A longitudinal approach to communicable disease prevention

Centre for Longitudinal Research-He Ara ki Mua

School of Population Health, Tamaki Campus, 4th April 2011

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Epidemic disease in New Zealand prior to colonisation

“beyond a vague account of an epidemic that swept through the Taiamai district in the North about 150 years ago, there are no accounts of epidemics occurring in pre-European times”

Te Rangi Hīroa (Buck PH). Medicine amongst the Maoris in ancient and modern times by "Abound" [pseudonym] [A thesis for the degree of Doctor of Medicine]. Dunedin, New Zealand: University of Otago; 1910.
Epidemic disease in New Zealand prior to colonisation

“Yaws and filariasis with its attendant elephantiasis which were prevalent in Polynesia were not introduced. Typhoid, tuberculosis, measles, and venereal disease were all introduced after European contact”.

Te Rangi Hīroa (Buck PH). The coming of the Maori. Wellington: Maori Purposes Fund Board; 1950.
And then a second wave of migration
The first epidemic described by the Māori was “Rewharewha”

- somewhere in the time period from 1790 to 1802

“The epidemic spread with extraordinary virulence throughout the North Island and even to the South. From the rapid manner in which it spread it seems to have been influenza. The fact that rewharewha is used to denote coughing points to the fact that bronchitis and chest symptoms were some of the outstanding features of the epidemic.”

Epidemic diseases in the decades following colonisation

• “various epidemics were introduced by civilisation and have remained with us ever since” ...
• “measles, typhoid, scarlet fever, whooping cough and almost everything, except plague and sleeping sickness, have taken their toll on Māori.”
• “Without doctors and medicines the ravages of introduced diseases in the early days were frightful.”

Buck PH. The coming of the Maori. Wellington: Maori Purposes Fund Board; 1950
National epidemiological descriptions of epidemic disease in Māori in the decades following colonisation.

How many epidemiological descriptions were there?

### Availability of annual population, mortality and morbidity statistics for Māori

<table>
<thead>
<tr>
<th>Description</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total population</td>
<td>1920 -</td>
</tr>
<tr>
<td>Total births and deaths</td>
<td>1920 -</td>
</tr>
<tr>
<td>Deaths by diagnosis (subsequently ICD code)</td>
<td>1920 -</td>
</tr>
</tbody>
</table>
What would we have seen if we had the data?

It's also really bad for birth cohort studies.
Pertussis mortality rates in New Zealand Maori versus non-Maori 1920 to 1997

Grant CC. PhD thesis University of Auckland, 2004
So here we are today

Launching a centre that seeks to provide relevant evidence to improve the health and development of today's children
Overview of presentation

1. Communicable diseases in New Zealand today
2. What do we know about communicable disease prevention?
3. What can we learn from *Growing Up in New Zealand*?
Communicable diseases in New Zealand today

In which direction are we heading?
Infectious diseases hospitalisations
New Zealand 1989-2008

Rate per 100,000 age adjusted

Percentage of all hospitalisations

Close-contact infectious diseases

- Humans are the only or the most important source
- Transmission is by direct physical contact, respiratory or faecal-oral spread
- Infections are predominantly acquired in the community

Largest contributor to the increase in infectious diseases in NZ over past 20 years

Mills CF et al. NZMJ 2002;115:254-7
Close contact infectious diseases as a % of all cause hospital admissions

Increase over 20 years of
15% for European/Other
20% for Māori
26% for Pacific peoples

Baker M, Close-contact infectious diseases in NZ University of Otago, 2010
Close contact infectious diseases hospitalisations New Zealand 1989-2008 age 0 to 5 years

- 40% 1989 to 1993
- 53% 2004 to 2008

Rate per 100,000

Age 0 to 5 years close contact infectious diseases % of hospitalisations
- 40% 1989 to 1993
- 53% 2004 to 2008

Baker M, Close-contact infectious diseases in NZ. University of Otago, 2010
Are we alone?
NZ hospital admission rates serious skin infections age 0-14 & 15-24 years 1990-2006

Cellulitis hospital admission rates twice those in Australia, USA

Craig E et al. Monitoring the Health of New Zealand Children and Young People 2007
NZ hospital admission & mortality rates bronchiolitis infants 1990-2006

NZ rate 2002-06 More than twice that in USA & UK

Note: *Mortality is for 2004 year only

Craig E et al. Monitoring the Health of New Zealand Children and Young People 2007
International comparison infant pertussis hospitalisation rates

New Zealand rate 3 to 6 times greater than England, Australia or USA

Elliot E. PIDJ 2004;23:246-52.
Van Buynder P. Epidemiol Infect 1999;123:403-11
Tanaka M. JAMA 2003;290:2968-75.
Developed world pneumonia morbidity: hospital admission rates per 1000: preschool (<5 yrs)*

NZ rate 2 to 5 times greater

* All pre-conjugate pneumococcal vaccine

- Grant CC *J Paed Child Health* 1998;34:355-9
- Henrickson KJ *PIDJ* 2004;23:S11-8
- Sung RY *Clin Infect Dis* 1993;17:894-6
- Williams P *Int J Epid* 1997;26:797-805
- Clark JE *Epidemiol & Infect* 2007;135:262-9
Are we alone? No but we are in the least safe orbit
Adult ‘non-communicable’ disease

Rheumatic heart disease

- Rheumatic fever incidence 15/100,000
- Ethnic disparity increasing
  - Pacific (60 fold)
  - Māori (30 fold)
- 150 deaths per year

Bronchiectasis

- 4 per 100,000 < 15 years old
- 7 times more prevalent than Finland
- Symptoms < age 5 yrs

Significant causes of premature death in New Zealand

Twiss J. Arch Dis Child 2005;90:737-40
Kolbe J. Respirology 1996;1:221-5
Adult non-communicable disease: Do infections in early childhood contribute to the development of atherosclerosis?

- William Osler 1908
- Atherosclerosis is an inflammatory condition
- Infection produces a systemic inflammatory insult
- Acute infections in childhood cause reversible derangements in endothelial function

Adult non-communicable disease: Do infections in early childhood contribute to the development of atherosclerosis?
Communicable diseases in New Zealand today

- Most common cause of acute hospitalisation
  - Rates of hospital admission are increasing
  - Proportion of all hospitalisations is increasing

- Marked ethnic differences which are increasing
  - Especially for close-contact infectious diseases

- Greatest burden in the youngest children

- Respiratory infections and bacterial skin infections are big players

- National shame diseases: slow progress
  - Rheumatic heart disease
  - Pertussis in infants

- Potential role in adult non-communicable diseases
What do we know about communicable disease prevention?
<table>
<thead>
<tr>
<th><strong>Child death, communicable diseases and nutrition</strong></th>
<th><strong>True</strong></th>
<th><strong>False</strong></th>
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Look to the developing world for answers
Look to the developing world for answers

Nutrition

Immunisation

Case management

Living environments
Using nutrition as an example
Global impact of maternal and child malnutrition

11% of global disease burden
35% of DALY age <5 years
35% of deaths age <5 years

DALY = the number of years lost due to ill-health, disability or early death

Nutritional problems before or after birth cause child death from communicable diseases

Pre Birth

Macronutrient

Post birth

Micronutrient

Communicable disease risk in child increased

Proteins, carbohydrates & fats. In large amounts. They provide calories

e.g. Vitamins, minerals, acid found in our diets, normally only in very small amounts
Nutrition and communicable disease interaction over the life course

<table>
<thead>
<tr>
<th>Nutrition during:</th>
<th>Communicable disease risk in childhood</th>
<th>Immune and inflammatory response to infection</th>
<th>Disease sequelae</th>
<th>Risk of subsequent non-communicable disease</th>
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<tr>
<td>Infancy</td>
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<tr>
<td>Preschool</td>
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<tr>
<td>School age</td>
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</table>
# Nutritional interventions for child health: what works globally?

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Survival</th>
<th>Health*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micronutrient supplements in pregnancy</td>
<td></td>
<td>🌟🌟🌟</td>
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* increased birth weight, decreased anaemia, decreased stunting

But struth Trev, what has this got to do with New Zealand!
Weight for gestational age of New Zealand children at birth

Craig E et al. Monitoring the Health of New Zealand Children and Young People 2007
Ministry of Health Food and Nutrition Guidelines for Healthy Pregnant and Breastfeeding Women, 2006
Weight for height z-scores for New Zealand children 6 to 23 months old

Grant CC et al. J Paed Child Health 2007;43:532-8
The low birth weight – rapid subsequent growth combo

• Is a set up for micronutrient deficiency
  – Vitamin D
  – Iron

• Is a set up for subsequent non-communicable disease
  – account for 60% of all deaths and 46% of the global disease burden in 2001
  – by 2020, the proportion of deaths from chronic diseases will increase to 75%

Child nutrition and lower respiratory tract disease burden in New Zealand. Where is there potential?

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<th>Potential lower respiratory tract disease burden</th>
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# Potential nutrition & communicable disease interaction over the life course in New Zealand

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<td>![Red to Yellow Gradient]</td>
<td>![Green to Blue Gradient]</td>
<td>![Purple Gradient]</td>
<td>![Red Gradient]</td>
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What do we know about communicable disease prevention?

- Knowledge from the developing world
  - Improved nutrition
  - Immunisation and vaccines
  - Better case management
  - Improved living environments

- With respect to nutrition
  - Both macronutrients and micronutrients are important
  - Nutrition before birth and during childhood both very important

- The timing of the nutritional insult determines its effect on
  - Communicable disease risk in childhood
  - Immune and inflammatory response to infection
  - Disease sequelae
  - Risk of subsequent non-communicable disease

- In New Zealand the nutrition interventions most likely to result in reduced respiratory disease morbidity are
  - Reducing low birth weight
  - Breastfeeding promotion
  - Micronutrient supplements in infancy
  - Decreasing obesity
What can we learn from *Growing Up in New Zealand*?: New Zealand’s new longitudinal study
Longitudinal studies are of most value to New Zealand if they enrol New Zealand children and address problems that occur in New Zealand today.
New Zealand has a rich history of longitudinal studies, with studies in Christchurch (1977) & Dunedin (1972), both internationally recognised and now in their 4th decade.
At the time these cohorts were enrolled the death rate from pneumonia for Maori infants was 28 times higher than for non-Maori infants

It is again time to collect robust evidence about children growing up in New Zealand.
Non-european ethnic groups in New Zealand are increasing

Statistics New Zealand 2006 Census
To provide a robust, relevant evidence base to inform policy related to children and their families in 21st century New Zealand.
“In particular, a sample size with sufficient capacity to consider these trajectories over time for Māori tamariki and their whānau, as well as within the broad Pacific and Asian groups is required. In the context of the principles of participation and partnership under the Treaty of Waitangi, the proportion of Māori births required should be the key driver for the total cohort size to allow for adequate explanatory power in this ethnic group.”

The *Growing Up in New Zealand* cohort

District Health Boards
- Auckland
- Counties-Manukau
- Waikato

6,822 pregnant women with expected birth date April 25th 2009 and March 25th 2010

Growing Up in New Zealand

Ethnicity of enrolled mothers & partners

Mother

Partner

- New Zealand European
- Maori
- Pacific
- Asian
- Middle Eastern/Latin American/African
- Other
Understanding pathways to communicable diseases in preschool children

- Host genetic variability
- Organism genetic variability
- Host biomarkers and immune response
- Environmental diversity
Using nutrition as an example of a pathway from early life to subsequent health
Using micronutrients as an example of nutrition

Vitamin D
- The body itself makes vitamin D when it is exposed to the sun.

Cheese, butter, margarine, fortified milk, fish, and fortified cereals are food sources of vitamin D.

Iron

Vitamin A

Zinc

Zinc
- 65.39
- 7.14
- 420
- 907

Iodine
Using vitamin D as an example of a micronutrient

Vitamin D

The body itself makes vitamin D when it is exposed to the sun.

Cheese, butter, margarine, fortified milk, fish and fortified cereals are food sources of vitamin D.
There are very few food sources of vitamin D in New Zealand.

The body itself makes vitamin D when it is exposed to the sun.

- Cheese, butter, margarine,
- fortified milk,
- fish and fortified cereals are food sources of vitamin D.
Vitamin D status in New Zealand is sup-optimal across the age range

Optimal vitamin D level > 75 nmol/L (30 ng/ml)

27.5 nmol/L level needed to prevent rickets

Women of childbearing age
Cord blood
Infants
School aged children

Average serum 25 OH vitamin D nmol/L

Children with rickets get pneumonia and other respiratory infections.
Action of vitamin D on the immune system

Innate defenses

Surface barriers
- Skin
- Mucous membranes

Internal defenses
- Phagocytes
- Fever
- NK cells
- Antimicrobial proteins
- Inflammation

Antigen presentation

Pathogen killing

Adaptive defenses

Humoral immunity
- B cells

Cellular immunity
- T cells

Cellular immunity
Pacific children have lower vitamin D levels & more pneumonia

Translation of vitamin D & communicable disease research into policy

Other disease endpoints

Vitamin D at birth

Vitamin D intake pregnancy

Respiratory disease preschool

New Zealand nutrition policy

Clinical trial

Government consultation

? vitamin D dose
Overview of presentation

1. Communicable diseases in New Zealand today
   - We are heading in the wrong direction
     - Our population has a large disease burden
     - Amount of disease is increasing
     - Differences between ethnic groups are increasing
     - Slow progress

2. What do we know about communicable disease prevention
   - Improve nutrition, use vaccines, improve living environments, improve case management

3. What can we learn from *Growing up in New Zealand*
   - Knowledge that is relevant to today's population
   - Information that translates into better health
Ko a tatou tamariki, nga taonga mo apopo??

Our children are the treasures of tomorrow?
Ko a tatou tamariki, nga taonga mo apopo!!

Our children are the treasures of tomorrow!!