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The Incidence Of Bariatric Surgery Has Plateaued In the U.S

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Abstract

Background—Estimates of the procedure incidence for bariatric surgery have been derived primarily from surveys of bariatric surgeons or from inpatient data sources. New population representative databases of outpatient surgery are available that enable accurate estimation of bariatric surgery case volumes.

Methods—The 2006 National Hospital Discharge Survey, National Inpatient Sample and National Survey of Ambulatory Surgery were assessed for bariatric surgery procedures. Data were compared to inpatient data from 1993 to 2007. Procedure costs were estimated.

Results—The incidence of bariatric surgery has plateaued at approximately 113,000 cases per year. Open gastric bypass now only comprises 3% of all cases but costs \$4,800 less than laparoscopic procedures. Laparoscopic gastric banding is performed in 37% of all bariatric surgery cases and costs the same as laparoscopic gastric bypass to perform. Complication rates have fallen from 10.5% in 1993 to 7.6% of all cases in 2006. Bariatric surgery costs the health economy at least \$1.5 billion annually.

Conclusion—Despite predictions of continued growth of bariatric surgery, it appears that the annual incidence for these operations has remained stable since 2003. Most operations are performed laparoscopically but open gastric bypass is substantially less costly than laparoscopic operations. Despite its simplicity, laparoscopic gastric banding costs the same as gastric bypass. There is no cost savings associated with ambulatory bariatric surgery.

INTRODUCTION

More than 2/3 of the U.S. population is overweight or obese ¹. Obesity is on the rise ² and the incidence is increasing most rapidly in the morbidly obese population, i.e. those with a BMIs exceeding 40 kg/m^{2,3}. Although the increasing incidence of obesity is undoubtedly due to progressively rising caloric intake, the lack of effective treatment for obesity is a substantial contributor to this major public health problem. A plethora of diets and several medications are available for obesity treatment that are only marginally effective ⁴. Only surgery results in substantial, long-term weight loss for obese individuals. Because of high rates of complications and the limited efficacy of some of the early operations employed for obesity treatment, obesity surgery remained controversial until the NIH convened a consensus conference in 1991. The

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NIH panel concluded that some bariatric surgical procedures were an effective treatment for certain categories of patients⁵. This opened the door for bariatric surgery but its initial growth was slow.

Almost a decade passed until there was appreciable growth in the number of bariatric surgical procedures in the U.S.⁶. Bariatric operations proved very effective in managing some of obesity complications such as diabetes⁷⁻⁹ and hypertension¹⁰⁻¹² resulting in insurer's recognition of these operations benefits and the greater acceptance of these procedures culminating in their inclusion in benefit packages. Prior studies have shown that the incidence of bariatric operations was increasing exponentially suggesting that there would be 200,000 operations performed in the U.S. annually [ASMBS website].

In recent years there has been downward pressure on bariatric surgery availability. Citing high complication rates, several insurers have withdrawn coverage for bariatric surgery. Centers of Excellences initiatives potentially limit access to bariatric surgery^{13;14}, reducing the numbers of procedures performed. How these phenomena have impacted the number of bariatric surgeries performed in the U.S. is not known. Via the CDC, the U.S. government monitors hospital utilization and, therefore, surgical procedure volumes by the National Hospital Discharge Summary (NHDS). This survey is specifically designed to monitor U.S. hospital utilization and has a population based stratified-sample design to ensure accurate estimation. However, the survey's ability to capture the total U.S. experience for surgery was limited by the recent advent of ambulatory surgery centers which have not been part of this survey. This limitation has been overcome by the institution of the National Survey of Ambulatory Surgery (NSAS) which provides population representative information about outpatient surgery enabling accurate estimation of the total U.S. experience for surgical procedures.

Laparoscopic banding procedures have become popular. They are amenable to outpatient surgery. Gastric bypass has also been reported as an outpatient operation¹⁵. Because of a shift in bariatric surgery from inpatient to outpatient facilities, surveys based on inpatient activity have not been able to produce reliable estimates for trends in bariatric surgery in the U.S. With the recent release of the NSAS, it is now possible to determine, in an objective way, the numbers of bariatric operations performed in the U.S.

METHODS

NSAS

The 2006 NSAS was obtained from the CDC website (<http://www.cdc.gov/nchs/nsas.htm>). The NSAS is the only national study of ambulatory surgical care in hospital-based and freestanding ambulatory surgery centers (ASCs). Data for the NSAS was collected for approximately 52,000 ambulatory surgery cases from a nationally representative sample of hospital-based and freestanding ambulatory surgery centers. Sampled facilities were asked to complete a Facility Questionnaire and return it by the mail. The intent of the NSAS is to provide statistics describing the characteristics of ambulatory surgical visits to hospital-based and freestanding ambulatory surgery centers. These include patient demographic characteristics, source of payment, information on anesthesia given, diagnoses, surgical and non-surgical procedures of patients visiting hospital-based and freestanding ambulatory surgery centers. These data are collected for use by the U.S. Congress, public health policy makers, and government agencies for academic purposes.

NSAS has total facility charges associated with each procedure. The median total charge was determined for bariatric operations found in the database.

NHDS

The annual National Hospital Discharge Survey (NHDS) databases for the years 1993–2006 were acquired from the Centers for Disease Control (CDC) (<http://www.cdc.gov/nchs/about/major/hdasd/nhds.htm>). The NHDS is the principal database used by the U.S. Government for monitoring hospital utilization. Each year approximately 300,000-hospital discharges are selected for the NHDS from the 35,000,000 total discharges nationally, by a complex, multistage design to ensure that the database is representative of the U.S. hospitalized population. Using U.S. Census information, the CDC provides statistical weighting factors for each patient entry in the NHDS database so that incidence and prevalence estimates of hospitalized disease can be made for the entire U.S. population.

NIS

The National Inpatient Survey (NIS) was used to compare facility charge information to that obtained from the NSAS. Charges are not collected in the NHDS. The 2006 and 2007 National Inpatient Survey (NIS) was obtained from the Agency for Healthcare Research and Quality (AHRQ)¹⁶. The NIS is a population representative sampling of hospital discharges obtained from 20% of all the hospitalizations in the United States in any given year. In contrast to the National Hospital Discharge Survey that samples a fraction of discharge from any given hospital, the NIS obtains information about all discharges from a select number of facilities in the United States. This has the advantage of providing the full spectrum of activity from hospitals in various regions. Although the NIS is statistically corrected to be population representative, data are only collected from hospitals in 29 states and ethnicity data are often times incomplete. Recently, the Agency for Healthcare Research and Quality released the State Ambulatory Surgery Database that contains information similar to the NIS but only has information from 27 states. Data fields collected vary from state to state and information about free-standing ambulatory surgery centers is only available from a fraction of the 27 states. Thus, there are regions and populations that may not be well represented in the NIS. For this reason, we compared procedure incidence data from both the NIS and the more population representative NHDS.

NIS provides total hospital charges for most of the cases in its database. Each hospital has its own unique charge to cost ratio (CCR) that is an average CCR for all patients in that particular hospital. Hospitalization cost information was calculated from each patients total hospital charges multiplied by the CCR for that hospital.

We used NIS data for comparing outpatient charge information obtained from the NSAS to inpatient charges derived from the NIS.

Case Identification

Bariatric procedures were identified by discharges encoded with Diagnostic Related Group (DRG) = 288. DRGs are assigned at the time of a patient's discharge based on combinations of diagnostic and procedure codes along with information from the patient's medical record to best reflect the primary reason a patient was hospitalized. DRG 288 (operating room procedures for obesity) is only used when the primary reason for hospitalization was to undergo procedures related to morbid obesity. Thus, any patient encoded with DRG 288 was admitted with the intent to perform an operation for a problem related to a patient's morbid obesity. Procedures associated with plastic surgical procedures, i.e. those with ICD-9-CM procedure codes ranging from 85.XX to 86.XX were excluded. Similar to our prior approach for case identification⁶, procedures encoded from 43.80 to 44.98 along with DRG=288 were defined as bariatric surgical procedures. DRG's were not included in the NSAS. For the NSAS, bariatric operations were identified by associated bariatric surgical principal procedure codes with a primary diagnosis code of 278.01.

LAGB was assumed if the any ICD-9 procedure code was 44.68 (laparoscopic gastroplasty) or 44.95 (laparoscopic gastric restrictive procedure). Pure restrictive operations such as the vertical banded gastroplasty are rarely done and laparoscopic approaches to purely restrictive bariatric surgery have not been aggressively pursued. Procedures were only included in the analysis if there were more than 60 cases in the database to ensure reliability of the estimates based on the various databases complex sample design.

Surgeon Fees

Surgeons fees were obtained from the CMS web site (<http://www.cms.hhs.gov/PhysicianFeeSched/PFSRVF/list.asp#TopOfPage>, accessed March 18, 2009), using the October 2006 National Fee Schedule. Bariatric procedures were identified by their CPT codes. Total RVUs for the procedures were multiplied by the conversion factor listed in the fee schedule (\$37.8975/Total RVU).

Complications rates were detected by the presence of any diagnostic code ranging from 996.00 to 999.99 (Complications of surgical and medical care, not elsewhere classifiable), or being 415.11 (Pulmonary Embolism), or 453.XX (Deep Venous Thrombosis).

RESULTS

Figure 1 demonstrates the changes in bariatric operations as practiced in the United States from 1993 to 2006. These procedures increased in incidence from 8,597 procedures in 1993 to a high of 115,194 in 2004 (Table 1). Inpatient procedures began a steady decline in 2004 that resulted in 91,289 cases performed in 2006. In 2006, 21,710 laparoscopic bands were placed in outpatient facilities such that there were a total of 112,999 bariatric procedures performed in the U.S. The annual frequencies of laparoscopic revision procedures (ICD-9-CM 44.69), laparoscopic removal of bands (44.97), laparoscopic adjustment of bands (44.98) and gastric sleeve resection (43.89) were below the limits of detection in the NHDS.

Figure 2 plots complication rates as a function of time. Complication rates have progressively fallen from 10.5% of cases in 1993 to 7.6% of all bariatric operations in 2006.

Table 1 demonstrates the changing pattern of bariatric procedures that has evolved since 1993. Because of a lack of specific coding, it was difficult to determine how many ORYGB or LRYGB were performed in the years between 1993 and 2004. The precipitous drop in 2005 in gastric bypass (ICD=44.31), the first year ICD-9 codes were available for laparoscopic bariatric operations; suggest that many LRYGB were encoded with ICD-9 44.31. With the availability of population representative ambulatory surgery data in 2006, a complete assessment of the procedure incidence and procedure types can be obtained. These data show a considerable shift to laparoscopic bariatric surgery with only 3% of all operations being ORYGB. Another 18% classified as open gastrojejunostomies. The exact nature of these procedures cannot be determined from these data but are presumably some combination of open RYGB, BPD and DS. Laparoscopic gastrojejunostomy, presumably mostly LRYGBs, accounted for 41% of all bariatric operations. There were no RYGB performed in the ambulatory surgery setting and about 1/2 of all LAGB procedures are performed in ambulatory surgery centers. LAGB accounted for 37% of all bariatric operations.

Table 2 shows the estimates for procedure volumes and facility costs for bariatric procedures performed in 2006. Inpatient data from the NHDS and NIS are compared. Outpatient LAGB volumes were obtained from the NSAS. The estimates for the various operations are reasonably similar between the NHDS and the NIS. Both databases closely approximated each other for estimates of the total number of bariatric operations performed in 2006: about 92–95,000. When added to the 22,000 outpatient LAGB procedures, there were approximately 113,000

bariatric operations performed in 2006. Hospital cost information was obtained from the NIS after applying CCR adjustments to the total hospital charge data found in the NIS. The overall CCR for the entire 2006 NIS database was 0.48 and was 0.42 for bariatric procedures. ORYGB was associated with the lowest per case hospital cost. ORYGB had a median LOS of 3 days, LRYGB of 2 days and LAGB 1 day (data not shown). LRYGB and LAGB had very similar inpatient hospital costs: \$11,912 and \$11,019 respectively.

Because the NSAS does not provide CCR information, the actual costs for LAGB performed in ambulatory surgery centers could not be determined. The median charge for LAGB in ambulatory surgery centers was \$29,722. This is similar to the median charge of \$26,219 for LAGB performed in inpatient settings that was found in the NIS.

There is some ambiguity in coding for LAGB. There are 2 ICD-9 procedure codes that could be interpreted as being LAGB: 44.68 (laparoscopic gastroplasty) and 44.95. There were relatively few procedures encoded with 44.68: 2,259 in NHDS and 2,693 in NIS. Far greater numbers were encoded as 44.95: 18,107 in NHDS and 13,736 in NIS. Counts for cases encoded as 44.68 and 44.95 were added together and assumed to represent LAGB.

Table 3 summarizes the surgeons fees associated with the various bariatric operations that were obtained from the 2006 Medicare fee table. Since Medicare fees are determined by CPT code, the table is organized by CPT rather than the ICD-9 codes used for procedures in the databases we assessed. Case volumes for each procedure were obtained from the equivalent procedures as determined by ICD-9 codes in the NHDS from table 2. Hospital cost information was also obtained from table 2. Outpatient facility costs were assumed to be the same as inpatient costs since the charges were the same for both settings. If all operations performed were reimbursed at Medicare rates, \$155 million dollars were expended in 2006 as surgeon fees. Hospital costs, both in and outpatient, were \$1.34 billion. Surgeon fees only account for 11.6% of the \$1.5 billion expended in 2006 on bariatric surgery.

Both LRYGB and LAGB had equivalent costs for combined surgeon and facility fees. ORYGB was considerably less costly (34%) than LRYGB.

DISCUSSION

Bariatric surgery has gained in acceptance and popularity as evidenced by a substantial increase in the procedure incidence after 2001. Its rapid rise resulted in predictions that procedure volumes would continue to increase given the very large population that could benefit from bariatric surgery¹⁸⁻²³. This is especially true since non surgical treatments for weight loss in the morbidly obese are rarely successful in the long term²⁴. Expansion of procedure volume has been tempered by events that have reduced bariatric surgery availability. Several years ago, a few insurance companies cited high complication rates and withdrew from bariatric surgical coverage. Others, never extended coverage to their insured. The advent of bariatric surgery centers of excellence potentially restricts access to bariatric surgery^{13;14}. The impact these factors had on the overall bariatric surgery incidence has not been known because of the expansion of these operations into outpatient surgery centers has made estimation of the procedure incidence from inpatient databases unreliable.

Introduction of the NSAS has allowed an accurate, objective estimation of the total U.S. bariatric surgical incidence. Rather than progressively increase, the total number of bariatric operations plateaued in 2003. In 2006, the last year when complete in and outpatient data are available, there were 113,000 bariatric surgical operations performed annually in the U.S. It appears that this number has been approximately stable for since 2003. Rather than result in a net increase, the advent of outpatient bariatric operations has shifted procedures from the inpatient to outpatient arena. Based on the 2007 NIS, the number of inpatient bariatric

operations continued to fall. Until the 2007 NSAS database is released, it will not be known if this fall was offset by an expansion of ambulatory bariatric surgery cases. The total national procedure volume for bariatric surgery may be somewhat underestimated by these databases since they exclude free-standing specialty hospitals only offering laparoscopic banding procedures.

Laparoscopic operations dominate. Open gastric bypass, once the mainstay of bariatric surgery, now only accounts for 3% of these procedures. Although performed infrequently, open gastric bypass is the least costly means of surgically induced weight loss. The open gastric bypass costs \$4,600 less than its laparoscopic counterpart. Although there is a lower surgeon reimbursement for open operations, most of the difference is attributable to the facility costs. The differential is particularly striking since open gastric bypass had one more day of hospitalization than laparoscopic procedures (3 vs. 2 day median LOS) suggesting that the cost differential results from operating room supply costs. Laparoscopic gastric bypass requires a substantial amount of specialized equipment and expensive supplies. This observation raises some concerns. Laparoscopic procedures result in more rapid recovery and earlier return to work. This benefits employers who, for the most part, pay for health insurance. This financial benefit results at the expense of greater hospital costs, shifting the financing of greater worker productivity from employers to the health care system. The greater costs of laparoscopic operations should be accounted for in hospital contract negotiations.

Laparoscopic operations confer some benefits relative to open operations: Aside from more rapid recovery, there are fewer (but not absent) wound infections and post operative hernias. Recently published outcomes from the Longitudinal Assessment of Bariatric Surgery study found that despite the fact that patients undergoing open gastric bypass were at a higher risk for complications than those undergoing laparoscopic operations, the outcomes were equivalent. These data suggest that the extra costs attributable to LRYGB may not be justified. Laparoscopic operations do have a higher incidence of post operative bleeding, internal hernia development and anastomotic strictures than open operations. The much greater up-front cost associated with laparoscopic gastric bypass should be considered in the context of the long-term outcomes from both procedures. Most likely, the apparent advantages of laparoscopic procedures might have been overstated.

Surprisingly, costs associated with LAGB procedures were the same as for LRYGB. LAGB had a median LOS of only 1 day for inpatient procedures compared to a median LOS of 2 days for LRYGB. This suggests very high operating room costs associated with LAGB. This probably resulted from the need to use laparoscopic instrumentation and ports combined with the high cost of the band device itself ²⁵. LAGB requires much more intense follow up than gastric bypass. Coupled with the relatively inconsistent and modest weight loss associated with LAGB ²⁶, the cost effectiveness of LAGB as a weight loss strategy is questionable.

Most surprisingly, there was no apparent cost savings attributable to outpatient LAGB compared to the inpatient procedure. The NSAS has charge but not cost information. Nevertheless, the median charges associated with in and outpatient LAGB was the same. The overall cost to charge ratio for inpatient bariatric surgery is 0.42. This CCR is similar to the overall CCR for 2006 which was 0.48. One can assume that CCRs for outpatient care is the same as for inpatient hospitalizations. If true, then no cost saving are realized as a result of outpatient bariatric surgery. This should be taken into consideration for policy development. CMS does not allow outpatient bariatric surgery. Considering the potential risks that morbidly obese individuals have for postoperative complications such as sleep apnea and respiratory arrest while recovering from surgery, the lack of a cost benefit suggests that outpatient LAGB is ill advised

Bariatric surgery complication rates have fallen since last assessed in the NHDS (Figure 2)¹⁷. The rise in bariatric surgery observed after 2000 coupled with the fall in complication rates most likely represents the greater acceptance of bariatric surgery by referring health care providers and insurance companies that occurred in the aftermath of the 1991 NIH consensus statement on obesity surgery⁵. Before that time bariatric surgery was mired in controversy. Even in the early days following publication of the conference results, only the highest risk patients with very advanced stage comorbid disease were referred for bariatric surgery. As these procedures became more accepted, patients with lower body weights and with fewer obesity-related complications underwent weight loss operations. These patients have lower risks for postoperative complications. This conjecture is supported by findings from North Carolina where a substantial increase in bariatric surgery was noted from the years 1990 to 2001. The number of men undergoing these operations was constant and the large increase in bariatric operations was accounted for by an increase in the number of women undergoing these operations²⁷. On average, women have a much lower risk for complications than do men, primarily because men undergoing bariatric surgery tend to be larger than women and have a larger abdominal girth²⁸.

Complication rates were low at 7.6%. This rate is similar to the 4.3% rate observed in the recently published Longitudinal Assessment of Bariatric Surgery (LABS) study²⁹. The higher rate we report results from our inclusion of all adverse events that were encoded during a patient's bariatric surgery hospitalization compared to the limited set of complications defined as major complications followed by the LABS study (death; deep-vein thrombosis or venous thromboembolism; reintervention with the use of percutaneous, endoscopic, or operative techniques; or failure to be discharged from the hospital within 30 days after surgery). We estimated complication rates from the index hospitalization only and would miss those associated with hospital readmissions, potentially underestimating the overall complication rate. When similar data was analyzed from a California-based inpatient hospitalization database, the in-house mortality rate was 0.18%, a rate that increased to 0.33% when assessed at 30 days³⁰. Only assessing in-house complication rates undoubtedly underestimates the overall complication rates but probably only by less than ½ the true rate.

Abbreviations

NHDS	National Hospital Discharge Survey
NSAS	National Survey of Ambulatory Surgery
NIS	National Inpatient Sample
NIH	National Institutes for Health
CDC	Centers for Disease Control
CMS	Centers for Medicare and Medicaid Services
CPT	Current Procedural Terminology
ICD-9-CM	International Classification of Diseases-Clinical Modification-Version 9
DRG	Diagnosis Related Group
RVU	Relative Value Unit
CCR	Charge-to-Cost Ratio
ASC	Ambulatory Surgery Center
LRYGB	Laparoscopic Roux-en-Y Gastric Bypass
ORYGB	Open Roux-en-Y Gastric Bypass

BPD	Biliary Pancreatic Diversion
DS	Duodenal Switch
LAGB	Laparoscopic Adjustable Gastric Band

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Figure 1.

Annual incidence of bariatric operations. Dark circles from 1993 to 2005 represent estimates derived from the inpatient NHDS database. For 2006, the dark circle represents the total number of in and outpatient procedures. The open circles represent the number of bariatric operations performed as inpatient procedures in 2006 and 2007.

Figure 2.
Secular complication rates for bariatric surgery 1993–2006.

Table 1

Annual incidence of bariatric operations per procedure 1993–2006. Data sources are the NHDS and NSAS.

	Procedure Name	Gastric Bypass	Gastrojejunostomy	Gastric NEC	Laparoscopic Gastroenterostomy	Inpatient Lap Band	Outpatient Lap Band	Total Inpatient Procedures	Total Overall Porcedures
	ICD-9-CM	44.31	44.39	44.69	44.38	44,68,44.95	44,68,44.95		
Year									
1993		1,252	2,258	5,087				8,597	8,597
1994		1,352	2,077	3,660				7,089	7,089
1995		2,067	7,546	3,689				13,302	13,302
1996		2,198	2,655	1,855				6,708	6,708
1997		2,523	3,511	3,044				9,078	9,078
1998		10,586	2,842	3,151				16,579	16,579
1999		9,952	4,050	3,750				17,752	17,752
2000		21,180	4,918	2,117				28,215	28,215
2001		32,656	8,922	3,541				45,119	45,119
2002		62,444	18,557	5,462				86,463	86,463
2003		77,567	27,993	6,566				112,126	112,126
2004		22,436	78,939	13,819				115,194	115,194
2005		6,046	25,515	3,400	56,505	13,643		105,109	105,109
2006		3,309	20,840	255	46,519	20,366	21,710	91,289	112,999

Table 2

Procedure volume and facility cost for bariatric operations in 2006. Data were acquired from the NHDS, NSAS and NIS.

	Procedure Name	Gastric Bypass	Gastrojejunostomy	Gastric NEC	Laparoscopic Gastroenterostomy	Inpatient Lap Band	Outpatient Lap Band	Lap Removal of Band	Rev ision of Gastric Anastomosis	Total Inpatient Procedures	Total Overall Porcedures
2006	ICD-9-CM	44.31	44.39	44.69	44.38	44,68,44,95	44,68,44,95	44,97	44.5		
NHDS+NSAS		3,309	20,840	255	46,519	20,366	21,710	153	370	91,812	113,522
NIS		4,273	12,843	1,197	59,350	16,429		201	158	94,451	
NIS-Cost		\$7,480	\$13,908	\$17,396	\$11,912	\$11,019		\$15,587	\$14,635		

Table 3

Surgeon fees and aggregated costs attributable to bariatric surgery in 2006.

	Gastric Bypass	Gastrojejunostomy	Laparoscopic Gastroenterostomy	Lap Band Placement	Lap Removal of Band	Revision of Gastric Anastomosis	Total
CPT	43846	43847	43644	43770	43772	43848	
Total RVU	37.24	41.35	42.22	26.62	23.36	45.06	
Surgeon Fee	\$1,411	\$1,567	\$1,600	\$1,009	\$885	\$1,708	
Facility Cost	\$7,480	\$13,908	\$11,912	\$11,019	\$15,587	\$14,635	
Total Cost per Case	\$8,891	\$15,475	\$13,512	\$12,028	\$16,472	\$16,343	
Total Surgeon Expenditure	\$4,670,001	\$32,657,564	\$74,431,910	\$42,447,592	\$135,449	\$631,835	\$154,974,351
Total Hospital Expenditure	\$24,751,320	\$289,842,720	\$554,134,328	\$463,655,013	\$2,384,811	\$5,414,950	\$1,340,183,142
Total Expenditure	\$29,421,321	\$322,500,284	\$628,566,238	\$506,102,605	\$2,520,260	\$6,046,785	\$1,495,157,493