Management of End-Stage Ankle Arthritis: A Cost-Utility Analysis Using Direct and Indirect Costs
Benedict Uchenna Nwachukwu, MD, MBA (New York, New York)
Alexander S. Mclawhorn, MD, MBA; Kamran S. Hamid, MD, MPH; Constantine A. Demetracopoulos, MD; Jonathan T. Deland, MD; Scott J. Ellis, MD

Introduction
Total ankle replacement (TAR) and ankle fusion are costly but clinically effective treatments for ankle arthritis. Prior cost-effectiveness analyses for the management of ankle arthritis are limited by lack of consideration for indirect costs and non-operative management. Further, there is now also improved knowledge regarding comparative outcomes after TAR and ankle fusion. The purpose of this study was to compare the cost-effectiveness of modern operative and non-operative treatments for ankle arthritis using both direct and indirect costs.

Methods
A state-transition Markov model was constructed to compare the cost-effectiveness of non-operative care, ankle fusion and TAR for ankle arthritis. The analysis was performed from a health-systems perspective using direct costs and also from a societal perspective using both direct and indirect costs. Probabilities, costs and utilities were obtained from the available literature. Costs were expressed in 2013 US dollars and effectiveness was expressed in quality adjusted life year (QALY). The principal outcome measure was the incremental cost-effectiveness ratio (ICER). Deterministic and probabilistic analyses were performed to account for uncertainty in assumptions.

Results
In direct cost analysis for the base case, cohort age 55, compared to non-operative management TAR was associated with an ICER of $49,400/QALY. A lifetime cost of $46,580 in productivity losses was incurred with non-operative care of ankle arthritis in the base case. The ICER decreased to $24,800/QALY when indirect costs were taken into account. In the base case, TAR dominated ankle fusion (more effective and lower cost per QALY). At a $100,000/QALY threshold, surgical management of ankle arthritis was preferred in patients younger than 82 years and TAR was increasingly more cost effective in younger patients. Our model was sensitive to age at surgery, costs of the operation, utility values and the failure rate of TAR.

Conclusions
Compared to non-operative treatment for the management of end stage ankle arthritis TAR is a preferred strategy to ankle fusion and is highly cost effective with increasing effects seen in younger patients. As indications and utilization of TAR increases continued research is needed to define appropriate subgroups of patients who would likely have the greatest clinical benefit from TAR.
Cost-Effectiveness Analysis

Cost, $

Effectiveness, QALY

- ▲ Ankle fusion
- □ Non-operative
- ◊ TAA
- ○ dominated
- + undominated