The accuracy of limb x-ray interpretation by Emergency Nurse Practitioners in Melbourne, Australia

Geraldine Lee, Lecturer, KCL
(Previously at Alfred Health, Melbourne)

N. Jennings, K. Chou, E. McKeown: Nurse Practitioners
G. O’Reilly, A. Bystrzcki: ED Consultants
D. Varma, Consultant Radiologist
The Alfred Emergency & Trauma Centre
Nurse Practitioners in Australia

- Introduced to Victoria in 2005
- NP is a protected title

5 main extensions to practice:
- Initiating diagnostic imaging & laboratory tests
- Prescribing medications
- Referral to specialists
- Admitting & discharge rights
- Approving absence from work certificates
The Alfred Hospital

Victorian stats:
- Population of ~4 million
- Large disparities in access to health services between metro & rural areas
- Large migrant population

<table>
<thead>
<tr>
<th>New settler arrivals per 100,000 population</th>
<th>148.1 metro</th>
<th>696.1 rural</th>
</tr>
</thead>
</table>

[Map of Victoria highlighting different regions]
Emergency & Trauma Centre (E&TC)

- 8 Resuscitation & Trauma Bays
- 19 fully monitored general cubicles (including 6 rapid assessment cubicles)
- 6 Fast Track cubicles
- 18 bed Short Stay Unit
- A dedicated CT and MRI scanner
- 57,000 emergency patients attend annually-majority high acuity
- 50% of patients presenting require admission
Evidencing the Emergency NP role

• Evaluating outcomes of the Emergency Nurse Practitioner Role in a major urban Emergency Department, Melbourne, Australia. J Clin Nurs, 2008; 17 (8):1044-50


Aims of the study

Based on lit review of studies on the effectiveness of Nurse Practitioners ability to order and interpret X-rays, we decided to compare NPs and consultants

Aim was to examine the level of agreement and sensitivity and specificity between emergency NPs (ENPs), emergency physicians (EPs) & the gold standard radiologist in x-ray interpretation of isolated limb injuries.
Sensitivity and specificity

• Sensitivity = number of patients correctly diagnosed as having a fracture, that is true positives

• Specificity = number of patients correctly identified as having negative x-ray (no fracture), that is true negatives
Previous research

- Critical of benchmarking emergency nurses interpretation of x-rays & ask were junior doctors suitable comparator (Hardy and Barrett, 2004; Hardy and Barrett, 2003).

- Levels of sensitivity vary from 93% to 96% (Mayhue et al., 1989; Freij et al., 1996; Benger 2002) & specificity of 98.8% compared to consultant radiographer (Tachakra et al., 2002).

- Overall favourable result with similarities reported between ED doctors & ED nurses (Sakr et al., 1999; Derksen et al., 2006; Hardy and Barrett 2003; Freij et al. 1996; Benger et al., 2002)

- Appropriately trained NPs perform at least as well as medical staff in not only recognising the need for an X-ray, but as competent in their interpretation.
Methodology

• Prospective blinded comparative design
• Enrolment and consent obtained by ENP
• 2 clinician groups in study (1. ENPs and 2. EP)
  – Each clinician group examined the patient independently and blinded to the other clinician’s examination findings, decision to X-ray the limb, anatomical region to be X-rayed and X-ray interpretation
• Data analysis – clinician groups compared against consultant radiologist and each other
• Consultant Radiologist conducted final interpretation of X-ray (gold standard)
• Study Population 200
• Ethics approval granted
Inclusion Criteria

• Age >18 years
• Patients must give informed, written consent
• Isolated Injury to a limb (head of the humerus to the fingertips / femoral head to the tips of the toes)
• An ENP is on duty
Exclusion Criteria

- Multiple injuries
- Patient under the influence of drugs or alcohol
- Pregnant
- Patient assessed as unwilling or unable to comply
- Required immediate resuscitation
- Required immediate procedure (e.g., Reduction of a fracture/dislocation)
- Patient unable to consent
- Results of X-ray known to the clinician prior to their independent X-ray interpretation
- Clinician is privy to X-ray ordered by another clinician prior to their independent assessment of the patient
Data tool: Completed by Clinician

1. Patient UR (only identifying feature in order to track X-ray report)
2. Date of examination
3. Clinician – NP / Emergency Physician (grouped to ensure anonymity between individual practitioners)
4. Mechanism of injury
5. Clinical examination findings
6. Limb x-ray required **YES/ NO** & anatomical region for X-ray as per standard protocols
7. Interpretation of limb x-ray (No fracture, possible fracture, definite fracture and comments)
Clinician Participants

• 6 Emergency NPs
• 10 Emergency Physicians

• Project ran for 7 months from November 2011 to June 2012.
Interpretation of limb x-ray

- Definite fracture
- Possible fracture*
- No fracture

*Possible fractures analysed as definite rather than negative fractures
Independent researcher (GL)

- Responsible for
  - Collecting and storing the completed data forms
  - Data entry & analysis
  - Coding data to de-identify it to ensure the consultant Radiologist is blinded to the clinician group & interpretation
  - Did not access the radiographs
Measuring agreement

• Level of agreement between clinician groups we have used kappa inter-rater reliability
  – (above 0.7 is excellent & below 0.3 is poor)

• Sensitivity and specificity
• Sensitivity - have a fracture (true positives)
• Specificity - no fracture (true negatives)
## Demographic data

<table>
<thead>
<tr>
<th>Gender</th>
<th>Males = 125</th>
<th>Females = 75</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean Age (Yrs)</strong></td>
<td>41</td>
<td></td>
</tr>
<tr>
<td><strong>Mechanism of Injury</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical Fall</td>
<td>100 (50%)</td>
<td></td>
</tr>
<tr>
<td>Blunt trauma</td>
<td>57 (25%)</td>
<td></td>
</tr>
<tr>
<td>Other mechanism/unknown</td>
<td>26 (13%)</td>
<td></td>
</tr>
<tr>
<td>Cyclist</td>
<td>10 (5%)</td>
<td></td>
</tr>
<tr>
<td>Pedestrian</td>
<td>4 (2%)</td>
<td></td>
</tr>
<tr>
<td>Motor vehicle accident</td>
<td>3 (1.5%)</td>
<td></td>
</tr>
<tr>
<td><strong>Limb Injury</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper limb</td>
<td>101 (50.5%)</td>
<td></td>
</tr>
<tr>
<td>Lower limb</td>
<td>99 (49.5%)</td>
<td></td>
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</tbody>
</table>
Results

• Overall 203 patients enrolled
• 3 excluded due to EP time constraints
## Results - Fracture identification

<table>
<thead>
<tr>
<th>Clinician Group</th>
<th>Emergency Nurse Practitioner</th>
<th>Emergency Physician</th>
<th>Consultant Radiologist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definite Fracture</td>
<td>68</td>
<td>68</td>
<td>73</td>
</tr>
<tr>
<td>No Fracture</td>
<td>111</td>
<td>121</td>
<td>122</td>
</tr>
<tr>
<td>Possible Fracture</td>
<td>21</td>
<td>11</td>
<td>5</td>
</tr>
</tbody>
</table>
## Results - Level of agreement

<table>
<thead>
<tr>
<th>Fracture identified and clinician</th>
<th>kappa</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP and EP</td>
<td>0.84 (weighted)</td>
<td>92.5</td>
</tr>
<tr>
<td>NP and EP (possible # counted as a fracture)</td>
<td>0.80</td>
<td>90.5</td>
</tr>
<tr>
<td>NP and EP (possible # counted as no fracture)</td>
<td>0.87</td>
<td>94.5</td>
</tr>
</tbody>
</table>
Possible fractures outcomes

16 of the 21 NP “possible” fractures had definite fractures

Compared to 5 of the 11 from the ED physicians

4 of the 5 from the consultant radiologist
### Results - sensitivity and specificity

<table>
<thead>
<tr>
<th>Comparators</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurse Practitioners &amp; Consultant radiologist</td>
<td>91%</td>
<td>85%</td>
</tr>
<tr>
<td>Emergency Physicians &amp; Consultant radiologist</td>
<td>88%</td>
<td>91%</td>
</tr>
</tbody>
</table>
Limitations

- Patients require clinical examination by 2 clinicians
- Time constraints – Busy E & TC
- Potential for bias
  - Being privy to another clinicians decision to X-ray and region
  - Viewing of X-ray report prior to independent interpretation
  - NP more conservative (possible # diagnoses)
  - What role does clinical exam play in X-ray interpretation?
Conclusion

• This study validates the clinical & diagnostic skills of NPs in the interpretation of isolated limb injury x-rays

• Demonstrated a high level of agreement between the Nurse Practitioners & Emergency Physicians against the gold standard, the Consultant radiologist.

• With appropriate training and education, NPs are just as competent as their senior medical colleagues in ordering & interpreting x-rays.
Thank you

Email: gerry.lee@kcl.ac.uk