

# Can we reduce disease burden from osteoarthritis?

## An evidence-based priority-setting model

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OSTEOARTHRITIS (OA) AFFECTED over 1.2 million Australians in 1995<sup>1</sup> and is associated with both substantial loss of quality of life and high management costs. In 2001, these costs were estimated at \$1090 million.<sup>2</sup>

There is a wide range of options for managing OA. These include prescription drugs, over-the-counter medications, exercise and strength training, surgery, patient education and complementary therapies. Recognising that distortions in funding arrangements for the delivery of healthcare result in highly disparate cost-effectiveness ratios,<sup>3-5</sup> logic suggests there are opportunities for health gain in redistributing resources from services that perform poorly (high cost per unit of benefit) to those that perform better (low cost per unit of benefit). Priority-setting models are designed to identify such desirable resource shifts, and one model that has been found to be appropriate for national or regional decision-making is the Health-sector-Wide (HsW) disease-based model.<sup>6,7</sup> This model, like the Quality Adjusted Life Year (QALY) league table approach and Program Budget Marginal Analysis, involves comparing marginal cost-effectiveness ratios of possible interventions.<sup>7</sup> The model also insists on objective evidence for determining effectiveness, a defined process for selecting interventions to ensure comprehensiveness, and a means for staging the analysis through diseases and disease stages. The model was recently applied to investigating how the disease burden of OA might be reduced by adjusting the health service mix.<sup>2</sup>

### Methods

Applying the model involved three broad research tasks:

- identifying all potential interventions (service types) for preventing and managing OA and, through a literature review, selecting a subset for inclusion in the model;
- conducting economic evaluations of the selected interventions, using published evidence on outcomes and costs; and
- comparing performance of the interventions (primarily in terms of cost-effectiveness) and developing policy recommendations on desirable resource shifts.

An advisory panel of clinicians, health department officers, consumers and consumer organisation representatives (see Acknowledgements) was established to support the research team, ensuring appropriate coverage of the literature and application of the model.

### Selection of interventions

The selection of management options to be included in the HsW model aims for comprehensive coverage of treatment modalities, delivery settings, disease stage and population sub-groups, including common approaches to management

### ABSTRACT

- The comparison of disparate interventions for the prevention and management of osteoarthritis (OA) is limited by the quality and quantity of published efficacy studies and the use of disparate measures for reporting clinical trial outcomes.
- The “transfer to utility” technique was used to translate published trial outcomes into a health-related quality-of-life (utility) scale, creating a common metric which supported comparisons between disparate interventions.
- Total hip replacement (THR) and total knee replacement (TKR) surgery were the most effective treatments and also highly cost-effective, at estimated cost per quality-adjusted life-year (QALY) of \$7500 for THR and \$10 000 for TKR (best estimate).
- Other apparently highly cost-effective interventions were exercise and strength training for knee OA (< \$5000/QALY), knee bracing, and use of capsaicin or glucosamine sulfate (< \$10 000/QALY).
- The cost per QALY estimates of non-specific and COX-2 inhibitor non-steroidal anti-inflammatory drugs were affected by treatment-related deaths and highly sensitive to the discounting of life-years lost.
- OA interventions that have been shown to be ineffective (eg, arthroscopy) are targets for redistribution of healthcare resources.
- OA interventions which lack efficacy studies (eg, prevention programs) require further research to assist priority setting.
- The application of the Health-sector Wide model to OA demonstrates its role as an evidence-based model that can be successfully applied to identify marginal interventions — those to be expanded and contracted to reduce the expected burden of disease, within current healthcare resources.

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## 1: Interventions for prevention and management of osteoarthritis (OA) that were included in the modelling

### Primary prevention

#### ■ Weight loss

Comprehensive media/community campaign;<sup>8,9</sup> intensive primary care (GP and nurse) diet and behavioural weight loss intervention for a general overweight group;<sup>10</sup> intensive primary care weight loss intervention for people with previous knee injury;<sup>10,11</sup> surgery for obesity (eg, gastric banding)<sup>12</sup>

### Patient management

#### ■ Patient education

Lay-led program;<sup>13,14</sup> GP/clinical nurse educator-led program<sup>15,16</sup>

#### ■ Physical therapies

Specially fitted knee brace for person with OA of the knee<sup>17</sup>

#### ■ Exercise/strength training

Home-based basic program;<sup>18</sup> home-based intensive program;<sup>19</sup> primary care clinic-based intensive program;<sup>20</sup> out-patient-based intensive program<sup>21</sup>

#### ■ Pharmacotherapies

##### ➤ Prescription/over-the-counter medications

Non-specific non-steroidal anti-inflammatory drugs (NSAIDs) (diclofenac and naproxen);<sup>22,23</sup> COX-2-specific NSAIDs (celecoxib)<sup>22,24</sup>

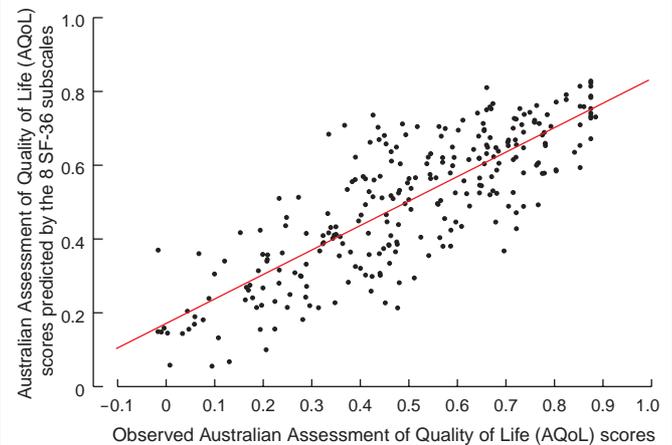
##### ➤ Complementary medicines

Oral glucosamine sulfate;<sup>25</sup> ASU (avocado/soybean unsaponifiables);<sup>26</sup> topical capsaicin<sup>27</sup>

#### ■ Surgery

Total knee replacement;<sup>28</sup> total hip replacement;<sup>28</sup> knee arthroscopy with lavage<sup>29</sup>

## 2: Relationship between observed assessment of quality of life utility values and utility values predicted using SF-36 subscales, based on a sample of 303 people with osteoarthritis



instrument such as the European EQ-5D<sup>30</sup> or the Australian Assessment of Quality of Life (AQoL) instrument.<sup>31,32</sup> Conversion of the SF-36<sup>33</sup> to a utility scale has been the subject of ongoing research, but the initial algorithm appeared to truncate at the severe end of the scale and was therefore unsuitable for our purposes.<sup>34,35</sup> While this conversion has since been revised, it requires access to the full SF-36 dataset, which is an impediment to its use.<sup>36</sup> The use of disability weights to calculate disability-adjusted life-years (DALYs) was also rejected, as the published disability weights for OA describe only three levels, which did not map onto trial data.<sup>37</sup>

For this study, commonly used OA outcome scales were converted into a utility-equivalent scale. The technique, termed “transfer to utility”, or TTU, involved administering the AQoL alongside common OA outcome instruments such as the SF-36, a visual analogue scale (VAS) for pain, and the Western Ontario and McMaster Arthritis Index<sup>38</sup> in 303 people with OA. Participants were recruited from rheumatology clinics, orthopaedic waiting lists and the Arthritis Foundation of Victoria to ensure a wide range of severity of OA was captured. The survey was approved by the Royal Melbourne Hospital Human Ethics Committee.

Equivalent utility values (based on the AQoL) for the selected outcome instruments were estimated from these data by means of multiple regression analysis. These relationships were applied to outcomes reported in published studies for both the intervention and control cohorts to estimate utility gain attributable to interventions.

The technique can be illustrated by applying it to total hip replacement (THR), where the reported outcomes are the SF-36 subscale scores, measured before and after surgery. A multiple linear regression model of the AQoL (dependent variable) was constructed as a function of the eight subscales of the SF-36. The relationship between the observed and predicted scores is shown in Box 2, and shows the good explanatory power of the model (adjusted  $R^2=0.66$ ;  $P<0.001$ ). Separate weights were obtained for hip OA ( $R^2=0.70$ ;

and more innovative approaches. Reliance on objective evidence requires that published trial data contain, at a minimum, a precise program description and quantitative evidence of effectiveness derived from an acceptable research design, and, preferably, health endpoints, a usual-care or placebo control, and a suitable follow-up period. In the OA study, six standard search engines, including MEDLINE, PubMed and CINAHL, were used to identify potential interventions. Cochrane Reviews were used when available, and 19 interventions were selected with input from the advisory panel (Box 1).

### Comparison of outcomes from disparate studies

The variety of disease-specific and generic instruments that have been used to report the effectiveness of OA treatments makes it difficult to compare published studies. HsW modelling required a means to compare each intervention on the same scale. Ideally, the method for doing this should also enable global comparisons, and combine quality of life and mortality. Health-Related Quality of Life, based on “utility” and scaled between 0 (death) and 1 (best possible health), meets this requirement. Outcomes expressed as utility values can be combined with time lived in particular health states and added to mortality rate differentials to calculate effectiveness in quality-adjusted life-years (QALYs). In this way, the performance of all interventions can be measured in the same metric (cost/QALY) and directly compared. Utility values can be obtained from a multi-attribute utility

**3: Conversion of SF-36 subscale scores to a utility score for osteoarthritis of the hip**

SF-36 subscale	Regression weight	Before surgery			12 months after surgery		
		SF-36 score*	Adjustment <sup>†</sup>	Utility score <sup>‡</sup>	SF-36 score*	Adjustment <sup>†</sup>	Utility score <sup>‡</sup>
(Constant)	-0.1976						
Physical function	0.4803	26.9	0.4661	0.224	66.6	0.7345	0.353
Role physical	-0.0001	14.6		-0.002	58.7		-0.007
Bodily pain	0.2438	32.9	0.4562	0.111	72.8	0.7486	0.182
General health	0.0003	66.3		0.023	73.8		0.025
Vitality	0.0009	47.1		0.045	67.5		0.064
Social function	0.0018	52.5		0.092	88.6		0.155
Role emotion	-0.0003	60.0		-0.018	71.8		-0.022
Mental health	0.0026	71.4		0.187	81.7		0.214
Estimated utility value <sup>§</sup>				0.464			0.767
Utility change							0.304

\* Source: Bachmeier, March and Cross.<sup>28</sup> † The physical function and bodily pain scales undergo an initial non-linear transformation. The physical function score of 26.9 is transformed by means of a quadratic adjustment:  $0.108164 + (0.01595 \times 26.9) - (0.000098 \times 26.9^2) = 0.4663$ , which is multiplied by the regression weight of 0.4803 to obtain the utility component of 0.224. ‡ SF-36 subscale is multiplied by the subscale-specific regression weight. For example, the mental health score of 71.4 is multiplied by the regression weight of 0.0026 to obtain a "utility component" score of 0.187. § The utility component of each subscale is summed with the constant to obtain a total "utility equivalent" score.

$P < 0.001$ ) and knee OA ( $R^2 = 0.63$ ;  $P < 0.001$ ). Box 3 shows hip-specific parameters and the estimation of utility-equivalent outcomes from the chosen THR study,<sup>28</sup> showing a utility gain 12 months after surgery of 0.304. Further details of the "transfer to utility" technique are described elsewhere.<sup>2</sup>

**Downstream impacts/discounting**

Future impacts (costs and benefits) were calculated where relevant and when evidence was available. For THR and total knee replacement (TKR) surgery, benefits and costs (including costs for revision surgery) were modelled over 15 years, knee bracing was modelled over 18 to 36 months and exercise over 12 months. Primary care was modelled over 20 years, with estimated mortality based on all-cause mortality, and quality-of-life gain based on the reduced incidence of OA.

Because there has been debate about the desirability of discounting health,<sup>39</sup> we derived two sets of cost-effectiveness estimates, using discount rates on health benefits of 5% per annum and zero, but costs always discounted at 5% per annum. In the United Kingdom, future life-years are discounted at 1.5%–2.0% per annum, and future costs at 6% per annum (the status until 2003, with the revised standard discounting of costs and benefits at 3.5% per annum),<sup>40,41</sup> while the Australian Pharmaceutical Benefits Advisory Committee guidelines for listing of drugs on the Pharmaceutical Benefits Scheme (PBS) suggest costs and benefits be discounted at 5% per annum.<sup>42</sup>

**Costs**

Costs included resources applied to the intervention and to the management of treatment side effects, and, for primary prevention, estimated savings in "downstream" healthcare service use. Intervention costs were calculated as the product of program inputs, based on descriptions of interventions, multiplied by current published unit costs (such as the

PBS, the Medicare Schedule, Australian National Diagnosis Related Groups cost-weights, and standard charge-out rates for health-professional groups). Further detail is reported elsewhere.<sup>2</sup>

**Performance**

For each intervention, values for incremental cost/QALY were calculated as the quotient of differential program cost (adjusted for any cost savings) and estimated utility benefit (relative to a placebo or usual care comparator), and then cost/QALY estimates were compared.

While the study takes a societal perspective, the scope of the costs and benefits included was limited by the data available. Also, published trial data (and study resources) did not allow subgroup analysis, which is ideal for comparing marginal populations within marginal programs (ie, those with the capacity to gain most or lose least from the addition or removal of services). Key assumptions are specified in Box 4. Univariate sensitivity analyses were performed, using alternative values for trial outcomes, period of benefit and discounting of future health gains or losses. The level of certainty in outcome and costs data was also noted.

**Results**

Results are reported as utility benefit, cost per individual and cost/QALY in Box 5.

**Surgery:** The most effective intervention modelled was THR. The estimated utility gain from THR was 0.305. This indicates a substantial improvement in quality of life, considerably greater than that associated with other interventions modelled. As benefits persist for several years (except for the 12%–20% of patients expected to receive revision surgery),<sup>43,44</sup> estimated QALY gain over a lifetime from THR was 3.52 per hip (adjusting for expected surgical

#### 4: Key assumptions underlying the modelling

Attribute and modality	Key assumption
<b>Duration of benefits</b>	
Primary prevention	20 years
Education/self-management	2 years
Exercise	1 year
Knee brace	18 months to 3 years
Total hip and knee replacement	15 years, adjusted for all-cause mortality <ul style="list-style-type: none"> <li>■ Total hip replacement cohort: surgery at 70 (women) and 66 (men) years of age</li> <li>■ Total knee replacement cohort: surgery at 70 (women) and 71 (men) years of age</li> </ul> Revision surgery, 12% or 20%, spread evenly over 15 years
Non-steroidal anti-inflammatory drugs*	12 months (treatment contiguous with benefit)
Natural therapies	12 months (treatment contiguous with benefit)
<b>Discount rate all modalities</b>	
Downstream costs/cost savings	Beyond 12 months, discounted at 5% per annum
QALY gains or losses	0 (undiscounted) 5% per annum
<b>Excess morbidity</b>	
Non-steroidal anti-inflammatory drugs*	Hospitalisation: <ul style="list-style-type: none"> <li>■ Congestive heart failure, 0.5/100 patient-years of NSAID use</li> <li>■ PUBs, 2.13/100 patient-years of NSAID use</li> </ul>
<b>Excess mortality</b>	
Non-steroidal anti-inflammatory drugs*	Death rate: <ul style="list-style-type: none"> <li>■ The same across all NSAIDs*</li> <li>■ Congestive heart failure, 5%; morbidity, 0.00025 per patient-year of NSAID use</li> <li>■ Gastrointestinal mortality, 10%; hospitalisation for PUBs, 0.00213 per patient-year of NSAID use</li> </ul> Translation of deaths to life-years: mortality x 18.5 life-years (mean life expectancy, age 65 years)
Total hip and knee replacement	Death rate from surgery, 1/1000
<b>Sensitivity analyses</b>	
	Discount rate of QALYs, 0 and 5% Clinical trial results: $\pm 1$ SD (NSAIDs) or $\pm 2$ SDs (other)

NSAID = non-steroidal anti-inflammatory drug. QALY = quality-adjusted life-year. PUBs = perforations, peptic ulcerations, gastric bleeding.

\* Diclofenac, naproxen, celecoxib.

mortality of 1/1000 and all-cause mortality in the cohort), and 2.086 per knee for TKR. At a weighted cost of primary and revision surgery of \$16 000–\$17 000 per case, cost/QALY for THR was \$5000 (future benefits undiscounted) or \$7000 (discounted at 5%), and, for TKR, a cost/QALY of \$8000 (future benefits undiscounted) or \$11 000 (discounted at 5%). Cost/QALY was not calculated for arthroscopy in knee OA, as recent randomised controlled trials (RCTs) suggest that the treatment is equivocal.<sup>29,45</sup>

#### **Non-steroidal anti-inflammatory drugs (NSAIDs):**

Non-specific NSAIDs and COX-2 NSAIDs were found to perform similarly in terms of outcomes and side effects, based on seminal trials and a report by the United States Federal Drugs Administration which interpreted side-effect data.<sup>46</sup> NSAIDs modelled were diclofenac, naproxen and celecoxib, using doses reported in the key trials. Based on three placebo/paracetamol-controlled trials,<sup>22-24</sup> estimated mean utility benefit compared with placebo was 0.043. This benefit was offset by excess mortality equal to 0.044 or 0.029 QALYs (future life-years undiscounted or discounted at 5% per annum, respectively). Net QALY gain was close to

zero or negative if future life-years from current deaths were undiscounted and 0.014 if discounted at 5% per annum, resulting in a wide estimate of cost/QALY from \$15 000 to “infinity” for non-specific NSAIDs and between \$33 000 and infinity for COX-2-specific NSAIDs. In most scenarios, COX-2 NSAIDs are dominated by non-specific NSAIDs.

**Primary prevention:** Because of the absence of RCTs for the primary prevention of OA through weight loss (or other means), this model used epidemiological data on the prevalence of OA and obesity, incorporating evidence of the effectiveness of weight loss interventions.<sup>1,12-9</sup> Cost/QALY estimates ranged from \$2000 to \$48 000, depending on the type of program. But, in the absence of intervention trials, this analysis is speculative and requires testing through intervention trials. Primary prevention through modifying other risk factors, such as recreational or work-related injury, could not be established owing to lack of evidence.

**Patient education:** Although community-based education programs are widely applied, there is little published quantitative evidence. Group programs, including those run by lay leaders<sup>13,14</sup> and health professionals,<sup>15,16</sup> were reviewed, but

**5: Key results of cost-utility analyses**

Program	Mean QALY gain per person* (zero discount rate)	Mean program cost per person	Cost/QALY† best estimate
<b>Primary prevention</b>			
1. Comprehensive mass media program for weight loss		\$4	\$20 000
2. Intensive primary care weight loss program delivered by GP or dietitian for overweight or obese people	0.09	\$720	\$11 000
3. Intensive primary care weight loss program delivered by GP or dietitian for overweight or obese people with previous knee injury	0.08	\$720	\$12 000
4. Surgery for obese people	1.05	\$15 000	\$20 000
<b>Management</b>			
<i>Education</i>			
5. Lay-led group education	0.072	\$162	\$2 400 to ∞
6. Primary care: GP or clinical nurse educator plus phone support	Equivocal	\$200–\$400	∞
<i>Exercise/strength training</i>			
7. Home-based exercise — basic	0.022	\$400	\$18 000 to ∞
8. Home-based exercise — intensive	0.100	\$1 420	\$15 000
9. Clinic-based exercise — primary care	0.091	\$480	\$5 000
10. Clinic-based exercise — outpatients	0.078	\$590	\$8 000
<i>Knee brace</i>			
11. Specially fitted knee brace	0.12 to –0.355	\$1 300	\$6 000
<b>Pharmacotherapies: prescription or over-the-counter medications</b>			
12. Non-specific NSAIDs (naproxen, diclofenac)	+ 0.043‡ –0.029 to 0.044§	Drug, \$104/year; Morbidity, \$70	\$15 000 or ∞¶
13. COX-2-specific NSAIDs (celecoxib)	+ 0.043‡ –0.029 to 0.044§	Drug, \$391/year; Morbidity, \$70	\$33 000 or ∞¶
<b>Complementary medicines</b>			
14. Glucosamine sulfate	0.052	\$180	\$3 000
15. Avocado/soy unsaponifiables	0.081	\$333	\$5 000 to ∞
16. Topical capsaicin	0.053	\$236	\$5 000
<b>Surgery</b>			
17. Total knee replacement	+ 2.086‡ – 0.015§	\$16 500	\$8 000¶ or \$11 000
18. Total hip replacement	+ 3.52‡ – 0.015§	\$16 500	\$5 000¶ or \$7 000
19. Knee arthroscopy with lavage	Equivocal	\$3 500	∞

\* Relative to placebo, or to no intervention, for total hip and knee replacement surgery. † Rounded to nearest \$1000; both costs and benefits discounted at 5% unless otherwise stated. ‡ Benefit from symptom control. § Mortality from cardiac and gastrointestinal side effects for NSAIDs or perioperative mortality for total hip replacement, total knee replacement, deducted from QALY gain. ¶ Zero discounting of future life-years lost from current deaths. QALY = quality-adjusted life-year. NSAIDs = non-steroidal anti-inflammatory drugs. ∞ = No evidence of benefit, possible negative benefit.

cost/QALY estimates could not be generated as inconsistent findings made the evidence for effectiveness difficult to interpret.

**Knee brace:** Specifically manufactured and fitted knee braces for people with knee OA were found to be effective and cost-effective. Cost/QALY was \$4000–\$12 000, depending on the length of time the brace was worn.<sup>17</sup>

**Exercise and strength training:** Intensive exercise and strength training based in primary care<sup>20</sup> or outpatient clinics<sup>21</sup> was highly cost-effective (\$3000–\$15 000/QALY) and somewhat less cost-effective for an intensive home-based program (\$10 000–\$34 000/QALY).<sup>19</sup> The evidence

for the effectiveness of a less intensive home-based program was equivocal.<sup>18</sup>

**Other pharmacotherapies:** Topical capsaicin (for knee, hand, elbow and ankle OA) and glucosamine sulfate were found to be cost-effective at less than \$5000/QALY. These drugs had equivalent efficacy to NSAIDs, with no evidence of excess morbidity or mortality.<sup>25,26,47</sup> The performance of avocado/soy unsaponifiables was unclear because of conflicting results from the small number of published reports.<sup>48</sup> Results for these therapies should be considered provisional, as they are based on only a few RCTs. However, recent trials lend support to a role for glucosamine sulfate.<sup>49,50</sup>

## 6: Resource implications for the prevention and management of osteoarthritis based on cost-utility analyses

Highly cost-effective programs (cost/QALY < \$15 000) supported by strong evidence

- Intensive clinic outpatient-based exercise/strength training programs
- Total hip replacement surgery
- Total knee replacement surgery

*Policy implication:* Programs/service level should meet all clinically indicated need.

Programs that appear highly cost-effective (cost/QALY < \$10 000), but are based on limited evidence

- Topical capsaicin
- Glucosamine sulfate
- Knee brace

*Policy implication:* Programs/services might warrant expansion to match clinical need. A program to collate/gather additional trial evidence should be supported. In the interim, greater access in response to clinical need appears appropriate.

Interventions which may be highly cost-effective (cost/QALY < \$20 000), but based on indirect evidence

- Primary prevention through weight loss in obese persons through comprehensive community-based media campaign, intensive primary care intervention, surgery for persons who are seriously obese (to determine impact on incidence of OA)

*Policy implication:* A research program should be supported, possibly through pilot implementation and/or well constructed observational studies.

Interventions for which cost-effectiveness is uncertain and highly sensitive to assumptions of the model (and the specific formulation)

- Non-specific non-steroidal anti-inflammatory drugs
- COX-2-specific non-steroidal anti-inflammatory drugs
- Patient education — lay-led models

*Policy implication:* Explore assumptions of the model and cost-effectiveness in specific patient groups (and with particular formulations); redirect resources to patient groups where higher net benefit can be realised.

Interventions where efficacy is equivocal or not demonstrated

- Patient education — professionally led models
- Arthroscopy to manage knee OA

*Policy implication:* Services to be curtailed and resources redirected to areas with demonstrated effectiveness.

QALY = quality-adjusted life-year. OA = osteoarthritis.

identification and interpretation of the literature, but not in development of the evidence base.

The quality of the advice resulting from the HsW model is dependent on the quality of clinical evidence. The modelling highlighted, in a systematic way, critical data gaps and future research priorities. Given the gaps in the data, outcomes and costs had to be modelled. This involved adopting assumed values and some limitation in scope, the latter reflecting the breadth of a priority-setting exercise relative to the research resources available. Most important of these limitations was the failure to conduct analyses at the subpopulation level, effectively assuming that mean incremental cost–utility ratio was a reasonable approximation across the relevant clinical population. Further, the scope of effects has been restricted to health benefits (defined by QALYs) and healthcare costs related to individuals with OA, a common (although not universal) assumption of cost-effectiveness analyses. In terms of technical simplifications, costs and benefits for a cohort should be based on the actual age distribution, rather than assuming a cohort of mean age consistent with the clinical trial information as we did in this study. Further, multivariate probabilistic sensitivity analysis is preferable to the use of univariate sensitivity analysis.

Despite these limitations, a number of conclusions can be developed from the HsW analysis, especially where clinical trial evidence is strong and the range of cost-utility estimates is narrow across plausible parameter values (Box 6). In drawing conclusions from the model it is presumed that cost-effectiveness is the sole or primary decision criterion. Given this premise, and the strong evidence of effectiveness and favourable cost–utility ratios for THR, TKR, intensive clinic-based exercise and strength training, and knee bracing, providing these services to all those for whom the treatment is clinically appropriate would represent an efficient use of healthcare resources. Subject to confirmatory evidence for efficacy and side-effect profile, topical capsaicin and oral glucosamine may also fit this category, with more modest effectiveness compensated by lower costs. The need for better targeting of COX-2 NSAIDs to subpopulations with greater capacity for net benefit is suggested by the wide range of cost–utility estimates (relative to placebo), and dominance by non-specific NSAIDs in many scenarios. Our analysis suggests that the resources released could be redirected to interventions that yield greater benefit per unit cost to reduce the overall disease burden of OA. Additional research into NSAIDs to highlight the performance of specific formulations and the impact on identifiable subpopulations is indicated. Independent of the HsW model, the literature suggests that the wide application of some treatments, such as arthroscopy for knee OA, may be a poor use of resources.<sup>29,45</sup>

It can be seen that economic analyses such as this can provide structured support to policy, and can complement clinicians' judgement. How to achieve any agreed resource shifts and the optimal size of redistributions is properly the subject of a separate study. The translation of priority-setting recommendations into policy, and ultimately into health improvements for the population, will require the involvement of policymakers and clinical communities. The

## Discussion

An important contribution of this priority-setting exercise is the development of an empirically driven method for comparing interventions, based on the published clinical trial literature, even where different outcome instruments are used. The “transfer to utility”, or TTU, allowed disparate trial outcome data to be translated into a common metric — a utility equivalent score — and the incorporation of mortality and costs to ascertain performance in terms of cost/QALY. This technique placed all treatments on a “level playing field”. The HsW model incorporating this technique should be less prone to the biases of more subjective priority-setting techniques, such as Program Budget Marginal Analysis, which allow “expert opinion” a greater role.<sup>6,7</sup> The inclusion of the Advisory Panel in the process was found to be valuable for

## Bone and Joint Decade and its commitment to reducing the burden of disease from OA may contribute to this process.

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### Competing interests

An Advisory Panel, including people from the DHA (see funding source, above), assisted by commenting on drafts and interpretation of the results. The authors controlled all intellectual decisions, and the views presented in this report are those of the researchers and not the DHA.

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