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Optimizing the pathway for simple stable fractures

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Aims

In the Netherlands, general practitioners (GPs) can request radiographs. After a radiologically diagnosed fracture, patients are immediately referred to the emergency department (ED). Since 2020, the Máxima Medical Centre has implemented a new care pathway for minor trauma patients, referring them immediately to the traumatology outpatient clinic (OC) instead of the ED. We investigated whether this altered care pathway leads to a reduction in healthcare consumption and concomitant costs.

Methods

In this retrospective cohort study, patients were included if a radiologist diagnosed a fracture on a radiograph requested by the GP from August to October 2019 (control group) or August to October 2020 (research group), on weekdays between 8.30 am and 4.00 pm. The study compared various outcomes between groups, including the length of the initial hospital visit, frequency of hospital visits and medical procedures, extent of imaging, and healthcare expenses.

Results

A total of 634 patients were included. The results show a median reduction of 25 minutes in duration of initial hospital visits, one fewer hospital visit, overall fewer medical procedures, and a decrease in healthcare costs of €303.40 per patient in the research group compared to the control group. No difference was found in the amount of imaging.

Conclusion

The implementation of the new care pathway has resulted in a substantial reduction in healthcare use and costs. Moreover, the pathway provides advantages for patients and helps prevent crowding at the ED. Hence, we recommend immediately referring all minor trauma patients to the traumatology OC instead of the ED.

Cite this article: *Bone Jt Open* **2023;4-10:728–734.**

Keywords: Trauma, Fracture, Simple stable fractures, Emergency department

Introduction

In the Netherlands, general practitioners (GPs) can request radiographs in hospitals. Once a fracture is diagnosed by the radiologist, the patient is immediately referred to the emergency department (ED) and reviewed by the ED team (consisting of emergency physicians).[1] There, a plaster cast is applied if repositioning or surgery is not necessary. Only when surgery is needed will a patient be reviewed by someone from the surgery or orthopaedic department at the ED. After this conservative treatment, a fracture check takes place after five to eight days in the traumatology outpatient clinic (OC). At the OC, patients will be reviewed by someone from the surgery or orthopaedic department. In some cases, a new radiograph may need to be obtained before the scheduled appointment.[1]

As they are given the lowest priority, trauma patients referred secondarily often must endure lengthy waiting times in the ED before receiving treatment.[2] Therefore, Máxima Medical Centre (MMC), a 614-bed teaching hospital in the Netherlands, has changed its care pathway regarding minor trauma. Since April 2020, when a fracture

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doi: 10.1302/2633-1462.410.BJO-2023-0079.R1

Bone Jt Open 2023;4-10:728–734.

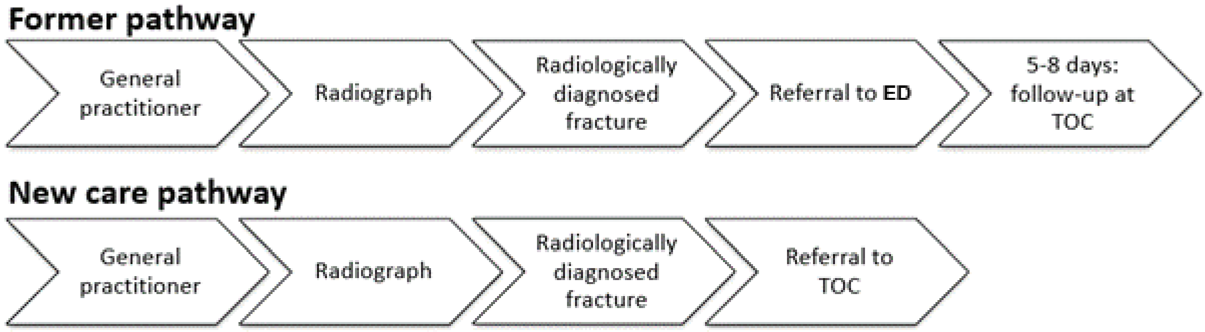

Fig. 1

Flow diagram of the former and new care pathways. ED, emergency department; GP, general practitioner; TOC, traumatology outpatient clinic.

is diagnosed, patients are immediately referred to the trauma OC instead. To our knowledge, this adjustment to the care pathway for fracture patients has not been studied before. Literature on slightly different adjustments is scarce, but results are promising.[3,4] Figure 1 shows a flow diagram of the former and new care pathways.

Accordingly, this study aimed to describe beneficial healthcare consumption and costs of immediately referring patients to the traumatology OC after diagnosis instead of the ED. We hypothesized that the new care pathway leads to shorter duration of hospital visits, fewer hospital visits, less imaging, fewer medical procedures, and a decrease in healthcare costs.

Methods

Study design. A retrospective cohort study was conducted, including two groups of patients who visited our clinic, before and after the introduction of the new care pathway. To preclude any seasonal effects, we selected patients in the same months of 2019 and 2020.

Approval of the medical ethical committee was requested but formal approval was deemed unnecessary, according to Dutch law (METC Máxima MC, N21.058, 21 June 2021). The study procedure was approved by our Institutional Review Board (2021-MMC-63, 15 July 2021). The necessity to obtain informed consent of each participant was waived on the condition that patients had not objected against the use of their medical data for research purposes.

Patients. Patients were included who received a radiograph that was requested by a GP in either August to October 2019 (control group), or August to October 2020 (research group), on weekdays between 8.30 am and 4.00 pm. This radiograph then needed to show a fracture that was diagnosed by the radiologist.

Excluded were patients dependent on ambulance transport and/or bed transport. In addition, this study reviewed simple stable fractures. Therefore, patients with an obvious need for admission and/or surgery, patients with an open fracture, and patients with facial fractures were also excluded. Furthermore, patients who previously objected to the use of their medical data for scientific research (opt-out in electronic files) were excluded.

Participants. During the period of August to October 2019 and August to October 2020, 739 patients meeting inclusion criteria were admitted to the ED or were seen at the traumatology OC. A total of 105 of these patients were excluded, for reasons shown in Figure 2. Consequently, 321 patients were retrospectively included in the control group and 313 patients were included in the research group. The flowchart depicting inclusion and exclusion is summarized in Figure 2.

An interesting difference between the number of excluded patients who needed reposition between both study groups is presented in the flowchart. This difference might be explained by variation in training levels of the staff in both groups. ED staff might be more guarding than the (orthopaedic) surgeons because they have less experience, and therefore may perform more repositions to optimize the fracture position.

Baseline characteristics. Baseline characteristics of the study population are comparable between the research and control groups (Table I). The only difference can be found in the amount of rib fractures, which has a higher percentage in the control group than in the research group (0.6% vs 3.0%, respectively).

Data collection. To address the research question, the researchers gathered the following data from the medical records: age (years), sex, fracture type, the number of hospital visits (including consultations by phone), the number of days elapsed from the date of the trauma to the date the patient presented at the hospital, the time spent in the hospital during the initial visit (starting at the time the radiograph was made until the doctor recorded the treatment in the electronic file (research group), or until the patient left the ED (control group)), the total number of imaging procedures performed (including radiography, MRI, CT, and ultrasound), the amount of changes in medical procedures (for example, changes in cast or from cast to an orthosis), and the overall healthcare costs per patient.

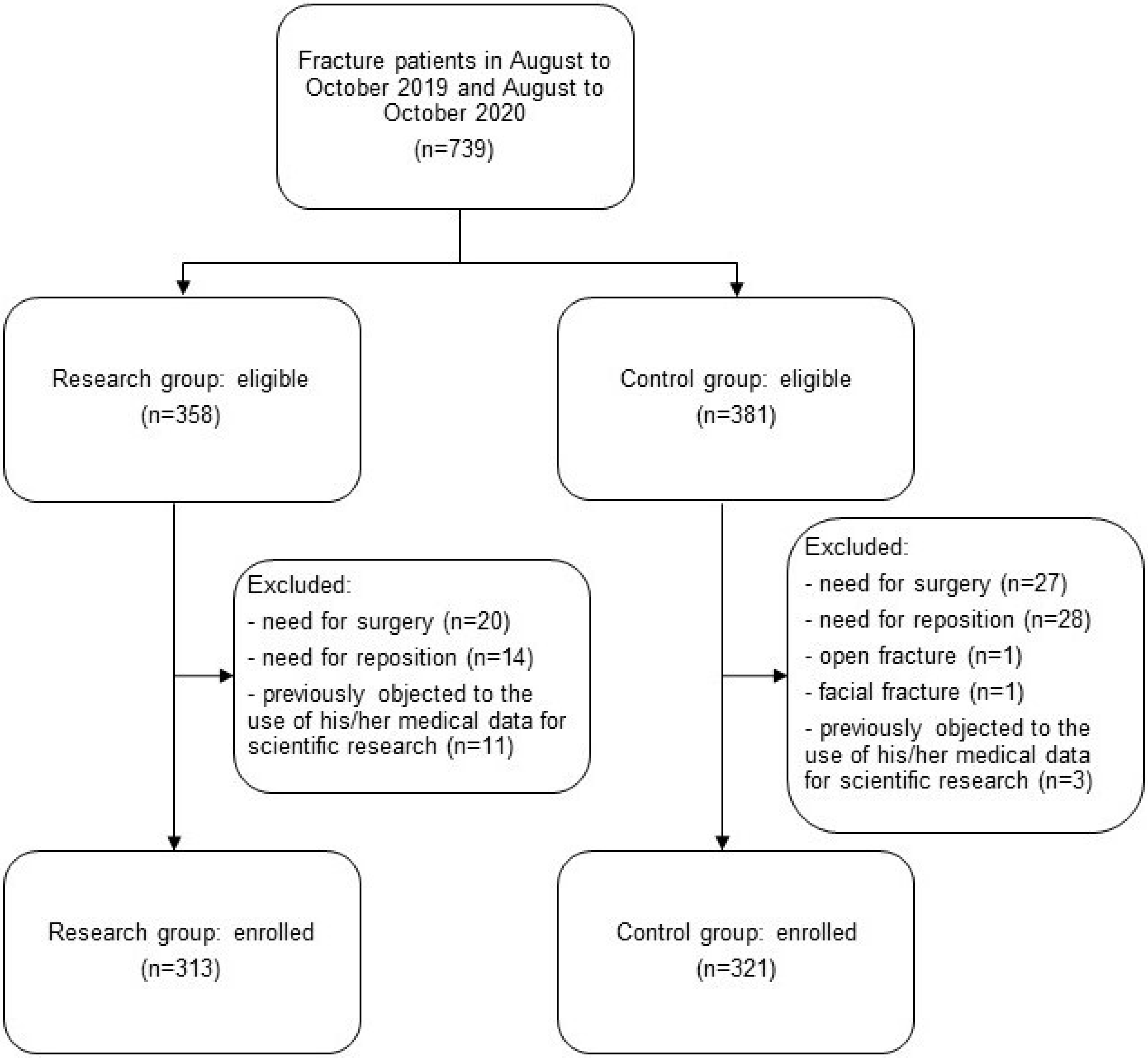

Fig. 2

Flowchart of patients included and excluded in the study groups.

The overall healthcare costs were measured as the combined costs for doctor visits (costs for the initial visit at the traumatology OC or ED and the amount of repeat consultations multiplied by the standard consultation fee), imaging (multiplying the usage of a particular imaging modality by the corresponding standard fee), and medical procedures (multiplying the frequency of a certain medical procedure by its standard fee). These data were collected, analyzed, and compared between both groups.

Statistical analysis. As no prior studies were available, we could not perform a precise sample size calculation. However, in the three-month period, data were available from 321 patients in the control group and 313 patients in the research group. We postulated that a study population of 634 patients would be sufficient to demonstrate even relatively small differences between the two groups, i.e. an effect size (d) of 0.26, based on a power of 90%, $\alpha = 0.05$ and equal group sizes. All statistical analyses were performed with SPSS for Windows version 28 (IBM, USA), and a p-value < 0.05 was considered significant for all statistical tests.

The baseline characteristics and outcome measures were compared between both groups and described as mean with standard deviation (SD), median with interquartile range (IQR), or absolute value with percentage, depending on the characteristic. Dichotomous variables were analyzed by Pearson's chi-squared test. For

Table I. Baseline characteristics. Continuous variables are presented as mean (standard deviation) or median (interquartile range), depending on the normality of the data distribution. Dichotomous variables are presented as n (%).

Variable	Total (n = 634)	Research (n = 313)	Control (n = 321)	p-value
Sex (male)	320 (51)	161 (51)	159 (50)	0.631‡
Age, yrs	40.2 (26.6)	39.0 (26.9)	41.2 (26.4)	0.296§
Time between trauma and hospital visit, days*	2 (1 to 5)	2 (1 to 7)	2 (1 to 5)	0.455¶
Multiple fractures	17 (3)	7 (2)	10 (3)	0.493‡
Type of fracture†				0.062‡
Clavicle	31 (5)	17 (5)	14 (4)	
Upper arm	16 (3)	11 (3)	5 (2)	
Scapula	1 (< 1)	0 (0)	1 (< 1)	
Acromion	1 (< 1)	0 (0)	1 (< 1)	
Glenoid	1 (< 1)	0 (0)	1 (< 1)	
Distal humerus	1 (< 1)	1 (< 1)	0 (0)	
Mid-shaft humerus	1 (< 1)	1 (< 1)	0 (0)	
Humeral condyle	11 (2)	9 (3)	2 (1)	
Proximal humerus	20 (3)	8 (3)	12 (4)	
Radial head	30 (5)	17 (5)	13 (4)	
Lower arm	34 (5)	20 (6)	14 (4)	
Olecranon	2 (< 1)	1 (< 1)	1 (< 1)	
Radial neck	7 (1)	4 (1)	3 (1)	
Mid-shaft radius	1 (< 1)	1 (< 1)	0 (0)	
Mid-shaft ulna	1 (< 1)	1 (< 1)	0 (0)	
Both bone forearm	6 (1)	4 (1)	2 (1)	
Distal ulna	2 (< 1)	1 (< 1)	1 (< 1)	
Radial styloid	10 (2)	7 (2)	3 (1)	
Ulnar styloid	5 (1)	1 (< 1)	4 (1)	
Distal radius	81 (12)	37 (12)	44 (13)	
Hand: carpals	23 (4)	15 (5)	8 (2)	
Finger: metacarpals and phalanges	168 (26)	74 (23)	94 (28)	
Other	13 (2)	2 (1)	11 (3)	
Sternum	1 (< 1)	0 (0)	1 (< 1)	
Rib	12 (2)	2 (1)	10 (3)	
Vertebrae of the spinal column	26 (4)	12 (4)	14 (4)	
Lower limbs	20 (3)	13 (4)	7 (21)	
Pelvis	2 (< 1)	2 (1)	0 (0)	
Femur	1 (< 1)	1 (< 1)	0 (0)	
Patella	6 (1)	3 (1)	3 (1)	
Tibial plateau	3 (1)	2 (1)	1 (< 1)	
Fibular head	1 (< 1)	0 (0)	1 (< 1)	
Proximal fibula	2 (< 1)	1 (< 1)	1 (< 1)	
Mid-shaft tibia	3 (1)	2 (1)	1 (< 1)	
Mid-shaft fibula	1 (< 1)	1 (< 1)	0 (0)	
Cruris	1 (< 1)	1 (< 1)	0 (0)	
Lateral and medial malleolus	64 (10)	27 (8)	37 (11)	
Foot	125 (19)	67 (21)	58 (18)	

Differences analyzed using Pearson's chi-squared test, independent-samples *t*-test, or Mann-Whitney U test as appropriate.
*These data were missing for 52 patients. Furthermore, two patients with multiple fractures had their fractures diagnosed on two different days, which are both included in the analysis. This resulted in: n = 584 (research group, n = 274; and control group, n = 310).
†The baseline characteristics have been measured per patient, whereas the fracture types have been measured per fracture. Since 17 patients had two fractures, the total number is higher for the fracture types. This means that n = 651 (research group, n = 320; and control group, n = 331).
‡Pearson’s chi-squared test.
§Independent-samples *t*-test.
¶Mann-Whitney U test.

continuous variables, an independent-samples *t*-test or a Mann-Whitney U test was used, depending on the distribution of the data.

Results

Outcomes. All outcome measures were compared between the research and control groups and are presented

Table II. Results of outcome measures between the two groups. Continuous variables are presented as median (interquartile range). Dichotomous variables are presented as n (%).

Variable	Total (n = 634)	Research (n = 313)	Control (n = 321)	p-value
Time spent during the first hospital visit (mins)*	76.0 (53.0 to 102.0)	62.0 (42.0 to 85.5)	87.0 (70.0 to 118.0)	< 0.001‡
0 to 30	43 (7)	40 (13)	3 (1)	< 0.001§
31 to 60	161 (25)	111 (36)	50 (16)	
61 to 90	212 (33)	92 (29)	120 (37)	
91 to 120	125 (20)	46 (15)	79 (25)	
≥ 121	95 (15)	24 (8)	71 (22)	
Hospital visits (n)	2 (2 to 3)	2 (1 to 3)	3 (2 to 4)	0.001‡
1	150 (24)	95 (30)	55 (17)	0.003§
2	188 (30)	89 (28)	99 (31)	
3	142 (22)	60 (19)	82 (26)	
4	77 (12)	33 (11)	44 (14)	
≥ 5	77 (12)	36 (12)	41 (13)	
Imaging (n)	1 (1 to 2)	1 (1 to 2)	1 (1 to 2)	0.762‡
> 1 modality	36 (6)	16 (5)	20 (6)	0.543§
Medical procedures (n)†	0 (0 to 1)	0 (0 to 1)	0 (0 to 1)	< 0.001‡
0	415 (65)	228 (73)	187 (59)	0.003§
1	136 (21)	56 (18)	80 (25)	
2	53 (8)	19 (6)	34 (11)	
≥ 3	27 (4)	10 (3)	17 (5)	
Healthcare costs, €	492.1 (308.9 to 701.3)	308.7 (210.1 to 474.6)	612.1 (495.1 to 817.2)	< 0.001‡
Hospital visits	391.9 (170.2 to 537.5)	170.2 (129.1 to 296.7)	536.9 (414.5 to 584.7)	< 0.001‡
Imaging	29.2 (29.2 to 58.4)	29.2 (29.2 to 58.4)	29.2 (29.2 to 58.4)	0.469‡
Medical procedures	63.6 (14.1 to 150.3)	63.5 (14.1 to 137.7)	63.8 (14.1 to 167.0)	0.408‡

*Two patients with multiple fractures had their fractures diagnosed on a different day, and have therefore been at the hospital for a first visit twice. This resulted in: n = 636 (research group, n = 313; and control group, n = 323).
†These data were missing for three patients. This resulted in: n = 631 (research group, n = 313; and control group, n = 318).
‡Mann-Whitney U test.
§Pearson's chi-squared test.

in Table II. The median time spent during the initial hospital visit was 25 minutes shorter for the research group (62 vs 87 minutes; $p < 0.001$, Mann-Whitney U test). The median number of hospital visits was also lower in the research group (2 vs 3; $p = 0.001$, Mann-Whitney U test). Moreover, fewer medical procedures were executed in the research group than in the control group ($p < 0.001$, Mann-Whitney U test). While most individuals in both groups did not require any medical procedures, the number of patients who underwent one or more procedures was lower in the research group (27% vs 41% in the control group; $p = 0.003$, Pearson's chi-squared test). Additionally, total healthcare costs were lower for the research group than for the control group (€308.70 vs €612.10; $p < 0.001$, Mann-Whitney U test). This cost reduction was caused by a variance of €200 in the costs for a first visit at the traumatology OC or the ED and one fewer hospital visit, which saved approximately €100 for the research group. No difference was found in healthcare costs for imaging and medical procedures, nor was a difference found between the median number of radiological images (median 2 (IQR 1 to 2); $p = 0.762$, Pearson's chi-squared test) or the number of patients who required more than one radiological modality ($p = 0.543$, Pearson's chi-'squared test).

Discussion

The present analyses show that the new care pathway leads to shorter initial hospital visits, fewer hospital visits, a reduction in the number of medical procedures, and a considerable overall decrease in healthcare costs. No reduction in imaging was found.

The new fracture care pathway implemented by MMC provides a novel model of care resulting in a decrease in workload at the ED. The intervention involved referring patients with radiologically diagnosed fractures, identified through a radiograph requested by their GP, to the traumatology OC instead of the ED. The implementation of the new care pathway did not lead to an increase in workload at the traumatology OC, as a pilot was conducted to determine when and how many appointment slots at the clinic should be kept vacant for these fracture patients.

The efficacy of various care pathways for fracture patients remains unclear. Several initiatives on other care pathways have been studied. First, the Trauma Triage clinic (TTC) in Edinburgh, UK presents a new way of triaging in the ED. The presence of risk factors in relation to the complication of recovery of a fracture was examined by a consultant-supervised nurse practitioner directly via the

ED or after a telephone consultation. If these risk factors applied, a medical specialist was immediately involved. Otherwise, a patient was sent home with a removable orthosis. A patient was also referred to the TTC to receive a definitive treatment plan.[3] Our study showed that this care pathway is a safe and effective method for the treatment of minor traumas. Although all patients in our study were seen by a medical specialist, we found similar results: fewer hospital visits were necessary to accomplish the same treatment outcome, making it an effective care pathway. Moreover, both studies found a decrease in healthcare costs per patient (£130 (€155, 22 November 2021) for the TTC versus €303 for this present study). However, we found a larger decrease in healthcare costs, since our patients did not visit the ED at their initial hospital visit. This saved approximately €200 per patient for the first hospital visit alone. The other €100 per patient was saved because of one fewer hospital visit. Although the research group overall had fewer medical procedures, no difference was found in costs for medical procedures since circular casts and walking casts were more common in the research group than in the control group. Such casts are more expensive than plaster casts (which were more common in the control group). No difference was found in imaging costs in this present study.

The Virtual Fracture Clinic (VFC) 1.0, implemented in Amsterdam, Netherlands, is akin to the TTC. Patients with a radiologically diagnosed fracture in the ED were provided a brace or pressure bandage to be removed themselves. Since these patients did not receive a plaster cast, they did not need follow-up visitations in the OC or plaster room. This resulted in a decrease of 91% in repeat consultations and a decrease of 72% in imaging, while patient satisfaction and treatment outcomes remained the same.[5] In the present study, we did not see a reduction in imaging because in our former protocol, no routine follow-up imaging was enclosed except for proximal humeral fractures. Furthermore, we found a decrease in repeat consultations. However, we only found a decrease of 33% in repeat consultations and no significant difference in imaging between both care pathways. Meanwhile, the VFC 1.0 had fewer physical repeat consultations than MMC (mean 1.3 vs 1.9 repeat consultations) and repeat imaging (mean 0.3 vs 0.7 repeat imaging) per patient at baseline.[5] This difference in number of repeat consultations may be attributable to a difference in definition; the VFC 1.0 only calculated physical repeat consultations, while we calculated both physical consultations and consultations by telephone. In the VFC 1.0 study, most follow-up checks were planned by telephone. Nevertheless, if follow-up by telephone or video calling would have been included, the VFC 1.0 would still have found a larger reduction in the number of repeat consultations than the present study. On the other hand, the VFC 1.0 found a smaller mean decrease in healthcare costs per patient (€86 versus €291.73). Although a median was used for healthcare costs in the current study, we here present the mean to enable comparison with results of the VFC 1.0. This difference between both studies is caused by the difference in costs for an ED visit versus an OC visit. Both study groups in the VFC 1.0 visited the ED, whereas patients in our study visited the traumatology OC, saving approximately €200 per patient. The decrease in health costs in the VFC 1.0 can be explained by a reduction in repeat consultations and imaging.

Another initiative, the VFC 2.0, also implemented in Amsterdam, is a fast-track process in the ED in which patients receive a plaster, bandage, or removable brace after a radiologically diagnosed fracture. The next working day, the patient's case is discussed by a specially equipped team, led by a medical specialist, after which the patient receives a treatment proposal and the dates of the planned telephone or video call follow-up. The VFC study found a shorter hospital stay during the initial hospital visit, comparable to the present study.[6]

Consequently, three systematic reviews concluded that other VFCs appeared to be safe, cost-effective, and efficient in treating patients with minor traumas.[7–9] These VFCs are different from VFC 1.0 and VFC 2.0 implemented in Amsterdam, and different from the care pathway presented in the current study. In the case of a suspected fracture, patients who visit VFCs undergo a radiograph, but they do not receive the results or visit the ED, nor are they contacted by a traumatologist afterwards. The next working day, the radiograph is reviewed by the radiologist, after which the patient is called by a traumatologist and informed about the policy. Although patients in the reviewed studies had to return to the hospital the day after their radiograph, unlike patients in the present study, these studies also demonstrated a decrease in healthcare costs.

The present study has several strengths. To our knowledge, this is the first study to assess the effectiveness of a care pathway in which patients do not visit the ED after the diagnosis of a simple stable fracture. Second, the present study had a large sample size (n = 634), providing a reasonably accurate representation of the outcomes that could be expected if this care pathway was implemented in the population. Third, as far as we know, this is also the first study to evaluate the number of medical procedures for a new care pathway for minor trauma patients. Other studies have analyzed cost-effectiveness and differences in frequency of imaging and number of hospital visits, but not the differences in the number of medical procedures. Finally, the cost-effectiveness of a comparable, albeit not identical, care pathway has been analyzed by Mackenzie et al.[4] While they recommend further research into the clinical effectiveness and cost-effectiveness of the

TTC, the present study assessed these two factors and is therefore a complement to the known literature about new care pathways for fracture patients.

This study also has several limitations. First, the data were obtained retrospectively, hence we were not able to analyze patient satisfaction. Nevertheless, the information for the most relevant outcome measures to analyze cost-effectiveness was present. Second, obtaining data on the time spent by patients in the hospital was somewhat challenging for the research group, as it involved using the time log from the notes in the electronic patient file. However, we believe that any potential information bias resulting from this challenge is minimal, based on our understanding of daily practice. It is recommended that future research into other care pathways for minor trauma patients focuses on other relevant outcome measures, such as treatment outcome and patient satisfaction.

We conclude that our new care pathway results in shorter initial hospital visits, fewer hospital visits, a reduction in medical procedures, and a substantial reduction in healthcare costs. Therefore, we recommend that each patient with a simple stable fracture diagnosed by a radiologist is referred to the traumatology OC instead of the ED. It is a cost-effective method of treating fracture patients that can prevent crowding at the ED.

Take home message

- Literature on the effectiveness of altered care pathways for fracture patients is scarce but promising.
- Our findings indicate that immediately directing patients with radiologically diagnosed fractures to the traumatology outpatient clinic instead of the emergency department reduces healthcare use and associated costs.

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- R. M. H. Roumen: Writing – review & editing.
- W. A. van Dijk: Conceptualization, Formal analysis, Supervision, Writing – review & editing.

Funding statement:
- The authors received no financial or material support for the research, authorship, and/or publication of this article.

Data sharing:
- The datasets generated and analyzed in the current study are not publicly available due to data protection regulations. Access to data is limited to the researchers who have obtained permission for data processing. Further inquiries can be made to the corresponding author.

Acknowledgements:
- The authors thank 'Ejear editing' for their language editing services.

Ethical review statement:
- Approval of the medical ethical committee was requested but formal approval was deemed unnecessary, according to Dutch law (METC Máxima MC, N21.058, 21 June 2021). The study procedure was approved by our Institutional Review Board (2021-MMC-63, 15 July 2021). The necessity to obtain informed consent of each participant was waived on the condition that patients had not objected against the use of their medical data for research purposes.

Open access funding:
- The authors report that they received open access funding for their manuscript from the Máxima Medical Centre research fund.

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