Purpose of review
Based on current projections, the American Academy of Orthopedic Surgeons estimates that approximately 750,000 joint-replacement procedures will be performed annually. Total-hip-replacement surgery has been shown to be one of the safest and most effective interventions in medicine, decreasing pain and restoring mobility and function in people with long-term hip disease, or injury.

Recent findings
With the reported increases in life expectancy, a large segment of the population will be entering their fifties and sixties over the next decade. Many of these so-called baby-boomers have been physically active through their life and have a strong desire to maintain their current active lifestyles. Demand on these joint-replacement procedures will increase significantly. Between one-third and one-half of all joint-replacement procedures performed in the USA are hip replacements.

Summary
It is estimated that over $15 billion per year are spent on hip-replacement surgery in the USA alone. These large outlays of dollars have made this procedure the focus of cost-containment efforts by the government and private payers.

Keywords
cost, financial impact, hip replacement, osteoarthritis
intervention, the cost savings on transport and assisted living can be significant. In addition, the lack of mobility increases heart and pulmonary disease morbidity. In a recent study from India, lack of mobility was reported to increase morbidity due to an increased incidence of urinary-tract infection, high blood pressure, and diabetes [6]. The prevalence of these conditions can increase the cost on the healthcare system by as much as $3444 per patient per month [6].

The potential costs of new technologies as well as changes in current clinical pathways have to be explored. These new technologies and pathway changes will on occasion improve the outcomes and at other times increase the complications and costs. Having a broad knowledge of the economic issues involved will help clinicians develop appropriate resource-utilization strategies in the future.

**Current costs related to hip-replacement surgery**

The costs of any surgical intervention can be divided into two main components: hospital and professional. The hospital costs for hip-replacement surgery have been the subject of several publications [7,8]. In total hip-replacement surgery, a large percentage of these costs are taken up by the implant [8,9] (Figs 1 and 2). Professional costs are usually a fraction of the hospital costs and include the fees of the surgeon, radiologist, anesthesiologist and any other physician consultants that participate in patient care.

The CMS program in the USA pays for over 60% of the hip replacements and, as a result of this, they have become an important force in dictating reimbursement for this procedure. Whereas the hospital reimbursement by CMS for primary joint replacement has increased at a relatively small rate, implant costs continue to rise substantially. In the USA in 2005, the hip-implant market was worth approximately $2.1 billion [10]. From 1996 to 2004 the selling price for total hip implants had increased by 117% [11]. The median cost of an implant in 2001 was approximately $3200 and by 2005 the median cost had risen to over $6400 [12] (Fig. 3).

CMS reimbursement for primary total hip arthroplasty for hospitals and manufacturers has steadily risen over the past decade. Surgeon reimbursement in the other hand has declined significantly. Over the 15 years from 1991 to 2006, physician reimbursement has decreased 39% [11] (Fig. 3). This reduction in physician reimbursement by the CMS is usually adopted by most private payers. In Miami Dade County, where the senior author of this article (C.J.L.) practices, all the managed-care companies base their contracts and pay on a percentage of the CMS reimbursement, with most paying the surgeons less than 100% of CMS rates. These declines in reimbursement have occurred in spite of large increases in practice expenses. Although most orthopedic surgeons still participate in the CMS program a significant number of so-called expert or master surgeons have abandoned the program.

One of the first papers in which costs related to hip replacement were described was published over 10 years ago by the senior author (C.J.L.). In this work, a small cohort of patients was analyzed documenting the charges for 25 individuals having a primary total hip replacement [8]. The total charges for the procedure were more than $19,000, which included over $15,000 in hospital charges [13]. This included surgical fee, implant cost, and total hospital charges. Although this paper had a small number of patients it started a formal examination by practicing clinicians of the costs associated with arthroplasty.
Examining financial data from 290 primary hip-replacement surgeries in a teaching hospital from 1993 to 1995, Iorio et al. [14] reported that the average hospital cost was slightly more than $11,000. An important finding was that the average length of stay was approximately 5 days. This paper highlighted the importance of implant costs as well as length of stay. In addition it illustrated the significant decrease in length of stay that occurred in a period of 6 years.

March and colleagues [15] investigated the preoperative health status of the individual and how that related to event cost issue in the mid-1990s. They reported that people who perceived worse physical function and pain before surgery spent more ‘out of pocket’ in the first year after surgery.

Shah and colleagues [16] reported on the relationship of hospital cost with severity of illness following primary hip-replacement surgery. Their data showed how hospital costs increased with severity of illness. From 2000 to 2002, Bozic and colleagues [17*] reported similar results. They also reported that preoperative health was a predictor of higher resource utilization.

Vincent et al. [18*] noted that regardless of age, average inpatient hospital charges were almost $2,000 more for females than males. Furthermore, for both men and women, those individuals who incurred the greatest hospital cost were those of 85 years or older. These data, as well as the prior studies, clearly demonstrate the increase in costs associated with an increase in the patient’s age as well as the medical severity of illness.

**Hip-replacement surgery outside the USA**

Countries outside the USA have different methods for delivery and paying for healthcare. For example, Martineau and colleagues [19*] reported that from three Canadian hospitals with high patient volume, there were much lower overhead, direct, and total costs for performing a total hip procedure when compared to hospitals with low patient volume. The total cost of performing total hip arthroplasty in low-volume hospitals was approximately $2,900 more than if the surgery was performed in a high-volume hospital.

Antoniou and colleagues [20] compared the hospital cost of hip-replacement surgery done in Canada with those in the USA (three hospitals). In Canada, the average total cost for the procedure was $6,766; this included both direct and overhead costs [20]. The total cost in the USA was over $13,000. One interesting point was that the average length of stay in the USA was 4 days whereas the average length of hospital stay in Canada was 7 days.

O’Shea and colleagues [21] reported that the average implant cost in Ireland was only 8.2% of the total cost for the procedure. The implant cost in one Canadian hospital was 25% of the total cost ($16,95), whereas in US hospitals the cost of the implant ranges from 45 to 60% of the total cost ($8,017) [20].

**Postoperative complications**

Complications in primary total hip replacement can include, among other things, death, dislocation, infection, and pulmonary embolus. In over 58,000 primary hip replacements performed in Medicare beneficiaries over a 1-year period (1995–1996), about 3% of the surgeries...
had dislocation within the first 90 days after the procedure [22]. Although these complications involve only a small percentage of the cases, they can place an increased financial burden on the hospital, the patient, and society.

Bozic and Ries [23*] noted that the cost of revision secondary to infection was over $96,000. Other complications, such as deep-vein thrombosis and postthrombotic syndrome, can have a significant financial impact on the total cost of primary hip replacement [18*,24].

Although complications are infrequent in primary hip replacement, when considered over the large number of surgeries done in the USA they become a significant economic factor.

**New technologies**

Total-hip-replacement surgery is a safe and effective intervention, yet clinicians and researchers continue to develop new devices, procedures, and protocols that can improve the outcome. Minimally invasive surgery is one area that has gained recent popularity. In a small, recent pilot study, cost comparisons were made between a group of individuals having total hip replacement using a traditional inpatient model with those having total hip replacement at an outpatient facility (minimally invasive surgery) [25*]. In this study, inpatient hospital charges were $4000 more than the procedure completed on an outpatient basis. When comparing inpatient and outpatient procedures, studies have shown that there were more perioperative complications with the outpatient procedure. [26–28,29**].

Bozic et al. [30*] recently evaluated the cost effectiveness of alternative bearing surfaces in hip-replacement surgery. The authors reported that bearing surfaces may be have a positive cost/utility ratio only in certain age groups [30*]. Moreover, the authors suggest that further evidence is needed to determine whether, over the long run, these surfaces provide better wear profiles [30*]. Alternative bearing surfaces can double the implant costs in primary surgery and the evidence for improved outcomes in the long run remains controversial.

**Postdischarge costs**

Although an important factor in hip-replacement surgery, rehabilitation costs have not been well documented. Recently, Brunenberg et al. [31**] investigated the cost of an intense joint-recovery program which included physiotherapy during and immediately following hip-replacement surgery. Compared with individuals receiving usual care, the people who participated in the advanced joint-recovery program had higher functional outcomes. In this study, individuals participating in the joint-recovery program had lower admission ($5104) and discharge ($4281 compared with $5063) costs. Furthermore, the length of hospital stay was approximately 4 days shorter for those patients completing the joint-recovery program.

Postdischarge or rehabilitation strategy costs have also received some attention in the literature. Rehabilitation hospital costs were reported in a study by Walker and investigators [32]. The authors reported the rehabilitation hospital cost to be slightly more than $10,000 in 39 individuals having primary hip replacement from 1994 to 1998.

We recently reported an analysis of postdischarge costs in a cohort of patients treated in Miami [9**]. Although this report was limited to a geographic area, it clearly showed that rehabilitation costs are significant and that some strategies are significantly more expensive than others. We reported that postdischarge costs were five times greater in those patients who were discharged to a comprehensive rehabilitation unit compared to those who went home with home care services [9**] (Figs 1 and 2). More importantly, functional outcomes were similar between individuals staying home with home-care services and those going to a comprehensive rehabilitation unit [9**]. Using our data, and an algorithm to estimate postdischarge costs, we estimated that the national average postdischarge expenditures exceeded $3.4 billion. Clearly, attention should be directed at defining more appropriate interventions in rehabilitation in an effort to maximize functional outcomes and minimize postdischarge costs.

**Conclusion**

Overall, it is clear from this review that significant work needs to be done under the guidance of practicing clinicians to optimize the economic factors surrounding total hip replacement while improving the outcome. Researchers in orthopedics need to clearly document the economic impact that a hip arthroplasty can have for society.

**References and recommended reading**

Papers of particular interest, published within the annual period of review, have been highlighted as:* of special interest,** of outstanding interest

Additional references related to this topic can also be found in the Current World Literature section in this issue (p. 83).

Payment analysis of total hip replacement

Lavernia et al.


9 Lavernia CJ, D’Apuzzo MR, Hernandez VH, et al. Postdischarge costs in total hip arthroplasty surgery. J Arthroplasty 2006; 21 (suppl 2):144–150. This is a recent study documenting postdischarge costs after replacement surgery examining cost after surgery and the relationship with discharge placement. The study reported that compared to individuals discharged to home, postdischarge costs were higher in those individuals going to a rehabilitation unit, yet functional outcomes were similar.


11 Mendenhall Associates. Hip and knee implant prices rise 6.3%. Orthopedic Network News 2006; 17:1. This article presents good data and a graph of the average implant selling price over an 8-year period.


13 Felden JM, Cumming JM, Home JG, et al. Waiting for hip arthroplasty: economic costs and health outcomes. J Arthroplasty 2005; 20:990–997. This is an interesting study from New Zealand which reports that the timing of when to have surgery may have an impact on the overall cost of total hip arthroplasty. Those individuals who waited less than 6 months to have total hip arthroplasty saved almost $1500 in total costs compared with those who waited longer than 6 months.


18 Vincent HK, Alfano AP, Lee L, et al. Sex and age effects on outcomes of total hip arthroplasty after inpatient rehabilitation. Arch Phys Med Rehabil 2008; 87:461–467. This was an investigation which evaluated the cost of total hip arthroplasty in men and women. The authors found that women had higher total charges and men were more often discharged to home.

19 Martineau P, Filion KB, Huk OL, et al. Primary hip arthroplasty costs are greater in low-volume than in high-volume Canadian hospitals. Clin Orthop Rel Res 2005; 437:152–156. This article reports on a cross-sectional study of 940 patients following total hip arthroplasty, comparing the cost of surgery between high and low-volume centers in Canada. The results indicated that overhead, direct, and total costs were greater in hospitals with low volume.


23 Bozic KJ, Ris MD. The impact of infection after total hip arthroplasty on hospital and surgeon resource utilization. J Bone Joint Surg Inc 2005; 87-A:1746–1751. This was a small study indicating that infection following total hip arthroplasty which requires revision is extremely costly.


25 Berin KC. Minimally invasive outpatient total hip arthroplasty: a financial analysis. Clin Orthop Rel Res 2005; 435:154–163. This was a small pilot study which showed that minimally invasive surgery was cost-effective compared to a traditional inpatient protocol.


31 Brunenberg DE, Steyn MIV, Sluimer JC, et al. Joint recovery programme versus usual care: an economic evaluation of a clinical pathway for joint replacement surgery. Med Care 2005; 43:1018–1026. This study compared the cost-effectiveness of a specific joint-recovery protocol with standard care. The results showed that when compared with people having the standard care, those individuals who had a specific goal-directed protocol following surgery had higher function levels and quality of life many weeks and up to 1 year after the procedure.