

# Narrative review of published evidence

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## Abstract

**Background:** Currently, there is paucity of published evidence on the Virtual Fracture Clinic (VFC) model. There are limited resources from which conclusions could be drawn relating to the management of orthopaedic conditions, cost effectiveness, quality and safety, patient satisfaction rates and management when using the VFC model.

**Objectives:** This narrative review of current published evidence aims to reveal how cost effective the VFC model is in relation to the orthopaedic management of both children and adults in the United Kingdom (UK). The review also seeks to identify gaps in current available literature and make recommendations for further research into the VFC model.

**Methods:** This narrative review is secondary research of the evidence available on the VFC using a systematic approach. Seven electronic databases were searched to identify relevant peer-reviewed studies published since January 2010. The literature review identified 678 initial articles produced by undertaking key word searches (appendix I). A Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram was used to assist in illustrating the process of filtering and applying the inclusion and exclusion criteria to the search retrieval which subsequently led to 32 articles [1]. In total 14 relevant papers were selected following deduplication. Seven studies of various study types were selected and subjected to critical analysis using a systematic approach [2,3]. The main themes that have been selected are identified in Table 1.

**Results:** No Randomised Controlled Trials (RCTs) or systematic reviews were found regarding VFCs. Seven articles were identified and reviewed following an in-depth databases search, these consisted of clinical audits, simulation study, comparison study, perspective analysis and retrospective research. All studies were from the UK only. One paper focused on paediatric fractures, two dedicated their research to Webber B ankle breaks and fifth metatarsal, including Jones fractures. The other four research articles consisted of mainly cost comparison and service redesign studies. All studies but one, by White, *et al.* (2017) reported positive findings. Overall, cost effectiveness of VFCs ranged from £13.91 per patient to £122. Individual study trusts estimated variable cost savings, ranging from £81,920 to £212,705, also Nationally approximate projections confirmed sums reaching £1.1 million per year.

**Conclusion:** This narrative review shows that there are potential cost savings to be made when using the VFC model. Current financial projections cannot be taken for granted at this present time. Further robust evidence such as RCTs or systematic reviews with meta-analysis are required before final conclusions can be drawn regarding cost effectiveness when using the VFC model throughout the UK.

## Introduction

There is growing evidence of exceeded maximum capacity fracture clinic lists in multiple hospitals in the UK [4-6]. Recent experience in working alongside an upper limb team, where their routine fracture clinic consists of over 100 patients for one morning alone made the practitioner reflect on how the service could be improved. Larger fracture clinics, with appropriate infrastructure could be built and more staff could be employed, however, this would take time and resources which are currently not available in the National Health Service (NHS). Exploring the VFC model seemed appropriate at this time.

The VFC, defined by the writer as an indirect approach, healthcare professionals and patients managing fracture healing from a distance. Logishetty and Subramanyam (2017) [7] describe the VFC as an alternative to the conventional fracture clinic model. An extensive research process took place around the topic to evaluate current evidence of the use and cost effectiveness of VFCs in the UK. The VFC is not a new concept as the Glasgow Royal Infirmary (GRI) pioneered this model from 2011 [8]. Further enquiry consisted of talking to various trauma and orthopaedic consultants about the topic, which revealed different opinions. This variety of opinion encouraged the writer to explore the evidence further.

Historically, fracture clinics in the UK are overbooked and have 2-3 hour delays [7,9]. NICE (2013) and NHS England (2017) indicated that such inefficiency in fracture clinic services required an immediate service delivery change. Hence, the writer's literature search was directed towards the VFC model [4,9].

Currell, *et al.* (2000) states that virtual clinics are an alternative to face-to-face (FTF) care delivery when providing support, monitoring and management of patients [10]. Anderson, *et al.* (2017) suggests that VFC is a relatively new concept in the UK starting in the early 2010s [8]. Jenkins, *et al.* (2016) states that current outpatient fracture clinics have not changed since 1935 [11]. It could be argued that the current fracture clinic model is not sustainable to accommodate our current aging population, reduction in financial investment and lack of trained professionals such as nurses and physicians. Pearce, *et al.* (2017) states that the UK is failing to meet the British Orthopaedic Association (BOA) guidelines due to current fracture clinic services exceeding maximum capacity and failing to comply with BOA requirements, thus

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compromising efficient service and patient management [12]. McKirdy and Imbuldeniya (2017) claim that the VFC model provides clinical effectiveness and is achieving BOA targets; reducing waiting times which ensure that the management of some injuries will not be delayed.

As more research evidence is undertaken evaluating the VFC model across the UK (Table 1) more robust, multicentre evidence needs to become available, such as systematic reviews or RCTs to identify true cost effectiveness when using the VFC model [7,13].

**Table 1.** Characteristics of seven studies

Reference	Methodology	Findings	Sample/ Time period	Comments
Anderson G, Jenkins P, McDonald D, Van Der Meer R, Morton A, <i>et al.</i> (2017) Cost comparison of orthopaedic fracture pathways using discrete event simulation in a Glasgow hospital. <i>BMJ Open</i> 7: 014509.	Simulation Modelling approach vs VFC with simulated TFC Discrete event simulation (DES) and cost in time driven activity-based costing (TDABC) models used “Top-down” approach examining administrative & financial data already done	Aim- to determine micro cost savings  VFC pathway in operation since 2011, has spread rapidly across UK VFC shows evidence of quality improvement Showing savings and increased other type activities	?2009-2012  6291 patients considered from hospital ortho electronic database Only 35% of initial 6291pts was reviewed in F2F	Pioneers in VFC since 2011 VFC promoted by Scottish Government Focused on non- operative trauma Objectives clear Ethical approval was not required-as project was classified as service evaluation Reported costs are based on figures 2013/14 TFC-£36.81 vs VFC-£14.23 per patient Research was funded by Scottish Government Themes: cost, savings, patient satisfaction and pathway
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. <i>Injury</i> 48: 1670-1673.	Clinical audit	£237 per patient savings with VFC model An estimated £40000 per year	Sep 2013- Sep 2015. Over 8500 referrals415 with stable #. Males and females	4 authors already took part in a similar article in Feb 2017 Aim to evaluate management of # in VFC setting also clinical outcomes, complications and cost Themes: cost effectiveness, isolated injury and pathway
Brogan K, Bellringer S, Akehurst H, Gee C, Ibrahim N, <i>et al.</i> (2017) Virtual fracture clinic management of fifth metatarsal, including Jones, fractures is safe and cost-effective. <i>Injury</i> 48: 966-970.	Clinical Audit	Prove to provide high quality and cost-effective care. Study have showed safe practice	Sep 2013-Sep 2015 period 977 sustained metatarsal # 663 met the criteria	Local population 600.000. Tertiary service 1.5 million. Min follow up 6 mts. X-rays reviewed; concerns raised. Aim- is VFC model safe and cost effective Limitations disclosed Themes: safety, cost, pathway, lower limb injury
Jenkins PJ, Morton A, Anderson G, Van Der Meer RB, Rymaszewski LA (2016) Fracture clinic redesign reduces the cost of outpatient orthopaedic trauma care. <i>Bone Joint Res</i> 5: 33-36.	The Scottish cost book and Standard financial returns table Top-down analysis off cost effectiveness used Robust protocols	Overall, less staff resources. Potential to achieve significant cost savings	2009-2014 period No discussion on study sample	Longest period of study It states that current care delivery has not changed since 1935 Study achieved £212,705 savings National adoption of VFC model could have resulted in cost savings of £3,535,808 Study strengths and limitations recognised The aim clear Inclusion/ exclusion criteria worth of discussion Themes: cost savings
White TO, Mackenzie SP, Carter TH, Jefferies JG, Prescott OR, <i>et al.</i> (2017) The evolution of fracture clinic design: the activity and safety of the Edinburgh trauma triage clinic, with one-year follow-up. <i>Bone Joint J</i> 99: 503-507.	6mth pre and 6mths post comparison study traditional model vs virtual care	Showed cost effective Benefits going virtual	August 2013- August 2014 626 pts reviewed	Patients with radial head and neck had highest 232cases Included PROM's results  Themes: Patient satisfaction, cost effectiveness
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. <i>Bone Joint Res</i> 6: 259-269.	Cochrane recommended robust methodological approach used Retrospective Study Before and after interrupted time series T-test were used for direct comparison. Aim clearly stated	Showed VFC is cost effective  National tariffs were taken from NHS England website	May 2013- April 2016  Included all patients referred to OP # clinic including ed, minor injuries and GP referrals	Largest study Referrals from ed, minor injuries and GP. Ethical approval not required National tariffs were compared with local tariffs which were higher Referral pathways changed in pre-post study Study has measured both themes Limitations have been recognised Themes: cost and clinical effectiveness
Robinson P, Sim F, Latimer M, Mitchell P (2017) Paediatric fracture clinic re-design: Incorporating a virtual fracture clinic. <i>Injury</i> 48: 2101-2105.	Protocols for the Home Management of Stable Paediatric Fractures Prospective analysis=often classed as cohort studies  Themes: savings, pathway, safety	Protocols had inclusion/ exclusion criteria. Safety was maintained and no serious adverse consequences reported.	Dec 2014-March 2015 (initial period) May-July 2015 (second part) A year later (last cycle) AGE: 18months-15 years 364 days	The only study looking @ paediatric VFC Study took three stages with every stage patient numbers increased: 65, 164, 253. New tariffs for VFC management agreed with CCG's Incorrect use of protocol during initial period, table provided £45000 annual saving for CCG's in new patient tariffs & £106000 per year to the hospital Doesn't provide exact time scale of the study

## Aim of the review

The aim of this narrative literature review is to establish the cost effectiveness of the VFC model for both children and adults' orthopaedic management in the UK.

## Methodology

This narrative literature review aims to identify and critically evaluate current evidence. This is an essential process in producing a literature review, including identifying all relevant literature, filtering to that which is most appropriate to produce a summary of the current body of evidence relating to this topic. The review then identifies gaps in the literature and allows the production of recommendations for areas of further research to be undertaken. Although a literature review can be a lengthy process, this method is fundamental to Evidence-Based Practice (EBP) and often described as "conscientious, explicit and judicious" process [14]. This critical review of published evidence will be presented using a systematic approach. A systematic search of the literature was conducted using seven databases in order to locate full-text, peer-reviewed research, published from January 2010 until October 2019 (Appendix I). A PRISMA diagram was used to illustrate the process of selecting appropriate and relevant articles from an overall retrieval (Figure 1).

The literature search was conducted electronically using seven different databases: ProQuest, Cochrane Library, Medline, Scopus, PubMed, Embase, Cinahl and a manual search of Google Scholar. The search strategy included defined key search terms: #1 cost effectiveness OR cost utility OR price per patient; #2 phone clinic OR virtual clinic OR online clinic OR virtual model; #3 fracture OR bone break OR orthopaedic. The above databases search resulted in 39,565,659 hits for the identified terms which were then permuted together. PubMed and Scopus databases had no facility to specify children or adults in the search, hence alternative planning took place. The search included defined key search terms: #4 child\* OR infant OR paediatric OR youth OR junior OR adolescent; #5 adult OR mature OR grown up OR person. To identify the relevant literature #1, #2 AND #3 and in two cases #4 and #5 was performed electronically resulting in 678 hits. Those document titles and abstracts were screened where possible against inclusion/ exclusion criteria.

The inclusion criteria were set out as per Table 2. Firstly, a primary focus was set on time period, publications considered only from January 2010. Key aim- the VFC is a relatively new concept with a paucity of publications nationally [13]. Secondly, full text and peer reviewed publications. Full text is necessary to complete the article analysis fully and peer-review is essential for validity and credibility of the research paper. Thirdly, English language and ultimately UK only

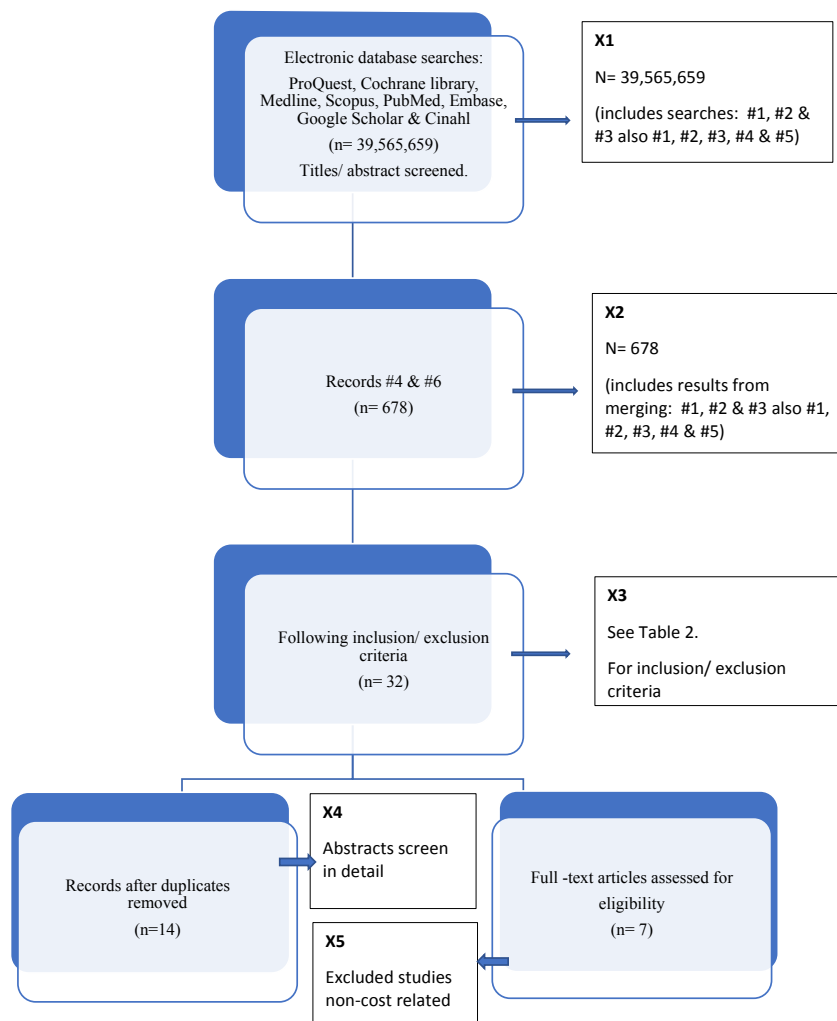


Figure 1. Prisma Flow diagram

were selected as inclusion criteria due to the designated time limit for this project. The exclusion criteria were as follows: literature published before January 2010, non- peer reviewed and no full text available, non-English language and non-UK publications.

After applying inclusion and exclusion criteria 32 studies remained. Duplicates were then removed resulting in total of 14 research studies identified for further critical analysis. Titles and abstracts of 14 studies were explored in detail leading to the purging of a further seven studies based on additional exclusion criteria: one study on foot and ankle surgery, one on management of hip and joint replacement, two articles consisted non relevant orthopaedic procedures, two studies discussed unnecessary reviews and finally guideline related papers were excluded. Seven of these papers had no financial link within the research topic. Finally, seven papers were selected for critical analysis and main themes were selected (Table 1).

An algorithm for classifying study design was used (Appendix I) to enhance the effectiveness of analysis. Caldwell, Henshaw and Taylor (2011) checklist was used for a systematic critical analysis (Appendix II) [2].

## Results

Seven electronic databases were searched by key word and identified 678 results. A PRISMA flow diagram demonstrates how information was systematically selected through different phases of the research process for this narrative review (Figure 1) [1]. After applying inclusion and exclusion criteria 32 studies remained. Duplicates were then removed resulting in total of 14 research studies identified for further critical analysis. Titles and abstracts of 14 studies were explored in detail leading to the purging of a further seven studies based on additional exclusion criteria: foot and ankle surgery, hip and joint replacement, other orthopaedic procedures, papers discussing unnecessary reviews and guideline related studies. Seven of these papers had no financial link within the research topic. Finally, seven papers were selected for critical analysis and main themes were selected (Table 1).

All seven studies (Table 1), were conducted in the UK as the writer tried to identify available evidence only relevant to this country. The VFC model and service redesign was commenced in acute secondary care units, however the main patient management plan and treatment delivered in primary care settings.

As per Table 3, participant sample size and financial data is variable. Potential savings per an individual trust could be estimated up to £425,000. Nationally, from the figures available, an estimated saving of £14 million could be achieved if the VFC model were to be rolled out in every UK trust. The writer found it impossible to produce an overall number of new service redesign sites or professional numbers as some research is not clear on those aspects. Large samples were selected by White, *et al.* (2017) of 12,069 patients and McKirdy and Imbuldeniya (2017) of 17,116 participants [13]. Although both studies had satisfactory samples the results of the retrospective analysis appeared more robust, they also provided p values relating to: reduction in patient numbers attending FTF clinics  $p < 0.0001$  and a statistically

**Table 2.** Inclusion criteria

Inclusion criteria	Exclusion criteria
Jan 2010-Oct 2019	Before Jan 2010
Full text & Peer reviewed	Abstract only
English language	Non-English language
UK only	Non-UK

**Table 3.** Participant sample size and financial data

Studies	Sample size	Cost per patient	Local savings	Savings Nationally
Anderson, <i>et al.</i> (2017)	6,291	£13.97	-	-
Bellringer, <i>et al.</i> (2017)	314	£237	-	-
Brogan, <i>et al.</i> (2017)	663	£122	-	-
Jenkins, <i>et al.</i> (2016)	-	-	£212,705	£3,535,808
White, <i>et al.</i> (2017)	9,233	-	-	-
McKirdy, Imbuldeniya (2017)	17,116	-	£81,920	£129,885
Robinson, <i>et al.</i> (2017)	482	-	£106,000	£45,000-£10,100,000

significant increase in compliance with the BOA guidelines  $p < 0.0001$  [13]. The achievement of British Orthopaedic Association Standards for Trauma 7 (BOAST 7) was 46.4% which is a substantial achievement, yet still 53.6% below an ideal goal.

Robinson, *et al.* (2017) identified a precise focus on stable paediatric fractures and their treatment using a “home management protocol” [15]. Two audits by Bellringer, *et al.* (2017) and Brogan, *et al.* (2017) focused their research on isolated fracture management [16,17]. Bellringer, *et al.* (2017) focused on stable Webber B fracture treatment and was the only study to include sample demographics. Their results showed a treated patient mean age of 50, which included 42.2% of male and 57.8% of female. Therefore, men and women who potentially lead busy working lives, could benefit from the treatment options of the VFC which has theoretical benefits such as: cost savings, reduced level of inconvenience, time management and additional stress. Brogan, *et al.* (2017) states results of £126 per patient for Jones fractures and £88 per patient for all other fifth metatarsal injuries. An astonishing 75% of all 663 patients had an immediate discharge following this injury resulting in 779 avoided clinic visits and an estimated £60,000 savings.

A simulation analysis by Anderson, *et al.* (2017) did not specify their study time period. A prospective data collection by Jenkins, *et al.* (2017) clearly took place over a five-year period. This is important as longitudinal studies are more beneficial, offering several advantages such as following change over time, providing continuous measures and developing a unique insight into a hypothesis [18]. In this case, the benefits of a longitudinal study would be to determine the VFC model effectiveness and sustainability.

Anderson, *et al.* (2017) and Jenkins, *et al.* (2016) focused on determining the cost effectiveness of service redesign using the VFC model. They were both written by the same authors working in the same trust therefore it is likely that results relating to cost effectiveness will be comparable in both papers. Interestingly, the writer felt that the simulation analysis was superior to Jenkins, *et al.* (2016) due to increased focus and conciseness.

## Discussion

Seven studies were selected to explore true cost savings using the VFC model versus the traditional fracture clinic model. Evidence searched between Jan. 2010- Oct. 2019. This is the first narrative review of published literature exploring cost effectiveness of the VFC model. Three main themes have been chosen to explore in depth:

### Cost effectiveness

-Legal aspects & Tariff



## Care delivery

- Time management
- Quality improvement

## Safety and sustainability

- Advantages and disadvantages

“Effective use of resources is fundamental to enable health and social care providers to deliver and sustain high quality services for people” [19].

Understanding potential financial implications for any service is important, especially in the NHS. The NHS long-term plan sets some ambitious targets to improve current services by injecting an additional £20.5 billion in the next five years, however, austerity in healthcare is ongoing and expected to increase with social spending pressures rising at an average 3.7 per cent a year until 2030/31 [20]. When planning or evaluating practice and service improvement, cost must be considered and calculated accurately to reduce the chance of further decline in NHS finances. The purpose of this narrative review is to evaluate the current literature on how cost effective the VFC model is deemed to be.

A systematic search process (Table 2) revealed the final body of evidence available on this narrative review subject. All identified studies mention cost savings; however, it is important to understand and critically analyse the validity of those results. Six papers out of seven provided local cost savings when using the VFC model and an estimated sum in the UK. Anderson, *et al.* (2017) state their VFC model savings for attendance as £22.58 and overall reduction in cost by £13.97 per patient from a study sample of 6,291 participants. Similarly, an audit by Bellringer, *et al.* (2017) state their savings of £237 per patient and provided a one-year estimate of over £37,000 in cost savings. A clinical audit by Brogan, *et al.* (2017) also gives cost saving margins classified to one fracture and then accumulative cost for all others. For management of Jones fractures using the VFC model Brogan, *et al.* (2017) state savings of £126 and for a management of fifth metatarsal I and II fractures they state savings of £88 per patient. Overall £62,600 cost savings over a two-year period treating fifth metatarsal I, II and III fractures using the VFC pathway were identified by Brogan, *et al.* (2017). A retrospective analysis by Jenkins, *et al.* (2016) found savings of £212,705 in comparison to the national average using the VFC model. The care was delivered at the GRI Trust over the five-year period between 2009-2014. However, the GRI trust was noted to be 11% below the national average on staffing cost and an outpatient department capacity, therefore their total cost savings of £212,705 may differ from any other part of the UK depending on a trust by trust basis. An estimated annual CCG's savings of £3,535,808 have been suggested by Jenkins, *et al.* (2016) if the VFC model was initiated throughout the UK over the five-year period. Jenkins, *et al.* (2016) calculated their cost saving using The Scottish Cost Book, evidently this is a comparison system of various cost saving elements within the Health Services of Scotland, however to predict these cost savings elsewhere would be questionable as the Scottish Cost Book is only relevant to the Scottish geographical area. This article does not show how the study sample was selected or randomised, or what the number of participants were, Jenkins, *et al.* (2016) only provides their evidence based on NHS financial returns for the purpose of service redesign over 2009-2014. This lack of detail and demographic information makes generalising or transferring their findings to other contexts unreliable.

An observational one-year cohort study with one year follow up by White, *et al.* (2017) has not included any financial data in their

article although, an infographic poster which derived from this study implied a 25% cost saving using the VFC model in their geographical area (Appendix III). However, White, *et al.* (2017) mentions a tariff and according to their study, Scotland does not operate patient attendance tariffs, unlike England. There is a potential loss of £130 attendance tariff to the trust in England if they choose to initiate fracture clinic re-design. White, *et al.* (2017) state 12,069 referrals were received in one calendar year, however the total sample number relating to the VFC is not clearly defined as 2,836 patients were brought for surgical review, 2,366 people attended a specialist clinic and another 2,776 were seen by a nurse practitioner.

McKirdy and Imbuldeniya (2017) declare annual savings of £81,920 in their locality, with an estimated financial figure of £129,885.67 for their Clinic Commissioning Group (CCGs). The only prospective analysis study looking at fracture clinic re-design in paediatrics, over a 20-month period, estimated £106,000 annual savings to the area and predicted future savings of £45,000 to CCGs and an estimated £10.1 million if the VFC model were to be used in all hospitals nationally [15].

The legal aspects of new service re-design model must be discussed as it has an impact on potential cost savings. Jenkins, Stephenson and Rymaszewski (2016) report that VFC in the GRI was introduced in 2011, with the service receiving no complaints or legal actions from diagnosis or management of patients using the VFC model, that includes up to 8,000 patients per year. However, by providing service such as the VFC, professionals could be subjected to further legal liability. Primarily, as there are no set standards of information delivery to those patients seen in the VFC [21]. Robinson, *et al.* (2017) demonstrate satisfactory communication with their service users. They had advice leaflets designed for parent information about the new home protocols and an advice leaflet for an individual condition with care instructions when at home. Robinson, *et al.* (2017) also provided a letter to their participants which explained post review outcomes and kept an open appointment for an FTF if required. To minimise the risk or liability, Robinson, *et al.* (2017) excluded non-English speaking families and automatically diverted those to traditional clinics with the assistance of an interpreter. Other papers reviewed (Table 1) had not stated specific choices of communication for those people referred to the VFC. A uniform design must be found nationally for the use of the VFC to become sustainable in order to minimise injury to patients and risk of litigation to professionals.

Care delivery is one of the other main themes identified in this literature review. The patient focused approach is part of the foundations of nursing and an important subject discussed in the Care and Quality Commission (CQC) report by Behan and Richards (2018). This theme has two sub themes which are relevant to the main topic of further discussion: time management and quality improvement. All studies referenced (Table 2) aimed to confirm safety and patient satisfaction when applying the VFC model in their departments.

Robinson, *et al.* (2017) selected 482 children with stable injuries for the first time in this field to confirm the claims of safety when applying the VFC model in care delivery. This study found reductions in patient attendance and other related benefits such as more complex cases receiving more timely paediatric orthopaedic consultants' expertise. Jenkins, *et al.* (2016) shared similar conclusions when focusing on quality of care delivery and prove that their service redesign had not led to any harmful events in the GRI trust. They demonstrated 10% reduction in patient attendance, hence quality improvement for all patients in those units, not just participants. Research by Brogan, *et al.* (2017) and White, *et al.* (2017) also provided evidence that patient

management via the VFC pathway does not cause any harm for those patients referred. Brogan, *et al.* (2017) conclude that the VFC system can be standardised with high-quality to all patients with fifth metatarsal injuries as a safe and effective way of care delivery to patients.

An audit by Bellringer, *et al.* (2017) shows improvements in patient experience and safe delivery of newly redesigned services. This is the only study from the selected evidence (Table 1) which provides the reader with study sample demographics. This is important as participant's data indicates a mean average age being 50, of which 42.2% male and 57.8% female. Thus, suggesting working age people who have work and childcare commitments and for whom time management maybe difficult may benefit particularly. Bellringer, *et al.* (2017) demonstrate better time management and cost savings for this group of patients when their treatment was provided via the VFC. A simulation study by Anderson, *et al.* (2017) shares similar aims to improve patient outcomes and satisfaction. Saving time and improvement in patient flow management appeared common findings. McKirdy and Imbuldeniya (2017) state service improvement in several clinical areas with their interrupted time series analysis. They have evidently improved time management by reducing patient waiting times, enhanced quality of care to their patients by increasing the number of patients seen in the first 72 hours and achieved 46.4% of patients seen within 72-hour period as per BOA guidelines (McKirdy and Imbuldeniya, 2017). Anderson, *et al.* (2017) attained increased patient capacity and activities by providing high standard care delivery for over 30,000 patients managed using the VFC pathway between 2011-2016.

It is evident that the care delivery for patients managed using the VFC model revealed no negative impact on their treatment or experience in any of the seven studies (see table 1). White *et al.*, (2017) and Robinson *et al.*, (2017) state their primarily aim of the research was safety when using the VFC model of care delivery. The importance of time management is evident in Anderson *et al.*, (2017) and McKirdy and Imbuldeniya's (2017) studies. Although all studies focused on quality of care and patient's satisfaction, research by Bellringer, *et al.* (2017), Brogan, *et al.* (2017) and Jenkins, *et al.* (2016) demonstrated more detailed and significant emphasis on these aspects.

Safety and sustainability of service re-design are another essential component of responsible patient management. A service which continues to provide safe care and management of people would suggest long term financial stability which leads to an economic strength in local trusts and more importantly high rates of patient satisfaction. Service redesign of current fracture clinics must be undertaken to take full advantage of Improved technology and expertise.

Since 2015 nurse and doctor numbers have been falling according to the National Audit Office (2019), however over 2,500 professionals registered to work in the UK from outside the European Economic Area (EEA) for the first time [22]. The Nursing and Midwifery Council (NMC) (2019) has confirmed a sudden increase of over 8,000 more nurses and midwives from outside the European Union (EU) in comparison to last year [23]. This rapid influx of nursing professionals to the UK may be due to higher job opportunities in the UK when compared to other Non-EU countries such as India, Philippines, but does not suggest a long term sustainable work force in the UK [22].

Hospitals across the UK are struggling to achieve government targets as service costs are rising [6]. As technology is improving fast, traditional hospital patient management and care must evolve into new services such as the VFC. With an aging population worldwide, acute hospitals continue to be in demand, however many acute hospitals

may not survive this fast-artificial intelligence change due to various obstacles such as financial issues, regular staffing problems and changes in government plans.

To achieve a more sustainable future for secondary care facilities health care managers need to re-design models of traditional care and create new workforce policies in order to adapt. Stepping away from a traditional fracture clinic model since 1935 to a model of the VFC can be a beneficial starting point in this journey [11]. Such changes are more accessible and affordable in the NHS healthcare environment rather than in private care facilities currently, making the NHS ideally placed to demonstrate its capability and commitment to service redesign to cope with rising demand.

The format of the VFC can be a videoconference for example, between a professional and a patient in the comfort of their own home. This would reduce time, decrease financial concerns and most importantly reduce people's anxiety and frustration at waiting for an appointment for several hours. In addition, the VFC patients would be likely to feel more in control of their own care and management of their injury than before. Patient compliance to treatment rates would potentially increase due to higher attendance and less did not attend (DNAs). Service re-design could lead to some patients changing their priorities. Without the opportunity of the VFC, for example, a single mum who cares for a number of children may choose to prioritise her children, neglect her own health care needs. Therefore, the VFC offers an opportunity to be treated and increase some peoples' compliance and wellbeing.

The traditional model of fracture clinics is outdated [11]. It was a service improvement at the time, yet it was aligned to provider's, not the patients' needs and these FTF clinics experienced high numbers of patient non-attendance with financial implications for all trusts [24]. Non-attendance also results in poor management of injuries for those patients and can have an impact on greater emergency medicine use.

Critically analysed articles selected for this narrative review confirm that successful adoption of the VFC model produces safe children and adult orthopaedic care delivery (Table 1).

Greater emphasis on patient safety was evident in four studies: Bellringer, *et al.* (2017), Brogan, *et al.* (2017), Jenkins, *et al.* (2016) and Robinson, *et al.* (2017) provided the reader with additional awareness on children and adult protection and wellbeing during the study period. These four studies demonstrate that use of the VFC model of care, rather than continuing with traditional FTF patient review, has the potential to solve issues such as: time management, high costs to patients and departments, high levels of anxiety, inadequate and inefficient use of professional experience and patient inconvenience.

## Conclusion

The aim of this first narrative review is to establish the cost effectiveness of the VFC model for both children and adults' orthopaedic management in the UK. A systematic approach was taken to identify topic relevant searches. Although, there is paucity of published evidence on the VFC model seven relevant articles conclude that there are potential cost savings to be made. Financial data was variable, it ranged from £13.91 per patient to £122. Individual study trusts estimated variable cost savings, ranging from £81,920 to £212,705, also Nationally approximate projections confirmed sums reaching £1.1 million per year. Overall, an estimated sum of £425,000 nationally and anticipated saving of £14 million could be achieved if the VFC model would be rolled out in every UK trust.

The summary of the literature demonstrates that service re-design to VFCs has been successfully adopted alongside traditional fracture clinics does not require additional staff members or new clinic appointments. In fact, time savings achieved from using the VFC resulted in the ability to open additional services and devoting extra consultant time to those patients who needed their care and expertise the most. There was no evidence of compromising care delivery or declining standards in the quality of treatment. There was no evidence of breach of safety. Therefore, the VFC model is sustainable in relation to safety.

However, the legal aspects of the new service re-design must be considered as it has potential implications to future cost savings. Current evidence shows no complaints or legal actions from diagnosis or management of patients using the VFC model, however, by providing service such as the VFC, professionals could be subjected to further legal liability, primarily, as there are no set standards of information delivery to those patients seen in the VFC.

This narrative review has outlined that the new service redesign is effective in relation to a number of different aspects of care, however the orthopaedics department will never be managed through the VFC pathway alone due to complex injuries and the range of service users and their specific needs. Consequently, traditional fracture clinics will remain in high demand, however, to improve the management of high patient influx especially, over seasonal terms, the VFC model alongside FTF clinics is a sensible and sustainable option in the UK.

Currently, there are limited resources from which conclusions could be drawn relating to management of orthopaedic conditions, cost effectiveness, quality and safety, patient satisfaction rates and management when using the VFC model. Proposed financial projections cannot be taken for granted at this present time. Further robust evidence such as RCTs or systematic reviews with meta-analysis are required before final conclusions can be drawn regarding cost effectiveness when using the VFC model throughout the UK. One of the main gaps in the current literature identified by the researcher is a lack of research focussing on patient experience and satisfaction. Further research in this area is required.

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