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# Healthcare utilization and related costs among older people seeking primary care due to back pain: findings from the BACE-N cohort study

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## ABSTRACT

**Objectives** To describe healthcare utilization and estimate associated costs during 1 year of follow-up among older people seeking primary care due to a new episode back pain and to describe healthcare utilization across patients with different risk profiles stratified using the StarT Back Screening Tool (SBST).

**Design** Prospective cohort study.

**Participants and setting** A total of 452 people aged ≥55 years seeking Norwegian primary care with a new episode of back pain were included.

**Outcome measures** The primary outcome of this study was total cost of healthcare utilization aggregated for 1 year of follow-up. Secondary outcomes included components of healthcare utilization aggregated for 1 year of follow-up. Healthcare utilization was self-reported and included: primary care consultations, medications, examinations, hospitalisation, rehabilitation stay, and operations. Costs were estimated based on unit costs collected from national pricelists. Healthcare utilization across patients with different SBST risk profiles was compared using Kruskal-Wallis test, post hoc Mann-Whitney U tests and Bonferroni adjustment.

**Results** In total, 438 patients were included in the analysis. Mean (BCa 95% CI) total cost per patient over 1 year was €825 (682-976). Median (BCa 95% CI) total cost was €364 (307-440). The largest cost category was primary care consultations, accounting for 56% of total costs. Imaging rate was 34%. The most commonly used medication was paracetamol (27%–35% of patients). Medium- and high-risk patients had a significantly higher degree of healthcare utilization compared with low-risk patients (p<0.030).

**Conclusion** This study estimated a 1 year mean and median cost of healthcare utilization of €825 and €364, respectively. Patients within the top 25th percentile accounted for 77% of all costs. Patients classified as medium risk and high risk had a significantly higher degree of healthcare utilization compared with patients classified as low risk.

**Trial registration number** ClinicalTrials.gov NCT04261309, results

## STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The main strength of the present study is that it was conducted in line with the PROGnosis RESearch Strategy framework and preplanned with a published statistical analysis plan.
⇒ We used descriptive statistics to conduct an overall prognosis study and provide evidence to inform quality improvement in primary care management of back pain.
⇒ The main limitation with this study is that we had missing data (18.4% to 26.0%) on variables used to estimate the outcome variables and had to manually replace missing values.
⇒ Due to differences in primary care organisation between countries, readers are advised to exercise caution with generalisation of the results to other healthcare systems.

## INTRODUCTION

The burden of back pain has been growing along with an increasing and ageing population.[1–4] In recent years, back pain has become the leading cause of disability globally[4 5] and an extensive burden to our healthcare systems.[1 6–8] According to a recent systematic review, the prevalence rate of healthcare utilization for back pain ranges from 28% to 92%,[9] and patients with back pain have previously been shown to consume close to two times as much healthcare as the general population.[10] Physiotherapists, chiropractors and general practitioners (GP) are healthcare providers commonly engaged in the management of back pain.[9] Back pain is one of the most prevalent complaints encountered in primary care.[3 8 11] In Norway, a former study has shown that back pain accounts for as many as 27, 82 and 10% of all consultations to physiotherapists, chiropractors and GPs, respectively.[12]

Updated international clinical guidelines provide, more or less, consistent recommendations for how to assess and treat patients with back pain.[13–16] A key recommendation

is to adopt a stratified healthcare approach, guided by the patients response to care or the results of risk prediction tools (such as the StarT Back Screening Tool (SBST),[7 14 17 18] which has been shown to be a cost-effective strategy in primary care.[19] As targeting resources to those most likely to benefit might allow an improvement in patient outcomes while reducing avoidable costs and the burden on healthcare systems.[14 18–20]

Although these guidelines are well established and health providers report being aware of them, concerns about substantial gaps between guidelines and practice have been highlighted. Problems include both underuse of high-value care (eg, education, advice to remain active and exercise), overuse of low-value care (eg, pharmacological treatment as first-line treatment and high imaging rates), and thereby misuse of limited healthcare resources.[1 2 13 14] The extent to which this concern also applies to older people seeking primary care due to back pain is unknown. Historically older people have been underrepresented in back pain research,[21–23] though in recent years, cohort studies have been designed to specifically investigate the course and prognosis of back pain in older people.[24 25] To improve use of scarce resources and thus reduce the burden on our healthcare systems, researchers have highlighted the importance of monitoring and understanding healthcare utilisation and costs related to back pain.[2 14]

Therefore, the primary aim of this study was to describe healthcare utilization and estimate associated costs during 1 year of follow-up among older people seeking primary care due to a new episode of back pain. The secondary aim was to describe healthcare utilisation across patients with different risk profiles stratified according to the SBST.

## METHOD

This study is designed and performed in accordance with the PROGnosis RESearch Strategy (PROGRESS) framework[26] and is considered part of overall prognosis research. In line with recommendations from the PROGRESS framework,[26] a study protocol including a statistical analysis plan has been published (ClinicalTrials.gov Identifier: NCT04261309).[27]

### Design and setting

This study presents data from the Back Complaints in the Elderly—Norway study (BACE-N), a prospective observational cohort study with 1 year of follow-up within a Norwegian primary care setting. The BACE-N is part of the international BACE consortium.[24]

### Participants and recruitment procedure

Eligible participants were people 55 years of age or older seeking primary care (physiotherapist, chiropractor or GP) with a new episode of back pain (preceded by 6 months without visiting a primary care provider for similar complaints). Patients were excluded if they had difficulties completing the questionnaires (eg, unable to speak, read or write in Norwegian) or if they had difficulties completing the physical examination (eg, are wheelchair-bound). Patients were recruited from physiotherapists, chiropractors and GPs working in Norwegian primary care between April 2015 and February 2020. Patients who met the eligibility criteria and completed the consent to participate were included in the study.

### Data collection, outcome, screening tool and other variables

At baseline, all patients responded to a comprehensive questionnaire and went through a standardised physical examination conducted by local research assistants at test stations established within each recruiting area. Follow-up questionnaires were sent at 3, 6 and 12 months after inclusion. All questionnaires were preferably completed electronically, but paper versions were available for patients not familiar with electronic data collection. Within this study, only data from questionnaires were used.

#### Outcome variables

The primary outcome of this study was total cost of healthcare utilization aggregated for 1 year of follow-up. Secondary outcomes included components of healthcare utilization aggregated for 1 year of follow-up.

Healthcare utilization was self-reported and included: consultations to healthcare professionals (type and frequency), use of back medication (both prescription and over-the-counter, type and frequency), number of diagnostic examinations (type and frequency), number of days of hospitalisation and/or rehabilitation stay and back operations. Consultations to healthcare professionals and use of back medication were reported with a 3-month recall period at each timepoint of follow-up. Number of diagnostic examinations and days of hospitalisation and/or rehabilitation stay were reported with a 3-month recall period at 3-month and 6-month follow-up and a 6-month recall period at 12-month follow-up. Back operations were reported with a 12-month recall period at 12-month follow-up. Total costs of healthcare utilization per patient were estimated by multiplying frequency of use by unit costs collected from national pricelists (see table 1). Non-healthcare costs related to provision of healthcare (as transportation) were not estimated. Costs related to back medication were estimated based on medication type (not exact medication name) and frequency of use (data on dosage were not available).

#### Screening tool

The SBST[17] was used to classify included patients into low, medium or high risk of poor disability outcome. The SBST is a brief 9-item tool designed to screen primary care patients with low back pain for prognostic indicators that are relevant to initial decision-making. The tool is summed to produce an overall score from 0 to 9 and a psychological subscale score from 0 to 5. Patients with an overall score between 0 and 3 are classified as low risk. Patients with an overall score of minimum 4 and a

**Table 1** Cost categories, units, unit price, all numbers in euros (€) and Norwegian kroner (NOK) for 2020

| Cost categories | Unit | Unit price (€) | Unit price (NOK) | Reference (source) |
|---|---|---|---|---|
| *Primary care* | | | | |
| General practitioner | Per visit | 43.1 | 431 | The Norwegian Medical Association, estimated average |
| Physiotherapist | Per visit | 47.2 | 472 | The Norwegian Physiotherapy Association, estimated average |
| Chiropractor | Per visit | 55.0 | 550 | Private price lists, estimated average |
| Manuel therapist | Per visit | 74.2 | 742 | The Norwegian Physiotherapy Association, estimated average |
| Naprapath | Per visit | 64.0 | 640 | Private price lists, estimated average |
| Osteopath | Per visit | 65.0 | 650 | Private price lists, estimated average |
| Psychologist | Per visit | 110.0 | 1100 | The Norwegian Psychological Association, estimated average |
| Other therapists | Per visit | 75.0 | 750 | Private price lists, estimated average |
| *Medication* | | | | |
| Paracetamol | Per daily defined dose | 0.5 | 5 | NoMA price list, estimated average |
| NSAID | Per daily defined dose | 1.2 | 12 | NoMA price list, estimated average |
| Muscle relaxant | Per daily defined dose | 0.7 | 7 | NoMA price list, estimated average |
| Sleep medication | Per daily defined dose | 0.2 | 2 | NoMA price list, estimated average |
| Cortisone | Per daily defined dose | 0.4 | 4 | NoMA price list, estimated average |
| Opioid | Per daily defined dose | 0.9 | 9 | NoMA price list, estimated average |
| *Examination* | | | | |
| Blood sample | Per examination | 20.4 | 204 | The Norwegian Medical Association, estimated average |
| X-ray | Per examination | 119.0 | 1190 | Unilabs price list, estimated average |
| MRI | Per examination | 269.0 | 2690 | Unilabs price list, estimated average |
| CT | Per examination | 189.0 | 1890 | Unilabs price list, estimated average |
| *Secondary care* | | | | |
| Back operation | Per operation | 5220.0 | 52200 | DRG2150 |
| Hospitalisation (non-operation) | Per day | 1880.0 | 18800 | The Norwegian Directorate of Health, SAMDATA |
| Rehabilitation stay | Per day | 315.0 | 3150 | UniCare pricelist, estimated average |

NoMA, Norwegian Medicines Agency; NSAID, non-steroidal anti-inflammatory drug.

subscale score of maximum 3 are classified as medium risk. Patients with an overall score of minimum 4 and a subscale score of 4 or 5 are classified as high risk.

The SBST has been recommended in guidelines to enable stratified care for patients with low back pain.[14 18] Simpler and less intensive support should be considered for people who are likely to improve quickly and have a good outcome. More complex and intensive support should be considered for people with higher risk of a poor outcome. The SBST was translated into Norwegian by Storheim and Grotle in 2012 and has shown to have an acceptable accuracy in predicting persistent disabling back pain.[17 28–31]

### Other variables

Overall prognosis may vary depending on context (time, place, healthcare setting) and characteristics of the study population. In line with the PROGRESS framework and recommendations for overall prognosis studies,[26] descriptive variables were based on previous scientific literature and included the following variables measured at baseline:

- Sex[32–35] (female/male).
- Age[32–35] (years).
- Educational level[36 37] measured as the highest education completed and categorised into low (elementary and high school level) or high (university level).
- First healthcare provider[38] (physiotherapist, chiropractor or GP).
- Pain severity[33 34 39–42] measured by the Numeric Rating Scale (range 0–10, higher score indicate higher pain severity).[43]
- Pain duration[39] measured by the question 'how many days have you had your current back pain?'
- Pain history[40] measured by the question 'have you had back pain before?'
- Radiating pain below the knee[41] measured by the question 'did your back pain radiate to your legs last week? If yes, how far down did the pain radiate?'
- Disability[33 34 37 39–41] measured by the Roland-Morris Disability questionnaire (range 0–24, higher score indicates higher degree of back-related disability).[44]
- Comorbidity[42 45 46] measured by the Self-Administered Comorbidity Questionnaire (13 predefined comorbidities and two optional comorbidities. Item number 12 (back pain) was replaced with a third optional comorbidity).[47]
- Health-related quality of life[34 42] measured by the Short-Form Health Survey 36-item physical and mental summary score (range 0–100, higher score indicate better health-related quality of life).[48]
- Emotional well-being[37 39 41 45 49] measured by the Centre for Epidemiological Studies-Depression questionnaire (range 0–60, higher score indicates more signs of depression).[50]
- Kinesiophobia[41 49] measured by the Fear Avoidance Beliefs Questionnaire—Physical Activity subscale (range 0–24, higher score indicates higher levels of kinesiophobia).[51]
- Red flags (cancer, first episode of back pain, constant pain, unexplained weight loss, systematically unwell, fever, urinary retention or loss of bladder control, age ≥75 years, trauma cause of back pain, osteoporosis, cortisone use and severe morning stiffness).[52 53]
- Total costs related to healthcare utilization prior to inclusion measured in the period from baseline to 6 weeks retrospectively. Healthcare utilization prior to inclusion was self-reported and included: primary care consultations, use of back medication and number of diagnostic examinations. Total cost of healthcare utilization was estimated by multiplying frequency of use by unit costs collected from national pricelists (see table 1).

In addition, included patients were described with respect to ethnicity and pain location.

## Analyses

The statistical analysis plan for this study was informed by recommendations from the PROGRESS framework.[26] All analyses are outlined in the statistical analysis plan published a priori[27] and performed using the IBM SPSS V.26 (IBM Corporation, Armonk, New York). P values <0.05 were considered statistically significant. All statistical tests were two sided.

### Study flow

The flow of participants through the study was reported according to the STROBE guidelines[54] with a flowchart. Reasons for dropout were provided where known. Baseline differences between responders and non-responders at 12-monthfollow-up were evaluated. Mann-Whitney U test was used for continuous variables. Pearson $\chi^2$ and Fisher's exact test (if <5 cases in one cell) were used for categorical variables.

### Missing data

Missing value pattern was visually explored, and missingness at random was assumed. Also, we found evidence against the hypothesis that values were not missing completely at random (Little's test, p>0.05). Missing baseline data were handled by multiple imputation within the BACE-N. Five multiple imputation data sets with 10 iterations were created using regression estimation. We did not impute missing outcome values, as the imputation model had poor predictive performance and caused a clear trend of values being overestimated. Instead, missing values on variables used to calculate the outcome scores were imputed with: (1) each patient's individual average of observed values for the variables: consultations to healthcare professionals and medication use, (2) a value of zero costs for the variables: diagnostic examinations, hospitalisation, rehabilitation stay and back operations.

### Healthcare utilization and cost estimation

Type and frequency of use of different healthcare resources were calculated for each of the follow-up

periods. All costs were presented in euros (€) 2020 and estimated with both mean and median values with 95% CI, using bias-corrected and accelerated (BCa) bootstrapping for each follow-up period and the whole year. The BCa was conducted with a bootstrap sample size of 1000. Cost data are commonly skewed, thus both mean and median values were presented to support the result interpretation. Values in Norwegian kroner (NOK) were recalculated to euros using the exchange rate from February 2020 (1€=NOK 10).

### Healthcare utilization across patients with different risk profiles

Type and frequency of use of different healthcare resources were described for the 1-year follow-up, for the following subgroups: (1) low, (2) medium and (3) high risk of persistent disabling back pain according to the SBST. The Kruskal-Wallis test including post hoc Mann-Whitney U tests with Bonferroni adjustment were conducted to determine between-group differences with regards to number of primary care consultations, number of patients using back medication, number of patients receiving imaging (X-ray, MRI, CT) and number of patients receiving secondary care (back operation, hospitalisation, rehabilitation stay). The Bonferroni adjustment was applied by multiplying raw P values by the number of tests conducted (0.05×3).

### Sensitivity analysis

To test credibility of the manual imputation on missing values used to calculate the outcome scores and total cost calculations related to the primary analyses, two sensitivity analyses were performed; (1) complete case analysis without adjustment for missing data and (2) without outliers. Outliers were identified with simple scatterplots by visual inspection and defined as patients with remarkably high total costs at each time period; 5 patients with costs ≥ €2433 at 0–3 months, 5 patients with costs ≥€6025 at >3–6 months, 8 patients with costs ≥€3518 at >9–12 months and 11 patients with costs ≥€8004 at 0–12 months. All outliers were patients with healthcare utilisation within secondary care, primarily hospitalisation and operations.

### Sample size

This study contains secondary analyses embedded in the BACE-N. Details on sample size calculation are provided in the BACE-N protocol.[27] We considered a sample size of 450 participants within the BACE-N to be sufficient to describe healthcare utilisation and estimate associated costs.[55]

## Patient and public involvement

Patient representatives were part of the scientific board of the study and involved in designing and establishing BACE-N. Results will be disseminated to the recruiting primary care providers and the participating patients in an annual newsletter.

## RESULTS

A total of 452 patients were included in this study. Table 2 shows patient characteristics and clinical status at baseline, along with the proportion with missing data per variable. Flow of patients through the study is shown in figure 1. Fourteen patients (3%) were dropouts at 12-month follow-up and were, thus, removed from the analyses. There was a larger proportion of women (55 vs 42%) among the responders as compared with non-responders. Otherwise, there were no differences between responders and non-responders.

Missing data ranged from 0.0% to 16.8% for included baseline variables and 18.4% to 26.0% for healthcare variables used to calculate the outcome values. Total missingness was 4.9% and 23.3% for all baseline and follow-up values, respectively.

## Healthcare utilization and cost estimation

Table 3 shows healthcare utilization throughout 1 year of follow-up. Table 4 shows costs related to healthcare utilization for each follow-up period and aggregated for 1 year of follow-up. Almost all included patients (87%) had costs related to healthcare utilization during the 1 year of follow-up. Nevertheless, the distribution of costs was highly skewed to the left, indicating that most of costs emerged from a minority of the patients. Patients within the top 5th, 10th and 25th percentile accounted for, respectively, 43%, 55% and 77% of total costs within the sample. The mean (BCa 95% CI) and median (BCa 95% CI) total cost per patient for 1 year of follow-up were estimated at €825 (682–976) and €364 (307–440), respectively. The largest cost category was primary care consultations, accounting for 56% of total costs. The remaining cost categories; back medication, examination, hospitalisation, rehabilitation stay and back operation accounted for 6, 8, 16, 3 and 11% of total costs, respectively.

The sensitivity analyses showed no substantial change in point estimates when comparing complete case analysis and analysis without outliers to the main analysis. The complete case analysis provided an estimated mean (BCa 95% CI) and median (BCa 95% CI) of total cost per patient for 1 year of follow-up at €873 (670–1116) and €343 (280–463), respectively. Furthermore, the analysis without outliers provided an estimated mean (BCa 95% CI) and median (BCa 95% CI) of total cost per patient for 1 year of follow-up at €573 (505–635) and €340 (277–416), respectively.

## Healthcare utilization across patients with different risk profiles

Table 5 shows healthcare utilization throughout 1 year of follow-up across patients with different risk profiles according to the SBST. The SBST classified 289 patients (66%) as low, 120 (27%) as medium and 29 (7%) as high risk of persistent disabling back pain, respectively. Healthcare utilization increased with increasing degree of risk of persistent disabling back pain according to formal testing with the Kruskal-Wallis test, including post

**Table 2** Patient characteristics and clinical status at baseline*

| | All participants (n=452) | Missing, n (%) | Stratified risk profile† | | |
|---|---|---|---|---|---|
| | | | Low (n=297) | Medium (n=125) | High (n=30) |
| Female | 235 (52) | 0 (0) | 137 (46) | 78 (62) | 20 (67) |
| Age in years | 66 (59–72) | 0 (0) | 66 (59–72) | 65 (58–73) | 70 (65–77) |
| Educational level high | 199 (44) | 20 (4) | 140 (47) | 48 (39) | 10 (33) |
| Ethnicity Norwegian | 430 (95) | 0 (0) | 287 (97) | 116 (93) | 27 (90) |
| First healthcare provider | | | | | |
| General practitioner | 127 (28) | 0 (0) | 51 (17) | 26 (21) | 7 (23) |
| Physiotherapist | 130 (29) | 0 (0) | 107 (36) | 41 (33) | 12 (40) |
| Chiropractor | 195 (43) | 0 (0) | 139 (47) | 58 (46) | 11 (37) |
| Pain location | | | | | |
| Thoracic | 61 (14) | 11 (2) | 37 (12) | 21 (17) | 3 (10) |
| Lumbar/sacral | 414 (92) | 11 (2) | 273 (92) | 112 (90) | 29 (97) |
| Radiating pain below the knee | 141 (31) | 0 (0) | 66 (22) | 63 (50) | 12 (40) |
| Pain severity average last week (NRS, 0–10) | 5 (4–7) | 31 (7) | 5 (3–7) | 7 (5–8) | 7 (5–8) |
| Pain duration | | | | | |
| <6 weeks | 297 (66) | 76 (17) | 194 (65) | 89 (71) | 14 (47) |
| 6 weeks to 3 months | 59 (13) | 76 (17) | 37 (13) | 16 (13) | 6 (20) |
| >3 months | 96 (21) | 76 (17) | 66 (22) | 20 (16) | 10 (33) |
| Previous episodes of back pain | 426 (94) | 29 (6) | 279 (94) | 120 (96) | 27 (90) |
| Disability (RMDQ 0–24) | 9 (4–13) | 45 (10) | 6 (3–10) | 13 (10–16) | 17 (13–19) |
| Comorbidity (SCQ, 0–15) | 1 (1–2) | 18 (4) | 1 (0–2) | 2 (1–3) | 2 (2–3) |
| Health-related QOL (SF36, 0–100) | | | | | |
| Physical component | 42 (36–47) | 41 (9) | 45 (39–50) | 37 (33–43) | 33 (30–39) |
| Mental component | 55 (47–60) | 41 (9) | 57 (51–61) | 51 (43–56) | 38 (29–48) |
| Emotional well-being (CES-D, 0–60) | 8 (4–15) | 57 (13) | 6 (3–11) | 12 (8–18) | 18 (15–29) |
| Kinesiophobia (FABQ-PA, 0–24) | 10 (5–13) | 18 (4) | 10 (5–15) | 15 (10–19) | 19 (15–22) |
| Numbers of red flags (0–12) | 1 (0–2) | 50 (11) | 1 (0–1) | 1 (1–2) | 3 (1–4) |
| *Healthcare utilization prior to inclusion* | | | | | |
| Primary care consultation last 6 weeks | | | | | |
| General practitioner | 83 (18) | 21 (5) | 47 (16) | 24 (19) | 12 (40) |
| Physiotherapist | 129 (29) | 21 (5) | 87 (29) | 32 (26) | 10 (33) |
| Chiropractor | 188 (42) | 21 (5) | 123 (41) | 56 (45) | 9 (30) |
| Manual therapist | 19 (4) | 21 (5) | 13 (4) | 6 (5) | 0 (0) |
| Naprapath | 15 (3) | 21 (5) | 8 (3) | 5 (4) | 1 (3) |
| Osteopath | 3 (1) | 21 (5) | 2 (0.7) | 0 (0) | 1 (3) |
| Psychologist | 2 (0.4) | 21 (5) | 1 (0.3) | 1 (0.8) | 0 (0) |
| Other therapists | 7 (2) | 21 (5) | 4 (1) | 2 (2) | 1 (3) |

Continued

**Table 2** Continued

| | All participants (n=452) | Missing, n (%) | Stratified risk profile† | | |
|---|---|---|---|---|---|
| | | | Low (n=297) | Medium (n=125) | High (n=30) |
| Use of medication | 189 (42) | 38 (8) | 94 (32) | 71 (57) | 23 (77) |
| Diagnostic examination last 6 months | | | | | |
| Blood sample | 12 (3) | 24 (5) | 7 (2) | 0 (0) | 5 (17) |
| X-ray | 26 (6) | 24 (5) | 12 (4) | 7 (6) | 7 (23) |
| MRI | 53 (12) | 24 (5) | 30 (10) | 15 (12) | 8 (27) |
| CT | 8 (2) | 24 (5) | 6 (2) | 1 (0.8) | 1 (3) |
| Previous hospitalisation | 54 (12) | 21 (5) | 24 (8) | 18 (14) | 12 (40) |
| Previous rehabilitation stay | 18 (4) | 25 (6) | 7 (2) | 7 (6) | 4 (13) |

All values are presented by number (percentage of total) or median (IQR).
*The presented characteristics are pooled estimates based on the multiple imputation procedures.
†According to the StarT Back Screening Tool.
CES-D, Center for Epidemiological Studies-Depression; FABQ-PA, Fear-Avoidance Beliefs Questionnaire-Physical Activity subscale; NRS, numeric rating scale; RMDQ, Roland-Morris Disability Questionnaire; SCQ, Self-administered Comorbidity Questionnaire; SF-36, Short Form Health Survey 36 Item.

hoc Mann-Whitney U tests: low-risk patients had fewer primary care consultations (p<0.001), used less frequently back medication (p<0.001) and received less frequently imaging (p<0.003) and secondary care (p<0.030), compared with medium-risk patients. Moreover, low-risk patients had fewer primary care consultations (p<0.001),

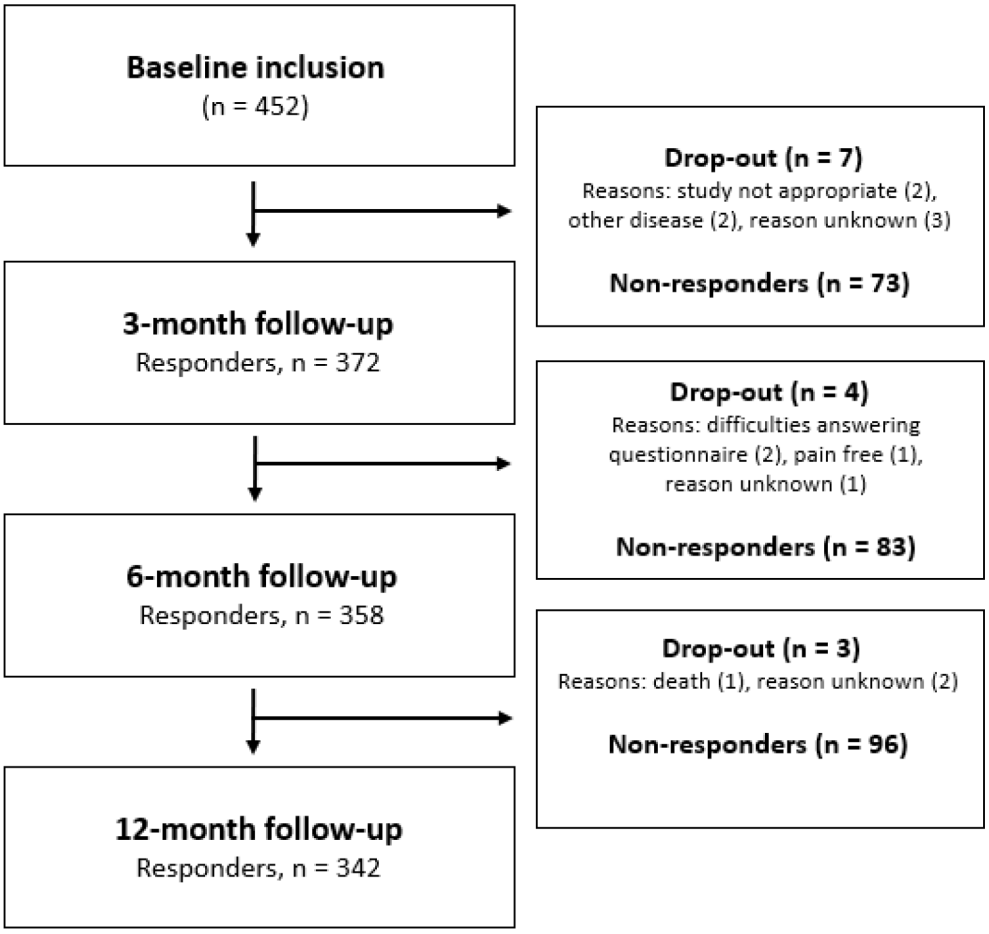


**Figure 1** Participant flowchart.

**Table 3** Healthcare utilization throughout 1 year of follow-up (n=438)

| | 0–3 months | | >3–6 months | | >9–12 months | |
|---|---|---|---|---|---|---|
| | | Missing, n (%) | | Missing, n (%) | | Missing, n (%) |
| *Primary care* | | | | | | |
| Primary care consultation, N (%) | | 79 (18) | | 87 (20) | | 108 (24) |
| General practitioner | 44 (12) | | 30 (9) | | 22 (7) | |
| Physiotherapist | 119 (33) | | 70 (20) | | 48 (15) | |
| Chiropractor | 124 (35) | | 76 (22) | | 50 (15) | |
| Manual therapist | 22 (6) | | 5 (1) | | 7 (2) | |
| Naprapath | 6 (2) | | 11 (3) | | 6 (2) | |
| Osteopath | 2 (0.6) | | 1 (0.3) | | 3 (1) | |
| Psychologist | 0 (0) | | 1 (0.3) | | 1 (0.3) | |
| Other therapists | 10 (3) | | 12 (3) | | 7 (2) | |
| No primary care consultations | 93 (26) | | 179 (51) | | 212 (64) | |
| Numbers of consultations, median (IQR)* | | | | | | |
| General practitioner | 1 (1–2) | 0 (0) | 1 (1–2) | 0 (0) | 1 (1–3) | 0 (0) |
| Physiotherapist | 4 (2–8) | 0 (0) | 4 (2–10) | 2 (3) | 5 (1–9) | 0 (0) |
| Chiropractor | 4 (2–6) | 0 (0) | 2 (1–4) | 4 (5) | 3 (1–5) | 0 (0) |
| Manual therapist | 3 (1–5) | 0 (0) | 3 (2–14) | 0 (0) | 1 (1–4) | 0 (0) |
| Naprapath | 3 (1–5) | 0 (0) | 4 (2–6) | 0 (0) | 3 (1–4) | 0 (0) |
| Osteopath | 3 (2-) | 0 (0) | 2 (2–2) | 0 (0) | 10 (2-) | 0 (0) |
| Psychologist | – | – | 1 (1–1) | 0 (0) | 7 (7–7) | 0 (0) |
| Other consultations | 4 (1–6) | 0 (0) | 1 (1–8) | 0 (0) | 4 (2–8) | 1 (14) |
| *Medication* | | | | | | |
| Use of back medication, N (%) | | 80 (18) | | 96 (22) | | 114 (26) |
| Paracetamol | 124 (35) | | 91 (27) | | 86 (27) | |
| NSAID | 86 (24) | | 75 (22) | | 64 (20) | |
| Muscle relaxants | 6 (2) | | 4 (1) | | 3 (1) | |
| Sleep medication | 22 (6) | | 22 (6) | | 13 (4) | |
| Cortisone | 5 (1) | | 9 (3) | | 4 (1) | |
| Opioid | 5 (1) | | 5 (2) | | 3 (1) | |
| No use of back medication | 197 (55) | | 213 (62) | | 213 (66) | |
| Frequency of use paracetamol, N (%)** | | | | | | |
| Daily | 46 (37) | 0 (0) | 32 (35) | 0 (0) | 30 (35) | 0 (0) |
| Weekly | 35 (28) | 0 (0) | 30 (33) | 0 (0) | 28 (33) | 0 (0) |
| Monthly or less | 43 (35) | 0 (0) | 29 (32) | 0 (0) | 28 (32) | 0 (0) |
| Frequency of use NSAID, N (%)† | | | | | | |
| Daily | 22 (26) | 0 (0) | 16 (21) | 0 (0) | 17 (26) | 0 (0) |
| Weekly | 14 (16) | 0 (0) | 25 (33) | 0 (0) | 19 (30) | 0 (0) |
| Monthly or less | 50 (58) | 0 (0) | 34 (46) | 0 (0) | 28 (44) | 0 (0) |

Continued

Table 3 Continued

| | 0–3 months | | >3–6 months | | >9–12 months | |
|---|---|---|---|---|---|---|
| | | Missing, n (%) | | Missing, n (%) | | Missing, n (%) |
| Frequency of use opioid, N (%)† | | | | | | |
| Daily | 3 (60) | 0 (0) | 4 (80) | 0 (0) | 2 (67) | 0 (0) |
| Weekly | 1 (20) | 0 (0) | – | – | – | – |
| Monthly or less | 1 (20) | 0 (0) | 1 (20) | 0 (0) | 1 (33) | 0 (0) |
| *Examination* | | | | | | |
| Diagnostic examination, N (%) | | 79 (18) | | 86 (20) | | 106 (24) |
| Blood sample | 9 (3) | | 5 (1) | | 6 (2) | |
| X-ray | 12 (3) | | 8 (2) | | 16 (5) | |
| MRI | 37 (10) | | 17 (5) | | 20 (6) | |
| CT | 4 (1) | | 2 (1) | | 2 (1) | |
| No diagnostic examination | 281 (77) | | 316 (89) | | 289 (87) | |
| *Secondary care* | | | | | | |
| Back operation, N (%) | – | – | – | – | 7 (2) | 103 (24) |
| Hospitalisation, N (%) | 5 (1) | 75 (17) | 6 (2) | 84 (19) | 2 (1) | 104 (24) |
| Duration of stay in days, median (range) | 1 (1–2) | 0 (0) | 3 (2–5) | 1 (17) | 2.5 (2-) | 0 (0) |
| Rehabilitation stay, N (%) | 0 (0) | 73 (17) | 1 (0.3) | 84 (19) | 1 (0.3) | 104 (24) |
| Duration of stay in days, median (range) | – | – | 20 (20–20) | 0 (0) | 7 (7–7) | 0 (0) |

Cells marked with a dash (-) indicate that the variable was not reported.
*Numbers of consultations are calculated on the basis of patients who have reported primary care consultations.
†Frequency of back medication use is calculated on the basis of patients who have reported back medication use.
NSAID, non-steriodal anti-inflammatory drug.

used less frequently back medication (p<0.001) and received less frequently imaging (p<0.015), compared with high-risk patients. No differences were revealed between medium-risk and high-risk patients.

## DISCUSSION

The present study describes the prevalence and associated costs of healthcare utilization among older people seeking primary care due to a new episode of back pain. The mean and median total cost per patient during the 1 year of follow-up was €825 and €364, respectively. The largest cost category was primary care consultations. Patients within the top 25th percentile accounted for 77% of all costs. Patients with medium-risk and high-risk of poor disability had a significantly higher degree of healthcare utilization compared with patients with low risk.

Direct comparability of this study with other studies is limited. To the best of our knowledge, no similar study has been conducted among a sample of exclusively older people with back pain or within the Norwegian healthcare system.[56] Furthermore, there is a widespread heterogeneity in the methodologies used among back pain cost of illness studies.[56 57] Nevertheless, several of our findings are generally in accordance with previous research on primarily middle-aged patients with back pain. The majority of cost of illness studies recruiting participants from primary care have estimated in 2020 euros a 1-year mean total direct cost related to back pain per patient ranging from €1.000 to €2.000.[41 56 58 59] Furthermore, several studies have found that primary care consultations are frequently used and a large cost category among patients with back pain,[8 33 56–62] and that the majority of healthcare utilization and related costs stem from a relatively small group of patients.[61 63 64] In the present study, descriptive statistics indicated a gradual decrease in costs related to primary care and a gradual increase in costs related to secondary care during the 1 year of follow-up. Yet, that result should be interpreted with caution, especially for costs related to secondary care where the mean values deviated to a fairly large extent from the median values, hence indicating that the increase is largely due to a few individuals with (remarkably) high costs.

**Table 4** Cost (€) due to healthcare utilization from 0 to 3 months, >3–6 months, >9–12 months and 0–12 months* (n=438)

| | Patients with zero costs, n (%) | 0–3 months | | >3–6 months | | >9–12 months | | 0–12 months* | |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean (95% CI)† | Median (95% CI)† | Mean (95% CI)† | Median (95% CI)† | Mean (95% CI)† | Median (95% CI)† | Mean (95% CI)† | Median (95% CI)† |
| Primary care | 83 (21) | 199 (178 to 222) | 116 (94 to 154) | 138 (118 to 161) | 43 (24 to 47) | 120 (98 to 145) | 0 (0 to 0) | 458 (404 to 516) | 242 (192 to 330) |
| Medication | 176 (44) | 19 (15 to 23) | 0 (0 to 0.4) | 17 (14 to 21) | 0 (0 to 0) | 16 (13 to 20) | 0 (0 to 0) | 52 (43 to 61) | 3 (1 to 7) |
| Examination | 308 (77) | 31 (23 to 39) | 0 (0 to 0) | 15 (9 to 21) | 0 (0 to 0) | 19 (13 to 26) | 0 (0 to 0) | 65 (50 to 81) | 0 (0 to 0) |
| Secondary care | 390 (97) | 33 (9 to 61) | 0 (0 to 0) | 90 (28 to 162) | 0 (0 to 0) | 120 (50 to 216) | 0 (0 to 0) | 243 (116 to 388) | 0 (0 to 0) |
| **Total** | 52 (13) | 281 (244 to 322) | 165 (165 to 165) | 261 (189 to 346) | 55 (46 to 55) | 276 (195 to 370) | 44 (23 to 46) | 825 (682 to 976) | 364 (307 to 440) |

*Cost due to healthcare utilisation for the entire follow-up period is calculated on the basis for the three follow-up periods.
†Bias-corrected and accelerated bootstrapping (1000 simulations).

**Table 5** Healthcare utilization throughout 1 year of follow-up, across patients with different risk profile according to the StarT Back Screening tool (n=438)*

| | Stratified risk profile | | |
|---|---|---|---|
| | Low (n=289) | Medium (n=120) | High (n=29) |
| *Primary care* | | | |
| Primary care consultation, N (%) | 205 (76) | 94 (86) | 21 (88) |
| Numbers of consultations, median (IQR)† | 5 (3–11) | 12 (6–19) | 15 (8–22) |
| *Medication* | | | |
| Use of back medication, N (%) | 128 (48) | 77 (71) | 21 (91) |
| Paracetamol | 95 (35) | 68 (63) | 18 (78) |
| NSAID | 88 (33) | 39 (36) | 10 (44) |
| Muscle relaxants | 1 (0.4) | 7 (7) | 3 (13) |
| Sleep medication | 14 (5) | 11 (10) | 8 (35) |
| Cortisone | 4 (2) | 4 (4) | 5 (22) |
| Opioid | 4 (2) | 4 (4) | 2 (9) |
| *Examination* | | | |
| Diagnostic examination, N (%) | 73 (27) | 45 (42) | 12 (50) |
| Blood sample | 14 (5) | 3 (3) | 2 (9) |
| X-ray | 15 (6) | 10 (9) | 5 (22) |
| MRI | 30 (11) | 24 (22) | 6 (26) |
| CT | 3 (1) | 4 (4) | 1 (4) |
| *Secondary care* | | | |
| Back operation, N (%) | 4 (2) | 1 (1) | 2 (11) |
| Hospitalisation, N (%) | 4 (2) | 6 (6) | 2 (9) |
| Rehabilitation stay, N (%) | 0 (0) | 2 (2) | 0 (0) |

Valid percentages are given and have been rounded off.
*Healthcare utilization throughout 1 year of follow-up is calculated on the basis for the three follow-up periods.
†Number of consultations is calculated on the basis of patients who have reported primary care consultations.
NSAID, non-steriodal anti-anflammatory drug.

In the present study, we revealed an imaging rate of 34% during the 1 year of follow-up, including the time period from baseline to 6 months retrospectively. Comparably, Werner and Ihlebæk[65] showed that 39% of patients with low back pain in 2011 were referred for imaging by GPs in Norway. Likewise, in a recent systematic review of healthcare provided for patients with low back pain, Kamper *et al*[13] reported that around one in four was referred for imaging in family practice. Updated clinical guidelines recommend that imaging should not be routinely used, but rather reserved for patients for whom the result is likely to change management.[14 18 66] Also, evidence suggests that

prevalence of serious pathology as cause of back pain, for which imaging is indicated, in primary care is ≤6%.[1 52 67 68] In that context, a rate of 34% seems to indicate an overuse of imaging.[66 69]

Our findings regarding medication use are slightly different from previous research. In our study, paracetamol (27%–35%) followed by NSAIDs (20%–24%) were most commonly used, whereas only a small proportion of patients used opioids (1%–2%). Estimates provided by Kamper *et al*[13] have suggested that around 20% of low back pain patients within family practice are recommended paracetamol, 35%–40% NSAIDs and up to 30% opioids. Differences in paracetamol use might be explained by the fact that most studies do not include over-the-counter medication, thus use of paracetamol is probably underrepresented within the review by Kamper *et al*.[13] Differences in NSAIDs use might be explained by the fact that our sample consists of exclusively older people who often have a higher risk of NSAID-related side effects.[70 71] Differences in opioid use might be explained by the fact that Norway has strict opioid prescription regulations.[72] Updated clinical guidelines recommend pharmacological treatment as an adjunctive option in case of an inadequate response to first-line treatment.[14 18] NSAIDs should be first-line pharmacological treatment, taking into account possible side effects. Opioids should be used only in carefully selected patients. Paracetamol is not recommended. In that context, it appears that opioid use within this study might be in line with clinical guidelines, as opposed to paracetamol use.

Low-risk patients had a significantly lower degree of healthcare utilization compared with medium-risk and high-risk patients. We revealed no difference in healthcare utilization between medium-risk and high-risk patients. Yet, that result should be interpreted with caution due to a small sample size within the high-risk subgroup, thus risk of low statistical power. Updated clinical guidelines recommend a stratified healthcare approach.[7 14 18] In that context, it is promising that low-risk patients have a lower degree of healthcare utilization compared with medium-risk and high-risk patients.

The main limitation with this study is that we had missing data on variables used to estimate the outcome variables and had to manually replace missing values. It is well known that healthcare utilization is prone to missing data.[73–75] Also, that missing values should be replaced in order to make use of all reported data.[73 74] Unfortunately, due to poor predictive performance, multiple imputation could not be used in this study. We, therefore, chose a frequently used, though not optimal, method for replacing missing values and have been transparent in our reporting. A second limitation is the fact that we expect to have somewhat underestimated total healthcare utilization and related costs. Self-reports tend to underestimate the true value of healthcare utilization due to potential recall bias.[76–79] Furthermore, we lack data on primary care consultations and medication use between 6 and 9 months. A third limitation is the lack of data on eligible participants that declined to participate or for other reasons were not invited. Due to limited resources and practical reasons related to recruitment from a broad network of clinicians, it was not possible to record information on all eligible participants during the data collection period. To compensate for this limitation and assess the representativeness of the BACE-N sample, it has previously been compared on key sociodemographic variables with a subsample from a longitudinal population study: 'The Norwegian study on life course, ageing and generation (NORLAG)'.[80 81] The subsample (NORLAG MSK) is expected to be a representative sample of people aged ≥55 years with musculoskeletal complaints. Characteristics of the two samples were largely comparable, though the BACE-N sample has more men, and more with higher education levels. Previous studies have shown that women[33 34 40] are more likely to seek care for back pain as are people with lower education levels.[33 36 37] In that context, it is likely to assume that the amount of healthcare utilization presented in this study is somewhat underestimated. Furthermore, the BACE-N sample is largely comparable to younger Norwegian back pain cohorts[82 83] and to the BACE cohort from the Netherlands.[84] A fourth potential limitation, which might have affected the representativeness of the BACE-N sample, is that we used an age cut point of ≥55 years to define a population of older people. Commonly, older people are defined as those aged 60 or 65 years or older,[85] whereas in BACE-N, only 74% and 58% of patients were ≥60 and 65 years at baseline, respectively. An age cut point of ≥55 years within the BACE-N was determined based on the standardised methodology of the BACE consortium,[24] as this would allow comparisons across different countries. Within the BACE consortium, the decision of the age cut point was based on an age cut point (of ≥55 years), which was used in a large population cohort study of older people in the Netherlands (The Rotterdam Study).[86] Finally, a fifth potential limitation is that we conducted this study from a health system perspective, thus, indirect costs related to productivity loss were not estimated. Indirect costs are expected to have a strong impact on total costs related to back pain.[55] Therefore, this should be taken into account when interpreting the results.

The main strength of the present study is that it was conducted in line with the PROGRESS framework[26] and preplanned with a published statistical analysis plan. Also, it is the first study to estimate healthcare utilization and related cost among a sample of exclusively older people with back pain. Mapping healthcare utilization is vital to improve use of scarce healthcare resources and reduce the burden on our healthcare systems, where possible and appropriate.[2 14] This study addressed potential gaps between guidelines and practice; the use of paracetamol and imaging seems to be important areas for quality improvement in primary care management of older people with back pain.

## Conclusion

In conclusion, this study estimated a 12-month mean and median cost of healthcare utilization of €825 and €364, respectively, among older people seeking Norwegian primary care due to a new episode of back pain. Patients

within the top 25th percentile accounted for 77% of all costs. Furthermore, patients classified as medium risk and high risk had a significantly higher degree of healthcare utilization compared with patients classified as low risk. Since this is the first study to estimate healthcare utilization and related cost among a sample of exclusively older people with back pain, further research is needed to complement these findings.

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**Contributors** RMK originated the idea. RMK, KS, DAW and MG designed the study. MG and KS contributed to the funding of the study. RMK, ZZK, ØNV and LK collected data for the study. RMK analysed the data. RMK, KS, DAW, ZZK, ØNV, MCS and MG contributed to the interpretation of data. RMK drafted the manuscript with all authors contributing in reading, commenting and approving the final manuscript. RMK is the guarantor.

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**Competing interests** None declared.

**Patient and public involvement** Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

**Patient consent for publication** Not applicable.

**Ethics approval** The study was assessed by the Norwegian Regional Committee for Medical Research Ethics and was classified as a quality assessment study (ref number 2014/1634/REK vest). They specified that a quality assessment study does not require their explicit approval. The study was approved by the Norwegian Social Science Data Service (ref number 42149). Participants gave informed consent to participate in the study before taking part.

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## REFERENCES

1 Hartvigsen J, Hancock MJ, Kongsted A, *et al*. What low back pain is and why we need to pay attention. *Lancet* 2018;391:2356–67.
2 Buchbinder R, van Tulder M, Öberg B, *et al*. Low back pain: a call for action. *Lancet* 2018;391:2384–8.
3 Deyo RA, Mirza SK, Martin BI. Back pain prevalence and visit rates: estimates from U.S. national surveys, 2002. *Spine* 2006;31:2724–7.
4 Vos, T, GBD 2019 Diseases and Injuries Collaborators. Global burden of 369 diseases and injuries in 204 countries and territories, 1990-2019: a systematic analysis for the global burden of disease study 2019. *Lancet* 2020;396:1204–22.
5 Chen S, Chen M, Wu X, *et al*. Global, regional and national burden of low back pain 1990-2019: a systematic analysis of the global burden of disease study 2019. *J Orthop Translat* 2022;32:49–58.
6 van Tulder M, Koes B, Bombardier C. Low back pain. *Best Pract Res Clin Rheumatol* 2002;16:761–75.
7 Traeger AC, Buchbinder R, Elshaug AG, *et al*. Care for low back pain: can health systems deliver? *Bull World Health Organ* 2019;97:423–33.
8 Kinge JM, Knudsen AK, Skirbekk V, *et al*. Musculoskeletal disorders in Norway: prevalence of chronicity and use of primary and specialist health care services. *BMC Musculoskelet Disord* 2015;16:1–9.
9 Beyera GK, O'Brien J, Campbell S. Health-Care utilisation for low back pain: a systematic review and meta-analysis of population-based observational studies. *Rheumatol Int* 2019;39:1663–79.
10 Jöud A, Petersson IF, Englund M. Low back pain: epidemiology of consultations. *Arthritis Care Res* 2012;64:1084–8.
11 Licciardone JC. The epidemiology and medical management of low back pain during ambulatory medical care visits in the United States. *Osteopath Med Prim Care* 2008;2:11.
12 Werner ELIA. Kunnskap, praksis OG holdninger TIL rygglidelser HOS leger, fysioterapeuter OG kiropraktorer. *Tidsskr Nor Laegeforen* 2005;125:1794–7.
13 Kamper SJ, Logan G, Copsey B, *et al*. What is usual care for low back pain? A systematic review of health care provided to patients with low back pain in family practice and emergency departments. *Pain* 2020;161:694–702.
14 Foster NE, Anema JR, Cherkin D, *et al*. Prevention and treatment of low back pain: evidence, challenges, and promising directions. *Lancet* 2018;391:2368–83.
15 Corp N, Mansell G, Stynes S, *et al*. Evidence-Based treatment recommendations for neck and low back pain across Europe: a systematic review of guidelines. *Eur J Pain* 2021;25:275–95.
16 O'Connell NE, Cook CE, Wand BM, *et al*. Clinical guidelines for low back pain: a critical review of consensus and inconsistencies across three major guidelines. *Best Pract Res Clin Rheumatol* 2016;30:968–80.
17 Hill JC, Dunn KM, Lewis M, *et al*. A primary care back pain screening tool: identifying patient subgroups for initial treatment. *Arthritis Rheum* 2008;59:632–41.
18 NICE. *Low back pain and sciatica in over 16s: assessment and management*. London: National Institute for Clinical Excellence, 2016.
19 Hill JC, Whitehurst DGT, Lewis M, *et al*. Comparison of stratified primary care management for low back pain with current best practice (start back): a randomised controlled trial. *Lancet* 2011;378:1560–71.
20 Hall JA, Jowett S, Lewis M, *et al*. The start back stratified care model for nonspecific low back pain: a model-based evaluation of long-term cost-effectiveness. *Pain* 2021;162:702–10.
21 Maher C, Underwood M, Buchbinder R. Non-Specific low back pain. *Lancet* 2017;389:736–47.
22 Paeck T, Ferreira ML, Sun C, *et al*. Are older adults missing from low back pain clinical trials? A systematic review and meta-analysis. *Arthritis Care Res* 2014;66:1220–6.
23 Bressler HB, Keyes WJ, Rochon PA, *et al*. The prevalence of low back pain in the elderly. A systematic review of the literature. *Spine* 1999;24:1813–9.
24 Scheele J, Luijsterburg PAJ, Ferreira ML, *et al*. Back complaints in the elders (BACE); design of cohort studies in primary care: an international Consortium. *BMC Musculoskelet Disord* 2011;12:193.
25 Jarvik JG, Comstock BA, Bresnahan BW, *et al*. *Study protocol: the back pain outcomes using longitudinal data (BOLD) registry*. *BMC Musculoskelet Disord* 2012;13:64.
26 Hemingway H, Croft P, Perel P, *et al*. Prognosis research strategy (progress) 1: a framework for researching clinical outcomes. *BMJ* 2013;346:e5595.
27 Grotle M. *BACk Pain in Elders in Norway (BACE-N)*, 2020. Clinicaltrials.Gov. Available: https://clinicaltrials.gov/ct2/show/NCT04261309
28 Ø V. N, Storheim K, GM. With what accuracy can we predict persistent disability in sciatica patients with self-reported screening tools? *Oslo University College* 2014.
29 Bier JD, Ostelo RWJG, van Hooff ML, *et al*. Validity and reproducibility of the start back tool (Dutch version) in patients with low back pain in primary care settings. *Phys Ther* 2017;97:561–70.
30 Mehling WE, Avins AL, Acree MC, *et al*. Can a back pain screening tool help classify patients with acute pain into risk levels for chronic pain? *Eur J Pain* 2015;19:439–46.
31 Suri P, Delaney K, Rundell SD, *et al*. Predictive validity of the start back tool for risk of persistent disabling back pain in a U.S. primary care setting. *Arch Phys Med Rehabil* 2018;99:1533–9.
32 Rattay P, Butschalowsky H, Rommel A, *et al*. [Utilization of outpatient and inpatient health services in Germany: results of the German Health Interview and Examination Survey for Adults (DEGS1)]. *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz* 2013;56:832–44.
33 Wenig CM, Schmidt CO, Kohlmann T, *et al*. Costs of back pain in Germany. *Eur J Pain* 2009;13:280–6.

34 Mutubuki EN, Luitjens MA, Maas ET, *et al*. Predictive factors of high societal costs among chronic low back pain patients. *Eur J Pain* 2020;24:325–37.
35 Chechulin Y, Nazerian A, Rais S, *et al*. Predicting patients with high risk of becoming high-cost healthcare users in Ontario (Canada). *Healthc Policy* 2014;9:68–79.
36 Hoebel J, Rattay P, Prütz F, *et al*. Socioeconomic status and use of outpatient medical care: the case of Germany. *PLoS One* 2016;11:e0155982.
37 Lim K-L, Jacobs P, Klarenbach S. A population-based analysis of healthcare utilization of persons with back disorders: results from the Canadian community health survey 2000-2001. *Spine* 2006;31:212–8.
38 Fritz JM, Kim J, Dorius J. Importance of the type of provider seen to begin health care for a new episode low back pain: associations with future utilization and costs. *J Eval Clin Pract* 2016;22:247–52.
39 Engel CC, von Korff M, Katon WJ. Back pain in primary care: predictors of high health-care costs. *Pain* 1996;65:197–204.
40 Ferreira ML, Machado G, Latimer J, *et al*. Factors defining care-seeking in low back pain--a meta-analysis of population based surveys. *Eur J Pain* 2010;14:747.e1–747.e7.
41 Becker A, Held H, Redaelli M, *et al*. Low back pain in primary care: costs of care and prediction of future health care utilization. *Spine* 2010;35:1714–20.
42 Lentz TA, Harman JS, Marlow NM, *et al*. Factors associated with persistently high-cost health care utilization for musculoskeletal pain. *PLoS One* 2019;14:e0225125.
43 Von Korff M, Jensen MP, Karoly P. Assessing global pain severity by self-report in clinical and health services research. *Spine* 2000;25:3140–51.
44 Roland M, Morris R. A study of the natural history of back pain. Part I: development of a reliable and sensitive measure of disability in low-back pain. *Spine* 1983;8:141–4.
45 Stewart WF, Yan X, Boscarino JA, *et al*. Patterns of health care utilization for low back pain. *J Pain Res* 2015;8:523–35.
46 Ritzwoller DP, Crounse L, Shetterly S, *et al*. The association of comorbidities, utilization and costs for patients identified with low back pain. *BMC Musculoskelet Disord* 2006;7:72.
47 Sangha O, Stucki G, Liang MH, *et al*. The self-administered comorbidity questionnaire: a new method to assess comorbidity for clinical and health services research. *Arthritis Rheum* 2003;49:156–63.
48 Ware JE, Sherbourne CD. The mos 36-item short-form health survey (SF-36). I. conceptual framework and item selection. *Med Care* 1992;30:473–83.
49 Keeley P, Creed F, Tomenson B, *et al*. Psychosocial predictors of health-related quality of life and health service utilisation in people with chronic low back pain. *Pain* 2008;135:142–50.
50 Radloff LS. The CES-D scale: a self-report depression scale for research in the general population. *Appl Psychol Meas* 1977;1:355–85.
51 Waddell G, Newton M, Henderson I, *et al*. A Fear-Avoidance beliefs questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability. *Pain* 1993;52:157–68.
52 Enthoven WTM, Geuze J, Scheele J, *et al*. Prevalence and "Red Flags" Regarding Specified Causes of Back Pain in Older Adults Presenting in General Practice. *Phys Ther* 2016;96:305–12.
53 Verhagen AP, Downie A, Popal N, *et al*. Red flags presented in current low back pain guidelines: a review. *Eur Spine J* 2016;25:2788–802.
54 von Elm E, Altman DG, Egger M, *et al*. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *PLoS Med* 2007;4:e296.
55 Johnston KM, Lakzadeh P, Donato BMK, *et al*. Methods of sample size calculation in descriptive retrospective burden of illness studies. *BMC Med Res Methodol* 2019;19:9.
56 Zemedikun DT, Kigozi J, Wynne-Jones G, *et al*. Methodological considerations in the assessment of direct and indirect costs of back pain: a systematic scoping review. *PLoS One* 2021;16:e0251406.
57 Dagenais S, Caro J, Haldeman S. A systematic review of low back pain cost of illness studies in the United States and internationally. *Spine J* 2008;8:8–20.
58 Depont F, Hunsche E, Abouelfath A, *et al*. Medical and non-medical direct costs of chronic low back pain in patients consulting primary care physicians in France. *Fundam Clin Pharmacol* 2010;24:101–8.
59 Hong J, Reed C, Novick D, *et al*. Costs associated with treatment of chronic low back pain: an analysis of the UK general practice research database. *Spine* 2013;38:75–82.
60 Ekman M, Jönhagen S, Hunsche E, *et al*. Burden of illness of chronic low back pain in Sweden: a cross-sectional, retrospective study in primary care setting. *Spine* 2005;30:1777–85.
61 Olafsson G, Jonsson E, Fritzell P, *et al*. Cost of low back pain: results from a national register study in Sweden. *Eur Spine J* 2018;27:2875–81.
62 Lambeek LC, van Tulder MW, Swinkels ICS, *et al*. The trend in total cost of back pain in the Netherlands in the period 2002 to 2007. *Spine* 2011;36:1050–8.
63 Vlaeyen JWS, Maher CG, Wiech K, *et al*. Low back pain. *Nat Rev Dis Primers* 2018;4:52.
64 Wammes JJG, van der Wees PJ, Tanke MAC, *et al*. Systematic review of high-cost patients' characteristics and healthcare utilisation. *BMJ Open* 2018;8:e023113.
65 Werner EL, Ihlebæk C. Primary care doctors' management of low back pain patients--ten years after. *Tidsskr Nor Laegeforen* 2012;132:2388–90.
66 Patel ND, Broderick DF, Burns J, *et al*. ACR Appropriateness criteria low back pain. *J Am Coll Radiol* 2016;13:1069–78.
67 Henschke N, Maher CG, Refshauge KM, *et al*. Prognosis in patients with recent onset low back pain in Australian primary care: inception cohort study. *BMJ* 2008;337:a171.
68 Henschke N, Maher CG, Refshauge KM, *et al*. Prevalence of and screening for serious spinal pathology in patients presenting to primary care settings with acute low back pain. *Arthritis Rheum* 2009;60:3072–80.
69 Weiner DK, Kim Y-S, Bonino P, *et al*. Low back pain in older adults: are we utilizing healthcare resources wisely? *Pain Med* 2006;7:143–50.
70 Machado GC, Abdel-Shaheed C, Underwood M, *et al*. Non-Steroidal anti-inflammatory drugs (NSAIDs) for musculoskeletal pain. *BMJ* 2021;372:n104.
71 McCarberg BH. Nsaids in the older patient: balancing benefits and harms. *Pain Med* 2013;14 Suppl 1:S43–4.
72 Muller AE, Clausen T, Sjøgren P, *et al*. Prescribed opioid analgesic use developments in three Nordic countries, 2006-2017. *Scand J Pain* 2019;19:345–53.
73 Franklin M, Lomas J, Walker S, *et al*. An educational review about using cost data for the purpose of cost-effectiveness analysis. *Pharmacoeconomics* 2019;37:631–43.
74 Leurent B, Gomes M, Carpenter JR. Missing data in trial-based cost-effectiveness analysis: an incomplete journey. *Health Econ* 2018;27:1024–40.
75 Briggs A, Clark T, Wolstenholme J, *et al*. Missing presumed at random: cost-analysis of incomplete data. *Health Econ* 2003;12:377–92.
76 Petrou S, Murray L, Cooper P, *et al*. The accuracy of self-reported healthcare resource utilization in health economic studies. *Int J Technol Assess Health Care* 2002;18:705–10.
77 Icks A, Dittrich A, Brüne M, *et al*. Agreement found between self-reported and health insurance data on physician visits comparing different recall lengths. *J Clin Epidemiol* 2017;82:167–72.
78 Short ME, Goetzel RZ, Pei X, *et al*. How accurate are self-reports? analysis of self-reported health care utilization and absence when compared with administrative data. *J Occup Environ Med* 2009;51:786–96.
79 Hunger M, Schwarzkopf L, Heier M, *et al*. Official statistics and claims data records indicate non-response and recall bias within survey-based estimates of health care utilization in the older population. *BMC Health Serv Res* 2013;13:1.
80 Slagsvold B, Veenstra M, Daatland SO, *et al*. Life-course, ageing and generations in Norway:the NorLAG study. *Nor Epidemiol* 2012;22.
81 Vigdal Ørjan Nesse, Storheim K, Munk Killingmo R, *et al*. Characteristics of older adults with back pain associated with choice of first primary care provider: a cross-sectional analysis from the BACE-N cohort study. *BMJ Open* 2021;11:e053229.
82 Grotle M, Brox JI, Glomsrød B, *et al*. Prognostic factors in first-time care seekers due to acute low back pain. *Eur J Pain* 2007;11:290–8.
83 Nordstoga AL, Vasseljen O, Meisingset I, *et al*. Improvement in work ability, psychological distress and pain sites in relation to low back pain prognosis: a longitudinal observational study in primary care. *Spine* 2019;44:423–9.
84 Scheele J, Enthoven WTM, Bierma-Zeinstra SMA, *et al*. Characteristics of older patients with back pain in general practice: BACE cohort study. *Eur J Pain* 2014;18:279–87.
85 Nations U. World Population Ageing 2019. In: *Department of economic and social Affairs*. New York: Population Division, 2020.
86 Hofman A, Grobbee DE, de Jong PT, *et al*. Determinants of disease and disability in the elderly: the Rotterdam elderly study. *Eur J Epidemiol* 1991;7:403–22.