Irish Journal of Medical Science (1971 -) (2019) 188:371–377
https://doi.org/10.1007/s11845-018-1901-3

ORIGINAL ARTICLE

Electronic referrals for virtual fracture clinic service using the National Integrated Medical Imaging System (NIMIS)

Oisin Breathnach[1] · Marc O'Reilly[1] · Keith Morrissey[2] · Breda Conlon[1] · Eoin Sheehan[1]

Received: 16 August 2018 / Accepted: 7 September 2018 / Published online: 18 September 2018

Abstract

Introduction Virtual fracture clinics (VFC) are now prevalent across many orthopaedic services in the UK and Ireland. The management of a variety of musculoskeletal injuries using the VFC model has been demonstrated to be safe, cost-effective and associated with high levels of patient satisfaction. Referrals were made available through the National Integrated Medical Imaging System (NIMIS). NIMIS allows for electronic movement of patient images throughout the Irish health service.

Methods A retrospective review of 157 orthopaedic fracture referrals from a regional hospital was performed. The referrals were received during a 6-week period between May 2016 and June 2016. Each of these referrals was sent electronically. These referrals were reviewed each day by a consultant-led multi-disciplinary team.

Results Thirty (93%) patients agreed or strongly agreed that they received adequate information in relation to the VFC when they attended the emergency department (ED). All patients except for one either agreed or strongly agreed that they were satisfied with their recovery (97%). Fifteen parents advised us that they would have had to take time off to attend fracture clinic with their child. Two patients attended their general practitioner (GP) or ED to seek further pain relief following their injuries. Only one patient reported a poor clinical outcome. Nine (28%) patients reported that they would have preferred a face-to-face appointment rather than being treated by the VFC.

Conclusion Virtual review of orthopaedic trauma patients results in satisfactory patient outcomes. Clinical outcomes were acceptable with minimal additional medical attention required following injury. Electronic transfer of information allows for the virtual service to operate from sites long distances from the primary orthopaedic centre. The NIMIS is a safe and confidential means of collaborating with other institutions and has huge potential in the areas of trauma care delivery, clinical conferencing and other image-based disciplines.

Keywords Electronic referrals · National Integrated Medical Imaging System · NIMIS · Patient safety · Virtual fracture clinic

Introduction

Virtual fracture clinics (VFC) are now prevalent across many orthopaedic services in the UK and Ireland. The management of a variety of musculoskeletal injuries using the VFC model has been demonstrated to be safe, cost-effective and associated with high levels of patient satisfaction [1–7]. The VFC adopted in the Department of Trauma and Orthopaedics in Tullamore Regional Hospital, called the Trauma Assessment Clinic or TAC, is based on the service provided in Glasgow, Scotland [6]. The TAC aims to identify patients with stable and minor fractures that can be treated with early mobilisation and self-care. Patients, in the past, have been attending hospitals on multiple occasions with stable and minor fractures with little change in their initial management plan.

Tullamore Regional Hospital serves a population across four counties of approximately 292,000 with one level 2 hospital and two level 3 hospitals. The level 3 hospitals in the catchment area previously forwarded referrals to our fracture clinic service using the postal service and by fax. Patients attended our fracture clinic within 48–72 h. The unit provides for fracture clinics 5 days a week. Previously, both radiology scans and the letter of referral were provided to the patients in a hard copy form prior to their attendance in fracture clinic.

✉ Oisin Breathnach
opbreathnach@hotmail.com

[1] Tullamore Regional Hospital, Tullamore, Ireland

[2] National Integrated Medical Imaging System (NIMIS), Dublin, Ireland

The referral process was altered to allow all fracture clinic referrals and radiology scans to be sent electronically.

Referrals were made available through the National Integrated Medical Imaging System (NIMIS). NIMIS allows for electronic movement of patient images throughout the Irish health service with the appropriate security and access requirements. It was initiated by the Health Service Executive (HSE) in 2007. NIMIS implement electronic ordering and requesting of radiology examinations. The system could support our request for electronic orthopaedic referrals to be scanned for review. Tullamore Regional Hospital is the first orthopaedic unit in Ireland to use NIMIS for both imaging and electronic referrals and to also have a virtual fracture clinic service. When the NIMIS service is used in this way in conjunction with the VFC, it allows for remote assessment of patients.

The trauma department in our unit arranged with Portlaoise General Hospital (PGH) to perform a pilot study of the NIMIS electronic referral and radiology service. We arranged VFC workshops for clerical and medical staff in this unit and followed the pilot study for 6 weeks.

Objectives

The aims of this study were threefold:

1. Assess satisfaction levels amongst patients following the introduction of the VFC
2. Assess patient outcomes following the introduction of the VFC
3. Audit of referrals provided via NIMIS

Patients and methods

A retrospective review of 157 orthopaedic fracture referrals from PGH was performed. The referrals were received during a 6-week period between May 2016 and June 2016. Each of these referrals was sent electronically. These referrals were reviewed each day with a consultant and a multi-disciplinary team (MDT). The MDT team consisted of a trauma and orthopaedic consultant surgeon, a trauma and orthopaedic specialist registrar, an orthopaedic clinical nurse specialist (CNS), a physiotherapist and VFC clerical officer. VFC protocols were applied to all these referrals to assess whether patients could be discharged at source.

Twenty-four referrals were deemed inappropriate at initial review. These patients were asked to attend our emergency department or a prompt out-patient (OPD) appointment. Forty-two (26%) of original referrals were discharged without any further follow-up from our service and were discharged following attendance at our emergency department. These 42 discharged patients were reviewed to assess satisfaction levels with the new service of VFC. The remaining 111 patients were seen in our routine fracture clinic OPD. These patients had suffered injuries that were outside the remit of VFC. They may also have been seen in OPD due to inadequate information on referral form.

The referral was a complete electronic referral in terms of patient information, clinical details and radiology scans. Patients attended PGH for assessment. Treatment was instigated following clinical examination and radiographs. The radiographs are available to be viewed nationwide by using the NIMIS system. The fracture clinic referral form (see Fig. 1) was completed by the attending doctor or the advanced nurse practitioner (ANP). This referral form was then scanned electronically into the NIMIS system. NIMIS can be accessed by relevant health workers using a unique identification username and password.

A series of review questions were put to each patient or their guardian by means of a telephone call survey (see Table 1). The questions were a combination of yes/no answers and other questions posed using a five-level Likert scale grading classification. The survey focused on three key components:

1. The provision of information to patients attending the VFC/ ED
2. Patient satisfaction with the new structure of a VFC
3. Patient satisfaction with clinical outcome was also assessed

Twenty-six percent of patients referred to our service were discharged at source ($n = 42$). Thirty-two patients completed our telephone survey. Five patients were uncontactable. Four patients reported poor recall of events and felt unable to complete the survey due to the time lapse from the time of initial injury. One patient had died, from unrelated causes since they were referred to VFC. Thirteen patients were male and 19 were female. Eighteen patients were treated as paediatric patients i.e. below the age of 16 years of age at the time of injury.

Each patient attending ED and referred to VFC was due to receive an information leaflet outlining their injury after attending ED (see Fig. 2 for example). This leaflet included a helpline contact number on it. Rather than attending our fracture clinics, patients were counselled over the phone in relation to their injury by the CNS. Patients were asked about their satisfaction with the clinical outcome following their injury and attendance at VFC and ED. Patients were asked to compare the VFC process with the previous format of face-to-face fracture clinics. Provision of childcare whilst attending clinic was assessed.

The electronic referrals sent to our unit were assessed as part of this review. We reviewed the quality of the referral sent to us. We assessed the quality of the referral in terms of legibility, clinical details and provision of contact details for patients.

Fig. 1 The fracture clinic referral form

Name:
Patient ID Number:
D.O.B.:
Ward:
Address:

(Affix Patient Identification Label)

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Tullamore Virtual Fracture Clinic

Upper Limb Referral

Contact Details:

1. Patient's Mobile Number _____
2. Patient's Home Number _____
3. Next-of-Kin Name and Phone Number _____
4. Patient's Email Address _____

History/Mechanism of Injury:

_____
_____
_____
_____

Is the skin intact? Yes ☐ No ☐ **Is there any Neurovascular deficit?** Yes ☐ No ☐ **Left?** ☐ **Right?** ☐

Area of Tenderness – mark on diagram:

Treatment Plan:

_____
_____
_____

Is a back-slab applied? Yes ☐ No ☐ **Is a splint applied?** Yes ☐ No ☐ **Was a sling provided?** Yes ☐ No ☐

Orthopaedic Diagnosis _____

Signature of Doctor:

Name _____

IMC Number _____

Date of Referral _____

Advice Sheet Given to Patient: ☐ **Direct Discharge:** ☐

Signature of ANP:

Name _____

Registration Number _____

Modern Printers, Kilkenny. 056-7721739

Results

Fourteen (42%) of patients reported not receiving any information leaflet from the ED at the time of the injury. Thirty (93%) patients agreed or strongly agreed that they received adequate information in relation to the VFC when they attended ED.

Twenty-two (68%) patients (or their guardians) advised us that they would have had to take time off for their follow-up appointment. Fifteen patients in this group of 32 were

Name:
Patient ID Number:
D.O.B.:
Ward:
Address:
(Affix Patient Identification Label)

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Tullamore Virtual Fracture Clinic

Lower Limb Referral

Contact Details:

1. Patient's Mobile Number _____
2. Patient's Home Number _____
3. Next-of-Kin Name and Phone Number _____
4. Patient's Email Address _____

History/Mechanism of Injury:

_____
_____
_____
_____

Is the skin intact? Yes ☐ No ☐ **Is there any Neurovascular deficit?** Yes ☐ No ☐

Area of Tenderness – mark on diagram:

Treatment Plan:

_____
_____
_____

Is a back-slab applied? Yes ☐ No ☐ **Is a splint applied?** Yes ☐ No ☐ **Was a sling provided?** Yes ☐ No ☐

Orthopaedic Diagnosis _____

Signature of Doctor:

Name _____

IMC Number _____

Date of Referral _____

Advice Sheet Given to Patient: ☐ **Direct Discharge:** ☐

Signature of ANP:

Name _____

Registration Number _____

Modern Printers, Kilkenny. 056-7721739

Fig. 1 continued.

children. Fifteen parents advised us that they would have had to take time off to attend fracture clinic with their child. Two parents/guardians advised us that they would not have had to take time off work.

All patients agreed or strongly agreed that they were provided with adequate information over the phone when contacted following their injury. Thirty patients advised us that they felt that the service could be accessed directly should the need require it. Twenty (62%) patients were not aware that there was a phone number helpline available to them to contact the orthopaedic service directly. Two patients attended their general practitioner (GP) or ED to seek further pain relief

Table 1 Review questions to each patient or their guardian by means of a telephone-call survey

Did you receive an information leaflet in the Emergency Department in relation to your injury?
The information received in the Emergency Department regarding our service was satisfactory?
If you had to attend a follow up clinic with your child, would you or your partner have had to organise childcare for other children in your family?
The information received in the telephone call from our team was adequate?
It was clear that our service could be accessed directly if you had any difficulties during the time your injury was healing.
Were you aware that there was a helpline number to ring if your encountered problems?
Did your child have to attend your GP/Emergency Department again due to his/her injury?
Are you satisfied with your/your child's recovery from your injury?
Would you have preferred to attend a clinic appointment for your child rather than the phone consultation?

following their injuries. Only one patient reported a poor clinical outcome. This patient had suffered an elbow injury and was referred to the physiotherapy services after encountering difficulties.

The remainder of the group agreed or strongly agreed that they were satisfied with their recovery (97%). Nine (28%) patients reported that they would have preferred a face-to-face appointment rather than being treated by VFC. Four patients reported poor recall of events and felt unable to complete the survey due to the time lapse from the time of injury. They did however state that they were satisfied with the VFC service and were also happy with their clinical outcome (see Figs. 3 and 4).

There was a combination of injuries noted amongst those who completed the phone survey (see Table 2).

Discussion

The review of VFC provides for high levels of satisfaction amongst patients. Patients were provided with a high level of information in ED and were happy with the way the information was relayed to them. The high levels of satisfaction with the service would be consistent with reported literature [2]. Unfortunately, nearly half of all patients surveyed reported not receiving any written information after attending ED. It is clear therefore that staff in ED were happy to provide information when speaking with patients, but that written information was not made available to all patients. The patients not provided with written information would not have been able to contact the VFC helpline in this instance. Almost two thirds of patients reported later in the survey that they were not aware of any phone helpline. This is major failing as a part of this pilot study. Whilst patient satisfaction levels were high, the VFC service did not provide enough paper-based information in ED.

The survey highlights a significant number of patients that were treated as children. Parents of 15 children (46% of total patients surveyed) advised us that they would have needed to take time of work to attend a routine fracture clinic


Tullamore Regional Hospital

Department of Trauma and Orthopaedic Surgery

Discharge Advice: *Paediatric (Childrens) Clavicle Fracture*

➢**Your child has fractured their Clavicle (Collar Bone)**

➢**This type of fracture is common in children**

➢**This type of fracture heals well – the only treatments required are painkillers and a sling**

➢**We would expect the collar bone to be painful for 4 – 6 weeks**

➢**Your child may find it more comfortable to sleep sitting upright for a few days after the injury**

➢**The shoulder and arm can be moved out of the sling as comfort allows. This will usually be about 2 weeks after the injury but can be sooner if comfortable**

➢ **The 'bump' over the fracture is quite normal and is produced by healing bone. It may take up to one year to disappear. If your child is older than ten years a small bump may remain**

Fig. 2 Information leaflet outlining patient injury after attending ED

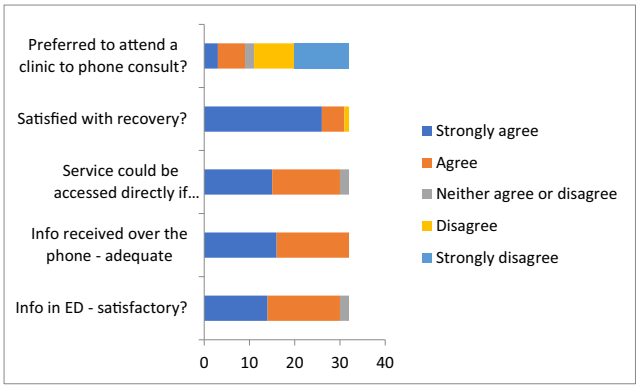

Fig. 3 Survey results from patients following injury

appointment. The distal radius forearm 'buckle' fracture was the most common injury treated by the VFC in the paediatric population. All forearm 'buckle' fractures were treated without any further appointment. These injuries were treated by means of removeable splint. The clinical information was forwarded electronically which allowed our service to treat this injury with one follow-up phone call. Loss of earnings for parents and the reduction in childcare costs are clearly a factor when managing paediatric injuries. High hospital direct cost savings in redesigning paediatric VFCs have been identified previously [7]. Indirect costs have been quoted by some studies as being as much as €80 per consultation in societal costs and to equate to almost half a school day lost [9, 10].

Patients were happy with the outcome following their respective injuries. Only two of the 32 patients surveyed felt the need to attend ED or their GP for further medical management. The high levels of patient satisfaction following their injuries were achieved by our service with minimal patient contact. These levels of satisfaction were achieved using VFC protocols and the NIMIS information technology system. Limited ED or GP follow-up for injuries treated using VFC protocols is well established [1, 2, 8]. One patient did require further assistance from the physiotherapy services and was unhappy with the outcome of their injury. The VFC survey did not examine individual outcome scores for the knee,

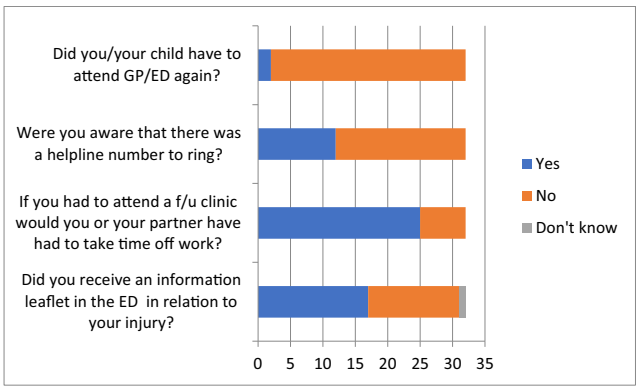

Fig. 4 Survey results from patients after VFC service

Table 2 Injuries noted among patients

Type of injury	Number of patients
Forearm buckle fracture	8
Simple distal radius fracture	1
Phalangeal/soft tissue injury-hand	7
Phalangeal/soft tissue injury-foot	4
Elbow injury	3
Metacarpal injury	1
Metatarsal injury	1
Clavicle injury	1
Shoulder injury	1
Ankle soft tissue injury	5
Total	32

shoulder etc. but rather focused on a general satisfaction level from patients on their outcome from injury.

Only 42 patients were reviewed from 157 referrals. We acknowledge that this is a low number of referrals assessed as part of the overall fracture clinic service. There were several reasons for this low number including the need for emergency admission for surgery for some patients, illegible writing, inadequate information on referral form, injuries that were chronic in nature, soft tissue injuries needing assessment in OPD and fracture patterns that were not appropriate for 'virtual' review.

Only one patient reported a poor clinical outcome. This patient suffered an elbow injury. They required a prolonged assessment by physiotherapy. Each injury was not assessed by means of clinical outcome scores for each joint i.e. wrist functional assessment score or a knee functional assessment score. Patients were specifically asked for their general level of satisfaction with their outcome from injury.

Almost a third of patients reported that they would prefer a face-to-face assessment as part of the management of their injury. This preference for face-to-face assessment contrasts with the high levels of satisfaction with the VFC noted earlier in the survey. Patients may require more reassurance and information at the initial presentation to ED. The high number of patients who would prefer a face-to-face appointment is surprising considering how many patients reported high levels of satisfaction with the VFC service.

The use of virtual clinics has also been adopted across several other medical specialities including nephrology, ophthalmology and gastroenterology [11–13]. These have been shown to provide a safe patient pathway that is cost-effective, efficient and associated with high patient satisfaction levels [11, 14–17]. The NIMIS provides a unique platform within the Irish Public Health System and is a ready-made portal for safe and confidential exchange of patient information amongst participating institutions for remote and acute scenarios [18]. Presently, there is only one study that looks at 'end-user

experiences' but no studies looking at the non-radiology-based uses of the NIMIS. This study revealed that of 260 respondents, almost half used the NIMIS purely for reviewing or ordering imaging whilst a little over half used the NIMIS for other functions (e.g. copying a CD) only on a weekly or monthly basis [18]. Our pilot study shows that a completely paperless system functions well by maximising the capabilities of this electronic pathway. This pathway has potential, not only in trauma and orthopaedics (e.g. patient referrals to the national spinal unit, patient referrals to the National Centre for the Treatment of Pelvic and acetabular fractures) but also for other image-based specialities like dermatology, cardiology and histology/pathology. It could also improve clinical-pathological conferencing in Ireland.

A primary weakness of this study was that it took place 18 months (and up to 2 years in some cases) to complete. Despite this time lag, the VFC has been demonstrated to be efficient and reports high levels of satisfaction with patients. The use of NIMIS and VFC facilitates a 'virtual' review of patients from an off-site location. The number of referrals discharged at source may only have been a quarter of all patients. With further education, workshops for the staff involved and further focus on patient information with leaflets etc., VFC can facilitate improved trauma and orthopaedics services for both staff and patients alike.

In recent times the VFC has evolved to include two full time physiotherapist posts. Many soft-tissue injuries were highlighted as part of our VFC review. The VFC service in 2018 has improved with large number of patients now being assessed directly by a physiotherapist and not requiring any fracture clinical assessment in our hospital.

Conclusion

Virtual review of orthopaedic trauma patients results in satisfactory patient outcomes. Clinical outcomes were acceptable with minimal additional medical attention required following injury. Using the VFC in the paediatric population eases pressures on patients and their families in terms of childcare and parents requiring leave from work. Electronic transfer of information allows for the virtual service to operate from sites long distances from the primary orthopaedic centre. The NIMIS is a safe and confidential means of collaborating with other institutions and our electronic paperless pathway could have huge implications for other image-based specialties and clinical conferencing in Ireland.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest. The research complied with all ethical standards.

References

1. Gamble D, Jenkins PJ, Edge MJ, Gilmour A, Anthony IC, Nugent M, Rymaszewski LA (2015) Satisfaction and functional outcome with "self-care" for the management of fifth metacarpal fractures. Hand (N Y) 10(4):607–612
2. Bhattacharyya R, Jayaram PR, Holliday R, Jenkins P, Anthony I, Rymaszewski L (2017) The virtual fracture clinic: reducing unnecessary review of clavicle fractures. Injury 48(3):720–723
3. Vardy J, Jenkins PJ, Clark K, Chekroud M, Begbie K, Anthony I, Rymaszewski LA, Ireland AJ (2014) Effect of a redesigned fracture management pathway and 'virtual' fracture clinic on ED performance. BMJ Open 4(6):e005282
4. Bellringer SF, Brogan K, Cassidy L, Gibbs J (2017) Standardised virtual fracture clinic management of radiographically stable Weber B ankle fractures is safe, cost effective and reproducible. Injury 48(7):1670–1673
5. McKirdy A, Imbuldeniya AM (2017) The clinical and cost effectiveness of a virtual fracture clinic service: an interrupted time series analysis and before-and-after comparison. Bone Joint Res 6(5): 259–269
6. Anderson GH, Jenkins PJ, McDonald DA, van der Meer R, Morton A, Nugent M, Rymaszewski LA (2017) Cost comparison of orthopaedic fracture pathways using discrete event simulation in a Glasgow hospital. BMJ Open 7(9):e014509
7. Robinson PM, Sim F, Latimer M, Mitchell PD (2017) Paediatric fracture clinic re-design: incorporating a virtual fracture clinic. Injury 48(10):2101–2105
8. Ferguson KB, McGlynn J, Jenkins P, Madeley NJ, Kumar CS, Rymaszewski L (2015) Fifth metatarsal fractures - is routine follow-up necessary? Injury 46(8):1664–1668
9. Holm A, Lurås H, Randsborg P (2016) The economic burden of outpatient appointments following paediatric fractures. Injury 47(7):1410–1413
10. Morris M, Bell M (2006) The socio-economical impact of paediatric fracture clinic appointments. Injury 37(5):395–397
11. Mark D, Fitzmaurice G, Haughey K, O'Donnell M, Harty J (2011) Assessment of the quality of care and financial impact of a virtual renal clinic compared with the traditional outpatient service model. Int J Clin Pract 65(10):1100–1107
12. Rathod D, Win T, Pickering S, Austin M (2008) Incorporation of a virtual assessment into a care pathway for initial glaucoma management: feasibility study. Clin Exp Ophthalmol 36(6):543–546
13. Hunter J, Claridge A, James S, Chan D, Stacey B, Stroud M, Patel P, Fine D, Cummings JRF (2012) Improving outpatient services: the Southampton IBD virtual clinic. Frontline Gastroenterology 3(2):76–80
14. Court J, Austin M (2015) Virtual glaucoma clinics: patient acceptance and quality of patient education compared to standard clinics. Clin Ophthalmol:745
15. Trikha S, Macgregor C, Jeffery M, Kirwan J (2012) The Portsmouth-based glaucoma refinement scheme: a role for virtual clinics in the future? Eye 26(10):1288–1294
16. Kotecha A, Brookes J, Foster P, Baldwin A (2015) Experiences with developing and implementing a virtual clinic for glaucoma care in an NHS setting. Clin Ophthalmol:1915
17. Kotecha A, Bonstein K, Cable R, Cammack J, Clipston J, Foster P (2015) Qualitative investigation of patients' experience of a glaucoma virtual clinic in a specialist ophthalmic hospital in London, UK. BMJ Open 5(12):e009463
18. J Smith, HK Kok, WC Torreggiani. Examining the end-user experience of the National Integrated Medical Imaging System (NIMIS). Irish Medical Journal January 2016 Volume 109 Number