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Costing Methodology and Key Drivers of Health Care Costs Within Economic Analyses in Musculoskeletal Community and Primary Care Services: A Systematic Review of the Literature

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Abstract

Background: Identifying variation in musculoskeletal service costs requires the use of specific standardized metrics. There has been a large focus on costing, efficiency, and standardized metrics within the acute musculoskeletal setting, but far less attention in primary care and community settings. **Objectives:** To (*a*) assess the quality of costing methods used within musculoskeletal economic analyses based primarily in primary and community settings and (*b*) identify which cost variables are the key drivers of musculoskeletal health care costs within these settings. **Methods:** Medline, AMED, EMBASE, CINAHL, HMIC, BNI, and HBE electronic databases were searched for eligible studies. Two reviewers independently extracted data and assessed quality of costing methods using an established checklist. **Results:** Twenty-two studies met the review inclusion criteria. The majority of studies demonstrated moderate- to high-quality costing methods. Costing issues included studies failing to fully justify the economic perspective, and not distinguishing between short- and long-run costs. Highest unit costs were hospital admissions, outpatient visits, and imaging. Highest mean utilization were the following: general practitioner (GP) visits, outpatient visits, and physiotherapy visits. Highest mean costs per patient were GP visits, outpatient visits, and physiotherapy visits. **Conclusion:** This review identified a number of key resource use variables that are driving musculoskeletal health care costs in the community/primary care setting. High utilization of these resources (rather than high unit cost) appears to be the predominant factor increasing mean health care costs. There is, however, need for greater detail with capturing these key cost drivers, to further improve the accuracy of costing information.

Keywords

costing, economic analysis, musculoskeletal health, cost drivers

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Introduction

Musculoskeletal (MSK) conditions account for the third largest area of NHS program spending (£4.7 billion in 2013-2014).[1,2] Following Lord Carter's review for the Department of Health in 2016,[3] there has been an increased focus on high-cost procedures and interventions, and on defining, mapping, and collecting cost data. This focus includes areas such as elective surgical procedures and MSK trauma admissions.[3,4] However, there has been significantly less attention given to defining costs and collecting widespread comparable MSK cost data in primary and community settings.

Unwarranted variation within the NHS acute sector has been estimated at a value of £5bn in terms of an efficiency opportunity.[3] This was estimated by reviewing all key resource areas such as clinical staff, pharmacy and medicines, diagnostics and imaging, procurement, back office functions and estates and facilities.[3] Identifying variation requires the use of these specific metrics as outlined in Lord

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Carter's report and there has been a large focus on costing and efficiency in acute care, leading to clear examples of unwarranted variation being identified within acute services. Hip prostheses, for example, have been shown to vary in cost from £788 to £1590 across NHS Trusts, with those buying the most not paying the least.[3] This work is developing within the Model Hospital,[4] a digital information service set up to support secondary care providers to improve productivity and efficiency. The Model Hospital demonstrates how appropriately applied metrics can allow for a useful comparison of services and their efficiency. However, similar economic metrics have not yet been formalized or evaluated for MSK primary and community care in the United Kingdom.

Economic evaluation is "the comparative analysis of alternative courses of action in terms of both their costs and consequences."[5] The objectives of health economic analyses are to identify, measure, value, and compare costs and consequences of alternative treatments/pathways of care.[5] Economic evaluation techniques therefore provide the framework for capturing costs and outcomes/benefits of different health interventions.[6] In this review economic costing methodology will be explored, with the aim of identifying the most important cost variables for making resource use comparisons within primary and community MSK settings. The quality of costing methods will also be evaluated to determine the strength of these findings.

Graves et al[7] described 12 criteria for specifically assessing the quality of costing methods of economic analyses. These criteria include, for example, stating and justifying the perspective, distinguishing between short and long run costs, and reporting methods for estimating quantities of resources. Graves et al[7] reviewed 45 economic analyses against the 12 criteria in 2002, and concluded that more attention should be given to costing methods to ensure the accuracy of costing estimates.

Mogyorosy and Smith[8] also reviewed methodological issues with costing health care services across Europe in 2005 and highlighted the usefulness of defining cost drivers. Cost drivers are variables such as medical visits that affect costs over a given period of time and can be directly linked to changes in costs.[9] It is important to identify the most relevant cost drivers for a specific setting as these can help explain changes or differences in overall costs of care. It is also sometimes sufficient and necessary to limit data collection (or costing) to the key cost drivers.[10] Activity-based costing looks to improve the accuracy of cost estimation by using multiple cost drivers.[8]

Costing within economic analyses will differ dependent on the perspective, which can include a health perspective looking at direct costs to health managers, or a societal perspective looking at direct and indirect costs, including productivity losses.[11] In this review, only direct health care costs will be examined in detail as the review looks to identify key drivers of MSK health care costs only.

This review aims therefore to evaluate the quality of costing methods used within MSK economic analyses and also to identify the most important cost drivers (provider variables) that could be reported by individual primary care and community MSK services and used to develop a system level methodology to broadly cost and compare these services. The perspective will be that of a health service perspective looking at costs incurred by MSK patients being predominantly treated in community/primary care, as this is the area at present where a clear methodology is lacking.

Method

This review followed protocol guidance set out within the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement[12] (see Supplement 1 for PRISMA Checklist).

Eligibility Criteria

Inclusion criteria were the following: all types of economic analyses, economic analysis needed to be the primary focus of the study and clearly stated from the outset, studies published within the past 10 years (January 2008 to May 2018) in order to ensure applicability of costing approaches, English language papers only (due to resource limitations of the review), studies primarily set within community or primary care health settings to support the focus of the paper, patient population to include patients undergoing treatment for most prevalent MSK disorders (back, neck, shoulder, knee or all MSK conditions,[13,14] studies needed to report disaggregated health care costs, and papers needed to be published in full within a peer-reviewed journal.

Searches

Medline, AMED, EMBASE, CINAHL, HMIC, BNI, and HBE electronic databases were searched. Searches were limited to papers within the past 10 years only to ensure applicability when looking to review costing methods. Search terms were grouped into core areas of type of economic evaluation such as cost benefit or cost utility,[6] study type such as analysis or evaluation, and prevalent MSK condition such as back, neck, knee, or shoulder.[13,14] Searches were combined using Boolean logic (AND and OR). Additional gray literature was identified using reference lists of included articles. Included studies were required to have a combination of key search terms (Table 1) within the study title, to ensure studies were focused on economic evaluation, and not on intervention effectiveness.

The review did not set out to identify every economic analysis within the field of MSK, but to systematically

Table 1. Search Terms.

Column 1 (Economic Evaluation Type)	Column 2 (Study Type Required)	Column 3 (Musculoskeletal Conditions)
Economic	Analysis	Musculoskeletal
Cost consequence	Evaluation	Back
Cost benefit		Neck
Cost utility		Spinal
Cost-effectiveness		Knee
Cost minimization/minimization		Shoulder

identify economic analyses within the field of MSK from community/primary care settings that met the inclusion criteria, using a structured, transparent, and reproducible search methodology. The full electronic search strategy for searching the database Medline can be viewed within Supplement 2.

Selection Criteria

One reviewer (RB) reviewed search results and identified those based on title and abstract unquestionably excluded from the review, and those appropriate for full review. The same reviewer (RB) and a second reviewer (JH) then independently read full papers for identified studies and determined eligibility based on inclusion/exclusion criteria to ensure all criteria were met for inclusion into the systematic review.

Data Extraction

Data were extracted using an extraction sheet made up of study descriptors such as author, year, title, objectives, setting, population, study size, perspective, outcomes, cost variables, cost year, costing sources, and analysis type, for example, cost-effectiveness analysis (CEA), cost utility analysis (CUA), cost benefit analysis (CBA), cost consequence analysis (CCA). This was followed by the 12 quality criteria described by Graves et al.[7] Two reviewers independently extracted data (RB and JH), one reviewer had a clinical MSK background (RB) and one was a health economist (JH). All health care costs were extracted and included whether the cost was for treatment within primary, community or secondary care as although the studies were predominantly set within primary care/community clinics, costs were still borne by the health care system across all settings (eg, if a patient was sent for an investigation or consultant opinion).

The focus of the study was restricted to costs and therefore outcomes and specific interventions were not reviewed. Detailed costs were reported and analyzed for the usual care/control groups only in order to allow for broad comparisons of key cost drivers to be made across studies. Due to the broad focus of the review (including all common MSK conditions) cost drivers were ranked for each study rather than being directly compared.

Quality of Costing Methodology

Quality of costing methods within included studies was evaluated using 12 criteria described by Graves et al[7] and following this guidance organized into 4 predefined categories; general costing issues (criteria 1-4), methods used to determine the quantities of resources (criteria 5-7), methods used to determine the value of resources consumed (criteria 8 and 9), and reporting of data (criteria 10-12).[7] Quality of costing methodology within studies was evaluated independently by 2 reviewers (RB and JH) and inputted directly into the extraction sheet. A third reviewer was then available (ML) if agreement could not be reached.

Results

Search Results

A total of 751 records were identified through electronic searching of relevant databases. This gave 344 records after electronic duplicates were removed (see Figure 1 for detail).

Following initial review of titles and abstracts 276 articles were excluded for failing to meet the eligibility criteria. Following full review of the remaining 68 articles against eligibility criteria by the 2 reviewers, 22 studies were suitable for inclusion in the review. The main reasons for exclusion were the following: not providing disaggregated costs to determine patient-level health care costs, not being undertaken from the right clinical setting, being a secondary analysis rather than a preplanned economic analysis, being an abstract only, or being a model or review rather than a primary study.

The majority of studies were economic analyses conducted alongside randomized controlled trials (n = 21) or other trial-based analyses (n = 1).[15] See Table 2 for characteristics of included studies.

Quality of Costing Methodology in Included Studies

The results of quality assessment of costing methodology are summarized in Table 3, following criteria set out by Graves et al.[7]

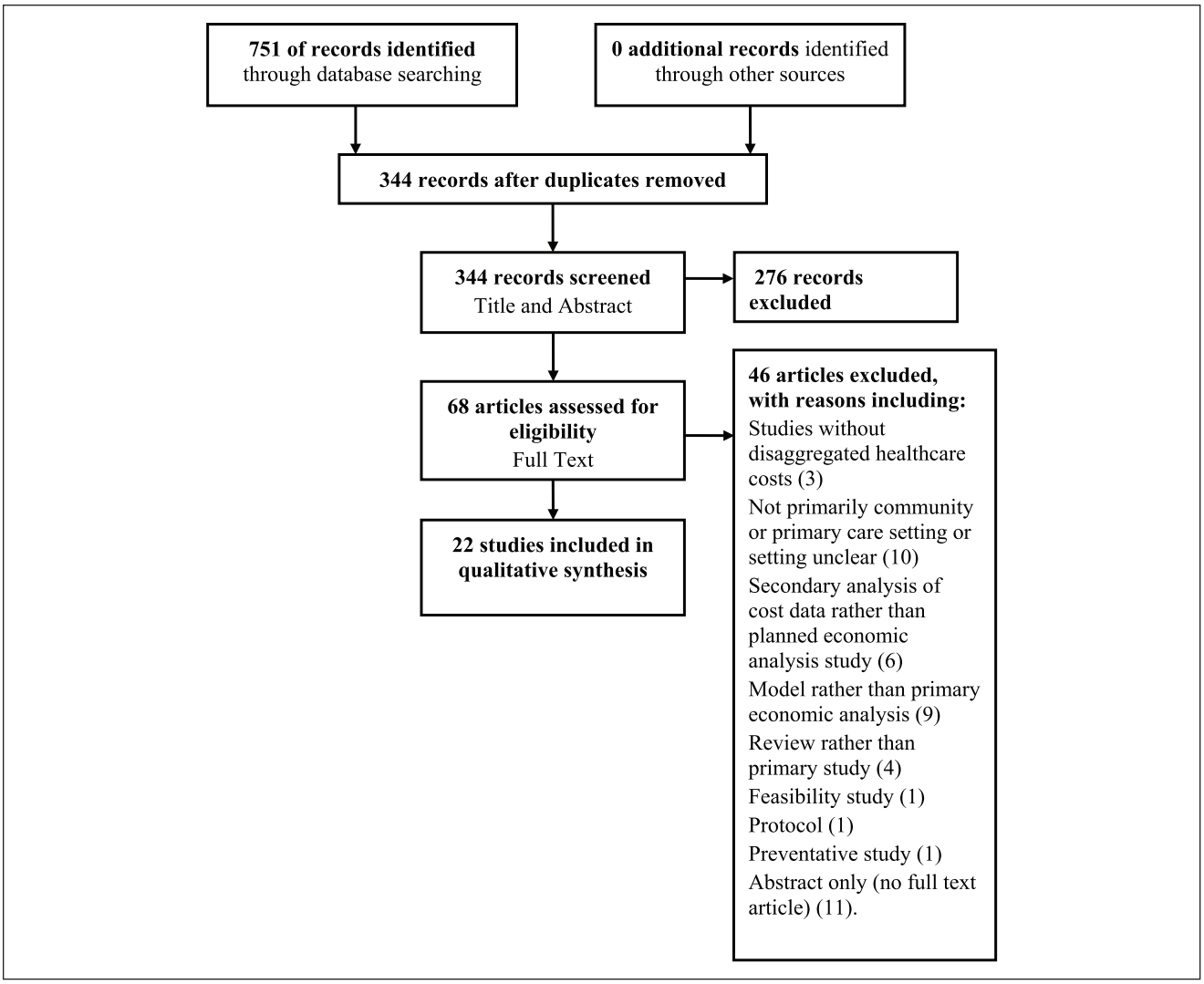

Figure 1. Flowchart of search results.

Costing Criteria

Category 1: General Costing Issues (Questions 1-4). The majority of studies stated the economic perspective (Q1) (21 out of 22) with a mixture of health care perspective (n = 4), societal perspective with disaggregated costs (n = 9), both health care and societal perspective stated (n = 8), and one with no perspective stated but with disaggregated health care costs. The majority of studies did not fully justify their perspective (Q2) but simply stated it within their introduction or methods (7/22 fully justified stated perspective, and 7/22 partially justified). Studies scored as "partial" for Q2 did not give an explicit statement but gave some form of justification within the introduction/methods for their approach such as discussing at length the societal burden of the MSK condition then adopting a societal perspective. All studies apart from one study[16] (and the study without a stated perspective[17]) gave cost data that satisfied the stated perspective (Q3).

Category 2: Methods Used to Determine the Quantity of Resources Used (Questions 5-7). As within the review by Graves et al,[7] studies rarely made a distinction between short- and long-run costs (Q4) (only 1/22 studies[18]). Methods for quantities of resources used by patients (Q5) were largely based on patient self-report cost diaries either collected through a questionnaire or through interview that detailed resource utilization such as clinical visits to GP (general practitioner), practice nurse, physiotherapist, hospital outpatient appointment, day case and other hospital admissions, A&E (accidents and emergencies), and prescriptions,[19] (21/22 studies used some form of self-report questionnaire). Other methods included using clinician inputted data[18] and extracting data from medical databases.[16,20] The study by Pinto

Table 2. Characteristics of Included Studies.

First Author (Reference number)	Country/Origin	Population	RCT	Setting	Study Size (No. of Patients)	Analysis Type	Group Costs Reported for in Analysis
Barton[33] 2009	UK	OA knee with high BMI (>28 kg/m^2)	Yes	PC	389	CUA	Usual care
Bosmans[29] 2011	Netherlands	Subacute neck pain	Yes	PC and C	146	CUA	Usual care
Bultmann[20] 2009	Denmark	MSK disorder	Yes	C	119	CBA	Usual care
Chuang[26] 2012	UK	Chronic LBP	Yes	PC and C	313	CEA	Usual care
Essex[19] 2017	UK	Neck pain	Yes	PC and C	293	CEA, CUA	Usual care
Haines[31] 2017	Australia	Chronic LBP	Yes	PC and C	112	CEA	Usual care
Henchoz[32] 2010	Switzerland	Chronic LBP	Yes	PC and C	105	CUA	Usual care
Hollinghurst[27] 2008	UK	Persistent back pain	Yes	PC and C	579	CUA	Usual care
Hollinghurst[18] 2013	UK	MSK disorder	Yes	C	2249	CCA and CUA	Usual care
Jenson[16] 2017	Denmark	LBP	Yes	PC	1101	CUA	Usual care
Jowett[28] 2013	UK	Shoulder	Yes	PC and C	232	CUA	Usual care
Lamb[22] 2010	UK	Subacute or chronic LBP	Yes	PC	701	CUA	Usual care
Lambeek[40] 2010	Netherlands	Chronic LBP	Yes	PC and SC	134	CUA	Usual care
Marra[34] 2014	Canada	Knee OA	Yes	PC	139	CUA	Usual care
McKenna[24] 2009	UK	Acute shoulder pain	Yes	PC	200	CEA, CUA	Usual care
Pinto[21] 2013	New Zealand	Knee and hip OA	Yes	PC and C	206	CEA and CUA	Usual care
Saha[35] 2018	Swedan	Neck or back pain	Yes	PC and C	352	CEA, CUA	Usual care
Smeets[33] 2009	Netherlands	Chronic LBP	Yes	C	172	CEA, CUA	Combined treatment
van de Roer[30] 2008	Netherlands	Chronic LBP	Yes	C	114	CEA and CUA	Usual care
Vermeulen[41] 2013	Netherlands	MSK disorder	Yes	C	163	CEA	Usual care
Werner[17] 2016	Norway	LBP	Yes	PC	216	CEA	Usual care
Whitehurst[15] 2015	UK	LBP	No (cohort study)	PC	922	CUA	Usual care

Abbreviations: C, community; RCT, randomized controlled trial; CEA, cost-effectiveness analysis; CBA, cost benefit analysis; CUA, cost utility analysis; CCS, const consequence analysis; BMI, body mass index; LBP, low back pain; MSK, musculoskeletal; OA, osteoarthritis; PC, primary care; SC, secondary care.

et al[21] used the Osteoarthritis Cost and Consequences Questionnaire (OCC-Q) to collect cost data from patients, and then cross-checked this information against national GP and health information databases. All studies met this criterion.

The majority of studies (20/22) described their methods for allocating time for human resources (Q6). Included studies mainly used the national average times for each type of health care consultation to estimate costs, other studies split time for group sessions between participants,[22,23] and some were unclear.[20] Methods for allocating prices between patients (Q7) were also often only clear within intervention group sessions where the cost was split between patients,[23] or through splitting the cost of intervention training,[24] although some studies detailed splitting the cost for shared capital costs such as staff travel and space provided by the NHS.[22]

Category 3: Methods Used to Determine the Value of Resources Consumed (Questions 8 and 9). The majority of studies (19/22) gave methods for the estimation of prices, unit costs, or charges (Q8), with most studies counting all resource inputs for each patient such as visits to the GP or physiotherapist, and multiplying each by the unit cost to provide the direct cost for each group of patients and then calculating the mean resource cost per patient. Published estimates of unit costs were used by the majority of studies, including, for example, UK NHS Reference Costs and Unit Costs of Health and Social Care publications by Curtis and Burns[25] for secondary care and primary care costs respectiv ely,[15,18,19,26-28] the Danish National Health Insurance Service Register (primary care), Danish National Patient Register (secondary care) and Danish National Prescription Registry (medication),[16] the Dutch Guidelines or Dutch Central Organisation for Healthcare Charges (primary and secondary care costs) or the Royal Dutch Society of Pharmacy (medication),[29,30] or private practice charges.[21,31] Lamb et al[22] stated that intervention costs were estimated using in-trial analysis but did not give reference to the full costing

Table 3. Quality of Costing Methodology in Included Studies (Criteria Defined by Graves et al[7]).

	Graves Costing Quality Criteria													
First Author	1	2	3	4	5	6	7	8	9	10	11	12	Total	Complete
	Perspective stated	Perspective justified	Cost data satisfied perspective	Short and long run costs (as appropriate)	Methods for quantities resources used by patients	Methods for allocating time of human resources	Methods for allocating other resources (fixed) between patients	Methods for estimating price, unit costs, charges	Were data other than hospital charges used	Was the year data collected reported	Was base cost year reported	Were adjustments made for different time periods where necessary	Total score out of 12	Complete cost data (%)
Barton 2009	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	10	48
Bosmans 2011	Yes	Partial	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	10.5	81-86
Bultmann 2009	Yes	Partial	Yes	No	Yes	Unclear	Unclear	Partial	Yes	Yes	Yes	Yes	8	55-82
Chuang 2012	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11	Unclear
Essex 2017	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	10	58
Haines 2017	Yes	Partial	Yes	No	Yes	Partial	Yes	Yes	Yes	Yes	Yes	Yes	10	Unclear
Henchoz 2010	Yes	Partial	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	8.5	57-73
Hollinghurst 2008	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	10	62
Hollinghurst 2013	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	12	56
Jenson 2017	Yes	Partial	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9.5	43
Jowett 2013	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	10	88
Lamb 2010	Yes	No	Yes	No	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	9	70
Lambeek 2010	Yes	Partial	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	10.5	87
Marra 2014	Yes	No	Yes	No	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	9	86
McKenna 2009	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	10	77
Pinto 2013	Yes	No	Yes	No	Yes	Yes	Unclear	Unclear	Yes	Yes	Yes	Yes	8	85
Saha 2018	Yes	Yes	Yes	No	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	10	91
Smeets 2009	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11	79.70
van de Roer 2008	Yes	Partial	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	9.5	89
Vermeulen 2013	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11	71
Werner 2016	No	No	No	No	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	7	68.10
Whitehurst 2015	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11	59

methods. All studies used more than just hospital charges to calculate costs (Q9), including, for example, medication costs in addition to hospital charges[20,31] or using a variety of costing resources.

Category 4: Reporting of Data (Questions 10-12). The majority of studies reported the year cost data were collected (Q10), with only 3 studies omitting this level of detail.[19,30,32] The base cost year was also reported for most studies (Q11) with this information not present in only 1 study.[32] Adjustments for costs made in different time periods (Q12) were frequently not necessary due to the majority of studies being run over a 12 month period and therefore not needing to discount for different time periods, with the exception of Barton et al[33] who discounted at a rate of 3.5%. The majority of other studies stated adjusting prices for inflation to match base cost year.[15,16,18,21,22,34]

Cost Drivers

Detail of cost drivers extracted across studies included; highest resource unit cost, highest resource utilization, and highest mean resource cost per patient, where available. There was minimal detail however within some studies; for example, Barton et al[33] had a key cost driver of "visit costs" but this was not broken down between different types of clinicians. In contrast, detailed visit costs were broken down and provided in the study by Hollinghurst et al,[18] providing detail of; hospital care/A&E visit costs, GP home visit costs, GP surgery visit costs, GP out-of-hours costs, GP telephone consultation costs, district nurse home visit costs, practice nurse consultation costs, practice nurse telephone consultation costs, and health care assistant/phlebotomist costs.

Unit Costs. The highest unit costs were consistently found to be outpatient visits/medical specialist visits, hospital admissions (day case and hospital stay), and imaging (magnetic resonance imaging [MRI], computed tomography [CT]). This demonstrates that the secondary care costs make up the highest unit costs within MSK health care (see Table 4 for further detail and drivers).

Resource Utilization. The highest resource utilization across studies was found to be; primary care visits to the GP, outpatient/medical specialist visits, and physiotherapy visits (see Table 5 for further detail and drivers).

Mean Resource Use Cost per Patient. Thirteen studies gave data on the mean resource use cost per patient allowing for analysis of key drivers of costs within studies. Analysis of these studies shows that important drivers of MSK health care costs (starting with highest costs) were the following: primary care visits to the GP, outpatient/medical specialist visits, and physiotherapy visits. This demonstrates that predominantly high levels of utilization of key resources were driving cost, with the top 3 drivers exactly matching those for highest utilization (see Table 6a; this table is available with costs converted/inflated to GDP 2018 within Supplement 3 as Table 6b). Converted costs, however, need to be viewed with caution due to the significant heterogeneity between studies including heterogeneity in MSK conditions treated, health systems, time horizons, and costing methods. Costs therefore cannot be directly compared and have instead been ranked within individual studies in order to identify the highest cost drivers.

Discussion

This review captured MSK economic analyses across a number of varied health systems/nations, including the United Kingdom, the Netherlands, Denmark, Norway, Switzerland, Sweden, Italy, the United States, Canada, Australia, and New Zealand, and focused on trials providing treatment primarily within primary and community health care settings.

Quality of Costing Methods

Only one study[18] satisfied all of the costing criteria reported by Graves et al.[7] The lowest conforming study satisfied 7 of the 12 costing criteria (58%),[17] which could imply errors in costing methods.[7] In all, 14/22 (64%) of studies, however, satisfied at least 10 or more criteria.

In the review by Graves et al[7] in 2002, only 2 out of the 12 costing quality questions (Q5 and Q8) were satisfied by more than 67% of included articles. In this review 10 of the 12 questions (all except Q2 and Q4) were satisfied by more than 77% of included articles.

The quality assessment of costing methods within this review demonstrates that more attention still needs to be given to the costing methods used to estimate individual patient costs with particular attention needed to clarify short- and long run-costs and to fully justify the chosen perspective. There appears, however, to have been a significant improvement with costing within economic analyses when these results are compared with the previous similar review of 45 economic analyses by Graves et al[7] in 2002.

Key Cost Drivers

The highest resource unit costs were secondary care–based costs, in contrast to the highest resource utilization, which included primary, community, and secondary health care drivers, such as GP visits, physiotherapy visits, outpatient/medical specialist visits, and prescriptions. When these were evaluated together to give the mean resource use cost per patient, the same cost drivers for utilization were driving

Table 4. Highest Unit Costs.[a]

			Primary Care and Community				Secondary Care				Imaging		Private
First Author	Currency	Cost Year	GP	Chiropractor/ Osteopath	Psychologist	Occupational Health Physician	Outpatient Visit	A&E	Hospital Stay (Days)	Hospital Admission	MRI	CT	Private Other (PT/ Acupuncturist/MT)
Barton 2009													
Bosmans 2011	Euros	2004	20.44				56.66				178.51	105	
Bultmann 2009													
Chuang 2012	£ Sterling	2008-2009	45				41	123		2515			55
Essex 2017	£ Sterling	2012-2013	34				108	115	693	1877.86			
Haines 2017													
Henchoz 2010													
Hollinghurst 2008	£ Sterling	2005	24				133	61		2065			71.2
Hollinghurst 2013	£ Sterling	2009	27				103						
Jenson 2017	Euros	2015											
Jowett 2013													
Lamb 2010													
Lambeek 2010	£ Sterling	2007	16		59	162	53			261			
Marra 2014	$ Canadian	2009	34	120			99				895		67.33
McKenna 2009	£ Sterling	2005-2006	20.75				90	110	90	188			70
Pinto 2013	£ Sterling	2009	62	47			158	322	650	13576	836		
Saha 2018	Euros	2013	366		415		424						
Smeets 2009	Euros	2003	20.2		60.5	20.2	56			337			
van de Roer 2008	Euros	2004	20.4	42.5			56.6			341	223	128	
Vermeulen 2013	Euros	2008	22				74			439	179	147	
Werner 2016	$ US	2012	98	86			216			28323			
Whitehurst 2015	£ Sterling		31	38			124		562	1157	179	100	
Total in top 4			3	2	3	3	11	4	4	11	6	3	2

Top 2 (first/second) unit costs within studies
Next 2 (third/fourth) top unit costs within studies
Abbreviations: GP, general practitioner; MRI, magnetic resonance imaging; CT, computed tomography; PT, physical therapist; MT, manual therapist.
[a]Cost drivers only included within this table if they were within the top 4 unit costs within at least 2 studies. Costs are in different currencies and so cost years are not directly comparable. Mean costs per patient reported for control/usual care/reference group.

Table 5. Highest Utilization.[a]

Utilization Within Usual Care/Control

	Primary Care and Community							Secondary Care	Imaging/Investigations		Medication	Private	
First Author	GP	Practice Nurse	Physiotherapist	Manual Therapy	Other HCP	Psychologist	All Primary Care	Outpatient Visit	X-Ray	All Investigations	Prescription Medications	Private Consults	Private Other HCP
Barton 2009	0.15	0.41			0.2			0.28					
Bosmans 2011	0.6		1	0.3				0.05	0.03	0.05			
Bultmann 2009	69		66		21	3							
Chuang 2012													
Essex 2017	3.59	1.06	1.12					0.77			3.83	2.11	0.14
Haines 2017													
Henchoz 2010	0.5		2.3		0.1			1.1					
Hollinghurst 2008							0.43	0.32			0.85		
Hollinghurst 2013	0.77	0.04			0.02			0.17			1.36		
Jenson 2017													
Jowett 2013					3.13		2.75	0.58		0.26		0.03	0.41
Lamb 2010	1.86	0.11	0.9			0.09		0.21	0.28	0.83	5.33	0.06	1.79
Lambeek 2010	0.6		21.7	5.4		0.9		0.6		4.7			2.8
Marra 2014	0.67							0.09	0.62				2.1
McKenna 2009													
Pinto 2013	1.75	0.12	0.75		0.12			0.49	0.35				
Saha 2018													
Smeets 2009	2.12		7.36			0.34		1.55	0.26				
van de Roer 2008	1.4		2.1	0.2				0.2	0.3				
Vermeulen 2013													
Werner 2016													
Whitehurst 2015	1.32	0.13	1.45					0.3	0.12			0.18	
Total in top 4	11	1	9	2	3	1	2	8	3	1	4	2	4

Top 2 (first/second) mean utilization within studies
Next 2 (third/fourth) top mean utilization within studies
Abbreviations: HCP, health care professional; GP, general practitioner.
[a]Cost drivers only included within this table if they were within the top 4 mean utilizations within at least 1 study. Utilization reported for control/usual care/reference group. Values are mean resource use per patient.

Table 6a. Highest Mean Costs per Patient.[a]

Mean cost per patient

		Primary Care and Community						Secondary Care			Imaging/ Investigations		Medication	Private	
First Author	Currency	GP	Physiotherapy	Manual Therapy	Psychologist	Complementary Medicine/ET/Massage	Other HCP	Outpatient Visit	Hospital Stay Day Case	Hospital Admission	X-Ray	MRI	Prescription Medicine	Private Other HCP	Equipment/ Aids
Barton 2009															
Bosmans 2011	Euros	10.22	23.02	10.36				2.83			1.25	3.57	10.00		
Bultmann 2009															
Chuang 2012															
Essex 2017	£	122.06	40.51			4.90		83.16	62.37	56.34			32.06		
Haines 2017															
Henchoz 2010	Euros	31.7	73.1				12.2	106.4							
Hollinghurst 2008	£	11.03					0.35						9.82	169.65	
Hollinghurst 2013	£	19.21	69.73				0.03	30.74		51.02			11.04		
Jenson 2017	Euros	306	464				43	394		263			17	616	
Jowett 2013	£						117.1						2.54	16.17	
Lamb 2010															
Lambeek 2010	£														
Marra 2014	$ (Can)	22.59				24.58		10.93			21.45	40.68		12.24	89.74
McKenna 2009	£	83	26				10	53						77	96
Pinto 2013															
Saha 2018	Euros	255.77	293		106.89		64.89	65.89							
Smeets 2009	Euros	42.82	168.54		20.57		2.42	86.8		29.95			58.04		
van de Roer 2008	Euros	28.56	48.3	6.44		4.66		11.32			14.94		13		
Vermeulen 2013	Euros	23.7	253.8	87		16.5	36.5	126.9		88.9	39.8	53.3	227.7		
Werner 2016															
Whitehurst 2015	£	40.85	34.19					34.88		16.53	3.69	20.65	19.2	55.09	
Total in top 4		11	9	1	1	1	1	9	1	3	1	1	4	3	2

Top 2 (first/second) mean costs within studies
Next 2 (third/fourth) top mean costs within studies
Abbreviations: GP, general practitioner; ET, exercise therapy; HCP, health care professional; MRI, magnetic resonance imaging.
[a]Cost drivers only included within this table if they were within the top 4 mean costs within at least 1 study. Mean costs reported for usual care/control/reference group.

mean resource use costs per patient, showing that the high level of utilization rather than the initial unit cost seems to be the predominant factor in driving mean costs within MSK health care in this setting (see Tables 4-6). These findings therefore support a shift in focus for those commissioning and evaluating MSK services, from high-cost procedures (such as surgical interventions and inpatient stays) within MSK health care (largely at a secondary care level) to high utilization of key resources such as GP visits and physiotherapy visits within primary care and community settings, with further scrutiny of the cost-effectiveness of the entire pathway of MSK health care provision.

We summarized the key drivers of MSK health care costs within an international context, and found that the highest mean costs across studies (in order) were for: GP visits, physiotherapy visits, outpatient medical specialist visits, prescription medication, and Hospital Admissions (day case and elective stay grouped together). These 5 drivers captured over 70% of the costs in the majority of studies with fully disaggregated costs (7/11 studies). Recommendations from the review would be to collect detailed costs for the above key drivers particularly with regard to GP, physiotherapy, and outpatient visits, which formed over 50% of the costs across the majority of studies (8/11 of those with fully disaggregated costs; these 3 drivers alone captured over 75% of costs in 2 recent studies.[16,35] This detail might include capturing standard treatment times within clinics (such as 30- or 45-minute physiotherapy consultations) and grade of treating clinician (basic grade or advanced level) in order to further improve the accuracy of costing for the most important cost drivers. Hollingsworth et al[18] was the only study to detail the treating clinician grade to further improve the accuracy of their costing calculation and overall provides a useful exemplar of high-quality costing methods within community MSK health care. Grieve et al[36] supports this individualized approach, highlighting that cost-effectiveness analyses using average unit costs can report inaccurate incremental costs. Clearly, some studies were restricted by the research costs and practicalities of collecting this level of data, however, capturing this detail would improve the accuracy of costing information in this setting as these are key cost drivers that are not standardized across MSK services, as was too often assumed. This is particularly relevant as significant system changes are made within MSK health care such as the introduction of first contact practitioners (FCP) in the United Kingdom, where GPs are being replaced in certain areas by advanced MSK physiotherapists to assess and manage MSK patients in primary care.[37] Using a standardized mean unit cost for the physiotherapist contact in these instances would not take into account the seniority of clinicians used or the differing consultation times allocated, and could therefore lead to inaccurate evaluations of cost.

Additional costs that are useful to collect dependent on the perspective of the economic review are; private health care professional costs (such as private physiotherapy, acupuncture, osteopathy), equipment (including patient aids, orthotics, etc) and imaging costs (MRI/X-ray were the most important of these).

Limitations of the Review

Limitations of this review were that not all MSK economic analyses were included within the review, which means that our results cannot be generalized to all MSK economic analyses. Non-English studies were also not included due to the resource limits of this review. Only direct health care costs were reviewed, future studies incorporating additional societal costs would be useful to further inform population level health systems. This study was a broad review of MSK economic analyses and due to this breadth, there was a large amount of heterogeneity between studies. This means that caution needs to be applied when looking to make direct comparisons between studies. Future research in this area focusing on one health system or one condition would allow for a more detailed and in-depth analysis of direct costs. Further review of other sources of activity/spend data alongside prospective studies evaluating the cost drivers identified within this review in primary/community MSK services would also be useful to further explore and validate findings.

Conclusion

This review provides a detailed overview of the quality of costing methods used within MSK economic analyses and has identified key drivers of MSK health care costs for patients accessing treatment in community and primary care settings. The quality and accuracy of costing data in this setting need more attention around capturing the grade of treating clinicians and specific consultation length for clinical visits to more accurately determine true patient-level costs as these factors were key cost drivers. If this information was collected in a standardized, accurate, and consistent manner, it could form a useful part of a standardized MSK data set (alongside key metrics measuring treatment outcome/performance) and help develop future benchmarking capabilities within these settings supporting national data evaluations and informing health care policy (such as NHS RightCare in the UK setting).[38] Such an approach would also support a future direction toward value-based care (health outcomes achieved per monetary unit spent) which looks to achieve good outcomes in the most efficient way,[39] helping form a system level framework for restructuring health care delivery for the future.

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Supplemental Material

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