Association of contact, ethnicity, & pneumococcal carriage three years post-PCV10: Fiji

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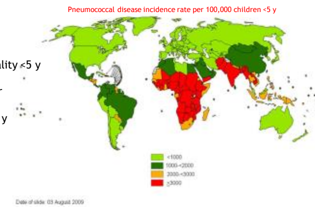
Background: pneumococcal disease burden

- Leading cause of morbidity & mortality <5 y
- 11.1 – 18 million cases <5 y per year
- 0.8 – 0.9 million deaths per year <5 y
- Majority cases in LMICs



1 WHO.http://www.who.int/gho/child_health/mortality/mortality_causes_region_text/en/
2 O'Brien KL et al Lancet. 2009;374(9693):893-902.
3 Drijkoningen JJ et al Clin Microbiol Infect. 2014;20 Suppl 5:45-51

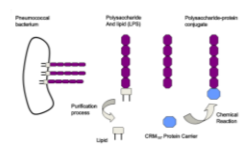
Background: pneumococcus & disease

- Commensal organism of human nasopharynx; disease prerequisite
- Asymptomatic carriage common; prevalence highest in toddlers, who have been considered main reservoir
- Spread: non-sterile sites → non-IPD; sterile sites → IPD
- Dense pneumococcal carriage → severity of pneumococcal respiratory illness

4. Bogaert D, De Groot R, Hermans PW. Streptococcus pneumoniae colonisation: the key to pneumococcal disease. The Lancet Infectious diseases. 2004;4(3):144-54.

Background: pneumococcal conjugate vaccines

- >90 identified pneumococcal serotypes
- PCVs reduce carriage, transmission, IPD
- Despite efficacy of PCVs, pneumococcus is important cause of morbidity and mortality in LMICs
- Rates IPD & impact of PCV differs between ethnic groups



6. Toms C, de Kluyver R, Enhanced Invasive Pneumococcal Disease Surveillance Working Group for the Communicable Diseases Network A. Invasive pneumococcal disease in Australia, 2011 and 2012. Communicable diseases intelligence quarterly report. 2016;40(2):E267-84.
7. Pneumococcal conjugate vaccine [Image]. Available from: http://slideplayer.com/slide/6052082/

Background: potentially infectious contacts?

- Close contact associated with viral respiratory pathogen transmission, e.g., influenza
- Previously assumed frequency of physical *or* conversational potentially infectious contacts drive pneumococcal transmission
- Empirical data & evidence lacking

5 Mossong J et al . PLoS Med. 2008;5(3):e74

Background: Fiji

- 56.8% Indigenous iTaukei (iTaukei)
- 37.5% Fijian of Indian Descent (FID)
- PCV10 in Oct 2012, 3 + 0 schedule
- PCV10 national coverage 89% 2015

8. Fiji Map [Image]. Available from: http://www.fiji.travel/
9. Fiji Bureau of Statistics. Available from: http://www.statsfiji.gov.fj/index.php

Background: Fiji and the pneumococcus

- Carriage — iTaukei > FID (2006) RR: 1.96 95% CI 1.70 - 2.26, p<0.001
- Density — iTaukei > FID
- Pneumonia — iTaukei > FID (2007-2011) (IRR: 3.2, p<0.001
- IPD — iTaukei > FID (2010) (IRR: 4.3, 95% CI 2.1 - 10.3, p<0.001)

- Anecdotally — frequency & intensity contact iTaukei > FID, especially young children

10. Dunne EM et al J Clin Micro. 2012;50(2): 1034 - 1038
11. Russell FM et al. Annals of tropical paediatrics. 2006;26(3):187-97
12. Russell FM et al. Pediatr Infect Dis J. 2010;29(9):870-2.
13. Tuivaga E. Fiji Journal of Public Health. 2014;3(2):2.

Aims

- Does frequency & intensity of contact vary by ethnicity in Fiji?
- Is frequency & intensity of contact associated with pneumococcal nasopharyngeal carriage & density

14. Laboratory for communications and applications [Image]. Available from: http://lca.epfl.ch/student-projects/projects/2014-spring/ita-direct_project_bulut_epidemics-dynamic-nets.html

Methods

- Design: Cross-sectional carriage & contact survey, Suva, Fiji, 2015; Infants, toddlers, children, caregivers, n = 500 per group
- Data: Demographics & nasopharyngeal swabs[36]; 24 h later, interviewer led phone based contact survey
- Lab: *lytA* qPCR & microarray to detect & quantify pneumococci; Provide overall, PCV10, & NVT carriage, & density
- Analyse: Age stratified contact matrices by ethnic group; GEE regression: association of contact & ethnicity with carriage & density

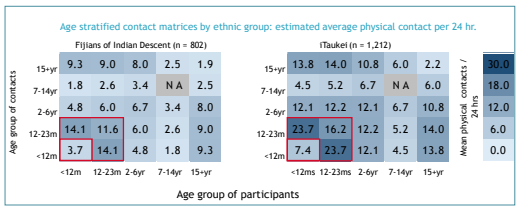
15. Satzke C et al. Vaccine. 2013;32(1):165-79.

Results: demographics (n = 2,014)

Characteristics, n (%) or median (IQR)	iTaukei (n = 1,212)	Fijians of Indian Descent (n = 802)	p-value
Male sex, n (%)	511 (42.2)	319 (39.8)	0.287
Rural residential location, n (%)	571 (47.1)	397 (49.5)	0.293
Antibiotic use in past fortnight, n (%)	43 (3.6)	18 (2.2)	0.095
Exposure to household cigarette smoke, n (%)	658 (54.3)	429 (53.5)	0.725
Poverty, n (%)	631 (52.1)	426 (53.1)	0.643
Symptoms of URTI, n (%)	393 (32.4)	162 (20.3)	<0.001
Household members, median (IQR)	7 (5 - 10)	5 (4 - 7)	<0.001
Household members <5y, median (IQR)	2 (1 - 3)	1 (1 - 2)	<0.001
Pneumococcal carriage Total, n/N (%) Vaccine type, n/N (%) Non-vaccine type	538 / 1,195 (45.0) 85 / 1,182 (7.2) 476 / 1,182 (40.3)	108 / 798 (13.5) 29 / 797 (3.6) 80 / 797 (10.0)	<0.001 0.001 <0.001
Density, n median log_{10} GE/ml (IQR)	538/4.9 (4.0 - 5.7)	108 / 4.7 (3.9 - 5.5)	0.158
PCV10 vaccination coverage, n (%)	375 (30.9)	238 (29.7)	0.546

Results: physical contact

- Most contact was physical



Results: all type pneumococci

Participant prevalence pneumococci

- Pooled 32.4% (95%CI 30.4 - 34.5)

Physical contact frequency with young children & iTaukei ethnicity ↑ carriage odds

- Physical contact 12 - 23 mo. — aOR 1.34 (95%CI 1.09 - 1.64) p = 0.005
- Physical contact 2 - 6 yr. — aOR 1.11 (95%CI 0.99 - 1.25) p = 0.076
- iTaukei — aOR 5.17 (95%CI 3.97 - 6.74) p < 0.001
- Symptoms of URTI — aOR 2.00 (95%CI 1.57 - 2.54) p < 0.001
- Adult participant — aOR 0.08 (95%CI 0.04 - 0.15) p < 0.001

Results: PCV10 type pneumococci

Participant prevalence PCV10 type pneumococci

- Pooled: 5.7% (95%CI 4.8 – 6.9)

Physical contact frequency with *older* children & iTaukei ethnicity ↑ PCV10 carriage odds

Physical contact 7 – 14 yr.	aOR 1.25 (95%CI 1.07 – 1.13) p = 0.006
iTaukei	aOR 1.70 (95%CI 1.05 – 2.75) p = 0.031
Symptoms of URTI	aOR 1.51 (95%CI 1.00 – 2.29) p < 0.050
Adult participant	aOR 0.07 (95%CI 0.02 – 0.27) p < 0.001

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Results: non-vaccine type pneumococci

Participant prevalence of NVT pneumococci

- Pooled 28.1% (95%CI 26.1 – 30.1)

Physical contact frequency with young children & iTaukei ethnicity ↑ NVT carriage odds

Physical contact 12 – 23 mo.	aOR 1.25 (95%CI 1.02 – 1.54) p = 0.031
Physical contact 2 – 6 yr.	aOR 1.13 (95%CI 1.00 – 1.27) p = 0.051
iTaukei	aOR 5.99 (95%CI 4.48 – 8.00) p < 0.001
Symptoms of URTI	aOR 1.85 (95%CI 1.45 – 2.35) p < 0.001
Adult participant	aOR 0.08 (95%CI 0.04 – 0.16) p < 0.001

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Results: pneumococcal density

Median density of for those carrying pneumococci

- 4.9 GE/ml $\log_{10}$ (IQR 4.0 – 5.7)

No association between contact frequency, or ethnicity, with density

Physical contact <12 mo.	mean adjusted diff. 0.10 (-0.07, 0.28) p=0.243
Physical contact 12 – 23 mo.	mean adjusted diff. -0.02 (-0.16, 0.12) p=0.750
Physical contact 2 – 6 yr.	mean adjusted diff. 0.02 (-0.05, 0.10) p=0.564
Physical contact 7 – 14 yr.	mean adjusted diff. 0.00 (-0.07, 0.07) p=0.950
Physical contact 15+ yr.	mean adjusted diff. 0.01 (-0.04, 0.06) p=0.735
iTaukei	mean adjusted diff. 0.12 (-0.10, 0.34) p=0.270
Participants aged 2 – 6 yr.	mean adjusted diff. 0.57 (0.25, 0.89) p<0.001
Symptoms of URTI	mean adjusted diff. 0.32 (0.15, 0.49) p<0.001
Rural residential location	mean adjusted diff. 0.23 (0.06, 0.40) p=0.007

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Conclusions

- First study investigating contact & carriage with empirical data in a post-PCV setting
- Frequency & intensity of contact differs by ethnicity in Fiji
- iTaukei ethnicity remains associated with increased carriage of all pneumococci
- Frequency & intensity physical contact with young children was associated with overall & NVT carriage
- Frequency & intensity of contact with *older* children was associated PCV10 carriage; unvaccinated age group; transient reservoir of vaccine type pneumococci
- Pneumococcal density not associated with ethnicity or frequency or intensity of contact
- Next? Pneumococcal transmission model to help inform disease control strategies

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