



## Method for Quantifying Patient Expectations and Early Recovery After Total Knee Arthroplasty

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### Abstract

Many components of a surgeon's total knee arthroplasty (TKA) treatment regimen affect the rate of recovery, such as patient selection, preoperative education, surgical technique, pain management, and postoperative rehabilitation. Therefore, accurate counseling requires that the surgeon quantifies patient expectations and early recovery of the treatment regimen with a method that minimizes interviewer bias.

Preoperatively and 4 to 5 weeks after TKA, 285 patients (306 consecutive primary TKAs) responded to a survey consisting of customized questions, the Oxford score, the SF-12, and Knee Society scores on a handheld data acquisition device. The average response to each question on the 4- to 5-week postoperative survey defined patient expectations, and the change in a response between the 4- to 5-week postoperative and the preoperative survey determined whether the surgical intervention improved the patient.

At 4 to 5 weeks postoperatively, 80% of patients walked without a cane, 54% drove a car, 88% thought the treated knee was functioning better than before surgery, 93.5% thought the treated knee was normal or nearly normal, and 98% thought the alignment of their limb was "just right." By 4 to 5 weeks, patients experienced less pain and showed significant improvements in 11 of 12 activities queried by the Oxford score, SF-12 physical score, Knee function score, Knee Society score, and knee extension. Flexion was significantly less at 4 to 5 weeks, and the SF-12 mental score was not significantly different. Average hospital stay was 2 nights, with 98% discharged home. Surgeons should consider a method that minimizes interviewer bias to quantify patient expectations and rate of recovery of their specific treatment regimen, and then use this information to counsel their patients to avoid disappointment after TKA.

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The expectation of an arduous or prolonged recovery period may cause patients to unnecessarily forego total knee arthroplasty (TKA). Conversely, an inaccurate expectation of the rate of recovery may cause patients to be dissatisfied with their surgical intervention. Patients form their expectations of the surgical outcome from information provided by their surgeon or general practitioner, experiences shared by relatives and friends that have been through TKA, and the considerable information available in the media.<sup>1</sup> Because some of this information may be inaccurate, surgeon counseling may best influence patients' expectations.

However, it is well known that surgeons expect better results than their patients, which means that the primary source of information for patient counseling should be patient expectations, not those of the surgeon.<sup>1-3</sup> Greater attention to the individual requirements of patients may improve evaluation of the outcomes of orthopedic treatments.<sup>2</sup> To reliably determine patient expectations, surveys need to be self-administered by the patient, as this minimizes potential bias unwittingly introduced by the surgeon (ie, interviewer bias) when assessing the results themselves.<sup>2</sup>

It is well known that the expectations and rate of recovery after any surgical procedure are affected by many factors, including patient motivation, education, selection (preoperative deformities, preoperative motion, prior limb trauma, previous knee surgery, comorbidities, body mass index [BMI]), surgical technique (alignment, patella eversion, patella replacement), surgeon level of skill and experience, pain management, method of anticoagulation, postoperative rehabilitation, and the effectiveness of the support system after discharge. Therefore, accurate counseling requires that patient expectations and early recovery be quantified for the surgeon's specific treatment

regimen.

The objective of this study is to introduce a method that uses a handheld data acquisition device to minimize interviewer bias and comprehensively quantifies patient expectations and rate of recovery 4 to 5 weeks after TKA. For the treatment regimen described in the present study, we determined the incidence and rate of return to independent ambulation and driving and the change in satisfaction, pain, limb alignment, and activities in a large series of patients (306 knees in 285 subjects) by having each patient self-administer surveys with a handheld data acquisition device. The average response to each question on the 4- to 5-week postoperative survey defined patient expectations, and the change in a response between the 4- to 5-week postoperative and the preoperative survey determined the rate of recovery. The average number of nights in the hospital and distribution of discharge location (ie, home or extended care facility) defined patient expectations concerning the duration of hospitalization and discharge disposition.

**Materials and Methods**

Beginning October 29, 2007, our practice instituted the routine use of a handheld computerized device (Palm; Palm, Inc, Sunnyvale, California) to prospectively administer surveys to all patients considering or treated with TKA. The handheld device presents questions in a simple, easy-to-read format that the patient answers by touching the screen on the desired response with a stylus. When a patient has visual, language, or technical difficulties, they can rely on a family member or friend to ask each question and enter the data. This self-administered data collection method was chosen because it reduces interviewer bias, since only the patient answers the questions<sup>4</sup>; reduces nonresponder bias because the handheld device is programmed so that the patient cannot finish each survey unless every question is answered; and reduces entry error and loss of data by daily syncing of the device to a central database (MedTrak, Conshohocken, Pennsylvania).

Each survey required the patient to answer all the subjective questions that comprise the Oxford score (best score is 48), SF-12 physical score (average score is 50), SF-12 mental score (average score is 50), Knee function score (best score is 100), and Knee Society score (best score is 100). The 4- to 5-week postoperative survey contained additional customized questions designed to assess the patient’s rate of return to independent ambulation and driving, level of satisfaction of the treated knee compared to the preoperative knee and a normal knee, and limb alignment (Table 1). The Knee Society score required the examiner (blinded) to enter extension, flexion, and the data obtained from the clinical examination of the knee. The Knee Society score was therefore the only score that was not self-assessed by the patient. Flexion and extension were measured with a long goniometer with the patient supine and actively positioning the knee.

Table 1 Customized Questions and Response Options	
At 4 weeks after surgery, can you walk without a walker?	Yes or no
How soon did you walk without a walker?	1, 2, 3, or 4 weeks
At 4 weeks after surgery, can you walk without a cane?	Yes or no
How soon did you walk without a cane?	1, 2, 3, or 4 weeks
At 4 weeks after surgery, are you driving the car?	Yes or no
How soon did you drive?	1, 2, 3, or 4 weeks
At 4 weeks after surgery, how is your knee compared to before surgery?	Better, same, or worse
At 4 weeks after surgery, how is your knee compared to a normal knee?	Normal, nearly normal, abnormal, or severely abnormal
How straight is your leg?	Just right, too bow-legged, too knock-kneed

A patient was included in the study if he or she filled out a preoperative and a 4- to 5-week postoperative survey between October 29, 2007, and December 1, 2008, and was treated with a primary TKA. Eight patients who filled out a preoperative survey but not a 4- to 5-week postoperative survey were excluded: 3 patients missed their appointments, 3 lived out of state and were unwilling to return for the appointment, 1 died perioperatively from

aspiration, and 1 died after discharge from a necrotic bowel unrelated to surgery. Thus, 285 consecutive patients (165 women, 120 men) with an average age of  $67\pm 9$  years and a BMI of  $30\pm 5$  enrolled in the study. Since 21 patients had bilateral, sequential TKAs under a separate anesthetic, a total of 306 consecutive primary TKAs comprised the study. An institutional review board approved the study.

All patients were treated with a cruciate-retaining TKA (Vanguard; Biomet, Inc, Warsaw, Indiana) implanted and fixed with cement under a general anesthetic. The patella was resurfaced in 80% of cases. The knee was exposed through a mid-vastus approach without patella eversion. Details of the surgical procedure, which uses image-generated, custom-fit cutting guides to 3-dimensionally and kinematically align the components, has been previously described.<sup>5,6</sup>

Postoperatively, drains and peripheral nerve blocks were not used. Discomfort was managed with an intra-articular injection of 20 to 30 cc of 0.5% bupivacaine with epinephrine mixed with ketorolac 30 mg, patient-controlled analgesia overnight (morphine sulphate or demerol), intravenous ketorolac 15 mg every 8 hours, and oral analgesics until discharge. Thromboembolism prophylaxis was managed with a calf sequential compression device used on the untreated leg during surgery and continued on both legs during the hospital stay. Three hundred twenty-five mg of aspirin was given twice a day starting on the day of surgery and continuing for 28 days. Patients taking warfarin prior to admission or having a history of pulmonary embolism were treated with a coumadin protocol for 21 days.

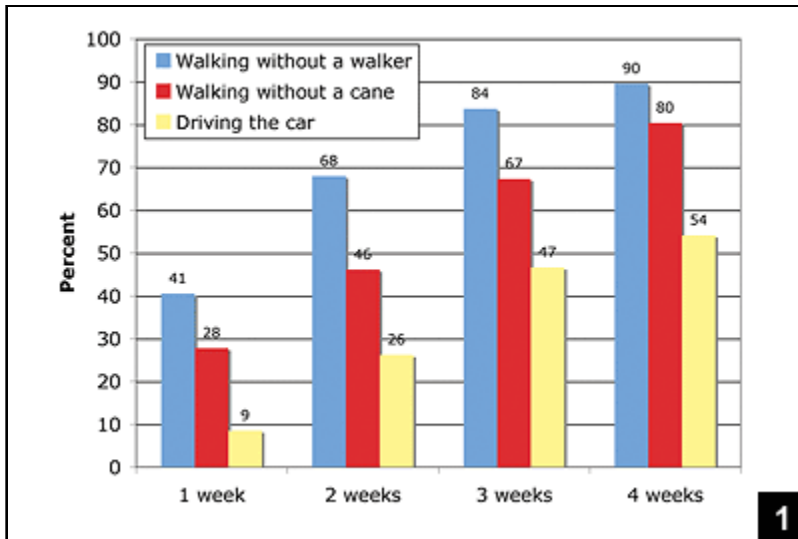
Rehabilitation started in the recovery room with the use of continuous passive motion initially set at  $0^\circ$  to  $70^\circ$  that was increased as tolerated and continued during the hospital stay. A physical therapist administered range-of-motion (ROM) exercises and ambulated patients on the day of surgery. The day after surgery, patients were treated with a physical therapy and occupational therapy session in the morning, and stair-climbing was taught in a group physical therapy session in the afternoon. On the morning of the second postoperative day, patients were instructed on a home exercise program, and if there were no medical complications they were discharged. After discharge, each patient was seen twice a week by a physical therapist until the patient was able to safely leave the house, and by a nurse once a week when there were medical or wound issues. A review of hospital records determined the length of stay and whether discharge was to home or to a skilled nursing facility.

## Statistical Methods

The two-tailed, paired *t* test for continuous data and the chi-square test for categorical data were used to determine whether a patient's pain level, function, satisfaction, and activities changed from preoperatively to 4 to 5 weeks postoperatively after TKA. Data were expressed as mean $\pm$ 1 standard deviation, with  $P<.05$  indicating a significant difference. Each analysis was performed with JMP version 7.0.2 statistical software (SPSS, Inc, Chicago, Illinois).

## Results

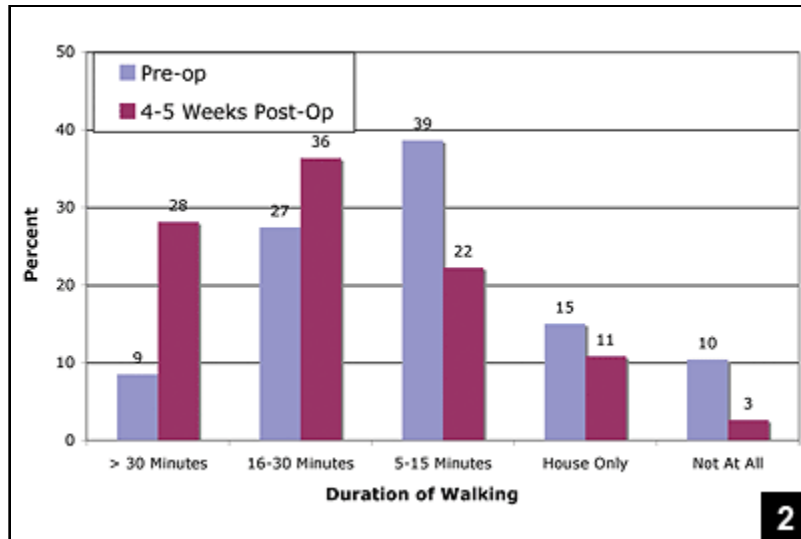
Each patient's response to 3 customized questions quantified the rate of return to independent ambulation and driving. By 4 weeks postoperatively, 90% of patients (N=303) walked without a walker, 80% (N=303) walked without a cane, and 54% (N=294) who had driven preoperatively resumed driving (Figure 1).



**Figure 1:** Column graph showing the percentage of patients walking without a walker, walking without a cane, and driving the car at each week. By 4 weeks, 80% were walking without an assistive device and over half of those who drove preoperatively resumed driving.

Each patient’s response to 3 customized questions quantified his or her satisfaction 4 to 5 weeks after TKA. Compared to their preoperative knee, 88% of patients assessed their treated knee as better, 8% the same, and 4% worse. Compared to a normal knee, 93.5% of patients thought their treated knee was normal or nearly normal (19.5% normal, 74% nearly normal, 4.5% abnormal, and 2% severely abnormal). Ninety-eight percent thought their limb was aligned “just right,” and 2% thought their limb was too “knock kneed” (ie, valgus).

Each patient’s response to the 12 questions that comprise the Oxford score<sup>4</sup> quantified their change in pain (5 questions) and activities (7 questions).<sup>4,7</sup> In terms of pain, at 4 to 5 weeks postoperatively, knee pain was less ( $P<.0001$ ), walking for longer time periods without severe pain was easier ( $P<.0001$ ), night pain persisted ( $P=.0003$ ), pain interfered less when performing usual work and housework ( $P<.0001$ ), and when standing up from a chair the pain was less and the activity was easier ( $P<.0001$ ) than preoperatively. In terms of function, at 4 to 5 weeks postoperatively, washing and drying was easier ( $P=.0001$ ), getting in and out of a car was easier ( $P<.0001$ ), limping was less ( $P<.0001$ ), giving way was less ( $P<.0001$ ), household shopping was easier ( $P<.0001$ ), and walking down stairs was easier ( $P<.0001$ ) than preoperatively (Figure 2). Only kneeling was more difficult than preoperatively ( $P<.0001$ ).



**Figure 2:** Column graph showing the distribution of the preoperative and 4- to 5-week postoperative responses to the Oxford score question: "For how long have you been able to walk before pain in your knee becomes severe?"<sup>4,7</sup> By 4 to 5 weeks, 64% of patients admitted to walking >16 minutes before pain in the knee became severe, whereas only 36% did preoperatively ( $P<.0001$ ).

At 4 to 5 weeks postoperatively, the Oxford score, Knee Society score, Knee function score, SF-12 physical score, and knee extension were significantly better than preoperatively, whereas the SF-12 mental score was not significantly different and knee flexion was significantly less (Table 2). Average hospital stay was 2 nights with 98% discharged home. The time interval between the day of surgery and the postoperative evaluation averaged 31.7±6 days (4 to 5 weeks). Average time required to fill out the preoperative survey was 8±1 minutes, and for the 4- to 5-week postoperative survey was 10±1 minutes.

Outcome Variable	Preoperative	4- to 5-week Postoperative	Difference
Oxford score (of 48)	20±8	29±8	$P<.0001$
Knee Society score (of 100)	40±14	89±9	$P<.0001$
Knee function score (of 100)	45±19	52±21	$P<.0001$
SF-12 physical (50 average)	29±8	36±9	$P<.0001$
SF-12 mental (50 average)	54±11	53±9	$P=.1317$
Knee extension, deg	8±8	2±3	$P<.0001$
Knee flexion, deg	114±13	106±12	$P<.0001$

<sup>a</sup>Values are expressed as the mean ± standard deviation.

## Discussion

Our study introduced an efficient method using a handheld data acquisition device to minimize interviewer bias that comprehensively quantifies patient expectations and the rate of recovery 4 to 5 weeks after TKA. Quantifying patient expectations and the rate of recovery helps the surgeon formulate a realistic understanding of the effects of their specific treatment regimen that they can use when counseling patients considering and recovering from TKA.

The primary limitation of the study is that surgeons using a different treatment regimen should be cautious about using patient expectations and rate of recovery described in the study to counsel their patients. Many variables affect

a patient's assessment of a treatment regimen, including patient motivation, preoperative deformities, preoperative motion, prior limb trauma, previous knee surgery, comorbidities, BMI, patella resurfacing, surgical technique, surgeon's level of skill and experience, pain management, anticoagulation, pre- and postoperative rehabilitation protocol and supervision, and the effectiveness of the support system after discharge.

An example of how the treatment regimen affects the rate of recovery is illustrated by contrasting a prior study with the present one. A prior study of highly selected patients treated with a minimally invasive technique showed that the average flexion of 123° at 6 weeks was 17° better than the consecutive series of patients in the present study; however, the highly selected patients in the prior study had a preoperative flexion of 131° that was 17° greater than the present study, and a Knee Society score of 50 that was 10 better than the present study.<sup>8</sup> These differences in patient selection, preoperative flexion, pain, activity, and surgical technique are just some of the multiple factors that make up a surgeon's treatment regimen and affect the rate of recovery. Therefore, if a surgeon's goal is to effectively counsel his or her patients, the surgeon should quantify patient expectations and rate of recovery of his or her own specific treatment regimen.

We can counsel patients considering TKA that a typical patient will be better at 4 to 5 weeks postoperatively than he or she was preoperatively with a limb alignment that appears normal. More than half will walk without a cane, drive a car, have less pain, limp less, and walk for longer periods of time than preoperatively. Working, shopping, getting up from a chair, and going down stairs will be easier than preoperatively. Patients should notice improvement in extension and plan to stay 2 nights in the hospital and then go home; however, many will have pain at night, difficulty kneeling, and some loss of flexion at 4 to 5 weeks postoperatively. With the treatment regimen described in the present study, patients should not expect an arduous or prolonged recovery period that may cause them to unnecessarily forego TKA.

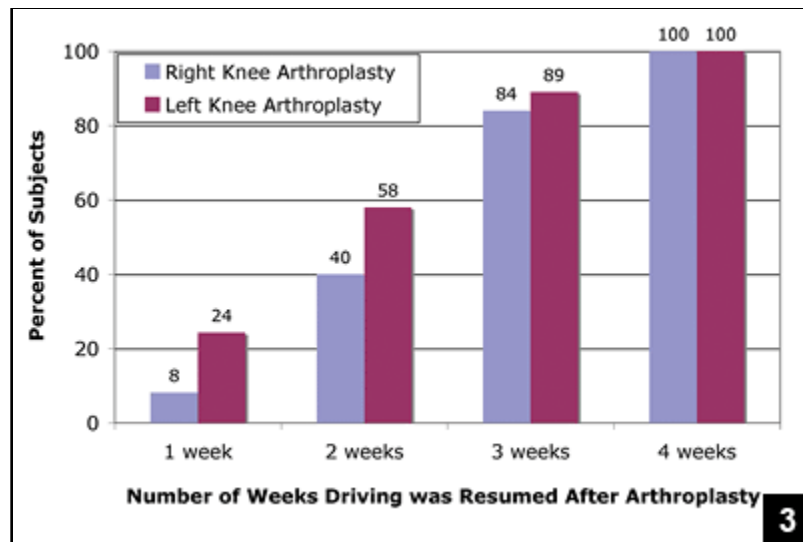
One set of self-assessment questions helpful for counseling patients concerning the expected level of activities at 4 to 5 weeks postoperatively are the responses to the customized questions that determine the rate of return to independent ambulation and driving, the level of satisfaction of the treated knee compared to the preoperative knee, and the patient's perception of a normal knee (Table 1). Patients with inaccurate or unrealistic expectations may feel that their level of activity and recovery at 4 to 5 weeks is inadequate. We counsel such patients that if they walk without a cane or walker, walk further and with less pain than preoperatively, and assess their treated knee as better at 4 to 5 weeks than preoperatively, then their recovery is on schedule based on the evidence they provided.

Another helpful assessment for counseling patients is the answers to each of the 12 questions that comprise the Oxford score. The questions in the Oxford score were designed to be joint specific to increase their sensitivity to TKA outcome and to be influenced as little as possible by other comorbidities. The Oxford knee scores have been evaluated independently and found to be the best and most reliable systems for the assessment of TKA.<sup>4</sup> A patient's assessment of pain relief, ease of washing and drying, difficulty getting in and out of a car, duration he or she can walk before feeling severe pain, level of pain when standing from a chair, frequency of a limp, difficulty kneeling, frequency of night pain, amount of pain interfering with work (ie, housework), frequency of giving way, difficulty doing household shopping, and difficulty walking down stairs gives a concise and comprehensive evaluation of the patient's recovery.<sup>7</sup> Activities the patient is having difficulty with can be readily identified by reviewing his or her responses to these questions, and a problem-specific treatment program can be instituted.

The database is useful for identifying patients performing below average and determining whether their poor performance may be associated with a preoperative condition. For example, in the present study, 6.5% of patients (20 of 306) had <90° of flexion 4 to 5 weeks postoperatively, which was less than the average flexion of 106° of all patients in the study. A post-hoc analysis determined that the subgroup of patients with <90° of flexion at 4 to 5 weeks had an average of 107±16° of preoperative flexion, which was significantly less than the subgroup of patient with >90° of flexion at 4 to 5 weeks that had an average of 116±12° preoperative flexion ( $P=.03$ ). Because others have shown that preoperative flexion is a determinant of postoperative flexion,<sup>9-12</sup> and because the present study supports this view, we counsel patients with loss of preoperative flexion that the rate of recovery of flexion at 4 to 5 weeks will be slower than those with more normal preoperative flexion.

Clinical studies of brake response time have suggested that patients should be advised to wait 30 days postoperatively before resuming driving if they had a right TKA<sup>13</sup> and 10 days if they had a left TKA,<sup>14</sup> as long as they drive a car with automatic transmission and not under the influence of narcotics. In our study, we allowed patients to self-determine when to resume driving by suggesting that they wait to drive until they felt safe behind the wheel, so that if they got in an accident it was not because they had difficulties driving the car but because of a

judgment error. We observed that by 4 weeks, 48% of patients (85 of 177) with a right TKA and 57% of patients (74 of 129) with a left TKA resumed driving (Figure 3). When patients considering TKA ask when they can expect to drive, we remind them that they should only drive when they feel safe behind the wheel and that they will drive sooner if they have their left knee replaced and drive a car with an automatic transmission than if they have their right knee replaced or drive a car with a manual transmission.



**Figure 3:** Column graph showing the distribution of the percentage of patients who resumed driving at 1, 2, 3, and 4 weeks. By 4 weeks, 48% of patients (85 of 177) with a right TKA and 57% of patients (74 of 129) with a left TKA resumed driving. At 2 weeks, a post-hoc analysis showed that a higher percentage of patients with a left TKA returned to driving than with a right TKA (steering wheel on right side of vehicle;  $P=.028$ ).

Patient use of the handheld computer to self-administer and record the surveys has improved the efficiency of pre- and postoperative visits. Patients spend an average of 8 to 10 minutes answering the survey, which they fill out in the waiting room before being seen. A list of the preoperative Oxford, SF-12 physical, SF-12 mental, Knee Society Function, and Knee Society scores, as well as flexion and extension, can be kept on the chart and compared to the patient's responses at each follow-up visit. Showing the patient the improvement in each score between visits gives a sense of accomplishment, satisfaction, and quantitative reassurance that the patient is getting better. In the case where the score between visits worsens, the cause(s) of the poor score can often be identified.

The handheld data collection system is licensed on a yearly basis, with the cost depending on a number of factors, including practice size, amount of customization, and the duration of the license. The hardware and the ability to create custom questions are included in the licensing fee. A large number of standard forms for knees, hips, and spine are available, including the SF-12, Oxford knee/hip, Western Ontario and McMaster Osteoarthritis Index (WOMAC), Knee Society, Harris Hip, Knee Injury and Osteoarthritis Outcome Score (KOOS), Hip Disability and Osteoarthritis Outcome Score (HOOS), Oswestry Disability Index, and many others. Collecting custom data requires a practice or surgeon to provide the company with the questions they wish to collect, which are then added to the site's data set. A password-protected, Health Insurance Portability and Accountability Act (HIPAA)-compliant website ([www.orthosight.com](http://www.orthosight.com)) offers a suite of reporting and analysis tools that give surgeons and practices a day-to-day overview of their outcomes data. Collected information can also be exported in standard formats for more in-depth analysis.

### Conclusion

It is important to understand the expectations of a patient to avoid disappointment after TKA. With increasing litigation in medicine, the emphasis of preoperative counseling seems to be on a detailed description of the risks of surgery. However, the positive results of the majority of patients should also be stressed.<sup>1</sup> Obtaining patient responses to preoperative and postoperative surveys with a handheld data acquisition device and without

interviewer bias is a simple and efficient way to define patient expectations and improvement from a surgeon's specific treatment regimen, which can be useful when counseling those considering and recovering from TKA.

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Dr Howell is a cofounder, stockholder, and unpaid consultant for OtisMed, Inc. Ms Rogers has no relevant financial relationships to disclose.

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