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ABSTRACT

BACKGROUND: Patients and clinicians may misinterpret the clinical importance of imaging findings in patients with low back pain, leading to potential harm related to overdiagnosis.

PURPOSE: Our aims were to qualitatively summarize the characteristics of tested interventions that target the reporting, communication, or clinical interpretation of lumbar imaging findings and determine whether interventions are effective in improving low back pain–related health outcomes, health care use, or health care costs.

DATA SOURCES: PubMed, MEDLINE, CINAHL, EMBASE, PsycINFO, and the Cochrane Library were searched from inception to October 20, 2021.

STUDY SELECTION: The search retrieved 4394 articles, nine articles (seven studies) met the inclusion criteria to summarize intervention characteristics. Five of these studies had an adequate design for evaluating intervention effectiveness.

DATA ANALYSES: Intervention characteristics were summarized using the Template for Intervention Description and Replication checklist. Effectiveness data were extracted from short, intermediate, and long-term follow-up points. Studies were assessed for risk of bias, and Grading of Recommendations Assessment, Development and Evaluation methodology was used to determine the certainty of the evidence.

DATA SYNTHESIS: Four studies investigated the insertion of prevalence information into imaging reports. Single studies investigated withholding diagnostic information, education, and reassurance. Moderate-quality evidence (from 1 study) suggests that inserting prevalence information into imaging reports probably does not change the overall health care use in the long-term but may reduce opioid prescribing.

LIMITATIONS: The available evidence is limited, and a meta-analysis was not possible.

CONCLUSIONS: Further work is required to develop and test interventions that target the reporting, communication, and clinical interpretation of lumbar imaging findings that may reduce overdiagnosis and improve the management of low back pain.

ABBREVIATIONS: EPOC = Effective Practice and Organization of Care; GRADE = Grading of Recommendations Assessment, Development and Evaluation; LBP = low back pain; RoB = risk of bias; TIDieR = Template for Intervention Description and Replication

Low back pain (LBP) is a leading cause of disability, contributing to a persistent, escalating, global economic burden.[1] While conventional diagnostic imaging (x-ray, CT, or MR imaging) may improve LBP management through the diagnosis of specific pathology (eg, cauda equina syndrome, fracture, cancer, or infection), in most cases, a nociceptive pain source cannot be identified.[2] A recent systematic review suggests that diagnostic imaging for patients with LBP (without suspicion of specific pathology) may be associated with increased medical costs, health care use, and absence from work, without a clear clinical benefit,

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compared with those who did not undergo imaging.[3] Knowledge and interpretation of imaging report findings may negatively impact a patient's mental health and potentially influence pain-related cognitions and behaviors (eg, fear avoidance) that could result in poorer health outcomes.[4,5]

Potential harm associated with diagnostic imaging may occur through exposure to radiation (from x-ray or CT) or through acting on incidental or age-related findings that may have minimal-to-no prognostic value[6] and do not inform treatment. Many degenerative changes are common in people without pain and increase in prevalence with age, suggesting that they may represent normal, age-related changes.[7,8] These degenerative changes are weakly correlated with LBP.[7,8] Patients or clinicians may misinterpret the clinical importance of such findings[9] or act on incidental findings, possibly leading to further tests, investigations, and overtreatment. In 1 study of patients presenting with low back degenerative changes, more than half were willing to undergo an operation on the basis of imaging abnormalities alone, even in the absence of symptoms.[10]

To prevent potential harm, clinical practice guidelines recommend that imaging for LBP be limited to specific circumstances,[11] and interventions have been developed to support clinicians in reducing inappropriate imaging referrals.[12] However, about one-quarter of patients with LBP presenting to primary care receive lumbar imaging as well as one-third of patients with LBP who present to the emergency department,[13] and incidental or age-related findings are likely, regardless of whether imaging is indicated. Therefore, interventions that target the reporting, communication, and clinical interpretation of imaging findings for those who undergo any imaging for LBP are warranted.

Accordingly, the aims of this study were the following:

1. To provide a qualitative, descriptive summary of the characteristics of interventions that target the reporting, communication, or clinical interpretation of lumbar imaging findings
2. To investigate the effectiveness of interventions on health outcomes, health care use, or health care costs associated with LBP.

MATERIALS AND METHODS

The systematic review protocol was developed from guidelines of the Cochrane Effective Practice and Organization of Care (EPOC) Review Group and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Statement. The protocol was registered with PROSPERO (www.crd.york.ac.uk/PROSPERO; registration No. CRD42020209410).

Data Sources

An electronic search strategy was developed using keywords and medical subject headings related to LBP, imaging, and interventions. LBP terms used in the search were recommended by the Cochrane Back and Neck group, and the search strategy was adjusted for each database with the assistance of a senior librarian (Online Supplemental Data). PubMed, MEDLINE, CINAHL, EMBASE, PsycINFO, and the Cochrane Central Register of Controlled Trials were searched from inception to October 20, 2021. Citation tracking was performed, and the references of identified articles were searched for additional studies.

Eligibility

Aim 1. Studies were eligible for inclusion in aim 1 (summarizing the characteristics of tested interventions) if they assessed patients with LBP who had undergone diagnostic imaging, including x-ray, CT, or MR imaging. Studies needed to have reported on health outcomes, health care use, or health care costs associated with LBP and included an intervention related to the reporting, communication, or clinical interpretation of imaging findings. Any study design with a comparator group was included. Nonrandomized designs such as before-after studies and prospective and retrospective longitudinal cohort studies were included, as long as a comparator group was clearly defined. We excluded studies in which the participants were specifically those who had undergone an operation or had serious pathology.

Aim 2. To be eligible for aim 2 (investigating if interventions were effective), studies needed to meet the above criteria and use a study design recommended and defined by the EPOC group,[14] including randomized controlled trials, nonrandomized controlled trials, interrupted time-series, and controlled before-after studies. Cluster trials and controlled before-after studies needed to include at least 2 intervention and 2 control sites. Controlled before-after studies were required to have contemporaneous data collection and use identical methods of measurement.[14] Studies were translated if not reported in English.

Data Extraction and Analysis

Two authors (J.L.W. and G.H.I.) independently screened the title and abstract and, when eligible, the full text. Any disagreements were resolved through discussion and arbitration with a third reviewer if required (M.J.H.). Three reviewers (G.H.I, M.J.H., and J.L.W.) independently extracted study data using a standardized pretested data-extraction form. One author (J.L.W.) extracted intervention characteristics using the Template for Intervention Description and Replication (TIDieR) checklist informed by the TIDieR guide,[15] which was cross-checked by a second author (M.J.H.). Attempts were made to contact study authors if information was unclear.

Outcome data were extracted as reported in the study for 3 follow-up time periods: short (<3 months), intermediate (3–6 months), and long-term (6 months). For studies with multiple follow-up periods, we extracted the time points closest to 6 weeks (short-term), 3 months (intermediate-term), and 1 year (long-term). Difference in means of final measurements with 95% CIs were calculated for continuous outcomes. Risk ratios and 95% CIs were calculated for dichotomous outcomes when possible. Homogeneity of study design, intervention type, patient characteristics (presenting condition), intervention setting, and outcome measures (including timepoint) was necessary to pool data across studies for aim 2. Data-extraction forms are available on request.

Risk of Bias and Certainty of Evidence Assessment

For studies meeting inclusion for examining effectiveness (aim 2), two authors (J.L.W. and H.J.J.) independently assessed the risk of bias (RoB) for each outcome and performed certainty-of-

Table 1: Summary of included studies for aims 1 and 2

Study	Imaging Technique	Intervention vs Comparator	Study Inclusion	
			Aim 1 Intervention Characteristics	Aim 2 Intervention Effectiveness
1) Ash et al, 2008[19]	MR imaging	Patients and physicians were blinded to imaging results vs standard care	Yes	Yes
2) Karran et al, 2018[22]	CT or MR imaging	Educational intervention vs standard spinal clinic consultation	Yes	Yes
3) Jarvik et al, 2020[21] Marcum et al, 2021[25] Suri et al, 2021[26]	X-ray, CT, or MR imaging	Prevalence information in imaging report vs standard report	Yes	Yes
4) Rajasekaran et al, 2021[27]	MR imaging	Patients reassured imaging findings were normal vs factual explanation of imaging findings	Yes	Yes
5) Weeks et al, 2020[24]	MR imaging	Prevalence information in imaging report vs standard report	Yes	Yes
6) Fried et al, 2018[20]	MR imaging	Prevalence information in imaging report vs standard report	Yes	No
7) McCullough et al, 2012[23]	MR imaging	Prevalence information in imaging report vs standard report	Yes	No

evidence assessments. Any disagreements were resolved through discussion or arbitration with a third author (M.J.H.). RoB for randomized studies was assessed using the Cochrane RoB 2.0[16] tool with domains rated as low, some concerns, or high RoB. Nonrandomized studies were assessed using the Risk of Bias in Nonrandomized Studies of Interventions (ROBINS-I[17]) tool, with domains rated as critical, high, some concerns, low, or no information.

Certainty of evidence of the interventions was rated as high, moderate, low, or very low certainty using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) certainty ratings. Confidence in the evidence was downgraded for the following: 1) study limitations, if <50% of the study weightings were rated as low risk of bias; 2) inconsistency of results, if there was wide variability in point estimates across individual trials or an I^2 value of >80%; 3) imprecision, when the 95% confidence interval included values that may change clinical decisions or when there were <400 participants for a continuous outcome or <300 events for a dichotomous outcome;[18] and 4) publication bias, if studies finding negative results were insufficiently reported, or insufficient data were reported to be included in a meta-analysis. Only populations of interest and relevant outcomes with direct comparisons were included; therefore, indirectness was not evaluated. When there was only 1 included study with fewer than 400 participants, it was downgraded for inconsistency and imprecision (ie, sparse data) and rated as low-quality evidence. Evidence from a single study presenting with >400 participants was only downgraded for inconsistency.

RESULTS

Study Characteristics

Our electronic data base search identified 4394 articles. Of the 59 articles reviewed in full, 50 were excluded, leaving 9 articles[19-27] that met criteria for aim 1. A flow diagram of study selection and exclusion reasons is shown in the Online Supplemental Data. The 9 articles[19-27] comprised 7 studies including one in which different outcomes were reported in 3 articles (Table 1).[21,25,26] Study characteristics are provided in the Online Supplemental Data.

Intervention Characteristics (Aim 1). The 7 studies[19-27] comprised 2 randomized controlled trials;[19,27] 1 stepped wedge cluster randomized trial;[21,25,26] 1 nonrandomized controlled trial;[22] 1 controlled before-after study;[24] 1 retrospective cohort study;[23] and 1 before-after study.[20] Outcomes were evaluated after MR imaging in 5 studies[19,20,23,24,27] and after MR imaging, CT, or x-ray imaging in 2 studies.[21,22,25,26]

A descriptive summary of the intervention characteristics using a modified TIDieR checklist is provided in the Online Supplemental Data. The most common intervention characteristic was that all interventions[19-27] occurred following the imaging procedure. Interventions targeted patients[22,27] or patients and physicians.[19-21,23,24] Two interventions involved tailoring information to patients.[21,22,25,26] Five interventions were delivered in a primary care setting in the United States,[19-21,23-26] 1 in a secondary care spinal clinic in Australia,[22] and 1 in a tertiary care spine center in India.[27] A common intervention goal was to reduce potential harm associated with overdiagnosis. Intervention implementation fidelity was measured in only 1 study.[21]

Four studies [20,21,23-26] reported testing an intervention in which prevalence information (ie, how common imaging findings were in an asymptomatic population) was inserted into the imaging report. One study[19] tested an intervention that was facilitated by radiologists and involved withholding the MR imaging report from patients and physicians for 6 months unless critical to care (ie, identification of specific pathology). One study[22] used physiotherapists to deliver an educational intervention involving a positive re-interpretation of imaging findings designed to reassure patients, with provision of take-home information explaining pain and promoting physical activity. One intervention[27] involved a discussion in which patients were reassured by a spinal surgeon that their MR imaging findings were completely normal with only incidental and age-related findings.

Effectiveness of Interventions (Aim 2). Five studies[19,21,22,24-27] met our additional EPOC study design criteria to investigate the

Table 2: Summary of findings for inserting prevalence information into imaging reports versus standard reports[a]

Study/No. of Participants	GRADE Rating	Follow-Up Period	Outcome Health Care Use or Cost, Outcome Measure	Effect OR, 95% CI, or Rate Ratio (*P* Value)
Jarvik et al, 2020[21] *N* = 238,886[c]	Moderate	Short-term	Written opioid prescription	OR = 0.95 (0.90–0.99)[b]
Marcum et al, 2021[25] *N* = 170,680[c]	Moderate	Short-term	New prescription for nonopioid pain-related medications[d]	OR = 1.02 (0.97–1.08)[b]
Jarvik et al, 2020[21] *N* = 238,886[c]	Moderate	Long-term	Written opioid prescription	OR = 0.95 (0.91–1.00)[b]
Suri et al, 2021[26] *N* = 238,886[c]	Moderate	Long-term	Nonsurgical procedures[e]	OR = 1.01 (0.93–1.09)[b]
			Any spine surgery	OR = 0.99 (0.91–1.07)[b]
Weeks et al, 2020[24] *N* = 6904	Very low	Long-term	Primary care visits	Rate ratio = 0.86 *P* = NS[f]
			Chiropractic care visits	Rate ratio = 1.37 *P* = .05[f]
			Physical therapy care visits	Rate ratio = 1.19 *P* = NS[f]
			Specialty care visits	Rate ratio = 0.95 *P* = NS[f]
			Nerve-conduction tests	Rate ratio = 0.57 *P* = .05[f]
			MR imaging testing	Rate ratio = 0.89 *P* = NS[f]
			Non-MR imaging	Rate ratio = 0.73 *P* = .04[f]
			Facet injection	Rate ratio = 0.71 *P* = .02[f]
			On an opioid	Rate ratio = 0.98 *P* = NS[f]
			On a muscle relaxant	Rate ratio = 0.82 *P* = NS[f]
			Nonfusion spine surgery	Rate ratio = 0.71 *P* = NS[f]
			Fusion spine surgery	Rate ratio = 0.76 *P* = NS[f]
Weeks et al, 2020[24] *N* = 6904	Very low	Long-term	Cost, total spine-related per member per month expenditures	Rate ratio = 0.85 *P* = NS[f]

Note:—NS indicates not significant.

[a] Dichotomous outcomes are shown. A rate ratio of <1 represents an effect in favor of the intervention group.

[b] Adjusted for health system, clinic size, age range, sex, imaging technique, Charlson Comorbidity Index category, seasonality, and health-specific trends. Results of opioid prescription additionally adjusted for prior opioid use. Results of nonsurgical procedures additionally adjusted for nonsurgical use in the year preceding index imaging.

[c] Articles reporting outcomes from the same study.

[d] Nonopioid, pain-related medications including skeletal muscle relaxants, NSAIDs, gabapentenoids, tricyclic antidepressants, and benzodiazepines.

[e] Procedures include lumbosacral epidural steroid injection, facet joint injection, facet join radiofrequency ablation, or sacroiliac injection.

[f] Adjusted for age, sex, line of business, deductible, and forecasted risk score at the time of first MR imaging.

effectiveness of the interventions. They are outlined in Table 1. Meta-analysis was not performed due to the heterogeneity of outcomes, intervention types, and study designs. RoB for 6 articles[19,21,22,25,26] was evaluated using the RoB 2.0 tool.[24] Only 1 study[21,25,26] was rated as having a low RoB across all 5 domains (Online Supplemental Data). The majority[19,22,27] (75%) of these studies had some concerns or high RoB for the domains "deviations from the intended interventions" and "missing outcome data." One study[24] was evaluated with the ROBINS-I tool and was rated as low risk for only 2 of the 7 domains and a serious risk of bias for confounding (Online Supplemental Data).

Summaries of findings are presented in Tables 2–4. We attempted to contact the authors of 1 study[19] to clarify the scale used to measure self-efficacy; however, we did not receive a response, so this outcome was not included in our results. Another author was contacted and provided additional intervention information (Online Supplemental Data). We could not calculate the difference in means in 1 study[21] because the median rather than mean scores were provided; hence, the difference in median scores is presented. Rather than a risk ratio, the relative rate of change for 1 article[24] and adjusted odds ratios for 3 articles[21,25,26] are presented.

Inserting Prevalence Information into Imaging Reports Compared with a Standard Report

Health Care Use and Cost. Two studies [21,24-26] reported outcomes related to health care use, and 1 study reported health care costs.[24] One study ($n = 238,886$)[21] investigated overall long-term health care use (as measured by spine-related relative value units, ie, a single metric summarizing inpatient and outpatient encounters in the year following the index imaging[21]) and provided moderate certainty evidence (rated down for inconsistency) of no effect of the intervention (median difference = −0.7%; 95% CI, −2.9%−1.5%). However, there was moderate certainty evidence provided that the intervention was effective at reducing opioid prescribing in the short-term (OR = 0.95; 95% CI, 0.90−0.99) and long-term[21] (OR = 0.95; 95% CI, 0.91−1.00) (Table 2). Moderate certainty evidence (downgraded for inconsistency)[26] was provided that the intervention had no effect on new prescriptions of nonopioid medications in the short-term (OR = 1.02; 95% CI, 0.97−1.08). Moderate certainty evidence (downgraded for inconsistency)[25] was provided that the intervention had no effect in the long-term on the use of nonsurgical spine procedures (epidural steroid injection, facet joint injection, radiofrequency ablation, or sacroiliac injection) (OR = 1.01; 95% CI 0.93−1.09) or surgical procedures (any surgical procedures of the spine including fusion and decompression) (OR = 0.99; 95% CI, 0.91−1.07) (Table 2 and Online Supplemental Data).

One controlled before-after study[24] ($n = 6904$) investigated health care costs and a number of different indicators of health care use in the long-term. Very low certainty evidence (rated down for risk of bias, inconsistency, and imprecision) was provided of no effect of the intervention regarding health care costs or health care use in the long-term involving primary care visits, physical therapy visits, specialty care visits, performance of MR

Table 3: Summary of findings for withholding MR imaging results for 6 months versus results received within 48 hours[a]

Follow-Up Period/Outcome	Outcome Measure (Scale)	Effect Size[b] Mean Difference (95% CI)
Short-term		
Pain	VAS (0–10)	−0.54 (−1.35−0.27)
Disability	RMDQ (0–24)	−1.00 (−2.63−0.63)
Absenteeism	Mean No. sick days	0.20 (−0.47−0.87)
Quality of life	SF−36 (0–100)	PF: −7.00 (−13.99 to −0.01); RP: −9.70 (−21.74−2.34) BP: −8.50 (−15.51 to −1.49); GH: −3.10 (−8.35−2.15) VT: −4.80 (−10.97−51.37); SF: −0.70 (−7.00−5.60) RE: −7.30 (−17.29−2.69); MH: −9.30 (−15.44 to −3.16)
Fear of movement	FABQ: PA (0–24)	−0.40 (−2.29−1.49)
	FABQ: W (0–42)	−1.30 (−4.57−1.97)
Long-term		
Pain	VPAS (0–10)	−0.10 (−1.0−0.80)
Disability	RMDQ (0–24)	−0.70 (−2.54−1.14)
Absenteeism	Mean No. sick days	0.07 (−0.74−0.88)
Quality of life	SF −36 (0–100)	PF: −0.70 (−9.30−7.90); RP: −1.00 (−14.68−12.68) BP: −0.60 (−9.82−8.62); GH: −5.00 (−12.57−2.57) VT: −3.50 (−11.09−4.09); SF: −0.70 (−7.00−5.60) RE: −1.60 (−12.26−9.06); MH:−6.70 (−13.15 to −0.25)
Fear of movement	FABQ: PA (0–24)	0.60 (−1.74−2.94)
	FABQ: W (0–42)	−0.50 (−3.04−4.04)

Note:—FABQ indicates Fear-Avoidance Beliefs Questionnaire; PA, physical activity; W, work; RMDQ, Roland Morris Disability Questionnaire; SF, short form−36; PF, physical functioning; RP, role-physical; BP, bodily pain; GH, general health; VT, vitality; RE, role-emotional; MH, mental health; VAS, visual analog scale.
[a] Ash et al, 2008,[19] *n*= 246, GRADE = very low. Negative values of the mean difference estimate represent an effect in favor of the intervention group.
[b] Only mean difference effects are presented.

Table 4: Summary of findings for an educational intervention versus standard, spinal clinic consultation[a]

Follow-Up Period/Outcome	Outcome Measure (Scale)	Effect Size, Mean Difference (95% CI)
Intermediate		
Pain	NRS (0–10)	1.20 (−1.00−3.40)
Disability	NRS (0–10)	1.40 (−1.46−4.26)
Fear of movement	TSK−11 (11–44)	6.70 (−2.12−15.52)

Note:—NRS indicates numeric rating scale; TSK-11, Tampa Scale of Kinesiophobia−11.
[a] Karran et al, 2018,[22] $n = 31$. GRADE = very low. Negative values of the mean difference estimate represent an effect in favor of the intervention group.

imaging, opioids, muscle relaxants, fusion, and nonfusion spine surgery. Very low certainty evidence (rated down for risk of bias, inconsistency, and imprecision) was provided that the intervention reduced health care use involving nerve-conduction tests, non-MR imaging, and facet injections. Very low certainty evidence (rated down for risk of bias, inconsistency, and imprecision) was provided that the intervention was effective at increasing chiropractic care visits (Table 2).

Withholding MR Imaging Results from Patients and Physicians for 6 Months Unless Critical to Care Compared with Standard Care in which Results Were Received within 48 Hours

Pain, Disability, Absenteeism, Fear of Movement, Self-Efficacy, and Quality of Life. One study ($n = 246$)[19] investigated the outcomes of pain, disability, fear of movement, self-efficacy, absenteeism, and quality of life in the short- and long-term. Very low certainty evidence (downgraded for risk of bias, inconsistency, and imprecision) was provided that the intervention was effective at improving some quality-of-life indicators in the short-term (physical functioning, bodily pain, and mental health) and long-term (mental health). Very low certainty evidence (downgraded for risk of bias, inconsistency, and imprecision) was provided of no effect of the intervention on pain, disability, fear of movement, self-efficacy, and some indicators of quality of life in the short- and long-term (Table 3).

An Educational Intervention Compared with a Standard Physiotherapy Spinal Clinic Consultation

Pain, Disability, and Fear of Movement. One small study ($n = 31$)[22] investigated the outcomes of pain, disability, and fear of movement in the intermediate-term. This study was a feasibility study and provided very-low-quality evidence (downgraded for risk of bias, inconsistency, and imprecision) of no effect of the intervention on pain, disability, and fear of movement in the intermediate-term (Table 4).

An Intervention Involving Reassurance That MR Imaging Findings Are Normal versus a Factual Explanation of MR Imaging Findings

Pain, Self-Efficacy, and Quality of Life. One study ($n = 44$)[27] investigated the effect of the intervention on pain, self-efficacy, and quality of life in the short-term. This study provided low-certainty evidence (downgraded for inconsistency and imprecision) that the intervention was effective at improving pain, self-efficacy, and quality of life in the short-term (Table 5).

DISCUSSION

Key Findings

We qualitatively summarized the intervention characteristics from 7 studies[19-27] that targeted the reporting, communication, or clinical interpretation of imaging findings for people with LBP. A common characteristic was that all interventions occurred following the imaging procedure. In 4 studies,[20,21,23-26] the intervention involved the insertion of prevalence information into the

Table 5: Summary of findings for an intervention involving reassurance that MR imaging findings are normal versus a factual explanation of MR imaging report[a]

Follow-Up Period/Outcome	Outcome Measure (Scale)	Effect Size, Mean Difference (95% CI)
Short		
Pain	VAS (0–10)	3.76 (−4.55 to −2.97)
Pain self-efficacy	PSEQ–2 (0–12)	4.68 (−5.62 to −3.74)
Quality of life	SF-12 (physical) (0–100)	8.46 (−13.12 to −3.80)
	SF-12 (mental) (0–100)	10.48 (−14.76 to −6.20)

Note:—VAS indicates visual analog scale; PSEQ −2, Pain Self-Efficacy Questionnaire–2; SF-12, 12-item Short Form Health survey (physical and mental dimensions).

[a] Rajasekaran et al, 2021,[27] $n = 44$. GRADE = low. Negative values of the mean difference estimate represent an effect in favor of the intervention group.

imaging report. One intervention[19] involved withholding imaging-report information from patients and clinicians; another[27] provided reassurance to patients that findings were normal; and 1 study investigated an educational intervention that was designed to reassure patients and promote an active recovery.[22]

Five[19,21,22,24-27] of the 7 studies[19-27] met our inclusion criteria to evaluate the effectiveness of the interventions (Table 1). There was moderate-certainty evidence from 1 large, randomized controlled trial[21] that including prevalence data in imaging reports probably provides no change to overall long-term health care use. However, the intervention may have a small effect in the long-term on reducing opioid prescribing (Table 2). Providing reassurance that imaging findings are normal might be effective at improving pain, disability, or quality of life in the short-term (1 study,[27] low-certainty evidence). We are uncertain of the effect of interventions on reducing health care costs associated with LBP because the certainty of the evidence assessed was very low.[24]

Implications, Comparison with Other Studies, and Future Directions

Inserting prevalence information of common lumbar imaging findings into an imaging report was the most common intervention investigated.[20,21,23,24] The goal of this intervention was to contextualize the clinical importance of imaging findings, thereby reducing overdiagnosis. While the intervention probably does not change overall health care use, the small effect on reducing opioid prescribing warrants consideration given the considerable harm associated with long-term opioid use.[28] Some other indicators of downstream health care use were reduced; however, the certainty of evidence was very low.[24]

Operationally, inserting prevalence information is a relatively simple and low-cost intervention that could be routinely implemented in imaging reports. By contrast, withholding imaging-report information from patients and physicians, which was investigated by 1 study[19] in our review, had an unclear effect based on very low certainty evidence and may not be feasible or ethical to implement in clinical practice. Clinicians have an ethical responsibility to explore patient expectations of lumbar imaging and consider the potential harm that may arise from the identification of incidental or common degenerative findings. A strategy of "anticipate and communicate" was recommended by a US commission on the ethical management of incidental findings in clinical contexts.[29] Recommendations for clinicians include communicating the possibility of identifying an incidental finding and the benign nature of these findings to patients before imaging is requested. Future studies could include tools to support conversations regarding incidental and common degenerative findings for patients with LBP, along with strategies to provide reassurance and validation of the patient's pain experience.

Additionally, the timing of the intervention delivery should be considered. All interventions in this review were delivered after the imaging procedure had been conducted. Given that patients with LBP increasingly have access to their reports,[30] an intervention delivered before imaging that is designed to improve health literacy and challenge beliefs may be an acceptable strategy requiring further exploration. The educational messages included in the intervention by Karran et al[22] could be adapted for this purpose in primary care and could be delivered to patients at the time of the imaging referral.

Patients have expressed a preference for their imaging results to be communicated by their general practitioner,[30] yet none of the studies in our review contained interventions where general practitioners delivered imaging results. General practitioners have expressed difficulty in interpreting imaging reports of back pain, with a preference for reports clarifying the likelihood of disease, the clinical relevance of findings, and/or the need for further investigations.[31] Some interventions proposed but not yet tested involve inclusion of lay language or a clinical interpretation summary and/or using alternative, less threatening terminology in the report.[32,33] Additionally, the evidence was limited in our review regarding the best way to communicate imaging results and provide effective reassurance.[22,27] To increase the effectiveness of future interventions, strategies are required to support general practitioners to both interpret and communicate results.

Strengths and Limitations

We developed a protocol a priori and used broad inclusion criteria to identify and present results from an emerging body of evidence. However, we did not include intervention characteristics from studies without a comparison group (eg, development studies) or studies with potentially relevant interventions that were tested on patients without LBP. As a result, we may have missed some interventions in the development stage. To summarize the intervention characteristics, we used the TIDieR checklist,[15] which provided a systematic construct to summarize important intervention characteristics. The electronic search strategy may have limited identification of novel intervention types, but we attempted to overcome this by searching multiple data bases, citation tracking, and hand-searching relevant articles. A limitation of the evidence in our review is the small number of studies with varying degrees of methodologic rigor. Additionally, due to the paucity and heterogeneity of studies, a meta-analysis could not be performed.

CONCLUSIONS

We found 7 studies that tested interventions targeting the reporting, communication, or clinical interpretation of diagnostic imaging studies (x-ray, CT, or MR imaging) to improve outcomes in people with LBP. The most common intervention type was inserting prevalence information into imaging reports, and this probably has no effect on overall long-term health care use but may have a small effect on reducing opioid prescribing. Providing reassurance that imaging findings are normal might be effective at improving pain, disability, or quality of life in the short-term.[27] We are uncertain of the effect of interventions in reducing health care costs associated with LBP because the certainty of the evidence assessed is very low.[24] No studies, to our knowledge, have investigated interventions delivered before imaging occurs, that aim to improve a patient's understanding of the role of imaging, or the prevalence of common incidental findings. These issues could be areas for future research. Further work is required to develop and test interventions that target the reporting, communication, or clinical interpretation of imaging findings that could improve health outcomes, health care use, and health care costs.

Disclosure forms provided by the authors are available with the full text and PDF of this article at www.ajnr.org.

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