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This Issue in the Journal

**Household characteristics of children aged under 2 years admitted with lower respiratory tract infection in Counties Manukau, South Auckland**  
Adrian Trenholme, Alison Vogel, Diana Lennon, Charissa McBride, Joanna Stewart, Emma Best, Henare Mason, Teuila Percival

This study describes household conditions of children admitted to Kidz First Children’s Hospital (South Auckland) with chest infections. There were 580 admissions involving 465 children from August to December 2007. The caregivers of 394 of these children completed questionnaires. Sixty-four percent of admissions had a diagnosis of bronchiolitis and 26% of pneumonia. Longer total stay was more likely in those of younger age, who were premature or of Māori or Pacific ethnicity. Household characteristics demonstrate that 25% live with ≥7 other people, 33% live with 4 or more children, 65% of children are exposed to cigarette smoke and 27% use no form of heating. Smoking (exposure to secondhand smoke), lack of heating and large households in overcrowded conditions are well known risk factors for these illnesses in children and these were confirmed in this study.

**Medical readmissions amongst older New Zealanders: a descriptive analysis**  
Tom Robinson, Ngaire Kerse

About one in six older people who go home from hospital after being treated for an acute illness will be readmitted within a month. Men, Maori and Pacific people, and people living in poorer areas are especially likely to need to return to hospital. If people are readmitted, on average, they will be sicker and more likely to die. Preventing these readmissions would be good for the patient and may save the health system money. We suggest providing better help to the patient around the time of discharge may be one way of improving this problem.

**Modelling a two-tier tobacco excise tax policy to reduce smoking by focusing on the addictive component (nicotine) more than the tobacco weight**  
Murray Laugesen

All cigarettes currently sold are addictive. A lower excise rate for Denic cigarettes would allow smokers to choose their own mix of Addictive cigarettes and lower priced Denics, which could relieve cravings and control smoking costs to under $10 a day. Smokers would be able to reduce their addiction before they quit, be more likely to succeed when they next quit, without being forced to quit before they are ready. This would make it feasible to increase excise on Addictive cigarettes more than at present.
Emergency food storage for organisations and citizens in New Zealand: results of optimisation modelling
Nhung Nghiem, Mary-Ann Carter, Nick Wilson

In this study, we used NZ food price data (e.g., from the Food Price Index) and nutritional data from a NZ food composition database. We used a mathematical technique (linear programming) to identify the lowest-cost foods for emergency storage. The study identified a collection of low-cost emergency storage foods that meet daily energy requirements for men were identified e.g., at a median purchase cost of NZ$ 2.21 per day (95% simulation interval = NZ$ 2.04 to 2.38). The cost of such a collection of foods which did not require cooking, was slightly higher (NZ$3.67) while foods that meet all nutritional recommendations (and not just energy) was substantially higher (at NZ$ 7.10 per day). In summary, it appears to cost very little to purchase basic emergency foods for storage in the current New Zealand setting. The lists of the foods identified could be considered by organisations who participate in disaster relief (civil defence) but also by citizens.

What risks do women face when seeking advice during pregnancy from pharmacies and natural health retailers?
Sarah Jefferies, Bridget Healy, Mark Weatherall, Richard Beasley, Philippa Shirtcliffe

There are potential risks to mothers and their unborn babies with the incorrect use of complementary and alternative medicine (CAM) products during pregnancy. 21 Health Food Stores (HFS) and 21 geographically matched pharmacies were visited by a researcher who sought advice regarding vitamin supplementation and nausea in early pregnancy. A minority of pharmacies and HFS made primary recommendations for nausea which were supported by Ministry of Health guidelines, and both pharmacies and HFS recommended products contrary to these guidelines. Pharmacies were more likely to give advice consistent with MOH recommendations for folic acid. Regulatory reform of CAM products and those who sell them is called for in NZ.

Back so soon: rapid re-presentations to the emergency department following intentional self-harm
Silke Kuehl, Katherine Nelson, Sunny Collings

This study examined a group of patients who visited a New Zealand emergency department with intentional self-harm, and who then returned for any reason within one week. Records over a 12 month period were reviewed showing that 48 patients returned to the emergency department on 73 occasions within 7 days. One half of return visits (55%) happened within one day. Mental health assessments by emergency department staff were minimal; more than half of the patients were involved in challenging incidents; and second visits resulted in an increase number of hospital admissions. Return visits increase costs and workload of an already overcrowded emergency department.
Time to invest in better housing for New Zealand children

Michael G Baker, Philippa Howden-Chapman

The paper by Trenholme and colleagues in this issue of the Journal provides further evidence of the need to improve housing as a high priority for protecting the health of vulnerable children in New Zealand. This experienced group of researchers obtained information on 508 hospital admissions for lower respiratory tract infection in children aged less than 2 years in Counties Manukau from August to December 2007 (notably during a period of relatively low unemployment). They identified markedly higher hospitalisation rates for Māori and Pacific children and those living in the most deprived neighbourhoods.

Two-thirds of children were potentially exposed to secondhand tobacco smoke, 27% reported no source of heating at home and 33% lived with four or more children. A study of 106 child admissions to Wellington Hospital in August 2012 identified a similar pattern of high rates of respiratory admissions in Māori and Pacific children and a strong association with poor housing conditions.

The health benefits of improving housing conditions

Trenholme and colleagues summarise the persuasive evidence about the important contribution of housing conditions to high rates of child admissions for respiratory disease. New Zealand now has overwhelming research evidence about the advantages of reducing exposure to household crowding and the benefits of home insulation and heating. Better housing conditions would support Government’s admirable target to reduce the incidence of rheumatic fever by two-thirds by 2017.

As mentioned by Trenholme, probably the most compelling evidence for the health benefits of housing improvement comes from evaluating the effects of the Housing New Zealand Corporation (HNZC) Healthy Housing Programme. This programme focussed on housing improvements (insulation, ventilation, heating, crowding reduction) and improved access to primary health care and social services. The largest proportion of households receiving this intervention were in Counties Manukau. Two separate evaluations showed that this programme was extremely effective at reducing rates of hospitalisation for children living in intervention household and underscored this is as a critical area for further investment.

The case for Government action on housing supply and quality

There is abundant evidence that the housing market has failed to deliver both the quantity and quality of housing needed. We have historically low levels of building consents particularly in affordable housing. This situation has caused a growing housing crisis in Auckland, which has the most rapid population growth in the country and has a shortfall of new house construction of at least 4000 a year. This situation is compounded by the Christchurch earthquake, which has destroyed an estimated 11,000 houses.
An inevitable consequence of a shortage of affordable housing is household crowding. Exposure to severe household crowding (a shortage of two or more bedrooms) is far more common for Māori children (10% of those under 15 years at 2006 Census) and Pacific children (21%) than for European/Other children (2%).

Thousands of children are experiencing severe housing deprivation, officially defined as lack of access to minimally adequate housing. These children are living in situations where they have no security of tenure, little privacy, and in some cases not even basic amenities.

In addition, the housing market has produced a legacy of old housing stock that is generally of poor quality and particularly in the case of private rental housing, has high levels of deferred maintenance. The litany of problems is now familiar: poorly insulated, inadequately heated, damp and mouldy housing. Added to this is the stock of ‘leaky’ homes which have severe weatherproofing issues.

These problems are further compounded by ‘functional crowding’ where children and other household members all sleep in the same room to keep warm during cold winter months. An important driver for households behaving in this way is fuel poverty, where, as the Trenholme article highlights, an increasing proportion of low income people cannot afford to heat their homes. Structural and functional crowding has the obvious potential to greatly increase transmission of infectious disease.

The case for more active Government intervention in the housing market therefore appears overwhelming. This need has been recognised already by the current Warm Up New Zealand programme which has insulated 188,000 homes. This programme was supported by several controlled trials and economic evaluations showing health benefits and positive benefit-to-cost ratios.

There is now a strong case for large-scale construction of social housing in Auckland and Christchurch. Housing should be seen as important national infrastructure as proposed by the Expert Advisory Group on Solutions to Child Poverty convened by the Office of the Children’s Commissioner. Continuing that logic, we could begin to talk of ‘housing of national significance’ in Auckland and Christchurch (and balance the benefits of investing in this infrastructure against ‘roads of national significance’).

Additionally, Government needs to use its considerable regulatory powers to improve housing quality in New Zealand. A useful mechanism would be to introduce a ‘warrant of fitness’ for rental housing supported by an appropriate regulatory framework. Young children spend virtually all of their time in the home environment, much of which is poor quality rental housing.

A warrant of fitness could require basic health and safety features such as insulation and protection from falls. Again, such a measure is a key recommendation of the Expert Advisory Group on Solutions to Child Poverty. New Zealand has already established a validated tool for measuring the health and safety of housing, the Healthy Housing Index. Application of this tool has shown that there is a significant association between the number of respiratory symptoms (wheezing or whistling when breathing, or an asthma attack) of occupants and the number of respiratory hazards in a house. A similar association has been found between the number of home injuries (ACC claims) and the number of injury hazards in the house.
Finally, HNZC should reinstate a realistic level of funding for its very successful Healthy Housing Programme. This programme could be extended to cover all of its 69,000 properties which contain many of New Zealand’s most vulnerable children.  

**Using the power of child health information**

The high proportion of children admitted to hospital with potentially harmful exposures at home raises the question as to whether these children should be routinely screened for such exposures. Where we have such strong evidence that poor housing is making children sick, it doesn’t make health or economic sense to return them to the conditions that are making them ill.

An obvious barrier to active screening is the probable lack of suitable housing alternatives in a deteriorating housing market such as Auckland. In the medium to longer term, systematic screening for harmful housing exposures needs to be considered for all children admitted to hospital with respiratory illnesses. There are good reasons to focus on respiratory illness given its large, and increasing contribution to hospital admissions.

From a public health surveillance perspective, it would be useful to consider periodic surveys of the prevalence of housing exposures in children admitted to hospitals (covering the sorts of exposures described in the Trenholm paper and a recent survey of paediatric admissions in Wellington). Such information could be used to guide and evaluate policies and programmes aimed at improving housing quality and supply and related activities such as reducing tobacco smoke exposure. These data could potentially add to the excellent child health surveillance reporting now operating in NZ.

**Conclusion**

Evidence, ethics, and economics all point towards investing in better housing for children. The Trenholme paper and other commentators remind us of the compelling arguments for taking action to improve child health. A good starting point would be a warrant of fitness for rental housing and a reinvigorated HNZC Healthy Housing Programme.

Establishing a large-scale programme for construction of medium-density social housing in Auckland and Christchurch would also produce many benefits. Not only would such housing reduce crowding and improve child health, it would also provide a valuable economic stimulus and help retain skilled labour in New Zealand.

**Competing interests:** Nil

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References:


Readmission: use with caution

Juliet Rumball-Smith, Diana Sarfati

The article by Robinson and Kerse in this issue of the Journal looks at rates of readmission in a national sample of elderly hospital patients. This paper conceptualises readmission in a simple and clear way: as an adverse health outcome. That is, although readmission may represent appropriate medical or social care for a given patient, readmission—like any hospitalisation—is an event that both patient and healthcare provider would hope to avoid.

However, readmission is commonly used outside these parameters, the event extrapolated to also represent the receipt of substandard healthcare quality - this interpretation assuming that a patient treated in the right way at the right time in the right place should not experience such an event.

While readmission is an easily derived measure that lends itself readily to risk-adjustment and sub-analysis, and is available from routinely collected data, it is also considered an important event because it represents a significant financial burden. For example, it has been estimated that unplanned readmissions cost US Medicare more than US$17 billion in 2004, and the Canadian Government more than CAN$1.8 billion in 2010. However, while readmission is itself an outcome of importance to patients and providers alike, the use of readmission rates as a proxy measure of hospital quality should be viewed with caution.

This is not a hypothetical concern. Readmission is employed in this way by many national health organisations—the National Health System of the United Kingdom has monitored rates since 1998, the Australian Institute of Health and Welfare since 1996, and the US Department of Health and Human Services use this measure to publicly rank the quality of hospitals nationally (see www.hospitalcompare.hhs.gov).

The NZ Ministry of Health also uses readmission as a quality measure, publishing rates of readmission within 7 days of discharge for each District Health Board in its quarterly Hospital Benchmarking Reports. Moreover, it does so without controlling for any associated differences between hospitals in patient, clinical or other exogenous factors, which might be independently associated with readmission.

For while some readmissions may be preventable, the risk of readmission is intractably intertwined with factors beyond a hospital’s control; including age, case-complexity, comorbidity, the social/economic environment, and a number of as-yet-unknown variables. This means that differences in rates of readmission between health care providers do not necessarily reflect differences in underlying quality of care. In fact, although controlling for established confounders may improve the validity of the measure, even with risk-adjustment methods it is likely that readmission rates are a valid proxy of quality of care in only a few situations.

Nonetheless, readmission continues to be used as an indicator of quality, often with significant consequences. For example, some jurisdictions apply financial penalties to
facilities with higher readmission rates—from April 2011, primary care trusts in the UK ceased to pay hospitals for acute readmissions within 30 days of discharge from a planned hospital stay, and as of 1 October 2012, Medicare commenced fining US hospitals for ‘excessive’ rates of readmission for patients experiencing heart attack, heart failure or pneumonia.

In addition to its lack of specificity for healthcare quality, some worry about unintended consequences of this application of readmission. For example, strategies encouraging the reduction of readmissions may incentivise clinicians to delay discharge or increase a patient’s length of stay, and discourage the provision of patient-centred care.

Particular concerns have been raised about the impact of policy aimed at reducing readmissions on vulnerable populations. Currently, there are two distinct applications for the iPad or iPhone freely available on the iTunes store that calculate an individualised ‘readmission risk’ for a given patient. It is possible that in some health systems, institutions or providers concerned about the financial implications of caring for ‘high readmission risk’ patients (such as the elderly, the deprived, and some ethnic groups) may subconsciously or deliberately choose not to care for them at all.

We suggest considerable caution in the use of readmission as an indicator of quality of hospital care. Our recent research examined differences in the rates of readmission between Māori and NZ Europeans admitted for defined surgical interventions. While it found a small but significant difference between the two ethnic groups (16% higher rate of readmission among Māori patients, 95% CI 8%–24%), quantitative bias analyses suggest that only around 30% of this difference may be attributable to poor quality care. That is, 70% of the difference was likely to be the result of other factors, unrelated to healthcare quality.

We strongly recommend that crude measures of readmission should not be used as a measure of quality of care. We also recommend that interpretations of the risk-adjusted readmission measure as a proxy for quality should be extremely cautious, and limited to defined situations only—for example, comparisons of the same population over time, or to identify (with the intention of exploring and learning more about) outlying facilities.

Nonetheless, a simpler conceptualisation of readmission as an adverse health outcome (such as how it is employed in the paper by Robinson and Kerse) is useful in its ability to identify groups that may benefit from targeted interventions (whilst in hospital or post-discharge) in order to reduce future morbidity.

Policy or programmes that focus on particularly vulnerable populations may reduce readmission while also being economically efficient for the health system and society as a whole. We suggest that this is a more appropriate use of readmission, and one that avoids the use of cautionary labels.
Competing interests: Nil.

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http://ax.search.itunes.apple.com/WebObjects/MZSearch.woa/wa/search?media=all&term=readmission+risk+calculator
Household characteristics of children under 2 years admitted with lower respiratory tract infection in Counties Manukau, South Auckland

Adrian Trenholme, Alison Vogel, Diana Lennon, Charissa McBride, Joanna Stewart, Emma Best, Henare Mason, Teuila Percival

Abstract

Aim To describe household characteristics of admissions for lower respiratory tract infection (LRI) in children aged less than 2 years in Counties Manukau, South Auckland, New Zealand.

Methods Prospective recruitment of all children aged less than 2 years admitted with a primary diagnosis of LRI from August to December 2007 with caregiver questionnaire.

Results There were 580 admissions involving 465 children, 394 of whom had completed questionnaires (85% response rate). Sixty-four percent of admissions had a diagnosis of bronchiolitis and 26% of pneumonia. Relative risk of admission was 4.4 (95% CI 3.2–6.2) for Māori, 5.8 (4.4–7.9) for Pacific peoples compared with European/others and 3.1 (2.4–3.9) for the most deprived quintile compared with other quintiles. Longer total stay was more likely in those of younger age, who were premature or of Māori or Pacific ethnicity. Household characteristics demonstrate that 25% live with ≥7 other people, 33% live with 4 or more children, 65% of children are exposed to cigarette smoke and 27% use no form of heating.

Conclusions Among young children admitted with LRI there is a high rate of exposure to known avoidable risk factors such as smoking, lack of heating and large households in overcrowded conditions.

Internationally lower respiratory infection (LRI) is a major cause of hospital admission in young children. Admissions for LRI have been increasing over the late 1990s and early 2000s in developed countries.1–3 New Zealand has high rates of admissions for LRI and these admissions are concentrated in Māori and Pacific and in areas of high deprivation. Counties Manukau District Health Board (DHB) has the highest rate of admission for childhood LRI of any DHB in New Zealand.4 LRI has been identified as a more useful epidemiologic and clinical description than differentiating between bronchiolitis and pneumonia, as there is significant variation in diagnosis and interpretation of chest X-ray with considerable proportions of children with a discharge diagnosis of bronchiolitis being found to have radiological evidence of pneumonia.3 This study was undertaken to provide detailed prospective epidemiology in order to understand these admissions better. It formed part of baseline data collection prior to the introduction of conjugate pneumococcal vaccination (PCV7) to allow evaluation.
of its effect on LRI admission rates amongst a group at highest risk of pneumococcal disease.

Methods

Study population—Counties Manukau District Health Board (CMDHB) is responsible for approximately 433,000 people of whom 112,500 are 0–14 years of age including 30% European, 26% Pacific, 23% Māori, 15% Asian and 5% other or not stated. The CMDHB Middlemore Hospital includes Kidz First Children’s Hospital which provides secondary acute emergency and inpatient care for children aged 0–14 years from the CMDHB geographic area.

Ninety-five percent of children resident in the CMDHB area who are admitted with LRI are admitted to Kidz First. Children aged less than 2 years admitted to Kidz First with a primary diagnosis of LRI from 1 August 2007 to 23 December 2007 were eligible.

Those admitted with a clinical diagnosis of a lower respiratory infection (bronchiolitis, pneumonia, bronchopneumonia, bronchitis, empyema/lung abscess/TB/pertussis/pneumonitis ) (ICD 10 bronchiolitis, ICD 9466.1, ICD 1010 J 21, pneumonia ICD 948486, 487, ICD 10 J 12–18, J 100 and J110, acute and specified lower respiratory infection ICD 10 J 22, acute bronchitis ICD 9 466, ICD 10 J20, lung abscess and parathorax ICD 9 510, 513, ICD 10 J 85–86, pertussis ICD 9 033, ICD 10 A37) were included.

Study procedures—Eligible patients were identified as part of daily screening of admissions by the study nurse and consent was obtained from parents for study participation. Detailed information on household characteristics was sought in a face to face parent questionnaire which included information on family, maternal age, housing, heating, smoke exposure and number in the house. Number of rooms in the house excluded bathrooms, showers, toilets, laundries, halls, garages and pantries.

Socioeconomic deprivation for each child was estimated using the NZDep2006 index for area of their residential address. The NZDep2006 index combines 9 variables from the 2006 NZ Census. Individual area scores are then ranked and placed on an ordinal scale from 1 to 10, with decile 10 representing the most deprived 10% of small areas. Children were clinically reviewed daily by the study nurse and the severity of illness documented. Nasopharyngeal aspirates were performed for viral and bacterial testing (data not presented in this paper).

Relative risk of subgroups for at least one admission was calculated using the CMDHB 2007 birth cohort (data from National Minimum Dataset) as the denominator. In those admitted to hospital with LRI an analysis of risk factors related to total length of hospital stay in the 5 months of the study was performed.

A general linear model was fitted with the log of the total length of stay (the sum of all admissions) for a child as the outcome and child’s age (at start of study), mothers age, ethnicity of child, deprivation index of home address (coded as 1-8 or 9,10) whether or not premature (<36 weeks), household density (number of rooms in house divided by the number of people in the house), number of smokers in the home and whether or not there was a source of heating in the house included as explanatory variables. Analyses were also run with these variables included individually to ensure associations were not being obscured because of correlation among these explanatory variables. The study was approved by the Northern Regional Ethics Committee (NTX/07/07/059).

Results

During the study period there were 465 children with 580 admissions to Kidz First wards with LRI. Of these, 394 children (85%) with 508 admissions consented to the study. These admissions were similar to the total group in ethnicity and diagnosis.
Table 1. Characteristics of study children admitted to CMDHB facilities with LRI, 1 August 2007–23 December 2007

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cohort N=394</th>
<th>%</th>
<th>CMDHB births 2007 n=8833</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>118</td>
<td>29.9</td>
<td>1962</td>
<td>22.2</td>
</tr>
<tr>
<td>Pacific</td>
<td>221</td>
<td>56.1</td>
<td>2808</td>
<td>31.8</td>
</tr>
<tr>
<td>Other</td>
<td>55</td>
<td>14.0</td>
<td>4063</td>
<td>46.0</td>
</tr>
<tr>
<td>Deprivation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (least) to 8</td>
<td>84</td>
<td>21.3</td>
<td>3990</td>
<td>45.2</td>
</tr>
<tr>
<td>9</td>
<td>124</td>
<td>31.4</td>
<td>1747</td>
<td>19.8</td>
</tr>
<tr>
<td>10 (most deprivation)</td>
<td>186</td>
<td>47.2</td>
<td>3066</td>
<td>34.7</td>
</tr>
<tr>
<td>Prematurity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 33/40</td>
<td>25</td>
<td>6.3</td>
<td>107</td>
<td>1.2</td>
</tr>
<tr>
<td>33/40 to 35+6</td>
<td>33</td>
<td>8.4</td>
<td>276</td>
<td>3.1</td>
</tr>
<tr>
<td>36/40 or more</td>
<td>336</td>
<td>85.3</td>
<td>8309</td>
<td>94.1</td>
</tr>
</tbody>
</table>

Table 1 compares the characteristics of the study population with that of the 2007 birth cohort. Relative risk for admission was 4.4 (95%CI 3.2–6.2) for Māori, 5.8 (95%CI 4.4–7.9) for Pacific peoples compared with others, and 3.1 (2.4–3.9) for those living in the most deprived quintile (NZ Dep 9 and 10) compared with those in NZ Dep 1–8 areas. Relative risk of admission was 5.8 (3.8–8.7) for those born at less than 33 weeks gestation and 3.0 (2.1–4.3) for those born at 33<36 weeks gestation compared with those born after 36 weeks.

Of the 508 admissions, 323 (64%) had a clinical diagnosis of bronchiolitis, 132 (26%) pneumonia, and 53 (10%) other LRI. Seventy-one (18%) had more than one admission and number of admissions ranged from 1 to 6. Length of stay ranged from 1 to 27 days with a median of 3 days. There was a total of 121 ICU bed days in 21 (5%) patients.

The characteristics of households are detailed in Table 2. It is of note that two-thirds of children were exposed to smoke in their home and that two-thirds of families had English as their first language with most others speaking Pacific languages (Table 2).

The median number of people in the house was 6, with range 2–31. Median number of adults was 2, median number of children 0–14y was 3, and 100 children (25%) lived in households with ≥7 other people. Thirty-three percent lived in households with four or more children. 224 (57%) had some period of full breastfeeding, 86 (22%) were partially breastfed. Twenty-seven percent lived in houses where caregivers reported never using any form of heating (Table 3).

Thirty-nine percent of Pacific families compared with 11% of Māori and 11% of other families had no source of heating.
Table 2. Characteristics of households of study children admitted with LRI to CMDHB, 1 August 2007–23 December 2007

<table>
<thead>
<tr>
<th>Maternal age</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20 yrs</td>
<td>60</td>
<td>15.2</td>
</tr>
<tr>
<td>20–24 yrs</td>
<td>117</td>
<td>29.7</td>
</tr>
<tr>
<td>&gt;25 yrs</td>
<td>217</td>
<td>55.1</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Birth order</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st child</td>
<td>125</td>
<td>31.7</td>
</tr>
<tr>
<td>4th or subsequent</td>
<td>98</td>
<td>24.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>First language</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>266</td>
<td>67.5</td>
</tr>
<tr>
<td>Pacific</td>
<td>113</td>
<td>28.7</td>
</tr>
<tr>
<td>Asian</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Māori</td>
<td>5</td>
<td>1.2</td>
</tr>
<tr>
<td>Child in house in daycare</td>
<td>111</td>
<td>28</td>
</tr>
<tr>
<td>No one in house in employment</td>
<td>44</td>
<td>11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Access to car during day</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>336</td>
<td>85.3</td>
</tr>
<tr>
<td>No</td>
<td>58</td>
<td>14.7</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Access to phone</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>380</td>
<td>96.4</td>
</tr>
<tr>
<td>No</td>
<td>14</td>
<td>3.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Smoking exposure</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>257</td>
<td>65.2</td>
</tr>
<tr>
<td>No</td>
<td>137</td>
<td>34.8</td>
</tr>
</tbody>
</table>

Table 3. Heating source for households with study children aged <2 years admitted with LRI to Kidz First Children’s Hospital, 1 August 2007–23 December 2007

<table>
<thead>
<tr>
<th>Heating source</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>106</td>
<td>26.9</td>
</tr>
<tr>
<td>Electric</td>
<td>210</td>
<td>53.3</td>
</tr>
<tr>
<td>Bottled gas</td>
<td>68</td>
<td>17.3</td>
</tr>
<tr>
<td>Wood</td>
<td>54</td>
<td>13.7</td>
</tr>
<tr>
<td>Mains gas</td>
<td>10</td>
<td>2.5</td>
</tr>
<tr>
<td>Coal</td>
<td>5</td>
<td>1.3</td>
</tr>
<tr>
<td>Solar</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Therapy given during the admission is illustrated in Table 4.
Table 4. Therapies received by study children <2 years admitted with LRI to Kidz First Children’s Hospital 1 August 2007 to 23 December 2007 by admission

<table>
<thead>
<tr>
<th>Therapies</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxygen</td>
<td>361</td>
<td>71.0</td>
</tr>
<tr>
<td>CPAP</td>
<td>24</td>
<td>4.7</td>
</tr>
<tr>
<td>Ventilation</td>
<td>2</td>
<td>0.0</td>
</tr>
<tr>
<td>Fluids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NG fluids</td>
<td>234</td>
<td>46.1</td>
</tr>
<tr>
<td>IV fluids</td>
<td>118</td>
<td>23.2</td>
</tr>
<tr>
<td>Medications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ventolin</td>
<td>140</td>
<td>23.2</td>
</tr>
<tr>
<td>Adrenaline</td>
<td>34</td>
<td>6.7</td>
</tr>
<tr>
<td>Atrovent</td>
<td>14</td>
<td>2.7</td>
</tr>
</tbody>
</table>

Reflecting severity, 5% of admissions received CPAP and 87% (n=441) received oxygen, salbutamol or supplementary fluids. In 57% (288) of the admissions supplementary fluid was given either via NG tube (46%) and/or as intravenous fluids (23%). In 224 admissions a full blood count was performed, 56 (25%) had an abnormal haemoglobin.

A primary care doctor was visited prior to 397 (78%) admissions. Following 390 (77%) admissions some form of follow-up was recommended after discharge, with 271 (53%) referred to the short-term Kidz First home nurse visiting service.

In those admitted to hospital the total days in hospital during the study period was associated with prematurity (p=0.005), ethnicity (p=0.02) and age of child (p=0.0002) with those who were premature, or Māori or Pacific ethnicity likely to have a stay approximately 40% longer than respectively those not premature or of European ethnicity.

The model also predicted every increase of a month in the child’s age to result in a 3% reduction in length of stay (see Table 5). The estimates of the effect sizes differed only marginally when the explanatory variables were analysed individually, with no change in the variables able to be shown to be associated with length of stay.
Table 5: Regression coefficient estimates for the log of total length of stay (the sum of all admissions) for a child as the outcome and child’s age in days (at start of study), mothers age in years, ethnicity of child, deprivation index of home address (coded as 1–8 or 9,10) whether or not premature (<36 weeks), household density (number of rooms in house divided by the number of people in the house), number of smokers in the home and whether or not there was a source of heating in the house included as explanatory variables.

<table>
<thead>
<tr>
<th>Source</th>
<th>Estimate</th>
<th>SE*</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Māori v Pacific</td>
<td>-0.01</td>
<td>0.10</td>
<td>0.02</td>
</tr>
<tr>
<td>European/other v Pacific</td>
<td>-0.36</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>Deprivation index</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1–8 v 9,10</td>
<td>0.12</td>
<td>0.10</td>
<td>0.25</td>
</tr>
<tr>
<td>Premature</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥36 v &lt;36wks</td>
<td>-0.34</td>
<td>0.12</td>
<td>0.005</td>
</tr>
<tr>
<td>Age child</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-0.001</td>
<td>0.0003</td>
<td>0.0002</td>
<td></td>
</tr>
<tr>
<td>Age mother</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-0.005</td>
<td>0.033</td>
<td>0.87</td>
<td></td>
</tr>
<tr>
<td>Household density</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-0.004</td>
<td>0.050</td>
<td>0.93</td>
<td></td>
</tr>
<tr>
<td>Number smokers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.01</td>
<td>0.03</td>
<td>0.67</td>
<td></td>
</tr>
<tr>
<td>Heating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some vs none</td>
<td>-0.15</td>
<td>0.10</td>
<td>0.13</td>
</tr>
</tbody>
</table>

*SE: Standard Error.

Discussion

This study sought to provide more detailed epidemiology of admissions of CMDHB children aged less than 2 years with LRI. We have confirmed that in the CMDHB geographical area Māori and Pacific children, children resident in deprived areas and preterm infants are at high risk of admission for LRI. Most of these admissions are relatively short, but 20% had multiple admissions (up to 6) over this 5-month period.

We have shown that, of those admitted, younger infants, Māori and Pacific and premature children have a significantly higher number of days in hospital with LRI. Previous studies in Auckland have shown high rates of admissions for pneumonia in young Pacific children and that Māori and Pacific children have more severe disease on admission. In both the UK and New Zealand admission rates for LRI are higher for children resident in areas of deprivation.

Two-thirds of the children were reported as smoke exposed at home. In the 2006 Census 40% of the South Auckland population aged 0–14 years were smoke exposed at home- a higher proportion than the national average.

Many admitted infants have young mothers and live in large households, both previously identified risk factors for LRI however, within those admitted to hospital, we did not find a significant association between hospitalised bed days and crowding as measured by people per room.

In a case control study of Auckland preschool children Grant el al showed an increased risk of acquiring pneumonia where there was household crowding and dampness, and an increased risk of hospitalization with these factors and with exposure to cigarette smoke in the home.

Amongst indigenous populations such as Alaska Alaskan Native children living in households with 4 or more children aged <12 years had an increased risk of
hospitalisation with RSV. One-third of our cohort lived in houses with 4 or more children under 15.

Surprisingly for a temperate climate and an area with poor housing insulation, just over a quarter report not using any heating in the winter, predominantly Pacific families. In comparison in the 2006 Census 1.4% of households in South Auckland stated that no fuels were used for heating.

This study has identified a number of key areas for intervention. Cigarette smoke exposure in utero and postnatally is well recognised as increasing the risk of admission for LRI. There is a need to improve the identification of smoke exposed children both in utero and in the home and to offer support for smoking cessation.

Breastfeeding is also known to reduce the risk of admission for LRI. Promotion and protection of breastfeeding needs addressing to improve both initiation and exclusivity of breastfeeding.

Many of the children admitted live in large households with inadequate heating in low decile areas. Given the nature of our study without community controls we were unable to investigate the risk of household crowding on admission although crowding has been found to be associated with the risk of meningococcal disease.

There are three pieces of New Zealand research which suggest that housing and heating interventions may reduce admissions. In a community based single blinded cluster randomised study Howden-Chapman et al showed that insulation resulted in a small increase in bedroom temperatures in the winter despite lower energy consumption. They also found a substantial but non significant reduction (OR 0.53, CI 0.59-1.37) in the need for hospitalisation for respiratory illness. In a further community based randomised study, they showed that installation of non polluting more effective home heating reduced symptoms of asthma, days off school, healthcare utilisation and visits to a pharmacist in school aged children with asthma.

In 2011 Jackson reported on a pre/post intervention study of the Auckland based Healthy Housing programme which is a joint initiative between Housing New Zealand (social housing provider) and the local District Health Board. The programme concentrated delivery to defined geographic areas and sites for the programme were selected using the following criteria: a) "potentially avoidable hospitalisations", b) concentration of Housing New Zealand homes c) social deprivation rates and d) census reported overcrowding.

The primary focus was on the health of the children. A joint assessment of health and housing need was made with linkages made to other health and social services. Housing needs including crowding and insulation were addressed.

The results show a reduction in acute admissions in those under age 34 with the greatest reduction in the 5–34 year age group. The programme so far has targeted small areas of high risk social housing, and does not include properties rented on the private market.

Admissions for infectious diseases are increasing nationally, and increasing inequalities by ethnicity and socioeconomic status have recently been shown by Baker et al.
The risk factors for respiratory disease are also risk factors for a number of other health conditions prevalent in South Auckland including acute rheumatic fever, admissions to hospital with cellulitis and meningococcal disease\textsuperscript{4}. The Māori and Pacific child and adult population in South Auckland also has very high rates of bronchiectasis which is being increasingly linked to LRI hospital admission in infancy.\textsuperscript{23, 24}

We believe that for South Auckland the way forward, in addition to continuing to pursue full immunisation coverage including pneumococcal, is to progress with breastfeeding and smoking interventions given the known risk of these factors for LRI and their high rates in this hospital sample. Secondly to expand housing and social policy initiatives such as the proven healthy housing programme, despite the high up front costs and significant interagency cooperation and prioritisation of funding required.

**Competing interests:** Nil.

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**References:**


Medical readmissions amongst older New Zealanders: a descriptive analysis

Tom Robinson, Ngaire Kerse

Abstract

Aim Preventing acute hospital readmissions is attractive because it may achieve the triple aims of improving health outcomes, the patient experience, and reducing health costs. The aim of this study is to better understand medical readmissions in older people in New Zealand so as to help decide whether readmissions prevention strategies might be worthwhile.

Methods Data on hospitalisation and mortality in New Zealand was obtained from the Ministry of Health. Acute medical admissions in people 65 years and older were examined for the period 1 April 2009 to 31 March 2010 (n=95,318). We studied prevalence and risk factors for 30-day and 90-day readmissions and characterised those readmissions.

Results Medical readmissions are common in older people with 16.1% (95%CI 15.8–6.3%) of admissions resulting in a readmission within 30 days of discharge. The risk of readmission was greater in Māori, Pacific people, men, and people living in deprived areas. People being readmitted had more complex and costly illnesses and suffered poorer outcomes.

Conclusion Medical readmissions are a significant issue in terms of health burden, health inequalities and health care costs. Consideration should be given to whether some of these readmissions could be prevented.

The New Zealand health system faces the triple challenges of improving quality of care and patient experience, health outcomes and equity, and getting best value from health resources. Reducing hospital readmissions offers the prospect of achieving these aims and is therefore a topic of considerable interest.

District Health Boards (DHBs) have been asked to make improvements in productivity and efficiency, but not at the expense of quality of care. Hospital unplanned acute readmission rates are a well-established measure of quality of care and are included in DHB performance measures.

In 2010/11, across DHBs, 7.6–11.5% of admissions are followed by an unplanned acute readmission within 28 days. However, whilst readmissions have attracted considerable interest internationally, particularly in USA recently, there has been comparatively little analysis in New Zealand. This study describes acute medical readmissions in New Zealand hospitals with a particular focus on older patients.

This work was initially undertaken to support the design of a Waitemata DHB programme to prevent medical readmissions amongst older people by improving the transition from hospital to home.
Readmissions defined

There is no agreed definition of readmissions in the literature. Unplanned or acute admissions following and earlier admission are usually of greatest interest. Authors have used time periods varying between 1 day and 12 months after discharge to define a readmission. The time period chosen may depend upon the reason for interest in readmissions.

Readmissions are frequently used as a measure of hospital care quality. In this case readmissions soon after discharge are more likely to be related to deficiencies in care. However, since our interest is in interventions aimed at supporting the transition of patients from hospital back into the community a longer time period also seems relevant.

People at risk of readmission

Readmission rates have been shown to vary considerably between countries, between areas within countries, and between hospitals. Internationally a number of risks have been identified for increased risk of readmission including being older, male, lower education, some ethnicities, widowed or divorced and having poor social networks or living alone.

In New Zealand surgical readmissions in the elderly have been shown to be more common in men, older people and Māori and Pacific people. Chance of readmission has also been related to a number of clinical factors such as health service use, diagnosis, co-morbidities, disability, and function. Readmission rates for medical admissions have been found to be higher than for surgical admissions.

Readmissions are of interest because it is thought that some are potentially preventable. Higher rates of readmission are associated with lower quality of care in hospital. However, assessment of the proportion of readmissions that are potentially preventable vary widely from 5–71%. This reflects different periods used, the difficulty in deciding whether an admission is preventable, and the widely varying methods used to make this judgement.

Of greater importance is whether interventions in hospital or in the community can lead to actual reductions in readmissions. A number of systematic reviews have examined this question, and found that interventions can be effective, although not all are.

The aims of this study are to investigate the degree to which acute medical readmissions might be a suitable target for improving the quality and efficiency of the health system.

Specifically we aim to answer a number of questions:

- How common are medical readmissions in older people?
- Which groups are at greatest risk?
- What is the health and health system burden of people who are readmitted?
- What is the potential for prevention?
Methods

NZ publically funded hospital admissions for the period 1 April 2009 to 31 March 2010 were examined. Data from the Ministry of Health’s National Minimum Data Set (NMDS) collection was obtained on hospitalisations of people admitted between 1 Feb 2009 and 31 June 2010 to allow recognition of admissions three months before and three months after index admissions. Mortality data for the period 1 April 2009 to 31 June 2010 was also obtained and linked to the hospitalisation data using encrypted NHIs.

Index admissions were defined as acute medical admissions in NZ residents where the person had stayed overnight and where they had ended in a routine or self discharge. We included self discharges as we were less interested in readmissions as a marker of quality of care than as an opportunity for intervention and people who self discharge would still be offered such an intervention. Readmissions were defined as a further acute medical admission. We particularly considered 30- and 90-day readmission rates.

Ethnicity in the NMDS collection is self identified and allows multiple ethnicities to be recorded. These were prioritised according to the Ethnicity Data Protocols for the Health and Disability Sector\(^1\) and then aggregated to Māori, Pacific, Asian, and Other (Other includes Europeans). Deprivation was assigned at Census Area Unit using the NZDep2006 Index of Deprivation which is an area based index.\(^2\) Rurality was also assigned by Census Area Unit and is taken from tables provided by the Wellington School of Medicine which were in turn based up Statistics New Zealand definitions.\(^3\)

For univariate analyses chi squared tests were used for dichotomous outcomes and Wilcoxon rank-sum test for continuous outcomes. Binomial regression was undertaken for multivariate analyses. All analyses were undertaken using Stata v11.2 software®.

Results

There were 217,323 acute medical admissions amongst 164,428 patients with a subsequent routine discharge in the study period. 95,318 of these admissions in 66,983 patients were in people 65 years and older. These are the focus of this study.

Readmission by age group—Readmission was very common. Up to one-third of acute medical admissions were followed by another acute medical admission within the next 3 months in some population groups. Rates of readmission increased with age until the seventies and then tended to plateau.

Māori and Pacific people had higher readmission rates for most age groups than Asians and Others. Readmission rates in Māori, Pacific, and Asians after the age of 90 years are not shown because of the small numbers of people in these older age groups. 30-day readmission rates showed a similar pattern (not shown but available on request).
Figure 1. Adult medical readmission within 90 days of discharge by age and ethnic group, New Zealand 2009/10

The higher rates of readmission for older people led us to focus on older people when planning potential interventions. The remainder of the analysis in this paper focuses on people 65 years and over.

Figure 2 Cumulative readmission rates for people 65 years and over by time after discharge, New Zealand 2009/10
The cumulative chance of readmission for an older person who is discharged after an acute medical admission increases over time reaching 10.8% (95% CIs 10.6–10.9%) by 30 days after discharge and 18.3% (95% CI 18.1–18.3%) after 90 days. As shown in Figure 2 second readmissions within 90 days were also not rare.

Whereas 10.8% of individuals who were admitted went on to be readmitted within 30 days, 16.1% (95% CI 15.8–16.3%) of admissions were followed by a readmission within 30 days. This difference is due to people with high readmission rates being counted only once in the first analysis but multiple times in the second. Within 90 days, 27.8% (95% CI 27.5–28.1%) of admissions were followed by a readmission.

When considering the impact of readmissions on the health system the proportion of admissions that are readmissions is also important. 13.8% (95% CI 13.6–14.0%) of all acute medical admissions in over 65 year olds in the study period were 30-day readmissions and 25.5% (95% CI 25.5–26.0%) were 90-day readmissions.

Groups at risk of readmission—Māori and Pacific were more likely to be readmitted than those in other ethnic groups. Table 1 shows the result of a multivariate model which included age, ethnicity, gender, deprivation and rurality as predictors of readmission within 30 days.

Increasing age, increased deprivation and male gender were also associated with increased risk of readmission. Interestingly, people living in rural areas were slightly less likely to be readmitted.

Table 1. Risk factors for readmission within 30 days of discharge for people 65 years and over, New Zealand 2009/10
(*Note: years over the age of 65 was use in the analysis rather than age)

<table>
<thead>
<tr>
<th>Variable</th>
<th>RR</th>
<th>Lower 95% CI</th>
<th>Upper 95% CI</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (5 years)</td>
<td>1.026</td>
<td>1.016</td>
<td>1.036</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>European</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maori</td>
<td>1.179</td>
<td>1.115</td>
<td>1.246</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pacific</td>
<td>1.283</td>
<td>1.203</td>
<td>1.370</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Asian</td>
<td>0.929</td>
<td>0.845</td>
<td>1.022</td>
<td>0.131</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1.161</td>
<td>1.127</td>
<td>1.197</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>NZDep06</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-7</td>
<td>1.043</td>
<td>1.000</td>
<td>1.087</td>
<td>0.049</td>
</tr>
<tr>
<td>8-10</td>
<td>1.152</td>
<td>1.104</td>
<td>1.203</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Rurality</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Major urban</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary or minor urban</td>
<td>0.976</td>
<td>0.940</td>
<td>1.014</td>
<td>0.200</td>
</tr>
<tr>
<td>Rural centre or rural</td>
<td>0.891</td>
<td>0.839</td>
<td>0.946</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Morbidity and mortality of people who were readmitted—Whilst it is not surprising, it is still worthy of comment that people who are being readmitted with acute medical problems are more unwell and have worse outcomes than people being admitted for their first admission.

Table 2. Comparison of readmissions (within 30 days of discharge) and first admissions for mean admission complexity and outcomes for people 65 years and older

<table>
<thead>
<tr>
<th></th>
<th>First admissions</th>
<th>Readmissions</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Admission complexity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complex (%)</td>
<td>51.3</td>
<td>58.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Length of stay (days)</td>
<td>4.3</td>
<td>4.9</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Costweight</td>
<td>0.892</td>
<td>0.949</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Outcomes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mortality in hospital (%)</td>
<td>4.6</td>
<td>6.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mortality with 90 days of discharge (%)</td>
<td>8.5</td>
<td>15.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Readmission within 30 days (%)</td>
<td>13.3</td>
<td>26.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Readmission within 90 days (%)</td>
<td>23.8</td>
<td>40.9</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Readmissions were more likely to be complex (coded as having a patient clinical complexity level other than 0), and had a longer mean length of stay, and a higher mean cost weight than first admissions. This indicates that people being readmitted were more unwell and/or more complex than first admissions. Readmission outcomes were also worse than first admissions. They were almost twice as likely to die within hospital or soon after discharge. Readmissions were also almost twice as likely to result in a further readmission.

Prevention—As we were interested in designing interventions to prevent readmissions we were interested in what proportion of readmissions were potentially preventable. Unfortunately this is very difficult to determine from hospitalisation data. However, we have looked at two indicators that provide some information. A readmission might be more likely to have been preventable by better hospital or transition care if it was for the same disease as the preceding admission.

Our analysis shows that 30.9% (95% CI 30.1–31.6%) of 30-day readmissions had the same diagnosis as the preceding admission (defined by having the same DRG code e.g. F62 heart failure) and 48.0% (95% CI 47.1%–48.8%) were in the same diagnostic group (defined by having the same first letter in the DRG code e.g. F circulatory). The second indicator we considered was whether the readmission was for an ambulatory sensitive hospitalisation (ASH). These admissions might potentially be preventable by linking people back into community care more effectively. Overall, 34.7% (95% CI
33.8–35.5%) of 30-day readmissions and 35.6% (95%CI 34.9–37.2%) of 90-day readmissions were for ASH conditions.

When considering possible interventions to reduce readmissions the question arises whether we should target a few high risk diagnoses such as congestive heart failure (CHF) and chronic obstructive pulmonary disease (COPD) or instead design an intervention that reaches all people at high risk of readmission. We therefore looked at to what extent particular diagnostic groups or diagnoses made up the majority of readmissions.

Table 3. Main diagnostic groups and diagnoses of readmissions within 30 days of an acute medical admissions in people 65 years and older, New Zealand 2009/10

<table>
<thead>
<tr>
<th>Group</th>
<th>Diagnosis</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td>Angina/chest pain</td>
<td>7.0</td>
</tr>
<tr>
<td></td>
<td>CHF</td>
<td>7.0</td>
</tr>
<tr>
<td></td>
<td>CVA</td>
<td>1.1</td>
</tr>
<tr>
<td>Respiratory</td>
<td>COPD</td>
<td>9.4</td>
</tr>
<tr>
<td></td>
<td>Pneumonia</td>
<td>3.7</td>
</tr>
<tr>
<td>Gastroenterology</td>
<td></td>
<td>7.4</td>
</tr>
<tr>
<td>Cancer</td>
<td></td>
<td>6.3</td>
</tr>
<tr>
<td>Genitourinary</td>
<td></td>
<td>4.7</td>
</tr>
<tr>
<td>Infectious</td>
<td></td>
<td>4.4</td>
</tr>
<tr>
<td>Endocrine</td>
<td>Diabetes</td>
<td>1.8</td>
</tr>
<tr>
<td>Musculoskeletal</td>
<td></td>
<td>3.7</td>
</tr>
<tr>
<td>Skin</td>
<td></td>
<td>2.5</td>
</tr>
<tr>
<td>Neurology</td>
<td></td>
<td>2.0</td>
</tr>
<tr>
<td>Mental health</td>
<td></td>
<td>1.4</td>
</tr>
<tr>
<td>Symptoms/signs</td>
<td></td>
<td>14.2</td>
</tr>
</tbody>
</table>

Cardiovascular disease and respiratory disease together made up over 40% of readmissions. However, the four commonest diagnoses (angina/chest pain, CHF, COPD, and pneumonia) made up only 27% of all readmissions.

Discussion

Medical readmissions were common amongst older people and are a potentially worthwhile focus for intervention. A quarter of all acute medical admissions were preceded by another acute medical admission within 3 months. These admissions were more costly and complex than other admissions. If these readmissions could be reduced substantially there would be significant savings to the health system. In
addition people being readmitted are at risk of poor outcomes as measured by mortality and further readmissions. Interventions to provide this group better care might reduce these poor outcomes.

It is of concern that there were groups of our population who were at increased risk of these poor outcomes. These included Māori, Pacific people, people living in deprived areas and men. Possible reasons for this disparity are that these groups were less healthy, that the care we provided, either in hospital or in the community, was less effective for their needs, or that they had lower access to other community resources that enabled them to recover their health. We believe that these are serious concerns and warrant further study. It also behoves any one developing an intervention to prevent readmissions to make particular efforts to ensure that the interventions meet these groups’ needs.

Readmissions are of interest because some are thought to be preventable by improvements in the health care system. However, as previously discussed, there is no agreement on what proportion of readmissions are preventable or indeed which groups of readmissions are preventable. A readmission may be preventable by better care whilst the patient is in hospital, by better organised and supported care of the transition back into the community, or by better ongoing care once the patient is established back in the community.

Data presented here are limited in examining the potential for prevention of readmissions. Patients who are quickly readmitted to hospital with the same illness might be more likely to benefit from better hospital or transition care. This group made up nearly a third of readmissions over 30 days in our study. However, not all of these readmissions will be preventable, and many readmissions with unrelated illnesses might well benefit from the same improvements in care.

Ambulatory sensitive hospitalisations (ASH) made up just over a third of readmissions. ASH may be related to quality of primary care and higher quality of care is thought to reduce admission from this group of diagnoses. This category of admission has not previously been examined in relationship to readmission. This high proportion of readmissions in this category suggests that primary care intervention may be an area worth considering.

This study examines a population with a potential to improve care and reduce health system costs. However, to achieve these aims we must first be able to identify reliably those people at risk of readmission and then find interventions that can be shown to reduce readmissions and other adverse outcomes. CHF and COPD are well recognised chronic conditions that contribute significantly to readmissions in older people. There is ample evidence from systematic reviews that a range of interventions can reduce hospitalisations in these groups.24–28

Another approach may be to focus on those patients at high risk of readmission and support their transition back into the community. Panattoni et al, in examining predictive risk models to identify patients at high risk of emergency hospitalisation in New Zealand suggest development of cost-effective strategies.29 A predictive risk model was developed for Waitemata DHB in 2009 and a further model focused on older people is currently under development. Similar approaches have being reported internationally.11,30
A number of systematic reviews have examined the effectiveness of ‘transition’ interventions. One concluded that programmes that begin in hospital, are continued in the community and are multidimensional are more likely to be effective. Unfortunately, whilst there is reasonable evidence for reducing hospitalisations there is less for reducing other poor outcomes such as mortality.

A limitation and strength of this study is that it relies on national routinely collected data. Whilst this means we are able to present a national picture of medical readmissions in older people it means we are limited to data that is part of this collection. We have further limited our study to only considering demographic risk factors for readmission. As mentioned previously a range of other social and clinical risk factors are known to be highly correlated with readmission and these are being examined in the development of a predictive risk model for Waitemata DHB.

Whilst considerable attention is given to ensuring the accuracy of the NMDS collection it is unlikely to be as accurate as data collected for a research study. For example it is known that hospital records continue to mis-record people’s ethnicities which may lead to inaccurate estimates of risk of readmission related to ethnicity.

In conclusion, medical readmissions in older people in New Zealand are common and, if predicted and effectively prevented, represent an opportunity to improve people’s outcomes, reduce disparities and reduce health service costs. Other studies will be needed to show which interventions in these, or subgroups of these patients, are effective and cost-effective.

Competing interests: Nil.

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Modelling a two-tier tobacco excise tax policy to reduce smoking by focusing on the addictive component (nicotine) more than the tobacco weight

Murray Laugesen

Abstract

**Aim** To determine whether adding a low tax category for very-low nicotine content (denicotinised or Denic) cigarettes would facilitate higher excise and reduced consumption of addictive cigarettes (AddictiveCigs, defined as containing ≥2 mg nicotine per cigarette).

**Method** Nicotine content was laboratory-tested to classify cigarettes into two tiers for excise. PubMed was searched for studies of low nicotine content cigarettes. Nicotine delivery studies and estimated current and future cigarette prices provided the basis for estimating the effect of smoking a mix of AddictiveCigs and Denics.

**Results** The test results indicated that mean nicotine content per cigarette for the 22 most popular New Zealand brands was 8.7 mg (range 5.6–12.4 mg); only AddictiveCigs were sold. Annual 10% excise increases now legislated are estimated to increase price to $17.60 per 20s packet by 2016. A minority of smokers will quit, by abstaining from AddictiveCigs. Continuing smokers if able to buy lower-priced Denics ($11 a packet), could partly switch to these, which although no less toxic would relieve cravings, reduce nicotine inhaled by 68–86%, and contain smoking costs, without reducing total cigarettes smoked per day.

**Conclusion** Introducing a lower excise rate for Denics would: (1) allow smokers to select their own mix of AddictiveCigs and Denics; (2) make Denics available to reduce cravings, reduce addiction, and reduce smoking costs of continuing smokers; (3) increase the political feasibility of increasing excise on AddictiveCigs sufficiently to greatly reduce addictive smoking; and (4) enable smokers to reduce their addiction before they quit, and therefore probably become more likely to succeed when they do so.

In 2010, in this *Journal*, the End Smoking New Zealand trust identified tobacco taxation and reducing the nicotine in cigarettes as two of the most powerful policies for reducing smoking.¹

In this paper we do not seek to supplant those policies, but to combine aspects of each to create a new tobacco tax policy focused on nicotine, to reduce tobacco addiction.

Very low nicotine “Denic” cigarettes (not currently on sale in New Zealand) have become commercially available this year in the United States, and we propose that these cigarettes, which actually assist smokers to quit² and which can reduce tobacco addiction,³-⁵ merit a lower rate of excise to make them available at a lower price than other (addictive) cigarettes.
The concept of a second-tier lower excise rate has precedent. Customs up until 2010 taxed hand-rolled (roll your own or RYO) cigarette tobacco at a lower rate, and levies lower rates of excise on beer than on wine or spirits. A lower excise based on a lower content of either the toxic or addictive substance thus has precedent.

Since 2010, equalisation of the excise on RYOs and factory-made (FM) cigarettes on the basis of tobacco content has meant that all smokers face similar increases in the cost of smoking. With respect to Denics however, this paper proposes a lower tax classification, so that during 2013–16 and beyond, Denics can be taxed at a flat and steady lower rate, while AddictiveCigs would be taxed at an increasing rate. Such a two-tier excise system would require cigarettes to be classified as either (highly) addictive, or of very low addictive potential, according to nicotine content.

A study of 25,000 New Zealand year 10 adolescent smokers found that of those who had smoked either one or two cigarettes only, one-quarter had developed symptoms of addiction. It is this addictiveness which we consider should be taxed most heavily.

All cigarettes generate toxic chemicals in the smoke regardless of nicotine content, but reducing the degree of addiction would make success easier for the one third of smokers who attempt to quit each year. Parents may be concerned that Denic cigarettes would lead young smokers to smoke AddictiveCigs but Denics used on their own actually decrease tobacco addiction and AddictiveCigs are becoming increasingly expensive. Lifetime addiction to tobacco smoking is the underlying factor in nearly 5000 cigarette-attributable deaths annually, which make up one sixth of all deaths in New Zealand.

In 2010 the Māori Affairs Parliamentary Select Committee (MASC) completed its Tobacco Inquiry recommending halving tobacco consumption and smoking prevalence by 2015 to make “New Zealand a smoke-free nation by 2025.”

In 2011 Government replied: “The Government agreed to set specific mid-term targets as a means to ensure meaningful progress towards the longer term goal of making New Zealand essentially a smoke-free nation by 2025.” Government’s adoption of this goal is a major step, but it will need effective policies to achieve it, but with a goal and a date to achieve it by, a wider range of policies and some new products could be needed.

For example, in 2010, 119 of 121 members of parliament (MPs) voted for three increases in tobacco excise during 2010–12. Then in its May 2012 Budget Government announced four further excise increases on tobacco of 10% annually. Health groups submitted to Parliament’s Finance and Expenditure Committee that 10% increases would not achieve the 2025 goal until 2050, and asked for excise increases averaging 25% annually. The Committee said that the Customs and Excise (Tobacco Products-Budget Measures) Amendment Bill was “to encourage smokers to quit without punishing unduly those who are unable or unwilling to do so.” Accordingly the Committee recommended that Parliament pass the Bill unchanged, but also recommended that Government “monitor closely the progress made over the next few years towards the goal of a smokefree New Zealand by 2025 and implement further excise tax increases after 2016 if its achievement is in doubt.”

The main objection to increased excise is that very high cigarette prices would further increase the observed stress in the majority of smokers who fail to quit, and this
remains true as long as no substitute inhalable nicotine products which produce smoke or visible vapour are on sale, as is currently the case in New Zealand.

Accordingly, End Smoking NZ in its written and oral submission proposed (a) legalised sale of nicotine electronic cigarettes and (b) a reduced excise rate for denicotinised (Denic) cigarettes. The Committee said they would like to see further research undertaken on these types of substitutes and indeed clinical trials on both are in progress at the National Institute of Health Innovation, University of Auckland.

This paper explains and models the Denic proposal for the first time, for possible adoption as part of tobacco excise policy in due course.

The bill was enacted 23 October 2012, increasing tobacco excise rates 10% above the level of inflation annually through to 2016, commencing 1 January 2013.

Nicotine electronic cigarettes and denicotinised cigarettes both replace the smoking experience, both relieve cravings for tobacco cigarettes, and both would relieve financial pressure on smokers. Otherwise they are different—the electronic cigarette is a nicotine vaporizer and thus is far safer than any combustible cigarette including the Denic, but the Denic could reduce addiction for the majority of smokers reluctant to either quit or switch to electronic cigarettes.

Denics have no attraction to smokers if priced the same as AddictiveCigs, and manufacturers have no commercial interest in their sale. If Denics however, were taxed at a lower rate and thus cheaper, some smokers could be expected to substitute Denics for some of their daily cigarettes. Once the excise difference increased sufficiently, the trade could be expected to offer Denics for sale at a price lower than for AddictiveCigs. As excise rates for AddictiveCigs increased, fewer of them would be smoked, and even allowing for more intensive smoking, less nicotine would be inhaled, making quitting more likely.

Smokers themselves want less addictive cigarettes: 86% of current smokers support laws to make their cigarettes less addictive, even if smoking them would be less pleasurable; one third of smokers try to quit each year and of these fewer than 10% succeed, despite graphic disease warnings on the packets since 2008, and large ‘Smoking kills’ warnings at point of sale.

As a second stage or complementary policy, government might wish to progressively lower nicotine content across all brands, a policy first proposed in the United States in 1994. This policy could yet be necessary. Meantime half a million New Zealand smokers would say they are addicted, and whereas mandated nicotine reduction could take many years to become law, introducing a lower excise rate for Denics would allow smokers to reduce their nicotine consumption voluntarily, and so could win political acceptance sooner.

Proposal—The two-tier excise policy would

- Strengthen current government policy to annually increase the excise rate on AddictiveCigs and other smoking tobacco products above the level of inflation, and:
• Introduce at the earliest a lower excise rate for Denic cigarettes, levied for example, at 80% of the 2012 excise rate, that is, at $0.353 per cigarette. This rate would be adjusted annually for inflation, but not increased above it.

• Provide continuing smokers with a price incentive to smoke fewer AddictiveCigs in favour of more Denics, become less addicted, and become more likely to quit smoking entirely.

In this paper we investigate the nicotine content of popular New Zealand cigarette brands, examine recent studies of Denic cigarettes, and model the effects of the two-tier excise policy on cigarette prices, the daily cost of smoking, and nicotine delivery to smokers.

In short, this paper explores the effects of introducing a lower excise rate for denicotinised cigarettes as a way to reduce smokers’ addiction, and so improve the effectiveness of the national programme to achieve the 2025 smokefree nation goal.11

Method

Nicotine content of the un-burnt commercial cigarette is significantly and strongly correlated with how much nicotine is absorbed from smoking it,22 and is selected as the best basis for nicotine taxation. In contrast, nicotine yield tested by traditional machine testing of the smoke of commercial cigarettes is weakly correlated if at all with nicotine absorbed23 and so is no longer printed on cigarette packaging.

In 2011 22 popular brand cigarettes (based on highest brand sales by volume in 2010,24 list available from the author) were purchased from a Christchurch retailer, and nicotine extracted and analysed by Canterbury Health Laboratories, Christchurch, New Zealand for 10 factory-made (FM) brands, and 6 hand-rolled (roll-your-own [RYO]) tobacco brands of 0.7 g tobacco each. The most popular brands at low nicotine yields from 0.1 mg to 0.6 mg were separately tested to ensure testing of the lowest nicotine content brands on sale.

Estimations of daily consumption per smoker were based on 2009 Ministry of Health data.8

A standard cigarette was defined as either a factory-made (FM) cigarette containing <0.8 g tobacco, or a RYO cigarette containing 0.7 g tobacco, on the basis that from May 2010 standard cigarettes attracted equal rates of excise per cigarette.

Prices Separate indices for RYO and FM AddictiveCigs were obtained from Statistics NZ and used to calculate the consumer price of RYO and FM standard cigarettes. The actual 2012 price of a standard cigarette ($0.65) is lower than given by the combined consumer price index for cigarettes and tobacco which assumes 1 g of tobacco per RYO cigarette. Standard cigarettes whether RYO or FM have attracted the same excise rate since 2010 standard cigarettes and are priced similarly. Future prices for 2012-16 in 2012 dollars were based on the incremented 10% annual real excise increases now legislated. during 2013–16.13 The ratio of standard cigarette price to excise in 2012 was 1.47 and was assumed to decrease to 1.35 in 2016. The price elasticity for sales was estimated at -0.76, based on 2009–10 data on weekly supermarket sales and prices.25

Bioavailability of nicotine was estimated from a mouth exposure study of 391 New Zealand smokers of leading brands of New Zealand cigarettes.26 Maximum nicotine extracted per AddictiveCig, as when only 1 or 2 AddictiveCigs per day were smoked per day, was estimated at two standard deviations above this mean25 and from a clinical study.27

The effect of selling Denics alongside AddictiveCigs was estimated from a laboratory study by Johnson et al28 in which smokers carried out a repetitive task to earn three puffs of (addictive) cigarettes while exposed to simulated price increases, which caused smokers to reduce consumption of the AddictiveCig brand, allowing estimation of elasticity of demand. (This simulates current government policy.) When Denics (not identified to participants as such) were concurrently available at a steady lower price (as this paper proposes) AddictiveCig consumption reduced more steeply; the price elasticity was 4.95% greater.28 Denic sales in their first year on sale were estimated very approximately at 10% of AddictiveCigs sold, based on 10% of AddictiveCig smokers using Denics if available.28
Previous studies—The US National Library of Medicine database (www.pubmed.org) was searched for studies of reduced nicotine content, denicotinised and very low nicotine content cigarettes. In addition, we searched for studies relating nicotine delivery, cigarette consumption, addiction, and the likelihood of quitting.

The nicotine content definitions for Denics and AddictiveCigs were selected on the basis of these studies of both types of cigarette.

Results

Due to legislated 10% excise increases, cigarettes are estimated to increase in price (in 2012 dollars) by some 7% annually to $17.60 per 20s packet by 2016 and result in (very approximately) 10,000 fewer smoking each year. In current dollars, at say 3% inflation, some brands could cost over $20 over the counter by 2016.

Published studies found that cigarettes containing as little as 5 mg of nicotine maintained addiction to smoking\(^2\) while cigarettes of less than 2 mg nicotine (Denics) actually reduced addiction.\(^2,4,5\)

Nicotine content (Table 1)—was measured in 22 brands of New Zealand cigarettes—the most popular brands in their category in 2010.\(^24\) Mean content across all brands was 8.65 mg per standard cigarette. Nicotine concentration of the tobacco was 30% higher per standard RYO cigarette than for factory-made brands. All cigarettes contained >5 mg nicotine.

<table>
<thead>
<tr>
<th>Product category and sales of brands tested as % of total sales in 2010 in each category</th>
<th>Nicotine content mean [SD] (range) mg /cigarette</th>
<th>Tobacco content mean [SD] (range) g per cigarette</th>
<th>Nicotine concentration mean [SD] (range) % of tobacco weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factory-made manufactured cigarettes, (FM) 10 brands. 55% of category sales</td>
<td>8.1 [1.26] (5.6–9.6)</td>
<td>0.68 [0.05] (0.56–0.72)</td>
<td>1.19 [0.12] (1.00–1.35)</td>
</tr>
<tr>
<td>FM with yields 0.6 mg or less 6 brands. 76 % of category sales</td>
<td>7.32 [0.65] (6.4–7.9)</td>
<td>0.62 [0.07] (0.51–0.71)</td>
<td>1.20 [0.19] (1.01–1.51)</td>
</tr>
<tr>
<td>RYO tobacco 6 brands. 85% of category sales</td>
<td>10.9 [1.25] (9.5–12.4)</td>
<td>0.70 (standard cigarette)</td>
<td>1.55 [0.18] (1.36–1.77)</td>
</tr>
</tbody>
</table>

SD= standard deviation. FM = factory-made. RYO= roll-your-own cigarettes. Tobacco was measured as moist weight.

No reports were found of brands with 2.0–4.9 mg nicotine content among New Zealand brands (Table 1) and few studies were found globally for brands in this category. To eliminate any grey area between the two categories, cigarettes \(\geq 2.0\) mg were defined as AddictiveCigs, and Denics were defined as <2.0 mg nicotine content on the basis of recent research studies.\(^2,5,23\)

Addictive Cigarettes sold in New Zealand and tested on New Zealand smokers, delivered a mean 1.62 mg (SD 0.49 mg) of nicotine to the mouth.\(^25\) AddictiveCigs
include the Quest 2 research cigarettes with nicotine content 5 mg, and nicotine yield 0.3 mg. Even at this low yield, Quest 2 was found to maintain addiction.5

**Denicotinised Cigarettes** These cigarettes contained < 2 mg nicotine and yielded as little as 0.05 mg of nicotine within the 0.05 to 0.2 mg range (such as the Vector Quest 3 research cigarette containing 1.5 mg nicotine, yielding 0.1 mg nicotine). Denics yielding 0.05 mg had a cessation rate equal to nicotine lozenges.5

In a large randomised controlled trial Walker et al found that for New Zealand smokers wishing to quit smoking, Denics prolonged abstinence from 2 weeks for usual care out to 2 months.2 Denics but not AddictiveCigs were found to decrease addiction to smoking, and they increased the time from waking to first cigarette of the day,3 decreasing addiction scores within days or weeks.4,5 Denics decrease the urge to smoke by 31% compared with an AddictiveCig.5 Denics increase quitting success in studies of smokers intending to quit.2,4,5 Denics were accompanied by low levels of compensatory smoking, approximately 20% for compliant subjects on DeNics for 2 months.4,5,29

The smoke from Denic and AddictiveCigs is assumed to be equally toxic though, due to less nicotine in the smoke, NNK, a tobacco-specific nitrosamine and nicotine-derived lung carcinogen in smoke, is reduced.29 A Denic binds and occupies 26% of the main type (alpha-beta2) of brain nicotine acetylcholine receptors and does not satisfy, whereas a single regular AddictiveCig can occupy and saturate 88% of these receptors, sufficient to release dopamine, lift mood and give satisfaction.30

Unlike AddictiveCigs, Denics fail to increase plasma nicotine or heart rate.31 Smokers blinded to AddictiveCigs and Denics rated AddictiveCigs more stimulating,32 while in another study AddictiveCigs were associated with a higher level of “exhilaration.”33 On the other hand, Denics relieve cravings as strongly as AddictiveCigs.3

When AddictiveCigs and Denics are both on sale, smokers prefer AddictiveCigs,34 but not entirely: a Denic cross-elasticity of 0.228 means that if AddictiveCig prices increased 10% annually, Denic sales would increase 2% annually due to switching from AddictiveCigs.

Figures 1 and 2 model the options for the average smoker, as prices increase under the legislated 10% excise increases, as smokers juggle expenditure with their need for nicotine, assuming Denics were an option.

**Modelling smokers’ costs in the face of increasing excise rates (Figure 1)—**

Denics, if taxed at a steady lower excise level of $0.353 per standard cigarette (80% of the 2012 excise rate of $0.442), could be priced at 55 cents each, or $11 per packet of 20, assuming 2012 price to excise ratio and trade margins as for AddictiveCigs. For comparison, the April-June 2012 consumer price for 20 standard cigarettes was $13.00; supermarkets reported an average $15 price for 20; this price was discounted in dairies.

Figure 1 depicts the expenditure options for continuing smokers smoking 12 cigarettes a day in 2012, based on legislated excise increases of 10% per year.

The upper plot line (no change in smoking) depicts the increasing expenditure required to smoke 12 cigarettes per day (cpd) as excise increases packet prices over time to an average $17.60 per 20s packet in 2016.
The middle plot line (cigarette reduction) depicts the expenditure required for a smoker gradually reducing AddictiveCig consumption from 12 cpd in 2012 to 9 cpd in 2016. Expenditure remains unchanged around $8 throughout, but the smoker will have to wait longer each year until the next cigarette, which, depending on their Latency To Next Cigarette, may increase the distress for some smokers if the reduction is sudden, as after a price increase.

The lower plot line (nicotine reduction) shows the effect of reducing AddictiveCigs from 12 to 1 cpd over 4 years, replacing these with Denics, to maintain consumption at 12 cpd, and using Denics to relieve cravings for the next AddictiveCig. Expenditure is controlled and is 12% lower and $1 a day less in real terms by 2016. As reducing from three AddictiveCigs in 2015 to one AddictiveCig in 2016 would save 50 cents a day, many might prefer to not reduce below 3 AddictiveCigs per day, in the absence of media campaigns to urge them to quit altogether.

Figure 1. Expenditure options for continuing smokers during 2013–16, based on the legislated excise increases of 10% annually; estimated at 2012 prices

Modelling smokers’ nicotine intake as excise is increased (Figure 2)—Smoking fewer cigarettes per day tends to save smokers more money than switching to cheaper brands. In 1985 New Zealand smokers smoked a mean 26 cigarettes per day (cpd), 14 a day in 2009, and an estimated 12 cpd in 2012. Smokers in 2012 spent an estimated average $8 a day. As prices increase further, most will smoke fewer cigarettes, but as noted, the cravings induced depends on each smoker’s latency before the next cigarette.
Figure 2 models the daily nicotine obtained from New Zealand cigarettes, as the prices increase, based on the estimated mean nicotine mouth delivery to New Zealand smokers, of 1.62 mg per cigarette.\textsuperscript{26} Estimated nicotine absorbed per day declines 86\% from left to right in Figure 2 as smokers switch progressively to Denic cigarettes. Smokers shifting to Denics would be rewarded by a reduction in expenditure of up to $1 per day. (The lower plot, copied from the lower plot in Figure 1.)

The left hand column represents the average smoker in 2012, smoking 12 cigarettes per day (cpd) and inhaling a mean 19 mg of nicotine per day.

In the middle column, nicotine is nearly halved to 10 mg, by reducing AddictiveCigs from 12 to 6 cpd, assuming Denics yield 0.1 mg nicotine per cigarette. However, simply reducing the number of AddictiveCigs (Smoking reduction) would result in a longer period of unrelieved cravings between AddictiveCigs. Instead this middle column depicts smoking a mix of Denics and AddictiveCigs to make up 12 cigarettes a day as before.

The two columns on the right in Figure 2 show the effect of smoking three, then only one AddictiveCig per day, thus reducing nicotine intake by 68\% then by 86\% below 2012 levels, and consequently reducing the number of nicotine puffs and strong nicotine pulses to the brain. As noted above, Denic cigarette puffs send much weaker pulses of nicotine which occupy only one quarter of nicotine receptors, but this is enough to reduce cravings.\textsuperscript{30}

Figure 2. Effect of reducing AddictiveCigs and increasing Denics, to maintain consumption at 12 cigarettes per day, on mean daily nicotine delivery and daily dollar cost

\textbf{Source}: Mariner.\textsuperscript{26} Benowitz.\textsuperscript{27}
Exposure to cigarette smoke nicotine and the likelihood of quitting—At lower rates of nicotine supply, the Latency To Next Cigarette might be expected to gradually lengthen, but this is not yet known for Denic cigarettes. Less nicotine absorbed however, predicts quitting success. And less addicted smokers are more likely to successfully quit.

The Health Survey for England found that smokers who normally extract less nicotine per cigarette and who also smoke fewer cigarettes per day absorbed the least nicotine. Mean nicotine daily mouth delivery to New Zealand smokers was high (30 mg mean, SD 15.6 mg), and varied greatly among smokers, as did daily cigarette consumption (mean 18.8, SD 9.1).

Discussion

Main findings and interpretation—A two-tier excise policy with exemption of Denic cigarettes from future excise increases would make it easier to justify legislated increases in AddictiveCig excise rates, as the smoker switching to Denics could control and reduce the cost of smoking as in Figures 1 and 2.

Denic smoke being as toxic as AddictiveCig smoke but less addictive would merit an excise rate set and held at say 80% of the 2012 rate, creating price incentives for smokers to switch from their current AddictiveCig brands, and for manufacturers and importers to make or sell Denic cigarettes. Sale of Denic cigarettes wherever AddictiveCigs are sold would provide an escape product for addicted smokers facing higher prices each January over the next four years.

Smokers could smoke a mix of AddictiveCig and Denic cigarettes in any quantity, combination or sequence they chose, to balance their cravings for more AddictiveCigs within their current smoking budget. Denics would be available for all smokers to buy alongside AddictiveCigs and could substantially reduce cigarette nicotine consumption for most smokers.

Repeated annual real excise increases of 10% for AddictiveCigs begun in 2010 will now extend to 2016, and if continued to 2025 would raise the price of 20 cigarettes to over $40. Normally this would cause distress for smokers, but not if smokers switch to an Denic-AddictiveCig mix (smoking only 3 AddictiveCigs per day then only 1 per day, otherwise mostly smoking Denics) The switch can be gradual. Then even if AddictiveCigs cost $40 smokers would spend no more than $7 a day on cigarettes. In any given year, smokers of such a mix would be absorbing 68% to 86% less nicotine than in 2012, making for more success in quitting.

Denicotinised Cigarettes—We would expect Denic sales to increase sharply within weeks of any increase in excise. However for quitting, Denics might work best by boosting the success rate of the next quit attempt. As one-third of smokers try to quit each year, making an average two attempts per year, Denics could boost success for up to 1000 quit attempts a day. At population level Denics might thus take several years to exert their full effect on stopping smoking.

Regular and random surveillance of the nicotine content of all cigarettes and labelling whether Denic or not, would be essential to prevent tax evasion. Current arrangements for manufacturers to report nicotine yields analysed by their own laboratories would not suffice. Manufacturers would compete to sell the less-taxed, less-costly Denic
cigarettes which relieve cravings. Lower price would incentivise many AddictiveCig smokers to use them, and without compulsion. As a new product class, Denics would normally need several years to gain market share, and particularly because tobacco products cannot be advertised or displayed.

The planned annual increases in excise rates for AddictiveCigs are likely to ensure increased Denic sales. Manufacturers also have freedom to flavour Denic tobacco to make it more appealing to smokers as there is no restriction on cigarette ingredients.

**Concomitant sale of AddictiveCigs and Denics**—Smokers would select their own daily mix of AddictiveCig and Denic cigarettes to maintain satisfaction and addiction, but as AddictiveCig prices increased smokers would include more Denics, as in Figure 2. A lower excise rate for Denics would make them price-attractive, decrease AddictiveCig sales, and reduce daily nicotine absorbed, even after allowing for more nicotine extracted per cigarette if 3 or fewer AddictiveCigs are smoked per day.

Studies comparing nicotine inhaled in cigarette smoke against the likelihood of quitting suggest that those smoking the fewest AddictiveCigs tend to absorb less nicotine and have the greatest chance of stopping smoking. Current online prices in June 2012 suggested that smokers could smoke three cigarettes and stay addicted for $2 a day.

The legislated 10% increases from 2013 to 2016, at current price elasticities imply that half a million will still be smoking in 2016, suggesting that much steeper increases in excise on AddictiveCigs may be required after 2016.

**Strengths and limitations of this study**—Denics could succeed in New Zealand, as smokers would not be asked to quit smoking, only to smoke less nicotine. New Zealand due to its distance from other nations, its strong tobacco control legislation, no commercial tobacco growing, its effective border control, the government’s goal of a smokefree nation by 2025, and government’s interest in increasing tobacco excise for the next 4 years to achieve that goal, provides a favourable environment for developing such a policy.

We propose that AddictiveCigs be smoked mixed with Denics, but information on concomitant use is limited. Excise-induced reduction in AddictiveCig sales with partial switching to Denics would send fewer strong nicotine surges to the brain and over weeks and months the urge to smoke may reduce in some smokers; research is planned to elucidate this matter.

A small study may also be needed to determine whether smoking an AddictiveCig would suppress brain nicotine receptors for some hours so that the receptors were not activated by the much weaker pulse from Denic smoking, leaving cravings unrelieved.

On the other hand Denics may have powerful placebo effects on cravings. Use of a placebo cigarette look-alike non-nicotine inhaler to treat cravings in those smokers who gave above average importance to smoking rituals and cigarette handling, was found to double quitting success.

Estimations of the price elasticity of AddictiveCigs when sold with Denics, and of Denics when sold with AddictiveCigs are based on a single study. The Denic
cigarette is novel, and its market share would depend on the price of AddictiveCigs, as Denics are a true economic substitute for AddictiveCigs.  

The policy is novel and the current trial will help find out how many smokers will smoke Denics, and how many Denics and AddictiveCigs they will smoke each day. The proportion of smokers who would initially use Denics is uncertain but not critical, as their price advantage will increase as the price of AddictiveCigs is increased by taxation.

**Implications for surveillance and further research**—A well-resourced ongoing programme of regular and random laboratory testing of Denic cigarettes for nicotine content would be necessary to protect this new government revenue stream, with substantial penalties for false labelling and excise evasion. The Smokefree Environments Act may need strengthening at Section 35 (Returns and Reports) to require more frequent electronic monitoring of cigarette sales. The three cigarette firms which account for 98% of the 3 billion standard cigarettes sold last year have access to weekly electronic national retail sales data by brand and price down to store level, and top-line quarterly and regional reports could be mandated under the Act, separately for AddictiveCigs and Denics, so that national and District Health Board goals can be set and policy effects monitored. Ongoing research studies and surveys would be needed to map the effects of smoking different mixes of AddictiveCig and Denic cigarettes on addiction scores and on quitting.

**Policy implications**—A lower excise rate for Denic cigarettes would require an amendment to the Customs Act schedules. Regulations would also be required for nicotine content testing and labelling of tobacco packaging. Manufacturers would need due notice to make or source denicotinised cigarettes.

Denic cigarettes are designed to lessen addiction—which otherwise keeps smokers from quitting; and quitting too late results in cigarette deaths— around 5000 annually. Many studies attest that as smoking prevalence declines, cigarette attributable deaths reduce to near zero with full effect 15–20 years later. In addition, life expectancy would increase by nearly 5 years for the Māori population and by 3 years for non-Māori. Going smoke-free as a nation by 2020 (compared to no change from the 2006 Census smoking prevalence), would close ethnic inequalities in life expectancy by nearly 2 years.

The Māori Affairs Select Committee was concerned that Māori should fully achieve the MASC national goals, such as halving (AddictiveCig) sales by 2015. Health groups’ tax recommendations could have achieved this goal by 2016, but annual excise increases of 10% now legislated, using linear projections and current price elasticities, means that AddictiveCigs sales may not be halved until 2025.

A lower tax rate for Denics would remove the main ethical objection to tobacco taxation of poor smokers and would also narrow the absolute differences in smoking prevalence between ethnic groups. Maori and Pacific smokers, more sensitive to price, may quit sooner.

Border control services’ success in keeping out smuggled AddictiveCigs could be aided by regulations to require manufacturers to provide markings to distinguish AddictiveCigs, Denics, and duty-paid cigarettes, and to disclose nicotine content. A Denic-driven resurgence of smoking is unlikely, as Denics are negatively rated, are
not addictive, and help smokers quit. Limited cultivation of home-grown RYO AddictiveCig tobacco for personal use is currently permitted, but if used to fortify Denic cigarettes, its sale would be illegal.

Conclusion

A two-tier excise policy would be importantly kinder to smokers, as it would allow them to select and smoke a mix of expensive AddictiveCigs and low-cost Denics to control smoking costs, reduce cravings and facilitate quitting. A lower tax rate classification for Denics would make it politically easier to increase the price of addictive cigarettes and thereby reduce smoking more rapidly to much lower levels.

Competing interests: The author has no financial interest in any nicotine, pharmaceutical or tobacco company. No funding was received apart from payment from the Ministry of Health for nicotine content testing.

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References:


Emergency food storage for organisations and citizens in New Zealand: results of optimisation modelling

Nhung Nghiem, Mary-Ann Carter, Nick Wilson

Abstract

Aims New Zealand (NZ), is a country subject to a wide range of natural disasters, some of which (e.g., floods and storms) may increase in frequency and severity with the effects of climate change. To improve disaster preparations, we aimed to use scenario development and linear programming to identify the lowest-cost foods for emergency storage.

Methods We used NZ food price data (e.g., from the Food Price Index) and nutritional data from a NZ food composition database. Different scenarios were modelled in Excel and R along with uncertainty analysis.

Results A collection of low-cost emergency storage foods that meet daily energy requirements for men were identified e.g., at a median purchase cost of NZ$2.21 per day (equivalent to US$1.45) (95% simulation interval = NZ$2.04 to 2.38). In comparison, the cost of such a collection of foods which did not require cooking, was NZ$3.67 per day. While meeting all nutritional recommendations (and not just energy) is far from essential in a disaster setting, if such nutritionally optimised foods are purchased for storage, then the cost would be higher (NZ$7.10 per day). Where a zero level of food spoilage was assumed (e.g., storage by a government agency), the cost of purchasing food for storage was as low as NZ$1.93 per day.

Conclusions It appears to cost very little to purchase basic emergency foods for storage in the current New Zealand setting. The lists of the foods identified could be considered by organisations who participate in disaster relief (civil defence) but also by citizens.

New Zealand is subject to wide range of natural disasters including: “earthquakes, volcanic eruptions, tsunamis, storms, floods and landslides”. In particular, the country lies in a geologically unstable zone with major fault lines running for much of the length of the country. Most recently an earthquake on 22 February 2011 caused widespread destruction of Christchurch with 182 deaths and 6659 people injured in the initial 24 hours.

Flooding, due to intense or prolonged rain, is by far the most frequent natural disaster to impact on New Zealand. Flooding disasters, as well as severe storms, may also become more common with climate change. New Zealand’s population growth may also contribute to the impact of flooding disasters, if house building continues on flood plains and low-lying coastal areas. Pandemics and economic disasters can also potentially cause disruptions to basic societal functions, including food supply.

Due to the risk of these disasters, New Zealand civil defence authorities encourage preparation measures—including emergency food storage. Food storage of “non-
perishable food (canned or dried food)” for a minimum of 3 days is encouraged and a civil defence website provides tips on the type of dried and canned foods which can be stored. More specific lists of foods, but with no explicit consideration of cost or nutritional value, are detailed on local government websites (e.g., Porirua City Council).

Yet there is evidence that such types of disaster preparations are not fully made by the New Zealand population (e.g., while 92% of respondents in a flood-prone area reported having canned food, only 27% had bottled water). Indeed, food insecurity is a significant problem for low-income populations in New Zealand, and so it is likely that such households often have no emergency food supplies. A recent study found that in the preceding 12 months, 50% of the families in a longitudinal study reported that they had been “forced to buy cheaper food in order to afford other necessities” and 13% of the families “reported having used food grants or food banks”.

Due to the high prevalence of obesity and over-weight, most New Zealanders actually carry many days of stored energy in their bodies in fat deposits. Nevertheless, for optimal physical functioning in a disaster setting, on-going access to food containing carbohydrates, protein and fat is highly desirable. This is particularly the case for those contributing to disaster rescue and relief work and those subject to increased energy requirements (e.g., via physical activity and exposure to cold). Similarly, food can provide psychological comfort, prevent additional anxiety associated with hunger, and facilitate going to sleep at night. Preparing and eating food with others may also contribute to a sense of normality and communal experience in a disaster setting.

A particular method for identifying low-cost foods that meet nutrient requirements is through linear programming. For example, this technique has been used to consider optimisation of diets in a number of studies (e.g., in France, for a cancer prevention diet, a diet without processed foods, and for designing the “Thrifty Food Plan”— albeit using a non-linear programming for the latter). Given this background, the aim of this study was to perform optimisation analyses for the New Zealand context to inform emergency food stockpiling policies that organisations can promote (e.g., civil defence) and that citizens can consider.

Methods

Initial food selection—Given the thousands of different food products for sale in New Zealand, we had to take a simplified approach for selecting food products to include in the modelling. We therefore used dried, processed or canned foods from:

- The foods used in compiling the country’s Food Price Index (FPI).
- A list in previous work that identified low-cost sources of protein in New Zealand.
- Those unprocessed foods that were found in the “bulk bins” of a supermarket and the low-cost canned foods (convenience sample in the capital city, Wellington).
- The lists of selected foods from a previous nutrition optimisation study in France.

Scenarios—The first scenario (EP-B) considered achieving daily dietary energy intake for men at the lowest cost, and included foods which required cooking (Table 1). The second (EP-NC) added the requirement that foods did not need to be cooked (while also allowing some foods to be able to be sprouted or soaked before eating). The next scenario (EP-H) included foods that were optimised for low-cost, but also to meet all nutrient requirements for men (albeit with a higher iron requirement to increase relevance for women). The last scenario (EP-NS) considered the situation of zero spoilage (e.g., well-organised storage by institutions).
Table 1. Specific scenarios used for the optimisation modelling for determining emergency foods for storage

<table>
<thead>
<tr>
<th>Aim of specific scenario</th>
<th>Additional details on the constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP-B) Baseline scenario, trying to achieve the lowest cost for dried and canned foods</td>
<td>To minimise the daily cost while obtaining the target dietary energy (kJ) detailed in Table 3 and no other nutrient targets. To ensure some modest level of variety (and to protect from some types of foods perishing without being replaced in time), a maximum limit of 100 g per specific food was set except for the amount of vegetable oil (set at 4 tablespoons, i.e., 60 g).</td>
</tr>
<tr>
<td>EP-NC) As per Scenario EP-B but only for no-cooking required foods</td>
<td>As above for Scenario EP-B, but only for foods that can be eaten without cooking (e.g., including all canned items in Table 2 such as canned meat/fish, canned pulses, canned fruit, canned vegetables, canned spaghetti, vegetable oil, olive oil, powdered milk etc). But we included grains that could be soaked and then eaten e.g., wholemeal oats. Also included were foods that can be soaked in water and sprouted within a few days e.g., lentils, and dried peas. In this scenario the maximum amount of vegetable oil was set lower than for EP-B (at 2 tablespoons, i.e., 30 g). The lower limit for all foods that were selected in the optimisation process was 10 g.</td>
</tr>
<tr>
<td>EP-H) As per Scenario EP-B but to meet all the daily nutritional requirements for men (maximising health)</td>
<td>As above for Scenario EP-B, but where all the nutritional requirements for men are achieved (see Table 3). This can be considered a luxury in disaster circumstances but would give reassurance to those groups who are particularly interested in maintaining good nutrition e.g., for children, pregnant women, lactating women, and adults with chronic health problems. Also in this Scenario, we increased the maximum limit to 200 g per any particular food to ensure that there was a feasible solution in the optimisation process.</td>
</tr>
<tr>
<td>EP-NS) As per Scenario EP-B but with no spoilage (e.g., very well-organised storage)</td>
<td>As above for Scenario EP-B, but where there is zero spoilage assumed e.g., very well-organised storage by citizens or by an institution or disaster relief organisation.</td>
</tr>
</tbody>
</table>

Data inputs (price and nutrients)—For food items from the FPI we used the relevant price data (monthly data averaged over multiple stores nationally for the 12 months of 2011). But for other food items, we used online supermarket data (Countdown, January 2012), or the lowest in-store (e.g., bulk bin) prices from New World or Countdown supermarkets (both in Karori, Wellington). We ignored prices on “specials” and only considered non-bulk products (i.e., ≤1.5 kg).

Nutrient values for the foods were obtained from the “New Zealand food composition database” (New nutrient database in 2012: http://www.foodcomposition.co.nz/foodfiles). Nutrient intakes were adjusted to account for food spoilage (see below).

Spoilage estimates—We found no data on the rates of spoilage of stored food in New Zealand (and international data on household food wastage was not considered applicable). So we made informed guesses as follows for the condition of stored emergency food at the one-year point:

- “High spoilage” at 20% for stockpiled foods that are at particular risk of being damaged by pantry moths (e.g., *Plodia interpunctella*), and weevils e.g., the wheat weevil (*Sitophilus granaries*) and the rice weevil (*Sitophilus oryzae*) that are established in New Zealand. Pantry moths may also be an increasing problem in New Zealand.
- “Moderate” at 10% for food that can still be damaged by rodents which can eat through plastic wrapping.
- “Low” at 5% for cans which can rust or glass containers which can break.

We applied these estimates as per the details in Table 2, but also in one Scenario (EP-NS) we assumed no loss from spoilage or other storage related losses.
Table 2. Foods entered into the model, price data inputs and spoilage factors (foods ordered by increasing price within each food category)

<table>
<thead>
<tr>
<th>Food category / items</th>
<th>Scenario EP-B (All)</th>
<th>Scenario EP-NC (no cooking required)</th>
<th>Price (NZD per 100 g)</th>
<th>Spoilage assumption: point estimate (%)</th>
<th>Spoilage uncertainty interval (%)#</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grains and cereals</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wholemeal flour</td>
<td>Yes**</td>
<td></td>
<td>0.14</td>
<td>20</td>
<td>12–28</td>
</tr>
<tr>
<td>White flour (wheat, standard)</td>
<td>Yes**</td>
<td></td>
<td>0.14</td>
<td>20</td>
<td>12–28</td>
</tr>
<tr>
<td>Pasta (dried)</td>
<td>Yes**</td>
<td></td>
<td>0.21</td>
<td>20</td>
<td>12–28</td>
</tr>
<tr>
<td>Rice (white)</td>
<td>Yes**</td>
<td></td>
<td>0.25</td>
<td>20</td>
<td>12–28</td>
</tr>
<tr>
<td>Oats (whole grain, raw)</td>
<td>Yes**</td>
<td>Yes**</td>
<td>0.32</td>
<td>20</td>
<td>12–28</td>
</tr>
<tr>
<td>Semolina</td>
<td>Yes**</td>
<td></td>
<td>0.38</td>
<td>20</td>
<td>12–28</td>
</tr>
<tr>
<td>Spaghetti (canned)</td>
<td>Yes**</td>
<td>Yes**</td>
<td>0.40</td>
<td>5</td>
<td>3–7</td>
</tr>
<tr>
<td>Pop corn</td>
<td>Yes</td>
<td></td>
<td>0.79</td>
<td>20</td>
<td>12–28</td>
</tr>
<tr>
<td>Couscous</td>
<td>Yes**</td>
<td></td>
<td>0.99</td>
<td>20</td>
<td>12–28</td>
</tr>
<tr>
<td>Breakfast biscuits (e.g., “Weetbix”)</td>
<td>Yes*</td>
<td>Yes*</td>
<td>0.55</td>
<td>20</td>
<td>12–28</td>
</tr>
<tr>
<td><strong>Fruit &amp; vegetables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canned vegetables (“generic brand” tomatoes diced, lowest cost canned vegetables)</td>
<td>Yes*</td>
<td>Yes*</td>
<td>0.24</td>
<td>5</td>
<td>3–7</td>
</tr>
<tr>
<td>Canned fruit (“generic brand” fruit salad in syrup, lowest cost canned fruit)</td>
<td>Yes*</td>
<td>Yes*</td>
<td>0.26</td>
<td>5</td>
<td>3–7</td>
</tr>
<tr>
<td>Canned fruit (“generic brand” apricot halves)</td>
<td>Yes*</td>
<td>Yes*</td>
<td>0.27</td>
<td>5</td>
<td>3–7</td>
</tr>
<tr>
<td>Fruit juice (apple)</td>
<td>Yes</td>
<td>Yes</td>
<td>0.31</td>
<td>5</td>
<td>3–7</td>
</tr>
<tr>
<td>Peaches (canned)</td>
<td>Yes</td>
<td>Yes</td>
<td>0.42</td>
<td>5</td>
<td>3–7</td>
</tr>
<tr>
<td>Sultanas</td>
<td>Yes</td>
<td>Yes</td>
<td>0.57</td>
<td>10</td>
<td>6–14</td>
</tr>
<tr>
<td>Raisins</td>
<td>Yes</td>
<td>Yes</td>
<td>0.79</td>
<td>10</td>
<td>6–14</td>
</tr>
<tr>
<td><strong>Meat, fish and dairy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk (powdered, skim)</td>
<td>Yes**</td>
<td>Yes**</td>
<td>1.00</td>
<td>10</td>
<td>6–14</td>
</tr>
<tr>
<td>Sardines (canned)</td>
<td>Yes*</td>
<td>Yes*</td>
<td>1.22</td>
<td>5</td>
<td>3–7</td>
</tr>
<tr>
<td>Tuna (canned)</td>
<td>Yes*</td>
<td>Yes*</td>
<td>1.30</td>
<td>5</td>
<td>3–7</td>
</tr>
<tr>
<td>Canned ham (“lite” and “spiced”)</td>
<td>Yes**</td>
<td>Yes**</td>
<td>1.66</td>
<td>5</td>
<td>3–7</td>
</tr>
<tr>
<td>Canned sheeet meat (“corned lamb”, lowest cost sheep meat)</td>
<td>Yes**</td>
<td>Yes**</td>
<td>1.67</td>
<td>5</td>
<td>3–7</td>
</tr>
<tr>
<td>Canned chicken (chicken chunks in spring water)</td>
<td>Yes**</td>
<td>Yes**</td>
<td>2.11</td>
<td>5</td>
<td>3–7</td>
</tr>
<tr>
<td>Pastrami (“Instore Deli” lowest cost pastrami/salami, made from beef)</td>
<td>Yes**</td>
<td>Yes**</td>
<td>2.87</td>
<td>10</td>
<td>6–14</td>
</tr>
<tr>
<td><strong>Pulses</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dried peas</td>
<td>Yes**</td>
<td>Yes (sprouting)**</td>
<td>0.34</td>
<td>10</td>
<td>6–14</td>
</tr>
<tr>
<td>Lentils (canned)</td>
<td>Yes*</td>
<td>Yes*</td>
<td>0.65</td>
<td>5</td>
<td>3–7</td>
</tr>
<tr>
<td>Lentils (dried brown)</td>
<td>Yes*</td>
<td>Yes (sprouting)**</td>
<td>0.99</td>
<td>10</td>
<td>6–14</td>
</tr>
<tr>
<td><strong>Seeds and nuts</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spreads (peanut butter)</td>
<td>Yes</td>
<td>Yes</td>
<td>0.61</td>
<td>5</td>
<td>3–7</td>
</tr>
<tr>
<td>Nuts (peanuts)</td>
<td>Yes</td>
<td>Yes</td>
<td>1.09</td>
<td>10</td>
<td>6–14</td>
</tr>
</tbody>
</table>
### Food category / items

<table>
<thead>
<tr>
<th>Food category / items</th>
<th>Scenario EP-B (All)</th>
<th>Scenario EP-NC (no cooking required)</th>
<th>Price (NZD per 100 g)</th>
<th>Spoilage assumption: point estimate (%)</th>
<th>Spoilage uncertainty interval (%) #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunflower seeds</td>
<td>Yes</td>
<td>Yes</td>
<td>1.29</td>
<td>10</td>
<td>6–14</td>
</tr>
<tr>
<td>Coconut cream</td>
<td>Yes*</td>
<td>Yes*</td>
<td>0.36</td>
<td>5</td>
<td>3–7</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soft drink</td>
<td>Yes</td>
<td>Yes</td>
<td>0.16</td>
<td>5</td>
<td>3–7</td>
</tr>
<tr>
<td>Potato crisps (plain)</td>
<td>Yes</td>
<td>Yes</td>
<td>1.17</td>
<td>10</td>
<td>6–14</td>
</tr>
<tr>
<td>Sugar (white)</td>
<td>Yes</td>
<td>Yes</td>
<td>0.20</td>
<td>10</td>
<td>6–14</td>
</tr>
<tr>
<td>Salt (table)</td>
<td>Yes</td>
<td>Yes</td>
<td>0.24</td>
<td>5</td>
<td>3–7</td>
</tr>
<tr>
<td>Oil (vegetable, blend)</td>
<td>Yes</td>
<td>Yes</td>
<td>0.47</td>
<td>5</td>
<td>3–7</td>
</tr>
<tr>
<td>Tomato sauce</td>
<td>Yes</td>
<td>Yes</td>
<td>0.52</td>
<td>5</td>
<td>3–7</td>
</tr>
<tr>
<td>Olive oil</td>
<td>Yes</td>
<td>Yes</td>
<td>1.10</td>
<td>5</td>
<td>3–7</td>
</tr>
<tr>
<td>Biscuit (chocolate coated)</td>
<td>Yes</td>
<td>Yes</td>
<td>1.55</td>
<td>10</td>
<td>6–14</td>
</tr>
<tr>
<td>Chocolate (dark)</td>
<td>Yes</td>
<td>Yes</td>
<td>1.55</td>
<td>10</td>
<td>6–14</td>
</tr>
</tbody>
</table>

**Notes:**
* These canned foods may be preferable to eat when heated – but most people would probably consider it reasonable to eat these foods cold in emergency situations.

** All these foods are pre-cooked or cured and can be eaten directly out of the can.

* Requires stored water (e.g., for cooking or to make up liquid milk from powdered milk).

# We used the formula: 95%UI=(2SD)/Mean with standard deviation (SD) = 20% of the point estimate.

---

**Approach to mathematical modelling**—We used the simplex algorithm to solve this linear programming problem (see Briand et al., for a detailed description of the linear programming). The scenarios were modelled in Microsoft Excel 2010 (Excel Solver, Simplex method).

**Approaches to uncertainty**—For food prices we generally used the variation in the monthly prices (from the FPI data, fitting to gamma distributions). For non-FPI foods we applied the same patterns used for the FPI foods (e.g., from the median values of the “fresh fruit and vegetable” grouping). With regards to food spoilage, we applied a beta distribution for the total food spoilage proportion with the uncertainty values as per Table 2.

There is also heterogeneity in nutrient requirements for men and so we utilised the uncertainty data identified in nutritional guidelines for Australia and New Zealand (Table 3, and applying normal distributions). But for the target energy intake we derived uncertainty values from the published survey results (based on the 95% CIs in the NZANS we assumed a normal distribution with SD = 184.4).

We then coded the models and ran 2000 iterations for a representative scenario in the R programming language (version 2.14.1, IpSolve package).
Table 3. Nutrient levels used for targets or constraints used for the achieving all nutrients scenario (Scenario EP-H) with most of these being “estimated average requirements” (EARs)* of nutrients per day for adult men (based on values set for Australia and New Zealand\textsuperscript{19} unless otherwise stated)

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>EARs or other target values used in the modelling</th>
<th>Standard deviation (SD) (% of EAR)\textsuperscript{19}</th>
<th>Comment on constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kJ) (using estimated energy requirement (EER),\textsuperscript{19} averaged for 4 adult age-groups at the mid-range level of physical activity of 1.6 MJ/day)</td>
<td>11,450 kJ</td>
<td>1.6</td>
<td>Intake must reach or exceed this EER in the modelled scenario.</td>
</tr>
<tr>
<td>Saturated fatty acids (g)</td>
<td>For an upper limit we used 12% of total energy (27.5 g)</td>
<td>10**</td>
<td>Intake must be equal/below this upper limit.</td>
</tr>
<tr>
<td>Polyunsaturated fatty acids (g) (current intake in New Zealanders from the NZANS\textsuperscript{20})</td>
<td>13.1 (current)</td>
<td>10**</td>
<td>These current levels must be reached/exceeded.</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>52</td>
<td>12</td>
<td>EARs must be reached/exceeded.</td>
</tr>
<tr>
<td>Dietary fibre (g) [Adequate intake = AI]</td>
<td>30 (AI)</td>
<td>10**</td>
<td>AI must be reached/exceeded.</td>
</tr>
<tr>
<td><strong>Minerals (selected)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium (mg)</td>
<td>840</td>
<td>10</td>
<td>EARs must be reached/exceeded.</td>
</tr>
<tr>
<td>Iron (mg)</td>
<td>8</td>
<td>18</td>
<td>In this case we used the EAR value for women (8mg) rather than the value for men (6mg). This is the only nutrient in this table where there is a higher value for women than for men.</td>
</tr>
<tr>
<td>Potassium (adequate intake) (mg)</td>
<td>3800 (AI)</td>
<td>10**</td>
<td>EARs must be reached/exceeded.</td>
</tr>
<tr>
<td>Selenium (µg)</td>
<td>60</td>
<td>10</td>
<td>EARs must be reached/exceeded.</td>
</tr>
<tr>
<td>Sodium (mg) (upper level)</td>
<td>2300 (upper limit)</td>
<td>10**</td>
<td>Upper limit must be equal/below this level. The NHMRC Report actually suggests a target of 1600mg/day (70mmol) for men and women. EARs must be reached/exceeded.</td>
</tr>
<tr>
<td>Zinc (mg)</td>
<td>12</td>
<td>10</td>
<td>EARs must be reached/exceeded.</td>
</tr>
<tr>
<td><strong>Vitamins (selected)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin A (µg RE)</td>
<td>625</td>
<td>20</td>
<td>EARs must be reached/exceeded. Upper limit is 3000 for men.</td>
</tr>
<tr>
<td>Thiamin (mg)</td>
<td>1.0</td>
<td>10</td>
<td>EARs must be reached/exceeded.</td>
</tr>
<tr>
<td>Vitamin C (mg)</td>
<td>30</td>
<td>21</td>
<td>As above.</td>
</tr>
<tr>
<td>Vitamin E (Adequate intake: as alpha-tocopherol equivalents) (mg)</td>
<td>10 (AI)</td>
<td>10**</td>
<td>As above.</td>
</tr>
</tbody>
</table>

**Notes:**
- * The focus here was on the range for healthy adult men. Different values may apply to children, adolescents, pregnant and breastfeeding women, and older people. The EAR is defined as “a daily nutrient level estimated to meet the requirements of half of the healthy individuals in a particular life stage and gender group.” In some cases “adequate intake” (AI) was used. This is “the average daily nutrient intake level based on observed or experimentally-determined approximations or estimates of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate. The NHMRC did not set an EAR for carbohydrate due to limited data.
- ** No standard deviation (SD) was found, and hence SD was set at 10% of the EAR.
Results

The cost of purchasing emergency food supplies to ensure adequate dietary energy (and ignoring other nutrients) was only $2.22 per day (Scenario EP-B, Table 4). The uncertainty analysis around the results of Scenario EP-B is shown in Table 5. This indicates a fairly narrow range of daily costs for the optimised selection of low-cost foods (95% simulation interval [SI] = $2.04 to $2.38). Our requirement for a mix of foods (up to a maximum weight of 100g) increased the cost slightly in Scenario EP-B. However, without such a constraint only flour and vegetable oil would have been selected in Scenario EP-B (i.e., these appear to be the cheapest two foods providing dietary energy).

For emergency food that did not require cooking (Scenario EP-NC) the cost was slightly higher (at $3.67) than Scenario EP-B. Nevertheless, one of the selected foods (dried peas) would require time to sprout.

For the stored emergency foods designed to meet all daily nutritional requirements for men, the purchase cost was substantially higher at $7.10 per day (Scenario EP-H). However, the variety of foods was improved compared to that of the above-mentioned Scenarios (i.e., 10 vs 7 food items). Moreover, this was the only scenario in which the optimisation process involved the selection of fruit or vegetable products.

Where zero spoilage was assumed (i.e., well-organised storage in Scenario EP-NS), the cost of purchasing food for storage was as low as NZ$ 1.93 per day.

Table 4. Foods per person per day (with weights) included in the various emergency food scenarios as a result of the optimisation process

| Food items selected by the optimisation process (for further details see Table 2) | Total food weights suggested per day (g) by Scenario |
|:---|:---|:---|:---|
| **Food that requires cooking** | | | | |
| White flour | 100* | 0 | 0 | 100 |
| Rice (white) | 100 | 0 | 0 | 100 |
| Pasta (dried) | 100 | 0 | 0 | 100 |
| Wholemeal flour | 0 | 0 | 200* | 0 |
| **Food that can be eaten without cooking** | | | | |
| Peanut butter | 100 | 100 | 51 | 85 |
| Sugar | 100 | 100 | 14 | 100 |
| Oats (whole grain, raw) | 74 | 100 | 0 | 100 |
| Oil (vegetable, blend) | 60 | 30 | 0 | 60 |
| Peas (dried) [requires sprouting] | 0 | 100 | 200 | 0 |
| Sultanas | 0 | 100 | 0 | 0 |
| Peanuts, raw | 0 | 96 | 0 | 0 |
| Breakfast biscuits (“Weetbix”) | 0 | 10 | 0 | 0 |
| Peaches (canned) | 0 | 0 | 200 | 0 |
| Fruit salad (canned) | 0 | 0 | 200 | 0 |
| Apricots (canned) | 0 | 0 | 200 | 0 |
| Tomatoes (canned) | 0 | 0 | 200 | 0 |
| Sardines | 0 | 0 | 183 | 0 |
| Tomato sauce | 0 | 0 | 145 | 0 |
Flour with oil in EP-B and EP-NS could be used to make scones or rotis. Flour and water in EP-H could be cooked as damper (potentially with some of the sugar used). Additional ingredients would improve the range of options e.g., baking powder, herbs.

Table 5: Uncertainty analysis of selected foods included in the daily dietary scenario for the lowest cost collection of emergency foods (2000 iterations of Scenario EP-B)

<table>
<thead>
<tr>
<th>Food item selected by the optimisation process</th>
<th>Mean</th>
<th>Median</th>
<th>Lower 95% simulation interval (SI) bound</th>
<th>Upper 95% SI bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasta (dried)</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Rice (white)</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Sugar</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Peanut butter</td>
<td>92</td>
<td>100</td>
<td>25</td>
<td>100</td>
</tr>
<tr>
<td>White flour</td>
<td>84</td>
<td>100</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Oil (vegetable, blend)</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>Oats (whole grain, raw)*</td>
<td>51</td>
<td>61</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Peas (dried) [can be sprouted]</td>
<td>34</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Wholemeal flour*</td>
<td>16</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Semolina*</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>54</td>
</tr>
<tr>
<td>Total food weight</td>
<td>640</td>
<td>621</td>
<td>385</td>
<td>914</td>
</tr>
<tr>
<td>Cost to purchase (NZD)</td>
<td>$2.21</td>
<td>$2.21</td>
<td>$2.04</td>
<td>$2.38</td>
</tr>
</tbody>
</table>

* These results are influenced by a small number of values that are outside of the 95% SI.

Discussion

Main findings and interpretation—This study was able to identify relatively low-cost collections of foods for emergency storage for as low as NZ$ 2.21 per day in the baseline Scenario (EP-B). For the recommended 3 days of food storage per person, this totals to only around $7 per person. The cost was slightly more for storing foods that don’t require cooking (i.e., $11 for 3 days of foods in Scenario EP-NC).

These prices suggest that food storage for emergencies should be feasible for nearly all New Zealand families. Nevertheless, given the issues around food insecurity (see Introduction), the Ministry of Civil Defence and Emergency Management (and other government agencies), may need to assume that home-stored food will not be available for some families. Indeed, this should probably be the default assumption anyway for disasters where buildings are severely damaged by floods or earthquakes and citizens cannot access any of their own household food stockpiles.
This study found that purchasing healthier foods for storage (that meets all daily nutrient requirements for men for 3 days), did cost somewhat more at around $21 for one man for 3 days. Storing these healthier foods are unlikely to be feasible for some low-income families dealing with food insecurity. However, achieving optimal nutrition for a few days is generally relatively inconsequential in disaster situations.

Emergency storage recommendations could focus on ensuring families store non-perishable foods providing sufficient energy with suggested alternatives to provide additional nutrients for special population groups such as children, pregnant and lactating women.

**Study strengths and weaknesses**—Particular strengths of this study were that it appears to be the first such approach (to our knowledge) of optimising emergency foods for storage in the New Zealand situation. We also included uncertainty analysis, which appears to be rare in such optimisation studies. Yet some specific limitations should be noted as outlined below:

- The process for food selection was not exhaustive and we may have missed certain low-cost food items that are suitable for long-term storage.
- We were conservative with the pricing data and so may have over-estimated the “real world” prices given that some citizens may focus on buying “specials” and buy in bulk (e.g., 25 kg sacks of rice cost significantly less ($0.18–0.22 per 100g) than smaller amounts such as the $0.25 used in Table 2). While we used the prices of some “generic” brands (e.g., “Home Brand”), the foods covered by generic brands vary between supermarket chains and can result in large savings compared to branded foods (as per an Australian study). Also for foods not covered by the FPI, we used prices from relatively typical supermarkets and not those from one New Zealand supermarket chain that specialises in low prices. Finally, organisations preparing emergency food stores could also potentially get lower-priced food through bulk purchase arrangements.
- The spoilage estimates were crude and not informed by any New Zealand specific studies (since none appear to have been done).
- For the nutrient analysis in one scenario, some of the nutrient values obtained may be on the optimistic side as overcooking may occur with some foods with associated loss of micronutrients.
- We have only presented results for adult men and other groups will have differing nutrient requirements. Nevertheless, men have higher dietary energy requirements and higher nutrient requirements (except for iron) than other population groups (and we used the EAR for women which is greater than the EAR for men).
- There are likely to be more uncertainties than we modelled, for example future changes in price of food.

Some of these issues could be addressed by future research such as studies on food spoilage levels in the New Zealand environment. Other optimisation work could
consider other issues e.g., what emergency food is best for New Zealand to provide to Pacific Island countries damaged by cyclones.

Possible implications—From a government agency perspective (e.g., civil defence and even the military), these results could inform the promotion of cost-effective food storage decisions for disaster relief planning at the community and household levels. While these agencies do not stockpile emergency food supplies themselves, if they ever decide that this is a worthwhile option then many other issues would be relevant. For example, the economies around food rotation to reduce costs (e.g., consumption by the military on a routine basis); the costs of warehousing; volume and weights of food (if helicopter airlifts were being considered); and what are the foods that are best suited for preparation in a field-kitchen, etc.

At the household level, this information on the cost and nutrition of emergency food may provide reassurance that such planning need not be expensive. But there are other considerations that citizens are likely to be interested in when it comes to emergency food storage:

- Use of more routinely consumed foods that can be rotated as part of routine or occasional meals (to reduce the wastage associated with spoilage of stored emergency foods).
- Foods that reflect cultural preferences or other personal preferences e.g., vegetarian, gluten-free etc.
- Foods that are also suitable for feeding companion animals during a disaster (e.g., canned fish or meat that can also be given to cats and dogs), if actual extra pet food was not stored.
- Foods that are particularly low in sodium to reduce the risk of thirst at times of potential water-supply shortages. But on the other hand, some higher salt foods may have lower spoilage rates.

In summary, it appears to cost very little to purchase basic emergency foods for storage in the current New Zealand setting. The lists of the foods identified in this study could potentially be promoted by organisations who participate in disaster relief (civil defence and the military) but also acted on by citizens.

Competing interests: Nil.

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References:


What risks do women face when seeking advice during pregnancy from pharmacies and natural health retailers?

Sarah Jefferies, Bridget Healy, Mark Weatherall, Richard Beasley, Philippa Shirtcliffe

Abstract

Aim Potential risks to mother and foetus exist with the incorrect use of complementary and alternative medicine (CAM) products during pregnancy. This study aimed to identify the risks that a woman may face when seeking advice during pregnancy from pharmacies and health food stores (HFS) in Greater Wellington (New Zealand).

Methods 21 HFS and 21 geographically-matched pharmacies were visited by a researcher who sought advice regarding vitamin supplementation and nausea in early pregnancy using a standardised scenario. Any advice given, including details of recommended products, was documented immediately upon leaving the premises. Proportions were obtained and paired contingency table analysis was used to examine the agreement between the matched pairs.

Results A minority of pharmacies (5/21, 23.8%) and HFS (1/21, 4.8%) made primary recommendations for nausea which were supported by Ministry of Health (MOH) guidelines, and both pharmacies (14/21, 66.7%) and HFS (7/21, 33.3%) recommended products contrary to these guidelines. A greater proportion of pharmacies gave advice consistent with MOH recommended dosage of folic acid supplementation than HFS (20/21, 95.2% vs 10/21, 47.6%). 2/21 (9.5%) of pharmacies and 4/21 (19%) of HFS gave advice with a potential risk of vitamin A overdose.

Conclusions Pharmacies and HFS in Greater Wellington provided potentially hazardous advice, recommending products, often branded for pregnancy, which contradicted NZ MOH guidelines. Regulatory reform of CAM products and those who sell them is called for in New Zealand.

Natural health products are popular among pregnant women in Australasia, yet potential risks of exposure to teratogenic herbs, vitamins and other substances raise concerns regarding the present lack of effective regulation of the complementary and alternative medicine (CAM) industry in New Zealand.

Natural health (or CAM) products, including herb, mineral and vitamin supplements, are marketed for pregnancy on the basis of health promotion as well as to remedy pregnancy-associated ailments such as nausea and vomiting of pregnancy (NVP).

Consumers may use them with the belief that they are ‘natural’ and therefore safe; attracted by the autonomy of self-care; or wary of conventional medicines and their adverse effects. However, not only is there little evidence of the efficacy or safety of CAMs promoted for pregnancy in New Zealand, but there are risks of toxicity from
herbal ingredients and supplement overdosing, product contamination and adulteration, as well as interactions with conventional drugs.\(^4\)

CAMs are widely available from advertisements, pharmacies, health food stores, supermarkets, on the Internet and from medical practitioners.\(^5\) In New Zealand the CAM industry is substantial, with manufacturers’ annual turnovers ranging from $100,000 to >$20M.\(^6\)

CAM use in pregnancy is specifically addressed by the New Zealand Ministry of Health (MOH) in the Food and Nutrition Guidelines for Healthy Pregnant and Breastfeeding Women which sets out evidence-based recommendations regarding the use of vitamins, minerals and herbs.\(^7\)

The guidance explicitly states that there is no requirement for a healthy pregnant woman to take multi-vitamin supplementation; and that a balanced diet is sufficient. It also states that ‘all herbs should generally be avoided’. It advocates discussion with the lead maternity carer regarding taking any supplements and herbs prior to their commencement. Unfortunately, research shows that CAM use is often not discussed with a primary care physician.\(^8\)

NVP is a common and distressing ailment of early pregnancy and the use of the herb ginger (\textit{Zingiber officinale}) and vitamin B\(_6\) (pyridoxine) are popularly promoted. However, a recent Cochrane review of randomised controlled trials of therapies for mild-moderate NVP concluded that the evidence for a beneficial effect of ginger or pyridoxine supplementation was inconsistent and/or limited.\(^9\)

Matthews et al. found that while adverse effects had not been reported in trials using short courses of low dose ginger 1g daily or 30-75mg pyridoxine daily for NVP, this research was insufficient to prove safety.\(^9\) There are also concerns regarding potential toxicity of these substances: pyridoxine is neurotoxic at high doses\(^10\) and ginger is considered an emmenagogue (induces menstrual bleeding) in traditional medicine\(^11\) and its constituents have been shown to inhibit thromboxane synthetase activity\(^12\) and exhibit antiplatelet\(^13\) and cytotoxic properties\(^14\) although there is conflicting evidence.\(^15,16\)

NZ MOH guidelines recommend that pregnant woman choosing to use ginger for NVP do not exceed a daily dose of 1g and also advise an upper limit of 50mg pyridoxine daily.\(^7\)

The key issue that this study sought to investigate was the risks which a woman may face when seeking advice regarding NVP, and vitamin supplementation during pregnancy from pharmacies and health food stores (HFS) in Greater Wellington.

\textbf{Methods}

A search of The Yellow Pages telephone directory in February 2010 identified 26 Health Food Stores (HFS) in the Greater Wellington region. Of these, 5 were excluded: 3 were no longer in operation, 1 was a residential property, and 1 specialised in sports supplements.

Twenty-one HFS and 21 geographically-matched pharmacies (on the basis of closest location to the HFS) were visited by the same researcher between the months of February to July 2010.

With each visit, the researcher commenced a conversation with a retail assistant by saying she was 6–8 weeks pregnant, having problems with morning sickness, and enquiring about any herbal products which the retail assistant could recommend to help reduce nausea. The researcher would then ask what
the retail assistant could recommend with regards to vitamin supplementation. Finally she asked which vitamins were important during pregnancy and if there were any to avoid.

If questioned by the retail assistant, the researcher would reply, as appropriate, saying she was: 30 years old, married, excited about her first pregnancy, currently working in a clerical office job, and otherwise fit and healthy with no previous medical history.

During each interaction, the researcher would take note of the products recommended and their prices, and upon leaving immediately complete a standardised data collection form to document the advice received. The ingredients of each recommended product were later confirmed by searching for the product on the Internet.

The NZ MOH Food and Nutrition Guidelines of Healthy Pregnant and Breastfeeding Women (revised 2008) was the standard against which all advice was compared. For ingredients not noted therein, a database search using Medline was performed for evidence of safety during the first trimester of pregnancy.

The following criteria were used to evaluate advice given:

**Products recommended for nausea in the first trimester of pregnancy**

**Safe**—Product contains ingredients which are not absolutely contraindicated in pregnancy or their daily dose does not exceed the upper limit recommended by NZ MOH guidelines, or, if the ingredient is unknown, there is no evidence that it may be unsafe by Medline search of the literature.

**Unsafe**—Product contains ingredients which are absolutely contraindicated in pregnancy or the daily dose exceeds the upper limit recommended by NZ MOH guidelines, or, if the ingredient is unknown, there is evidence that it may be unsafe by Medline search of the literature.

**Advice regarding vitamin supplementation in early pregnancy – folic acid advice**

**Correct**—Dose advised corresponds with NZ MOH guidelines for supplementation with 800 mcg/day in low-risk pregnancy.

**Incorrect**—Folic acid not recommended or dose advised was less than 800 mcg/day.

**Advice regarding vitamin supplementation in early pregnancy – Vitamin A overdose risk.**

**Safe**—Advice given did not pose risk of vitamin A overdose. This includes recommendation of a multivitamin product marketed for pregnancy which did not contain doses of vitamin A exceeding 3000mcg/day of retinol, even without demonstrating explicit vitamin A overdose awareness.

**Unsafe**—Advised that there is no limit to vitamin dosing during pregnancy or recommended a product containing >3000 mcg/day of retinol or advised to take any generic multivitamin.

**Statistical analysis**

Paired contingency table analysis was used to examine the agreement between the matched pairs in advice between pharmacies and HFS. Statistical analysis was by an exact McNemar’s test and a confidence interval for the difference in marginal proportions, representing the proportion of pharmacies that gave particular advice versus the proportion of matched HFS that gave advice.¹⁷

A statistically significant McNemar’s test means the marginal proportions of the contingency table are different. In the analysis McNemar’s test is based on an exact test whereas the confidence interval is based on asymptotic (large sample) assumptions. Where more than one product was recommended for nausea, the primary recommended products were compared in one analysis, and then the secondarily recommended products compared separately.

The number of matched pharmacies/HFS was based on an earlier study comparing the advice from HFS assistants with that of pharmacy assistants given to an individual presenting with symptoms suggestive of moderate to severe asthma who should be referred to a medical practitioner.¹⁸ Based on this, it was calculated that the study would need to have 19 store/pharmacy pairs to have 80% power to detect the difference.
The study was approved by the Central Regional Ethics Committee.

**Results**

Data was collected from 21 HFS and 21 geographically-matched pharmacies in the Greater Wellington region. The investigator was advised by retail assistants in all the HFS, with 6/21 (28.6%) HFS advising further discussion with a naturopath (n=2) or GP (n=4).

In 7/21 pharmacies, advice was indirectly (n=3) or directly (n=4) from the pharmacist. 9/21 (42.9%) of pharmacies referred the researcher to a GP (n=7) and/or midwife (n=2) during the interaction.

Table 1 lists the products recommended for nausea and Table 2 summarises other recommendations made, including multivitamin supplementation.

**Table 1. Products recommended for nausea by Health Food Stores (HFS) and pharmacies (P), their retail price, ingredients and adherence with MOH guidelines**

<table>
<thead>
<tr>
<th>Recommended products: Name, manufacturer (recommended by)</th>
<th>Price range of products offered ($)</th>
<th>Daily doses if maximum dose taken as directed on packet/otherwise directed</th>
<th>MOH recommendation (Y/N)</th>
<th>Safe/Potentially unsafe (S/PU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ginger + Vitamin B6: Morning Sickness Formula, Blackmores (8HFS, 10P)</td>
<td>17.50–23.00</td>
<td>Ginger root 1.2g B6 75mg</td>
<td>N</td>
<td>PU</td>
</tr>
<tr>
<td>Ginger: Travel Calm Ginger, Blackmores (10P)</td>
<td>16.50–18.60</td>
<td>Ginger root 5.6g</td>
<td>N</td>
<td>PU</td>
</tr>
<tr>
<td>Ginger syrup/ capsules, Lifestream (4HFS)</td>
<td>17.00–17.40</td>
<td>Ginger rhizome 1–3g</td>
<td>1g=R (1HFS) &gt;1g=N (3HFS)</td>
<td>PU</td>
</tr>
<tr>
<td>Crystalised ginger (3HFS)</td>
<td>4.10–7.30</td>
<td>Not directed</td>
<td>N</td>
<td>PU</td>
</tr>
<tr>
<td>Ginger drops, Botanicals (1HFS)</td>
<td>14.00</td>
<td>‘Ginger veg glyceride’ 1g</td>
<td>Y</td>
<td>S</td>
</tr>
<tr>
<td>Ginger from a general store e.g. Raw ginger/ ginger beer/ale (3HFS, 5P)</td>
<td>4.60–7.85</td>
<td>Not directed</td>
<td>N</td>
<td>PU</td>
</tr>
<tr>
<td>Ginger tea, Planet Organic (2HFS)</td>
<td>4.60–7.85</td>
<td>Not directed</td>
<td>N</td>
<td>PU</td>
</tr>
<tr>
<td>Raspberry leaf: Raspberry leaf, Blackmores (1P)</td>
<td>12.79</td>
<td>Rubus idaeus (Raspberry) leaf powder/equivalent 6g</td>
<td>N</td>
<td>PU</td>
</tr>
<tr>
<td>Vitamin B6 supplements: From multivitamins (1HFS, 2P)</td>
<td></td>
<td>Varying levels in multivitamins - all &lt;50mg</td>
<td>N</td>
<td>S</td>
</tr>
<tr>
<td>Other vitamins: Morning</td>
<td>29.99</td>
<td>Vit B6 75mg</td>
<td>N</td>
<td>PU</td>
</tr>
</tbody>
</table>
Wellness Support, Clinicians (1P)

Homeopathy:
- Morning medrelief, Naturopahrm (1HFS) 19.60–21.30 N/A N S
- Nausyn, Weleda* (2HFS) 14.00–18.90 N/A N S
- Nausmed relief, Naturopahrm (2HFS) 20.30–20.80 N/A N S
- Saccharum/Mel complex, Weleda (1HFS) 17.50 N/A N S

Other:
- Acupressure wrist bands (11P) 22.50–23.99 N/A Y S
- Frequent snacking (2HFS) N/A Y S

In brackets = Number of HPS and P recommendations for the product. *Also contains herb mixture called cardiodoron 250mg/15 drops = Digestion, equiv. fresh plant juice: Hyoscyamus niger, herb 1mg; onopordon acanthium, flower 25mg; Primula veris, flower 25mg. Nausyn is licensed by Medsafe as a Medicine.

Advice given for nausea in the first trimester of pregnancy—5/21 (23.8%) of pharmacies and 1/21 (4.8%) of HFS made primary recommendations for nausea which were supported by the NZ MOH guidelines, with a non significant difference in marginal proportions of 19.1% (95%CI -2.3% to 40.4%), p=0.10.

Both pharmacies (14/21, 66.7%) and HFS (7/21, 33.3%), made primary recommendations which were contrary to NZ MOH safety guidance. The difference in marginal proportions was 33.4% (95%CI 5.9% to 60.8%), p= 0.07. With regards to recommendations of second-line products which were contrary to MOH safety guidance, this occurred in 7/21 (33.3%) of pharmacies and 10/21 (47.6%) of HFS with a non significant difference in marginal proportions of -14.3% (95%CI -41.6% to 13.0%), p=0.51. The most common reason for a product being considered unsafe was that it provided >1g ginger ± >50 mg pyridoxine in the maximum daily dose as directed (Table 1).

7/21 (33.3%) of pharmacies and 0/21 (0%) of HFS advised GP consultation if nausea did not settle. Due to two zero cell counts in the paired contingency table, it was not possible to calculate McNemar’s test or a confidence interval for the difference in paired proportions.

Advice promoting a balanced diet with folic acid supplementation—1/21 (4.8%) of HFS and 0/21 (0%) of pharmacies correctly advised that a balanced diet, along with folic acid supplementation, was recommended during pregnancy in otherwise healthy young women. However, 0/21 of HFS and 18/21 (85.7%) of pharmacies primarily recommended Elevit by Bayer, a multivitamin product which is licensed by Medsafe. Due to zero cell counts in the paired contingency tables, it was not possible
to calculate McNemar’s test or a confidence interval for the difference in these paired proportions.

Table 2. Summary of other products/ advice given. Numbers represent the total number of pharmacies (P) or Health Food Stores (HFS) giving recommendation (whether primary or secondary)

<table>
<thead>
<tr>
<th>Multivitamin supplements</th>
<th>Other supplements</th>
<th>Miscellaneous advice for nausea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevit, Bayer (20P)</td>
<td>Folic Acid, Blackmores, Red Seal, Solgar, NFS, or via GP (17HFS, 20P)</td>
<td>Acupuncture (1P)</td>
</tr>
<tr>
<td>Prenatal Nutrients, Solgar (10HFS)</td>
<td>Omega 3 Fish oil (Efanatal, Prenatal DHA)/Flaxseed oil (Waihati Bush)) (13HFS, 2P)</td>
<td>Spiritual healer (1HFS)</td>
</tr>
<tr>
<td>Pregnancy and Breast Feeding Gold, Blackmores (5HFS, 4HFS)</td>
<td>Iron, Solgar (1HFS)</td>
<td>Referred to the local HFS for advice as the pharmacy too busy (1P)</td>
</tr>
<tr>
<td>Multipregnancy Essentials, NFS (2HFS)</td>
<td>Spirulina, Lifestream (3HFS)</td>
<td></td>
</tr>
<tr>
<td>Meta B Multivits, Metagenics (1HFS)</td>
<td>Probiotics, brand not specified (1HFS, 1P)</td>
<td></td>
</tr>
<tr>
<td>Pregnacare, Thomsons (2HFS, 4P)</td>
<td>Pregnancy Tea, Artemis Contains: Raspberry leaves, Lady's Mantle, Nettle, St John's Wort, Lemon Balm, Horsetail, Yarrow (1HFS)</td>
<td></td>
</tr>
<tr>
<td>NFM Professional Multi (2HFS)</td>
<td>Eczema Shield, Ethical Nutrients Contains: Lactobacillus rhamnosus (GG) organisms (LGG®) (1HFS)</td>
<td></td>
</tr>
<tr>
<td>Multi for Pregnancy, Radiance (1HFS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PregaVit, Clinicians (1P)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Advice regarding folic acid—The majority of those promoting folic acid supplementation advised that this was for the prevention of neural tube defects (14/20 pharmacies and 13/17 HFS). 20/21 (95.2%) of pharmacies and 10/21 (47.6%) of HFS correctly gave dosing recommendations on the basis of national standards, with a difference in marginal proportions of 47.6% (95%CI 22.5% to 72.7%), p=0.006. 1/21 (4.8%) of pharmacies and 4/21 (19.0%) of HFS did not actively recommend taking folic acid supplementation.
Advice regarding Vitamin A overdose risk—2/21 (9.5%) of pharmacies and 4/21 (19.0%) of HFS vitamin recommendations were unsafe due to the potential risk of vitamin A overdose, with a non significant difference in marginal proportions of 9.5%, p=0.69.

Discussion

Both pharmacies and HFS recommended products for nausea in early pregnancy which did not adhere with NZ MOH safety guidance.

A minority also provided potentially unsafe advice regarding vitamin supplementation. There were no statistically significant differences between stores in the majority of recommendations made, except pharmacies were more likely than matched HFS to advise correctly regarding folic acid dosing. While this difference is unsurprising taking into consideration that pharmacies promote Medsafe-approved folic acid products which only they can sell, it does demonstrate the positive influence of product approval.

This study supports the urgent introduction of regulatory reform of the CAM industry and the businesses which sell these products.

This study is the fourth in a series of surveys in New Zealand looking at the appropriateness of advice given by pharmacies and HFS for a range of medical conditions. Previous surveys have all raised concerns regarding the advice provided by HFS when compared with pharmacies. This is the first scenario to find that the standard of advice was, on the whole, similarly matched between both types of store.

In fact there was a trend towards the primary promotion of potentially unsafe products for NVP by pharmacies when compared with matched HFS. This is largely due to the primary promotion of homeopathy by HFS, which although only able to offer a placebo effect at best, is inherently safe.

There were several limitations of this study. One of these is the possibility of recall bias although advice was entered into a data collection sheet immediately following the interaction to minimize this. The study was limited by the sample size available to the researchers in the greater Wellington region and although no statistically significant differences were found the confidence intervals for the comparisons were quite wide.

While this is the first study in New Zealand examining advice given by CAM retailers for a scenario of pregnancy, the closest comparative is a survey carried out in 2003 in North America. In this study, advice was sought from HFS via telephone for the treatment of nausea and migraines in early pregnancy. They found that HFS readily made recommendations, 5% of which were for products contraindicated in pregnancy, and most stores primarily promoted ginger for NVP giving incorrect dosing instructions.

Since the 1990s the use of CAM has surged worldwide and the World Health Organization actively recommends the regulation of all complementary and herbal medicine products and practitioners. This is particularly so in situations where the practice of complementary medicine brings economic benefit. This is to ensure the quality of the service received and thus to protect the public from potential harm.
This study supports the introduction of the Natural Health Products Bill in New Zealand (currently before the Health Committee) which is aimed at improving regulation by making pre-marketing ‘product approval’ mandatory, establishing a database of permitted CAM ingredients, requiring product labeling and licensing of CAM product manufacturers. This proposed legislation would ensure that commercially available CAM products complied with national guidelines prior to appearing on the shelves. Furthermore it would help ensure the quality of the ingredients used.

Analysis of the contents of the recommended products was outside the scope of this study, but it would have been interesting to assess the accuracy of the listed ingredients.

Research has demonstrated a wide variation in the constituents of ginger present in commercially available ginger supplements. This not only has implications for the rights of the consumer, but lack of standardisation of the products used in research, as exemplified by the variety of preparations used in ginger studies, may create misleading results.

Further monitoring of the therapeutic claims made on product labeling is also appropriate; a number of products not registered as medicines by Medsafe, and therefore not permitted to make therapeutic claims, were found to do so.

Unfortunately the proposed bill will not address the issue of setting minimum staff training requirements for the promotion of health food goods. Although only a minority provided unsafe advice regarding vitamin supplementation (e.g. 4.8% of pharmacies and 19.0% of HFS did not recommend folic acid) in the context of a retailer presenting themselves as a source of health advice to the public, any unsafe practice is unacceptable.

In conclusion, this study found that both HFS and pharmacy staff made potentially unsafe recommendations for nausea and vitamin supplementation in early pregnancy.

Many of the pregnancy promoted products recommended often did not adhere to the safety guidance set out by the NZ MOH. This study supports the call for legislative change and high quality research to guide the practice of health care professionals and retailers who sell natural products which may exert both beneficial and harmful effects.

Competing interests: Nil.

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References:
Back so soon: rapid re-presentations to the emergency department following intentional self-harm

Silke Kuehl, Katherine Nelson, Sunny Collings

Abstract

Aim To describe the number, characteristics and management of patients who presented to an emergency department (ED) with intentional self-harm and then re-presented for any reason within 1 week, over a 1-year period.

Method A retrospective records review from one New Zealand ED over 12 months.

Results Of the 120 patients who attended the ED more than once with intentional self-harm, 48 re-presented on 73 occasions within 7 days of the index presentation. Of the re-presentations, 55% occurred within 1 day. Mental health assessments by emergency department staff were minimal; challenging incidents occurred in 40% of presentations; and there was an increase in the inpatient admission rate for second presentations.

Conclusion We identified a small group of patients who rapidly re-present to the ED following intentional self-harm. The reasons behind those re-presentations could include limited mental health assessments in ED and inadequate follow-up on discharge. System improvements in the ED including better collaboration with mental health services could improve how services address the needs of patients who present with intentional self-harm and reduce costs.

People who intentionally self-harm commonly present to emergency departments (EDs), with a sub-group re-presenting on multiple occasions. Intentional self-harm (ISH) is one of the strongest predictors of eventual suicide with repeat suicidal behaviour particularly suggestive of severe psychopathology.

In New Zealand almost half of those known to have made serious suicide attempts make a further fatal or non-fatal attempt within 5 years.

EDs have an important role in suicide prevention. The acute setting provides an opportunity to assess and treat this vulnerable group of patients.

Research on repeat ISH presentations to ED has focused on describing the population and their re-presentations. Usually studies measure time to re-presentation at intervals of up to 12 months, with intervals of 6 months and 1 month being used less often.

Investigations of ISH repetition within 12 months have shown that 10% returned to ED within 1 week. Similar repetition rates (9%) within 1 week were found when examining the aftercare by GPs.

Overcrowding in EDs has led to the investigation of general re-presentation rates to find ways to reduce the workload. Moore et al found that 60% of ED re-presentations
happened within a week, with a quarter of these patients troubled by mental health issues.\textsuperscript{14}

Studies on “unscheduled returns” to ED within 72 hours have focused on physical presentation for complaints such as abdominal pain\textsuperscript{15} and discovered errors of prognosis, treatment and follow-up care\textsuperscript{16}. Neither of these studies examined unscheduled returns to ED following ISH.

The aim of our study was to examine ED re-presentations following ISH within 7 days of the index ED presentation, and to describe the clinical activities in ED associated with the management of this group.

**Method**

**Study design**—This study is a retrospective records review of ED presentations over a 12-month period. The study was approved by the Central Regional Ethics Committee.

**Setting**—The study was set in a New Zealand tertiary hospital serving a regional population of 900,000 people.

**Sample**—The records of 48 patients with 73 pairs of presentations, where the index presentation was for ISH and the second was for any reason, with both presentations occurring within a seven day period. The sampling method is illustrated in Figure 1. People who had 13 or more presentations within the 12-month period were excluded as they were considered to have a different profile.

**Figure 1. Sampling methodology**
Data—This was extracted from the ED clerical and clinical notes. Demographic data included gender, age, ethnicity, and past health history. Presentation data included date of presentations; presenting complaints; assessment by doctors and nurses; challenging incidences; mental health referral to and from ED; assessment by mental health services; ward admission and planned follow-up. Additional information about sequences of events and context were entered into a log book.

Procedure—in the year of the study 44,882 ED presentations were recorded; of these 6.5% were re-presentations. Hospital Information Services performed a systematic database search to capture all patients with a presenting problem related to overdose or mental health, situational crisis and lacerations. In total, 1985 patients presented to ED with ISH, with the majority presenting only once (n=1865). Preliminary inspection of the data showed that of 120 patients with multiple ISH presentations 56 had returned within 1 week. The 852 presentations of 120 patients made up 1.9% of the total ED presentations for that year. A sample of 48 patients with 73 presentation pairs was identified (Figure 1) representing 2.4% of the ISH population.

Determining a presentation pair was complex. Fifteen patients had 40 presentation pairs, with individuals having between two and six pairs. Seventeen pairs were linked, meaning a second presentation was also counted as an index presentation if the next time the person came to the ED was within 7 days. To be an index presentation required the documentation of ISH, defined as attempted suicide, self-harm and suicidal ideation (Table 1).

Table 1. Identification of presentation pairs

<table>
<thead>
<tr>
<th>No. of presentation pairs per patient</th>
<th>No. of patients</th>
<th>No. of re-presentations</th>
<th>No. of ISH presentations counted twice</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>33</td>
<td>33</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>18</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>48</td>
<td>73</td>
<td>17</td>
</tr>
</tbody>
</table>

There was no one pattern to presentations and pairs. Of the nine patients who had two presentation pairs, seven patients’ presentation pairs were connected. Of the four patients who had three presentation pairs, two had three interconnecting presentation pairs within three and 12 days respectively, one had two out of the three pairs connected, and the fourth had all unconnected presentation pairs.

The patient with four presentation pairs had three connected pairs and one unconnected. The patient with six presentation pairs first two presentation pairs were unconnected; the second, third and fourth connected; and the fifth and sixth connected.

Analysis—The Statistical Program for Social Science (SPSS) Version 14 was used for analysis: (i) the characteristics of the two sets of presentations (i.e. index presentations for ISH, and second presentation) were summarised using simple descriptive statistics; and ii) inferential statistics were used to test for differences in assessment and management between first and second presentations. Content analysis of log book entries was used to describe events between and during ED presentations.

Results

Of the 73 re-presentations by 48 people, more than half (55%) occurred within 24 hours of the index presentation. Re-presentations within one day included 9 (12%) on the same day and 31 (43%) the following day (Table 2). The mean interval between index presentation and re-presentation was 2.6 days (SD 2.2, with a median of 1 day).
Table 2. Days to re-presentation by number and frequency

<table>
<thead>
<tr>
<th>Days to re-presentation</th>
<th>Number of presentations (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0*</td>
<td>9 (12.3)</td>
</tr>
<tr>
<td>1</td>
<td>31 (42.5)</td>
</tr>
<tr>
<td>2</td>
<td>5 ( 6.8)</td>
</tr>
<tr>
<td>3</td>
<td>6 ( 8.2)</td>
</tr>
<tr>
<td>4</td>
<td>9 (12.3)</td>
</tr>
<tr>
<td>5</td>
<td>6 ( 8.2)</td>
</tr>
<tr>
<td>6</td>
<td>3 ( 4.1)</td>
</tr>
<tr>
<td>7</td>
<td>4 ( 5.5)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>73 (100)</strong></td>
</tr>
</tbody>
</table>

*Same day

**Demographic characteristics and clinical features of patients**—Of the 48 patients, 56% were female. Age at the first of their paired presentations ranged from 14–51 years, with a mean of 29 years (SD 10.7). Patients most commonly identified as European (67%) and Māori (23%). At the patient’s first presentation a history of mental illness/personality disorder (96%) and/or ISH (65%) was commonly documented. Over a third of the sample (38%) had physical illness recorded in their past medical history. A number of patients had a documented background history of alcohol (42%) and drug (28%) use. A majority of patients (80%) presented to ED between two and four times for any cause in the year of observation.

**Arrival information**—The majority of index presentations (82%, n=60) included complaints of suicidal thoughts on arrival to ED, compared to only 62% (n=45) for second presentations. In nearly half of the presentation pairs (n=36), suicidal thoughts were among the presenting complaints for both visits. Harm sustained from ISH was more common for index presentations (n=47, 65%) than for second presentations (n=39, 53%) and consisted mostly of overdoses and lacerations (Table 3).

Physical presentation complaints for second presentations (n= 18/25%) included non-ISH lacerations and foreign bodies; pain; drug and alcohol issues; seizures; pregnancy issues; anaemia/hypotension and sleep deprivation.

For approximately a quarter of presentations, patients had pre-arranged appointments with the Mental Health Crisis Team (MHCT) (n=16, 22% first; n=21, 29% second presentations) in ED. Where ED documentation was missing for expected patients, MHCT only involvement was assumed.
Table 3. Harm sustained from intentional self-harm type, both presentations

<table>
<thead>
<tr>
<th>Type of ISH</th>
<th>1st Presentation n (%)</th>
<th>2nd Presentation n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overdose</td>
<td>25 (34)</td>
<td>21 (29)</td>
</tr>
<tr>
<td>Laceration</td>
<td>12 (17)</td>
<td>8 (11)</td>
</tr>
<tr>
<td>Attempted hanging</td>
<td>2 (3)</td>
<td>2 (3)</td>
</tr>
<tr>
<td>Ingestion/insertion foreign body</td>
<td>4 (6)</td>
<td>2 (3)</td>
</tr>
<tr>
<td>Head injury</td>
<td>2 (3)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Stabbing self</td>
<td>1 (1)</td>
<td>0</td>
</tr>
<tr>
<td>Traffic</td>
<td>1 (1)</td>
<td>0</td>
</tr>
<tr>
<td>Gassing</td>
<td>0</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Jumping from a height</td>
<td>0</td>
<td>3 (4)</td>
</tr>
<tr>
<td>Burn</td>
<td>0</td>
<td>1 (1)</td>
</tr>
<tr>
<td>No details recorded</td>
<td>1 (1)</td>
<td>4 (6)</td>
</tr>
<tr>
<td>No harm sustained*</td>
<td>25 (34)</td>
<td>30 (41)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>73 (100%)</strong></td>
<td><strong>73 (100%)</strong></td>
</tr>
</tbody>
</table>

*Includes presentations for suicidal ideation. For second presentations it also includes physical reasons.

**Emergency department assessment and management**—Documentation of assessment and management by ED doctors and nurses was minimal (Box 1, Scenario 1). In general, nursing documentation consisted of a description of the whereabouts of the patient and stated service involvement. The number of nursing assessments of patients’ physical or mental state was higher for index (n=53, 73%) than for second (n=43, 59%) presentations (Fisher’s Exact, p=0.016).

In 13 pairs of presentations, no nursing assessments were documented. Mental health assessments by ED doctors were less common for second than for index presentations, decreasing from 55% (n=40) to 38% (n=28) (Fisher’s Exact 0.233). For 23 presentation pairs, no mental health assessments were done by ED doctors in either presentation.

**Box 1. Scenarios of events in ED**

**Scenario 1 – Triage assessment: Risk to self and others**
Person Y presented to ED with thoughts of killing his neighbour and suicidal thoughts. Y was assessed by the MHCT and sent home. He arrived back in ED 2 days later. The triage nurse’s documentation is ‘Expected by MHCT. Appears calm’ and allocated a Code 4*. MHCT was delayed for 3 hours. No further assessments were done until they arrived.

**Scenario 2 – Management of minor injuries**
Person X presented with a deep hand laceration that required plastic surgery. He stated that he worked in a professional occupation and got his hand caught in a grinder by accident. X stated that he had no past medical history. Previous admission notes showed that he had attended two days previously distressed and suicidal.

**Scenario 3 – Challenging incident**
Person N presented to ED with lacerations to her lower legs. While waiting in a cubicle, she tried to set light to herself. Person N required restraint and two security staff to ensure her safety.

*Patient should wait for medical assessment and treatment no longer than 60 minutes
In contrast, in 42 (58%) presentation pairs, physical assessments were performed by ED doctors at both index and second presentation. When managing complaints for physical issues, notes from previous intentional self-harm admissions to ED were not always consulted (Box 1, Scenario 2).

Challenging incidents such as those listed in Box 1 (Scenario 3) were common. More than half (54%) of presentation pairs involving 26 patients included a report of such incidents in at least one presentation. Police input was required for nearly a third of index presentations and a quarter of second presentations. The use of a watch/special providing one-on-one care or supervision of a patient increased from 19% for index to 26% for second presentations (Table 4).

<table>
<thead>
<tr>
<th>Challenging incident</th>
<th>1st Presentation n (%)</th>
<th>2nd Presentation n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abusive behaviour</td>
<td>7 (10)</td>
<td>7 (10)</td>
</tr>
<tr>
<td>Mental Health Act</td>
<td>8 (11)</td>
<td>6 (8)</td>
</tr>
<tr>
<td>Police involved</td>
<td>22 (30)</td>
<td>18 (25)</td>
</tr>
<tr>
<td>Restraint use</td>
<td>7 (10)</td>
<td>6 (8)</td>
</tr>
<tr>
<td>Watch/special</td>
<td>14 (19)</td>
<td>19 (26)</td>
</tr>
<tr>
<td>No challenging behaviour</td>
<td>42 (58)</td>
<td>45 (61)</td>
</tr>
</tbody>
</table>

*People could have more than one challenging incident at each presentation.

**Clinical progress and outcome**—After assessment and treatment by ED, a referral to mental health services was made for 88% (n=64) of index and 74% (n=54) of second presentations (Fisher’s Exact, p=0.046). Services referred to included MHCT and community mental health agencies, alcohol and drug services, and child and adolescent services.

From second presentations 7% (n=5) referrals were to medical and surgical services. Only 66% (n=48) of index and 55% (n=40) of second presentations were actually assessed (Fisher’s Exact, p=0.044) by mental health services. For 15 paired presentations a comprehensive mental health assessment by MH services was not performed during people’s ED visits.

Patients were more likely to be admitted following their second presentation, with mental health or general ward admissions increasing from 23% (n=17) for index presentations to 32% (n=23) for second presentations. Index presentation admissions included six to a medical ward, and ten to a mental health facility or respite care. One person was discharged into police custody.

Second presentation admissions included 10 to a medical ward and 13 to a mental health facility. In ten pairs of presentations admission resulted both times. In 38 presentation pairs the patients were discharged home on both presentations. Planned follow-up was documented for 76% of index and 73% of second presentations.
Discussion

This study discovered that a group of patients re-presented to ED within days following ISH. Of concern was the risk of further serious ISH which was evidenced by increased inpatient admission numbers. A significant number of patients (54%) were involved in challenging incidents, demonstrating they were distressed, experiencing a mental health crisis and possibly were at risk to self and/or others.

While patients with mental health issues often report that general staff have negative attitudes toward them, some doctors have reported feeling helpless in addressing the emotional aspects of self-harm. This could have contributed to the finding that only half of the index visits and a third of the second visits had documented mental health assessments by ED, which might not be in alignment with assessments actually done.

A decreased level of consciousness, assumed of some patients post overdose, can also make a mental health assessment in ED difficult. Clinical notes about the inability to assess patients’ mental state, including information from support people or ambulance staff in regards to intent or risk, would assist with future mental health services engagement, discharge planning and follow-up so as to decrease re-presentations to ED.

A lack of an ED mental health assessment was apparent in presentations where patients had a pre-arranged appointment with the CMHT. Repetition of ‘the story’ to various health professionals might only cause increased stress and irritation for the patient. Of concern were the often extended waiting times to be seen by the CMHT. ED is seen as a safe environment by the CMHT, but without an assessment of risk to both patients and staff, safety measures could not be implemented.

An initial mental health assessment by ED staff within an hour of the patients’ arrival is recommended. The responsibility for safety remains with ED until the CMHT takes over the management of a particular presentation episode.

The CMHT only assessed a portion of those referred by ED despite best-practice guidelines recommending specialist mental health input for every ISH presentation to ED. Some researchers have questioned the effectiveness of increased resources for mental health care when there may be no decrease in subsequent ISH which is in line with a recent New Zealand study reporting no overall effects of a brief intervention following suicide attempts. However, even if an assessment is not associated with reduced repetition, being referred for specialist follow-up probably is.

Unless mental health services are involved on discharge from ED, follow-up care and linkage to other support systems is not guaranteed.

In this study patients who re-presented with minor complaints were usually treated for their injuries only and previous ISH presentations were missed or ignored. People at risk for completed suicide may obscure the cause of their injuries.

Implementation of an electronic ‘alert’ cue for re-presentations within a week could highlight to ED staff the need to review earlier presentations. In this ED setting, even if an attempt was made to access previous ED notes, the mental health crisis team and clinical notes were not easily accessible by ED staff. While sharing of notes between
services is recommended, dual record systems as evidenced here are still reported to exist in smaller DHBs in New Zealand.

ED re-presentations are costly. Healthcare expenses have become a focus for the public and government alike. Using 2002 financial costs of an ISH event of $6,350 the total estimated expense for the 73 re-presentations was over $32,500. This cost is based on what patients pay for their presentation if they do not reside in New Zealand; and because it excludes treatments such as blood tests and hospital admission, is an underestimate of true time and costs.

One of the limitations of this study was that there was no easy way to access data on ISH presentations. The group of patients who had repeat presentations for ISH had numerous other presentations. Presentation complaints and discharge diagnoses often lacked documentation about the intent behind some of the injuries; it is therefore possible that some ISH presentations were not identified.

The issue of identification raises questions around achieving the goals of the Suicide Prevention Strategy, in particular improving the care for people at risk of self-harm and suicide. ED care for people at risk of suicide and self-harm can be enhanced only if patients are identified. It is recommended that future Suicide Prevention Strategy implementation plans incorporate guidance on patient identification.

The classification of some presentations as both index and 2nd presentation could have introduced bias when comparisons were made between these groups and when overall results were interpreted. Nevertheless, it did highlight many ED visits within a short timeframe by a few patients where the issues and consequences of ISH events were not addressed.

Some patients were discharged without comprehensive mental health assessments leaving a risk of further undetected ISH. The consequent lack of a discharge plan or arranged follow-up could have contributed to patients seeking further assistance from ED when mental health services would have been better suited to meet their needs. For ED and mental health services the short timeframe to re-presentation raises an opportunity to intervene collaboratively within days as opposed to weeks.

A strength of this study is that it informed changes in ED management for people who present with ISH, demonstrating that simple data can make an important contribution to patient care and generally to quality improvement.

Alterations have been made to the IT system by adding ‘Self-harm’ as a presenting complaint and discharge diagnosis; also a mandatory field now has to be completed by clinical staff for certain diagnoses, such as ‘collapse’, to ascertain if it is related to ISH. In addition, a psychiatric liaison service linked to ED was established.

Expectations of this service include the assessment and management of those at risk of ISH in ED, and to support ED staff in the management of this group of patients. These system changes should contribute to improved ED care and decreased re-presentations of patients who intentionally self-harm. Other EDs should consider addressing issues of rapid re-presentations following ISH in ways that align with their systems and processes.
Conclusion

This paper presents one of the first detailed descriptions of a group of patients in New Zealand who rapidly re-present to ED. It highlights some important findings related to the timing of re-presentation and ED management. Re-presentations increase costs and workloads of an already overcrowded ED.

Subsequent investigation of mental health service input for this group contributed to improved IT services and the employment of psychiatric liaison nurses in ED. In future, analysis of data on ISH presentations as well as evaluation of the ED psychiatric liaison service is required to assess if system improvements led to improved outcomes.

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Health benefits of deer and elk velvet antler supplements: a systematic review of randomised controlled studies

Andrew Gilbey, Jose D Perezgonzalez

Abstract

Aims The aim of this systematic review was to evaluate the evidence from RCTs of velvet antler supplements for any condition, using the QUOROM statement as a guiding framework.

Methods Four electronic databases (PubMed, Medline, Web of Science and Academic search premier, via the bibliographical platform, Endnote) and two review articles were searched for all randomised clinical trials of velvet antler supplements. Retrieved trials were evaluated according to standardised criteria.

Results Seven RCTs were identified as satisfying all inclusion criteria and examined the effectiveness of velvet antler for rheumatoid arthritis (2), osteoarthritis (1), sexual function (1), and sporting performance enhancement (3). Their methodological quality ranged from 3–5, as measured on the Jadad scale. Two RCTs reported some positive effects of velvet antler supplements, but neither were convincing while the remaining five RCTs found no effect of velvet antler supplements.

Conclusions Claims made for velvet antler supplements do not appear to be based upon rigorous research from human trials, although for osteoarthritis the findings may have some promise.

Velvet antler (VA) is a dietary supplement made from the antlers of deer or elk that have been surgically removed from a live animal under anaesthetic. It is valued for its medicinal purposes for a wide range of health-based and performance issues. For example, it is claimed that (www.deervelvet.org) deer velvet antler:

- Improves immune system functioning;
- Improves athletic performance and strength;
- Improves muscle recovery after exercise;
- Reduces negative effects of stress;
- Enhances sexual functioning for both men and women;
- Promotes rapid recovery from illness;
- Has anti-cancer and anti-inflammatory properties.

VA is typically available powdered and capsulated, or as an extract in liquid form, and it is marketed as a food supplement, although it is described as an important part of Traditional Chinese Medicine. Deer velvet antler (DVA) is chemically synonymous to elk velvet antler (EVA) and is utilised commercially for identical purposes.

Like many supplements based upon Traditional Chinese Medicine, the scientific rationale for why benefits of velvet antler (VA) might accrue is somewhat unclear, at least when interpreted from a western perspective. However, the rationale is quite
likely related to the belief that the properties inherent in a substance (e.g., VA is the only mammalian organ with the ability to regenerate itself) will, if ingested, confer similar benefits on its user. This argument is known as the principle of correspondence.4

It is currently estimated that New Zealand will produce 430 tonnes of DVA,5 around one-third of the global production. At a price of between $86–106/kg, this would equate to a value between $36.98m–$45.58m,6 although the price of DVA is somewhat volatile (e.g., in NZ the value of the raw product fell from $250 per kilogram to $45 in 2004–5 and rebounded to $160 in 2006–7).

In 2011, New Zealand’s exports were predominantly to China (~$14m) and Korea (~$12m). An indication of the value added price of the final product can be found by examining websites selling VA products. One such example, 100 × 250mg capsules for NZ$52,7 would equate to ~$2000 per kilogram of raw VA. No data appears to be available for the number of users in New Zealand or, indeed, elsewhere in the world.

The aim of this systematic review was to critically evaluate randomised controlled studies (RCTs) for the effectiveness of VA supplements for any condition, using the QOURAM statement as a guiding framework.8

Method

Systematic literature searches were performed to identify all RCTs of DVA or EVA for any condition, using the search terms [velvet] AND [antler]. Computerised searches were conducted using PubMed, Medline, Web of Science and Academic search premier, via the bibliographical platform, Endnote. Manual literature searches for further relevant RCTs were conducted on the bibliographies of all retrieved full text articles and two reviews of velvet antler.2,3 No language restrictions were imposed.

Only studies described as double-blind, placebo controlled RCTs of DVA or EVA supplements were included. Non-human, in-vitro and studies only investigating safety or adverse reactions were excluded. The methodological quality of each study was assessed by both authors using the Jadad scale9 and assigned a rating of 0–5. Disagreements were resolved by discussion.

Results

A computerised literature search conducted in July 2011 returned 483 articles. Two reviews of velvet antler research returned a further 241 articles.2,3 Of the 724 articles potentially of interest, 246 duplicates were excluded. The remaining articles (478) were read first on the basis of the title and abstract. Of these, 7 articles were found to meet all inclusion criteria and were reviewed in full by both authors. A flowchart of study selection may be inspected in Figure 1.

The included RCTs scored between 3 and 5 points on the Jadad scale and investigated the effectiveness of velvet antler supplements for: rheumatoid arthritis (2), osteoarthritis (1), sexual function (1), and sport performance enhancement (3). Key characteristics of the included RCTs are presented in Table 1.

Two studies by Allen et al (2002; 2008)10,11 investigated the effect of EVA on rheumatoid arthritis (RA) and both concluded that there was no effect (although the earlier study was underpowered). Allen et al. (2008) noted that non-significant improvements tended to be in the experimental group and also that none of the participants who indicated that they felt ‘markedly better’ were in the placebo group.
Although there were a lack of significant findings, Allen et al (2008) concluded that, on the basis of promising animal research, further human research is warranted. Although claims about the effect of velvet antler supplements on rheumatic conditions are not supported by evidence from RCTs, it may hold some promise.

Figure 1. Flow chart of study selection.

Three RCTs explored the effect of velvet antler on sport performance.12,15,16 Broeder et al (2004)12 tested the effect of DVA on body composition, strength and maximal aerobic and anaerobic performance. It was concluded that DVA may be effective on the basis that some within-subject tests for DVA were significant, while similar within-subject tests for the placebo were not. However, to test this comparison one must actually examine the interaction term for a factorial test of both within- and between-subject factors to determine whether there is a statistically significant difference between the two arms of the trial.

No a priori power analysis was conducted and the study was certainly underpowered on completion, by which time 44% of participants had dropped-out. Due to flaws in this study, it fails to provide convincing support for the use of velvet antler supplements to enhance sport performance.

Sleivert et al (2003)15 reported that there was an increase in isokinetic strength and muscular endurance in the DVA powder group compared to the placebo. However, a similar effect was not observed in the DVA extract group, which might reasonably have been expected, and there were also no concomitant changes in the hormonal mechanisms hypothesised to underlie such changes.
<table>
<thead>
<tr>
<th>Name/year</th>
<th>Design/ Intervention(s)</th>
<th>Area</th>
<th>n</th>
<th>Participant characteristics</th>
<th>Main outcome measure(s)</th>
<th>Jadad score</th>
<th>Study conclusion(s)</th>
<th>A priori power analysis?</th>
<th>Potential sources of bias</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allen, Oberle et al. 2002</td>
<td>RCT 4 Arms (2, 4, or 6 EVA capsules/placebo)</td>
<td>Rheumatoid Arthritis</td>
<td>40</td>
<td>Adults with stage II RA and taking medication (e.g., NSAIDS) 115 females, 55 males. RA for 15yrs</td>
<td>Adverse events and health status (AIMS2)</td>
<td>3</td>
<td>No effect</td>
<td>no**</td>
<td>Blinding and randomisation procedures not fully described.</td>
<td>Underpowered and potential for bias</td>
</tr>
<tr>
<td>Allen, Oberle et al. 2008</td>
<td>RCT 2 Arms (EVA/placebo)</td>
<td>Rheumatoid Arthritis</td>
<td>168</td>
<td>32 males, ages 18-35, with at least 4yrs weight lifting experience</td>
<td>Arthritis Impact measurement scale, HAQ, VAS Body composition, strength, aerobic power, maximal power output</td>
<td>5</td>
<td>No effect</td>
<td>yes</td>
<td>None</td>
<td>Well designed trial</td>
</tr>
<tr>
<td>Broeder, Percival et al. 2004</td>
<td>RCT 2 Arms (DVA/placebo)</td>
<td>Body Composition, strength, &amp; maximal aerobic &amp; anaerobic performance</td>
<td>32</td>
<td>34 males (and their partners), ages 45-65, in a stable relationship and healthy. 33 females, 21 males with OA in knee for &gt;6months</td>
<td>Index of erectile dysfunction (males) brief index of sexual function (women) Visual Analogue scales and WOMAC questionnaire</td>
<td>5</td>
<td>May have positive effect on body Composition, strength, aerobic power, maximal power output</td>
<td>no</td>
<td>Blinding and randomisation procedures not fully described.</td>
<td>Underpowered, inappropriate statistical tests, and potential for bias makes these findings unconvincing</td>
</tr>
<tr>
<td>Conaglen, H.M., Suttie, J.M. et al (2003)</td>
<td>RCT (DVA/placebo)</td>
<td>Sexual function</td>
<td>34</td>
<td>38 males, ages 19-24 yrs, no strength training for &gt;5months, no dietary supplements</td>
<td>Weight, height, skinfolds, squat exercise, knee extensions, maximal aerobic power (V0max), endocrine response (EPO, IGF-1, TT) Resting or exercise stimulated hormonal response</td>
<td>3</td>
<td>No effect (any observed differences were likely due to Type I error)</td>
<td>no</td>
<td>None (Although velvet antler supplied by industry)</td>
<td>Well designed, but underpowered</td>
</tr>
<tr>
<td>Edelman et al. 2000</td>
<td>RCT 2 Arms (DVA/placebo)</td>
<td>Osteoarthritis</td>
<td>54</td>
<td>46 males, 21 females, mean age 25yrs, all healthy rowers</td>
<td>Visual Analogue scales and WOMAC questionnaire</td>
<td>3</td>
<td>Symptomatic relief in OA</td>
<td>no</td>
<td>Blinding and randomisation procedures not fully described.</td>
<td>Underpowered. Bias means findings are not convincing, although they are potentially promising</td>
</tr>
<tr>
<td>Sleivert, Burke et al. 2003</td>
<td>RCT 3 Arms (DVA extract or powder/placebo)</td>
<td>Aerobic power, erythropoiesis, &amp; muscular strength and endurance</td>
<td>38</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Underpowered and potential for bias</td>
</tr>
<tr>
<td>Syrotuik, MacFadyen et al. 2005</td>
<td>RCT 2 Arms (EVA/placebo)</td>
<td>Hormonal response to acute and chronic exercise in rowers</td>
<td>46</td>
<td>25 males, 21 females, mean age 25yrs, all healthy rowers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Underpowered and potential for bias</td>
</tr>
</tbody>
</table>
On the balance of evidence, in particular the lack of convergent validity, the authors concluded that the findings were most likely explained by type I error.

Syrotuik et al (2005) found no effect on either strength or hormonal changes after 10 weeks of EVA supplements on the performance of rowers when compared to placebo, although low experimental power may conceivably have caused type II errors. It is also possible that benefits do accrue, but not within the first 10 weeks of supplementation (e.g., one RCT suggested that there may be an effect of DVA supplements on osteoarthritis after 3 and 6 months, but not after 1 month).

The first and only study to have investigated the effect of velvet antler supplements on sexual functioning, Conaglen et al (2003), found no effects on the sexual functioning of either 32 male participants or their partners. However, this study was again somewhat underpowered and therefore, like six of the seven reviewed RCTs, may have been prey to type II error. Although underpowered, this study was judged to be of high methodological quality. The authors concluded that there was “no advantage in taking deer velvet to enhance sexual function”.

Finally, Edelman et al (2000) reported that participants with osteoarthritis treated with DVA showed improvement over baseline, relative to those treated with placebo. While the results are promising, it is important to note that there was a significant difference in duration of symptoms at baseline, with the placebo group having experienced symptoms for more than 50% longer duration. Furthermore, the lack of details of blinding and randomisation precludes any firm conclusions from being drawn. The findings therefore appear to offer some promise, but unless replicated are somewhat unconvincing.

Discussion

Overall, seven RCTs were found to fulfil the inclusion criteria for this systematic review. Five were of moderate methodological quality and two of high quality. In contrast to the numerous claims that there are benefits of velvet antler supplements, this systematic review of RCTs of velvet antler supplements found no convincing evidence of effectiveness when compared to placebo. However, it is possible that the lack of significant findings may be false negatives due to low experimental power, although the one trial with adequate power reported no effect of EVA on RA. There were some potentially promising findings for treating osteoarthritis, but these would require replication.

Given the size of the velvet antler industry and the plethora of claims made, the velvet antler industry could fund trials to test the claims being made. A further source of funding may also be available from the National Center for Complementary and Alternative Medicine (NCCAM). There are at least two university based departments with interests in deer velvet (AgResearch, Invermay, NZ, and the University of Alberta, Edmonton), who may also be able to trial velvet antler supplements as part of their own research program.

Future trials should ensure that there is sufficient experimental power to have a reasonable chance of detecting meaningful effects. Blinding and randomisation techniques should also be fully reported so that readers can draw informed opinions as to the validity of the trial.
This systematic review is not without limitations. The quality of the studies varied, although none were deemed to be of low quality. All except one of the included RCTs were underpowered and therefore the possibility of type II error cannot be ruled out. It is possible that trials with positive findings have not been published, although we are not aware that publication bias has ever discriminated on the basis of positive trials.

Despite a dearth of good quality positive human trials on the effectiveness of velvet antler supplements, numerous suppliers of velvet antler products make or imply claims about its use for a number of conditions.

Claims that velvet antler supplements have beneficial effects for any human condition are not currently supported by sound clinical data from human trials.

Competing interests: Nil.

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References:


Poisonous plants in New Zealand: a review of those that are most commonly enquired about to the National Poisons Centre

Robin J Slaughter, D Michael G Beasley, Bruce S Lambie, Gerard T Wilkins, Leo J Schep

Abstract

Introduction New Zealand has a number of plants, both native and introduced, contact with which can lead to poisoning. The New Zealand National Poisons Centre (NZNPC) frequently receives enquiries regarding exposures to poisonous plants. Poisonous plants can cause harm following inadvertent ingestion, via skin contact, eye exposures or inhalation of sawdust or smoked plant matter.

Aim The purpose of this article is to determine the 15 most common poisonous plant enquiries to the NZNPC and provide a review of current literature, discussing the symptoms that might arise upon exposure to these poisonous plants and the recommended medical management of such poisonings.

Methods Call data from the NZNPC telephone collection databases regarding human plant exposures between 2003 and 2010 were analysed retrospectively. The most common plants causing human poisoning were selected as the basis for this review. An extensive literature review was also performed by systematically searching OVID MEDLINE, ISI Web of Science, Scopus and Google Scholar. Further information was obtained from book chapters, relevant news reports and web material.

Results For the years 2003–2010 inclusive, a total of 256,969 enquiries were received by the NZNPC. Of these enquiries, 11,049 involved exposures to plants and fungi. The most common poisonous plant enquiries, in decreasing order of frequency, were: black nightshade (Solanum nigrum), arum lily (Zantedeschia aethiopica), kowhai (Sophora spp.), euphorbia (Euphorbia spp.), peace lily (Spathiphyllum spp.), agapanthus (Agapanthus spp.), stinking iris (Iris foetidissima), rhubarb (Rheum rhabarbarum), taro (Colocasia esculentum), oleander (Nerium oleander), daffodil (Narcissus spp.), hemlock (Conium maculatum), karaka (Corynocarpus laevigatus), foxglove (Digitalis purpurea) and ongaonga/New Zealand tree nettle (Urtica ferox). The combined total of enquiries for these 15 species was 2754 calls (representing approximately 25% of all enquiries regarding plant exposures). The signs and symptoms resulting from poisoning from these plants are discussed. Medical treatment recommendations are made.

Conclusion Poisoning following ingestion or other forms of exposures to plants in New Zealand is relatively common, particularly among children. However, serious adverse reactions are comparatively rare. Accurate plant identification and details on the type of exposure can be important in assessing the likely risks. Effective medical management of these poisonings can be achieved by following the principles outlined in this review.
New Zealand is host to a number of poisonous plants, both native and introduced, contact with which can lead to poisoning. Typically poisonous plants cause harm following inadvertent ingestion or via contact with the skin, but eye exposures to plant material or inhalation of sawdust or smoked plant matter are also exposure routes which may lead to poisoning.

Young children most commonly ingest plant material; this is typically due to their having a natural curiosity about their surroundings and their tendency for oral exploration, whereas adults tend to more commonly come into contact with poisonous plants via skin or eye contact following gardening or yard work. Occasionally there may be intentional ingestions, or poisonous species may be mistaken for an edible plant and ingested as food, or made into drinks such as infusions or teas.

Children are unlikely to develop significant effects following small exploratory ingestions of the majority of plants. However, there are some plants, when ingested in sufficient quantity, which are capable of causing severe poisoning in both children and adults.

The New Zealand National Poisons Centre (NZNPC) frequently receives enquiries regarding exposures to poisonous plants. In children, exposures are typically reported soon after ingestion when parents notice plant matter in the child’s mouth or notice the child playing with parts of the plant. Conversely adults exposed to a poisonous plant may only contact the Poisons Centre when they become symptomatic.

In this review we examine the poisonous plants about which the NZNPC most commonly receives enquiries and include their botanical descriptions, toxins present, mechanisms of toxicity and toxic effects and also provide comprehensive poisoning treatment protocols.

Methods

The NZNPC is the sole Poison Information Centre for New Zealand; covering a population of approximately 4.4 million people, it serves a mixed population of urban and rural areas. The NZNPC uses an in-house telephone collection system; it is built on Firebird™ v2.0.3 software which is developed by the Firebird Project. This system logs information pertaining to all enquires received by the NZNPC. Call data from the telephone collection database regarding human plant exposures were analysed retrospectively for the years 2003-2010 inclusively. Excluded were enquires regarding exposure to known non-poisonous plants, mushroom/fungi exposures, unidentified plants, animal poisonings and requests for general information in the absence of an actual exposure.

The 15 most commonly enquired about plants over the 8-year period were selected as the basis for this review. Some of these, however, possess similar toxins, mechanisms of action and/or clinical effects, and such plants were considered as a single entity. For example oleander and foxglove both contain toxic cardiac glycosides and have a comparable toxidrome.

In compiling the review article, an extensive literature review was performed by searching Ovid MEDLINE, ISI Web of Science, Scopus and Google Scholar. Initial searching of these databases was done using specific species and common names of the plants, along with the keywords ‘poisoning’, ‘poison’, ‘toxicity’, ‘ingestion’, ‘adverse effects’, ‘overdose’, ‘intoxication’ and ‘toxin’ to identify relevant articles. Bibliographies of identified articles were screened for additional relevant studies including non-indexed reports. In addition, non-peer-reviewed sources were also included; further information was obtained from book chapters, relevant news reports and applicable internet resources.
Results

For the years 2003–2010 inclusive, a total of 256,969 enquiries were received by the NZNPC, of which 171,130 were related to acute human exposure. Of these exposure enquiries, 11,049 (6.5%) involved plants and fungi.

The most common poisonous plant enquiries involved, in decreasing order of frequency, were black nightshade (*Solanum nigrum*), arum lily (*Zantedeschia aethiopica*), kowhai (*Sophora* spp.), euphorbia (*Euphorbia* spp.), peace lily (*Spathiphyllum* spp.), agapanthus (*Agapanthus* spp.), stinking iris (*Iris foetidissima*), rhubarb (*Rheum rhabarbarum*), taro (*Colocasia esculentum*), daffodil (*Narcissus* spp.), oleander (*Nerium oleander*), hemlock (*Conium maculatum*), karaka (*Corynocarpus laevigatus*), ongaonga/New Zealand tree nettle (*Urtica ferox*), and foxglove (*Digitalis purpurea*).

The combined total number of calls for these 15 species was 2754 (representing approximately 25% of all enquiries regarding plant exposures). Children (less than 12 years of age) were involved in 2210 (80%) of these calls while adults were involved in 544 (20%). The number of enquiries received for each of the 15 species over the 8 year period along with the number regarding children or adults are presented in Table 1.

Table 2 shows the number of exposures by different routes for each of the 15 species. The route of exposure was classified as either ingestion, eye contact, skin contact or inhalation (e.g. exposure following the inhalation of sawdust or smoked plant matter).

### Table 1. Total enquiries received and numbers of child and adult enquiries for each of the 15 plants from 2003–2010

<table>
<thead>
<tr>
<th>Common name</th>
<th>Species name</th>
<th>Number of calls</th>
<th>Children</th>
<th>Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Nightshade</td>
<td><em>Solanum nigrum</em></td>
<td>834</td>
<td>749 (90%)</td>
<td>85 (10%)</td>
</tr>
<tr>
<td>Arum Lily</td>
<td><em>Zantedeschia aethiopica</em></td>
<td>556</td>
<td>520 (93.5%)</td>
<td>36 (6.5%)</td>
</tr>
<tr>
<td>Kowhai</td>
<td><em>Sophora</em> spp.</td>
<td>155</td>
<td>137 (88%)</td>
<td>18 (12%)</td>
</tr>
<tr>
<td>Euphorbia</td>
<td><em>Euphorbia</em> spp.</td>
<td>149</td>
<td>36 (24%)</td>
<td>113 (76%)</td>
</tr>
<tr>
<td>Peace Lily</td>
<td><em>Spathiphyllum</em> spp.</td>
<td>144</td>
<td>143 (99%)</td>
<td>1 (1%)</td>
</tr>
<tr>
<td>Agapanthus</td>
<td><em>Agapanthus</em> spp.</td>
<td>136</td>
<td>108 (79%)</td>
<td>28 (21%)</td>
</tr>
<tr>
<td>Stinking Iris</td>
<td><em>Iris foetidissima</em></td>
<td>128</td>
<td>123 (96%)</td>
<td>5 (4%)</td>
</tr>
<tr>
<td>Rhubarb</td>
<td><em>Rheum rhabarbarum</em></td>
<td>121</td>
<td>92 (76%)</td>
<td>29 (24%)</td>
</tr>
<tr>
<td>Taro</td>
<td><em>Colocasia esculentum</em></td>
<td>95</td>
<td>53 (56%)</td>
<td>42 (44%)</td>
</tr>
<tr>
<td>Daffodil</td>
<td><em>Narcissus</em> spp.</td>
<td>84</td>
<td>56 (67%)</td>
<td>28 (33%)</td>
</tr>
<tr>
<td>Oleander</td>
<td><em>Nerium oleander</em></td>
<td>81</td>
<td>43 (53%)</td>
<td>38 (47%)</td>
</tr>
<tr>
<td>Hemlock</td>
<td><em>Conium maculatum</em></td>
<td>77</td>
<td>39 (51%)</td>
<td>38 (49%)</td>
</tr>
<tr>
<td>Karaka</td>
<td><em>Corynocarpus laevigatus</em></td>
<td>69</td>
<td>61 (88%)</td>
<td>8 (12%)</td>
</tr>
<tr>
<td>Ongaonga</td>
<td><em>Urtica ferox</em></td>
<td>64</td>
<td>5 (8%)</td>
<td>59 (92%)</td>
</tr>
<tr>
<td>Foxglove</td>
<td><em>Digitalis purpurea</em></td>
<td>61</td>
<td>45 (74%)</td>
<td>16 (26%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>2754</td>
<td>2210 (80%)</td>
<td>544 (20%)</td>
</tr>
</tbody>
</table>
Table 2. Total enquiries received and route of exposure for each of the 15 plants from 2003-2010

<table>
<thead>
<tr>
<th>Common name</th>
<th>Species name</th>
<th>Number of calls</th>
<th>Route of exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ingestion</td>
</tr>
<tr>
<td>Black Nightshade</td>
<td><em>Solanum nigrum</em></td>
<td>834</td>
<td>778</td>
</tr>
<tr>
<td>Arum Lily</td>
<td><em>Zantedeschia aethiopica</em></td>
<td>556</td>
<td>525</td>
</tr>
<tr>
<td>Kowhai</td>
<td><em>Sophora spp.</em></td>
<td>155</td>
<td>152</td>
</tr>
<tr>
<td>Euphorbia</td>
<td><em>Euphorbia spp.</em></td>
<td>149</td>
<td>31</td>
</tr>
<tr>
<td>Peace Lily</td>
<td><em>Spathiphyllum spp.</em></td>
<td>144</td>
<td>142</td>
</tr>
<tr>
<td>Agapanthus</td>
<td><em>Agapanthus spp.</em></td>
<td>136</td>
<td>102</td>
</tr>
<tr>
<td>Stinking Iris</td>
<td><em>Iris foetidissima</em></td>
<td>128</td>
<td>127</td>
</tr>
<tr>
<td>Rhubarb</td>
<td><em>Rheum rhabarbarum</em></td>
<td>121</td>
<td>120</td>
</tr>
<tr>
<td>Taro</td>
<td><em>Colocasia esculentum</em></td>
<td>95</td>
<td>86</td>
</tr>
<tr>
<td>Daffodil</td>
<td><em>Narcissus spp.</em></td>
<td>84</td>
<td>82</td>
</tr>
<tr>
<td>Oleander</td>
<td><em>Nerium oleander</em></td>
<td>81</td>
<td>46</td>
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<tr>
<td>Hemlock</td>
<td><em>Conium maculatum</em></td>
<td>77</td>
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</tr>
<tr>
<td>Karaka</td>
<td><em>Corynocarpus laevigatus</em></td>
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<td>69</td>
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<tr>
<td>Ongaonga</td>
<td><em>Urtica ferox</em></td>
<td>64</td>
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</tr>
<tr>
<td>Foxglove</td>
<td><em>Digitalis purpurea</em></td>
<td>61</td>
<td>45</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>2754</strong></td>
<td><strong>2358</strong></td>
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</tbody>
</table>

Solanine-containing plants

- **Black Nightshade (*Solanum nigrum*)**

**Description**—Black nightshade (*Solanum nigrum*) is a common weed distributed widely throughout New Zealand. The berries are small and round, up to 10 mm in diameter. The fruits are green when unripe, but ripen to a dull black (Figure 1). It has green leaves up to 10 cm long and small white star-shaped flowers with bright yellow anthers (Figure 2).

![Figure 1. *Solanum nigrum* - Black nightshade © Used with permission. Photo Credit: Robin Slaughter.](image-url)
Unfortunately, black nightshade is often mistaken for deadly nightshade (*Atropa belladonna*) due to the similar common names. True deadly nightshade is extremely rare in New Zealand and the two plants can be easily distinguished as deadly nightshade has large bell-shaped brownish-purple flowers (Figure 3) instead of the star-shaped white flower of black nightshade. The berries of deadly nightshade are also green ripening to black, but are larger.

Interestingly, unripe green berries of black nightshade have also been mistaken for peas and have sometimes been found in frozen vegetables.

**Toxin**—Black nightshade contains solanine and other related glycoalkaloids. These are present in all parts of the plant, but highest concentrations are in the unripe green berries. These alkaloids are heat stable, and not degraded by most cooking methods.

In addition to black nightshade, a further 1,700 species of the *Solanum* genus also contain solanine and related alkaloids.

The more commonly encountered species include bittersweet (*Solanum dulcamara*), egg plant (*Solanum melongena*), potato (*Solanum tuberosum*) and tomato (*Solanum lycopersicum*). The poisonous parts of the potato plant include the green berries, green tubers, flowers, leaves and seeds. However, fresh potato tubers are considered
non-poisonous. While the tomato has an edible fruit, the other parts of the plant are considered potentially toxic.\textsuperscript{6,7}

**Mechanism of action**—The toxic mechanism of solanine is not well described. In vitro studies have suggested that solanines are reversible inhibitors of human acetylcholinesterase (AChE) and pseudo or butyrylcholinesterase (pChE).\textsuperscript{8} However, this is of uncertain relevance as solanine toxicity is not typically associated with classic cholinergic symptoms.\textsuperscript{7} Rather, the symptoms displayed may reflect competing effects at nicotinic and muscarinic sites.\textsuperscript{9}

**Signs and symptoms**—Black nightshade is not highly toxic and small accidental ingestions of a few berries or leaves does not often lead to symptoms. Toxicity would only be expected following ingestion of large amounts of unripe berries or other plant matter, i.e. in the situation of mistaking the plant for a food plant and ingested a meal sized portion.

Symptoms of solanine poisoning are most common following ingestion and are typically gastrointestinal and neurological in nature.\textsuperscript{7} Mild poisoning may involve nausea, vomiting, diarrhoea, anorexia, malaise, fever, headache and/or sweating.\textsuperscript{9-11}

In severe poisonings further symptoms are possible and may include hallucinations, delirium, drowsiness, ataxia, blurred vision, slurred speech, weakness, paraesthesia, facial numbness or paralysis, coma and respiratory muscle weakness, with risk of respiratory failure.\textsuperscript{9,10} Hypotension or bradycardia may occur, possibly secondary to gastrointestinal symptoms. The effects of poisoning are usually delayed in onset for at least 6 hours, and may in some instances be delayed for up to 20 hours post-ingestion.\textsuperscript{7,9,10,12}

**Treatment**—There is no specific antidote for solanine poisoning, and treatment is supportive.\textsuperscript{7} There is limited information on the benefit or otherwise of gastrointestinal decontamination with activated charcoal.\textsuperscript{7} As supportive care is likely to produce a good outcome, the risks of adverse effects from administration of activated charcoal likely outweigh any benefit and it is therefore not recommended.

The most common serious complication of solanine poisoning is dehydration and marked electrolyte imbalance from excessive vomiting and diarrhoea.\textsuperscript{7} Fluid and electrolyte balance should be monitored in symptomatic patients; intravenous fluid and electrolyte administration may be necessary.\textsuperscript{7} With marked dehydration, sweating mechanisms may become impaired, with potential aggravation of any fever and risk of hyperthermia requiring external cooling measures.

Neurological effects including delirium, hallucinations or anxiety can generally be managed without pharmaceutical intervention by placing the patient in a quiet, safe and darkened environment and by conversing in a calm and reassuring manner. Benzodiazepines may be required for significant delirium or agitation;\textsuperscript{10} however, caution is indicated as they may exacerbate any central nervous system (CNS) and/or respiratory depression. Coma, respiratory weakness and potentially life threatening respiratory failure are rare complications; intubation and mechanical ventilation may be required.\textsuperscript{9}
Oxalate-containing plants

- Arum Lily (*Zantedeschia aethiopica*)
- Peace Lily (*Spathiphyllum spp.*)
- Taro (*Colocasia esculentum*)
- Rhubarb (*Rheum rhabarbarum*)

The most common oxalate-containing plants reported to the NZNPC are the arum lily (*Zantedeschia aethiopica*), peace lily (*Spathiphyllum spp.*), taro (*Colocasia esculentum*) and rhubarb (*Rheum rhabarbarum*).

Description—Arum lily (*Zantedeschia aethiopica*), peace lily (*Spathiphyllum spp.*) and taro (*Colocasia esculentum*) all belong to the Araceae or arum family, whereas rhubarb (*Rheum rhabarbarum*) belongs to the Polygonaceae family.

The arum lily is an evergreen perennial growing up to one metre in height. It has large green leathery arrow-shaped leaves and distinctive white funnel-shaped flowers containing a bright yellow spike (Figure 4). Peace lilies are evergreen perennials with large shiny green leaves and distinctive flowers consisting of a spike (spadix) surrounded by white, yellowish, or greenish leaf-like sheathing bract (spathe) (Figure 5). Taro is a herbaceous perennial growing 1 to 2 metres tall. It has large arrowhead-shaped green leaves on the end of large stalks (Figure 6). Rhubarb is a herbaceous perennial plant; growing from a thick rhizome, it has large fan-shaped leaves on a long thick reddish leaf stalk (Figure 7).

![Image](image-url)
Figure 5. *Spaichiphyllum* spp. - Peace lily © Used with permission. Photo Credit: Robin Slaughter.

Figure 6. *Colocasia esculenta* – Taro. Used with permission, Richard A. Howard Image Collection, courtesy of Smithsonian Institution.

Figure 7. *Rheum rhabarbarum* – Rhubarb © Used with permission. Photo Credit: Robin Slaughter.
Toxin—The major toxic components of these plants are oxalate compounds. Many different plant families and species contain oxalates; these can be present as insoluble compounds, usually calcium oxalate, or as soluble compounds, such as oxalic acid. The insoluble calcium oxalate salt is found in arum lilies, peace lilies and taro. Rhubarb leaves contain oxalic acid.

Mechanism of action—Insoluble oxalate-containing plants have spindle-shaped cells named idioblasts containing needle-shaped crystals of calcium oxalate called raphides, which may also be coated with a proteolytic enzyme. When the plant is crushed or chewed, the idioblasts are ruptured, and the sharp insoluble crystals and protease are injected into surrounding tissue structures such as the oral mucosa, tongue and throat.

The symptoms produced are thought to arise from mechanical injury from the calcium oxalate crystals, along with the chemical action of the proteolytic enzyme, which is thought to stimulate bradykinin and histamine release.

Soluble oxalates or oxalic acid, on the other hand, have less of a local effect but can bind more effectively with ionised calcium in the blood or tissues. Following large ingestions, there is a potential risk of hypocalcaemia with associated systemic effects. In addition, significant amounts of calcium oxalate may precipitate in organs such as the kidney, heart, lungs and liver.

Signs and symptoms—Plants containing the insoluble oxalates are more commonly responsible for human poisoning, but rarely cause significant systemic toxic effects. Exposures are most common following ingestion (Table 2). The plant typically needs to be crushed, chewed or masticated to produce a local reaction; brief sucking on a leaf is not likely to cause toxicity.

Following oral exposure, initial symptoms typically develop within five minutes; they can include transient local irritation or a burning sensation of the oral mucosa and occasionally vomiting. Symptoms typically do not progress from these initial mild effects, as the prompt reaction in the mouth generally limits the amount of plant material ingested. However, in some instances, intense burning pain and oedema of the mouth, tongue and throat, increased salivation, dysphagia, ulceration and aphonia may occur. Upper airway compromise and respiratory distress may occur if oropharyngeal oedema develops.

Soluble oxalates have a lesser local irritant effect, but may cause gastrointestinal upset following ingestion. In humans, systemic effects from soluble oxalates have not been well documented, as there have been very few reports. These reports typically relate to large meal sized amounts consumed misguided as a food, producing renal dysfunction and hypocalcaemia. The former includes nephrocalcinosis, urolithiasis and renal insufficiency.

Reported complications from hypocalcaemia include paraesthesias, tetany, hyperreflexia, muscle fasciculations and seizures. Older case reports, which attribute death to soluble oxalate-containing plants, may have overlooked other contributing factors.

Adverse effects in humans are also recognised from other routes of exposure. Eye contact with sap or other plant matter may lead to immediate pain, lacrimation,
photophobia, blepharospasm and a foreign body sensation. Crystals have been noted in the conjunctiva and on the corneal epithelium; injury to the latter may also include keratitis, corneal abrasions and areas of local necrosis.

Skin exposure to calcium oxalate-containing plants is typically of minor concern, usually only resulting in minimal symptoms. However, reported effects in sensitive individuals include pruritis, oedema and/or pain. Irritant contact dermatitis may occur in people who frequently handle these plants.

**Treatment**—In the majority of cases, only mild symptoms develop and specific management is unlikely to be necessary. Milk and/or ice have been recommended to relieve local oral effects; ice blocks/popsicles may be useful in children. Simple analgesics such as paracetamol may be required if pain is significant. Gastrointestinal decontamination with activated charcoal or other methods is not recommended, as it is unlikely to be of significant benefit.

With ingestion of insoluble oxalate plant matter, there is a risk of oedema of the oral cavity, pharynx and nearby structures. Therefore, the airway and breathing should be monitored in symptomatic patients; in the case of upper airway compromise, intubation to maintain airway patency may be required. Endoscopy may be necessary for patients with oral ulceration or dysphagia.

Clinical benefits from antihistamines for mucosal oedema have not been shown and these are therefore not recommended. Significant vomiting may require supportive care, including fluid resuscitation and anti-emetic administration. Ensuring adequate hydration also promotes the renal excretion of calcium oxalate.

Systemic symptoms do not appear common, but if they develop, monitoring of full blood count, serum electrolytes including calcium, and kidney function is recommended. Oxalate-induced hypocalcaemia does not often require treatment unless the patient is symptomatic, in which case it should be treated with IV calcium gluconate with cardiac monitoring. Deteriorating renal function may require supportive care including haemodialysis.

Ocular exposures should receive thorough decontamination with water or saline for 15 minutes. Fluorescein-staining and slit lamp examination is recommended. Pain and/or inflammation may require cycloplegics and/or steroids. Ophthalmological consultation should be arranged if there are significant abnormalities.

Skin exposure should be decontaminated with soap and water and any irritant contact dermatitis should be treated symptomatically.

**Nicotinic plants**

- **Kowhai (Sophora spp.)**
- **Hemlock (Conium maculatum)**

The plants kowhai and hemlock both contain alkaloids structurally related to nicotine. The similar symptoms produced are due to nicotinic receptor agonism.

**Description**—The common name kowhai refers to a number of species of Sophora in New Zealand, with *S. microphylla* being one of the most common. *S. microphylla* trees are 3 to 9 m tall with a trunk 30 to 60 cm in diameter. Flowering occurs between
August and October; flowers are yellow and up to 4.5 cm long in 4 to 10 flowered racemes.\(^2\),\(^40\) (Figure 8). They are found in open forests, forest outskirts, along rivers and in open places throughout both the North and South Island.\(^2\),\(^40\)

![Figure 8. Sophora micropylula – Kowhai © Used with permission. Photo Credit: Robin Slaughter.](image)

Hemlock (\textit{Conium maculatum}) is an annual, biennial, or perennial erect, branched plant which can reach 2 m in height. Growing from a thick yellow or white tap root, the stem is hairless, rigid and hollow with characteristic irregular purple blotches (Figure 9).\(^41\),\(^42\) The leaves are up to 30 cm long, triangular with finely divided leaflets, giving the plant a fernlike appearance. Flowers are white, small (2 mm diameter) and arranged in clusters. Each cluster is 2 to 5 cm in diameter.\(^41\),\(^42\) (Figure 9).

**Toxin**—It is thought all parts of \textit{Sophora} plants contain toxic alkaloids, particularly the seeds.\(^2\),\(^43\) The major alkaloid is cytisine; other related alkaloids include N-
methylcytisine, anagyrine, matrine, sophoramine and sophochrysine.2 These alkaloids are structurally similar to nicotine and act likewise, as nicotinic receptor agonists.41, 44

Hemlock contains a number of piperidine alkaloids throughout the plant; the two found in the largest amounts, and accounting for most of the plant’s toxic activity, are conine and gamma-coniceine.41, 45 The name hemlock is also applied to, and may be confused with, the North American plant water hemlock (Cicuta maculata) which, however, is not found in New Zealand.46

**Mechanism of action**—Structurally related to nicotine, the above alkaloids affect the neuromuscular junction where they act as non-depolarising neuromuscular blockers.47 They also act on the autonomic ganglia, with varying degrees of stimulatory and inhibitory (“biphasic”) effects, resembling those of nicotine.41

**Signs and symptoms**—Ingestion is the most common route of exposure to these plants (Table 2); however, significant effects following ingestion of kowhai leaves, flowers or seeds appear to be extremely rare as most exposures consist of the accidental ingestion of a few seeds. There do not appear to have been any confirmed cases of significant poisonings following kowhai ingestion in New Zealand.

Additionally, as the seeds have a very hard outer casing, this typically prevents the alkaloids from being released following ingestion. Only if the seeds have been crushed or soaked is poisoning anticipated; otherwise it is likely that they will pass through the gastrointestinal tract without causing toxicity.

Symptoms are likely to occur following ingestion of any amount of hemlock. Initial symptoms from these nicotinic plants may include gastrointestinal effects such as nausea, vomiting, abdominal pain and diarrhoea. Other frequent early signs include tremor, dizziness and pallor, and parasympathetic effects such as diaphoresis, salivation and bronchorrhea.41, 48, 49

In severe cases, more marked neurological and cardiovascular dysfunction become apparent. The clinical picture may follow a biphasic pattern due to initial stimulation of nicotinic cholinergic receptors followed quickly by their inhibition. This can produce restlessness, muscle fasciculation, seizures, hypertension, tachycardia and tachypnoea, followed by hypotension, bradycardia and respiratory depression, and finally leading to coma, muscle paralysis, respiratory failure, dysrhythmias and cardiovascular collapse.41, 48-51

**Treatment**—Medical attention for small accidental kowhai ingestions is not generally necessary unless symptoms are present. It can be difficult to distinguish toxic from non-toxic doses of hemlock, and there are several reports of significant poisoning following its ingestion, especially if mistaken for a food plant;41 thus medical assessment is recommended for any ingestion.

Supportive care is the mainstay of management with an emphasis on respiratory and cardiovascular support. Although the benefits are unproven, decontamination with activated charcoal can be considered in compliant patients presenting within one hour;52 however, supportive care measures should take precedence. Although there is no specific antidote, atropine can be useful for excessive parasympathetic effects such as bronchoconstriction and bronchorrhea, gastrointestinal hyperactivity and bradycardia.41
Significant vomiting requires anti-emetic treatment while monitoring fluid and electrolyte balance. Hypotension should be managed with intravenous fluids; refractory hypotension may require treatment with agents with vasopressor and/or inotropic properties.\textsuperscript{41}

Agitation, muscular over-activity or seizures should be managed with benzodiazepines; however, the latter may contribute to respiratory depression, and close monitoring of respiratory status is required.\textsuperscript{41} Severe cases may progress to muscle paralysis, coma and respiratory failure, necessitating intubation and intensive respiratory support.\textsuperscript{41}

**Euphorbia**

- *Euphorbia* spp.

**Description**—*Euphorbia* is a large genus encompassing about 1600 species. Generally they are annual or perennial herbs or shrubs, typically with flowers in terminal clusters, with alternate or opposite leaves of various shapes and sizes (Figure 10). The most common name for plants in this genus is “spurge”.\textsuperscript{15}

\begin{figure}[h]
\centering
\includegraphics[width=0.4\textwidth]{image10.png}
\caption{Euphorbia spp. – Euphorbia © Used with permission. Photo Credit: Robin Slaughter.}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=0.4\textwidth]{image11.png}
\caption{Euphorbia pulcherrima – Poinsettia © Used with permission. Photo Credit: Robin Slaughter.}
\end{figure}
The poinsettia (Euphorbia pulcherrima) (Figure 11) is a well-known member of this genus and has been reported historically as being highly toxic following ingestion. However, a review of 22,793 poinsettia ingestions or dermal exposures in the United States found accidental inadvertent exposures typically lacked any adverse effects and the plant was not associated with any significant morbidity or mortality.33

**Toxin**—All species of Euphorbia produce a milky white latex-like sap15 which contains complex diterpenoid euphorbol esters.43

**Mechanism of action**—The sap of toxic Euphorbia species is highly irritating and may cause localised effects following ingestion, or eye or skin exposures.

**Signs and symptoms**—Ocular exposure to the sap is the most common enquiry regarding Euphorbia spp. plants (Table 2). The sap is a strong ocular irritant. Reports of eye contact have described immediate symptoms of burning or stinging pain with blurred vision, itching, swelling of the lids, a foreign body sensation, photophobia and decreased visual acuity.

Eye injuries may worsen over hours to days following exposure; clinical findings may range from mild keratoconjunctivitis to severe keratitis with stromal oedema, epithelial and anterior uveitis. Injuries may have delayed healing but typically resolve completely within 1 to 2 weeks.54–57

Skin exposure to the sap may lead to irritant contact dermatitis with erythema, oedema and formation of blisters and vesicles.58,59 Dermal effects usually occur after two to eight hours and increase in severity in the following twelve hours, but normally resolve over the next three to four days without scarring.58

Reports of poisoning following ingestion are quite scarce. Symptoms are typically limited to local irritation; common effects include salivation, nausea, vomiting, diarrhea and gastroenteritis.15 These are usually mild and resolve spontaneously with minimal treatment.

Systemic effects are poorly documented, as it is rare that more than a taste or mouthful is ingested due to the plant causing an unpleasant burning sensation to the oral mucosa. However, reported effects include dizziness, delirium, convulsions and systemic collapse; these effects are possibly a consequence of fluid losses and electrolyte imbalances from the initial GI symptoms.15

**Treatment**—Eyes exposed to the sap should be thoroughly irrigated with water or saline. As significant adverse effects can occur, all symptomatic patients should be referred to an ophthalmologist. Ocular antibiotics, steroids and/or mydriatic and cycloplegic agents may be required.54–57 Cases treated soon after injury typically have a good outcome,55 while delayed treatment may lead to complications, with patients left with corneal scarring and decreased visual acuity.57, 60

Following skin exposure, the major treatment is ensuring the exposed area has been well washed with water and a mild soap.58 Patients may require analgesics or anti-inflammatory agents; any further treatment, such as for irritant contact dermatitis, is symptomatic and supportive.58

Small one-off ingestions of a few leaves or an accidental taste of the sap is unlikely to require any specific treatment; gastrointestinal irritation is typically mild and self-
limiting. Larger ingestions may lead to more severe GIT effects with the possibility of systemic toxicity. Decontamination is unlikely to be of benefit due to anticipated gastrointestinal distress and is not recommended. There is no specific antidote and treatment consists of symptomatic and supportive care.

Vomiting and diarrhoea may lead to dehydration with hypovolaemia; fluid resuscitation and electrolyte replacement may be required. Other systemic effects seem unlikely, but reported effects have included seizures and collapse; standard management of seizures with benzodiazepines and potentially barbiturates is recommended. Endo-tracheal intubation and assisted ventilation may on occasion be necessary for decreased level of consciousness, or upper airway compromise due to local swelling.

**Purgative plants**

- **Agapanthus** (*Agapanthus spp.*)
- **Daffodil** (*Narcissus spp.*)
- **Stinking Iris** (*Iris foetidissima*)

Agapanthus, daffodil and stinking iris are all purgative plants causing similar symptoms, mainly related to gastrointestinal disturbance.

**Description**—All members of the genus *Agapanthus* are broadly similar in appearance. The most common species in New Zealand is the South African native *Agapanthus praecox*. It is a perennial with rhizomatous roots, glossy green strap-shaped leaves and an umbel-shaped cluster of purple or white flowers (Figure 12).

Daffodils or jonquils belong to the genus *Narcissus*. Blooming in spring, daffodils have attractive flowers making them a popular garden plant. They have an underground bulb and grow from 15 to 45 cm in height, with long, flat, hollow green leaves. The flowers are usually single or in small groups, each having 6 petals with a trumpet-shaped corona in the middle of the flower. The outer petals are typically yellow or white with the corona being yellow, orange or red (Figure 13).

Members of the *Iris* genus are perennials growing from bulbs or rhizomes. They grow 15 to 100 cm in height and have long, thin, sword-shaped leaves growing from the base of the plant. The flowers are large and showy, having three major petals, which come in a variety of colours. A common species in New Zealand is the stinking iris (*Iris foetidissima*) which has violet-blue flowers and bright orange seeds (Figure 14).
Figure 12. *Agapanthus praecox* - *Agapanthus* © Used with permission. Photo Credit: Robin Slaughter.

Figure 13. *Narcissus spp.* - *Daffodil* © Used with permission. Photo Credit: Robin Slaughter.

Figure 14. *Iris foetidissima* - *Stinking iris* © Used with permission. Photo Credit: Robin Slaughter.
Toxin—The most toxic part of the Agapanthus plant appears to be the rhizome which contains saponins and sapogenins. Sapogenins isolated from the rhizomes include yuccagenin and agapanthogenin.62-64 Narcissus plants contain a number of heat-stable toxic alkaloids, the most common being lycorine.43, 65 The bulb appears to contain the highest concentrations of alkaloids.15, 65 Plants in the Iris genus contain a number of terpenoids which appear to be concentrated in the bulb and rhizome of the plant.43

Mechanism of action—The irritancy of these toxic components, especially on gastric mucosa, is thought to be responsible for the purgative action.43

Signs and symptoms—Following accidental ingestion of a few leaves or flowers, no effects or only minor gastrointestinal discomfort is anticipated; however, ingestions of larger amounts of plant material or ingestion of any amount of the bulb or rhizome may result in more severe effects including vomiting, diarrhoea, abdominal pain, shivering, lightheadedness and dizziness.43, 65, 66 Mild symptoms typically resolve over the course of a few hours.65 In animals, following ingestion of large amounts of Narcissus plant material there have been reports of more severe systemic toxicity including sedation, lack of coordination, seizures, paralysis, hepatic degeneration and cardiovascular dysfunction.43, 65, 67 However, these effects have not been reported in humans for the typical amounts consumed.

Treatment—Significant toxicity is not expected following small ingestions of leaves and flowers, and treatment should not generally be necessary. Decontamination is unlikely to be of benefit due to anticipated gastrointestinal distress and is not recommended. The major effects are gastrointestinal in nature; symptomatic patients may require maintenance of fluids and electrolytes and potentially anti-emetic and/or antidiarrhoeal medications.43 There may be a risk of hypotension as a result of hypovolaemia. IV fluids should restore blood pressure; however, if this is unsuccessful, a vasopressor may be necessary. In the unlikely event of significant CNS depression or seizures, management is supportive; airway protection, ventilatory support, and/or anticonvulsants may rarely be required. Most patients have a good outcome.65

Cardiac glycoside-containing plants

- Oleander (Nerium oleander)
- Foxglove (Digitalis purpurea)

Foxglove and oleander belong to a class of plants containing cardiac glycosides. The mechanism of toxicity and symptoms produced are similar.

Description—Oleander (Nerium oleander) is an evergreen shrub with many slender stems near ground level, which can reach from two up to 8 m in height.2, 6 The leaves are a dark dull green and are leathery, tapered at both ends, with a prominent mid-rib2, 6 (Figure 15). The leaves are 7.5 to 20 cm in length and 1-2 cm wide.6 At the end of the branches are clusters of attractive flowers, typically white, pink or dark red;2, 6 each is about 4-8 cm in diameter, and funnel-shaped with five petals (Figure 16).2, 6
Foxglove \((Digitalis purpurea)\) is a biennial herb; it has an erect flowering stem that grows up to 1.5 m in height (Figure 17).\(^2\) The leaves are arranged in a rosette with each leaf being oval in shape.\(^6\) The tip tapers and the leaves are covered in short, soft hairs, giving a greyish-green appearance.\(^6\) The flowers appear on a single spike, with up to 50 per spike,\(^6\) each flower being up to 4-5 cm in length.\(^6\) The petals are typically purplish pink, but may be white.\(^42\) The inner portion of the petal may have purple or brown spots, with these sometimes being ringed with white\(^6\) (Figure 18).

**Toxin**—Foxglove and oleander contain cardiac glycosides (termed cardenolides, they include digoxin, digitoxin, oleandrin). These have a characteristic structure consisting of a steroid nucleus joined to a lactone with attached sugar moieties.\(^69\)

Other plants which contain similar cardiac glycosides include lily of the valley \((Convallaria majalis)\),\(^70\) swan plants or milkweeds \((Asclepias spp.)\),\(^71\) the yew tree \((Taxus baccata)\),\(^72\) Cerbera plants\(^73\) and yellow oleander \((Thevetia peruviana)\).\(^74\)

Other cardiotoxic plants acting via different mechanisms include aconite and related cardiotoxic alkaloids \((Aconitum spp.)\),\(^75\) veratrum alkaloids \((Veratrum spp.)\),\(^76\) and grayanotoxins (mainly \(Rhododendron\) spp.).\(^77\)
Mechanism of action—Cardenolides inhibit normal function in the myocardium and cardiac conducting tissue. A major mechanism is their inhibition of membrane-bound sodium-potassium-ATPase, which normally exchanges extracellular potassium for intracellular sodium.78, 79 Inhibition causes decreased active transport of potassium into, and sodium out of, myocardial cells, producing hyperkalaemia and increased intracellular sodium concentrations.79 The latter reduces the activity of the sodium-calcium exchange mechanism, which normally transfers calcium out of the cell in exchange for sodium.78

The net effect is elevated cytosolic calcium which, while beneficial therapeutically in producing increased cardiac contractility,80 can also have adverse effects.79 Excess intracellular calcium changes the resting membrane potential of the cell sufficiently to increase the risk of spontaneous depolarisation (increased automaticity).80
Another major effect involves the autonomic nervous system, with an increase in cardiac vagal tone and decreased sympathetic activity. This decreases sinoatrial (SA) node firing and slows conduction through the atrioventricular (AV) node, often with significant AV block; the His–Purkinje system is similarly affected. The combination of slowed normal impulse formation and conduction, but increased excitation and automaticity elsewhere, risks a range of dysrhythmias. A third key factor can be hyperkalaemia, which also decreases normal impulse production and propagation.

**Signs and symptoms**—Exposures to oleander and foxglove are most commonly reported following ingestion (Table 2). Symptoms are rapid in onset following ingestion of tea extracts, whereas they can be delayed for up to 2 to 3 hours after consumption of raw cardiotoxic plant matter. Significant inter-individual differences in effect severity are reported, so that the clinical course can be difficult to predict; the estimated ingested dose of oleander plant matter in a fatal case was reported to be 4 g of leaves, whereas another patient suffered only mild cardiovascular effects, with full recovery, after ingesting “five handfuls” of oleander leaves.

Cardiac effects, albeit subclinical, have also been reported in four patients following the application of yellow oleander extract paste to ulcers, on alternate days for either one or two weeks. Any amount of cardiac glycoside-containing plant material could potentially produce symptoms, especially in children.

Following ingestion, initial symptoms typically include nausea, vomiting, abdominal pain and diarrhoea. There may also be CNS effects including disturbed colour vision, drowsiness, dizziness, weakness, confusion and delirium. Reported adverse cardiac effects encompass almost any kind of dysrhythmia, including sinus bradycardias (and arrest), atrial flutter/fibrillation, various degrees of AV block, junctional rhythms, and ventricular tachycardia; sudden ventricular fibrillation or asystole can also occur. Hyperkalaemia is a hallmark of cardioglycoside toxicity, and serum potassium concentrations typically correlate well with the severity of acute poisoning.

**Treatment**—Decontamination with activated charcoal can be considered if this can be administered safely within an hour of ingestion. There are limited data, but activated charcoal appears to have a favourable effect on the disposition of cardiac glycosides in acute yellow oleander (*Thevetia peruviana*) self-poisoning by reducing terminal half-life and mean residence time. Multiple dose activated charcoal (MDAC) has also been investigated as a treatment for poisoning by this plant, but two methodologically different studies had discordant findings, making a firm recommendation difficult. In one single-blind, randomised, placebo-controlled trial, MDAC was found to reduce life-threatening dysrhythmias and deaths. However, a later open-label, parallel group, randomised controlled study reported no reduction in mortality in those treated with either single dose, multiple dose, or no charcoal. Gastric lavage is not recommended due to the risk of further vagal stimulation and ventricular fibrillation or asystole.

Patient monitoring should include an ECG and fluid and electrolyte assessment, including potassium, calcium and magnesium concentrations; hypomagnesemia
may worsen toxicity. Anti-emetics should be used to control vomiting and thus reduce levels of vagal stimulation; intravenous metoclopramide is recommended initially to control vomiting but a 5HT3 antagonist such as intravenous ondansetron may be necessary if initial treatment is unsatisfactory. Fluid replacement may also be required.

The mainstay of treatment is use of digoxin-specific antibody fragments (digoxin-Fab). Data suggest it can be rapidly effective for reversing the effects of digoxin; observational data and one randomised controlled trial suggest it is also effective for cardiac glycoside-containing plants. It is recommended in patients with life-threatening dysrhythmia, haemodynamic compromise, or serum potassium greater than 5.5 mmol/L (5.5 mEq/L).

The optimum dose for plant cardiac glycoside poisoning is unclear, but a relatively high initial dose of 800 mg (20 vials) is recommended, due to possible lower binding affinity of digoxin-Fab to natural cardiac glycosides than to digoxin.

With digoxin, it has been suggested to commence Fab treatment if serum concentrations are greater than 10 nmol/L (7.8 ug/L) at 6 hours post-ingestion. However, assays originally designed to measure serum digoxin concentrations are of limited use for plants such as oleander, as such assays are only semiquantitive for other digoxin-like substances, and may misrepresent their concentrations.

In the absence of digoxin-Fab, meticulous supportive care is required. Cardiology consultation is strongly advised for patients with hemodynamically significant arrhythmia. In those where a substantial dose is suspected, the appropriate standard of care should include continuous ECG monitoring in an Intensive Care or Coronary Care area with availability of defibrillator equipment.

Bradyarrhythmias have been treated with atropine, catecholamines (such as isoprenaline and salbutamol) and/or temporary cardiac pacing. There is limited information on the relative efficacy and safety of these compounds, though catecholamines present an increased risk of tachyarrhythmias.

Atropine is most commonly recommended for bradycardia (<40 bpm) which is consistent with the known role of vagally mediated mechanisms. It can be titrated to maintain heart rates between 60 and 90 bpm. Many patients will tolerate a relative bradycardia and can be managed without intervention for heart rates 40-50 bpm, provided they remain haemodynamically stable with maintained blood pressure and perfusion.

Temporary transvenous pacing remains the mainstay of managing severe persistent bradycardia (usually complete AV block or profound sinus bradycardia or arrest) particularly when associated with syncope or haemodynamic collapse. Temporary cardiac pacing for severe bradycardia or ventricular dysrhythmia may be avoided when digoxin-Fab is available.

Cardiac pacing should not be routinely instituted for stable clinical situations, as the benefits of placing a transvenous pacing wire should be weighed against the possible risks of the wire causing mechanical stimulation of irritable myocardium, and thus increasing the risk of induced ventricular dysrhythmia; there is also the risk of myocardial perforation.
Magnesium sulphate may be useful for ventricular tachydysrhythmias.\(^{98, 102, 103}\) Lignocaine can also be useful for first and second degree AV block, some supraventricular bradydysrhythmias, ventricular ectopics, bigeminy, and ventricular tachydysrhythmias.\(^{90, 93, 104}\) It has been suggested that cautious use of phenytoin (a class 1B antiarrhythmic agent) may be of benefit for resistant dysrhythmias,\(^{105}\) but this agent is no longer favoured in the acute poisoning setting. Class 1A and 1C agents should be avoided due to their adverse impact on AV-nodal conduction.\(^{78}\)

When marked ventricular irritability is seen (frequent multifocal ectopics or runs of non-sustained ventricular tachycardia) a defibrillator should be close to the patient, and wearable defibrillator pads placed in readiness on the chest wall, to manage ventricular fibrillation should it occur.

Theoretically, electrical cardioversion is relatively contraindicated in the presence of cardiac glycoside toxicity, as it can result in asystole or ventricular fibrillation,\(^{80, 93}\) though the latter may respond to low energy cardioversion.\(^{95}\) The use of cardioversion to manage low risk arrhythmias, such as atrial fibrillation, should be avoided in this setting. Prompt cardioversion for ventricular fibrillation is the only appropriate life-saving medical intervention possible.

Potassium concentrations greater than 5.5 mmol/L (5.5 mEq/L) should initially be managed with digoxin-Fab,\(^{95}\) but in its absence IV insulin-dextrose may be beneficial.\(^{74}\) Sodium bicarbonate may not prove beneficial for hyperkalaemia, and polystyrene sulfonate is not advised as it may precipitate hypokalaemia, especially if it is given with digoxin-Fab.\(^{74}\) Furthermore, calcium is typically not recommended for hyperkalaemia, due to the theoretical risk that it may further increase myocardial calcium load and enhance risks of dysrhythmia.\(^{80, 106}\) Although the use of calcium in the situation of cardiac glycoside toxicity may not be as detrimental as previously thought,\(^{107-109}\) its use in cardiac glycoside poisoning remains controversial until more definitive studies are conducted.\(^{110}\) Haemodialysis may be necessary for particularly severe hyperkalaemia or in the renally impaired;\(^{93, 111}\) however, neither this nor other extracorporeal methods are effective in removing cardiac glycosides from the blood.\(^{93}\)

**Karaka**

- **Karaka (Corynocarpus laevigatus)**

**Description**—Karaka (Corynocarpus laevigatus) is a native evergreen, growing 9–15 m tall. (Figure 19) It has thick, glossy, dark green leaves, oblong in shape and 10–15 cm in length. The small flowers are greenish-yellow while the fruits are elliptical, bright orange when ripe and 25–40 mm long. (Figure 20.) Each fruit contains a large kernel (seed).\(^2\)

**Toxin**—This plant contains the toxin karakin, which upon hydrolysis yields the toxic metabolite 3-nitropropionic acid (3-NP).\(^{112}\) 3-NP and its precursors are also found in other species of plants including timber milkvetch (Astragalus mise); it is also produced by a fungus (Arthrinium spp.) which is associated with mouldy sugarcane.\(^{113}\)
Karakin is most concentrated in the kernel; however, this can be rendered non-toxic by heating to above 100° C for at least 4 to 6 hours.²,¹¹⁴ It was a principal source of food for Maori, who prepared it for human consumption by heating then washing the fruit.¹¹⁵,¹¹⁶

![Figure 19. Corynocarpus laevigatus – Karaka © Used with permission. Photo Credit: Robin Slaughter.](image1)

![Figure 20. Corynocarpus laevigatus – Karaka © Used with permission. Photo Credit: Robin Slaughter.](image2)

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![sucinic acid](image3)

Succinic acid

![3-nitroprionic acid](image4)

3-Nitroprionic acid

![Figure 21. The chemical structure of succinic acid and 3-nitroprionic acid.](image5)

**Mechanism of action**—3-NP structurally resembles succinic acid ("succinate") (Figure 21), a natural substrate within the Krebs (tricarboxylic acid) cycle which
contributes to ATP synthesis within mitochondria. 3-NP competes for, and effectively irreversibly inhibits, the enzyme succinate dehydrogenase (SDH), which converts succinate to fumarate (the next step in the cycle). This will inhibit the cycle, and thereby interfere with ATP synthesis and cellular energy production, while also causing an accumulation of succinic acid and lactate, the latter arising from a shift towards more anaerobic metabolism.

Other consequences may arise from compromised mitochondrial function, including oxidative stress due to the increased production of free radicals, such as super-oxide, hydroxyl radical and peroxynitrite. In addition, excitotoxic and neurodegenerative effects can occur secondary to inhibition of ATP-dependent ion pumps.

Calcium, which enters the cell during depolarisation, cannot be removed from the cell due to a lack of ATP-dependent ion transport, leading to calcium overload and subsequent apoptosis and necrosis of glutamatergic neurons. Such effects can lead to delayed neurodegeneration within the basal ganglia, associated with cognitive and motor deficits, which are characterised by hypokinesia, dystonia and chorea.

Signs and symptoms—The majority of reported exposures to karaka are following ingestion (Table 2). While an exact toxic dose is unknown, it is thought that any ingestion of the kernel could potentially produce signs and symptoms. However, the leaves and skin of the berry contain less toxin and the ingestion of a few of the leaves or the berry skin is therefore unlikely to lead to poisoning.

Nausea, vomiting, diarrhoea and abdominal pain typically occur early in the course of poisoning; they may be accompanied by headache, drowsiness, fever, nystagmus, aphasia, dizziness and lethargy. More severe acute symptoms include tremor, seizures, coma, respiratory depression and respiratory arrest.

Another major concern following poisoning is possible neurodegenerative damage, which can be delayed and may resemble symptoms of Huntington's disease. The most common manifestation is dystonia; other effects may include choreoathetoid movements and dyskinesia.

The onset of neurodegenerative damage may be delayed for 2 to 4 weeks post-ingestion, especially in children, and damage may not resolve completely. CT or MRI scans have shown hypodensity in the basal ganglia, commonly in the putamen and globus pallidus, and occasionally in the caudate nucleus. Furthermore, while not reported in humans, reports of poisonings in cattle, sheep and rabbits have described methaemoglobinaemia, likely secondary to the liberation of nitrite.

Treatment—As the most toxic part of the plant is the kernel, any ingestion of this part warrants medical attention and observation. Small accidental ingestions of other plant matter are unlikely to cause serious toxicity and in this situation medical attention is not generally necessary unless symptoms are present.

There are no specific antidotes, with the mainstay of management being symptomatic and supportive care. Initial treatment includes activated charcoal, which should ideally be administered within an hour of ingestion. Moderate to severe poisoning commonly leads to seizures; these will typically resolve spontaneously, but can be managed initially with a benzodiazepine or, if still refractory, a barbiturate.
Persistent vomiting or diarrhoea may require treatment with anti-emetic drugs and adequate fluid and electrolyte replacement.

Neurodegenerative lesions in the striatum may manifest as dystonia and/or athetosis. There is no known treatment for these symptoms; levodopa does not appear to be helpful, and there is no information regarding whether conventional management for dystonia such as benztrapine or diphenhydramine is effective. It is possible patients may, in rare instances, recover, but dystonia is generally permanent.

While in humans methaemoglobinemia appears just a theoretical concern, it should be monitored for, and if elevated managed along usual guidelines, with methylene blue if indicated.

**Stinging nettle plants**

- **Ongaonga (Urtica ferox)**

**Description**—Commonly known as ongaonga or New Zealand tree nettle, *Urtica ferox* is a native species of stinging nettle. It is a shrub which may grow up to 2 m or more in height. It has pale green leaves, 8–12 cm in length, and triangular in shape with coarsely toothed margins.

The leaf surfaces and leaf stalks and stems carry fine, pointed, white stinging hairs named trichomes, which are tapered capillary tubes rising from a bulbous base to a small spherical tip, which may be 5-6 mm in length (Figure 22).

**Toxin**—The trichomes of ongaonga contain a liquid which include the active components acetylcholine, histamine and serotonin.

**Mechanism of action**—When in contact with the skin, the trichome tip breaks off, exposing a fine needle-like point which penetrates the skin. The base of the trichome also becomes compressed, which forces the fluid in the bulb through the tube and into the tissue.

It appears that acetylcholine and histamine are responsible for the local effects; histamine, in association with serotonin, may also activate nociceptive pain neurons.
Kinins and leukotrienes may also be released, contributing to pain and inflammation. However, this does not readily explain all the effects described, and it is likely additional substances capable of secondary release, or an as yet unidentified neurotoxic agent, may contribute.124, 127

**Signs and symptoms**—The majority of reported exposures to ongaonga are following skin contact (Table 2); following even the slightest contact with the stinging hairs, intense pain with itching, inflammation, paresthesia, dermatitis and urticaria can quickly occur.124, 128 Local effects may last for 12 to 36 hours or longer.15

If a large surface area is involved, systemic symptoms may also occur. These may include abdominal pain, salivation, visual disturbances, paresthesia, muscle weakness, cramps, lack of co-ordination, paralysis and respiratory difficulties.124, 128 Systemic symptoms typically onset within 30 minutes and can last for 24 hours or longer, potentially for weeks.2, 124, 128

The urticaria is typically non-immunological; however, immediate hypersensitivity reactions, including systemic anaphylactic effects, while not well described with ongaonga, have occasionally been reported with other species of stinging nettle.129, 130 These are presumed IgE-mediated reactions, though a delayed skin reaction has also been reported.129, 130 Peripheral neuropathy may also rarely occur, with slow resolution of some symptoms and nerve conduction study findings.124

There is one anecdotal case reported of a fatality following an ongaonga sting in New Zealand. A hunter walked through a patch of nettle and approximately 1 hour post-exposure developed symptoms of stomach ache, difficulty breathing and paralysis. The patient was transported to medical care but died 5 hours post-exposure.2

**Treatment**—The primary goal following ongaonga exposure is timely treatment of local effects. The area should be promptly flushed with water, and local pain and itching relieved by cooling with ice packs and/or applying a moistened cloth. Oral analgesics, antihistamines and/or anti-inflammatories may also be necessary to alleviate pain, pruritis and inflammation. In the majority of cases involving brief dermal exposure, the effects are relatively mild and self-limiting, and do not require further specific therapy.131

If systemic symptoms are evident, more intense supportive care may be required. Muscle weakness, paralysis or respiratory insufficiency requires priority management, including close monitoring of airway function; intubation with respiratory support is recommended in significantly symptomatic patients. In the event of hypersalivation contributing to compromised upper airway patency, atropine as well as suctioning may be helpful.

Serious anaphylactic (or possibly anaphylactoid) reactions should be treated in the usual manner with attention to the airway, breathing and circulation, along with immediate administration of adrenaline.

**Conclusions**

New Zealand is host to a number of poisonous plants, both native and introduced. The NZNPC frequently receives enquiries regarding plant exposures. The majority of human exposures cause only minor symptoms, and serious poisoning is rare.
However, there are some plants, when ingested in sufficient quantity, which are capable of causing severe poisoning.

Accurate plant identification can be important as a preventive measure, as well as being central to determining the likely risk of adverse effects. Plant identification can be difficult in some situations, but plant books, commercial garden centres, botanical gardens or University botany departments may be helpful for accurately clarifying the species involved.

In the absence of definitive plant identification, management of poisoning relies on appropriate first aid, close monitoring of evolving clinical features, and management along the lines discussed in this review.

**First aid following plant exposures**

If it is suspected that exposure to a potentially poisonous plant has occurred first aid measures include:

Following ingestion: Remove any remaining plant material and rinse mouth

Following eye exposure: irrigate the eye with gently running water for minimum of 15 minutes

Following skin contact: Gently rinse the skin with running water

Phone the Poisons Centre on 0800 764 766 for further specific information.

**Competing interests:** Nil.

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**References:**


Crying and spilling—time to stop the overmedicalisation of normal infant behaviour

Ben Hudson, Anna Alderton, Claire Doocey, Denise Nicholson, Les Toop, Andrew S Day

Abstract

Many infants have periods of unsettledness, or irritability, over the first months of life. Spilling (or possetting) due to reflux of gastric contents is also seen very frequently. Almost universally, these are normal patterns of infancy (the first 12 months of life) that resolve with the passage of time. In recent years, these normal developmental processes have increasingly been ascribed to pathology and treated with medical therapies, including acid suppressants. There is clear evidence, however, that acid suppression has no role in the management of these behaviours. In addition, recent data illustrate increased risk of adverse effects of these drugs in infants.

Crying and spilling are very common behaviours in the first 6 months of life. The extent of these normal patterns varies widely, as does the extent to which parents seek help with them. As both occur commonly, health professionals may attribute persistent crying and irritability to gastro-oesophageal reflux. However, whilst both may occur simultaneously, they are not necessarily related. Over recent years, the tendency has been to label these behaviours as pathologic and to treat with various medical therapies, including acid suppressive drugs.

Many infants have periods of irritability, unsettledness or unexplained crying typically starting in the first weeks of life, peaking around 3–4 months and then resolving spontaneously by 6 months of age. Infants in this age group may cry for up 5–6 hours each day, with unsettledness typically worse in the late afternoon or early evening.

Up to 20% of parents report a problem with crying or irritability in the first 3 months.¹ These patterns have been observed in infants in both Western and hunter-gatherer cultures.² These behaviours are also well-described in historical accounts. For instance, the “all the world’s a stage” monologue in Shakespeare’s “As You Like It”³ describes the first of the seven ages of life thus: “And one man in his time plays many parts, His acts being seven ages. As, first the infant, Mewling and puking in the nurse’s arms”.

Over time, these patterns have been labelled in various ways, including the term “colic”.⁴ Various management techniques have been suggested and different therapies have been utilised. Although the cause of these behaviours has not been fully defined, they are most likely related to difficulties in the infant changing from one state of awareness to another as part of a normal maturational phase.⁴ This likely reflects a normal neurodevelopmental stage for infants.

Regurgitation, spilling and possetting are also commonly seen in otherwise healthy infants, consequent to the regurgitation of buffered gastric contents. This
developmentally normal process, termed physiological gastro-oesophageal reflux (GOR), is due to the immaturity of the upper gut in infancy. The infant oesophagus is relatively short with less intra-abdominal length. In addition, the lower gastro-oesophageal sphincter is immature, with increased transient relaxations leading to reduced patency. These anatomical features evolve over the first months of life, leading to self-resolution of physiological reflux by 12–15 months in almost all infants.

Up to 5% of infants with excessive crying or unsettled behaviours will have an underlying organic problem. Similarly, only a very small number of infants with reflux will have gastro-oesophageal reflux disease (GORD), which can be defined as upper gut symptoms present in association with complications (such as failure to thrive or haematemesis).

If these behaviours are sufficiently concerning, parents may seek medical attention or ask the advice of allied health professionals. Australian data show that parental concern about infant crying is the most common reason for general practitioner (GP) consultation in the first months of life.

Parental responses to crying and unsettled behaviours in their infants are likely reflective of their social supports and experience. Mothers with their first child are more likely to consult their GP about these concerns. In addition, higher levels of parental concern about infant unsettledness are linked with increased use of multiple health services in the first months of life.

More and more commonly, these behaviours have been erroneously seen as pathologic events or diseases and treated with a medical model of care. This may reflect societal expectations for a disease to be the cause of these behaviours, or perhaps an increasing parental expectation for an instant cure. As both physiological reflux and developmental irritability temporally coincide, it is perhaps not surprising that the former has been assigned a causative role for the latter.

The existence of (albeit rare) GORD and its association with acid damage appears then to have given both the physiological reflux, together with the coincidental irritability, status as an illness which in turn has provided a rationale for the decision to treat both medically, using drug therapies such as those that neutralise or suppress gastric acid.

Despite being unlicensed for use in infancy, there have been dramatic increases in prescribing of proton pump inhibitors (PPI) in infants over recent years. In Partnership Health Primary Health Organisation (PHO), Canterbury, 15% of infants (<1 year) received a prescription for the PPI omeprazole in 2010 (Personal communication, P Bridgford, Pegasus Health 2011). Five years earlier in 2005, only 4% of children in this age group were prescribed this drug (Figure 1).
Similar to the events in Canterbury, prescriptions of omeprazole in under-1 year olds across New Zealand also increased between 2006 and 2010. Over this period the greatest increase was in those aged 0–3 months amongst whom the number of prescriptions more than doubled. Data from the United States also show increasing rates from late last century, with one assessment demonstrating an 11-fold increase in PPI prescriptions for infants between 2002 and 2009.

In their review of North American healthcare databases, Barron et al suggest that few of the infants receiving PPI had acid-related disease. Although the local data on the indication for acid suppression are not available, it is likely that prescribing in NZ is similar.

Despite these changing patterns of prescription, there is little evidence that acid plays any role in patterns of unsettledness and irritability in infancy. Furthermore, there is evidence that acid suppression does nothing to improve these distressing behaviours and that PPI therapies are associated with important adverse effects.

Over the last decade, a small number of studies have assessed the role of acid suppressant therapy in the management of unsettled infants and those with reflux (physiological or pathological). None of these studies support the use of acid suppressants for these indications in infants.

A group of Australian investigators prospectively studied the impact of anti-reflux therapy in a group of infants with persistent crying. The 103 infants in this study were randomised to receive one of three interventions: anti-reflux therapy or placebo or an infant maternal health consultation. The anti-reflux intervention involved acid...
suppression with a histamine antagonist (ranitidine) and a prokinetic (cisapride) in standard doses. All infants had reduction in crying duration over the four week study regardless of their intervention with no particular advantage seen for anti-reflux therapy.

Four separate studies have examined the efficacy of proton pump inhibition to reduce gastric acid in infants with GORD. A placebo-controlled cross-over study conducted in Adelaide, Australia, randomised 30 infants to two treatment periods: omeprazole followed by identical placebo or placebo followed by omeprazole. The infants, with median age of 4.8 months, were shown to have increased oesophageal acid exposure (as indicated on 24 hour oesophageal pH studies) or histological evidence of oesophagitis. Oesophageal pH monitoring was repeated at the end of the first treatment period and parents kept cry/fuss diaries and visual analogue scales (VAS) of their infants’ irritability.

Infants receiving omeprazole had a significant reduction in their oesophageal acid exposure compared to placebo (-8.9% ± 5.6% vs -1.9% ± 2.0%; p<0.001), demonstrating that this drug reduced oesophageal acid exposure. However, despite this there was no difference in parent-recorded symptoms between the two groups of infants. Furthermore, symptoms significantly improved with time compared to baseline during treatment with both placebo and omeprazole. Infants who began the study with greater oesophageal acid exposure or abnormal oesophageal biopsy were no more likely to respond to omeprazole than those without these findings. Baseline scores for crying/fussing and VAS were not significantly different between infants with and without abnormal oesophageal biopsy or greater oesophageal acid exposure.

Similar findings were demonstrated by the same group in a small study of omeprazole in preterm infants. Ten preterm infants with features of GORD and evidence of pathological acid exposure were enrolled in this randomised double-blind placebo-controlled cross-over study of 1 week of omeprazole or placebo followed by one week of the other treatment. Oesophageal pH measurement was repeated at the end of the first and second weeks and a reflux symptom chart was completed by nursery staff. Although treatment with omeprazole significantly reduced gastric acidity and oesophageal acid exposure, this was not associated with any change in symptom scores.

Other PPI agents were evaluated in two studies based in North America. A multi-centre randomised placebo-controlled trial of lansoprazole enrolled 162 infants (median age 16 weeks, range 4–51 weeks) with GORD symptoms persisting despite one week of conservative measures. Infants were randomised to receive 4 weeks of lansoprazole or placebo. Symptoms were recorded using parent questionnaires. After 4 weeks of treatment, an equal proportion (54%) of infants in both arms responded to treatment and there was no significant difference between the groups for either parental or physician’s global severity assessment. Adverse outcomes occurred more frequently in infants taking lansoprazole than those receiving placebo (12% vs 2%; p=0.032).

A more recent study evaluated another PPI (pantoprazole) in a randomised placebo-controlled withdrawal study of 106 infants (mean age 5.1 months) with clinically diagnosed GORD and whose symptoms had improved during 4 weeks of open-label pantoprazole. Infants were randomised to continue pantoprazole or receive placebo
and were followed for 4 weeks. There was no significant difference between the two groups in the primary endpoint - withdrawal due to lack of efficacy.

Together the available evidence of acid suppressive therapy in infants does not support the use of PPIs in unsettled infants or those with clinically-diagnosed GORD. Furthermore, the results arising from the two studies that included endoscopy and oesophageal pH monitoring,\(^\text{16,17}\) clearly also question the central role that has been ascribed to gastric acid in the causation of these infants’ symptoms.

In these studies, although oesophageal acid exposure was reduced with the drug therapy, this was not associated with any symptomatic benefit. In addition, infants with more severe baseline measures of oesophageal acid exposure and histological changes neither displayed more severe symptoms nor responded more favourably to acid suppression than those infants without these findings.

Another important finding of these studies is that symptoms tend to improve over the study period in infants receiving active drug or placebo treatments. This is consistent with the observation that the patterns of infant irritability and reflux resolve spontaneously with time. This is likely to be an important confounding factor in non-controlled trials or in empirical trials of treatment for individual patients.

Over recent years, it has become clear that the spectrum of adverse effects of PPI drugs is broader than first envisaged. The use of PPIs in adults is now associated with problems such as increased risk of community acquired pneumonia, \textit{Clostridium difficile} infection, fractures, vitamin B12 deficiency and acute interstitial nephritis.\(^\text{20–24}\)

Although adverse effects in infants are less well studied, recent data raise significant concerns. For example, one prospective cohort study followed 91 infants and children prescribed acid suppressants (histamine antagonists or PPIs) for GORD and a matched group of 95 healthy children who were neither diagnosed with GORD nor prescribed acid suppressing medication.\(^\text{25}\) The median age of the subjects was 10 months and follow up was for 4 months. The infants and children prescribed an acid suppressant had significantly higher incidence of pneumonia (12% vs 2%; \(p=0.003\)) and gastroenteritis (47% vs 20%, \(p=0.001\)) over the period of observation than the control group.

Although it may be argued that, because the study was observational rather than experimental, the higher rates of gastroenteritis and pneumonia could be due to the presence of GORD rather than the acid-suppressing medication, it is notable that in the 4 months preceding the initiation of acid suppression, the incidence of gastroenteritis and pneumonia was not significantly different between the two groups.

Further evidence of adverse effects from these drugs in infants comes from the above-mentioned randomised controlled trial of lansoprazole, in which serious adverse events occurred six times more frequently in the group receiving PPI than placebo (\(p=0.032\)).\(^\text{18}\) The most common serious adverse events in the infants receiving PPI were lower respiratory tract infections.

In view of the available data regarding the balance between benefit and harm of PPIs in infancy, there is increasing recognition that these drugs are not indicated, particularly in infants with excessive crying or physiological reflux who are otherwise
healthy. Indeed, a recently published clinical guideline for the management of reflux in children concluded that PPI therapy was not indicated as empiric therapy for infant irritability or GOR and that these drugs have little role in the management of most infants with GORD. A recent systematic review reached similar conclusions.

In the light of the currently available evidence, it is clear that the management of infants with irritability or spilling should focus on supporting the parents, not on drugs. In the vast majority of cases reassurance and support is all that is required. Acid suppression is not indicated without histologically-proven oesophagitis. Warning signs indicative of possible serious conditions include haematemesis, bilious vomiting, melaena, poor weight gain, altered development or apnoeas. Infants with one or more of these features may require specific investigations and paediatric consultation.

In contrast, infants lacking these warning signs (the majority) should be managed conservatively with an expectation of spontaneous improvement. This approach should be multidisciplinary and encompass education, support, and appropriate resources. Parental mental health assessment, support and intervention may be required.

Persistent crying has been implicated as a trigger for children being harmed by their care-givers. Hence as part of a holistic approach, practitioners should discuss with caregivers strategies for managing the stress involved in caring for an unsettled infant and involve social service agencies as needed.

In summary, crying and spilling are common, unlinked and normal behavioural patterns in early infancy. Almost all infants with excessive crying or irritability are healthy without any underlying disease. Spilling on the basis of physiological reflux is also common, and is infrequently complicated as GORD. Both crying and spilling behaviours are expected to resolve spontaneously with the passage of time. Medical therapies for these patterns are unnecessary, non-efficacious and potentially harmful.

In conclusion, it is now time for us to move from thinking of irritable but healthy infants as having underlying treatable pathology, to approaching this as a normal (albeit sometimes difficult) period of infant development to be managed with multidisciplinary education, support and reassurance.

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References


Euthanasia and physician-assisted death

A D (Sandy) Macleod

Abstract

Medical practitioners do not have the knowledge and expertise to participate competently and reliably in selecting those fit to be offered euthanasia and assisted suicide. Issues relating to the clinically assessment of such requests by the terminally ill, diagnostic errors, prognosis, competency, and mental health status are, as yet, not adequately scientifically resolved.

Maryan Street’s proposed End of Life Choice Bill has reignited discussion about euthanasia and physician assisted suicide (PAS). There are philosophical, religious, financial, moral and legal components to this debate. There are also medical ones.

Having practised medicine at the bedside of the dying for over three decades and having recently reviewed the medical aspects of assisted death legislations and practices in those jurisdictions with liberalised law, it is apparent that, as yet, the discipline of medicine is not in a position to be supportive of a law change.1

Euthanasia is the deliberate ending of another person’s life at his or her request. A doctor intentionally helping a person to commit suicide by providing drugs for self-administration, at the person’s voluntary and competent request, is PAS. Withholding and withdrawing futile treatments and palliative (deep) sedation are not considered euthanasia.2 These allow natural death.

Street’s proposed Bill would allow mentally competent adults suffering a terminal disease with a prognosis of less than 12 months, or those with an irreversible physical or mental medical condition rendering his or her life unbearable, to request from a volunteering medical practitioner life-ending medications to be delivered orally, per gastric tube or by injection.

Another doctor would be required to certify capacity for this self-determining end of life decision, which would need to be confirmed within 7 days. The consultation of family and the seeking of professional counselling would be encouraged.

The attending medical practitioner may delegate his or her functions to another person and the cause of death must be recorded as the underlying disease and not as medicinal killing.

Assisted death discussions in the developed world have been stimulated by the technical ability to artificially sustain life in those mortally traumatised or severely ill, the effectiveness of oncological treatments to extend quantity of life in cancer sufferers, and the prevailing philosophy of self-autonomy in a youth and health valuing society. Modern medicine’s skills have allowed the accumulation of multiorgan pathologies, particularly affectations affecting the brain and mind, to complicate the dying process.3
Dying of malignant disease, now generally a chronic condition, is potentially a more protracted and difficult event in the modern world. The fear of dying badly (dysthanasia), rather than the fear of death itself is a recent concern.

The estimated shortening of life for those euthanased in the Netherlands is less than 4 weeks. Unattended the process of dying may be unendurable, but few in this country have the misfortune of not being able to access palliative care services and receive symptomatic relief.

The intent of palliative care is to kill distressing symptoms, not the patient. Good end of life care allows persons to live longer well and die well. But modern palliative care is not perfect, and is not always equal to the complex challenges it faces.

Diagnostic errors will always occur in clinical medicine, which is an ‘art of probabilities’ rather than a science. Post mortem studies reveal an incorrect or missed diagnosis in 5% of hospital deaths. Estimating prognosis in the severely ill remains an imprecise impression. It does become more accurate as death approaches but even in the last days of life, let alone the remaining weeks, some still defy the sincere prognostications of health professions.

Most die earlier than predicted, but a few surprise us. Determining the lethality of a cancer is difficult but considerably easier than it is for a neurodegenerative disorder or a psychiatric illness. Diagnostic and prognostic uncertainties trouble doctors as they do their patients.

It is well established that ‘desire for a hastened death’ ideations fluctuate wildly, by the hour and by the day, in the terminally ill. They constitute a medical emergency and in practice are usually alleviated by attention to pain, distress or whatever discomfort befalls the dying.

Thirteen percent of Dutch requesters have a change of mind about assisted death once the formal process is initiated and a third of Oregonians provided a lethal prescription opt to die naturally. This change of mind may represent the insurance of knowing if desperate and trapped one has a way out or perhaps the acquisition of an acceptance of living until death occurs.

Samuel Johnson quipped thus “Depend upon it, Sir, when a man knows he is about to be hanged in a fortnight, it concentrates the mind wonderfully”. But whatever the reasons, a figure of 10–15%, whilst small, would be considered an unacceptably high operating mortality rate in surgical practice.

Sick people feel a burden and are a burden. Suffering influenza or breaking a leg also renders us burdensome. Whilst modern society resents the dependency of the frail or vulnerable, few if any of us, complete life exclusively as a free and independent being. Most requests for assisted death concern non-physical issues rather than symptoms such as pain.

Loss of control, dignity, and independence and concerns about an uncertain future tend to encourage such requests. However there are rewards for caring for others and being cared for is not necessarily entirely a recipient state. Terminal illness can stimulate psychological growth and heal families—it is never too late.
A doctor’s attitude can profoundly influence their patient’s subsequent decision-making. There exists a knowledge and power inequity between patient and doctor. Sick persons are forced to trust their medical attendants.

Tired, ‘burnt out’ clinicians may more easily agree with the seemingly hopeless terminally ill person. Alternatively the naïve and overly optimistic doctor may more readily direct their patient towards yet another futile treatment option. The bedside is dangerous territory with respect to communication—bodily gestures, transference, and linguistic oddities easily corrupt this dialogue.

Trust between patient and doctor, a vital ingredient of medical practice, would be sorely tested by Street’s Bill. That the doctor would be obliged to lie as to cause of death on the death certificate would profoundly undermine the ethics of medical practice.

The essential clinical criteria allowing a request for hastened death to proceed—and only about 20–30% of those requesting this do so in the Netherlands and 50% in Oregon\textsuperscript{10,11}—is whether the patient is enduring “continuous unbearable suffering”. There is no recorded definition of ‘unbearable suffering’.

Ultimately its definition depends on the subjective impressions of two medical practitioners. Their views will be influenced by their nationality, religion, medical experience, medical specialty, empathy or sympathy towards the patient, the availability of their time to assess the request, and a multitude of other contaminants. That the wish of the applicant is respected depends entirely upon the medical profession.

It is an illusion that persons have the ability to request and be granted a hastened death in any legalised assisted death legislation. It could be argued that in these jurisdictions it is not patients exerting autonomy, but doctors exercising power.

The assessment of mental competency or capacity is a difficult clinical process. The more complex the decision, the ‘bigger’ the capacity required. Depression, dementia, fatigue, and delirium all may adversely impact upon decision-making. The cognitive abilities reasonably required to make a rational decision about suicide have never been established. Opining as to whether or not undue influence of others influences is largely impressionistic on the part of the examiner.

The so-called “disability paradox”—that views and ideas alter (and often mellow) during the course of an illness—makes the accepting of advance directives contentious. The proximity of the death bed taints opinion for both patient and doctor. Watching an aftershock on television is not the same experience as being in an earthquake.

Diagnosing depressive disorder, particularly in the medically frail, can be challenging. Depression encourages ‘desire for hastened death’ thoughts, but effective treatment of this disorder may abolish such ideations.\textsuperscript{11}

Depression is a painful and nasty disease yet generally can be eased by psychological and pharmacological interventions. Demoralised mental states can potentially be managed by psychotherapeutic interventions. Very few of those who request early death in Oregon and the Netherlands are psychologically or psychiatrically examined.
despite a prevalence of major depression of 15–20%, and the inevitability of delirious states as organs fail towards the end of life.

Suicide is legal in our community. The rate of suicide in cancer patients is approximately twice that of the general population. The most likely cause of suicide, including in those terminally ill, is a depressive episode. The risk periods for suicide are those soon after diagnosis and in the advanced phase of the illness.

Legalising PAS would ‘normalise’ suicide. Supporting assisted suicide in one particular section of society but not in another (such as youth) is likely to convey a rather conflicting public health message. A few dying persons are so debilitated that they are unable to enact suicide, even if provided the means.

Every clinician knows of an exceptional case in which euthanasia might be a humane option. But it has been clearly shown that though a majority of those with for example high level spinal injuries acutely consider death as a preferred option, most soon change their mind. Palliative psychotherapies can be helpful in these dire clinical circumstances, at least in anecdotal experience.

The complexities associated with requests for assisted death from those who are “weary with life” or suffer dreadful psychiatric, brain injury and neurodegenerative disorders, an emerging trend in the Netherlands, are immense. Some may ‘give up’ before treatments have had an adequate opportunity to be helpful, some insist on living on (and enjoying opportunities) despite what dispassionate outsiders (and relatives) may view as an appalling quality of life.

Though the numbers requesting assisted death in those jurisdiction where PAS or euthanasia are legal are not clearly rising, reporting vagaries make this somewhat uncertain, particularly in Belgium. The ‘slippery slope’ concerns have not necessarily eventuated. In these jurisdictions the funding and provision of resources for palliative care have been actually stimulated by the law changes.

Good palliative care services certainly reduce, but do not extinguish, requests for assisted death. The available option of legalised euthanasia encourages ‘death talks’ and planning for death. This is a clear benefit for developed countries facing an aging and ‘death denying’ population bulge.

Deep sedation at the end of life for intractable symptoms such as the confusion of irreversible delirium, unrelieved (neuropathic) pain, or dyspnoea enhances the longevity of remaining life, rather than abbreviating it. These persons die of disease but not dehydration and starvation. This vigil can be difficult for surviving relatives yet may also provide an opportunity for family cohesion and the resolution of rifts.

The administration of a fatal cocktail of medication is a task doctors would find a particularly difficult undertaking. Indeed nursing staff are increasingly being delegated this role, the doctors in the Netherlands increasingly attempting to avoid such clinical predicaments.

Therapeutically titrating dangerous pharmaceuticals to lessen suffering, but not to kill, particularly in the very sick, is a delicate skill. Probably delivering a fatal overdose is not. It certainly does not require the skills of a medical practitioner. There is no technical necessity for doctors to be involved in the act of killing the terminally ill.
The quality of remaining life deserves and requires as much research investment as is directed at prolonging the quantity of life. If so, maybe some of the above quandaries would have already been resolved. Orchestrating the timing of death and sanitising the process of dying is fraught with medical concerns.

Presently medical practitioners do not possess the professional competency to participate in Street’s Member’s Bill. We do not have the knowledge to competently and confidently select those fit to be medically killed.

Until the above concerns are resolved by scientific endeavour the medical community are unlikely to agree to legal euthanasia and physician assisted suicide.

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References:

Spinal cord stimulation for intractable chronic upper abdominal pain: a case report of the first patient in New Zealand

Haitham Al-Mahrouqi, Zea Munro, Richard H Acland, Martin R MacFarlane

Abstract

We present the first patient in New Zealand to undergo Spinal Cord Stimulation (SCS) for intractable upper abdominal pain. The patient was a 53-year-old man with a 20-year history of debilitating upper abdominal pain associated with chronic pancreatitis secondary to pancreatic divisum. Prior to the SCS, he was prescribed 680mg of morphine sulphate equi-analgesia a day. Despite the intense analgesia, he still suffered monthly attacks of upper abdominal pain requiring hospitalisation. Nine months after implanting a Spinal Cord Stimulator, the monthly attacks ceased, his background pain was effectively controlled and the need for opioids decreased to 510mg of morphine sulphate equi-analgesia a day.

Spinal cord stimulation (SCS) is a type of neuromodulation which has gained significant popularity in recent years for managing certain chronic pain syndromes. It involves delivering low voltage electrical current in the posterior extradural space. The exact mechanism of pain relief is still not entirely understood. Possible mechanisms include inhibition of the peripheral noxious stimuli from reaching the spinal cord through concomitant stimulation of the dorsal horns or increased inhibitory action of gamma-aminobutyric acid in the dorsal horn.1

There is good evidence for the efficacy SCS in the management of Failed Back Surgery Syndrome, Complex Regional Pain Syndrome2 and Refractory Angina Pectoris.3 Recent reports on the use of SCS for chronic abdominal pain show promising results.4,5 Most patients with chronic abdominal pain reported about 50% decrease in pain and a reduction in opioid use.

In this article we report the first patient in New Zealand to undergo SCS for intractable upper abdominal pain secondary to pancreatic disease.

Case report

The patient is a 53-year-old man who first presented with an acute attack of pancreatitis at the age of 35 years with no apparent cause found; he had a cholecystectomy. Despite that, he suffered monthly unprecipitated attacks of acute pancreatitis.

An exploratory laparotomy revealed pancreatic divisum for which he underwent decompression and Roux-en-Y pancreatico-jejunostomy. This operation relieved his symptoms for approximately 5 months before the onset of further monthly attacks of upper abdominal pain again requiring hospitalisation. After 10 years of monthly
suffering, he underwent a splanchnic neurolytic block. This gave some short term pain relief.

In early 2011, he was being prescribed 680mg equivalent of morphine sulphate daily (IM pethidine, oral oxycodone SR, oral methadone), and 1200mg of gabapentin. The patient had a trial of a Spinal Cord Stimulator (SCS) where a lead with electrodes was inserted percutaneously to lie at the T7/8 level and then a one week trial of spinal cord stimulation which proved very beneficial in relieving his pain. The temporary lead was removed and definitive surgery planned. This took place in July 2011 and a permanent lead with eight electrodes was inserted percutaneously into the extradural space at L2/3 level and the passed in a cephalad direction to lie centred at the T8/9 level, the lead being connected to an Implantable Pulse Generator (IPG) placed subcutaneously in the abdominal wall.

At 16 months follow-up, the patient described no attacks and minimal pain (Table 1). He uses the SCS for a few hours two to three times a day and has managed to reduce the opioid dose at this stage to 510mg of morphine sulphate equi-analgesia a day. Socially, the patient described life as ‘beautiful’ once again; now being able to work uninterrupted and travel without having to think about medication and possible hospitalisation.

Table 1. Pain score and use of opioid before and 9 months after spinal cord stimulation

<table>
<thead>
<tr>
<th>Variables</th>
<th>Before SCS</th>
<th>Nine months after SCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>Background pain: Severity 3/10 (uncontrolled with the medications).</td>
<td>Background pain: Nil (controlled with SCS)</td>
</tr>
<tr>
<td></td>
<td>Monthly attacks: Severity 10/10.</td>
<td>Attacks: Nil</td>
</tr>
<tr>
<td>Morphine sulphate equi-analgesia</td>
<td>680mg (not including in hospital dosing)</td>
<td>510mg (and decreasing)</td>
</tr>
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Discussion

In this case report SCS has been successful to date in managing a refractory upper abdominal pain. The patient is essentially pain free and has reduced his reliance on opioid analgesia. The effect has been maintained for 9 months and still continues to date.

Effectiveness—The efficacy of SCS has been validated in the management of Failed Back Surgery Syndrome, Chronic Regional Pain Syndrome and Refractory Angina Pectoris. Recently, SCS has been found to be effective in relieving chronic visceral abdominal pain. The effect appears to be maintained long term with a persisting reduction in pain score, analgesia requirement and improvement in patient satisfaction.

Appropriateness—There is an increasing amount of evidence to support the notion that a similar result is achieved in chronic pancreatitis as with the case presented in this article. The use of SCS has been investigated in patients with a similar profile to our case. A positive response to the initial trial of SCS appears crucial for
predicting the outcome of permanent implantation. The result at 16-month follow-up appears promising; with a reduction in pain scores and opioid use. Our patient had a trial of SCS prior to permanent implantation.

Safety—To date there have been no serious concerns regarding the safety of SCS. The most common complications associated with the procedure are infection and lead migration. With regards to the safety of using the procedure for chronic pancreatitis; Kapural et al reported 3 patients of 24 experiencing adverse outcomes; 2 of which resulted in device removal due to infection, and 1 case of lead migration.

Fiscal neutrality—In addition to the results of the procedure, SCS has also been shown to be cost-effective, with the initial cost and follow-up being offset by a reduction in contact with health services and analgesia.

Chronic pain is a debilitating condition that hinders both physical and psychological functioning. Increasing the inclusion of patients with chronic visceral abdominal pain as an indication for SCS will allow patients suitable for the procedure the improvement in productivity and quality of life.

Conflicts of interest: Nil.

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Acknowledgement: We thank the patient for his cooperation and patience in providing all the necessary information.

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References:
The ‘Dr Google’ phenomenon—missed appendicitis

Neil Avery, Jamish Ghandi, John Keating

Abstract
Self-diagnosis has been around for many years. In today’s society with free access to information, particularly through the Internet, it is more prominent than ever. With new information sources available to patients, doctors may have their diagnostic process influenced. This is the case of a gentleman who self-diagnosed, and subsequently influenced his doctor’s diagnostic process, with results detrimental to his outcome. It illustrates the importance of awareness of the risks of self diagnosis, and management of patients who present with information and preconceived ideas regarding their condition.

This is a case of Internet self-diagnosis by a patient resulting in delayed diagnosis and treatment. Self-diagnosis in the past has typically been limited to doctors and other health professionals. In the age of the Internet, patients are now empowered more than ever. It is commonplace today for people without medical training to attempt self diagnosis and treatment using unvalidated Internet resources.

Few doctors have not encountered a patient who has “Googled” their symptoms or condition. Hudak et al found physicians believe Internet-based health information was often inaccurate and problematic, though many were unprepared to handle these patients despite literature in this area recommending against self diagnosis.1–3

Case report
Mr K is a 48-year-old healthy gentleman who became unwell with constant right-sid ed loin pain, at times radiating to the groin, and dark coloured urine. He attempted self diagnosis via internet search, deciding renal calculi were the most likely diagnosis. He started treatment with naproxen without consultation. His symptoms did not improve and after ten days he consulted his Family Physician, suggesting the diagnosis of renal calculi during the consultation. The doctor agreed changing his medication to celecoxib, and adding paracetamol and codeine. A computed tomography (CT) scan was suggested, though deemed too expensive.

Mr K’s condition worsened and after 2 weeks he presented to the emergency department with persisting right lower quadrant pain, reduced oral intake, watery diarrhoea and nausea. He was evaluated by an Emergency Physician and was febrile (38°C), tachycardic (heart rate 130 bpm) with localised lower abdominal peritonism. A CT KUB (Kidney, Ureter and Bladder) was ordered and showed two collections, a 14cm×8.4cm×12cm retrovesical collection, with an air-fluid level and dense rim, and a 5cm×9.5cm×8.7cm retrocaecal collection with pockets of internal gas, but no free intraperitoneal gas. In the inferior aspect a well circumscribed calcific density, likely to represent an appendicolith was seen. The kidneys were normal with no evidence of hydronephrosis or calculi.
Mr K was diagnosed with missed appendicitis with perforation by the General Surgical team and started on intravenous cefuroxime and metronidazole. He underwent CT guided drainage of 500mL of purulent fluid, using an 8 French pigtail catheter (Figure 1).

Mr K gradually improved and was discharged on oral antibiotics. He was well when followed up in clinic, and booked for an interval appendicectomy.

**Figure 1. CT image during the guided drainage procedure**

![CT image during the guided drainage procedure](image)

**Discussion**

Appendicitis is a common medical condition, though as many as 20% may perforate within 24 hours, which may result in abscess formation. Management of appendicitis complicated by perforation can be either surgical (laparoscopic or open) or CT guided drainage and interval appendicectomy. CT guided drainage (followed by interval appendicectomy) has been shown to be safe and effective, with success rates of over 90%. While the risks of self diagnosis are evident and may be related to increased availability of information for the general public, this information when used appropriately can positively influence healthcare. Available information may result in improved self awareness, understanding, and a sense of self responsibility for patient care. It may also cause some patients to seek specialist advice when they otherwise
would not have. This case demonstrates the downside of such availability, and the potential pitfalls of inappropriate use of such information.

The delay in diagnosis in this case was a likely contributing factor in perforation and abscess formation illustrating the risks of self diagnosis. These risks are being increasingly documented and commonly surround over the counter medication. This case is particularly pertinent as the patient, after attempting self diagnosis consulted his family doctor. A major lesson to be learned is when formulating a differential diagnosis extreme care must be taken not to be unduly influenced by a patient’s self-diagnostic conclusion.1

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References:
Where there’s smoke there’s fire—ear candling in a 4-year-old girl

Jeremy Hornibrook

Abstract

It is estimated that one-third of the United States population subscribes to alternative medical therapies (Eisenberg et al, NEJM 1993;328:246–252). Ear candles are popular products promoted by alternative health practitioners, and sold by health shops and even over the Internet. They have been promoted for ear and sinus discomfort, rhinitis, sinusitis, glue ear, colds, flu, migraine, tinnitus, but particularly for removal of ear wax (cerumen). In this case report, a 4-year-old girl in New Zealand presents with otitis media and during the course of the ear examination white deposits were noticed on her eardrum; this was confirmed as being caused by ear candling.

Ear candling involves placing hollow beeswax candle (Figure 1) in the external auditory canal and allowing it to burn for about 15 minutes. The promoted theory is that the candle creates a vacuum which draws out cerumen, which collects in the stub of the candle.

Experiments using ear candles have been performed in model ears and in patient ears. In the ear model, gas chromatography showed that a powder deposit left on a plastic membrane had the spectrogram of multiples alkanes which are found in candle wax. No human cerumen constituents were found.

In the human ears where there was cerumen there was no evidence of its removal. In cerumen-free ears the ear candles deposited candle wax in the open ear canal. Consequently there have been reports of outer ear and eardrum damage from ear candling. However it is seldom stressed that while burning the candles emit a profuse plume of ‘smoke’. It has never been reported that the lasting presence of the ‘smoke’ in the ear canal and on the eardrum can be a vital clue that a patient is using ear candling.

Figure 1. A pair of beeswax candles (length 30 cm) sold in New Zealand
Case history

Over some years the author noted an apparently asymptomatic particular deposit in the ear canals and on the eardrums of adult patients. Eventually one was questioned about the use of an ear candle and this was confirmed. The following case history is presented with the permission of the hospital institutional board.

A 4-year-old girl with otitis media with effusion was being examined before planned tympanostomy tube insertion. There was a white particulate deposit covering the medial ear canal and the eardrum (Figure 2). Her mother was asked if the child had been treated with an ear candle and she confirmed that it was their regular practice for ear cleaning and had occurred 1 week prior.

Figure 2. Right ear canal in a 4-year-old girl with “glue ear”, showing a particulate deposit covering the floor of the ear canal and ear drum
Discussion

A questionnaire returned by 122 U.S. Otolaryngologists\(^1\) established that one-third were ‘aware’ of ear candle use amongst one or more of their patients. Fourteen had treated complications of ear candling, including 13 burns of the auricle and canal, 7 partial canal occlusions from candle wax and 1 eardrum perforation. These injuries have been specifically detailed by others.\(^2\)\(^–\)\(^4\) This is the first photo-documented report that stresses that the particulate deposit from the ear candle ‘smoke’ could indicate the use of ear candling.

In summary, the profuse smoke from an ear candle can leave a lasting particulate deposit in the ear canal and on the eardrum, a clue that ear candling has occurred. While doctors might assume that this is being used only on adults, this case confirms that ear candling is also being used by parents on their children.

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**References:**

Corrosive thoracodynia

Victoria Mayoral Campos, Claudia Bonnet Carrón, Beatriz Carro Alonso, Blanca Madariaga Ruiz, José María Sainz Martínez

A 59-year-old female with a background of hiatal hernia presented with a sudden onset of breathlessness and epigastric pain. On examination, there was evidence of intense pain on epigastric palpation.

She was haemodynamically stable at presentation, with oxygen saturations of 95% breathing room air, but during the next hours she showed a continuous decrease of the haematocrit and respiratory difficulties.

A chest radiograph (Figure 1) was obtained at presentation, and a thoracic computed tomography (CT) scan (Figure 2) was also obtained.

Figure 1. Chest radiograph

What is the diagnosis?

Figure 2. Images from a CT scan
Answer

The chest radiograph demonstrates a pneumomediastinum.

The CT scan confirmed the radiographic findings of mediastinal air collection and the clinical suspicion of oesophageal rupture.

Emergency surgery confirmed a perforation of the anterior wall of the distal oesophagus. Primary suture was performed. The operative procedure was tolerated well.

There was improvement in symptoms and significant resolution of pneumomediastinum on follow-up chest radiographs.

Discussion

CT scan is the diagnostic modality of choice in suspected Boerhaave’s syndrome as it provides more precise information regarding the presence of ectopic air.1

The cause of the serious cardiorespiratory embarrassment and shock-like condition is secondary to the accumulation within the mediastinal and pleural spaces of corrosive gastric juices, enzymes, food and bacteria.2

All clinicians need to be aware of this lethal disease, its frequent unusual presentations and the importance of early diagnosis.3

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Does intronic DNA give smokers a survival advantage?

The reason for a large proportion of cellular DNA being a non-coding repetitive sequence—intronic DNA ('junk' DNA)—remains puzzling, but it might confer an evolutionary advantage by protecting important genes from chemical insults. Cells are exposed to myriad genotoxic insults during their lifetime, but surprisingly few manifest as functional changes (e.g. carcinogenesis); perhaps intronic DNA is the mutation target for carcinogens which might explain the surprisingly low incidence of cancer in human populations exposed to carcinogens every day.

Smoking is a good example; it results in exposure to potent mutagens such as benzo[a]pyrene which is metabolised by cytochromes P450 to reactive diol epoxides which alkylate the 2-amino group of DNA guanine residues. These mutations might initiate carcinogenesis if not repaired. The in vitro alkylation rate in [3H]-benzo[a]pyrene-exposed lymphocytes from lung cancer patients is 2 x 10^-16 moles/cell/2h. This means that in 2h 1.2 x 10^8 benzo[a]pyrene molecules would alkylate DNA; since there are approximately 6.4 x 10^9 nucleotides in the human genome this represents approximately 2% alkylation of the genome.

Cellular DNA repair mechanisms will undoubtedly put right many of these mutations, but some will remain for long enough to be amplified by cell division (i.e. promotion) and thus might lead to cancer. This explains why the cumulative risk of lung cancer to age 75 for smokers (e.g. in the UK = 15.7%) is very much greater (e.g. in the UK, 78-fold) than for non-smokers (e.g. in the UK = 0.2%)².

In addition, O⁶-methylguanine repair efficiency is reduced in lung cancer patients³ which means that mutations are likely to have a greater impact in these people because they are less efficiently repaired. The fact that cancer patients’ cells have an inbuilt inefficiency in DNA repair and that long-term smokers have a regular intake of potent carcinogens would suggest a greater cancer risk for smokers compared to controls than is the case. This points to either DNA repair being very efficient or that the key DNA sequences involved in cancer initiation and promotion are not damaged.

It is likely that the majority of the DNA alkylated is intronic DNA because it is a large proportion of total cellular DNA; if this were the case, there would be few physiological consequences which might, in turn, explain the lower than expected cancer risk in smokers. Therefore, Intronic DNA might give cells an evolutionary advantage by mopping up extraneous alkylation capacity so protecting the DNA that codes for proteins with important cell functions. Perhaps this is why intronic DNA evolved; it is an ingenious carcinogen detoxification mechanism.

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Increases in disease in Malayan war veterans’ children may be misleading

The conclusions reached by Carran and Shaw 1 on the health of offspring of Malayan war veterans who served in 1948 to 1960 and live in Canterbury are likely to be incorrect and misleading. McBride and Schep 2 have already emphasised the weaknesses in this study, which uses data from a questionnaire sent not to the people concerned, but to their fathers, with only a 34% response rate, without any validation of the data, and without information on the attained ages of the offspring. As well as these issues, the comparison figures used are incorrect. For breast cancer, 3 cases in 76 women were reported (4%); this is compared to a figure of 0.48% from a US source. But this comparison rate is an annual incidence rate, while the survey assessed any breast cancer occurring up to the time of the survey. This will give a cumulative incidence rate, dependent on age at diagnosis, age at the time of the survey, and calendar year (none of which are given). An approximate rate can be calculated from New Zealand incidence data; 3 the risk reaches 4% at age 50–55, and 8% by age 69. The 4% observed cumulative incidence may not be any greater than the usual rate.

For hypospadias, Carran and Shaw report a rate of 2 cases in 79 males, 2.5%, which they say was statistically significantly higher than comparison rates they use of 0.33% in 2000 and 0.30% in 2005. Perhaps they have included both male and female livebirths in the denominator. The correct national rate for 2000 is 0.65% (189 cases 4, which also includes a small number of epispadias cases, among 29,157 male livebirths 5) and for 2005, 0.55% (162 cases among 29,546 male livebirths). The period over which the survey cases were born is not given. The 2000 to 2005 national rate is 0.65% (1125 cases among 173,177 male livebirths). Using that gives a relative risk is 3.90 with a 95% confidence interval of 0.99–15.3, which indicates that the rate of hypospadias in the survey is marginally statistically significantly higher than this national rate, but not to the extent cited by Carran and Shaw.

The calculations for cryptorchidism (or undescended tests) are similarly flawed; the correct rates are 2.13% (622 cases) in 2000 and 1.79% (529 cases) in 2005 4. Again using the national rate for 2000 to 2005, 1.78% (3427 cases among 173,177 male livebirths), the 4 cases recorded give a relative risk of 2.56 with a 95% confidence interval of 0.98–6.65, not quite statistically significantly increased.

So for both cryptorchidism and hypospadias, Carran and Shaw’s data do show increased rates compared to the national data for 2000 and 2005, but the rates are based on very small numbers (4 and 2 cases); the excess is not quite statistically significant at the 5% level and so could be due to chance, and the potential for recall and selection bias in using questionnaire data only from the father, with a minority of subjects responding, is high. Time trends over the last 60 years could also affect the expected numbers; there have been recorded increases in both these defects, but these could be influenced by changes in recording 6. For breast cancer the data has not been correctly analysed and no excess may be present.
A much better study is needed before conclusions are drawn. The conclusions of Carran and Shaw may be misleading, and may create unwarranted anxiety in veterans and their families.

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WELLINGTON, April 20.

The Hospital Board decided yesterday to expend £817 8s. in procuring panel pictures to be used in adorning the interior walls of the new Children's Hospital. Speaking for the Hospital Committee, Mr. R. C. Kirk remarked that at a recent meeting the Hospital Committee had been empowered to make inquiries as to the cost of providing internal decorations at the Children's Hospital. The medical Superintendent (Dr. Hardwick Smith), had strongly urged the Committee to procure Doulton ware panels of considerable size, to be erected over the cots. The panels would illustrate nursery tales, and similar subjects. In Australia and elsewhere these tablets had been installed in children's wards with satisfactory results. Dr. Hardwick Smith was not getting all that he would like, but the Committee had recommended the allocation of the largest sum it thought advisable.

The Annual Hospitals Conference will open in Wellington on June 14th. The North Canterbury Board, at its meeting to-day received, *inter alia*, the following draft remits from its Policy Committee:—

(1) Consideration of provision for Sanitoria for Consumptives on lines laid down in Dr. Blackmore's report, namely, one sanatorium for the North Island, and one for the South Island. In this connection the Government to be asked, as a step towards stamping out consumption, to bring this disease within the scope of infectious diseases for compulsory treatment, also to give powers to hospital and charitable aid boards of legal detention of all patients in infectious hospitals and institutions during periods medically declared necessary for the recovery of such patients,

(2) Necessity of founding a state School for defective girls, similar to that established for boys at Otekaike*, and a State home with powers of detention for women of feeble character, whose proclivities are a source of danger to the community, both from a physiological and moral point of view.

(9) Visiting of out-patients at their homes by qualified nurses, and consideration of the question of setting up dispensaries elsewhere than at public hospitals.

(Where is it going to end?—Ed. N.Z.M.J.)

Leptin signaling through STAT3 and STAT5 pathways is not required for fertility in mice. A Singireddy, G Anderson. Centre for Neuroendocrinology and Department of Anatomy, Otago School of Medical Sciences, University of Otago, Dunedin.

The peptide hormone leptin is critical for the regulation of body weight as well as fertility. Lack of leptin or leptin receptors leads to obesity and infertility. The long-form leptin receptor (LepRb) mediates leptin actions in the hypothalamus through multiple signaling pathways, including Janus kinase-signal transducer and activator of transcription (JAK-STAT) pathways. Previous studies have shown that deletion of STAT3 or STAT5 from the brain results in an obese phenotype, suggesting that these pathways are critical for body weight regulation. However, their involvement in leptin-mediated regulation of fertility remains unclear. The present study investigates the roles of STAT3 and STAT5 in leptin modulation of fertility.

A Cre-loxP transgenics approach was used to delete STAT3 (n = 6), the closely related STAT5 (n = 7), or both STAT3 and STAT5 (n = 9) specifically from leptin receptor expressing cells to investigate their role in the regulation of fertility. Immunohistochemical analysis confirmed the inability of leptin to induce phosphorylation of STAT3 and STAT5 in mutant mice. Body weight and reproductive function were measured in all mutant mice and their littermate controls.

Knocking out STAT3 or both STAT3 and STAT5 from LepR expressing cells, but not STAT5 alone led to obesity (P < 0.05, two-way ANOVA), suggesting that leptin-specific STAT3 signaling is crucial for body weight regulation. All STAT3 and STAT5 single knockout (KO) mice exhibited normal puberty onset and fertility compared to control littermates. Surprisingly, STAT3 and STAT5 double KO mice also exhibited normal puberty onset and subsequent fertility (mean difference ± SEM, litters born control 4.1 ± 0.5; litters born double KO 4.0 ± 0.3, P > 0.05, student’s t-test).

These results suggest that while STAT3 signaling is crucial for the regulation of body weight, neither STAT3 or STAT5 is required for regulation of fertility by leptin.

Sympathetic modulation of cardiac function in diabetes – paired in vivo and ex vivo study. 1A Thaung, 2C Baldi, 1D Schwenke, 1R Lamberts. 1Department of Physiology, Otago School of Medical Sciences, 2Department of Medicine, Dunedin School of Medicine, University of Otago, Dunedin.

The burden of type 2 diabetes mellitus (T2DM) is increasing globally. The majority of T2DM patients suffer from diabetes-related cardiovascular disease, such as heart failure. The literature hints at augmented sympathetic nerve activity (SNA) as being...
accountable for this increased risk of cardiovascular disease. Prior findings on cardiac SNA in T2DM were interpreted based on data obtained from recording of muscle SNA, renal SNA, or plasma noradrenaline spillover. Central control of SNA is differentially regulated to different organs. Therefore, it is important to assess SNA to the heart in diabetes. The aims of our study were i) to measure the sympathetic nerve input to the heart \textit{in vivo} and ii) to assess $\beta$-adrenergic receptor ($\beta$-AR) responsiveness of the heart to the nerve input \textit{ex vivo}.

Cardiac SNA was directly recorded in Zucker Diabetic Fatty rats (T2DM model) and their nondiabetic littermates \textit{in vivo} (urethane anesthesia, 1.5 g/kg, intraperitoneal). Cardiac responsiveness to dobutamine ($\beta$-AR agonist, 10 $\mu$M) was assessed using the Langendorff-perfused isolated heart retrieved from the same animal \textit{ex vivo}.

Preliminary data suggests that sympathetic drive to the heart in diabetic rats is elevated (mean difference ± SEM, diabetic SNA = 0.90 ± 0.53 $\mu$V.s, n = 5; nondiabetic SNA 0.66 ± 0.14 $\mu$V.s, n = 5). Cardiac responsiveness to dobutamine indicated a reduced response in diabetic rats (diabetic left ventricular pressure = 124 ± 12; nondiabetic left ventricular pressure 186 ± 16 mmHg).

This study is the first to directly record cardiac SNA in diabetes. In addition, the paired \textit{in vivo} and \textit{ex vivo} approach in the same animal provides the ability to distinguish between the central regulation of cardiac function and the intrinsic functional capacity of the heart in diabetes, respectively. This provides a unique opportunity to understand how the sympathetic nervous system regulates cardiac function in diabetes.

\textbf{Reduced cardiac function and $\beta$-adrenergic receptor responsiveness in the isolated human diabetic myocardium. H-Y Wang$^1$, J Baldi$^2$, P Saxena$^3$, S Coffey$^{2,4}$, M Williams$^{2,4}$, R Lamberts$^1$. $^1$Department of Physiology, Otago School of Medical Sciences, $^2$Department of Medicine, Dunedin School of Medicine, University of Otago, $^3$Department of Cardiothoracic Surgery, $^4$Department of Cardiology, Dunedin Hospital, Dunedin.}

The prevalence of type 2 diabetic mellitus is closely associated with cardiovascular complications. Despite unknown aetiologies, it is established that patients with preserved ejection fraction (EF) are still vulnerable to heart failure. Until now, little is known about the specific functional effects of diabetes on a heart with preserved EF and hence this study aimed to address this by investigating the functional parameters of the heart from these diabetic patients. It is hypothesised that isolated cardiac muscles from diabetic patients will have reduced functional parameters both at basal conditions, and after $\beta$-adrenoceptor ($\beta$-AR) stimulation mimicking a physiological stress response.

Using isolated cardiac muscles obtained from right atrial appendages of patients undergoing coronary artery bypass grafting, functional characteristics of non-diabetic (n = 8) and diabetic myocardium (n = 6) were compared. Samples from patients who had acute coronary artery disease and reduced EF (< 40%) were excluded. Contractile and relaxation parameters of both cohorts were first determined under basal conditions, then in response to a $\beta$-AR agonist (dobutamine, 0.1 to 10 $\mu$M).
Compared to non-diabetics, diabetic muscles had a slower rate of maximum contraction (+dF/dt\text{max}) (287 ± 55 vs. 220 ± 19 mN/mm\text{2}/s, \(P < 0.05\), Student’s t-test) and relaxation (-dF/dt\text{max}) (-188 ± 25 vs. -130 ± 14 mN/mm\text{2}/s, \(P < 0.05\)) with prolonged relaxation times under basal conditions. The diabetic muscles were also less responsive to \(\beta\)-AR stress response, as shown by the lesser increase in developed tension, +dF/dt\text{max} and -dF/dt\text{max}, and smaller reduction relaxation times. These results suggest that cardiac muscles from diabetic patients contract less forcefully, as well as having a prolonged relaxation time under basal conditions and during \(\beta\)-AR activated stress.

In conclusion, diabetic human atrial myocardium from patients with preserved EF has systolic and diastolic dysfunctional characteristics, and reduced \(\beta\)-AR responsiveness.

Colocalisation of estrogen receptor alpha with leptin receptor-expressing cells in the hypothalamus of the mouse using transgenics. J Kim, G Anderson. Centre for Neuroendocrinology and Department of Anatomy, Otago School of Medical Sciences, University of Otago, Dunedin.

Leptin and 17\(\beta\)-estradiol (\(E_2\)) are two seemingly distinct hormones that are critical regulators of both energy balance and reproduction. \(E_2\) has similar anorexigenic effects to that of leptin, and both hormones exert their effects in many overlapping hypothalamic regions to regulate nutrition and fertility. Estrogen receptor alpha (ER\(\alpha\)) has been suggested to interact with the leptin signaling pathway, modulating leptin sensitivity. Technical difficulties of leptin receptor (LepR) immunohistochemistry, identifying hypothalamic cells that are both leptin and \(E_2\) responsive has been inconclusive. Using two different, highly specific transgenic mouse models, the project aims to characterise hypothalamic cells that are both \(E_2\) and leptin-responsive.

This study utilised transgenic mice that express green fluorescent protein (GFP) from the LepR promoter, or in neuropeptide-Y (NPY) neurons, which are known to be leptin-responsive. Brains were harvested from euthanized mice, the preoptic area and entire hypothalamus were sliced into 30\(\mu\)m coronal sections. A subcutaneous injection of leptin (1mg/kg) was administered and phosphorylated STAT3, a marker of LepR activation, was colocalised with GFP; confirming that the GFP expressing cells are indeed leptin responsive. Following validation of the transgenic model, we used immunohistochemistry to determine if ER\(\alpha\) colocalises with the GFP expressing Leptin responsive cells.

A low percentage of GFP positive LepR cells co-expressing ER\(\alpha\) were observed in the arcuate nucleus (24%), ventromedial hypothalamus (25%), and ventral premamillary nucleus (35%). However, high coexpression was recorded at the medial preoptic area (88%), and moderate to high amounts at the rostral dorsomedial hypothalamus (64%) and lateral hypothalamus (62%). We then explored the possibility that \(E_2\) and leptin may selectively interact in specific cell types, however we observed no colocalisation of ER\(\alpha\) with NPY-positive neurons.

This project has provided a reliable identification of LepR-ER\(\alpha\) colocalisation and explores the mechanisms underlying the anorexigenic effects of \(E_2\). Furthermore, it
identifies the potential leptin responsive cells that may be involved in the link between nutrition and fertility.

**Triadin decreases the propensity for Store Overload Induced Calcium Release (SOICR).** M Deo, J McLay, P Jones. Department of Physiology, Otago School of Medical Sciences, University of Otago, Dunedin, New Zealand.

Arrhythmia occurs in a number of heart diseases including heart failure (HF). It has been shown that Store Overload Induced Calcium Release (SOICR) is a common mechanism underlying many types of arrhythmia. SOICR occurs due to the inappropriate opening of the cardiac ryanodine receptor (RyR2) once calcium in the sarcoplasmic reticulum (SR) reaches a certain threshold. RyR2 forms a large macromolecular complex with other proteins. One such protein is triadin; which is known to be lost from the RyR2 complex in HF. In the present study, we aim to characterise the effect of triadin on the threshold for SOICR to determine whether the loss of triadin could be responsible for the arrhythmias associated with HF.

Single cell fluorescence imaging in HEK 293 cells stably expressing RyR2 with or without transfection of triadin, using the luminally targeted calcium indicator protein D1ER, showed that the expression of triadin increased the threshold for SOICR (86.2% ± 0.03%, n = 77, p < 0.001, mean % of maximum store ± S.E.M, unpaired t-test) as compared to RyR2 alone (79.5% ± 0.78%, n = 54), suggesting the presence of triadin inhibits SOICR. This was confirmed by measuring the occurrence of SOICR (increases in cytosolic calcium) using the cytosolic calcium dye Fluo-4-AM. This showed that SOICR occurs less readily in cells expressing RyR2 and triadin (65.3% ± 1.8%, n = 21, p < 0.01, at 1mM extracellular calcium) than in cells expressing RyR2 alone (75.0% ± 2.5%, n = 22).

These results provide evidence that the presence of triadin reduces the propensity for SOICR by increasing the threshold that SR calcium must reach to trigger SOICR. Conversely, this suggests that the loss of triadin in HF is arrhythmogenic. Therefore, stabilising the interaction of triadin with RyR2 in patients susceptible to arrhythmias is likely to be therapeutic.

**Macrophage and T cell distribution in autoimmune inflammation of the gut.** E Dunn¹, E Taylor¹, M Schultz², G Butt³, R Kemp¹. ¹Department of Microbiology and Immunology, Otago School of Medical Sciences, ²Dunedin School of Medicine, ³Department of Physiology, Otago School of Medical Sciences, University of Otago, Dunedin.

The autoimmune diseases Inflammatory Bowel Disease (IBD), Spondyloarthritis (SpA) and Type 1 Diabetes Mellitus (T1DM) have epidemiological, symptomatic and genetic overlap. Many patients with IBD develop SpA and overlapping genetic loci exist between IBD and T1DM patients. This genetic and symptomatic crossover between IBD, SpA, and T1DM suggests a role for the immune system in linking these diseases. The aim of this study was to establish methods for intestinal T cell and macrophage analysis with which to investigate the pathophysiological crossover between intestinal inflammation in patients with IBD, SpA and T1DM.
Intestinal tissue biopsies are collected from healthy or diseased patients, dissociated, then cells labelled with cell-specific antibodies and analysed using flow cytometry. Methods were initially optimised using healthy donors.

Analysis of different areas of the intestinal tract of healthy individuals using these techniques revealed increased T cell frequencies in the terminal ileum (TI) compared to the colon (24.9 ± 3.4% and 9.2 ± 2.1%, respectively, mean ± SEM, n = 5, P < 0.001, One-way-ANOVA with Tukey’s posthoc test). Further analysis of TI mucosal tissue from IBD patients revealed increases in inflammatory (IL-17+) (IBD, 1.1 ± 0.4%; control, 0.23 ± 0.04%, n = 3, P < 0.05, unpaired Student’s t-test) and CD8+ regulatory (FoxP3+CD25Hi) T cells (IBD, 0.95 ± 0.20%; control, 0.16 ± 0.06%, n = 3, P < 0.01). This illustrates the efficacy of these methods in analysing healthy and inflamed environments and that IBD mucosa harbours distinct immune populations. Macrophages have also been identified by these methods, and their phenotypes in intestinal mucosa of IBD, SpA and T1DM patients will now be characterised.

Knowledge of the presence and function of innate and adaptive immune cell populations will provide insight into the linkages between IBD, SpA and T1DM, and show how the immune balance has been altered to favour disease progression.

Improved atrial relaxation in human type 2 diabetes mellitus, S Lingam1, P Saxena2, S Coffey3,4, M Williams3,4, J Baldi4, R Lamberts1, P Jones1.
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Type 2 diabetes mellitus (T2DM) is characterised by impaired relaxation of the heart that can eventually lead to heart failure. The cardiac relaxation pathway is governed by the combined activity of sarcoplasmic reticulum Ca$^{2+}$-ATPase (SERCA2a) and phospholamban (PLB). SERCA2a actively resequesters free cytosolic Ca$^{2+}$ to the sarcoplasmic reticulum, promoting cardiac relaxation, whereas PLB inhibits this SERCA2a activity, thereby reducing cardiac relaxation. Several type 1 diabetes mellitus (T1DM) animal and human studies and a few T2DM animal studies have found decreased SERCA2a activity and increased PLB expression in the left ventricle of the heart, indicating this is a mechanism which impairs cardiac relaxation in diabetes. The present study investigates the protein expression of SERCA2a and PLB in humans with T2DM.

To examine the level of SERCA2a and PLB protein expression, we carried out western blotting analysis in human atrial appendages from T2DM (n = 5) and non-diabetic (n = 15) patients with preserved contractile function, undergoing coronary artery bypass surgery (CABG). Blot analysis (mean ± SEM, unpaired t-test) revealed similar total SERCA2a protein levels between T2DM and non-diabetic patients (T2DM 0.98 ± 0.2, non-diabetics 0.80 ± 0.1, P = 0.88). There was, however, a significant decrease in PLB protein levels in T2DM patients compared to non-diabetic patients (T2DM 0.98 ± 0.2, non-diabetics 0.80 ± 0.1, P = 0.88). There was, however, a significant decrease in PLB protein levels in T2DM patients compared to non-diabetic patients (T2DM 1.33 ± 0.4, non-diabetics 2.20 ± 0.4, P = 0.02), resulting in a decreased PLB:SERCA2a ratio in T2DM patients compared to non-diabetic patients (T2DM 2.00 ± 0.8, non-diabetics 5.60 ± 1.5, P = 0.17).
Thus, in contrast to previous studies in diabetic animals (T1DM and T2DM) and humans (T1DM), our current data in T2DM patients, without contractile dysfunction, indicate increased SERCA2a activity, suggesting improved atrial relaxation. This suggests that in the pre-failing diabetic heart SERCA2A activity is increased as a compensatory mechanism against other diabetic changes that reduce cardiac relaxation.

Characterisation of a tamoxifen-inducible STAT5 knockout mouse. P Gustafson, S Bunn, D Grattan. Department of Anatomy, Otago School of Medical Sciences, University of Otago, Dunedin.

Prolactin synthesis and release is regulated by activation of the hypothalamic tuberoinfundibular dopaminergic (TIDA) neurons. While experiments using a genetic knockout (KO) suggest that signal transducer and activator of transcription 5 (STAT5) mediates this activation, a developmental loss of TIDA neurons compromises this conclusion. Therefore, this projected aimed to characterise an inducible STAT5 KO model in which neuronal development is preserved.

Transgenic mice were generated using the tamoxifen-inducible LoxP-Cre recombinase (Cre) system to delete STAT5 from adult females (0.2mg tamoxifen per day for 5 days, intraperitoneal). Wildtype (WT) and inducible STAT5 KO mice were treated with prolactin (0.2mg for 20 min, intraperitoneal) before being euthanized. Neural tissue was collected and 30µm coronal sections were taken through the hypothalamus. Cre, tyrosine hydroxylase (a marker for the TIDA neurons) and phosphorylated STAT5 (pSTAT5) expression was detected using immunohistochemistry.

TIDA neuron number in STAT5 KO mice (122 ± 6, mean ± SEM, n=7) was not significantly different to WT control mice (112 ± 6, n=12; P=0.26, Student’s t-test). Tamoxifen induced Cre nuclear translocation in approximately 50% of these neurons. The percentage of TIDA neurons expressing pSTAT5 in STAT5 KO mice (55 ± 6%, n=8) was not significantly different from inducible-Cre control mice (51 ± 1, n=3). Tamoxifen initially suppressed prolactin levels from 199 ± 86ng/ml to 24 ± 3ng/ml in STAT5 KO mice. Levels recovered back to that of untreated WT control mice (250 ± 34ng/ml) after three weeks but then fell again after four (44 ± 11ng/ml) and six (55 ± 13ng/ml) weeks (P=0.0011, one-way ANOVA with Dunnett’s posthoc test).

TIDA neuron number was preserved in STAT5 KO mice. Tamoxifen did not delete STAT5 from TIDA neurons but the complex temporal profile of prolactin levels in the KO suggests STAT5 deletion may have occurred in another neuronal population that regulate prolactin secretion.
Symptom presentations and other characteristics of colorectal cancer patients and the diagnostic performance of the UK NICE Referral Guideline for Suspected Colorectal Cancer in the South Auckland population

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Aim: To review the presenting symptoms of colorectal cancer in the ethnically diverse South Auckland population

To evaluate the performance of both the Regional grading criteria and its NICE Guideline precursor as prediction tools for selecting colorectal cancer cases referred from primary care

Method: Retrospective review of all colorectal cancer (CRC) cases diagnosed between 2006 and January 2011. Information extracted from case note review was used to grade patients using both criteria.

Results: 573 patients were included. Outpatient presenting symptoms: rectal bleeding (42.1%), change in bowel habit (25.1%), and abdominal pain (15.3%). Inpatient symptoms: abdominal pain (34.8%), rectal bleeding (32.4%), change in bowel habit (24.2%), and constipation (18.8%).

41.7% of Pacific Island (PI) patients had stage IV disease compared to 23.6% of other groups combined (p<0.01). The tumour non-resection rate of Pacific Island group was 33.3% compared to 15.6% (European), 15.2% (Maori) and 8.0% (Asians), respectively (p=0.002). The age-adjusted mortality rates was: European 14.92, Maori 3.27, Pacific people 5.21, and Asian 1.05 (per 100,000)

The Regional grading criteria and NICE Guideline would miss 27.7% and 33.2% of the presenting symptoms of CRC patients in the referral population.

Conclusion: While rectal bleeding and change in bowel habit are frequent presenting symptoms, low-risk atypical symptoms including constipation, weight loss and abdominal pain were not uncommon.

Significant proportion of Pacific Island patients present with late stage disease.

Both the Regional grading criteria and NICE guideline would miss significant proportion of our study population with colorectal cancer.
The 2012 Characteristics and Antibiotic Susceptibility of treatment naïve \textit{Helicobacter pylori} Infections in South Auckland, New Zealand (Interim result)

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Aims:

1. To ascertain the current prevalence of \textit{H. pylori} infection in the ethnic diverse population of South Auckland
2. To assess the current antibiotic susceptibility of treatment naïve \textit{H. pylori} infection in patients undergoing gastroscopy and provide up to date treatment recommendations

Methods: Prospective study of consecutive patients undergoing gastroscopy between February 2012 and September 2012. Prevalence data was determined from all Campylobacter-Like organism (CLO) tests performed. Following informed consent CLO test was performed at routine gastroscopy. Biopsies for culture and antibiotics testing were obtained. Bacterial culture and resistance testing to common antibiotics (amoxicillin, tetracycline, clarithromycin, metronidazole and moxifloxacin) was performed. Eradication success was determined by following stool antigen clearance.

Results: The prevalence of \textit{H. pylori} infection among treatment naïve patients by ethnic group was: Maori (34.8%), Pacific people (31.3%) and Asian (23.8%). The interim results from 68 CLO positive patients were:

- Endoscopic indication- 19.1% iron deficiency anaemia, 20.6% dyspepsia, and 26.5% gastrointestinal bleeding.
- Antibiotic resistance: Amoxicillin 4.2% (2/48), Tetracycline 0.0% (0/48), Metronidazole 47.9% (23/48), Clarithromycin 12.5% (6/48), Moxifloxacin 7.9% (3/38 – extrapolating from levofloxacin breakpoints).
- Dual resistance to clarithromycin and metronidazole was 4.2%.
- Clearance testing: compliance 95.1% (39/41 patients) and success 76.7% (23/30).

Discussion: \textit{H. pylori} infection is very common among the Maori, Pacific and Asian groups. The resistance to clarithromycin and metronidazole is significant among treatment naïve patients.

Conclusion: Resistance to Clarithromycin and Metronidazole has increased over historical NZ data and may contribute to low clearance rate. The current guidelines should be reviewed with respect to first-line regimens.
Adherence to Hepatocellular Carcinoma (HCC) Surveillance Guidelines

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2New Zealand Liver Transplant Unit, Auckland City Hospital, Auckland

Introduction: Local guidelines recommend six monthly hepatic ultrasound (US) and alpha –fetoprotein (AFP) testing for patients with a high risk of developing hepatocellular carcinoma (HCC).

Aim: To assess the adherence to HCC surveillance guidelines at our institution.

Method: Patients with a high risk of HCC between 2007 and 2011 were identified from our clinic database. A retrospective review of electronic records was undertaken to record clinic attendance and adherence to six monthly AFP and US surveillance.

Results: A total of 460 patients were identified. Cirrhosis was present in 409, severe hepatic fibrosis in 38, chronic hepatitis B and a family history of HCC in 13. European ethnicity was observed in 36%, Asian 23%, Pacific Island 20%, and Maori 12%. The aetiology of the underlying liver disease was: HBV (41%), Hepatitis C (23%), and Alcohol related liver disease (16%). The median age at diagnosis was 56 years, 62% were male. The median duration of surveillance was 3.4 years. HCC was detected in 23 patients (5%). The overall adherence rate for AFP testing and US surveillance was 79% and 59%, respectively. US adherence correlated strongly with clinic attendance but even in those attending regularly, 20% of US surveillance scans were missed.

Conclusion: The poor performance of US surveillance highlights the rationale for continuing AFP testing at this time. Strategies that we have undertaken to improve US surveillance rates include: a patient education brochure, nurse specialist cirrhosis clinics, and improving clinic non-attendance procedures. We are endeavouring to organise a radiology based recall system.

Predictors of serologic and clinical outcomes in childhood-acquired HBV infection in New Zealand Māori: results of 28 year longitudinal study

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Background: High baseline HBV DNA is associated with increased risk of liver-related complications in Asians with vertically-transmitted chronic hepatitis B virus (HBV) infection. This longitudinal study evaluates the baseline predictors for
liver-related complications and serologic outcomes in 572 patients identified from a 1984 seroprevalence study with early horizontally-acquired HBV infection.

Methods: Serum samples from 1984 were tested for HBeAg, HBV DNA and HBsAg level. Liver-related mortality and hepatocellular carcinoma (HCC) incidence were previously determined in these 572 HBV carriers compared to 1142 HBsAg-negative case-controls. Transient elastography (TE) was performed in 2012 in all surviving HBsAg+ individuals. Cox-proportional hazards models were used to determine independent baseline predictors for five long-term outcomes: severe fibrosis (TE>8KPa), HCC, liver-related mortality and HBsAg+HBeAg seroconversion.

Results: After 28 years, 14 HBsAg+ patients developed HCC (vs none in HBsAg-controls [P<0.001]). 11 HBsAg+ patients died from liver-related causes (vs none in controls [P<0.001]). To-date, 291/515 (57%) surviving HBsAg+ patients have been followed-up. 25% had elevated ALT; 12% had severe fibrosis/cirrhosis (TE>8KPa). Increasing age, Māori ethnicity and baseline HBV DNA were predictors for liver-related death and HCC. Māori ethnicity was a predictor for severe fibrosis. Baseline HBsAg level and gender were not predictors for long-term outcome. Since 1984, 90% of HBeAg+ patients have undergone HBeAg seroconversion (median age=23 yrs [range 6-66]). 31% spontaneously lost HBsAg (median age 39 yrs [range 9-80]), with higher rates in HBeAg-(44%) vs HBeAg+ patients (9%)(p<0.0001).

Conclusions: In a young Māori population with early horizontally-acquired HBV, HBV DNA, but not HBsAg-level, was associated with increased risk for liver-related complications. Higher rates of spontaneous HBeAg and HBsAg loss are seen compared to Asians HBV populations.

Disclosure statement: The authors have no disclosures.

CMV and EBV disease in adult liver transplant recipients
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Introduction: Herpes virus infections are an important cause of morbidity and mortality following solid organ transplantation. NZLTU has used CMV antiviral prophylaxis in all D+/R- transplants. This audit determines the incidence of CMV disease and EBV disease.

Methods: CMV and EBV D/R serostatus was collected prospectively. Pharmacy and virological data were used to identify CMV and EBV infection and disease.

Results: 409 adult liver transplants were evaluated. CMV serostatus was D+/R- in 57 (12.5%), D-/R+ in 112 (27.4%), D+/R+ in 188 (46%), D-/R- in 51 (12.5%). CMV infection was detected in 47 patients (11.5%), at mean 41 weeks. There were 26 cases of CMV disease (6.4% total), diagnosed at mean 57 weeks. CMV disease developed in 16 D+/R- (28.1%), 5 D-/R+ (4.5%) and 5 D+/R+ (2.7%). Mycophenolate was associated with increased risk of CMV disease (RR 4.0; 95% CI 2.3 – 3.8; p<0.0001).

EBV serostatus was D+/R- in 17 (4.8%), D-/R+ in 29 (8.3%), D+/R+ in 302 (86%), D-/R- in 3 (0.9%). Six cases of EBV-associated PTLD (1.5% total) were diagnosed at mean 86 weeks. EBV disease developed in 5 (29.4%) D+/R- and 1 (0.3%) D+/R+.
Conclusion: Antiviral prophylaxis has reduced incidence and delayed onset of CMV disease in D+/R- transplants. Mycophenolate is associated with an increased risk of CMV disease. EBV D+/R- transplants have a high rate of PTLD. Better EBV prophylaxis and monitoring regimens are needed.

Entecavir in Chronic Hepatitis B – “Real World” Experience

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Introduction: Entecavir is an approved antiviral treatment for chronic hepatitis B¹. Global registration trials demonstrated excellent safety and efficacy – serum HBV DNA undetectable in 90% after 48 weeks of treatment.² Similar results have been reported in “real-world” experience.³

Methods: This is an audit of patients at Auckland and Middlemore Hospitals treated with entecavir for at least 12 months. Patients were excluded if they had prior antiviral therapy, or a diagnosis of HCC within 12 months. Data on ALT, HBV DNA, resistance studies, ethnicity and HBeAg serology was collected. Clinic notes were reviewed for evidence of treatment adherence.

Results: Entecavir was approved in 459 patients, of whom 351 have received 12 months therapy. After exclusions there were 108 HBeAg positive and 157 HBeAg negative. Twenty (18.5%) HBeAg positive patients underwent HBeAg seroconversion. Of the remaining 88 eAg positive patients, HBV DNA was suppressed to undetectable or ≤3 log in 60 (68.2%). In the 28 subjects with sub-optimal virological response, 10 were adherent and had decreasing HBV DNA whilst the remaining 18 had poor adherence/ nonattendance.

Of the HBeAg negative patients, 111 (71.2%) had undetectable HBV DNA, 15 (9.6%) had levels < 3 log IU/mL. Seven (4.5%) had sub-optimal virological response, all showed poor adherence. Sequencing studies did not identify resistance mutations.

Conclusion: The efficacy and safety of entecavir is in clinical practice is similar to that observed in registration studies, with 80.7% and 74.1% viral suppression in eAg negative and positive chronic hepatitis B patients respectively. Lack of response reflected poor adherence rather than entecavir resistance.

References:

Prealbumin measurement as a guide to adequate nutritional supports in patients receiving parenteral nutrition

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North Shore Hospital, Auckland, New Zealand

Prealbumin is a visceral protein and negative acute phase reactant used as a nutritional status screening tool to detect malnutrition. Its relatively short physiological half-life of 48 to 72 hours provides a dynamic measure of protein-energy status and adequacy of nutritional support (1). A rise in prealbumin of greater than 0.04 g/L has been suggested to indicate switch from a catabolic to an anabolic state (2).

**Aims:** To assess the use of serial measurements of serum prealbumin in patients receiving short-term parenteral nutrition (PN), to determine whether anabolism can be achieved during short-term PN and the relation between change in prealbumin and acute phase response level indicated by C-reactive protein (CRP).

**Methods:** Retrospective review of Nutrition Support Database from May 2005 to May 2012.

**Results**:
From 494 patients identified receiving PN, 142 patients had paired prealbumin and CRP data available.

Negative correlation was confirmed between CRP and prealbumin (r=-0.52). Following PN therapy the mean C-reactive protein decreased from 123 to 53 mg/L (p<0.001). Mean serum prealbumin increased from 0.12 to 0.22 g/L (p<0.001).

Prealbumin rise of greater than 0.04 g/L was achieved in 72% (n=102) of patients. Mean CRP after completion of PN in this group was significantly less (42 vs 83 mg/L, p<0.001), suggesting ongoing inflammation may impede visceral protein synthesis.

**Conclusion:** Serial prealbumin measurements in patients receiving short-term parenteral nutrition are a useful guide to the adequacy of nutritional support.

An anabolic state switch can be achieved in most patients despite persistent systemic inflammatory response.

**References**

The Scratch Test for identifying the lower liver edge is at least as accurate as percussion and is more effective for trainees - a randomized controlled study

Huelsen A,1,2 Fischer J,1 Hegarty J,3 Lim JY,2 Burnside MJ,2 Karim SN,2 Onyango N,2 Frampton C,4 Spencer AJ,2 Barclay ML.1,4

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Introduction: Clinical examination of the liver requires experience to achieve accuracy. The scratch test is a simple technique to identify the lower liver edge and enhance liver palpation, and may be easier for trainees.

Aims and Methods: We aimed to evaluate the accuracy of the scratch test compared to percussion at different levels of medical training. Eight examiners, from trainee intern to consultant level, were randomized to scratch or percussion testing, followed by liver palpation, on 50 subjects. Later, each examiner performed the alternative test on each subject. Confidence with each test was rated 0-3 (unsuccessful - very confident). Ultrasound scan (USS) was performed as a reference for liver location.

Results: Ultrasound revealed 33/50 (66%) of livers extended below the right costal margin in the midclavicular line during quiet respiration (range 0-16cm). Of these 33, 84% and 81% were identified within 2cm of the USS location using scratch and percussion tests, respectively (p>0.05) for all examiners, but with greater accuracy for the scratch test in young trainees (86% v 80%). Ability to palpate the liver was not different following either test. Examiner confidence in the test result was significantly higher using the scratch test versus percussion, average confidence scores being 2.2 versus 1.8 (p=0.007), with a greater difference in the young trainee group (p=0.003).

Conclusion: The scratch test was at least as accurate as percussion in identifying the lower liver edge. In addition, all examiners and especially the young trainees were more confident in their findings using the scratch test.

Predictors of poor outcome in patients with autoimmune hepatitis: a population-based study

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Background/Aim: Autoimmune hepatitis (AIH) can lead to cirrhosis, hepatic failure and death. Identifying predictors of poor outcomes could help in devising tailored management strategies. We aimed to describe predictors of poor outcomes in the population-based AIH cohort from Canterbury.

Methods: Multiple case finding methods were employed, including searches of all public and private, adult and paediatric outpatient clinics, hospital notes and pathology reports. Cases diagnosed after 1980 that fulfilled standardised diagnostic
criteria were included. End of follow-up was at death, liver transplantation or the end of study (31st December 2011). The associations of putative risk factors and outcomes were analyzed using Cox proportional hazards regression. The times to event outcomes were summarized using Kaplan-Meier curves.

**Results:** A total of 133 AIH patients were included. Independent predictors of poor liver related outcomes were incomplete normalization of ALT at 6 months (p<0.01), baseline serum albumin <36g/L (p<0.01) and age at presentation of ≤ 20 years or >60 years (p=0.01). Kaplan-Meier estimates showed 10 years adverse liver event free survival were 80% for age at presentation ≤20 years and >60 years, and 93% and 100% for age at presentation between 21-40 years and 41-60 years respectively.

**Conclusion:** Incomplete normalization of ALT at 6 months, low serum albumin concentration at diagnosis and age at presentation of ≤ 20 years or >60 years, were significant independent predictors of poor liver related outcomes. Histological cirrhosis at diagnosis was not associated with poor prognosis and did not influence the response to initial immunosuppressive treatment.

**Environmental risk factors in autoimmune hepatitis: a population-based case control study**

**Ngu, J.H.** 1,2, **Gearry, R.B.** 1,2, **Frampton, C.M.** 2, **Stedman C.A.M.** 1,2

1 Department of Gastroenterology, Christchurch Hospital 2 University of Otago, Christchurch, New Zealand.

**Background/Aim:** The precise aetiology of autoimmune hepatitis (AIH) remains unknown and likely involves a complex interaction of genetic and environmental factors. However, to date, systematic examination of association between environmental factors and AIH has yet to be performed. We aimed to perform a population-based case control study to investigate for associations between exposure to putative environmental factors and AIH.

**Methods:** Cases were AIH patients who were alive and resided in Canterbury between 1st July 2011 and 30th June 2012. Controls were randomly selected from the Electoral Roll and were matched 2:1 to each case by age and gender. Self-reporting questionnaires that cover lifestyle factors, childhood factors and family history were used.

**Results:** A total of 72 AIH cases and 144 controls were included. Univariate analysis showed that antibiotic (p<0.01) and being vegetarian >1 year (p=0.04) were risk factors for AIH. Alcohol consumption (p<0.01), childhood home with vegetable garden (p=0.01) and wood heating (p<0.01) were protective factors. Multivariate analysis showed that antibiotic, alcohol consumption and childhood home with wood heating were independently associated with AIH. The crude risk of AIH in first degree relatives was 0.2%.

**Conclusion:** This is the first population-based study investigating for associations between exposure to environmental factors and AIH. We found that antibiotics were an independent risk factor, whereas alcohol consumption and childhood home with
wood heating were independent protective factors for AIH. Risk of AIH in first degree relatives was low.

**Auckland experience with Tenofovir therapy in nucleoside/nucleotide experienced patients with Chronic Hepatitis B**

**Johns E**, Naidoo M, Gane E, New Zealand Liver Transplant Unit, Auckland

The nucleotide analogue Tenofovir is funded for patients with hepatitis B, loss of virological response (HBV DNA 20 000 IU/mL or >1 log from nadir) and proven antiviral resistance.

In treatment-naïve patients 76% of HBeAg-positive and 93% of HBeAg-negative achieve viral suppression (HBV DNA <400 copies/mL or 69 IU/ml) at 48 weeks. Treatment-experienced cohorts show a similar response but questions remain over durability in patients with adefovir resistance.

We report local experience in treatment-experienced patients switched to tenofovir as monotherapy or in combination with lamivudine.

**Results:** 144 of 146 patients tolerated treatment and were analysed. 38 received combination therapy. Median follow up was 26 months (range 1-94) with 116 patients completing 12 and 75 patients 24 months of therapy. Previous treatment included lamivudine (95%), adefovir (64%) and telbivudine (12%).

On intention to treat analysis 67% of HBeAg-positive, 72% of HBeAg-negative and 69% of all patients achieved viral suppression (<400 copies/mL) at 12 months, and 70%, 82% and 75% respectively at 24 months. In patients meeting PHARMAC criteria for treatment failure at commencement of therapy suppression was 56% at 12 and 75% at 24 months; results were similar in the adefovir-resistant subgroup (57% and 71%).

HBeAg seroconversion occurred in 13% of patients treated for ≥ 12 months; no patient lost HBsAg.

**Conclusion:** Our experience with tenofovir rescue therapy in patients with antiviral resistance is consistent with published series. Adefovir-resistant patients had a similar virologic response but longer follow-up is needed. The need for combination rather than monotherapy in this population needs further evaluation.
**Disease assessment in Crohn’s disease (CD): Data from the Novel Biomarkers in Inflammatory Bowel Disease (NBIBD) project cohort**

Falvey, JD, aHoskin T, aMeijer B, aAshcroft A, bHampton, MB, c,eDay AS a,dGearry, RB.

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**Introduction:** Colonoscopy, the gold standard for CD assessment, is not suitable for regular monitoring while clinical assessment is often inaccurate. We aimed to determine the clinical utility of three established non-invasive methods of CD assessment, the Harvey Bradshaw index (HBI), serum CRP and faecal calprotectin (FC), and one novel biomarker candidate, serum macrophage migration inhibitory factor (MIF).

**Methods:** Patients attending for colonoscopy with known or suspected IBD were recruited to the NBIBD cohort. Cases provided full demographic and disease activity data (HBI) in addition to biological samples. Endoscopic activity was recorded using the simple endoscopic score of Crohn’s disease (SES-CD)

**Results:** 108 cases were included. Median (IQR) SES-CD, 4 (2-12). Spearman correlation coefficients for comparison with SES-CD were: HBI r=0.24 (p=0.007); CRP, r=0.44 (p<0.0001); FC r=0.55 (p<0.0001, n=82); MIF r=0.14 (p=0.2, n=85). A trend to better diagnostic utility was observed for FC over CRP (active≡SES-CD ≥3, AUC 0.74 (p=0.0006) and AUC 0.64 (p=0.003) respectively). HBI had modest diagnostic accuracy for severe disease only (SES-CD ≥16 vs. ≤15, AUC 0.78 (p=0.0002)). Sensitivity, specificity, PPV and NPV of FC ≥125µg/g for SES-CD ≥3 disease were, 71%, 71%, 85% and 50% respectively. Neither HBI, FC nor CRP could anticipate endoscopic remission. Combining CRP (≥10mg/L) and clinical data (HBI ≥8) significantly improved PPV for the detection of moderate-severe CD (SES-CD ≥7) cf. CRP alone (PPV 73% (95%CI 51-93%) vs. 50% (95%CI 34-65%) respectively).

**Conclusions:** Established methods of non-invasive disease assessment offer modest diagnostic utility. Novel biomarkers with greater sensitivity and specificity are urgently needed.
Clinical assessment of murine Dextran Sodium Sulphate (DSS) colitis: prospective validation of a novel scoring tool.

**Falvey JD, Munday JS, Keenan, JI, Dyer AE, Gearry, RB, Hampton, MB**

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**Introduction:** Murine DSS colitis is a common research model for IBD. Histological examination of the colon provides gold standard assessment; however, non-lethal assessment is critical for disease monitoring and secondary endpoint analysis. Coopers’ murine colitis score (MCS), the current standard, correlates well with histology but has low content validity in some domains.

**Aims:** To develop and prospectively validate a novel MCS.

**Methods:** Developmental phase: Novel stool consistency and rectal bleeding indices were developed in order to improve content validity of these domains. Variations of the MCS were tested in post hoc analysis against histology. Validation stage: 2% DSS was provided ad libitum to 24 mice. Three mice per day (0-7) were selected randomly; disease was assessed independently by 2 observers using a proforma from which a complex MCS, a simple MCS (SMCS) and the Cooper MCS were derived. Non-invasive assessment was compared with histological activity.

**Results:** Murine colitis scores correlated highly with histology (Spearman r=0.93, r=0.91 and r=0.91 for the simple, the complex and the Cooper MCS respectively (p<0.0001)). Correlation with histology was non-significantly greater for the novel stool score compared with Cooper stool score (r=0.86 (95%CI 0.69 - 0.94) vs. r=0.77). There was a high level of agreement (linear weighted \( k=0.86 \) (95%CI 0.77-0.96)) and correlation (r=0.94 (95%CI 0.87-0.98) p<0.0001) between observers for the SMCS.

**Conclusions:** A modification of the Coopers colitis score (SMCS) comprising a weight loss score, novel stool score and dichotomous rectal bleeding score, provides a valid and simple method for the non-invasive assessment of DSS colitis.

Disease assessment in Ulcerative Colitis (UC): Data from the Novel Biomarkers in Inflammatory Bowel Disease (NBIBD) project cohort

**Falvey JD, Hoskin T, Meijer B, Ashcroft A, Hampton, MB, Day AS, Gearry, RB.**

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**Introduction:** Colonoscopy, the gold standard for UC assessment, is not suitable for regular monitoring while clinical assessment is frequently inaccurate. We aimed to
determine the clinical utility of three established non-invasive methods of disease assessment, the simple clinical colitis activity index (SCCAI), serum CRP and faecal calprotectin (FC), and one novel biomarker candidate serum macrophage migration inhibitory factor (MIF) in the normal clinical setting.

**Methods:** Patients attending for colonoscopy with known or suspected IBD were recruited to the NBIBD cohort. Cases with UC provided full demographic and disease activity data (SCCAI) in addition to biological samples. Endoscopic activity was recorded using the modified Baron score

**Results:** 65 cases were included. Spearman r correlation coefficients for comparison with endoscopic score were: CRP, r=0.4 (p<0.0001); SCCAI r=0.44 (0.31-0.62, p=0.0002); FC r=0.55 (p<0.0001, n=51). Overall disease burden (severity*extent) correlated better with each parameter but differences were not significant. No correlation was observed between plasma MIF and endoscopic activity (r=0.11, p=0.2, n= 85). ROC analysis revealed significant diagnostic utility for SCCAI, CRP and FC (AUC 0.73 (p=0.002), AUC 0.78 (p=0.002) and AUC 0.75 (p=0.004) respectively). Optimal thresholds for distinguishing Baron ≥2 disease were (threshold (sensitivity, specificity, PPV and NPV)): SCCAI, 3.5 (59%, 88%, 72%, 81%); CRP 5mg/L (64%, 74%, 56%, 80%); FC 125 ug/g (83%, 64%, 56%, 88%). Neither CRP nor FC could reliably anticipate endoscopic remission (Baron 0).

**Conclusions:** Established methods of non-invasive disease assessment offer modest diagnostic utility. Novel biomarkers with greater sensitivity and specificity are urgently needed.

**Outcomes of adalimumab therapy for Crohn’s disease from five New Zealand hospitals**

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Departments of Gastroenterology,1 Dunedin,2 Christchurch,3 Auckland City,4 Hutt Valley Hospitals

**Introduction:** Adalimumab (ADA) is an effective therapy for the treatment of Crohn’s disease (CD). We aimed to describe the use of this drug across five hospitals (Christchurch, Dunedin, Auckland City, Hutt Valley and Wairarapa) throughout New Zealand.

**Methods:** A retrospective case note review was performed of patients. Demographic, phenotypic, clinical, outcome and safety data were extracted and analysed.

**Results:** 196 CD patients were identified (Christchurch 117, Auckland 30, Dunedin 19, Hutt Valley and Wairarapa 28). 30 (15.3%) were diagnosed before 17 years, 132 (67.3%) between 17-40 years and 64 (32.6%) after 40 years. 50 (25.5%) had ileal, 58 (29.6%) colonic and 88 (44.9) ileocolonic disease location. 103 (52.6%) had inflammatory, 50 (25.5%) stricturing and 43 (21.9%) penetrating disease behaviour. 64 (32.7%) had perianal disease. Median disease duration was 7 years (IQR 3-13 years). Indications for ADA were medically refractory disease (CDAI>300) 110 (56.1%), extensive small bowel disease 40 (20.4%), presence of a stoma 9 (4.6%),
grandfathered prior to Pharmac criteria 13 (6.6%) and risk of short gut15 (7.7%). For those patients in whom a CDAI was calculated, there was a significant reduction between initiation CDAI and 3 month follow up (373 to 119 respectively, p<0.0001). The mean number of days in hospital per patient per year before and after initiation of ADA were 3.5 and 1.9, respectively (p<0.0001). Adalimumab cessation rates at 3, 6, 9 and 12 months were 5.7%, 12.2%, 22% and 33.3%, respectively.

Conclusions: ADA is effective for the treatment of CD in NZ leading to reduced hospitalisations.

**Immunochromical identification of Lynch syndrome using an initial two antibody panel is as predictive as the current four antibody panel**

O’Regan T, Chau K, Smith T, Tatton M, Parry S, Bissett I

The current practice in immunochemistry staining for Lynch Syndrome (LS), in patients meeting the revised Bethesda Criteria, is to use a four antibody panel, (MLH1, MSH2, MSH6, PMS2) to screen for the four Mismatch Repair (MMR) gene expressions involved.

Our study further supports the evidence already shown by two separate studies, Shia et al. and Hall et al., that testing two MMR gene antibodies (MSH6, PMS2), followed by MLH1 and MSH2 only when there is loss of expression (LOE) of the first two antibodies, would be as effective as using an initial panel of all four in detecting LS. This hypothesis is based on the biochemical binding properties of the MMR proteins heterodimers.

To test the hypothesis we selected all cases of colorectal cancer that were stained for MMR gene expression at Auckland City Hospital from the year 2000 to 2010 (n=423). Cases showing heterogeneous staining and unsatisfactory results were excluded (leaving n=413). The MMR gene protein stains were regarded as demonstrating LOE when there was no uptake in the nucleus of the tumour cells, with a positive internal control. 74 cases showed LOE of MSH6 or PMS2. One showed LOE of all four MMR proteins. The remaining 339 cases stained for all four proteins.

Our study gives further evidence that staining with an initial two MMR gene antibody panel is sufficient to diagnose LS. This study has implications for significant cost cutting and improved efficiency in detection of MMR gene LOE.

**Partial splenic embolisation to facilitate interferon-based treatment of chronic hepatitis C: the Auckland City Hospital experience**

Boswell T, Harry R, Duncan D. Auckland City Hospital

**Introduction:** Hypersplenism associated with hepatitis C (HCV) cirrhosis may result in cytopenias limiting the use of pegylated interferon and reducing the likelihood of sustained viral response (SVR). Partial splenic arterial embolisation (PSE) has been shown to be safe and effective in treating such cytopenias facilitating treatment of HCV. Experience with PSE is limited in New Zealand.
Methods: Patients undergoing PSE between 01/06/2007 and 31/11/2011 were identified from the Auckland City Hospital radiology database. Retrospective notes reviews were undertaken of the indications, techniques and outcomes of PSE and of subsequent HCV treatment.

Results: Eight patients were identified who had undergone PSE to facilitate HCV treatment. Two were liver transplant recipients. Mean platelet count pre-procedure was 59.5 x 10^9/L and peak within 60 days was 208.3 x 10^9/L. Techniques used for PSE were highly variable. All patients reported abdominal pain post procedure, 1 developed pneumonia. One procedure was complicated by portal and splenic vein thrombosis, persistent fever and ascites. Only 2 patients went on to receive treatment for HCV and 1 achieved SVR.

Conclusion: Whilst PSE can increase platelet counts due to hypersplenism in HCV cirrhosis, subsequent successful treatment of HCV is uncommon. Complications of PSE are common and in keeping with published descriptions. Careful patient selection is critical. As such, this procedure should be standardised at a single centre in New Zealand to improve experience.

Endoscopic ultrasound of benign biliary disease

Cederwall, C; Weilert, F. Waikato Hospital

Introduction: Endoscopic ultrasound contributes to the assessment and treatment of pancreaticobiliary disorders with definite advantages over other imaging techniques including trans-abdominal US, CT and MRI. EUS prior to ERCP is attractive to confirm the need for intervention due inherent risks of pancreatitis, bleeding and perforation.

Aim: Review the utility of EUS prior to ERCP.

Methods: We performed EUS prior to ERCP in patients where potential treatment decision could be influenced by the EUS result. Focus was on benign biliary disorders and known cases of pancreatic cancer were excluded. Patient’s prior imaging was reviewed where available in conjunction with biochemical markers and clinical signs and symptoms.

Results: From June 2011 – July 2012, 92 pancreaticobiliary EUS cases with no known tumour or prior pancreatic lesion, were performed with intent to progress to ERCP if indicated. 47/92(51%) received ERCP for stone extraction and 8/92(8.6%) received FNA. 40 (43.5%) cases did not progress to ERCP. Average age was 50.1 years, 30/40(80%) female. 35/40 (87.5%) were referred within our DHB and 22/40(55%) referred by gastroenterologists. 17/40(42.5%) had prior cholecystectomy. Assessment showed 17/40(42.5%) had normal EUS, 5/40(12.5%) suspected SOD, 6/40(15%) pancreatic divisum, 6/40(15%) with EUS features of chronic pancreatitis, 2/40(5%) side-branch IPMN, 2/40(5%) fatty liver, 2/40(5%) fatty infiltration of the pancreas. 12/40(30%) had Gallbladder microlithiasis and were referred for cholecystectomy without ERCP or sphincterotomy.
**Conclusion:** EUS prior to ERCP during the same session can avoid 40/92 (43.5%) of ERCP’s, while 23/92 (25%) of patients were provided with new diagnostic information in relation to their presentation.
Statins and cancer-related mortality

The authors of this study start with the hypothesis that a reduction in the availability of cholesterol may limit the cellular proliferation required for cancer growth and metastasis. To test this hypothesis they assessed mortality among patients from the entire Danish population who had received a diagnosis of cancer between 1995 and 2007. Among patients 40 years of age or older, 18,721 had used statins regularly before the cancer diagnosis and 277,204 had never used statins. They report that hazard ratios for statin users compared with non-users were 0.85 for death from any cause and death from cancer. They also note an absence of a dose-response relationship. The ratio reduction was seen for each of 13 types of cancer. They feel that these results warrant trials of statins in patients with cancer.

NEJM 2012;367:1792-802.

Macrolide antibiotics and cardiovascular diseases

Macrolide antibiotics are broadly used for the treatment of various microbial infections. However, they are also known to have multiple biologic effects such as alteration of inflammatory factors and matrix metalloproteinases (MMPs). This review delves into this subject. They acknowledge that results from clinical trials are controversial. They have previously reported that clarithromycin suppresses the development of myocarditis, cardiac rejection and myocardial ischaemia in animal models. They believe that because of the anti-MMP effects of clarithromycin this compound or a derivative may be useful to prevent harmful cardiac remodelling in cardiovascular disease. The drawback is that long-term treatment with macrolides may result in the emergence of bacterial resistance. A future option of merit would be the development of macrolide derivates that have no antibacterial effects.


The risk of venous thromboembolic events in women taking progestin-only contraception

Contraception with oestrogens carries a risk for venous thromboembolism. This study addresses the thromboembolic risks of progestin-only contraception. Eight observational studies were included in the meta-analysis and the results were that the relative risk of venous thromboembolism was 1.03 for progestin users versus non-users. However, a subgroup analysis showed that the relative risk for users of an injectable progestin formulation was 2.67. The researchers note the paucity of publications on the topic and the fact that there are no randomised trials. They speculate that a selection bias cannot be excluded as the basis of a significant association between depot administration and venous thrombosis.

BMJ 2012;345:e4944.
Screening for coronary heart disease with electrocardiography

Some authorities recommend screening for coronary heart disease with electrocardiography. The US Preventive Service Task Force (USPSTF) has recently updated its recommendations. And their conclusion was against screening with resting or exercise electrocardiography (ECG) for the prediction of coronary heart disease (CHD) events in asymptomatic adults at low risk for CHD events. They also conclude that the current evidence is insufficient to assess the balance of benefits and harms of screening with resting or exercise ECG for the prediction of CHD events in asymptomatic adults at intermediate or high risk for CHD events.


Risk of cardiovascular events in people with iatrogenic Cushing’s syndrome

It is known that long-term glucocorticoid treatment is associated with an increased risk of cardiovascular events. The question examined in this cohort study is whether those with manifest iatrogenic Cushing’s syndrome are exposed to an even greater risk. Participants were those prescribed glucocorticoids with either a diagnosis of iatrogenic Cushing’s syndrome (n=547) or no diagnosis of iatrogenic Cushing’s syndrome (n=3231) and those not prescribed glucocorticoids (n=3282). The researchers report that those with a Cushingoid appearance have nearly a three times greater risk of cardiovascular disease, including coronary heart disease, heart failure, and cerebrovascular disease. This risk increases to over fourfold when compared with people not prescribed systemic glucocorticoids.

BMJ 2012;345:e4928.
William James (Bill) Treadwell


Bill was born into a farming family in Mataroa near Taihape, in 1928, and was educated at Ruanui School, St Georges School and Wanganui Collegiate, where he played cricket and rugby, to First XI and First XV levels.

He then completed a Science degree at Victoria in Wellington, before going on to Otago Medical School, graduating in 1955.

He met his wife, Lancely (nee Colquhoun), who was a school teacher in the Children’s Wards at Wellington Hospital, and they were married in 1952.

Their first child, Anne, was born profoundly deaf, as a result of maternal rubella, and in those days would have been sent to the Van Asch Deaf School in Christchurch for her education, but her parents decided to keep her at home with her family. Bill became chairman of a group of like-minded parents of deaf children, whose efforts eventually led to the establishment of a series of deaf units in Wellington schools covering the years from kindergarten to secondary school.

In 1958 Bill opened his general practice in the Wellington suburb of Northland and in the next almost-60 years served his patients day and night, as medical advisor and friend. He particularly enjoyed the continuity of looking after up to three generations of his original families.

He was always interested in rugby and was club doctor for several Wellington Rugby Clubs in 1959 and 1960, before being appointed Honorary Medical Office at Athletic Park. In 1965 he was asked to travel to India and Pakistan as medical officer with John Reid’s New Zealand cricket team, the first time a doctor had been a part of a touring sports group.

His pioneering interest in Sports Medicine arose from his realisation that untreated sports injuries very often led to serious disabilities in later life, so he held sports clinics at his surgery early in the morning and after hours - Monday mornings saw a parade of weekend casualties—but they were always satisfactorily highly-motivated and compliant patients and so a pleasure to treat.

As well as his general practice Bill became a Police Surgeon in the early 1960s and was later appointed Director of NZ Police Medical Services, where he was responsible for the health and fitness of serving officers throughout the country. In this capacity he instituted a regime of regular medical examinations and fitness
checks. He became known as the author of “Dear Fatty” letters to officers whose weight increased to higher than ideal levels.

He worked also with the Wellington Fire Service on health issues, as well as occasionally with the Customs Department.

In the wake of the Erebus plane disaster in 1979, he was sent to Auckland to deal with any health issues among the Police personnel, particularly those working in the Victim Identification Squad. Theirs was an extremely stressful job and Bill continued for some time afterwards to check on the welfare of the staff members involved.

His work with the Police Force led to the Police Council of Sport’s asking Bill and his wife, as the medical team, to accompany the Wellington District contingent of athletes and teams such as softball, netball and touch-rugby on several trips to Australia and America to compete in Australasian and World Police and Emergency Services Games. They had to take with them all the medical supplies they would need as there were no facilities at the grounds. It was literally grass-roots sports medicine, with suturing, splinting and dressings done on the sideline. These trips were busy and challenging but a pleasant change from the routine of working in the surgery.

In 1975 and 1976 Bill was the Chairman of the NZ Medical Association.

Later, he became a Fellow of both the Royal College of General Practitioners and the Royal New Zealand College of General Practitioners.

“Dr Bill”, as he was widely known in Wellington, felt that good general practice was the foundation of a good health service. He was dedicated to that principle and committed to the care of his patients.

Apart from his work, his interests lay in all forms of sport and in travel, particularly to the United Kingdom where he kept in touch with colleagues in the field of Police Medical Services and Forensic Medicine.

Bill was a very good doctor who enjoyed the interaction with his patients and was stubborn in his determination to find the best possible outcomes for them and their problems.

He is survived by his wife Lancely, sons Rob and David and daughter Caroline, four grandchildren and two great-grandchildren.

Tim Donoghue, Lancely Treadwell and others compiled this obituary.
Anna Muriel Kathleen Nielsen (née Little)

Dr Muriel Nielsen died suddenly on 13 September 2012. She was New Zealand’s third woman ophthalmologist, after Drs Caroline Stenhouse of Christchurch and Dorothy Potter of Masterton. Muriel provided an outstanding ophthalmic service to the Rotorua area for 35 years.

Dr Nielsen was born in Downhill, County Londonderry, Northern Ireland, the youngest of six children. Her medical education was at Trinity College, Dublin, where she won the final year prize in surgery. Following a year as house surgeon, Muriel became a registrar at the Birmingham and Midland Eye Hospital where she completed the Diploma in Ophthalmology. After this success she decided to visit her sister who was living in Wellington, and before leaving Birmingham she secured a registrar appointment in the eye department at Wellington Hospital. She frequently rode her horse to the hospital much to the delight of colleagues.

After 2½ years in Wellington, Muriel was encouraged to accept a part-time consultant position in Rotorua, which was without ophthalmic services, and the centre of a large Maori population. Patients came from far and wide. Some walked from Opotiki, and district nurses brought Maori children from outlying schools.

As the only ophthalmologist in the area, Muriel’s professional life was demanding. There was a considerable load of trauma surgery before the days of laminated car windscreens, seat belts, and drink-driving laws. Also, diabetic retinopathy was prevalent in the Maori population. Some relief came after 16 years when Dr Murray Ashbridge arrived in Rotorua in 1971.

Muriel married George Nielsen, an electrical engineer, soon after arriving in Rotorua, and together they brought up four children. Combined with hospital duties and private ophthalmology practice, this made for a hectic life.

Despite such family and professional demands, Muriel was a foundation member of the Rotorua branch of Zonta, and was on the local branch of the Royal New Zealand Foundation of the Blind. She also maintained her lifelong interests in the piano and foreign languages.

After 35 years of sterling ophthalmic service to the Rotorua area, Muriel and George retired to Auckland to be nearer their family.

Muriel was a dedicated ophthalmologist, and a loving wife and mother. Our sympathy is with her husband George, four children, and five grandchildren.

Bruce Hadden (Honorary Associate Professor, University of Auckland), with assistance from George Nielsen, wrote this obituary.
Malcolm Sleeman Robertson

MB, BS (London), MRCS, LRCP, FRCS FRACS, RACS

Malcolm came from a medical family. His father, Malcolm (Senior), was also an ear nose and throat surgeon, one brother was a paediatrician and the other is a psychiatrist.

Malcolm was born in 1928 and educated at Medbury Preparatory School and at Christ’s College. After spending a year at Canterbury University he trained in medicine at St Mary’s Hospital, Paddington, London, qualifying in 1954.

While at university he was a prominent athlete representing Canterbury at a Junior (under 19) level. He was NZ Junior High Jump Champion and was awarded a NZ University Blue in 1947. In the UK he represented United Hospitals and the University of London.

As a house surgeon at St Mary’s Hospital he worked for the Senior Surgeon Mr Handfield Jones and for Sir Arthur (later Lord) Porritt. He also worked for the Thoracic Surgery Unit. Malcolm was a house physician at the North Middlesex Hospital for a year gaining experience in general medicine, endocrinology, dermatology, geriatrics and psychiatry. He next worked in orthopaedics as a senior house officer at the Albert Dock Seamen’s’ Hospital.

In 1956 Malcolm returned to NZ and worked at the Christchurch Hospital as Senior Casualty Officer. He returned to the UK a year later and passed his Primary FRCS (Eng) examination.

Uncertain as to what branch of surgery he would like to follow, he applied for and was successful in obtaining a position as a senior house surgeon to the Professional Unit at the Royal National Throat, Nose and Ear Hospital in Greys Inn Road, London. He worked for Henry Shaw who was one of the early head and neck cancer surgeons and who had trained with Dr Hayes Martin at the Memorial Hospital in New York.

Also working in this Unit was one of the early facial plastic surgeons who had initially been trained in ENT. Malcolm was delighted to be working with such excellent teachers and felt that this was the direction and the specialty he should be taking.

He subsequently worked for 2 years as a registrar in Otolaryngology at University College Hospital. This position also involved working with the plastic unit on head and neck reconstructive procedures.
In 1958 Malcolm obtained his FRCS (Eng). For the next 4 years he was Senior Registrar in Otolaryngology at the Royal London Hospital where he did as much head and neck surgery as he could. In particular he gained experience in salivary gland surgery.

In 1964 he was appointed Consultant Surgeon to the Department of Otolaryngology at the Christchurch Hospital and in 1970 he passed the FRACS examination.

Malcolm began the Head and Neck Oncology Clinic in conjunction with the Radiotherapy Department in 1971. When surgery was indicated, he carried this out doing his own reconstructions. In the same year he became a member of the British Society of Head and Neck Oncologists and was later a Foundation member of the Head and Neck Section of the Australasian College of Surgeons.

In the pursuit of excellence Malcolm travelled widely overseas to North America and to Europe visiting head and neck clinics and in addition attended courses on rhinoplasty, otoplasty and endoscopic sinus surgery. He presented papers at almost every NZ and Australian Otolaryngological Conference and at the Royal Australian College of Surgeons General Scientific Meetings over a period of 25 years. He was frequently on the panel when head and neck cancer topics were discussed.


He had 30 papers on all aspects of the specialty published in international journals. In 1970 Malcolm was awarded a Gold Medal of the British Medical Association for his role as Medical Adviser to the film “A Deaf Child in the Family,” which was produced by the NZ National Film Unit.

Head of the Department of Otolaryngology, Head and Neck Surgery at Christchurch Hospital from 1988–1992, Malcolm was also President of the New Zealand Society of Otolaryngologists and Head and Neck Surgeons from 19871989. He was a member of the Court of Examiners of the Royal Australasian College in his specialty for several years. He also was a specialist representative on the Medical Advisory Committee of the Christchurch Hospital for a number of years. He retired from the staff of the Christchurch Hospital in 1995 but continued in private practice until 1997.

In retirement Malcolm spent many months of the year with his wife Elizabeth at the beloved Golden Bay property, where gardening, sea fishing and trout fishing and reading occupied his time. He wrote a biography of his mother, the artist Dorothy Robertson, and was completing an autobiography of his years in medicine. Malcolm also enjoyed travelling to Australia, Europe and Asia.

Malcolm was a devoted father. He had three children, Ian, Stuart and Julie, by his first marriage. He and his wife, Elizabeth, had two children together, Jane and William. He was also the proud grandfather of Hamish and Anna.

Malcolm is survived by his wife and loving family.

This obituary was written by the family according to Malcolm's CV.
Ross Fordyce Burton

Ross was born on 19 September 1922, the second of three children of school principal, Percy and Mildred Burton. Ross began his schooling in Opotiki and followed on to Brixton Road School in Mt Eden, Auckland.

He showed a high level of intelligence at an early age and went through school a year ahead of his peers. This led to him spending 3 years in the 6th form at Mt Albert Grammar where he played tennis, cricket, and First XI soccer and enjoyed harriers.

There was a plus to this extra schooling as he was able to gain a University Scholarship in his second 6th form year and he was placed second overall in New Zealand in his 3rd year when sitting, although this was only academic due to it already having been achieved in the previous year. This, together with his subsequent junior and senior scholarships helped fund his later training at medical school.

On leaving Mt Albert Grammar, Ross did a preliminary year at Auckland University prior to entry to Otago Medical School where he spent 5 years. There he became an anatomy demonstrator and did a postgraduate year as a teacher in the Anatomy Department.

Towards the end of World War 2 Ross was back in Auckland working as a house surgeon at the Mater and then Middlemore Hospital. In 1949, Ross went to London where he studied for his Fellowship at the Royal College of Surgeons and had no difficulty in passing his Primary Fellowship and final FRCS (Eng). He also spent time at Cambridge where he attained qualifications in radiotherapy and played golf at that stage achieving every golfer's dream of a hole-in-one!

Returning to Auckland at the end of 1954 Ross began working as a radiotherapist at Auckland Hospital. At the end of 1959 he assumed the responsibility of Head of the Department and worked through the traumatic years during "The Brych Saga" and Brych Inquiry which was regrettably supported by some of the leading academic doctors in some specialities in Auckland and made running the Radiotherapy Department very difficult in that era when orthodox radiotherapy was being challenged.

Subsequent to that period I became involved in chemotherapy and the surgical techniques of organ perfusion with high dosage of chemotherapeutic drugs which became an orthodox treatment carried out under special conditions with tourniquet isolation of the tumour bearing area so that could receive a high dosage of
chemotherapeutic drug. Ross's expertise was seriously required in this era and his experience and advice of paramount importance to his patients and his colleagues.

As a surgeon with an interest in these techniques Ross and I had many professional discussions and got to know each other at a professional level. It is of interest that we met up in London when we were each doing locum work at the Royal Northern Hospital in Holloway Road, Ross as Casualty Officer and I as Anaesthetist. Each out of his chosen specialty. I was summoned to the A & E Department to give an anaesthetic to set a Colles fracture of the wrist.

Ross said "this is ridiculous! I'm training to be a radiotherapist and you're training to be a general surgeon! Why don't you do the setting of the fracture and I'll do the anaesthetic?" My reply was prompt and definitive. "Not on your life! I'm doing what I was appointed to do and advise you to do the same. If anything went wrong we would have no defence and we'd be up before the Medical Council!" Commonsense and security prevailed and all went well for both of us. Ross then went off for a holiday in Europe and I continued with my locum duties.

When I returned to Auckland as a surgical specialist at Middemore Hospital then Greenlane Hospital we met up again and I was able to consult Ross for my patients from both these hospitals and receive a good opinion with great confidence.

Ross by then was a very experienced radiotherapist and many patients in their era would have been grateful for his wise and knowledgeable advice, skilful care, and friendly personal manner. As Head of Department of Radiotherapy in Auckland Ross attended the Cancer Clinic on a weekly basis to advise the consultants from all specialities on the best treatment for their patients with malignant disease. His wise counsel was valued and doctors got good advice whenever they required it where X-ray therapy was considered.

In 1976 he worked at St Margaret's Private Hospital Outpatients treating superficial lesions suitable for local radiotherapy; here he also had many appreciative patients who received good results.

As the Auckland population grew the Cancer Clinic became increasingly busy and Ross had to increase his clinical staff to manage the load. Eventually when he retired in 1987 he was succeeded by an English radiotherapist, Professor Probert, who continued to run the Department with modern equipment imported from Europe and new techniques in keeping with the times.

Ross's interests in retirement were of course his family, playing golf at the Whitford Country Club, and his Whitford farmlet where he farmed a small mob of sheep and had a family dog who kept guard and was a friend of the grandchildren whenever they visited.

Keith Ewan wrote this obituary.
Heart Foundation Grants Awarded November 2012

At the November 2012 meeting of the Scientific Advisory Group of the National Heart Foundation, a total of 16 grants were awarded. The awards included 7 Small Project Grants and 9 Travel Grants.

SMALL PROJECT GRANTS

Dr James Baldi  
*Department of Medicine, University of Otago, Dunedin*
Cardiovascular effects of high intensity exercise in type 2 diabetes: a pilot study.  
$15,000 for 2 years

Dr Susan Wells  
*Section of Epidemiology and Biostatistics, University of Auckland*
The impact of run charting CVD risk assessments in general practice  
$11,200 for 18 months

Professor Janet Hoek  
*Department of Marketing, University of Otago, Dunedin*
Estimating the effects of dissuasive cigarette sticks.  
$15,000 for 8 months

Dr Peter Jones  
*Department of Physiology, University of Otago, Dunedin*
Assessment of a novel mechanism of preventing cardiac arrhythmias in human tissue.  
$9,120 for 5 months

Mr Vaughan Roberts  
*National Institute for Health Innovation, University of Auckland*
Feasibility of an exercise programme to reduce smoking during pregnancy among Māori.  
$14,300 for 7 months

Dr Harriet Watkins  
*School of Biological Sciences, University of Auckland*
Deciphering adrenomedullin receptor activation; towards new therapeutics.  
$15,000 for 1 year
**Dr Scott Harding**  
*Department of Cardiology, Wellington Hospital*  
Toll like receptor mediated platelet activation.  
$7,262 for 10 months

**TRAVEL GRANTS**

**Dr Katherine Black**  
Department of Human Nutrition, University of Otago, Dunedin  

**Assoc Professor Cliona Ni Mhurchu**  
National Institute for Health Innovation, University of Auckland  

**Dr Karen Peebles**  
Department of Surgery & Anaesthesia, University of Otago, Wellington  
*Experimental Biology Conference, Boston, USA, 2013.*

**Mr Andrew Waa**  
Department of Public Health, University of Otago, Wellington  
*Society for Research into Nicotine and Tobacco 19th Annual International Meeting, Boston, USA, 2013.*

**Dr Helen Eyles**  
National Institute for Health Innovation, University of Auckland  

**Ms Leila Pfaeffli**  
National Institute for Health Innovation, University of Auckland  
*34th Annual Meeting & Scientific Sessions of the Society for Behavioural Medicine, San Francisco, USA, 2013.*

**Dr Shieak Tzeng**  
Department of Surgery & Anaesthesia, University of Otago, Wellington  
*Experimental Biology Conference, Boston, USA, 2013.*

**Dr Wilma Waterlander**  
National Institute for Health Innovation, University of Auckland  
Dr Paula Skidmore

Department of Human Nutrition,
University of Otago, Dunedin

*International Society of Behavioural
Nutrition and Physical Activity Annual
Meeting, Ghent, Belgium, 2013; and the
60th Annual Meeting of the American
College of Sports Medicine and 4th
World Congress on Exercise is Medicine,
Indianapolis, USA, 2013*
Heart Foundation: 2013 Grant Applications

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Heart Foundation: 2013 Senior Fellowship

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((Libraries, print out the PDF above and replace this page))
Heart Foundation: Māori Cardiovascular Research Fellowship

View this document in PDF at:

((Libraries, print out the PDF above and replace this page))
Medical Benevolent Fund

NZMA Members, and families of deceased Members, may apply for aid when in situations of financial hardship or distress.

Applications should be directed through the NZMA:
   Central Office
   P O Box 156
   Wellington
   Tel: 0800 656161
Understanding Troubled Minds: A guide to mental illness and its treatment (2nd edition)


The second edition of Understanding Troubled Minds: A guide to mental illness and its treatment follows the first edition by psychiatrists Bruce Singh and Sidney Bloch, which was published in 1997. The ambitious aim of providing a “clear, well-informed, objective assessment of the nature of mental illness and its treatment” for the general public is stated in the preface of the 360-page book.

Emeritus Professor Bloch, with decades of experience as a community psychiatrist and editor of the Australian and New Zealand Journal of Psychiatry between 1991 and 2005 is the sole author, and well placed to tackle the self-imposed challenge of the book.

Set out over 21 chapters Understanding Troubled Minds covers a vast range of topics, ranging from the history of psychiatry, to a thorough review of common mental illnesses and their treatment, psychiatric ethics, personality and reactions to modern stress, and topics of special interest including women, children and adolescence, and the elderly.

This is a very readable book with illustrative case reports and quotes from famous personalities emphasising the nature and impact of mental illness.

The tone is authoritative, jargon-free and humanistic, and conveys a sense of optimism and hope for patients and the state of the profession. The introductory chapter on history is particularly helpful as it contextualises the significant recent advances and developments in psychiatry “Astonishingly, more has been achieved in the past 50 years than during the entire 24 centuries since the ancient Greeks inaugurated the systematic study of the disturbed mind”.

Unfortunately the breath of the book comes with sacrifice in the depth of content in relation to some key areas of modern psychiatry. The chapter on drugs and other physical treatments fails to provide a balanced account of the current controversies associated with modern psychopharmacology.

In general the side-effects of medications are under-reported and not sufficiently emphasised, for example the sexual side-effects associated with SSRI antidepressants (such as Prozac) are not mentioned. Metabolic side-effects of antipsychotic medications and their long-term impact are under-emphasised. The recent trends to excessive ‘off-label’ use of psychiatric medications (particularly in the young and elderly), polypharmacy and the at times problematic influence of the pharmaceutical industry in prescribing are left out entirely.
Despite some limitations *Understanding Troubled Minds* is an absorbing, engaging and informative book, which provides a very helpful overview of psychiatry. It is particularly suited to allied health workers, the general public and as a reference source for students.

Erik Monasterio
Senior Clinical Lecturer, University of Otago – Christchurch, and Consultant in Forensic Psychiatry
Hillmorton Hospital, Christchurch
Australian Pharmacy Law & Practice


This book aims to provide readers with a guide to the law that underpins the practice of pharmacy in a practical and reader-friendly manner.

It traverses the relevant laws and ethical considerations that govern the obligations of pharmacists, processes and compliance activities, professional standards and practice all against the context of historic events and the evolution of practice of pharmacy, the current issues and the future projections. The book not only provides a comprehensive overview of the laws that govern practice of pharmacy in Australia, it also provides healthcare professionals with summary of the legal environment and legal concepts necessary for the understanding of the relevant laws in order to practice safely and competently.

There is a myriad of legislation that governs the manufacture, distribution, and dispensing of medicines. The Australian Pharmacy Law and Practice book provides a useful summary of the obligations of the legislation in the practice of pharmacy and would be a valuable to students, interns and pharmacists.

Sanya Ram
Senior Tutor: Pharmacy Law & Ethics
School of Pharmacy
University of Auckland