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The factors contributing to delayed discharge of patients with suspected non-accidental injury in a quaternary paediatric orthopaedic ward



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A dissertation submitted to the Faculty of Health Sciences, University of the Witwatersrand, in fulfilment of the requirements for the degree of

Master of Science (Medicine)

Johannesburg, 2023

Declaration

I Dina Yaeli Simmons declare that this dissertation is my own, unaided work. It is being submitted for the Degree of Master of Science in the branch of Orthopaedic Surgery at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.



……

(Signature of candidate)

16th day of May 2023 in Johannesburg

Dedication



I dedicate this work to my family.

My parents who raised me to think for myself, to be unique and to follow my goals.

My brothers who knew better than to expect less from the only girl.

My husband who believes me capable of everything and makes it all possible.

Finally, my children Benjamin, Noa and Kira, who I love with everything that I am and without whom this probably would have taken a fraction of the time to complete.

Presentation Arising From Research Project

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Abstract

Introduction

Child abuse is a critically important discussion within any society and poses challenges in the social, legal and medical systems. The international literature is rich with descriptions of patient and family based risk factors and suspicious injuries. Based on these descriptions, we have created a protocol for the identification and investigation of children with suspected non-accidental injuries. The paediatric orthopaedic ward is faced with many children being delayed in the ward once fit for discharge due to delays in investigations or regulatory body assessments of these cases. This study aimed to quantify those delayed discharges and describe the demographics and risk factors for abuse we see within the local population.

Methodology

After obtaining ethics clearance and hospital approval, the study was conducted as a retrospective review of records from the Teddy Bear Clinic, as well as admission records of the children. The study examined the demographic characteristics of the children, their family background, injury characteristics and referral to Child Welfare. The delay of discharge from hospital was quantified for each child in days and was then compared to the initial characteristics of each child.

Results

Records were collected from 1 January 2015 to 31 December 2020. Seventy-nine complete records were included in the review. There were 40 male and 39 female patients with an average age of 20 months. Sixty children (75.9%) were under the age of 36 months. Of the 35 (44.3%) foreign nationals, 31 were undocumented. Seventy-three (94.1%) of the cases sustained lower limb fractures of which 51 were femur fractures. Fifty-two of the cases showed a delayed discharge of the child. The delay ranged from 1 to 233 days. Examining patient characteristics showed an association between an age less than 36 months and delayed discharge. There were no significant correlations between caregiver characteristics and delayed discharge. The admission progress revealed that the later the day of completion of investigations, the more likely there was to be a discharge delay. There was also a

statistically significant correlation between referral to Child Welfare and delayed discharge.

Discussion

The majority of the patients referred for investigation were below the age of 36 months which agrees with the literature that this is the highest risk group. We could not identify any specific caregiver characteristics which were risk factors for suspicion. Delayed discharge of patients was associated with age less than 36 months, upper limb fractures and referral to Child Welfare. Despite the delayed discharge, most children were returned to the same home environments and in two described cases they were placed back into a high risk situation.

Conclusion

This review investigated the demographics of the children in the paediatric orthopaedic ward with a suspected non-accidental injury. The study also highlighted the challenges of inadequate support from regulatory social services when trying to assist these children.

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Nomenclature

CMJAH Charlotte Maxeke Johannesburg Academic Hospital, a Central hospital (quaternary academic complex) in Gauteng, the economic hub and most densely populated province in South Africa

CT Computerised tomography

NAI Non accidental injury

SA South Africa

TBC Teddy Bear Clinic

CHAPTER 1: INTRODUCTION

1.1 Introduction

Child abuse is a critically important issue as it deals with a very vulnerable population. It also revolves around a socioeconomic burden, which is not discussed or understood in most settings of health systems. Few members outside the specialised units which deal with these children understand the extent of the resources, both monetary and time, which this issue demands. The life changing impacts on children and opportunity costs on services of caring for these children is poorly understood. The peer-reviewed literature contains very little data to investigate these issues. Specialised units are few and under resourced particularly in lower and middle-income countries.

1.2 Background

1.2.1 Historical development of concept of non-accidental injury in children

The earliest mention of physical abuse was by Tardieu in his article published in 1860. However, it is only much more recently that child abuse has been accepted as a complex challenge of modern health care (1). In 1962, Kempe et al published their article called ‘The Battered Child Syndrome’ (2). Since then, this social and family disturbance has become known by many different names. While it may be known as ‘child abuse’, ‘non-accidental trauma or injury’, ‘Caffey’s Syndrome’ or ‘The non-accidental trauma syndrome’, the fact remains that it is of growing concern throughout the world and certainly locally in South Africa (SA). (3) The South African scenario is unique due to the historical segregated nature of our population and the economic discrepancies, which still exist today. Since the end of apartheid, abuse among the black population has for the first time come to the fore, and at the same time the rights of the child were being prioritised by the new government. Starting with the writing of the new constitution and by several acts and charters between 1994 and 2006, the South African government has attempted to safeguard the rights of the children of the country (3).

The exact extent of abuse in SA is not known. In 2016 a national prevalence study

estimated that one third of children experience physical and sexual abuse before the age of 18. However, several smaller local studies have been performed which estimate the numbers much higher with up to 56% of children experiencing physical abuse under the age of 18 in Mpumalanga and the Western Cape (4). However, SA has a very diverse population with substantial diversity in cultural beliefs. Thus, in order to understand abuse at a national level in SA, we need to understand the definition of child abuse independently of cultural beliefs and practices.

In 1988 Finklehor and Korbin explained that any definition of child abuse needs to achieve two objectives. Firstly, it needs to define the abuse independently of other socioeconomic and health challenges in the society. Secondly it needs to be elastic enough to cover a variety of situations in the presence of a range of cultural and social contexts (5,6).

They defined child abuse as “the portion of harm to children that results from human action that is proscribed, proximate and preventable”. This means abuse is commission of harm to children that is outlawed, performed in direct contact with the child and can be prevented by simply choosing an alternative course of action. The concept of being preventable is interesting as it defines a difference between a child dying from lack of medication in a resource poor environment and the same medication being withheld where it is readily accessible. The authors also recommended six dimensions, which could be used to determine if something can be considered abuse. These are: (i) the act is intentional, (ii) the acts are denounced in that region, (iii) the acts fit the international consensus of abuse, (iv) individuals perpetrate the acts, (v) the harm of this act is suffered exclusively by children and (vi) the acts are perpetrated against a child who is considered a person by the society (5).

Gough (1996) reviewed many different proposed definitions and simplified the definitions to basically two key factors, harm and the responsibility of that harm. The harm could be potential or actual and resulting in adverse effects on the child’s development. These effects on development could be social, emotional, physical or cognitive (7).

1.2.2 Clinical diagnosis of non-accidental injury in children

Orthopaedic surgeons are integral to the identification and flagging of child abuse cases as fractures are the most common presentation of abuse after soft tissue injuries (8). On presentation there are certain aspects of paediatric trauma, which need to be examined to decide whether an injury is suspicious for non-accidental injury (NAI).

1. Are there any characteristics of the patient that make it more likely to be abuse rather than an accidental injury? Some of these have been well described by authors and include inconsistent description of events, delayed seeking of medical help, multiple fractures. On examining these children suspicious features include associated head injury, mechanism of trauma inconsistent with the injury pattern and severity and long bone fractures in children not yet walking (9).
2. Is the fracture pattern or location suspicious for abuse? In 1983 Leonidas described the injury patterns that were more likely due to abuse than accidental injury. These included metaphyseal/epiphyseal injuries such as corner fractures, bucket handle fractures and subperiosteal fractures. He also highlighted extensive periosteal reactions as a suspicious feature. Diaphyseal fractures are more common in accidental and non-accidental fractures: however, transverse or oblique fractures are more likely to be abuse related as they are caused by bending or direct forces. Other osseous injuries suspicious for abuse are skull fractures in children under two years of age, rib fractures, fractures of the distal ends of the clavicles and vertebral fractures (10).
3. There are a few other features, which should raise alarm for possible abuse. These include multiple injuries in various stages of healing, a combination of fractures and soft tissue injuries, occult bone injuries (10).

According to Fong et al., more than half of children presenting with fractures due to NAI are under the age of three years. In addition each child sustained on average just less than three fractures per child. Fractures with the highest specificity for abuse were (in order of incidence in this study):

1. Fractures of different ages

2. Rib fractures
3. Bilateral fractures
4. Metaphyseal fractures
5. Less commonly seen, scapula, skull, clavicle, vertebral

They also found in the study that 4% of children presented with isolated long bone fractures and 1% with simple clavicle fractures (11). Dwek performed a literature review to ascertain which osseous lesions were most suspicious for NAI. His findings agreed with Fong et al. (12).

The literature is in general agreement that fractures sustained by younger children are more likely to be the result of non-accidental trauma. Fong et al. quoted three years as the age below which there should be suspicion of abuse (11). Sink et al. agreed with the cut-off of three years as raising suspicion for NAI (13). Pandya et al., in their institutional review found a significantly increased risk of abuse in children presenting with fractures below the age of 18 months (14). Wolgruber et al. reviewed femur fractures caused by abuse and also found that age less than 18 months was significant (9). Another review, of the literature, looked at the percentage risk factor for children at various ages and found a significantly higher risk of NAI as the cause of fractures in children under 11 months (15). There is no published South African study looking specifically at the age of patients sustaining fractures due to physical abuse.

It is a combination of these points which decided the policy in our paediatric orthopaedic unit regarding which patients are admitted for referral and investigation for NAI. (Appendix A)

1.2.3 Demographic, social, and behavioural risk factors for NAI in children

In addition to the age-related risk of physical abuse, there have been several studies which have examined the relationship of various family and child related risk factors to the prevalence of child abuse. Most of the studies examine abuse in general, including physical and sexual abuse. Doidge et al. in particular looked at a birth-based population cohort in Australia. They studied 2443 individuals and assessed a list of 21 family and child related risk factors for child maltreatment. Their study identified nine risk factors that independently and cumulatively placed children at a

higher risk for maltreatment. Previous studies have identified the following child related risk factors as increasing the risk of abuse, age, gender, ethnicity, developmental level, behavioural and social problems, disabilities, health and school attendance. Parent and family characteristics affecting risk of abuse include age, ethnicity, size and structure of the family. Socioeconomic factors, substance abuse and family stability also play a significant role (16).

In the above-mentioned Australian study, Doidge et al. found that cognitive/behavioural challenges, immigrant parents, parents younger than 22 years of age, episodes of parental unemployment, growing up 'poor', parental mental health issues or substance abuse, divorced parents, and instability during high school years were the strongest independent risk factors for maltreatment. The risk was cumulative, rising with increased numbers of risk factors (16).

Patwardhan et al. studied the cumulative family risk. There was an increased risk of abuse with each additional family risk factor. Above three cumulative family risk factors the risk of abuse increases exponentially with each further risk factor. They studied six family related risk variables. These variables were parental employment, physical and mental health, housing stability, drug abuse and domestic violence between parents (17).

1.2.4 Hospital admission in the management of NAI in children

In 1998 the American Academy of Pediatrics recommended that children living in areas where there are no specialised community-based units for the care and evaluation of abused children should be admitted to hospital to expedite the care and investigation of these children. All children seen in the casualty department where abuse or neglect is suspected are admitted for evaluation, even in cases where the medical injuries themselves do no warrant admission (18).

However, the hospital setting is not designed, nor ideal for the long-term management of the abused or neglected child. The setting of a hospital is designed to identify the patients at risk, evaluate and investigate those patients and refer them to appropriate services where the legal and psychosocial management process can continue. Our hospital has the Teddy Bear Clinic (TBC) which is a specialised unit for the investigation of child abuse and assists with the preparation of legal cases

and placement of affected children. The hospital setting should be reserved for crisis intervention (19).

The Teddy Bear Foundation was established in 1986 by Professor Lorna Jacklin to care specifically for abused and neglected children. The TBC at Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) is staffed jointly by the hospital and foundation, and cares for children referred from clinics, social services, general practitioners, families and from within CMJAH itself. While the numbers vary year to year, the clinic sees up to 280 cases within a year. The clinic is also responsible for all the medico-legal examinations of children in preparation for legal cases of abuse. One of the source's of referred patients to the clinic is the paediatric orthopaedic unit within the hospital (20).

Ideally, the hospital team should consist of a multidisciplinary team consisting of social workers and psychologists, paediatricians and other relevant specialists to the cases. All these disciplines should have the specific training and expertise in the field of abuse. The investigations of these children should be expedited in the hospital setting. This is essential as some of the standard investigations are very time sensitive, for instance an ophthalmology review as resolution can occur as soon as 24 hours later with certain injuries within the eye in small children (21).

1.2.5 CMJAH procedures for investigating suspected NAI in children

The paediatric orthopaedic ward at CMJAH is shared with plastic surgery. Eighteen beds are allocated to paediatric orthopaedics. According to the schedule of fees the cost in our hospital for an inpatient is R2030 per day according to the standard schedule of fees published by the South African Department of Health. The cost to be cared for by a specialist is a further R305 per day (22).

Patients are identified as requiring investigation according to the unit protocol (Appendix A). Once admitted in the paediatric orthopaedic ward, investigations typically carried out in suspected abuse cases are designed to both identify injuries and exclude some of the differential diagnoses of NAI. The psychosocial assessment, while challenging in younger children is a major part of the evaluation. The children have blood investigations. These are to exclude metabolic bone disorders and more specifically rickets or an underlying chronic disease. A

computerised tomography (CT) brain scan will detect any associated brain bleeds, and features of shaken baby. The ophthalmology examination also identifies features of injuries secondary to abuse. Finally, a skeletal survey identifies any other osseous trauma. Multiple fractures in various stages of healing and extensive periosteal reactions are very specific to abuse cases. These investigations are agreed in several different articles (19,21,23).

Of these investigations, the most critical is the ophthalmology examination as the changes which may be related to abuse resolve fairly quickly and can be missed if the examination is delayed (21).

1.2.6 Preliminary literature review

The challenge with this literature review is both the poor quantity of studies related to fractures and child abuse as well as the poor quality of the research, which has been conducted in this field. A PubMed search was conducted using several different combinations of keywords to try find studies relating to different aspects of the issue. The keywords used consisted of the following combinations and variations thereof:

- Child abuse; orthopaedics; fractures
- Non–accidental trauma; child abuse
- Child abuse; costs; economics
- Evaluation; management; protocols; physical child abuse; programs
- Child abuse; programs; hospital
- Child abuse; South Africa
- Risk factors; child abuse; child violence

The results yielded a total of 50 studies that were relevant to this literature review. The Journal of Pediatric Orthopaedics describes the levels of evidence in studies as follows; Level 1 studies are high quality prospective studies or systematic reviews of level 1 studies. Level 2 studies are retrospective studies, lower quality prospective studies or systematic reviews of level 2 evidence. Level 3 indicates case control studies, level 4 would be a case series and level 5 an expert opinion. According to these levels, the evidence was overall of a poor standard (24). All 50 studies fell into the categories three, four and five and only 20 could be considered level three studies. There were no level one and two studies in the literature related to this topic.

The South African literature was altogether much sparser and showed no level one or two studies.

Argent et al. published a study in 1995 discussing the protocols for the investigation of NAI at the Red Cross Children's hospital in Cape Town. They retrospectively reviewed their child abuse management services from 1989-1990. They saw 503 children in the period. One-hundred and sixty (160) cases were confirmed physical abuse and 229 cases were confirmed sexual abuse. They specifically noted the challenge in Xhosa speaking families and communication barriers. The main conclusion made by the authors was that while not every child could be seen by a specialist, they determined that the hospital needed to allocate sufficient staff to deal with all the children with suspected abuse. This study assists in recommending enough staff to comprehensively look at these children. However, they did not examine the challenges of referral of the children into the social services system. There was also no critical analysis of their existing protocols (25).

Chen et al. published a review of the management of suspected abuse and neglect. The Ministry of Health in Israel has determined that all children involved in cases of suspected abuse or neglect need to be admitted to hospital. The hospital setting provides the opportunity for the child to be removed from any immediate danger and allow for careful observation of the child. Once removed from their home environment, many children may disclose events they were too afraid to discuss beforehand. The admission also allows the various specialists including doctors, psychologists, social workers, and specialised nurses to collaborate in one place to investigate the situation. They emphasise that they merely provide medical treatment and investigation and diagnosis of abuse. The children are then referred for management of the causes of abuse. The review demonstrates well the benefits of collaboration within a tertiary institution and the importance of a multidisciplinary team. However, they do not describe the referral processes in detail and the discharge or step-down timelines. This was not a study but rather a position statement of the services they offer at the hospital (19).

Lee et al. investigated the outcomes for children admitted with suspected abuse in Hong Kong before and after the implementation of a management protocol in 2002. Their study, published in 2006, studied case outcomes, amount of testing done, time

to case conference and length of stay in hospital. This was a retrospective review of their service at the two different times. Like the Israeli and American recommendations and our local practice, due to poorer community resources and expertise, most cases in Hong Kong are admitted to hospitals for the benefit of the experienced multidisciplinary team. Their study found that the characteristics of the groups before and after their protocol was implemented were similar, except the average age in the latter group was slightly higher. They also found the number of cases enrolled tripled in the latter cohort of patients. They found that following their protocol they reduced the number of children having clotting tests from 75% to 9%, the number having blood counts from 86% to 16% and the number of skeletal surveys from 78% to 6%. The length of stay of the cases also reduced from 15.3 to 6.1 days. The most significant finding was that there was no decrease in the number of cases progressing to case conference and substantiation of the NAI, and in fact an increased proportion of cases being registered in the official Child Protection Registry (26).

1.2.7 Gaps in literature, from issues identified in CMJAH paediatric orthopaedic ward

Two of our local concerns, are not addressed by Lee et al. in their paper. Firstly, anecdotally, cases at CMJAH are subject to a significant delay in the social and legal processes. Secondly, if these cases progress to court proceedings, defence attorneys look to escape convictions when all differentials have not been excluded by laboratory and radiological investigation (26).

At CMJAH, once a child has been identified as sustaining an injury suspicious for NAI based on the protocol (Appendix A), the investigations are performed under the supervision of our specialised child abuse unit in the hospital. All suspicious cases are also referred to social workers that assist in assessing the circumstances at home and those surrounding the injury, in the worrying cases they start the legal process by referring the case to Child Welfare. Child Welfare is responsible for conducting the background investigation and arranging for the safe placement of the children. They need to determine if returning the child home directly is safe or if a temporary place of safety is needed. Child Welfare is also responsible for the

placement of the child in a suitable facility where indicated. The challenge with this process is that, whereas the initial investigations and treatment of these children can be completed within a few days, the background processes between the social workers and Child Welfare can take several weeks or even months to finalise. This means that we regularly have children admitted for suspected NAI or neglect who are investigated on admission but continue to remain in our ward for extended periods of time while awaiting work-up and placement. However, this has never been properly studied or quantified.

1.2.8 Problem statement

The extended length of stay in our ward, after patients with suspected child abuse are medically fit for discharge, needs to be explored and better understood. The excess lengths of stay and their underlying factors, including barriers to discharge or placement of these children, needs to be characterised. Once the reason/s for delayed discharge have been considered, we may be able to recommend some strategies to reduce the strain on our bed occupancy and budget within our hospital.

1.3 Study aim and objectives

The aim of this study is to explore the factors contributing to extended length of stay in children investigated for NAI within a quaternary paediatric orthopaedic ward.

The objectives are:

1. To perform a retrospective review to generate descriptive analyses of all children referred to the TBC from the paediatric orthopaedic ward with suspected NAI from 1 January 2015 – 31 December 2020.
2. To compare our demographics and patient profile for suspected NAI to the international literature.
3. To calculate the length of stay of all the patients identified in objective one and determine the excess length of stay i.e. when they were medically fit for discharge and the delay to actual discharge.
4. To compile a regression analysis to explore any associations between specific patient variables explored in objective one and extended length of stay.

CHAPTER 2: METHODOLOGY

2.1 Research question

What patient factors are likely to result in a prolonged length of stay in children presenting with injuries suspicious for NAI?

2.2 Research design

The study was a retrospective review of inpatient records.

2.3 Materials and methods

After obtaining ethics approval and departmental and CEO permission, the study was conducted in ward 275, which is the Paediatric Orthopaedic Unit of the CMJAH. Records of the TBC are more accessible and easier to study than those within the ward. For this reason this study was performed by first studying records at the TBC. The records for the included years were studied and those patients referred from the orthopaedic unit were identified. The TBC records were reviewed and the data collection form was filled in using RedCap. Each record was then reviewed again and completed where necessary using the records archives of the hospital. To ensure anonymity each record was assigned a number and all identifiers such as the date of admission, name, hospital number and date of birth were removed The study covered records of patients referred from the Paediatric orthopaedic ward from 1 January 2015 to 31 December 2020.

2.4 Sample

The aim was to collect a minimum of 36 complete records as determined by using a sample size calculation (Appendix B). All records fitting the inclusion criteria were included in the study.

2.4.1 Selection criteria

Inclusion Criterion

- All children admitted to ward 275 orthopaedics, referred for investigation to the TBC for suspected NAI or neglect using the ward protocol (Appendix A).

Exclusion Criteria

- Cases which were initially referred, but where NAI was ruled out early or an alternative diagnosis was made.
- Cases with incomplete records.

2.5 Data collection

All data were collected by the principal investigator. Cases were identified for each year from the cases investigated by the TBC. All cases referred from paediatric orthopaedics were included. Records were reviewed from the TBC and from the admission records in the CMJAH archives to complete the data collection form on REDCap (Appendix C).

Data collected using REDCap included the following:

- Demographic data
    - Age
    - Gender
    - Area of residence and type of residence (formal/informal, over-crowding, foster care/children's home)
    - Caregiver – age, relationship, marital status, family support, employment
    - Nationality – South African, documented foreigner, undocumented foreigner
    - Number of children in the home
    - Day care or school details
    - Presence of disability
    - Nature of suspicion for NAI
    - Any previous issues of abuse or domestic violence

- Type of injury
    - Presenting injury
    - Presence of any suspicious features of fracture/injury
    - Mechanism – based on history
    - Previous injuries – based on history
    - Findings of
        - Blood investigations
        - Skeletal survey
        - CT Brain
        - Ophthalmology examination
    - All injuries identified after investigations were complete
- Length of stay
    - Date of admission
    - Date of referral to social work and 'Teddy Bear' child abuse clinic
    - Date of completion of investigations
    - Date when medically fit for discharge
    - Date of discharge
    - Main factor delaying discharge – as documented in patients file
    - Whose care was the child discharged to
    - Discharge decision
    - Referral to Child Welfare

2.6 Data Analysis

The data were analysed with the assistance of a biostatistician.

Descriptive statistics was used to summarise the data. A test for normality showed that the data were not normally distributed, p-value <0.05 (Table 2.1), therefore non-parametric statistics was used to analyse the data. The descriptive data were presented using median, interquartile range, percentages, and frequencies. An association between categorical variables was performed using the Fischer's exact test. An association between continuous variables and two group categorical variables was performed using the Mann Whitney U test and with three group variables, this was performed using the Kruskal-Wallis test. Univariate and

multivariate binary logistic regression was performed with discharge delay as the dependent variable. The probability was calculated as $\frac{OR}{1+OR}$. Variables from the association tests with a p-value < 0.06 were included in the regression analyses.

Table 2.1: Test for normality

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Age in months	0.200	78	0.000	0.755	78	0.000
Day of referral to social worker	0.285	78	0.000	0.641	78	0.000
Day of referral to TBC	0.194	78	0.000	0.796	78	0.000
Day of completion of investigations	0.183	78	0.000	0.859	78	0.000
Day medically fit for discharge	0.134	78	0.002	0.934	78	0.001
Day of discharge	0.252	78	0.000	0.534	78	0.000
Number of days of excess admission	0.383	78	0.000	0.505	78	0.000

CHAPTER 3: RESULTS

Cases referred for investigation of possible NAI were collected from 1 January 2015 to 31 December 2020. Over the six-year period, 80 cases were identified which had been investigated by a hospital social worker and TBC. Of those cases identified, one case was excluded for incomplete data. Seventy-nine 79 patient records were collected and analysed.

3.1 Demographic characteristics

The demographic characteristics of the participants are shown in Tables 3.1 and 3.2.

There were 39 female and 40 male patients in the cohort with a median age of 20 months (interquartile range 6-34.5 months). Sixty of the 79 children (75.9%) were under the age of 36 months. Five children (6.3%) had some form of disability.

The social circumstances of the children were also reviewed. Forty-four children (55.7%) were South African, and 35 children were foreign nationals. Of the foreign nationals, 31 (91%) were undocumented. Sixty (75.9%) patients lived in the inner-city areas surrounding the hospital including inner city Johannesburg, Hillbrow, Yeoville and Berea. Nineteen (24.1%) patients were from further afield including Alexandra and the South and Eastern areas around Johannesburg. Seventy-seven (97.5%) of the patients lived in formal housing. Only two were living in shacks.

When collecting data about the home circumstances of the children the following factors were examined: who the caregiver of the child was, the age and marital status of the caregiver and whether the caregiver had family support. Seventy-two (91.1%) children were being cared for by their parents with the other seven either being cared for by grandparents, nannies, children's homes, or friends. One child was living alone on the street. The age of the caregivers was evenly distributed. Of note only six (7.6%) caregivers were under the age of 20 years. The majority, of the caregivers were cohabiting i.e. 40 (54.8%), 17 (23.3%) were single parents, 16 (21.9%) were formally married and for six (7.6%) it was not noted. Sixty-seven (84.8%) of the caregivers reported they had support at home and 12 reported they had no support in caring for their children.

Table 3.1: Demographics characteristics of the children (n=79)

Demographics	Statistic
Age in months, Median (interquartile range)	20 (6-33.5) months
Age as category, n (%)	
< 36 months	60 (75.9)
>36 months	19 (24.2)
Gender, n (%)	
Female	39 (49.4)
Male	40 (50.6)
Disability of child, n (%)	
Physical	3 (3.8)
Physical and intellectual	2 (2.5)
None	74 (93.7)
Nationality, n (%)	
South African	44 (55.7)
Documented migrant	3 (3.8)
Undocumented migrant	32 (40.5)
Area of residence, n (%)	
Alexandra	4 (5.1)
Hillbrow	7 (8.9)
Inner city JHB	32 (40.5)
Yeoville/Berea	17 (21.5)

Other	19 (24.1)
Type of residence, n (%)	
Formal housing	77 (97.5)
Informal housing	2 (2.5)

Table 3.2: Caregiver's characteristics

Caregiver, n (%)	
Parent	72 (91.1)
Children's home	2 (2.5)
Grandparent	2 (2.5)
Other (Family friend, nanny, homeless)	3 (3.8)
Age of caregiver	
<20	6 (7.6)
20-25	21 (26.6)
25-30	20 (25.3)
30-35	16 (20.3)
>35	16 (20.3)
***Marital status, n (%)**	
Single	17 (23.3)
Cohabitation	40 (54.8)
Married	16 (21.9)
Family support	
Yes	12 (16.2)
No	67 (83.8)

***n=73**

3.2 Admission diagnosis

The admission diagnosis for each child is shown in Figure 3.1. Most the children investigated were admitted with lower limb fractures. This was followed by upper limb fractures. Isolated limb fractures accounted for 73 (94.1%) of the presenting injuries. Of note 51 (69.9%) of the lower limb cases sustained femur fractures.

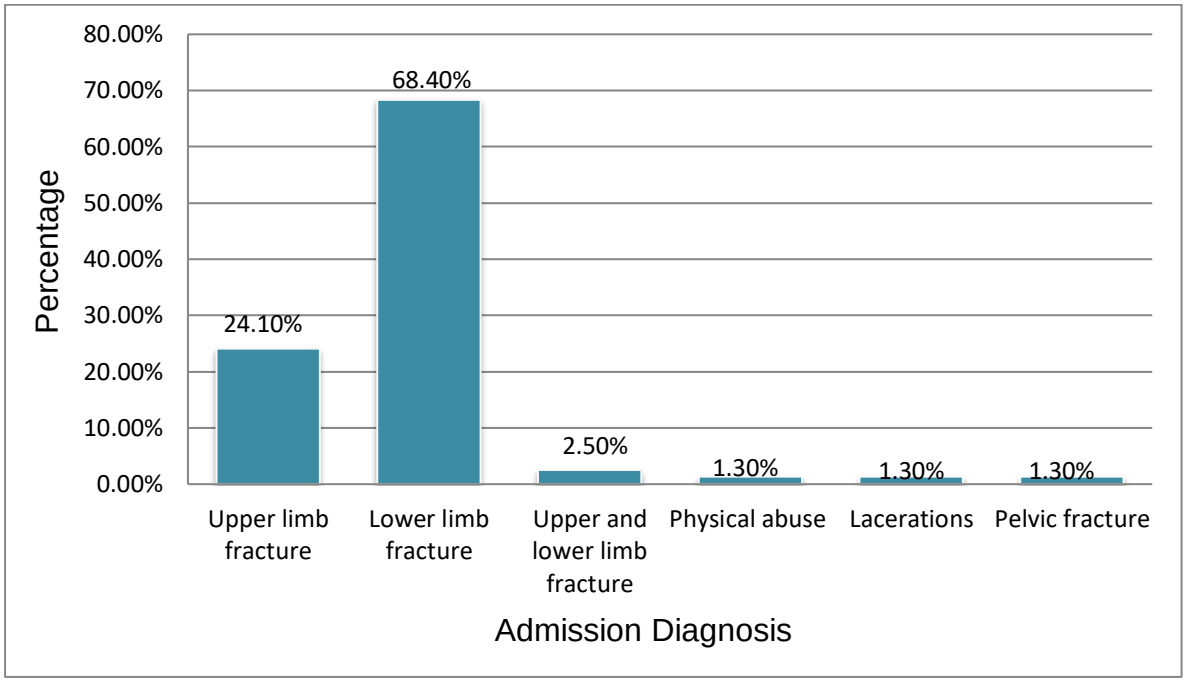


Figure 3.1: Admission diagnosis

3.3 Mechanism of injury

The mechanism resulting in the injury as received on admission history is shown in Figure 3.2. Forty-three patients (54.4%) reported a history of a fall. Only five patients (6.3%) were initially reported as assault. Twenty-three cases (29.1%) had an unknown mechanism of injury where either the carer was not sure what had happened in the care of another, or the injury was unwitnessed.

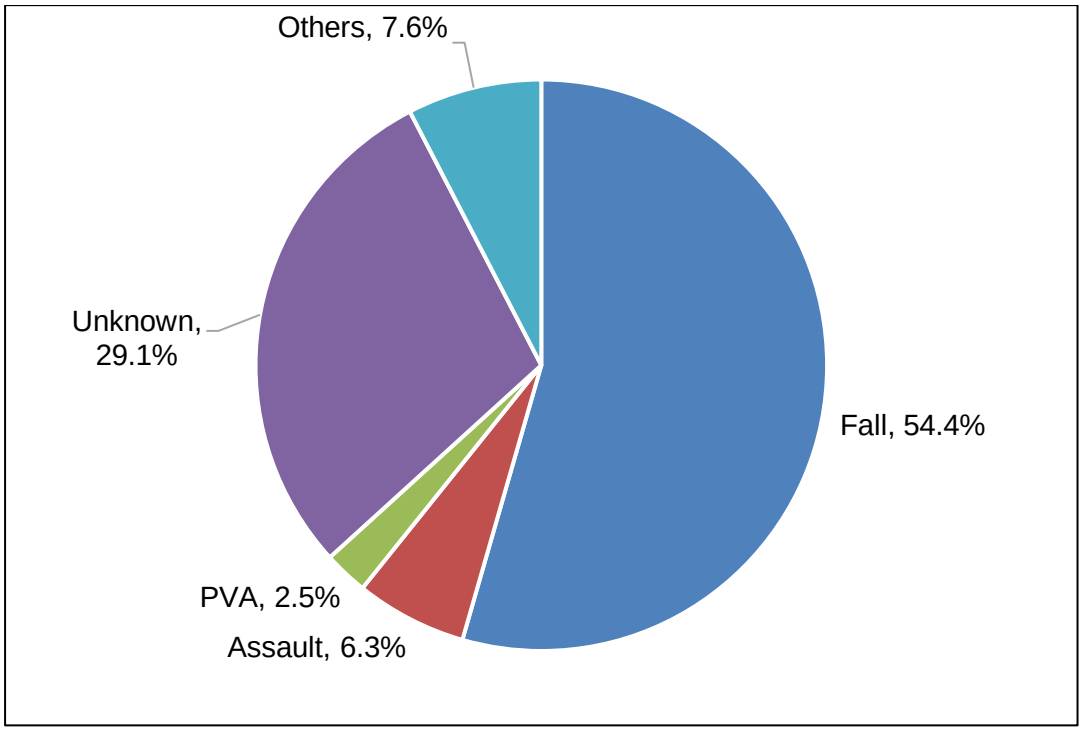


Figure 3.2: Reported mechanism of injury

3.4 Reason for suspicion of NAI

Only four (5.1%) of the children had a known history of domestic violence in the family, whereas all the remaining children were de novo presentations. Similarly, only five (6.3%) and four (5.1%) of the children had any previous trauma or medical admissions respectively. The primary reason for suspicion of non-accidental history was the age of the child in 25 (31.6%) cases, suspicious circumstances surrounding the injury in 24 (30.4%) and a history inconsistent with the injury or with other reports in 17 (21.5%) cases. The remaining 13 (16.5%) cases were suspicious due to the

fracture type, the child disclosing abuse, repeated presentations and three other concerns.

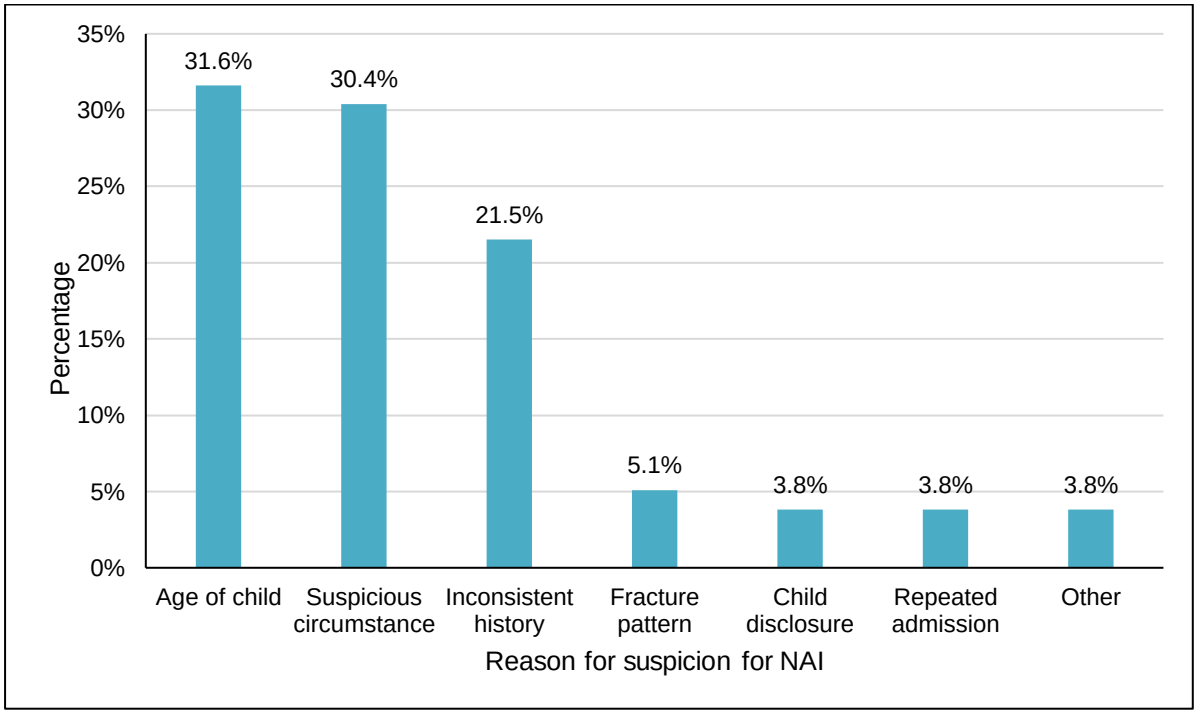


Figure 3.3: Reason for suspicion of NAI

3.5 Investigations done and abnormal findings

The decisions taken about what investigations were indicated was taken on a case-by-case basis depending on the age of the child, the reason for suspicion and the nature of the injuries. The investigations performed and the outcomes are shown in Table 3.3.

Sixty (75.9%) of the children underwent a skeletal survey, and of those 60, 11(18.3%) revealed abnormal findings. Forty-six (59%) children received an ophthalmology examination, although none of these examinations revealed any ophthalmological evidence of abuse. Thirty-six (46.2%) children had blood investigations done of which seven (20.6%) had abnormal results. The most common investigations were rickets blood tests, full blood count and urea and electrolytes. Finally, 18 (22.8%) children underwent a CT or MRI brain scan of which two (12.8%) revealed pathological findings.

Table 3.3: Investigations done and abnormal findings

Investigations n(%)	
Skeletal survey (n=60)	
Normal	49 (81.7)
Abnormal	11 (18.3)
CT/MRI brain (n=16)	
Normal	14 (87.5)
Abnormal	2 (12.5)
Opthalmologist examination (n=46)	
Normal	46 (100)
Abnormal	0 (0)
Blood Investigations (n=34)	
Normal	27 (79.4)
Abnormal	7 (20.6)

3.6 Relationship between demographic characteristics and delayed discharge

Of the 79 cases, 28 (35.4%) were referred for further investigation to child welfare. Fifty-one (64.6%) were resolved by the multi-disciplinary team without involvement of the regulatory body.

Fifty-two (65.8%) of the records analysed showed a delay in the discharge of the patients. Twenty-seven (34.2%) were discharged on the day on which they were medically fit for discharge.

Of the cases that had delayed discharge the minimum delay was one day and the maximum was 233 days with a median and interquartile range of 15.5 (6-32).

As noted in Table 3.4, when comparing patient demographic characteristics and delayed discharge, an age less than 36 months was associated with delayed discharge (p=0.014).

Table 3.4: Relationship between demographic characteristics of the patient and discharge delay

Demographics	Yes	No	p-value
Age in months, Median (interquartile range)	18.5 (6-54.25)	20 (7-30)	0.737
Age as category, n (%)			
< 36 months	36 (67.9)	25 (92.6)	0.014*
>36 months	17 (32.1)	2 (7.4)	
Gender, n (%)			
Female	27 (51.9)	12 (44.4)	0.641
Male	25(48.1)	15 (55.1)	
Disability of child, n (%)			
Physical	3 (5.8)	-	0.466
Physical and intellectual	2 (3.8)	-	
None	48 (90.4)	27 (100)	
Nationality, n (%)			
South African	32 (61.5)	12 (44.4)	0.094
Documented migrant	3 (5.8)	-	
Undocumented migrant	17 (32.7)	15 (55.6)	

Area of residence, n (%)			
Alexandra	3 (5.8)	1 (3.7)	0.994
Hillbrow	5 (9.6)	2 (7.4)	
Inner city JHB	21 (40.4)	11 (40.7)	
Yeoville/Berea	11 (21.2)	6 (22.2)	
Other	12 (23.1)	7 (25.9)	
Type of residence, n (%)			
Formal housing	50 (96.2)	27 (100)	0.547
Informal housing	2 (3.8)	-	

3.7 Relationship between caregiver characteristics and discharge delay

Table 3.5 examines the relationship between caregiver characteristics and delayed discharge. No statistically significant correlations were found in this grouping.

Table 3.5: Relationship between the caregiver characteristics and discharge delay

Caregiver, n (%)	Yes	No	p-value
Parent	1 (1.9)	1 (3.7)	0.908
Children's home	47 (90.4)	-	
Grandparent	2 (3.8)	25 (92.6)	
Other (Family friend, nanny, homeless)	2 (3.8)	1 (3.7)	
Age of caregiver			
<20	5 (9.6)	1 (3.7)	0.520
20-25	13 (25)	8 (29.6)	
25-30	12 (23.1)	8 (29.6)	
30-35	9 (17.3)	7 (25.9)	
>35	13 (25)	3 (11.1)	
***Marital status, n (%)**			
Single	15 (28.8)	2 (7.7)	0.059
Cohabitation	23 (44.2)	16 (65.4)	
Married	9 (17.3)	7 (26.9)	
Family support			
Yes	11 (21.2)	1 (3.7)	0.051
No	41 (78.8)	26 (96.3)	

3.8 Relationship between discharge delay and admission diagnosis

When examining the relationship between delayed discharge and admission diagnosis (Table 3.6), there was a statistically significant correlation between patients admitted with upper limb fractures and delayed discharge (p=0.002).

The likelihood of delayed discharge was compared with family history of abuse, previous admissions of the child, the reason for suspicion of NAI, mechanism of injury and outcomes of investigations. There were no statistically significant correlations with any of those factors (p>0.05).

Table 3.6: Relationship between discharge delay and admission diagnosis

Admission diagnosis	Yes	No	p-value
Upper limb fracture	18 (34.6)	1 (3.7)	0.002*
Lower limb fracture	28 (53.8)	26 (96.3)	
Upper and lower limb fracture	2 (3.8)	-	
Physical abuse	1 (1.9)	-	
Lacerations	1 (1.9)	-	
Pelvic fractures	1 (1.9)	-	
Upper limb fractures and lacerations	1 1.9)	-	

3.9 Relationship between discharge delay and admission progress

On examination of the relationship between delayed discharge and the time of referral to a social worker and the TBC and completion of investigations, there was a significant difference in the day of completion of investigations. Patients with delayed discharge had significantly higher number of days to complete investigations compared to patients without delayed discharge (p=0.047) (refer to Table 3.7).

Table 3.7: Relationship between discharge delay and admission progress

Referral and admission	Yes	No	p-value
Day of referral to social worker	2 (1-2)	2 (1-2)	0.536
Day of referral to TBC	3 (2-5)	4 (2-6)	0.528
Day of completion of investigations	11 (6-19)	7 (5-10)	0.047*

3.10 Relationship between discharge delay and Child Welfare involvement

Finally, the likelihood of a delayed discharge was compared to the involvement of child welfare. When there was a delay in discharge the average number of days delay increased from seven days when child welfare was not involved to 32 days when Child Welfare was consulted (Figure 3.4). There was a significant association (p=0.001) between referral to Child Welfare and delayed discharge (refer to Table 3.8)

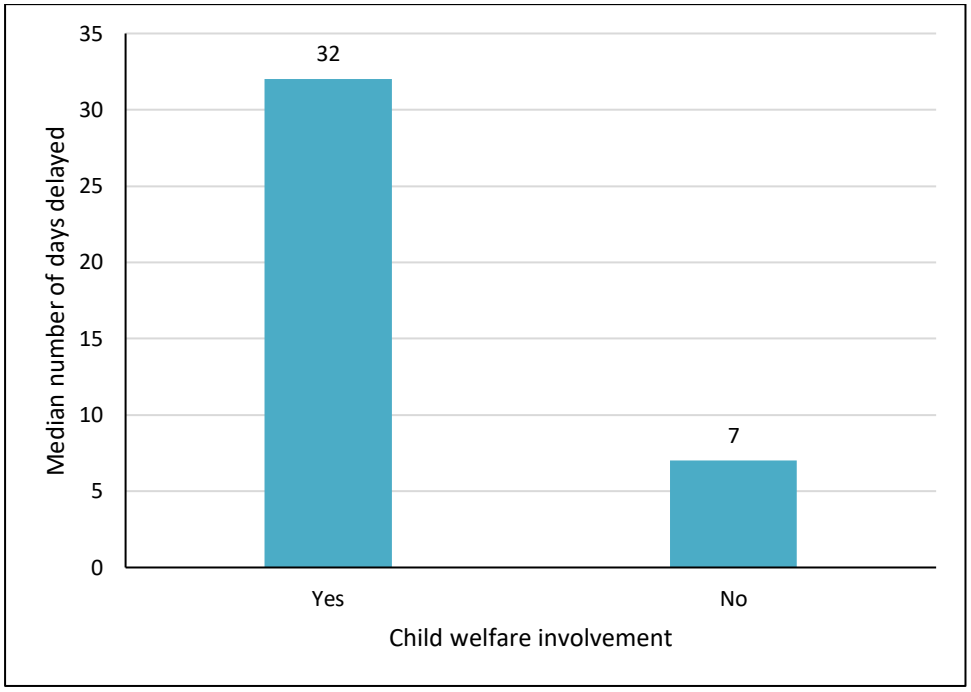


Figure 3.4: Average days of delayed discharge with and without referral to Child Welfare

Table 3.8: Relationship between discharge delay and Child Welfare involvement

	Yes	No	p-value
Child Welfare involvement			0.001*
No	27 (51.9)	24 (88.9)	
Yes	25 (48.1)	3 (11.1)	

3.11 Predictors of delayed discharge

Univariate and multivariate binary logistic regression were performed to determine the predictors of delayed discharge. The variables included in the regression were the child's demographics (age and gender) and explanatory variables from the association statistics with a p-value < 0.1.

Table 3.9: Univariate binary logistic regression

	Exp(B)	95% CI for Exp(B)		Sig.	Probability
		Lower	Upper		
Age					
<36 months	Ref	Ref	Ref	Ref	
>36months	6.071	1.285	28.676	0.023*	85.9%
Gender					
Male	Ref	Ref	Ref	Ref	
Female	1.350	0.531	3.435	0.529	57.4%
Family support					
Yes	Ref	Ref	Ref	Ref	
No	0.143	0.017	1.771	0.071	12.5%
Child Welfare involved					
No					
Yes	7.407	1.983	27.667	0.003*	88.1%
Day of completion of investigations	1.079	1.005	1.160	0.037*	51.9%
Admission diagnosis					
Upper limb fracture	Ref	Ref	Ref	Ref	
Lower limb fracture	0.060	0.007	0.480	0.008*	5.6%

The univariate binary logistic regression (Table 3.9) showed that the age of the child, involvement of Child Welfare and admission diagnosis were independent significant predictors of discharge delay, $p<0.05$.

The probability of children ≥ 36 months having a discharge delay compared to children younger than 36 months is 85.9%.

With each additional day it took to complete the investigations, the probability that the child will have a discharge delay is 51.9%.

Child Welfare involvement represents a probability of 88.1% to present with a discharge delay.

Table 3.10: Multivariate binary logistic regression

	Exp(B)	95% CI for Exp(B)		Sig.	Probability
		Lower	Upper		
Age					
<36 months	Ref	Ref	Ref	Ref	
>36months	1.676	0.221	12.732	0.617	62.63%
Gender					
Male	Ref	Ref	Ref	Ref	
Female	0.897	0.249	3.228	0.868	47.29%
Family support					
Yes	Ref	Ref	Ref	Ref	
No	0.133	0.012	1.454	0.098	11.74%
Child Welfare involved					
No	Ref	Ref	Ref	Ref	
Yes	6.196	1.348	28.473	0.019*	86.1%
Day of completion of investigations	1.117	1.009	1.237	0.033*	52.76%
Admission diagnosis					
Upper limb fracture	Ref	Ref	Ref	Ref	
Lower limb fracture	0.034	0.003	0.344	0.004*	3.29%

The multivariate regression analysis showed that child welfare involvement, admission diagnosis and days to complete an investigation were significant predictors of delayed discharge.

The involvement of Child Welfare and the age of a child ≥ 36 months increased the probability of delayed discharge by 86% and 62.6%, respectively.

A unit increase in the day of completion of an investigation increases the probability of delayed discharge by 52.76%. The diagnosis of a lower limb fracture increases the probability by 3%.

3.12 Discharge decision

Twenty-eight (35.4%) cases were deemed concerning enough for referral to a regulatory body however on discharge only 7 (9%) were removed to a place of safety pending further investigation. All other cases were discharged directly back to their parents or to a relative. See Figure 3.5.

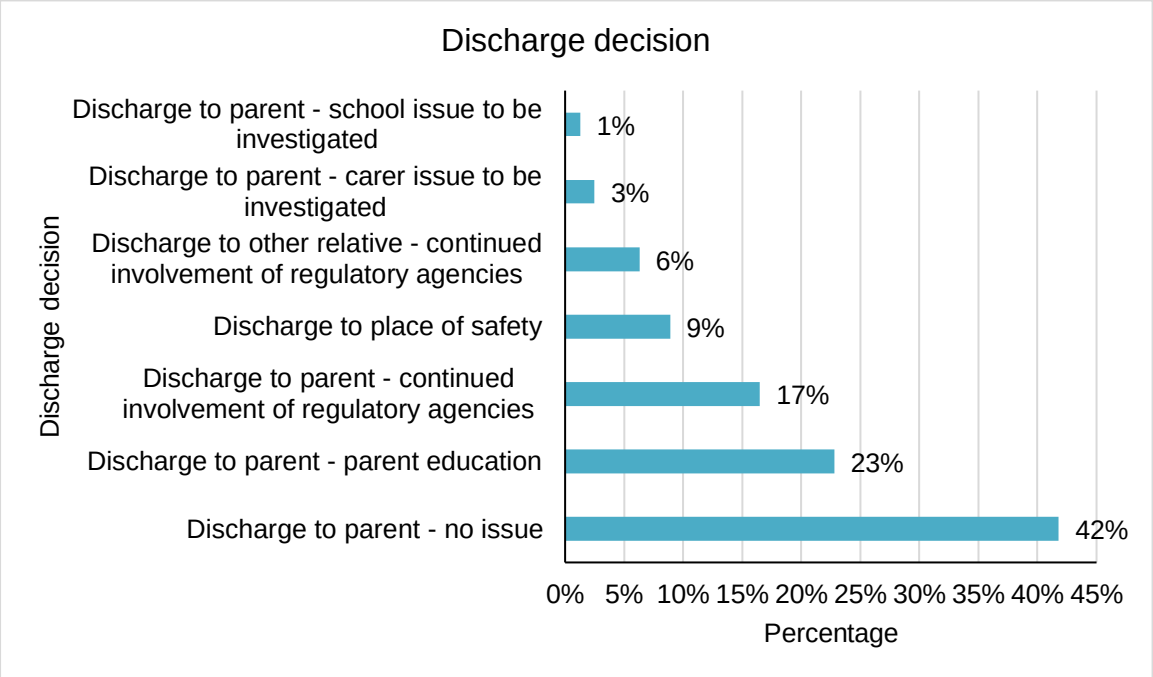


Figure 3.5: discharge decision

CHAPTER 4: DISCUSSION

4.1 Spectrum of patients identified as suspicious for NAI

The demographic picture of patients in our cohort is mostly consistent with that which is seen in the literature. Of the 79 patients, 60 (75.9%) of the children were younger than 36 months, which agrees with the findings of Fong et al. who showed most children with NAI were under the age of three years old (11). Sink et al. suggested that it was unnecessary to raise the alarm for suspected abuse over the age of three years. Our results show that although most of the patients were below the age of 36 months by creating an absolute cut off, 24% of the patients referred for investigation would not have been considered (13).

Both Patwardhan et al. and Doige et al. suggested very clear parental and home factors, which placed children at a higher risk of a NAI (16,17). In this study we could not fully explore all of the risk factors involved. The retrospective nature of the study resulted in records where not all the risk factors mentioned in the studies above were captured in all the cases. However, this study could confirm several risk factors as being statistically insignificant in this population. Seventy-two (91.1%) patients were cared for by parents, with the majority being over the age of 22 years. Within this group, 76.7% were either formally married or living with their partners. Only 5.1% had a history of domestic violence. Disability among the children was not common in the group at 6.3%. There was no specific data collected about employment status and drug history among the parents as it was only noted as a positive finding in selected files. Therefore, employment status and drug history could not conclusively be excluded as they were not noted as a specific negative finding in the other files.

The only risk factor that may be clinically significant was that of immigrant parents. Forty-four (55.7%) of the children were South African and the remaining 35 (44.3%) consisted of documented and undocumented foreign patients. Of note, 32 of the 35 foreign patients were undocumented with home affairs. This is of major concern as these children are not accommodated in the social service system. They are not funded, not accepted by the places of safety and very difficult to try and assist through the diplomatic processes. The number of foreign nationals is weighted heavily in the CMJAH hospital population, which is predominantly South African.

However, the exact significance would have to be assessed with more accurate numbers of foreign nationals being admitted for other causes within the hospital.

4.2 Admission injuries

In our cohort of patients, 68.4% presented with lower limb fractures. The majority of these were femur fractures. A further 24.1% were admitted with upper limb fractures. On the 60 (75.9%) that had a skeletal survey, 18.1% had other abnormal skeletal findings. Fong et al. and Dwek et al. described the types of fractures that had a high specificity for NAI (11,12). Only 5.1% of our cases were referred for investigation based on the fracture type. Fracture patterns with a high specificity for NAI were rare within the patient group.

The high number of lower limb fractures highlighted a bias within the study. The majority of mild upper limb fractures can be treated on an outpatient basis and may be sent home directly from casualty. Only those where there is an immediate concern of a NAI or severe injuries requiring surgery are admitted. Lower limb fractures, and more specifically femur fractures, are much more likely to require admission. Therefore, the number of cases referred is a factor of those types of injuries requiring admission. This bias will be further discussed with the univariate and multivariate analyses of the data.

4.3 Delayed discharge

The CMJAH policy is in agreement with the statement of the American Academy of Orthopaedics, where children with a suspected NAI are admitted for care and investigation, as the community support structures are poor (18). However, the hospital environment is not an optimal one for long-term management of these children, which should ideally only assist in crisis intervention (19). As is borne out in this review, this is not the case in the CMJAH setting. CMJAH becomes the temporary place of safety for many of the children. This means the children concerned are not receiving proper schooling, are blocking beds needed for children

requiring specialist care and are occupying beds costing more per day than any proper place of safety or lower level hospital.

Our review showed that 65.8% of the patients were not discharged on the day on which they were medically fit for discharge. An age of less than 36 months and upper limb fractures were the only independent patient factors that made a delay of discharge more likely. As previously discussed, there was a much higher likelihood of more suspicious circumstances in children with upper limb fractures being investigated for NAI. Lower limb fractures were more likely in general to require admission and were referred for investigation because of the policy to refer long bone fractures in children under 36 months of age. Upper limb fractures were more often admitted due to the suspicion for NAI and thus less likely to be cleared quickly and required an extended stay in hospital. This correlation is thus more likely a bias in the results rather than a true correlation.

Interestingly, an age over 36 months was an independent risk factor for delayed discharge in the univariate analysis. This is likely because children under the age of 36 months are referred as part of our policy for investigation, regardless of the suspicion around the injuries. Children over the age of 36 months are more likely to be referred for investigation where there is a genuine suspicion of NAI.

Another independent risk factor for an extended length of stay was the time it took to complete investigations. Certain blood investigations, in particular those for rickets, reported skeletal surveys, and CT or MRI examinations may all take time to complete due to the long waiting lists and slow turnaround times within the busy government hospital.

The correlation between referral to Child Welfare and delayed discharge was perhaps the most significant of the findings. This was however not surprising, as children referred to Child Welfare were the more concerning and complicated of the cases. The longest delay to discharge was 233 days, which is around 6 months. The average delay to discharge of these cases increased from seven to 32 days once Child Welfare was involved. The concern is that after the very slow resolution time of Child Welfare, many of the cases were returned to the custody of the families. This resulted in repeated incidents in some instances, as described in the case reports below.

This delay in resolving cases once the regulatory bodies are involved in these cases may be due to several factors. The social workers themselves may be overworked and dealing with unreasonable caseloads. They also rely on the court system in many cases which may result in further delays as they have to wait for court dates. Another possible issue is the lack of suitable facilities which can be used as places of safety; thus they are using the hospital wards to house social cases while awaiting resolution. These postulated problems would need to be examined in more detail and may guide the process of trying to resolve the excessive lengths of stay for these children.

The delay in discharge of patients with suspected NAI is significant, as shown in the analysis above. A quaternary institution has an approximate cost per day of R2533 for the facility fee and the specialist care (22). This means that an estimate of the cost of the extended stay for the one patient who had 233 days delayed discharge is just under R600 000. This points to a system which does not function efficiently in managing these children.

4.4 Case discussions

This review aimed to quantify delayed discharge in patients with suspected NAI and understand the factors resulting in those delays. On examining the files of these patients, it became clear that there is not only an issue of delayed discharge and cost but also of a system which is failing to effectively identify and protect victims of child abuse. Two cases where this is very evident are presented below to highlight that the system is not only delaying these children in hospital but failing them.

Case 1

Miss LB was admitted to two weeks before her first birthday with a fracture of her left humerus and right femur. There was no clear indication of how the injuries had been sustained. She was cared for by her mother who was a 17 year old South African scholar and her father, a 27 year old foreign national. Her parents were cohabiting in a flat in Berea. On admission, her mother, father, nanny and grandfather all presented a different version of events.

Exploration of the home environment revealed that her mother had conceived the child at 15 years old. She had been a victim of sexual abuse herself. The mother blamed the father for the injury. The father and nanny accused the mother and the grandfather suspected both parents. Investigations revealed only the two identified fractures, normal eye examination and normal blood results. The social worker (SW) and TBC were concerned and referred the case to Child Welfare.

The child recovered from her injuries and was medically fit for discharge on day 14. It took a further 32 days for child welfare to complete their own assessments. The recommendation finally was that the child should be discharged into the care of her aunt. On discharge, the child left the ward with her aunt who promptly handed the child back to her parents. Ten days later we received a report that the child was deceased. Despite contact with the police and forensic pathology department, we could not get any further information regarding the case.

Case 2

Miss BK was admitted to the ward at the age of 3 years and 9 months. She and her older brother lived with her father and his girlfriend. Her mother had died shortly after her birth. The children had recently come to live with their father in Johannesburg after their oldest brother died in Zimbabwe from meningitis. They had previously resided with their grandparents in Zimbabwe. BK had been taken to the doctor several times due to scratches on her face and a rash. She had also complained of a swollen arm and persistent pain. She was brought to the hospital as the pain had not resolved. The child denied any knowledge of how she had sustained her injuries.

On examination, she had multiple lacerations of her face and above her right ear. She had necrosis of the nasal septum. The child also had an axillary abscess, wounds over her right scapula and ulcers on the palmar and dorsal aspects of her hands. Her orthopaedic injury was a partially healed fracture of the right forearm.

Her investigations revealed a normal CT brain and blood results.

The child did not require admission for any medical or orthopaedic indication, but there was an immediate concern that the injuries were the result of abuse. After two months in the ward waiting for child welfare to complete their investigations, a case

conference was called. This was attended by the hospital team, the child's father, his partner, and her older brother.

At the conference it was noted that the brother was hiding his head under the hood of his sweatshirt. On asking him to show his face it was noted that he had similar scratches and lacerations of his face and round his ears. He was immediately admitted, and he revealed that his father's partner had beat him to ensure his silence at the case conference. He also explained she used to beat his sister with a branch when she wet herself. Proper examination also revealed bruising of his thigh and perineum and old lacerations of his hands and back.

The siblings were kept in the ward for a further three weeks while child welfare concluded their investigation at which point the children were placed into a place of safety. We were contacted about three months later by another hospital looking for information about the sister as she had been admitted into their hospital with recurrence of similar injuries. On following up we learned that the father had allegedly paid a bribe, and his children were returned to him. He was still residing with the same woman who had allegedly abused the siblings.

These two cases illustrate that while everything is done within the hospital to identify and protect children with suspected NAI, the follow up and management once discharged is suboptimal and our social services are not fulfilling their mandate to protect these children. Despite allowing children to remain in our wards at a significant cost until investigations can be properly concluded, the most concerning victims are no safer after the fact.

4.5 Discharge decisions

The orthopaedic team, hospital social worker and TBC doctor jointly assess patients who are admitted for suspected NAI. The team investigates each case, and only those which remain as suspicious after the investigation process are referred to Child Welfare. Despite the referral to child welfare of 28 cases in this review, only seven (25%) were eventually deemed by Child Welfare to require protection in a place of safety for further investigation and legal processes. This low rate is in partly because the hospital ward itself is improperly used to provide the function of

temporary place of safety. Even after significant delays in the ward, the system is still failing some children as illustrated by the case reports above.

4.6 Recommendations

Based on the results of this review, the following is recommended:

- The hospital needs consider using different regulatory social workers for the investigation of NAI within our hospital. Child Welfare processes are slow and as illustrated in the reported cases they are reluctant to separate families and the placements are not proving safety for the victims. There are several non-government organisations who employ regulatory social workers who may provide a better and more efficient service for these children.
- While keeping a child safe in the ward while investigations are concluded is essential, a quaternary specialist unit with limited beds is not the appropriate facility for this function. Our unit requires a step-down ward close to the hospital with professional nurses and general care to look after these children while the regulatory processes are being concluded. A primary health facility, where our social workers and TBC can continue working with the regulatory system and the families to ensure the best outcome for these children, is needed.
- Investigating officers and members of the South African police child involved with these cases should be part of the multidisciplinary team within the hospital. By incorporating them into the team, it may motivate them and help them understand the implications of these cases more clearly.

4.7 Limitations

The design of the study was retrospective, so the data collected is limited to information that was collected at the time of admission. There was also an unintentional bias in the collection of the data. The sample only included patients who were admitted so the type of injuries was biased to those injuries, which would automatically require an admission e.g. femur fractures. This meant that for upper

limb fractures, which were more often treated on an outpatient basis, the suspicion of NAI was much higher as they were often admitted specifically for referral and investigation.

CHAPTER 5: CONCLUSION

The aim of this review was to quantify the extended length of stay of patients being investigated for NAI in a paediatric orthopaedic ward. The review has shown that of 70 records reviewed, 52 (65.8%) of the cases were discharged later than medically indicated. These delays ranged from one to 233 days with a median of 15.5 days.

When compared to the international literature, the only demographic characteristic in common with our group of patients was the predominance of children under 36 months (75.9%) of age. Our caregivers did not display any specific characteristics, which were significant in the study cohort. While being a foreign national was not a risk factor, it is notable that of the 35 foreign nationals, 32 were undocumented. This does mean that the regulatory bodies have less ability to assist these children because they are not accommodated in the social services and they are difficult to place, as they have no funding.

On analysis of the delayed discharge and the factors associated with those delays, this review identified that at an age over 36 months, together with upper limb fractures, the number of days to complete investigations and referral to child welfare were associated with the delayed discharge of patients. On the regression analyses, the univariate analysis showed there is an increase in likelihood of delayed discharge associated with an age >36 months (85.9%), each additional day to complete investigations (51.9%), and child welfare involvement (88.1%). The multivariate analysis demonstrated that Child Welfare involvement, admission diagnosis (upper limb fracture) and days to complete investigations were predictors for delayed discharge.

This review also highlights the need for efficient and effective social services to underpin the efforts made to identify, investigate, and protect children presenting with injuries suspicious of NAI.

References

1. Picini M, Gonçalves JRR, Bringhenti T, Forlin E. Evaluation of suspected physical abuse in children: a 500-case study. Rev Bras Ortop (English Ed. 2017;52(3):284–90.
2. Hosalkar HS, Wenger DR. Nonaccidental trauma in children: Editorial comment. Clin Orthop Relat Res. 2011;469(3):751–2.
3. Janssen TL, van Dijk M, Al Malki I, van As AB. Management of physical child abuse in South Africa:Literature review and children's hospital data analysis. Paediatr Int Child Health. 2013;33(4):216–27.
4. L J, W S, S M. Out of harm's way? Tracking child abuse cases through the child protection system in five selected sites in South Africa. Cape T Child Institute, Univ Cape Town ©. 2017;
5. Finkelhor D, Korbin J. Child abuse as an international issue. Child Abus Negl. 1988;12(1):3–23.
6. Pierce L, Bozalek V. Child abuse in South Africa: An examination of how child abuse and neglect are defined. Child Abus Negl. 2004;28(8):817–32.
7. Gough D. Defining the problem. Child Abus Negl. 1996;20(11):993–1002.
8. Tenenbaum S, Thein R, Herman A, Chechik O, Shazar N, Zur S, et al. Pediatric nonaccidental injury: Are orthopedic surgeons vigilant enough? J Pediatr Orthop. 2013;33(2):145–51.
9. Baldwin K, Pandya NK, Wolfgruber H, Drummond DS, Hosalkar HS. Femur fractures in the pediatric population: Abuse or accidental trauma? Clin Orthop Relat Res. 2011;469(3):798–804.
10. Leonidas JC. Skeletal trauma in the child abuse syndrome. Pediatr Ann. 1983;12(12):875–81.
11. Fong CM, Cheung HM, Lau PY. Fractures associated with non-accidental injury - An orthopaedic perspective in a local regional hospital. Hong Kong Med J. 2005;11(6):445–51.
12. Dwek JR. The radiographic approach to child abuse. Clin Orthop Relat Res.

2011;469(3):776–89.

13. Sink EL, Hyman JE, Matheny T, Georgopoulos G, Kleinman P. Child abuse. The role of the orthopaedic surgeon in nonaccidental trauma. Clin Orthop Relat Res. 2011;469(3):790–7.

14. Pandya NK, Baldwin K, Wolfgruber H, Christian CW, Drummond DS, Hosalkar HS. Child abuse and orthopaedic injury patterns: Analysis at a level I pediatric trauma center. J Pediatr Orthop. 2009;29(6):618–25.

15. Berthold O, Frericks B, John T, Clemens V, Fegert JM, Von Moers A. Misshandlung als Ursache von Frakturen im Kindesalter. Dtsch Arztebl Int. 2018;115(46):769–75.

16. Doidge JC, Higgins DJ, Delfabbro P, Segal L. Risk factors for child maltreatment in an Australian population-based birth cohort. Child Abus Negl [Internet]. 2017;64:47–60. Available from: http://dx.doi.org/10.1016/j.chiabu.2016.12.002

17. Patwardhan I, Hurley KD, Thompson RW, Mason WA, Ringle JL. Child maltreatment as a function of cumulative family risk: Findings from the intensive family preservation program. Child Abus Negl [Internet]. 2017;70(December 2016):92–9. Available from: http://dx.doi.org/10.1016/j.chiabu.2017.06.010

18. Care H, Abuse C. Committee on Hospital Care and Committee on Child Abuse and Neglect. Pediatrics. 1998;101(4):715–6.

19. Chen W, Balaban R, Rn MA, Stanger V, Msw H, Zur S. Suspected child abuse and neglect: Assessment in a hospital setting. IMAJ. 2002;4(August).

20. Foundation teddy bear. Annual report. 2019.

21. Levin A V., Luyet FM, Knox BL. Ophthalmologic Concerns in Abusive Head Trauma. J Fam Violence. 2016;31(7):797–804.

22. http://www.health.gov.za/uniform-patient-fee-schedule/. (Last accessed 20/01/2023)

23. Di Pietro MA, Brody AS, Cassady CI, Kleinman PK, Wyly JB, Applegate KE, et al. Diagnostic imaging of child abuse section on radiology. Pediatrics.

2009;123(5):1430–5.

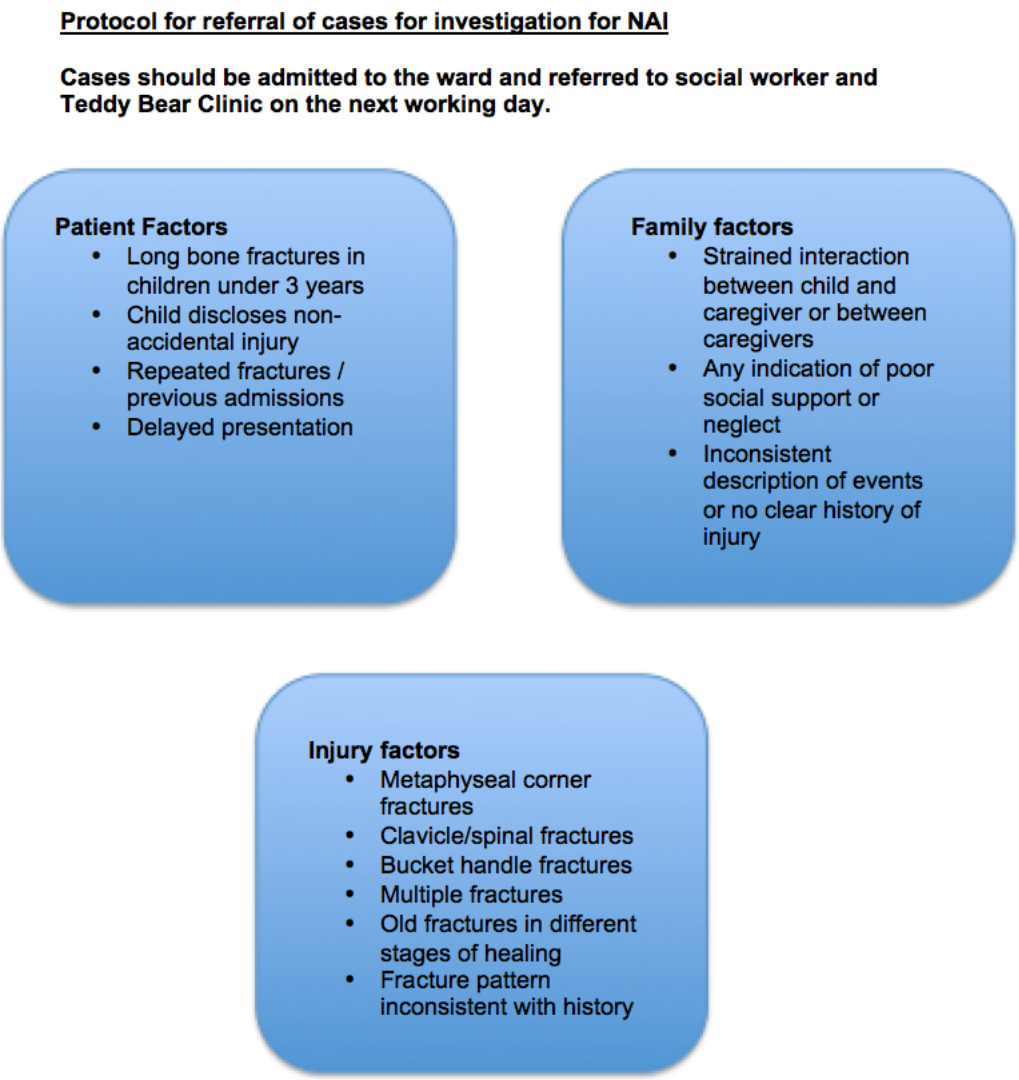
24. Cashin MS, Kelley SP, Douziech JR, Varghese RA, Hamilton QP, Mulpuri K. The levels of evidence in pediatric orthopaedic journals: Where are we now? J Pediatr Orthop. 2011;31(6):721–5.

25. Argent AC, Bass DH, Lachman PI. Child Abuse Services at a children's hospital in Cape Town, South Africa. Child Abus Negl. 1995;19(11):1313–21.

26. Lee ACW, Li CH, So KT. The impact of a management protocol on the outcomes of child abuse in hospitalized children in Hong Kong. Child Abus Negl. 2006;30(8):909–17.

Appendices

Appendix A: Protocol for referral of children for suspected NAI



Appendix B: Sample size calculation

Assumptions

- There is a paucity of data on NAI in children in South Africa. Available studies reported:
    1. Prevalence of child abuse 33% nationally and up to 56% in local studies (Mpumalanga and Western Cape Provinces). These data are not disaggregated to reflect the proportion of NAI or physical abuse.
    2. In Red Cross Hospital, physical abuse accounted for 31.8% (160/503) of all the child abuse cases managed at this facility during the study period.
- Hypothesised prevalence of NAI in children based on the above data are: National 10.5% (31.8/100 x 33) and Local 17.8% (31.8/100 x 56).
- For this study, the null hypothesis: prevalence of NAI in CMJAH is 14.2% (midpoint between hypothesised national and local prevalence). The alternate hypothesis: prevalence of NAI at CMJAH is 31.8% (the same as the Red Cross study).
- Note that all the above stated figures are estimates based on data available and may be rounded up to one decimal place.

Sample size

Using Stata 14 for sample size calculation with the following parameters:

alpha = 0.0500 (level of significance)

Power = 80%

Null hypothesis (p0) = 0.1400

Alternate hypothesis (pa) = 0.3200

Estimated sample size (N) = 36

Note that this is the minimum number of study participants required.

Appendix C: Data collection forms

Demographic data

Please complete the survey below.

Thank you!

Age in months	_____
Gender	◯ Male ◯ Female
Caregiver	◯ Parent ◯ Grandparent ◯ relative ◯ children's home ◯ Other
Other caregiver	_____
Family Support	◯ Yes ◯ No
Marital status	◯ Married ◯ single ◯ Cohabitation ◯ not applicable
age of caregiver (in years)	◯ < 20 ◯ 20-25 ◯ 25-30 ◯ 30-35 ◯ >35
Area of residence	◯ Hillbrow ◯ Inner city JHB ◯ Alex ◯ Yeoville/Berea ◯ Other
other area of residence	_____
Type of residence	◯ formal housing ◯ informal housing
Nationality	◯ south African ◯ documented foreigner ◯ undocumented foreigner
Previous history of abuse or domestic violence	◯ Yes ◯ No
details of abuse/violence	_____

Admission details

Please complete the survey below.

Thank you!

Admission counter	
Day of referral to social worker	_____
Day of referral to TBC	_____
Day of completion investigations	_____
Day medically fit for discharge	_____
Day of discharge	_____
Number of days of excess admission	_____

Medical details on admission	
Diagnosis on admission	_____
Reported mechanism of injury	◯ assault ◯ fall ◯ PVA ◯ unknown ◯ other
Other mechanism of injury	_____
Previous trauma admissions	◯ Yes ◯ No
details of injury	_____
Previous medical admissions	◯ Yes ◯ No
details of admission	_____

Reason for suspicion of NAI	◯ fracture pattern ◯ inconsistent history ◯ suspicious circumstance ◯ repeated admission ◯ family history ◯ child disclosure ◯ age of child ◯ other
Other reasons for suspicion of NAI	_____
Any other injuries or pathologies noted?	_____
Child welfare involved?	◯ Yes ◯ No

Investigations

Please complete the survey below.

Thank you!

Skeletal survey done?	◯ Yes ◯ No
Skeletal survey normal?	◯ Yes ◯ No
Abnormal findings	_____
CT Brain done?	◯ Yes ◯ No
Was CT Brain normal?	◯ Yes ◯ No
Details of CT brain	_____
Opthalmology exam done?	◯ Yes ◯ No
Ophthalmology exam normal?	◯ Yes ◯ No
Details of ophthalmology exam	_____
Blood investigations done?	◯ Yes ◯ No
Blood investigations details	☐ FBC ☐ U&E ☐ CRP ☐ LFT ☐ VIT D ☐ PTH ☐ ALP ☐ CMP ☐ ESR ☐ INR ☐ HIV ☐ STORCH ☐ HEP B
Blood investigations normal?	◯ Yes ◯ No

Details of blood investigations	_____
Discharge comment	◯ School issue to be investigated discharge to parent ◯ Carer issue to be investigated discharge to parent ◯ No issue discharge to parent ◯ Parent education discharge to parent ◯ Continued involvement of regulatory discharge to parent ◯ Continued involvement of regulatory discharge to other relative ◯ Discharge to place of safety ◯ Other

Appendix D: Ethics clearance certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R49 Dr D Simmons

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M210361

NAME: (Principal Investigator)	Dr D Simmons
DEPARTMENT:	School of Clinical Medicine Department of Orthopaedic Surgery Medical School University
PROJECT TITLE:	*The factors contributing to the delayed discharge of patients with suspected non-accidental injury in a quaternary paediatric orthopaedic ward*
DATE CONSIDERED:	2021/03/26
DECISION:	Approved unconditionally
CONDITIONS:	
NOTE:	If contact information regarding student study participants is required, please contact the Registrar's office - <Nicoleen.Potgieter@wits.ac.za>
SUPERVISOR:	Professor A Robertson and Dr N Raphaely
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	2021/10/13

This Clearance Certificate is valid for 5 years from the date of approval. An extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office secretariat on the 3rd floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to submit details to the Committee. **I agree to submit a yearly progress report**. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in March and therefore reports and re-certification will be due in the month of **March** each year. Unreported changes to the study may invalidate the clearance given by the HREC (Medical).

Signature of Principal Investigator

1/04/2021
Date