

Cost-effectiveness of a physiotherapist-led service for orthopaedic outpatients

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Full title

The cost-effectiveness of a novel physiotherapy led service for orthopaedic outpatients

Key words

Cost-effectiveness, orthopaedics, service delivery

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Declaration of conflicting interests

The authors declare that they have no conflict of interest.

Abstract

Background

Non-surgical treatment options can be effective for many musculo-skeletal conditions and improving access to these options may improve the efficiency of hospital services. The Orthopaedic Physiotherapy Screening Clinic and Multidisciplinary Service (OPSC & MDS) model of care is an initiative offering early comprehensive assessment and coordinated, patient-centred care within a multidisciplinary framework. The aim of this study was to assess the value for money of OPSC & MDS.

Methods

A Markov model was constructed to estimate the quality-adjusted life years and health care costs from the perspective of the health payer of the OPSC & MDS for outpatients with low back, knee or shoulder conditions compared to a usual hospital orthopaedic care pathway. Data were obtained from a retrospective chart review, administrative sources, literature and expert opinion. The time frame was five years and all costs were reported in 2011 \$AUD.

Results

Compared with usual orthopaedic care, the OPSC & MDS cost an additional \$1,691 per QALY gained. The model remained cost-effective over a range of one-way sensitivity analyses; however, a probabilistic sensitivity analysis showed the variance was wide.

Conclusion

The robust evaluation of new models of care is critically important in the context of increasing demands on health services. This study indicates that the OPSC & MDS model is likely to be highly cost effective, although the results of this model would be enhanced with prospective data collection to ensure that robust estimates of all parameters are available.

Key Words

Cost-effectiveness, Economic Evaluation, Orthopaedics, Physiotherapy

Background:

Cost-effectiveness evaluation in health care is a tool used to ascertain the technical efficiency of a new technology. Most cost-effectiveness studies are undertaken in the context of new medicines or new devices. Using cost-effectiveness to evaluate a service is not routinely performed. However, given increasingly scarce health resources and the emergence of new models of care designed to improve both patient flow and the distribution of health resources to those most in need, methods to evaluate these new services are urgently required.

In Australia, arthritis and musculo-skeletal conditions are a major cause of increasing health care expenditure representing \$4.0 billion of direct health care costs in 2004-05.¹ These costs are rising rapidly partly due to increasing prevalence of these conditions but also because of increasing reliance on expensive surgical options for their management despite little evidence on long term benefit. In the face of constrained health budgets these rising health care costs have increased the emphasis and need for economic evaluation of health care programs including in orthopaedics²⁻⁴.

Up to 80% of orthopaedic outpatients do not need surgery and can be managed by effective conservative management⁵, indicating that alternative models of orthopaedic care could be more efficient and effective than traditional models. The recognition of this has led to non-surgical service re-design to manage these chronic musculoskeletal conditions^{6,7}. The innovative Orthopaedic Physiotherapy Screening Clinic and Multidisciplinary Service (OPSC & MDS) model of care is one such initiative, offering early expert assessment and comprehensive, coordinated, patient-centred care within a multidisciplinary framework⁸. The service model has been implemented in most orthopaedic services in Queensland public hospitals. The OPSC & MDS is led by experienced Musculoskeletal Physiotherapists working

in an advanced practice role. They undertake initial assessment, diagnosis, management planning, and case management. They also lead and provide consultancy for a designated multidisciplinary team who provide follow up treatment services for this patient group. Models of care employing experienced physiotherapists in advanced roles in hospital specialist outpatient services have been successfully implemented in the UK,⁹⁻¹¹ and in other Australian states¹²⁻¹⁴. A particular focus of these services is to reduce waiting times for patients unlikely to require surgery. There is sound evidence that extended waiting times are detrimental to quality of life (QoL),¹⁵⁻¹⁷ physical and psychological wellbeing, expected benefits of surgery¹⁸⁻²⁰ and have significant economic consequences.²¹⁻²³

Although many examples exist of service re-design, little has been achieved in providing a comprehensive economic evaluation of the impact of introducing these services. In orthopaedics, only two studies assessed the costs and outcomes of alternative non-surgical models of care. These studies found that alternate service delivery models could result in cost savings to the health system however neither used a cost-utility approach. Brown et al²⁴ compared a musculo-skeletal physician and conventional orthopaedic surgeon-led service for the assessment and treatment of outpatients unlikely to require surgery. That study found equivalent patient outcomes at twelve months in both groups with lower cost for the musculo-skeletal physician group, driven mainly by reduced surgical costs. Daker-White et al²⁵ compared the outcomes and costs for patients referred to a hospital outpatient orthopaedic department treated by either specially trained physiotherapists or junior orthopaedic surgeons. No clinically important differences were found between the two groups however physiotherapists were less likely to order investigations and refer patients for surgery, resulting in lower direct hospital costs.

The aim of this study is to assess the costs, health outcomes, value for money and potential for cost-savings of OPSC & MDS compared with usual orthopaedic care from the perspective of the health care payer.

Methods

An economic model was constructed to estimate the quality-adjusted life years gained (QALYs) and health care costs from the perspective of the health payer (Queensland Government). Clinical pathways for orthopaedic outpatients with low back, knee or shoulder conditions considered to be unlikely to require surgery were identified for Usual Care (UC) and OPSC & MDS in consultation with an expert working group of clinicians and managers convened for the project. These pathways formed the basis of the model. The time frame for the model was five years. Costs and benefits were discounted at 5% per year.

UC Pathway: Figure 1 represents the path of a person through a UC pathway. Referrals for an orthopaedic consultation are triaged by clinical staff according to the written referral as Category 1 (urgent), 2 (semi-urgent) and 3 (non-urgent) and entered onto a waiting list for an initial consultation. In Queensland public hospitals, target waiting times to be seen for an initial consultation are <3 months for category 2 and <12 months for category 3; however, many patients wait longer than these targets ²⁶.

Following the initial consultation the patient may be: returned for continuing management by their General Practitioner; referred to conservative management which could include physiotherapy or other medical management such as injections; placed on a surgical wait list; or continue to be monitored for the need for surgery and called back for review at a later date.

<FIGURE 1 GOES HERE >

Figure 2 represents the alternative OPSC & MDS pathway. Potentially eligible patient referrals are screened by a Musculoskeletal Physiotherapist (OPSC & MDS Clinical Leader)

when received by the orthopaedic outpatient service. Patients are referred to the OPSC & MDS if they have been triaged to be Category 2 or 3, have benign musculoskeletal conditions where serious pathology is not suspected and immediate surgery is not indicated, and are considered as likely to benefit from non-surgical management.

Compared to UC, the initial wait time of the OPSC & MDS pathway is considerably less with patients generally seen within one month of referral. Patients within the OPSC & MDS are given a one hour initial screening assessment with a Physiotherapist who has postgraduate qualifications in musculoskeletal physiotherapy (in addition to the usual four year Bachelor degree). These clinicians typically have more than 10 years experience in the management of patients with musculoskeletal conditions, have undertaken additional targeted professional development and have developed an extensive breadth and depth of clinical consultancy in the management of patients with chronic and complex musculoskeletal conditions. Therefore, these clinicians are highly educated and skilled in the area of specialty.

Following the OPSC & MDS initial screening the patient may be referred for co-ordinated multi-disciplinary non-surgical management provided within the service. This can include physiotherapy, occupational therapy, dietetics, psychology and pharmacy as well as other allied health intervention when indicated (e.g. podiatry). In addition to services tailored to individual patients, group based programs are used to support ongoing self-management, knowledge and skill development. Alternatively, following this initial screening the patient may be referred back to the orthopaedic specialist waitlist. This may occur if issues are identified at the initial assessment that indicate the need for urgent medical attention or suggest a strong need for surgical review. Depending on the urgency of the presentation the patients waiting time until specialist review may be fast-tracked during this process via recommendation from the OPSC & MDS clinician. Although this process may not require further input from the OPSC & MDS, the initial screening by the OPSC & MDS will have resulted in earlier identification and specialist consultation for those patients whose

conditions are not benign or who may require surgery. This early identification could potentially lead to better outcomes and quality of life for these patients.

At the conclusion of management within the OPSC & MDS several options are possible for patients of the service. These are:

- Discharge from both OPSC & MDS and orthopaedic services
- Discharge from OPSC & MDS but reinstated/remains on orthopaedic waiting list for review due to:
 - the recommendation of the OPSC & MDS Clinical Leader (same or higher category for review) or
 - at the specific request of the patient

Model Structure

A Markov model with nine health states was constructed in TreeAge Pro 2013[®]. Table S1 provides an overview of the health states in the Markov model and the possible transitions in each health state.

<REFER TO SUPPLEMENTARY TABLE S1>

A series of assumptions are made in the model:

- Death rate is calculated from the Australian Life Tables and represents death from all causes.
- Transitions from the wait list states are modelled using a tunnel state where individuals remain in that state for a certain number of cycles before moving into other states. This is to represent the minimum time people will have to wait for before any possibility of an appointment.

- The perspective of the costs analysis is limited to that of the health care system. This doesn't factor in substantial costs which can be incurred by individuals on waiting lists due to impacts on income or other medical expenses.

Clinical Data

The efficacy of the OPSC& MDS model was based on a retrospective review of 980 patients from seven Queensland public hospitals who were managed within the OPSC & MDS for their knee, low back, or shoulder pain. These represent the most common chronic orthopaedic conditions managed by the OPSC & MDS at the majority of sites. The following Table 1 outlines some basic characteristics of the sample.

<INSERT TABLE ONE ABOUT HERE>

Outcomes

Probabilities (for example the probability of a person responding to treatment) were calculated where possible from the retrospective review or from internal audit data, other published evidence or expert opinion.

Health State Utilities

Health state utilities were collected from the retrospective review. Quality of Life was measured pre and post management within the OPSC & MDS service using the Assessment of Quality of Life four dimensions (AQoL-4D), a generic health related quality of life instrument²⁷. The AQoL-4D instrument is a multi-attribute utility instrument designed to collect utility values for the purposes of economic evaluations and consists of 4 separately scored dimensions (independent living, mental health, relationships, senses) with a total of 12 items that were developed from other mental health scales and focus groups. The AQoL

scoring algorithm combines responses into dimension scores and a single summary utility score appropriate for economic evaluation²⁸. Summary scores are anchored between 0 and 1, with 0 representing dead and 1 representing full health.

Utilities were used to derive quality-adjusted life years (QALYs), a measure combining both quantity and quality of life and used in the denominator of the Incremental Cost-Effectiveness Ratio (ICER).

Costs

Costs were calculated directly from data obtained in the retrospective review where possible or estimated using expert opinion and published data. All costs were reported in 2011 Australian Dollars (AU\$1 ~ US\$1).

Table 2 summarises the probabilities, costs and utility values used in the economic model.

<INSERT TABLE 2 ABOUT HERE>

Data analysis

The ICER of the OPSC & MDS relative to UC was calculated by dividing the difference in the discounted costs of OPSC & MDS and UC by the difference in the quality-adjusted life years gained between OPSC & MDS and UC.

Sensitivity analysis

The uncertainty of the model was assessed by one way and probabilistic sensitivity analysis. In the one way analysis key cost, probability and utility parameters were tested by altering costs +/- 30% from baseline and using the 95% confidence intervals for probability and utility values. In addition, the discount rate was altered from 0 to 10%.

Probabilistic sensitivity analysis determines the impact of simultaneously varying all parameters in a model on the ICER, thereby providing an assessment of the level of model uncertainty. All variables in this model were assigned a distribution (using mean (SD) or 95% confidence interval where data was available or by estimating variability in the parameter by +/- 30% of the mean value). We assumed beta distributions for transition probabilities and utilities and gamma distributions for costs. A second order Monte Carlo simulation of the model was conducted in Treeage Pro® 2013 with 10,000 iterations. This has the effect of running the model 10,000 times, each time randomly sampling from all the distributions of all the variables in the model. The output from this gives 10,000 pairs of results for the OPSC & MDS and UC strategies covering many scenarios possible with the variability of parameters built into the model. The values are plotted on a cost-effectiveness plane with incremental costs on the y axis and incremental QALYs represented on the x axis. A cost effectiveness acceptability curve was constructed to demonstrate the likelihood of the intervention being acceptably cost-effective at different willingness to pay levels.

Results

Base Case

Table 3 presents both the base case and one way sensitivity analyses. The OPSC & MDS model is slightly more expensive than UC at an incremental cost of \$112 however also results in a net incremental benefit of 0.07 QALYs resulting in a small ICER of \$1,714.

<INSERT TABLE 3 ABOUT HERE>

The model is sensitive to both the cost of the OPSC & MDS service and the probability that it will result in a successful outcome for the patient. The variance in the model from changes in other cost estimates is small. The highest impact is from the cost of surgery which is the highest input cost. Rising costs of surgery over other health care costs (e.g. wages) would make the OPSC & MDS relatively more cost-effective.

Probabilistic sensitivity analysis

The first 1,000 pairs of incremental costs and effects from the Monte Carlo simulation are plotted in Figure 3. The cost-effectiveness plane shown depicts four quadrants. Points in the southeast quadrant represent interventions that are both cost saving and more effective and hence “dominate”. Points in the northeast quadrant are more effective than the comparator and also cost more, and hence, a decision must be made on whether it is worth funding these interventions based on society’s willingness to pay.

<INSERT FIGURE THREE ABOUT HERE>

The cost-effectiveness acceptability curve (CEAC) calculates the probability that the intervention is cost-effective compared with the do nothing alternative, for a given value of the maximum acceptable ratio (i.e. willingness to pay (WTP) for each QALY gained, defined as λ). That is; the CEAC presents the probability that an intervention is cost-effective compared with the alternative for a range of values of λ .

Figure 4 demonstrates the CEAC based on a conservative acceptable range of \$20,000 per QALY.

<INSERT FIGURE FOUR ABOUT HERE>

The CEAC demonstrates that if a cost neutral strategy was required by decision makers, the OPSC & MDS would have around a 40% probability of meeting this requirement. However, if decision makers were willing to pay at least \$20,000 per additional QALY, the OPSC & MDS would have around a 95% chance of being cost-effective.

While the base case favours the use of OPSC & MDS, with similar costs and better outcomes to traditional models of care, the wide variability of results in the probabilistic sensitivity analysis demonstrates the need to obtain more robust measurements to inform this model.

Discussion

This is the first paper proposing an economic model to compare traditional medical specialist led orthopaedic services in public hospital settings to that of a more recently established physiotherapy led service. The model utilised data relevant to the management (conservative and surgical) of three common orthopaedic conditions. Previous economic analyses in orthopaedics have in the main compared different surgical techniques only. Given the increasing cost of managing musculoskeletal conditions that often don't require surgical intervention, it is imperative that models such as the one proposed in this paper investigating new innovative services such as the OPSC & MDS model are developed.

Integral to the development of the model is the known detrimental impact of long waits for specialist consultation on quality of life. The use of a Markov model and the use of QALYs within that model allows for the critically important effects of waiting times to be incorporated into the model by allowing the use of quality of life decrements for extended waiting. Using the most commonly applied outcome in health economic evaluation of QALYs gained, allows this model to be compared with other types of health care interventions.

While using QALYs allows comparisons between health care programs, it provides no information on whether this intervention might provide value for money when considering government budgets generally. This requires some idea of the society's or the funder's willingness to pay for a QALY. This can be difficult to determine as no Australian funder of

health care services is willing to explicitly nominate a set figure. However, it is possible to determine a general willingness to pay by looking at decisions made in Australia by the Pharmaceutical Benefits Advisory Committee who take into consideration the cost-effectiveness of new medications when making their decisions. This 'revealed preference' indicates that the willingness to pay for a QALY in the early 2000's in Australia was somewhere in the range of \$50,000 to \$60,000 ²⁹ and this figure is supported by a more recent international survey which found a figure of \$64,000 per QALY for Australia ³⁰.

Based on this estimate of willingness to pay, the ICER of \$1,691 for the OPSC & MDS program could be considered highly cost-effective and may even be cost saving in a number of scenarios. However, this evidence is subject to some uncertainty which is reflected in the probabilistic sensitivity analysis and the CEAC. The 95% credible intervals from the probabilistic sensitivity analysis range from a dominated scenario where the OPSC & MDS costs more and is less effective (reported in 2.7% of the simulations) to a dominant scenario where the OPSC & MDS is cost-saving and is more effective (reported in 36% of simulations). The most frequently occurring scenario was where OPSC & MDS resulted in greater health benefits at additional costs (60% of the simulations).

Conclusions

The promising findings of this study have provided the impetus to utilise this model to undertake a fully informed analysis with prospective data from both OPSC & MDS and UC orthopaedic pathways. Importantly the model will be modified in this prospective study to evaluate the additive value of the OPSC & MDS when combined with UC services as both are considered crucial to orthopaedic patient care. This prospective study is currently underway. It is also anticipated that the model proposed in this study could be easily varied to allow comparison of medically led versus allied health led treatment pathways in other areas of health care - for example pain management or incontinence clinics.

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Tables

Tables

Table 1 Demographic details of the participants

Demographic details	Mean (sd) or N(%)
Age	56.7 (13.9)
Gender (female)	546 (56%)
Classification (Proportion Category 3)*	823 (84%)
Symptom duration (months)	54.9 (87.3)
Body Mass Index	31.5 (7.3)
Number of co-morbidities	2.3 (1.9)
Number of medications	4.6 (4.2)
Location of pathology	
Shoulder	n = 368 (37.6%)
Low back	n = 275 (28.1%)
Knee	n = 337(34.4%)

Notes: *Remainder of patients were classified as category 2.

Table 2 Model parameters

Description	Expected Value	Distribution	Source
Costs			
Usual Care Clinic	\$65.44	Gamma ($\alpha=9.003$, $\lambda=0.138$)	Expert
OPSC &MDS assessment	\$60.50	Gamma ($\alpha=8.997$, $\lambda=0.149$)	RR
Usual conservative care	\$181.27	Gamma ($\alpha=1$, $\lambda=0.006$)	Expert
OPSC & MDS intervention	\$470.00	Gamma ($\alpha=2.269$, $\lambda=0.005$)	RR
OPSC & MDS Additional medical care (e.g.injections, x-rays)	\$120.00	Gamma ($\alpha=1$, $\lambda=0.008$)	Expert
Surgical intervention	\$12,311	Gamma ($\alpha=2.664$, $\lambda<0.001$)	AR-DRG
Medical care post surgery	\$425.45	Gamma ($\alpha=1$, $\lambda=0.002$)	Expert
Probabilities			
OPSC &MDS team care after initial assessment	0.83	Beta (n=980, r=810)	RR
Conservative treatment	0.50	Beta (n=500, r=250)	Expert
Conservative treatment success	0.50	Beta (n=500, r=250)	Expert
Expedited review	0.50	Beta (n=500, r=250)	Expert
Return to OPSC &MDS after expedited review	0.50	Beta (n=500, r=250)	Expert
OPSC &MDS with no additional medical	0.91	Beta (n=980, r=887)	RR
Discharge to GP first assessment	0.30	Beta (n=500, r=150)	Expert
Discharged to GP subsequent	0.10	Beta (n=500, r=50)	Expert
Surgical waitlist	0.11	Beta (n=500, r=56)	Audit**
Receiving surgery from the waitlist	0.40*	Beta (n=500, r=200)	Audit**
Responder after surgery	0.80	Beta (n=500, r=400)	Lit
OPSC & MDS responder after treatment	0.52	Beta (n=980, r=512)	RR
OPSC & MDS non responder requires review	0.58	Beta (n=468, r=271)	RR
OPSC Responder requires review	0.28	Beta (n=512, r=145)	RR
Utilities			
Utility on entry	0.59	Gamma ($\alpha=1177.473$, $\lambda=824.351$)	RR
Utility non responder	0.48	Gamma ($\alpha=209.162$, $\lambda=224.334$)	RR
Utility responder	0.68	Gamma ($\alpha=511.503$, $\lambda=235.762$)	RR

RR=retrospective review; AR-DRG= Australian refined diagnosis-related groups

* This value used in a tunnel state, patient will not receive surgery for two years to reflect waiting list times.

**Audit data was supplied by an orthopaedic administrator of a large metropolitan hospital and subsequently reviewed by the project team.

Table 3 Base Case and One way sensitivity analysis

Item	Direction	Usual Care	OPSC & MDS	Increment	ICER
Base case Cost / Effect		\$1,292	\$1,404	\$112	\$1,714
Base Case Effect (QALYs)		2.74	2.81	0.07	
One way sensitivity analyses					
0% Discount rate	Reduced	\$1,558	\$1,589	\$31	\$425
		3.10	3.17	0.07	
10% Discount rate	Increased	\$1,076	\$1,250	\$174	\$2,948
		2.44	2.50	0.06	
OPSC & MDS Team Care	Reduced	\$1,292	\$1,289	-\$3	Dominant
Costs	Increased	\$1,292	\$1,519	\$227	\$3,471
Usual conservative care	Reduced	\$1,279	\$1,404	\$126	\$1,924
Costs	Increased	\$1,306	\$1,404	\$98	\$1,503
Surgery Costs	Reduced	\$967	\$1,136	\$169	\$2,592
	Increased	\$1,617	\$1,672	\$55	\$836
Probability of being referred for surgery	Reduced	\$1,074	\$1,246	\$172	\$2,706
	Increased	\$1,530	\$1,563	\$33	\$485
Probability of responding to OPSC & MDS care	Reduced	\$1,292	\$1,477	\$184	\$4,045
		2.74	2.79	0.05	
	Increased	\$1,292	\$1,323	\$31	\$353
		2.74	2.83	0.09	
Utility of a responder	Reduced	2.73	2.76	0.03	\$3,832
	Increased	2.75	2.84	0.09	\$1,259

Notes: QALY = quality-adjusted life year; ICER = incremental cost-effectiveness analysis. OPSC & MDS = Orthopaedic Physiotherapy Screening Clinic and Multi-disciplinary Service

Supplementary Tables

Table S1 Transitions possible in the Economic Model

State	Description	Possible Transitions
Waitlist for appointment	Waiting for an appointment at a public hospital orthopaedic department	Initial Appointment and treatment Drop out Die
Initial appointment and treatment	Review by OPSC & MDS clinician OR review by an orthopaedic consultant resulting in a treatment decision	Review GP management* Waitlist for appointment** Surgical waitlist Responder Non responder Drop out Die
Review	Wait and see state with regular review by orthopaedic consultant	Surgical waitlist GP management Drop out Die
Surgical waitlist	Waiting for elective surgery	Responder Non responder Drop out Die
GP management	Discharged to be managed by GP	Continue Die
Responder	Meets minimally clinically important difference on functional outcome measure	Continue Die
Non responder	Did not meet minimally clinically important difference on functional outcome measure	Continue Die
Drop out	Dropped out from treatment and unable to determine outcome.	Continue Die
Dead	Die from any cause	Absorbing state

Notes: *= in Usual care arm only **= in OPSC&MDS arm only.

Figures

Figure 1 Usual Care Pathway

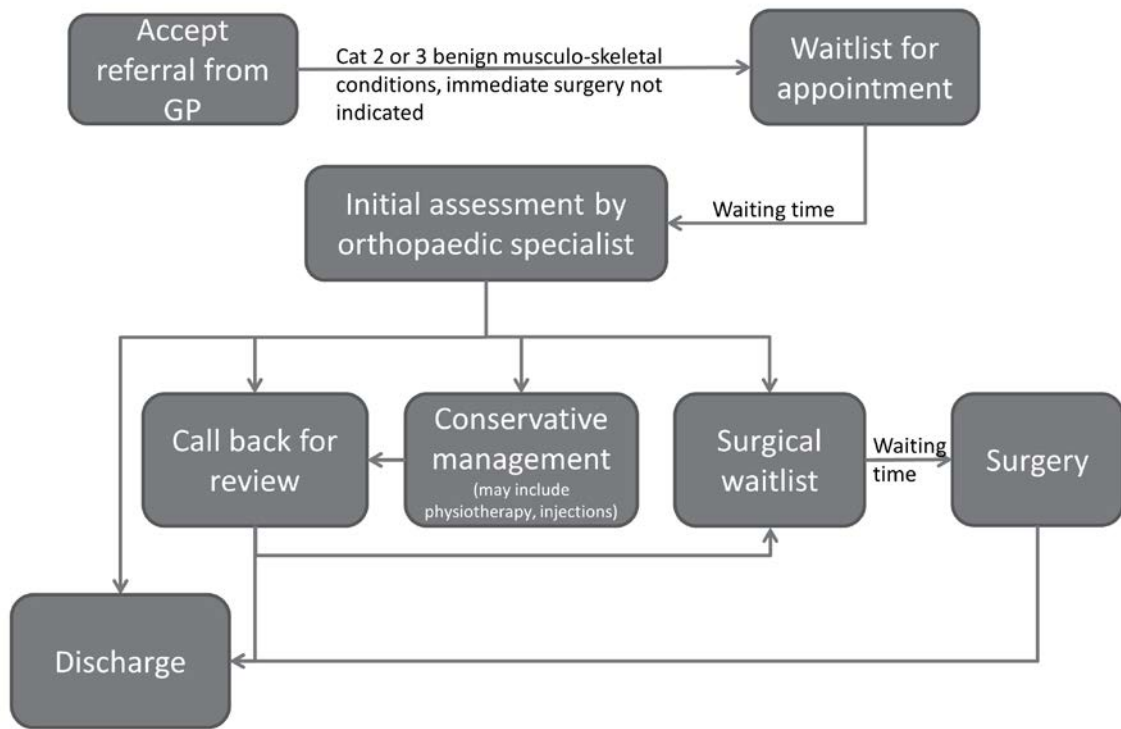


Figure 2 Orthopaedic Physiotherapy Screening Clinic Pathway

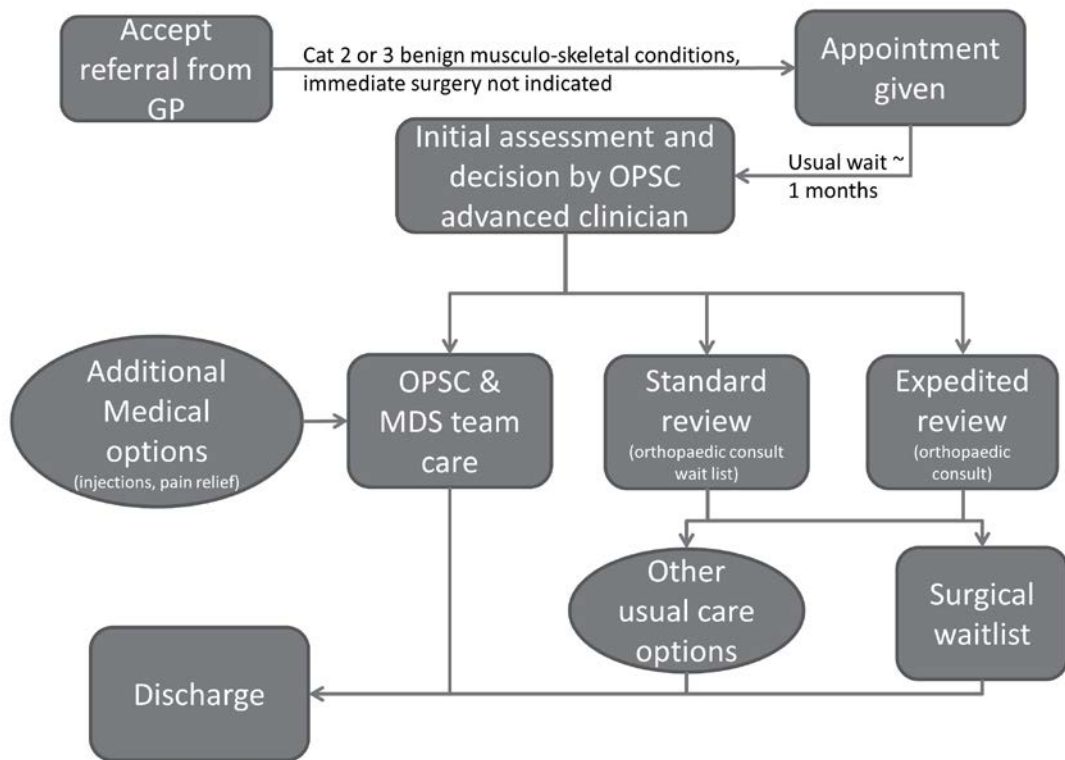


Figure 3 Incremental Cost-effectiveness OPSC versus Usual Care

Incremental Cost-Effectiveness, OPSC v. Usual Care

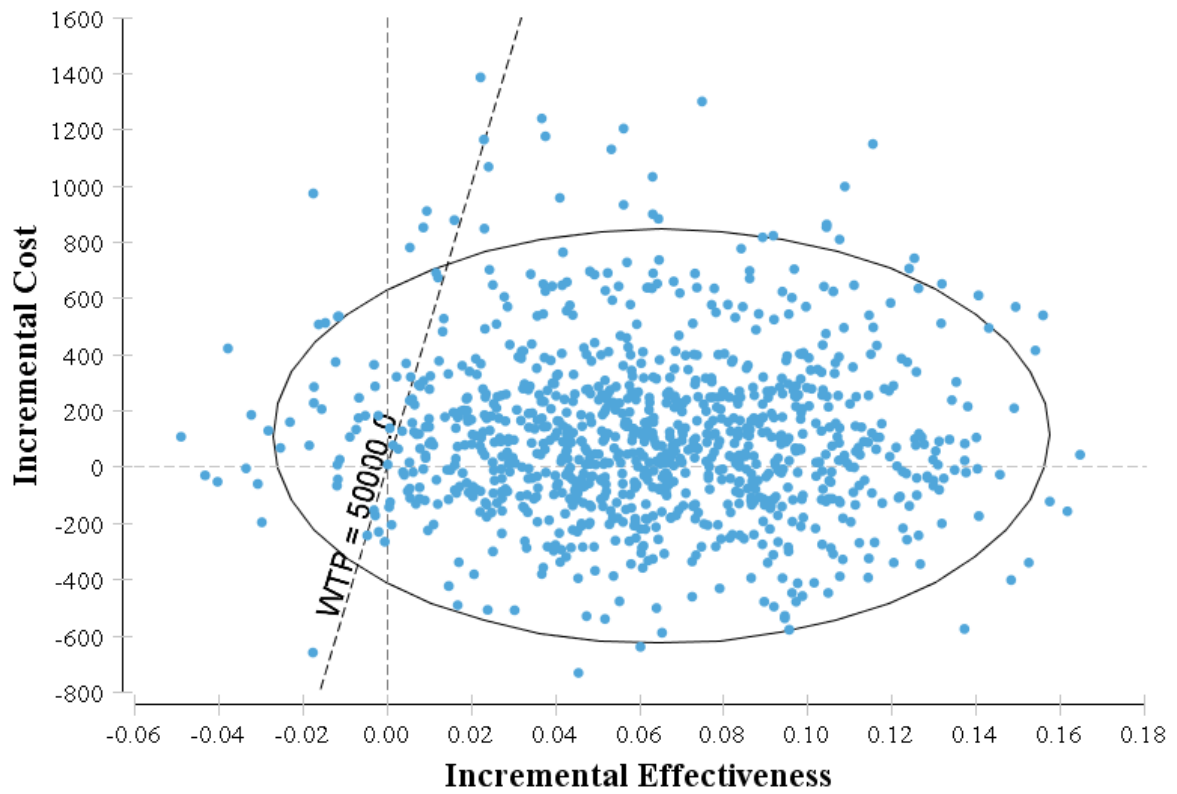


Figure 4 Cost-effectiveness acceptability curve

