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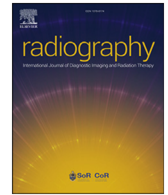

Benchmarking non-attendance patterns in paediatric medical imaging: A retrospective cohort study spotlighting First Nations children

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A B S T R A C T

Introduction: Non-attendance at Medical Imaging (MI) appointments can result in inefficiencies in healthcare resource allocation, increased financial burdens, and lead to potential barriers to effective healthcare delivery. We evaluated factors associated with non-attendance of MI appointments for children including variables: gender; age groups; residential postcodes; Indigenous status; appointment dates; appointment reminders and socio-economic status.

Method: Retrospective cohort study of children with scheduled MI appointments at a Tertiary paediatric hospital in Australia, between January and December 2022. Data were extracted from the Radiology Information System and integrated with socio-economic census data through linking with postcode. Chi-squared, and logistic regression analysis were performed to identify significant predictors of non-attendance.

Results: Out of 17,962 scheduled outpatient appointments, 6.2 % did not attend. Males were less likely to attend than females (7.3 % vs. 5.8 %; $p < 0.001$). Older children had the highest frequency of non-attendance ($p < 0.001$). First Nations identified children had a higher likelihood of non-attendance at 14.5 % compared to non-First Nations at 5.8 %, and the odds ratio (OR) of First Nation children not attending was 2.54 (CI 2.13–3.03; $p < 0.001$) higher than non-First Nations children. Children from areas of disadvantage were less likely to attend ($p < 0.001$). Bone mineral densitometry had the highest odds of non-attendance (19.4 % of bookings) compared to other imaging modalities ($p < 0.001$).

Conclusion: The following characteristics were associated with non-attendance: older male gender, residing in areas of socio-economic disadvantage, or identifying as First Nations Australians. By reviewing these findings with the cultural and professional experience of our Indigenous co-author, we have identified some strategies for improving attendance amongst First Nations children.

Implications for practice: Factors associated with non-attendance, or “missed opportunities for care”, provide opportunities for intervention to improve attendance for vulnerable groups of children who require medical imaging.

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Introduction

Patient non-attendance at hospital outpatient appointments remains a global issue.[1–7] Instances of missed appointments without prior notification, recorded as a “Did Not Attend” (DNA) event, have high resource costs and implications for patient care.[1] Failure to attend paediatric medical imaging (MI) appointments

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can lead to delayed diagnosis or the inadequate surveillance of chronic or oncological conditions. This places children at a higher risk of experiencing poorer, long-term health outcomes, given their longer life expectancy compared to adults.[8]

Appointment non-attendance in paediatric medical imaging

Most children are passive regarding their healthcare needs, requiring support from a carer or parent.[8] Repeat non-attendance requires monitoring and may assist in the early detection and intervention of cases of child neglect. In Queensland, Australia, 7.9 % of state-wide outpatient appointments went unattended in 2017–18,[9] and in a central Queensland health service 15.5 % of paediatric medicine appointments were missed during 2015–16. A media report from 2014 indicated missed specialist appointments were costing Queensland $3.8 million each month.[10] A recent analysis of missed radiology appointments in children from Massachusetts, in the United States of America (USA), had a similar finding at 8 %,[8] and 11.4 % of children did not attend congenital cardiac MRI appointments in a 2017 study.[11]

First Nations attendance

Non-attendance at paediatric MI appointments is particularly concerning for Australia's First Nations children. They face distinct and well-documented differences in disease burden and health outcomes compared to the non-First Nations population.[12–16] A study from a large paediatric hospital in New South Wales reported that more than 40 % of presentations by First Nations children to emergency departments could be categorised as preventable.[17] First Nations children are also more likely to be admitted after initially presenting to an emergency department.[18] The barriers and enablers for attendance to medical appointments are particularly complex in these children and may include factors relating to: racism; insufficient cultural security; limited access to and choice of services; inadequate community consultation; and past negative healthcare experiences.[17–19]

Study setting

Children's Health Queensland Hospital and Health Service (CHQHHS) provides specialised paediatric services to children (typically up to their 16th birthday) across Queensland and Northern New South Wales, as well as some other interstate regions for certain clinical specialities such as cardiac surgery for children from Western Australia and the Northern Territory. The Queensland Children's Hospital (QCH) located in Brisbane, is the primary clinical facility within CHQHHS. Along with state-wide specialized care, it also caters for children residing in the Brisbane area (total population 1,242,825 at 2021 census)[20] requiring primary paediatric services (e.g. emergency, general paediatrics and surgery). Whilst the Brisbane area has a lower density of First Nations people (1.8 %), Queensland overall (4.6 %) is higher than the national average (3.2 %).[20] As a state-wide service, CHQHHS must consider the needs of patients across the whole catchment, particularly those identifying as First Nations patients and families.

Study aim

This study aims to benchmark attendance rates for all children attending outpatient medical imaging appointments at a tertiary level paediatric hospital, with a particular focus on First Nations children. Patient and appointment demographic data will be then used to highlight factors associated with non-attendance of First Nations children. The retrospective data in this study has been limited by those variables available within existing information systems, and this has restricted our ability to engage in the cultural or consumer co-design of this study. We have however been fortunate to draw upon the cultural understanding and lived experience of author JMW, a Registered Nurse and proud Ghungalu, Bidjara woman, in discussing the study findings with perspectives on potential targeted strategies for First Nations groups. The findings will undergo additional review by hospital staff, consumer representatives, and other First Nations stakeholders. This collaborative effort aims to establish a platform for comparing the impact of future interventions aimed at improving attendance and aligns with Children's Health Queensland Aboriginal and Torres Strait Islander Health Equity Strategy 2022–2025.[21]

Methods

Study design

A retrospective audit of DNA appointments was undertaken at the QCH.

Inclusion criteria

Patients were enrolled based on data pertaining to outpatient imaging that necessitated a pre-scheduled appointment and obtained from the hospital's Radiology Information System (RIS) (Radiology +, Soliton I.T. Australasia, Brisbane, Australia) between 1 January 2022 and 31 December 2022. Examinations were classified as DNA in the RIS at the end of the day when the examination was not attended, non-attendance for other reasons (e.g. late notice cancellation, patient too unwell, patient deceased, duplicate examination, etc.) were coded separately and not included as DNA for this analysis.

Exclusion criteria

Patients were excluded if they were admitted to the hospital before their scheduled appointment as requested by their treating teams; in these cases, the admission code in the RIS for the examination changed from outpatient to inpatient. General radiography examinations were excluded as they are not routinely booked for outpatients; only 15 (approximately 0.08 %) such examinations were booked in the 12 months reviewed, all but one were skeletal surveys and often directly co-ordinated with child-protection services.

Variables

Variables extracted included gender; age; First Nations' identification; imaging modality (based on the RIS code); attendance (yes or no); referral source (determined by the referring clinician's clinic associated with the medical imaging request in the RIS – such as Oncology, Neurology etc); residential postcode; appointment scheduled date; and if a reminder SMS or letter was sent (letters were only sent if the appointment was greater than 10 business days in advance to permit delivery time). Some variables were aggregated for statistical analysis and comparison to the literature.[8,22] Patient age was grouped into six subcategories using the United States Food and Drug Administration (FDA) standard: Neonates (Birth up to 1 month); Infants (1 month up to 2 years); Children (2 up to 12 years); Adolescence (12 up to 16 years); Late Adolescence (16 up to 18 years).[23] Residential postcodes were categorised based on the Modified Monash Model (MMM), including Metro, Regional Centre, Large-Medium-Small Rural Towns, Remote Communities and Very Remote Communities.[24]

Appointment dates were grouped per weekday and season to analyse weekly and seasonal variability in attendance. In Australia the seasons are: Autumn (March to May); Winter (June to August); and Spring (September to November), Summer (December to February). Residential information was linked to Socio-economic Indexes for Areas (SEIFA), data published by the Australian Bureau of Statistics (ABS) produced in the 2016 national census.[25] Our study used the Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) to assess if local economic and social conditions influenced non-attendance. This category is represented by five quintiles ordered from areas of most disadvantage to areas of most advantage, the lowest 20 % are given a quintile number of one and the highest 20 % given a quintile number of five.[25]

Statistical analysis

All statistical calculations were performed in R version 4.2.2.[26] A power calculation for a chi-squared anaylysis between demographic sub-groups used a significance level (alpha) of 0.05 and 80 % power, indicating a minimum sample size of 2377 examinations. This calculation was informed by the 4.6 % proportion of First Nations individuals in the Queensland population and non-attendance rates of 4.8 % and 11.8 % observed in non-First Nations and First Nations populations, respectively, from comparable demographic and clinical settings.[20,22] The first full calendar year available after the installation of a new RIS was extracted to meet the power calculation described above, and also to capture larger samples of modality sub-groups for analysis over a comparable period to a similar study using a related population and geographical region.[22]

Descriptive statistics were used to analyse the study population and those who failed to attend. A chi-squared analysis detected an association between attendance and non-attendance within demographic groups. To analyze factors impacting First Nation children non-attendance, a multivariate logistic regression was used to model statistically significant individual predictors. A binary univariate logistic regression identified significant predictors for multivariate analysis. The inclusion of suitable predictors was confirmed via stepwise regression in forwards, backwards, as well as both directions. The p-value, Odds Ratio (OR) and 95 % Confidence Intervals (CI) for all predictors associated with non-attendance are reported. A p-value of less than 0.05 was considered statistically significant.

Ethics

The study was approved by the Chair of the Children's Health Queensland Human Research Ethics Committee (EX/2022/QCHQ/92138). A waiver for consent was approved as the study was retrospective, and all data was de-identified before analysis.

Results

Demographics

During the audit period, the department scheduled 17,962 outpatient paediatric MI appointments (Table 1). Males represented 54 % (n = 9706) of all appointments and children 2–12 years were the most represented group 49.8 % (n = 8937). Although most appointments were scheduled for patients living in metropolitan areas 74.6 % (n = 13393), home locations were widely distributed

Table 1
Overview of demographic, referral, and attendance characteristics among children at the tertiary study hospital medical imaging department (January–December 2022).

Characteristic	Total (n = 17962)	Did not attend (n = 1110)	Frequency of non-attendance (%)
Sex			
Female	8253	453	5.5 %
Male	9706	657	6.8 %
Indeterminate	3	0	0.0 %
Age Category			
Neonates (birth up to 1 month)	3099	173	5.6 %
Infants (1 month up to 2 years)	1379	54	3.9 %
Children (2 up to 12 years)	8937	522	5.8 %
Adolescents (12 up to 16 years)	3647	278	7.6 %
Late Adolescence (16 up to 18 years)	794	62	7.8 %
Missing	106	21	–
First Nations Identification			
Neither Aboriginal nor Torres Strait Islander origin	16386	900	5.5 %
Aboriginal and/or Torres Strait Islander origin	1529	194	12.7 %
Not stated/unknown	47	16	–
Geographical location[a]			
Metropolitan area	13394	834	6.2 %
Regional centre	1620	86	5.3 %
Large rural town	515	36	7.0 %
Medium rural town	224	14	6.3 %
Small rural town	1951	127	6.5 %
Remote community	117	5	4.3 %
Very remote community	142	8	5.6 %
Index of Relative Socio-economic Advantage and Disadvantage (IRSAD)			
Quintile 5 (most advantage)	3592	147	4.1 %
4	3591	192	5.3 %
3	3592	300	8.4 %
2	3593	236	6.6 %
1 (least advantage)	3594	235	6.5 %
Modality			
Bone Mineral Densitometry	602	117	19.4 %
Computed Tomography	1352	87	4.8 %
Fluoroscopy/Interventional Radiology	690	33	4.0 %
Magnetic Resonance Imaging	6836	274	3.1 %
Nuclear Medicine (excl PET)	575	18	0.5 %
Positron Emission Tomography (PET)	209	1	7.5 %
Ultrasound (excluding cardiac ultrasound)	7698	580	12.7 %
Season in which examination was scheduled			
Autumn	4134	135	3.3 %
Winter	4809	269	5.6 %
Spring	5259	377	7.2 %
Summer	3741	310	8.3 %
Missing	19	19	–
Scheduled day of examination			
Monday	3459	231	6.7 %
Tuesday	3720	209	5.6 %
Wednesday	3706	261	7.0 %
Thursday	3214	168	5.2 %
Friday	3510	200	5.7 %
Saturday	334	22	6.6 %
Missing	19	19	–
SMS sent with appointment information			
No	5426	315	5.8 %
Yes	12536	795	6.3 %
Letter sent with appointment information			
No	6795	239	3.5 %
Yes	11167	871	7.8 %

[a] Geographic location was based on the Modified Monash Model.[24]

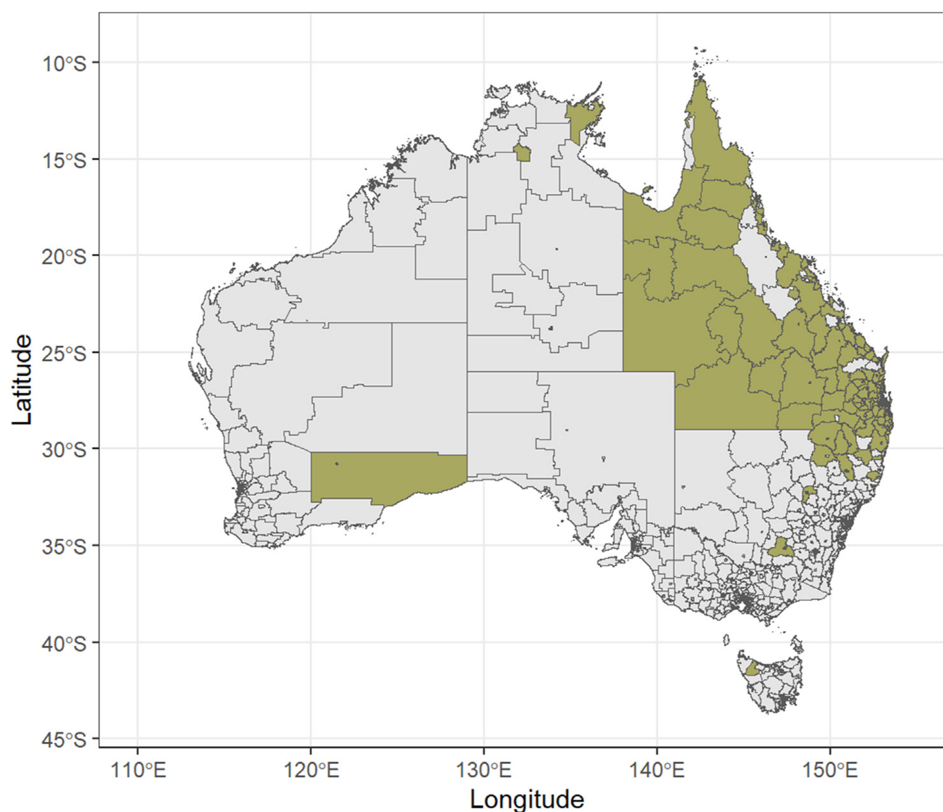

Figure 1. Visualisation of Demographic and Referral locations of children referred for scheduled imaging, January to December 2022.

across Queensland, Northern New South Wales, Western Australia, and Tasmania (Fig. 1).

Appointment non-attendance in paediatric medical imaging

Of 17,962 scheduled appointments, 6.2 % (n = 1110/17962) patients did not attend without prior notification. Male patients were significantly less likely to attend than females (6.8 % vs 5.5 %, $\chi^2(1) = 11.5$, $p < 0.001$). Older children, within the adolescent (12 up to 16 years) and late adolescent (16 up to 18 years) group, had the highest frequency of non-attendance at 7.6 % (n = 278/3647) and 7.8 % (n = 62/794), respectively. These were significantly higher than the other age categories ($\chi^2(4) = 33.1$, $p < 0.001$). Non-attendance of First Nations children was significantly higher than non- First nations children (12.7 % vs 5.5 %, $\chi^2(1) = 122$, $p < 0.001$). Bone Mineral Densitometry (BMD) had the highest frequency of non − attendance (19.4 %) and there was a significant association with non-attendance between modality types ($\chi^2(6) = 286$, $p < 0.001$).

A child's relative remoteness using the modified Monash model was not associated with non-attendance ($\chi^2(6) = 3.9$, $p = 0.71$), however the relative advantage and disadvantage of a child's home site was associated with non-attendance (($\chi^2(4) = 5.2$, $p < 0.001$). There was a significant seasonal ($\chi^2(3) = 100$, $p < 0.001$) and weekly ($\chi^2(3) = 100$, $p < 0.001$) variability associated with non-attendance. The delivery of SMS message was not significantly associated with non − attendance ($\chi^2(1) = 2.7$, $p = 0.09$), however there was a significant association with non-attendance if an appointment letter was sent ($\chi^2(1) = 122$, $p < 0.001$).

To understand the impact of the multiple characteristics available and to calculate the probability of non-attendance specific to the First Nations population, significant variables from the univariate analysis were entered into a multivariate logistic regression. The OR of all independent predictors of non-attendance are displayed in Table 2.

First Nations attendance

From the regression analysis, the OR of First Nations patients not attending was 2.54 (CI: 2.13–3.03; $p < 0.001$), higher than patients who did not identify as First Nations. Appointment characteristics such as modality type, scheduling day and season and the use of appointment reminders will potentially impact all children attending the health service. Further, the higher proportion of non-attendance in the adolescent (OR: 1.50, CI: 1.21–1.85; $p < 0.001$) and late adolescent groups (OR: 1.63, CI: 1.18–2.23; $p = 0.003$) relates to the entire study cohort. However, by controlling certain variabilities' predictive probabilities can be calculated from the regression model for specific age groups and compared between First Nations and non-First Nations attendance. Controlling for modality type, seasonal and weekly variability, the likelihood of non-attendance in our model for a First Nations, late adolescent male from a region of significant disadvantage is 23.1 % (CI: 16.9 %–30.8 %). Comparatively, for a male who has not identified as First Nations in the same age group and socio-economic quintile, the probability of not attending is 10.5 % (CI: 7.6 %–14.6 %). Analyses by age categories and First Nations identification are demonstrated in Fig. 2a (females) and 2b (males).

Discussion

To the authors' knowledge, this is the first study to investigate patient characteristics of non-attendance of scheduled MI appointments in an Australian tertiary paediatric hospital. Our study

Table 2
Fitted multivariate model showing the likelihood of scheduled appointment non-attendance by multiple characteristics.

Characteristic	OR	95 % CI	p-value
Sex			
Female	–	–	
Male	1.24	1.09, 1.41	**0.001**
Age Category			
Neonates (birth up to 1 month)	–	–	
Infants (1 month up to 2 years)	0.69	0.50, 0.94	**0.023**
Children (2 up to 12 years)	1.16	0.96, 1.41	0.12
Adolescents (12 up to 16 years)	1.50	1.21, 1.85	**<0.001**
Late Adolescence (16 up to 18 years)	1.63	1.18, 2.23	**0.003**
First Nations Identification			
Neither Aboriginal nor Torres Strait Islander. Origin	–	–	
Aboriginal and/or Torres Strait Islander origin	2.54	2.13, 3.03	**<0.001**
Index of Relative Socio-economic Advantage and Disadvantage (IRSAD)			
Quintile 5 (most advantage)	–	–	
4	1.32	1.05, 1.66	**0.020**
3	2.11	1.71, 2.62	**<0.001**
2	1.61	1.29, 2.02	**<0.001**
1 (least advantage)	1.61	1.29, 2.01	**<0.001**
Modality			
Bone Mineral Densitometry	–	–	
Computed Tomography	0.30	0.22, 0.42	**<0.001**
Fluoroscopy/Interventional Radiology	0.26	0.17, 0.40	**<0.001**
Magnetic Resonance Imaging	0.18	0.14, 0.23	**<0.001**
Nuclear Medicine (excl PET)	0.17	0.10, 0.28	**<0.001**
Positron Emission Tomography (PET)	0.04	0.00, 0.17	**0.001**
Ultrasound (excluding cardiac ultrasound)	0.43	0.34, 0.55	**<0.001**
Season in which examination was scheduled			
Autumn	–	–	
Winter	1.67	1.35, 2.08	**<0.001**
Spring	2.29	1.87, 2.83	**<0.001**
Summer	3.24	2.62, 4.03	**<0.001**
Scheduled day of examination			
Monday	–	–	
Tuesday	0.88	0.72, 1.08	0.2
Wednesday	0.98	0.81, 1.19	0.8
Thursday	0.77	0.62, 0.95	**0.014**
Friday	0.83	0.68, 1.02	0.078
Saturday	1.75	1.06, 2.76	**0.022**
Letter sent with appointment information			
No	–	–	
Yes	2.43	2.09, 2.84	**<0.001**

OR = Odds Ratio, CI = Confidence Interval

highlights an association of several patient demographics and referral characteristics with non-attendance. Demographic predictors associated with non-attendance include older male children, First Nations origin and children from lower socio-economic communities regardless of remoteness. The study also demonstrated some weekly and seasonal variability and some interesting findings related to modality types and the use of letter reminders. Weekday attendance variation may have been associated with several factors that will be explored following this study, for example particular specialist clinics operate on certain days. Seasonal attendance variation may have also had an influence with climate variability.[5] The year studied was the wettest on record in some parts of the population catchment, which may have affected transport arrangements/access,[27] with Spring and Summer having slightly higher rates of non-attendance than the cooler/drier seasons. Below we explore the trends of non-participation relevant to the imaging department. This discussion also includes a commentary that delves into First Nations attendance, drawing insights from cultural understandings and perspectives.

Appointment non-attendance in paediatric medical imaging

The overall non-attendance rate in our study was similar to a recent study examining MI department non-attendance at a district general hospital roughly 100 km away from ours and also in Queensland (5.4 vs 6.2 %).[22] Mander et al. (2018) included a paediatric cohort as 3.5 % (n = 464) of the overall study (n = 13,458 appointments) and demonstrated an increased frequency of non-attendance in children aged 0–9 years (7.9 %) and 10–17 years (8.5 %),[22] compared to 5.6 % (0–12 years) and 7.6 % (12–16 years) in our study. However, modelling did not demonstrate these groups were vulnerable to non-attendance when other variables were adjusted. In contrast, our study demonstrated a clear trend of increasing non-attendance with increasing age. Similar to our study, though across all age categories, Mander et al. (2018) also observed higher rates of non-attendance among males (OR 1.57, vs our 1.24) and First Nations patients (OR 2.66 vs our 2.54).

The imaging modality with the highest non-attendance proportion was Bone Mineral Densitometry (BMD). These scans are often requested for our muscular dystrophy patients, who require regular testing to diagnose the early development of osteoporosis. Children with Duchenne Muscular Dystrophy (DMD) are prone to low bone mineral density and, consequently, are at a greater risk of fractures when combined with treatment glucocorticoids, reduced weight-bearing activity, and poor nutrition.[28] The poor attendance of these patients is concerning as regular BMD scans help guide treatment interventions to prevent fractures and associated morbidity. After reviewing the workflow in this modality, it is possible that these scans are ordered on what can be exhausting clinic visits with a battery of other tests or that the poor mobility of some DMD patients means that transferring to and from the scanning bed is an uncomfortable process.[29] The audit findings indicate further investigation of this subgroup is required to mitigate the poor attendance rate identified.

Unexpectedly, the use of letter reminders was linked to higher non-attendance rates. Although the reason for this association is unclear, several potential factors may contribute. For instance, letters were not sent if appointments were scheduled within 10 days, particularly for urgent scans arranged via phone. Interestingly, patients not receiving letters had a lower non-attendance rate, a phenomenon we plan to explore further by better capturing the lead time between booking and the actual appointment in future audits. Unfortunately, our current data set lacks information on appointment creation dates and letter dispatch. Moreover, the suitability of letters in a large catchment area, including rural towns, may be limited due to potential delivery delays. The reduction in volume of letters posted worldwide, particularly in Australia, is likely to reduce delivery frequency, and people's preferences for appointment notifications appear to be changing to more electronic forms.[30–32] Letters received close to the appointment date may not allow sufficient time for travel preparation. Additionally, letters should consider health literacy and language, especially in multilingual communities where understanding the letter's content may be challenging.[33]

SMS reminders have been shown to reduce non-attendance in paediatric outpatient clinics.[34] Our study did not show an association between attendance and SMS reminders. Most patients received an SMS reminder, so it is difficult to determine the effect on non-attendance if the current standard of SMS reminders was reduced. Digital reminder strategies are likely to continue; however, these may need to be tailored to a particular patient group. A reminder that includes additional helpful information, such as processes to reschedule or options for transport, has proven effective.[35]

First Nations attendance

Despite First Nations Australians representing 4.6 % of the Queensland population, they accounted for 8.5 % of MI outpatient appointments in 2022. Older children in this study are of particular

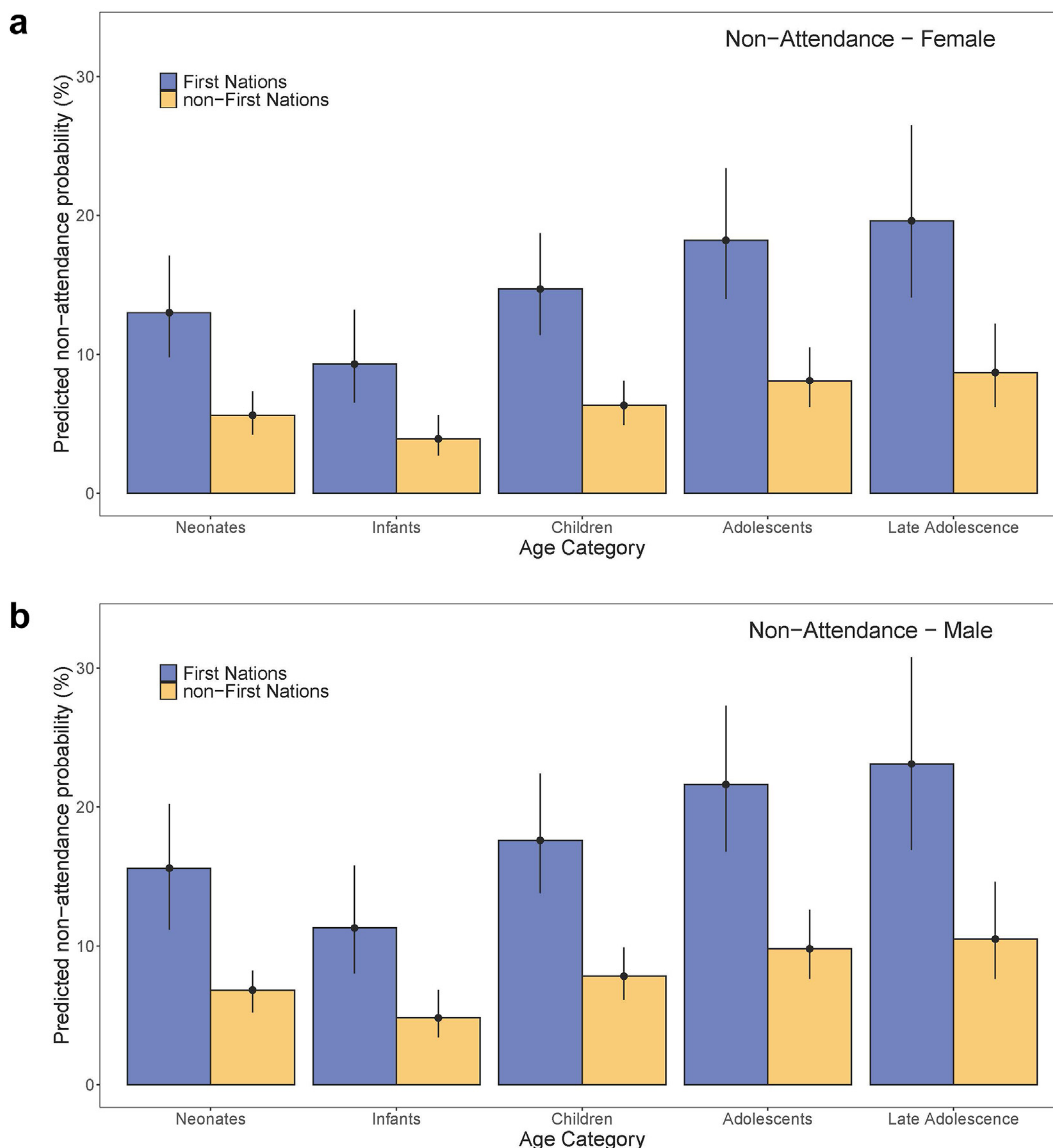

Figure 2. Likelihood of attendance by age category, and First Nations status, controlling for modality type, season, and weekday, for females (2A) and males (2B).

concern, 24.8 % of children were aged 12–18 years, with 8.3 % identified as First Nations. This age group had the highest rate of non-attendance. It is known that adolescence is a particularly important period for First Nations people as the mortality gap begins to widen at this point.[36] In their literature review on the intersection of culture, health, and well-being, Salmon et al. (2018)[37] highlighted the complex and interconnected factors shaping the influence of First Nations culture on well-being. Therefore, understanding the reasons why young First Nations individuals and their families foster strength to engage in the health services in which they participate must be a priority.[38,39] Research in the field must also authentically integrate First Nations perspectives to ensure projects are designed to enable ownership by communities so that epistemological experiences are clearly articulated.[40]

Developing community health service partnerships and ensuring that First Nation families are supported by First Nations staff throughout their healthcare pathway has been identified as a critical priority area by Children's Health Queensland.[21] The literature reports that targeted interventions via direct community engagement has proven successfully in younger age groups,[19] however more work is required and the sharing of evidence where older children are concerned. A potential pathway could incorporate co-designing intervention with community stakeholders,[40] although King et al. (2022) have recently identified a lack of evidence as to whether co-design is more effective at achieving desired outcomes and equity for Indigenous and young people from priority social groups than other approaches.[41] A more assertive approach for the development of a roadmap to guide actions for Aboriginal and Torres Strait Islander adolescent health recently highlighted the need for engagement of youth in governance as opposed to merely involving ad hoc advisors to overcome historic failures in this area.[42] Unfortunately the reporting of young people's advisory groups in health research broadly is poor, with less than 1 % of all studies on young people reporting youth advice, more evidence and better reporting will help inform future strategies.[43]

Implications for care

Appointment non-attendance in paediatric medical imaging

Through partnership with consumers and our Media and Communications team, enhancement of our appointment reminder system using SMS and more online patient information is being implemented.[44] Parents and carers will receive a link to the hospital website which will have video content about their visit, and more information about their examination. Targeted engagement with frequent referrers for BMD will also be undertaken so that referrers can reinforce the importance of attendance when engaging with families. The impact of these initiatives will be evaluated through a future repeat of this audit and comparison with our results as a benchmark. Reclassifying these missed appointments as “missed care opportunities” may better contextualise the social and cultural factors that apply in many instances.[8,45]

First Nations attendance

For patients identified as Aboriginal or Torres Strait Islander the hospital system, engaging with referrers, established Connected Care and Nurse Navigators programs, and linking with local Indigenous healthcare providers will be explored.[46] We will look to source funding for an identified Indigenous Health Worker role within medical imaging as a pilot project. Speaking to a medical imaging staff member who identifies as a First Nations person may help establish more trust and engagement with the service through improved cultural sensitivity.[47] This role will review bookings across all modalities for First Nations patients in advance, and then engage them through a SMS and phone calls to remind them of their appointment, and prompt them with other assistance that may be available to improve attendance. One such example within South East Queensland is a service called *Mob Link* established by the *Institute for Urban Indigenous Health* (iuih.org.au), which is available to facilitate transport for First Nations families. Linking patients and their families through these initiatives may better ensure transport support and communication with appropriate family or community members to facilitate child attendance.

Strengths and limitations

The retrospective design of this study is a limitation; the only data available was information routinely collected within the RIS. Additional potential predictors, such as transport opportunities, financial costs, and other psychosocial factors, may influence an individual's ability to attend appointments. Enriched data may be available to analyse in the future as the hospital has commenced gathering patient reported experience measures where patients and families volunteer responses, but we do not have enough data or a method to link it to variables in medical imaging at present. General radiography examinations (X-rays) are not routinely booked at QCH, and are not represented in the results, however, they are often performed in conjunction with outpatient clinic appointments. This may similarly be affected by previously mentioned issues but were outside the scope of this audit. A strength was the large dataset available compared to other studies,[8,11,22] and the careful exclusion of subgroups that may be admitted for short periods before a scheduled outpatient appointment which could potentially influence attendance behaviour due to communications from a variety of admitting/treating teams such as anaesthetics.

Conclusion

This study sought to benchmark attendance rates for children scheduled to attend MI appointments at our hospital, with a particular focus on Aboriginal and Torres Strait Islander children. Our results indicated key factors associated with non-attendance which included patients who: were male, residing in socio-economic disadvantage; were adolescent; or identified as First Nations Australians. Patients scheduled for bone mineral density scans were also less likely to attend. Identifying these variables provides our hospital and other organisations with an opportunity to develop strategies to target these groups and improve attendance. Our next steps involve collaborating with health professionals who identify as First Nations people to enhance cultural sensitivity. Additionally, we aim to enhance the promotion of transport and logistics services for First Nations patients and their families.

Conflict of interest statement

The authors declare no conflicts of interest.

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References

1. Wise S, Hall J, Haywood P, Khana N, Hossain L, Van Gool K. Paying for value: options for value-based payment reform in Australia. *Aust Health Rev* 2022;**46**(2):129–33. https://doi.org/10.1071/AH21115.
2. Paget SP, McIntyre S, Goldsmith S, Ostojic K, Shrapnel J, Schneuer F, et al. Non-attendance at outpatient clinic appointments by children with cerebral palsy. *Dev Med Child Neurol* 2022;**64**(9):1106–13. https://doi.org/10.1111/DMCN.15197.
3. Cox E, Awe M, Sabu S, Tumin D, Akpan US. Does greater distance from the hospital exacerbate socioeconomic barriers to neonatal intensive care unit clinic attendance? *J Rural Med* 2023;**18**(2):55–61. https://doi.org/10.2185/jrm.2022-035.
4. Hamilton K, Short S, Cudby K, Werner M, O'Connor-Robertson O, Larkins W, et al. Role of communication in successful outpatient attendance in a New Zealand hospital: a qualitative study. *Intern Med J* 2023;**53**(9):1648–53. https://doi.org/10.1111/imj.15892.
5. Alawadhi A, Palin V, van Staa T. Prevalence and factors associated with missed hospital appointments: a retrospective review of multiple clinics at Royal Hospital, Sultanate of Oman. *BMJ Open* 2021;**11**(8):e046596. https://doi.org/10.1136/bmjopen-2020-046596.
6. Su W, Zhu C, Zhang X, Xie J, Gong Q. Who misses appointments made online? Retrospective analysis of the outpatient department of a general hospital in Jinan, Shandong Province, China. *Risk Manag Healthc Pol* 2020;**13**:2773–81. https://doi.org/10.2147/RMHP.S280656.
7. Tsai WC, Lee WC, Chiang SC, Chen YC, Chen TJ. Factors of missed appointments at an academic medical center in Taiwan. *J Chin Med Assoc* 2019;**82**(5):436–42. https://doi.org/10.1097/JCMA.0000000000000068.
8. Flores EJ, Daye D, Peña MA, Lopez DB, Jaimes C, Glover M. Analysis of socio-economic and demographic factors and imaging exam characteristics associated with missed appointments in pediatric radiology. *Pediatr Radiol* 2021;**51**(11):2083–92. https://doi.org/10.1007/s00247-021-05111-x.
9. Greenup EP, Best D, Page M, Potts B. No observed reduction of non-attendance rate in telehealth models of care. *Aust Health Rev* 2020;**44**(5):657–60. https://doi.org/10.1071/AH19127.
10. Remeikis A. Missing specialist appointments costing Queensland $3.8 million each month. *Brisbane Times* [online] 2014. Available from: https://www.brisbanetimes.com.au/national/queensland/missing-specialist-appointments-costing-queensland-38-million-each-month-20141231-12g7q5.html. [Accessed 13 October 2023].
11. Lu JC, Lowery R, Yu S, Ghadimi Mahani M, Agarwal PP, Dorfman AL. Predictors of missed appointments in patients referred for congenital or pediatric cardiac magnetic resonance. *Pediatr Radiol* 2017;**47**(8):911–6. https://doi.org/10.1007/s00247-017-3851-8.
12. Eades SJ, Stanley FJ. Improving the health of first nations children in Australia. *Med J Aust* 2013;**199**(1):12–3. https://doi.org/10.5694/mja13.10726.
13. Luke J, Dalach P, Tuer L, Savarirayan R, Ferdinand A, Mcgaughran J, et al. Investigating equity in access to Australian clinical genetic health services for

Aboriginal and Torres Strait Islander people. *Nat Commun* 2022;**13**:4966. https://doi.org/10.1038/s41467-022-32707-0.
14. Chapman R, Smith T, Martin C. Qualitative exploration of the perceived barriers and enablers to Aboriginal and Torres Strait Islander people accessing healthcare through one Victorian Emergency Department. *Contemp Nurse* 2014;**48**(1):48–58. https://doi.org/10.5172/CONU.2014.48.1.48.
15. Shahid S, Finn LD, Thompson SC. Barriers to participation of Aboriginal people in cancer care: communication in the hospital setting. *Med J Aust* 2009;**190**(10):574–9. https://doi.org/10.5694/J.1326-5377.2009.TB02569.X.
16. Australian Institute of Health and Welfare. *The health and welfare of Australia's Aboriginal and Torres Strait Islander peoples*. 2015. https://doi.org/10.25816/5ebcbd26fa7e4.
17. Duncan C, Williams K, Nathanson D, Thomas S, Cottier C, O'Meara M, et al. Emergency department presentations by Aboriginal children: issues for consideration for appropriate health services. *J Paediatr Child Health* 2013;**49**(9). https://doi.org/10.1111/jpc.12225.
18. Thomas DP, Anderson IP. Use of emergency departments by aboriginal and Torres Strait Islander people. *Emerg Med Australasia (EMA)* 2006;**18**(1):68–76. https://doi.org/10.1111/j.1742-6723.2006.00804.x.
19. Cresp R, Clarke K, McAuley KE, McAullay D, Moylan CA, Peter S, et al. Effectiveness of the Koorliny Moort out-of-hospital health care program for aboriginal and Torres Strait Islander children in Western Australia. *Med J Aust* 2016;**204**(5):197. https://doi.org/10.5694/mja15.00827. 197.
20. Australian Bureau of Statistics. *Brisbane, census all persons QuickStats* [online]. 2021. Available from: https://abs.gov.au/census/find-census-data/quickstats/2021/LGA31000. [Accessed 13 October 2023].
21. Children's Health Queensland Hospital and Health Service. *Aboriginal and Torres Strait Islander Health Equity Strategy 2022-2025*. 2022. Available from: https://www.childrens.health.qld.gov.au/resources/about-us/strategies-plans-and-frameworks/aboriginal-and-torres-strait-islander-health-equity-strategy-2022-2025.
22. Mander GTWW, Reynolds L, Cook A, Kwan MM. Factors associated with appointment non-attendance at a medical imaging department in regional Australia: a retrospective cohort analysis. *J Med Radiat Sci* 2018;**65**(3):192–9. https://doi.org/10.1002/jmrs.284.
23. Job KM, Gamalo M, Ward RM. Pediatric age groups and approach to studies. *Ther Innov Regul Sci* 2019;**53**(5):584–9. https://doi.org/10.1177/2168479019856572.
24. Australian Government, Department of Health and Aged Care. *Modified Monash Model*. Available from: https://www.health.gov.au/topics/rural-health-workforce/classifications/mmm. [Accessed 13 October 2023].
25. Australian Bureau of Statistics. *Socio-economic Indexes for areas (SEIFA)*. 2021. Available from: https://www.abs.gov.au/statistics/people/people-and-communities/socio-economic-indexes-areas-seifa-australia/latest-release. [Accessed 13 October 2023].
26. R Foundation for Statistical Computing. *R: A language and environment for statistical computing*. 2023. Vienna, Austria. Available from: https://www.R-project.org/.
27. Bureau of Meteorology, Queensland in 2022 [online] Available from: http://www.bom.gov.au/climate/current/annual/qld/summary.shtml. (Accessed 24 October 2023).
28. Buckner JL, Bowden SA, Mahan JD. Optimizing bone health in Duchenne muscular dystrophy. *Internet J Endocrinol* 2015;**2015**:928385. https://doi.org/10.1155/2015/928385.
29. Morse LR, Geller A, Battaglino RA, Stolzmann KL, Matthess K, Lazzari AA, et al. Barriers to providing dual energy x-ray absorptiometry services to individuals with spinal cord injury. *Am J Phys Med Rehabil* 2009;**88**(1):57–60. https://doi.org/10.1097/PHM.0b013e31818a5f87.
30. Alexander P. *Post apocalypse: the end of daily letter deliveries is in sight. The conversation* [online] [cited 2023 Dec 22] (2023) Available from: https://theconversation.com/post-apocalypse-the-end-of-daily-letter-deliveries-is-in-sight-201094. [Accessed 22 December 2023].
31. Department of Infrastructure, Transport, Regional Development Communication and the Arts. *Postal Services Modernisation-Discussion Paper*. 2023. Available from: https://www.infrastructure.gov.au/sites/default/files/documents/postal-services-modernisation-discussion-paper.pdf.
32. Crutchfield TM, Kistler CE. Getting patients in the door: medical appointment reminder preferences. *Patient Prefer Adherence* 2017;**11**:141–50. https://doi.org/10.2147/PPA.S117396.
33. Beauchamp A, Mohebbi M, Cooper A, Pridmore V, Livingston P, Scanlon M, et al. The impact of translated reminder letters and phone calls on mammography screening booking rates: two randomised controlled trials. *PLoS One* 2020;**15**(1):e0226610. https://doi.org/10.1371/journal.pone.0226610.
34. Kruse LV, Hansen LG, Olesen C. [Non-attendance at a pediatric outpatient clinic. SMS text messaging improves attendance]. *Ugeskr Laeger* 2009;**171**(17):1372–5.
35. McLean SM, Booth A, Gee M, Salway S, Cobb M, Bhanbhro S, et al. Appointment reminder systems are effective but not optimal: results of a systematic review and evidence synthesis employing realist principles. *Patient Prefer Adherence* 2016;**10**:479–99. https://doi.org/10.2147/PPA.S93046.
36. Azzopardi P, Blow N, Purcell T, Brown N, Ritchie T, Brown A. Investing in the health of Aboriginal and Torres Strait Islander adolescents: a foundation for achieving health equity. *Med J Aust* 2020;**212**(5):202. https://doi.org/10.5694/mja2.50500.
37. Salmon M, Doery K, Dance P, Chapman J, Gilbert R, Williams R, et al. Defining the indefinable: descriptors of aboriginal and Torres Strait Islander peoples' cultures and their links to health and wellbeing. In: *Aboriginal and Torres Strait Islander health team, research school of population health*. Canberra: The Australian National University; 2019.
38. Smallwood R, Usher K, Woods C, Sampson N, Jackson D. De-problematising Aboriginal young peoples' health and well-being through their voice: an Indigenous scoping review. *J Clin Nurs* 2023;**32**(9–10):2086–101. https://doi.org/10.1111/jocn.16308.
39. Gee G, Dudgeon P, Schultz C, Hart A, Kelly K. Aboriginal and Torres Strait Islander social and emotional wellbeing. In: Dudgeon P, Milroy H, Walker R, editors. *Working together: aboriginal and Torres Strait Islander mental health and wellbeing principles and practice*. 2nd ed. Commonwealth of Australia; 2014. p. 55–68.
40. Tamwoy N, Rosas S, Davis S, Farthing A, Houghton C, Johnston H, et al. Co-design with aboriginal and torres strait islander communities: a journey. *Aust J Rural Health* 2022;**30**(6):816–22. https://doi.org/10.1111/ajr.12918.
41. King PT, Cormack D, Edwards R, Harris R, Paine S-J. Co-design for indigenous and other children and young people from priority social groups: a systematic review. *SSM - Popul Heal* 2022;**18**:101077. https://doi.org/10.1016/j.ssmph.2022.101077.
42. Westhead S, Appleby Q, Andrews B, Brodie T, Brown A, Canuto K, et al. The need for a roadmap to guide actions for Aboriginal and Torres Strait Islander adolescent health: youth governance as an essential foundation. *Med J Aust* 2022;**217**(1):13–5. https://doi.org/10.5694/mja2.51592.
43. Sellars E, Pavarini G, Michelson D, Creswell C, Fazel M. Young people's advisory groups in health research: scoping review and mapping of practices. *Arch Dis Child* 2021;**106**(7):698–704. https://doi.org/10.1136/archdischild-2020-320452.
44. Children's Health Queensland Hospital and Health Service. *PET-CT scan | medical imaging | Queensland Children's Hospital* [online]. 2023. Available from: https://www.childrens.health.qld.gov.au/service-medical-imaging-pet-ct-scan/. [Accessed 13 October 2023].
45. Commission on Social Determinants of Health. *Closing the gap in a generation: health equity through action on the social determinants of health: final report of the commission on social determinants of health. Final report of the commission on social determinants of health*. Geneva: World Health Organization; 2008.
46. Children's Health Queensland Hospital and Health Service. *Connected Care and Nurse Navigator programs | QCH* [online]. 2023. Available from: https://www.childrens.health.qld.gov.au/qch/patients-families/connected-care/. [Accessed 13 October 2023].
47. Thomas SL, Williams K, Ritchie J, Zwi K. Improving paediatric outreach services for urban Aboriginal children through partnerships: views of community-based service providers. *Child Care Health Dev* 2015;**41**(6):836–42. https://doi.org/10.1111/cch.12246.