Improving nurse initiated X-ray practice through action research

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Abstract

Introduction: Due to increasing demands on hospital Emergency Departments (EDs), the role of registered nurses, with additional training, has been extended to include requesting X-ray examinations. The aim of this study was to evaluate nurse practice guidelines for requesting X-rays in the ED setting and to utilise inter-professional learning and change management theory to promote practice improvements. Methods: Three hundred and one nurse initiated X-ray (NIX) requests were randomly selected between January and March 2012, and reviewed for observance of local department guidelines and quality of clinical history. The results of this preliminary review were used to inform the investigating team in order to improve and support practice. A collaborative educational intervention utilising inter-professional learning and change management theory was implemented with an aim of improving the clinical history provided in NIX requests and development of a new policy to support clinical practice. A second review was repeated from February to April 2014 to evaluate the success of the educational intervention. Results: Observance of NIX guidelines improved from pre-intervention to post-intervention (48% vs. 90%, P > 0.001). Quality of clinical history also significantly improved in all four essential variable criteria: (1) mechanism of injury; (2) injury location; (3) side of injury; and (4) clinical question. Conclusion: This study demonstrates that utilising inter-professional learning and change management theory can contribute to significant improvements in and support clinical practice of NIX in the emergency setting.

Introduction

Nursing practice background

Due to increasing demands on hospital emergency departments (EDs), the role of registered nurses, with additional training, has extended to include requesting X-ray examinations. Patients assigned to triage category 4 and 5, in the ED, often wait long periods of time to see a medical officer and enabling X-ray examinations to be requested by an appropriately trained nurse and completed prior to medical officer review has been an effective way of reducing patient waiting times. The Clinical Initiative Nurse (CIN) role has been used by New South Wales (NSW) Health since 2009, to initiate diagnostics, such as nurse initiated X-ray (NIX) requests, and treatment for patients in the waiting room.

Radiation exposure justification

The largest dose of ionising radiation that any Australian is likely to receive will arise from medical procedures, and therefore, these exposures should be limited to those deemed absolutely medically necessary. Each X-ray examination is required to be justified by appropriate clinical history. Medical radiation exposures should...
Unification of nursing and X-ray practice

There are government recommendations for all NSW EDs to collaborate with Radiology Departments to publish a protocol and provide adequate education to ensure best practice for all nurse initiated radiology requests. Several studies have recommended that clear guidelines are required to provide a model and standard of practice for NIX requests. It is these guidelines in each ED that facilitate appropriately trained nursing staff requesting X-ray examinations.

IPL and change management theory

Inter-professional learning (IPL) activities have been successfully used to improve inter-professional relationships. Transformative learning is the aim of many IPL activities, where the goal is for participants to realise how their previous assumptions, beliefs, and perspectives can be reshaped to change the way they practice. Prior to attempting to implement any major change, it is critical that there is a clear and common understanding and definition of the change, its constraints and parameters and the desired outcomes. It is important that all members of the multidisciplinary team have the same perception of the outcomes to be produced. Effective implementation of change is characterised by a shared purpose, goal and process. Using structured change management approaches allow staff to understand which external elements impact their daily work routines and to work together to identify opportunities for improvement. Staff involvement, engagement, collaboration between multiprofessional stakeholders and appropriate leaders are pivotal to the success of any change management project.

Current study

This study was designed to evaluate the quality of NIX requests at a level 6 ED using action research design. Part of the local CIN education programme educates registered nurses to clinically assess patients and then request X-ray examinations if clinically indicated, with requesting authority being provided by the ED Director as part of the local practice guidelines. The primary aims were to evaluate the appropriateness of the then current practice guidelines and to review the quality of clinical history provided in NIX requests to establish a baseline for practice improvement. Ethics approval for this study was obtained from Western Sydney Local Health District Human Research and Ethics Committee. All data was de-identified and no patients participated in this study, therefore patient consent was not required.

Methodology

This study utilised an action research approach to quality improvement. Action research is characterised by a collaborative approach, with emphasis on practical issues, focusing on professional development and incorporating a cycle of plan, action, reflect and review. The plan included evaluating the practice requirements for NIX requests first by reviewing the current practice behaviours, sharing experiences and collaborating to understand experiences, reflecting on how practice requirements must be incorporated into a new policy and reviewing the practice to ensure the new policy supported the practice.

Emergency departments must have locally endorsed guidelines documented for NIX; each ED can have different inclusion and exclusion criteria. The local NIX guidelines in 2012 included upper and lower limb X-ray examinations only and excluded patients under 16 years of age and those who were cognitively impaired or intoxicated.

First review

The first review took place between January and March 2012. A power analysis was performed and 301 requests were randomly selected from a total of 1043 NIX requests; this was a sufficient number of requests in order to maximize (>0.995) the power of the analysis. The requests were then evaluated by a clinical nurse consultant and a clinical specialist radiographer. The NIX requests were assessed by evaluating their adherence with the then local practice guidelines, including: (1) requesting person being a CIN trained nurse; (2) approved anatomical region requested; and (3) appropriateness of the anatomical region requested as determined by the clinical history provided.

To qualify the quality of the clinical history provided by the nurses in the upper and lower limb NIX requests,
Table 1. Variables to assess quality of the clinical history in upper and lower limb X-ray requests, assessment criteria and clinical history example.

| Variable | Assessment criteria | Clinical history example |
|----------|---------------------|--------------------------|
| Mechanism of injury | 1 Not stated | 1 ‘Painful wrist’ |
| | 2 Stated or ruled out | 2 ‘Painful wrist post fall’ (stated) |
| | 3 Stated and described | ‘Post back-slab application’ (ruled out) |
| Injury location | 1 Not stated | 1 ‘Pain post fall’ |
| | 2 Injury ruled out | 2 ‘Painful wrist, nil trauma’ |
| | 3 Generalised injury site mentioned | 3 ‘Painful wrist’ |
| | 4 Specific injury site mentioned | 4 ‘Painful distal radius’ |
| | | 5 ‘Painful wrist, 1 Scaphoid fracture’ |
| Side of injury | 1 Stated | 1 ‘Painful right wrist’ |
| | 2 Not Stated | 2 ‘Painful wrist’ |
| Clinical question | 1 Stated | 1 ‘Painful wrist post fall: fracture’ |
| | 2 Not Stated | 2 ‘Painful wrist post fall’ |

Second review

The second review took place between February and April 2014, 207 nurse initiated requests were made in this period, and therefore, all NIX requests from this period were included in this review. The second review was conducted utilising the same assessors and assessment tools as in the first pre-intervention review.

The second review utilised the updated NIX policy. The new policy in 2014 included provisions for chest X-rays for patients on the chest pain pathway and OPGs at the request of the after-hours dentist with exclusion criteria remaining the same.

Data collection and analysis

Information from electronic X-ray examinations requested by nursing staff within the ED was captured from both the Emergency Department Information and from the Radiology Information System. Comparison of data from the first to second review was performed using chi-square ($\chi^2$ test). The test for significance level ($\alpha$) was set at $\leq 0.05$. The data was imported and analysed using SPSS 22 for Windows (IBM, Chicago, IL, USA).

Intervention

The descriptive findings from the first review were reflected on and used to inform the nursing staff within the ED and the radiographers. Specific concepts associated with IPL were utilised to ensure effective collaboration between the radiology department and ED. IPL sessions were held three times each week for 4 weeks; staff participation was on a voluntary basis where the results of the first review were explained and discussed with the ED staff, 90% of nursing staff attended the education sessions. Targeted education was provided by radiographers to ensure nursing staff were aware of how their practice impacted the radiographers, radiologists and potentially patient care decisions. The intervention also addressed clinical and managerial governance. This was conducted by carefully reviewing the results of the first review and discussing the medicolegal considerations related to departmental guidelines for NIX requests. These discussions involved representatives from the nursing staff, department directors, ED nurse unit manager and chief radiographer. A new policy incorporating the identified practice requirements from the first review was developed and implemented to replace the previous guidelines for NIX requests.

Results

In Table 2, adherence with NIX guidelines is presented at both pre- and post-intervention reviews. There were significant improvements in all three variables (requesting person being a CIN trained nurse, approved anatomical region requested and appropriateness of the anatomical region requested as determined by the clinical history provided) related to guideline compliance.

In Table 3, the evaluation of clinical history is presented at both pre- and post-intervention reviews. There were significant improvements in all four variables...
Table 2. Summary of findings at pre- and post-intervention related to observance of nurse initiated X-ray requests guideline/policy.

| Variable                              | Pre-intervention | Post-intervention | P      |
|---------------------------------------|------------------|-------------------|--------|
| Requested by CIN trained nurse        | 227 (75)         | 200 (97)          | <0.001 |
| Approved anatomical region requested  | 146 (49)         | 170 (92)          | <0.001 |
| Anatomical area requested             |                  |                   |        |
| Appropriate                            | 73 (24)          | 139 (67)          | <0.001 |
| Not appropriate                        | 228 (76)         | 67 (23)           | <0.001 |
| Observance of NIX guideline/policy    | 144 (48)         | 185 (90)          | <0.001 |

NIX, Nurse Initiated X-ray; CIN, Clinical Initiative Nurse.

Table 3. Summary of clinical history variable evaluation for first and second review periods.

| Variable                              | Pre-intervention | Post-intervention | P      |
|---------------------------------------|------------------|-------------------|--------|
| Mechanism of injury                   |                  |                   |        |
| Not stated                            | 198 (66)         | 58 (28)           | <0.001 |
| Stated or ruled out                   | 44 (15)          | 49 (24)           | <0.001 |
| Stated and described                  | 59 (19)          | 99 (48)           | <0.001 |
| Injury/Location mentioned             |                  |                   |        |
| Not stated                            | 184 (61)         | 37 (12)           | <0.001 |
| Injury stated/ruled out               | 45 (15)          | 18 (6)            | <0.001 |
| Generalised injury stated             | 39 (13)          | 67 (22)           | <0.001 |
| Specific injury stated                | 33 (11)          | 84 (40)           | <0.001 |
| Side respected in clinical history    | 50 (17)          | 117 (57)          | <0.001 |
| Clinical question stated              | 18 (6)           | 30 (10)           | <0.001 |

Discussion

This study aimed to evaluate and improve the quality of NIX requests by applying IPL and change management theory in the ED setting. Use of this strategy resulted in significant improvements in observance of NIX guidelines and quality of patient history provided on NIX requests.

The importance of comprehensive audit and evaluation of NIX requests as a practice is emphasised in prior literature. There has been some concern expressed that NIX requests may cause an increase in unnecessary requests and therefore a clear protocol is necessary to prevent such occurrences. This study found that provided in X-ray requests lacked sufficient information to inform the radiographer when performing the X-ray examination. This lack of meaningful clinical information has also been reported in previous studies of examining requests from medical officers. The assessment tool designed for this study, specifically assessing documentation related to mechanism of injury, specific location of injury, side of injury and clinical question, may be used as a guide to further educate all clinicians on what information to include in future X-ray requests for upper and lower limbs.

Implications on practice and future research

This study has demonstrated that targeted assessment of practice, education, IPL and improved governance can improve the quality of NIX practice within an ED. A dramatic decrease in the total number of NIX requests was demonstrated from the initial review period in 2012 to the second review period in 2014. This is believed to have occurred as a result of education to nursing staff on requesting X-rays and ensuring appropriate requests are made and adequately justified by clinical examination. The findings in this study have revealed that observance of NIX guidelines resulted predominantly from non-CIN trained nurses requesting X-ray examinations, 25% of the requests were by non-CIN trained nurses and 75% of the requests were for anatomical regions not included in the NIX guidelines. Improved governance and awareness of policy resulted in a dramatic decrease in NIX requested during the second review period. As we did not investigate specifically the appropriateness of the request to the patient condition or the impact of the X-ray on the patient journey, future studies are required to inform future new policies. Importantly, this study identified the benefit of collaborative practice between ED staff and radiology department staff, an essential component of developing a policy which supported NIX practice. Future studies could evaluate and compare NIX practice with that of medical practitioner requests, which if utilised in a similar action research improvement process, may enhance quality of all future X-ray requests.

Limitations

There are some limitations to this study including data accuracy being reliant on accurate computer records. The requests that were evaluated were electronically requested, there were no paper hand written requests included in this study. There may have also been communication between the radiographers and requesting nurses that has not been recorded and therefore could not be taken into consideration in this study. The results of this study are
representative of this ED only and therefore may not be representative of other specialty areas of practice in relation to X-ray examination requests.

Conclusion

This study has defined many features involved in the practice of NIX at one hospital ED and assisted the multidisciplinary team there to highlight areas in need of improvement. Our study, with an action research design has resulted in improvement to an area viewed as deficient using solutions from inter-professional stakeholders and managers and the methodology is recommended for those considering a review of clinical service processes and systems. The appropriateness of the then current practice guidelines (in 2012) were found to be lacking and did not support NIX practice, nor was the education provided to CIN trained nurses and the implementation of NIX practice sufficient. The education for nurses completing the CIN training package now incorporates IPL and engages radiology staff. All CIN trained nurses are now encouraged to communicate and work with the radiographers in the ED to ensure best NIX practice. The quality of NIX requests as determined by adherence to the practice guidelines and policy have dramatically improved as a result of this study. The investigating team also recommends that the following variables (1) mechanism of injury; (2) injury location; (3) side of injury; and (4) clinical question, be included in the clinical history of all request for upper and lower limbs, regardless of which clinician group is making the request.

Conflict of Interest

The authors declare no conflict of interest.

References

1. Fry M. Triage nurses order X-rays for patients with isolated distal limb injuries: A 12-month ED study. J Emerg Nurs 2001; 27: 17–22.
2. Davis J. X-ray vision of shorter queues. Nurs Times 1994; 90: 52–4.
3. Tambimuttu T, Hawley R, Marshall A. Nurse-initiated X-ray of isolated limb fractures in the emergency department: Research outcomes and future directions. Aust Crit Care 2002; 15: 19–122.
4. Kelly A, McCarthy S, Richardson S, Parris W, Kerr A. Triage nurse initiated X-rays for limb injuries are accurate and efficient. Emerg Med 1995; 7: 81–4.
5. Lindley-Jones M, Finlayson BJ. Triage nurse requested x-rays—are they worthwhile? J Accid Emerg Med 2000; 17: 103–7.
6. Klassen T, Ropp L, Sutcliffe T, et al. A randomized, controlled trial of radiograph ordering for extremity trauma in a pediatric emergency department. Ann Emerg Med 1993; 22: 1524–9.
7. Ropp L, Blouin R, Durbeg C. Radiograph ordering: Agreement between the triage nurse and the physician in a pediatric emergency department. J Emerg Med 1990; 8: 697–700.
8. NSW Department of Health, CIN Educational Program Participation Manual. NSW Department of Health, North Sydney, 2011.
9. Radiation Health and Safety Advisory Committee. Advice to CEO of ARPANSA on medical radiation issues. Radiation Health and Safety Advisory Committee 2006, viewed 21 October 2011. Available from: http://www.arpansa.gov.au/pubs/rhasc/medical_ad.pdf
10. Lam D, Egan I, Baird M. The radiographer’s impact on improving clinical decision-making, patient care and patient diagnosis: A pilot study. Radiographers 2004; 51: 133–7.
11. Matthews K, Brennan P. Justification of X-ray examinations: General principles and an Irish perspective. Radiography 2008; 14: 349–55.
12. Stavem K, Foss T, Botnmark O, Andersen O, Eriksen J. Inter-observer agreement in audit of quality of radiology requests and reports. Clin Radiol 2004; 59: 1018–24.
13. Longrigg B, Channon B. The X-ray request – an effective vehicle of communication? J Diagn Radiogr Imaging 2006; 6: 35–42.
14. McQuillen-Martensen K. Radiographic Image Analysis, 3rd edn. Saunders Elsevier, St Louis, 2011.
15. Loy C, Irwig L. Accuracy of diagnostic tests read with and without clinical information. JAMA 2004; 292: 1602–9.
16. Mendelson R, Murray C. Toward the appropriate use of diagnostic imaging, Med J Aust 2007; 187: 5–6.
17. McRae R. Practical Fracture Treatment, 3rd edn. Churchill Livingstone, New York, 2000.
18. NSW Clinical Excellence Commission. Improving patient access to acute care services. NSW Clinical Excellence Commission 2005, viewed 21 October 2011. Available from: http://www.cec.health.nsw.gov.au/__data/assets/pdf_file/0007/136960/pfsc_toolkit.pdf
19. McArthur C, Thomas M. Comparison of triage nurse versus emergency physician ordering of extremity radiographs. Am J Emerg Med 1995; 13: 248–50.
20. Thurston J, Field S. Should accident and emergency nurses request radiographs? Results of a multicentre evaluation. J Accid Emerg Med 1996; 13: 86–9.
21. Hasan M. Interprofessional education: A review. Rev Clin Gerontol 2005; 14: 253–6.
22. McAllister M, Tower M, Walker R. Gentle interruptions: Transformative approaches to clinical teaching. J Nurs Educ 2005; 46: 304–12.
23. Manley K, McCormack B. Practice development: Purpose, methodology, facilitation and evaluation. *Nurs Crit Care* 2003; 8: 22–9.
24. O’Connell T, Ben-Tovim D, McCaughan B, Szwarcbord M, McGrath K. Health services under siege: The case for clinical process redesign. *Med J Aust* 2008; 188: S9–13.
25. Implementation Management Associates. Accelerating Implementation Methodology: A Practical Guide to Change Project Management. Implementation Management Associates, Sydney, 2005.
26. NSW Ministry of Health. Role Delineation Levels of Emergency Medicine. NSW Ministry of Health 2014, viewed 8 July 2016. Available from: http://www.health.nsw.gov.au/Hospitals/Publications/role-delineation-levels.pdf
27. Cohen J. Statistical Power Analysis for the Behavioural Sciences. Revised 2nd edn. Elsevier Science, New York, 2013.
28. Egan I, Baird M. Optimising the diagnostic imaging process through clinical history documentation. *The Radiographer* 2003; 50: 11–18.
29. Wong T, Lee K, Lau C, Fu Y, Fung K. A protocol helps emergency triage nurses to request X-rays. *Emerg Med* 2009; 9: 307–10.
30. Egan I, Baird M. Optimising the diagnostic imaging process through clinical history documentation. *Radiographers* 2003; 50: 11–8.