

An evaluation of the use of paediatric X-ray imaging in public health centres within Primary HealthCare in Malta

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ABSTRACT

Introduction

Despite the possible harms of ionising radiation, guidelines for the use of X-rays in children are not available locally. International guidelines are also limited.

Aim

The aim of this study was to evaluate all X-rays taken in paediatric patients in Primary HealthCare in Malta over a period of six months.

Method

A list of all X-rays taken in children aged 0-16 years during the period of July 2020 till December 2020 in all publicly funded Primary HealthCare health centres in Malta was compiled using the Radiology Information System (RIS), Picture Archiving and Communication System (PACS) and iSOFT Clinical Manager (iCM). A form was designed using Microsoft Excel® to facilitate collection of data. Patient demographics were collected, and data was evaluated for the type of X-ray ordered, reason for request and source of referral, as well as the result of the X-rays and any subsequent follow-up organised.

Results

Over the six-month period studied, 1176 children were referred for X-ray imaging with 1324 X-rays being taken. These were mostly 13-16 years of

age, with the majority being male. Most patients were referred by general practitioners working in health centres, with X-rays of the upper limb being the most ordered radiographs. The commonest reason for requesting an X-ray was a history of trauma. In total, 75.8% of X-rays ordered were reported as normal. Only 4.3% of all requests referred to existing guidelines. With reference to lower limb X-rays, Ottawa rules were referred to in 11.4% of X-ray requests, with 78.6% of these being reported as normal. Follow-up visits were planned for 34% of children referred for X-ray.

Conclusion

The results of this evaluation show that most X-rays in the paediatric population were taken in view of trauma, and approximately 75% of all X-rays taken were normal. Educating doctors about the use of judicious x-ray imaging and development of local guidelines might help to reduce unnecessary investigations.

Keywords

Paediatrics, radiography, guidelines, primary care, Malta

INTRODUCTION

Background

When it comes to referring a child with a physical injury for an X-ray, there can be no one-size-fits-

all answer. Children are different and should not be considered as just small adults (The Royal College of Radiologists, 2014).

Unfortunately, there are no readily available local guidelines for imaging in children which can be used in primary care. Guidelines and criteria would help in the recognition of the different physiological and anatomical considerations of the growing child and to highlight the different approaches needed for imaging (The Royal College of Radiologists, 2014).

Frush (2012) has highlighted the fact that there is no safe lower level of radiation exposure. A number of factors contribute to the increased risk from ionising radiation in children. Developing and maturing tissues in the growing child are more radiosensitive, there is a cumulative radiation risk over a lifetime, and children have a longer lifetime in which to express the increased relative risk. These factors emphasise the need to adhere to the “as low as reasonably achievable” (ALARA) principle (The Royal College of Radiologists, 2014; Centre for Disease Control and Prevention, 2015; European Society of Radiology, 2019).

The European Society of Radiology (ESR) has adapted the criteria from the American College of Radiology (ACR) for use in the European Clinical Decision Support (CDS) platform ESR iGuide (European Society of Radiology, 2019). Such guidelines and criteria have been set up to ensure appropriate utilisation of medical imaging for patients and justification of radiological procedures (Graham and Yox, 2018; American College of Radiology, 2021).

Aim

The aim of this study was to evaluate all X-rays taken in paediatric patients in primary care in Malta over a period of six months.

Objectives

The objectives of this study were to evaluate the use of X-ray imaging in the paediatric population in primary care in Malta by:

- Quantifying the number of X-rays taken in paediatric patients between July and December 2020 in all Primary HealthCare centres in Malta.

- Describing the patients’ demographics, type of X-ray, reason for X-ray request and source of referral.
- Analyzing the results of the X-rays performed in primary care (normal/abnormal) and any subsequent follow-up organized.

The results will then be used to suggest possible improvements that can be implemented in practice when it comes to the use of x-rays in the paediatric population.

METHOD

Data collection

This was a retrospective cross-sectional observational study. A list was compiled of all X-rays taken at Mosta, Qormi, Floriana and Paola Health Centres in children aged 0-16 years during the period of 1st July 2020 till 31st December 2020. This data covered all X-rays taken in the primary care setting within the public health sector in Malta (that is in all public-funded health centres). The list was compiled using the Radiology Information System (RIS) and Picture Archiving and Communication System (PACS). Furthermore, follow-up appointments were collected and analysed using the iSOFT Clinical Manager (iCM).

Subsequently, a form was designed using Microsoft Excel® to facilitate collection of data. Data collected from systems mentioned above included the following:

- The day (weekday/weekend) and month when imaging was performed.
- The age and gender of the patient.
- The source of referral for the X-ray.
- The type of X-ray.
- The reason for the X-ray request, and whether specific guidelines were followed when requesting the X-ray.
- Whether the X-ray result was normal or abnormal.
- Whether there was any registered follow-up, and if yes, the type of follow-up.

Data analysis

Data input and analysis was carried out using Microsoft Excel®2016.

Study approval

Approval was obtained from the Department of Primary HealthCare and the Data Protection Officer of the same department prior to the commencement of the study. Ethical clearance was also obtained from the Faculty Research Ethics Committee (FREC) of the Faculty of Medicine and Surgery. Data was accessed by all listed authors. Parent/patient permission was not deemed necessary since data was anonymised for use in this research.

RESULTS

Total number of children referred for imaging and x-rays taken

Over the 6-month period studied in this evaluation (July to December 2020), a total of

1176 children were referred for X-ray imaging, and the total number of X-rays taken was 1324. This discrepancy is explained by the fact that some children were referred for more than one X-ray during a single visit.

Demographic details

The majority of children referred for imaging during the 6-month study period were males (72.4%), and 27.6% were females. The most frequent age group was 13-16 years. The age/gender distribution of these patients is reproduced in Figure 1.

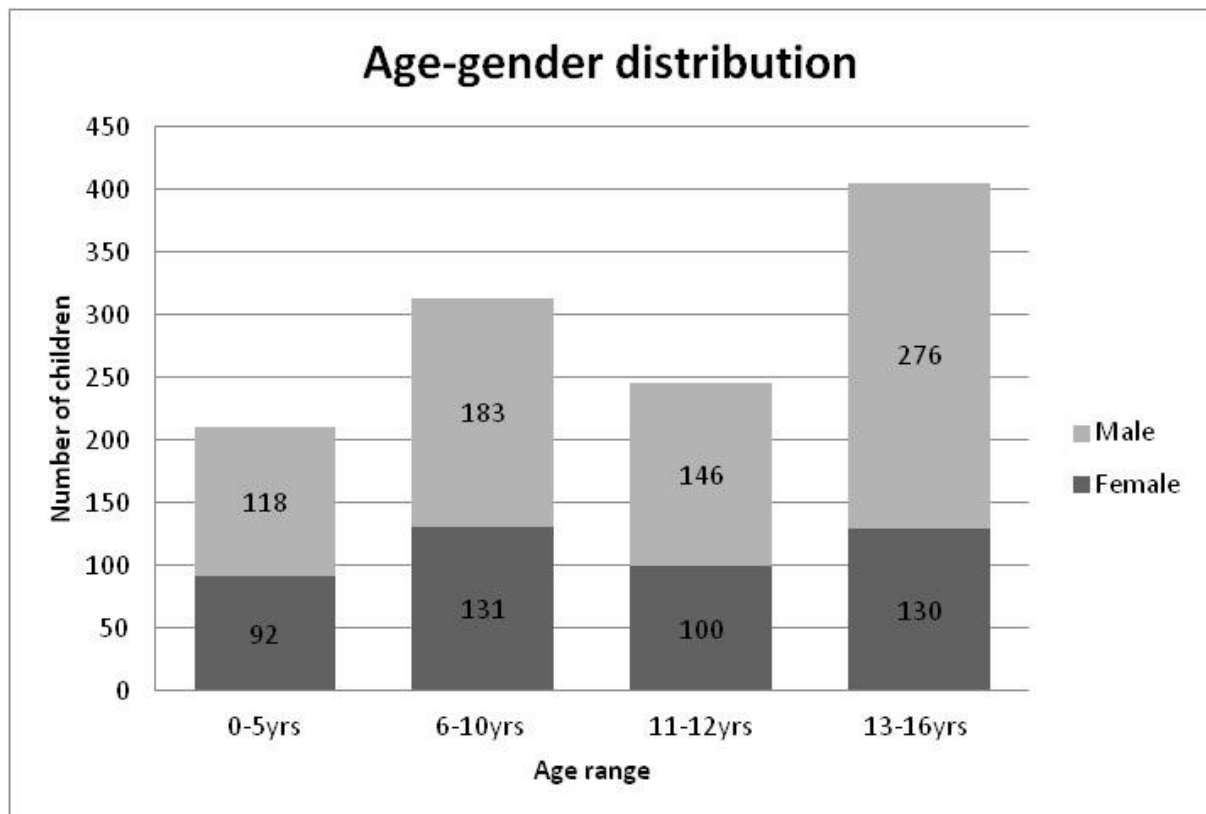


Figure 1: Age-gender distribution of children referred for X-rays

Day and month

Most of the X-rays were performed during weekdays (73%), with the rest being taken on Saturday (16%) and Sunday (11%). The highest number of X-rays were found to be taken during the months of November (20.5%) and December (18.7%). This was followed closely by July (17.6%). Figure 2 gives a detailed representation of these findings.

Source of referral

The majority of X-rays were ordered by general practitioners (GPs) working in the health centres (40%), followed by general practitioner trainees (29%) and foundation doctors (19%). Foundation doctors are doctors who are in their first two years of non-specialised training. Only 7% of X-rays were ordered by GPs working in the private sector and 5% by consultants.

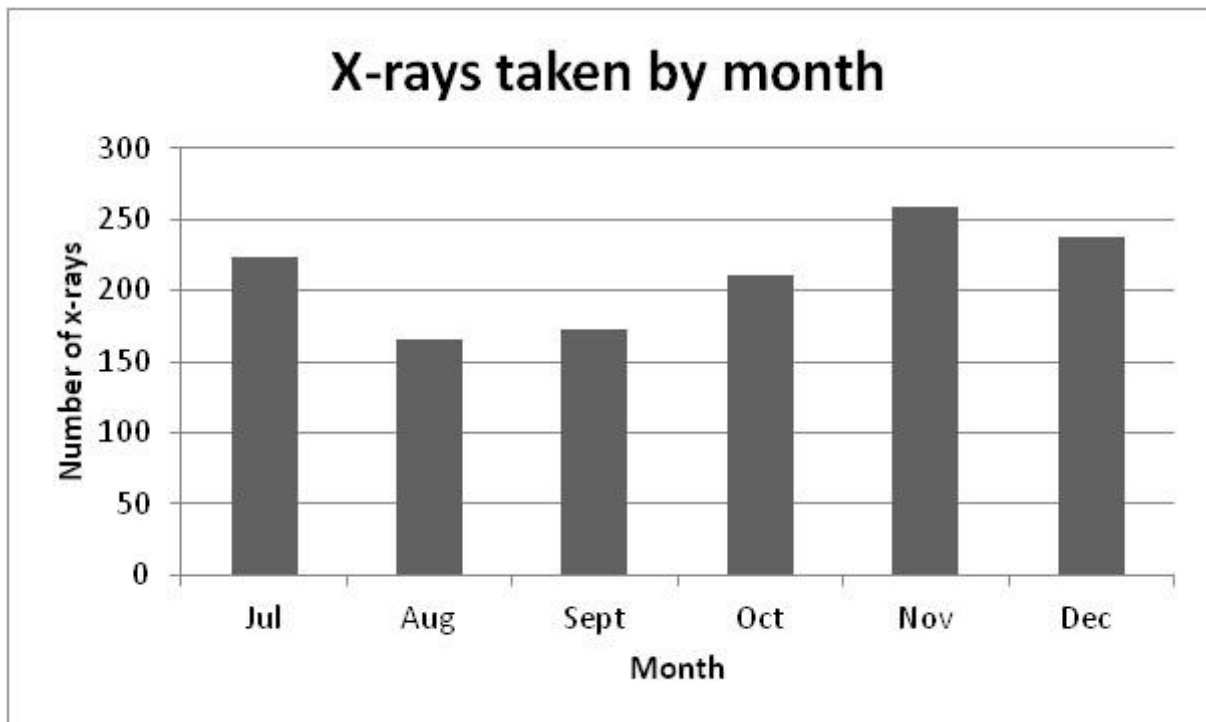


Figure 2: Number of x-rays taken by month of the year

Imaging procedures performed

Most imaging investigations were taken to examine the upper limb (53.1%) and lower limb (37.1%), followed by chest X-rays (5.8%). Figure 3 summarizes these findings.

Reason for X-ray request

The highest number of X-rays (36.3%) were requested for trauma, the type of which was not specified by the doctor on the electronic request. This was followed by trauma secondary to a fall (32%), trauma secondary to sports injury (12.2%) and pain or tenderness (5.2%). Trauma was therefore the indication for the majority of imaging performed. Chest clinic requests for chest X-rays for tuberculosis (TB) screening made up 4% of referrals. Other reasons for referral included, amongst others, 'investigations for cardiomegaly', 'assessment of response to treatment', 'broken plaster' and follow-ups of fractures (3.6%). No clinical details were provided in 2.6% of cases. A graphic representation of these results can be seen in Figure 4.

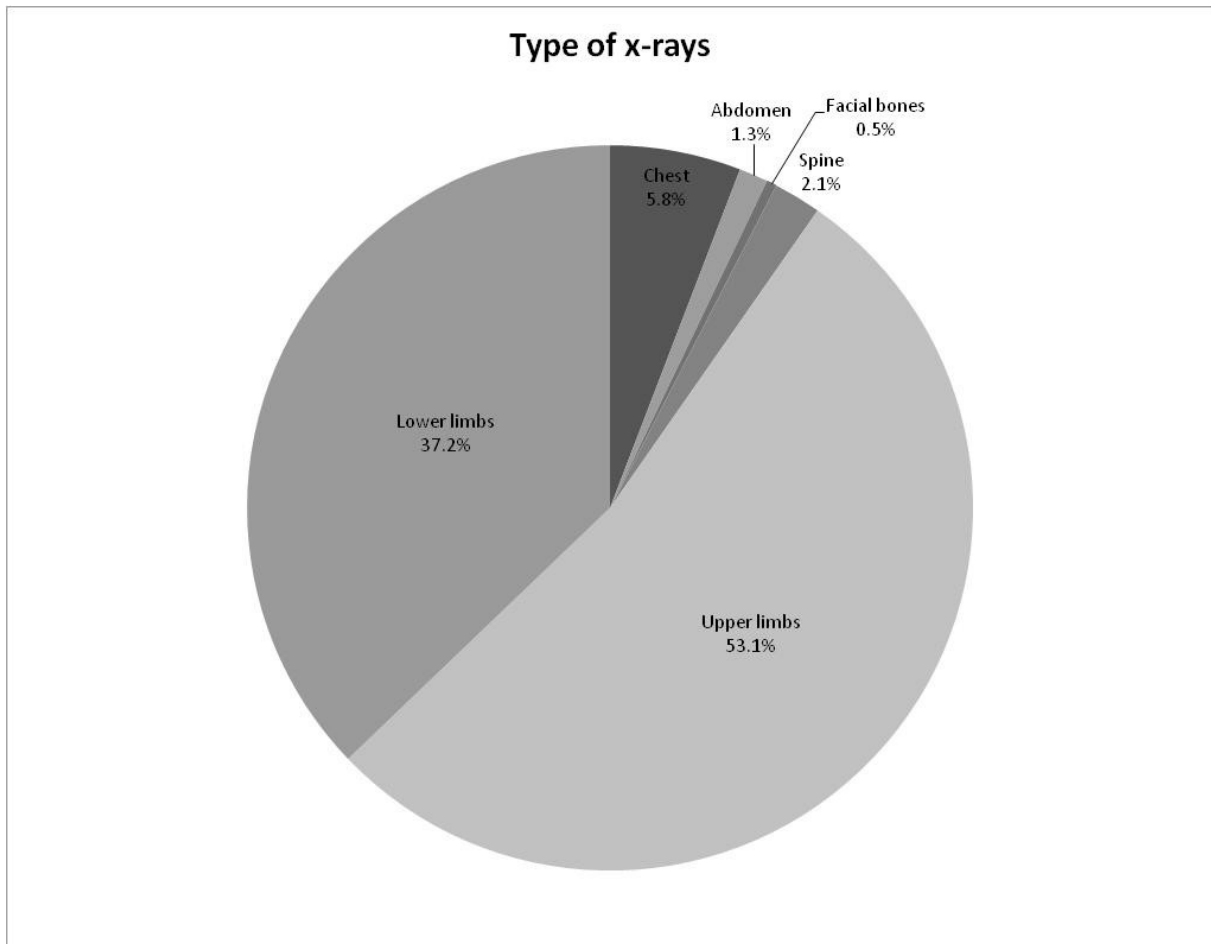


Figure 3: Type of X-rays ordered

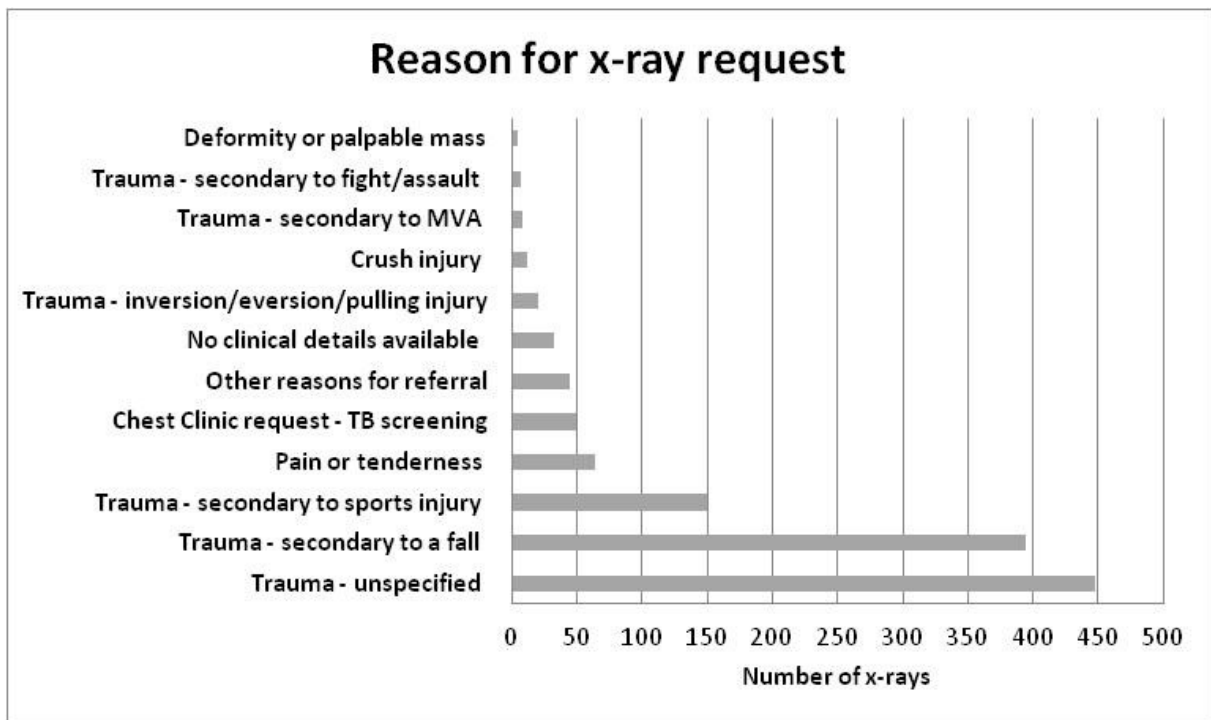


Figure 4: Reason for X-ray request

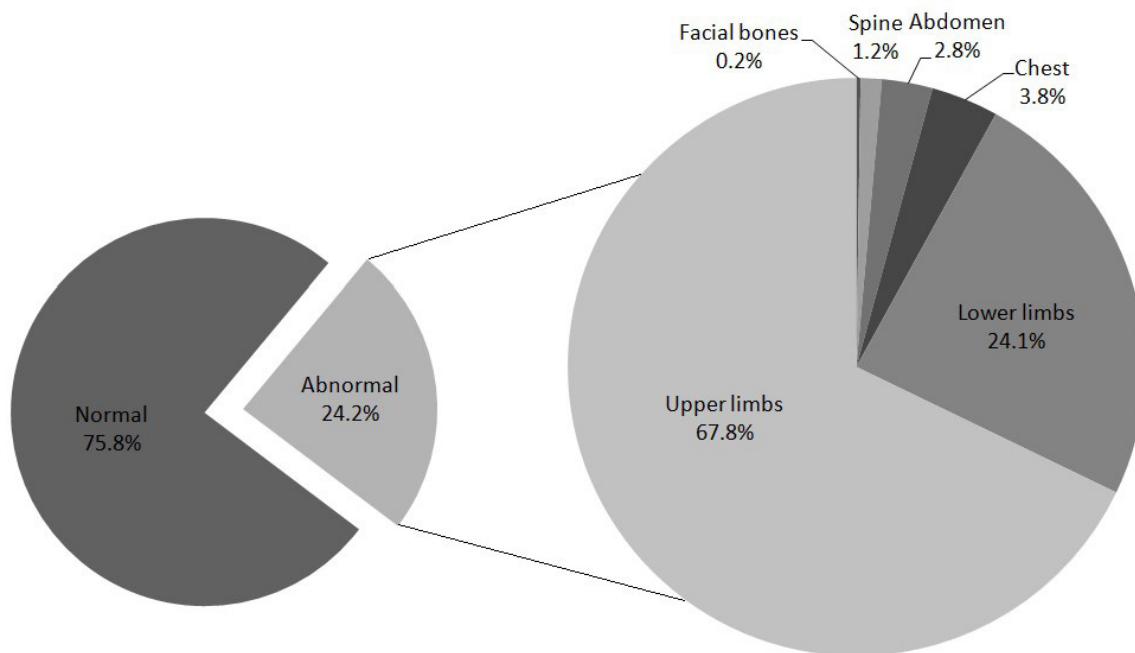


Figure 5: Types of X-rays with an abnormal result

Guidelines

From the details provided by the referring doctors on the request form, 4.3% of requests were seen to follow specific guidelines. These were namely the Ottawa rules of the ankle (45.6%), foot (38.6%) and knee (15.8%).

X-ray findings

The majority (75.8%) of X-rays taken were reported as normal, with the remaining 24.2% reporting a fracture or abnormality. Figures 5 and 6 provide more detail about those X-rays which were reported as abnormal, namely the type of X-rays and the reason for referral for X-ray.

From all the trauma X-rays, 66% were reported as normal, and 34% were abnormal.

Lower limb x-ray requests and Ottawa rules

A total of 490 lower limb x-rays were taken, with 20.8% of these being reported as abnormal, and 79.2% reported as normal. From the total number of lower limb x-rays taken, 369 (75%) were requested in view of trauma. Of these, 20% were reported as abnormal. Figure 7 summarizes the result of all lower limb X-rays taken in relation to whether any specific guidelines were used to guide the request of the X-ray.

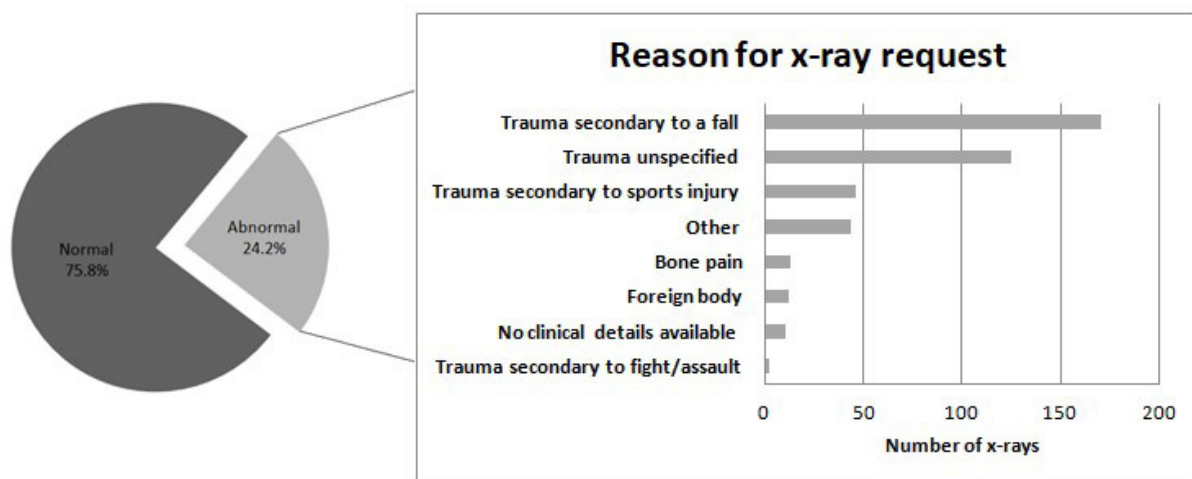


Figure 6: Reason for request in X-rays with an abnormal result

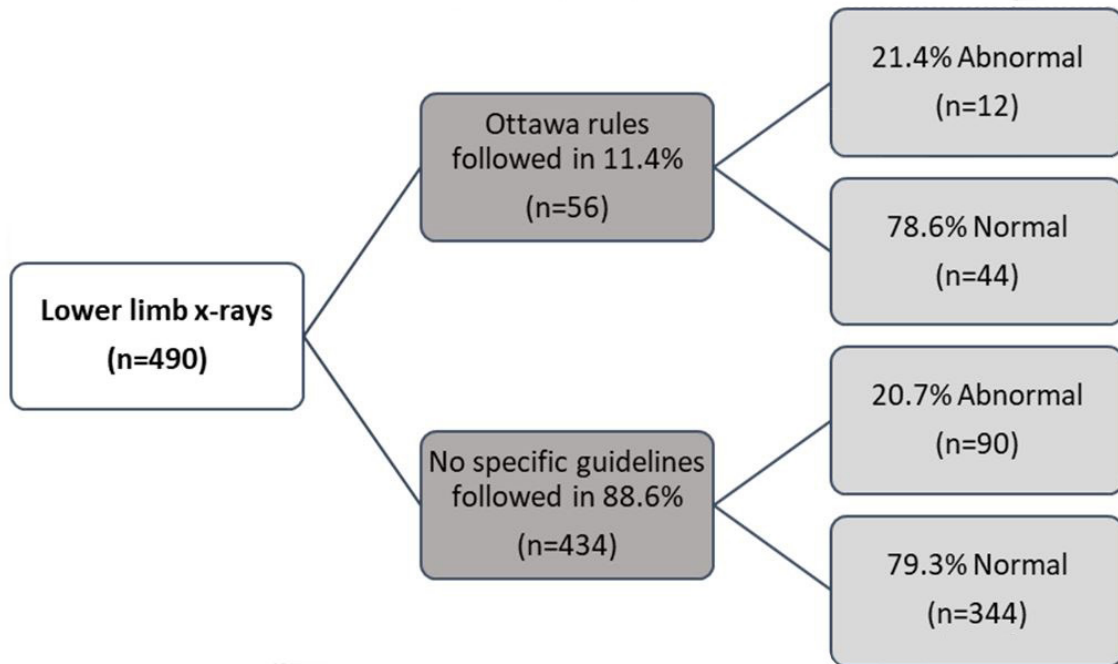


Figure 7: Lower limb x-ray requests

Patient follow-up

From the children referred for x-ray, 34% had a registered follow-up in the days or weeks after the imaging was done. The majority of children had a Fresh Trauma Clinic appointment (49.8%), and 33.9% had a registered visit at the Accident and Emergency (A&E) department. Other types of follow-up amounted to 16.3%, and these included appointments for further imaging, such as Magnetic Resonance Imaging (MRI),

physiotherapy appointments and admission to hospital for surgery. Figure 8 summarizes these findings.

The majority (86%) of children who had a registered follow-up had an abnormal x-ray result. The other 14% who were referred had a normal X-ray result. The reasons why this subset of patients was referred were not identified in this study. The most common follow-ups were A&E visits and outpatient appointments.

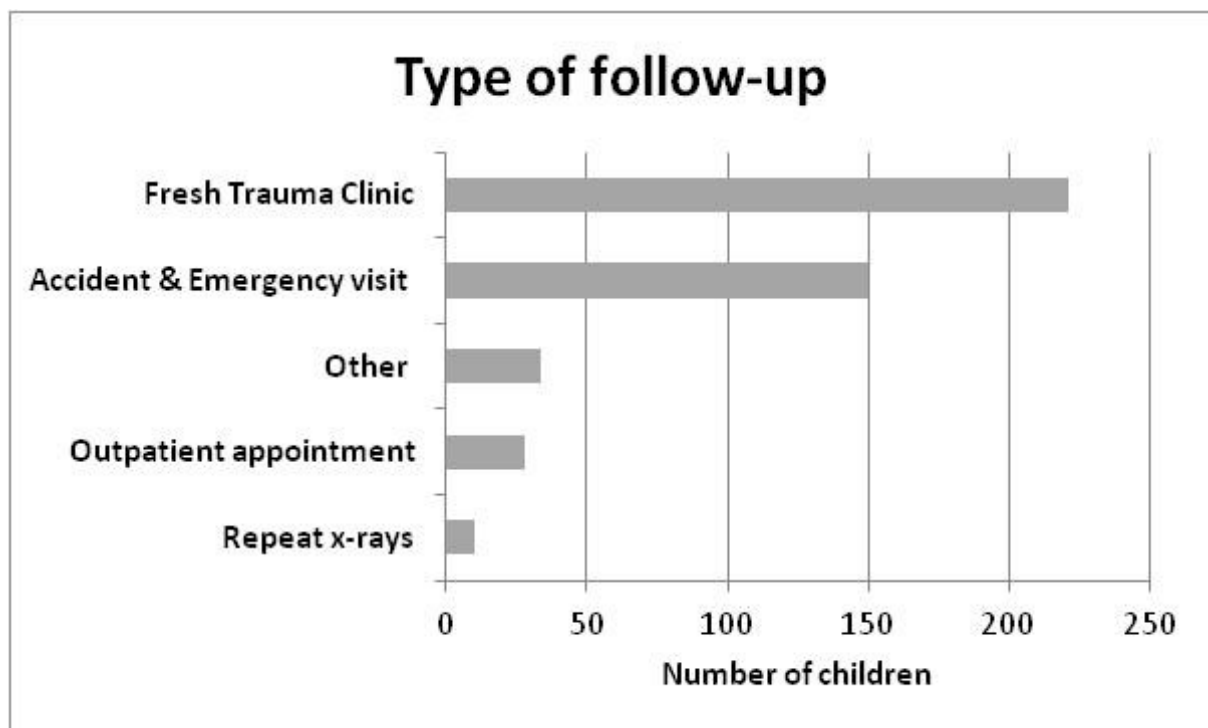


Figure 8: Type of follow-up

DISCUSSION

Children may be at a higher risk of sustaining trauma in view of their more active lifestyles. Injuries are one of the most common complaints for the paediatric population to present at a primary care level or emergency department (Larsen et al., 2020). Consequently, post-traumatic imaging will be performed to confirm or exclude a fracture. This evaluation confirms that the majority of imaging performed in children in the primary care setting is secondary to some form of trauma, with a predominance of male children. The main issue lies in the clinical decision regarding whether imaging is warranted or not, depending on the specific case.

Considering that X-rays form part of the electromagnetic spectrum, concern about their use is warranted, even though they are not at any extreme end. In low doses, such as in diagnostic X-rays, it is considered safe across all ages (Oakley and Harrison, 2020). Oakley and Harrison (2020) point out evidence that shows that low dose X-rays, when separated by at least 24 hours, do not lead to an accumulation of radiation in the body. The lag period of 24 hours or more allows the body to heal itself and remove any radiation-induced DNA damage. This also applies to children and adolescents, where Tubiana, et al. (2011) determined that children who were exposed to low dose radiation had no excess cancers detected in those parts of the body which were imaged.

In total, 75.8% of images reviewed in this study resulted as normal, and 66% of all trauma X-rays were normal. This might suggest that most of the images ordered at primary care level could have been avoided; however one must take into consideration the difficulty in obtaining a history from a child and significant signs that might not be present upon presentation.

Guidelines may be useful in reducing the number of unnecessary imaging procedures. The Ottawa rules of the knee, ankle and foot are possibly the guidelines that are referred to most commonly in cases of trauma. Interestingly, the results in the evaluation showed very similar numbers between those lower limb x-rays which used and did not use any of the Ottawa

rules. Plint, et al. (1999) and Empananza & Aginaga (2001) comment that the Ottawa rules of the knee and ankle are 100% sensitive, even in children. Bachmann, et al. (2003) comment that the Ottawa ankle rules have almost 100% sensitivity with a modest specificity. The similarity in numbers seen in Figure 7, where the numbers of abnormal x-rays identified were similar between using Ottawa rules or not, could be related to a lack of clinical details provided in some electronic requests. In this scenario, it was assumed that the rules were not used, even though they might have been used to guide the clinician's decision about requesting the X-ray.

Although trauma guidelines could assist the clinician in further reducing the number of unnecessary imaging using evidence-based decision making, the final decision is always based on the doctor's clinical judgement. Guidelines cannot be tailored to all specific situations. The ESR iGuide tries to help in this area, where it provides several possible scenarios to meet the requirements of the patients who present for a consultation with a possibility of requiring an X-ray.

The other reasons enlisted which required imaging were considerably less common than trauma. Ingestion of foreign bodies is a relatively common scenario in children, and therefore the Royal Children's Hospital, Melbourne provides a structured and detailed guideline on which scenarios merit imaging, and those which require further management with regards to such cases (The Royal Children's Hospital Melbourne, 2020).

Adapting international guidelines to local requirements, both at primary and secondary levels of care could benefit patients and clinical staff alike, providing a structured care pathway and avoiding unnecessary radiation where possible.

Study strengths

This study has covered the whole paediatric population who required X-rays at a primary care level in the public sector, over a 6-month period. Thus, the data collected is extensive, providing a clear scenario of the incidence of X-rays requested within this setting. Several

factors were identified in order to evaluate the reasons for X-ray referral and the outcome of the radiological interventions performed.

Study limitations

The above data was collected during the first wave of the COVID-19 pandemic where restrictions to social gatherings may have contributed to decreased cases of trauma. Only X-rays taken at health centres were included in this study, therefore excluding patients presenting to the Emergency Department or in the private sector. Clinical details upon requesting the X-rays were sometimes limited or unable to be accessed as in the case of X-rays referred from the private sector.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The objectives of this evaluation were reached. The results show that the majority of X-rays taken during this study in the paediatric population were referred following trauma. Approximately 75% of all X-rays taken were normal.

Recommendations

Educating doctors about the use of judicial x-ray imaging and development of local guidelines might help to reduce unnecessary investigations. The available international guidelines might be used to guide development of local guidelines. Scoring systems associated with such guidance might also be included in X-ray requests where it would serve as a reminder for the requesting clinician. It is planned to repeat this evaluation after implementing the recommendations, to assess for any significant change in the outcome of the study.

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