### Science of Rheumatic Fever Surveillance and Control

# **Rheumatic Fever & Housing: Opportunities for prevention**

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## Outline

- Epidemiology of RF vs. other serious IDs in NZ
- Patterns of household crowding in NZ
- Association between household crowding and RF vs. other serious IDs
- Risk factors for RF
- Intervening to prevent RF through better housing
- Conclusions & implications

### **RF Epidemiology** Increasing incidence





### Serious infectious diseases

Large (51%) increase in ID hospitalisations from 1989 to 2010. Largely occurred from 1991 to 2001



Source: Baker et al. Lancet 2012; 379, 1112 - 19

### **Serious Infectious Diseases** Hospitalisation rates by ID categories



Infectious disease category

Source: Baker et al. Lancet 2012; 379, 1112 - 19

### **RF Epidemiology** Increasing ethnic inequalities



**Fig. 1** Annual index cases and incidence rates for acute rheumatic fever in 1993–2009 for children 5 to 14 years of age. Māori (----); Pacific (----); non-Māori/Pacific (----).

#### Source: Milne, Lennon, et al. J Paed Child Health 2012; 48: 685-91

### **Serious Infectious Diseases**

# Children < 5 years, Ratio of Māori & Pacific ID rates to European/Other, 1989-2008



Source: Baker et al. Lancet 2012; 379, 1112 - 19

# **Possible causes for increase in IDs**

Income inequality increased markedly 1988 to 2000 period as measured by Gini coefficient & other indicators used by MSD & internationally



Source: Ministry of Social Development (Perry). Household incomes in NZ, 2011. Low Gini coefficient  $\Rightarrow$  low income inequality

# **Possible causes for increase in IDs**

### Housing affordability = proportion of households spending > 30% of income on housing costs From 1988 to 1997 prop increased 11% to 25%



Source: Ministry of Social Development. The Social Report 2010.

# **Household crowding**



#### Source: Baker et al. Household crowding in NZ. 2012.

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# **RF & household crowding**

Cases of Rheumatic Fever (2007-2012) by percent households crowded (Canadian National Occupancy Standard)



#### Source: NZ Ministry of Health, 2012.

# **RF & household crowding**

### Average annual RF first admission rates by household crowding, deprivation, income quintiles, 1996-2005



#### Source: Jaine, Baker, Venugopal. Paed Infect Dis J 2011; 30: 315-9

# **RF & household crowding**

### Multivariate analysis

- Risk of ARF hospitalisation in relation to CAU features
- Zero inflated negative binomial regression
- Restricted to Māori & Pacific 5-14 years, 1996-2005

Explanatory variable	Incidence rate ratio	95% conf. interval	p-value
Household crowding	1.022	1.010-1.034	0.000
Household income	1.006	0.998-1.024	0.523
Prop. 5-14 year olds	1.038	1.005-1.071	0.022

#### Source: Jaine, Baker, Venugopal. Paed Infect Dis, 2011; 30: 315-9

# **RF risk factors**

- Few high-quality studies of housing conditions & RF (or risk factors generally)
- Potential for case-control studies of ARF and cohort studies and cross-sectional studies of RHD
- RF strongly associated with age, ethnicity, poverty → confounding unless adjusted in analysis
- PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions

## **RF risk factors**

# Best quality studies show no significant association between household crowding and risk RF or RHD

Study, year	Country Time period	Study design	Out- come measure	Exposure measure: crowding	Comparison group	Subjec ts	No. subject	OR / RR, 95%CI	p- value
Kurahara 2006	US 1998- 2001	Case- control	RF	No. in subjects bedroom	Hospital controls with non-RF heart conditions	<18yo	26 cases + 41 controls	Mean cases: 1.4; controls: 1.7	NS
Vlajinac, 1991	Yugo- slavia 1982	Case- control	RF	>2 persons / room	Neighbour- hood & school controls	<18yo	148 cases + 444 controls	OR=1.60, CI 0.61-3.00	NS
Oli, 1999	Ethiopia 1995	Cross - section	RHD preval- ence	Persons / bedroom (2+ in univariate analysis)	Children without RHD	10- 15уо	9378	OR=1.01, CI 0.99-1.02	NS
Coggon, 1993	UK 1936- 1989	Cohort (retro)	Mortality from RHD	Crowding index 1.00+ vs. <0.50	No RHD as adults	All ages	8138	-	NS

Source: Baker, McDonald et al. 2012. Household crowding & risk of IDs: A systematic literature review & meta-analysis of observational studies.

## **RF Risk factors**

### **Risk factors for RF:**

• Age	+++
• Ethnicity	++
• Poverty	+
<ul> <li>Access to health services</li> </ul>	+
<ul> <li>Household crowding</li> </ul>	+/?
<ul> <li>Household dampness</li> </ul>	+/?
<ul> <li>Urbanisation</li> </ul>	?
<ul> <li>Poor nutrition</li> </ul>	?

Sources:

- Steer, Carapetis, et al. Paediatr. Child Health 2002; 38: 229–34
- Kerdemelidis, Lennon, et al. J Paediatr. Child Health 2010; 46 534–48
- NZ Guidelines Group, RapidE: Rheumatic Fever, 2011
- Baker, McDonald, et al. Household crowding & risk of IDs, 2012

### **IDs and Household Crowding** Multiple studies on Meningococcal disease



Source: Baker, McDonald et al. 2012. Household crowding and the risk of infectious disease: A systematic literature review and meta-analysis of observational studies.

### **IDs and Household Crowding** Meta-analysis of multiple IDs

Disease/category	Ν	Case-control (cross- sectional studies*)	Cohort studies		
Respiratory infections:					
Pneumonia	7	OR 1.58, CI 1.19-2.10	RR 1.61, CI 1.12-2.31		
Other respiratory	8	OR 1.38, CI 0.71-2.67	RR 1.35, CI 1.02-1.79		
infection					
<ul> <li>Haemophilus influenza</li> </ul>	6	OR 1.74, CI 1.27-2.37			
Meningococcal disease	7	OR 2.13, CI 1.38-3.29			
RSV / bronchiolitis	4	2.24, CI 1	1.14-4.38		
• ТВ	7	OR 3.78, CI 1.78-8.13			
Enteric infections:					
Gastroenteritis	4	OR 1.13, CI 1.01-1.26			
• Hepatitis A	6	OR 1.42, CI 1.15-1.75			
• H. pylori	28	OR 1.82, CI 1.55-2.13			
Skin/eye infections:					
Trachoma	2	OR 2.07, CI 1.06-4.06			
Total	79				

Source: Baker, McDonald et al. 2012. Household crowding & risk of IDs: A systematic literature review & meta-analysis of observational studies.

# **Mechanism linking crowding to RF**

Classical studies in US Air Force Base barracks in 1950s.

Acquisition of streptococcal infections increased when beds moved closer together Biological basis for effect of crowding on ARF incidence

Source: Wannamaker LW. The epidemiology of streptococcal infections. In: McCarty M, ed. Streptococcal Infections. Columbia University Press, New York, 1954





### **Mechanism linking crowding to RF**



### Interventions

**HNZC Healthy Housing Programme (HHP)** HHP tenants (7,477) compared with Non-HHP tenants (27,903)in Auckland and Northland 2004-08

### Children <20 years participating in HHP:

- 27% (95%CI -43% to -6%) decline in acute and arranged hospitalisations
- Crowding reduction associated with:
  - 61% (95%CI -79% to -26%) reduction in acute and arranged hospitalisations
  - 69% (95%CI-91% to +1%) reduction in IDs

Sources:

- Baker et al. 2012. Health Impacts of the HHP on HNZC Tenants: 2004-2008
- Jackson et al. J Epidemiol Community Health 2011;65:588-93

### Interventions

- 32% of RF cases (<18 years, 2004-2010) were HNZC tenants reflecting high proportion of Maori & Pacific children
- Age-ethnicity adjusted RR 1.6 (95%CI 1.5-1.7) for RF in HNZC tenants vs. Other NZers



## Conclusion

- RF is associated with exposure to household crowding, but evidence base is small & may be confounded by poverty
- Mechanism is presumably through an increased risk of GAS pharyngitis
- Strong evidence for household crowding increasing risk of many IDs
- In NZ incidence & ethnic inequalities have increased for RF and serious IDs generally
- Some of these increases may be related to increasing exposure to household crowding
- HNZC healthy housing programme highly effective at reducing IDs in children

## Implications

- **1. Sufficient evidence to justify reducing exposure of NZ children to severe household crowding to prevent IDs**
- 2. Need to enhance & extend the HNZC Healthy Housing Programme
- 3. Need to increase supply of social housing, particularly in Auckland
- 4. Need high quality research to investigate relationship of household crowding (+ other features of home environment) with (a) GAS pharyngitis & (b) RF

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