The RURAL Study: Rural & Urban Risks of Appendicitis Complications. A Comparison of Anatomic Severity of Acute Appendicitis in Rural and Urban Children: A Multicentre, Prospective Cohort Study

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Rural & Urban Risks of Appendicitis CompLications

Comparison of Anatomic Severity of Acute Appendicitis in Rural and Urban Paediatric Patients: A Multicentre Prospective Cohort Study

New Zealand's first Locally-Designed, Trainee-led National Prospective Surgical Study

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REVIEW ARTICLE

Effect of Delay to Operation on Outcomes in Patients with Acute Appendicitis: a Systematic Review and Meta-analysis

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Abstract

Background Many studies have investigated the association between time interval and incidence of complicated appendicitis and post-operative surgical site infection (SSI), but the results are controversial.

Methods A systematic search of the electronic databases identified studies that investigated the association of appendectomy delay with complicated appendicitis and SSI among patients with acute appendicitis. Qualitative and quantitative meta-analysis of the results was conducted.

Results Twenty-one studies were included in the final analysis. Meta-analysis showed no significant difference in complicated appendicitis incidence between patients in the 6–12 h, > 12 and < 6 h groups (OR 1.07, 95% CI 0.89–1.30, $p = 0.47$; OR 1.04, 95% CI 0.88–1.22, $p = 0.64$). Comparison of the 6–12 h category with the < 6 h category of in-hospital delay revealed significant associations between longer in-hospital delay and increased risk of post-operative SSI (OR 1.40, 95% CI 1.11–1.77, $p = 0.004$). Patients in the 24–48 h category had 1.99- and 1.84-fold ($p < 0.05$) higher odds of developing complicated appendicitis compared to patients in the < 24 h category for pre-hospital delay and total delay, respectively (OR 1.99, 95% CI 1.35–2.94, $p = 0.0006$; OR 1.84, 95% CI 1.05–3.21, $p = 0.03$). When pre-hospital and total delay time extended to more than 48 h, the odds of risk increased 4.62- and 7.57-fold, respectively (OR 4.62, 95% CI 2.99–7.13, $p < 0.00001$; OR 7.57, 95% CI 6.14–9.35, $p = < 0.00001$).

Conclusion Complicated appendicitis incidence was associated with overall elapsed time from symptom onset to admission or operation; short appendectomy in-hospital delay did not increase the risk of complicated appendicitis but was associated with a slightly increased risk of SSI. Prompt surgical intervention is warranted to avoid additional morbidity, enabling quicker recovery in this population.

Background

- Appendicitis is the most common reason children require urgent surgery.
- The exact cause of appendicitis and subsequent perforation is unclear.
- Perforation rates in children is as high as 70%.
- Generally worse outcomes in minority/indigenous, lower socioeconomic and rural population groups.
- Despite prehospital symptoms reliably being predictive of perforation, the prehospital domain remains neglected.

Figure 1: Locations of the 14 participating hospitals across New Zealand

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Taking it national

- Prospective multicenter cohort study.
- Consecutive patients aged ≤16 years admitted to hospital with suspected appendicitis.
- January to July 2020.

Coverage of our project:

- 14 hospitals – urban and regional
- 54 collaborators across the country

Outcomes:

- Effect of rurality and ethnicity on the Anatomical Severity of Appendicitis (AAST Grade)
- Evaluate the effect of participant-level prehospital and socioecomic predictors of access.
- Explore the national management of paediatric appendicitis.

AAST – American Association for the Surgery of Trauma Anatomical Severity

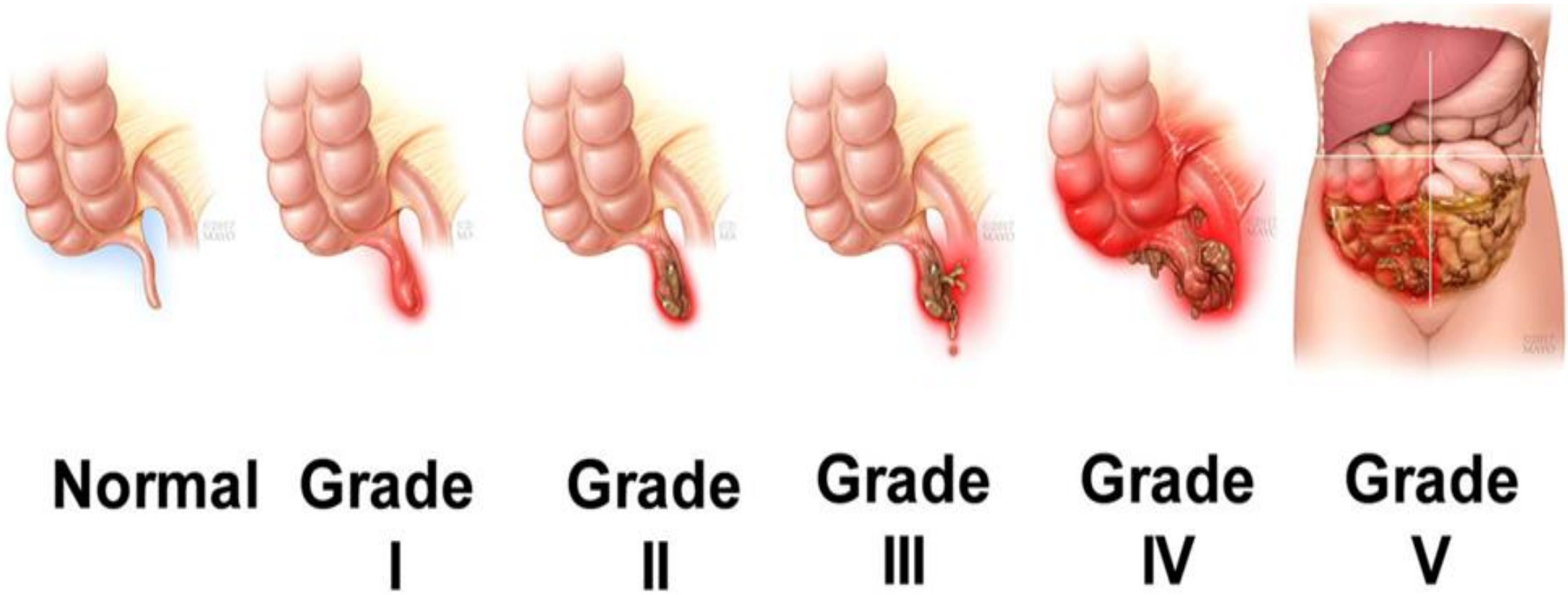

Figure 2: Pictorial representation of the AAST Anatomical Severity Grade for Acute Appendicitis.

Reprinted by permission from Springer Nature: World Journal of Surgery, Appendicitis: Rural Patient Status is Associated with Increased Duration of Prehospital Symptoms and Worse Outcomes in High and Low-Middle-Income Countries, Matthew C. Hernandez et al,[108] copyright 2017.

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- Comprehensive prospective clinical & operative dataset.

- **Supplemented by:**
  - Parental questionnaire covering patient-level health seeking behaviour, socioeconomic concerns & barriers to care.
  - Site survey covering resource availability, guidelines & management.

Prehospital Data Point
Time of symptom onset
Was this a school or work day?
Main symptom of child on presentation
Work absence in order to present to hospital?
If time was taken off work did this make it hard for the household financially?
Approximate total annual household income
Total number of dependent children
Prior awareness of Appendicitis?
Seek help from a non-healthcare source?
Present to another health service before arriving to hospital?
Who made the decision to present to hospital?
Method of transport to hospital
Self-Reported Rurality
Family-reported presence of prehospital delay + reason
Self-Reported Ethnicity

Results

Participant Characteristics

- 208 children aged ≤16 admitted to hospital with suspected appendicitis.
- 182 ended up having histologically or radiologically diagnosed appendicitis.
- Median age was 11.6 years (2-16).
- 37% defined as rural by Stats NZ.
- 23% self-identified as Māori.

- **Complicated appendicitis rate: 38%**
- **Negative appendicectomy rate: 13%**

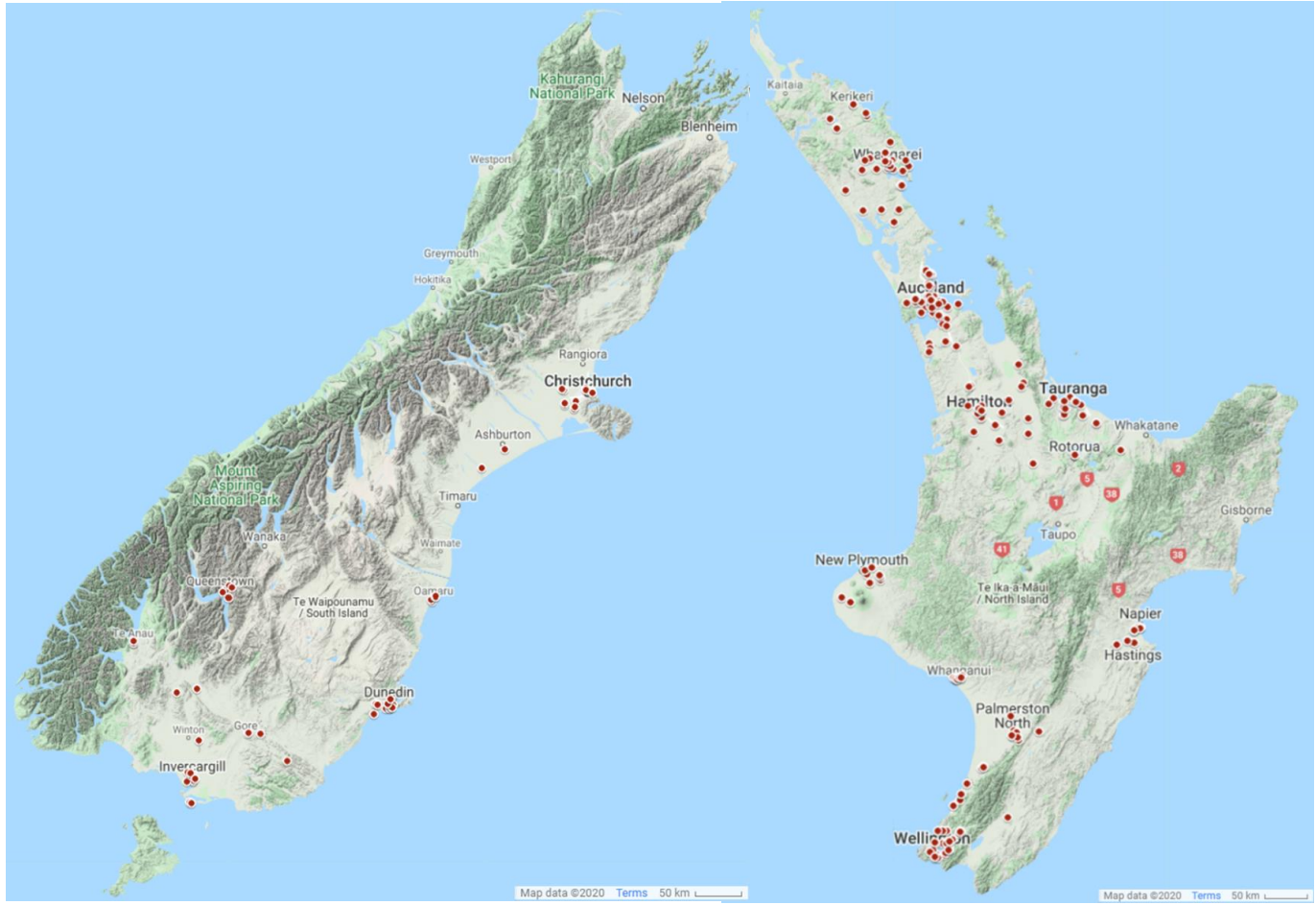


Figure 3: Geographic Distribution of Recruited Participants for RURAL Study.

The Average Kiwi Child

Prehospital Duration of Symptoms
26.8 hours

Time to Preoperative Antibiotics
4.7 hours

Time to Operation
13.1 hours

Postoperative Stay
28.2 hours

The Role of Delay

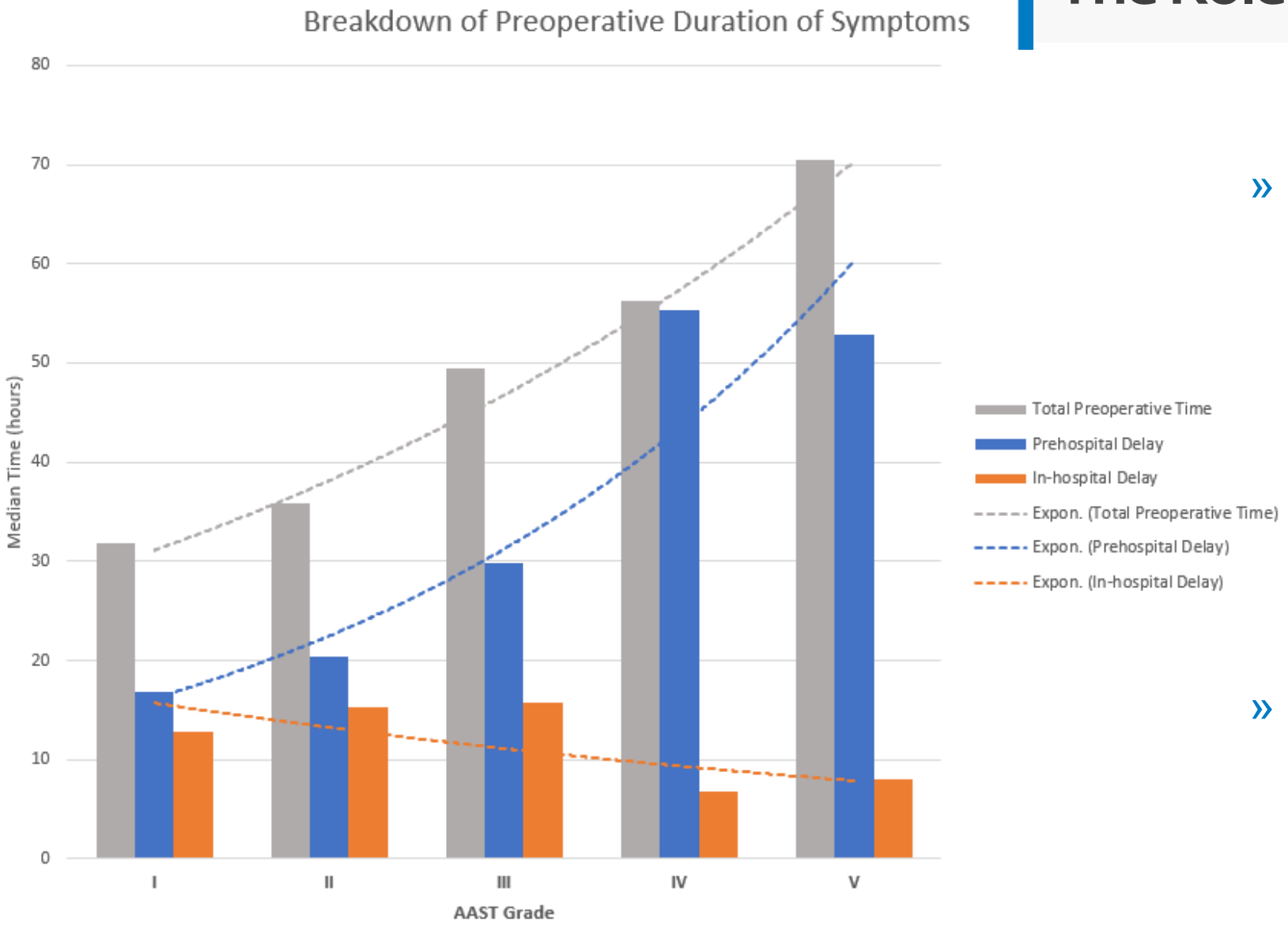


Figure 4: Breakdown of preoperative delay in paediatric appendicitis by AAST grade.

- Median prehospital time was significantly longer in the complicated appendicitis group. **(45.9h vs 19.4h, p>0.001)**
- Median in-hospital time was slightly reduced in complicated appendicitis. **(13.2h vs. 10.7h, p=0.147).**

Why increased severity mattered:

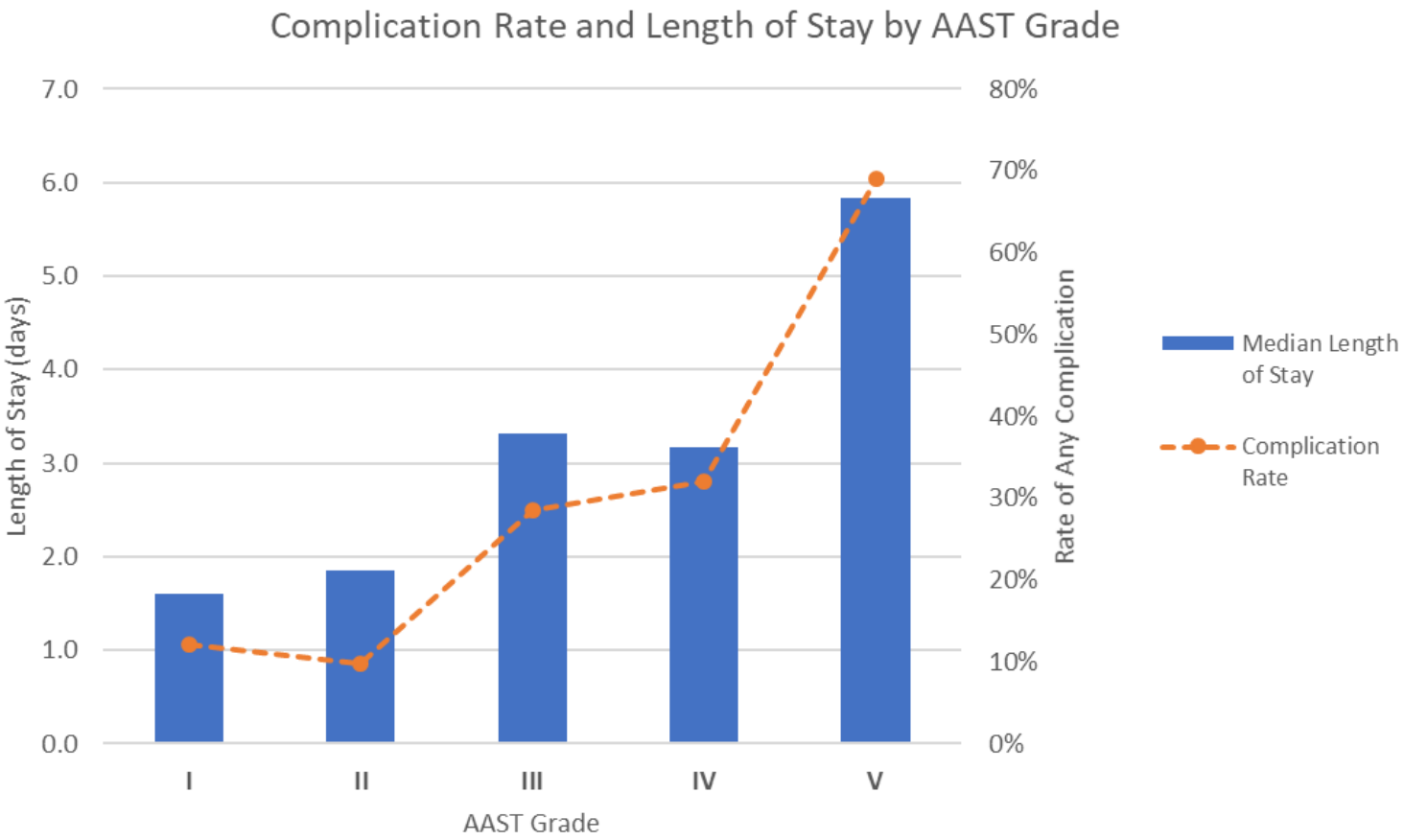
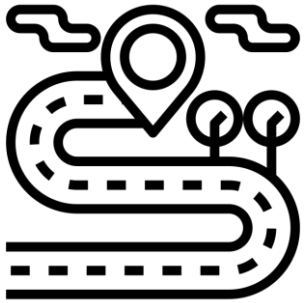


Figure 5: Complication rates and length of stay by AAST grade.

Comparing AAST grade 1 to grade 5:

- Increased post-operative complication rates-
  (10% to 68%)
- Increased median length of hospitalisation -
  (1.6 days to 5.8 days)

Impact of Paediatric Appendicitis on Kiwi Families:



Mean Travel Distance

35.3km

Median Annual Total Household Income

$100,000 NZD

Median Household Dependents

3

Required Parental Leave from Work

58%

Significant Acute Financial Distress

36%

Did Not Present in Own Car

17%

Factors Associated with Complicated Appendicitis

Prehospital Delay
(45.9h vs 19.4h, p>0.001)
OR 1.015; p=0.0002

Rurality
(45% vs 33%, p=0.04)
OR 4.33; p<0.0001

Unfamiliarity with Appendicitis
(51% vs. 22%; p<0.0001)
OR 3.61; p=0.0002

Younger Age
(10.8y vs. 11.8y, p=0.012)
OR 0.855; p=0.0028

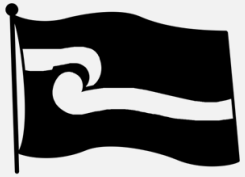
Māori
(33% vs 17%, p=0.018)

OR 2.39; p=0.0189

Not Presenting in Own Car
(29% vs. 10%, p=0.002)
OR 6.94; p>0.0001

Why could these groups be at risk?

Māori Children



» Increased median prehospital delay,
(33h vs. 25h, p=0.029)

AND:

- Significantly lower median annual total household income.
($70,000 vs. $100,000, p=0.0001)
- Less likely to report familiarity with appendicitis prior to this episode
(54% vs. 72%, p=0.029)

Rural Children

» No tendency to increased prehospital delay,

BUT:

- Significantly more likely to have an appendicolith
(32% vs. 18%, p=0.034)
- Significantly more likely to have purulent abdominal free fluid.
(72% vs. 41%, p=0.001)
- Had higher median inflammatory markers

Site Survey & In-hospital Management

- Only 4 dedicated paediatric surgical services across the country.
- Therefore, all other centres, children were cared for by primarily adult surgeons.

- Most services did **not** had guidelines for paediatric appendicitis.

- When present, they provided **contradictory advice** on utilisation of antibiotics, non-operative management and removal of macroscopic appendixes.

- Access to acute theatre and imaging was variable.
- 26% of children had preoperative imaging.

Conclusions

- Prehospital delay is a key predictor of increasing severity of appendicitis.
- Disparate outcomes exist in acute appendicitis for Rural and Māori children in New Zealand.
- Rural children may have a more aggressive pathologic phenotype of appendicitis with higher rates of appendicoliths.
- Māori children tended to have differential access to key determinants of health.
- Our complicated appendicitis rate (38%) and negative appendicectomy rate (13%) is high.
- Management across the country was heterogenous and imaging was infrequently used.

Question time & Acknowledgements:

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- Our participants who saw value in the study.
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