



This is the accepted version of this paper. The version of record can be accessed at
<https://doi.org/10.1016/j.berh.2020.101597>

Chapter 6 Advances in delivery of health care for MSK conditions

6.0 Introduction

Kristina E Åkesson, MD, PhD

Professor, Department of Clinical Sciences, Lund University, Malmö, Sweden; Clinical and Molecular Osteoporosis Research Unit, Skåne University Hospital, Malmö, Sweden.

6.1 Low back pain

Rachelle Buchbinder AO MBBS (Hons) MSc PhD FRACP FAHMS

Director, Monash Department of Clinical Epidemiology, Cabrini Institute,
Professor, Department of Epidemiology and Preventive Medicine, School of Public Health and Preventive Medicine, Monash University; and
Rheumatologist, Cabrini Health, 4 Drysdale St, Malvern, Melbourne Australia 3144.

6.2 Chronic MSK pain in LMIC (low and middle income countries) (spine care program)

Margareta Nordin, Dr. Med. Sci, PT.

Professor (Research) Departments of Orthopedic Surgery and Environmental Medicine, New York University, New York, NY, USA.
Past President World Spine Care Europe, Holmfirth, United Kingdom.

6.3 Joint pain management – NSAIDs to self management

Michael V. Hurley BSc, PhD

Professor of Rehabilitation Sciences. Faculty of Health, Social Care and Education, St George's University of London and Kingston University, London SW17 0RE, United Kingdom

Clinical Director MSK Programme, Health Innovation Network, Minerva House, 5 Montague Close, London SE1 9BB, United Kingdom

6.4 Orthopaedic surgery – changing role and technical advances – spine and joint

Sören Overgaard, MD, DMSc

Professor, Department of Orthopaedic Surgery, Odense University Hospital, Odense, Denmark

6.5 Post-fracture management – Fracture Liaison Services Taiwan

Lo-Yu Chang, MD

School of Medicine, National Taiwan University, Taipei, Taiwan

Rong-Sen Yang, MD, PhD

Department of Orthopedics, National Taiwan University Hospital, Taipei, Taiwan

Ding-Cheng (Derrick) Chan, MD, PhD, FACP

Superintendent Office, National Taiwan University Hospital Chu-Tung Branch, Hsinchu County, Taiwan

6.6 RA – from DMARDs to biologics

Anthony Woolf, BSc, MBBS, FRCP

Bone and Joint Research Group, Royal Cornwall Hospital, Truro, TR1 3HD, United Kingdom

6.7 Delivery of health care – innovative models and e-health

Leif Dahlberg, MD, PhD

Nero H. PhD

Professor, Orthopedics, Department of Clinical Sciences, Lund (IKVL), Lund University, Lund, Sweden. Arthro Therapeutics, Malmö, Sweden

6.8 Conclusion, practice points and research agenda

Kristina E Åkesson, MD, PhD

Professor, Department of Clinical Sciences, Lund University, Malmö, Sweden; Clinical and Molecular Osteoporosis Research Unit, Skåne University Hospital, Malmö, Sweden.

Anthony Woolf, BSc, MBBS, FRCP

Bone and Joint Research Group, Royal Cornwall Hospital, Truro, TR1 3HD, United Kingdom

6.0 Introduction

Kristina Åkesson, MD, PhD

Department of Clinical Sciences, Lund University, Malmö, Sweden; Clinical and Molecular Osteoporosis Research Unit, Skåne University Hospital, Malmö, Sweden.

Over recent decades, the many advances in science and technology have changed *what* is possible to achieve and *how* it can be achieved.

At the same time, our expectations and needs have changed, moving towards person-centered care and shared decision making. The global burden of disease has also shifted, with an increase in non-communicable diseases many of which are now chronic.

Beyond this are demographic changes, with proportionally more people living well into old age. Even if the majority remain healthy, this still represents a substantial musculoskeletal health risk with functional limitations throughout the life course. This includes the areas of back pain, joint diseases and fractures. This also leads to increasing demands on the health care systems and costs to the economy, warranting changes in practice to find better ways of providing high value care.

The use of innovations and trend toward digital solutions however, needs to be monitored in order not to distort delivery of care, which could decrease the opportunity for equity of care.

How are these needs and opportunities reflected in MSK care? In this chapter we give a series of case studies, highlighting the advantages, gaps and challenges.

6.1 Low back pain

Rachelle Buchbinder AO MBBS (Hons) MSc PhD FRACP FAHMS

Low back pain remains the leading cause of disability globally and in most countries of the world. According to the latest Global Burden of Disease Project estimates, it contributes 42.5 million years lived with disability or 7.6% of the world's disability burden [1]. This burden has increased by over 50% since 1990, disproportionately affecting low- and middle-income countries [2]. Working-age groups are most affected, which means that the economic burden of low back pain is also enormous.

Based upon studies performed in high-income countries these costs are also rising [2-4]. Low back pain accounts for the highest proportion of medically certified sick leave and early retirement in Europe [5]. Lower socioeconomic status and educational attainment are risk factors for both development of disabling low back pain and forced premature retirement due to chronic low back pain; contributing to social inequality and the poverty cycle [2, 6]. This is accentuated in poorer regions of the world where informal employment is common, there may be limited opportunities for modified work and there is non-existent or poorly managed occupational health and social support systems [2].

Despite these compelling data, global and national efforts to address the burden of low back pain remain suboptimal. As outlined in *The Lancet* series on low back pain, published in 2018 co-authored by 31 authors from 12 countries, over-medicalisation of low back pain has led to health care that is not only ineffective but potentially harmful, and this is true across all income settings [2, 7, 8]. Pervasive low-value practices include unnecessary imaging, care taking place in emergency settings, and liberal use of bed rest, electrotherapies, opioids, spine injections and surgery. Rather than declining, these practices are escalating in many parts of the world [9, 10].

There is a pervasive and deeply embedded culture that is resistant to de-medicalising the problem [8]. For example, despite consistent evidence to the contrary, the majority of patients believe imaging is necessary to get the best medical care for low back pain [11]. Many clinicians also believe this, particularly doctors with a self-reported special interest in low back pain [12]. Vested interests and perverse incentives that reinforce low-value care and discourage right care are rife, while fragmented and outdated models of care also contribute to the problem [9].

A harmonised systems approach that takes into account and addresses legal, administrative, social, political, clinical and cultural challenges is needed to address the burden of low back pain [9, 13, 14]. The *Lancet* call to action recommended that at the global level, the World Health Organization (WHO) should prioritise new public policies and urgent political action to ensure strategies are put in place to mitigate the global burden of low back pain as well as other musculoskeletal conditions [8]. Despite being among the most burdensome non-communicable diseases, only half of the Organisation for Economic Co-operation and Development member states make reference to musculoskeletal conditions [15]. Putting musculoskeletal health on the WHO target list could increase attention to these problems, and low back pain, together with other similar regional musculoskeletal conditions, should also be integrated into all chronic disease initiatives.

Public health education approaches that aim to simultaneously modify knowledge and attitudes of a large proportion of the community continues to show potential. A recent systematic review of mass media campaigns that included 18 studies, all conducted in high-income countries, found positive and

persistent effects on both societal and healthcare provider beliefs [16]. While the results were mixed in terms of effects on disability behaviour and health utilisation, the largest benefits were observed following a well-funded Australian campaign; it used television advertisements as the primary medium, had almost universal awareness of the messaging, and was supported by policy and legislation that encouraged remaining at work [17, 18]. Creative use of digital and social media platforms, particularly in low- and middle-income countries, are promising new avenues for public health interventions. Underpinned by the available evidence, these should carefully consider the local cultural and regulatory environment and barriers to behaviour change, and the health and economic effects should be rigorously evaluated.

Many health systems are not designed to optimise evidence-based care for low back pain [13]. Health systems and policy solutions that may address this include wiser use of funding and reimbursement drivers, more focused attention on implementation of best practice, reform of the education and training of health care professionals, better coordination between health and occupational care, and changes to clinical care pathways [7, 8, 13].

One strategy receiving increased attention is to change the first health care provider that a patient with low back pain sees. Retrospective analyses of claims data have consistently found important differences between the care that is received, depending upon the initial healthcare provider [19-21]. Compared with initially being seen in primary care, seeing a physical therapist or chiropractor first reduced the risk of imaging, surgery, and both early and long-term opioid use [19, 20]. On the other hand compared with primary care, seeing a physical medicine specialist first increased risk of receiving radiographs and advanced imaging, injections and surgery [19], while being seen in emergency or acute care facilities increased the risk of early opioid prescription. Initial care by pain management, anesthesia or physical medicine and rehabilitation providers increased the risk of long-term opioid use [21]. Several studies have now found that physiotherapist-led direct referrals or screening and management of patients on orthopaedic waiting lists reduces waiting times and results in greater patient and referrer satisfaction [22, 23], however further data are needed to determine whether they also improve patient outcomes and are cost-effective or cost-saving in comparison with usual care.

Some attempts to limit inappropriate imaging have met with success. For example, Baker et al reported a 37% reduction in x-ray requests by emergency physician doctors with use of a special requisition form [24], while a UK randomised trial of provision of short education messages on MRI reports reduced lumbar spine MRI requests by 23% [25]. Further trials are needed to determine whether changing the way in which imaging findings are reported, particularly the terminology used to describe age-related findings, likely of little clinical relevance, may also lead to less clinician and patient anxiety and the subsequent cascade of low value treatment.

Based upon the premise that healthcare professionals lack the confidence or skills to deliver guideline concordant care of low back pain including advice about self-management, training programs have now been developed in various countries such as New Zealand, Ireland and Denmark with promising early results [26-29]. Clinician-led initiatives such as Choosing Wisely which aim to identify and reduce low-value medical care have identified overuse of imaging for low back pain as a problem across many countries including the US, Canada, Italy, the Netherlands, Japan, Switzerland and Australia [30, 31], although as yet this has not translated in any significant decline in imaging rates [30, 32-34].

The guiding principles of Choosing Wisely recommendations are that they should be within or significantly impact a particular health professional specialist domain of practice, thereby creating impetus for behavior change within that specific group as well as other groups within their sphere of influence. They are also required to be based upon compelling evidence for change. Governments could

be examining these recommendations and changing health policies to support or even compel change. For example, following a recent Choosing Wisely Australia recommendation made by the Australian Faculty of Pain Medicine that patients with low back pain should not be referred for spinal fusion surgery [35], the Australian government narrowed the indications for publicly subsidised spinal fusion [36]. However medical association lobbying that claimed this was an inappropriately restrictive change, led to a partial retraction of the changes, demonstrating some of the challenges with disinvestment.

Another strategy that governments could employ is to conditionally approve new or unproven interventions pending evidence, as has been done in The Netherlands. For example, radiofrequency denervation for chronic back pain was conditionally approved, but later withdrawn when the Dutch government's commissioned trial demonstrated it provided no added benefits over a standardised exercise program [37]. National Clinical Care Standards are a relatively recent scheme for reducing unwarranted variation in care that complement clinical practice guidelines. Designed to encourage implementation of guideline recommendations in health care settings regardless of location, Standards focus on a small number of critical evidence-practice gaps for a particular clinical condition. They comprise a brief list of 'quality statements' that outline the care that patients should expect to receive and are accompanied by 'quality indicators' that enable monitoring of the quality of care. To date, only the UK [38] and Ontario Canada [39] have developed Clinical Care Standards for low back pain, and their effects on care and patient outcomes have not yet been reported.

There are many potential public health policy and health system solutions to the growing burden of disabling low back pain. While further evaluation of their effects is needed prior to their widespread application, political resolve will also be needed to realise large-scale improvements in medical care. Major challenges include the de-implementation and disinvestment from unhelpful practices, identifying the most cost-effective strategies for implementation of guideline-supported practice, and enforcing tougher policy decisions to reduce the unhelpful influence of industry and others.

6.2 Chronic MSK pain in LMIC (low and middle income countries) (spine care program)

Margareta Nordin Dr. Med. Sci, PT.

Musculoskeletal pain and spine pain affect the low-and middle-income countries in a substantial way. Low back pain (non-specific) may lead to inability to work, leading to poverty and affects the wellbeing of the family and thereby the community.

The largest increase in disability caused by low back pain in the past few decades have occurred in low- and middle-income countries. In Asia, Africa, and the Middle East, most countries are constantly challenged by infectious diseases and are poorly equipped to deal with the growing burden of disability caused by back pain [40].

In 2017, the World Health Organization launched the Rehabilitation 2030 initiative, highlighting the growing unmet need for rehabilitation worldwide, as a result of health and demographic trends, and calling for coordinated action amongst all stakeholders to prevent disability through low cost initiative based on evidence (<https://www.who.int/rehabilitation/rehab-2030-call-for-action/en/>).

In 2018 there was a call for change of paradigm for treatment of low back pain published in the Lancet and the European Spine Journal. These two large research groups; The Lancet Low Back Pain Series Working Group (3 publications) [2, 8] and the Global Spine Care Initiative (16 publications) [41, 42] pointed out the need for evidence based early treatment and a focus on prevention of disability for low back pain.

In 2018 the World Health Organization included musculoskeletal disease as a non-communicable disease as a priority for research and implementation of recommendations within the framework of the Basic Rehabilitation Package for the Health Workforce. These recommendations will be a World Health Organization resource that provides information on low-cost, high-impact and evidence-based interventions for rehabilitation that can be easily, safely and effectively delivered by existing workforce in primary health care and low-resource settings (<https://www.who.int/rehabilitation/rehabilitation-guide-for-action/en/>). In 2020 the World Health Organization invited an expert group for low back pain to provide recommendations by spring 2021 and thereby offering a change of paradigm focused on evidence based care for low back pain in low- and middle-income countries.

What will be the expected consequences?

It is estimated that around 1, 2 billion individuals or about 15% of the global population are affected by disability worldwide and growing. People with disabilities have generally poorer health, lower education achievements, fewer economic opportunities, and higher rates of poverty than people without disabilities [42]. This is largely due to the lack of services available to them and the many obstacles they face in their everyday lives. Disability affects disproportionately the women, the elderly, the rural communities, and the lowest income population. There for a host of actions is necessary, such as universal healthcare, access to care through primary care providers. Low back pain is the number 1 cause of disability according to the Global Burden of Disease [40].

Current evidence shows that many regions use secondary and tertiary care to manage low back pain. Globally, individuals with low back pain present to emergency or medical specialists, which are high cost; low back pain should be managed first in primary care for patient seeking care. Finally, public health is not adequately engaged in prevention of low back pain disability (Figure 1 A).

The expectations of implementing evidence-based recommendations for low back pain are that; the public health sector will be more engaged by providing public health education and exercise, the access to spine care will be enhanced, early care for low back pain will be evidence-based, while care will be a continuum and patient centered to prevent disability (Figure 1B).

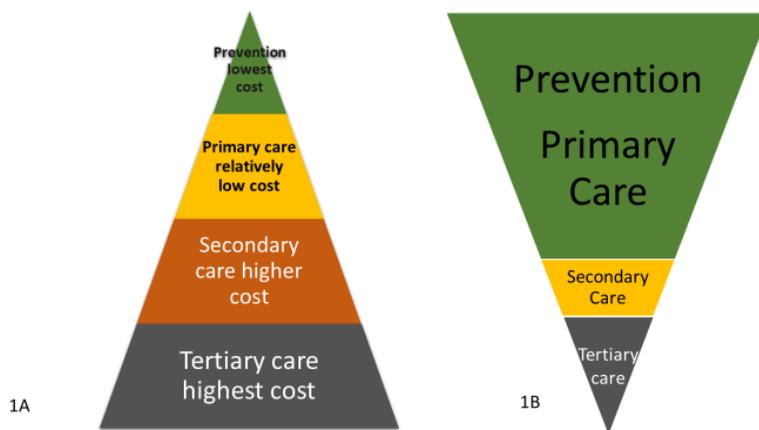


Figure 1A. Depicts current low back pain care in many countries where access to care is available. Figure 1B Depicts optimizing spine care based on evidence to prevent disability. Adapted from Johnson CD et al, The Global Spine Care Initiative: model of care and implementation. *European Spine Journal* 2018 27 (Suppl 6): S925-S945 [43]

The current evidence for public health initiatives are that exercise and education in combination have a moderate effect on the prevention of disability for low back pain [7, 44, 45].

Guidelines developed for high income settings were adapted by the Global Spine Care Initiative and the Lancet Back Pain Series to serve communities in low- and middle-income communities by considering factors such as costs and feasibility, benefits, harms as well as the quality of underlying evidence [7, 44]. It is important to adapt treatment to cultural availability, cost of interventions acceptability in the community and patient preference.

Treatment options for low back pain based on evidence for acute (≤ 3 months) and chronic (> 3 months) are depicted in Figure 2. These guidelines also point out the importance to involve the community and the use of a bio-psychosocial framework. The efficacy of these treatment is small to moderate.

Systematic reviews and guidelines low back pain

<ul style="list-style-type: none">• Treatment Acute \leq 3 months<ul style="list-style-type: none">• Patient education and reassurance• Stay active• Manipulation• Muscle relaxants	<ul style="list-style-type: none">• Treatment Chronic $>$3 months<ul style="list-style-type: none">• Structured education and reassurance• Exercise (Walking, yoga, patient preferences)• Manipulation or mobilization• Clinical or relaxation massage• NSAID drugs• Needle acupuncture• Multimodal (significant distress or disability)<ul style="list-style-type: none">a) Exerciseb) Cognitive/behavioral approaches
--	---

Figure 2: Evidence treatment for low back pain based on guidelines and systematic reviews. Adapted from Chou R et al: The Global Spine Care Initiative: applying evidence-based guidelines on the non-invasive treatment on back and neck pain in low- and middle-income communities. European Spine Journal (2018) 27 (Suppl 6): S851-S860 [44]

It is hoped that these recommendations will be adopted by the primary healthcare providers and thereby reduce disability from non-serious low back pain.

Future consideration

Musculoskeletal impairment and disability are increasing due to the aging population and lack of access to evidence-based care. Low back pain is a source of worry for the low- and middle-income communities. The recommendations to shift the responsibility to primary healthcare providers and to base treatment options on evidence can only yield positive results for the individual seeking care for low back pain. The massive effort of the World Health Organization for low back pain is commendable and will reach all member countries of the organization in 2021.

6.3 Joint pain (OA) management – NSAIDs to self-management

Michael V. Hurley

Chronic joint pain in older people, usually labelled osteoarthritis (OA), impact all aspects of people's personal, social and working lives, resulting in enormous health and social care expenditure [46, 47], that are increasing rapidly [48, 49]. Despite its prevalence joint pain is managed poorly. Current care pathways can be unnecessarily complicated, costly, inefficient, disjointed and delay, even prevent, people accessing appropriate, timely treatment [50-53]. Management guidelines recommend exercise and maintaining healthy body weight as cost-effective ways to improve pain, mobility, physical and mental wellbeing [50-56]. Unfortunately, GPs receive little training in promoting and supporting lifestyle changes, and these cannot be conveyed in a 12-minute consultation [52, 57, 58]. Most people are maintained on long-term analgesia, despite this having limited effectiveness, unpopular [59], expensive [60] and risks serious side-effects [61-63], and joint replacement has limited availability and is contra-indicated in many older people. Few people receive advice about self-management and importance of participating in regular physical activity and maintaining a healthy body weight.

This has led to new ways of delivering high quality effective, efficient care [64, 65] for people with uncomplicated musculoskeletal conditions [66-68], by-passing the delay and cost of unnecessary primary or secondary care physician referral, instead led by allied healthcare and other professionals [59, 66, 69, 70]. These include *telephone helplines* [71], *specialist help in primary care and first contact practitioners* [72-74], *patient initiated appointments* [75] and *self-referral to physiotherapy* [76]. Such innovative schemes can improve timely access to more appropriate management.

Once in the system effective, rehabilitation programmes based on the “biopsychosocial model” of healthcare can help people appreciate what they can (not) and what they should (not) do for themselves, promoting active self-management. Biopsychosocial healthcare considers ill-health to be a complex interaction of the physiological, psychological and socioeconomic sequelae of health problems [77-79]. It places great importance on the influence of people's health beliefs, experiences, emotions, social networks and external environment on their reaction to ill-health and subsequent behaviour. It compels us to deliver health care that address people's holistic needs, to help them understand why and how they can manage their problems, by adopting lifestyles that minimise its affects and maximise their ability.

Effective rehabilitation programmes of this type exist. *Enabling Self-management and Coping with Arthritic Pain using Exercise (ESCAPE-pain)* [80-82] and *Joint Pain Advice (JPA)* [66, 70] integrate information-giving, advice, support to change behaviours and exercise participation. They help people understand their problem better, dispel erroneous health beliefs, advise them what (not) to do and experience the benefits of exercise on their physical, mental and emotional wellbeing. Participants learn that adopting healthy lifestyles (physical activity, weight control) are self-management strategies they can use to control their symptoms. They become more self-reliant, confident, positive and optimistic. Such programmes are more effective, efficient and sustainable ways of helping the large numbers of people help themselves to control chronic joint pain.

Unfortunately, such programmes have traditionally been delivered by healthcare professionals in healthcare facilities. Given the logistic and financial constraints of healthcare systems, seriously limit the number of people that can be “reached” and benefit. Moreover, without sustained support, people

stop exercising and short-term improvements are lost. Long-term support cannot be provided by healthcare systems. Other ways of maintaining adherence to regular exercise need to be established in order to sustain its benefits.

To address these limitations, we have delivered *ESCAPE-pain* in leisure and community venues led by exercise professionals, avoiding the need for limited, costly healthcare facilities and professionals. In addition, this de-medicalises joint pain that people accept as a normal part of life and ageing, they get used to attending non-medical establishments and community organisation that can put in place additional ways to support people in their local community after completing the programme. Consequently, healthcare commissioners are now commissioning *ESCAPE-pain* outside hospitals led by other professional groups.

Similarly, *JPA* can be delivered by a range of professionals (clinicians, health trainers, social prescribers, community pharmacists, occupational health), in a range of clinical and community settings [66, 70]. It may be particularly useful delivered in workplace settings to address the enormous problem of lost productivity, presenteeism and absenteeism caused by chronic knee, hip and back pain.

Interventions like *ESCAPE-pain* and *JPA* require people to attend healthcare or community facilities. This precludes people if an intervention is not running near them, and in rural, isolated communities. The recent Coronavirus pandemic brought these issues into much sharper focus and more important. COVID-19 disproportionately affected older people who were forced to socially isolate, exposing them to the consequences of prolonged inactivity and social isolation and group interventions were prohibited. We worked with clinicians and exercise professionals to adapt *ESCAPE-pain* so that some centres delivered the programmes online. Feedback has been mixed. Some centres successfully recruited people and delivered “online-programme”. Others have reported difficulties with recruitment, technical problems (equipment, no/poor reception), issues for disadvantaged groups (language, technical understanding and ability and access, social deprivation, cognitive impairment in the elderly). It is not always a cheaper option as providers still need to provide a room or studio to deliver from, facilitator’s time, technical equipment and support. Moreover, we do not know if the virtual programme is as effective as the face-to-face programme, which enables participants to socialise with their peers and is considered vital to its success. However, the success of some centres demonstrates these types of interventions can be delivered online, and could enable people currently excluded to access the programme. Although there are many challenges, online/remote/virtual/tele-interventions are likely to become more common.

To help the already large and increasing number of people with joint pain who require help, advice and on-going support, we need to rethink and redesign the way we deliver effective care. This can be achieved if we utilise a range of professionals to deliver evidence-based programmes that deliver information, advice, supported self-management and exercise, and help them sustain the benefits in their local communities. This would revolutionise care of people with joint pain, making it better, more accessible, more effective and more efficient.

6.4 Orthopaedic surgery – changing role and technical advances – ~~spine and joint~~

Søren Overgaard

Orthopaedic surgery including traumatology has developed dramatically during the last decades. Most departments have developed into very efficient units with short lengths of stay. Day surgery for hip and knee arthroplasties is routine in many clinics. Moreover, new technologies have emerged, giving more possibilities for patient treatment. The volume of new information, scientific publications and new technology are increasing rapidly. This challenges the orthopaedic surgeon, both in selecting the right treatment for each patient and especially the evidence for applying that treatment. Several other challenges will emerge in the future, including an increased demand for health care services, the reason that a change in practice may be required. Moreover, diversity is warranted in orthopaedic surgery and traumatology.

Increasing demand for health care service

In many parts of the world the elderly population will expand due to the greying of the baby boomers and to longer life expectancies. It is estimated that a variety of surgical procedures within degenerative joint diseases of spine, hips and knees will increase significantly. Forecasts indicate increasing numbers of total knee replacements; depending on forecast model, increases of 143% and up 855% in volume are projected in 2050 compared to 2012 [83].

This increase is explained partly by more elderly people, but also, change in indication for surgery as shown by registry data - especially in the younger age groups and in the 90+ age group. In trauma, the number of proximal femoral fractures is expected to increase by a factor of 2-3 particularly in Asia [84]. Although a small decrease in age and sex specific incidence has been identified in some countries, this may not have any significance on the total numbers world-wide.

In contrast to osteoarthritis and traumatology, surgical treatment of patients with rheumatoid arthritis within the area of total knee (TKA) and hip arthroplasties (THA) has decreased during the last decades and this trend is expected to continue [85].

Stakeholders demand

Patients are becoming more demanding, expecting high activity level and better quality of life for a longer time period than ever before. Hence there is a societal demand to do something, and often a joint replacement. This may also play a role in the demand for short waiting lists which, will in turn increase the demand for surgery. Thus, there is a need for change in practice, in order to keep up with an otherwise increasing demand, since every surgical procedure has a risk of complication and the health care system has a limited capacity.

Change in practice

Non-surgical treatment. In recent years, the focus has been on effect of non-surgical treatments for degenerative joint diseases but also patients with fractures. There is evidence that training may play a role in treatment of more early stage knee osteoarthritis [86]. A more systematic approach may delay the need for a surgical procedure and in the future should be applied before surgery is considered.

Regarding trauma cases, proximal humerus and clavicle fractures have successfully been treated non-surgically which has in part, changed practice [87].

At present, there seems to be no pharmaceutical treatment of degenerative diseases, but if or when this changes, it will revolutionize the health care system and treatment of patients suffering from osteoarthritis.

Shorter stay in hospital. Same-day discharges following THA and TKA have become feasible during recent years. It is reported to be safe in selected cases, especially in patients younger than 80 years not living alone. There is a need for education of patients and health care providers to make a success of this. Shorter stay in hospital within other patient groups is also needed - for better treatment of the patients but also because hospitals of the future are built with fewer beds.

Specialisation. Orthopaedic surgery is specialized into trauma, hand, shoulder-elbow, spine, hip, knee, foot and ankle, infection, tumour surgery and sports. In many countries, specialisation means that the majority of surgeons do only one or two sub-specialities. This trend had the aim of increasing treatment quality. Specialisation has been one of the drivers in moving towards more patient-specific treatment, such as patient-specific implants.

More possibilities are emerging. These will encourage surgeons to try new techniques in the future which will challenge the health care system, as they are likely to be much more expensive. Robotic surgery may emerge, similarly custom made implants and 3D printing for surgical planning; and there is a need to validate these new techniques before taking them into routine practice. As in many other specialties, artificial intelligence and machine learning may develop within orthopaedics, with a good basis for this due to the existence of many big databases, for example joint replacement.

Diversity

There is also a need for diversity and harmonisation, including attracting all genders to the orthopaedic speciality. More women are needed in orthopaedic surgery, but the specialty has to be attractive to them.

Diversity is also expressed through variation in treatments. Although that we have the same knowledge around the world, there is a large variation in treatments between countries and even between regions in countries. This is explained by the existence of few evidenced-based studies to demonstrate which techniques or procedures are most effective, such that patients rely on the advice and preference of their individual physician and surgeon; leading to discrepancies between practice patterns and utilization. The need to harmonize is clear, but may be challenged by differences in cultures, traditions, and health care systems.

Future perspectives

To meet future requirements in orthopaedic surgery there is a need for continuous medical education; which should ensure basic knowledge to prevent complications, such as infections. Research into preventing osteoarthritis and use of non-surgical treatment are of utmost importance, otherwise the numbers for surgery will overload capacity. Too long waiting lists are already the scenario in many countries. Moreover, the incentive to not perform surgery may be more balanced in the future. The payment system, even in public health care systems, encourages surgeons to perform surgery.

If there is no change in treatment practice, a clear increase in numbers of nurses, physicians and surgeons, and the production system itself, will be required to give the same health care service as today. Increases in the cost of health care will be evident.

The need for evidence based treatment may be even more demanded and demanding in future. This is to ensure safety, efficient treatment and judicious use of healthcare resources, thus more clinical research is warranted.

6.5 Post-fracture management – Fracture Liaison Services Taiwan

The fragility fracture care gap in Taiwan and Fracture Liaison Service (FLS) in National Taiwan University Hospital healthcare system

In the 21st century, osteoporotic fractures have become a serious public health crisis due to rapid population aging. Osteoporosis is characterized by decreased bone mass and disrupted bone architecture, resulting in increased bone fragility fracture risk [88].

In Taiwan, the lifetime fracture risk of vertebrae, hip, or wrist is 33% and 20% in women and men, respectively. Furthermore, the 1-year mortality rate after hip fracture was 11% and 18% in women and men, respectively, in 2009 [89]. However, despite the high burden of fragility fracture, only one-fourth hip fracture patients underwent bone mineral density (BMD) assessment [90]. Moreover, only about 15% of male and one-third of female osteoporosis patients in Taiwan received anti-osteoporosis treatments around 10 years ago [91]. Fracture liaison service (FLS), a coordinated program to prevent further fractures, has been shown to improve BMD testing rate, medication initiation rate, adherence, overall survival, and decrease re-fracture rate significantly [92].

In 2014, National Taiwan University Hospital (NTUH) was the first health care institute to establish an FLS program in Taiwan. Here, we would use the NTUH model to exemplify the backbone structure of FLS programs in Taiwan [93].

In this model, newly diagnosed hip fracture patients in orthopedic ward (Group A), unrecognized vertebral compression fracture patients from the geriatrics ward, (Group B), and clinic vertebral compression fracture patients (Group C) were enrolled from outpatient clinics. (Figure 1)

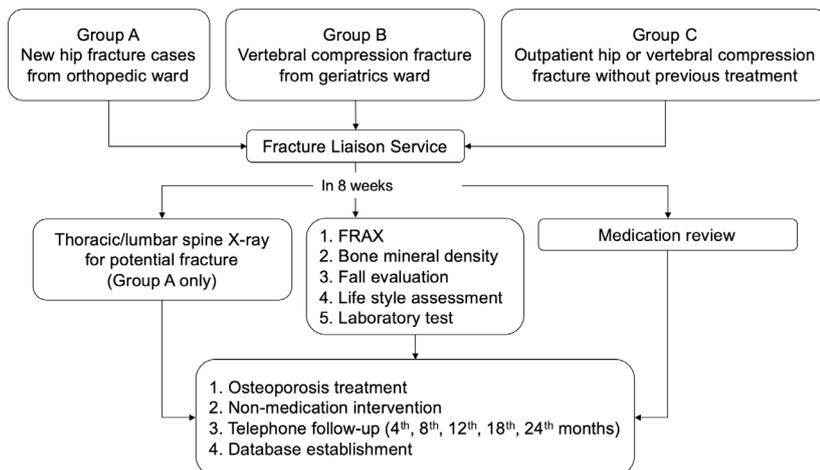


Figure 1. Flowchart of NTUH FLS program enrollment and interventions [93]

Based on this protocol, enrolled cases receive multifaceted evaluation including 10-year fracture risk assessment, BMD assessment, fall risk assessment when appropriate, lifestyle evaluation, and laboratory tests for secondary causes of osteoporosis. Furthermore, if the patient has been receiving medication for osteoporosis, the reviews for side effects, dosage, interaction, compliance, and contraindications were incorporated. Medications were initiated or modified after assessment. Regular telephone follow-ups and frequent communications between care coordinators and patients were provided.

FLS network development in Taiwan

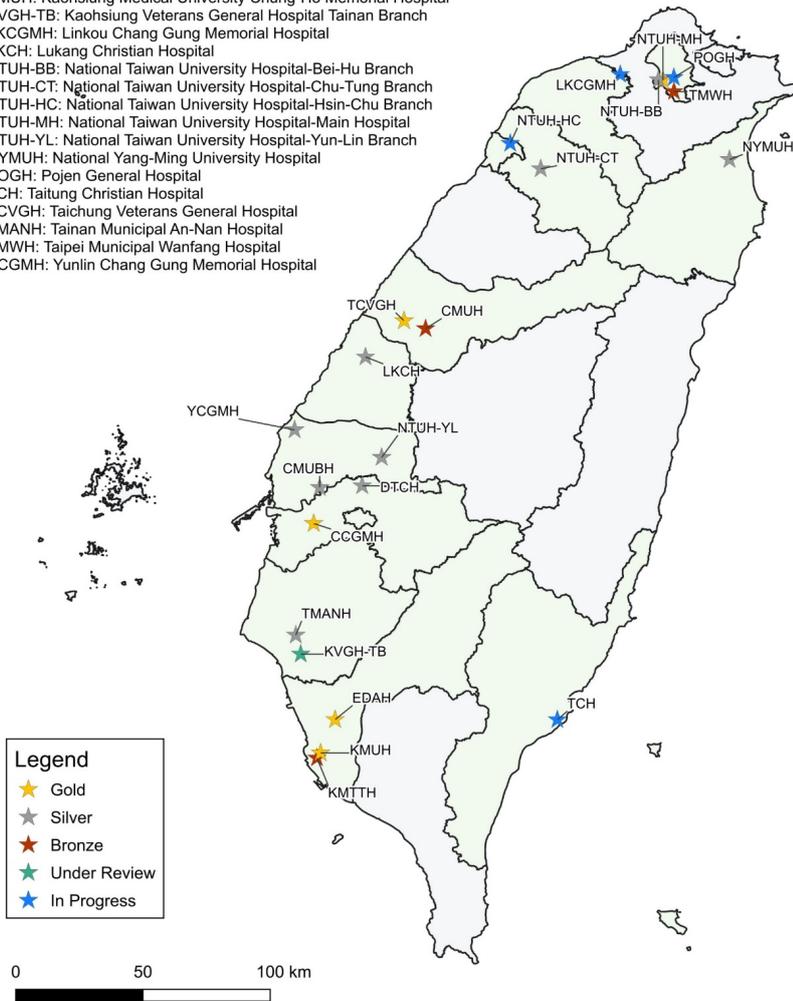
Since 2014, the number of new FLS programs has grown rapidly across Taiwan, and these programs now cover osteoporosis patients nationwide. The Taiwan Osteoporosis Association (TOA) has hosted multiple workshops to facilitate the establishment FLS in the national scale from 2016. Furthermore, the TOA encourages health care institutions to apply for Best Practice recognition from International Osteoporosis Foundation (IOF). As of March 2020, 21 FLS programs accredited on the Map of Best Practice as gold (5), silver (9), bronze (3), under review (1), and in progress (3), were included on the Capture the Fracture (CtF) website (<http://capturethefracture.org/map-of-best-practice>) [94]. (Figure 2)

Since some cultural aspects were not well addressed in the original Best Practice Framework, some of the framework components might be difficult to implement in the Asia-Pacific region. Therefore, the TOA gathered domestic and international experts to develop the “Consensus on Fracture Liaison Service Best Practice Standard in the Asia-Pacific Region” in 2017 to modify the guideline to be more applicable in the AP region [95]. The TOA was awarded the Best Secondary Fracture Prevention Promotion at the 2017 World Congress on Osteoporosis, Osteoarthritis and Musculoskeletal Diseases (WCOESCO) held in Florence. In 2019, TOA was also granted the best World Osteoporosis Day Campaign at the WCOESCO for FLS promotions. Taiwan may have one of the highest densities of FLS programs in the AP region, considering the population size (approximately 23.6 million in 2019) [96].

Field Code Changed

CCGMH: Chiayi Chang Gung Memorial Hospital
 CMUBH: China Medical University Beigang Hospital
 CMUH: China Medical University Hospital
 DTCH: Buddhist Dalin Tzu Chi General Hospital
 EDAH: E-Da Hospital
 KMTTH: Kaohsiung Municipal Ta-Tung Hospital
 KMUH: Kaohsiung Medical University Chung-Ho Memorial Hospital
 KVGH-TB: Kaohsiung Veterans General Hospital Tainan Branch
 LKCGMH: Linkou Chang Gung Memorial Hospital
 LKCH: Lukang Christian Hospital
 NTUH-BB: National Taiwan University Hospital-Bei-Hu Branch
 NTUH-CT: National Taiwan University Hospital-Chu-Tung Branch
 NTUH-HC: National Taiwan University Hospital-Hsin-Chu Branch
 NTUH-MH: National Taiwan University Hospital-Main Hospital
 NTUH-YL: National Taiwan University Hospital-Yun-Lin Branch
 NYMUH: National Yang-Ming University Hospital
 POGH: Pojen General Hospital
 TCH: Taichung Christian Hospital
 TCVGH: Taichung Veterans General Hospital
 TMANH: Tainan Municipal An-Nan Hospital
 TMWH: Taipei Municipal Wanfang Hospital
 YCGMH: Yunlin Chang Gung Memorial Hospital

Figure 2. FLS



programs established in Taiwan until March 2020.

FLS outcome from Taiwan experience

In the NTUH FLS program, Chao et al. have demonstrated that among FLS participants, advanced age and comorbidities (e.g. chronic kidney disease, heart and neurologic disease, cancer, osteoarthritis, and diabetes) predicted a lower probability of short-term recovery, worse 2-year survival rate, and a higher

risk of falls [97, 98]. On the other hand, markers of good nutrition, such as higher body mass index and serum albumin levels, correlated with lower mortality. If the patient has comorbidities affecting dietary protein intake (e.g. in chronic kidney disease patients), nutrition is an even more crucial factor and should be suitably addressed.

Conclusion

The development of FLS in Taiwan is still dynamic and the coordinated care model has been shown to benefit patients in the long term. The sustainability and distribution of the FLS program can be further improved if the programs are incorporated into National Health Insurance system and provide aid to more patients in need.

6.6 Rheumatoid arthritis – from DMARDs to biologics, from palliation to control and onto cure

Anthony Woolf

Changes in the management and outcome of Rheumatoid Arthritis

Rheumatoid arthritis has changed. 40 years ago, it was a chronic, progressive disabling disease with significant systemic features and no effective treatments that significantly modified the outcome. It was characterised by a variety of extra-articular manifestations such as weight loss, chronic anaemia, rheumatoid nodules, sicca syndrome, amyloid and vasculitis including indolent leg ulcers. Cervical myelopathy was seen due to atlanto-axial subluxation resulting from joint damage. Significant disability was considered inevitable, and there was increased mortality related to the various extra-articular manifestations and increased risk of infections. Although there were a range of disease-modifying anti-rheumatic drugs (DMARDs) in use there was little evidence that they changed the long-term course of disease and they were often used late and sequentially for limited periods of time because of side effects or lack of efficacy. Now it is a disease that can be effectively controlled in many people and, if from an early stage, it has a limited impact with people able to participate in the activities they want to and need to. Many extra-articular manifestations are seldom seen. This has come about not from changes in the epidemiology or pathogenesis of the disease but from better therapeutic agents based on a scientific understanding of the molecular and regulatory mechanisms of the disease, its epidemiology and much improved strategies for how to use these treatments. This has been supported by the development of better measures of disease activity and measures of disease impact that are relevant to people with rheumatoid arthritis.

In 1997, when this publication first considered early rheumatoid arthritis [99], joint damage was often already evident at diagnosis which was usually late. Disease activity was monitored but inconsistently with no clear strategy. The aim was to learn how to identify those with a poor prognosis and then treat aggressively, with the benefit of methotrexate having been shown to be an effective disease modifying agent. Various early arthritis cohorts were followed to understand prognostic factors [100, 101] and to investigate the aggressive use of combination therapies. The ability to perform large multicentre studies such as the COBRA study [102], along with the benefit of better ways of assessing disease activity and the outcome both in terms of radiographic damage and function [103] not only identified effective interventions but also led to a better understanding of how to use them to most effect. The scientific community committed itself to make rheumatoid arthritis a curable or at least a suppressible disease rather than accepting just trying to modify it. The use of the term ‘disease modifying drugs’ reflected the lack of ambition.

Having more effective interventions has been pivotal. As the pathophysiology of rheumatoid arthritis was becoming more clearly defined, biotechnological advances were putting forward candidate biologic interventions which were investigated in animal models followed by clinical trials which in the 1990’s were beginning to show exciting data for monoclonal antibodies against anti TNF α [104]. Methotrexate was shown to be effective at reducing disease activity in the 1980s [105] and soon found to be more effective and better tolerated enabling longer term use in the 1990s resulting in improved long-term outcomes. The addition of a range of very effective biologic agents has greatly increased therapeutic options which are widely available, although access is limited by cost.

Knowing how to use these new effective agents is equally important and the early arthritis cohort studies showed it was difficult to predict with any certainty who would do well and who would do badly. This led to the thinking of treating everyone with the disease as early as possible. The concept of inverting the pyramid and treating aggressively with combination therapies as early as possible came from studies such as COBRA – a large multicentre long-term study with multiple treatment arms [102]. If the goal was to suppress the disease, then measures were needed to evaluate this. Previously the aim was to make people better but the change in ambition was to make them good and aim for remission [106]. This was supported by the standardisation of endpoint measures for clinical trials by OMERACT [107], the European League Against Rheumatism (EULAR) and the American College of Rheumatology (ACR) and gaining general support through the community working together. The development of an absolute measure of disease activity - the DAS (Disease Assessment Score) and response criteria [103] supported the development of the strategy of treating to a target [108] to achieve remission. A patient centred approach has long been taken in the management of rheumatoid arthritis considering function, with the development of AIMS [109, 110] and these measures have been further refined with the focus on patient relevant outcome measures [111].

A strategy to treat early and aggressively to achieve a target of remission faced the barrier of the early diagnosis and a different approach to diagnostic criteria changed thinking to the early identification of those with a probability of a poor outcome with new EULAR / ACR diagnostic criteria [112]. This was supported by identifying anti-cyclic citrullinated peptide (anti-CCP) as an early indicator of poor prognosis [113] and the use of ultrasound to identify synovitis [114].

Embedding such changes in everyday clinical practice is a challenge, with novel therapeutic agents but also different ways of using them. There are also implications for how care is delivered, with the move to early diagnosis and close monitoring of disease activity. It was recognised in 1997 that changing practice in the management of RA needed to be supported by guidelines that provided explicit recommendations on the most effective management in the light of scientific evidence [108]. This matched the new focus on evidence-based medicine and also the need to be demonstrate the cost-effectiveness of any treatment strategy if one wants it to be implemented by healthcare systems, with the development of quality-adjusted life years to enable the impact of different diseases to be compared.

In all these advances, a global collaborative approach by the whole rheumatology community – clinicians, clinical researchers, scientists and people with personal experience of RA – has been a powerful driver.

Although disease activity and outcomes have been shown to be different in populations around the world related to availability and access to treatments [115] with a relationship to national gross domestic product [116], overall there has been an improvement of outcomes across the globe. However, these differences highlight key issues of availability, accessibility, affordability - all key components of universal health coverage [117]. Important factors are ensuring people are diagnosed early and have timely access to appropriate management. This means getting timely access to the right level of competency within the healthcare system which is a barrier in many countries. It also needs a change in expectation of people with rheumatoid arthritis and for them to seek appropriate care at the onset of their symptoms to achieve remission – an important role for advocacy and public education.

Changes in services for the management and support of people with RA

The changes in the management of RA and in the co-morbidities and disability now seen along with changed expectations of healthcare has consequences for how health care systems provide care at the micro and meso level as well as what is required at the policy level, both now and in the future.

Previously, chronic disabling nature of RA with extra-articular features and associated with major long-term physical disability but without effective treatments resulted in a multidisciplinary palliative and rehabilitative approach to manage the disease and its consequences, along with a therapeutic approach in an attempt to control it. This brought together rheumatologists, physiotherapists, occupational therapists with the support of orthopaedic surgeons, podiatrists and other specialties to help manage extra-articular manifestations. Rheumatologists were involved in the rehabilitation of patients along with disease management and care was often in-patient based. Supporting people with RA and helping them help themselves has long been a priority, with education, self-management programmes and the third sector providing information and support. Specialist nurses to educate support patients were introduced and the expert patient programmes were first developed to enable people with RA to self-manage [118]. People with RA clearly stated what they expected from health care systems to support them [119]. Person-centred integrated care and shared decision making has long been embedded in care pathways. What service was needed to deliver this in Europe was defined [120].

With the focus on achieving remission and the reduction in disease-related joint damage, few severe extra-articular manifestations and reduced impact on individuals when disease control or remission is achieved, the services needed and how they are delivered have changed. The focus is on monitoring disease activity and adjusting treatment as needed. This can be done in ambulatory care with possibilities of remote monitoring and there are few dedicated inpatient facilities. This is along with general changes in how long-term conditions are managed, and there are now few dedicated in-patient rheumatology facilities. The need for rehabilitation and joint replacement surgery is also less, but there is a greater need for education and support to enable the person to actively participate in the management of their disease. It is more challenging to take an integrated approach if the team is not working together in a hospital facility and specialist rheumatology nurses provide the anchor for people with RA in some countries with a major role in patient education and are often supporting disease management through monitoring disease activity. The third sector remains an important source of information and support but done largely through help lines and the internet, rather than face-to-face support groups.

The needs of people with RA have not changed, however. Although it can be better controlled, there is not a cure and many people still have limits on their participation in everyday life, including work [121]. The standards of care for what people with RA should expect to receive and health-care quality indicators that measure whether the health services are delivering them have been established in Europe to improve access to appropriate care and outcomes [122, 123] and still identify the need for treatment, pain management and rehabilitation.

The change in delivery of health care at the present time in response to the Covid pandemic has accelerated the introduction of e-health and remote monitoring and support of people with RA and few face-to-face interactions. This may be an advance, but some aspects of care and support may be missed and it may increase inequalities of care and outcome. This needs to be carefully evaluated.

What is needed to deliver current strategies for the management of Rheumatoid Arthritis

Health systems need to deliver the most cost-effective strategies that also meet the needs and wishes of people with RA. There is greater awareness by many of what can be achieved. Cure is the ultimate

goal but achieving remission is a realistic target for many if diagnosed early before irreversible damage has occurred.

Any health system must therefore enable early diagnosis; treatment to target; support people's active participation in their care; manage any co-morbidities; and meet their functional expectations and needs including enabling to stay in work. There are health-care quality indicators developed in Europe [122] that reflect what should be provided and achieved. This needs a workforce fit for purpose taking a person-centred integrated approach as well as equitable access to modern therapeutic agents. With the challenges of greatly different resources, both economic and human, between high-, middle- and low-income countries, the improved opportunities and outcomes for many also exacerbate the disparities that exist and need to be addressed through ensuring universal health coverage includes equitable access to modern therapies for rheumatoid arthritis.

6.7 Delivery of health care – innovative models and e-health

Leif E Dahlberg, Håkan Nero

Traditionally, health care is delivered by a number of face-to-face meetings to obtain patient history and perform examinations to finally establish a diagnosis and eventually start treatment. This praxis, in spite of seeming rational by patients and health care professionals, needs to be reconsidered in light of shrinking healthcare resources combined with increasing needs and public demands.

Chronic diseases use some 80% of healthcare resources and half of the population in the western world has at least one chronic condition. The need for continuous and frequent treatment to handle chronic conditions, not the least during pandemic conditions when unnecessary exposure to the virus should be avoided, makes it obvious that the present way of delivering health care is not compatible with future needs and demands.

The question is whether it is possible to establish a diagnosis, in order to start treatment, by other means while still reaching similar outcomes, treatment risks and costs. We suggest that it is a myth, related to old tradition and routine, that a face-to-face meeting is always necessary. The patients are well aware of their body symptoms and can, most of the time, give conclusive answers to correct questions. Still, it is always possible in situations of uncertainty, to see the patient face-to-face in a traditional care setting. For example, Teladoc refers 1% of their telehealth patients. With the use of algorithms, patients can be optimally triaged even before meeting with any health care professional.

Telehealth was first developed in areas outside MSK. Studies show significant HbA1c reduction, continued weight loss and reduced cardiovascular diseases using privately developed e-health solutions in diabetes care [124, 125]. In relation to MSK, several peer reviewed studies are now available on the effectiveness of digital delivery of OA management by new e-health technology platforms [126-130]. Treatments, including management of osteoarthritis of the knee and hip as well as low back pain, show clinically relevant improvements in pain and function. The most costly procedure of osteoarthritis of the knee and hip is total joint replacement. A notable finding with respect to osteoarthritis of the knee and hip is that after continuous participation in a telehealth program, patients decrease their willingness for surgery.

Another issue to consider is that, regardless of how relevant and adequate the information in the telehealth solution, to be used it needs to be appreciated by the users. In this respect the authors can provide information from a Swedish treatment platform for OA. This digital solution is an application available in iOS and android. Qualitative studies support that patients find the application beneficial and easy to use. It has been developed in close relationship to the users, in order to fulfill expectations from the patients and physiotherapists. One of the databases also shows a NPS of 55 which is considered very high (Net Promoter Score (-100-+100) is calculated by subtracting the percentage of customers who answer the NPS question (0-10) with a 6 or lower (known as ‘detractors’) from the percentage of customers who answer with a 9 or 10 (known as ‘promoters’) [128]. Questionnaires answered by the physiotherapists using the application show that they find the application easy to use and that they can handle patients more efficiently. Finally, patients rate their support by the physiotherapists 4.5 on a scale of 1-5.

Besides the possibility of reaching a high level of satisfaction if the digital application is designed in a patient friendly manner, by using telehealth there is no need for transportation to a facility, and treatment can thereby be done whenever it fits into each patient's schedule. Notably, remote locations around the globe can equally access telehealth. Likely explanations for the impressive results of some of these digital platforms is the ease of access to individualized treatment, engagement, support and nudging from a licensed healthcare professional, together with high daily treatment adherence facilitated by the digital nature of the program.

In conclusion, most patients with MSK conditions can be diagnosed and treated by a telehealth solution. With results that are similar or better compared to traditional care, seemingly without risk and at a lower cost, this suggests that telehealth will grow exponentially in the coming years; not least since people will most likely seek to continue using these services even after the pandemic subsides. Further confirmation is to be presented in future studies.

Disclosure statement

LED is co-founder and CMO of Joint Academy

HN is Head of Research and Science at Joint Academy

6.8 Discussion

Advances in delivery of health care for MSK conditions has been extraordinary, for some conditions, over the past decades, whereas for others much more is needed as this chapter highlights. Musculoskeletal pain is still one of the greatest challenges, reducing the quality of life for those affected whether from back pain, joint pain or from other regions of the musculoskeletal system. Encouraging inroads to improved management are, however, on their way. Surgical and technological advances are closely linked with advances in other areas of medicine; allowing surgical intervention at much greater ages, leading to greater independence and mobility. This is true both for degenerative conditions and fracture treatment. Better treated fractures, particularly fragility fractures, requires appropriate post-fracture care to reduce the risk of recurrence, a serious threat to better health in the older person. The paramount advances in management and treatment of RA has vastly reduced the need for surgical procedures, with biological treatments contributing to a huge shift and the possibility for remission in an otherwise potentially severely disabling condition.

Delivery of medical care has changed rapidly during the past year with the Covid-19 pandemic and changes, that otherwise would take years if not decades, have been introduced rapidly. Digital patient visits and other digital modes of delivering care are likely to be a normal part of future medicine.

Practice Points

- Standardized care pathways focusing on the individual are the most patient-, system- and cost-effective mode of delivering high value care, whether pharmacological, surgical or preventive.
- Standardized care pathways require an integrated multi-professional approach; everyone around the table has the same aim – what will be best for the patient(s).
- New management models and treatment modalities, including new technology, requires appropriate evaluation prior to implementation, through standardized health technology assessment.
- New management models must consider all ages, all cultures, all economies in addition to available competencies to ensure the best possible access and outcome across the life course.

Research Agenda

- Systematically collected real-world data is needed to demonstrate effectiveness from any new ways of delivering care.
- Studies of patient-perception on new ways of delivering care will be essential for appropriate health care development, to ensure quality and acceptability.

Chapter 6 Bibliography

1. 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(10100):1211-59.
2. Hartvigsen J, Hancock MJ, Kongsted A, Louw Q, Ferreira ML, Genevay S, et al. What low back pain is and why we need to pay attention. *Lancet*. 2018;391(10137):2356-67.
3. Lambeek LC, van Tulder MW, Swinkels IC, Koppes LL, Anema JR, van Mechelen W. The trend in total cost of back pain in The Netherlands in the period 2002 to 2007. *Spine*. 2011;36(13):1050-8.
4. Dieleman JL, Cao J, Chapin A, Chen C, Li Z, Liu A, et al. US Health Care Spending by Payer and Health Condition, 1996-2016. *Jama*. 2020;323(9):863-84.
5. Bevan S, Quadrello T, McGee R. Fit for work? Musculoskeletal disorders in the European workforce. 2009 18 Sept 2009.
6. Schofield DJ, Callander EJ, Shrestha RN, Percival R, Kelly SJ, Passey ME. Labor force participation and the influence of having back problems on income poverty in Australia. *Spine*. 2012;37(13):1156-63.
7. Foster NE, Anema JR, Cherkin D, Chou R, Cohen SP, Gross DP, et al. Prevention and treatment of low back pain: evidence, challenges, and promising directions. *Lancet*. 2018;391(10137):2368-83.
8. Buchbinder R, van Tulder M, Öberg B, Costa LM, Woolf A, Schoene M, et al. Low back pain: a call for action. *Lancet*. 2018;391(10137):2384-8.
9. Downie A, Hancock M, Jenkins H, Buchbinder R, Harris I, Underwood M, et al. How common is imaging for low back pain in primary and emergency care? Systematic review and meta-analysis of over 4 million imaging requests across 21 years. *Br J Sports Med*. 2020;54(11):642-51.
10. Martin BI, Mirza SK, Spina N, Spiker WR, Lawrence B, Brodke DS. Trends in Lumbar Fusion Procedure Rates and Associated Hospital Costs for Degenerative Spinal Diseases in the United States, 2004 to 2015. *Spine*. 2019;44(5):369-76.
11. Jenkins HJ, Hancock MJ, Maher CG, French SD, Magnussen JS. Understanding patient beliefs regarding the use of imaging in the management of low back pain. *Eur J Pain*. 2016;20(4):573-80.
12. Buchbinder R, Staples M, Jolley D. Doctors with a special interest in back pain have poorer knowledge about how to treat back pain. *Spine*. 2009;34(11):1218-26; discussion 27.
13. Traeger AC, Buchbinder R, Elshaug AG, Croft PR, Maher CG. Care for low back pain: can health systems deliver? *Bulletin of the World Health Organization*. 2019;97(6):423-33.
14. Loisel P, Buchbinder R, Hazard R, Keller R, Scheel I, van Tulder M, et al. Prevention of work disability due to musculoskeletal disorders: the challenge of implementing evidence. *J Occup Rehabil*. 2005;15(4):507-24.
15. Briggs AM, Persaud JG, Deverell ML, Bunzli S, Tampin B, Sumi Y, et al. Integrated prevention and management of non-communicable diseases, including musculoskeletal health: a systematic policy analysis among OECD countries. *BMJ Glob Health*. 2019;4(5):e001806.
16. Suman A, Armijo-Olivo S, Deshpande S, Marietta-Vasquez J, Dennett L, Miciak M, et al. A systematic review of the effectiveness of mass media campaigns for the management of low back pain. *Disabil Rehabil*. 2020:1-29.
17. Buchbinder R, Jolley D, Wyatt M. 2001 Volvo Award Winner in Clinical Studies: Effects of a media campaign on back pain beliefs and its potential influence on management of low back pain in general practice. *Spine*. 2001;26(23):2535-42.
18. Buchbinder R, Jolley D, Wyatt M. Population based intervention to change back pain beliefs and disability: three part evaluation. *Bmj*. 2001;322(7301):1516-20.

19. Fritz JM, Kim J, Dorius J. Importance of the type of provider seen to begin health care for a new episode low back pain: associations with future utilization and costs. *J Eval Clin Pract.* 2016;22(2):247-52.
20. Kazis LE, Ameli O, Rothendler J, Garrity B, Cabral H, McDonough C, et al. Observational retrospective study of the association of initial healthcare provider for new-onset low back pain with early and long-term opioid use. *BMJ open.* 2019;9(9):e028633.
21. Azad TD, Vail D, Bentley J, Han SS, Suarez P, Varshneya K, et al. Initial Provider Specialty Is Associated With Long-term Opiate Use in Patients With Newly Diagnosed Low Back and Lower Extremity Pain. *Spine.* 2019;44(3):211-8.
22. Desmeules F, Roy JS, MacDermid JC, Champagne F, Hinse O, Woodhouse LJ. Advanced practice physiotherapy in patients with musculoskeletal disorders: a systematic review. *BMC musculoskeletal disorders.* 2012;13:107.
23. Oakley C, Shacklady C. The Clinical Effectiveness of the Extended-Scope Physiotherapist Role in Musculoskeletal Triage: A Systematic Review. *Musculoskeletal Care.* 2015;13(4):204-21.
24. Baker SR, Rabin A, Lantos G, Gallagher EJ. The effect of restricting the indications for lumbosacral spine radiography in patients with acute back symptoms. *AJR Am J Roentgenol.* 1987;149(3):535-8.
25. Eccles M, Steen N, Grimshaw J, Thomas L, McNamee P, Soutter J, et al. Effect of audit and feedback, and reminder messages on primary-care radiology referrals: a randomised trial. *Lancet.* 2001;357(9266):1406-9.
26. Darlow B, Stanley J, Dean S, Abbott JH, Garrett S, Wilson R, et al. The Fear Reduction Exercised Early (FREE) approach to management of low back pain in general practice: A pragmatic cluster-randomised controlled trial. *PLoS medicine.* 2019;16(9):e1002897.
27. Weeks WB, Pike J, Donath J, Fiacco P, Justice BD. Conservative Spine Care Pathway Implementation Is Associated with Reduced Health Care Expenditures in a Controlled, Before-After Observational Study. *J Gen Intern Med.* 2019;34(8):1381-2.
28. Hurley DA, Murphy LC, Hayes D, Hall AM, Toomey E, McDonough SM, et al. Using intervention mapping to develop a theory-driven, group-based complex intervention to support self-management of osteoarthritis and low back pain (SOLAS). *Implement Sci.* 2016;11:56.
29. Kjaer P, Kongsted A, Ris I, Abbott A, Rasmussen CDN, Roos EM, et al. GLA:D(®) Back group-based patient education integrated with exercises to support self-management of back pain - development, theories and scientific evidence. *BMC musculoskeletal disorders.* 2018;19(1):418.
30. Hong AS, Ross-Degnan D, Zhang F, Wharam JF. Small Decline In Low-Value Back Imaging Associated With The 'Choosing Wisely' Campaign, 2012-14. *Health Aff (Millwood).* 2017;36(4):671-9.
31. Morrisroe K, Nakayama A, Soon J, Arnold M, Barnsley L, Barrett C, et al. EVOLVE: The Australian Rheumatology Association's 'top five' list of investigations and interventions doctors and patients should question. *Intern Med J.* 2018;48(2):135-43.
32. Born KB, Levinson W. Choosing Wisely campaigns globally: A shared approach to tackling the problem of overuse in healthcare. *J Gen Fam Med.* 2019;20(1):9-12.
33. Kost A, Genao I, Lee JW, Smith SR. Clinical Decisions Made in Primary Care Clinics Before and After Choosing Wisely. *J Am Board Fam Med.* 2015;28(4):471-4.
34. Rosenberg A, Agiro A, Gottlieb M, Barron J, Brady P, Liu Y, et al. Early Trends Among Seven Recommendations From the Choosing Wisely Campaign. *JAMA Intern Med.* 2015;175(12):1913-20.
35. Choosing Wisely Australia. Faculty of Pain Medicine, Australian and New Zealand College of Anaesthetists Recommendations.: [Available from: <https://www.choosingwisely.org.au/recommendations/fpm5>

36. MBS Online Medicare Benefits Schedule. Changes to MBS Items for Spinal Surgery Services - Frequently Asked Questions.
37. Juch JNS, Maas ET, Ostelo R, Groeneweg JG, Kallewaard JW, Koes BW, et al. Effect of Radiofrequency Denervation on Pain Intensity Among Patients With Chronic Low Back Pain: The Mint Randomized Clinical Trials. *Jama*. 2017;318(1):68-81.
38. National Institute for Health and Care Excellence - Quality standard [QS155]. Low back pain and sciatica in over 16s. 2017.
39. Health Quality Ontario. Low back pain Care For Adults with Acute Low Back Pain 2019 2019 [Available from: <https://www.hqontario.ca/Portals/0/documents/evidence/quality-standards/qs-low-back-pain-quality-standard-en.pdf>]
40. Vos T, Allen C, Arora M, Barber RM, Bhutta ZA, Brown A, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet*. 2016;388(10053):1545-602.
41. Haldeman S, Nordin M, Chou R, Côté P, Hurwitz EL, Johnson CD, et al. The Global Spine Care Initiative: World Spine Care executive summary on reducing spine-related disability in low- and middle-income communities. *Eur Spine J*. 2018;27(Suppl 6):776-85.
42. World Health Organization and World Bank. World report on disability, 2011: 2011 [updated 2011. 325]. Available from: <https://www.who.int/publications/i/item/world-report-on-disability>.
43. Johnson CD, Haldeman S, Chou R, Nordin M, Green BN, Côté P, et al. The Global Spine Care Initiative: model of care and implementation. *Eur Spine J*. 2018;27(Suppl 6):925-45.
44. Chou R, Côté P, Randhawa K, Torres P, Yu H, Nordin M, et al. The Global Spine Care Initiative: applying evidence-based guidelines on the non-invasive management of back and neck pain to low- and middle-income communities. *Eur Spine J*. 2018;27(Suppl 6):851-60.
45. Shiri R, Coggon D, Falah-Hassani K. Exercise for the Prevention of Low Back Pain: Systematic Review and Meta-Analysis of Controlled Trials. *American journal of epidemiology*. 2018;187(5):1093-101.
46. Losina E, Walensky RP, Reichmann WM, Holt HL, Gerlovin H, Solomon DH, et al. Impact of obesity and knee osteoarthritis on morbidity and mortality in older Americans. *Annals of internal medicine*. 2011;154(4):217-26.
47. Nüesch E, Dieppe P, Reichenbach S, Williams S, Iff S, Jüni P. All cause and disease specific mortality in patients with knee or hip osteoarthritis: population based cohort study. *Bmj*. 2011;342:d1165.
48. Arthritis Research UK. State of Musculoskeletal Health 2018: Arthritis & other musculoskeletal conditions in numbers: 2018 [Available from: www.arthritisresearchuk.org/arthritis-information/data-and-statistics/state-of-musculoskeletal-health.aspx].
49. Conaghan PG, Porcheret M, Kingsbury SR, Gammon A, Soni A, Hurley M, et al. Impact and therapy of osteoarthritis: the Arthritis Care OA Nation 2012 survey. *Clin Rheumatol*. 2015;34(9):1581-8.
50. Blakeman T, Chew-Graham C, Reeves D, Rogers A, Bower P. The Quality and Outcomes Framework and self-management dialogue in primary care consultations: a qualitative study. *The British journal of general practice : the journal of the Royal College of General Practitioners*. 2011;61(591):e666-73.
51. Cottrell E, Roddy E, Rathod T, Porcheret M, Foster NE. What influences general practitioners' use of exercise for patients with chronic knee pain? Results from a national survey. *BMC Fam Pract*. 2016;17(1):172.

52. Foster NE, Hartvigsen J, Croft PR. Taking responsibility for the early assessment and treatment of patients with musculoskeletal pain: a review and critical analysis. *Arthritis research & therapy*. 2012;14(1):205.
53. Ganz DA, Chang JT, Roth CP, Guan M, Kamberg CJ, Niu F, et al. Quality of osteoarthritis care for community-dwelling older adults. *Arthritis Rheum*. 2006;55(2):241-7.
54. National Institute for Health and Care Excellence . Osteoarthritis: the care and management of osteoarthritis in adults 2014 (CG177): 2014 [Available from: www.nice.org.uk/guidance/cg177].
55. Fernandes L, Hagen KB, Bijlsma JW, Andreassen O, Christensen P, Conaghan PG, et al. EULAR recommendations for the non-pharmacological core management of hip and knee osteoarthritis. *Annals of the rheumatic diseases*. 2013;72(7):1125-35.
56. Hochberg MC, Altman RD, April KT, Benkhalti M, Guyatt G, McGowan J, et al. American College of Rheumatology 2012 recommendations for the use of nonpharmacologic and pharmacologic therapies in osteoarthritis of the hand, hip, and knee. *Arthritis care & research*. 2012;64(4):465-74.
57. Hagen KB, Smedslund G, Østerås N, Jamtvedt G. Quality of Community-Based Osteoarthritis Care: A Systematic Review and Meta-Analysis. *Arthritis care & research*. 2016;68(10):1443-52.
58. Basedow M, Esterman A. Assessing appropriateness of osteoarthritis care using quality indicators: a systematic review. *J Eval Clin Pract*. 2015;21(5):782-9.
59. Hurley MV, Walsh N, Bhavnani V, Britten N, Stevenson F. Health beliefs before and after participation on an exercised-based rehabilitation programme for chronic knee pain: doing is believing. *BMC musculoskeletal disorders*. 2010;11:31.
60. Solomon DH, Glynn RJ, Bohn R, Levin R, Avorn J. The hidden cost of nonselective nonsteroidal antiinflammatory drugs in older patients. *The Journal of rheumatology*. 2003;30(4):792-8.
61. Hippisley-Cox J, Coupland C. Risk of myocardial infarction in patients taking cyclo-oxygenase-2 inhibitors or conventional non-steroidal anti-inflammatory drugs: population based nested case-control analysis. *Bmj*. 2005;330(7504):1366.
62. Hippisley-Cox J, Coupland C, Logan R. Risk of adverse gastrointestinal outcomes in patients taking cyclo-oxygenase-2 inhibitors or conventional non-steroidal anti-inflammatory drugs: population based nested case-control analysis. *Bmj*. 2005;331(7528):1310-6.
63. Trelle S, Reichenbach S, Wandel S, Hildebrand P, Tschannen B, Villiger PM, et al. Cardiovascular safety of non-steroidal anti-inflammatory drugs: network meta-analysis. *Bmj*. 2011;342:c7086.
64. Tavabie JA, Simms JM. Career planning for the non-clinical workforce - an opportunity to develop a sustainable workforce in primary care. *Educ Prim Care*. 2017;28(2):94-101.
65. Health Education England. The future of primary care: Creating teams for tomorrow London: [Available from: https://www.hee.nhs.uk/sites/default/files/documents/WES_The-future-of-primary-care.pdf]
66. Walker A, Williams R, Sibley F, Stamp D, Carter A, Hurley M. Improving access to better care for people with knee and/or hip pain: service evaluation of allied health professional-led primary care. *Musculoskeletal Care*. 2018;16(1):222-32.
67. Holdsworth LK, Webster VS, McFadyen AK, Scottish Physiotherapy Self R. What are the costs to NHS Scotland of self-referral to physiotherapy? Results of a national trial. *Physiotherapy*. 2007;93(1):3-11.
68. Nordeman L, Nilsson B, Möller M, Gunnarsson R. Early access to physical therapy treatment for subacute low back pain in primary health care: a prospective randomized clinical trial. *Clin J Pain*. 2006;22(6):505-11.
69. Ludvigsson ML, Enthoven P. Evaluation of physiotherapists as primary assessors of patients with musculoskeletal disorders seeking primary health care. *Physiotherapy*. 2012;98(2):131-7.

70. Hurley MV, Semple A, Sibley F, Walker A. Evaluation of a health trainer-led service for people with knee, hip and back pain. *Perspect Public Health*. 2019;139(6):308-15.
71. Hollinghurst S, Coast J, Busby J, Bishop A, Foster NE, Franchini A, et al. A pragmatic randomised controlled trial of 'PhysioDirect' telephone assessment and advice services for patients with musculoskeletal problems: economic evaluation. *BMJ open*. 2013;3(10):e003406.
72. Healey EL, Main CJ, Ryan S, McHugh GA, Porcheret M, Finney AG, et al. A nurse-led clinic for patients consulting with osteoarthritis in general practice: development and impact of training in a cluster randomised controlled trial. *BMC Fam Pract*. 2016;17(1):173.
73. Maddison P, Jones J, Breslin A, Bargon C, Fleur J, Lewis R, et al. Improved access and targeting of musculoskeletal services in northwest Wales: targeted early access to musculoskeletal services (TEAMS) programme. *British Medical Journal*. 2004;329(7478):1325-7.
74. Department of Health, UK. Our health, our care, our say: a new direction for community services: 2006 [Available from: <https://www.gov.uk/government/publications/our-health-our-care-our-say-a-new-direction-for-community-services>].
75. Hewlett S, Kirwan J, Pollock J, Mitchell K, Hehir M, Blair PS, et al. Patient initiated outpatient follow up in rheumatoid arthritis: six year randomised controlled trial. *Bmj*. 2005;330(7484):171.
76. Department of Health U. Self-referral pilots to musculoskeletal physiotherapy and the implications for improving access to other AHP services. London, UK; 2008.
77. Gatchel RJ. Psychological Disorders and Chronic Pain: Are There Cause-and-Effect Relationships? In: Gatchel RJ, Turk DC, editors. *Psychological Approaches to Pain Management - A Practitioner's Handbook*. Guilford Press, New York 1996. p. 33-52.
78. Turk DC. Biopsychosocial Perspective on Chronic Pain. In: Turk DC, Gatchel RJ, editors. *Psychological Approaches to Pain Management - A Practitioner's Handbook* Third ed: Guilford Press, New York; 1996. p. 3-32.
79. Walsh NE, Mitchell HL, Reeves BC, Hurley MV. Effectiveness of rehabilitation programmes combining exercise and self-management interventions for hip and knee osteoarthritis: A systematic review. *Phys Ther Rev* 2006;11:289-97 2006;11:289-97.
80. Hurley MV, Walsh NE, Mitchell H, Nicholas J, Patel A. Long-term outcomes and costs of an integrated rehabilitation program for chronic knee pain: a pragmatic, cluster randomized, controlled trial. *Arthritis care & research*. 2012;64(2):238-47.
81. Hurley MV, Walsh NE, Mitchell HL, Pimm TJ, Patel A, Williamson E, et al. Clinical effectiveness of a rehabilitation program integrating exercise, self-management, and active coping strategies for chronic knee pain: a cluster randomized trial. *Arthritis Rheum*. 2007;57(7):1211-9.
82. Jessep SA, Walsh NE, Ratcliffe J, Hurley MV. Long-term clinical benefits and costs of an integrated rehabilitation programme compared with outpatient physiotherapy for chronic knee pain. *Physiotherapy*. 2009;95(2):94-102.
83. Inacio MCS, Paxton EW, Graves SE, Namba RS, Nemes S. Projected increase in total knee arthroplasty in the United States - an alternative projection model. *Osteoarthritis Cartilage*. 2017;25(11):1797-803.
84. Cheung CL, Ang SB, Chadha M, Chow ES, Chung YS, Hew FL, et al. An updated hip fracture projection in Asia: The Asian Federation of Osteoporosis Societies study. *Osteoporosis and sarcopenia*. 2018;4(1):16-21.
85. Cordtz RL, Hawley S, Prieto-Alhambra D, Højgaard P, Zobbe K, Overgaard S, et al. Incidence of hip and knee replacement in patients with rheumatoid arthritis following the introduction of biological DMARDs: an interrupted time-series analysis using nationwide Danish healthcare registers. *Annals of the rheumatic diseases*. 2018;77(5):684-9.

86. Skou ST, Roos EM, Laursen MB, Rathleff MS, Arendt-Nielsen L, Simonsen O, et al. A Randomized, Controlled Trial of Total Knee Replacement. *N Engl J Med.* 2015;373(17):1597-606.
87. Keding A, Handoll H, Brealey S, Jefferson L, Hewitt C, Corbacho B, et al. The impact of surgeon and patient treatment preferences in an orthopaedic trauma surgery trial. *Trials.* 2019;20(1):570.
88. Eastell R, O'Neill TW, Hofbauer LC, Langdahl B, Reid IR, Gold DT, et al. Postmenopausal osteoporosis. *Nat Rev Dis Primers.* 2016;2:16069.
89. Kannegaard PN, van der Mark S, Eiken P, Abrahamsen B. Excess mortality in men compared with women following a hip fracture. National analysis of comedications, comorbidity and survival. *Age Ageing.* 2010;39(2):203-9.
90. Kung AW, Fan T, Xu L, Xia WB, Park IH, Kim HS, et al. Factors influencing diagnosis and treatment of osteoporosis after a fragility fracture among postmenopausal women in Asian countries: a retrospective study. *BMC Womens Health.* 2013;13:7.
91. Wang CY, Fu SH, Yang RS, Shen LJ, Wu FL, Hsiao FY. Age- and gender-specific epidemiology, treatment patterns, and economic burden of osteoporosis and associated fracture in Taiwan between 2009 and 2013. *Archives of osteoporosis.* 2017;12(1):92.
92. Wu CH, Tu ST, Chang YF, Chan DC, Chien JT, Lin CH, et al. Fracture liaison services improve outcomes of patients with osteoporosis-related fractures: A systematic literature review and meta-analysis. *Bone.* 2018;111:92-100.
93. Chang LY, Tsai KS, Peng JK, Chen CH, Lin GT, Lin CH, et al. The development of Taiwan Fracture Liaison Service network. *Osteoporosis and sarcopenia.* 2018;4(2):47-52.
94. International Osteoporosis Foundation. Capture the Fracture – Map of Best Practice <https://capturethefracture.org/map-of-best-practice>: [cited 11 March 2020 2020 March 11]. Available from: <https://capturethefracture.org/map-of-best-practice>.
95. Chan DD, Chang LY, Akesson KE, Mitchell P, Chen CH, Lewiecki EM, et al. Consensus on best practice standards for Fracture Liaison Service in the Asia-Pacific region. *Archives of osteoporosis.* 2018;13(1):59.
96. The World Factbook - Taiwan 2017 [2020 March 11]. Available from: https://www.cia.gov/library/publications/the-world-factbook/geos/print_tw.html.
97. Chao CT, Yang RS, Huang WJ, Tsai KS, Chan DD. Risk Factors for Poor Functional Recovery, Mortality, Recurrent Fractures, and Falls Among Patients Participating in a Fracture Liaison Service Program. *J Am Med Dir Assoc.* 2019;20(9):1129-36.e1.
98. Chao CT, Yang RS, Hung LW, Tsai KS, Peng JK, Chang CH, et al. Chronic kidney disease predicts a lower probability of improvement in patient-reported experience measures among patients with fractures: a prospective multicenter cohort study. *Archives of osteoporosis.* 2018;13(1):126.
99. Woolf AD, van Riel PL. Early Rheumatoid Arthritis. Woolf AD, van Riel PLCM, editors 1997 Feb. 1-190 p.
100. Young A, van der Heijde DM. Can we predict aggressive disease? *Bailliere's clinical rheumatology.* 1997;11(1):27-48.
101. Swedish Rheumatology Quality Register [Available from: www.srq.nu].
102. Boers M, Verhoeven AC, Markusse HM, van de Laar MA, Westhovens R, van Denderen JC, et al. Randomised comparison of combined step-down prednisolone, methotrexate and sulphasalazine with sulphasalazine alone in early rheumatoid arthritis (Erratum: *Lancet* 1998;351:220). *Lancet.* 1997;350(9074):309-18.
103. van Gestel AM, van Riel PL. Evaluation of early rheumatoid arthritis disease activity and outcome. *Bailliere's clinical rheumatology.* 1997;11(1):49-63.

104. Elliott MJ, Maini RN, Feldmann M, Long-Fox A, Charles P, Bijl H, et al. Repeated therapy with monoclonal antibody to tumour necrosis factor alpha (cA2) in patients with rheumatoid arthritis. *Lancet*. 1994;344(8930):1125-7.
105. Weinblatt ME, Trentham DE, Fraser PA, Holdsworth DE, Falchuk KR, Weissman BN, et al. Long-term prospective trial of low-dose methotrexate in rheumatoid arthritis. *Arthritis Rheum*. 1988;31(2):167-75.
106. Smolen JS, Aletaha D, Bijlsma JW, Breedveld FC, Boumpas D, Burmester G, et al. Treating rheumatoid arthritis to target: recommendations of an international task force. *Annals of the rheumatic diseases*. 2010;69(4):631-7.
107. Available from: <https://omeract.org/>
108. Smolen JS, Landewé R, Breedveld FC, Dougados M, Emery P, Gaujoux-Viala C, et al. EULAR recommendations for the management of rheumatoid arthritis with synthetic and biological disease-modifying antirheumatic drugs. *Annals of the rheumatic diseases*. 2010;69(6):964-75.
109. Meenan RF, Gertman PM, Mason JH. Measuring health status in arthritis. The arthritis impact measurement scales. *Arthritis Rheum*. 1980;23(2):146-52.
110. Fries JF, Spitz P, Kraines RG, Holman HR. Measurement of patient outcome in arthritis. *Arthritis Rheum*. 1980;23(2):137-45.
111. Hill JC, Kang S, Benedetto E, Myers H, Blackburn S, Smith S, et al. Development and initial cohort validation of the Arthritis Research UK Musculoskeletal Health Questionnaire (MSK-HQ) for use across musculoskeletal care pathways. *BMJ open*. 2016;6(8):e012331.
112. Aletaha D, Neogi T, Silman AJ, Funovits J, Felson DT, Bingham CO, 3rd, et al. 2010 Rheumatoid arthritis classification criteria: an American College of Rheumatology/European League Against Rheumatism collaborative initiative. *Annals of the rheumatic diseases*. 2010;69(9):1580-8.
113. van der Helm-van Mil AH, Verpoort KN, Breedveld FC, Toes RE, Huizinga TW. Antibodies to citrullinated proteins and differences in clinical progression of rheumatoid arthritis. *Arthritis research & therapy*. 2005;7(5):R949-58.
114. Kaeley GS, Bakewell C, Deodhar A. The importance of ultrasound in identifying and differentiating patients with early inflammatory arthritis: a narrative review. *Arthritis research & therapy*. 2020;22(1):1.
115. Sokka T, Kautiainen H, Toloza S, Mäkinen H, Verstappen SM, Lund Hetland M, et al. QUEST-RA: quantitative clinical assessment of patients with rheumatoid arthritis seen in standard rheumatology care in 15 countries. *Annals of the rheumatic diseases*. 2007;66(11):1491-6.
116. Sokka T, Kautiainen H, Pincus T, Toloza S, da Rocha Castelar Pinheiro G, Lazovskis J, et al. Disparities in rheumatoid arthritis disease activity according to gross domestic product in 25 countries in the QUEST-RA database. *Annals of the rheumatic diseases*. 2009;68(11):1666-72.
117. Kieny MP, Bekedam H, Dovlo D, Fitzgerald J, Habicht J, Harrison G, et al. Strengthening health systems for universal health coverage and sustainable development. *Bulletin of the World Health Organization*. 2017;95(7):537-9.
118. Hill J. A practical guide to patient education and information giving. *Bailliere's clinical rheumatology*. 1997;11(1):109-27.
119. EULAR. Available from: https://www.eular.org/myUploadData/files/PARE%20BROCHURE_FINAL_290212.pdf
120. Woolf AD. Healthcare services for those with musculoskeletal conditions: a rheumatology service. Recommendations of the European Union of Medical Specialists Section of Rheumatology/European Board of Rheumatology 2006. *Annals of the rheumatic diseases*. 2007;66(3):293-301.

121. Crawford JO, Berkovic D, Erwin J, Copey SM, Davis A, Giagloglou E, et al. Musculoskeletal health in the workplace. *Best Pract Res Clin Rheumatol.* 2020:101558.
122. Petersson IF, Strömbeck B, Andersen L, Cimmino M, Greiff R, Loza E, et al. Development of healthcare quality indicators for rheumatoid arthritis in Europe: the eumusc.net project. *Annals of the rheumatic diseases.* 2014;73(5):906-8.
123. Stoffer MA, Smolen JS, Woolf A, Ambrozic A, Bosworth A, Carmona L, et al. Development of patient-centred standards of care for rheumatoid arthritis in Europe: the eumusc.net project. *Annals of the rheumatic diseases.* 2014;73(5):902-5.
124. Available from: www.omadahealth.com
125. Available from: <https://www2.livongo.com>
126. Ekman B, Nero H, Lohmander LS, Dahlberg LE. Costing analysis of a digital first-line treatment platform for patients with knee and hip osteoarthritis in Sweden. *PloS one.* 2020;15(8):e0236342.
127. Cronström A, Dahlberg LE, Nero H, Ericson J, Hammarlund CS. 'I would never have done it if it hadn't been digital': a qualitative study on patients' experiences of a digital management programme for hip and knee osteoarthritis in Sweden. *BMJ open.* 2019;9(5):e028388.
128. Available from: <http://www.jointacademy.com>
129. Available from: www.hingehealth.com
130. Available from: www.kaiiahealth.com

Formatted: Swedish (Sweden)