

## A Careful Analysis of Trends in Spinal Fusion in the United States from 1998 to 2008.

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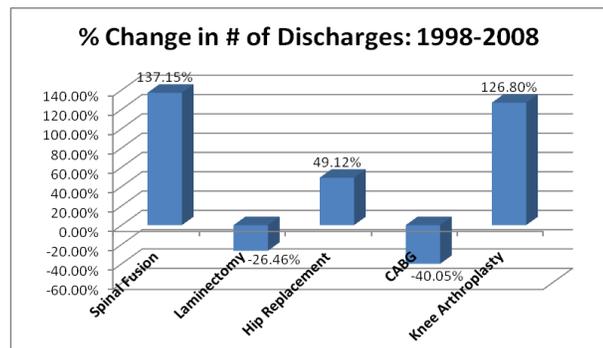
### INTRODUCTION:

Since the earliest descriptions of spinal fusion by Hibbs and Albee in 1911, arthrodesis of the spine has been one of the most commonly employed procedures, and today, it remains to be the gold standard for treatment of numerous spinal conditions. As of 2008, spinal fusion ranks number 16 in total number of discharges amongst all inpatient procedures, with approximately 413,000 spinal fusions performed annually in the US. Looking back to 1998, where it was ranked in position 37, it becomes clear that the practice of spinal fusion has grown at a significantly higher rate in comparison to that of other notable procedures in the US. While previous reports have demonstrated the growth in the utilization of spinal fusion in earlier time frames, limited information has been presented pertaining to certain patient and healthcare-related characteristics associated with spinal fusion, including: age, patient race, patient household income, payer type, total hospital charges, length of hospital stay, in-hospital deaths, and geographical distribution of spinal fusions. Furthermore, the influence of many advances in spine surgery that have occurred in the last decade has not yet been evaluated.

This current study provides an analysis on the utilization of spinal fusion procedures from 1998 to 2008, addressing how developments in the field of spine surgery have influenced fusion rates. It also reports on detailed patient and healthcare system-related characteristics associated with spinal fusion in the United States that have not been addressed previously.

RANKING	1998	2000	2002	2004	2006	2008
Spinal Fusion	#37	#31	#25	#20	#19	#16
Laminectomy	#17	#21	#23	#29	#30	#29
Hip Replacement	#20	#19	#17	#16	#16	#15
CABG	#16	#16	#19	#28	#28	#31
Knee Arthroplasty	#18	#17	#15	#13	#12	#9

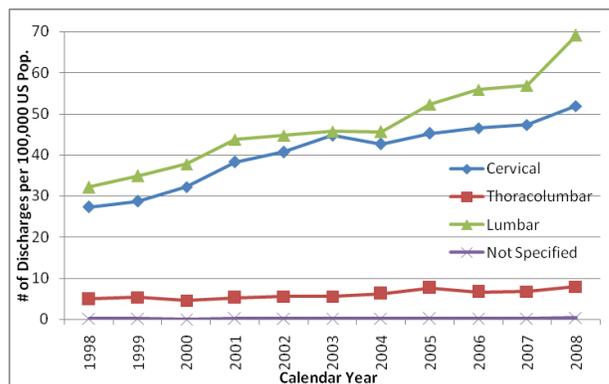
**Table 1. Rank of spinal fusion compared to other notable inpatient procedures from 1998 to 2008. (Based on number of discharges)**



**Fig.1 % Change in total number of discharges from 1998-2008.**

### METHODS:

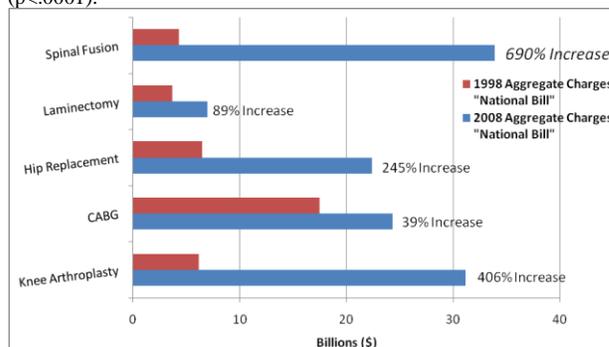
All data analyzed in this study were from the Nationwide Inpatient Sample (NIS) obtained from the Healthcare Cost and Utilization Project (HCUP) for the years 1998-2008 (cite). Patients who underwent spinal fusion were identified (n= 3,143,246 ) using ICD-9-CM codes (Cervical Fusion = 81.01-81.03, Thoracolumbar Fusion = 81.04-81.05, Lumbar Fusion = 81.06-81.08). Calculation of population-based rates was performed using data from the United States census. Associated patient characteristics studied included mean age, payer type, household income, and race. Associated healthcare system related characteristics studied included length of hospital stay, in-hospital deaths, and total charges and costs for spinal fusion. Statistical analysis was performed using computer software (SAS version 9.1) along with the HCUPET website.



**Fig.2 Graph of Utilization Rates per 100,000 US Pop. for spinal fusion from 1998-2008**

### RESULTS:

Spinal fusion has experienced a rapid increase in utilization during the ten year period of 1998-2008. In 1998, there were approximately 174,223 spinal fusion discharges; this number rose to 413,171 in 2008, showing a 2.5-fold increase. Cervical fusion rose by 114%, thoracolumbar fusion grew by 81%, and lumbar fusion grew by 142%. The average age for patients receiving spinal fusions rose from 49 years-old in 1998 to 54 years old in 2008. During this period, the gender gap rose with 54.4% of all spinal fusion discharges being female in 2008, compared to 51.5% in 1998. Total charges associated with spinal fusion rose from \$24,671 in 1998 to \$81,858 in 2008. Compared to hip replacement, which has realized only a 131% increase in total charges over this ten year period, spinal fusion has realized a 231% increase. The national bill for spinal fusion rose 690%, which was significantly higher than that of other notable procedures (Fig. 4). The proportion of patients on Medicare rose from 21.3% of all spinal fusion patients in 1998 to 30.3% in 2008. Private insurance patients rose as well, but less significantly, with 51.8% in 1998 and 54.7% in 2008. Total length of hospital stay was reduced over the ten year period from 4.3 days to 3.7 days. The correlation between length of stay and total hospital charges in 2008 was positively correlated with a correlation coefficient  $r = .67$  ( $p < .0001$ ).



**Fig. 4. Sum of all charges for all hospital stays in the US based on procedure from 1998 to 2008.**

### DISCUSSION:

The present study demonstrated a substantial increase in the number of spinal fusion procedures performed annually in the US, specifically in comparison to other inpatient procedures in contemporary practice. This increase could be influenced by multiple factors, such as recent advances in spinal fusion technology and our improved understanding of the human spine. The changes in utilization and demographics associated with spinal fusion identified in this study can be used to assess the effect of changes in medical care, direct health care resources, and future research.