

Determinants of patient and surgeon perspectives on maximum acceptable waiting times for hip and knee arthroplasty

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Objectives: Lengthy waiting times for hip and knee arthroplasty have raised concerns about equitable and timely access to care. The Western Canada Waiting List project has developed priority criteria scores linked to maximum acceptable waiting times (MAWT) for different levels of priority. Our study purpose was to assess the determinants of patient- and surgeon-rated MAWT, and to test whether the anticipated waiting time has an independent influence after adjusting for age, sex and patient urgency. A second aim was to compare MAWT, waiting time and anticipated waiting time for different levels of urgency assessed using the priority criteria score.

Methods: Orthopaedic surgeons assessed 233 consecutive patients waiting for arthroplasty in terms of their urgency (assessed using the priority criteria score and a visual analogue scale), MAWT and anticipated waiting time. Patient data included urgency (assessed by a visual analogue scale), MAWT and the Western Ontario McMaster Osteoarthritis index. We used hierarchical linear regression to test the models.

Results: After adjusting for age and sex, urgency (assessed by priority criteria score and visual analogue scale) and anticipated waiting time accounted for 40% of the variance in surgeon MAWT. The patient model accounted for 30% of the variance in patient MAWT. Older patients preferred significantly shorter MAWTs ($P < 0.05$). Anticipated waiting time added significantly to both the surgeon and patient MAWT models (R^2 change 0.11 and 0.07, respectively). Actual waiting time was weakly correlated with urgency assessed using the priority criteria score ($r = -0.25$, $P < 0.0001$).

Conclusions: Patients' and surgeons' views are critical to a fair process of establishing MAWT for elective procedures. Anticipated waiting time may influence the perspectives on MAWT and must be considered in their interpretation.

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Introduction

The presence of lengthy waiting times for joint arthroplasty in Canada has raised concerns about equitable and timely access to care. Recent information suggests that waits longer than six months from referral to orthopaedic consultation and waits longer than 12 months from consultation to surgery may have

adverse effects on 12-month outcomes for hip arthroplasty.¹ Moreover, there is increasing evidence to suggest that individuals with worse health status pre-operatively have worse health status up to two years postoperatively.²

In general, across surgeons, the waiting time from orthopaedic consultation to surgery appears unrelated to the level of urgency.^{3,4} Accordingly, priority setting based on urgency is receiving more attention as a means of better managing waiting lists for elective services.⁵ The Western Canada Waiting List (WCWL) Project Hip and Knee Replacement Priority Criteria Score (PCS) is intended to improve the fairness of the system by providing a standardized transparent method to assess patient urgency and thus order patients in the queue.⁶

To be useful for access management, it is important to link maximum acceptable waiting times (MAWT) to priority scores. However, there is little published

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literature on the rationale and evidence used to determine MAWT standards for elective surgery, particularly in the absence of explicit outcomes such as mortality. Factors to consider in their development include clinical evidence, such as the effects of waiting time on patient outcomes, costs associated with waiting, the availability of resources, and patient, physician and public acceptance of waiting time standards.

Patient, physician and public perspectives on acceptable waiting times provide valuable inputs. Physician input has been primarily through surveys⁷ or the use of expert panels.⁸ Patients' perspectives have been assessed through interviews^{4,9} and preference-based economic methods such as willingness to pay¹⁰ and trade-off techniques.¹¹ Methods such as discrete choice analysis have been used to determine public values using tradeoffs between location of surgery and waiting times.¹² Governments in Sweden, the UK and New Zealand have all attempted to establish standards and care guarantees for acceptable waits for elective services. These initiatives to date have met with mixed success.¹³⁻¹⁵

The primary purpose of this study was to assess the determinants of surgeon and patient perspectives on MAWT and to test whether anticipated waiting times, in other words, what can be expected taking into account local conditions, have an independent influence after adjusting for patient demographics and patient urgency. We also wanted to assess the determinants of differences in patient and surgeon MAWTs. Finally, we wanted to explore the relationships between physician and patient MAWTs, and anticipated waiting time and actual waiting time, and compare their patterns across different levels of patient urgency.

Methods

Consecutive patients, 18 years and older, who were placed on a waiting list for hip or knee arthroplasty at two tertiary care centres in Alberta, Canada, were recruited to the study from December 2000 to June 2001. The study continued in parallel with the current system of prioritizing and booking patients, i.e. scores were not used to prioritize patients. The surgeons rated each patient using the WCWL Hip and Knee Replacement PCS, designed to assess patient urgency, defined as the severity and impact of illness combined with expected benefit.¹⁶ It includes seven criteria: pain on motion, pain at rest, ability to walk without significant pain, other functional limitations, abnormal findings on physical exam, potential for progression of disease documented by radiographic findings, and threat to role and independence. The tool may be found at www.wcwl.org. The weighted sum of the item scores results in an urgency score from 0 (least urgent) to 100 (most urgent). The validity of the PCS is described in a separate paper.¹⁷

In addition to completing the priority criteria on each patient, surgeons were asked to rate the urgency of patients on a visual analogue scale (VAS) from 0 ('not

urgent') to 100 ('extremely urgent'). The MAWT from the surgeon's perspective was evoked by the question: 'In your clinical judgement, what should be the appropriate maximum waiting time for this patient. Waiting time is defined as the time from the decision date for surgery to the actual surgery'. Anticipated waiting time was assessed by asking surgeons to estimate the length of time that each patient would be likely to wait in their practice. Actual waiting time was the time from being placed on the list until the date of surgery, not including the time that a patient was unavailable for surgery due to medical reasons.

Consenting patients were asked to rate their urgency on a similar VAS and to offer a MAWT with the question: 'In your judgement, what should be the appropriate maximum waiting time for you or a person like yourself?' Other patient measures included age, sex, revision or primary surgery and the Western Ontario McMaster Osteoarthritis index, a 24-item condition-specific health status measure with three subscales: pain, function and stiffness.¹⁸ Subscale scores were transformed to a 0-100 (better to worse) scale. Ethics approval for this study was given by the University of Alberta.

Hierarchical (sequential) linear regression is a technique used to order the entry of independent variables based on the purpose and logic of the research.¹⁹ The incremental proportion of variance in the dependent variable (R^2 change) is accounted for by a given independent variable or set of independent variables, beyond what has been accounted for by prior sets. We hypothesized that measures of patient urgency would be the most influential determinant of both patient and surgeon MAWT. We also wanted to determine if the addition of information regarding anticipated waiting time in practice improved the prediction of surgeon-rated and patient-rated MAWT beyond that accounted for by age, sex and patient urgency.

Independent variables for the surgeon MAWT model were entered in four sets in the following order: (1) age and sex; (2) the seven priority criteria; (3) surgeon-rated VAS urgency; (4) anticipated waiting time in practice. The order of entry of the independent variables for the patient MAWT model was: (1) age and sex; (2) the three osteoarthritis subscales; (3) patient-rated VAS urgency; (4) anticipated waiting time in practice.

Finally, we used hierarchical linear regression to assess the determinants of differences in surgeon and patient MAWTs. The dependent variable was the difference between the surgeon and patient MAWT. To limit the number of independent variables, we used the osteoarthritis index score. The order of entry of independent variables was: (1) age and sex; (2) the priority criteria; (3) osteoarthritis index score; (4) the difference in VAS urgency between surgeons and patients.

Paired *t*-tests were used to test the mean differences between surgeon and patient MAWT, anticipated waiting time and actual waiting time. Correlational analysis

was used to assess the relationships between MAWTs, anticipated waiting time and actual waiting time. To determine the pattern of MAWTs, anticipated waiting time and actual waiting times for increasing levels of urgency, patients were split into 10 groups based on percentiles of the priority criteria scores.

Results

Sixteen orthopaedic surgeons (approximately 60% of all orthopaedic surgeons) recruited 233 patients (62% females, 38% males) with a mean age of 66.3 years (SD 11.7). We were unable to document the numbers or characteristics of patients who did not participate. Descriptive statistics of all measures are presented in Table 1. There was no significant difference between surgeon and patient mean MAWT, and no significant difference between actual waiting time and anticipated waiting time. Actual waiting time was significantly higher than either patient or surgeon MAWT. In all, 95% of MAWTs rated by surgeons were 20 weeks or less and those rated by patients were 24 weeks or less.

Table 2 summarizes the findings from the surgeon MAWT model and shows the unstandardized and standardized regression coefficients and intercept after entry of all of the independent variables. With

unstandardized regression coefficients, all variables are expressed in raw scores, whereas with standardized regression coefficients all variables are expressed as z-scores with a mean of 0 and a standard deviation of 1. The unstandardized regression coefficient is more useful for making predictions. For example, holding the other variables constant, for every increase of one week in anticipated waiting time, the predicted value for surgeon-rated MAWT increased by approximately one day (0.14 of a week). Differences in raw score regression coefficients are influenced by the standard deviations of the independent variables and cannot be compared. The standardized regression coefficient is more convenient for evaluating the relative contributions of the independent variables. For example, holding the other variables constant, surgeon-rated MAWT increased by 0.35 standard deviations when anticipated waiting time increased by one standard deviation.

The priority criteria provided the largest R^2 change (0.28, $P < 0.0001$). After adjusting for age, sex, the priority criteria and urgency (assessed with the VAS), anticipated waiting time added significantly to the model (R^2 change = 0.11, $P < 0.0001$). The multiple R is the measure of association between the dependent variable and the optimal linear combination of the independent variables, while R^2 is the proportion of

Table 1 Descriptive statistics of surgeon and patient measures

Measures	Mean	SD	Median	Min	Max	n
Actual waiting time (weeks)	22.20	14.79	21.07	0.00	57.57	202
Surgeon measures						
Anticipated waiting time* (weeks)	22.58	14.18	20.00	6.00	96.00	230
MAWT (weeks)	11.83	5.56	12.00	2.00	36.00	233
Priority criteria score	48.63	20.52	49.50	3.00	100.00	230
VAS urgency	57.45	20.25	61.00	0.00	100.00	233
Patient measures						
MAWT	11.43	8.35	8.00	0.00	48.00	218
WOMAC pain	60.09	16.83	60.00	5.00	100.00	229
WOMAC stiffness	66.49	19.36	62.50	0.00	100.00	232
WOMAC function	63.60	16.28	64.71	7.35	100.00	228
VAS urgency	70.19	17.53	73.00	12.00	100.00	227

*Surgeon-rated anticipated waiting time. MAWT, maximum acceptable waiting time; VAS, visual analogue scale of urgency; WOMAC, Western Ontario McMaster Osteoarthritis index. Higher scores for the priority criteria score, VAS urgency and WOMAC subscales (scaled 0–100) connote more urgency and worse health status.

Table 2 Hierarchical regression model of the determinants of surgeon-rated maximum acceptable waiting time (in weeks)

Order of entry (R^2 change)	Independent variables	B^*	Beta [†]
Entry 1 (0.02)	Age	-0.02	-0.05
	Sex	-0.61	-0.05
Entry 2 (0.28) [‡]	Pain on motion	-0.72	-0.07
	Pain at rest	-0.71	-0.09
	Ability to walk without significant pain	-0.48	-0.06
	Functional limitations	-0.06	-0.01
	Abnormal findings on physical exam	-1.42 [§]	-0.14 [§]
	Potential for progression (radiographic findings)	1.81 [‡]	0.32 [‡]
	Threat to role and independence	-1.47 [§]	-0.17 [§]
Entry 3 (0.00)	Visual analogue scale of urgency	-0.03	-0.12
Entry 4 (0.11) [‡]	Anticipated waiting time	0.14 [‡]	0.35 [‡]
Constant		19.43	

*Unstandardized coefficient (variables expressed in raw scores); [†]Standardized coefficient (variables expressed as z-scores);

[‡]Significance < 0.001; [§]Significance < 0.05.

the variance in the dependent variable that is accounted for by the optimally weighted independent variables. After step 4, with all independent variables in the equation, $R = 0.64$, $F(11,215) = 13.47$, $P < 0.0001$. In the final model, significant predictors of surgeon-rated MAWT were three priority criteria items (abnormal findings on physical exam, potential for progression documented by radiographic findings, and threat to role and independence) and anticipated waiting time. These accounted for approximately 40% of the variance in physician-rated MAWT ($R^2 = 0.41$, adjusted $R^2 = 0.38$).

Table 3 shows the unstandardized and standardized regression coefficients and intercept after entry of all of the independent variables for the patient MAWT model. Age was a significant predictor of MAWT with older patients preferring shorter MAWTs. After adjusting for age and sex, the osteoarthritis index subscales as a set (step 2) added significantly as predictors of patient MAWT (R^2 change 0.09). After adjusting for age, sex, osteoarthritis index subscales and urgency, the anticipated waiting time in practice added significantly to the model (R^2 change = 0.07). After step 4, with all independent variables in the equation, $R = 0.55$, $F(7, 202) = 12.68$, $P < 0.0001$. The final model accounted for approximately 30% of the variance in patient MAWT ($R^2 = 0.31$, adjusted $R^2 = 0.28$). Holding the other variables constant, for every increase of one week in anticipated waiting time, the predicted value for patient-rated MAWT increased by approximately one day (0.15 of a week).

Table 4 shows the regression coefficients after entry of all of the independent variables for the difference in surgeon and patient MAWT. After step 4 with all independent variables in the equation, $R = 0.41$, $F(11,203) = 3.62$, $P < 0.0001$. The final model accounted for approximately 12% of the variance in the difference between surgeon and patient MAWT ($R^2 = 0.16$, adjusted $R^2 = 0.12$). Two priority criteria items (abnormal findings on physical exam and potential for progression documented by radiographic findings) and the difference in assessment of urgency between surgeons and patients were significant predictors of the difference in surgeon and patient MAWT. Holding the other variables constant, for an increase of a one-point difference in surgeon and patient urgency assessment, the predicted value of the difference in surgeon and patient MAWT increased by approximately half of a day (0.07 of a week).

Actual waiting time was weakly but significantly correlated with the priority criteria score (-0.25 , $P < 0.0001$), surgeon-rated urgency (-0.31 , $P < 0.0001$) and surgeon-rated MAWT (0.28, $P < 0.0001$). Patient and surgeon MAWTs were moderately correlated (0.44, $P < 0.0001$). Figure 1 shows the median surgeon and patient MAWTs, actual waiting time and anticipated waiting time for 10 levels of urgency based on the percentiles of the priority criteria score. Median surgeon and patient MAWTs for the most urgent 10% of patients (score greater than 76) were six and four weeks, respectively, and for the least urgent 10%, 12 and 16 weeks, respectively. Although

Table 3 Hierarchical regression model of the determinants of patient-rated maximum acceptable waiting time (in weeks)

Order of entry (R^2 change)	Independent variables	B^*	Beta [†]
Set 1 (0.04) [‡]	Age	-0.09 [‡]	-0.13 [‡]
	Sex	-0.02	-0.00
Set 2 (0.09) [§]	WOMAC pain	0.06	0.12
	WOMAC function	-0.03	-0.07
	WOMAC stiffness	-0.06	-0.14
Set 3 (0.11) [§]	Visual analogue scale of urgency	-0.17 [§]	-0.37 [§]
Set 4 (0.07) [§]	Anticipated waiting time	0.15 [§]	0.26 [§]
Constant		28.58	

*Unstandardized coefficient (variables expressed in raw scores); [†]Standardized coefficient (variables expressed as z-scores); [‡]Significance < 0.05; [§]Significance < 0.001; WOMAC, Western Ontario McMaster Osteoarthritis index.

Table 4 Hierarchical regression model for the difference in surgeon and patient maximum acceptable waiting time (in weeks)

Order of entry (R^2 change)	Independent variables	B^*	Beta [†]
Set 1 (0.02)	Age	-0.07	-0.10
	Gender	-0.66	0.04
Set 2 (0.07) [‡]	Pain on motion	-1.51	-0.10
	Pain at rest	0.94	0.08
	Ability to walk without significant pain	-0.70	-0.07
	Functional limitations	-0.93	-0.08
	Abnormal findings on physical exam	2.67 [‡]	0.19 [‡]
	Potential for progression (radiographic findings)	-2.04 [§]	-0.26 [§]
	Threat to role and independence	0.11	0.01
Set 3 (0.04) [§]	WOMAC total score	-0.07	-0.14
Set 4 (0.03) [‡]	Difference in surgeon and patient VAS urgency	-0.07 [‡]	-0.21 [‡]
	Constant	12.76	

*Unstandardized coefficient (variables expressed in raw scores); [†]Standardized coefficient (variables expressed as z-scores); [‡]Significance < 0.05; [§]Significance < 0.001; WOMAC, Western Ontario McMaster Osteoarthritis index.

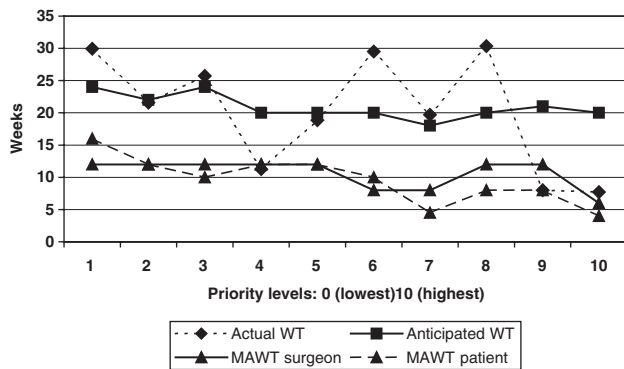


Figure 1 Comparison of surgeon and patient maximum acceptable waiting time (MAWT), anticipated waiting time (WT) in practice and actual WT for levels of patient priority. Priority levels are based on percentiles of the priority criteria score.

there was no clear pattern of actual waiting times across levels of urgency, the median actual waiting time was lowest for the two most urgent groups (8 and 7.71 weeks).

Discussion

Our results showed that patient urgency, as hypothesized, had an independent effect on both patient and surgeon MAWT, and older patients were significantly more likely to report shorter MAWTs. In contrast to the surgeon model, urgency assessed with a visual analogue scale added significantly to the patient MAWT model beyond what was accounted for by age, sex, and the osteoarthritis index. As the priority criteria were designed to model clinical judgement and assess surgeon-rated patient urgency, this was not surprising. In a retrospective survey of patients who had undergone knee replacement two to seven years earlier, Coyte *et al.*⁹ reported that older patients and those with greater disability had less acceptance of a longer wait. In a hypothetical trade-off task with patients waiting for total joint replacement, Llewellyn-Thomas *et al.* found that utility values (preferences for health states) were weakly associated with patients' tolerance of waiting times.¹¹ However, in their study, an unexpected finding was a lack of relationship of MAWT and osteoarthritis scores.

Anticipated waiting time had an independent effect on both patient and surgeon-rated MAWT after adjusting for age, sex, and measures of health status and urgency. The only other report of possible effects of anticipated waiting times on priority was a Swedish study that assessed prioritization of identical simulated referrals for orthopaedic consultation.²⁰ Priority was assessed in terms of waiting time from referral to orthopaedic consultation. Reviewers at units with shorter waiting times tended to give patients greater priority (i.e. shorter waiting time) than reviewers at units with longer waiting times. In the Fraser Institute physician opinion surveys, median values for clinically reasonable waiting times for orthopaedic surgery were

highest (53.4 weeks) for the province with the longest estimated waiting time, whereas the province with the shortest clinically reasonable waiting times (4.2 weeks) had actual estimated waiting times that were 41.6 weeks shorter.⁷

Two priority criteria – abnormal findings on physical exam and potential for progression of the disease – were significant predictors of differences in surgeon and patient perceptions of MAWT. These criteria are unique to an orthopaedic assessment as they are dependent on orthopaedic knowledge, the physical examination and radiographic findings. In addition, the difference in patient and surgeon urgency assessments using a visual analogue scale was a significant determinant of the difference in MAWT.

It has been suggested that basing a queuing system on patient measures such as the osteoarthritis index may be a more objective measure of severity than surgeons' impressions and could reinforce the desired outcome of shorter waits for more severely symptomatic patients.³ Our findings support the inclusion of both surgeon and patient perspectives in the development of standardized waiting times. This may be particularly relevant for patients scheduled for revision hip or knee replacement who may have lower symptom severity but higher urgency based on radiographic findings.

Although surgeon and patient MAWTs were only moderately correlated, there was agreement between them, on average, of approximately three months. Both surgeons and patients rated 95% of all MAWTs at six months or less. This could be viewed as an upper limit for determining target waiting times and is similar to standards set by New Zealand (six months), but longer than the three-month guaranteed waiting times in Sweden. Patients' MAWTs in our study were similar to an average waiting time of 13.2 weeks reported for patients who viewed their waiting time for knee replacement surgery as acceptable but shorter than those assessed by Llewellyn-Thomas *et al.* (mean eight months).¹¹ However, because their trade-off technique introduced different levels of risk of postoperative mortality, MAWTs in their study may have been confounded by risk aversion.

Actual waiting times and differences in actual waiting times and surgeon-rated MAWTs were very similar to findings by the Fraser Institute physician surveys.⁷ They reported a median estimated waiting time of 24 weeks and a difference of 11.6 weeks between actual estimated waiting time and clinically reasonable waiting time.

For use in the management of waiting lists, MAWTs need to be established for different levels of urgency. Thus far, little work has been done in this area. While most studies have assessed average or median acceptable waiting times across all patients, our study linked MAWTs to levels of patient urgency. The one other study that attempted to relate patient-rated acceptable waiting times to three categories of priority based on surgeon assessment found that the majority of patients

would have desired their surgery within six months of the interview.⁴ However, at the time of the interview, 42% of the patients had waited longer than one year. In addition, the sample size was small ($n=35$) and 94% of patients were categorized as either severe or extreme. In our earlier work, surgeons were asked to assess the priority and MAWT for six standardized patients waiting for a hip or knee replacement.²¹ Median MAWTs ranged from four weeks for the most urgent to 24 weeks for the least urgent. MAWTs for the most urgent group were also similar to time frames developed by Naylor *et al.* to rate cases for appropriateness and waiting list priority for joint arthroplasty.⁸

As priority systems arose out of public concern with long waiting times and timely access to care, it is important to understand patients' MAWTs within the context of expectation theory and its relationship to satisfaction. In a review of the conceptualization of expectation in relation to patient satisfaction, Thompson and Sunol identified four types of expectation: ideal (desired or preferred), predicted (anticipated), normative (what ought to happen) and unformed (unable or unwilling to articulate expectations). Our study addresses the predicted and normative types of expectation. A MAWT can be viewed as a minimal level of service that an individual expects and may affect satisfaction with the service.²² Satisfaction is determined by the magnitude and direction of the gap between expectation and perception of performance.^{23,24}

A limitation of our study is that we did not know whether patients were aware of their anticipated waiting time at the time of assessment. A common practice was to give patients a rough estimate of their length of wait, although they were not given a surgery date at that time. Results may not be generalizable, as the study took place in one health region and patients and surgeons were those who were willing to participate. In addition, we were unable to assess differences in surgeon or patient responders and non-responders. However, health status at baseline and actual waiting times were similar to those reported in similar populations.^{7,25} Our continuing research involves the assessment of MAWT in different health regions with varying actual waiting times.²⁶ Finally, the interpretation of our results is limited by the absence of information about other variables that might have an impact on MAWT. Future research should involve the study of MAWT as it relates to ideal waiting time,²⁷ patient information,^{28,29} perceived equity,³⁰ past experience with waiting, and patient satisfaction.^{23,24} The use of qualitative methods would enhance our understanding of these concepts.

In non-life-threatening conditions, in which there is insufficient evidence on the long-term effects of waiting times on clinical outcomes, patient, physician and public input to decision making is critical to a fair process for establishing standards for acceptable waiting times for scheduled procedures. Knowledge of the determinants of MAWTs can assist decision makers to

understand the contextual factors that influence these perspectives. Of substantial importance, both anticipated and actual waiting times may influence perspectives on MAWTs and must be taken into account in the interpretation of public and surgeon values.

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