

RESEARCH ARTICLE

Changes in received quality of care for knee osteoarthritis after a multicomponent intervention in a general practice in Denmark

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Abstract

Objective: First-line treatment for patients with knee osteoarthritis should ideally prescribe patient education, exercise, and if needed, weight loss. In practice, however, adjunctive treatments, including painkillers and referrals to specialists, are typically introduced before these measures. This study evaluated interventions to sustainably improve general practitioner delivered care for patients with knee osteoarthritis.

Design: Comparison of impacts of knee osteoarthritis care during four half-year periods: before, 6, 12, and 18 months after primary intervention based on electronic medical records (EMR) and patient questionnaires.

Setting: Danish general practitioners (GPs) treating 6240 patients.

Participants: Four GPs, two GP trainees, and six staff members.

Interventions: Six pre-planned primary interventions: patient leaflet, GP and staff educational session, knee osteoarthritis consultation, two functional tests monitoring patient function, EMR phrase aiding consultation, and waiting room advertisement and three supportive follow-up interventions.

Main outcome measures: Usage of first-line and adjunctive treatment elements, the functional tests, and the EMR phrase.

Results: Approximately 50 knee osteoarthritis cases participated in each of the four half-year periods. Primary interventions had only transient effects lasting <12 months on the knee osteoarthritis care. Functional tests and EMR phrases were used predominantly during the first 6 months, where a transient drop in the referral rate to orthopedics was observed. Use of educational elements was moderate and without significant change during follow-up.

Conclusion: More routine use of the primary or inclusion of novel increased-adherence interventions is needed to sustainably improve care for knee osteoarthritis patients in Danish general practice.

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KEYWORDS

clinical guidelines, general practice, knee osteoarthritis, quality improvement, treatment

1 | INTRODUCTION

Recommended first-line treatments for knee osteoarthritis patients comprise patient education, exercise, and if needed, weight loss.¹⁻⁷ Core treatments can be supported by adjunctive procedures, including painkillers and referrals to imaging and other specialists as recommended by the 2012 Danish national clinical guidelines.⁵

In health care systems, such as the Danish, general practitioners (GPs) act as gatekeepers and first contacts, and therefore play a key role in securing first-line treatment adherence. Nevertheless, in Denmark less than half of the patients with knee osteoarthritis receive the recommended first-line treatment elements from their GP.^{8,9}

First-line treatments for knee osteoarthritis have been similarly poorly implemented in many other countries,^{7,8,10-12} indicating low quality of health care in need of intervention. To remediate the issues, the UK conducted the Management of Osteoarthritis in Consultations study (MOSAICS) in 2011/2012.^{13,14} Due to its success in increasing the provision of the recommended first-line treatments, it was extended to the quality improvement project “Joint Implementation of osteoarthritis guidelines across Western Europe” (JIGSAW-E) (<https://jigsaw-e.com>) whereupon the report here evaluates the Danish initiative.

Interventions from the JIGSAW-E project were culturally adopted and extended to match the Danish external, organizational, and professional context.¹⁵ This study reports results of interventions from one voluntary general practice, which became the “champion” clinic to facilitate broader implementation across Denmark.

1.1 | Aim

The aim of this study was to evaluate the effect of multiple interventions on the quality of care for knee osteoarthritis patients visiting a Danish general practice.

2 | METHODS

The Revised Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0) was applied.

2.1 | Context

The study was conducted in the Danish JIGSAW-E champion clinic with four GPs, two GP trainees, and six members of staff. The chosen GP clinic coded diagnoses of all consultations using the International

Classification of Primary Care (ICPC-2-R) and accessed electronic medical records (EMR) with the possibility of free text search in the consultation records. Hospital diagnosis codes were converted to ICPC-2-R codes.

2.2 | Interventions

Four JIGSAW-E culturally adopted interventions, including a patient-oriented osteoarthritis guidebook written by patients and health professionals, model consultation, training for health professionals, and medical records and patient-derived quality indicators of osteoarthritis care, were extended by two additional interventions (Table 1). In addition, three supportive follow-up interventions followed to remind clinic staff of their expected active participation after implementation.

2.2.1 | Primary interventions

The six primary interventions were: (I) a knee osteoarthritis patient leaflet, and (II) educational program for health professionals, (III) two functional tests, (IV) a model consultation, (V) an EMR phrase aiding the consultation and documentation, and (VI) Webpage and GP clinic screen information (see Table 1). The interventions I, II, IV, and V were culturally adopted from JIGSAW-E interventions. Two functional tests were added, including the 30-second chair stand and maximal step-up height test¹⁶ (Figure 1). The aim of including these validated functional tests (Supplement 3) was to monitor patient functional level.¹ The maximal step-up-height test asks patients to climb on a step, which is adjustable for height in 3 cm steps. The test serves as a relevant leg function test and health indicator, reliably measuring knee extension strength and self-reported physical functioning.^{17,18}

Interventions I-V targeted the GPs and practice staff. They were introduced at a 3-hour meeting organized by two osteoarthritis researchers (ER, LB) and one GP researcher (JL). Four GPs, two GP trainees, one nurse, two bio-analysts, two secretaries, and the practice manager participated at the meeting. The clinic health professionals co-designed the implementation of the primary interventions with the researchers. It was decided how, and from whom, these interventions should be conducted. This included recommending extra appointments with the GPs for osteoarthritis care. It was decided that the GPs should apply the EMR phrase aiding the consultation and documentation, as well as the two functional tests. Intervention VI targeted the patients, and was conducted by the researchers and the clinic staff in cooperation. Information for the GP clinic webpage and waiting room screen was prepared to inform the patients about the ongoing quality improvement project.

TABLE 1 Overview of study interventions

Nr.	Primary intervention	Description
I.	Osteoarthritis patient leaflet	An osteoarthritis patient leaflet, which was adopted and shorten by Danish patients from 50 pages to 4 pages from the JIGSAW-E OA guidebook (https://jigsaw-e.com/patient-focus/guidebook/) (Supplement 2).
II.	Education program for health professionals	Education for health professionals, in line with the JIGSAW-E training, informing on clinical knee osteoarthritis guidelines, outlining diagnosing and the stepwise treatment approach.
III.	Two functional tests	Two functional tests, the 30-second chair stand and maximal step up height test were presented, demonstrated, and conducted (Supplement 3)
IV.	Model consultation	A model consultation following the JIGSAW-E model consultation approach, whereby using a volunteering patient, was demonstrated by JL to the staff of the GP champion clinic.
V.	EMR phrase aiding the consultation and documentation	Co-designing an aiding EMR phrase to support addressing and documenting the recommended diagnostic criteria and provided treatment elements. It popped up when pressing a key combination in the documentation system. According to JIGSAW-E, the EMR phrase should have included information on the fulfillment of quality indicators, but the GP clinic staff chose to omit this feature (Supplement 4)
VI.	Webpage and GP clinic screen information	Written information to the patients about the JIGSAW-E quality improvement project was prepared by the GP clinic staff and the researchers.
Nr.	Supportive follow-up interventions	Description
I.	Open GP clinic day	During an open clinic day, for the listed patients, on men's health in September 2017, one researcher (LB) presented the JIGSAW-E project including the functional tests.
II.	Publication of a joint article	Joint publication with two GPs of the clinic on the JIGSAW-E project published in the Danish general practitioner journal in May 2018 (Månedsskriftet for Almen Praksis).
III.	Feedback on performance	In October 2018, during a regular lunch break, a feedback session regarding the management of osteoarthritis patients at the champion clinic was conducted by one of the researchers (LB).

Abbreviations: EMR, electronic medical records; GP, general practitioner; JIGSAW-E, Joint Implementation of Osteoarthritis Guidelines across Western Europe.

2.2.2 | Supportive follow-up interventions

In addition to the six primary interventions, to support adherence of clinic staff to the project, three supportive follow-up interventions were initiated and conducted after the introductory meeting: (I) presentation of the quality improvement project for patients at an open clinic day from a JIGSAW-E researcher (LB), (II) a joint publication in a monthly Danish journal for GPs,¹⁹ and (III) a feedback session in the clinic with presentation of preliminary data (Table 1). Furthermore, the clinic was visited at least twice every half year by one of the researchers (LB) for data collection. The second and third supportive follow-up interventions were initiated after recognizing limited usage of the patient leaflet and functional tests during the data collection at the GP clinic (LB).

2.3 | Evaluation

To monitor intervention implementation and impact, EMR and patient questionnaire data were collected for four half-year periods (Figure 2). For each period, the study included all patients who had at least one

knee osteoarthritis consultation during the period. Patients with a knee replacement were excluded, as they were unlikely to need all first-line treatments. Multiple consultations from the same patient were included.

2.4 | Definition of knee osteoarthritis

An EMR search for patients was performed using an ICPC-2-R code of *knee* osteoarthritis (L90), osteoarthritis (L91), or *knee complaints* (L15) during the 2-year study period. A patient was only included and considered to have knee osteoarthritis if they were at least 30 years old and had an encounter in the health care system that was diagnosed and coded with *knee* osteoarthritis (L90), or had an encounter that was coded with osteoarthritis (L91) with *knee* stated as the joint of complaint in the related records, or had an encounter coded with *knee complaints* (L15) with records indicating continuing symptoms for at least 3 months without acute trauma or other relevant explanation other than knee osteoarthritis. Cases of uncertainty regarding the presence of knee osteoarthritis were resolved by committee.

2.5 | Measures

Outcome measures were (1) usage of the two objective functional tests, (2) the documentation aid, and (3) provision of first-line elements, including referral to physiotherapy and provision of educational treatment materials, as well as adjunctive treatment elements. Data on usage of the two functional tests, the aiding EMR phrase, on all received adjunctive treatment elements, as well as on referrals to a physiotherapist, were obtained from the EMR. These included information on the prescription of painkillers, and the reception of knee-related referrals to physiotherapy, orthopedics, rheumatologists, X-ray, and magnetic resonance



FIGURE 1 The maximal step-up height test

imaging. A patient was coded as having received a referral if the EMR either included a referral to, or a feedback note from, the specialist service during the respected period. In addition, the inclusion diagnosis, which could be multiple L15, L90, and L91 codes, and the number of contacts and number of knee-related contacts with the clinic were obtained for the specific time period. Patient age, sex, and comorbidities were obtained from the EMR as well. Comorbidities were counted and categorized according to the Danish version of the ICPC-2-R. Patients were coded as either having or not having at least one disease of a comorbidity group (eg, N = neurological disease) if it was listed under the chronic conditions of the patient. For counting the number of comorbidities and for the comorbidity-group musculoskeletal disease (L), knee osteoarthritis was not considered, as all included patients had the disease according to the used definition.

Reception of the educational first-line treatment elements was evaluated by a questionnaire, which was sent out after the first, second, and third time period, thus the first questionnaire was sent out half a year after the primary interventions (Figure 2). It was sent from the GP champion clinic to the patients. The data obtained from the patient questionnaire included information on received educational first-line treatment elements and also background information on knee related quality of life, measured by the Knee injury and Osteoarthritis Outcome Score (KOOS) subscale QoL, and history of knee surgeries. Information on the educational first-line treatment elements was obtained by the OA-QI questionnaire²⁰ (Supplement 1). To all questions on reception of information, patients could answer either “yes,” “no,” or “I do not remember” unless for reception of received weight reduction advice, where patients could answer either “yes,” “no,” or “I am not overweight.” The answer options were dichotomized into “yes” and “no” or “I do not remember.” In the analysis of received weight reduction advice, patients who stated that they were not overweight were excluded. If patients had not responded after 14 days, a reminder was mailed. The mailed questionnaire can be found in Supplement 1.

2.6 | Analyses

Descriptive statistics were provided as mean and SD or number and percentages, as appropriate. If five or less cases belonged

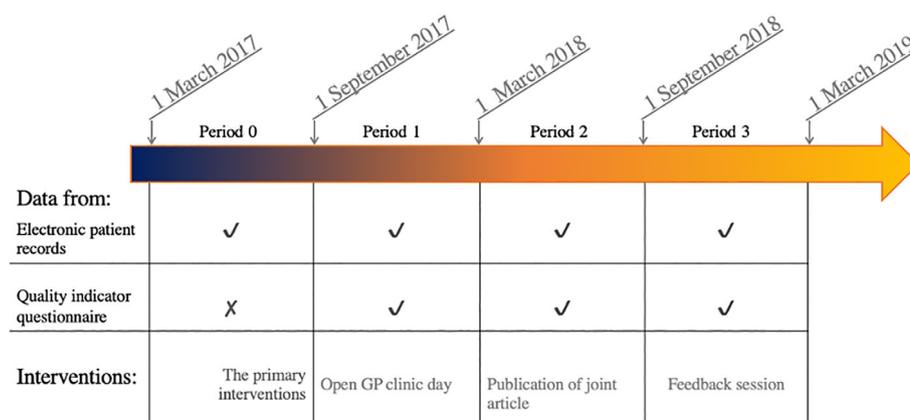


FIGURE 2 Overview of the data collection and timeline of the study collection and timeline of the study

to a variable group, “ ≤ 5 ” was reported to protect patient anonymity. ANOVA, chi-square, or the Fisher test were used to identify differences between time periods as appropriate. Two-sided *P*-values lower than 0.05 were considered as statistically significant. All statistical analyses were performed in R (Version 1.1.4632009-2018).

2.7 | Ethical Considerations

The project was registered with the University of Southern Denmark's legal services (SDU, 10.267). The ethics committee in the Region of Southern Denmark decided that their approval was not needed. All patients provided written, informed consent for use of their data for this research project.

3 | RESULTS

In total, 6240 patients visited the clinic, of which 4174 were at least 30 years old by January 2018. Of these, 51% were female. During the 2-year study period, 309/4174 (7%) presented with knee osteoarthritis and were invited to participate in the study. Of the 309 patients, 169 (55%) agreed to participate in the study. The 140 invitation non-responders were on average 61 years old with 87 (62%) females. The 169 patients who agree to participate were on average 62 years old, with 96 (57%) female. Nine of these were subsequently excluded due to a prior knee replacement. In sum, 160 patients were included in the study, providing 199 total visits, as 28 patients had contacts during two time-periods and six patients during three. These 199 cases account for 39% (421/1092) of all registered contacts

TABLE 2 Patient characteristics and information on consultations

	0. Period n = 54	1. Period n = 54	2. Period n = 45	3. Period n = 46	<i>P</i> -value
Age, mean (SD)	66.54 (14.41)	63.30 (12.02)	63.62 (11.93)	62.17 (13.17)	.367
Female sex, n (%)	17 (31)	26 (48)	14 (31)	26 (57)	.024
BMI, mean (SD) ¹¹⁶⁺	30.29 (6.96)	25.87 (10.18)	34.46 (8.64)	27.76 (11.36)	.055
KOOS QoL score, mean (SD) ^{a 8+}	—	51.32 (19.03)	44.66 (20.23)	44.74 (19.58)	.162
Number of co-morbidities, mean (SD)	3.37 (2.37)	3.50 (2.60)	3.67 (3.02)	3.24 (2.04)	.867
Hypertension (K), n (%)	24 (44)	28 (52)	17 (38)	23 (50)	.510
Cancer (any type), n (%)	8 (15)	8 (15)	9 (20)	10 (22)	.729
Digestive diseases (D), n (%)	7 (13)	7 (13)	9 (20)	7 (15)	.746
Sensory diseases (F, H), n (%)	6 (11)	≤ 5 (9)	≤ 5 (11)	≤ 5 (11)	.283
Cardiovascular diseases (K), n (%)	13 (24)	11 (20)	8 (18)	12 (26)	.770
Hypercholesterolemia diseases (T), n (%)	7 (13)	11 (20)	10 (22)	10 (22)	.601
Musculoskeletal diseases (L), n (%)	20 (37)	21 (39)	17 (38)	17 (37)	.997
Neurological diseases (N), n (%)	≤ 5 (9)	6 (11)	≤ 5 (11)	≤ 5 (11)	.584
Psychological diseases (P), n (%)	11 (20)	8 (15)	13 (29)	13 (28)	.274
Pulmonary diseases, n (%)	8 (15)	14 (26)	11 (24)	6 (13)	.253
Skin diseases, n (%)	11 (20)	14 (26)	9 (20)	7 (15)	.623
Endocrine diseases (T), n (%)	16 (30)	11 (20)	13 (29)	14 (30)	.627
Urinary and genital diseases (U, W, X, Y), n (%)	13 (24)	9 (17)	15 (33)	≤ 5 (11)	.052
Number of GP contacts during half a year, mean (SD)	9.91 (8.20)	8.96 (8.09)	8.18 (6.57)	9.02 (7.07)	.730
Number of knee related GP contacts during half a year, mean (SD)	2.20 (1.72)	1.94 (1.47)	1.96 (1.59)	2.37 (1.48)	.482
Reason for consultation					
Knee complaint (L15), n (%)	32 (59)	27 (50)	33 (73)	33 (72)	.051
Knee osteoarthritis (L90), n (%)	29 (54)	32 (59)	19 (42)	18 (39)	.147
Osteoarthritis (L91), n (%)	≤ 5 (9)	6 (11)	≤ 5 (11)	≤ 5 (11)	.938
At least one prior knee related consultation due to					
Knee complaint (L15), n (%)	44 (81)	43 (80)	42 (93)	40 (87)	.229
Knee osteoarthritis (L90), n (%)	26 (48)	37 (69)	15 (33)	21 (46)	.005
Osteoarthritis (L91), n (%)	17 (31)	13 (24)	12 (27)	11 (24)	.800

Abbreviations: —, not available; KOOS, Knee injury and Osteoarthritis Outcome Score; ⁿ⁺, number of missing values.

^aSelf-reported information.

TABLE 3 Received treatments in patients with knee osteoarthritis

		0. Period n = 54	1. Period n = 54	2. Period n = 45	3. Period n = 46	P-value
Element of consultation	Usage of:					
	Maximal step-up height test, n (%)	—	14 (26)	≤5 (11)	≤5 (11)	<.001
	30 seconds chair stand test, n (%)	—	13 (24)	≤5 (11)	≤5 (11)	<.001
	Documentation aid, n (%)	—	9 (17)	≤5 (11)	≤5 (11)	<.001
First-line treatment elements	Received information on:					
	Osteoarthritis ^a , n (%) ⁶⁺	—	13 (25)	12 (28)	15 (34)	.611
	Treatment options ^a , n (%) ⁶⁺	—	23 (43)	21 (50)	15 (34)	.323
	Managing osteoarthritis ^a , n (%) ⁸⁺	—	16 (31)	16 (37)	14 (33)	.825
	Physical activity and exercise ^a , n (%) ⁴⁺	—	30 (56)	28 (65)	23 (52)	.450
	Reducing weight (in case of overweight) ^a , n (%) ⁷⁺	—	9 (18)	10 (23)	≤5 (11)	
	Not overweight	—	15 (30)	13 (30)	20 (44)	.546
	The relation between body weight and osteoarthritis ^a , n (%) ¹⁰⁺	—	17 (34)	14 (33)	11 (26)	.636
	When the next review of your joint should happen ^a , n (%) ⁵⁺	—	7 (13)	≤5 (11)	6 (14)	.631
	Received referral to:					
	Physiotherapist, n (%)	17 (31)	24 (44)	17 (38)	18 (39)	.584
Adjunctive treatment elements	Orthopedic surgeon, n (%)	16 (30)	9 (17)	19 (42)	14 (30)	.049
	Rheumatologist, n (%) ²⁺	≤5 (9)	≤5 (9)	≤5 (11)	≤5 (11)	.319
	X-ray, n (%) ¹⁺	14 (26)	10 (19)	17 (38)	11 (24)	.184
	MRI, n (%) ¹⁺	≤5 (9)	≤5 (9)	≤5 (11)	≤5 (11)	1
	Received prescription of painkillers:					
	Total, n (%) ²⁺	25 (46)	25 (48)	34 (76)	30 (65)	.008
	Opioids, n (%)	≤5 (9)	≤5 (9)	7 (16)	≤5 (11)	.243
NSAIDs, n (%)	10 (19)	10 (19)	13 (29)	11 (24)	.553	
Paracetamol, n (%)	23 (43)	19 (35)	32 (71)	29 (63)	.001	
Others (%)	≤5 (9)	≤5 (9)	≤5 (11)	≤5 (11)	.214	

Abbreviations: —, not available; ⁿ⁺, number of missing values.

^aSelf-reported information.

in the EMR due to knee osteoarthritis, osteoarthritis, and knee complaints during the 2-year study period. Table 2 shows characteristics of patients in each half-year period, where period-specific differences for “sex” and “prior knee osteoarthritis diagnosis” were observed.

Table 3 provides the summary of used elements of knee-related care for each time period. The maximal step-up height test, the 30 seconds chair stand test, and EMR phrase were almost ubiquitously used during the first half-year period following in 26%, 24%, and 17% of the cases, respectively. Between the time periods, the referral rate to orthopedics dropped from approximately 30% to 17%, but increased to 42% and 30% in the next two periods. The only other statistically significant difference in the received elements of care between the time periods was a temporary decrease in the prescription of paracetamol during the second period followed by a heavy increase.

4 | DISCUSSION

4.1 | Summary

The principal findings of the study were that in the half-year period following the primary intervention referrals to orthopedics dropped, as well as the prescription of paracetamol, but in the next half year both measures increased to levels higher than before the intervention. The functional tests and EMR template were only used during the first half-year period. Since baseline data on the provision of educational first-line treatment elements were not available, it remains unclear whether the interventions changed the provision of first-line treatment elements. The observed provision of the first-line treatment referral to physiotherapy was higher than before the primary intervention and also 15% points higher than previously reported.⁸ However, despite the multiple interventions,

it remained below 50 %, as most of the educational first-line treatment elements did.

Hence, the proposed interventions to increase quality of care for knee osteoarthritis patients in one voluntary Danish general practice were only achieved for 6 months. Multiple quality-improvement interventions, including three follow-up interventions, failed to reach sustainable improvements.

4.2 | Interpretation

In implementation studies, it is important that the intervention is matched with the external context, the organization, and the professionals.²¹ Therefore, the JIGSAW-E interventions were culturally adopted and extended.

The results of this study are in line with findings from other quality improvement projects, such as the MOSAICS study, from which the JIGSAW-E intervention originated, and the Norwegian “SAMBA” project. Despite major differences in the design and concrete implementation, all three studies found that the interventions employed improved the quality of care delivered to knee osteoarthritis patients during the first half year after the interventions, even though there is still room for further improvements.²²⁻²⁴ In the MOSAICS study, the provision of written information about osteoarthritis and advice regarding exercise and weight reduction increased²⁵; in the SAMBA study more patients were referred to physiotherapy and less to orthopedic specialists,²⁴ and in the present study, referrals to orthopedics, and prescriptions of painkillers decreased.

One of the differences between the published Norwegian, the Great Britain MOSAICS, and the present Danish study is that the latter additionally evaluated the usage of two functional tests, and the sustainability of changes arising from the interventions by data collected 12 and 18 months after the primary intervention. Furthermore, it included supportive follow-up interventions after the primary interventions. However, as is common among quality improvement studies, positive changes faded away after half a year despite supportive follow-up interventions.^{26,27} Suggested reasons may include changes in the GP clinic workforce over time; for example, one initiating GP retired during the study period and the GP trainees rotated as well.²⁸

Additionally, a professional barrier suggested from previous studies asserts that GPs were concerned regarding their patient-relationship when addressing lifestyle changes and contradicting evidence was first published recently.²⁹⁻³² Furthermore, the primary intervention might not have perfectly matched the external context, as other health professionals belonging to the context, such as physiotherapists, were not involved in the project.

Moreover, unobserved factors may have influenced results. For the increase in painkiller prescriptions, other underlying diseases could have influenced results since a clear link between chronic knee pain and painkiller prescription could not be secured in the data collection. Furthermore, seasons might have influenced the findings, since the predominant weather affects symptoms of patients.³³

Finally, since 34 patients had contact with the GP clinic at least twice during the study period, the proportion of patients who had already received the first-line treatment was likely higher in the second and third period after the intervention, which may explain the higher referral rates to second line treatments in these periods. In summary, results of this study show that interventions need to better fit the external context, organization, and professionals. Further support to GPs and trainees and adaptation of the routines seems necessary within 6 months after implementation for better adherence to providing the recommended knee osteoarthritis care in order to reach successful long-term results.

4.3 | Limitations

The findings about the influence of the innovations on the receipt of first-line treatment, obtained from the OA-QI questionnaire, have several limitations. First, from the quality indicator questionnaire it remains unknown if patients received the educational treatment elements from one specific staff of the GP clinic or any other health professional as it is only asked if information was received. Furthermore, due to the lack of baseline data, it remains unknown if any change happened in the GP clinic due to the primary interventions. Nonetheless, compared with the Danish results from a study from 2015 using the same OA-QI, average reception rates after the primary intervention of all educational first-line treatment elements in the present study were slightly higher, except for the weight reduction advice.⁸

Changes in reception of painkillers were obtained from the EMR data. However, unlike the referral rates, a clear link between the prescription and underlying disease or condition was not available within the EMR data. Furthermore, some painkillers such as ibuprofen and paracetamol are available over the counter in Denmark. Therefore, the finding of a change in painkiller prescriptions should be interpreted with caution. BMI was obtained from the EMR, however, it was incompletely documented, only identified in 45/169 cases, which reduces the generalizability of information. Another limitation of the obtained EMR data was that if several diseases were addressed during one consultation the main purpose was unknown. However, to estimate the priority of osteoarthritis of an individual patient, the total number of consultations and the number of knee-related consultations during a time period were obtained from the EMR.

The included sample also had limitations. Only 55% of the invited patients agreed to participate in the study. However, this response rate is comparable to European survey studies.³⁴ Furthermore, there were no clinically relevant differences in age and sex between responders and non-responders. The inclusion of two or three cases from the same patient is questionable, as the used statistical tests require the observations to be independent.³⁵ However, an exclusion would have introduced a sampling bias. We investigated the provided amount and percentage of knee osteoarthritis treatments between different time periods over all cases sampled within each of the time periods. Since we assume, that the distribution of patients with

previous visits is conserved between the time periods, the assumption of independence holds.

The major strength of the study was the high completeness and detail of the data, as most patients ≥ 30 years with knee osteoarthritis in the area were treated at the studied GP clinic, due to the lack of alternatives in the surroundings.

5 | IMPLICATIONS

This study shows that short-term changes of 6 months can be reached with multiple, adjusted, and co-designed interventions at a voluntary GP clinic. However, for sustainable improvements, different quality improvement efforts are needed. Furthermore, other interventions may lead to high improvement rates in the delivery of recommended osteoarthritis care at general practices, where there was still large room for improvement.

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CONFLICT OF INTEREST

The authors report no conflict of interest.

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Formal analysis: Linda Baumbach, Donna Ankerst

Investigation: Linda Baumbach, Ewa M. Roos, Jesper Lykkegaard

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Writing—review, editing and final approval: Linda Baumbach, Ewa M. Roos, Donna Ankerst, Lillemor A. Nyberg, Elizabeth Cottrell, Jesper Lykkegaard

Linda Baumbach had full access to the data included in the study. She takes responsibility for the integrity of the data and the accuracy of the performed analyses.

TRANSPARENCY STATEMENT

The lead author confirms that this manuscript is an honest, accurate, and transparent account of the study being conducted. No important aspects of the study have been omitted.

DATA AVAILABILITY STATEMENT

The anonymized data may be available upon request to the authors.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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