Preferences and beliefs of Dutch orthopaedic surgeons and patients reduce the implementation of “Choosing Wisely” recommendations in degenerative knee disease

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Abstract

Purpose The purpose of this study was to assess which factors were associated with the implementation of “Choosing Wisely” recommendations to refrain from routine MRI and arthroscopy use in degenerative knee disease.

Methods Cross-sectional surveys were sent to 123 patients (response rate 95%) and 413 orthopaedic surgeons (response rate 62%) fulfilling the inclusion criteria. Univariate and multivariate logistic regression analyses were used to identify factors associated with implementation of “Choosing Wisely” recommendations.

Results Factors reducing implementation of the MRI recommendation among patients included explanation of added value by an orthopaedic surgeon [OR 0.18 (95% CI 0.07–0.47)] and patient preference for MRI [OR 0.27 (95% CI 0.08–0.92)]. Factors reducing implementation among orthopaedic surgeons were higher valuation of own MRI experience than existing evidence [OR 0.41 (95% CI 0.19–0.88)] and higher estimated patients’ knowledge to participate in shared decision-making [OR 0.38 (95% CI 0.17–0.88)]. Factors reducing implementation of the arthroscopy recommendation among patients were orthopaedic surgeons’ preferences for an arthroscopy [OR 0.03 (95% CI 0.00–0.22)] and positive experiences with arthroscopy of friends/family [OR 0.03 (95% CI 0.00–0.39)]. Factors reducing implementation among orthopaedic surgeons were higher valuation of own arthroscopy experience than existing evidence [OR 0.17 (95% CI 0.07–0.46)] and belief in the added value [OR 0.28 (95% CI 0.10–0.81)].

Conclusions Implementation of “Choosing Wisely” recommendations in degenerative knee disease can be improved by strategies to change clinician beliefs about the added value of MRIs and arthroscopies, and by patient-directed strategies addressing patient preferences and underlying beliefs for added value of MRI and arthroscopies resulting from experiences of people in their environment.

Level of evidence IV.

Keywords Choosing Wisely · Degenerative knee disease · Magnetic resonance imaging · Knee arthroscopy · De-implementation · Barriers and facilitators

Abbreviations

MRI Magnetic resonance imaging
CW Choosing Wisely

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Introduction

Approximately, 25% of patients aged 50 years and over experience knee symptoms from degenerative knee disease [37, 41]. These patients suffer from pain during walking, climbing stairs and squatting, and have functional loss [15, 26]. In some cases, knee range of motion is limited due to a meniscal tear, also known as locking symptoms. These degenerative meniscal tears could be symptoms of early stage osteoarthritis [18, 19].

For diagnosing patients with degenerative knee disease, clinical practice guidelines [2, 4, 7, 8] and literature recommend weight-bearing radiographs (fixed flexion view—Rosenberg view) to determine the presence and severity of degenerative knee disease and to exclude other causes of knee pain, such as osteonecrosis of the femoral condyle or tibial plateau [18, 45]. Although MRI has high sensitivity and specificity in detecting meniscal tears in older patients [18, 39], routine use of MRI is not recommended for diagnosis because of the poor correlation with patient symptoms [14, 19, 20, 33]. Similarly, clinical practice guidelines do not recommend the use of arthroscopic surgery as there is no benefit shown of arthroscopic surgery over non-surgical treatments such as exercise therapy, analgesic medication and dietary advice [2, 17, 18, 27, 29–31, 37, 38, 43, 44]. If locking symptoms are present, or if pain is not reduced after non-surgical treatments, arthroscopy may be warranted. So, MRI and arthroscopic surgery without prior conservative management in degenerative knee disease can be considered as unnecessary or low value care as these provide no benefit for the patient, waste resources and may even cause harm to the patient [17, 35].

Although practice guidelines and the underlying evidence do not recommend routine use of MRI and arthroscopy, many patients aged 50 years and over with degenerative knee disease receive an MRI and/or a knee arthroscopy [9, 13, 16, 17, 24, 28, 32, 40]. Arthroscopic knee surgery is even the most common orthopaedic procedure in countries with available data and is, on a global scale, performed more than two million times each year [37].

In an effort to reduce the unnecessary use of MRIs and knee arthroscopies for patients with degenerative knee disease, medical societies in several countries have formulated “Choosing Wisely” recommendations regarding their use [1, 3, 6, 10]. A recent study of Rosenberg et al. [34] showed that developing such recommendations does not necessarily eradicate low value care. To stimulate the implementation of the CW recommendations, interventions should be adapted to the factors associated with implementation of specific CW recommendations—in this case ‘do not order an MRI for suspected degenerative meniscal tears’ and ‘do not perform knee arthroscopy for patients with degenerative meniscal tears of degenerative knee disease without mechanical symptoms’ [42]. Previous research has suggested that conducting knee arthroscopies is driven by clinician beliefs in the effectiveness [24, 28], the need to meet patient expectations [12], perverse financial incentives for clinicians/hospitals [24, 28], fragmented clinical decision pathways [24], and insurance coverage [32]. However, no study has systematically studied factors influencing the implementation of these CW recommendations on degenerative knee complaints in patients of 50 years and older.

Therefore, the aim of this study is to investigate which factors are associated with implementation of CW recommendations among patients and orthopaedic surgeons in the Netherlands which aim to reduce the number of unnecessary MRIs and arthroscopies in patients aged 50 years and over with degenerative knee disease. Based on the previous research above, it was hypothesized that orthopaedic surgeons’ beliefs in the effectiveness of MRI and knee arthroscopy, the need to meet patient expectations, perverse financial incentives and insurance coverage all hamper the implementation of CW recommendations.

Materials and methods

To investigate which factors are associated with implementation of CW recommendations, cross-sectional online surveys were performed among Dutch patients ≥ 50 years with degenerative knee disease and orthopaedic surgeons specialized in knee pathology (members of Dutch Knee Society) throughout the Netherlands. In the Netherlands, patients with (suspected) degenerative knee disease first visit a general practitioner before being referred to an orthopaedic surgeon.

A literature search and semi-structured interviews among Dutch patients with degenerative knee disease (N = 3) and orthopaedic surgeons (N = 3) were performed to identify potential factors influencing implementation of CW recommendations regarding MRIs and arthroscopies in patients ≥ 50 years with degenerative knee disease. For the interviews, purposive sampling was applied to obtain contrasting views, thereby identifying a broad spectrum of potential factors. Patients ≥ 50 years with degenerative knee problems who did and did not have an MRI and/or arthroscopy, and orthopaedic surgeons who either do or do not perform an MRI and/or arthroscopy in these patients were selected. The interview questions were based on the framework of Grol and Wensing [23]. This framework distinguishes factors influencing implementation at the following six levels: (a) innovation, (b) individual professional, (c) patient, (d) social context, (e) organisational context as well as the (f) economic and political context.
The semi-structured interviews were audio-taped, fully transcribed and analysed using open coding. The qualitative analysis was performed using the software program ATLAS.ti (version 7.5.16). A total of 55 factors were identified from the literature [21, 22, 25, 36, 46] for orthopaedic surgeons and patients. Besides, four factors were added based on the interviews among orthopaedic surgeons and patients. Overall, 59 factors were found, 26 for the patient and 33 for the orthopaedic surgeon.

**Survey for patients**

The survey included items about (1) background characteristics, (2) characteristics of the received care and (3) factors influencing implementation of the CW recommendations regarding MRI and arthroscopy. The items of these first two categories are given in “Appendix 1: Items survey patient”. The third part of the survey about factors influencing implementation of the CW recommendations consisted of 26 items identified in the interviews and literature. Answers could be given on a 4-point Likert scale, ranging from “totally agree” (coded 1) to “totally disagree” (coded 4) and some questions could be answered with yes/no. If the patient underwent an MRI or arthroscopy, additional questions followed, for example on waiting time.

**Population**

Patients were recruited via advertisements in newspapers and on websites of patient organisations. Assuming a baseline implementation rate of 15% in those with a certain barrier for implementation, sample size calculations showed that at least 120 patients would be needed to be able to detect a twofold increase odds in those without the barrier with 80% power and 95% reliability. The developed survey was sent to a sample of patients with degenerative knee disease (N=138). Inclusion criteria were: age ≥ 50 years; degenerative knee disease; consultation with an orthopaedic surgeon for their degenerative knee disease. Patients on a waiting list for a total knee arthroplasty (TKA) or who already received a TKA were excluded. Also, patients with an inability to understand written Dutch were excluded. If patients indicated that they preferred to fill in the survey on paper rather than online, they received a paper survey. Two reminders were sent in case of non-response, one after 6 and one 12 weeks after the initial invitation. Patients received a ten euro gift card as an incentive upon completion of the survey.

**Survey for orthopaedic surgeons**

The survey for orthopaedic surgeons included items regarding (1) background characteristics, (2) characteristics of care delivery and (3) factors influencing implementation of the CW recommendations. The items of these first two categories are given in “Appendix 2: Items survey orthopaedic surgeon”. The third part consisted of 33 items covering the factors influencing implementation of the CW recommendations for orthopaedic surgeons. Answers could be given on a 4-point Likert scale, ranging from “totally agree” (coded 1) to “totally disagree” (coded 4).

**Statistical analysis**

Data from all respondents who completed the survey and fulfilled the inclusion criteria were included in the analyses. Descriptive statistics were used to describe the background characteristics, the care received by the patients, and characteristics of the care delivery according to the orthopaedic surgeon. The factors influencing implementation were dichotomized into agree ‘1’ (totally agree and agree) and disagree ‘0’ (totally disagree and disagree), because of few observations in some categories of the original Likert scale. If patients had an MRI and/or an arthroscopy, implemented CW recommendation was coded as 0 (no) and as 1 (yes) otherwise.

For patients, univariate logistic regression analysis was first used to assess which background characteristics, received care and potential factor for implementation were associated with the implemented CW recommendation, with MRI and arthroscopy (‘1’ yes and ‘0’ no) as the dependent variable. A similar analysis was conducted for orthopaedic surgeons, with self-reported implementation of the MRI/arthroscopy recommendations (yes/no) as dependent variable and background characteristics, care delivery characteristics and the factors influencing implementation of the CW recommendations (agree/disagree) as independent variables.

In addition, for both patients and orthopaedic surgeons, a multivariate logistic regression analysis was performed including those background characteristics, characteristics of the received care/care delivery and the factors influencing
the CW recommendations with a \( p \) value \( \leq 0.10 \) in univariate analyses. All analyses were performed using the software package SPSS (IBM SPSS, version 23).

**Results**

Of the 138 recruited patients, 131 completed the survey (response rate 95%). Fifteen were excluded because they did not fulfill the inclusion criteria (“Appendix 3: Flowcharts”). Of the 422 invited orthopaedic surgeons, 261 completed the survey (response rate 62%). Nine were excluded because they did not treat any patients \( \geq 50 \) years with degenerative knee disease. Table 1 shows that the majority of the patients were female (61%) receiving higher education (47%), with average age 63.2 years. The majority of patients had additional coverage in their insurance (85%). In the Netherlands, patients are obliged to have a basic insurance with or without an additional coverage. The basic insurance has a mandatory excess of 385 euro. Patients who completed the survey represented the target group well, compared to the characteristics of Dutch orthopaedic patients [5]. Most of the orthopaedic surgeons who responded were male (90%), with an average age of 47.2 years and 12.0 years of working experience (Table 2). This was a realistic representation of the orthopaedic workforce in the Netherlands. The largest group worked in a general hospital (41%) in the middle region of the Netherlands (42%). Most of these orthopaedic surgeons saw more than 20 new patients per month (78%).

**Factors influencing the use of MRI and arthroscopy among patients**

Table 3 shows that most patients agreed with the statements “Good contact with physical therapist helped me to persevere the physical therapy treatments” (90%), “Good guidance of the physical therapist helped me to persevere all physical therapy treatments” (90%), “I have an additional coverage” (85%), and “Physical activity was difficult because of pain” (84%).

Table 4 shows that undergoing an MRI was associated with five barriers and two background characteristics among patients. Undergoing a knee arthroscopy was associated with five barriers, three facilitators and one background characteristic. From these, the orthopaedic surgeon’s explanation about the added value of an MRI \( [OR \ 0.18 \ (95\% \ CI \ 0.07–0.47)] \) and the preference of the patient for an MRI \( [OR \ 0.27 \ (95\% \ CI \ 0.08–0.92)] \) remained as independent factors associated with reduced implementation of the CW recommendation regarding MRI, whereas a higher age \( [OR \ 1.07 \ (95\% \ CI \ 1.01–1.14)] \) was associated with higher implementation. For arthroscopy, the preference of the orthopaedic surgeon for arthroscopy \( [OR \ 0.03 \ (95\% \ CI \ 0.00–0.22)] \) and positive experiences of people in the patient’s environment \( [OR \ 0.03 \ (95\% \ CI \ 0.00–0.39)] \) remained as independent factors associated with reduced implementation of the CW recommendation regarding arthroscopy.

**Factors influencing the use of MRI and arthroscopy among orthopaedic surgeons**

Table 5 shows that most orthopaedic surgeons agreed with the statements “asking questions about the previous nonsurgical treatments” (98%), the familiarity with the CW recommendation for MRI (99%) and arthroscopy (98%) as influential factors for implementation.

Table 6 shows that implementation of the CW recommendation regarding MRI was associated with four barriers and six facilitators among orthopaedic surgeons in univariate analysis. Implementation of the CW recommendation regarding arthroscopy was associated with two barriers, five facilitators and three background characteristics. From these, agreement with the CW recommendation regarding MRI \( [OR \ 12.10 \ (95\% \ CI \ 3.51–41.64)] \) remained as an independent factor associated with higher implementation of the CW recommendation in multivariate analysis, whereas higher valuation of own experience than existing evidence \( [OR \ 0.41 \ (95\% \ CI \ 0.19–0.88)] \) and higher estimated patients’ knowledge to participate in shared decision-making \( [OR \ 0.38 \ (95\% \ CI \ 0.17–0.88)] \) were associated with reduced implementation. Knowledge of \( [OR \ 58.17 \ (95\% \ CI \ 2.63–1287.24)] \) and agreement with the CW recommendations regarding arthroscopy \( [OR \ 37.45 \ (95\% \ CI \ 5.39–260.24)] \) as well as actively searching for newest evidence and guidelines \( [OR \ 3.28 \ (95\% \ CI \ 1.19–9.08)] \) were associated with higher implementation of the CW recommendation regarding arthroscopy, whereas higher valuation of own experience than existing evidence \( [OR \ 0.17 \ (95\% \ CI \ 0.07–0.46)] \) and belief in the value of arthroscopy \( [OR \ 0.28 \ (95\% \ CI \ 0.10–0.81)] \) were associated with reduced implementation.

**Discussion**

That the implementation of CW recommendations to reduce unnecessary MRIs and knee arthroscopies was hampered by patient preferences for MRI, positive experiences with arthroscopies in the patient’s environment, orthopaedic surgeons’ preferences for arthroscopy and their beliefs in the added value as well as valuing their own clinical experience to be more important than existing evidence were the most important findings of this study. On the other hand, orthopaedic surgeons’ knowledge of and agreement with the CW recommendations, as well as a proactive attitude towards searching for new evidence and guidelines facilitate implementation. Furthermore, older age of patients increased implementation of CW recommendations regarding MRI.
| Background characteristics |  
|---------------------------|
| Age in years, mean (SD)   | 63.2 (7.9) |
| Female, n (%)             | 71 (61.2)  |
| Region of residence, n (%)|  
| North                     | 38 (32.8)  |
| Middle                    | 68 (58.6)  |
| South                     | 10 (8.6)   |
| Education, n (%)          |  
| Basic                     | 8 (6.9)    |
| Intermediate              | 53 (45.7)  |
| High                      | 55 (47.4)  |
| Start of symptoms of degenerative knee disease, n (%) |  
| ≤ 1 year ago              | 18 (15.4)  |
| > 1 year ago              | 98 (84.5)  |
| Diagnosis of locking symptoms by orthopaedic surgeon, n (%) | 7 (12.5) |
| Pain before consult with orthopaedic surgeon (VAS), mean (SD)f | 7.1 (2.2) |
| Pain at this moment (VAS), mean (SD)f | 4.7 (2.2) |
| Type of insurance, n (%)  |  
| Basic only                | 17 (14.7)  |
| Basic with additional coverage | 99 (85.3) |

Received care

| Patient visited …, n (%) |  
|--------------------------|
| General practitioner (GP)| 103 (88.8) |
| Physical therapist       | 85 (73.3)  |
| Dietician                | 10 (8.6)   |
| Other primary care specialists | 13 (11.2) |

| Patient underwent …, n (%) |  
|---------------------------|
| MRI scan                  | 74 (63.8)  |
| Arthroscopy               | 56 (48.3)  |

| Time between the start of knee complaints and the consultation with the general practitioner, n (%)f |  
|---------------------------------------------------------------|
| ≤ 6 weeks                                                     | 47 (51.1) |
| > 6 weeks                                                    | 45 (48.9) |

| Time between consultation with the general practitioner and orthopaedic surgeon, n (%)d |  
|----------------------------------------------------------------------------------------|
| ≤ 6 weeks                                                                               | 83 (80.6) |
| > 6 weeks                                                                               | 20 (19.4) |

| Waiting time for MRI scan, n (%) |  
|---------------------------------|
| ≤ 2 weeks                       | 40 (66.7) |
| > 2 weeks                       | 20 (33.3) |

| Waiting time for arthroscopy |  
|-----------------------------|
| ≤ 2 weeks                   | 11 (23.9) |
| > 2 weeks                   | 35 (76.1) |

| Implementation of CW recommendation regarding MRI/arthroscopy, n (yes), % |  
|--------------------------------------------------------------------------|
| MRI, n (%)                                                               | 42 (36.2) |
| Arthroscopy, n (%)                                                       | 58 (50.0) |

n = 116

\( ^a n = 46 \)

\( ^b n = 60 \)

\( ^c n = 92 \)

\( ^d n = 103 \)

\( ^e n = 56 \)

\( ^f \) Pain measured on a visual analogue scale (VAS), 0 (no pain)—10 (unbearable pain)
| Background characteristics                                      |   |
|------------------------------------------------------------------|---|
| **Age in years, (mean, SD)**                                    | 47.2 (8.5) |
| **Female, n (%)**                                                | 25 (9.9)   |
| **Years of work experience as orthopaedic surgeon (mean, SD)**  | 12.0 (8.0) |
| **Work region, n (%)**                                          |   |
| North                                                            | 85 (33.7)  |
| Middle                                                           | 105 (41.7) |
| South                                                            | 62 (24.6)  |
| **New patients ≥ 50 years with knee complaints seen per month, n (%)** |   |
| 0–1                                                              | 1 (0.4)    |
| 2–5                                                              | 9 (3.6)    |
| 6–10                                                             | 12 (4.8)   |
| 11–20                                                            | 34 (13.5)  |
| > 20                                                             | 196 (77.8) |
| **Number of MRI scans ordered per month, n (%)**                |   |
| 0–1                                                              | 70 (27.8)  |
| 2–5                                                              | 81 (32.1)  |
| 6–10                                                             | 55 (21.8)  |
| 11–20                                                            | 35 (13.9)  |
| > 20                                                             | 11 (4.4)   |
| **Number of arthroscopies carried out per month, mean (SD)**    |   |
| 0–1                                                              | 107 (42.5) |
| 2–5                                                              | 97 (38.5)  |
| 6–10                                                             | 37 (14.7)  |
| 11–20                                                            | 9 (3.6)    |
| > 20                                                             | 2 (0.8)    |
| **Percentage of patients ≥ 50 years undergoing an arthroscopy because of locking symptoms, n (%)** |   |
| 0–10%                                                            | 41 (16.3)  |
| 11–20%                                                           | 11 (4.4)   |
| 21–30%                                                           | 16 (6.3)   |
| 31–40%                                                           | 11 (4.4)   |
| 41–50%                                                           | 14 (5.6)   |
| 51–60%                                                           | 17 (6.7)   |
| 61–70%                                                           | 16 (6.3)   |
| 71–80%                                                           | 38 (15.1)  |
| 81–90%                                                           | 45 (17.9)  |
| 91–100%                                                          | 43 (17.1)  |
| **Characteristics of care delivery**                             |   |
| Centre has its own MRI scan, n (%)b                              | 228 (90.5) |
| **Waiting time for MRI scan, n (%)**                            |   |
| ≤ 2 weeks                                                        | 125 (51.0) |
| > 2 weeks                                                        | 120 (49.0) |
| **Waiting time for arthroscopy, n (%)b**                         |   |
| ≤ 2 weeks                                                        | 60 (24.5)  |
| > 2 weeks                                                        | 185 (75.5) |
| **Implementation of CW recommendation regarding MRI/arthroscopy, n (yes), %** |   |
| MRI, n (%)                                                       | 203 (80.6) |
| Arthroscopy, n (%)                                               | 208 (82.5) |

n = 252

a n = 244

b n = 245
| Table 3 | Presence factors influencing the implementation of CW recommendation for MRI and/or arthroscopy reported by patients ($n = 116$) |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------|
| **Individual professional**                  | **Agree n (%)**                                                                                  |
| Orthopaedic surgeon asked which treatments the patient previously received for his/her knee complaints | 89 (76.7)                                                                                     |
| Orthopaedic surgeon listened well to patient’s wishes | 89 (76.7)                                                                                     |
| Orthopaedic surgeon thought along with patient | 86 (74.1)                                                                                     |
| Orthopaedic surgeon takes time to explain benefits and drawbacks of treatment options (medication, physical therapy or arthroscopy) | 81 (69.8)                                                                                     |
| Orthopaedic surgeon explained the added value of MRI | 60 (51.7)                                                                                     |
| Orthopaedic surgeon explained the benefits and drawbacks of an arthroscopy | 60 (51.7)                                                                                     |
| Orthopaedic surgeon preferred an arthroscopy | 47 (40.5)                                                                                     |
| **Patient**                                   |                                                                                                 |
| Physical activity was difficult because of pain | 97 (83.6)                                                                                     |
| Patient searched for information before visiting the orthopaedic surgeon | 73 (62.9)                                                                                     |
| Patient wanted an arthroscopy only if it was the last treatment option | 55 (47.4)                                                                                     |
| Patient expected to undergo an MRI scan before the consult with the orthopaedic surgeon | 37 (31.9)                                                                                     |
| Patient expected to undergo an arthroscopy prior to the consult with the orthopaedic surgeon | 39 (33.6)                                                                                     |
| Patient preferred to undergo an MRI scan during the consult with the orthopaedic surgeon | 54 (46.6)                                                                                     |
| Patient preferred to undergo an arthroscopy during the consult with the orthopaedic surgeon | 52 (44.8)                                                                                     |
| Patient previously had negative experiences with physical therapy | 15 (12.9)                                                                                     |
| In a situation in which different treatment options have approximately the same results: |                                                                                                 |
| … patient prefers to decide about the treatment him/herself (active) | 35 (30.2)                                                                                     |
| … patient prefers to decide about the treatment together with the orthopaedic surgeon (shared) | 61 (52.6)                                                                                     |
| … patient prefers to let the orthopaedic surgeon decide about the treatment (passive) | 20 (17.2)                                                                                     |
| In the situation of the consult of the patient with his/her orthopaedic surgeon: |                                                                                                 |
| … patient decided about the treatment him/herself (active) | 30 (25.9)                                                                                     |
| … patient decided about the treatment together with the orthopaedic surgeon (shared) | 41 (35.3)                                                                                     |
| … patient let the orthopaedic surgeon decide about the treatment (passive) | 45 (38.8)                                                                                     |
| **Social context**                            |                                                                                                 |
| Good consultation between orthopaedic surgeon and physical therapist$^a$ | 17 (29.3)                                                                                     |
| People in patient’s environment recommended an MRI scan | 33 (28.4)                                                                                     |
| People in patient’s environment had good experiences with arthroscopy | 48 (41.4)                                                                                     |
| People in patient’s environment stimulated to keep on moving despite pain | 75 (64.7)                                                                                     |
| **Organisational context**                    |                                                                                                 |
| Sufficient time for the orthopaedic surgeon to explain all treatment options (medication, physical therapy or arthroscopy), including benefits and drawbacks | 80 (69.0)                                                                                     |
| Good contact with physical therapist helped patient to carry on with non-surgical therapy$^b$ | 64 (90.1)                                                                                     |
| Good guidance of the physical therapist helped the patient withstand the duration of the non-surgical therapy$^b$ | 64 (90.1)                                                                                     |
| **Economic and political context**            |                                                                                                 |
| Additional payment for physical therapy not (fully) covered by insurance | 99 (85.3)                                                                                     |
| Patient preferred an arthroscopy because physical therapy was not covered by insurance | 4 (3.4)                                                                                       |

$^a$Question answered by 58 of the 116 participants ($n = 58$)

$^b$Question answered by 71 of the 116 participants ($n = 71$)
Table 4 Influencing factors, background characteristics and received care reported by patients for implementation of CW recommendations (n = 116) (univariate and multivariate analyses)

| Factors influencing the implementation of the CW recommendations | Univariate analyses | Multivariate analyses |
|---------------------------------------------------------------|-------------------|----------------------|
| | Implementation of CW MRI recommendation OR (95% CI) | Implementation of CW arthroscopy recommendation OR (95% CI) | Implementation of CW MRI recommendation OR (95% CI) | Implementation of CW arthroscopy recommendation OR (95% CI) |
| **Individual professional** | | | |
| Orthopaedic surgeon asked which treatments the patient previously received for his/her knee complaints | 1.18 (0.48–2.92) (+) | 0.61 (0.26–1.47) (−) | x | x |
| Orthopaedic surgeon listened well to patient’s wishes | 0.95 (0.39–2.33) (−) | 0.91 (0.38–2.15) (−) | x | x |
| Orthopaedic surgeon thought along with the patient | 0.67 (0.29–1.56) (−) | 1.00 (0.44–2.30) | x | x |
| Orthopaedic surgeon takes time to explain benefits and drawbacks of treatment options (medication, physical therapy, or arthroscopy) | x | 0.92 (0.42–2.04) (−) | x | x |
| Orthopaedic surgeon explained the added value of an MRI | 0.15 (0.06–0.36) (−) | x | **0.18 (0.07–0.47) (−)** | x |
| Orthopaedic surgeon explained the benefits and drawbacks of an arthroscopy | x | 0.30 (0.14–0.64) (−) | x | 0.61 (0.09–3.94) (−) |
| Orthopaedic surgeon preferred an arthroscopy | x | 0.02 (0.01–0.06) (−) | x | **0.03 (0.00–0.22) (−)** |
| **Patient** | | | |
| Patient expected to undergo an MRI scan previous to the consult with the orthopaedic surgeon | 0.45 (0.19–1.07) (−) | x | 1.31 (0.35–4.90) (+) | x |
| Patient expected to undergo an arthroscopy previous to the consult with the orthopaedic surgeon | x | 0.30 (0.13–0.68) (−) | x | 4.88 (0.36–65.71) (+) |
| Patient preferred to undergo an MRI scan during the consult with the orthopaedic surgeon | 0.21 (0.09–0.50) (−) | x | **0.27 (0.08–0.92) (−)** | x |
| Patient preferred to undergo an arthroscopy during the consult with the orthopaedic surgeon | x | 0.12 (0.05–0.27) (−) | x | 0.24 (0.04–1.65) (−) |
| Physical activity was difficult because of pain | 1.28 (0.45–3.66) (+) | 0.88 (0.33–2.36) (−) | x | x |
| Patient searched for information previous to the visit to the orthopaedic surgeon | 0.42 (0.19–0.93) (−) | 1.25 (0.59–2.66) (+) | 0.84 (0.31–2.28) (−) | x |
| Patient wanted an arthroscopy only if it was the last treatment option | x | 0.81 (0.39–1.69) (−) | x | x |
| Patient previously had negative experiences with physical therapy | 0.60 (0.18–2.03) (−) | 1.17 (0.39–3.46) (+) | x | x |
| In a situation in which different treatment options have approximately the same results…: … patient prefers to decide about the treatment him/herself | 0.60 (0.19–1.91) (−) | 1.78 (0.58–5.43) (+) | x | x |
Table 4 (continued)

| | Univariate analyses | Multivariate analyses |
|---|---------------------|-----------------------|
| | Implementation of CW MRI recommendation OR (95% CI) | Implementation of CW arthroscopy recommendation OR (95% CI) | |
| | | | Implementation of CW MRI recommendation OR (95% CI) | Implementation of CW arthroscopy recommendation OR (95% CI) |
| ... patient prefers to decide about the treatment together with the orthopaedic surgeon | 0.97 (0.35–2.73) (−) | 1.55 (0.56–4.32) (+) | x | x |
| ... patient prefers to let the orthopaedic surgeon decide about the treatment | Reference category | Reference category | x | x |

In the situation of the consult of the patient with his/her orthopaedic surgeon:

| | Univariate analyses | Multivariate analyses |
|---|---------------------|-----------------------|
| | Implementation of CW MRI recommendation OR (95% CI) | Implementation of CW arthroscopy recommendation OR (95% CI) | |
| ... patient decided about the treatment him/herself | 0.91 (0.34–2.40) (−) | 1.97 (0.77–5.08) (+) | x | x |
| ... patient decided about the treatment together with the orthopaedic surgeon | 1.16 (0.48–2.78) (+) | 0.89 (0.38–2.09) (−) | x | x |
| ... patient let the orthopaedic surgeon decide about the treatment | Reference category | Reference category | x | x |

Social context

| | Univariate analyses | Multivariate analyses |
|---|---------------------|-----------------------|
| | Implementation of CW MRI recommendation OR (95% CI) | Implementation of CW arthroscopy recommendation OR (95% CI) | |
| Good consultation between orthopaedic surgeon and physical therapist<sup>a</sup> | x | 0.80 (0.26–2.48) (−) | x | x |
| People in patients’ environment recommended an MRI scan | 0.37 (0.14–0.95) (−) | x | 0.64 (0.19–2.12) (−) | x |
| People in patients’ environment had good experiences with arthroscopy | x | 0.13 (0.06–0.31) (−) | x | 0.03 (0.00–0.39) (−) |
| People in patients’ environment stimulated to keep on moving despite the pain | 1.36 (0.61–3.04) (+) | 1.99 (0.92–4.32) (+) | x | 2.77 (0.24–31.44) (+) |

Organisational context

| | Univariate analyses | Multivariate analyses |
|---|---------------------|-----------------------|
| | Implementation of CW MRI recommendation OR (95% CI) | Implementation of CW arthroscopy recommendation OR (95% CI) | |
| Sufficient time for the orthopaedic surgeon to explain all treatment options (medication, physical therapy or arthroscopy), including risks and benefits | x | 1.18 (0.54–2.58) (+) | x | x |
| Good contact with physical therapist helped the patient to carry on with non-surgical therapy<sup>b</sup> (−) | x | 8.22 (0.94–72.33) (+) | x | 7.69 (0.01–5090.47) (+) |
| Good guidance of the physical therapist helped the patient to withstand the duration of the non-surgical therapy<sup>b</sup> | x | 8.22 (0.94–72.33) (+) | x | 5.95 (0.01–3504.06) (+) |

Economic and political context

| | Univariate analyses | Multivariate analyses |
|---|---------------------|-----------------------|
| | Implementation of CW MRI recommendation OR (95% CI) | Implementation of CW arthroscopy recommendation OR (95% CI) | |
| Additional payment for physical therapy (fully) covered by insurance | 0.78 (0.27–2.23) (−) | 1.15 (0.41–3.22) (+) | x | x |
| Patient preferred an arthroscopy because physical therapy was not covered by insurance | 1.80 (0.24–13.27) (+) | 1.00 (0.14–7.35) | x | x |

Background characteristics

| | Univariate analyses | Multivariate analyses |
|---|---------------------|-----------------------|
| | Implementation of CW MRI recommendation OR (95% CI) | Implementation of CW arthroscopy recommendation OR (95% CI) | |
| Age | 1.09 (1.03–1.15) (+) | 0.98 (0.94–1.03) (−) | 1.07 (1.01–1.14) (+) | x |
| Gender | 0.90 (0.41–1.94) (−) | 1.94 (0.91–4.13) (+) | x | 2.28 (0.31–16.82) (+) |
Previous studies were limited in only presenting the clinician perspective and mentioned clinician beliefs in the effectiveness of arthroscopic surgery [24, 28], clinicians’ need to meet patient expectations [12], perverse financial incentives [24, 28], fragmented clinical pathways [24] and insurance coverage [32] as possible barriers for implementation of CW recommendations regarding MRI and arthroscopy in degenerative knee disease. Our study results confirm that clinician beliefs hamper implementation, but perverse financial incentives for clinicians/hospitals, fragmented clinical decision pathways, and insurance coverage were not identified as barriers. Possibly, this can be explained by a different health-care system in which the studies are performed. In this study only 7% of the orthopaedic surgeons felt pressure to perform MRIs and arthroscopies because of production agreements and 75% of the orthopaedic surgeons reported that they were able to make clear agreements with GPs, physical therapists and dieticians about care delivery (Table 5). Furthermore, in this study 85% of the patients have reported that they have additional coverage for physical therapy treatment (Table 1).

Previous studies also showed that clinicians felt CW recommendations were hard to accept for patients [46], were worried about malpractice claims and did not have enough time to discuss the risks and benefits of imaging with the patient [36]. Around 70% of the orthopaedic surgeons reported in this survey that they thought patients had difficulties in accepting the CW recommendations (Table 5), but these were not independently associated with implementation in multivariate regression analyses. In addition, fear of malpractice claims and lack of time to discuss risks and benefits of imaging with the patients were also not found to hamper implementation: less than 11% of the orthopaedic surgeons felt they needed to request an MRI or perform an arthroscopy for medicolegal substantiation (Table 5). Sixty-six percent of orthopaedic surgeons reported they had enough time to explain treatment options to patients (Table 5) and 69% of the patients felt that their orthopaedic surgeon spent sufficient time to explain treatment options including risks and benefits (Table 3). This underlines the importance of assessment of factors influencing the implementation of every CW recommendation for different countries and also to include both the clinician and the patient perspective.

That the implementation of CW recommendations can also be influenced by patients was shown by this study, in addition to other studies. While previous studies regarding
Table 5 Orthopaedic surgeons’ agreement with factors influencing the implementation of the CW recommendation regarding MRI and/or arthroscopy ($n = 252$)

| Level                                                                 | Agree n (%) |
|-----------------------------------------------------------------------|-------------|
| Individual professional                                               |             |
| Orthopaedic surgeon asks about previously received non-surgical treatments (physical therapy, medication, nutritional advice when BMI > 25 and lifestyle advice) | 248 (98.4) |
| Orthopaedic surgeon prescribes one or more non-surgical treatments (physical therapy, medication, nutritional advice when BMI > 25 and lifestyle advice) if patient did not receive all non-surgical treatment care yet | 240 (95.2) |
| Belief in effectivity of non-surgical treatment strategy (physical therapy, medication, nutritional advice when BMI > 25 and lifestyle advice) for knee complaints of patients ≥ 50 years | 234 (92.9) |
| Fully familiar with the CW recommendation for MRI                     | 249 (98.8) |
| Agrees with the CW recommendation for MRI                             | 228 (90.5) |
| Higher valuation of own experience with MRI than of existing evidence | 90 (35.7)  |
| Belief in value of MRI over fixed flexion view                        | 109 (43.3) |
| Fully familiar with the CW recommendation for arthroscopy             | 248 (98.4) |
| Agrees with the CW recommendation for arthroscopy                     | 234 (92.9) |
| Higher valuation of own experience with arthroscopy than of existing evidence | 73 (29.0)  |
| Belief in value of arthroscopy for patients ≥ 50 years with knee complaints, without ‘locked knee’ complaints, despite possible complications and risks | 50 (19.8)  |
| Important to perform arthroscopy as soon as possible for patients ≥ 50 years with knee complaints, without ‘locked knee’ complaints | 5 (2.0) |
| Actively searches for latest knowledge about evidence and guidelines for diagnosis/treatment of knee complaints | 199 (79.0) |
| Orthopaedic surgeon wants to meet patients’ expectations$^a$           | 147 (59.5) |
| Orthopaedic surgeon is able to clarify to the patient whether an MRI scan is necessary, even if the patient has a contradictory opinion at first$^a$ | 169 (68.4) |
| Orthopaedic surgeon is able to clarify to the patient whether an arthroscopy is necessary, even if the patient has a contradictory opinion at first$^a$ | 188 (76.1) |
| Patient                                                               |             |
| Orthopaedic surgeon notices that patients are well prepared for the consult by gaining knowledge | 67 (26.6)  |
| Patients’ level of knowledge is sufficient to make a shared decision about treatment | 80 (31.7)  |
| Patients ≥ 50 years with knee complaints have certain expectations about diagnostics and treatment when they come to the consult$^a$ | 134 (94.7) |
| Most patients find it difficult that the CW recommendation for MRI also applies to them$^a$ | 190 (76.9) |
| Most patients find it difficult that the CW recommendation for arthroscopy also applies to them$^a$ | 170 (68.8) |
| Social context                                                        |             |
| Colleagues all follow the CW recommendation for MRI and arthroscopy$^b$ | 155 (63.3) |
| Colleagues tell me when I do not follow the guidelines$^b$             | 197 (80.4) |
| Colleagues are in favour of non-surgical treatments (physical therapy, medication, nutritional advice and lifestyle advice)$^b$ | 220 (89.8) |
| Organisational context                                                |             |
| Able to make clear arrangements with primary care (GP, physical therapist, dietician) | 188 (74.6) |
| Good feedback from primary care (GP, physical therapist, dietician) to orthopaedic surgeon about patient progress | 139 (55.2) |
| Enough time to keep knowledge of guidelines up to date                 | 156 (61.9) |
| Enough time to explain to the patient which diagnosis and treatment options are applicable to the patient’s situation$^a$ | 164 (66.4) |
| Pressure of production MRI$^b$                                        | 17 (6.9)   |
| Pressure of production arthroscopy$^b$                                | 17 (6.9)   |
| Economic and political context                                         |             |
| Financial reasons determine patient preference (arthroscopy more often covered by insurance than non-surgical treatment$^a$) | 84 (34.0) |
| Medicolegal substantiation to follow the CW recommendation for MRI$^b$ | 27 (11.0) |
| Medicolegal substantiation to follow the CW recommendation for arthroscopy$^b$ | 7 (2.9) |

$n = 252$

$^a n = 247$

$^b n = 245$
Table 6 Influencing factors and background characteristics reported by orthopaedic surgeons for the implementation of the CW recommendations (n = 252) (univariate and multivariate analyses)

| Factors influencing the implementation of CW recommendations | Univariate analyses | Multivariate analyses |
|--------------------------------------------------------------|---------------------|-----------------------|
| | Acts according to CW MRI recommendation OR (95% CI) | Acts according to arthroscopy CW recommendation OR (95% CI) | Acts according to CW MRI recommendation OR (95% CI) | Acts according to arthroscopy CW recommendation OR (95% CI) |
| Individual professional | | | | |
| Orthopaedic surgeon asks about previously received non-surgical treatments | 1.39 (0.14–13.65) (+) | x | x | x |
| Orthopaedic surgeon uses step-by-step treatment strategy | 2.17 (0.63–7.51) (+) | 2.50 (0.72–8.70) (+) | x | x |
| Belief in effectiveness of non-surgical treatment strategy | 2.91 (1.07–7.95) (+) | 2.58 (0.91–7.29) (+) | 0.96 (0.22–4.27) (−) | 0.31 (0.03–3.10) (−) |
| Knowledge about the CW recommendation for MRI | 2.09 (0.19–23.57) (+) | x | x | x |
| Agree with the CW recommendation for MRI | 14.88 (5.72–38.70) (+) | x | 12.10 (3.51–41.64) (+) | x |
| Higher valuation of own experience with MRI than of existing evidence | 0.27 (0.14–0.51) (−) | x | 0.41 (0.19–0.88) (−) | x |
| Belief in value of MRI over fixed flexion view | 0.36 (0.19–0.69) (−) | x | 0.49 (0.23–1.07) (−) | x |
| Orthopaedic surgeon actively searches for latest knowledge about evidence and guidelines for diagnosis/treatment of knee complaints | 2.46 (1.24–4.91) (+) | 2.64 (1.30–5.37) (+) | 1.87 (0.79–4.45) (+) | 3.28 (1.19–9.08) (+) |
| Knowledge about the CW recommendation for arthroscopy | x | 15.15 (1.54–149.25) (+) | x | 58.17 (2.63–1287.24) (+) |
| Agrees with the CW recommendation for arthroscopy | x | 58.86 (12.85–269.66) (+) | x | 37.45 (5.39–260.24) (+) |
| Higher valuation of own experience with arthroscopy than of existing evidence | x | 0.14 (0.07–0.28) (−) | x | 0.17 (0.07–0.46) (−) |
| Belief in value of arthroscopy despite possible complications and risks | x | 0.10 (0.05–0.22) (−) | x | 0.28 (0.10–0.81) (−) |
| Important to perform arthroscopy as soon as possible | x | 0.84 (0.09–7.73) (−) | x | x |
| Orthopaedic surgeon wants to meet patients’ expectationsa | 0.80 (0.41–1.54) (−) | 1.20 (0.62–2.34) (+) | x | x |
| Orthopaedic surgeon is able to clarify to the patient whether an MRI scan is necessary, even if the patient has a contradictory opinion at firsta | 1.29 (0.66–2.52) (+) | x | x | x |
| Orthopaedic surgeon is able to clarify to the patient whether an arthroscopy is necessary, even if the patient has a contradictory opinion at firsta | x | 1.29 (0.62–2.72) (+) | x | x |
### Table 6 (continued)

|                                | Univariate analyses | Multivariate analyses |
|--------------------------------|---------------------|-----------------------|
|                                | Acts according to CW MRI recommendation OR (95% CI) | Acts according to arthroscopy CW recommendation OR (95% CI) | Acts according to CW MRI recommendation OR (95% CI) | Acts according to arthroscopy CW recommendation OR (95% CI) |
| Patient                        |                     |                       |                       |
| Orthopaedic surgeon notices that patients are well prepared for the consult by gaining knowledge | 0.62 (0.32–1.20) (−) | 0.64 (0.32–1.30) (−) | x                      | x                      |
| Patients' level of knowledge is sufficient to make a shared decision about treatment | 0.55 (0.29–1.04) (−) | 1.00 (0.50–2.00)      |                       | 0.38 (0.17–0.88) (−) x |
| Patients ≥ 50 years with knee complaints have certain expectations about diagnostics and treatment when they come to the consult<sup>a</sup> | 0.76 (0.16–3.57) (−) | 0.86 (0.18–4.01) (−) | x                      | x                      |
| Most patients find it difficult that the CW recommendation for MRI also applies to them<sup>b</sup> | 0.26 (0.09–0.75) (−) | x                      | 0.34 (0.10–1.16) (−) | x                      |
| Most patients find it difficult that the CW recommendation for arthroscopy also applies to them<sup>b</sup> | x                      | 0.53 (0.24–1.17) (−) | x                      | x                      |
| Social context                 |                     |                       |                       |
| All colleagues follow the CW recommendation for MRI and arthroscopy<sup>b</sup> | 2.09 (1.10–3.97) (+) | 4.79 (2.37–9.69) (+) | 1.54 (0.66–3.60) (+) | 2.51 (0.94–6.70) (+) |
| Colleagues speak to me when I do not follow the guidelines<sup>b</sup> | 1.78 (0.85–3.72) (+) | 1.79 (0.84–3.81) (+) | x                      | x                      |
| Positive attitude of colleagues towards non-surgical treatments (physical therapy, medication, nutritional advice and lifestyle advice)<sup>b</sup> | 3.30 (1.38–7.91) (+) | 1.99 (0.77–5.11) (+) | 1.13 (0.32–3.94) (+) | x                      |
| Organisational context         |                     |                       |                       |
| Orthopaedic surgeon is able to make clear arrangements with primary care (GP, physical therapist, dietician) | 1.22 (0.61–2.46) (+) | 1.68 (0.83–3.38) (+) | x                      | x                      |
| Good feedback from primary care (GP, physical therapist, dietician) to orthopaedic surgeon about patient’s progress | 1.00 (0.54–1.88)     | 1.60 (0.83–3.09) (+) | x                      | x                      |
| Enough time to keep knowledge of guidelines about diagnosis/treatment of knee complaints up to date | 1.75 (0.93–3.28) (+) | 0.81 (0.41–1.61) (−) | 2.14 (0.95–4.84) (+) | x                      |
| Enough time to explain the patient which diagnosis and treatment options are applicable to the patients’ situation<sup>a</sup> | 1.03 (0.52–2.00) (+) | 0.95 (0.47–1.90) (−) | x                      | x                      |
| Pressure of production MRI<sup>b</sup> | 1.84 (0.41–8.36) (+) | x                      | x                      | x                      |
| Pressure of production arthroscopy<sup>b</sup> | x                      | 0.99 (0.27–3.62) (−) | x                      | x                      |
| Waiting time for MRI scan      | 1.00 (0.53–1.89)     | x                      | x                      | x                      |
the use of MRI and arthroscopies in degenerative knee disease mainly mentioned clinician-related barriers [24, 28], it was shown by this study that also patients’ preferences for MRIs and positive experiences of people in their environment with arthroscopies hampered implementation of the CW recommendations. This is an important finding for future initiatives to improve implementation of CW recommendations. These should include both patient- and orthopaedic surgeon-directed strategies.

Implications for clinical practice are that the use of unnecessary MRIs and knee arthroscopy for patients with degenerative knee disease can potentially be reduced by strategies tailored to the identified barriers for implementation of the CW recommendations [11]. This reduction is of great importance as MRIs and arthroscopies for patients with degenerative knees provide no benefit for the patient, waste resources and may even cause harm to the patient [17, 35].

Although this study identified important starting points for improving implementation of CW recommendations, there are also limitations. First, only three patients and three orthopaedic surgeons were interviewed for survey development. However, after the second interview with the orthopaedic surgeon, no new information was obtained so more interviews were not required. Besides, the interviews were only used to explore if other factors should be included in the survey than already found in the literature. Both patients and orthopaedic surgeons were asked to report
the characteristics of received care/care delivery and barriers/facilitators retrospectively, and the use of CW recommendation. Therefore, it is possible that some patients and orthopaedic surgeons were not able to fully recall their respective care trajectory and provided care. Third, patients were self-selected after seeing the advertisements in the newspapers or on the websites, which may have caused selection bias. However, it seems that the patients who completed the survey represented the target group well [5].

**Conclusions**

The identified factors give important starting points for improving implementation of the CW recommendations regarding MRIs and arthroscopies in degenerative knee disease. It seems important to search for strategies to change clinician beliefs on the added value of arthroscopies and MRIs. Moreover, these strategies should focus on the importance of clinical experiences based on evidence. Furthermore, patient-directed strategies are needed to address patient ‘subjective’ preferences based on social feedback from environment and social media. These may add to underlying misbeliefs on the value of MRI and arthroscopies in degenerative knee disease.

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**Compliance with ethical standards**

**Conflict of interest** The authors declare that they have no competing interests.

**Ethical approval** This study was approved by the Medical Ethical Committee (CME P16.190/NV/nv) of the Leiden University Medical Center.

**Informed consent** For this type of article, formal consent is not required.

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**Appendix 1: Items survey patient**

- **Background characteristics**
  - Age: In years
  - Gender: Male, female
  - Region of residence: North (Friesland, Groningen, Flevoland, Noord-Holland, Drenthe, and Overijssel), middle (Zuid-Holland, Utrecht, and Gelderland) and south (Noord-Brabant, Zeeland, and Limburg)
  - Education level: Basic education (no or only primary education), intermediate education (prevocational secondary education, senior secondary vocational training, senior secondary general education, pre-university education) or higher education (higher professional education or university (bachelor’s, master’s or PhD degree)
  - Start of disease symptoms: 0–3 months, 3–6 months, 6–12 months, and > 1 year
  - Diagnosis of locking symptoms by orthopaedic surgeon if patient received arthroscopy: Yes, no
  - Pain before visiting an orthopaedic surgeon: Visual analogue scale (VAS)
  - Pain at the moment of the survey: Visual analogue scale (VAS)
  - Health insurance: Basic insurance or additional coverage
  - History of caregivers: General practitioner (GP), physical therapist, orthopaedic surgeon, dietitian, and/or other
  - Received care modalities: MRI, arthroscopy and/or physical therapy (yes/no)
  - Time between start of knee complaints and visiting the GP: < 1 week, 1–6 weeks, > 6 weeks, or no idea
  - Waiting time between GP and orthopaedic surgeon: 1–2 weeks, 3–4 weeks, 5–6 weeks, more than 6 weeks, or no idea
  - Waiting time MRI: 1–2 weeks, 3–4 weeks, 5–6 weeks, more than 6 weeks, or no idea, not applicable (NA)
  - Waiting time arthroscopy: Waiting time arthroscopy (1–2 weeks, 3–4 weeks, 5–6 weeks, more than 6 weeks, or no idea, NA)
  - Preferred and actual role of the patient in treatment decision-making process: Control Preference Scale (CPS) [17]

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*In the Netherlands, applying for a basic insurance is compulsory. In addition, patients can choose for an additional coverage*
Appendix 2: Items survey orthopaedic surgeon

**Background characteristics**

| Age                      |  
|--------------------------|
| Gender                   | Male, female  
| Years of working experience |  
| Work setting             | University medical centre, teaching hospital, general hospital, independent treatment centre  
| Work region              | North (Friesland, Groningen, Flevoland, Noord-Holland, Drenthe, and Overijssel), middle (Zuid-Holland, Utrecht, and Gelderland), and south (Noord-Brabant, Zeeland, and Limburg)  
| Number of new patients per month |  
| Number of MRIs and arthroscopies per month |  
| Percentage of patients undergoing an arthroscopy with locking symptoms |  

**Characteristics of care delivery**

| Availability of MRI scan in hospital | Yes, no  
| Waiting time MRI | 0–1 week, 1–2 weeks, 3–4 weeks, 4–5 weeks, or more than 5 weeks  
| Waiting time arthroscopy | 0–1 week, 1–2 weeks, 3–4 weeks, 4–5 weeks, or more than 5 weeks  
| Implementation of CW recommendation | 4-point Likert scale, ranging from “totally agree” (coded 1) till “totally disagree” (coded 4)  

Appendix 3: Flowcharts

**Flowchart patients**

**Flowchart orthopaedic surgeons**

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