of helicopter transport missions.

Proportionately, 75% of these long missions were category A or B patients, and 55% of the patients were under 50 years of age. In terms of clinical services 16% were under the care of paediatrics and 9% under the care of orthopaedics although these services accounted for only 6 % of overall transports each.

Conversely 12% were under the care of cardiology, 10 % under neurosurgery, and 4% under cardiothoracic specialities but respectively these services accounted for 16 %, 14%, and 9% of overall transports. When the services are considered individually 22% of all paediatric 14% of all orthopaedic and 11% of general medicine transfers took 8 hours or more.

A doctor accompanied the patient in 34% of overall transports, the trend showing a steady increase from 28% in the 2006 period up to 43% of transports in the 2010 period. Over the period of review a total of 18 Category A patients were transferred without a doctor present, and 13 of these patients were ventilated during this transport. In 8 cases the patient was being transferred back to a secondary hospital for withdrawal of treatment and palliative care.

A doctor was involved in the transfer of 14% of category B cases during the study period, and less than 1% of Category C cases. A midwife was present for 4% of overall transports.

Discussion

This is the first published data which describes and characterises the workload of a New Zealand-based flight service and its role in interhospital transfer. It is limited by the fact that it utilises a retrospective data-set and does not explore patient outcomes. Nevertheless it provides an overview of the nature of the workload, and the

characteristics of patients who are transported between hospital facilities by a dedicated tertiary transfer team.

Over a 5-year period the Wellington Fight Service completed an average of 2.2 missions per day, the median mission time of 4.5 hours indicating that around 9 hours a day is spent undertaking interhospital transfers. A significant and steadily increasing volume (proportionately) of transferred patients were critically ill (Category A), and requiring advanced care from intensive care clinicians during transport. A high proportion of transports were for cardiology/cardiothoracic or neurosurgical related care, which reflects the tertiary nature of services provided by the receiving hospital.

The disparity between total missions logged and missions undertaken (figure 1) should be considered in light of a funding allocation change in 2006 when the District Health Board of domicile (DHBod) became responsible for all transfer costs associated with tertiary level care for their patients rather than just retrieval costs. The impact of this may have been an increasing focus by some DHBods on establishment and greater use of in-house transfer teams.

There are relatively few descriptions of flight services, with a number of publications restricting the focus to those patients who were critically ill,[8] or mechanically ventilated at the time of transport.[11–13] Despite this, a case mix of neurosurgical, cardiac, respiratory and trauma patients is generally described in adult patients,[11,12] with paediatric transport described in distinct studies.[14]

Overall fixed wing aircraft were used for 70% of transports and the trend for helicopter use showed a steady decline over the 5-year period. However for the critically ill Category A patients helicopters were used for 28% of transports, which may reflect efforts to minimise delay through a 'hospital to hospital' transport rather than including the extra 'hospital to airport' road transports necessary when fixed wing aircraft are used. The relative safety of fixed wing aircraft compared to rotary wing has not been systematically examined,[13] but this may be an important issue given the greater use of rotary wing aircraft for Category A patients.

While virtually all (99.6%) category A patients were managed by both a doctor and a flight nurse, the majority of category B patients were managed by an intensive care flight nurse alone (86%). All flight nurses in the service are current ICU nurses who have trained additionally in flight nursing. While this provides a high level of skill, accurate triage of patients into category A or B is essential given the difference in level of staffing that this classification results in. There are no published guidelines or standards defining acuity and adequate level of staffing for air transportation in New Zealand.

The policy for Wellington ICU is that all subarachnoid haemorrhage patients (Category B) are accompanied by a doctor even if they have a Glasgow Coma Score (GCS) of 15 because their risk of re-bleed in the first 24 hours is high. There is also a recognition that discrepancies of GCS scoring sometimes occur or that this may change rapidly either whilst awaiting arrival of the transfer team or during transfer, so a doctor may be transported as a precaution.

The rates of major adverse events in the transportation of critically ill patients remain very low,[11-13] and there are significant difficulties in determining what proportion of the minor adverse events that occur are a product of the underlying pathophysiology

as compared to the product of stresses introduced by flight transportation.[13,15] In this study we have not examined clinical outcomes, or adverse events and these areas do require further investigation.

Work carried out late at night (from midnight to 7am) predominately transferred high acuity patients (90%), most of whom were coming to Wellington Hospital for tertiary care (70%). Given the increased risk of flying at night, the circadian effects on both medical staff and patients during these missions and the difficulties for the receiving hospital of dealing with new patients in the early hours of the morning,[13,16] this is an appropriate caution. However despite this caution, on average 45 missions a year occurred in this midnight to 7am time frame, and careful examination of the necessity of night-time transport for each of these cases should be examined.

Overall a significant number (9%) of missions took 8 hours or more, and missions of this duration have the potential for staff fatigue to compromise patient safety. The patients involved in these long missions tended to be somewhat younger and higher numbers were under the care of paediatrics and orthopaedics. This is not unexpected in light of the fact that younger people requiring emergent transfer to a tertiary centre are often critically ill and in an age-group over represented in trauma statistics where greater levels of pre-transfer stabilisation and preparation may be required.

Tertiary care for paediatric and spinal trauma patients may also require transfer over greater distances to specialist facilities located in Auckland and Christchurch respectively, and logistically patients may be transferred from services which do not provide pre-transport patient preparation or dedicated coordination of local ground transport.

Closer examination of the component times of each mission, looking at time from referral to the team arriving at the transporting hospital, time from arrival at referral hospital to departure (patient preparation time), departure from the referral hospital to arrival at the receiving hospital (transport time) and from arrival at the receiving hospital to the receiving department have all been advocated as key performance indicators of flight services but these are not routinely collected or reported. [17]

Limitations—This is a retrospective analysis of workload of a single flight service, and we have limited analysis to work undertaken. Further prospective analysis including patient outcomes is required to fully characterise the workload of this service and to examine both the appropriateness with which this service is utilised and the risks that are associated with air transport of these patients. Given the high cost associated with the operation of this type of service, and the severity of illness of many of the patients transported, these are issues that do require close investigation.

Conclusion—The Wellington Flight Service completes 2.2 interhospital transfers a day, the median duration for each transfer being 4.5 hours. Twenty-one percent of patients transferred are in critical condition (category A), with a further 51% having significant clinical problems (category B). While virtually all ventilated patients are transported by a physician and a nurse, the majority of other transfers are undertaken by a nurse alone. A significant portion of this work occurs after hours and overnight, and 9% of missions are of longer than 8 hours duration. Further examination of the clinical outcomes in this cohort of patients transported to tertiary care is required to fully evaluate these services.

Competing interests: None declared.

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Difficulties with defining lymphoedema after axillary dissection for breast cancer

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Abstract:

Aim Axillary lymph node dissection(AND) is a common treatment for breast cancer. An important side effect of the surgery is lymphoedema (LO). The primary aims of this study were to assess the local prevalence of LO in patients who had undergone AND and how the subjective symptoms described by patients compare with objective measurements. Secondary aims were to investigate the relationship between risk factors and the prevalence of LO and to establish an easy and convenient way to detect LO patients in surgical clinics.

Method Eligible women after AND for breast cancer underwent three circumference measurements on the operated and non operated (control) arm. LO was defined as one or more measurements with an increase ≥7.5% than control after dominant arm correction. Questionnaires were used to assess severity of symptoms related to lymphoedema. 73 patients also had serial measurements in arms and change in arm volume in operated arm was calculated using Casley-Smith method and LO was defined as ≥20% increase in volume.

Results 193 women with AND were analysed. Mean age was 61 years and mean time since surgery was 56 months. The overall prevalence of LO was 23.3%. LO prevalence by arm volume was 8.2%. Using volume as the standard, an arm circumference increase of ≥7.5% and ≥10% showed a sensitivity and specificity of 83% and 81%, and 66% and 89% respectively. Significant risk factors for LO were age, radiotherapy and infection to the operated arm

Conclusion Circumference measures are a simple office method of screening for LO. A patient history and ≥10% increase in any circumference is optimal for determining LO after AND.

Assessment of axillary node status remains one of the single most important prognostic indicators in breast cancer, and may influence choice of adjuvant therapies. Until recently, Axillary Node Dissection (AND) has been the standard surgical technique to assess these nodes.

A serious side effect of AND is lymphoedema (LO). LO is a build up of lymphatic fluid in the arm caused by damage to arm lymphatic drainage when axillary lymph nodes are removed.[12] With moderate or severe lymphoedema, the affected arm can be painful, tired and heavy.[6,1,12,13] The excess lymphatic fluid acts as a culture medium and the disrupted lymph flow prevents a normal immune response making the arm[1] more susceptible to infection.

Patients are advised to take particular care of their affected limb and to seek medical treatment promptly if infection develops to try to minimise LO risk.[11] Long term LO is accompanied by subcutaneous and lymphatic fibrosis.[6]

The current literature around assessment of LO is confusing. There are several different measurement techniques in use, and consensus on definition of LO, particularly with arm circumference measures is poor. The incidence of LO is also changing over time as surgery and treatment techniques change. Due to these two factors the reported incidence ranges from 2–56%.[1]

This wide variation makes it difficult to compare studies and to know how a particular locality measures up to the published literature. It is important for both patients and surgeons to know the local risk for developing lymphoedema after AND. There is only one study to date in New Zealand to report local incidence of LO and it was retrospective study based on postal questionnaires.[20]

Several risk factors for developing LO have been previously determined, such as: treating the axilla with axillary radiation after AND, which causes tissue fibrosis, and chronic lymphoedema by constricting lymphatic channels.[12]

The primary aims of this study were to ascertain the local prevalence of lymphoedema after AND and to compare the relationship between the objective measures of LO and the subjective reporting of arm complications. Given the difficulty with LO definition, we decided to examine simple methods of assessment, in a subset, to determine which was best.

Secondary aims of the study were: to see if there were any local risk factors that affect the rate of LO; to measure the morbidity associated with LO using QoL questionnaire and to establish an easy and convenient way to detect LO patients in surgical clinic after AND

Methods

The participant population comprised consecutive women attending a breast cancer follow-up clinic at Waikato Hospital's Breast Care Centre or at a local surgeon's private rooms. Woman who met eligibility criteria were recruited when an interviewer was available.

Exclusion criteria included bilateral surgery; pre-existing lymphoedema prior to AND; less than 3 months after surgery; and surgery not carried out in the Waikato. Those who consented underwent an interview and arm assessment. The assessments were conducted by four trained staff members.

The assessment consisted of a questionnaire followed by an examination in which the patient's arm circumferences were measured. The questions were designed to find out risk factors for lymphoedema (arm work, post op breast/axillary wound infection or seroma collection, air flight travel, intravenous cannula to operated arm, arm infection or cellulitis and arm injury). Pathological and treatment details were obtained from medical records.

Quality of Life (QoL) questionnaire[16] included; activities requiring reaching overhead, driving car for > 15min, pulling shirt overhead, combing hair, doing up a back fastening bra, pushing a supermarket trolley with both hands, making a bed, zipping a back fastening dress, wiping down a table top, doing usual sporting activities (total of 10 questions and patients were asked to circle 0-4; 0=unknown, 1=no difficulty, 2=some problem, 3=very difficult, 4=unable to perform). Scores were summed for analysis.

Arm measurement was conducted using a tape measure. All of the participants had their arms measured 15cm above and 10 cm below the olecranon, and around the hand. The hand measurement was conducted by asking the participant to make a fist with the thumb on the outside of the fist, then measuring the circumference of the widest point, which is the base of the thumb and mid metacarpal.

To measure arm circumference for each point, minimal pressure with the tape was used to avoid compressing the arm soft tissues.

73 patients towards the end of study also had another 7 measurements starting from base of middle finger proximally every 10cm apart up to arm. A tape measure was used to mark points at 10cm intervals from middle finger on both hands with most distal point marked at 60cm from base of middle finger. Arm volumes were calculated using Casley-Smith method for calculation of volume of a truncated cone.[17]

Subjective questions were asked to ascertain which women had experienced ongoing problems with LO. They were asked to circle on a scale of 1–4 (1=no problems, 2=a little, 3=quite a bit and 4=very much), if since surgery they had experienced: arm swelling; heaviness; or tightness. For the purposes of analysis they were grouped as under: **Group 2+** that included those who circled 2, 3 or 4 for any of the questions; and **Group 3+** that circled 3 or 4 for any of the questions.

Statistical analysis—Data collected during interviews was then entered into a Microsoft Access database. We used multivariate logistic regression method for analysis of LO risk factors. A binary variable (lymphoedema Y/N) was the dependent variable. Statistical analysis for the Activities of daily living questionnaires was performed using GraphPad Prism (version 5.0). Continuous variables were compared using the Mann Whitney test. A p-value of <0.05 was retained as statistically significant.

Arm dominance correction—A correction was made for arm dominance using a factor of 1.4% for the forearm measurement, 1.2% for the hand measurement and 0% for the upper arm measurement. These figures were devised by using a subset of 105 women who said they had never had arm swelling and did not have any detectable swelling on measurement (at the 7.5% threshold). These women most probably do not have lymphoedema. The measurements of the dominant and non-dominant arms of these women were compared and the difference was found as detailed above.

These figures are comparable with those found in the literature. Kannus et al (1995) [14] found that the difference was 0.7% in the upper arm and 1.2% in the forearm. Another study [15] found the difference was 2.5%. Both of these studies had different population groups than the women in this study {healthy young controls} so the correcting factor determined in our own population was considered to be more accurate, and is what was used in the analysis.

Results

193 women with complete data were analysed. Patient demographics are shown in Table 1.

Table 1. Patient demographics

Variables	Mean ± SD
Age	61 ± 11 yrs
Weight	74 ± 17 kg
Height	157 ± 30 cm
BMI	28 ± 6 Kg/m^2
Time since surgery	56.42 ± 37.48 (3-183 months)

Lymphoedema in our study was defined as ≥7.5% increase in any circumference in the operated arm compared to non operated (control) arm after arm dominance correction. A 7.5% increase in circumference at all points is comparable to 15.5% increase in volume using formula:

$$\text{Area} = C^2/4\text{pi}.$$

A 7.5% increase at just one point, therefore indicates a much smaller increase in arm volume. A 10% increase in arm circumference corresponds to a 20% increase in arm

volume, if this occurs at all points and considerably less if just at one point. A ≥20% increase in arm volume is defined as moderate lymphoedema by an International Consensus Group.[19]

We also calculated the prevalence of LO using several different thresholds used in the literature (Table 2).

Table 2. Prevalence of lymphoedema using subjective and objective criteria

Criteria used to define lymphoedema	Percentage (number)
Subjective 2+ score (a little arm swelling or more)	41.9% (81)
Subjective 3+score (quite a bit of arm swelling or very much)	10.8% (21)
Any measurement ≥10% increase in operated arm	12.9% (25)
All 3 measurements ≥10% in the operated arm	0.0% (0)
Any measurement ≥7.5% increase in operated arm	23.3% (45)
All 3 measurements ≥7.5 in the operated arm	1.0% (2)
Any measurements ≥5% in the operated arm	40.9% (79)
All measurements ≥5% in the operated arm	2.1% (4)
Any measurement ≥2cm increase in operated arm	25.3% (49)
Volume ≥20% increase in operated arm	8.2% (6/73)
Volume ≥15% increase in operated arm	9.6% (7/73)
Volume ≥10% increase in operated arm	19.1% (14/73)

In a subset of 73 patients out of 193, serial measurements were done along with 3 basic measurements and we calculated % increase in volume in the operated arm compared to the other arm as control by using Casley-Smith method.[17] In this subset, the prevalence of LO was 8.2%, 9.6% and 19.1% using volume increase cut offs of 20%, 15% and 10% compared to non operated arm respectively.

International consensus guidelines for management of LO[19] define the LO in terms of volume increase as Mild < 20%, Moderate 20-40% and Severe >40% volume increase in operated arm. None of our women developed severe LO. Prevalence of LO using subjective method—i.e. subjective arm swelling at any time since surgery, was 10.8% (3+ score) and 41.9% (2+ score). Prevalence using ≥ 2cm increase in any circumference in operated arm was 25.3%.

We calculated the sensitivity and specificity of the circumference and subjective methods by comparing ≥20% increase in the volume as gold standard in the subgroup of 73 patients (Table 3).

Table 3. Sensitivity and Specificity of Subjective and Objective methods:

Different methods to detect lymphoedema	Sensitivity	Specificity
Any measurement ≥7.5% inc Op arm	83%	81%
Any measurement ≥10% inc Op arm	66%	89%
Any measurement ≥2cm inc Op arm	66%	80%
Subjective 3+ (quite a bit and very much)	67%	93%

Based on that, a 7.5% increase in circumference in the operated arm compared to the non operated arm has a high sensitivity to detect LO but still will call 19% of women with mild or no LO as having LO. Concordance between subjective and objective measurements is shown in Table 4.

Table 4. Concordance between the subjective and objective measurements

Variables	**Y/N**	**≥7.5% increase in any measurement (Total 45)** ***Number (Percentage)***
Arm swelling score 3+	NO	31 (69%)
(quite a bit and very much)	YES	14 (31%)
Arm swelling score 2+	NO	11 (24%)
(a little arm swelling or more)	YES	34 (75%)

Variables	**Y/N**	**≥10 % increase in any measurement (total 25)** ***Number (Percentage)***
Arm swelling score 3+	NO	13 (52%)
(quite a bit and very much)	YES	12 (48%)
Arm swelling score 2+	NO	2 (8%)
(a little arm swelling or more)	YES	23 (92%)

Variables	**Y/N**	**Arm swelling 2+**	**Arm swelling 3+**
≥7.5% increase in any measurement	NO	47	7
	YES	34(42%)	14 (67%)
	Total	81	21

Concordance using ≥7.5% increase in any circumference criteria was 31% in 3+ and 75% in 2+ groups. Of patients describing LO swelling; 67% of women with score 3+ (14/21) and 42% (34/81) with score 2+ group had LO on arm circumference measurements respectively. It shows that there is not good concordance between patients describing swelling at any stage since surgery and actual increase in arm circumference, when the ≥7.5% threshold is used. Using 10% threshold for LO; 48% had Subjective LO. It shows this threshold has more concordance with patient symptoms.

Risk factors for LO—Table 5 shows the risk factors analysis based on univariate analysis. Increasing age, infection to operated arm, LN positivity and radiotherapy to axilla/breast were significant risk factors. On multivariate logistic regression (Table 6), increasing age (p=0.02), radiotherapy to axilla (p=0.02), radiotherapy to breast (p=0.03) and infection to operated arm (p=0.02) were significant risk factors for development of LO.

Level of axillary dissection, lymph node positivity, chemo or endocrine therapy and operating surgeon (consultant vs registrar) had no significance for development of LO.

Table 5. Risk factors for lymphoedema (univariate)

Variables	Any measurement ≥ 7.5%	
TNM	T1	25.3%
	T2	21.6%
	T3	26.7%
Age	≤51	14.3%
	52–61	15.9%
	62–71	31.6%
	72+	34.4%
Infection or cellulitis to operated arm	No	21.6%
	Yes	62.5%
Radiotherapy	No	11.8%
	to Breast	25.4%
	to Axilla	50.0%
Chemotherapy	No	23.7%
	Yes	22.9%
Operating surgeon	Consultant	24.8%
	Registrar	19.2%
Positive nodes	≤0	23.6%
	1 to 3	16.7%
	4+	38.5%
Level of dissection	L2	21.3%
	L3	34.5%

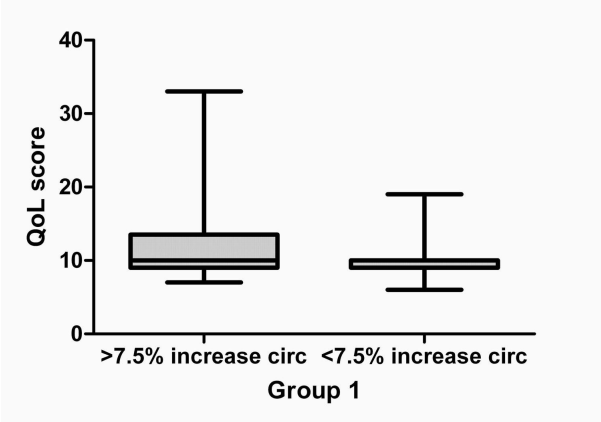
Table 6. Risk factors for lymphoedema (multivariate)

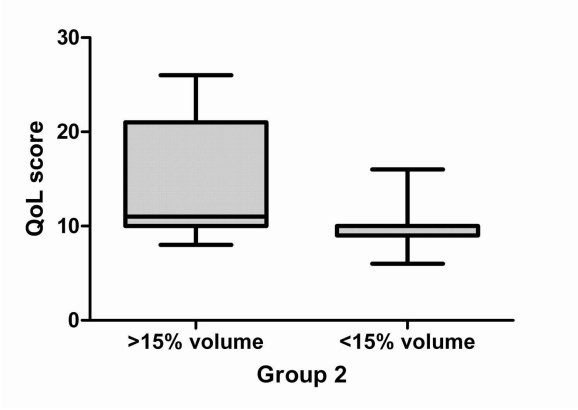
Variables	Odd ratio	P values
Age	1.1	0.02
BMI	1.1	0.08
Time since surgery	1.0	0.32
Operating surgeon	3.3	0.12
Level of axillary dissection	1.8	0.29
Lymph node positivity	1.0	0.49
Radiotherapy to breast	3.8	0.02
Radiotherapy to axilla	7.7	0.03
Chemotherapy	0.7	0.54
Endocrine therapy	2.1	0.14
Infection	6.7	0.02

Activities of daily living / QoL scores were summed and then the mean for the 193 women with arm circumferences compared using the ≥7.5% threshold and the 73 women with arm volume measures were compared using the 15% threshold. There was a significant increase in QoL scores in ≥15% volume increase group from mean of 9.9 to 14 with p-value <0.04. Mean scores were less significant in 7.5% increase in any circumference group(Table 7, Graph 1 & 2).

Table 7. Activities of daily living / QoL score

Variables	Mean ± SD	p-value
Any measurement ≥ 7.5% inc Op arm	12.5±5.7	<0.004
Any measurement < 7.5% inc Op arm	9.9±2.0	
Volume increase ≥ 15% Op arm	14±6.7	<0.04
Volume increase < 15% Op arm	9.9±1.6	





Discussion

There is a lack of international consensus on defining lymphoedema. This is due partly to different measurement techniques that are not directly correlated (including arm circumference measures, volume estimates from circumference, volume measurement by water displacement or infrared scanning and use of bioelectrical impedance).[2,8] In choosing a measurement technique, accuracy must be weighed up against ease of use.

In our study we used arm circumference measures as it is a quick procedure that can be done in the clinical setting with minimal expense on time or equipment. We adopted the protocol from IBCSG 10-93[16] which used 3 measurement sites for detection of LO. Volume measures by infrared or water displacement techniques are more accurate but require specialised equipment.

This study reports the rate of lymphoedema by several different criteria. This was done to enable comparison with other papers and to help determine the simplest and most accurate method of assessment.

Some women with lymphoedema only have swelling in one part of their arm and using a threshold increase at any single point enables detection of this. Using the percentage increase rather than an absolute measure {for example 2cm increase} takes into account the fact that to a large woman 2cm increase in the upper arm may be unnoticeable, but a smaller woman with a 2cm increase in circumference in the forearm or hand may have severe symptoms.

After choosing a measurement technique, the next step is choosing the threshold level at which a patient will be said to have lymphoedema. Listed below are some of the different definitions of lymphoedema found in a literature review using arm circumferences:

- ≥2cm difference in any circumference[4,8,6];
- ≥5% increase in circumference at any sites[(5- sensitivity 91%)]
- ≥10% increase in circumference at any site[(5- sensitivity 49%)]
- 5% difference in the sum of arm circumferences[2]
- >10% difference in the sum of arm circumferences[2]

The ≥2cm circumference yielded very similar results to the ≥7.5% increase in arm circumference group in our study, but in the subgroup with truncated arm volume measures, using a ≥2cm threshold was much less sensitive and specific. The ≥5% increase in circumference threshold for lymphoedema was too low in our study. It comes too close to the bounds of measurement error and gave a LO diagnosis rate of 41%. Using a ≥10% increase in circumference, our pick up rate was 12.9%. This threshold was also the most specific that we examined. The last 2 measures, lack adequate sensitivity.

Tewari et al[17] compared the volume displacement method with serial arm measurements and found out that there is a very high correlation ($p<0.0001$) between these two methods and recommended serial arm measurements for detection of LO. In our study we did serial measurements on 73 patients and found out that LO pick up rate using this technique was 9.6% and 19.1% using 15% and 10% increase in volume thresholds respectively. 15% threshold was used in SNAC trial group of RACS[18] and reported LO incidence of 6.9% in prospective manner which is comparable to our results. 10% increase in arm volume have been used by Bland KL et al.[5] to define LO.

International consensus for LO management[19] have defined LO based on percentage increase in volume as; Mild <20%, Moderate 20-40% and Severe >40% increase in arm volume. Based on this definition we had LO prevalence of 8.2%.

In our own data, a ≥7.5% increase in circumference at any site, appeared to be the most reasonable cutoff when the data were first examined, so this was used for the bulk of the analyses. However, of these women, 24% have never noticed any degree of arm swelling since surgery, and a further 45% have only had a little. Another common definition of mild lymphoedema is ≥2–5cm increase in arm circumference.

A cutoff of 7.5% falls right at the bottom of this range particularly for forearm, where LO was most commonly diagnosed. Using a definitions of LO from the SNAC Trial of ≥15% in arm volume, all three measures would have to increase by 7.5% (or some by much more than 7.5%) to meet the SNAC criteria—not just one. For an ≥20% for moderate LO from the International Consensus,[19] all three measures would have to increase by an average of 10%.

Only 2 women out of 193 had all 3 measures ≥7.5%. Using one measure increasing by ≥10% gets us closer to being consistent with these volume definitions, than the single measure ≥7.5%. Finally, using the ≥7.5% threshold, made very little difference in Activities of daily living / QoL mean score, from a numerical (i.e. practical perspective). On this basis, we considered the ≥7.5% threshold, is setting the cutoff too low, and not at an adequate level of specificity.

Many other studies used the pre-surgery volume of the arm as a control to be compared with later measurements. Our study instead used the opposite arm as a control. This is helpful in removing the effect of weight change over time (both arms should lose or gain weight equally), and to enable assessment when previous measures are not available. However it does raises the issue of handedness.

If the operated arm was the dominant arm, it is impossible to know if any difference is due to the lymphoedema or just the fact that the muscles of the dominant arm are larger due to greater use. Golshan and Smith[4] state that a >2cm circumferential difference is unlikely to be due to the dominant arm effect, and therefore any greater difference can be attributed to lymphoedema.

A strength of this study is that we have determined and used a correction factor for dominant arm based on measurements in subset of 105 women who said they never had arm swelling on subjective questionnaire and did not had any detectable swelling on measurement (at 7.5% threshold). This is an easy thing to do.

The subjective and objective measures showed poor concordance. This might be explained by the nature of the questions asked for subjective LO. Women were asked if they had experienced swelling of their arm at any time since surgery.

Some women may have had temporary swelling during the post-operative period, which was no longer there at time of assessment. Alternatively, some women may had LO successfully treated, so that minimal swelling was apparent at time of assessment. Our LO rate of 41.9% using subjective scores (2+, minimal symptoms), is comparable to the incidence of 38% reported in the Otago nursing study on lymphoedema published in 1997 based on subjective symptoms.[20]

Soren et al[7] assessed risk factors and how they affect the severity of lymphoedema. Soren study reported infection to operated arm, BMI and level of hand use to be significant risk factors for lymphoedema.

Our study had similar results for infection to operated arm as a significant risk factor for LO and we also found out that increasing age, radiotherapy to axilla or to the breast are also significant risk factor for LO. Increasing BMI showed a trend toward LO in our study on multivariate analysis and has been shown by others to be a significant factor.

Conclusions

- Measuring arm circumferences is easy and convenient office procedure to identify patients with LO and therapy can be started soon after with referral to LO specialist.
- Significant risk factors for LO are increasing age, infection or cellulitis to operated arm, radiotherapy to axilla and breast. These patients should be considered for more intensive LO screening so that referral and treatment may be started as early as possible.
- A 7.5 increase in any arm circumference above or below the elbow or at wrist was the most sensitive threshold to detect true cases of LO, but it lacks specificity and concordance with symptoms. We therefore recommend using a threshold of ≥10% increase in circumference at any site. This may readily be used for screening in clinic by clinicians and combined with subjective questions if clinician wish to improve sensitivity - the combination acting as a basis for referral to LO specialists.

Competing interests: None declared.

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The epidemiology of serious skin infections in New Zealand children: comparing the Tairawhiti region with national trends

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Abstract

Aim Serious skin infections are an increasing problem for New Zealand children with the highest national incidence in the Gisborne (Tairawhiti) region on the East Coast of New Zealand's North Island. This study aimed to describe the epidemiology of serious skin infections in children in this region, and make comparisons with equivalent national data to identify factors that might be contributing to elevated infection rates.

Methods Hospitalisation data were reviewed for 0–14-year-old children in the Tairawhiti region discharged from hospital with a serious skin infection between 1990 and 2007. A range of demographic variables were compared to equivalent data for New Zealand cases over the same period. The ratio of observed to expected discharges was calculated after indirectly standardising the Tairawhiti population age, ethnicity and deprivation composition to that of the total New Zealand population.

Results In Tairawhiti the age-adjusted incidence of serious skin infections increased from 641.1/100 000 in 1990–1999 to 988.4/100 000 in 2000–2007, while the New Zealand incidence increased from 354.3/100 000 to 531.7/100 000. Preschool-aged children, Māori children, and those living in deprived neighbourhoods had the highest infection rates in all regions. The disparity between Māori and non-Māori children was significantly greater in Tairawhiti than nationally. The standardised ratio of observed to expected discharges in Tairawhiti compared with New Zealand was 1.42 (95%CI 1.32–1.52) in 1990–1999 and 1.28 (95%CI 1.19–1.36) in 2000–2007.

Conclusions Serious skin infections are an increasing problem for all New Zealand children, but incidence rates in the Tairawhiti region are consistently greater than average national trends, with significantly larger ethnic disparities. The population composition of this region only partly accounts for the difference, suggesting the involvement of other unknown aetiological factors; these warrant further research.

Skin and subcutaneous tissue infections are a heterogeneous group of superficial bacterial infections, most commonly caused by opportunistic skin pathogens: *Staphylococcus aureus* and *Streptococcus pyogenes*.[1]

While these infections are usually effectively treated within the primary care setting, several international studies have recognised an increase in the number of cases serious enough to require hospitalisation.[2–4] This subset of more significant cases has been termed 'serious skin infections'.

In New Zealand (NZ) the increase has been particularly marked, with the rate of cellulitis double that of Australia and the United States of America.[5] Between the

years 1990 and 2007 the national incidence rate almost doubled,[6,7] making these infections one of the most common reasons for childhood hospitalisation.[8]

Within NZ significant inter-regional variation in the incidence of serious skin infections has been noted; these differences are hypothesised to be multi-factorial and in part reflect the distribution of population groups who are known to experience higher disease rates, notably Māori and Pacific children, children from lower socioeconomic backgrounds, and children less than 5 years old.[5–10]

The Tairawhiti (Gisborne) region and District Health Board (DHB) is a geographically isolated area of 45 000 people on the East Coast of NZ's North Island. The region is unique for its warm climate, large Māori population (47.3% of the total population and 58.0% of the 0-14 year old population), youthfulness (26.2% of people are aged less than 15 years old),[11] and high level of deprivation (the region has the largest proportion of highly-deprived residents in the country).[12]

In Tairawhiti, skin infections present a major challenge in both primary and secondary level care; recent research by the authors found that between 1990 and 2007 Tairawhiti District Health had the highest incidence of childhood serious skin infections out of all NZ DHBs.[6]

This study aimed to describe the incidence and epidemiology of serious skin infections in children in the Tairawhiti region over the period 1990–2007, to compare these local patterns to equivalent national data, and to determine whether the infection incidence observed in the Tairawhiti region is greater than that which is expected given the 'high-risk' population composition.

Methods

Case selection and data extraction—Hospital discharge data were obtained from the NZ Ministry of Health for all children aged 0-14 years, admitted at least overnight to a NZ public hospital between 1 January 1990 and 31 December 2007, with a principal or additional discharge diagnosis from a defined list of serious skin infection International Classification of Disease (ICD) codes (see Appendix 1 at the end of this article). Cases after July 1999 were identified using ICD-10 diagnostic codes, and cases prior to this date by ICD-9 codes which were forward and backward mapped from ICD-10.

This case definition was developed in recent work which found the validity of the former definition was markedly improved by including categories of skin infections previously overlooked in epidemiological analyses. With the addition of skin infections of atypical anatomical sites, those secondary to either primary skin disease or trauma, and those recorded as additional diagnoses (see Appendix), the sensitivity of the case definition increased from 61.0% to 98.9% with little loss in specificity.[13]

Each discharge record included a unique patient identifier (encrypted National Health Index number) enabling transfers and readmissions within 30 days with the same principal diagnosis code to be removed. To ensure a better match with the census population, overseas visitors were excluded. Day cases were excluded from the case definition due to inconsistencies in the recording of these events between regions and over time.

Patient variables including age, prioritised ethnicity, gender and home domicile code and admission variables such as the season, year, DHB, duration and outcome of admission were recorded and collated. Due to the small numbers of Pacific and other non-Māori ethnic groups in the Tairawhiti region, prioritised ethnicity used only two categories, Māori and non-Māori, with non-Māori including NZ European, Pacific, Asian and all other non-Māori ethnic groups.

Assigning levels of socioeconomic deprivation used the New Zealand Deprivation Index (NZDep) and was based on the home domicile census area units (CAUs) of cases. The NZDep is based on nine variables extracted from census data;[14] NZDep 1 indicates least deprivation and 10 indicates highest

deprivation. In 2.21% of cases domicile codes could not be linked to CAUs due to retired codes and addresses outside of classification.

To reduce the impact of these 'missing CAUs', retired domicile codes were linked to new codes using files from the Ministry of Health and Statistics NZ (R. Bishop, Statistics New Zealand, personal communication; CAU changes 1991-2006, Wellington, 2009; C. Lewis, New Zealand Health Information Service, personal communication; Domicile code mapping, Wellington, 2009).

Data analysis—The data were analysed using Microsoft Excel® and SAS®. Denominators in rate calculations were derived from usually resident population counts from the 1991, 1996, 2001, and 2006 censuses. Counts from each census were used to approximate the population in the preceding and subsequent two years. Age adjustment used the World Health Organisation (WHO) standard population. Trends between populations were explored by the calculation of rate ratios (RRs) with 95% confidence intervals (95% CIs) calculated using the log-transformation method.[15] Significant differences in RRs were indicated by a two-tailed p-value <0.05.

Indirect standardisation—The final part of this analysis used indirect standardisation to adjust for variables in the Tairawhiti population that could affect disease rates, and hence establish whether the observed incidence (or crude incidence) of serious skin infections in the region was in line with the incidence expected after taking into account the high-risk age, ethnicity and deprivation composition of the population.

Typically, direct standardisation is used to validly compare two or more groups that differ in health determinants, however this method requires a large population to ensure age, deprivation and ethnicity-specific rates remain stable. Due to the small numbers in some subgroups in the Tairawhiti population, direct standardisation could not be used.

Age/ethnicity/deprivation-specific rates were calculated using interpolated usually resident population counts by CAU from the 1991, 1996, 2001, and 2006 censuses. Indirect standardisation was used to standardise each variable, both individually and in combination, across two time periods (1990–1999 and 2000-2007) with NZ in total (including Tairawhiti) used as the standard population. Expected discharge numbers for each age/ethnicity/deprivation group were calculated by multiplying the national rates for that stratum by the usually resident population for that stratum in the Tairawhiti region. Five cases with unknown deprivation scores were excluded from this analysis.

The ratio of observed to expected (O:E) cases was then calculated. An O:E of '1' denoted the observed number of discharges was the same as the expected number, an O:E less than '1' indicated the observed number was less than the expected number and conversely an O:E greater than '1' indicated the observed number was greater than the expected number. Statistical significance was determined by calculating 95% confidence intervals for these ratios.

Results

Selection of cases, incidence and impact—In the Tairawhiti region a total of 1976 hospitalisations met the case definition. From this total, 10 (0.5%) overseas visitors, 50 (2.5%) transfers, 166 (8.4%) day cases, and 39 (2.0%) readmissions were excluded. This left 1711 (86.6%) cases of childhood serious skin infection for further analysis. Of these cases, 1 patient was reported to have been discharged dead from hospital (case fatality of 0.06%). Hospitalisation data recorded a total of 6459 hospital days over the study period. The median and mean lengths of stay were 2 and 3.8 days respectively.

In New Zealand during the same period there were a total of 82 408 hospitalisations which met the case definition. From this, 213 (0.3%) private hospital admissions, 955 (1.2%) overseas visitors, 3109 (3.8%) transfers, 12 353 (15.0%) day cases, and 1210 (1.5%) readmissions were excluded. Of the remaining 64 568 cases, 29 were reported to have been discharged dead from hospital (case fatality 0.04%). Hospitalisation data recorded a total of 213 141 hospital days over the study period. The mean and median lengths of stay were 2 and 3.3 respectively.

Table 1 shows the incidence of childhood serious skin infections in both the Tairawhiti region and NZ during 1990–1999 (ICD-9) and 2000-2007 (ICD-10). As recommended by the previous work developing the case definition, these data are disaggregated by category and level of diagnosis.[13] During the earlier time period, 1990–1999, the age-adjusted total incidence of infections in Tairawhiti was 641.1/100 000 while the total NZ incidence was slightly over half this rate at 354.3/100 000.

By 2000–2007 the incidence in Tairawhiti had increased by over 50% to 988.4/100 000, while that in NZ had increased by a similar proportion to 531.7/100,000. A more detailed version of this table is provided in the Appendix.

Table 1. The incidence of serious skin infections in children aged 0-14 years in Tairawhiti and NZ, disaggregated by category and level of diagnosis, between 1990–1999 (ICD-9) and 2000–2007 (ICD-10)

Category	Level of diagnosis	Tairawhiti region				New Zealand			
		1990–1999		2000–2007		1990–1999		2000–2007	
		No.†	Rate‡	No.†	Rate‡	No.†	Rate‡	No.†	Rate‡
Serious skin infections of typical sites (previously used case definition)	Principal All level	352 456	284.5 368.5	431 580	453.8 610.7	13541 17074	166.3 209.7	18177 24086	264.9 351.0
Serious skin infections of atypical anatomical sites	Principal All level	72 100	58.2 80.8	37 45	39.0 47.4	3170 5233	38.9 64.3	1866 2270	27.2 33.1
Serious skin infections secondary to primary skin disease	Principal All level	81 194	65.5 156.8	82 212	86.3 223.2	1406 5364	17.3 65.9	1909 6170	27.8 89.9
Serious skin infections secondary to external trauma	Principal All level	25 48	20.2 38.8	15 76	15.8 80.0	635 1270	7.8 15.6	420 3101	6.1 45.2
Crude total serious skin infections	Principal All level	530 798	428.3 644.9	565 913	594.9 961.4	18752 28941	230.3 355.4	22372 35627	326.0 519.2
Age-adjusted total serious skin infections	All level		641.1		988.4		354.3		531.7

ICD: international classification of disease.

†Total number of cases during time period.

‡Average annual incidence per 100 000 (based on usually resident population counts from NZ Census).

Incidence by year and season, 1990–2007—Figures 1 and 2 illustrate the incidence of serious skin infections in the Tairawhiti region and in the whole of NZ during each of the 18 years studied. Results are presented for incidence by category and in total. Between the years 1990 and 2007 the incidence of infections more than doubled in the Tairawhiti region (from 423.6/100 000 in 1990 to 952.6/100 000 in 2007), while the NZ incidence increased by just under double (from 298.0/100 000 to 547.3/100 000).

In both settings the increasing infection incidence was a direct reflection of increases in the incidence of serious skin infections of typical sites, along with a small contribution from infections secondary to primary skin trauma. Infections secondary

to primary skin disease increased less, and those of atypical sites declined over this period.

Figure 1. The incidence of serious skin infections in 0–14-year-old children in the Tairawhiti region by category and year, 1990–2007

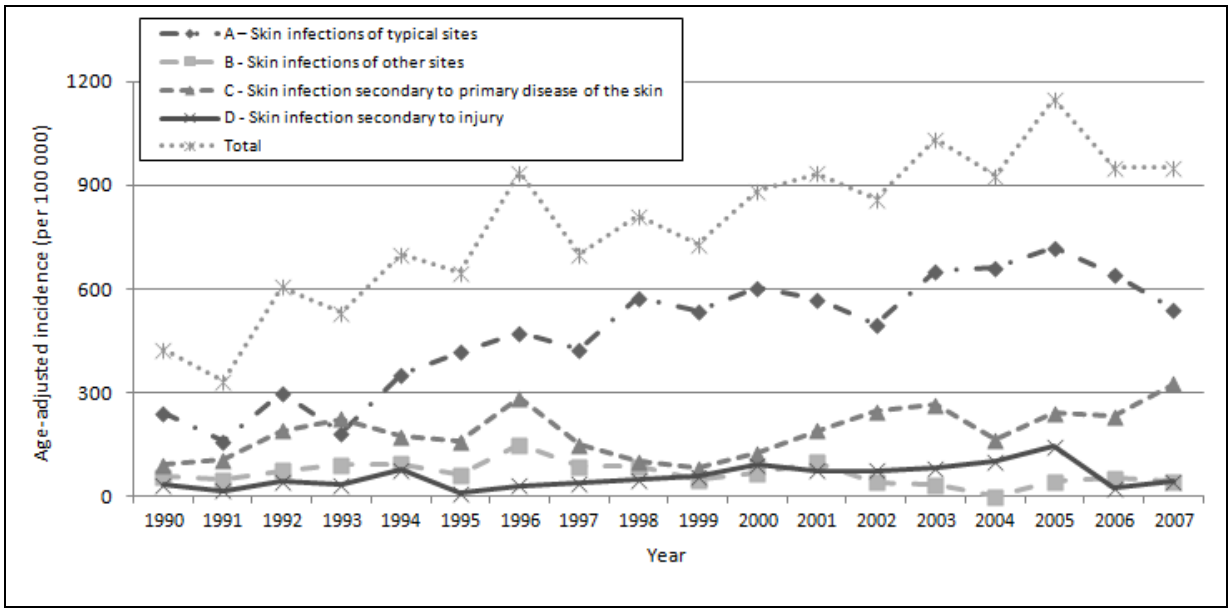

Figure 2. The incidence of serious skin infections in 0–14-year-old children in NZ by category and year, 1990–2007

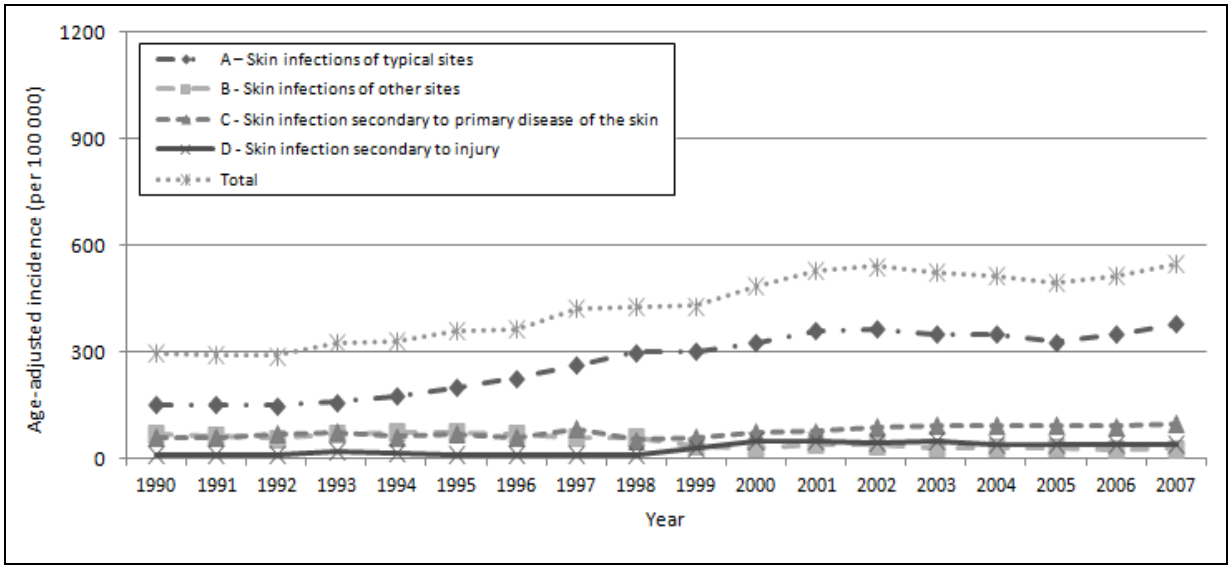

Table 2 shows the seasonal variation in the incidence of serious skin infections. In NZ, the crude incidence of infections was significantly higher during summer and

autumn compared to winter (RR 1.12 for both). This trend was less distinct in Tairawhiti, with no significant difference in the seasonal incidence of infections. There was, however, no statistically significant difference in this trend between Tairawhiti and NZ.

Table 2. The crude incidence of serious skin infections in 0-14 year old children by season, gender, age group, ethnicity and deprivation level for the Tairawhiti region and NZ, 1990–2007

Variable	Category	Tairawhiti region			New Zealand			Difference in RRs#
		Freq	Rate	RR (95% CI)	Freq	Rate	RR (95% CI)	*p*
Season†	Autumn	450	823.0	1.01(0.95-1.08)	17176	457.9	1.12(1.11-1.14)	0.42
	Winter	445	813.9	1.00*	15290	407.6	1.00*	
	Spring	391	715.1	0.88(0.82-0.94)	15000	399.9	0.98(0.97-0.99)	0.42
	Summer	425	777.3	0.96(0.90-1.02)	17102	455.9	1.12(1.11-1.13)	0.24
Gender	Male	935	834.1	1.15(1.09-1.20)	37349	485.7	1.31(1.30-1.32)	0.25
	Female	776	727.8	1.00*	27218	372.1	1.00*	
	Unknown				1			
Age	0-4 yr	988	1364.0	2.99(2.81-3.17)	36376	733.3	2.99(2.96-3.02)	1.00
	5-9 yr	394	530.9	1.16(1.08-1.25)	15873	316.0	1.29(1.27-1.30)	0.43
	10-14 yr	329	456.6	1.00*	12319	245.4	1.00*	
Ethnicity	Māori	1312	1068.0	2.56(2.43-2.71)	23736	694.8	1.97(1.96-1.99)	0.05
	Non-Māori	399	416.4	1.00*	40832	352.4	1.00*	
NZDep‡	1-2	18	262.2	1.00*	5313	207.3	1.00*	
	3-4	72	364.9	1.39(1.08-1.79)	7190	270.6	1.31(1.28-1.33)	0.90
	5-6	72	227.3	0.87(0.67-1.11)	9462	336.3	1.62(1.60-1.65)	0.03
	7-8	130	428.5	1.63(1.29-2.08)	14045	451.5	2.18(2.14-2.21)	0.17
	9-10	1414	1200.9	4.58(3.66-5.74)	28102	788.2	3.80(3.75-3.86)	0.21
	Missing§	5						
Total		**1711**			**64568**			

Freq: frequency of cases for the entire period; Rate: average annual incidence per 100 000; RR: rate ratio.

† Where Autumn is considered March, April, May; Winter is June, July, August; Spring is September, October, November; and Summer as December, January and February.

‡ The New Zealand Deprivation Index (NZDep) is a measure of socioeconomic deprivation based on nine variables extracted from census data.[14] NZDep 1 indicates least deprivation and 10 indicates highest deprivation.

§Missing refers to cases with domicile codes that could not be linked to CAUs.

*Arbitrary reference category.

Compares the RR of each variable between the Tairawhiti region and NZ, with $p<0.05$ indicating a statistically significant difference between settings.

Incidence by age, gender, ethnicity, and deprivation level, 1990–2007—Table 2 details the crude incidence of serious skin infections in both the Tairawhiti region and NZ by a range of patient characteristics.

Boys had a significantly greater risk of suffering a serious skin infection than girls in both settings, with an incidence of 834.1/100 000 in male children compared to 727.8/100 000 in female children in the Tairawhiti region (RR 1.15) and 485.7/100 000 compared to 372.1/100 000 in NZ (RR 1.31). There was no difference in this trend between settings (p 0.25).

The incidence of skin infections decreased with increasing age. Preschool-aged were at the greatest risk with three times the rate of infections compared with 10-14 year old children in both settings (RR 2.99 in Tairawhiti and NZ). While the Tairawhiti region had a greater incidence of serious skin infections in all age groups compared with the NZ population, there was no significant difference in the age-distribution between settings.

In the Tairawhiti region, the incidence of serious skin infections in Māori children was 1068.0/100 000, over double the non-Māori rate of 416.4/100 000 (RR 2.56). In NZ the incidence of infections was not only lower in both groups (Māori 694.8/100 000, non-Māori 352.4/100 000), but the disparity between them was significantly less (RR 1.97, p 0.05).

In both Tairawhiti and NZ the incidence of serious skin infections was lowest in areas of least deprivation and increased with rising deprivation levels. The ratio of deprivation appeared greater in the Tairawhiti region, where the incidence of serious skin infections in the most deprived children was over four times higher than the incidence in least deprived children (RR 4.58 in Tairawhiti compared with RR 3.80 in NZ), however this difference did not reach statistical significance.

Indirect standardisation—The results of the indirect standardisation analysis are presented in Table 3. From 1990 to 1999 there were 793 children living in the Tairawhiti region discharged from hospital with a diagnosis of a serious skin infection, double the crude expected number of 398.2 discharges (O:E 1.99, 95%CI 1.86–2.14). Between 2000 and 2007 there were 913 observed discharges, also double the crude expected number of 453.8 discharges (O:E 2.01, 95%CI 1.88–2.15).

Table 3. The ratio of observed to expected childhood serious skin infection discharges in the Tairawhiti region after indirectly standardising age, deprivation and ethnicity to the NZ population, 1990–1999 and 2000–2007

Period	Variable(s) standardised	Expected number of discharges	Observed number of discharges	Ratio observed to expected discharges (O:E)	95% CI
1990–1999	None (crude)	398.2	793	1.99	1.86–2.14
	Age	399.8	793	1.98	1.85–2.13
	Ethnicity	481.7	793	1.65	1.53–1.76
	Deprivation	545.6	793	1.45	1.35–1.56
	Age, ethnicity	478.2	793	1.66	1.54–1.78
	Age, deprivation	540.7	793	1.47	1.37–1.57
	Ethnicity, deprivation	567.4	793	1.40	1.30–1.50
	Age, ethnicity, deprivation	559.9	793	1.42	1.32–1.52
2000–2007	None (crude)	453.8	913	2.01	1.88–2.15
	Age	451.4	913	2.02	1.89–2.16
	Ethnicity	571.8	913	1.60	1.49–1.70
	Deprivation	676.9	913	1.35	1.26–1.44
	Age, ethnicity	559.6	913	1.63	1.53–1.74
	Age, deprivation	665.0	913	1.37	1.29–1.46
	Ethnicity, deprivation	730.2	913	1.25	1.17–1.33
	Age, ethnicity, deprivation	715.8	913	1.28	1.19–1.36

Age-standardisation produced little change in the expected number of discharges in either 1990–1999 (O:E 1.98, 95%CI 1.85–2.13) or 2000–2007 (O:E 2.02, 95%CI 1.89–2.16). Adjusting for the ethnic composition of the region produced more of an effect, reducing the number of observed discharges to 65% more than expected in 1990–1999 (O:E 1.65, 95%1.53–1.76) and 60% more in 2000–2007 (O:E 1.60, 95%CI 1.49–1.70). Deprivation-standardisation reduced the difference even further, although there were still 45% more observed than expected discharges in 1990–1999 (O:E 1.45, 95%CI 1.35–1.56) and 35% more in 2000–2007 (O:E 1.35, 95%CI 1.26–1.44).

After standardising the Tairawhiti population composition to that of the NZ population by age, ethnicity and deprivation in combination, the observed number of discharges was still 42% higher than the expected number of 559.9 cases in 1990–1999 (O:E 1.42, 95%CI 1.32–1.52) and nearly a third higher than the expected 715.8 cases in 2000–2007 (O:E 1.28, 95%CI 1.19–1.36).

Discussion

This is the first published study to describe the epidemiology of serious skin infections in children in the Tairawhiti region, an area of NZ with the highest national incidence of these infections. Findings showed that while serious skin infections are an important and increasing problem for all NZ children, the incidence in Tairawhiti is almost double that nationally, with no reduction in this difference over time.

During the last 18 years the observed infection rates been significantly greater than that expected, despite taking into account the higher risk population composition of this region. In addition, already large ethnic disparities in national infection rates are considerably wider in the Tairawhiti region.

The disparity between infection rates in Māori and non-Māori children in Tairawhiti was significantly greater than that observed nationally. In a region that is already suffering the highest incidence of infections nationally, and is home to one of the largest Māori populations in NZ, this inequality is of particular concern.

Māori generally experience higher rates of infectious diseases than non-Māori.[16] The reasons for this disparity are complex and multifactorial; they are likely to include household overcrowding, barriers to accessing primary healthcare and a range of socioeconomic factors.[16–20]

Pacific Peoples form an important and unique proportion of the NZ population that are known to suffer particularly high rates of skin infections.[9] Due to the small number of Pacific Peoples in the Tairawhiti region a separate analysis of this ethnic group (and likewise other ethnic groups) was not undertaken. It is worth noting that by not analysing Pacific Peoples separately, the disparity between infection rates in Māori and non-Māori children is likely to be underestimated.

Socioeconomic deprivation was an important risk factor for infection, with children from highly deprived neighbourhoods in the Tairawhiti region more than four times as likely to suffer a serious skin infection as their least deprived counterparts. Similar disparities were observed in the national population. This association has been described previously and is likely to be linked to ethnic inequalities as discussed

below. Other mediating factors are thought to include hygiene, nutrition, household crowding, and the ability to access timely medical care.[5-7,21-24]

In both Tairawhiti and NZ populations, boys and preschool-aged children were found to be at a greater risk of serious skin infections than girls and children over the age of 5 years. This finding could reflect an increased frequency of minor skin trauma in these groups or delays in seeking medical care. While it is unlikely that gender affects hospitalisation practices, it is possible that age trend is in part due to a lower threshold for hospital admission in younger children.

Interestingly, the usual seasonal trends in skin infection rates were not observed in the Tairawhiti region. Previous analyses have found the greatest incidence during the late Summer and early Autumn months,[2,5,6,8,10,22-26] thought to be due to warmer air temperatures leading to more frequent insect bites, deficiencies in hygienic precautions, and the wearing of loose clothing exposing skin to skin contact and minor trauma.[3,27,28] It is possible that the year-round warmer temperatures in the Tairawhiti region results in less seasonal fluctuation.

Previous work has suggested Tairawhiti DHB's elevated incidence of childhood serious skin infections could be solely due to the 'high-risk' population structure.[6] We investigated this hypothesis by using indirect standardisation to control for the age, ethnicity and deprivation composition of the region.

Adjusting for these population variables did reduce the difference between the number of skin infections observed and expected, with deprivation and ethnicity standardisation producing the largest reductions. However, even after taking all three factors into account, the observed rate of infections was still significantly greater than the expected rate, by 42% in 1990–1999 and 28% in 2000-2007. This persisting difference suggests that other unaccounted for or unknown factors are contributing to the high disease burden in the Tairawhiti region.

A proportion of the local population, particularly in rural settings, lacks reticulated water and relies on rainwater tanks leading to lack of sufficient water for washing in the dry summer months. Local rivers are often used for bathing in the summer. The effect of water supply and other local environmental factors on the development of skin infections warrants further investigation. Similarly it is important to investigate access to health services and the potential role that the local normalisation and acceptance of skin infections may play in delays in seeking medical care.

It is also possible that the risk of skin infection has a non-linear relationship with the size of the vulnerable population in a region. This outcome could be observed if there are high rates of carriage of the organisms causing skin infections in these same vulnerable population groups. Finally, it is possible that some of the difference between observed and expected infection incidence could be due to misclassification of risk categories, such as deprivation and ethnicity. The influence that this last factor may have had on the results is unknown.

Indirect standardisation is limited in that it cannot be used to compare a population over time, hence we could not analyse the changes in the ratios between 1990–1999 and 2000-2007. Likewise it cannot be used to compare different populations, such as other DHBs. Direct standardisation would enable these comparisons, but due to small numbers in some age-ethnic-deprivation groups, this analysis was not viable.

Hospitalisation data have strengths and weaknesses as a basis for the surveillance of serious skin infections. The main limitation of these data is that, by definition, they only represent the 'tip of the iceberg' and cannot on their own provide a measure of the total incidence of skin infections in the community. This is a limitation that is common to other areas of infectious disease epidemiology where the clinical condition is on a continuous disease spectrum and any case definition will be somewhat arbitrary.[29]

The strengths of this data source are that it is accessible and likely to be relatively sensitive as, by definition, serious skin infections are those skin infections which require overnight hospitalisation for treatment.[13] On this basis we used the term 'incidence' to describe hospitalisation rates. It is possible that the sensitivity of such surveillance has changed over time, such as the increased recording of day patients as admissions, however our use of a high threshold for inclusion (notably the requirement for a minimal one night admission) should minimise this effect.

Modifications to the ICD coding system may have contributed to changes in surveillance over time; despite using standardised mapping tables the frequency of some diagnoses varied markedly between the two periods studied (see Appendix). However, as there was a steady increase in the total infection incidence over the years when the major ICD revision occurred (from ICD-9 to ICD-10), the variation is likely to reflect inter-code and inter-category drift and gives further justification to our use of a more inclusive case definition than that used previously.

It is likely that the threshold for hospitalisation varies regionally; geographical and social considerations may favour overnight admission in Tairawhiti, while larger paediatric centres may be more equipped to admit children for day stay operative procedures rather than overnight. While these differences need to be considered, it is unlikely they account for more than a small proportion of the difference in incidence rates.

Finally, while age-adjusted rates were calculated for the overall incidence of infections, age stratified rates could not be obtained for all variables so crude rates are presented in some cases. However, both national and regional populations do not significantly differ with the WHO standard population, which indicates that age-standardisation for individual variables is unlikely to make a significant difference to our findings.

This study highlights a need for action to prevent serious skin infections in the children of both the Tairawhiti region and throughout NZ. Further work is required to better understand the cause of these infections and the measures which will most effectively reduce their incidence. Investigating the aetiological processes contributing to the development of serious skin infections in the Tairawhiti region could take the form of a retrospective case note review (see article entitled *Serious skin infections in children: a review of admissions to Gisborne Hospital (2006–2007)* in this issue of *The New Zealand Medical Journal)*, a prospective case series, or a case-control study, and would assist in determining areas to most effectively direct local interventions.

The epidemiology of skin infections in primary care and the wider population is largely unknown; future study in this area could improve our understanding of

whether inequalities in serious skin infection rates are a direct reflection of similar trends in the community (see article entitled *Skin infections in children in a New Zealand primary care setting: exploring beneath the tip of the iceberg* in this issue of *The New Zealand Medical Journal*).

In combination with the findings of this study, ongoing work could aid in reducing serious skin infection morbidity and narrowing health inequalities for children in both the Tairawhiti region and wider NZ.

Competing interests: None declared.

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Appendix 1. The incidence of serious skin infections in 0–14-year-old children in Tairawhiti and NZ, 1990–2007, disaggregated by ICD code, coding category and level of diagnosis

				Tairawhiti		New Zealand	
CATEGORY A ICD codes (skin infection sub-chapter of ICD-10)	**ICD-10**	**ICD-9**	**Level of diagnosis**	**Rate 1990-1999†**	**Rate 2000-2007†**	**Rate 1990-1999†**	**Rate 2000-2007†**
Impetigo	L01.0-L01.1	684	Principal	17.8	17.9	7.9	10.1
			All level	57.4	57.9	18.2	23.5
Cutaneous abscess, furuncle and carbuncle	L02.0-L02.9	6800-6809	Principal	18.6	185.3	9.4	107.4
			All level	21.8	208.5	11.1	118.3
Cellulitis	L03.01-L03.9	68100-68102, 68110, 68111, 6819-6829	Principal	225.5	209.5	126.5	122.6
			All level	250.5	268.5	146.7	160.3
Acute lymphadenitis	L0.40-L04.9	683	Principal	5.7	20.0	6.8	15.0
			All level	5.7	24.2	7.8	17.0
Pilonidal cyst with abscess	L05.0	6850	Principal	0.8	3.2	0.5	1.6
			All level	0.8	3.2	0.6	1.6
Pyoderma	L08.0	6860	Principal	0.8	0.0	0.4	0.7
			All level	0.8	6.3	1.2	6.6
Other infections of skin and subcutaneous tissue	L08.1,L08.8, L08.9	390, 6868-6869, 9101-9179, 9191-9199	Principal	15.4	17.9	17.5	7.7
			All level	31.3	43.2	24.1	23.7
Total			**Principal**	**284.5**	**453.8**	**166.3**	**264.9**
			All level	**368.5**	**610.7**	**209.7**	**351.0**
CATEGORY B ICD codes (serious skin infections of atypical anatomical sites)							
Erysipelas	A46	035	Principal	0.0	1.1	0.5	0.3
			All level	0.8	1.1	0.6	0.4
Hordeolum/cellulitis/abscess eyelid	H00.0	37311-37313	Principal	13.7	10.5	3.8	6.5
			All level	16.2	10.5	4.6	8.1
Abscess/cellulitis external ear and infective otitis externa	H60.0-H60.3, H62.0, H62.4	38010, 38011, 38013, 38014	Principal	9.7	9.5	7.4	5.5
			All level	21.0	15.8	12.0	7.8
Abscess/cellulitis nose	J34.0	4781	Principal	5.7	2.1	8.5	1.6
			All level	11.3	2.1	25.5	1.9
Anal abscess/cellulitis (excludes rectal, ischiorectal or intersphincteric regions)	K61.0	566	Principal	17.8	8.4	8.2	7.2
			All level	17.8	8.4	8.6	7.8
Acute inflammation/cellulitis/abscess of orbit	H05.0	37600-37601	Principal	8.9	0.0	7.2	2.1
			All level	10.5	0.0	9.0	2.3
Other inflammatory disorders of penis, scrotum and unspecified male genital organ (excludes deeper	N48.2,N49.2, N49.9	6072, 6084	Principal	1.6	4.2	1.8	1.4
			All level	2.4	5.3	2.4	2.2

tissues)							
Abscess/cellulitis of vulva	N76.4	6164	Principal	0.8	3.2	1.6	2.5
			All level	0.8	4.2	1.6	2.7
Total			**Principal**	**58.2**	**39.0**	**38.9**	**27.2**
			All level	**80.8**	**47.4**	**64.3**	**33.1**
CATEGORY C ICD codes (serious skin infections secondary to primary skin disease)							
Varicella with other complications	B01.8	0527-0528	Principal	9.7	11.6	2.9	3.9
			All level	12.9	12.6	3.6	4.6
Scabies	B86	1330	Principal	12.9	3.2	3.3	1.3
			All level	28.3	16.8	15.6	7.3
Dermatitis unspecified and other specified (eczema) and infective eczema‡	L30.8,L30.9, L30.3 0	6908, 6929, 7028	Principal	42.8	71.6	11.0	22.5
			All level	115.6	193.7	46.6	78.0
Total			**Principal**	**65.5**	**86.3**	**17.3**	**27.8**
			All level	**156.8**	**223.2**	**65.9**	**89.9**
CATEGORY D ICD codes (serious skin infections secondary to external trauma)							
Insect/spider bites	S10.13,S10.83,S10.93,S20.13,S20.33,S20.43,S20.83,S30.83,30.93,S40.83,S50.83,S60.83,S70.83,S80.83,S90.83,T00.9,T09.03,T11.08,T13.03,T14.03,T14.03,T63.3,T63.4	9104, 9114, 9124, 9134, 9144, 9154, 9164, 9174, 9192, 9194, 9198, 9248, 9895	Principal	15.4	12.6	5.8	4.2
			All level	27.5	15.8	7.9	6.6
Post-traumatic wound infection not elsewhere classified	T79.3	9583	Principal	3.2	3.2	1.9	1.6
			All level	8.1	10.5	5.4	6.7
Open wound infection with foreign body (+-infection) and open wound with infection	T89.01,T89.02	8799	Principal	1.6	0.0	0.1	0.3
			All level	3.2	53.7	2.2	31.9
Total			**Principal**	**20.2**	**15.8**	**7.8**	**6.1**
			All level	**38.8**	**80.0**	**15.6**	**45.2**

†Average annual incidence per 100 000 in 1990-1999 and 2000-2007 by discharge diagnosis code with Category A prioritisation (Categories B-D exclude admissions already included by a code in Category A, then by a code in Category B, then by a code in Category C).

‡The medical definition of infective eczema (a primarily inflammatory condition) is not in keeping with the clinical description of a serious skin infection, however due to similarities in terminology, this code is incorrectly used for eczema with a superficial bacterial infection.

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Serious skin infections in children: a review of admissions to Gisborne Hospital (2006–2007)

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Abstract

Aim Serious skin infections are an important and increasing problem in New Zealand children. The highest national rates are in the Tairawhiti (Gisborne) region on the East Coast of New Zealand's North Island, where evidence of significant ethnic disparities exists. This study aimed to describe the characteristics of serious skin infections in children hospitalised in the Tairawhiti region.

Methods The hospital charts of all children aged 0–14 years admitted to Gisborne Hospital between 1 January 2006 and 31 December 2007 for a serious skin infection were retrospectively reviewed and data on a range of variables analysed.

Results There were 163 cases of serious skin infections during the study period with 83% occurring in Māori children. The most common types of infection were cellulitis (38%) and subcutaneous abscesses (36%), and the most frequent sites of infection were the head, face and neck (32%) and lower limbs (32%). A previous episode of skin infection was recorded in 34% of children, with previous hospitalisation in 12%. A skin injury preceded infection in 37% of cases, more than reported in the Auckland and Wellington regions. Of the 77% of children who saw a GP 60% required immediate hospital admission. Compared with figures from the Auckland region, there were longer delays to medical care with a mean duration of symptoms of 2.5 days prior to visiting a GP. The most frequently isolated organisms were *Staphylococcus aureus* (48%) and *Streptococcus pyogenes* (20%) with similar proportions and resistance patterns to other New Zealand settings.

Conclusions The characteristics of serious skin infections in the Tairawhiti region are largely similar to those reported in other New Zealand regions. However, some differences in preceding skin injuries and delays in seeking medical care exist which may contribute to the high incidence of hospitalised infections in the region. These differences require further investigation.

Skin and subcutaneous tissue infections are a heterogeneous group of infections predominantly caused by *Staphylococcus aureus (S. aureus)* and *Streptococcus pyogenes (S. pyogenes).*[1] They are common childhood complaints in primary care, where they are usually adequately treated (see companion skin infection articles in this issue of the *New Zealand Medical Journal).* However in an increasing number of cases worldwide, failed or delayed outpatient therapy is leading to more severe disease, requiring costly hospitalisations for often invasive treatment.[2–5]

In New Zealand (NZ), the incidence of serious skin infections in children has almost doubled between 1990 and 2007.[5] This increasing disease burden results in important health, social and economic consequences (in 2007 the estimated direct hospitalisation costs alone of these infections was NZ$15 million).[5] These infections

also contribute to ethnic and deprivation-related health inequalities with evidence of worsening disparities over time.[5]

In NZ, serious skin infection rates are known to be highest in Māori and Pacific Island children, children younger than 5 years old, boys, children living in deprived neighbourhoods and urban areas, and Northern districts of the country.[5]

Risk factors for infection have been reported in a number of international studies as household crowding, close skin to skin contact, undernourishment, low socioeconomic status, poor hygiene, shared bathing, sharing of soap, minor skin trauma, eczema, chickenpox, insect bites, scabies, recent seawater contact, and warm humid climates.[6–20] While there are a number of recent national and regional reports,[21–25] there are no published studies examining these risk factors in the NZ setting.

Gisborne (Tairawhiti) is a region of NZ where skin infections present a major challenge to the health system; the incidence of serious skin infections in children is the highest out of all NZ regions, with evidence of significantly greater ethnic disparities.

During the period 1990–2007 the observed incidence of infections in the Tairawhiti region was significantly greater than that expected, even after standardising for the high-risk age, ethnicity and deprivation population composition (see this issue of *The New Zealand Medical Journal).*

This study follows on from that work and aimed to further describe the characteristics of serious skin infections in children of the Tairawhiti region to identify any features that might explain the high burden of disease.

Methods

A retrospective review was undertaken of clinical notes from all children aged 0-14 years admitted overnight to Gisborne Hospital between 1 January 2006 and 31 December 2007 with a principal or additional diagnosis of serious skin infection.

The Tairawhiti region is a relatively isolated area of 45 000 people on the East Coast of NZ's North Island. The region experiences a warm year-round climate and is unique for its large Māori population (47.3% of the total population), youthfulness (26.2% of people are aged less than 15 years old),[26] and high level of deprivation (the region has the largest proportion of highly-deprived residents in the country).[27] Gisborne Hospital is a 120-bed secondary referral centre which provides inpatient and outpatient health services for the region.

Cases of serious skin infections were identified using a defined list of skin infection International Classification of Disease Tenth Revision (ICD-10) codes; this definition was developed in earlier work by the authors and the ICD-10 codes are listed in Appendix 1.[28] Day cases, overseas visitors, transfers and readmissions within 30 days with the same diagnosis were excluded.

The clinical notes of all selected patients were reviewed by one investigator (CO). Information on patient demographics, prioritised ethnicity, social and environmental characteristics, past medical history, clinical findings, precipitating events, progress and outpatient management of the current infection, investigations, inpatient management and outcome were recorded on a standardised data collection form.

Levels of socioeconomic deprivation were assigned based on the patient's home address using the New Zealand Deprivation Index (NZDep); a neighbourhood index based on nine variables extracted from census data where NZDep 1 indicates least deprivation and 10 indicates highest deprivation.[29] Information was primarily collected from the records of the current admission, but previous admission notes, general practitioner referral letters and computerised investigation results were reviewed if relevant.

Raw data were entered into Microsoft Excel® and analysed in EpiInfo™ (version 3.4.3, Centers for Disease Control and Prevention). Confidence intervals for proportions were calculated using the Wald method.

Regional Ethics Committee approval was sought and granted for this study.

Results

There were 161 children with 163 discrete cases of serious skin infection admitted to Gisborne Hospital between 1 January 2006 and 31 December 2007. These 163 cases accounted for 2.8% of the 5876 serious skin infection paediatric admissions to all NZ hospitals over the study period. Appendix 2 provides a detailed breakdown of patient characteristics and Appendix 3 summarises inpatient investigations, management and outcome of cases.

Demographics and environmental characteristics—The mean age of patients was 4.64 years with over half of children in the preschool age group. Males accounted for 54% of cases. Eighty-three percent (n=135) of children were Māori, 14% (n=23) were NZ European/Pakeha, 2% (n=4) Pacific, and the remaining 1% (n=1) other ethnicities. Almost half of cases came from households with residents who smoke, solely outside in 36% of cases and both inside and outside in 13% of cases. The mean number of usual household residents was 5.44 people (range 2-11). Forty-one percent of children measured greater or equal to the 90th weight percentile, with mean weight in the 67th percentile.

Past medical history—Fifty-six children (34%) had a recorded history of at least one previous skin infection, with a further 47 (29%) having no documentation of this in their notes. In 20 of the 56 children (12% of total) the previous skin infection was serious, requiring hospitalisation. Ten patients (6%) had a potentially significant pre-existing or concurrent medical condition recorded; these included prematurity (4), impaired glucose tolerance (1), behavioural disorders (1), iron deficiency anaemia (2), Downs' Syndrome (1), and juvenile arthritis requiring systemic immunosuppressants (1).

Clinical presentation—The two most common subtypes of infection were cellulitis and subcutaneous abscesses accounting for 38% and 36% of cases respectively. A superficial bacterial infection of a pre-existing skin condition such as eczema, scabies or chickenpox was present in 14% of cases, impetigo in 5%, acute lymphadenitis in 4%, and other specified types of skin infection in the remaining 3% of cases. The head, face and neck and the lower limbs were the most frequently involved sites (32% of cases each), followed by the trunk, groin and buttocks (18%), and upper limbs (11%). Multiple site involvement occurred in 7% of children.

Predisposing conditions and pre-hospital management—Just over one-third (37%) of children had a recorded history of trauma to the skin in the 2 weeks prior to the development of the infection. These injuries ranged in type and severity; Table 1 details the individual causes of injury and compares the frequency of these to that documented in previous reports on the Wellington and Auckland regions.[22,23] The Tairawhiti region had the highest percentage of cases with a preceding injury identified overall. There was some variation in the distribution of individual causes of injury between the regions; Tairawhiti had the greatest proportion of insect bite/sting related trauma, sports injuries and cuts by a sharp object.

Table 1. Identified causes of injury in children with trauma-related serious skin infections in the Tairawhiti, Wellington and Auckland regions

Cause	Tairawhiti (%) 2006–2007 (n=163)	Wellington (%) 1996–2003[22] (n=1199)	Auckland (%) 1994–1998[23] (n=2055)
Insect bite/sting	37.7	20.8	30.0
Accidental fall	9.8	15.1	15.0
Cut by sharp object	24.6	11.3	22.0
Animal related injury	3.3	8.8	1.0
Struck by person or object	4.9	8.2	12.0
Motor vehicle/cycle or pedestrian accident	0.0	6.9	6.0
Sports injury	4.9	3.8	2.0
Complication of surgical procedure	1.6	2.5	2.0
Vaccination related or iatrogenic	0.0	2.5	2.0
Other or unspecified	13.1	20.1	8.0
Total % of cases with preceding injury/trauma identified	**37.0**	**13.3**	**29.0**

Forty-two percent of children had a recorded history of a chronic or sub-acute skin pathology preceding the development of infection. These conditions included eczema (16%), school sores (10%), scabies (6%), varicella (4%) and other conditions (6%).

Over three-quarters (77%) of children consulted their general practitioner prior to eventual hospital admission with the median duration of skin infection symptoms prior to this consultation found to be 2 days (mean 2.5 days, range <24 hours to >7 days). Forty percent of children who visited their GP had a course of outpatient antibiotics trialled prior to hospitalisation, the remaining 60% were referred for admission immediately. The median duration of skin infection symptoms prior to hospital admission was 2 days (mean 4.0 days) and ranged from less than 24 hours to longer than a week.

Table 2 details the health conditions and management preceding infections in both Māori and non-Māori children. While the number of non-Māori children was too small to enable statistically valid comparisons, the absolute percentages of each variable are not widely divergent. The largest absolute differences are seen in the number of children with a previous serious skin infection; 13% of Māori children and 7% of non-Māori children, and the proportion of cases where antibiotics were started by the GP; 42% of Māori cases and 60% of non-Māori cases. Little absolute ethnic difference is found in the history of a previous skin infection or skin pathology, the frequency of consulting a GP and the duration of symptoms prior to seeking medical attention.

Table 2. Predisposing conditions and pre-hospital management of serious skin infections in 0–14-year-old Māori and non-Māori children in the Tairawhiti region, 2006–2007

Variable	Total(%)	Māori (n=135)		Non-Māori (n=28)	
		f	% (95% CI)	*f*	% (95%CI)
Previous skin infection					
Yes	56 (34)	47	35(27.3–43.2)	9	32(17.8–50.8)
No	60 (37)	49	36(28.7–44.7)	11	39(23.5–57.6)
Not recorded	47 (29)	39	29	8	29
Previous serious skin infection					
Yes	20 (12)	18	13(8.5–20.2)	2	7(0.9–23.7)
No	139 (85)	113	84(76.5–89.1)	26	93(76.3–99.1)
Not recorded	4 (3)	4	3		0
Skin injury/trauma					
Yes	61 (37)	53	39(31.4–47.7)	8	29(15.1–47.2)
No	94 (58)	75	56(47.1–63.7)	19	68(49.2–82.2)
Not recorded	8 (5)	7	5	1	4
Skin pathology†					
Yes	68 (42)	58	43(34.9–51.4)	10	36(20.6–54.3)
No	91 (56)	73	54(45.7–62.2)	18	64(45.8–79.3)
Not recorded	4 (2)	4	3	0	0
Duration prior to admission					
<24 hours	24 (15)	20	15(9.7–21.9)	4	14(5.1–32.1)
1 day	23 (14)	19	14(9.1–21.0)	4	14(5.1–32.1)
2 days	28 (17)	26	19(13.4–26.8)	2	7(0.9–23.7)
3 days	25 (15)	20	15(9.7–21.9)	5	18(7.4–36.1))
4 days	12 (7)	11	8(4.5–14.1)	1	4(<0.01–19.2)
5 days	5 (3)	5	4(1.4–8.6)	0	0
6 days	4 (3)	4	3(0.9–7.6)	0	0
≥7 days	25 (15)	17	12(7.9–19.3)	8	29(15.1–47.2)
Not recorded	17 (11)	13	10	4	14(5.1–32.1)
Mean/median (days)	*3.96/2*	*3.81/2*		*4.71/3*	
Consulted general practitioner					
Yes	126 (77)	106	79(70.8–84.7)	20	71(52.8–84.9)
No	37 (23)	29	21(15.4–29.2)	8	29(15.1–47.2)
Duration prior to consulting GP					
<24 hours	23 (14)	20	15(9.7–21.9)	3	11(2.9–28.0)
1 day	25 (15)	22	16(11.0–23.5)	3	11(2.9–28.0)
2 days	23 (14)	19	14(9.1–21.0)	4	14(5.1–32.1)
3 days	17 (10)	14	10(6.2–16.8)	3	11(2.9–28.0)
4 days	9 (6)	8	6(2.9–11.4)	1	3(<0.01–19.2)
5 days	3 (2)	2	2(<0.1–5.6)	1	3(<0.01–19.2)
6 days	2 (1)	2	2(<0.1–5.6)	0	0
≥7 days	8 (5)	8	6(2.9–11.4)	0	0
Not recorded	16 (10)	11	8(4.5–14.1)	5	18(7.4–36.1)
Not applicable	37 (23)	29	21	8	29(15.1–47.2)
Mean/median (days)	*2.45/2*	*2.51/2*		*2.03/2*	
Antibiotics started by GP					
Yes	50 (40)	45	42(33.5–52.0)	12	60(38.6–78.2)
No	76 (60)	61	58(48.0–66.5)	8	40(21.8–61.4)
Not applicable	37	29		8	
TOTAL	**163 (100)**	**135**	**100**	**28**	**100**

f Frequency of variable; †Skin pathologies include eczema, dermatitis, chicken pox, scabies, school sores, or any other chronic or sub-acute skin condition that could predispose to infection.

Investigations—Ninety-nine children (61%) had blood drawn for laboratory analysis; of these two-thirds (66/99) had a white cell count above the reference range (4.0-13.4 x 10^9/L), 36% (36/99) had a c-reactive protein greater than 5mg/L, and 29% (29/99) had an elevated platelet count (above the reference range 150-400 x 10^9/L). Eighty-one children (50%) had blood cultures taken with significant growth in 2 patients; both were methicillin-sensitive *S. aureus* (MSSA).

Just over half of patients (52%) had a microbiological swab taken with growth in 88% of cases; the most common organisms isolated were *S aureus* (40/84), *S pyogenes* (17/84) and a combination of both (9/84). There were no cases of methicillin-resistant *S. aureus* (MRSA) isolated during the study period. Ultrasonography of subcutaneous tissues was used in 3% of all cases (5/163) and computer tomography assisted diagnosis in one case.

Treatment—Ninety-six percent of patients received antibiotics during their admission, with just over two thirds (70%) of these being administered intravenously (IV), 29% orally and 1% intramuscularly. Flucloxacillin was the most common IV antibiotic prescribed, being given to 56% of patients overall and 84% of those receiving IV antibiotics.

Augmentin was prescribed in 11% of cases and was most frequently used for infections involving the face, head and neck and those related to an animal or human bite. Macrolide antibiotics and cephalosporins were prescribed in the remaining 2% and 3% of IV cases respectively. The median length of IV antibiotic administration was 2 days (mean 2.5 days, range 0.5-10 days). Surgical management, such as incision and drainage or debridement, was required in 31% of all cases. A large proportion of these surgical procedures were performed under general anaesthetic.

Length of stay, complications and outcome—The median length of stay was 3 days (mean 3.9). While this ranged from 1-14 days, just under two thirds (65%) of cases were admitted for three days or less. Most admissions were medically uneventful, but 6 children (4%) experienced a potentially serious complication; these included new abscess formation (3), osteomyelitis (1), febrile convulsion (1), and sepsis/septic shock (2). Four children required transfer to a specialist paediatric referral centre; in all cases this was due to young age and the requirement for a surgical procedure. There were no deaths during the study period.

Discussion

To our knowledge this is the first published study to report the characteristics of serious (hospitalised) skin infections in NZ children. Serious skin infections are a diverse group of conditions, with cellulitis and subcutaneous abscess the most common subtypes in our series. These infections occurred in mainly healthy children from a range of backgrounds, but in keeping with the findings of previous reports, Māori children, boys and children in the preschool age group were overrepresented.[5,21-25] (see article entitled *The epidemiology of serious skin infections in New Zealand children: comparing the Tairawhiti region with national trends* in this issue of the *New Zealand Medical Journal*).

Ethnic disparities in disease rates in NZ children are not unique to skin infections; similar patterns are noted for many infectious diseases[30,31] and are thought due to household crowding, barriers to accessing healthcare and a range of socioeconomic factors.[30-35]

Compared with data from unpublished studies in Wellington and Auckland,[22,23] a greater proportion of serious skin infections were preceded by an identified skin injury in our series. We hypothesise this difference could be related to the warmer climate of the Tairawhiti region. Increased environmental air temperature has been linked to higher frequencies of insect bites and subsequent rises in impetigo incidence.[20] In addition, increased skin exposure due to individual, socioeconomic and climatic factors may raise the rate of both insect bites and other minor skin injuries.

While differences in the size and methodology of our study compared with that used in the Wellington and Auckland studies must be taken into account, the high burden of disease in Tairawhiti could in part be explained by the hypothesis that more frequent minor skin injuries in local children in general lead to a higher incidence of skin infections overall.

We were unable to find any reliable comparative data for the proportion of serious skin infections preceded by sub-acute or chronic skin pathology in other settings, but with the identification of such a condition in 42% of cases in our series, this seems to be an important risk factor.

Eczema was particularly recognised as a frequent precipitant to infections and NZ has one of the highest reported rates of childhood eczema in the world;[36,37] multiple macroscopic and microscopic breaches in the skin surface, itching leading to further skin damage and the introduction of sub-ungal microorganisms, and increased bacterial colonisation of chronically damaged skin can all predispose to infection.[38,39]

The lower limbs and the head, face and neck were equally the most commonly affected sites in our study. Other authors have reported a predominance of lower limb infections and have reasoned this is likely to be a result of frequent minor trauma to the legs;[9,19,23] we agree with this hypothesis and note its particular relevance to the climate of the Tairawhiti region as described above. The equally high incidence of infections of the head, face and neck has not been observed in other settings, and may be due to regional differences in the mechanisms of skin barrier disruption, with higher rates of infections secondary to insect bites in Tairawhiti.

The number of children suffering a recurrence of skin infection, especially those 12% who had previously been hospitalised at least once for a serious skin infection, is concerning. It suggests that opportunities to modify relevant risks, such as delays to medical care, are being missed at the time of initial infection and that secondary prevention efforts by health providers need further improvement and resourcing. Comparative data from other settings were not available.

The 77% of children who saw their GP prior to hospital admission is somewhat less than the 93% reported in a currently unpublished Starship Hospital cellulitis case series,[40] and may reflect difficulties in accessing primary care for functional, geographic, socioeconomic and cultural reasons.

The mean duration of symptoms prior to consulting a GP was also significantly longer in this series compared to the Starship study[40] (2.5 days compared with 1.5 days respectively). This delay is likely due to similar barriers, but may also be contributed to by the normalisation of skin infections in the Tairawhiti region; a locally recognised phenomenon, likely due to the persistently high incidence of disease.

In addition, the proportion of children referred immediately for hospital admission was 60% in this series compared with 40% in the Starship study. This difference could directly relate to delayed first presentation resulting in more serious infection, or may be due to lower referral thresholds caused by geographical and socioeconomic factors in the region.

The ethnic distribution of predisposing conditions and pre-hospital management is notable, with small absolute differences observed in a number of areas. However our study does not have enough power to detect statistically significant differences between the two groups due to the small number of non-Māori children in the series and resulting wide confidence intervals. A similar study with a larger non-Māori sample size is needed to provide sufficient statistical power to investigate these ethnic differences.

The diagnosis of skin infection was primarily based on clinical signs and symptoms, with infrequent need for any investigations beyond basic haematology, biochemistry and microbiological testing. It is unclear whether even these tests were necessary for diagnostic purposes in the majority of cases; the Starship Hospital Cellulitis Clinical Guideline states investigations are not indicated in most children with cellulitis/subcutaneous abscess as they are of little diagnostic value.[41]

The types and proportions of causative organisms isolated were in keeping with those reported in previous NZ reviews,[25] suggesting no difference in local microbiological patterns that might explain higher rates of disease. In addition, during 2006 the incidence of antibiotic resistance was lower in Gisborne Hospital *S aureus* isolates than comparative isolates nationally.[42]

Treatment was primarily antibiotic-based with the majority administered intravenously; the 30% of children who did not receive IV treatment yet still required hospitalisation were either those where a surgical procedure was the primary treatment or where intensive topical skin cares were required in addition to oral antibiotic therapy, such as in cases of superficially infected eczema. The 4% who did not receive antibiotics were short admissions for drainage of a small abscess with antibiotics commenced on discharge.

Besides the small non-Māori sample size discussed above, this study had several other limitations. The study relied on retrospectively reviewing information recorded in standard hospital notes; in some cases these data were unavailable or unclear, resulting in high rates of ‘not recorded’ for some variables and the inability to investigate others.

Comparisons between the Tairawhiti region and other NZ settings largely relied on data in unpublished regional reports; differences in infection characteristics could be due to variations in study methodologies in addition to true differences.

This study has described factors contributing to the development of serious skin infections in the children of the Tairawhiti region. It has highlighted areas where variation in infection characteristics may account for some of the inter-regional differences in observed incidence rates. A case-control study should be considered to further explore these risk factors and quantify their importance with a specific examination on differences between Māori and non-Māori children. It would also be useful to describe characteristics and risk factors for skin infections in the primary care setting (see article entitled *Skin infections in children in a New Zealand primary care setting: exploring beneath the tip of the iceberg* in this issue of the *New Zealand Medical Journal*).

Robust information on these risk factors is critical to the design of evidence based interventions to reduce the high rate of serious skin infections and the large and widening ethnic disparities for children of the Tairawhiti region.

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Appendices

Appendix 1. International Classification of Disease Tenth Revision (ICD-10) diagnosis descriptions and codes included in study case definition

Diagnosis description	ICD-10 code(s)
Impetigo	L01.0-L01.1
Cutaneous abscess, furuncle and carbuncle	L02.0-L02.9
Cellulitis	L03.01-L03.9
Acute lymphadenitis	L0.40-L04.9
Pilonidal cyst with abscess	L05.0
Pyoderma	L08.0
Other infections of skin and subcutaneous tissue	L08.1, L08.8, L08.9
Erysipelas	A46
Hordeolum/cellulitis/abscess eyelid	H00.0
Abscess/cellulitis external ear and infective otitis externa	H60.0-H60.3, H62.0, H62.4
Abscess/cellulitis nose	J34.0
Anal abscess/cellulitis (excludes rectal, ischiorectal or intersphincteric regions)	K61.0
Acute inflammation/cellulitis/abscess of orbit	H05.0
Other inflammatory disorders of penis, scrotum and unspecified male genital organ (excludes deeper tissues)	N48.2, N49.2, N49.9
Abscess/cellulitis of vulva	N76.4
Varicella with other complications	B01.8
Scabies	B86
Dermatitis unspecified and other specified (eczema) and infective eczema†	L30.8,L30.9,L30.3 0
Insect/spider bites	S10.13, S10.83, S10.93, S20.13, S20.33, S20.43, S20.83, S30.83, 30.93, S40.83, S50.83, S60.83, S70.83, S80.83, S90.83, T00.9, T09.03, T11.08, T13.03, T14.03, T14.03, T63.3, T63.4
Post-traumatic wound infection not elsewhere classified	T79.3
Open wound infection with foreign body (+-infection) and open wound with infection	T89.01, T89.02

†The medical definition of infective eczema (a primarily inflammatory condition) is not in keeping with the clinical description of a serious skin infection, however due to similarities in terminology, this code is incorrectly used for eczema with a superficial bacterial infection.

Appendix 2. Demographic, social and environmental characteristics of 0-14 year old children with serious skin infections in the Tairawhiti Region, 2006–2007

Characteristic	Description	Number (%)	Mean
Age (years)	0-4	95 (58)	4.64
	5-9	39 (24)	years
	10-14	29 (18)	
Gender	Male	88 (54)	
	Female	75 (46)	
Ethnicity	NZ Māori	135 (83)	
	Pacific Island	4 (2)	
	NZ European/Pakeha	23 (14)	
	Other European	1 (1)	
Weight percentile	≤10th	13 (8)	67th
	25th	17 (11)	
	50th	33 (20)	
	75th	28 (17)	
	≥90th	66 (41)	
	Not applicable†	5 (3)	
Household smoking status	No smokers	27 (17)	
	Outside smokers only	59 (36)	
	Inside and outside smokers	22 (13)	
	Not recorded	55 (34)	
Number of people in household	2-3	12 (7)	5.44
	4-5	84 (52)	
	6-7	37 (23)	
	8-9	8 (5)	
	10-11	10 (6)	
	Not recorded	12 (7)	
Significant past medical history	Yes	10 (6)	
(excluding previous skin infections)	No	153 (94)	
TOTAL		**163 (100)**	

† Due to inconsistencies in gestation accuracy and the largely maternal determinant of birth weight, weight percentiles were not calculated in children younger than 1 month old.

Appendix 3. Inpatient investigations, management and outcome of 0–14-year-old children with serious skin infections in the Tairawhiti Region, 2006–2007

Variable	Description	Number (%)	Mean
Length of stay (days)	1-3 days	105 (65)	3.87
	4-6 days	30 (18)	days
	7-9 days	12 (7)	
	10-12 days	9 (6)	
	≥13 days	7 (4)	
Blood drawn for analysis	No	64 (39)	
	Yes	99 (61)	
	- *Leucocytosis (>13.4 x 10^9/L)*	*66 (66)*	
	- *Elevated CRP (>5mg/L)*	*36 (36)*	
	- *Thrombocytosis (>400 x 10^9/L)*	*29 (29)*	
Blood cultures taken	No	82 (50)	
	Yes	81 (50)	
	- *No growth*	*76 (94)*	
	- *Contaminant growth only†*	*3 (4)*	
	- *Staphylococcus aureus*	*2 (2)*	
Microbiological swabs taken	No	79 (48)	
	Yes	84 (52)	
	- *No growth*	*10 (12)*	
	- *Staphylococcus aureus*	*40 (48)*	
	- *Streptococcus pyogenes*	*17 (20)*	
	- *Staphylococcus aureus and Streptococcus pyogenes*	*9 (11)*	
	- *Staphylococcus aureus and other*	*5 (6)*	
	- *Other*	*3 (3)*	
Ultrasonography	No	158 (97)	
	Yes	5 (3)	
Computer tomography scan	No	162 (99)	
	Yes	1 (1)	
Antibiotic prescribed	No	6 (4)	
	Yes	157 (96)	
Route and type of antibiotic	Oral	46 (29)	
	Intramuscular	1 (1)	
	Intravenous	110 (70)	
	- *Flucloxacillin*	*92 (84)*	
	- *Augmentin*	*12 (11)*	
	- *Macrolide*	*2 (2)*	
	- *Cephalosporin*	*4 (3)*	

Duration of IV antibiotics	≤24 hours	10 (6)	2.45
	1-2 days	59 (36)	days
	3-4 days	27 (17)	
	5-6 days	11 (7)	
	≥7 days	3 (2)	
	Not given	53 (32)	
Surgical management required‡	No	113 (69)	
	Yes	50 (31)	
Complications§	None	157 (6)	
	New abscess formation	3 (2)	
	Osteomyelitis	1 (1)	
	Febrile convulsion	1 (1)	
	Sepsis or septic shock	2 (1)	
	Transfer	4 (2)	
	Death	0 (0)	
TOTAL		**163 (100)**	

†Based on conclusion of microbiological report

‡Surgical management of a serious skin infection refers to surgical procedures under general anaesthetic and includes incision and drainage, and surgical debridement

§The absolute numbers and percentages of complications do not sum to the total due to more than one type of complication in one some patients.

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Skin infections in children in a New Zealand primary care setting: exploring beneath the tip of the iceberg

Cathryn O'Sullivan, Michael G Baker

Abstract

Aim Over the past two decades there has been a documented steady rise in the incidence of hospitalised serious skin infections in New Zealand children. However there are few surveillance data from the primary care setting, where the majority of children with skin infections initially present. We aimed to describe the epidemiology of childhood skin infections presenting to primary care in a region of New Zealand with a particularly high burden of infection and compare this to hospitalised cases during the same period.

Methods A sample of general practitioners in the Tairawhiti (Gisborne) region recorded all cases of skin infections in 0–14 year old children diagnosed over a 10-week period in 2008. Observed case rates were directly standardised by age and ethnicity to the Tairawhiti population to give estimated rates for the whole region. Demographic data from primary care cases were compared to similar data from hospitalised cases during the same period.

Results There were 110 incident cases of skin infections seen by the nine participating general practitioners during the study period, equivalent to an annual incidence rate of 106.7 (95%CI: 85.2–127.2) cases per 1000 children in the region. For every one hospitalisation there were an estimated 14 primary care cases. Three quarters of skin infections in both primary care and hospital settings occurred in Māori children. There was no gender predominance in either setting, however hospitalised cases of serious skin infections were more likely to occur in the preschool age group whereas children aged 5–9 years predominated at the primary care level.

Conclusion Skin infections are a common childhood complaint in primary care in the Tairawhiti region, with hospital-based surveillance using coded discharge data only capturing a small proportion of the overall community disease burden. Previously observed ethnic disparities in hospitalisation rates for serious skin infections reflect similar disparities in skin infection rates in primary care. The establishment of a sentinel surveillance system in the New Zealand primary care setting would facilitate further research and monitoring of this and other important conditions.

Skin infections are a common complaint in primary care and are usually considered benign. However, in both New Zealand (NZ) and international settings, these infections are becoming an increasingly significant source of childhood morbidity, with the rate of skin infections requiring hospitalisation (termed 'serious skin infections') steadily increasing during the last two decades.[1–7]

In NZ, the rate of serious skin infections, doubled between 1990 and 2007.[4] In 2004, a report by Hunt found the national rate of cellulitis in children was twice that of Australia and the United States of America.[8]

Recent analyses have found that serious skin infections contribute heavily to health inequalities with the greatest hospitalisation rates observed in Māori and Pacific children.[4,5,8–11] These trends are hypothesised to reflect corresponding patterns of disease in the community,[8] however there are no published studies examining skin infections in the NZ primary care setting, where many patients initially present and the major burden of illness is managed. This deficit is likely due to the lack of routine primary care level surveillance for most health conditions in NZ.

Hospital admissions for serious skin infections represent the 'tip of the iceberg' in relation to the wider community burden of disease.[4,8] We aimed to estimate the incidence of skin infection cases in primary care in children in the Tairawhiti (Gisborne) region, describe the basic epidemiology of these infections, and compare these characteristics with serious skin infections hospitalised in the region during the same period.

Methods

We conducted a prospective observational analysis of skin infection cases in children seen by a cohort of general practitioners (GPs) in the Tairawhiti region.

Study location—The Tairawhiti region is a relatively isolated area of 45,000 people on the East Coast of NZ's North Island. The region is unique for its large Māori population (47.3% of the total population and 58.4% of the 0–14 year old population), young age distribution (26.2% of people are aged less than 15 years),[12] and high levels of deprivation (the Gisborne region has the highest proportion of the most deprived residents in the country).[13]

In Tairawhiti, childhood skin infections present a major challenge to both primary and secondary health services. The region's serious skin infection incidence is not only the highest in NZ,[4] research presented in companion articles in this issue of the *New Zealand Medical Journal* has shown it is considerably greater than that expected, even after standardising for the high-risk age, ethnicity and deprivation population composition.

General practitioner recruitment and data collection—The raw data for this study were collected by prospective consultation coding by a group of Tairawhiti GPs. All GPs within the region were approached and their voluntary participation in this study sought. Out of the usual local GP population of approximately 20 full-time equivalent practitioners working in six primary practices, nine GPs from three different practices agreed to participate. During the study period, 4627 of the 18,456 (25.1%) 0–14 year olds usually resident population of the Tairawhiti region were registered in the practice populations of these GPs.

Over the 10-week period, 19 May 2008 to 28 July 2008, GPs coded all incident cases of skin infection in children using the READ code system. Similar to International Classification of Disease (ICD) codes used in hospitals, READ codes are a standardised and hierarchically-arranged clinical terminology system widely used in primary care practices for coding diagnoses as well as a range of patient demographic and clinical data.[14]

All skin infections were included regardless of whether they were the primary reason for presentation or a secondary diagnosis. Repeat visits for the same episode of infection were not coded. All visits were during routine office hours of 8am to 5pm, Monday to Friday. A minimum level code of 'M0.00' (Skin/subcutaneous tissue infections) was recorded in the computerised clinical records of appropriate patients using MedTech32®, the electronic patient management system used in all participating practices.

Email reminders were sent to GPs every 3–4 weeks during the data collection phase. At the end of this period, the Query Builder® function of MedTech32® was used to design and run a standardised data query. An arbitrary and anonymous unique identifier was assigned to each case and raw data variables including READ code and free-text diagnosis description, date of birth, gender and ethnicity (Māori vs. non-Māori) were extracted and collated centrally.

Case definition—Cases of skin infection were diagnosed clinically based on the experience of participating GPs, however a written case definition was provided to standardise inclusion criteria:

> "Any child aged 0–14 years old, seen by a participating GP during the study period, with clinical evidence of a new episode of active bacterial infection of the skin or subcutaneous tissue including any of the following diagnoses: cellulitis, erysipelas, impetigo, subcutaneous abscess, furuncle, carbuncle, acute lymphadenitis, any pyoderma including bacterial super-infection of eczema/scabies/chickenpox/insect bites, and any other infection of the skin or subcutaneous tissue."

Hospital cases—We used anonymised hospitalisation data provided by the New Zealand Ministry of Health to identify all cases of serious skin infection in children aged 0–14 years admitted to Gisborne Hospital over the same 10-week period specified above. The case definition of hospitalised serious skin infection utilised in this study was developed in earlier work by the authors and has been described in detail elsewhere.[15] Cases were assigned an arbitrary and anonymous unique identifier and the same basic demographic variables as those collated for GP cases were extracted.

Data analysis—Age and ethnicity-specific skin infection rates from participating GP registers were directly standardised to the regional population to give an estimate of the total number and rate of skin infection cases seen in children in primary care in the Tairawhiti region. Confidence intervals (CIs) were constructed using the methods of Clayton and Hills.[16]

Denominators in rate calculations were based on usually resident population counts from the 2006 Census.

Annual infection rates were calculated from extrapolations of observed data. Seasonal adjustment was not made as recent work has shown there is very little seasonality in hospitalisation rates for skin infections in the Tairawhiti region compared to NZ (see companion articles in this issue of the *New Zealand Medical Journal)* and it is unknown whether rates of skin infections in primary care exhibit seasonal trends.

The ethnicity and gender distribution of children in general practice and in the hospital setting were compared using the Fisher's exact test. Age distributions were compared using the Mann Whitney U test. A two-tailed p-value of less than 0.05 was considered statistically significant.

Regional Ethics Committee approval was obtained for this study.

Results

Incidence and characteristics of skin infection cases in primary care—Over the 10-week data collection period, 110 incident cases of skin infections in 107 children were recorded by the nine participating GPs. Table 1 summarises the observed number and rate of cases in each age and ethnicity group.

Based on age and ethnicity standardisation of observed rates, there were an estimated 378.6 (95%CI: 312.4–458.9) cases of skin infections seen in primary care, equivalent to a rate of 20.5 cases (95%CI: 16.9 to 24.9) per 1000 0–14 year old children in the Tairawhiti region during the 10-week study period (see Table 1).

Extrapolating these data longitudinally, without taking seasonal adjustment into account, there were an estimated 1968.7 (95%CI: 1624.5–2386.3) cases of skin infections in children in the Tairawhiti region primary care setting during 2008. This frequency is equivalent to an annual incidence rate of 106.7 (95%CI: 85.2–127.2) per 1000 children in the region, or 10.7% of the population if there were no repeat infections in the same individuals.

In Māori children, there was a trend towards reducing case incidence with increasing age. This trend was less apparent in non-Māori children. Annual infection rates ranged from 29.0 per 1000 for non-Māori children aged 10–14 years, up to 245.5 per 1000 for Māori children aged 0–4 years.

Table 1. Skin infection incidence observed in the study population, and estimated for the Tairawhiti region, 0–14 year old children, May–July 2008

Ethnicity/age group	Observed case rate per 1000† (no. of cases/no. at risk)	Tairawhiti region population‡	Estimated no. of primary care cases in Tairawhiti region§	Estimated annual rate of primary care cases in Tairawhiti region#
Māori				
0–4 years	47.2 (34/720)	2163	102.1	245.5
5–9 years	42.6 (33/774)	2241	95.4	221.4
10–14 years	24.0 (18/751)	2403	57.6	124.6
Non-Māori				
0–4 years	11.9 (8/671)	3651	43.5	62.0
5–9 years	14.8 (12/813)	3852	56.9	76.8
10–14 years	5.6 (5/898)	4146	23.1	29.0
Total	**20.5** (95%CI: 16.9–24.9)	**18,456**	**378.6** (95%CI: 312.4–458.9)	**106.7** (95%CI: 85.2–127.2)

95% CI: 95% confidence interval; No.: number.

† Ethnicity and age-specific rates of skin infections observed in participating primary care practices during 10-week study period.

‡ Based on usually resident population data in 2006 Census.

§ Estimated number of primary care cases of skin infection in children in the Tairawhiti region during the 10-week study period, based on multiplying the age and ethnicity specific rates observed in participating GP practices by the Tairawhiti region population for that age/ethnicity group.

Estimated annual rate per 1000 of primary care cases of skin infection in the Tairawhiti region, based on annualising the 10-week rate (without seasonal adjustment).

Comparing skin infection cases seen in primary care and hospital settings— During the same 10-week data collection period, 27 cases of serious skin infection in 27 children were admitted to Gisborne Hospital. Based on the estimated 378.6 primary care skin infection cases in the region over this period, there were 14 primary care cases for every one hospitalised serious skin infection.

Table 2 and Figure 1 summarise and compare the basic demographic characteristics of primary care and hospital cases seen over the same period in 2008. Most primary care cases were coded only to the minimum code level of 'M0.00', so information on subtypes of skin infection and free-text diagnosis description was not available.

There was a significant difference in the age distribution of skin infection cases between the two settings (p=0.0041). Preschool-aged children accounted for two-thirds (67%) of hospitalised cases of serious skin infection but only 38% of infections in primary care. While just 15% of hospitalised cases were in children aged 5–9 years, this group made up the largest proportion of cases in primary care (41%). The 10–14 year old age group accounted for the smallest proportion of cases overall.

Slightly more boys were admitted to hospital with a serious skin infection than girls, 56% and 44% respectively, but this difference did not reach statistical significance. There was no gender predominance in primary care cases with equal numbers of male and female children suffering skin infections. The difference between settings was not significant (p=0.67).

Just over three-quarters (77%) of skin infection cases in the primary care setting were in Māori children. Hospitalised cases of serious skin infections exhibited a similar ethnic distribution, with 78% occurring in Māori children (p 1.00).

Table 2. Comparison of the demographic characteristics of children with skin infections seen in primary care and hospital settings in the Tairawhiti region, May–July 2008

Variable	Primary care cases		Hospital cases		Difference	
	No.	P_P (95% CI)	No.	P_H (95% CI)	$P_P - P_H$	p
Age (yrs)						
0–4	42	0.38(0.30–0.48)	18	0.67(0.48–0.81)	- 0.29	
5–9	45	0.41(0.32–0.50)	4	0.15(0.05–0.33)	+0.26	0.004
10–14	23	0.21(0.14–0.29)	5	0.18(0.08–0.37)	+0.03	
Gender						
Male	55	0.50(0.41–0.59)	15	0.56(0.37–0.72)	- 0.06	0.67
Female	55	0.50(0.41–0.59)	12	0.44(0.28–0.63)	+0.06	
Ethnicity						
Māori	85	0.77(0.69–0.84)	21	0.78(0.59–0.90)	- 0.01	1.00
Non-Māori	25	0.23(0.16–0.31)	6	0.22(0.10–0.41)	+0.01	

No.: Number of cases.

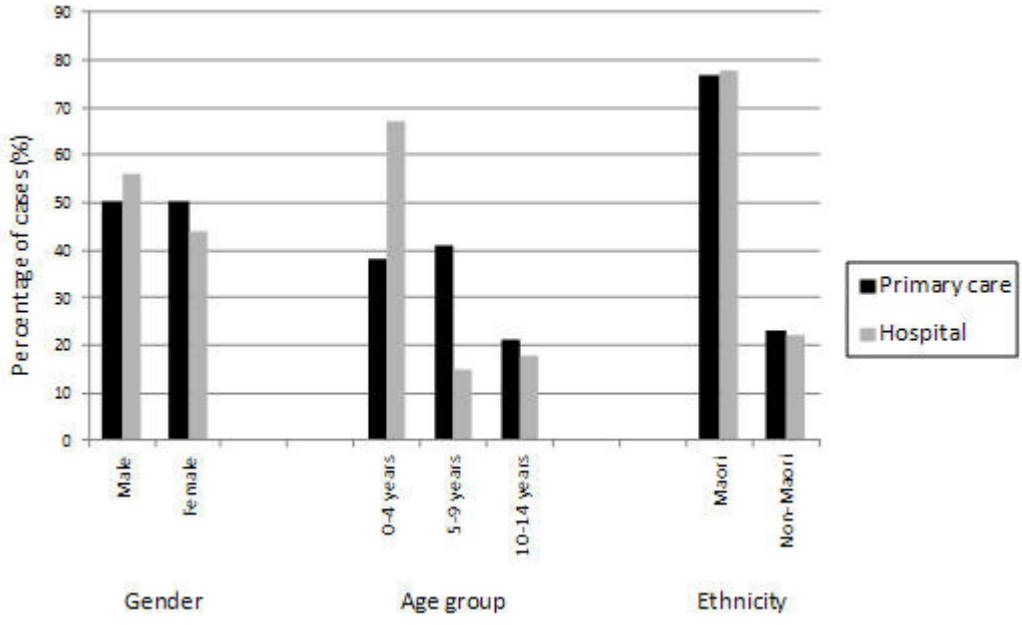
P_P: Proportion of primary care cases.

P_H: Proportion of hospital cases.

$P_P - P_H$: Difference between the primary care and hospital proportions.

p: Two tailed p-value (>0.05 considered statistically significant).

Figure 1. Gender, age and ethnicity distribution (%) of children with skin infections seen in primary care and hospital settings in the Tairawhiti region, May–July 2008



Discussion

Skin infections are a common childhood illness in NZ. Results of this study suggest that 10.7% of children in the Tairawhiti region consulted their GP with this complaint during 2008. The majority of infections are adequately treated in the primary care setting, avoiding hospitalisation. Population groups with the highest rates of infection were Māori children and those in both the 0–4 and 5–9 year old age groups, with no difference between male and female children.

We found that the epidemiology of skin infections in primary care reflected that of hospitalised serious skin infections, except for the age distribution of cases where there was a relatively higher proportion of 5–9 year olds presenting to primary care, whereas preschool-aged children were more dominant among those hospitalised (see articles entitled *The epidemiology of serious skin infections in New Zealand children: comparing the Tairawhiti region with national trends*, and *Serious skin infections in children a review of admissions to Gisborne Hospital (2006-2007)* in this issue of the *New Zealand Medical Journal*).

This study provides the first NZ estimate of the rate of skin infection in children at the primary care level. Findings indicate that during a 10-week period in 2008, there were 378.6 cases (95%CI: 312.4–458.9) of skin infections seen in primary care in the Tairawhiti region, equivalent to an annual incidence rate of 106.7 cases per 1000 children or one in every nine children in the region consulting their GP for a skin infection during the 2008 year. This figure does not take into account repeat presentations for the same episode of infection.

Over three-quarters of skin infections in primary care occurred in Māori children with an almost identical proportion seen in hospitalised cases. This similarity in ethnic distribution between the two settings is important; it indicates that the high rates of serious skin infections in Māori children reported in previous analyses of NZ hospitalisation data[4,5,8–11] are a reflection of a similarly high burden of disease at the primary care level, rather than ethnic disparities in hospital admission thresholds.

Māori experience higher rates of infectious diseases in general.[17] The reasons for this difference are complex and multifactorial; they include household crowding, barriers to accessing primary healthcare such as cost and longer travel distances, and a range of socioeconomic factors.[17–22]

The relatively even spread of primary care skin infection cases across the 0–4 and 5–9 year old age groups was unexpected. Previous analyses have found hospitalisation rates for serious skin infections are highest in preschool-aged children,[4,5,8,9,23–26] and this distribution has been thought to directly reflect community trends in infection incidence. This finding could be an aberration due to our small sample size, but alternative hypotheses could include lower admission thresholds in young children or more severe disease requiring admission in a greater proportion of such cases.

This is the first published study we are aware of that has described the basic epidemiology of skin infections in children in a primary care setting and made comparisons to equivalent data from hospitalised serious skin infection cases over the same period. It is also the only study we know of that has attempted to quantify the

total primary care burden of childhood skin infections within a region in NZ. However several limitations must be considered in conjunction with its results.

Our analysis was based on a small number of primary care cases recorded over a short time interval. Regional infection rates were extrapolated from these observed data, and hence are subject to considerable sampling error, reflected in wide confidence intervals. However, in comparison to previous work estimating the primary care burden of skin infections, which have solely comprised workforce surveys,[8,27] this is an important step forward. The results are an indication of the magnitude of the problem beyond frequently measured hospitalisation data, and start to illuminate the area beneath the 'tip of the iceberg'.

The generalisability of the findings to populations outside the Tairawhiti region needs to be considered. If the ratio of 14 primary care cases for every one hospitalised case applied uniformly across NZ, then the 4,453 hospitalisations observed annually (2000–2007)[4] would correspond to 62,347 GP cases per year. However, further studies in other primary care populations are needed before relying on such extrapolations.

As involvement in this study was voluntary, it was not feasible to have a randomly selected sample of local GPs participating. Convenience sampling was therefore used. Potential clustering of practices limited our ability to analyse certain census area unit-based demographic variables, namely deprivation status. In addition, the analyses of the local primary care burden of disease assume that the group of participating GPs are a representative sample of all GPs in the Gisborne region and exhibited an average hospital admission threshold similar to the population mean.

While this objective would be best guaranteed by randomisation, we tried to minimise selection bias by including over one-quarter of the usually resident 0–14 year old population of the Tairawhiti region in the sample group, and ensuring participating GPs were recruited from a broad range of practice sizes, types and locations. We were unable to obtain data to compare the practice population demographics of GPs who participated and those who did not.

There was a large difference between the expected number of GP cases (based on GP-reported estimates made during preliminary discussions) and the actual number of recorded cases. The facility to code patient diagnoses exists within the computerised practice management systems used in almost all NZ general practices. However, most consultations are not routinely assigned a diagnostic code, so data collection in this study relied on participating GPs manually entering READ codes. Hence, it is likely that low coding compliance accounts for much of the discrepancy in expected and actual case numbers; despite good intentions, a minimal level code for simplicity, and regular email reminders, several participating GPs estimated their coding compliance was approximately 50%. This bias will result in an underestimation of the primary care burden of disease. However, it is also possible that some of the discrepancy was because anecdotal case numbers were initially overestimated.

GP cases were only recorded during routine office hours of 8am to 5pm, Monday to Friday. While there is an after-hours GP call-out service available in Gisborne, high costs and direct access to the local emergency department mean it is rarely utilised.

As such, all cases presenting overnight and during weekends were excluded from the dataset.

This study was not able to ascertain whether children admitted to hospital with a serious skin infection were referred immediately by their GP or after a failed trial of outpatient treatment. In addition, because this was not a longitudinal study, we could not determine if the marked rise in hospitalisation rates over the last two decades was due to comparative increases in primary care case rates over this same period.

Further research is warranted to explore childhood skin infections beneath the tip of the iceberg of serious hospitalised cases. While infections seen by primary care providers do not comprise the whole community burden of disease (infections may be self resolving or self treated), they do account for a significant proportion.

Further work is needed to investigate whether the high admission rates in NZ, compared to other developed countries, solely reflect greater community rates of disease, or whether a larger proportion of skin infections result in hospital admission.

Routine collection of primary care consultation data would facilitate this endeavour, and eliminate many of the limitations described in this study. One option would be to establish routine primary care surveillance of skin infection in NZ. Such primary care surveillance is arguably one of the largest gaps in NZ's infectious disease surveillance system.[28]

Many countries have well established general practice sentinel systems that NZ could emulate[29–33] and NZ has successfully piloted syndromic surveillance in the past for conditions including skin and subcutaneous tissue infection.[34]

Competing interests: None declared.

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Thermography as a screening and diagnostic tool: a systematic review

Anita Fitzgerald, Jessica Berentson-Shaw

Abstract

Aims To determine the effectiveness of digital infrared thermography for the detection of breast cancer in a screening population, and as a diagnostic tool in women with suspected breast cancer.

Methods A comprehensive search of electronic databases together with a search of international websites was conducted. Diagnostic studies comparing thermography with mammography for screening in asymptomatic populations; or comparing thermography with histology in women with suspected breast cancer; were eligible for inclusion. Quality of included studies was appraised using the QUADAS criteria.

Results One study reported results for thermography in screening population and five studies reported diagnostic accuracy of thermography in women with suspected breast cancer. Overall, studies were of average quality. Sensitivity for thermography as a screening tool was 25% (specificity 74%) compared to mammography. Sensitivity for thermography as a diagnostic tool ranged from 25% (specificity 85%) to 97% (specificity 12%) compared to histology.

Conclusions Currently there is not sufficient evidence to support the use of thermography in breast cancer screening, nor is there sufficient evidence to show that thermography provides benefit to patients as an adjunctive tool to mammography or to suspicious clinical findings in diagnosing breast cancer.

Clinical thermography has been in use since the 1960s and detects temperature variation on the surface of the skin; in breast cancer, thermography involves using a thermal imaging device to detect and record the heat pattern of the breast surface.[1] There are several methods of thermography; this review will focus on the most common method used by commercial companies in New Zealand (NZ) and—infrared thermography where infrared radiation emitted by the skin surface is detected. Information from an infrared detector is relayed to a processing system, which produces images of temperature distribution.[2]

Thermography does not provide information on the morphological characteristics of the breast, rather it provides functional information on thermal and vascular conditions of the tissue. The role of thermography is considered to be complimentary to other techniques; as it is a test of physiology that alone is not sufficient for medical practitioners to make or confirm a diagnosis[1,3]

The current method of breast cancer screening in both New Zealand and Australia is by mammography. BreastScreen Australia was launched in 1991, followed by BreastScreen Aotearoa (New Zealand) in 1998; both services offer mammography to

women aged 45–69, although in Australia, women from 40 years, and women over 70 years are able to attend for screening.

A New Zealand-conducted Health Technology Assessment (HTA) reported high sensitivity and specificity of screening mammography and showed that test accuracy improves with the age of patients.[4] The current method of breast cancer diagnosis in both New Zealand and Australia, is the 'triple test' including clinical breast examination, diagnostic mammography, and fine-needle aspiration biopsy (FNAB). This combination is considered positive if any of the three components are positive, and negative if all three components are negative.[5]

The use of thermography is controversial; it is promoted as a tool to monitor breast health by private thermography clinics, while in New Zealand it is not part of any national breast cancer health program. One previous systematic review on the effectiveness of thermography for detection of breast cancer was conducted in 2004[2] but since then new studies on thermography have been published; the authors are unaware of any current systematic reviews including these recent articles.

The objective of this review is two-fold: to determine the effectiveness of digital infrared thermography for the detection of breast cancer in a screening (asymptomatic) population, and to determine the effectiveness of digital infrared thermography as a diagnostic tool in women with suspected breast cancer.

Methods

Searching the literature

The literature was systematically searched for English language articles that fitted the inclusion criteria from 1984 to the end of April 2011. Additionally, reference lists of retrieved studies were searched and websites discussing thermography were searched for potential studies.

The following databases were searched: MEDLINE, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Review, Database of Abstracts of Reviews of Effects, EMBASE, Cumulative Index to Nursing and Allied Health Literature, PsychoINFO and Web of Science. The clinical questions were able to be combined in one search and complete search strategies are available from the corresponding author on request.

Several additional sources were searched to minimise the likelihood of missing an important study. The following resources were searched for guidelines on thermography: Guidelines International Network, National Guideline Clearing House, National Library for Health (UK), SIGN, TRiP (Turning Research into Practice).

Several international websites, including all available HTA sites were searched for reports on thermography for breast screening or diagnosis; a full list is available on request. Additionally, a number of New Zealand-specific resources were searched, including: KRIS (Kiwi Research Information Service), Australasian Digital Theses Programme, Index New Zealand, Te Puna and Digital NZ.

Selection of studies for inclusion

Study design—This review included diagnostic accuracy studies of which there are two basic types, defined by the Centre for Reviews and Dissemination[6]; single-gate design and two-gate design. Full details of the designs of these studies is reported elsewhere.[6] Single and two-gate studies were eligible for inclusion if they compared digital infrared thermography with mammography in screening asymptomatic women, or if they compared with digital infrared thermography with histology in women with suspected breast cancer.

Studies were required to have sufficient data to construct a 2×2 contingency table which displays numbers of true-positive cases, false-positive cases, false-negative cases, and true-negative cases of breast cancer.

Participants—For studies investigating thermography for screening, asymptomatic women with unknown disease status were eligible for inclusion. For studies investigating thermography for diagnosis, women with suspicious symptoms (e.g. presenting with a breast lump or nipple discharge), women with suspicious findings on clinical examination or women with an abnormal mammogram were eligible for inclusion.

Studies of patients younger than 16 years, animal studies, and studies with fewer than ten participants were excluded.

Index test—Digital infrared thermography was the index test considered in this review. Other methods of thermography and outdated methods no longer available were excluded.

Studies which sought to develop interpretive software or models to assess the accuracy of different imaging parameters and that were not primarily designed to assess accuracy of thermography in testing for breast cancer in a normal patient population (diagnostic or screening), were excluded.

Reference standard—For studies investigating thermography as a screening tool, a reference standard of histology was not considered appropriate. In this case, mammogram or clinical diagnosis was accepted as the reference standard. For studies investigating thermography as a diagnostic tool, the reference standard was histology.

Data collection and analysis

For each included study, we used standard evidence tables to extract characteristics of participants, data about the index tests and reference standard, and aspects of study methods. We extracted indices of diagnostic performance from data presented in each primary study by constructing 2×2 contingency tables of true-positive cases, false-positive cases, false-negative cases, and true-negative cases. If these were not reported, we reconstructed the contingency table using the available information on relevant parameters (sensitivity, specificity or predictive values).

Study quality was assessed using the QUADAS checklist,[7] with each item scored as “yes”, “no”, or “unclear”. Results of the quality assessment are presented in the text, in graphs and in a table using the Cochrane Collaborations Review Manager 5 software.[8] The authors did not calculate a summary score estimating the overall quality of an article since the interpretation of such summary scores is problematic and potentially misleading.[9,10]

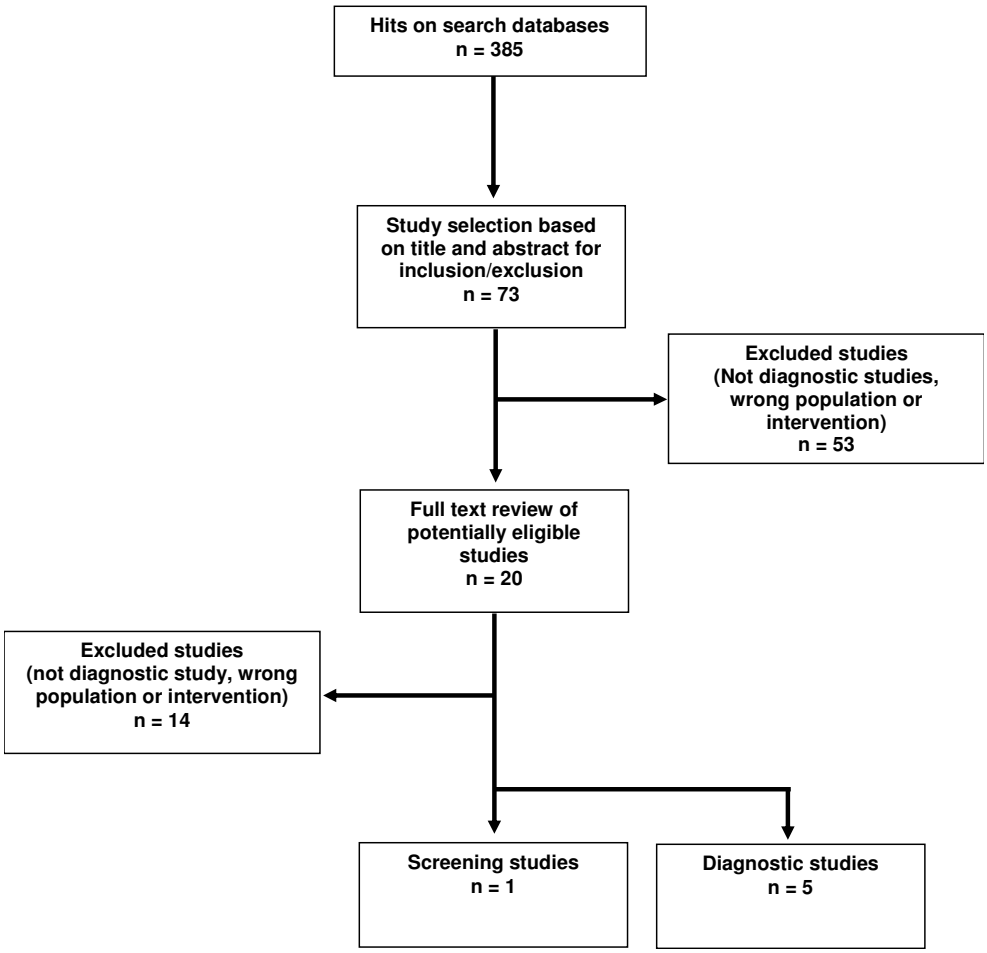
Sensitivity, specificity, negative predictive values, positive predictive values, and likelihood ratios (with 95% confidence intervals) were calculated for each test in each study using the methods described by the Centre for Reviews and Dissemination[6] and results tabulated and presented in ROC space. Area under the ROC curve gives a graphical representation of sensitivity and specificity of a test.

Results

The searches identified 385 citations of which 73 appeared to be relevant. Of these, 20 were considered relevant to the purpose of our review the fulltexts were retrieved (Figure 1). Fourteen articles were subsequently excluded.

The most common reason for exclusion was that the study was either not a primary diagnostic study of test accuracy or it did not involve appropriate comparisons. One study, with a total of 306 participants fulfilled the inclusion criteria for screening, and five studies, with a total of 1224 participants fulfilled inclusion criteria for diagnosis in women with suspected breast cancer.

Figure 1. Selection of studies for review



Breast thermography for screening

One study was identified investigating the accuracy of thermography to determine the diagnostic accuracy of digital infrared thermography for the detection of breast cancer in a screening (asymptomatic) population by Williams and colleagues in 1990 (Table 1).[11]

Quality of included study—The quality of the included study was poor. The QUADAS tool reports that 'reported estimates of diagnostic accuracy may have limited clinical applicability (generalisability) if the spectrum of tested patients is not similar to the patients in whom the test will be used in practice'; this study may have been subject to spectrum bias, since volunteers may have had greater risk of developing breast cancer than those not screened.

Spectrum bias occurs when the participants included in a study are not similar to those in whom the test would be used in practice and can limit the generalisability. There was confusion regarding the role of clinical examination as it seemed to occur in both

the index test and the reference standard groups; this meant that blinding, and accuracy of both the index test and reference standard were not clear.

Verification bias occurs when not all of the study group receive confirmation of the diagnosis by the reference standard (partial verification bias) or when some of the index test results are verified by a different reference standard (differential verification bias).

Verification bias is likely in this study because not all participants received the same reference standard, only those with positive findings on thermogram had a mammography; this could cause biased estimates of the performance of thermography as the negative results were not confirmed as being accurate. The effect of those lost to follow-up without explanation is unclear.

Diagnostic accuracy—A prospective single-gated (diagnostic cohort) study aimed to determine whether thermography could be used to identify women with breast cancer during screening, or identify women at risk of developing breast cancer within 5 years.[11]

10,229 women aged 40–65 were invited and attended a breast screening clinic. At the time of screening, infrared imaging reported a sensitivity of 61%, specificity of 74%, a positive predictive value of 0.01% and a negative predictive value of 1.00%. Five years following initial screening, infrared imaging reported a sensitivity of 28%, specificity of 74%, positive predictive value of 0.01% and a negative predictive value of 0.99%.

Thermography is not sufficiently sensitive to be used as a screening test for breast cancer, nor is it useful as an indicator of risk developing within 5 years. Currently there is not sufficient evidence to support the use of thermography in breast cancer screening.

Table 1. Included studies investigating thermography in a screening population (Williams 1990)

Participants	Index test	Reference standard	Method of analysis	Sens	Spec	PPV	NPV	LR+	LR-
n=10229	Infrared imaging**	Mammography	At screening	61%	74%	0.01%*	1.00%	2.35 (1.91–2.88)*	0.53 (0.38–0.73)*
			At 5-year follow-up	28%	74%	0.01%*	0.99%	1.09 (0.73–1.63)*	0.97 (0.83–1.14)*

Abbreviations: n – number of participants; PPV – positive predictive value; NPV – negative predictive value; LR+ - positive likelihood ratio; LR- - negative likelihood ratio.

* indicates NZGG calculated values.

** Device used – two devices were used in this study, one by AWRE (Aldermaston, in conjunction with Barr and Stroud) and one by Rank Precision Industries. No further details were reported.

Breast thermography for diagnosis

Five studies were identified assessing the use of thermography as a diagnostic tool in women with suspicious symptoms (Table 2).[12–16]

Quality of included studies—Overall the included studies were of average quality. All studies reported a high risk of bias for at least one item on the QUADAS checklist. Overall the most common sources of bias were insufficient descriptions of the reference standard and index tests; this is important because variations in diagnostic accuracy can often be traced back to differences in the execution of the index test or reference standard. It is also important because a clear and detailed description is needed to implement the test in another setting.

Another source of bias in the included studies was the spectrum of patients within the studies not being representative of the population in whom the test would be used in practice; this can limit the generalisability. Poor reporting of the delay between index tests and reference standards was evident in all included studies, and blinding of reference or index test results to the other was also poorly reported.

Diagnostic accuracy—A limited number of studies were identified comparing digital infrared thermography to histology in women with symptoms, suspicious clinical findings, or abnormal mammogram. Four studies used a single-gate (diagnostic cohort) design, while one study used a two-gate (diagnostic case-control) design. Two were conducted in the UK,[14,16] two in the USA,[12,15] and one in Canada.[13]

While most studies were able to show sensitivity over 70% for at least one mode of digital infrared thermography, the specificity of thermography for diagnosting breast cancer was generally low, between 12% and 85% for most studies (Table 2). One study reported results that conflicted with other studies, showing low sensitivity (25%) and a high specificity (85%)[14] and another study showed high (83%) sensitivity and high 81% specificity (81%)[13].

In the studies presented in this review, low specificities are due to a high number of false-positive results. For example, the study by Parisky[15] reported a false-positive rate of 1544 and a false-negative rate of 13 out of the 2299 patients tested. This means that for 68% of the patients in this study thermography provided an incorrect diagnosis. Another study by Arora[12] that showed a higher specificity reported a false-positive rate of 19 and a false-negative rate of 6 in a study of 92 participants. This means that for 27% of the patients in the study, thermography provided an incorrect diagnosis.

The study by Keyserlingk[13] provided figures for combined modality approaches to breast cancer diagnosis, however there was not enough data presented in that particular study to confirm the accuracy of the different combinations of tools.

When plotted in ROC space, overall the included studies show poor performance for accurately diagnosing breast cancer (Figure 2). Currently there is not sufficient evidence to show that thermography provides benefit to patients as an adjunctive tool to mammography or to suspicious clinical findings in diagnosing breast cancer.

Table 2. Included studies comparing thermography with biopsy/histology

Reference (study design)	Participants	Index test	Reference standard	Unit of analysis	Method of analysis	Sens	Spec	PPV	NPV	LR+ (95%CI)	LR- (95%CI)
Arora 2008 Single-gate	n=92	Infrared imaging	Histology	Patients	Screening mode (overall score determined by software from 0–7 where 0=normal and 1–7=abnormal)**	97%	12%	66%*	67%	1.10 (0.96–1.25)*	0.28 (0.05–1.47)*
					The location of the lesion under question based on prior imaging was assessed to generate a positive or negative clinical assessment **	90%	44%	74%*	71%	1.61 (1.18–2.20)*	0.23 (0.10–0.53)*
					Score of positive or negative generated by the artificial neural network	97%	26%	70%*	82%	1.31 (1.07–1.62)*	0.13 (0.03–0.55)*
Kontos 2011 Single-gate	n=63 (126 breasts)	Infrared imaging	Histology	Breasts	Manual review of images	25%	85%	24%	86%	1.67 (0.68–4.09)	0.89 (0.69–1.14)
Wishart 2010 Single-gate	n=100 (106 biopsies)	Infrared imaging	Histology	Biopsies	Screening mode (overall score determined by software from 0–5 where 0=normal and 1–5=abnormal)	53%	41%	59%	36%	0.92 (0.65–1.30)*	1.11 (0.71–1.74)*
					Score of positive or negative generated by the artificial neural network	48%	74%	73%	48%	1.79 (1.01–3.17)*	0.72 (0.54–0.96)*
					Manual review of images	78%	48%	69%	59%	1.49 (1.09–2.05)*	0.46 (0.26–0.81)*

					NoTouch BreastScan (artificial intelligence program, algorithm-based)	70%	48%	67%	51%	1.34 (0.97–1.87)*	0.62 (0.38–1.02)*
Keyserlingk 1998 Two-gate (included in HTA)	n=200 (100 cases, 100 controls)	Infrared imaging	Histology	Patients	Manual review of images	83%	81%	83%	81%	4.37 (2.89–6.61)	0.21 (0.13–0.33)
Parisky 2003 Single-gate (included in HTA)	2625 evaluations reported for 875 lesions	Infrared imaging	Histology	Number of evaluations	Manual review of images	97%	14%	24%	95%	1.14 (1.11–1.17)	0.18 (0.11–0.32)

Abbreviations: n: number of participants; PPV: positive predictive value; NPV: negative predictive value; LR+ : positive likelihood ratio; LR-: negative likelihood ratio.

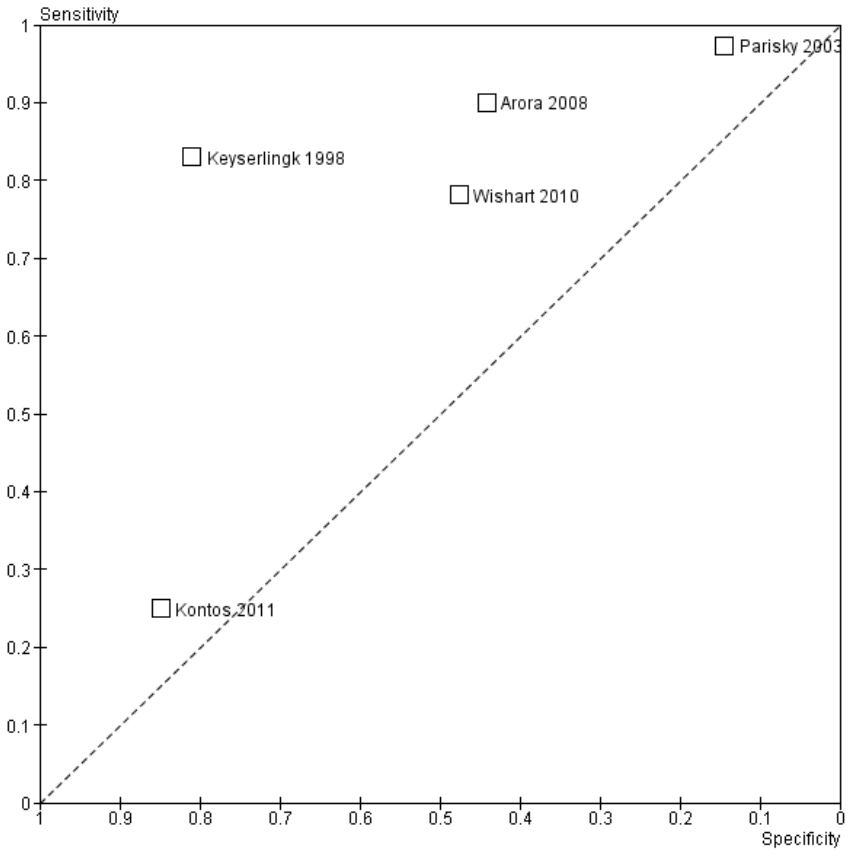
* Indicates NZGG calculated values.

** This is a direct quote from the study describing the 'clinical mode' used. It is unclear whether the scans were manually read or utilised the device software or were read by some other method.

† Device used: Meditherm med2000 thermal imaging system (Meditherm Beaufort, NC, USA).

‡ Device used: Sentinel BreastScan (Infrared Sciences Corp., Bohemia, NY, USA).

Figure 2. Include studies plotted in ROC space



Note: This graph represents single sensitivity and specificity measures for the manually reviewed thermograms (see Table 2). Studies by Arora and Wishart included other measures of accuracy (neural network interpretations of thermograms) but the thermogram interpretation by manual expert review was common to all studies and has been used here.

Discussion

Extensive systematic literature searches were conducted, study quality was carefully assessed using a validated tool,[7] and the authors attempted to maximise available data by deriving accuracy data from those studies where not all diagnostic measures were reported. In terms of its use as a screening tool, this review found that digital infrared thermography is not sufficiently sensitive to be used as a screening test for breast cancer, nor is it useful as an indicator of the risk of developing breast cancer within five years. In terms of its use as a diagnostic tool, this review found that there is not sufficient evidence to show that thermography provides benefit to patients as an adjunctive tool to mammography or to suspicious clinical findings in diagnosing breast cancer.

One of the limitations of reviewing the accuracy of diagnostic studies is poor reporting in the included; where authors of studies have not reported elements necessary to answer criteria included in a QUADAS appraisal, the authors cannot be

certain whether this indicates poor methodology with its subsequent consequence for bias, or simply poor reporting of a methodologically sound study.

The introduction and implementation of the STAndards for the Reporting of Diagnostic accuracy studies (STARD) guidelines may improve reporting of diagnostic studies in the future.[17,18] The objective of the STARD initiative is to improve the accuracy and completeness of reporting of studies of diagnostic accuracy, to allow readers to assess the potential for bias in the study (internal validity) and to evaluate its generalisability to populations of interest (external validity).

Industry sponsoring appears to have played a role in the conclusions of some of the included studies investigating thermography as a diagnostic tool. Three industry sponsored studies[12,15,16] concluded that thermography was a valuable adjunctive test to mammography and/or clinical examination, despite the low specificity reported.

Two studies did not state the source of funding; of these, one study[14] reported that due to the low specificity, thermography should not be used as an adjunctive tool to diagnose breast cancer; the other[13] reported more favourable results for thermography, but indicated that thermography trials are conducted in highly controlled environments and stated that "*Our initial data should not be extrapolated to either formal screening or non-controlled diagnostic environments without appropriate evaluation, preferably in prospective controlled multicentre trials*."[13] It is concerning that results differ between those industry sponsored studies reviewed and those conducted independent of industry. High quality, large scale diagnostic studies, with particular attention to sources of funding are needed.

This systematic review of thermography as a screening and diagnostic tool has some limitations. Overall, our findings are limited by the small number of studies available in the literature; incomplete reporting of studies' characteristics and results; limited methodological quality of those reviewed studies; and relatively small sample sizes. Only one study was identified investigating thermography as a screening tool.

For the studies investigating thermography as a diagnostic tool, pooling studies in a diagnostic meta-analysis was not possible because of limited data, and the heterogeneity between studies. Similarly, due to the limited number of identified studies, sensitivity analyses were not possible to assess which methodological aspects may have contributed to clinical heterogeneity (for example the timing of imaging, the different characteristics of the patient population) or heterogeneity related to study design (for example prospective versus retrospective studies, presence of incorporation bias).

Studies were heterogeneous in a number of areas:

- The units of analysis differed across studies; two studies reported results by number of patients, one by number of breasts, one by number of biopsies and one by number of evaluations
- The method of thermogram analysis differed between the included studies. Three studies used expert physicians to manually review the images, while two studies used modern artificial neural networks to review images.
- Study design differed, one study used a two-gated approach, four used single-gated approaches.

The high false-positive and false-negative rates noted in thermography are problematic in the context of commercially driven fee-for-service screening tests that are not part of an organised screening programme because of the ongoing ability to generate repeat business. Those with a negative or equivocal test result are often encouraged to 'monitor' their breast health by those organisations providing the service in order to identify future abnormalities; the consequences of this may be twofold, on one hand those with a positive result (abnormality on thermogram) are likely to seek unnecessary mammography at additional cost, even though there is a high chance that a positive result derived from a thermogram is false.

On the other hand, the very idea that their breast health is being monitored is likely to lead some consumers to the conclusion that they have been adequately screened and that mammography is unnecessary. The psychological cost of having a positive thermogram cannot be ignored, particularly when the rate of false-positives is likely to be high. Screening and diagnostic tools offered to at risk individuals in the context of, or as an adjunct to, tests within a comprehensive and organised screening programme must be sufficiently accurate and cost-effective to keep these issues to a minimum and to provide the best possible care for the patient.

To date, no studies of infrared thermography have been conducted in New Zealand or in Australia, although thermography is offered in both countries to members of the public on a fee for service basis.

In conclusion, currently there is insufficient evidence to support the use of thermography in breast cancer screening, nor is there sufficient evidence to show that thermography provides benefit to patients as an adjunctive tool to mammography or to suspicious clinical findings in diagnosing breast cancer.

Competing interests: None declared.

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THE NEW ZEALAND MEDICAL JOURNAL
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Latrodectism: case report of a katipo spider (*Latrodectus katipo*) bite and review of the literature

Lucinda Thatcher, Ron Janes

Abstract

We describe the case of a 29-year-old man who was bitten on the leg by a katipo spider, a relative of the Australian redback and American black widow spiders, while camping in sand dunes at Mahanga Beach, Mahia (North Island of New Zealand). Symptoms of latrodectism developed within hours, and were not diminished until two doses of the antivenom had been administered. This is only the second case report of a katipo spider bite in the recent literature. The katipo spider bite produces significant symptoms, however an antivenom is available in some hospital pharmacies.

The katipo spider, *Latrodectus katipo*, is a native New Zealand venomous terrestrial species that inhabits sand dunes along coastal regions.[1] The Māori word 'katipo' means night (po) stinger (kati). The genus *Latrodectus* also includes the Australian redback spider (*Lactrodectus hasseltii*) and the American black widow spider (*Latrodectus mactans)*.[2]

Case report

A healthy 29-year-old man was ocean kayaking down the east coast of the North Island of New Zealand, and stopped for the night at a remote section of Mahanga Beach, Mahia.

While eating dinner in the sand dunes, he felt something crawling on his left calf, and brushed it off with his hand. Half an hour later a sharp pain began in his left calf, and over the next few hours it intensified, migrated up his leg, and into his groin and lower abdomen. During this time, he also developed chest pain, nausea and oral tingling.

Ambulance services were activated, and while he was quickly located, it took several hours to get him from the remote beach to Wairoa Hospital, due to very poor weather. En route, the paramedic administered morphine (5 mg IV) for pain, adrenaline (0.5 mg IM) for mouth tingling (possible anaphylaxis), as well as aspirin and nitroglycerin spray for chest pain.

In hospital, pain persisted despite tramadol (50 mg IV), paracetamol (1 g PO), and diclofenac (100 mg PR). Vital signs and examination, including the skin of the left calf, were unremarkable.

His case was discussed with the National Poisons Centre toxicologist, who recommended the use of redback spider antivenom, but he had no knowledge of the closest hospital from which it could be sourced. At first, Hastings Hospital Pharmacy was contacted but then it was discovered that Wairoa Hospitalin fact had a supply of the antivenom on site.

Symptoms rapidly improved after the initial dose of 500 units of anti-venom IM, but they did not fully resolve. A second dose was given 2 hours later, which further reduced his pain. Additional supportive treatment included phenergan (25 mg PO) and IV fluids (1 L of normal saline). He was observed overnight, and discharged pain-free the next day with instructions that should pain recur, further doses of antivenom can still be given.[3]

Discussion

Hornabrook, in his 1951 review of the early literature on katipo spider bites, found a total of 22 cases, including 2 deaths.[4] Since 1951, there has been only one reported case of a katipo bite, involving severe myocarditis in a 22-year-old man,[5] despite katipo spiders inhabiting coastal beach dunes around New Zealand.[1]

While we could locate no published reports of katipo living in the Mahia region, local Department of Conservation (DOC) staff observed katipo spiders on the Mahanga Beach dunes during the 1990s (Personal Communication, Malcolm Smith, DOC, Gisborne, 2011).

The bite from spiders of the genus *Latrodectus* can produce a syndrome called latrodectism.[6] The signs and symptoms include local and systemic pain and sweating, hypertension and nausea.[6] In more serious cases pulmonary oedema, seizures, heart complications and even death have been reported, although there have no recorded deaths from katipo bites in the last century.[5,7]

Our subject exhibited classic symptoms, except sweating, and responded promptly to the antivenom, supporting a diagnosis of katipo spider bite. The major limitation to this case report is that there was no confirmed identification of the spider.

Valid indications for administering redback spider antivenom include evidence of systemic envenoming, or intractable pain in the context of a plausible history for a katipo spider bite.

Current TOXINZ guidelines (http://www.toxinz.com/) recommend giving 500 units of the antivenom IM (IV for severe or life-threatening envenomation). If there is no clinical response, then up to 3 vials can be administered at 2 hourly intervals. It is very rare for symptoms to persist for weeks or months, but in this atypical situation there is some limited evidence that antivenom given long after the initial bite may still be efficacious in resolving chronic symptoms.[3]

Adverse reactions to the antivenom are rare, with anaphylaxis occurring in 0.54% and serum sickness in 1.7% of doses.[8] The New Zealand Pharmacists' Association maintains a current list of those base hospitals in New Zealand that hold redback spider antivenom.[9]

It is interesting to note that not all base hospitals hold this antivenom, while some rural hospitals[10] (e.g. Wairoa Hospital) do, which in this case enabled prompt treatment.

We suggest that all base hospital pharmacies, as well as the National Poison Centre in Dunedin, should have a list of all sites currently holding the antivenom.

Competing interests: None declared.

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Acknowledgement: We thank our subject who agreed to our publishing his misfortune to educate others.

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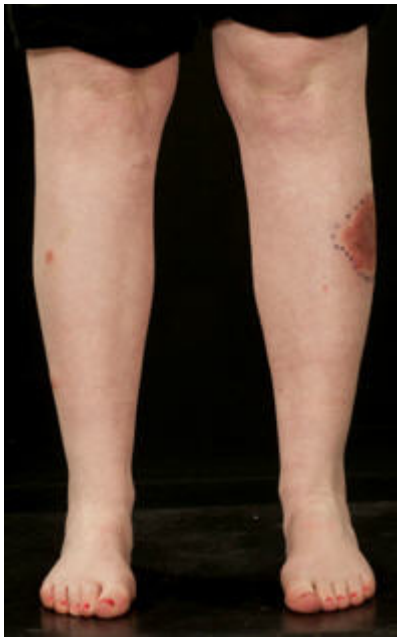
A skin diagnostic dilemma in a young female

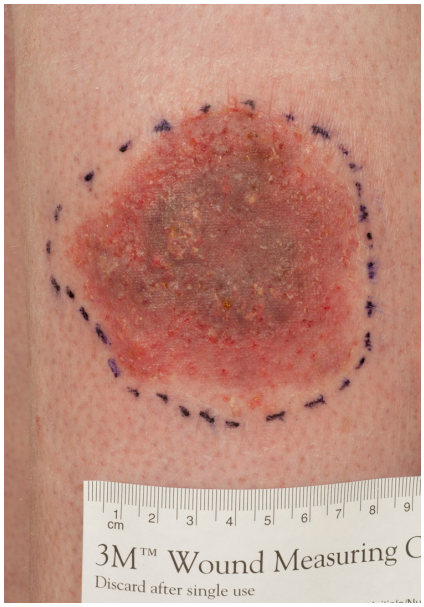
Colleen Wylie, Paul Maurice

Clinical—A 30-year-old lady presented with a lesion on her left lower leg, present for 3 months, which started as a small erythematous area. She thought it was an infection at the site of a spider bite.

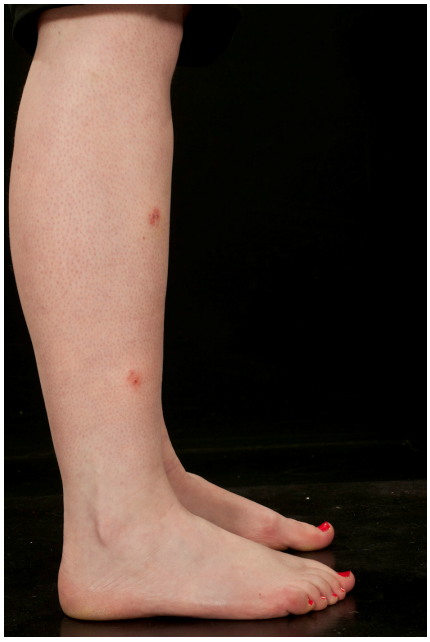
She was seen by multiple doctors and had multiple courses of antibiotics with little effect. The lesion grew and became raised and vesiculated. She had recently noticed two new lesions on the right leg.

Left leg lesion





Right leg lesions



What is the diagnosis?

Answer—She was reviewed by the dermatologist who recognised it as *discoid eczema*. She used clobetasol propionate 0.05% cream, a potent topical corticosteroid, and it improved dramatically. We also continued antibiotics for super-infection for 2 weeks.

Discussion—Discoid (or nummular) eczema is a common (prevalence 0.1–9.1%)[1] type of dermatitis affecting any part of the body especially the lower legs. Insect bites or skin injury can precipitate it. It is slightly commoner in adult males. Some cases are associated with atopy or venous stasis.

The lesions are well-defined, round or oval, often vesiculated in the acute stage, and subsequently become dry and erythematous. Pruritus is not always present. However it may present without an acute phase, particularly in the elderly, when dry skin is a causative factor. Acutely it can be mistaken for impetigo, while in the chronic phase it is often confused with psoriasis or fungal infection.

Treatment is with potent topical steroids and topical or oral antibiotics for secondary infection. In addition it is important to use soap substitutes such as emulsifying ointment and emollients regularly. These should be continued after the eczema has resolved to help prevent recurrence.

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THE NEW ZEALAND MEDICAL JOURNAL
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National prescribing data for dabigatran

We agree with Auckland City Hospital (ACH) staff (10 February 2012)[1] for the need for caution in the prescribing of dabigatran anticoagulation in patient groups at increased risk of drug-induced bleeding.

It is difficult to tell to what extent the authors' concerns about the use of dabigatran seen in patients admitted to the hospital relates to the particular demographics of hospital admissions and to the prescribing of dabigatran in Auckland itself. The population in the ACH preliminary sample was representative of patients admitted to hospital and with complications (both who tend to be older), and not necessarily the whole population using dabigatran.

Our analysis of national dispensing (PharmWareHouse) data indicates that during July to December 2011, the same 6 months that the authors observed at ACH, there have been around 11,840 patients prescribed and dispensed dabigatran in New Zealand. This meant 3,500 person-years' exposure to dabigatran (with 23,673 prescriptions). The mean age was 73.0 years and median 75 years, similar to the RE-LY trial's mean of 71.5 years[2], and younger than the ACH preliminary series' 76 year mean age and 84 year median.[1]

By domicile, we note there were 785 patients living in the Auckland District Health Board (DHB) catchment dispensed dabigatran, of whom 39% (309) were female, with a mean age of 72.8 years and median age of 75 years (being 3-9 years younger than the Auckland City Hospital preliminary series).

However, similar to the ACH series, nationally the proportion of women past/current users dispensed dabigatran was higher than in the RE-LY trial; nationally 60% were male and 40% female, compared with 36% female in RE-LY[2] and 42% female in the ACH preliminary series.[1] In addition, nationally women dabigatran users were older than men; men's mean age was 71.5 years, median 73; women's mean age was 75.3 years, median 77.

In the national dispensing data, of the 11,840 past/current users, 31% of patients (n=3,718) were aged 80 years and over (prevalence 1.3 per 1000 population aged 80+). This proportion was higher than the RE-LY trial's 17% being aged 80+ years.[3] Half of all New Zealand's users were aged 75+ (see footnote 1). For those living in the Auckland DHB catchment, 276 users were aged 80+ years (398 aged 75+), being 35% of all ages of users there.

Of note, 171 users (1.4% of all users, 4.6% of users aged 80+) were both aged 80 and over and ended up using the 150 mg formulation, with higher proportions for those aged 75+ and for those in Auckland (see footnote 2).

The dabigatran datasheet[4] and advice to prescribers[5,6] in effect have recommended against using the 150mg dose for atrial fibrillation in the very elderly because of the risks of age-related reduced renal clearance-related toxicity. This is where they advise treating patients with atrial fibrillation aged 80+ years with the 110 mg formulation

(220mg/day as twice daily 110mg doses), and where the RE-LY trial showed a trend towards increased bleeding with the 150mg dose c.f. warfarin in those aged 75+.[7]

The national dispensing data currently do not provide information on weight nor renal function including creatinine clearance, hence the appropriateness of prescribing cannot be easily assessed on a national level. A great step forward will be when we can readily datamatch pharmaceutical use with laboratory data.

We note though varying evidence that some older patients starting on the 150mg dose have then down-titrated to the dose recommended for age. Nationally, 356 patients aged 80+ had been dispensed the 150 mg formulation at any time, hence 52% of patients had apparently reduced to the lower dose 110mg formulation (see footnote 3). Again we cannot tell what proportion of those aged 80+ years remaining on the 150mg dose did so with known adequate renal function, versus what proportion still had compromised renal function at risk of bleeding (needing to reduce their dose as per the blanket guidance for all of that age).

Further detail on dabigatran dispensings (including breakdowns by formulation, age/gender and DHB) can be seen in the tables and graphs below.

We agree with calls for all patients, especially those aged 80 years or older with impaired renal function or low body weight, being carefully evaluated for the risks and benefits of treatment before starting dabigatran,[8] and then closely monitoring renal function (footnote 4).[4,9] To this end we will continue to publicise these and other risk factors in both primary and secondary care.

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Footnotes:

- All prevalence rates use 2006 Census denominators. In the national dispensing data, of the 11,840 users, 51% of patients (n=5,983) were aged 75 years and over (including the 3,718 aged 80+), with a prevalence of 29 per 1000 population aged 75+.

- Nationally, 1,121 users were aged 75+ years and ended with the 150mg formulation, being 9.5% of all users and 19% of all users aged 75+.
  For those living in the Auckland DHB catchment, 276 users were aged 80+ years (398 aged 75+), being 35% of all ages of users.
  There were 21 patients in the Auckland DHB catchment aged 80 years who were last prescribed dabigatran 150mg (8% of users in Auckland aged 80+, 1.8 per 1000 Aucklanders aged 80+).

- Nationally, 356 patients aged 80+ had been dispensed the 150 mg formulation at any time. As 171 patients of that age had the 150mg dose as their last dispensing of dabigatran, this suggests 52% of patients initially starting on the

150mg dose then reduced to the lower dose 110mg formulation (356 minus 171, divided into 356).
Likewise, nationally, 1,488 of those aged 75+ were dispensed the 150mg dose at any time, compared with the 1,125 of that age whose last dose dispensed was 150mg (thus 25% reducing to 110mg, i.e. 1488 minus 1125, divided into 1488).
Of Auckland patients aged 80+, 12 of the 33 patients reduced from 150mg to 110mg (36% reducing, the residual 21 apparently remaining on 150mg).

- According to the updated datasheet for dabigatran (November 2011),[4,9]
—renal function must be assessed in all patients before starting dabigatran;
—for patients taking dabigatran, renal function should be rechecked in any clinical situation where a decline in renal function is suspected, e.g. dehydration, hypovolaemia and with some medicines such as diuretics;
—renal function should be assessed at least annually in patients taking dabigatran aged over 75 years or with moderate renal impairment (creatinine clearance 30–50mL/min).

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Tables and graphs

Table 1

	no.
all patients	11,840
patients, caps 150mg	6,227
scripts, caps 75mg	366
scripts, caps 75mg	11,662
scripts, caps 75mg	11,645
total scripts	23,673

Graph 1

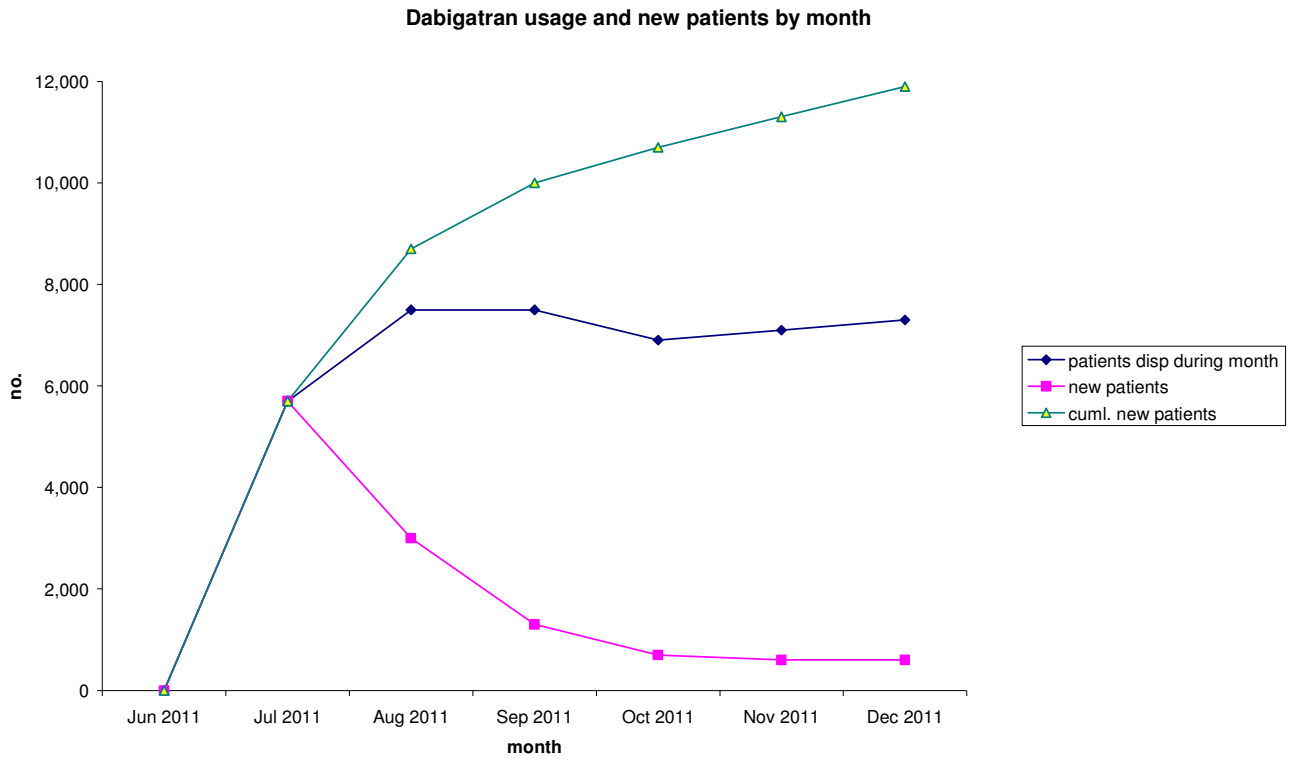

Table 2

5-year ageband	no. patients male	female	total
10-14	2	0	2
15-19	7	1	8
20-24	5	3	8
25-29	11	1	12
30-34	13	9	22
35-39	28	11	39
40-44	71	25	96
45-49	145	49	194
50-54	260	97	357
55-59	415	164	579
60-64	708	329	1037
65-69	1026	475	1501
70-74	1233	769	2002
75-79	1317	948	2265
80-84	1107	1070	2177
85-89	589	633	1222
90-94	103	189	292
95-99	10	15	25
100+	0	2	2
total	7050	4790	11840
mean age	71.5	75.3	73.0
median age	73	77	75
% by gender	60%	40%	100%
aged 80+			3718
% [aged 80+] of all			31.4%
aged 75+			5983
% [aged 75+] of all			50.5%

Table 3

	older patients who use/d 150mg caps dabigatran				
	150mg at any time	last dose 150mg	change to 110	% change	% remaining
aged 75+	1488	1121	367	25%	75%
aged 80+	356	171	185	52%	48%

Table 4

5-year ageband	no. patients by formulation of last dispensing of dabigatran				
	Cap 75 mg	Cap 110 mg	Cap 150 mg	multiple	total
10-14	0	1	1	0	2
15-19	0	3	5	0	8
20-24	0	1	7	0	8
25-29	0	2	10	0	12
30-34	0	7	15	0	22
35-39	0	5	34	0	39
40-44	1	16	79	0	96
45-49	1	31	162	0	194
50-54	2	43	312	0	357
55-59	1	101	477	0	579
60-64	8	179	850	0	1037
65-69	13	298	1190	0	1501
70-74	16	630	1355	1	2002
75-79	30	1284	950	1	2265
80-84	51	1999	126	1	2177
85-89	38	1145	38	1	1222
90-94	14	271	7	0	292
95-99	4	21	0	0	25
100-104	0	2	0	0	2
total	179	6039	5618	4	11840
aged 80+, cap 150mg			171		
% [aged 80+, cap 150mg] of all			1.4%		
aged 75+, cap 150mg			1121		
% [aged 75+, cap 150mg] of all			9.5%		

Graph 2

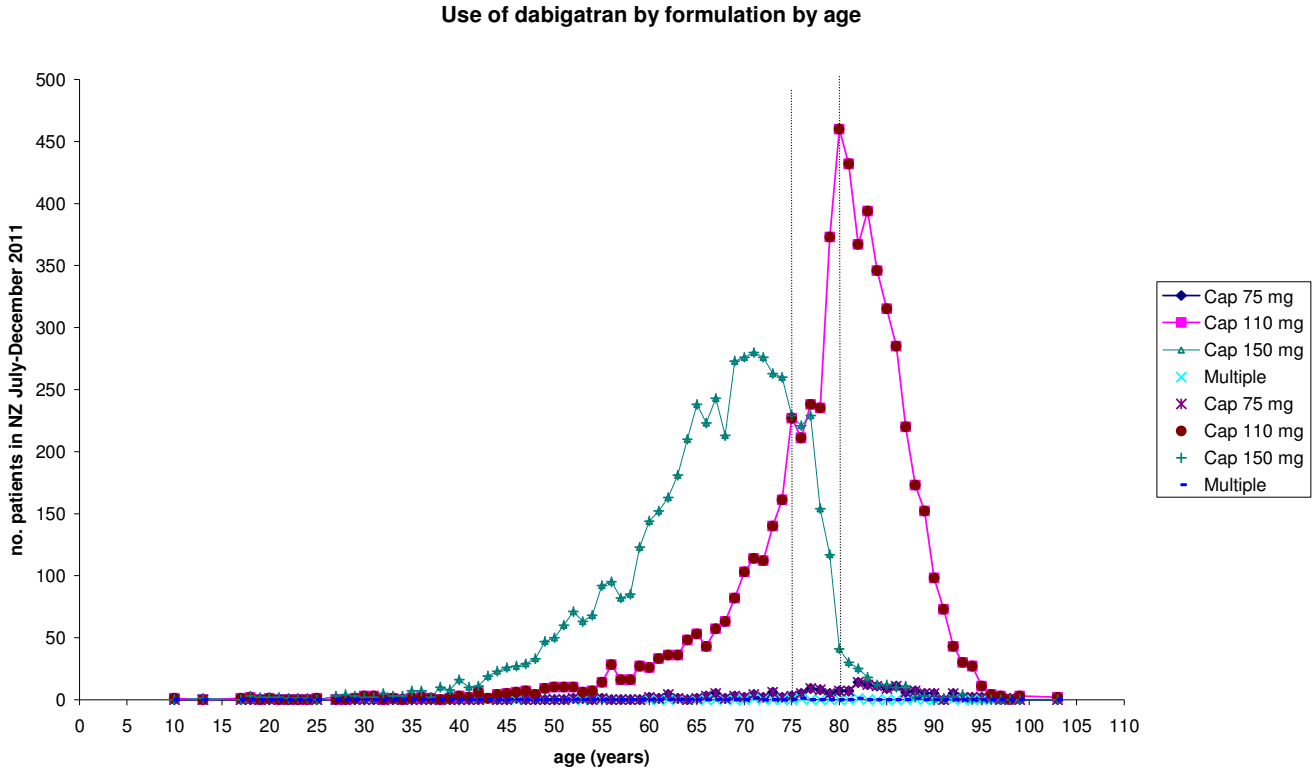

Table 5

no. prescriptions 23673
no. patients 11840

Count of NHI	Last_formulation gender												
	Cap 75 mg		Cap 75 mg Total	Cap 110 mg		Cap 110 mg Total	Cap 150 mg		Cap 150 mg Total	Multiple		Multiple Total	total
5_year_age_band	male	female		male	female		male	female		male	female		
10-14				1		1	1		1				2
15-19				3		3	4	1	5				8
20-24				1		1	4	3	7				8
25-29				1	1	2	10		10				12
30-34				3	4	7	10	5	15				22
35-39				5		5	23	11	34				39
40-44		1	1	12	4	16	59	20	79				96
45-49		1	1	21	10	31	124	38	162				194
50-54		2	2	29	14	43	231	81	312				357
55-59	1		1	67	34	101	347	130	477				579
60-64	5	3	8	102	77	179	601	249	850				1037
65-69	8	5	13	171	127	298	847	343	1190				1501
70-74	9	7	16	350	280	630	873	482	1355	1		1	2002
75-79	20	10	30	708	576	1284	588	362	950	1		1	2265
80-84	27	24	51	1006	993	1999	74	52	126		1	1	2177
85-89	22	16	38	547	598	1145	20	18	38		1	1	1222
90-94	4	10	14	94	177	271	5	2	7				292
95-99	2	2	4	8	13	21							25
100-104					2	2							2
total	98	81	179	3129	2910	6039	3821	1797	5618	2	2	4	11840
% formulation x age / total	0.8%	0.7%	1.5%	26%	25%	51%	32%	15%	47%	0%	0%	0%	100%
mean age	79.3	79.8	79.6	78.0	79.8	78.9	66.0	67.8	66.6	73.5	85.0	79.3	73.0
median age	81	82	82	80	81	80	67	70	68	71	82	76	75
formulation x gender, aged 75+	75	62	137	2363	2359	4722	687	434	1121	1	2	3	5983
formulation x gender, aged 80+	55	52	107	1655	1783	3438	99	72	171	0	2	2	3718
% [formulation x gender, aged 75+] of all	0.6%	0.5%	1.2%	20.0%	19.9%	39.9%	5.8%	3.7%	9.5%				50.5%
% [formulation x gender, aged 80+] of all	0.5%	0.4%	0.9%	14.0%	15.1%	29.0%	0.8%	0.6%	1.4%				31.4%
% [formulation x gender, aged 75+] of all aged 75+	1.3%	1.0%	2.3%	39.5%	39.4%	78.9%	11.5%	7.3%	18.7%				100%
% [formulation x gender, aged 80+] of all aged 80+	1.5%	1.4%	2.9%	44.5%	48.0%	92.5%	2.7%	1.9%	4.6%				100%
% [formulation x gender, aged 80+] of that formulation/sex	56%	64%	60%	53%	61%	57%	2.6%	4.0%	3.0%				31%
formulation x gender, all ages	98	81	179	3129	2910	6039	3821	1797	5618	2	2	4	11840
% [formulation x gender, all ages] of all	0.8%	0.7%	1.5%	26.4%	24.6%	51.0%	32.3%	15.2%	47.4%	0.0%	0.0%	0.0%	100.0%

Table 6

DHB	no. patients			% female	mean age (years)			median age (years)			aged 80+ years		aged 75+ years	
	male	female	total		male	female	all	male	female	all	no.	% of all	no.	% of all
Northland	552	389	941	41%	72.8	75.9	74.1	74	78	75	330	35%	513	55%
Waitemata	633	445	1078	41%	72.7	76.4	74.2	74	78	75	366	34%	577	54%
Auckland	476	309	785	39%	71.1	75.5	72.8	72	78	75	276	35%	398	51%
Counties Manukau	522	349	871	40%	68.9	72.9	70.5	70	75	73	214	25%	371	43%
Waikato	718	564	1282	44%	71.1	75.0	72.8	72	77	74	380	30%	614	48%
Lakes	202	118	320	37%	70.0	72.9	71.0	72	74	73	70	22%	141	44%
Bay of Plenty	642	398	1040	38%	72.0	75.6	73.4	73	77	75	340	33%	538	52%
Tairawhiti	112	80	192	42%	70.9	74.7	72.5	70	76	73	55	29%	88	46%
Taranaki	216	158	374	42%	71.7	76.9	73.9	73	78	75	126	34%	204	55%
Hawkes Bay	400	304	704	43%	73.0	77.5	74.9	75	78	77	256	36%	419	60%
Whanganui	94	84	178	47%	72.9	75.4	74.1	75	76	76	63	35%	100	56%
MidCentral	260	166	426	39%	72.4	74.9	73.4	74	76	75	134	31%	215	50%
Hutt Valley	124	114	238	48%	71.6	73.6	72.5	73	74	74	71	30%	113	47%
Capital and Coast	338	196	534	37%	69.4	74.8	71.3	71	77	73	161	30%	253	47%
Wairarapa	100	70	170	41%	72.9	76.1	74.2	73	79	76	60	35%	91	54%
Nelson Marlborough	189	118	307	38%	69.9	75.6	72.1	71	76	73	67	22%	134	44%
West Coast	38	22	60	37%	69.4	74.6	71.3	69	79	72	18	30%	25	42%
Canterbury	721	413	1134	36%	71.2	74.8	72.5	72	76	74	346	31%	548	48%
South Canterbury	156	117	273	43%	73.1	75.9	74.3	74	77	75	89	33%	146	53%
Otago	409	252	661	38%	71.9	75.6	73.3	74	78	76	219	33%	362	55%
Southland	136	119	255	47%	72.3	75.7	73.9	73	77	75	74	29%	130	51%
Overseas	11	6	17	35%							3	18%	3	18%
total	7049	4791	11840	40%	71.5	75.3	73.0	73	77	75	3718	31%	5983	51%

Table 7

DHB	no. patients aged 80+ years				all patients	prevalence 150mg per 1000 aged 80+	prevalence all doses, aged 80+	percentages	
	Cap 75 mg	Cap 110 mg	Cap 150 mg	all, 80+ years				%[80+,150mg] / all	%[80+,150mg] / 80+
Northland	7	316	7	330	941	1.5	68.6	0.7%	2.1%
Waitemata	9	342	13	366	1078	0.9	26.7	1.2%	3.6%
Auckland	11	244	21	276	785	1.8	23.8	2.7%	7.6%
Counties Manukau	2	205	7	214	871	0.8	24.9	0.8%	3.3%
Waikato	18	339	23	380	1282	2.2	36.2	1.8%	6.1%
Lakes	6	62	2	70	320	0.7	25.9	0.6%	2.9%
Bay of Plenty	4	316	20	340	1040	2.5	43.1	1.9%	5.9%
Tairawhiti	1	51	3	55	192	2.3	42.0	1.6%	5.5%
Taranaki	3	115	8	126	374	1.9	30.1	2.1%	6.3%
Hawkes Bay	2	248	6	256	704	1.1	47.1	0.9%	2.3%
Whanganui	5	54	4	63	178	1.6	24.6	2.2%	6.3%
MidCentral	0	129	5	134	426	0.9	23.1	1.2%	3.7%
Hutt Valley	3	68	0	71	238	0.0	17.7	0.0%	0.0%
Capital and Coast	3	148	10	161	534	1.3	21.6	1.9%	6.2%
Wairarapa	2	55	3	60	170	1.9	37.3	1.8%	5.0%
Nelson Marlborough	0	62	5	67	307	1.0	13.0	1.6%	7.5%
West Coast	0	18	0	18	60	0.0	16.8	0.0%	0.0%
Canterbury	9	319	18	346	1134	1.0	19.8	1.6%	5.2%
South Canterbury	3	83	3	89	273	1.2	34.7	1.1%	3.4%
Otago	17	192	10	219	661	1.4	31.2	1.5%	4.6%
Southland	2	70	2	74	255	0.6	21.2	0.8%	2.7%
Overseas	0	2	1	3	17				
total	107	3438	171	3718	11840	1.3	28.8	1.4%	4.6%

Table 8

Patients aged 80+ who use/d 150mg caps dabigatran

DHB	no. patients aged 80+ 150mg at any time	last dose 150mg	change to 110	% change	% remaining
Northland	29	7	22	76%	24%
Waitemata	21	13	8	38%	62%
Auckland	33	21	12	36%	64%
Counties Manukau	18	7	11	61%	39%
Waikato	52	23	29	56%	44%
Lakes	8	2	6	75%	25%
Bay of Plenty	37	20	17	46%	54%
Tairawhiti	6	3	3	50%	50%
Taranaki	9	8	1	11%	89%
Hawkes Bay	20	6	14	70%	30%
Whanganui	9	4	5	56%	44%
MidCentral	10	5	5	50%	50%
Hutt Valley	3	0	3	100%	0%
Capital and Coast	14	10	4	29%	71%
Wairarapa	4	3	1	25%	75%
Nelson Marlborough	6	5	1	17%	83%
West Coast	1	0	1	100%	0%
Canterbury	38	18	20	53%	47%
South Canterbury	6	3	3	50%	50%
Otago	26	10	16	62%	38%
Southland	5	2	3	60%	40%
Overseas	1	1			
total	356	**171**	185	52%	48%

THE NEW ZEALAND MEDICAL JOURNAL
Journal of the New Zealand Medical Association

A review of effects of retailer education on cigarette sales to minors in the greater Wellington region

Under the Smokefree Environments Act 1990 (SFEA) is it illegal to sell cigarettes or tobacco to a person under the age of 18. It has been established that the majority of smokers take up smoking during their teenage years; therefore the act provides a degree of health protection and prevention.[1,2]

In the greater Wellington region Regional Public Health supports the SFEA with two regulatory approaches designed to combat the sale of cigarettes to minors. These are: retailer education and regulatory enforcement. Retailers are educated on a one-to-one basis and their compliance is tested by means of controlled purchase operations (CPOs). There is some evidence suggesting retailer education may be a better method than CPO alone for achieving retailer compliance.[3,4]

Following a suggestion from Smokefree Officers in Wellington, I reviewed their data relating to this aspect of their work. The Smokefree Officers had hypothesised that their education visits to retailers would result in better compliance than CPO alone. During the normal course of their work, they had put this hypothesis to the test by measuring the two approaches. Across the region they divided 240 retailers into two equal groups. Group A (*N* 120) received an education visit followed by a CPO. Group B (*N* 120), a control, received only a CPO. A second phase of visits were conducted 15 months later (on average), during which CPOs alone were conducted on both groups.

The education visit consisted of a face-to-face discussion with the sales person or store manager. The discussion centred on the retailer's knowledge and obligations of the SFEA. Brochures on the legal requirements for the sale of tobacco were provided to retailers who needed them.

The CPO consisted of a visit by a minor who attempts to purchase cigarettes from the retailer under the supervision of a Smokefree Officer.

The reviewed data suggests that education visits (without CPOs) may have a slight advantage over CPO alone; there were more sales in the Group B (see Table 1), but research design and protocols were not established and therefore limit a full discussion of the data. However, there were two interesting incidental findings from this study.

Table 1. Number of cigarettes sales to minors across 240 retailers

Retailer response	Number of sales Phase 1	% of compliance	Number of sales Phase 2	% of compliance
Education Group A(*N* 120)	2	98%	2	98%
CPO Group B (*N* 120)	14	88%	3	97.5%
Combined	16	93%	5	98%

The first incidental finding from this review was that compliance with the SFEA among cigarette retailers in the Wellington region is generally very high. The combined results showed that 93% of the 240 retailers tested were not selling to minors during the first phase of visits, and 98% of retailers were not selling to minors in the second phase. Research had suggested retail compliance regarding the sale of cigarettes to minors was relatively poor and could be improved with education.

The second finding was that there may be clusters of retailers who sell cigarettes to minors. Fourteen retailers failed the (Group B) CPO by selling cigarettes to minors. Of these, eight were situated in neighbouring suburbs in South Wellington. Of these, three were small convenience stores located in close proximity on the same main arterial road and two more stores were opposite each other on another main arterial road. Why these sales happened in such close proximity is not clear, but one suggestion is that if one retailer sells cigarettes to minors, then other retailers could be copying the behaviour, possibly in competition for the sales.

Another interesting note is that the five closely clustered retailers who sold to minors were located in relatively affluent suburbs. The New Zealand deprivation index, scales suburbs from 1 to 10, a score of 1 being least deprived and 10 the most deprived. These clusters of sales were in suburbs that usually score 2–3 on this scale. This runs against the conventional logic, that areas of low deprivation are where smoking rates are generally higher and therefore where you might expect to find more sales to minors.

This review suggests that the perhaps best practice for Smokefree Officers is a targeted approach. For example, where there have been complaints received about a retailer selling to minors, Smokefree Officers should target that retailer, and a cluster of neighbouring retailers, using educational visits and follow-up CPOs.

Although aspects of this review may be encouraging it does not suggest that underage smokers have difficulty obtaining cigarettes or change their smoking behaviour as a result of the high compliance among retailers. The threshold for smoking initiation may be affected by other factors, such as price, familial and peer smoking, and mass media campaigns.

Future research contrasting deprivation, sales to minors and smoking prevalence might provide insights regarding youth smoking initiation.

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THE NEW ZEALAND MEDICAL JOURNAL
Journal of the New Zealand Medical Association

Fifty years since the Royal College Report: more action needed to achieve the "Smokefree New Zealand by 2025" goal

Fifty years ago (on 7 March 1962), a committee of the United Kingdom's Royal College of Physicians issued a major report on smoking and health.[1] It provided strong evidence that cigarette smoking caused lung cancer and bronchitis, and argued that it probably also contributed to cardiovascular disease. The Royal College Report (and subsequent follow-up reports in 1971, 1977 and 1983) also set out a range of measures needed to reduce smoking prevalence. These included health education campaigns, banning tobacco advertising and sponsorship, increasing cigarette taxation, providing smoking cessation support, restricting sales to children and reducing smoking in public places.

The 50th anniversary of the landmark 1962 Report is an opportunity to reflect on the state of tobacco control internationally, but also in New Zealand. With regard to the latter we note that the effects of the tobacco epidemic in this country remain very serious. Recent modelling work indicates that smoking will continue to constrain life expectancy improvements and reductions in ethnic inequalities in health, if substantive progress is not made in reducing smoking prevalence.[2] In addition to these direct effects, smoking continues to impose ongoing costs on the taxpayer-funded health system and to the economy (e.g., via absenteeism and premature deaths in workers).

An exciting development in thinking about tobacco use and how to prevent it, is the vision of a truly smokefree future, where children are protected from exposure to tobacco products and have a minimal risk of starting to smoke. This vision of a "Smokefree Aotearoa by 2025" was adopted in the Māori Affairs Select Committee Report and has since been endorsed by the New Zealand Government. The passing of the recent Smoke-free Environments (Controls and Enforcement) Amendment Act by 117 votes to 3 suggests that, for the first time, nearly all parties support progress towards the smokefree goal and are willing to work collaboratively to achieve this.

If, in future decades, New Zealand is not to look back on missed opportunities to reduce the harms cause by smoking, we need to implement further developments and intensification of the measures advocated in the Royal College reports by implementing other measures recommended by the Māori Affairs Select Committee. These include retailer licensing and plain packaging, measures whose effectiveness those of us in the research community have helped to document.[3 4]

We believe that in addition to these measures, major structural changes should also be performed. The major structural changes we favour include a sinking lid on sales[5] (i.e., systematic reductions in imports of tobacco) or other bold strategies,[6-8] since the 2025 goal requires a rapid reduction in prevalence unlikely to result from incremental measures alone. But there has been little discussion to date on how other *non-tobacco* actions might contribute to achieving the 2025 goal. Such discussion is important,

since activity in one public policy area may support goals in another. For example, action on alcohol may also reduce tobacco consumption. We list some such ideas in Table 1.

Table 1. Possible ancillary actions that may indirectly support progress towards the "smokefree New Zealand by 2025" goal

Actions	Detail
Fiscal actions	
Raising alcohol taxes	There is evidence that raising alcohol tax results in reductions in tobacco consumption[9-11] (i.e., these two products seem to act as "economic complements"). There is similar evidence for raising the legal alcohol purchase age of alcohol resulting in reduced adolescent smoking prevalence in the US.[12]
Legislative actions	
De-linking drinking and smoking	There is evidence that alcohol use is an important mediator in smoking uptake by youth,[13 14] and heavy alcohol use is associated with lower smoking quit rates.[15] Furthermore, NZ smokers are known to have relatively hazardous drinking patterns.[16] Therefore advancing alcohol control measures and also further decoupling of these two behaviours seems desirable. Options include: (i) strengthening alcohol control in general (e.g., increasing alcohol tax, tightening access and restraining marketing); (ii) banning tobacco sales at venues selling alcohol (e.g., as in Quebec[17]); and (iii) expanding the smokefree areas to include external areas of pubs and restaurants.
Progressing the Public Health Bill	This draft legislation is currently in limbo in the NZ Parliamentary system but it could be "revived" and strengthened to facilitate greater protection of NZ citizens from hazardous products (of which tobacco is a prime example).
Upgrading consumer protection legislation	Upgrading the "Fair Trading Act" so that it more comprehensively protects citizens from hazardous products in general. The weaknesses of the Commerce Commission with regard to the tobacco hazard have been described[18 19] and it has not acted to prevent a range of hazardous misperceptions held by NZ smokers.[20-22]
Strengthening local government law-making powers	Strengthening the by-law making powers of local government could have a range of public health benefits and empower local communities. For example, communities and local government could limit the numbers of vendors in their areas that they permit to sell hazardous products such as tobacco and alcohol. Furthermore, local government could pass stronger by-laws relating to alcohol control, a measure that may help to further de-couple smoking and drinking (see above).

We see these measures (in Table 1) as potentially ancillary and as such they should not be prioritised above enacting the major structural changes and intensification of existing approaches as outline above. But we note that some of these additional interventions are likely to be particularly cost-effective in their own right (e.g., raising alcohol taxes[23-26]) and would capitalise on the strong momentum for improving alcohol control in New Zealand.

Finally, measures which target other major threats to health like excessive alcohol consumption will have many other positive effects on public health (such as reducing incidence of many cancers, cardiovascular disease and diabetes[27]).

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THE NEW ZEALAND MEDICAL JOURNAL
Journal of the New Zealand Medical Association

1899 *BMJ* special correspondence mentioning New Zealand

From the *British Medical Journal*, 2, 1314, of 1899.

Special Correspondence

New Zealand seems to be an Eldorado for cancer curers, herbalists, faith and mind healers "et hoc genus omne", and it is an absurd fact that some members of the House of Representatives even suggested to grant some of them licenses to practise. In a country so far advanced in legislation, with its female franchise, old age pensions, etc, this would have been a decided retrograde step, but fortunately the suggestion was negatived by the Government.

Provided courtesy of retired anaethetist Basil Hutchinson who hand-copied it from an old *BMJ* some years ago when doing historical research.

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Childhood asthma and chronic obstructive pulmonary disease (COPD)

COPD is a major health problem and air pollution, particularly tobacco smoke, is generally regarded as the main causative factor. A Swedish study has suggested that about 50% of smokers eventually develop COPD. This begs the question—what is the cause of the other 50%? Childhood asthma has come to attention and this study comes to grips with this possibility in a New Zealand population. 749 people aged 25–75 years were recruited from a random population sample and were subjected to pulmonary function and atopy testing and a written questionnaire. COPD was defined as a post-bronchodilator forced expiratory volume in 1 s/forced vital capacity (FEV_1/FVC) ratio <0.7. The researchers report that the prevalence of COPD was higher in men and increased with age. It was more frequent in current and ex-smokers. A diagnosis of childhood asthma conferred a similar risk as an increase in age of 22 years or 62 pack years of cigarette smoking.

Intern Med J 2012;42:83–8.

Do hip and knee replacements last longer in those taking bisphosphonates?

Such operations are common and usually very beneficial. However, about 1 in 75 patients need a revision of their prosthesis within 3 years. It is believed that this is usually due to the bone supporting the prosthesis being resorbed.

This population-based retrospective study looked at 41,995 patients who had such surgery over a median period of 3.5 years. The researchers identified 1912 (4.6%) of this cohort as bisphoshonate users before their surgery. They report that bisphosphonate usage confers a strong protective effect on implant survival. Sounds convincing but the authors point out that such observational data needs to be confirmed by a prospective randomised trial.

BMJ 2012;344:17 (or BMJ 2011;343:d7222).

Immediate and late benefits of treating very elderly people with hypertension

Many clinicians have a relaxed approach to treating hypertension in the very elderly. This research study questions whether starting antihypertensive treatment in people aged 80 or over reduce cardiovascular events quickly enough to support starting treatment? 1882 patients aged 80 years or over with a sustained systolic blood pressure of 160 mmHg or above were randomised to receive indapamide SR 1.5 mg, with the addition of perindopril 2–4 mg as required to achieve the target blood pressure or placebo. Treatment was titrated to achieve the target of systolic blood pressure below 150 mmHg and diastolic pressure below 80 mmHg.

The triallists report the treatment was associated with a marked significant reduction in the incidence of stroke and heart failure and a reduction in all cause mortality. No serious adverse effects were reported. Patients with dementia, those requiring regular nursing intervention and those with many comorbidities were excluded from the study.

BMJ 2011;343:d7541.

Additional catheter-directed thrombolysis versus standard treatment for acute iliofemoral deep vein thrombosis

Conventional anticoagulant treatment for acute deep vein thrombosis (DVT) effectively prevents thrombus extension and recurrence, but does not dissolve the clot, and many patients develop post-thrombotic syndrome (PTS).

The authors of this paper from Norway set out to discover whether additional treatment with catheter-directed thrombolysis (CDT) using alteplase reduced development of PTS. 209 patients aged 18–75 years with a first-time ileofemoral DVT were included within 21 days from the outset of symptoms. The patients were randomly assigned to conventional treatment or this with CDT. At 24 months the patients who had CDT fared significantly better with an absolute risk reduction in the incidence of PTS, and the number needed to treat was 7. However, there were 20 bleeding complications related to CDT included 3 major and 5 clinically relevant bleeds. The authors conclude that additional CDT should be considered in patients with a high proximal DVT and low risk of bleeding.

Lancet 2012;379:31–8.

Colorectal-cancer screening—colonoscopy versus fecal immunochemical testing

Colonoscopy and fecal immunochemical testing (FIT) are accepted strategies for colorectal-cancer screening in the average-risk population. This randomised, controlled trial involving asymptomatic adults 50 to 69 years of age, compared one-time colonoscopy in 26,703 subjects with FIT every 2 years in 26,599 subjects. The semi-quantitative FIT was used rather than the older guaic test for occult fecal blood as it is considered to be more accurate.

The trial began in 2008 and the primary outcome was rate of death from colorectal cancer at 10 years. This interim report concluded that subjects in the FIT group were more likely to participate in screening that were those in the colonoscopy group. On the baseline screening examination, the numbers of subjects in whom colorectal cancer were detected were similar in the two study groups, but more adenomas were identified in the colonoscopy group.

They note that colonoscopy is superior in the detection and treatment of adenomas but this advantage may be diminished by the lower participation rate in the colonoscopy group. We will have to wait till 2021 to know the final outcome of this trial.

N Engl J Med 2012;366:697–706.

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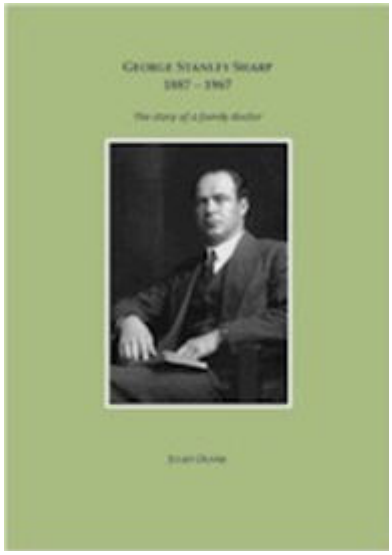
George Stanley Sharp:1887–1967: the story of a family doctor

Juliet Oliver. Published by Almo's Books, December 2011. ISBN 9780473199043. Contains 100 pages including photos. Price $30 plus $5 p&p (to order phone 06 3049160 or email Julieto@xtra.co.nz)

Juliet Oliver of Greytown has produced a book about Dr George Stanley Sharp 1887–1967. This is a very interesting book outlining the life of a general practitioner in a small rural town of Featherston from 1925 to 1950. In many ways it parallels the story of my own father in Masterton.



George Sharp was born in Tasmania, the son of a congregational minister and there went to school in the same year as Bernard (later Field Marshall) Montgomery. He entered Otago Medical School in 1906 and 2 years later won the Australasian 3 Mile Championship. He had to take 2 years off his course to raise money by teaching and entered his final year in 1914. Twenty-one of those students sat their exam early, without obstetrics, and after passing went straight into the army.

They left New Zealand in April 1915 for Cairo and thence to Gallipoli until January 1916; then to France for a year and then to England to be on the staff of the main New Zealand Hospital.

Back in New Zealand in 1919 while a house surgeon in Wellington Hospital he met his wife to be who was Matron of the Children's Hospital. After buying the Practice in Featherston, he still felt the need to go to Britain for his obstetric training.

In Featherston there was a small private hospital in the same grounds as his residence. As was the custom there he operated, delivered babies, saw his patients and then would do visits which may be as far as 25 miles away. A very active man, keen on all forms of sport and racing, with a lovely wife and four children, he was also Medical Officer to the Japanese Prisoner of War Camp in Featherston from 1942 to 1945.

He passed his Practice onto another very fine doctor but unfortunately nearly all his own records have been lost. The author has done a wonderful job of piecing together some very interesting stories of a life in a country practice in those days of the Depression and World War 2 and I recommend it to any interested in medical history.

Owen Prior
Retired GP
Masterton