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Author/s:

Buntsma, D;Lithgow, A;O'Neill, E;Palmer, D;Morris, P;Acworth, J;Babl, FE

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**Patterns of paediatric emergency presentations to a tertiary referral
centre in the Northern Territory**

Running Title: Paediatric Emergency Presentations NT

Authors

Davina Buntsma MBBS BMedSc DCH (1, 2)

Anna Lithgow MBBS MPHTM FRACP (3)

Evan O'Neill MBBS BMedSc (1)

Didier Palmer MB BCh FRCP FRCS FRCEM FACEM (3)

Peter Morris MBBS RACP PHD (4)

Jason Acworth MBBS FRACP (5)

Franz E Babl MBBS FRACP (2, 7)

1. Department of Emergency Medicine, The Children's Hospital at Westmead, Sydney, Australia
2. Murdoch Children's Research Institute, Royal Children's Hospital, Melbourne, Victoria, Australia
3. The Department of Emergency Medicine, The Royal Darwin Hospital, Darwin, Northern Territory

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4. Menzies School of Health Research Institute, Darwin, Northern Territory,
Australia
5. Emergency Department, Lady Cilento Children's Hospital, Brisbane,
Queensland
6. Faculty of Medicine, University of Queensland, Brisbane, Queensland
7. Department of Emergency Medicine, Royal Children's Hospital, Melbourne,
Victoria

Corresponding author:

Dr Anna Lithgow

Department of Paediatrics

The Royal Darwin Hospital

PO Box 41326, Casuarina

NT, 0810

annalithgow@gmail.com

+61416192626

Co-authors:

Dr Davina Buntsma

Department of Emergency Medicine

The Children's Hospital at Westmead

Westmead, NSW

Dr Evan O'Neill

Department of Emergency Medicine

The Children's Hospital at Westmead

Westmead, NSW

Dr Didier Palmer

Department of Emergency Medicine

The Royal Darwin Hospital

TIWI, NT, 0810

Professor Peter Morris

Department of Paediatrics

The Royal Darwin Hospital

TIWI, NT, 0810

Dr Jason Acworth

Faculty of Medicine

The University of Queensland

Brisbane, QLD

Associate Professor Franz Babl

Department of Emergency Medicine

The Royal Children's Hospital

Melbourne, Victoria

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**Patterns of paediatric emergency presentations to a tertiary referral
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ORIGINAL ARTICLE

Authors

Davina Buntsma MBBS BMedSc DCH ^{1, 2}

Anna Lithgow MBBS MPHTM FRACP ³

Evan O'Neill MBBS BMedSc¹

Didier Palmer MB BCh FRCP FRCS FRCER FACEM³

Peter Morris MBBS RACP PHD ⁴

Jason Acworth MBBS FRACP^{5,6}

Franz E Babl MBBS FRACP^{2, 7}

Affiliations

for the Paediatric Research in Emergency Departments International
Collaborative (PREDICT)

¹ Department of Emergency Medicine, The Children's Hospital at Westmead,
Sydney, Australia

² Murdoch Children's Research Institute, Royal Children's Hospital,
Melbourne, Victoria, Australia

³ The Department of Emergency Medicine, The Royal Darwin Hospital,
Darwin, Northern Territory

⁴ Menzies School of Health Research Institute, Darwin, Northern Territory,
Australia

⁵ Emergency Department, Lady Cilento Children's Hospital, Brisbane,
Queensland

⁶ Faculty of Medicine, University of Queensland, Brisbane, Queensland

⁷ Department of Emergency Medicine, Royal Children's Hospital, Melbourne,
Victoria

Abstract

Objective: To describe epidemiological data concerning paediatric attendances at the emergency department (ED) of Royal Darwin Hospital (RDH)

Methods: We conducted a retrospective cohort study of paediatric emergency visits to RDH ED for the years 2004 and 2013. Epidemiological data, including demographics, admission rates and diagnostic grouping, were analysed using descriptive and comparative statistical methods. We compared 2004 data with findings from a baseline epidemiological study by the Paediatric Research in Emergency Departments International Collaborative (PREDICT) conducted in the same year¹.

Results: A total of 12745 and 15378 paediatric presentations (age 0 to 18 years) to RDH ED were analysed for the years 2004 and 2013.

In 2004, the mean age of children presenting to RDH was 7.1 years and 44% were male. Indigenous patients accounted for 31.2% of presentations at RDH and were significantly more likely to be admitted than non-indigenous patients (31.6% vs 12.8%, OR 3.24, 95% CI 2.95-3.55). Children < 5 years old accounted for the highest number of presentations (45.2%) and admissions (51.2%) and there was a high proportion of adolescent presentations (18%). Similar to the PREDICT study, viral infectious conditions (bronchiolitis, gastroenteritis, upper respiratory tract infections) were the most common cause for presentations. Key differences included a higher proportion of

patients presenting with cellulitis and head injury at RDH and an increasing proportion of adolescent psychiatric presentations at RDH from 2004 to 2013.

Conclusion

This study provides important information regarding paediatric presentations to a major referral hospital in the Northern Territory. Overall there was a disproportionate rate of presentation and admission amongst Indigenous children. Other key findings were higher proportions of cellulitis, head injury and adolescent presentations. These findings can assist in service planning and in directing future research specific to children in the Northern Territory.

Background/Introduction:

The Royal Darwin Hospital (RDH) is the largest teaching hospital in the Northern Territory. The RDH Department of Emergency Medicine has an annual census of 68,000 patients, 23% of these attendances are children. Indigenous Australians represent a large proportion of presentations and the burden and spectrum of disease is very different to that seen elsewhere with high rates of trauma, sepsis, severe gastroenteritis, respiratory illness, post-streptococcal glomerulonephritis and acute rheumatic fever.²⁻⁷ It is likely that the patterns of paediatric emergency presentations in the Northern Territory differ to the rest of Australia, however this data has not been previously described.

Comprehensive data on patterns of paediatric attendances to Emergency

Departments (EDs) in Australia was published by the Paediatric Research in Emergency Departments International Collaborative (PREDICT) in 2009¹.

PREDICT is a network of all tertiary paediatric emergency centres and several larger mixed EDs in Australia and New Zealand that was established in 2004 to conduct multicentre research on topics related to the emergency care of children and adolescents.⁸ It was established to overcome a number of obstacles to research on paediatric emergency topics and facilitate better use of the vast amounts of data already available for analysis. The report published investigated at key epidemiological data from 2004 from each member site and included all states in Australia except the Northern Territory and Tasmania.

In the present study, we set out to provide epidemiological data about childhood illness and injuries presenting to the largest ED in the Northern Territory. Data was collected in 2014. The primary aim was to compare data on ED presentations to RDH with PREDICT in 2004 and then to compare data on ED presentations to RDH in 2004 with data from 2013. This should add to the existing knowledge on paediatric emergency presentations in Australia and New Zealand and inform local priorities in service delivery, education and research.

Methods:

Our study design was based on the PREDICT epidemiological study and we retrospectively identified all children aged 0-18 years attending the Royal

Darwin Hospital ED between 1st January 2004 and 31st December 2004 and 1st January 2013 and 31st December 2013. Data was obtained from the ED's existing electronic patient information systems. Diagnoses were based on the International Classification of Diseases 10th revision.⁹

Data collected included:

- Total number of paediatric patient presentations
- Number of presentations by age group, gender, ethnicity, triage category, time of day and month of year
- Number of admissions by age group, gender, ethnicity and month of year
- Mean and median age of patients
- Mode of arrival and disposition
- Most common diagnoses (total and by age group)

We compared RDH 2004 data with data from the PREDICT study in 2004 and subsequently compared RDH 2004 data with RDH 2013 data. The Human Ethic Research Committee of the Northern Territory Department of Health and Menzies School of Health Research approved this project.

Statistical Methods

Analyses were performed using Microsoft Excel. Percentages were calculated and compared for individual conditions. We considered percentage differences of >5% to have the potential to influence practice and differences

of >20% to be highly important. For dichotomous variables, odds ratios (OR) and 95% confidence intervals (95% CI) were calculated.

Results

There were a total of 12745 and 15378 paediatric presentations (age 0 to 18 years) to RDH ED for the years 2004 and 2013 respectively. Key epidemiological variables are summarised in Table 1 which includes comparison to 2004 data from the PREDICT study.

When comparing RDH data from 2004 with PREDICT data, the mean age of children at RDH was 7.1 years and 4.6 years respectively. At RDH, 56.0 % were female compared to 44.9% in PREDICT (OR 1.25, 95% CI 1.21-1.28). 45.2% of presentations at RDH were for children under 5 years of age compared to 59.7% in PREDICT (OR 0.76, 95% CI 0.73-0.78), with children in the first year of life responsible for a disproportionately high number of presentations and admissions in both groups. At RDH there was a higher proportion of adolescent presentations (15-18 years) accounting for 18% of paediatric ED visits to RDH in 2004 compared to 4.0% in the PREDICT group (OR 4.48, 95% CI 4.17-4.70).

Darwin saw a more uniform number of presentations throughout the year, without the winter peak seen in the PREDICT group. There was a reduction in the number of presentations to RDH in January and July correlating with school holidays (Figure 3). As in PREDICT, a large proportion of presentations occurred between midday and midnight.

Indigenous patients accounted for 31.2% of presentations at RDH in 2004 compared to only 2.13% in PREDICT. Indigenous patients were significantly more likely to be admitted, with 31.6% Indigenous compared to 12.8% of non-Indigenous patients admitted in 2004 (OR 3.24, 95% CI 2.95-3.55). This compares to an odds ratio of 1.25 (95% CI 1.18-1.31) for Indigenous as compared with non-Indigenous subgroups at Australian sites in the PREDICT study.

There was a trend at RDH for higher acuity patients with 36.8% of patients being ATS category 1-3 in 2004 compared to 32.4% in PREDICT (OR 1.06 95%CI 1.02-1.10). There was a significantly smaller proportion of ATS category 5 presentations at RDH compared to PREDICT (2.8% vs 15.4%; OR 0.16, 95% CI 0.14-0.18)

With the exception of infants, where admission rates were higher at RDH, (31.7% vs 24.3%) admission rates for other age groups were lower at RDH with the greatest difference in the older adolescents where the admission rate was 15.2% at RDH compared to 29.6% in PREDICT (Fig 2). In both groups, the majority of patients were discharged and deaths were rare.

When comparing RDH 2004 data with 2013, overall, the key epidemiological variables were similar. One important difference was a trend for increasing acuity of patients with a significant increase in the proportion of ATS category 2 presentations from 2.4% to 10.6% (OR 4.45, 95% CI 3.93-5.04). This may

reflect improved adherence to protocols mandating higher ATS category for neonates and trauma calls.

The ten most frequent diagnoses on presentation to RDH and in the PREDICT group are presented in Table 2, and the most frequent diagnoses on presentation for each age group are presented in Table 3. The ten most common presentations for the Indigenous sub-group are presented in Table 4.

DISCUSSION

This is the first study to describe paediatric emergency presentations to a major referral hospital in the Northern Territory and provides important epidemiological data to add to the existing knowledge of paediatric ED presentations in other states of Australia and New Zealand.

As in the PREDICT study, there were high numbers of presentations in the infant and pre-school age groups, and many children presented with infectious diseases (mostly viral) and respiratory conditions. Gastroenteritis remained the top presenting diagnosis to RDH in both 2004 and 2013, similar to the PREDICT study. The overall proportion of presentations reduced from 6.9% to 5.3% (OR 0.76, 95% CI 0.69-0.84), likely correlating with the introduction of the rotavirus vaccine in 2007.¹⁰

In our study, Indigenous patients accounted for a disproportionately large number of presentations (30%) and were significantly more likely to be

admitted than non-Indigenous patients (OR 3.24, 95% CI 2.95-3.55).

Indigenous children in The Northern Territory carry a very high burden of disease due to both respiratory tract infections and skin infections^{11, 12} and are over-represented given that the Aboriginal and Torres Strait islander people make up only 9.2% of the greater Darwin region and 26.8% of the total Northern Territory population.¹³

Cellulitis was a common presentation to RDH ED and disproportionately affected indigenous patients. It did not feature in PREDICT's top ten but was the 2nd most common reason for presenting to hospital for Indigenous patients in 2013 in Darwin. This correlates with data from remote Northern Territory communities where a high burden of skin infections was identified commencing within the first few months of life with 84% of children presenting with scabies or skin sores before 12 months of age.¹⁴ The high prevalence of skin infection is testament to the poor environmental conditions¹⁵ and household overcrowding in indigenous communities.¹⁶ Bacterial skin infection, in particular with Group A streptococcal infections contribute to the excess burden of ill health in Indigenous Australians and result in serious sequelae including acute post-streptococcal glomerulonephritis and acute rheumatic fever (ARF).¹⁷ The incidence of ARF in Australia has risen between 2004 and 2010 from 555 to 647 per 100,000 population, amongst the highest rates worldwide¹⁸ and mortality rates from rheumatic heart disease in Indigenous Australians are the highest reported in the world.¹⁹

In keeping with current literature, bronchiolitis was also over-represented by Indigenous patients who made up 45.0% of all cases in 2013 (OR 1.99, 95% CI 1.59-2.48).⁵ Indigenous children have more frequent respiratory tract infections that are more severe, and associated with the development of chronic suppurative lung disease.²⁰ Socio-economic risk factors have shown to account for the high rates of both acute and chronic respiratory tract infections in Indigenous children^{21, 22} and are likely to contribute to the high rates of bronchiolitis seen in our population.

Compared to PREDICT, a large proportion of RDH ED patients were adolescents with the 15-18 year age group showing the highest growth rate between 2004 and 2013 (3.3% per annum). The higher rate of adolescent presentations can likely be explained by RDH being a mixed ED which sees paediatric patients up to 18 years of age, compared to tertiary paediatric hospitals in the PREDICT study that saw patients up to 15 or 16 years of age. The higher admission rate of adolescents in the PREDICT group is likely to reflect referral patterns where older adolescents with complex medical conditions, more frequently needing admission, present to tertiary paediatric centres rather than local adult or mixed EDs.²³ Similar to the PREDICT group and recent published data from NSW, abdominal pain was the most common reason for presentation to ED for older adolescents in both 2004 and 2013.²³

In PREDICT, toxic effect of substance (including alcohol) and psychiatric or behavioural problems were the 2nd and 3rd most common reason for

presentation to emergency in the 15-18 year population. This was not seen in our top 5 diagnoses in 2004 but we saw a significant increase in numbers of psychiatric presentations in 2013 when it was the 2nd most common presentation to ED in the 15-18 year age group. Adolescents with behavioural and psychiatric presentations represent some of the most challenging clinical situations in the Emergency setting with long stays, high admission rates, and recurrent presentations.^{24, 25} This trend in adolescent psychiatric presentations in Darwin is particularly concerning given the limited adolescent health services in the top end and the known high rates of psychological illness amongst Indigenous young people.^{10, 26}

The proportion of children presenting with trauma was higher at RDH compared to the PREDICT study and increased from 2004 to 2013. When looking at data for head injury, the incidence rate was 2110 per 100 000 children attending the ED at RDH in 2004. This is comparable to incidence rates published from The Royal Children's Hospital in Melbourne in 2004.²⁷ In 2013 however, we saw the incidence rate of head injury increase by 53% to 3232 per 100 000 children attending the ED (OR 1.54, 95%CI 1.33-1.80). When using population data for the Greater Darwin region¹³, the incidence rate of head injury in children 0-18 in 2013 is 1641 per 100 000 which is higher than incidence rates published globally and more than double the incidence rate per population of patients with head injury presenting to Victorian EDs.^{28, 29}

It is well documented that injury is a significant health issue for Aboriginal and Torres Strait Islander people with rates of injury for specific causes many times that of other Australians.³⁰ Interestingly, in our population, for the most common injuries specified in our data there were not significant differences between indigenous and non-indigenous cohorts. The increasing rates of trauma, affecting all children, in the Darwin region is of major public health concern. There may be a number of contributing factors such as socioeconomic disadvantage, low levels of parental education, inadequate caregiver supervision of children, poor adherence to child safety laws mandating child car restraints and bike helmets and increased alcohol related violence affecting children. Further research into parental, family and community factors relating to injury is required to guide childhood injury prevention strategies.³¹

Limitations

Our study was limited by its retrospective design and small sample size compared to the larger original PREDICT study. The data was obtained from the ED's electronic database, which relies on discharge diagnoses inputted by doctors.

Conclusion

This study provides important information regarding paediatric presentations to a major referral hospital in the Northern Territory. Overall there was a disproportionate rate of presentation and admission amongst Indigenous children. Other key findings were higher rates of cellulitis and adolescent

presentations. The increasing rates of trauma, particularly head injury is of major concern requiring further evaluation and community attention. These findings can assist in developing services and directing future research specific to children in the Northern Territory.

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Tables and figures:

Table 1: Key epidemiological variables. PREDICT 2004, RDH 2004, 2013.

	PREDICT 2004	RDH ED 2004	RDH ED 2013
	Number of Presentations, Proportion (%)	Number of Presentations, Proportion (%)	Number of Presentations, Proportion (%)
Age			
<1 year	65112 (18.5%)	1610 (12.6%)	1976 (12.8%)
1-4 years	144916 (41.2%)	4157 (32.6%)	4791 (31.2%)
5-9 years	72845 (20.7%)	2595 (20.4%)	2861 (18.6%)
10-14 years	54272 (15.4%)	2089 (16.4%)	2726 (17.7%)
15-18 years	14121 (4.0%)	2294 (18.0%)	3024 (19.7%)
Not stated	174 (0.05%)	0	0
TOTAL	351 440 (100%)	12745 (100%)	15378 (100%)
Gender			
Male	193643 (55.1%)	5614 (44.0%)	6959 (45.3%)
Female	157797 (44.9%)	7131 (56.0%)	8419 (54.7%)
Ethnicity			
Aboriginal (Australian sites)	7495 (2.13%)	3977 (31.2%)	4477 (29.15)
Maori (NZ sites)	7758 (15.8%)	N/A	N/A
Pacific (NZ sites)	13979 (28.5%)	N/A	N/A
Triage Category (ATS)			
Category 1	2098 (0.6%)	183 (1.4%)	138 (0.9%)
Category 2	15581 (4.4%)	302 (2.4%)	1623 (10.6%)

Category 3	96105 (27.3%)	3811 (29.9%)	4761 (31.0%)
Category 4	182506 (51.9%)	8087 (63.5%)	8567 (55.7%)
Category 5	54055 (15.4%)	361 (2.8%)	289 (1.9%)
Not stated	1095 (0.3%)	1 (0.01%)	0
Method of Arrival			
Own transport	316253 (90.0%)	10334 (81.1%)	12724 (82.7%)
Road ambulance	30845 (8.8%)	1001 (7.9%)	1781 (11.6%)
Air ambulance	1009 (0.3%)	352 (2.8%)	492 (3.2%)
Other	318 (0.1%)	91 (0.71%)	380 (2.5%)
Not stated	3015 (0.9%)	967 (7.6%)	1 (0.01%)
Disposition			
Discharged	251829 (71.7%)	9562 (75.0%)	11416 (74.2%)
Admitted/transferred	84463 (24.0%)	2376 (18.6%)	3093 (20.1%)
Did not wait to be seen (DNW)	10129 (2.9%)	748 (5.9%)	808 (5.3%)
Left without treatment (against medical advice)	4629 (1.3%)	55 (0.4%)	59 (0.38%)
Died	65 (0.02%)	4 (0.04%)	2 (0.01%)
Other	325 (0.1%)	0	0

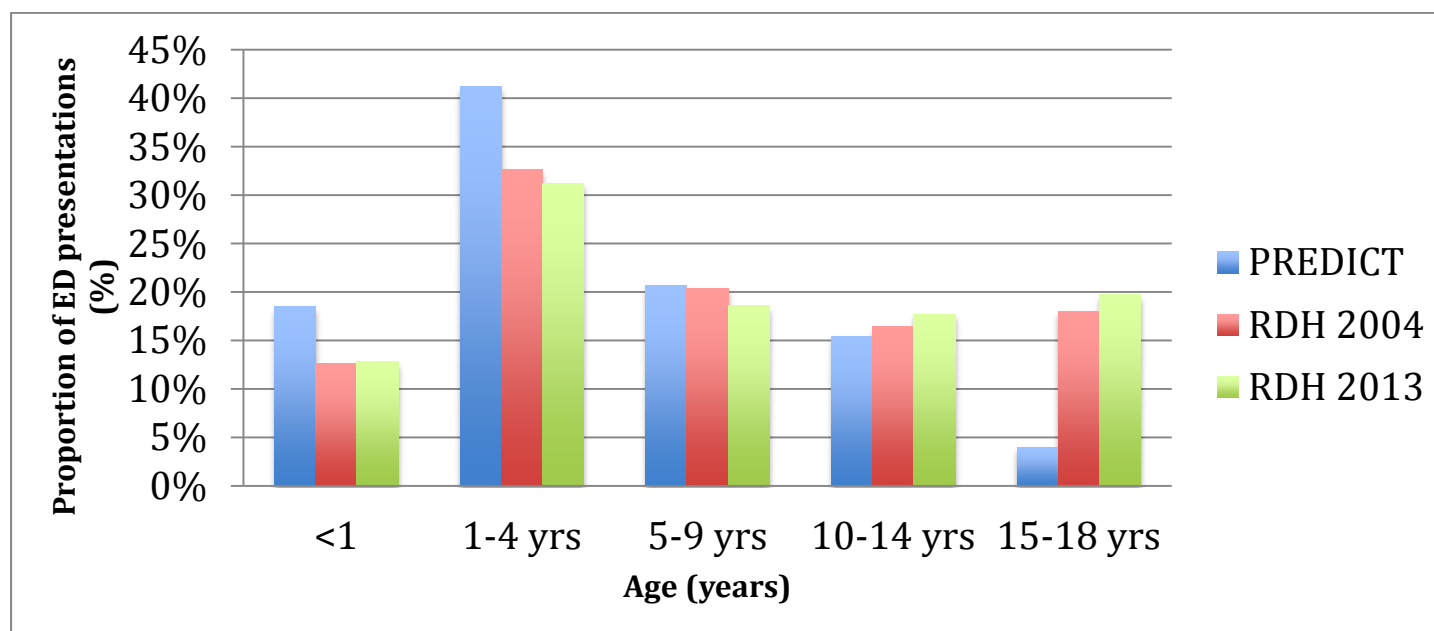


Figure 1. Proportion of ED presentations by age (%) to PREDICT sites 2004 and RDH Paediatric emergency in 2004 and 2013

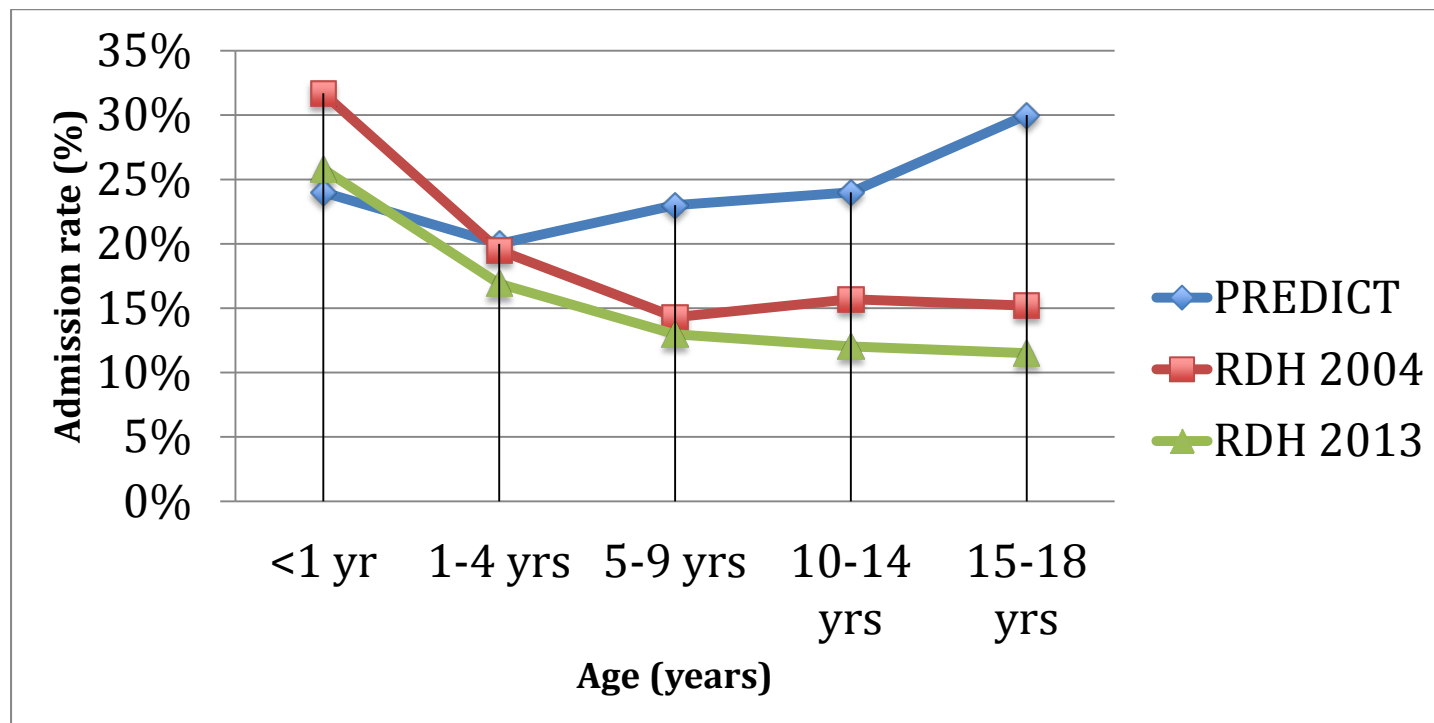


Figure 2. Proportion of admissions by age (%) to PREDICT sites 2004 and RDH Paediatric emergency in 2004 and 2013

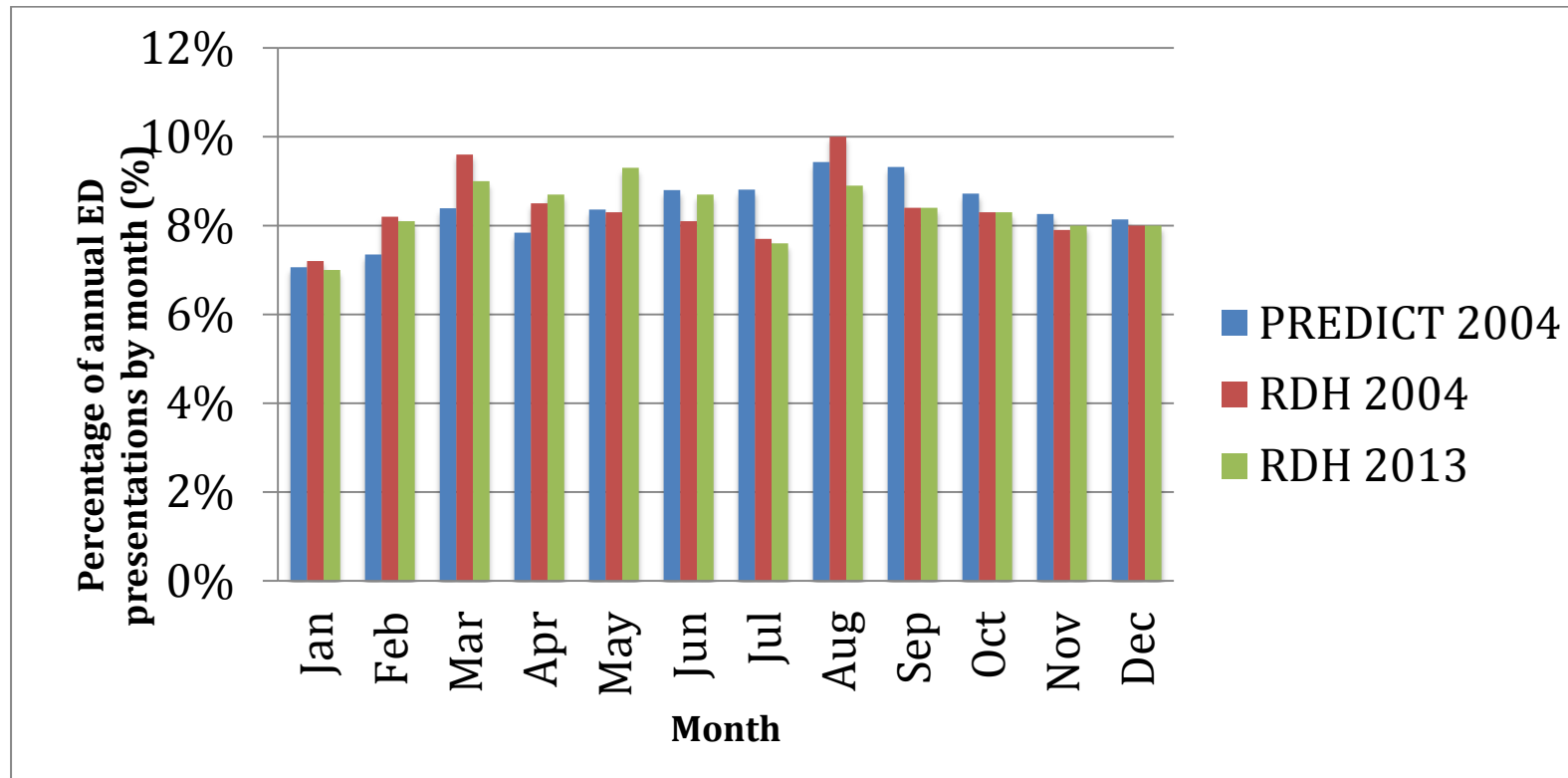


Figure 3. Patterns of presentation per month to RDH Paediatric emergency in 2004 and 2013

Table 2. Most frequent diagnoses of paediatric ED patients at PREDICT sites 2004 and RDH Paediatric emergency in 2004 and 2013

RANK	PREDICT 2004 n= 351440	count	%	RDH 2004 n=12745	count	%	RDH 2013 n=15378	count	%
1	Gastroenteritis	19704	6.3%	Gastroenteritis	884	6.9%	Gastroenteritis	810	5.3%
2	Viral Illness	15947	5.1%	Viral Illness	716	5.6%	Viral Illness	748	4.9
3	URTI	13956	4.4%	URTI	554	4.3%	Abdominal Pain, Non-specific	707	4.6%
4	Asthma	11043	3.5%	Laceration, face or Scalp	532	4.2%	Laceration, face or Scalp	562	3.7%
5	Croup	7369	2.3%	Abdominal Pain, Non-specific	470	3.7%	Head Injury	497	3.2%
6	Bronchiolitis	7183	2.3%	Cellulitis	333	2.6%	URTI	485	3.2%
7	Abdominal Pain, Non-specific	6822	2.2%	Fractured Forearm (radius and/or ulna)	311	2.4%	Fractured Forearm (radius and/or ulna)	429	2.8%
8	Laceration, Face or Scalp	6360	2.0%	Head Injury	269	2.1%	Cellulitis	353	2.3%

9	Fractured Forearm (radius and/or ulna)	5186	1.7%	Asthma	259	2.0%	Bronchiolitis	327	2.1%
10	Otitis Media	4996	1.6%	Fever without identifiable source	252	2.0%	Fever without identifiable source	294	1.9%

Table 3. Most frequent diagnoses by age of paediatric ED patients at PREDICT, RDH 2004 and 2013.

AGE		PREDICT 2004	count	%	RDH 2004	count	%	RDH 2013	count	%
<1	1.	Bronchiolitis	6214	12%	Gastroenteritis,	224	13.9%	Bronchiolitis	219	11.1%
	2.	Gastroenteritis,	461	8.9%	Viral Illness	163	10.1	Viral Illness	187	9.5%
	3.	URTI	4484	8.7%	URTI	157	9.7%	Gastroenteritis,	170	8.6%
	4.	Viral Illness,	3966	7.7%	Bronchiolitis,	108	6.7%	URTI	135	6.8%
	5.	Fever without identifiable source	1639	3.2%	Fever without identifiable source	87	5.4%	Fever without identifiable source	108	5.5%
1-4	1.	Bronchiolitis	9393	7.9%	Gastroenteritis,	455	10.9%	Gastroenteritis	375	7.8%
	2.	Viral Illness	8405	7.0%	Viral Illness	337	8.1%	Viral Illness	345	7.2%
	3.	URTI	8077	6.8%	URTI	264	6.4%	Laceration, Face or Scalp	277	5.8%
	4.	Asthma	6148	5.1%	Laceration, Face or Scalp	228	5.5%	URTI	255	5.3%
	5.	Croup	5524	4.6%	Asthma	124	3.0%	Head Injury	181	3.8%

5-9	1.	Gastroenteritis	2785	4.7%	Laceration, Face or Scalp	180	6.9%	Abdominal pain, non-specific	192	6.7%
	2.	Viral Illness	2580	4.3%	Abdominal pain, non-specific	134	5.2%	Fractured Forearm (radius and/or ulnar)	169	5.7%
	3.	Abdominal pain, non-specific	2489	4.2%	Fractured Forearm (radius and/or ulnar)	124	4.8%	Gastroenteritis	163	5.7%
	4.	Asthma	2304	3.9%	Viral Illness	121	4.7%	Laceration, Face or Scalp	161	5.6%
	5.	Fractured Forearm (radius and/or ulnar)	2158	3.6%	Gastroenteritis	106	4.1%	Viral Illness	116	4.1%
10-14	1.	Abdominal pain, non-specific	2360	5.5%	Fractured Forearm (radius and/or ulnar)	118	5.6%	Abdominal pain, non-specific	172	6.3%
	2.	Fractured Forearm (radius and/or ulnar)	1857	4.4%	Abdominal pain, non-specific	100	4.8%	Fractured Forearm (radius and/or ulnar)	160	5.9%
	3.	Gastroenteritis Acute	1090	2.6%	Cellulitis	65	3.1%	Head Injury	86	3.2%

	4.	Asthma, Acute	934	3.9%	Viral Illness, Acute	61	2.9%	Cellulitis	64	2.3%
	5.	Viral Illness, Acute	832	2.0%	Head Injury	53	2.5%	Gastroenteritis Acute	60	2.2%
15-18	1.	Abdominal pain, non-specific	541	5.1%	Abdominal pain, non-specific	135	5.9%	Abdominal pain, non-specific	220	7.3%
	2.	Toxic effect of substance (including alcohol)	308	2.9%	Cellulitis	75	3.3%	Psychiatric	108	3.6%
	3.	Psychiatric or behavioural disturbance	233	2.2%	Laceration, Face or Scalp	71	3.1%	Cellulitis	84	2.8%
	4.	Gastroenteritis, Acute	216	2.0%	4. Tonsillitis, Acute	49	2.1%	Head Injury	70	2.3%
	5.	Asthma, Acute	212	2.0%	5. Gastroenteritis, Acute	48	2.1%	Laceration, Face or Scalp	56	1.9%

Table 4. Most frequent diagnoses for Indigenous patients at RDH 2004 and 2013.

RANK	RDH 2004	n	%	RDH 2013	N	%
1	Gastroenteritis, Acute	310	7.8%	Gastroenteritis, Acute	208	4.6%
2	URTI, Acute	190	4.8%	Cellulitis	189	4.2%
3	Viral Illness, Acute	178	4.5%	Viral Illness, Acute	168	3.7%
4	Cellulitis	173	4.3%	Abdominal Pain, Non-specific	157	3.5%
5	Laceration, Face or Scalp	126	3.2%	Bronchiolitis, Acute	147	3.2%
6	Abdominal Pain, Non-specific	108	2.7%	URTI, Acute	137	3.0%
7	Bronchiolitis, Acute	103	2.6%	Laceration, Face or Scalp	130	2.9%
8	Pneumonia, Acute	96	2.4%	Head Injury	120	2.6%
9	Asthma, Acute	80	2.0%	Fractured Forearm (radius and/or ulna)	116	2.6%
10	Fever without identifiable source	80	2.0%	Fever without identifiable source	84	1.9%

