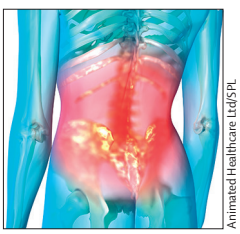
Low back pain: a major global challenge



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Low back pain is a major problem throughout the world and it is getting worse—largely because of the ageing and increasing world population.[1] It affects all age groups and is generally associated with sedentary occupations, smoking, obesity, and low socioeconomic status.[2] Years lived with disability caused by low back pain have increased by more than 50% since 1990, especially in low-income and middle-income countries (LMICs).[1,2] Disability related to low back pain is projected to increase most in LMICs where resources are limited, access to quality health care is generally poor, and lifestyle changes and shifts towards more sedentary work for some mean the risks will only increase.

These are some of the issues highlighted in a *Lancet* Series of two papers[2,3] and a Viewpoint[4] on low back pain by an international group of authors, led by Rachelle Buchbinder from Monash University, Melbourne, VIC, Australia. In the first paper, Jan Hartvigsen, Mark Hancock, and their colleagues[2] draw our attention to the complexity of the condition and the contributors to it, such as psychological, social, and biophysical factors, and especially to the problems in LMICs where health systems are not equipped to cope with the growing burden of low back pain. They discuss the challenges and causes of low back pain and make suggestions for the way forward in research.

In the second paper, Nadine Foster and colleagues[3] outline recommendations for treatment and the scarcity of research into prevention of low back pain. The evidence they discuss comes almost exclusively from high-income countries, and whether guidelines based on this evidence would be suitable for LMICs is not known. They propose solutions to inappropriate treatment, such as the use of opioids, but admit that the evidence base for them is inadequate.

The last paper is a call for action by Buchbinder and colleagues[4] who argue that persistence of disability associated with low back pain needs to be recognised and that it cannot be separated from social and economic factors and personal and cultural beliefs about back pain. They urge global organisations such as WHO to take action to try to reduce the increasing and costly effects of disabling low back pain. A major challenge will be to stop the use of harmful practices while ensuring access to effective and affordable health care for people with low back pain.

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1 GBD 2016 Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet* 2017; **390:** 1211–59.

2 Hartvigsen J, Hancock MJ, Kongsted A, et al. What low back pain is and why we need to pay attention. *Lancet* 2018; published online March 21. http://dx.doi.org/10.1016/S0140-6736(18)30480-X.

3 Foster NE, Anema JR, Cherkin D, et al. Prevention and treatment of low back pain: evidence, challenges, and promising directions. *Lancet* 2018; published online March 21. http://dx.doi.org/10.1016/S0140-6736(18)30489-6.

4 Buchbinder R, van Tulder M, Öberg B, et al. Low back pain: a call for action. *Lancet* 2018; published online March 21. http://dx.doi.org/10.1016/S0140-6736(18)30488-4.

Low back pain 1

What low back pain is and why we need to pay attention

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Low back pain is a very common symptom. It occurs in high-income, middle-income, and low-income countries and all age groups from children to the elderly population. Globally, years lived with disability caused by low back pain increased by 54% between 1990 and 2015, mainly because of population increase and ageing, with the biggest increase seen in low-income and middle-income countries. Low back pain is now the leading cause of disability worldwide. For nearly all people with low back pain, it is not possible to identify a specific nociceptive cause. Only a small proportion of people have a well understood pathological cause—eg, a vertebral fracture, malignancy, or infection. People with physically demanding jobs, physical and mental comorbidities, smokers, and obese individuals are at greatest risk of reporting low back pain. Disabling low back pain is over-represented among people with low socioeconomic status. Most people with new episodes of low back pain recover quickly; however, recurrence is common and in a small proportion of people, low back pain becomes persistent and disabling. Initial high pain intensity, psychological distress, and accompanying pain at multiple body sites increases the risk of persistent disabling low back pain. Increasing evidence shows that central pain-modulating mechanisms and pain cognitions have important roles in the development of persistent disabling low back pain. Cost, health-care use, and disability from low back pain vary substantially between countries and are influenced by local culture and social systems, as well as by beliefs about cause and effect. Disability and costs attributed to low back pain are projected to increase in coming decades, in particular in low-income and middle-income countries, where health and other systems are often fragile and not equipped to cope with this growing burden. Intensified research efforts and global initiatives are clearly needed to address the burden of low back pain as a public health problem.

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This is the first in a **Series** of two papers about low back pain

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Introduction

Low back pain is an extremely common symptom experienced by people of all ages.[1–3] In 2015, the global point prevalence of activity-limiting low back pain was 7·3%, implying that 540 million people were affected at any one time. Low back pain is now the number one cause of disability globally.[4] The largest increases in disability caused by low back pain in the past few decades have occurred in low-income and middle-income countries, including in Asia, Africa, and the Middle East,[5] where health and social systems are poorly equipped to deal with this growing burden in addition to other priorities such as infectious diseases.

Rarely can a specific cause of low back pain be identified; thus, most low back pain is termed non-specific. Low back pain is characterised by a range of biophysical, psychological, and social dimensions that impair function, societal participation, and personal financial prosperity. The financial impact of low back pain is cross-sectoral because it increases costs in both health-care and social supports systems.[6] Disability attributed to low back pain varies substantially among countries, and is influenced by social norms, local health-care approaches, and legislation.[7] In low-income and middle-income countries, formal and informal social-support systems are negatively affected. While in high-income countries, the concern is that the prevalent health-care approaches for low back pain contribute to the overall burden and cost rather than reducing it.[8] Spreading high-cost health-care models to

Key messages

- Low back pain is an extremely common symptom in populations worldwide and occurs in all age groups, from children to the elderly population
- Low back pain was responsible for 60·1 million disability-adjusted life-years in 2015, an increase of 54% since 1990, with the biggest increase seen in low-income and middle-income countries
- Disability from low back pain is highest in working age groups worldwide, which is especially concerning in low-income and middle-income countries where informal employment is common and possibilities for job modification are limited
- Most episodes of low back pain are short-lasting with little or no consequence, but recurrent episodes are common and low back pain is increasingly understood as a long-lasting condition with a variable course rather than episodes of unrelated occurrences
- Low back pain is a complex condition with multiple contributors to both the pain and associated disability, including psychological factors, social factors, biophysical factors, comorbidities, and pain-processing mechanisms
- For the vast majority of people with low back pain, it is currently not possible to accurately identify the specific nociceptive source
- Lifestyle factors, such as smoking, obesity, and low levels of physical activity, that relate to poorer general health, are also associated with occurrence of low back pain episodes
- Costs associated with health care and work disability attributed to low back pain vary considerably between countries, and are influenced by social norms, health-care approaches, and legislation
- The global burden of low back pain is projected to increase even further in coming decades, particularly in low-income and middle-income countries

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low-income and middle-income countries will compound rather than alleviate the burden. Low back pain is therefore an urgent global public health concern.

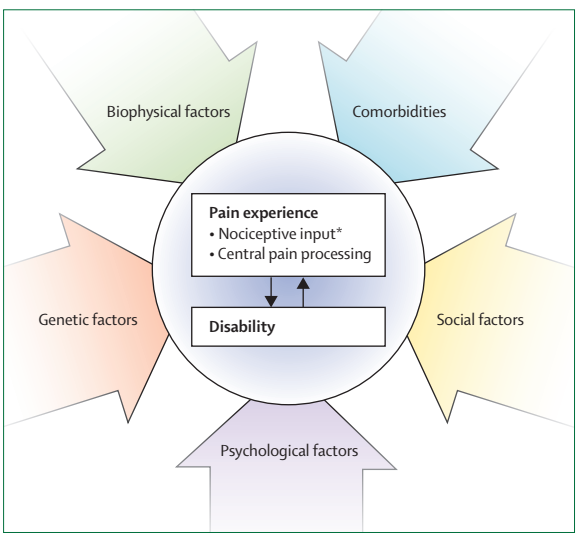

Figure 1: **Contributors to low back pain and disability**
The model includes key contributors to low back pain and disability but does not attempt to represent the complex interactions between different contributors. *Nociceptive input includes non-identifiable sources in non-specific low back pain, neurological sources (eg, radicular pain) and specific pathology (eg, fractures).

Panel 1: **Potential nociceptive contributors to low back pain that have undergone investigation**

Intervertebral disc

Although some imaging and clinical findings increase the likelihood that pain is arising from the intervertebral disc (with the reference standard of discography), no investigation has accurately identified a disc problem as contributing to an individual's pain;[14] there is no widely accepted reference standard for discogenic pain

Facet joint

Injecting facet joints with local anaesthetic can cause temporary relief of pain;[15] however, the Framingham Heart Study (3529 participants) did not find an association between radiological osteoarthritis of facet joints and presence of low back pain;[16] clinical identification of individuals whose facet joints are contributing to their pain is not possible.[17]

Vertebral endplates (Modic changes)

Modic changes are vertebral endplate abnormalities seen on MRI with specific subchondral and vertebral bone marrow features that can be classified according to different signal intensities into type 1, type 2, and type 3; endplate defects and disc herniation might predispose to the development of Modic changes; one theory is that the pro-inflammatory response, caused by structural damage to the disc or endplate, could allow microbial infiltration, autoimmune reactions, or both, that intensify and extend nociceptor stimulation by chemical or mechanical stimuli;[18] a low-grade infection by *Propionibacterium acnes* might promote the development of Modic changes;[19] the relevance of these findings to clinical practice is, however, unclear; a systematic review concluded that Modic type 1 changes are associated with low back pain;[20] a subsequent study, including 1142 people, found that Modic type 2 changes were associated with disability (odds ratio 1·56, 95% CI 1·06–2·31), but not pain (1·36, 0·88–2·09);[21] identification of individuals in whom Modic changes are contributing to their pain is not possible.

Against this backdrop, we present a series of two papers and a Viewpoint. The aim of this paper is to present a current understanding of what low back pain is, its burden and global impact, as well as an overview of causes and the course of low back pain. The evidence for the effectiveness of current treatments and promising new directions for managing low back pain is presented in paper two,[9] and the Viewpoint is a worldwide call to action.[10]

The approach for this Series involved the constitution of a team of leading international experts on back pain from different professional backgrounds and from countries around the globe who convened for a workshop in Buxton, UK, in June, 2016, to outline the structure of each paper. For this paper, we identified scientific studies using broad search terms in MEDLINE (PubMed) and Scopus. To identify potentially relevant papers from low-income and middle-income countries, we also searched Google Scholar and the African Index Medicus Database. To minimise selection bias and to ensure high-quality evidence was selected, systematic reviews were preferred and sought when possible. However, we also used information from large population-based cohorts, international clinical guidelines, and the Global Burden of Disease (GBD) 2015 study. Primary research from low-income and middle-income regions excluded from systematic reviews was also referenced where appropriate.

What is low back pain?

Low back pain is a symptom not a disease, and can result from several different known or unknown abnormalities or diseases.

It is defined by the location of pain, typically between the lower rib margins and the buttock creases.[11] It is commonly accompanied by pain in one or both legs and some people with low back pain have associated neurological symptoms in the lower limbs.

For nearly all people presenting with low back pain, the specific nociceptive source cannot be identified and those affected are then classified as having so-called non-specific low back pain.[12] There are some serious causes of persistent low back pain (malignancy, vertebral fracture, infection, or inflammatory disorders such as axial spondyloarthritis) that require identification and specific management targeting the cause, but these account for a very small proportion of cases. People with low back pain often have concurrent pain in other body sites, and more general physical and mental health problems, when compared with people not reporting low back pain.[13] The combined effect on individuals of low back pain and comorbidity is often more than the effect of the low back pain or the comorbidity alone and results in more care, yet typically a poorer response to a range of treatments.[13] Thus, many people living with low back pain have diverse problems in which psychological, social, and biophysical factors as well as comorbidities and pain-processing mechanisms impact

on both the pain experience and the associated disability (figure 1).

Causes of low back pain

Although clinical tests are unable to accurately identify the tissue source of most low back pain, several structures are innervated and have been shown to produce pain when stimulated. In some cases local anaesthetic relieves the pain (panel 1).[14,15] Many imaging (radiography, CT scan, and MRI) findings identified in people with low back pain are also common in people without such pain, and their importance in diagnosis is a source of much debate.[22] Nevertheless, at least in people younger than 50 years, some MRI abnormalities are more common in those with low back pain than in those without. A systematic review (14 case-control studies; 3097 participants) found several MRI findings had a reasonably strong association with low back pain, including Modic type 1 change (odds ratio [OR] 4·0, 95% CI 1·1–14·6), disc bulge (7·5, 1·3–44·6), disc extrusion (4·4, 2·0–9·7), and spondylolysis (5·1, 1·7–15·5; table 1).[20] However, evidence is insufficient to know whether MRI findings can be of use to predict the future onset, or the course, of low back pain.[23] Importantly, no evidence exists that imaging improves patient outcomes[24] and guidelines consistently recommend against the routine use of imaging for people with low back pain.[25–28]

	Number of studies	OR (95% CI)	Prevalence asymptomatic (95% CI)	Prevalence symptomatic (95% CI)	p value	Heterogeneity
Intervertebral disc degeneration-related outcomes						
Disc degeneration	12	2·2 (1·2–4·2)	34% (32–38)	57% (55–60)	0·01	High
Modic change	5	1·6 (0·5-5·4)	12% (10–15)	23% (22–27)	0·43	High
Modic type 1 change	2	4·0 (1·1-14·6)	3% (0·7–9)	7% (5–9)	0·04	Low
Internal disc rupture-related outcomes						
Annular fissure	6	1·8 (0·97–3·3)	11% (9–14)	20% (18–23)	0·06	High
High Intensity Zone	4	2·1 (0·7–6·0)	10% (7–13)	10% (8–13)	0·17	High
Disc displacement-related outcomes						
Disc bulge	3	7·5 (1·3–44·6)	6% (4–9)	43% (38–48)	0·03	High
Disc protrusion	9	2·7 (1·5–4·6)	19% (17–22)	42% (39–45)	0·00	High
Disc extrusion	4	4·4 (2·0–9·7)	2% (0·1–4)	7% (5–9)	<0·01	Low
Other outcomes						
Spondylolysis	2	5·1 (1·7–15·5)	2% (0–5)	9% (7–12)	<0·01	Low
Spondylolisthesis	4	1·6 (0·8–3·2)	3% (2–6)	6% (4–9)	0·20	Low
Central spinal canal stenosis	2	20·6 (0·1–798.8)	14% (10–19)	60% (55–64)	0·17	High

Data are modified from Brinjikji et al (2015).[20] Heterogeneity (I^2) was graded "low" only for "0" values since no CI for I^2 was presented. Prevalence data presented for reference only. OR=odds ratio.

Table 1: **Strength of association between MRI findings and low back pain in younger adults**

Neurological symptoms associated with low back pain

Radicular pain and radiculopathy

Radicular pain occurs when there is nerve-root involvement; commonly termed sciatica. The term sciatica is used inconsistently by clinicians and patients for different types of leg or back pain and should be avoided.[29] The diagnosis of radicular pain relies on clinical findings, including a history of dermatomal leg pain, leg pain worse than back pain, worsening of leg pain during coughing, sneezing or straining,[30] and straight leg raise test. Radiculopathy is characterised by the presence of weakness, loss of sensation, or loss of reflexes associated with a particular nerve root, or a combination of these, and can coexist with radicular pain. People with low back pain and radicular pain or radiculopathy are reported to be more severely affected and have poorer outcomes compared with those with low back pain only.[31] Disc herniation in conjunction with local inflammation is the most common cause of radicular pain and radiculopathy. Disc herniations are, however, a frequent finding on imaging in the asymptomatic population,[22] and they often resolve or disappear over time independent of resolution of pain.[32]

Lumbar spinal stenosis

Lumbar spinal stenosis is clinically characterised by pain or other discomfort with walking or extended standing that radiates into one or both lower limbs and is typically relieved by rest or lumbar flexion (neurogenic claudication).[33] It is usually caused by narrowing of the spinal canal or foramina due to a combination of degenerative changes such as facet osteoarthritis, ligamentum flavum hypertrophy, and bulging discs. Expert consensus is that the diagnosis of the clinical syndrome of lumbar spinal stenosis requires both the presence of characteristic symptoms and signs as well as imaging confirmation of narrowing of the lumbar spinal canal or foramina.[34] Symptoms of lumbar spinal stenosis are thought to result from venous congestion or ischaemia of the nerve roots in the cauda equina due to compression.[33]

Specific pathological causes of low back pain

Potential causes of low back pain that might require specific treatment include vertebral fractures, inflammatory disorders (eg, axial spondyloarthritis), malignancy, infections, and intra-abdominal causes (panel 2). A study of 1172 new presentations of acute (<2 weeks) episodes of low back pain in primary care in Australia found specific causes of back pain in 0·9% of participants, with fracture being by far the most common (eight of 11 cases), followed by inflammatory disorders (two of 11 cases).[37] A review from Uganda of 204 patients referred to a hospital orthopaedic clinic with a primary complaint of low back pain, showed that 4% of patients had serious spinal abnormalities due to tuberculosis, 3·5% had vertebral compression fractures, 1% brucellosis, and 1% had malignancy.[52] These differences in the patterns of specific pathological causes could reflect the ongoing burden of infectious diseases and their manifestations as low back pain in low-income countries. So-called red flags are case

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Panel 2: Specific pathological causes of low back pain

Vertebral fracture

Symptomatic minimal trauma vertebral fractures due to osteoporosis are rare under the age of 50 years but the incidence increases rapidly with age.[35] Although age-specific incidence is not changing, with an ageing population, the population burden is increasing. A systematic review (14 studies) found post-test probability for having a symptomatic vertebral fracture was 9% (95% CI 3–25) for those who were older (men aged >65 years, women aged >75 years), 33% (10–67) for those with a history of long-term corticosteroid use, and 62% (49–74) when a contusion or abrasion was present. The probability of a minimal trauma vertebral fracture being present when multiple risk factors (at least three of female, age >70, severe trauma, and long-term use of glucocorticoids) were present was 90% (34–99).[36] The predictive value of such a decision rule is, however, not greatly different from clinical assessment.[37] Symptomatic minimal trauma vertebral fractures have been shown in some studies to have a major health impact with a mean of 158 days of restricted activity and a third of those affected still have significant back pain after 2 years.[35] In some studies, minimal trauma vertebral fractures are also associated with a two-to-eight times increased risk of mortality.[35]

Axial spondyloarthritis

Axial spondyloarthritis is a chronic inflammatory disease that mainly affects the axial skeleton in young people (peak of onset 20–40 years). Although traditionally thought to be a disease of young men, there is only a slight male predominance in population studies.[38] The term axial spondyloarthritis covers both people who have already developed structural damage in the sacroiliac joints or spine visible, or both, on radiographs (radiographic axial spondyloarthritis; also termed ankylosing spondylitis) and those who have not yet developed such structural damage (non-radiographic spondyloarthritis).[39] Non-radiographic spondyloarthritis is a prodrome of axial spondyloarthritis that might subsequently produce structural bony damage in the axial skeleton.[40] The prevalence of radiological disease is between 0·3 and 0·8% in western countries and is dependent on the HLA-B27 prevalence in a given population.[38]

The typical presentation of axial spondyloarthritis includes morning stiffness, mostly in the lower back, with improvement seen with exercise but not with rest. In a Danish cohort of 759 people aged 18–40 years with chronic low back pain, the discriminative value of inflammatory back pain symptoms for axial spondyloarthritis was low with sensitivity and specificity ranging between 50% and 80% depending on the criteria being used.[41] However, around 30% of those referred to secondary care with symptoms of inflammatory back pain receive a final diagnosis of axial spondyloarthritis.[42] Around 5% of European people presenting with chronic low back pain in primary care could have axial spondyloarthritis.[43] There is often a delay between the onset of (back pain) symptoms and making a diagnosis of axial spondyloarthritis of 5 years or longer. People with axial spondyloarthritis are commonly misdiagnosed with non-specific low back pain. Since effective treatments are now available for axial spondyloarthritis, a specialist rheumatology referral is advised for people who are suspected of having an axial spondyloarthritis.

Malignancy

Back pain is a common symptom in people with metastatic cancer; vertebral metastases occur in 3–5% of people with cancer, and 97% of spinal tumours are metastatic disease.[44] Nevertheless, malignancy is an uncommon cause of low back pain. Past history of malignancy is the most useful indicator for identifying such disease in people presenting with low back pain; however, it only increases the post-test probability to 7% (95% CI 3–16) in primary care, and to 33% (22–46) in the emergency setting.[36] The common solid tumours metastasising to the spine are adenocarcinomas—ie, breast, lung, prostate, thyroid, and gastrointestinal. A past history of other tumours is less important. Myeloma typically presents as persistent bone pain in people aged 60 years and older.

Infections

Spinal infections include spondylodiscitis, vertebral osteomyelitis, epidural abscess, and rarely facet joint infection. Bacterial infections are divided into pyogenic (eg, *Staphylococcus aureus* and *S epidermidis*) and granulomatous diseases (eg, tuberculosis, brucellosis). Although rare, these disorders are associated with a substantial mortality; up to 3% for epidural abscesses, 6% for spinal osteomyelitis, and possibly as high as 11% for pyogenic spondylodiscitis.[45–47] In high-income countries, granulomatous diseases are mainly encountered in immigrant populations; pyogenic infections are seen largely in older patients (mean age 59–69 years).[48] In low-income countries, tuberculosis affects a broader span of ages (mean age 27–76 years), and could represent up to a third of spinal infections.[48] People with chronic comorbidities, particularly immunosuppressive disorders, and intravenous drug users, are at higher risk of spinal infections. Recent increases in the incidence of spinal infection are attributed to an ageing population with inherent comorbidities plus improved case ascertainment related to the availability of modern imaging techniques.[47,49]

Cauda equina syndrome

Although not strictly a cause of low back pain, cauda equina compression, which mainly arises from disc herniation, can have catastrophic consequences. It is rare and most primary care clinicians will not see a true case in a working lifetime.[50] Early diagnosis and surgical treatment are probably helpful; therefore, there needs to be a low threshold for further assessment when there has been a new onset of perianal sensory change or bladder symptoms, or bilateral severe radicular pain with low back pain of any duration.[50] The cardinal clinical features are urinary retention and overflow incontinence (sensitivity 90%, specificity 95%).[51]

history or clinical findings believed to increase the risk of a serious disease; however, 80% of people with acute low back pain have at least one red flag despite less than 1% having a serious disorder.[37] Nearly all recommended individual red flags are uninformative and do not substantially change post-test probabilities of a serious abnormality.[36] The very low specificity of most red flags contributes to unnecessary specialist referrals and imaging.[53] Clinicians do, however, need to consider if the overall clinical picture might indicate a serious cause for the pain, remembering that the picture can develop over time.[53] The US guideline for imaging advises deferral of imaging pending a trial of therapy when there are weak risk factors for cancer or axial spondyloarthritis.[54]

How common is low back pain?

Low back pain is uncommon in the first decade of life, but prevalence increases steeply during the teenage years; around 40% of 9–18-year olds in high-income, medium-income, and low-income countries report having had low back pain.[55,56] Most adults will have low back pain at some point.[57] The median 1-year period prevalence globally in the adult population is around 37%, it peaks in mid-life, and is more common in women than in men (figure 2).[1] Low back pain that is accompanied by activity limitation increases with age.[58] The mean prevalence in high-income countries is higher than in middle-income and low-income countries (32·9% [SD 19·0] *vs* 25·4% [25·4] *vs* 16·7% [16·7]), but globally there is no difference between rural and urban areas.[1] Jackson pooled results from 40 publications dealing with prevalence of persistent low back pain in 28 countries from Africa, Asia, the Middle East, and South America (n=80 076) and found that chronic low back pain was 2·5 (95% CI 1·21–4·10) times more prevalent in working population than in non-working populations for reasons that are not clear.[59] The gender pattern in low-income and middle-income regions might also differ from that of high-income countries and even differ between low-income regions. For example, men seem to report low back pain more often than women in Africa.[56] This was not the case in Latin America,[60] which might reflect African culture, in which men often do hard physical labour, as well as gender inequalities, which might result in women under-reporting their low back pain.

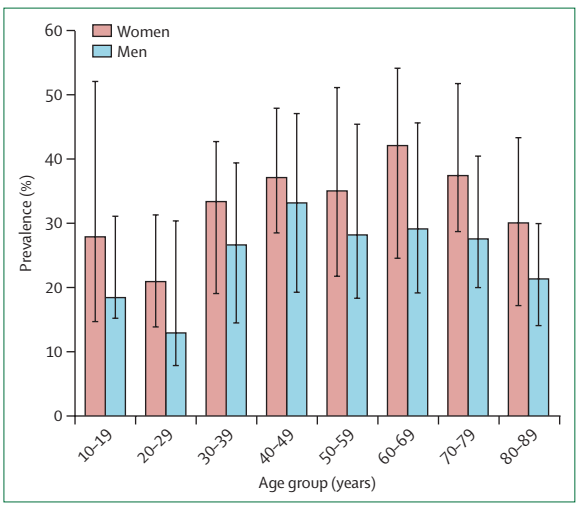

Figure 2: **Median prevalence of low back pain, with IQR, according to sex and midpoint of age group, reproduced from Hoy et al[1] with permission from John Wiley and Sons**

Burden and impact of low back pain

Overall disability

The GBD 2015 study calculated disease burden for 315 causes in 195 countries and territories from 1990 to 2015 and provides a comprehensive assessment of the patterns and levels of acute and chronic diseases and burden and disability of those worldwide.[61] Low back pain was responsible for around 60·1 million years lived with disability (YLD) in 2015, an increase of 54% since 1990.[4] It is the number one cause of disability globally, as well as in 14 of the 21 GBD world regions.[4] Less than 28% of prevalent cases (n=151 million) fell in the severe and most severe categories; however, these cases accounted for 77% of all disability caused by low back pain (46·5 million YLDs).[62] Thus, most people with low back pain have low levels of disability, but the additive effect of those, combined with high disability in a substantial minority, result in the very high societal burden. In high-income countries, disabling back pain is linked to socioeconomic status, job satisfaction, and the potential for monetary compensation (table 2). The overall increase in the global burden of low back pain is almost entirely due to population increase and ageing in both high-income, low-income and middle-income countries, as opposed to increased prevalence.[1,68]

Work disability

Disability from low back pain is highest in working age groups worldwide (figure 3),[4,61] which is especially concerning in low-income and middle-income countries where informal employment is common and possibilities for job modification are almost completely absent. Furthermore, occupational musculoskeletal health policies, such as regulations for heavy physical work and lifting, are often absent or poorly monitored.[69] A survey of 10 839 residents of an urban black community in Zimbabwe found that low back pain was among the top five reported primary health complaints, and reasons for activity limitation.[70] A survey among 500 farmers in rural Nigeria showed that more than half reduced their farming workload because of low back pain.[71] Thus, disability associated with low back pain might contribute to the cycle of poverty in poorer regions of the world.

In high-income countries, differences in social compensation systems, not differences in occupational

	Outcomes (predictor scale: association with low back pain disability)	Source of evidence
Symptom-related factors		
Previous episodes	Chronic disabling pain* at 3–6 months; more *vs* less episodes: median LR 1·0 (range 0·9–1·2); chronic disabling pain* at 12 months; more *vs* less episodes: median LR 1·1 (range 0·95–1·2)	Systematic review including nine longitudinal studies[63]
Back pain intensity	Chronic disabling pain* at 3–6 months; high intensity pain *vs* non-high: median LR 1·7 (range 1·1–3·7); chronic disabling pain* at 12 months; high intensity pain *vs* non-high: median LR 1·3 (range 1·2–2·0)	Systematic review including eight longitudinal studies[63]
Presence of leg pain	Chronic disabling pain* at 3–6 months; leg pain or radiculopathy *vs* no leg pain: median LR 1·4 (range 1·1–1·7); chronic disabling pain* at 12 months; leg pain or radiculopathy *vs* no leg pain: median LR 1·4 (range 1·2–2·4)	Systematic review including ten longitudinal studies[63]
Lifestyle factors		
Body mass	Chronic disabling pain* at 3–6 months; BMI >25 or >27 *vs* lower BMI: median LR 0·91 (range 0·72–1·2); chronic disabling pain* at 12 months; BMI >25 or >27 *vs* lower BMI: median LR 0·84 (range 0·73–0·97)	Systematic review including three longitudinal studies[63]
Smoking	Chronic disabling pain* at 3–6 months; current smoker *vs* not: median LR 1·2 (range 1·0–1·6)	Systematic review including three longitudinal studies[63]
Physical activity	Disability 1–5 years; significant association in one of five studies (no effect size reported)	Systematic review including five longitudinal studies[64]
Psychological factors		
Depression	Mixed outcomes; significant associations with poor outcome in eight of 13 cohorts; OR (range) 1·04–2·47	Systematic review including 13 longitudinal studies[65]
Catastrophising	Disability at 3–12 months; significant association in nine of 13 studies; high catastrophising: OR 1·56 (95% CI 1·05–2·33); 0–6 scale: 7·63 (3·70–15·74); 0–52 scale: 1·05 (1·02–1·08); contribution to explained variance: 0–23%	Systematic review including 13 longitudinal studies[66]
Fear avoidance beliefs	Pain or activity limitation at 3–12 months; no pooled estimates; no systematic association between fear avoidance and outcome; poor work-related outcome at 3–12 months; elevated fear avoidance: OR (range) 1·05 (95% CI 1·02–1·09) to 4·64 (1·57–13·71; from four studies done by disability insurance companies); chronic disabling pain* at 3–6 months; high *vs* no fear avoidance: median LR 2·2 (range 1·5–4·9); chronic disabling pain* at 12 months; median LR 2·5 (range 2·2–2·8)	Systematic review including 21 longitudinal studies[67] Systematic review including four longitudinal studies[63]
Social factors		
Physical work loads	Chronic disabling pain* at 3–6 months; higher *vs* lower physical work demands: median LR 1·2 (range 1·1–1·6); chronic disabling pain* at 12 months; higher *vs* lower physical work demands: median LR 1·4 (range 1·2–1·7)	Systematic review including four longitudinal studies[63]
Education	Chronic disabling pain* at 3–6 months; no college education or not college graduate *vs* more education: median LR 1·0 (range 0·97–1·3); chronic disabling pain* at 12 months; no college education or not college graduate *vs* more education: median LR 1·1 (range 1·1 –1·2)	Systematic review including ten longitudinal studies[63]
Compensation	Chronic disabling pain* at 3–6 months; compensated work injury or sick leave *vs* not compensated work injury or sick leave: median LR 1·3 (range 0·97–2·7); chronic disabling pain* at 12 months; compensated work injury or sick leave *vs* not compensated work injury or sick leave: median LR 1·4 (range 1·2–1·8)	Systematic review including seven longitudinal studies[63]
Work satisfaction	Chronic disabling pain* at 3–6 months; less *vs* more work satisfaction: median LR 1·1 (range 0·64–1·8); chronic disabling pain* at 12 months; less *vs* more work satisfaction: median LR 1·5 (range 1·3 –1·8)	Systematic review including five longitudinal studies[63]

The information provided in the table provides a broad overview and was not based on a systematic review of the literature. LR=positive likelihood ratio. BMI=body-mass index. OR=odds ratio. HR=hazard ratio. *Pain persistent beyond 3 months and at least moderately affecting ability to work or function.

Table 2: **Overview of selected predictors and their association with dichotomous outcomes of low back pain disability**

exposure or individual factors, are largely responsible for national differences in the rates and extent of work disability attributed to low back pain.[7] In Europe, low back pain is the most common cause of medically certified sick leave and early retirement.[72] However, work disability due to low back pain varies substantially among European countries. For example, in Norway and Sweden in 2000, short-term sickness absence rates in people with back pain were similar (5·1% and 6·4%, respectively), but the rate of longer-term medically certified sickness absence was very different (22% and 15%, respectively).[73] In the USA, low back pain accounts for more lost workdays than any other occupational musculoskeletal condition,[74] but although 58 of 10 000 US workers filed a back-related claim in 1999, the comparable figure from Japan during the same year was only one of 10 000.[75]

Social identity and inequality

The effect of low back pain on social identity and inequality is substantial worldwide. Ethnographic interviews of villagers in Botswana found that low back pain and other musculoskeletal symptoms resulted in both economic and subsistence consequences as well as loss of independence and social identity because of inability to fulfil traditional and expected social roles in a society with harsh living conditions.[76]

Froud and colleagues[77] reviewed 42 qualitative studies all from high-income countries, and found that many people living with low back pain struggled to meet their social expectations and obligations and that achieving them might then threaten the credibility of their suffering, with disability claims being endangered. Although those with back pain seek to achieve premorbid levels of health, many find with time that this aim is unrealistic and live with reduced expectations.[77] Likewise, MacNeela and colleagues[78] reviewed 38 separate qualitative studies, also from high-income countries, and found some common themes, including: worry and fear about the social consequences of chronic low back pain, hopelessness, family strain, social withdrawal, loss of job and lack of money, disappointment with health-care encounters (in particular with general practitioners),

coming to terms with the pain, and learning self-management strategies.

Globally, low back pain contributes to inequality. In low-income and middle-income countries, poverty and inequality might increase as participation in work is affected. Furthermore, formal return-to-work systems are often not in place, and workers might be retrenched, placing more strain on family and community livelihoods.[69] In Australia, Schofield and colleagues[79] found that individuals who exit the workforce early as a result of their low back pain have substantially less wealth by age 65 years, even after adjustment for education. The median value of accumulated wealth for those who retire early because of low back pain is only AUS$5038 by the time they reach 65 years of age, compared with $339 121 for those who remain in the workforce.[79]

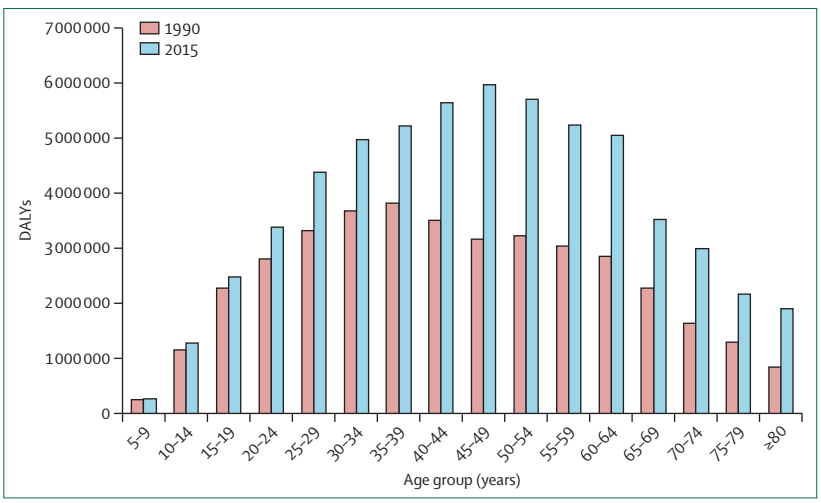

Figure 3: **Global burden of low back pain, in disability-adjusted life-years (DALYs), by age group, for 1990 and 2015**
Data are from the Global Health Data Exchange.

Cost of low back pain

No relevant studies on costs associated with low back pain from low-income and middle-income countries were identified. Costs associated with low back pain are generally reported as direct medical (health-care) costs, and indirect (work absenteeism or productivity loss) costs. Only a few studies have reported other direct non-medical costs, such as costs from transportation to appointments, visits to complementary and alternative practitioners, and informal help not captured by the health-care system, which means that most studies underestimate the total costs of low back pain (appendix). The economic impact related to low back pain is comparable to other prevalent, high-cost conditions, such as cardiovascular disease, cancer, mental health, and autoimmune diseases.[6] Replacement wages account for 80–90% of total costs, and consistently a small percentage of cases account for these.[80] Some of the observed variation in costs for low back pain over time might be explained by changes in disability legislation and health-care practices. For example, in the Netherlands, costs associated with low back pain were substantially reduced between 1991 and 2007 after a change in legislation that reduced disability pensions and applied evidence-based criteria for medical practices.[7,81]

Estimates of direct medical costs associated with low back pain are also all from high-income countries, with the USA having the highest costs, attributable to a more medically intensive approach and higher rates of surgery compared with other high-income countries (appendix).[8,82] In the UK in 2006, one in seven of all recorded consultations with general practitioners were for musculoskeletal problems with complaints of back pain being the most common (417 consultations per year for low back pain per 10 000 registered persons),[83] and in South Africa, low back pain is the sixth most common complaint seen in primary health care.[84] In addition to conventional medicine, complementary and alternative medical approaches are popular with people who have low back pain. For example, in the USA 44% of the population used at least one complementary or alternative health-care therapy in 1997;[85] and the most common reason was low back pain.[86]

For the **Global Health Data Exchange** see http://ghdx.healthdata.org/gbd-2016

Natural history

Low back pain is increasingly understood as a long-lasting condition with a variable course rather than episodes of unrelated occurrences.[87] Around half the people seen with low back pain in primary care have a trajectory of continuing or fluctuating pain of low-to-moderate intensity, some recover, and some have persistent severe low back pain.[88] A systematic review[89] (33 cohorts; 11 166 participants) provides strong evidence that most episodes of low back pain improve substantially within 6 weeks, and by 12 months average pain levels are low (6 points on a 100-point scale; 95% CI 3–10). However, two-thirds of patients still report some pain at 3 months; 67% (95% CI 50–83) and 12 months; 65% (54–75).[89,90] Recurrences of low back pain are common but a 2017 systematic review (seven studies; 1780 participants) found that research does not provide robust estimates of the risk of low back pain recurrence. The best evidence suggests around 33% of people will have a recurrence within 1 year of recovering from a previous episode.[91]

See **Online** for appendix

Risk factors and triggers for episodes of low back pain

Although the impact of low back pain in low-income and middle-income countries on systems and people differs from high-income countries, there seem to be fewer fundamental differences in the risk factors between regions. A systematic review[92] (eight cohorts; 5165 participants) found consistent evidence that people who have had previous episodes of low back pain are at increased risk of a new episode. Likewise, people with other chronic conditions, including asthma, headache, and diabetes, are more likely to report low back pain

than people in good health (pooled ORs 1·6–4·2).[93] People with poor mental health are also at increased risk. For example, a UK cohort study[94] (5781 participants) found psychological distress at age 23 years predicted incident low back pain 10 years later (OR 2·52, 95% CI 1·65–3·86]. The Canadian National Population Health Survey[95] with 9909 participants found that pain-free individuals with depression were more likely to develop low back pain within 2 years than were people without depression (OR 2·9, 95% CI 1·2–7·0). Mechanisms behind the coexistence of low back pain and other chronic diseases are not known, but systematic reviews of cohort studies indicate that lifestyle factors such as smoking,[96] obesity,[97,98] and low levels of physical activity[99] that relate to poorer general health are also associated with occurrence of low back pain episodes or development of persistent low back pain, although independent associations remain uncertain.

A systematic review[93] (seven twin studies; 35 547 participants) found the genetic influence on the liability to develop low back pain ranged from 21% to 67%, with the genetic component being higher for more chronic and disabling low back pain than for inconsequential low back pain. A comprehensive genetic epidemiological analysis of 15 328 Danish twins (44% monozygotic and 56% dizygotic) found that heritability estimates for pain in different spinal regions were quite similar and there is a moderate to high genetic correlation between the phenotypes, which might indicate a common genetic basis for a high proportion of spinal pain.[100]

An Australian case-crossover study (999 participants) showed that awkward postures (OR 8·0, 95% CI 5·5–11·8), heavy manual tasks (5·0, 3·3–7·4), feeling tired (3·7, 2·2–6·3), or being distracted during an activity (25·0, 3·4–184·5) were all associated with increased risk of a new episode of low back pain.[101] Similarly, work exposures of lifting, bending, awkward postures, and tasks considered physically demanding were also associated with an increased risk of developing low back pain in low-income and middle-income countries.[56,60] A systematic review (25 cohorts) showed that the effect of heavy workload on onset of low back pain ranged from OR 1·61 (95% CI 1·08–2·39) to OR 4·1 (2·7–6·4).[102] The existence of a causal pathway between these risk factors and low back pain, however, remains unclear.[103]

Multifactoral contributors to persistent disabling low back pain

In recent decades, the biopsychosocial model has been applied as a framework for understanding the complexity of low back pain disability in preference to a purely biomedical approach. Many factors including biophysical, psychological, social and genetic factors, and comorbidities (figure 1) can contribute to disabling low back pain (table 2). However, no firm boundaries exist among these factors and they all interact with each other. Thus, persistent disabling low back pain is not merely a result of nociceptive input. Although there are substantially fewer data from low-income and middle-income countries than from high-income countries, the available data suggest similar multifactorial contributors seem to be important in all countries.[104]

Biophysical factors

Although the role of biophysical impairments in the development of disabling low back pain is not fully understood, impairments are demonstrable in people with persistent low back pain. One example is that some people with persistent low back pain might have alterations in muscle size,[105] composition,[106] and co-ordination[107] that differ from those without pain. These changes could be more than merely a direct consequence of pain and are only partly affected by psychological factors.[108]

Psychological factors

Psychological factors are often investigated separately, but there is a substantial overlap of constructs such as depression, anxiety, catastrophising (ie, an irrational belief that something is far worse that it really is), and self-efficacy (ie, belief in one's ability to influence events affecting one's life). The presence of these factors in people who present with low back pain is associated with increased risk of developing disability even though the mechanisms are not fully understood (table 2). For example, in a UK cohort study of 531 participants, pain-related distress explained 15% and 28% of the variance in pain and disability, respectively.[109] The fear-avoidance model of chronic pain (including low back pain), which describes how fear of pain leads to the avoidance of activities and thus to disability, is well established. This model has more recently been expanded to capture the influence of maladaptive learning processes and disabling beliefs on pain perception and on behaviours, suggesting that pain cognitions have a central role in the development and maintenance of disability, and more so than the pain itself.[110] A systematic review, including 12 mediation studies, identified self-efficacy, psychological distress, and fear as intermediate factors explaining some of the pathway between having neck or back pain and developing disability.[111] The potential importance of self-efficacy is supported by a systematic review (83 studies; 15 616 participants) of chronic pain conditions (23 low back pain studies) that found self-efficacy to be consistently associated with impairment and disability, affective distress, and pain severity.[112] Therefore, some chronic pain treatments have shifted away from aiming to directly alleviate pain to aiming to change beliefs and behaviours.[113]

Social and societal factors

Chronic disabling low back pain affects people with low income and short education disproportionally. In a UK study of 2533 people, life-time socioeconomic status

predicted disability due to any pain condition in older age (independent of comorbid conditions, psychological indicators and body-mass index (BMI); OR 2·04 (95% CI 1·55–2·68).[114] Cross-sectional data from the USA (National Health Interview Survey 2009–10, 5103 people) found that those with persistent low back pain were more likely to have had less than high-school education (2·27, 1·53–3·38) and had an annual household income of less than US$20 000 (2·29, 1·46–3·58).[115] Suggested mechanisms for the effect of low education on back pain include environmental and lifestyle exposures in lower socioeconomic groups, lower health literacy, and health care not being available or adequately targeted to people with low education.[116] Also, being in routine and manual occupations and having increased physical workloads is associated with disabling low back pain (table 2).

Central pain processing and modulation

Nociceptive input is processed throughout the nervous system, including modulation within the spinal cord and supraspinal centres. In chronic pain, supraspinal centres can show varying levels of activation and can be recruited for activation (or not) in a dynamic fashion contingent on nociceptive drive, context, cognition, and emotion. If any of these factors change, the same nociceptive input can produce a different cerebral signature in the same patient.[117] A systematic review (27 studies; 1037 participants) identified moderate evidence that patients with chronic low back pain show structural brain differences in specific cortical and subcortical areas, and altered functional connectivity in pain-related areas following painful stimulation.[118] The clinical implication of these findings remains to be clarified.[117]

Multivariable predictive models

Pain intensity, psychological distress, and accompanying pain in the leg or at multiple body sites are identified as predictors across externally validated multivariable predictive models, which have been developed to identify people at particular risk of developing disabling low back pain (appendix). In a systematic review (50 studies; 33 089 participants), the average amount of variance explained in seven development samples was 43%, indicating that most of the variation between individuals is due to unknown or unmeasured factors.[119]

Limitations

Despite advances in many aspects of understanding low back pain, including the burden, course, risk factors, and causes, some important limitations exist. Most evidence comes from high-income countries, and may or may not generalise to low-income and middle-income countries. Although many factors are associated with both the development of low back pain and the transition to persistent disabling pain, the underlying mechanisms, including the effect of co-occurring non-communicable diseases, are poorly understood. Despite the burden of low back pain, research is often not a priority in low-income and-middle income countries, and thus the consequences of low back pain in these settings are largely unknown. The functional domains used in the GBD 2015 study do not take into account broader aspects of life, such as participation, well-being, social identity, carer burden, use of health-care resources, and work disability costs. In cost studies, a top-down approach is most often used and those might not capture all costs as seen from the individual point of view in specific contexts.

Conclusion

Low back pain is now the number one cause of disability globally. The burden from low back pain is increasing, particularly in low-income and middle-income countries, which is straining health-care and social systems that are already overburdened. Low back pain is most prevalent and burdensome in working populations, and in older people low back pain is associated with increased activity limitation. Most cases of low back pain are short-lasting and a specific nociceptive source cannot be identified. Recurrences are, however, common and a few people end up with persistent disabling pain affected by a range of biophysical, psychological, and social factors. Costs associated with health care and work disability attributed to low back pain are enormous but vary substantially between countries, and are related to social norms, health-care approaches, and legislation. Although there are several global initiatives to address the global burden of low back pain as a public health problem, there is a need to identify cost-effective and context-specific strategies for managing low back pain to mitigate the consequences of the current and projected future burden.

Contributors

JH and MU were part of the team that developed the original proposal for the series and coordinated production of papers. JH and MH led the drafting of this paper in collaboration with the other authors. AK, QL, and MU closely revised many sections. Thereafter all authors contributed to all sections of the paper and edited it for key intellectual content. JH, MJH, AK, JK, MLF, SG, RJS, QL, GP, and MU participated in the authors' meeting, drafted different sections of the paper, and took part in discussions during the drafting process. All other authors have read and provided substantive intellectual comments to the draft and approved the final version of the paper.

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Declaration of interests

See appendix for authors' declaration of interests.

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Low back pain 2

Prevention and treatment of low back pain: evidence, challenges, and promising directions

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Many clinical practice guidelines recommend similar approaches for the assessment and management of low back pain. Recommendations include use of a biopsychosocial framework to guide management with initial non-pharmacological treatment, including education that supports self-management and resumption of normal activities and exercise, and psychological programmes for those with persistent symptoms. Guidelines recommend prudent use of medication, imaging, and surgery. The recommendations are based on trials almost exclusively from high-income countries, focused mainly on treatments rather than on prevention, with limited data for cost-effectiveness. However, globally, gaps between evidence and practice exist, with limited use of recommended first-line treatments and inappropriately high use of imaging, rest, opioids, spinal injections, and surgery. Doing more of the same will not reduce back-related disability or its long-term consequences. The advances with the greatest potential are arguably those that align practice with the evidence, reduce the focus on spinal abnormalities, and ensure promotion of activity and function, including work participation. We have identified effective, promising, or emerging solutions that could offer new directions, but that need greater attention and further research to determine if they are appropriate for large-scale implementation. These potential solutions include focused strategies to implement best practice, the redesign of clinical pathways, integrated health and occupational interventions to reduce work disability, changes in compensation and disability claims policies, and public health and prevention strategies.

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This is the second in a **Series** of two papers about low back pain

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Introduction

Despite the plethora of treatments and health-care resources devoted to low back pain, back-related disability and population burden have increased.[1,2] The first paper[3] in this Series describes the global burden and effect of low back pain and provides an overview of the causes and course of low back pain. In this Series paper, we summarise the evidence for effectiveness of interventions for the prevention and treatment of low back pain and the recommendations from best practice guidelines. Despite generally consistent guideline recommendations around the world, clear evidence exists of substantial gaps between evidence and practice that are pervasive in low-income, middle-income, and high-income countries. Different response strategies are needed that prevent and minimise disability and promote participation in physical and social activities. Here we highlight examples of effective, promising, or emerging solutions from around the world and make recommendations to strengthen the evidence base for them.

Prevention

By contrast with the large number of trials that assess treatments for low back pain, evidence about prevention, particularly primary prevention, is inadequate (table 1). Most of the widely promoted interventions to prevent low back pain (eg, work-place education, no-lift policies, ergonomic furniture, mattresses, back belts, lifting devices) do not have a firm evidence base. A 2016 systematic review[4] identified only 21 trials with 30 850 adults (one in a low-middle-income country [Thailand]), and a 2014 systematic review[5] analysed only 11 randomised controlled trials with 2700 children (one in a low-middle-income country [Brazil]). The authors of the review in adults concluded that moderate quality evidence existed that exercise alone, or in combination with education, is effective for prevention; and poor to very-poor quality evidence existed that education alone, back belts, shoe insoles, and ergonomic programmes might not be effective.[4] The preventive effect of exercise and education was large, with a pooled relative risk of 0·55 (95% CI 0·41–0·74); however, the trials were mainly of secondary prevention and the effective programmes were quite intensive (eg, 20 1-hour sessions of supervised exercise in one trial).[4] The authors of the review in children concluded that moderate quality evidence existed that education is not effective and very low quality evidence existed that

Search strategy and selection criteria

We identified publications using broad search terms in PubMed and Scopus and based our examples on systematic searches of the published literature. To identify examples from low-income and middle-income countries, we additionally drew on experts in the team either based, or doing research, in these countries. The strength of evidence for the examples of the different solutions to the prevention and management of low back pain varied widely and, therefore, we have incorporated summaries of the extent of evidence and recommendations to strengthen the evidence base to inform future international efforts.

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Key messages

- Guidelines recommend self-management, physical and psychological therapies, and some forms of complementary medicine, and place less emphasis on pharmacological and surgical treatments; routine use of imaging and investigations is not recommended
- Little prevention research exists, with the only known effective interventions for secondary prevention being exercise combined with education, and exercise alone
- The evidence for prevention and treatment comes mainly from adults in high-income countries and whether the resulting recommendations are appropriate for children or those in low-income and middle-income countries is not known
- Non-evidence-based practice is apparent across all income settings; common problems are presentations to emergency departments and liberal use of imaging, opioids, spinal injections, and surgery
- Promising solutions include focused implementation of best practice, the redesign of clinical pathways, integrated health and occupational care, changes to payment systems and legislation, and public health and prevention strategies
- The evidence underpinning these solutions is inadequate and whether they are appropriate for widespread implementation is not known
- Further testing of these promising solutions, and development of new solutions, is needed, particularly in low-income and middle-income countries

	Effect in adults[4]	Effect in children[5]
Exercise and education	Effective (moderate quality)	No trials available
Exercise	Effective (low quality)	No trials available
Education	Ineffective (moderate quality)	Ineffective (moderate quality)
Back belt	Ineffective (very low quality)	No trials available
Shoe insoles	Ineffective (low quality)	No trials available
Ergonomic interventions at workplace	Ineffective (moderate quality)	No trials available
Ergonomic school furniture	NA	Effective (very low quality)

NA=not applicable.

Table 1: **Evidence of prevention strategies for low back pain: conclusions on effectiveness (and GRADE strength of evidence ratings) from systematic reviews**

ergonomically designed furniture could prevent low back pain compared with conventional furniture.[5]

Treatment

Low back pain without a known cause is referred to as non-specific low back pain and guidelines[5–8] recommend use of a biopsychosocial model to inform assessment and management in view of associations between behavioural, psychological, and social factors and the future persistence of pain and disability. Guidelines also recommend that laboratory tests and imaging should not be routinely used as part of early management, but rather reserved for patients for whom the result is likely to change management (eg, if a serious condition, such as infection, is suspected).

During the past three decades, changes have been made to key recommendations in national clinical practice guidelines. Greater emphasis is now placed on self-management, physical and psychological therapies, and some forms of complementary medicine, and less emphasis on pharmacological and surgical treatments. Guidelines encourage active treatments that address psychosocial factors and focus on improvement in function. The changed understanding of how best to manage low back pain is shown in three current guidelines, from Denmark,[6] the USA,[7] and the UK.[8] The reduced emphasis on pharmacological care is shown by the US guideline,[7] which recommends non-pharmacological care as the first treatment option and reserves pharmacological care for patients for whom non-pharmacological care has not worked. These guidelines endorse the use of exercise (Danish, US, and UK guidelines) and a range of other non-pharmacological therapies, alone and in combination, such as massage (US and UK), acupuncture (US), spinal manipulation (Danish, US, and UK), Tai Chi (US), and yoga (US).

Table 2 summarises the key recommendations of the three clinical guidelines for the management of low back pain and radicular pain,[6–8] separated by duration of symptoms when information is available. Consistent recommendations for early management are that individuals should be provided with advice and education about the nature of low back pain and radicular pain; reassurance that they do not have a serious disease and that symptoms will improve over time; and encouragement to avoid bed rest, stay active, and continue with usual activities, including work.[8] Early supervised exercise therapy is typically unnecessary;[9] however, it can be considered if recovery is slow or for patients with risk factors for persistent disabling pain.[9] For acute radiculopathy without severe or progressive motor weakness, data are insufficient to suggest that initial management should differ from that of acute non-specific low back pain.[8,9]

Recommended physical treatments, particularly for persistent low back pain (>12 weeks duration), include a graded activity or exercise programme that targets improvements in function and prevention of worsening disability. Since evidence showing that one form of exercise is better than another is not available, guidelines recommend exercise programmes that take individual needs, preferences, and capabilities into account in deciding about the type of exercise. Some guidelines do not recommend passive therapies, such as spinal manipulation or mobilisation, massage, and acupuncture, some consider them optional, and others suggest a short course for patients who do not respond to other treatment.[10] Other passive electrical or physical modalities, such as ultrasound, transcutaneous electrical nerve stimulation,

traction, interferential therapy, short-wave diathermy, and back supports are generally ineffective and not recommended.[6–8]

Guidelines also recommend consideration of psychological therapies—eg, cognitive behavioural therapy, progressive relaxation, and mindfulness-based stress reduction—and combined packages of physical and psychological treatment, for those with persistent low back pain or radicular pain who have not responded to previous treatments.[6–8] For patients who have not responded to first-line treatments, and who are substantially functionally disabled by pain, multidisciplinary rehabilitation programmes with coordinated delivery of supervised exercise therapy, cognitive behavioural therapy, and medication are more effective than standard treatments.[6–8,11]

Guidelines now recommend pharmacological treatment only following an inadequate response to first-line non-pharmacological interventions. Paracetamol was once the recommended first-line medicine for low back pain; however, evidence[12] of absence of effectiveness in acute low back pain and potential for harm has led to recommendations against its use.[7,8] Health professionals are guided to consider oral non-steroidal anti-inflammatory drugs (NSAIDs), taking into account risks, including gastrointestinal, liver, and cardiorenal toxicity, and if using, to prescribe the lowest effective dose for the shortest possible time.[8] Routine use of opioids is not recommended, since benefits are small and substantial risks exist, including overdose and addiction potential, and poorer long-term outcomes than without use.[9,13] Guidelines caution that opioid therapy should be used only in carefully selected patients, for a short duration,[13] and with appropriate monitoring. The role of gabaergic drugs, such as pregabalin, is now being reconsidered after a 2017 trial showed pregabalin to be ineffective for radicular pain.[14] Guidelines generally suggest consideration of muscle relaxants for short-term use, although further research is recommended.[8]

The role of interventional therapies and surgery is limited and recommendations in clinical guidelines vary. Recent guidelines[6–8] do not recommend spinal epidural injections or facet joint injections for low back pain but do recommend consideration of epidural injections of local anaesthetic and steroid for severe radicular pain.[8] Epidural injections are associated with small short-term (<4 weeks) reductions in pain, do not seem to provide long-term benefits or reduce the long-term risk of surgery,[6,15] and have been associated with rare but serious adverse events, including loss of vision, stroke, paralysis, and death.[16] The UK guideline[8] suggests consideration of radiofrequency denervation for chronic low back pain that is unresponsive to non-surgical treatments; however, the subsequently published MINT trials[17] challenge this recommendation.

The benefits of spinal fusion surgery for non-radicular low back pain thought to originate from degenerated lumbar discs (known as discogenic) are similar to those of intensive multidisciplinary rehabilitation and only modestly greater than standard non-surgical management.[18] Surgery is also more costly and carries a greater risk of adverse events than non-surgical management. The UK guidelines recommend that patients are not

	Acute low back pain (<6 weeks)	Persistent low back pain (>12 weeks)
Education and self-care		
Advice to remain active	First-line treatment, consider for routine use	First-line treatment, consider for routine use
Education	First-line treatment, consider for routine use	First-line treatment, consider for routine use
Superficial heat	Second-line or adjunctive treatment option	Insufficient evidence
Non-pharmacological therapy		
Exercise therapy	Limited use in selected patients	First-line treatment, consider for routine use
Cognitive behavioural therapy	Limited use in selected patients	First-line treatment, consider for routine use
Spinal manipulation	Second-line or adjunctive treatment option	Second-line or adjunctive treatment option
Massage	Second-line or adjunctive treatment option	Second-line or adjunctive treatment option
Acupuncture	Second-line or adjunctive treatment option	Second-line or adjunctive treatment option
Yoga	Insufficient evidence	Second-line or adjunctive treatment option
Mindfulness-based stress reduction	Insufficient evidence	Second-line or adjunctive treatment option
Interdisciplinary rehabilitation	Insufficient evidence	Second-line or adjunctive treatment option
Pharmacological therapy		
Paracetamol	Not recommended	Not recommended
Non-steroidal anti-inflammatory drugs	Second-line or adjunctive treatment option	Second-line or adjunctive treatment option
Skeletal muscle relaxants	Limited use in selected patients	Insufficient evidence
Selective norepinephrine reuptake inhibitors	Insufficient evidence	Second-line or adjunctive treatment option
Antiseizure medications	Insufficient evidence	Role uncertain
Opioids	Limited use in selected patients, use with caution	Limited use in selected patients, use with caution
Systemic glucocorticoids	Not recommended	Not recommended
Interventional therapies		
Epidural glucocorticoid injection (for herniated disc with radiculopathy)	Not recommended	Limited use in selected patients
Surgery		
Discectomy (for herniated disc with radiculopathy)	Insufficient evidence	Second-line or adjunctive treatment option
Laminectomy (for symptomatic spinal stenosis)	Insufficient evidence	Second-line or adjunctive treatment option
Spinal fusion (for non-radicular low back pain with degenerative disc findings)	Insufficient evidence	Role uncertain

Subacute low back pain is a transition period between acute and chronic low back pain; evidence on optimal therapies for subacute low back pain is scarce but a reasonable approach is to shift towards therapies recommended for chronic low back pain.

Table 2: **Overview of interventions endorsed for non-specific low back pain in evidence-based clinical practice guidelines (Danish,[6] US,[7] and UK[8] guidelines)**

offered disc replacement or spinal fusion surgery for low back pain, and instead recommend offering fusion surgery only as part of a randomised trial.[8] Patients with severe or progressive neurological deficits require surgical referral.[19] Spinal decompression surgery can be considered for radicular pain when non-surgical treatments have been unsuccessful and clinical and imaging findings indicate association of symptoms with herniated discs or spinal stenosis.[8] For a herniated disc, early surgery is associated with faster relief of radiculopathy than with initial conservative treatment with the option of delayed surgery, but benefits diminish with longer (>1 year) follow-up.[19] For symptoms associated with lumbar spinal stenosis, benefits of surgery over conservative care are not clear but some beneficial effects have been shown.[20] However, patients tend to improve with or without surgery and, therefore, non-surgical management is an appropriate option for patients who wish to defer or avoid surgery.[20]

The evidence underpinning low back pain guidelines is drawn almost exclusively from clinical trials of adults. A 2014 systematic review found only four paediatric trials,[5] so great uncertainty exists about the treatment of back pain in children. The trial evidence is also mainly from high-income countries and, therefore, whether these guideline recommendations are appropriate for low-income and middle-income countries is not known. Guidelines developed in low-income and middle-income countries (eg, Philippines,[21] Brazil[22]) provide near identical recommendations to those in high-income countries. Factors such as cultural acceptability of treatments, patient attitudes towards and adherence to treatment, and treatment providers could vary systematically between countries and influence treatment outcomes. Furthermore, in some countries access to some treatments endorsed in guidelines is poor or non-existent.

The global gap between evidence and practice

Despite multiple clinical guidelines providing similar recommendations for managing low back pain, a substantial gap between evidence and practice exists worldwide in high-income as well as low-income and middle-income countries.[23] Problems include both overuse of low-value care and underuse of high-value care. Panel 1 shows studies of clinical practice and highlights the disparity between ten guideline recommendations and the reality of current health care. Tremendous opportunity exists to improve health-care outcomes and potentially reduce costs by effectively implementing known best practice recommendations.

In high-income countries, guidelines recommend education and advice to keep active and at work; yet, data from Australia[36] and Qatar[37] show that such advice is provided only in a few consultations. By contrast with the guideline message that first-line care should be non-pharmacological, a study from the USA showed that only about half of people with chronic low back pain are prescribed exercise.[56] In Australian primary care[48] and in the emergency department setting in Canada,[70] the most common treatment is prescribed medication. Although physical therapists are in an excellent position to provide exercise advice, surveys from Sweden,[49] the USA,[50] and Australia[51] show high rates of use of electrical modalities, which the evidence shows are ineffective.

Despite the guideline message that low back pain should be managed in primary care, since few cases constitute medical emergencies, studies from France,[24] Australia,[26] Italy,[41] and the USA[71] show that patients often present to the emergency department. Although imaging has a very limited role, imaging rates are high; 39% of patients with low back pain are referred for imaging by general practitioners in Norway,[42] 54% in the USA,[27] and 56% in Italy.[41] Although guidelines discourage the use of opioids, they are widely used in many high-income countries, especially in, but not limited to, North America.[55,72] Although data for effects of opioids for acute low back pain are sparse,[73] one study showed that they were prescribed for around 60% of emergency department presentations for low back pain in the USA.[55] More than half the total number of people taking opioids long-term have low back pain,[72] although no randomised controlled trial evidence is available about long-term effects.[73,74] Surgery has, at best, a very limited role for low back pain, but studies from the USA,[59] Australia,[63] and the Netherlands[62] show frequent use of spinal fusion. Interventional procedures are also overused, with studies showing 990 449 lumbar or sacral facet injections and 406 378 lumbar or sacral facet neurotomy procedures funded by Medicare in the USA in 2011.[60]

The waste of health-care resources is an obvious consequence of overuse, but implications for patients also exist. The most obvious consequence of unnecessary lumbar imaging is exposure to radiation, but studies also suggest that more liberal use of imaging triggers additional medical care (eg, additional testing, specialist referral, surgery, and interventional procedures) and increases the risk of adverse outcomes, such as absence from work.[75] The most disturbing risks related to use of opioids are addiction, overdose, and death. In the USA, prescription opioid-related deaths were around 15 000 in 2015.[76] The growing use of complex fusion procedures in patients older than 60 years undergoing decompressive surgery for spinal stenosis is concerning, since fusion operations are three times more expensive than decompression alone, and have double the rates of wound complications, cardiopulmonary complications (such as stroke), and 30-day mortality.[77] Importantly, trials have clarified that adding fusion to decompressive surgery for symptomatic spinal stenosis does not improve outcomes.[78]

Even in high-income countries, access to best practice can be constrained by availability (eg, in rural and remote regions), payment models (eg, health-care systems'

coverage of medication and surgery, but not physical and psychological treatments), and patients' uncertainty about when or where to seek care.[79] A systematic review of 21 studies from 12 countries, four of which were medium-income (Cambodia, Cameroon, Barbados, Brazil), and eight high-income (Australia, Canada, Greece, Italy, France, Spain, the USA, and the UK) showed that many people go straight to emergency departments for their low back pain.[80] The authors estimated the prevalence of low back pain in the emergency department setting to be 4·39% (95% CI 3·67–5·18), similar to that of shortness of breath and fever and chills.[80] Many high-income countries, such as Australia and Canada, have culturally diverse populations with both an indigenous population and a large migrant population. The guideline-recommended treatments present real challenges in these diverse populations; for example, delivery of cognitive behavioural therapy or mindfulness-based stress reduction could be challenging if the therapist does not speak the same language as the patient, or does not appreciate the various ways low back pain could be conceptualised in different cultural groups.

For low-income and middle-income countries, although much less published evidence is available about current practice for low back pain, available data show that gaps between evidence and practice are also apparent in these countries (panel 1).[35] For example, in Cambodia,[30] Brazil,[31] and Argentina,[33] it is not uncommon for people with low back pain to present to the emergency department and then stay in hospital for several days. The previously mentioned systematic review of low back pain in the emergency department showed that middle-income countries have prevalences that are similar to those in high-income countries (eg, Cambodia 5·6%, Italy 4·9%).[80] In Iran,[29] most people with low back pain consult with specialists (eg, an orthopaedic surgeon, neurosurgeon, or rheumatologist) in view of the paucity of patient referral systems from general practice. A South African study[35] showed that 90% of patients with low back pain seen in primary care received pain medicines as the only form of treatment. Imaging rates for low back pain also seem to be inappropriately high in several low-income and middle-income countries, including India,[44] China,[45] Iran,[46] Brazil,[40] and Russia,[47] and although the availability of published data is limited, those that are available (from Brazil) suggest large increases in spinal surgery costs over the past 20 years.[65]

The paucity of comparative data makes comparisons of high-income, low-income, and middle-income countries challenging. However, the examples in panel 1 seem to suggest greater use of advice to rest and of passive electrical modalities in low-income and middle-income countries. In all countries, access to structured exercise programmes is variable, and poor access to cognitive behavioural therapy and multidisciplinary rehabilitation programmes remains a barrier to widespread use.[81] Clear evidence exists of lower consumption of opioids in low-income and middle-income countries than in high-income countries; but examples exist of high-income countries (eg, Japan) that have very low rates of opioid use, so the high consumption in countries such as the USA and Canada is not fully explained by the countries' wealth. The above information shows that many of the mistakes of high-income countries are already well established in low-income and middle income-countries. Initiatives are urgently needed that both reduce low-value health care for low back pain and help health-care professionals, patients, and policy makers make decisions more in line with best available evidence. The following section provides examples of effective, promising, and emerging directions.

Promising directions

Examples of effective, promising, and emerging solutions that target health care, public health, or both, are summarised in table 3. We particularly searched for examples from low-income and middle-income countries but found very few assessments of solutions within these countries that suggest they might offer helpful alternatives to current care. More data are urgently needed about effective and affordable strategies for prevention and management of low back pain in such countries. In these settings, strategies probably need to be integrated with other musculoskeletal and non-communicable disease initiatives to ensure maximum benefit from available resources. The examples in table 3 are mainly drawn from high-income countries, and for each we have added a judgment about the amount of evidence, which shows that many are still understudied or are confined to single, often observational, studies. Even those judged to be effective have underpinning evidence for effectiveness from only one country, and many were the focus of a research study, and not implemented or tested in new contexts outside a research setting. Therefore, important questions remain about effectiveness, cost-effectiveness, and scalability of these innovations.

Implementation of best available evidence

That guidelines without effective strategies to implement their recommendations have little or no effect on clinical practice has been repeatedly shown. Implementation strategies need to be tailored to overcome specific barriers to change[106] and feature education and training, social interaction, clinical decision support systems, and targeted reminders.[107,108] Some of the key challenges to implementing best practice for low back pain are known, including short consultation times, clinicians' poor knowledge of and misconceptions about clinical guidelines, fear of litigation in the event of missed, rare, serious pathology, and a desire to maintain harmonious relationships with patients.[108] Yet, successful examples exist of focused guideline implementation efforts (table 3). In the USA and UK, approaches that better support clinical decision making have changed clinical practice; use of a special radiograph requisition form that

Panel 1: Gaps between evidence and practice in the management of low back pain

Guideline message: low back pain should be managed in primary care

Practice: in high-income, low-income, and middle-income settings, people with low back pain present to emergency departments or to a medical specialist

High-income settings

- A 2003 study of an emergency department in Paris, France, found that the proportion of presentations in which low back pain was the primary complaint was 11·0%[24]
- In Victoria, Australia, between 2009 and 2012, 14 568 calls were made to 000 for an emergency ambulance for low back pain; in 22·3% of these cases, an emergency ambulance was dispatched and in 38·8%, a non-emergency ambulance was dispatched[25]
- In the 10 years from 2004–05 to 2013–14, the age-standardised rate of admissions to hospital for back problems in Australia increased by 20%[26]
- Low back pain results in 2·6 million visits to emergency departments a year in the USA[27]
- Of the 944 presentations for low back pain to an Italian emergency department in a year, six (0·6%) were diagnosed with a condition that was regarded as an emergency (defined as associated with high morbidity or mortality risk, requiring prompt assessment and hospital admission)[28]

Low-income or middle-income settings

- A 2011 study showed no patient referral system existed in Iran: most patients with acute or chronic low back pain visit directly an orthopaedic surgeon, neurosurgeon, or rheumatologist, rather than visiting general practitioners[29]
- A 2012 study of two emergency departments in Cambodia showed that the primary complaint was low back pain in 5·6% of the 1295 presentations (11th most common complaint); 41% of patients with low back pain were admitted[30]
- A 2009 study of an emergency department in Brazil showed that musculoskeletal conditions were the most common presentation, with low back pain the leading condition[31]
- The 2011 National Health and Wellness Survey in Brazil estimated that 16·8 million Brazilians had had low back pain; of these, 16·7% had been admitted to hospital in the past 6 months and 36·5% had visited an emergency department (rates were 8·8% and 19·74%, respectively, for those not having low back pain)[32]
- In Argentina, in 2006 to 2010, the most common reason for admission to hospital for a musculoskeletal condition was low back pain and the mean length of stay was 3·8 days[33]

Guideline message: provide education and advice

Practice: in high-income, low-income, and middle-income settings, this aspect of care is rarely provided

High-income settings

- Advice was provided at only 21% of consultations with a general practitioner in Australia[34]

Low-income or middle-income settings

- A 2014 survey in Community Health Centres in Cape Town, South Africa, reported that only 101 (23·3%) of 433 patients with low back pain reported receiving education about predisposing factors[35]

Guideline message: remain active and stay at work

Practice: in high-income, low-income, and middle-income settings, many clinicians and patients advocate rest and absence from work

High-income settings

- Three surveys of Australian general practitioners in the period 1997–2004 revealed that 24·5% of them who had a special interest in low back pain, endorsed the incorrect view that "Patients should not return to work until they are almost pain free" compared with 15·8% of those who did not have a special interest[36]
- A 2012 survey of primary care patients with low back pain in Qatar revealed that the most common treatment was bed rest (67·2% of 1829 patients)[37]

Low-income or middle-income settings

- A 2008 survey of all registered physiotherapists in the state of Maharashtra, India, (n=186, 70% response rate) showed that 46% of physiotherapists advised patients with low back pain to rest[38]
- 63% of Indians believe that bed rest is the mainstay of therapy[39]
- 90% of Brazilian rheumatologists advised patients with acute low back pain to rest[40]
- In Iran, "extended bed rest and reduction of physical activity are generally recommended by many clinicians, especially for patients with acute episodes of low back pain"[29]

Guideline message: imaging should only occur if the clinician suspects a specific condition that would require different management to non-specific low back pain

Practice: although such specific causes of low back pain are rare, in high-income, low-income, and middle-income settings, imaging rates are high

High-income settings

- Imaging was done for 56·4% of 746 patients who presented with low back pain to an emergency department of an Italian academic hospital in 2013[41]
- A 2011 Norwegian study showed that 38·9% of patients with low back pain were referred for imaging by their general practitioner[42]

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(Panel 1 continued from previous page)

- In the USA, a study of insurer data revealed that the rate of imaging for low back pain without red flag conditions was not influenced by the Choosing Wisely campaign: the baseline rate in 2010 was 53·7% (95% CI 52·5–54·9), and by the end of 2013 it was exactly the same, at 53·7% (52·5–54·9)[27]
- A survey of all Australian chiropractors (n=4859, 10% response rate) showed that 54% agreed that lumbar radiography is indicated for acute low back pain[43]

Low-income or middle-income settings

- A prospective study in the period 2008–10, of 251 patients with chronic low back pain reviewed in an Indian orthopaedic clinic, reported that 100% of patients underwent imaging, with 76% diagnosed with non-specific low back pain and 10% with spondylosis[44]
- A review of the lumbar spine MRI scans of 3107 patients from Hangzhou, eastern China, in 2013, showed that simple back pain was the most common reason for ordering an MRI (41·3%)[45]
- 400 consecutive patients with low back pain referred to four radiology clinics for MRI scans in Tehran, Iran, in 2012, completed a questionnaire to establish if the imaging was indicated; of these, only 187 (46·7%) had an indication for MRI[46]
- 70% of Brazilian rheumatologists order imaging at first visit for a patient with acute low back pain[40]
- A study in hospital outpatients with low back pain in Moscow, Russia, (n=1300) concluded that the most frequent diagnostic method used was radiography of the spine[47]

Guideline message: first choice of therapy should be non-pharmacological

Practice: surveys of care show that this approach is usually not followed

High-income settings

- A survey of Australian general practice care from 2000 to 2010 (21 350 patient encounters) showed that 64·5% of patients were prescribed a medicine at the first visit for a new episode of low back pain[48]
- A potential reason is the way in which health-care systems preferentially fund surgery and medicines over physical and psychological therapies

Low-income or middle-income settings

- 90% of primary care patients in South Africa received pain medicines as their only form of treatment[35]
- A potential reason is that health-care systems do not have the capacity to deliver non-pharmacological care

Guideline message: most guidelines advise against electrical physical modalities (eg, short-wave diathermy, traction)

Practice: worldwide these ineffective treatments are still used by the professionals who administer physical therapies

High-income settings

- A survey of Swedish physiotherapists (n=271, 65% response rate) showed that around 38% advocated transcutaneous electrical nerve stimulation for low back pain[49]
- A 2013 survey of US orthopaedic physical therapists (n=1001, 25% response rate) showed that 75% used lumbar traction[50]
- A 2009 survey in three Australian states (n=203, 36% response rate) asked for treatment choices for five patient vignettes and showed that 17–34% of physiotherapists advocated physical modalities for low back pain depending on the vignette[51]
- A study of Spanish National Health Service data for 2004–07 showed that 38·6% of expenditure for physical therapies was for treatments that are known to be ineffective[52]

Low-income or middle-income settings

- A 2008 survey in the state of Maharashtra, India, (n=186, 70% response rate) showed that physical modalities were the first treatment preference of 33% of all registered physiotherapists[38]
- A 2000 survey of Thai physiotherapists (n=559, 77·2% response rate) reported that 61·2% advocated ultrasound for low back pain and 61·0% advocated traction[53]
- A survey of practice in Ghana showed that over 60% of treatment sessions included multiple therapies (exercises, advice, massage, electrotherapy, and manual therapy)[54]

Guideline message: due to unclear evidence of efficacy and concerns of harm, the use of opioid analgesic medicines is now discouraged

Practice: these medicines have been overused in some, but not all, high-income countries; low-income and middle-income countries seem to have very low rates of use

High-income settings

- In 2009, opioids were prescribed for around 60% of presentations to emergency departments for low back pain in the USA[55]
- An Italian study of 746 patients with low back pain presenting to an emergency department showed that 42% were prescribed an opioid[41]
- A 2006 US population-based survey of people with chronic low back pain (n=706, mean pain duration 9·8 years), showed that of those who had seen a provider in the past year, 47·0% had taken a strong narcotic and 32·8% a weak narcotic (60·5% took some sort of narcotic) in the month before survey; of those who had not seen a provider, 5·9% had taken a strong narcotic and 14·7% had taken a weak narcotic[56]
- A 2004 US study based on health-care insurer data of 26 014 patients with low back pain managed in primary care, showed that 61·0% were prescribed an opioid and 18·8% were on long-term opioid therapy[57]

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(Panel 1 continued from previous page)

Low-income or middle-income settings

- Low-income and middle-income countries typically have low consumption of opioids (eg, in 2015, prescription of opioid medicines in Africa was 2·0 mg/head of population *vs* 677·0 mg/head of population in the USA)[58]

Guideline message: interventional procedures and surgery have a very limited role, if any, in the management of low back pain

Practice: these approaches are used widely in high-income countries; little evidence on their use is available for low-income and middle-income settings

High-income settings

- In the USA, in 2011, spinal fusion was responsible for the highest aggregate hospital costs of any surgical procedure (US$12·8 billion)[59]
- 990 449 lumbar or sacral facet injections and 406 378 lumbar or sacral facet neurotomy procedures were funded by US Medicare in 2011[60]
- 252 654 sacroiliac joint injections were funded by US Medicare in 2011[61]
- A survey of Dutch spinal surgeons (132 active surgeons surveyed, 70% response rate) showed that two-thirds do spinal fusion procedures for low back pain[62]
- In Australia from 2003 to 2013, the fastest increasing surgical procedure for spinal stenosis was complex fusion, although the surgery provides no added benefit compared with decompression alone, and is more costly and associated with greater harms[63]
- Use of epidural injections increased substantially in the US Medicare population from 2000 to 2011, with 2 023 481 epidural injections funded in 2011[64]

Low-income or middle-income settings

- In the period 1995–2014, in Brazil, the cost of spine surgeries increased by 540% (from R$27·1 million to $146·5 million)[65]

Guideline message: exercise is recommended for chronic low back pain

Practice: clinician treatment preferences and health-care constraints limit uptake

High-income settings

- 54% of people with chronic low back pain in the USA had not been prescribed exercise[56]
- Australia's universal health-care system, Medicare, has a limit of five allied health consultations, which is too few to deliver a typical exercise programme for chronic low back pain[66,67]

Low-income or middle-income settings

- A survey of Ghanaian physiotherapists revealed wide endorsement of exercise for patients with chronic low back pain[54] but access is limited by out-of-pocket costs to the patient[68]

Guideline message: a biopsychosocial framework should guide management of low back pain

Practice: the psychosocial aspects of low back pain are poorly managed in high-income, low-income, and middle-income settings

High-income settings

- Only 12% of people with chronic low back pain with depression in the USA had seen a psychiatrist or psychologist in the previous year[56]
- Only 8·4% of patients with low back pain in the USA were prescribed cognitive behavioural therapy[69]

Low-income or middle-income settings

- "Structured assessment of psychosocial factors is not part of routine management of low back pain in Iran, mainly because of absence of standard instruments"[29]
- "Management of patients with low back pain in Iran is dominantly based on a traditional biomedical model and therapeutic interventions based on a biopsychosocial approach are implemented only in a few university-affiliated physical therapy clinics"[29]

allowed only three guideline-appropriate indications led to a 36·8% reduction in lumbar spine imaging,[82] and the addition of short educational messages to all reports of lumbar spine MRIs significantly reduced imaging rates by 22·5%.[83] In Denmark, a multifaceted implementation strategy consisting of outreach visits, reports about the quality of care, and a self-completed questionnaire to help general practitioners to identify patients' risk of persistent pain led to reduced referral to secondary care and was cost-saving.[84,85] Reviews have shown no differences in effect on practice between multifaceted strategies compared with minimal, single, or no implementation strategy,[109] and the ineffectiveness of one-off implementation efforts, such as a single educational event.[110] Rather, it seems that implementation efforts need regular repetition or to be continuous to effectively change practice for low back pain.[110] Key challenges include identifying ways to remove existing unhelpful but well established practice patterns, and identify the most effective and cost-effective implementation strategies that ensure improvements are sustained over time. Very few randomised trials of implementation strategies have assessed costs.[111] Tough policy decisions are also needed that reduce the unhelpful influence of industry and reduce or remove reimbursement for low-value care.

Improved and better integrated education of health-care professionals could support implementation of best practice for low back pain, help to break down professional barriers, develop a common language, and create new and innovative strategies for practice.[112] Examples of such support include, the integrated education of medical

	Solution target and detail	Results	Strength of evidence* and readiness for large-scale implementation
Health care			
Focused effort to implement guideline recommendations			
USA[82]	Clinical decision support using a special radiographic requisition form for emergency room house officers to use to request lumbar spine radiographs. The new form was introduced, allowed only three guideline-appropriate indications for radiographs, and had to be used for a patient to have a radiograph. The implementation strategy was simple but ongoing in nature. The primary outcome was the number of imaging referrals.	Reduction in radiograph requests from 1443 to 759. The authors concluded that a 47% reduction in lumbar spine radiographs occurred in the first year, which they reported was maintained for the next 3 years.[82] A re-analysis of the study data, taking into account the time series design, estimated a significant decrease in imaging of 36·8% (95% CI 33·2–40·5).	Promising: one study of interrupted time series design, which did not report the total number of presenting patients. Unknown readiness for large-scale implementation.
UK[83]	Audit and feedback, and targeted reminder messages attached to all reports of lumbar spine MRI sent to 243 general practices. Control group received guideline dissemination. General practitioners' patients' records were examined for concordance with the guidelines. The primary outcome was number of radiograph requests per 1000 patients per year.[83]	Routine attachment of educational reminder messages to imaging reports led to an absolute change of –1·53 per 1000 patients (95% CI –2·5 to –0·57) from 6·8 per 1000 patients in the control group, a reduction in imaging of 22·5% (95% CI 8·4 to 36·8).	Promising: one randomised controlled trial (of before-and-after cluster randomised design). Unknown readiness for large-scale implementation.
Denmark[84,85]	Multifaceted implementation strategy with 60 general practices and 1101 patients. The strategy consisted of outreach visits, reports about quality of care, and the STarT Back Tool to identify patients' risk of persistent disabling pain. The control group received usual implementation approach. The aim was to reduce the proportion of patients being referred from primary care to secondary care within the first 12 weeks.	27 patients (5·0%) in the intervention group were referred to secondary care versus 59 patients (10·5%) in the control group (OR 0·52, 95% CI 0·30–0·90; p=0·020). The strategy saved £93·20 per patient (£406·51 *vs* £499·71). The implementation strategy resulted in lower patient satisfaction (OR 0·50, 95% CI 0·31–0·81; p=0·004).	Effective: one cluster randomised controlled trial with linked cost-effectiveness analysis. Potential for testing in other countries and settings.
Change clinical systems and pathways for low back pain			
UK[86–88]	Stratified primary care based on the patient's risk of persistent disabling pain (STarT Back). The approach consists of the use of a short self-completed questionnaire (the STarT Back tool)[86] to identify the patient's risk subgroup (low, medium, or high risk) with treatment then matched to the subgroup. The STarT Back trial[87] included 852 patients and the IMPaCT Back study included 922 patients.[88] The primary outcome was back-related disability.	Stratified primary care led to significantly improved back-related disability and improvements in other outcomes such as days lost from work. There were also changes in health-care use (less spinal imaging, fewer repeat visits to general practice, fewer specialist consultations) that contributed to cost savings of £34 (US$50) per patient in health-care costs, and £600 ($877) per employed patient when days lost from work were included.	Effective: two studies, one randomised controlled trial with linked cost-effectiveness analysis and one impact analysis sequential cohort study with linked cost-effectiveness analysis. Potential for testing in other countries and settings.
Canada[89–91]	Develop a systematic and multidisciplinary care pathway for low back pain to reduce variation in practice, improve quality, and access to care. The Saskatchewan Spine Pathway (SSP) has three components: (1) guideline-based education for clinicians (including a continuing medical education course with linked financial incentives) and education for patients; (2) specialised spine pathway clinics for patients who do not improve, supported by structured referral forms and staffed by specially trained physiotherapists that triage patients for further therapy, imaging, or referral to a spine surgeon; and (3) outcomes research. Key outcomes include pain, disability, waiting times, imaging, and referral to spine surgeon.	The clinic triaged patients for (1) non-surgical management or (2) referral to spine surgeon. Use of the SSP resulted in 71·3% of patients discharged after education, self-care advice, and conservative care compared with 28·7% of those referred to a surgeon. MRI use was significantly reduced (25·8% in patients discharged after conservative care compared with 92·0% in patients referred to surgeons). Use of the SSP did not result in different disability scores compared with patients managed as usual, but it led to shorter waiting times for MRI and surgical assessment, and greater proportions of patients referred to surgeons that were judged as suitable candidates for surgery.	Emerging: one retrospective analysis of 87 consecutive patients through the SSP,[89,90] and one retrospective medical record review of 215 referrals.[91] Unknown readiness for large-scale implementation.
UK[92,93]	Reform the whole clinical care pathway for low back pain, from first-line care to specialised care. The NHS England National Low Back and Radicular Pain Pathway developed by 30 stakeholder groups reached agreement on a uniform care pathway. Key to the pathway is the role of the specialist triage practitioner (predominantly specialist physiotherapists or nurses) and the availability of a comprehensive multidisciplinary combined physical and psychological programme.[94]	As of February, 2017, the pathway's free implementation pack (generic business case, value impact assessment, cost-saving calculator, training support, information technology support, step-by-step guide) had been downloaded by 30% of clinical commissioning groups in England with 15 actively implementing the Pathway. Early assessment in the northeast of England shows significant improvement in patient management, and in pain, disability, and mental health outcomes, high patient satisfaction, and significant reductions in community physiotherapy, radiographs, MRI scans, and referrals to secondary care. Wider national implementation is overseen by the NHS Trauma Programme of Care and the Spinal Services Clinical Reference Group.	Emerging: one before-and-after study summarised in a report for the UK NHS, further assessments are continuing but are also of observational (before-and-after) study design. Unknown readiness for large-scale implementation.

(Table 3 continues on next page)

doctors with chiropractors in Denmark;[112,113] the Centers for Excellence in Pain Education, funded by the National Institutes of Health in the USA that include e-learning modules focused on interactivity, expert modelling, and feedback;[114] and the promising results of a training course with Swedish physiotherapists aimed at identifying and addressing psychosocial obstacles to recovery in patients with low back pain.[115]

Clinical systems and pathways

A more radical health-care solution is to change the clinical-care model for low back pain. An example of this

	Solution detail	Results	Strength of evidence* and readiness for large-scale implementation
(Continued from previous page)			
Health care and public health			
Integrate health and occupational interventions			
USA[95]	Quality improvement intervention of financial incentives and organisation support aimed at reducing work disability. Baseline data included 33 910 workers' compensation claims (July, 2001, to June, 2003), and post-intervention data included 71 696 patients' data (July, 2004, to June, 2017). Outcomes at 1-year follow-up included work disability status, number of disability days, and costs.	Patients were less likely to be off work and on disability at 1 year (OR 0·79; p=0·003). The average reduction in disability days in patients with back pain was 29·5% (p=0·003). Total disability and medical costs were reduced by US$510 per claim (p<0·01).	Emerging: one non-randomised before-and-after study with non-equivalent comparison group. Unknown readiness for large-scale implementation.
Sweden[96]	Intervention aimed at both workers at risk of long-term impairments (n=140, 94% female) and the workplaces (55 supervisors). The intervention was manualised and based on cognitive behavioural therapy principles, and involved communication and problem-solving skills for both the worker and supervisor. The control received evidence-based treatment as usual.	The intervention showed significantly greater improvements compared with the control, in numbers of workers having work absence due to pain (intervention<control; p<0·05), health-care use (intervention<control; p<0·01), and perceived health (intervention>control; p<0·01).	Promising: one randomised controlled trial. Unknown readiness for large-scale implementation.
Netherlands[97,98]	Integrated care programme for low back pain patients (n=134) sicklisted for at least 12 weeks, that involved a patient-directed and workplace intervention (ergonomics, supervisor involvement, and a graded activity programme based on cognitive behavioural therapy principles). Control group received usual care. Outcomes included duration of time off work until full sustainable return to work and functional status.	Median duration of time off work until full sustainable return to work was 88 days in the intervention group *vs* 208 days in the control group (p=0·003). Integrated care was effective for return to work (HR 1·9, 95% CI 1·2–2·8; p=0·004) and functional status (p=0·01) *vs* usual care control. Total costs in the integrated care group (£13 165, SD 13 600 [US$18 229, SD 18 834]) were significantly lower than in usual care (£18 475, SD 13 616 [$25 660, SD 18 856]). The intervention resulted in a return on investment of £26 for every £1 invested ($36 for every $1·39) *vs* usual care.	Effective: one randomised controlled trial with health economic evaluation. Potential for testing in other countries and settings.
Change compensation and disability policies			
Netherlands[99,100]	Cost of illness study to investigate costs of back pain from 2002 to 2007, after introduction of new laws on health insurance and sickness benefits and new guidelines for health-care professionals. Data gathered from national registries, reports of research institutes, descriptive studies, and occupational health-care authorities.	The total costs of back pain fell from €4·3 billion in 2002 to €3·5 billion in 2007. The share of these costs was about 0·9% of the GNP in 2002 and 0·6% of GNP in 2007. The ratio between direct and indirect costs did not change noticeably over the years, that is, 12% for direct and 88% for indirect costs.[100]	Emerging: one non-randomised cost-of-illness study. Unknown readiness for large-scale implementation.
Public health			
Change the beliefs and behaviours of the public through mass-media campaigns			
Australia[101–103]	In Victoria, Australia, between September, 1997, and December, 1999, the mass-media campaign Back Pain: Don't Take it Lying Down was delivered for 12 months (intense campaign) followed by a further 15 months (less intense campaign). It had widespread endorsement from national medical bodies and was primarily delivered through television advertisements aired during prime time, featuring experts, sports personalities who had successfully managed back pain, and actors, comedians, and the minister for health. It also used radio, billboard, and print advertisements, posters, seminars, visits by well-known personalities to workplaces, and publicity articles and publications. The campaign's overall cost was US$7·6 million.	Improvements in back pain beliefs in Victoria (mean scores on the Back Beliefs Questionnaire 26·5, 28·4, and 29·7) but not in control (26·3, 26·2,and 26·3). Reduction in number of claims for back pain (15%), medical payments for claims for back pain (20%), and rate of days compensated.	Promising: quasi-experimental, non-randomised, before-and-after study with an adjacent Australian state as control group. Potential for testing in other countries and settings.
Canada[104,105]	In Alberta, Canada, from May, 2005, to December, 2016, a mass-media campaign, Back Active, was delivered. It had widespread endorsement from local health associations and featured local health professionals and organisations and an Olympic gold medallist. The primary medium was radio advertisements, but also used a website, posters, pamphlets, bus and billboard advertisements, articles in the public and industry news, and some television public service announcements. The campaign's overall cost for the first 3 years was US$723 300.	Improvements in back pain beliefs in Alberta were observed since the proportion of participants agreeing with a statement about staying active rose from 55·5% to 63·4% (p=0·008) with no change in control in the Saskatchewan population (consistently 60%). No effect seen on health-care use (imaging or visits to health professionals for back pain or work disabling claims).	Promising: quasi-experimental before-and-after study with adjacent Canadian province as a control.

GNP=gross national product. HR=hazard ratio. NHS=National Health Service. OR=odds ratio. *Conclusion on strength of evidence: effective=evidence of benefit from at least one randomised controlled study with health-economic analysis; promising=evidence of benefit from at least one controlled study; emerging=evidence of benefit from one uncontrolled study or other study design.

Table 3: **Examples of effective, promising, or emerging solutions, by solution target**

is a new model of stratified primary care for non-specific low back pain known as STarT Back that involves two components; first, a brief self-completed questionnaire to identify patients' risk of persistent disabling pain (low, medium, or high risk)[86] and second, treatments that are matched to each risk subgroup. Summarised in table 3 are two studies within the UK's National Health Service (NHS) that have shown stratified care to be more effective than a best care comparison group,[87] and more cost-effective than usual primary care.[88] On the basis of this evidence, the current UK clinical guideline now recommends risk stratification.[8] Stratified care approaches, such as STarT Back, that target resources to those most likely to benefit might allow more effective prioritisation of health-care resources.

Another potential health-care solution is to reconfigure, with agreement from all stakeholders, the whole clinical pathway from care at first contact through to specialised care. A clinical pathway has been defined as a "complex intervention for the mutual decision-making and organisation of care processes for a well-defined group of patients during a well-defined period"[116] and "an integrated, multi-disciplinary strategy to organise the timing, sequencing, and coordination of care to optimise patient outcomes and enhance efficiency".[117] A major barrier to changing clinical pathways relates to current models of health-care reimbursement, which reward volume rather than quality, perversely providing remuneration not for how effectively patients are treated, but for how much they are treated.[118] A 2011 systematic review of clinical pathways for low back pain identified four pathways, but none had outcome data available.[89] Since then, several further care pathways have been developed and implemented with some evaluation, albeit of weak design (table 3). An emerging example from Canada, the Saskatchewan Spine Pathway, is a co-ordinated multidisciplinary pathway that seems to reduce both requests for MRI and referrals to spinal surgery, and results in appropriate candidates for surgery being referred to spine surgeons.[90] In the UK, NHS England's national pathway for treatment of low back and radicular pain was first published in June, 2014, and updated in February, 2017.[92] The pathway was agreed by 30 stakeholders, is being implemented in many Clinical Commissioning Groups (NHS organisations that organise the delivery of NHS services in England, each typically responsible for services for around 300 000 people), with emerging evidence of benefits for patients and the health-care system.[93]

Integrate health and occupational interventions

A further promising direction could be to target both the health-care system and, more broadly, public health through integrated health-care and occupational interventions. If back pain symptoms are reduced, then return to work is expected to follow. The association between pain, function, and return to work is, however, weak with reviews suggesting that the association changes with low back pain duration (positive association in the acute phase, no association in the subacute phase, and negative association in the chronic phase).[119,120] People can improve in function and return to work even if pain remains, and evidence shows that return to work occurs before symptom recovery.[121] Therefore, health-care and occupational health interventions should be considered together in people with low back pain and work disability issues. Examples are available from the USA and Sweden of integrated and early interventions that shift the focus to problem-solving at work, and lead to fewer disability days, earlier return to work, and reductions in use of health care.[95,96] The new Department of Health Framework and Strategy for Disability and Rehabilitation Services in South Africa[122] includes goals to integrate comprehensive disability and rehabilitation services within priority health programmes and to foster intersectoral collaboration to address social determinants of ill health. Although low back pain is not specifically mentioned, opportunities could exist for inclusion of low back pain within their stated priority programmes of District Health Services and Health Promotion. Whether integration of health and occupational care is possible or desirable in low-income and middle-income countries with high reliance on temporary and unstable jobs, where little or no protection of employment due to low back pain exists, and where many depend on their pain as a source of income, is unknown. However, data provide evidence of the benefits of a participatory return-to-work programme for this group of workers in the Netherlands,[123] where the programme resulted in twice as high a rate of return to work and greater societal benefit (€2073 per worker) compared with usual care. Individuals with higher annual income seem more likely to believe that one should stay active during an episode of low back pain;[124] therefore, specific targeted interventions need to be developed and tested for those from lower socioeconomic groups to reduce health disparities, address barriers to reintegration into the workforce, and facilitate getting out of poverty.

Multisystem approaches to returning and staying at work could reduce the economic and societal burden of work disability pensions due to low back pain. The example provided in table 3 is of a Dutch integrated care programme for patients with low back pain on long-term disability benefits (on average 5–6 months) that resulted in twice as high a return to work rate, 4 months earlier sustainable return to work, and a return on investment of £26 for every £1 invested compared with usual care.[97,98]

Changes to compensation and disability policies offer another potential solution. Substantial differences exist between countries in the prevalence of claims for disability benefits related to back pain, with the back claim rate in the USA being 60 times higher than in Japan,[125] and musculoskeletal claims between states in Brazil being five to six times greater within highly developed states.[126] One of the first studies[127] to document the effect of compensation systems on claims for back pain showed in

Panel 2: Case study: policy reform in the Netherlands

In the past two decades, new health insurance and sickness benefit laws in the Netherlands have required employers to (1) pay 70–100% wages to their sick employees for 2 years, and (2) make a return-to-work plan agreed by employer and employee, detailing all actions for the employer and employee. Medical assessments for work disability benefits are postponed to 2 years after reporting sick to give the employee and employer the opportunity to achieve full and sustainable return to work. After 2 years, an independent medical assessment is done to decide on the full benefit for workers with complete sustainable work disability, or on a partial and temporary benefit—based on limitations in functional abilities—for workers who are temporarily or partly disabled; this group is stimulated by financial incentives to resume work for their remaining work capacity. These changes led to a large drop in sickness absence and disability pensions.[99] In line with these reductions, sick leave for low back pain fell by a third between 2002 and 2007 (figure). The total costs of back pain fell from €4·3 billion in 2002 to €3·5 billion in 2007.[100]

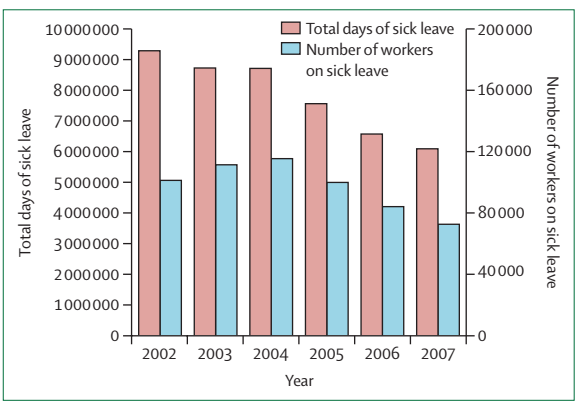

Figure: **Sick leave days and number of workers on sick leave in the Netherlands (2002–07)**
Reproduced from Lambeek et al,[100] with permission from Wolters Kluwer Health.

Canada that changing from a tort compensation insurance system with payments for pain and suffering to a no-fault system without such payments, led to a decrease in the incidence of claims and time to claim closure. An Australian study showed worse health outcomes in a fault-based system in New South Wales compared with a no-fault system in Victoria.[128] In Brazil, providing a large amount of income replacement (>100%) from the National Social Security Institute resulted in workers with musculoskeletal pain claiming benefits for longer.[129] Making changes to compensation systems aligns with recommendations from the Organisation for Economic Co-operation and Development (OECD).[130,131] The effect of different compensation policies on return to work and claim duration is evidenced by an Australian study of all-cause work disability claimants,[132] and a six-country study of 2825 compensation claimants with chronic low back pain who were off work for 3–4 months.[133] In the six-country study, sustainable return to work rates ranged widely between countries, from 22% in Germany to 62% in the Netherlands. The differences were largely due to the Dutch compensation system encouraging greater work interventions than did those of the other countries. The effects of the reform of the Dutch system (panel 2 and figure), in line with OECD recommendations, are evidenced by reductions in sickness absence and disability pensions for back pain from 2002 to 2007.[99,100] Although the absence of a control comparison is a limitation, this multisystem solution from the Netherlands is one that other countries could consider emulating. The Netherlands' approach, and a 2017 international evidence synthesis,[134] highlight the need for, and power of, policy changes that encourage work interventions supported by less strict compensation policies for disability benefits.

Public health interventions

Approaches that target public health also offer a possible solution. Public health interventions aim to change the public's back pain beliefs and behaviours. Mass-media campaigns about back pain have been studied in four high-income countries (Australia,[101] Scotland,[135] Norway,[136] and Canada[104]), and have proved to have some success (table 3). The campaign in Alberta, Canada, had a modest effect on the public's beliefs (regarding the importance of staying active) compared with a control population,[104] with positive effects on beliefs persisting 7 years after the initial assessment, with annual bursts of campaign activity.[105] The Australian mass-media campaign resulted in changes to beliefs and behaviours.[102,103] The campaign was well funded, predominantly used television commercials featuring recognisable spokespeople, provided practical information about how to stay active and at work despite pain, and had clinical, employer, and employee organisations as partners. Perhaps most importantly, supportive laws and public policies were in place, including financial penalties for employers who did not provide modified work options to employees with back pain. Mass-media campaigns with a clear focus on behaviours rather than beliefs alone, and that incorporate new ways to disseminate information, such as personalised marketing, social networks, and customised digital communications, could be considered. Such campaigns might be less expensive than traditional media, and allow more direct access to the public and greater targeting of messages.

Public health strategies are likely to be especially important for low-income and middle-income countries,[137] where, to date, greater focus and resources have centred on prevention and public health campaigns in infectious diseases. An example strategy in villages in rural Tibet, where 34% of people reported low back pain, consisted of training in back pain prevention and management in combination with a stand to support water containers. The intervention eased the burden of

collecting water with the potential to also reduce back pain prevalence and associated disability.[138] In South Africa, information about back health has been integrated into the Western Cape on Wellness project, promoting healthy lifestyles to reduce the burden of non-communicable diseases across community, work, and school settings.[139] However, we could not find any assessments or published data for the effectiveness of public health interventions for low back pain in low-income or middle-income countries.

Conclusions

Despite many clinical guidelines with similar recommendations for the management of low back pain, the gap between evidence and practice is pervasive. We have provided examples of effective, promising, and emerging directions that deserve greater attention and more rigorous assessment. Even the solutions judged effective draw on limited evidence, but they could potentially be replicable and cost-effective in other settings. Focusing on key principles, such as the need to reduce unnecessary health care for low back pain, support people to be active and stay at work, and reform unhelpful patient clinical pathways and reimbursement models, could guide next steps. The starting point in high-income countries will be different from low-income and middle-income countries, and their priorities are likely to differ. No single solution will be effective, and a collective, global effort will take time, determination, and organisation. Without the collaborative efforts of people with low back pain, policy makers, clinicians, and researchers necessary to develop and implement effective solutions, disability rates, and expenditure for low back pain will continue to rise.

Contributors

NEF, CGM, and DC were part of the team that developed the original proposal for the Series and coordinated production of papers. All authors drafted key sections of the paper, and NEF and CGM revised all sections. All authors have contributed to all sections of the paper and have edited it for intellectual content. NEF, CGM, DC, JRA, DPG, JMF, BWK, and PHF participated in the authors' meeting and discussion during the drafting process. All other authors have read and provided substantive intellectual comments on the draft and approved the final version of the paper.

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Declaration of interests

Please see appendix for authors' declaration of interests. See **Online** for appendix

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Low back pain: a call for action

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Low back pain is the leading worldwide cause of years lost to disability and its burden is growing alongside the increasing and ageing population.[1] Because these population shifts are more rapid in low-income and middle-income countries, where adequate resources to address the problem might not exist, the effects will probably be more extreme in these regions. Most low back pain is unrelated to specific identifiable spinal abnormalities, and our Viewpoint, the third paper in this *Lancet* Series,[2,3] is a call for action on this global problem of low back pain.

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The panel summarises the most pressing political, public health, and health-care challenges and identifies actions to meet them. Prevention of the onset and persistence of disability associated with low back pain requires recognition that the disability is inseparable from the social and economic context of people's lives and is entwined with personal and cultural beliefs about back pain.[4] Health and workplace policies and disability payment systems are often ineffective and wasteful, and they are key targets for improvements. Socioeconomically disadvantaged people are overrepresented among those with disabling low back pain.[5] In many settings they will be further disadvantaged by restricted access to accurate information sources, health-care approaches that provide appropriate support for self-management of uncomplicated low back pain, and to specialised effective interventions, such as multidisciplinary rehabilitation, for complex persistent low back pain.

Public health programmes that tackle obesity and low levels of physical activity might provide a model and structure for reducing the effects of low back pain on daily life,[6] although independent associations between the life-style issues and low back pain are uncertain. Implementation of these programmes is especially urgent in some low-income and middle-income countries where increasing obesity rates and rapid industrial growth and consequent reductions in physical activity are occurring in urban areas. Health system and societal initiatives addressing low back pain should act in synergy with the WHO European Region action plan for the prevention and control of non-communicable diseases, which recognises the need for comprehensive promotion of musculoskeletal health. Because low back pain disability often affects employability in the informal sector, integration between health, workplace, and social services should also be a key goal.

Disabling low back pain is partly iatrogenic. Studies in low-income countries and Indigenous and assimilated populations in high-income countries show that exposure to health care can sometimes have harmful consequences.[7–9] Such negative effects of health care reflect a change in views, from low back pain being a fairly benign part of daily life, to it being seen as a problem requiring medical attention. Increased use of ineffective potentially unsafe treatments has wasted limited health-care resources and harmed patients. The epidemic of addiction and rising mortality resulting from increased opioid prescribing in the USA over the past 20 years is a dramatic example of the disastrous effects of damaging medical intervention.[10] In low-income and middle-income countries, epidemiological evidence suggests that improving social and economic conditions could prevent or reduce incidence of low back pain, but could also create expectations and demands for medical investigations and low-value health care that paradoxically increase the risk of long-term back-related disability (what we term the low back pain paradox).

The global challenge is to prevent the use of practices that are harmful or wasteful while ensuring equitable access to effective and affordable health care for those who need it. High rates of advice to rest and use of ineffective treatments are already a reality in low-income and middle-income countries. Over-medicalisation disproportionately affects the wealthy minority, but it also threatens to reduce availability of high-value health-care services for the poor majority and further widen health and social disparities. Contextual factors, such as scarcity of suitable work, might also mean that advice that would be regarded as appropriate in high-income countries, such as encouragement to remain in work or return to work early, might not always be appropriate—or even an option—in low-income or middle-income countries.

Protection of the public from unproven or harmful approaches to managing low back pain requires that

Key messages

- Use the notion of positive health—the ability to adapt and to self-manage in the face of social, physical and emotional challenges—for the treatment of non-specific low back pain
- Avoid harmful and useless treatments by adopting a framework similar to that used in drug regulation—ie, only include treatments in public reimbursement packages if evidence shows that they are safe, effective, and cost-effective
- Address widespread misconceptions in the population and among health professionals about the causes, prognosis, and effectiveness of different treatments for low back pain, and deal fragmented and outdated models of care
- Policy, public health, health-care practice, social services, and workplaces must jointly tackle the low back pain paradox in low-income and middle-income countries, where improving social and economic conditions could prevent or reduce low back pain incidence, but at the same time create expectations and demands for medical investigations and low-value health care that increase the risk of long-term back-related disability

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Panel: Call for actions to meet the challenges associated with prevention of disabling low back pain

Political challenge: increase recognition of the effects and burden of back pain by international and national policy makers

- Call on WHO to put disabling low back pain on the target list for all nations and increase attention on the burden it causes, the need to avoid excessively medical solutions, and the need to integrate low back pain into all chronic disease initiatives
- Call on international and national political, medical and social policy leaders to adequately fund public health strategies focused on preventing low back pain from interfering with life, ensuring inclusion of disadvantaged and culturally diverse populations
- Call on national and international funding agencies to make low back pain research a global health priority in recognition of its impact on people's lives in all countries

Public health challenge: prevent onset and persistence of disability associated with low back pain

Change priorities

- Prioritise low back pain, together with other musculoskeletal conditions, as a public health problem
- Develop and implement positive strategies for primary prevention of disabling low back pain that are integrated with strategies for preventing other chronic conditions (physical activity, maintenance of healthy weight, mental health)
- Develop and implement strategies to address modifiable risk factors for disabling low back pain at all levels (society, workplace, health professionals, individuals)

Change systems and change practice

- Integrate back pain care with public health initiatives providing credible advice that people who develop low back pain should stay active and remain working, and that people with low back pain should be supported in early return to work
- Develop and implement strategies to ensure early identification and adequate education of patients with low back pain at risk for persistence of pain and disability
- Promote a healthy lifestyle and address common comorbidities in patients with persistent low back pain, tackle social determinants of disability, incentivise work through change and adaptation of the workplace and the job, and change worker disability policies which do not improve, promote, or support return to work
- Consider provision of financial incentives to resume appropriate work without risk of loss of benefits for people who are off work because of low back pain
- Promote active multidisciplinary rehabilitation to support return to work

Health-care challenge: move away from emphasis on a biomedical and fragmented model of care

Change culture

- Develop interventions to address misconceptions about low back pain among health professionals, patients, the media, and the general public
- Promote the concept of living well with low back pain: person-centred care focusing on self-management and healthy lifestyles as a means of restoring and maintaining function and optimising participation
- Investigate the effectiveness and place of traditional practices for reducing disability associated with low back pain in low-income and middle-income countries

Change clinician behaviour

- Invest in implementation research to address evidence-practice gaps across all relevant health-care providers
- Identify and implement effective behaviour change and training interventions to improve and integrate care
- Deliver a workforce fit-for-purpose, which includes targeted training of health-care professionals and others with the right competencies and resolve to deliver evidence-based care
- Build consensus across clinical disciplines, patient groups, and journal editors for shared guidelines of care that are straightforward and non-denominational

Change systems

- Develop clear care pathways, referral, funding, and information technology systems to enable people to see the right person for delivery of the right treatment at the right time, while precluding use of alternative inappropriate pathways
- Develop consistent evidence-based clinical care standards and key indicators integrated across health-care systems and settings
- Develop and implement cost-effective strategies that provide access to effective care in low-income and middle-income countries for all

Tackle vested interests

- Government, insurers, and commissioners should consider tackling conflicts of interest through regulation and contracts, including not paying for inappropriate tests and for unnecessary, ineffective, and harmful treatments
- Existing and new tests and procedures for low back pain should be regulated in the same way as drugs; evidence should be available showing that they are safe, effective, and cost-effective before they get reimbursed within public health-care systems
- Introduce incentives for effective and efficient care and disincentives for continued use of ineffective and potentially harmful approaches

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governments and health-care leaders tackle entrenched and counterproductive reimbursement strategies, vested interests, and financial and professional incentives that maintain the status quo. Funders should pay only for high-value care, stop funding ineffective or harmful tests and treatments, and commission research into tests and treatments without supporting evidence. As with drugs, which are subject to strict regulation in many countries, new diagnostic tests and non-drug treatments should be available only in trials until their efficacy, safety, and cost-effectiveness is established by robust research evidence.

Some countries are testing these approaches. In Australia, a clinician-led taskforce is reviewing all government-subsidised tests and procedures, with the aim of removing funding for those that are unnecessary, outdated, or potentially unsafe. In the Netherlands, unproven interventions are conditionally included in the public health insurance package only if there is evidence from high quality randomised controlled trials to inform a final decision that show whether or not the intervention is efficacious and safe. Stakeholders, including patients, agree to design and eligibility criteria for the assessment. Because radiofrequency denervation for patients with chronic low back pain does not provide clinically significant added benefit compared with a standardised exercise programme alone, it is no longer covered in the public health insurance package.[11]

Awareness of the biopsychosocial model of low back pain has greatly advanced the understanding of the prognostic significance of psychosocial factors in individual patients. The model has had less success in shifting practitioners away from managing patients within a biomedical framework. The importance of behavioural approaches to back pain management does not preclude the continuing need to investigate mechanisms and potential biological determinants of non-specific low back pain in phenotypically distinct subgroups.

We propose adoption of the so-called positive health concept as the overarching strategic approach to the prevention of long-term disability from low back pain.[12] Positive health, as proposed by Huber and colleagues, is "the ability to adapt and to self-manage, in the face of social, physical, and emotional challenges". This term encompasses a much broader idea of health than simply absence of disease and its emphasis on medicalisation and cure.

Evidence suggests that prevalence of long-term disabling low back pain could be reduced by adopting this positive health approach.[13,14] For health professionals, positive health focuses on alternatives to treatments and cures and promotes high-quality, meaningful lives for people with persistent low back pain. Public and patients' expectations need to change, so that people are less likely to expect a diagnosis or complete cure for their pain. This adjustment of attitude requires initiatives to change widespread and inaccurate beliefs about back pain,[13] helping future generations to avoid counterproductive patterns of illness behaviour, eg, prolonged rest, avoidance of usual activities, or staying away from work.

For people with persistent low back pain, positive health entails learning how to cope with a long-term health problem through self-management activities, and learning to seek health care only when needed. Passive approaches such as rest and medication are linked with worsening disability, whereas active strategies such as exercise are associated with reduced disability and less reliance on formal health care. Many behavioural and cognitive strategies are used by people with chronic pain in the community, regardless of whether or not they seek care.[15] In the occupational setting, interventions focusing on positive health, including peer support for the notion that low back pain is not an injury in need of medical treatment,[16] and redirecting problem-solving efforts away from seeking cures and towards improved individual adaptation to the pain, yield beneficial outcomes.[17]

Improved training and support of primary care doctors and other professionals engaged in activity and lifestyle facilitation, such as physiotherapists, chiropractors, nurses, and community workers, could minimise the use of unnecessary medical care. Crucial to changing behaviour and improving delivery of effective care are system changes that integrate and support health professionals from diverse disciplines and care settings to provide patients with consistent messages about mechanisms, causes, prognosis and natural history of low back pain, as well as the benefits of physical activity and exercise. Traditional healers, where integrated into the health-care system, community health workers, and family remain important providers of lower cost basic education and care in many low-income countries for most people with low back pain who do not require medical attention.[18] In rural and remote regions rehabilitation advice and support given online, combined with self-management, might be an option where internet access is available.

The success of a positive health approach will depend on whether relevant stakeholders share the same mission, vision, and objectives and on the success of strategies for knowledge transfer and exchange. The appendix lists information that well informed consumers, patients, clinicians, and policy makers should know about low back pain and its global burden.

See Online for appendix

Policy makers in all countries should look to local stakeholders to help decide what overall strategies should be put in place. Similar to other areas of research low-income and middle-income countries should ensure that investment in musculoskeletal services is effective for patients and does not damage local health systems.[19] Local participation and ownership, integration with existing priorities and policies, and coordination with national and regional systems and processes are crucial.

Funding for low back pain research is inadequate and uncoordinated. This scarcity of funds especially affects low-income and middle-income countries, where the effects of disabling low back pain remain under-recognised

and research priorities and funding remain focused on infectious diseases. One way forward would be to establish a global network of researchers from developed and developing countries, pooling experience and knowledge and building research capacity where it is needed.

The appendix lists major research priorities, which align with those previously identified by the international low back pain primary care research community.[20] Implementation research is necessary in all countries to ascertain how best to use existing knowledge and evidence through changes in patient and clinician behaviour and health system design. For low-income and middle-income countries, priorities include identifying interventions that are optimal in the context of the social, political, cultural, and health-resource factors. Although available evidence-based guidelines might be well suited for high-income countries and highly developed health-care systems, they might need adaptation to assure feasibility and cultural appropriateness for low-resource settings.

An active ongoing monitoring system is crucial to assess the effects of new strategies on outcomes such as disability, ability to work, and social participation. There is a pressing need for surveys and health-care databases in different countries that use common metrics for measuring the burden of low back pain, use of active self-management strategies such as exercise, tests, and treatments, and outcomes and costs of care. The appendix shows a set of indicators of success for surveillance. Uniform data collection would encourage benchmarking of health services within and across countries. Standardised definitions of low back pain for prevalence studies have already been developed and incorporated into the Global Alliance for Musculoskeletal Health Surveillance Taskforce survey module for musculoskeletal conditions.

Action is needed to address the growing burden of low back pain on many millions of people worldwide. Future social changes, including ageing, urbanisation, increasingly sedentary lifestyles, and the development of new technologies, will probably exacerbate this problem. For example, the use of increasingly sensitive imaging techniques, such as MRI, can reveal findings that might be incorrectly inferred to be the cause of a patient's symptoms.

Improved recognition of the growing burden of low back pain is essential to stimulate new, more effective, strategies of prevention and care. The effects of disabling low back pain can be reduced through social change that supports full participation in daily life. In low-income and middle-income countries, the paradox of low back pain needs to be addressed. Other barriers to optimal evidence-based management include widespread misconceptions of the general public and health professionals about the causes and prognosis of low back pain and the effectiveness of different treatments, fragmented and outdated models of care, and the widespread use of ineffective and harmful care, particularly in countries regarded as models of high quality care.

We have described actions all countries can take to reduce the effect of disabling low back pain on their populations. Strong and coordinated political action from international and national policy makers, including WHO and research funding agencies, is needed. Such action could substantially reduce disability and suffering and improve the effectiveness and efficiency of care for people with low back pain throughout the world.

Contributors

RB and MvT were part of the team that developed the original proposal for the series and RB coordinated the development and amendment of the paper. RB, MvT, BÖ, LMC, AW, MS, and PC all contributed to drafting and writing of this paper, and have edited it for key content. RB, LC, and PC drafted and analysed the survey of the *Lancet* Low Back Pain Series Working Group that populated the draft version of the panels in this paper. RB, MvT, BÖ, LMC, AW, and PC participated in the authors' meeting and discussion during the drafting process. All other authors have read and provided substantive intellectual comments on the draft and approved the final version of the paper.

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Declarations of interest are provided in the appendix.

Declaration of interests

RB is chief investigator or associate investigator on multiple previous and current research grants from government research agencies from Australia (eg, NHMRC, ARC), and overseas (eg, ZonMW in the Netherlands and PCORI in the USA). Her research has also received funding from philanthropy (eg, Arthritis Australia) and government agencies (eg, NSW WorkCover). She has been funded by research fellowships from NHMRC since 2005. She has received travel expenses for speaking at conferences from the professional organisations hosting the conferences. She chaired the back pain expert group for the 2010 Global Burden of Diseases, Injuries, and Risk Factors (GBD) Study. She was appointed to the Australian Medical Services Advisory Committee in May 2016. She has published multiple papers on low back pain, some of which might be referenced in the series. LMC is chief investigator or associate investigator on multiple previous and current research grants from government research agencies FAPESP and CNPq from Brazil. She has published multiple papers on low back pain some of which

may be referenced in the series. PC has been chief investigator or co-investigator on multiple previous research grants for musculoskeletal pain research from UK government agencies (including National Institute for Health Research and the Medical Research Council) and UK charitable organisations (Arthritis Research UK and the Wellcome Trust), but none from industry. His travel expenses have been covered by the organising professional organisations (including rheumatology, pain specialists, physical therapy, primary care) when he has been an invited speaker at conferences. He has received honoraria for reviewing grant proposals from government organisations in Canada, Norway and Sweden. PC's department has received payment for two reports to the UK Committee on Advertising Practice. He has published multiple papers on low back pain, some of which might be referenced in the series. BÖ is head of research at the division and is responsible for previous and ongoing research funded by government research agencies in Sweden. She has received travel expenses for speaking at conferences from the professional organisations hosting the conferences. She chaired the Scientific Council of Medicine and Health from 2013 to 2016 and has been a member from 2010 to 2012. MS receives most of his funding from the publishing company Wolters Kluwer for writing and editing an international newsletter on spine and back pain research (The BackLetter). He authors all the articles and shares editorial control with the executive editor (a researcher, academic spine surgeon, and Chairman, Department of Orthopaedics at Georgetown University Medical Center). Neither has any conflicts of interest with drug or device companies. MS has co-authored several editorials for journals owned by publishers (The Spine Journal and Spine—owned respectively by Elsevier and Wolters Kluwer). The editorials concerned the inadequacy of the evidence base for regulated surgical devices or drugs and biologics. He received nothing of value for those editorials. The remainder of his funding comes from the non-profit Sports Health and Safety Institute at the University of Washington for research, writing, and editing in the concussion area. He was previously a paid consultant for the non-profit Informed Medical Decisions Foundation in Boston, involved in the preparation of Decision Aids and Shared Decision Making materials. He occasionally receives travel funding from professional societies to take part in symposia sponsored by those societies. MS has been an unpaid editorial board member and Consumer Representative at the Cochrane Collaboration Back and Neck Group since 1999. MvT is chief investigator, or co-investigator on multiple previous and current research grants from government research agencies in the Netherlands (ZONMW; the Dutch Health Insurance Council) and Australia (NMHRC). His research has also received funding from professional organisations (eg, the Royal Dutch Association for Physiotherapy, the Netherlands National Chiropractic Association, and the European Chiropractic Union). His travel expenses have been covered by the organizing professional organizations when he has been an invited speaker at conferences. He has received honoraria for reviewing grant proposals from the Swedish Medical Research Council and VINNOVA (Sweden's innovation agency). He has not received any honoraria or travel expenses from the industry. MvT was chairman of the Netherlands National Multidisciplinary Guideline on Low Back Pain. He has published multiple papers on low back pain, some of which might be referenced in the series. AW has been chief investigator or co-investigator on projects to identify burden of musculoskeletal conditions and to develop strategies for their control. He has been an expert adviser to WHO. He is chair of the Global Alliance for Musculoskeletal Health. The European Community, professional bodies, and research agencies have supported his work. Professional bodies or organisers of scientific meetings have supported his travel expenses. He has not received any funding from the private sector.

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