

**Models of Care for musculoskeletal health: moving towards meaningful  
implementation and evaluation across conditions and care settings**

Andrew M Briggs<sup>1\*</sup> BSc (Phthy) Hons, PhD, FACP ([A.Briggs@curtin.edu.au](mailto:A.Briggs@curtin.edu.au))

Madelynn Chan<sup>2,3</sup> MBBS, MD, FRACP, FAMS ([madelynn\\_chan@ttsh.com.sg](mailto:madelynn_chan@ttsh.com.sg))

Helen Slater<sup>1</sup> BAppSci (Phthy), MAppSci (Phy), PhD, FACP ([H.Slater@curtin.edu.au](mailto:H.Slater@curtin.edu.au))

<sup>1</sup>School of Physiotherapy and Exercise Science, Curtin University, GPO Box U1987,  
Perth, WA, 6845. Australia.

<sup>2</sup>Lee Kong Chian School of Medicine, Nanyang Technological University, Singapore

<sup>3</sup>Tan Tock Seng Hospital, 11 Jalan Tan Tock Seng, Singapore 308433

\* Corresponding author

Tel: + 61 8 9266 4644

Fax: + 61 8 9266 3099

Email: [A.Briggs@curtin.edu.au](mailto:A.Briggs@curtin.edu.au)

**Conflict of interest statement:** The authors declare no conflicts of interest

## **Abstract**

Models of Care (MoCs) are increasingly recognised as a system-level enabler to translate evidence for ‘what works’ into policy and, ultimately, clinical practice. MoCs provide a platform for a reform agenda in health systems by describing not only *what* care to deliver, but also *how* to deliver it. Given the enormous burden of disease associated with musculoskeletal (MSK) conditions, system-level (macro) reform is needed to drive downstream improvements in MSK healthcare – at the health services (meso) level and at the clinical interface (micro) level. A key challenge in achieving improvements in MSK healthcare is sustainable implementation of reform initiatives, whether they be macro, meso or micro-level in scope. In this Chapter, we introduce the special issue of the Journal dedicated to implementation of MSK MoCs. We provide a contextual background on MoCs, a synthesis of implementation approaches across care settings covered across the Chapters in this themed issue, and perspectives on evaluation of MoCs.

**Keywords:** model of care, implementation, evaluation, policy, burden

## Introduction

The burden of disease of musculoskeletal conditions is a global priority.

The burden of disease of musculoskeletal (MSK) conditions at a global level is well established, evidenced most recently through the Global Burden of Disease (GBD) studies where the disability burden attributed to MSK conditions was observed to be enormous; exceeding all non-communicable diseases (NCDs) other than mental health and behavioural disorders [1, 2]. These data point to the upward trajectory of prevalence and escalating personal and societal impacts of MSK conditions and persistent pain across the life course, further reinforced by recent nation-specific whitepapers and seminal reports [3-14]. Against a background of significantly reduced quality of life, function and mental wellbeing, a major human capital consequence of impaired MSK health, is reduced workforce participation and early retirement [7, 15, 16]. Reduced participation has significant downstream consequences for retirement wealth for the individual, and upstream consequences for government, such as reduced taxation revenue and increased welfare payments in many nations [7]. In the context of low and middle-income economies and subsistence communities, MSK-related disability results in reduced capacity for work participation and therefore a critical threat to livelihoods. Importantly, while communicable diseases remain a large driver to disability-adjusted life years in low and middle income economies, the recent GBD data point to an increasing burden of NCDs, particularly MSK conditions, in low and middle-economies [17, 18]. In this context, addressing the burden of disease for MSK conditions across economies and across the life course, and their unifying feature of persistent or recurrent pain, is

indeed an urgent global priority [19]. Lim et al (Chapter 3) explore the burden of disease challenges in low and middle-income Asian economies.

The scale of the MSK burden and its sequelae present major challenges to which nations need to adequately respond. While the World Health Organisation (WHO) has developed an guide for nations to assess their policy and program capacity to respond to NCDs, the guide considers only cancer, lung diseases, diabetes and cardiovascular disease [20]. Similarly, the WHO 2013-2020 Global Action Plan for the Prevention and Control of Non-Communicable Diseases [21] focuses on cardiovascular diseases, cancer, chronic respiratory diseases and diabetes; although MSK conditions remain within its scope. Support for nations to develop and sustainably implement system response capacity is needed. This issue of the Journal tackles these challenges across different economic and care settings to provide readers with evidence-informed, practical guidance.

### Big problems need big solutions

MSK health outcomes are influenced by a range of factors: health system and public health factors (*macro*-level), service delivery factors (*meso*-level) and clinician and consumer behaviours (*micro*-level) [19] (Table 1). These factors are discussed in further detail across the various chapters in this issue of the Journal. Despite a large volume of evidence for ‘what works’ to address MSK health impairments and their sequelae, these evidence-based strategies are inadequately applied in practice by health providers [22-25], inadequately integrated into lifestyle behaviours by health

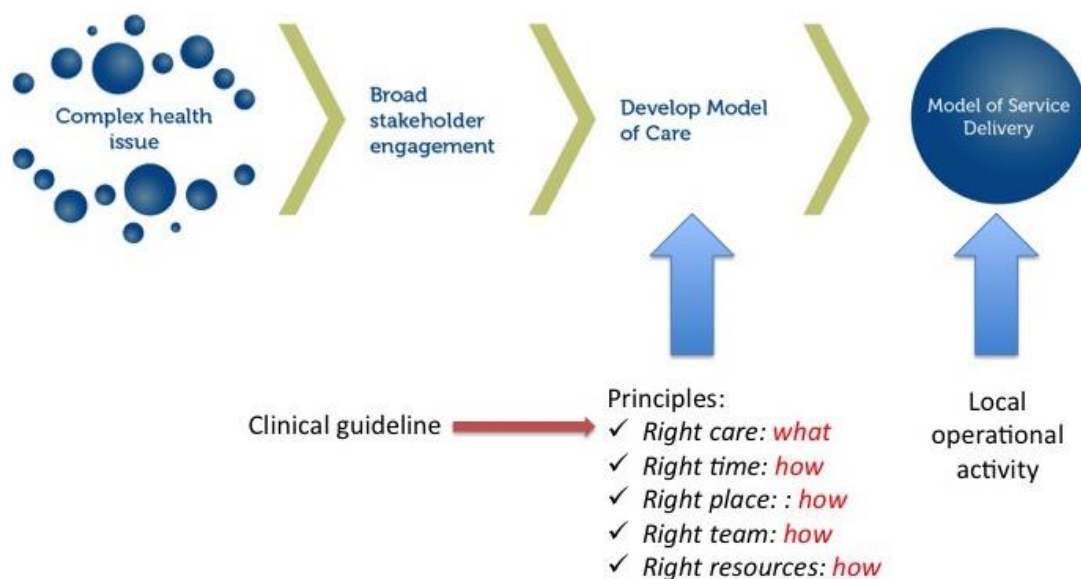
consumers [26-28], and feature in health policy and health service delivery objectives at a level grossly incommensurate with the burden of disease [29-33]. In order to effectively and sustainably address the burden of disease of MSK conditions, a multi-level response is required, where macro, meso, and micro-level factors need to be considered [19]. As outlined in the various chapters in this issue of the Journal, a multi-level response is necessarily a complex intervention that demands a cross-sector, multidisciplinary and a partnerships-driven approach, supported where feasible, by governments. Here, Models of Care provide one possible vehicle to drive effective change [19, 30, 34-36].

## Models of Care for musculoskeletal health

### What are they?

A MoC is an evidence-informed policy or framework that outlines the optimal manner in which condition-specific care should be made available and delivered to consumers at a systems level. A MoC aims to describe the principles of care for a given condition (the 'what'), as well as guidance on how those principles could be implemented in a local setting (the 'how'). MoCs aim to address current and projected community need in the context of local operational requirements. The guidance provided is coined as "the *right care*, delivered at the *right time*, by the *right team*, in the *right place*, with the *right resources*" [34]. MoCs are used as a facilitator to bridge the gap between evidence for what works (or doesn't work) in care delivery and practice, by describing not only *what* to do, but critically also *how* to do it within a health system, considering the macro, meso and micro levels. Here,

an important distinction is that a MoC is *not* a clinical practice guideline. Rather, MoCs complement clinical practice guidelines by serving as a guide to describe *how* best-evidence for delivery of MSK care can be implemented as a sector-wide model of service delivery by clinicians, consumers, and health systems across the disease continuum, while considering practicalities of the local environment. A Model of Service Delivery is not the same as a MoC. A Model of Service Delivery operationalizes the MoC and describes in detail how a given MoC is to be implemented in a local setting or health service at an operational level. A Model of Service Delivery is therefore the next step in the implementation continuum (Figure 1).



**Figure 1** Schematic of the continuum between identifying a complex health problem to implementing best practice care within a local setting. The Model of Care provides principle-level guidance on what care and how to implement it, while the Model of Service Delivery operationalizes these principles into local operational activity, informed by an implementation plan.

## How are MoCs developed?

The approach to developing a MoC will necessarily vary between sociocultural settings – what is appropriate and feasible in low-income Asian economies, for example, will not be the same as high-income European economies. These issues are considered in detail in Chapters 2 and 3. Consistent with contemporary principles of implementation science [37], MoCs are ideally developed using multi-stakeholder input, and importantly, meaningful involvement of consumers and carers, as highlighted in Chapter 4. These principles apply not only to developing strategies for MSK care, but to all NCDs and apply across sociocultural and economic settings [38]. The diversity and scope of the stakeholders involved will vary according to the clinical issue being addressed and will be further informed by how the local health system operates, and related political considerations. In Australia, for example, a centrally-coordinated Health Network model is used in some jurisdictions [34], with established effectiveness [39, 40]. Critically, given the increasing global attention towards the development and implementation of MoCs, there is a need to apply some level of standardisation to the development, implementation and evaluation of MoCs to enable benchmarking and accumulation of a comparable web of evidence regarding effectiveness. Indeed, this is one of the priorities of the Global Alliance for Musculoskeletal Health of the Bone and Joint Decade (<http://bjdonline.org/>). In this regard, an internationally-informed framework to support the development, implementation and evaluation of MoCs has recently been developed with relevant representation from high, middle and low-income economies [35, 41].

## How are Models of Care used in practice?

MoCs can be used to improve MSK care outcomes at macro, meso and micro levels by: informing policy and health strategy priorities, resourcing and health governance decisions (macro factors); service design and workforce capacity building initiatives (meso factors); consumers' participation in care and clinicians' practice behaviours (micro factors). In this regard, the Australian experience has been positive, where a number of MoCs and service frameworks have been developed collaboratively [30], and continue to be developed, monitored and iterated across jurisdictions. These MoCs have been instrumental in advocating for and initiating service improvement programs for a range of conditions, for example persistent pain [42-46], rheumatoid arthritis [47], osteoarthritis [48], and secondary osteoporotic fracture prevention [49]. At an international level, we have recently reviewed MoCs for persistent pain, rheumatoid arthritis, osteoarthritis, osteoporosis and MSK injury and trauma [36], while Hoy et al have considered the application of MoCs in practice in low and middle-income economies [17]. Unlike in high-income settings, they and others [17, 50] recommend approaching policy and program initiatives for MSK health in an integrated health manner that is not condition-specific. Rather than a disease-specific or 'vertical' approach taken in high-income settings (e.g. Chapters 2, 8 and 9), this integrated approach better supports whole-of-system strengthening and minimises threats of fragmentation and short-lived initiatives. Nonetheless, some condition-specific initiatives, such as the World Spine Care program (discussed further in Chapter 10), appear to have potential, but are notably supported by resources from high-income economies [51] and therefore in some contexts may not



align optimally with the principles of development effectiveness for longer-term sustainability [17].

## Approaches to implementation of Models of Care across settings

There is now an increasing recognition about the importance of theory-based implementation approaches, informed by implementation and behaviour change science, for the successful and sustainable delivery of health policy, programs or interventions. Stakeholders in MSK healthcare are fortunate that a large volume of evidence is now available about *'what'* care is required to effectively manage and prevent MSK conditions. For example, the Cochrane Musculoskeletal and Back groups provide libraries of rich systematic review-level evidence on intervention effectiveness for MSK therapies. There is, however, a dearth of research around what characterises the *'how'* for effective implementation approaches to translate evidence into practice [52]. In this context, in order to achieve improved MSK health outcomes outside research settings, a better understanding of the *'how'* to deliver MSK healthcare services and align evidence with policy and practice is required. While MoCs provide guidance on how the right care should be delivered to people with MSK health conditions, further guidance on various implementation approaches to achieve such system-wide care delivery reforms and sustainability in local models of service delivery is needed. This issue of the Journal is devoted to this topic. In this chapter we provide an overview of the implementation approaches used across care settings, ages and conditions.

## Implementation approaches across high-income economies

Implementation approaches will, necessarily, vary according to setting or context [35]. The chapters within this themed issue of the Journal demonstrate this well, particularly the differences in approaches adopted in high compared with low and middle-income economies (Chapters 2, 3, 8 and 9) and the nuances of the compensation environment (Chapter 5). High income economies tend to have a greater capacity to plan and execute health reform at a systems level due to greater resourcing, more stable governance arrangements and delineation across components of the health systems, population health surveillance capabilities, and more human capacity to undertake policy development and implementation within relatively stable political systems. This greater capacity, however, is sometimes offset with less agility to enact change at a local level, particularly in highly regulated care settings like the compensation environment, as discussed in detail by Beales et al (Chapter 5). Key drivers of implementation successes of MoCs in high-income economies seem to be based on a foundation of health policy that articulates with the MoC, thereby providing a platform for coordinated action by government and other organisations. Such policies might include chronic disease management frameworks, primary prevention frameworks, care integration strategies, workforce capacity building and role delineation plans, and so on, and directly enable implementation of components of MoCs. Mitchell et al (Chapter 9) provide a comprehensive commentary on these issues as they relate to fracture liaison services for secondary osteoporotic fracture management and orthogeriatric services while Allen et al (Chapter 8) provide a comprehensive commentary as it

relates to osteoarthritis care. On a background of this system-based policy, high-income economies often have capacity to establish pilot studies or undertake formative evaluations of MoCs. Often, these health service, pragmatic evaluations of implementation stem from primary efficacy studies such as randomised controlled trials (RCTs). Translation of RCT findings into an up-scaled, real-world, health services implementation initiative appears to be an effective approach to implementation of MoCs in high-income settings. Dziedzic et al (Chapter 2) provide examples of this approach as they relate to osteoarthritis and low back pain care in the United Kingdom. Such up-scaling, however, demands a theory-driven approach to implementation or behaviour change, such as that captured by the Consolidated Framework for Implementation Research (CFIR) [53] or the Behaviour Change Wheel [54]. Beales et al (Chapter 5) describe the application of the CFIR in practice.

A critical aspect of implementation in these settings is purposeful and thorough cross-sector engagement consultation of a range of stakeholders (e.g. clinicians, consumers, carers, policy makers, insurers, non-government organisations) and the support of clinician champions. The latter support may be provided through non-government organisations, research groups, government bodies or professional bodies. No matter what the support mode, coordination and support from a central agency is critical [40]. This concept of central agency support extends beyond single jurisdictions. For example, the highly successful and global approach to fragility fracture care, Capture the Fracture<sup>®</sup>, has been facilitated through the development and promotion of a Best Practice Framework which articulates standards for Fracture Liaison Services and benchmarks international services [55]. The

International Osteoporosis Foundation supports the program, the Best Practice Framework and an international program committee evaluate health services and support implementation of care standards (refer to Chapter 9 for further detail).

Implementation approaches in high-income settings must be coupled with evaluation, ensuring that outcomes are meaningful to system administrators and consumers, which requires measurement of both system-based (e.g. economic) and patient-reported (e.g. function) outcomes. At a service delivery level in high-income settings, MSK disease MoCs need to be better aligned with a contemporary understanding of pain biology and better articulate the need for care integration given the common co-morbidities associated with MSK pain, including mental health conditions such as depression and anxiety [56-58]. All too often, these areas of care are considered disparately (for example in osteoarthritis care), rather than integrated, leaving service fragmented and consumers failing to receive holistic, best-practice care. Both Beales et al (Chapter 5) and Allen et al (Chapter 8) discuss this barrier to best-practice pain co-care in the contexts of compensable musculoskeletal injuries and osteoarthritis care, respectively.

#### Implementation approaches in low- and middle-income settings in Asia

Care of MSK conditions in Asian low- and middle-income countries is severely limited by significant lack of funding resources and specialty-trained workforce capacity. Prioritisation of government healthcare funding is generally directed towards communicable diseases and other NCDs associated with higher mortality, such as

cardiovascular diseases, diabetes mellitus and cancer. MSK conditions represent a low healthcare priority and there is a lack of awareness of the increasing disease burden and cost to the economy. Scarce resources have resulted in government policies focusing on primary care and prevention of these diseases, often with little or no integration with specialist care. Whilst there have been no specific MoCs for MSK conditions developed in these countries, in Chapter 3, Lim et al. provide examples of approaches to overcome some of these barriers. Through the Community Oriented Program for Control of Rheumatic Diseases (COPCORD) project, epidemiological data have been gathered on the burden of pain, arthritis and disability in developing economies, through community surveys in rural areas (see <http://copcord.org/publications.asp> and Chapter 3). The COPCORD project, in particular, has helped to identify the magnitude of the burden for MSK conditions in these countries. In the Philippines, a low-income country, the Applied Rheumatology Made Simple (ARMS) programme is an educational programme developed by local specialist societies and funded by non-government organisations (an international specialist society and a pharmaceutical company) that has successfully built medical workforce capacity. This was achieved through education of primary care providers on MSK conditions and developing a shared-care model together with specialists from local clinical networks. The programme has also added workforce capacity through training of patients to be educators of their own diseases. More detail is provided in Chapter 3. In Malaysia, a middle-income country, a different approach to workforce capacity building has been taken through partnership of the Ministry of Health with specialist societies. For example, the osteoarthritis clinical practice guidelines were developed by the Malaysian Society of Rheumatology and

workshops to upskill regional and rural medical staff are conducted with active support by the Ministry of Health through endorsement, logistical support and funding. Both the Filipino ARMS program and Malaysian osteoarthritis clinical practice guidelines workshops highlight the critical importance of partnerships between government, private funders and other special interest groups in order to improve care for MSK conditions. Furthermore, government recognition and prioritisation of MSK conditions is a key factor for developing appropriate MoCs. However, evaluation of the efficacy of these programmes in improving patient outcomes is limited to participants' pre- and post- course knowledge. A system-wide evaluation of clinical practice standards would require further resources, which may not be feasible in low- to middle-income countries. Hoy et al. advocate a multi-pronged approach to the development of MSK MoCs to ensure effectiveness of these initiatives [17]. This approach involves:

- active ownership and participation by local communities [59];
- alignment of MSK MoC initiatives with existing priorities and policies such as national health strategies;
- harnessing research, information and evidence to inform MoC development and implementation;
- inclusion of performance indicators to monitor and evaluate the MoCs [60];
- integration of MoCs across existing health systems;
- financial transparency and accountability related to development and implementation of MoCs with organisational and funding partners;

- informing and engaging policymakers and leaders to develop and implement policies and legislation for the prevention of and management of MSK conditions and injuries; and
- appropriate resource allocation for MSK MoCs (development, implementation and evaluation components) [61, 62].

To ensure sustainability of these initiatives, local “champions” of MSK MoC implementation are required, consistent with the approach in high-income settings. These could include individuals involved in the education and mentoring of trainees, as well as those involved in research to develop a research agenda appropriate to local conditions.

### Building capacity to support implementation of Models of Care

Two priority foci of building capacity to support implementation of MoCs are consumer involvement and an appropriately skilled health workforce. A key lever to support both these foci is the use of digital technologies which can reach across care settings and bypass care disparities imposed by geography, sociocultural factors and economies. Such technologies therefore play a very important role in supporting system-wide implementation.

#### Consumer involvement

Harnessing consumer involvement to support implementation is an intuitive corollary of actively engaging consumers in the development of MoCs. This involvement extends to decisions about their care, how health services and systems

are designed, and delivered to empower consumers and achieve improved health outcomes, all factors consistent with WHO recommendations for consumer-centred healthcare [63].

In Chapter 4 of this edition, Walsh and colleagues specifically tackle the 'how to' harness consumer involvement and present an elegant evidence-synthesis and commentary relevant across health system levels (macro, meso and micro) [64].

Walsh and colleagues report that the current available evidence is primarily focused at the micro level and typically of a lower quality, with evidence lacking at the meso- and macro-levels. While they advocate 'no one size fits all' for adopting consumer involvement in MoCs, various options are presented to show how these may be adapted for use in low- and middle-income economies, or best suit high-income economies.

Consumer involvement strategies can extend from representation on MoC working groups, to stakeholder forums, workshops, and opportunities to provide feedback on draft MoC documents, as well as informing specific decisions about their care needs [30]. Macro-level initiatives can provide guidance for consumer involvement, for example the National Institute for Health and Care Excellence (NICE:

[www.nice.org.uk](http://www.nice.org.uk)), while agencies like the Cochrane Consumer Network

([www.consumers.cochrane.org](http://www.consumers.cochrane.org)) provide guidance to consumers and researchers on ways to increase consumer-oriented research. In Australia, the use of networks such as the New South Wales Agency for Clinical Innovation Musculoskeletal Network (<https://www.aci.health.nsw.gov.au/networks/musculoskeletal>) and the Western



Australian Musculoskeletal Network

(<http://www.healthnetworks.health.wa.gov.au/network/musculoskeletal.cfm>) have also been effective in engaging consumers as a standard part of MoC development including for osteoarthritis, elective joint replacement, inflammatory arthritis, paediatric rheumatology, low back pain and osteoporosis [34, 65]. There are however, still many unmet needs, according to two recent needs analyses undertaken in Australia of consumers with MSK conditions [58, 66]. Both reports highlight the importance of harnessing engagement of target consumer groups when informing MoC development to ensure their needs are met and empower consumers to support implementation.

### **Appropriately skilled health workforce**

Effective implementation of MoCs requires an appropriately skilled health workforce. In a comprehensive review of MoCs, we have previously described the evidence for *what* works in building capacity, flexibility and sustainability in the current and emerging health workforce [19, 36]. Models of education that prepare a 'fit for purpose' workforce are required if we are to meet the escalating needs associated with MSK conditions. Given that co- and multi-morbidities are commonly associated with MSK conditions [2], interprofessional educational frameworks need to resonate with chronic disease condition frameworks [67], in order to develop the requisite knowledge, skills and competencies to support effective multidisciplinary health care over the life course [68]. In Chapter 10, Chehade and colleagues comprehensively interrogate the '*how*' regarding the development and delivery of

integrated, collaborative interprofessional education models necessary to support quality, efficient and sustainable MSK MoCs across care settings. Current global health workforce needs, trends and challenges are examined, highlighting the deficiencies and care disparities imposed by geography, socio-politic and economic factors. For example, Chehade and colleagues describe how initiatives such as World Spine Care (WSC) [51], have supported a programme to address spinal pain in collaboration with the Botswana government and local communities. This initiative helps train local providers, thereby facilitating capacity building of the local health workforce to support spinal care MoCs. In Kenya, another capacity building initiative involves MSK first-line assessment and provision of a standardised programme delivered by physicians partnering with consumers who have themselves experienced a MSK condition.

Initiatives to develop national standards based on MSK core competencies such as the Australian Musculoskeletal Education Collaboration (AMSEC), also help support implementation by engaging national multidisciplinary and multi-profession collaboration with educational institutions, consumers and government [69, 70]. Chehade and colleagues argue that such frameworks support reflective practice by providing a shared language between educators, learners and consumers to make sense of health experiences, thereby strengthening health workforce efforts to sustain MoCs. Such collaborative models better support consumer-centred care and provide greater efficiency and improved outcomes, both key recommendations of contemporary MSK MoCs [30].

Previously, we have also described how extended scope practice across health professions can support effective implementation [36]. Chehade and colleagues extend this analysis by examining and discussing the critical role of flexible, funding models designed to sustain health workforce capacity building and support effective implementation of MoCs. For example, rheumatology nurses and rehabilitation professionals undertaking monitoring roles; in nurse specialists and nurse practitioners performing examinations, recommending medication changes and undertaking referrals to other health professionals; and physiotherapists triaging care of MSK patients, administering injections and requesting investigations.

Building capacity in the health workforce is also necessary to support different care requirements across the life course. In Chapter 6, Stinson and colleagues present a comprehensive overview of contemporary MSK MoCs for paediatric-specific populations, emphasising that children and adolescents with chronic MSK pain should not be viewed as “little adults,” as developmental differences mean that age-specific MoCs are needed. Stinson and colleagues, discuss the lack of confidence reported by primary care clinicians in their paediatric-MSK clinical skills, with unnecessary on-referrals and delays in triaging children to appropriate subspecialists, and outline how an interprofessional health workforce can be upskilled to support effective implementation of paediatric MoCs. A recent study we have undertaken in young 16-25 year old Australians with persistent MSK pain, further strengthens this concept, with young people clearly articulating an absence of age-appropriate health services and an appropriately skilled health workforce to support those services [58].

## Harnessing eHealth technologies to build capacity

EHealth is a part of the contemporary health landscape and is a critical enabler to implementation of accessible, sustainable and integrated MSK MoCs. Based on findings of the third global survey on eHealth 2015, the Atlas of eHealth country profiles has been developed to provide a snapshot of member states capacity to implement eHealth systems [71]. The use of eHealth as a mechanism to support implementation of MoCs is intuitive, given the capacity to up-scale effective technologies, to lever system and economic efficiencies, to contribute to sustainability, to adapt to low-resource settings and to mitigate access and care disparities [72, 73]. In Chapter 7, Slater and colleagues focus on the practical application of eHealth technologies across care settings to those MSK conditions contributing most substantially to the burden of disease, including osteoarthritis and inflammatory arthritis, skeletal fragility-associated conditions and persistent MSK pain.

At a macro level, the use of eHealth registries and central intake systems allow for efficient triaging and direction to appropriate clinical pathways with ongoing monitoring to ensure consumers receive the right care [74]. To match the escalating burden of MSK conditions, eHealth-enabled centralised referral systems in public healthcare settings will become even more important, to ensure timely access to appropriate care and to optimise service delivery efficiencies. Systems that offer standardised, efficient data entry, monitoring and management for end users, and also collect both clinical and patient-reported outcomes are necessary to address

such important public health issues. To date, this has been difficult to achieve, but recent initiatives such as the launch of The Swedish Fracture Registry, providing population-based data on fracture management in combination with patient-reported health outcomes, support the evaluation of system-wide MoCs for skeletal health [75]. Similar electronic systems for data capture, monitoring, and evaluation exist for persistent MSK pain. The electronic Persistent Pain Outcomes initiative (ePPOC), enables a systemised approach to electronic collection of a standard set of data items and assessment tools by specialist pain services throughout Australia and New Zealand and capture of person-centred and system outcomes in response to treatment [76]. In the United States of America, the Collaborative Health Outcomes Information Registry (CHOIR) system (<https://choir.stanford.edu/implementation/>) is an open source, free data-collection software created in partnership with cross-discipline scientists, clinical experts and the National Institutes of Health and allows clinicians to capture qualitative information from people with pain in a safe, secure, and easy-to-use system. Such systems will allow cross-jurisdictional comparison of treatment outcomes and clinical pathways, allowing for benchmarking of practice and economic analysis of cost effectiveness of MSK pain treatments.

eHealth systems can also facilitate building workforce capacity. For example, the TelePain Initiative has been implemented in Washington State, Wyoming, Alaska, Montana, and Idaho (USA), and uses video, web, and telephone conferencing technologies to bridge the gap in community needs for pain services [77]. Specific challenges (systems, clinician and patient, time and cost) highlight the critical role for strong cross-sector engagement as a cornerstone of successful implementation. In

low-income economies, partnership initiatives like the Telemedicine network, developed in Switzerland, can be used to scale up health professional education [73]. This initiative uses a suite of software tools specifically designed to work in low-bandwidth, low-infrastructure settings, to provide eLearning/mLearning distance education and tele-expertise consultations. This eHealth solution is suitable for rural, primary, secondary and tertiary care settings and has been implemented in areas of Africa, Bolivia and Laos.

For consumers, eHealth systems offer implementation support for MoC through a wide range of eHealth applications that aim to provide health information plus social support, decision support, and behaviour change support [74, 78]. In Chapter 7, Slater and colleagues demonstrate how advances in technologies have enabled real-time mobility and movement monitoring in natural settings [79], and how Internet-based treatment programs can support self-management of arthritis [80], bone health, and persistent MSK pain for adults [81] and for young people [82]. Online resources such as painHEALTH (<http://painhealth.csse.uwa.edu.au/>) and the Pain Tool Kit (<http://www.pain toolkit.org/>), offer free 24/7 access to practical knowledge and skills to support best practice pain co-care. Social media tools are another key driver of engaged and empowered patients taking a greater role in their own health care [83, 84]. Furthermore, the use of mHealth applications is transforming the health landscape. Young people in particular, many of whom are 'digital natives' indicate their preference for access to health services and resources is via eHealth and mHealth technologies [58], although this is not necessarily universal [85]. While the evidence of effectiveness lags behind the application of technology to health, it

is clear that health systems will need to catch up, as technology continues to gain momentum. This rapid pace of change is exciting and creates new opportunities for better supporting implementation of MoCs across care settings and the life course, while concurrently highlighting the critical need for implementation science research in this nascent area.

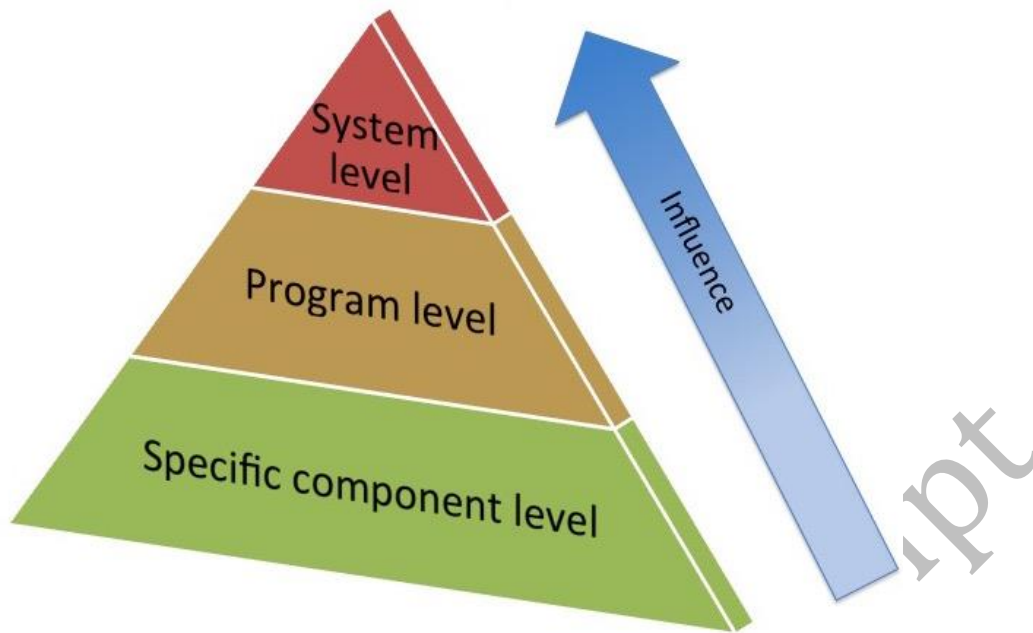
## Evaluating Models of Care for sustainable system reform

All current indications suggest that MoCs for the planning and delivery of evidence-informed and consumer-centred healthcare are here to stay in high-, middle- and low-income economies [17, 19, 30, 34, 36, 51, 86-88]. The Australian experience highlights that while MoCs offer improved consumer pathways of care (inclusive of experiences, satisfaction, access, safety and appropriateness) and system efficiencies, there remain significant challenges associated with sustainable implementation [65, 89]. This situation is anecdotally mirrored in other nations, as highlighted across the chapters in this issue of the Journal. There is an urgent need to optimise implementation approaches for MoCs. Continuous evaluation and monitoring of the outcomes of MoCs is critical to justify the resourcing and change processes required to support their integration into the highly complex, political and dynamic health landscape in a manner that is meaningful to decision makers [86, 90, 91].

Indeed, evaluation is a strategic priority of the Global Alliance for Musculoskeletal Health. Evaluation approaches for MoCs can be considered as a hierarchy (Figure 2).

Evaluation can be undertaken at the level of *specific components* of MoCs (e.g. strategies to build workforce capacity in skills and knowledge to deliver best MSK care [43, 45, 47]); evaluation of implementation of MoCs at a *system-wide programmatic level* (e.g. an osteoarthritis care program [48]); and the evaluation of MoCs at a *system-wide level* (e.g. influences on policy, funding decisions, resourcing decisions [89]). The majority of evaluation is targeted at the specific component level, since research questions are much simpler to answer at this level. Comparatively less work has been done at the systems level, largely because this level of evaluation requires significant resourcing contributions from administrative organisations, like Government, and evaluations take much longer to undertake and are inherently more complex. We suggest, however, that the impact and influence of system-wide or system-relevant evaluations are potentially far greater than component-level evaluations. Future evaluative work is therefore likely to be targeted more at the system level and will be facilitated through inter-agency partnership models and further accessibility to, and development of, linked data monitoring and data capture systems.





**Figure 2** Evaluation hierarchy for Models of Care. The potential impact and influence of evaluation outcomes increases with higher evaluation levels.

#### Ensuring effective implementation: readiness and success

As global momentum builds in the development of MoCs for NCDs, there is an increasingly important rationale to; i) develop strategies to optimise development efforts to ensure successful implementation, and ii) to support a standardised approach to outcomes evaluation. This will enable comparisons between various MoCs in order to generate a web of evidence meaningful to end users, and also allow the sharing and benchmarking of comparable outcomes between jurisdictions and/or nations.

A recent, large qualitative study provides primary evidence concerning the critical importance of appropriate evaluation of MoCs to i) optimise the chances of successful and sustainable implementation ('readiness evaluation') and ii) deliver meaningful indicators of implementation success ('success evaluation') [86]. Whereas the concept of success evaluation was well recognised and largely considered implicit as part of health system performance evaluation and quality improvement, the concept of readiness evaluation was considered far less well recognised. Readiness evaluation was found to be urgently needed, reflective of an appetite and expectation for deterministic and evaluative implementation approaches [92]. Further, these perceptions most likely reflect experiences of failed implementation beyond pilot studies and align with an emerging body of literature that now points to the need to assess organisational readiness for change in healthcare [37]. This is particularly so for chronic disease MoCs [94], and particularly relevant in primary care settings where the majority of MSK healthcare is delivered [37]. This approach to readiness assessment is not a new concept. Indeed, it is entrenched in the business sector. Here, it is considered a standard approach to business improvement and change management [95], embedded within contemporary implementation frameworks [92] and importantly, identified as a critical driver of evidence-practice gaps [37].

The need for outcomes (success) evaluation that considers consumer (i.e. patient reported), as well as system outcomes, is also apparent. While MoCs are necessarily jurisdictionally or nationally-specific, there is considerable risk of duplication in efforts when outcomes and experiences from MoCs, implemented in culturally and

socially similar contexts, are not shared. A level of standardisation is also important to ensure that evaluation endeavours produce outcomes that are meaningful to health decision makers.

### System-relevant evaluation outcomes: the importance of health economics

Evaluation efforts around MoCs must consider outcomes that are meaningful to end-users. Patient-reported outcomes are essential in order to judge quality, effectiveness, safety and satisfaction of care. In this context, there are many well-validated standard sets of outcome measures available, such as those recommended by the International Consortium for Health Outcomes Measurement (ICHOM) or the Patient-Reported Outcomes Measurement Information System (PROMIS). System-relevant outcomes are also important for making decisions about system change, particularly related to the economics of health service delivery. Since questions around resourcing implications and potential savings and cost effectiveness are of critical importance in health decision-making, system-wide evaluations are, necessarily informed largely by economic modelling. While the cost modelling of specific service change initiatives (i.e. a model of service delivery), such as a workforce role change [96], is important at a local service level, the broader system implications are not necessarily considered. Real cost calculations, undertaken retrospectively, are equally important for accurately assessing the status quo and observed trends *prior to* the introduction of system-level change: here the data may inform a rationale for change. A recent example is costing hospital care for osteoporotic fractures in Western Australia over the last 10 years, using linked data

systems [97]. Cost predictions at a systems level will also be critical to informing decisions about implementation of MoCs. For example, recent work by Ackerman et al [6] and Schofield et al [7] and based on the Arthritis, Diet and Activity Promotion Trial (ADAPT), estimated the health and broader economic benefits likely to be gained by implementation of a conservative care program for Australians with severe knee osteoarthritis [98]. They identified that hospital resource savings from avoiding or delaying knee joint replacement surgery would increase from \$170 million in 2015 to over \$233 million in 2030 based on 2015/16 Australian dollars [6]. The broader economic benefit of increased labour force participation from such conservative management of knee osteoarthritis in 15-64 year old Australians from 2015 to 2030, would be an increase in annual income from \$20.8 million to \$33.5 million. In 2015, there would be a saving of \$7.8 million in welfare payments (increasing to \$9.9 million in 2030) and an increase of \$5.4 million in taxation revenue (increasing to \$8.4 million in 2030) [7]. These broader system implications have significant value to government when developing and iterating contemporary policy frameworks.

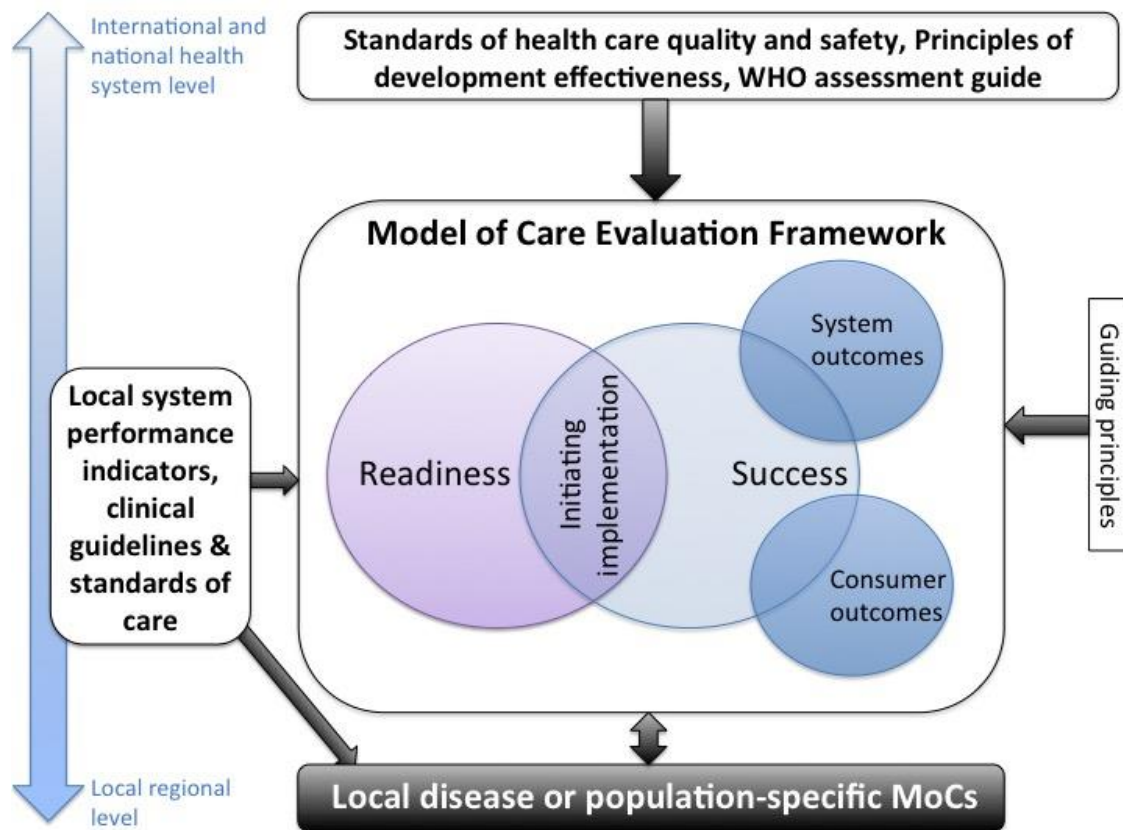
### [An internationally applicable approach to implementation](#)

Recently, an internationally-applicable approach to the development and evaluation of MSK MoCs has been developed [35, 41]. While the development of this Framework was grounded in MSK health, feasibly it could be applied to other chronic NCDs. Having been widely informed by stakeholders from 30 nations, the Framework is adaptable across settings in low, middle and high-income economies. The

Framework provides nations with an approach to guide development, implementation and evaluation of local MSK MoCs; considered a major priority across all nations [2, 17-19].

Applicability across nations is important. For this to be realised in practice, the Framework needs to articulate with established national health system development and evaluation approaches. In this context, the Framework aligns with the principles of Development Effectiveness, which are critical to health system reform initiatives in low and middle-income settings [17]. The Framework also aligns to healthcare quality dimensions applicable to high-income economies, such the Health Quality Council of Alberta Quality Matrix (<http://hgca.ca/about/how-we-work/the-alberta-quality-matrix-for-health-1/>), and the 2009 Australian National Health System Performance Framework (<http://meteor.aihw.gov.au/content/index.phtml/itemId/435314>).

At a disease-specific level, the Framework supports the adoption of consumer-centred Standards of Care for MSK conditions, such as those developed by the eumusc.net initiative [99, 100] and local, disease-specific system performance indicators [74, 101]. The articulation between the Framework, MoCs and these other guiding resources is illustrated in Figure 3. Further validating its components and use as a contemporary framework for evaluating development and implementation of MoCs, the Framework also aligns with contemporary generic implementation science frameworks [37, 53, 54].



**Figure 3** Schematic of where the Framework sits in relation to international and national health system guides and local/regional MoCs. WHO = World Health Organisation

## Summary

Models of Care are increasingly recognised as a system enabler for improving the planning and delivery of health services for NCDs, especially MSK conditions, by translating evidence into practical guidance. Sustainable implementation of MSK MoCs is important to realise improvements in population MSK health, improved health service delivery for people who live with chronic MSK conditions, and greater

system efficiencies. Implementation science is, therefore, fundamental to improving implementation initiatives. This issue of the Journal discusses the 'how to' of implementation for MSK MoCs across conditions and care settings. Cornerstones to effective implementation include sustained cross-sector engagement, support for clinical and administrative champions, alignment with existing health policy and system frameworks, and evaluating implementation efforts with consideration of patient-reported and system-relevant outcomes.

Accepted manuscript

**Table 1. A multi-level approach to addressing the burden of musculoskeletal (MSK) conditions, adapted from Briggs et al [19] (with permission from Oxford University Press).**

<i>System level factors</i>	<i>Determinants of musculoskeletal (MSK) health</i>
Macro	<p>The macro level considers the functionality and scope of health systems or organisations, health policy, infrastructure and resource allocation, and socioeconomic factors. Health systems/organisations and their governance through health policy play a critical role in the planning and delivery of MSK healthcare for older people. Healthcare systems in developed nations are usually oriented towards acute care services and respond to mortality risk rather than long-term morbidity associated with MSK conditions and their co-morbidities which stymies opportunities for service development in ambulatory and primary care – arguably, the setting where MSK healthcare is most needed. Given the MSK conditions are less frequently associated with mortality, health systems and policy tend to be less responsive to these conditions and place lower importance on the development of policies and programmes to address them. This contributes to a general lack of population awareness concerning the burden and impact associated with MSK conditions. Further, access to MSK healthcare is variable according to geography, ethnicity and socioeconomic status,</p>



	thus creating care disparities [102-106].
Meso	The meso level considers health services, the clinical workforce volume and competencies, health professional and student/trainee education, service delivery systems, funding models, and clinical infrastructure. Despite the identified burden of disease, the delivery of MSK care from practitioners and health systems inadequately aligns with best available evidence for what works [23, 25]. This may be attributed, in part, to deficiencies in knowledge and skills of health professionals, but is also largely influenced by funding and service models that inadequately support effective co-care. Access to, and delivery of, care is further complicated by the chronicity of MSK conditions and the high prevalence of comorbid conditions, particularly mental health conditions.
Micro	The micro level refers to the participation by the person in their care. The extent to which people participate in their care is largely dependent on their health literacy as it relates navigating the health system and MSK health. While all clinical guidelines recommend self-management by consumers, implicit in this expectation is that consumers have the knowledge and skills to do so. In many cases, this may not be the case, particularly for those people who live in socioeconomic disadvantage or in rural and remote settings. It is critical, therefore, for meso- and macro-level systems and services to build capacity in people to effectively participate in the management of their MSK health condition(s).

## References

1. Vos T, Barber RM, Bell B, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet 2015; **386**:743-800.
2. Vos T, Flaxman AD, Naghavi M, et al. Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet 2013; **380**:2163-96.
3. Arthritis and Osteoporosis Victoria. A problem worth solving. The rising cost of musculoskeletal conditions in Australia. Melbourne: Arthritis and Osteoporosis Victoria 2013.
4. Australian and New Zealand College of Anaesthetists. National Pain Strategy. Melbourne: Faculty of Pain Medicine 2010.
5. Institute of Medicine (IOM). Relieving Pain in America: A Blueprint for Transforming Prevention, Care, Education, and Research. Washington, DC: The National Academies Press 2011.
6. Ackerman IN, Bohensky MA, Pratt C, et al. Counting the Cost: Part 1 - Healthcare costs. The current and future burden of arthritis. Sydney: Arthritis Australia 2016.
7. Schofield D, Shrestha R, Cunich M. Counting the Cost: Part 2 - Economic Costs. The current and future burden of arthritis. Sydney: Arthritis Australia 2016.

8. United States Bone and Joint Initiative. The Burden of Musculoskeletal Diseases in the United States: Prevalence, Societal and Economic Cost. Rosemont, IL: USBJI 2016.
9. European Bone and Joint Health Strategies Project. European Action Towards Better Musculoskeletal Health. Lund: Department of Orthopaedics, University Hospital 2002.
10. Portenoy RK, Zeltzer L. A call to revolutionize chronic pain care in America: an opportunity in health care reform. New York: The Mayday Fund 2009.
11. The Pain Proposal Steering Committee. The pain proposal: improving the current and future management of chronic pain. A European consensus report. Belgium: European Pain Federation 2010.
12. Societal Impact of Pain Group. Societal Impact of Pain focus group report. Belgium: Societal Impact of Pain 2013.
13. Woo J, Lau E, Lau CS, et al. Socioeconomic impact of osteoarthritis in Hong Kong: utilization of health and social services, and direct and indirect costs. Arthritis Rheum 2003; **49**:526-34.
14. Xie F, Thumboo J, Fong KY, et al. Direct and indirect costs of osteoarthritis in Singapore: a comparative study among multiethnic Asian patients with osteoarthritis. J Rheumatol 2007; **34**:165-71.
15. Schofield DJ, Callander EJ, Shrestha RN, et al. Multiple chronic health conditions and their link with wealth assets. Eur J Public Health 2015; **25**:285-9.
16. Schofield DJ, Shrestha RN, Cunich M, et al. Lost productive life years caused by chronic conditions in Australians aged 45-64 years, 2010-2030. Med J Aust 2015; **203**:260.

- \*\*17. Hoy D, Geere JA, Davatchi F, et al. A time for action: Opportunities for preventing the growing burden and disability from musculoskeletal conditions in low- and middle-income countries. Best Pract Res Clin Rheumatol 2014; **28**:377-93.
18. March L, Smith EU, Hoy DG, et al. Burden of disability due to musculoskeletal (MSK) disorders. Best Pract Res Clin Rheumatol 2014; **28**:353-66.
- \*\*19. Briggs AM, Cross MJ, Hoy DG, et al. Musculoskeletal health conditions represent a global threat to healthy aging: A report for the 2015 World Health Organisation World Report on Ageing and Health. Gerontologist 2016; **56**:S234-S55.
20. World Health Organisation. Better non-communicable disease outcomes: Challenges and opportunities for health systems. Assessment Guide. Copenhagen: WHO Regional Office for Europe 2014.
21. World Health Organisation. Global action plan for the prevention and control of noncommunicable diseases 2013-2020. Geneva: WHO2013.
22. Grol R. Successes and failures in the implementation of evidence-based guidelines for clinical practice. Med Care 2001; **39**:II46-54.
23. Grol R, Grimshaw J. From best evidence to best practice: effective implementation of change in patients' care. Lancet 2003; **362**:1225-30.
24. McGlynn EA, Asch SM, Adams J, et al. The quality of health care delivered to adults in the United States. N Engl J Med 2003; **348**:2635-45.
25. Runciman WB, Hunt TD, Hannaford NA, et al. CareTrack: assessing the appropriateness of health care delivery in Australia. Med J Aust 2012; **197**:100-5.
26. Briggs AM, Jordan JE, O'Sullivan PB, et al. Individuals with chronic low back pain have greater difficulty in engaging in positive lifestyle behaviours than those

without back pain: An assessment of health literacy. BMC Musculoskelet Disord 2011; **12**:161.

27. Jordan JE, Briggs AM, Brand C, et al. Enhancing patient engagement in chronic disease self-management support initiatives in Australia: The need for an integrated approach. Med J Aust 2008; **189**:S9-S13.

28. Hinman RS, Nicolson PJ, Dobson FL, et al. Use of nondrug, nonoperative interventions by community-dwelling people with hip and knee osteoarthritis. Arthritis Care Res 2015; **67**:305-9.

29. Brand C, Hunter D, Hinman R, et al. Improving care for people with osteoarthritis of the hip and knee: how has national policy for osteoarthritis been translated into service models in Australia? Int J Rheum Dis 2011; **14**:181-90.

\*\*30. Briggs AM, Towler SC, Speerin R, et al. Models of care for musculoskeletal health in Australia: now more than ever to drive evidence into health policy and practice. Aust Health Rev 2014; **38**:401-5.

31. Hunter DJ, Neogi T, Hochberg MC. Quality of osteoarthritis management and the need for reform in the US. Arthritis Care Res (Hoboken) 2011; **63**:31-8.

32. Woolf AD, Akesson K. Understanding the burden of musculoskeletal conditions. The burden is huge and not reflected in national health priorities. BMJ (Clinical research ed) 2001; **322**:1079-80.

33. Briggs AM, Buchbinder R. Back pain: A National Health Priority Area in Australia? Med J Aust 2009; **190**:499-502.

34. Briggs AM, Bragge P, Slater H, et al. Applying a Health Network approach to translate evidence-informed policy into practice: a review and case study on musculoskeletal health. BMC Health Serv Res 2012; **12**:394.

- \*\*35. Briggs AM, Jordan JE, Jennings M, et al. Supporting evaluation and implementation of musculoskeletal Models of Care: Development of a globally-informed framework for judging 'readiness' and 'success'. Arthritis Care Res 2016; DOI: 10.1002/acr.22948.
- \*\*36. Speerin R, Slater H, Li L, et al. Moving from evidence to practice: Models of care for the prevention and management of musculoskeletal conditions. Best Pract Res Clin Rheumatol 2014; **28**:479-515.
- \*\*37. Lau R, Stevenson F, Ong BN, et al. Achieving change in primary care--causes of the evidence to practice gap: systematic reviews of reviews. Implement Sci 2016; **11**:40.
- \*\*38. Atun R, Jaffar S, Nishtar S, et al. Improving responsiveness of health systems to non-communicable diseases. Lancet 2013; **381**:690-7.
39. Cunningham FC, Morris AD, Braithwaite J. Experimenting with clinical networks: the Australasian experience. J Health Organ Management 2012; **26**:685-96.
40. Cunningham FC, Ranmuthugala G, Westbrook JI, et al. Net benefits: assessing the effectiveness of clinical networks in Australia through qualitative methods. Implement Sci 2012; **7**:108.
- \*\*41. Briggs AM, Jordan JE, Jennings M, et al. A Framework to Evaluate Musculoskeletal Models of Care. Cornwall: Global Alliance for Musculoskeletal Health of the Bone and Joint Decade 2016.
42. Davies S, Quintner J, Parsons R, et al. Preclinic group education sessions reduce waiting times and costs at public pain medicine units. Pain Med 2011; **12**:59-71.

43. Slater H, Briggs AM, Smith AJ, et al. Implementing evidence-informed policy into practice for health care professionals managing people with low back pain in Australian rural settings: a preliminary prospective single-cohort study. Pain Med 2014; **15**:1657-68.
44. Slater H, Briggs AM, Watkins K, et al. Translating evidence for low back pain management into a consumer-focussed resource for use in community pharmacies: a cluster-randomised controlled trial. PLoS One 2013; **8**:e71918.
45. Slater H, Davies SJ, Parsons R, et al. A policy-into-practice intervention to increase the uptake of evidence-based management of low back pain in primary care: A prospective cohort study. PLoS ONE 2012; **7**:e38037.
46. O'Connell Advisory. Pain Management Model of Care: Formative Evaluation. Sydney: NSW Agency for Clinical Innovation 2015.
47. Fary RE, Slater H, Chua J, et al. Policy-into-practice for rheumatoid arthritis: Randomized controlled trial and cohort study of e-learning targeting improved physiotherapy management. Arthritis Care Res 2015; **67**:913-22.
48. Deloitte Access Economics. Osteoarthritis Chronic Care Program Evaluation. Sydney: NSW Agency for Clinical Innovation 2015.
49. Aspex Consulting. Formative evaluation of the osteoporotic re-fracture prevention project. Final evaluation report. Sydney: NSW Health Agency for Clinical Innovation 2012.
50. Cassels A, Janovsky K. Better health in developing countries: are sector-wide approaches the way of the future? Lancet 1998; **352**:1777-9.

51. Haldeman S, Nordin M, Outerbridge G, et al. Creating a sustainable model of spine care in underserved communities: the World Spine Care (WSC) charity. Spine J 2015; **15**:2303-11.
52. Bourne AM, Whittle SL, Richards BL, et al. The scope, funding and publication of musculoskeletal clinical trials performed in Australia. Med J Aust 2014; **200**:88-91.
53. Damschroder LJ, Aron DC, Keith RE, et al. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. Implement Sci 2009; **4**:50.
54. Michie S, van Stralen MM, West R. The behaviour change wheel: A new method for characterising and designing behaviour change interventions. Implement Sci 2011; **6**.
55. Akesson K, Marsh D, Mitchell PJ, et al. Capture the Fracture: a Best Practice Framework and global campaign to break the fragility fracture cycle. Osteoporos Int 2013; **24**:2135-52.
56. Australian Institute of Health & Welfare. When musculoskeletal conditions and mental disorders occur together. Canberra: AIHW2010 Contract No.: Bulletin 80.
57. Dominick CH, Blyth FM, Nicholas MK. Unpacking the burden: understanding the relationships between chronic pain and comorbidity in the general population. Pain 2012; **153**:293-304.
58. Slater H, Jordan JE, Chua J, et al. Painful Transitions: An investigation of young people's experiences of living with persistent musculoskeletal pain, interactions with health services and their needs and preferences for optimal pain management. Melbourne: Arthritis and Osteoporosis Victoria and Arthritis and Osteoporosis Western Australia 2016.



59. Hoy DG, Rickart KT, Durham J, et al. Working together to address disability in a culturally-appropriate and sustainable manner. Disabil Rehabil 2010; **32**:1373-5.
60. Organisation for Economic and Co-operation Development. The Busan Partnership for Effective Development Co-operation. Paris: OECD 2011.
61. Spiegel DA, Gosselin RA, Coughlin RR, et al. The burden of musculoskeletal injury in low and middle-income countries: challenges and opportunities. J Bone Joint Surg Am 2008; **90**:915-23.
62. Spiegel DA. ABJS/CT Brighton workshop on musculoskeletal trauma in developing countries - Comment. Clinical Orthopaedics and Related Research 2008; **466**:2297-305.
63. World Health Organisation. People at the Centre of Health Care: Harmonizing mind and body, people and systems. Manila: WHO (Western Pacific Region) 2007.
64. Lowe D, Ryan R, Santesso N, et al. Development of a taxonomy of interventions to organise the evidence on consumers' medicines use. Patient Educ Couns 2011; **85**:101-7.
65. Department of Health (Western Australia). Results of the models of care survey: A snapshot of how models of care have been implemented in Western Australia. Perth: Health Networks Branch 2012.
66. Wluka AE, Chou L, Briggs AM, et al. Consumers' perceived needs of health information, health services and other non-medical services: A systematic scoping review Melbourne: MOVE muscle, bone & joint health 2016.
67. World Health Organisation. World Report on Ageing and Health. Geneva: WHO 2015.

68. Gardner P, Slater H, Jordan JE, et al. Physiotherapy students' perspectives of online e-learning for interdisciplinary management of chronic health conditions: a qualitative study. BMC Med Educ 2016; **16**:62.
69. Chehade MJ, Bachorski A. Development of the Australian Core Competencies in Musculoskeletal Basic and Clinical Science project - phase 1. Med J Aust 2008; **189**:162-5.
70. Chehade MJ, Burgess TA, Bentley DJ. Ensuring Quality of Care Through Implementation of a Competency-Based Musculoskeletal Education Framework. Arthritis Care Res 2011; **63**:58-64.
71. World Health Organisation. Atlas of eHealth country profiles: the use of eHealth in support of universal health coverage. Based on the findings of the third global survey on eHealth 2015. Geneva: WHO 2016.
72. World Economic Forum INSEAD. The Global Information Technology Report 2015. Geneva: World Economic Forum 2015.
73. World Health Organisation. Compendium of innovative health technologies for low-resource settings: assistive devices, eHealth solutions, medical devices, 2011-2013. Geneva: WHO 2014.
74. Barber CE, Patel JN, Woodhouse L, et al. Development of key performance indicators to evaluate centralized intake for patients with osteoarthritis and rheumatoid arthritis. Arthritis Res Ther 2015; **17**:322.
75. Wennergren D, Ekholm C, Sandelin A, et al. The Swedish fracture register: 103,000 fractures registered. BMC Musculoskelet Disord 2015; **16**:338.

76. Tardif H, Blanchard M, Fenwick N, et al. Persistent Pain Outcomes Collaboration National Report 2014. Wollongong: Australian Health Services Research Institute, University of Wollongong 2015.
77. Eaton LH, Gordon DB, Wyant S, et al. Development and implementation of a telehealth-enhanced intervention for pain and symptom management. Contemp Clin Trials 2014; **38**:213-20.
78. Li LC, Adam PM, Townsend AF, et al. Usability testing of ANSWER: a web-based methotrexate decision aid for patients with rheumatoid arthritis. BMC Med Inform Decis Mak 2013; **13**:131.
79. Shotton J, Sharp T, Kipman A, et al. Real-time human pose recognition in parts from single depth images. Commun ACM 2013; **56**:116-24.
80. Brosseau L, Wells G, Brooks-Lineker S, et al. Internet-based implementation of non-pharmacological interventions of the "people getting a grip on arthritis" educational program: an international online knowledge translation randomized controlled trial design protocol. JMIR Res Protoc 2015; **4**:e19.
81. Dear BF, Titov N, Perry KN, et al. The Pain Course: a randomised controlled trial of a clinician-guided Internet-delivered cognitive behaviour therapy program for managing chronic pain and emotional well-being. Pain 2013; **154**:942-50.
82. Stinson JN, Lalloo C, Harris L, et al. iCanCope with Pain: User-centred design of a web- and mobile-based self-management program for youth with chronic pain based on identified health care needs. Pain Res Manag 2014; **19**:257-65.
83. Stellefson M, Chaney B, Barry AE, et al. Web 2.0 chronic disease self-management for older adults: a systematic review. J Med Internet Res 2013; **15**:e35.

84. Swan M. Health 2050: The Realization of Personalized Medicine through Crowdsourcing, the Quantified Self, and the Participatory Biocitizen. J Personalized Med 2012; **2**:93-118.
85. Ackerman IN, Bucknill A, Page RS, et al. Preferences for disease-related education and support among younger people with hip or knee osteoarthritis. Arthritis Care Res (Hoboken) 2016.
- \*\*86. Briggs AM, Jordan JE, Speerin R, et al. Models of care for musculoskeletal health: a cross-sectional qualitative study of Australian stakeholders' perspectives on relevance and standardised evaluation. BMC Health Serv Res 2015; **15**:509.
87. Davis AM, Cott C, Wong R, et al. Models Of Care For Arthritis: Drivers, Facilitators and Barriers To Their Development and Implementation. Arthritis Rheum 2013; **65**:S822-S3.
88. MacKay C, Veinot P, Badley EM. Characteristics of evolving models of care for arthritis: a key informant study. BMC Health Serv Res 2008; **8**:147.
89. Department of Health (Western Australia). Implementation of models of care and frameworks – progress report 2015 Perth: Strategic System Policy and Planning Division, WA Department of Health 2015.
90. Bourgeault IL. The importance of evaluating new models of care to better meet patient needs. Healthcare Papers 2013; **13**:32-5; discussion 52-5.
- \*\*91. Kadu MK, Stolee P. Facilitators and barriers of implementing the chronic care model in primary care: a systematic review. BMC Family Practice 2015; **16**.
92. Nilsen P. Making sense of implementation theories, models and frameworks. Implement Sci 2015; **10**:53.

94. Gagnon MP, Labarthe J, Legare F, et al. Measuring organizational readiness for knowledge translation in chronic care. Implement Sci 2011; **6**.
95. Kotter JP. *Leading Change*. Boston: Harvard Business Review Press; 1996.
96. Standfield L, Comans T, Raymer M, et al. The efficiency of increasing the capacity of physiotherapy screening clinics or traditional medical services to address unmet demand in orthopaedic outpatients: A practical application of discrete event simulation with dynamic queuing. Appl Health Econ Health Policy 2016.
97. Briggs AM, Sun W, Miller LJ, et al. Hospitalisations, admission costs and re-fracture risk related to osteoporosis in Western Australia are substantial: a 10-year review. Aust N Z J Public Health 2015; **39**:557-62.
98. Messier SP, Loeser RF, Miller GD, et al. Exercise and dietary weight loss in overweight and obese older adults with knee osteoarthritis: the Arthritis, Diet, and Activity Promotion Trial. Arthritis Rheum 2004; **50**:1501-10.
99. Stoffer MA, Smolen JS, Woolf A, et al. Development of patient-centred standards of care for osteoarthritis in Europe: the eumusc.net-project. Ann Rheum Dis 2015; **74**:1145-9.
100. Stoffer MA, Smolen JS, Woolf A, et al. Development of patient-centred standards of care for rheumatoid arthritis in Europe: the eumusc.net project. Ann Rheum Dis 2014; **73**:902-5.
101. Barber CE, Marshall D, Mosher D, et al. Development of system-level performance measures for evaluation of models of care for inflammatory arthritis in Canada. J Rheumatol 2016; **43**:530-40.

102. Briggs AM, Slater H, Bunzli S, et al. Consumers' experiences of back pain in rural Western Australia: access to information and services, and self-management behaviours. BMC Health Serv Res 2012; **12**:357.
103. Anderson KO, Green CR, Payne R. Racial and Ethnic Disparities in Pain: Causes and Consequences of Unequal Care. J Pain 2009; **10**:1187-204.
104. Jacobi CE, Mol GD, Boshuizen HC, et al. Impact of socioeconomic status on the course of rheumatoid arthritis and on related use of health care services. Arthritis Rheum-Arthritis Care Res 2003; **49**:567-73.
105. Meghani SH, Polomano RC, Tait RC, et al. Advancing a National Agenda to Eliminate Disparities in Pain Care: Directions for Health Policy, Education, Practice, and Research. Pain Medicine 2012; **13**:5-28.
106. Al Maini M, Adelowo F, Al Saleh J, et al. The global challenges and opportunities in the practice of rheumatology: white paper by the World Forum on Rheumatic and Musculoskeletal Diseases. Clin Rheumatol 2015; **34**:819-29.