ADULT CARDIAC

Successful Linking of The Society of Thoracic Surgeons Database to Social Security Data to Examine Survival After Cardiac Operations

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Background. **Long-term evaluation of cardiothoracic surgical outcomes is a major goal of The Society of Thoracic Surgeons (STS). Linking the STS Database to the Social Security Death Master File (SSDMF) allows for the verification of "life status." This study demonstrates the feasibility of linking the STS Database to the SSDMF and examines longitudinal survival after cardiac operations.**

Methods. **For all operations in the STS Adult Cardiac Surgery Database performed in 2008 in patients with an available Social Security Number, the SSDMF was searched for a matching Social Security Number. Survival probabilities at 30 days and 1 year were estimated for nine common operations.**

Results. **A Social Security Number was available for 101,188 patients undergoing isolated coronary artery bypass grafting, 12,336 patients undergoing isolated aortic valve replacement, and 6,085 patients undergoing isolated mitral valve operations. One-year survival for isolated coronary artery bypass grafting was 88.9% (6,529 of 7,344) with all vein grafts, 95.2% (84,696 of 88,966) with a single mammary artery graft, 97.4% (4,422 of 4,540) with bilateral mammary artery grafts, and 95.6% (7,543 of 7,890) with all arterial grafts. One-year survival was 92.4% (11,398 of 12,336) for isolated aortic valve replacement (95.6% [2,109 of 2,206] with mechanical prosthesis and 91.7% [9,289 of 10,130] with biologic prosthesis), 86.5% (2,312 of 2,674) for isolated mitral valve replacement (91.7% [923 of 1,006] with mechanical prosthesis and 83.3% [1,389 of 1,668] with biologic prosthesis), and 96.0% (3,275 of 3,411) for isolated mitral valve repair.**

Conclusions. **Successful linkage to the SSDMF has substantially increased the power of the STS Database. These longitudinal survival data from this large multi-institutional study provide reassurance about the durability and long-term benefits of cardiac operations and constitute a contemporary benchmark for survival after cardiac operations.**

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As cardiothoracic surgeons, one of our professional responsibilities is the longitudinal follow-up of patients who undergo cardiothoracic operations. The Society of Thoracic Surgeons (STS) Database is the largest clinical cardiothoracic surgical database in North America [1]. The STS Adult Cardiac Surgery Database was established in 1989, and by 2009, had accumulated records from 3,731,055 cardiac operations performed between 1990 and 2008, inclusive.

Long-term evaluation of the outcomes of patients undergoing cardiothoracic operations is a major goal of STS [1, 2]. Despite the many strengths of the STS Database, one important limitation has been the lack of a mechanism to

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code and analyze information about follow-up beyond the initial operative time interval. (The end point of the operative time interval is defined as hospital discharge or 30 days after the operation, whichever occurs later). Furthermore, the accuracy of information collected after discharge and up to 30 days after the operation varies among institutions, and addressing this variability is a major goal of STS.

On January 1, 2008, in compliance with the Health Insurance Portability and Accountability Act of the United States, the STS Database began collecting unique patient identifiers, including the Social Security Number (SSN) [1]. In 2008, STS purchased access to the Social Security Death Master File (SSDMF). The SSDMF complements the STS Database by providing information about short-term and long-term survival. Linking STS Data to the SSDMF allows for the ascertainment and verification of “life status.”

Although identification of death alone is not sufficient to evaluate long-term outcomes, it is an important fundamental measure of the effectiveness of health care delivery. Several countries have identified the value of tracking mortality data longitudinally in combination with disease-specific epidemiologic surveillance programs. For example, by linking its Central Cardiac Audit Database to its national death registry, the United Kingdom has been able to better define health policy goals and priorities for patients with heart disease [3].

Regional experience using the SSDMF to assess long-term mortality rates after coronary artery bypass graft (CABG) operations has already proven the feasibility of linking a multi-institutional cardiac surgical registry to the SSDMF [4]. Successful linkage of the STS Adult Cardiac Surgery Data to the SSDMF has been accomplished at Emory University. This experience demonstrated the feasibility of such a linkage and the substantial benefit of such linkages to research and quality improvement activities [5–8].

The purpose of this study was (1) to demonstrate the feasibility of linking the STS Database to the SSDMF and (2) to use the linkage of the STS Database to the SSDMF to examine postoperative survival after nine common cardiac operations at discharge from the hospital, at 30 days, and at 1 year.

Material and Methods

Institutional Review Board Approval

The Duke University Health System Institutional Review Board approved the study and provided a waiver of informed consent. Although the data used in the analysis contain direct patient identifiers, they were originally collected for nonresearch purposes and the risk to patients was deemed to be minimal [9].

The STS Database

As of December 31, 2009, the STS Adult Cardiac Surgery Database had 1,004 Participants who represented 1,020 hospitals in the United States [2]. (An STS Database Participant is either a practice group of cardiothoracic surgeons or an individual cardiothoracic surgeon.) The 2008 American Hospital Association Annual Survey reported that 1,088 hospitals perform cardiac operations in adults in the United States [10]; therefore, STS believes that the current STS participating hospitals represent more than 90% of the hospitals that provide adult cardiac operations in the United States [2].

Table 1. The Society of Thoracic Surgeons (STS) Database Participation as of October 1, 2010

	Participants	Surgeons
STS Adult Cardiac Surgery Database	1,022	2,926
STS General Thoracic Surgery Database	190	657
STS Congenital Heart Surgery Database	98	275
Total STS Database	1,310	

Although this demonstration project was conducted using the STS Adult Cardiac Surgery Database, the methodology will eventually be applied to the STS General Thoracic Surgery Database and the STS Congenital Heart Surgery Database (Table 1). The STS Adult Cardiac Surgery Database captures detailed clinical data on adults undergoing cardiac surgical procedures performed by participants throughout the United States. The collection and analysis of data during a 20-year period has been shown to improve patient outcomes [11], primarily through feedback provided by center-specific reports that allow participants to evaluate critically their own local results and to compare their own local results with contemporary national risk-adjusted benchmarks.

Using risk-adjusted data from the STS Adult Cardiac Surgery Database, STS has created numerous statistical risk-adjustment models for several common cardiac surgical operations for mortality and a variety of complications [12–14]. The STS Database has also served as the basis for the development of performance measures that have been endorsed by the National Quality Forum [15].

The SSDMF

The SSDMF is a public-use national database of death records maintained by the United States Social Security Administration (SSA). The SSDMF was created in 1980 by the SSA subsequent to a lawsuit brought by an individual under the Freedom of Information Act [16]. The SSDMF contains information on all persons assigned a SSN who died after 1962 and whose death was reported to the SSA. The SSDMF is part of the SSA’s Numerical Identification Database called “NUMIDENT.” Information contained in the file includes SSN, name of decedent, date of birth, date of death, state, and ZIP code of last known residence, and ZIP code where a “death benefit payment” was sent. The SSDMF is a useful tool for research about health care because of its ability to create multiple reports from a vast array of data, including procedural, geographic, and racial data.

The following description of the SSDMF was taken from the SSDMF Web site [17]:

Table 2. Survival Rates for Nine Common Cardiac Operations[a]

Operation	Patients (No.)	Survival at Discharge in STS Database % (95 CI)	Survival at 30 Days Using SSDMF % (95 CI)	Survival at 1 Year Using SSDMF % (95 CI)
Isolated CABG with all vein grafts	7,344	94.9 (94.4–95.4)	94.7 (94.2–95.3)	88.9 (88.2–89.6)
Isolated CABG with Single Mammary	88,966	98.6 (98.5–98.7)	98.3 (98.2–98.4)	95.2 (95.0–95.3)
Isolated CABG with Bilateral Mammary	4,540	98.9 (98.6–99.2)	98.9 (98.6–99.2)	97.4 (96.9–97.8)
Isolated CABG with all arterial grafts	7,890	98.8 (98.5–99.0)	98.4 (98.1–98.7)	95.6 (95.2–96.1)
Isolated Aortic Valve Replacement with Mechanical Prosthesis	2,206	98.3 (97.7–98.8)	98.0 (97.4–98.6)	95.6 (94.7–96.4)
Isolated Aortic Valve Replacement with Biological Prosthesis (tissue valve)	10,130	97.2 (96.9–97.5)	96.9 (96.5–97.2)	91.7 (91.2–92.2)
Isolated Mitral Valve Replacement with Mechanical Prosthesis	1,006	96.9 (95.9–98.0)	97.3 (96.3–98.3)	91.7 (90.0–93.4)
Isolated Mitral Valve Replacement with Biological Prosthesis (tissue valve)	1,668	93.1 (91.8–94.3)	93.2 (92.0–94.4)	83.3 (81.5–85.1)
Isolated Mitral Valve Repair	3,411	98.7 (98.3–99.1)	98.5 (98.1–98.9)	96.0 (95.4–96.7)

[a] The total of 108,740 isolated CABG listed differs from the 101,480 records of patients in the STS Adult Cardiac Surgery Database undergoing isolated CABG described in the "*Availability of Social Security Numbers*" section of this report because of two reasons:

1. Some patients fit into more than one of the categories of isolated CABG. Some of the patients with single mammary CABG and bilateral mammary CABG are also in the category of CABG with all arterial grafts.

2. The data in Table 2 includes only the first operation of any given patient. Meanwhile the following statement includes all records in the STS Adult Cardiac Surgery Database of isolated CABG: "Of 167,914 records of patients in the STS Adult Cardiac Surgery Database undergoing isolated CABG during 2008, SSN was available for 101,480 (60.4%)."

CABG = coronary artery bypass grafting; CI = confidence interval; SSDMF = Social Security Death Master File; SSN = Social Security Number; STS = The Society of Thoracic Surgeons.

"The Death Master File (DMF) from the Social Security Administration (SSA) contains over 87 million records created from SSA payment records. This file includes the following information on each decedent, if the data are available to the SSA: social security number, name, date of birth, date of death, state or country of residence (2/88 and prior), ZIP code of last residence, and ZIP code of lump sum payment. The SSA does not have a death record for all persons; therefore, SSA does not guarantee the veracity of the file. Thus, the absence of a particular person is not proof this person is alive."

As a registered user, the Duke Clinical Research Institute receives SSDMF data quarterly in the form of raw data that includes SSN, first and last name, date of birth, ZIP code, and date of death. Oracle data management software (Oracle Corp, Redwood Shores, CA) is used to process SSDMF data. Estimation of optimal accuracy is after two quarters. The present analysis used SSDMF data from the third quarter SSDMF harvest of 2010.

Mortality Ascertainment

For our current analysis, the STS Adult Cardiac Surgery Database was linked to the SSDMF using a deterministic matching algorithm. Survival probabilities at discharge, 30 days, and 1 year were estimated separately for each of the nine surgical populations in Table 2. The study sample for each population consisted of patients who had the operation during 2008 and had a valid SSN entered in the STS Adult Cardiac Surgery Database. Patients with missing or invalid SSN were excluded from the SSDMF linkage and from analyses of survival.

Records in the STS Database and SSDMF were considered to be the same individual if there was an exact match on each digit of the SSN. From previous literature, matching on SSN was estimated to have sensitivity and specificity above 90% when patients with missing SSN were excluded. Probabilistic linkage with phonetic algorithms and partial matching was not used in the present analysis but is under evaluation for use in future STS-SSDMF analyses.

For STS records with a matching SSDMF record, mortality status at 30 days and 1 year after surgery was determined by comparing the death date on the SSDMF record with the operation date on the STS record. STS records with a valid SSN and no matching SSDMF record were assumed to be alive at 30 days and 1 year. (This analysis is only performed on patients for whom STS had a SSN. Thus, this assumption is only made for patients with a SSN. In people with a SSN, the SSDMF has been reported to have up to 99.6% sensitivity and 93% specificity [16].) Finally, mortality status at discharge was determined from the STS "discharge status" variable without reference to SSDMF data.

Survival probabilities at each time point were estimated by the proportion of patients still living. Estimates were accompanied by approximate Wald-type 95% confidence intervals. This study sought to determine all-cause mortality occurring after the types of operation in the analysis; cause of death was not considered.

Results

Availability of SSNs

Of 167,914 records of patients in the STS Adult Cardiac Surgery Database undergoing isolated CABG during 2008, a SSN was available for 101,480 (60.4%). For isolated CABG, of 942 unique STS Adult Cardiac Surgery Database Participants in 2008, 534 (56.69%) provided the SSN for 91% to 100% of their records and 290 (30.79%) provided SSN for 0% of their records (Fig 1).

Representativeness of Mortality for Patients with SSN

In 2008, the STS 30-day mortality status for isolated CABG was 1.87% (1,245) for records with no SSN and 1.92% (1,951) for records with SSN.

Analysis of the Matching Algorithm

Records in the STS Database and the SSDMF were considered to represent the same individual if there was an exact match on each digit of the SSN. Requiring an exact match on multiple variables in addition to the SSN (eg, SSN + first name + last name) substantially increased the false nonmatch rate in a large sample of STS patients who were known to have died according to the STS discharge mortality status variable. (In other words, by requiring an exact match on multiple variables, many patients who were known to be dead in the STS Database were not identified as dead in the SSDMF.) Conversely, matching that used other identifiers, such as name and date of birth without requiring an exact SSN match, did not provide sufficient specificity and resulted in increased false-positive matches. (For example, in an analysis of 151,333 STS records, 1,885 patients were matched to more than a single SSDMF record when the combination of first and last name + month and day of birth was used. Because each patient has at most one true matching record in the SSDMF, these results indicated that matching without the SSN was highly error prone). Although exact SSN matching was used for the present analysis, probabilistic record linkage with phonetic algorithms and partial matching may offer greater accuracy and is being evaluated for use in future STS-SSDMF analyses.

Analysis of Longitudinal Survival

Table 2 documents rates of postoperative survival at discharge from the hospital, at 30 days, and at 1 year for nine common operations.

Comment

The STS Adult Cardiac Surgery Database has been successfully linked to the SSDMF. Analysis of the combined data set has the potential to provide important new knowledge about cardiac surgical survival beyond the early postoperative period on a scale not previously possible. Indeed, the initial examination of this combined data set provides reassuring information about the durability of benefits to the patient after cardiac operations. This combined data set will be a rich source of information about long-term survival and may be essential for research comparing the long-term effectiveness of alternative treatment strategies.

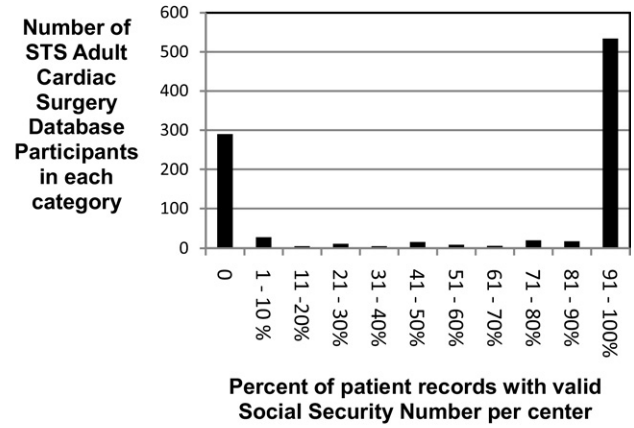

Fig 1. Distribution of sites for percentage of complete data for patient Social Security Numbers by The Society of Thoracic Surgeons (STS) participants.

A SSN was available for 101,188 patients undergoing isolated CABG, 12,336 undergoing isolated aortic valve replacement, and 6,085 undergoing isolated mitral valve operations. For the nine common cardiac operations, the probability of survival at 1 year ranged from 83.3% for mitral valve replacement with a tissue valve to 97.4% for CABG with bilateral mammary arteries. These data provide substantial evidence about the durability of benefits to the patient after a cardiac operation. Furthermore, the methodology will be useful in developing benchmarks for research that examines the comparative effectiveness of cardiac surgical vs nonsurgical treatment options.

Several general observations are noteworthy. The difference between discharge mortality recorded in the STS Database and 30-day mortality confirmed in the SSDMF is quite small in every operative category, typically a few tenths of a percent. This fact illustrates that death after discharge but before 30 days is uncommon and also provides reassurance regarding the accuracy of the STS mortality results. Although audits have shown that the accuracy of reporting 30-day mortality status is less than that of discharge mortality (which is nearly 100% accurate), internal analyses have shown that this has little impact on STS performance measures. The current study provides an explanation for this finding by demonstrating that the almost all 30-day deaths occur in the hospital.

Nevertheless, patients, providers, and health policy makers are justified in demanding to have access to outcome data that extends beyond the acute hospitalization and the first 30 days after the operation. An analysis using the United Kingdom Heart Valve Registry was published in 2003 based on 80,757 patients who had undergone heart valve replacement procedures in the United Kingdom since 1986 [18]. Kaplan-Meier actuarial survival analysis was calculated to determine mortality at 30 and 365 days. The authors reported that, "Thirty-day mortality represents around half (56%) of the 365-day mortality." They also stated that although in-hospital mortality is widely used by clinicians as a benchmark measure of outcome for determining risks/benefits of cardiac operations, patients may wish to have information on estimated longer-term outcomes. The authors state that, "Mortality risk by 1 year after the operation may be a more meaningful outcome statistic."

The Northern New England Cardiovascular Disease Study Group conducted similar research using the National Death Index. In one of their many publications, they linked National Death Index data with data about risk factors from the northern New England registries (35,000 patients) in patients who underwent CABG (1987 through 2001) or percutaneous coronary intervention (1992 through 2001), documenting 7,000 deaths [19]. This linkage facilitated the development of internally validated models to predict long-term survival after CABG and percutaneous coronary intervention.

The power of the STS Database will increase substantially by transforming it into a tool for longitudinal follow-up [1]. This transformation will ultimately result in higher quality of care for all cardiothoracic surgical patients by facilitating clinical and longitudinal comparative effectiveness research on a national level. Linking the STS Database to the SSDMF represents one of several potential strategies that will allow longitudinal follow-up with the STS Database:

First, probabilistic matching can be used to link the STS Database to administrative claims databases, such as the Centers for Medicare and Medicaid Services (CMS) Medicare Database; the resultant linked dataset will become a valuable source of information about long-term mortality, rates of rehospitalization, long-term morbidity, and resource utilization. The STS Database has been successfully linked to CMS claims files using a probabilistic matching algorithm that avoids the need for a universal patient identifier [1, 2, 9, 20]. The recent successful linking of the STS Adult Cardiac Surgery Database and the CMS database demonstrates high and increasing penetration and completeness of the STS Database [2]. Higher mortality was observed for unmatched cases at STS sites; the reasons for this observation are unclear and bear further investigation [2]. Linking STS and CMS data will also facilitate studying long-term outcomes of cardiothoracic operations beyond mortality alone [2].

Second, deterministic matching with shared unique identifiers can be used to link the STS Database to national death registries, such as the SSDMF (as demonstrated in this study) and the National Death Index, to verify life-status over time [1, 16].

Third, through probabilistic matching or deterministic matching, the STS Database can link to multiple other clinical registries, such as the National Cardiovascular Data Registry of the American College of Cardiology, to provide enhanced clinical follow-up and analysis of episodes of care rather than isolated interventions.

Fourth, the STS Database can develop clinical longitudinal follow-up modules of its own to provide detailed clinical follow-up.

The purpose of this study was to demonstrate the feasibility of linking the STS Database to the SSDMF and to use this linkage to examine longitudinal survival up to 1 year after cardiac operations. The study was not intended to make detailed comparisons of risk-adjusted longitudinal outcomes in various subgroups of cardiac surgical patients. Several ongoing analyses will create these formal risk models for the detailed longitudinal analyses of survival after cardiac operations [21, 22].

For example, the National Heart, Lung, and Blood Institute has funded The American College of Cardiology Foundation—The Society of Thoracic Surgeons Collaboration on the Comparative Effectiveness of Revascularization sTrategies (ASCERT) trial to study comparative effectiveness of percutaneous coronary intervention and CABG for the treatment of stable coronary artery disease [21]. This trial will compare catheter-based and surgical-based procedures using existing clinical databases from the American College of Cardiology and STS, as well as the CMS MEDPAR administrative data. The trial will study the detailed longitudinal outcomes after the treatment of coronary artery disease. Similarly, the longitudinal outcomes of mechanical vs biologic prosthesis is being studied in the Agency for Healthcare Research and Quality-funded Developing Evidence to Inform Decisions about Effectiveness (DECIDE) grant [22].

In the future, this STS-SSDMF link will facilitate time-related survival analyses (eg, the creation of Kaplan-Meier survival curves and hazard functions) from data in the STS Database and will allow long-term survival to be an end point of any analysis from the STS Database. The focus of this report is not a detailed analysis of these outcomes, but instead is a documentation of the process, methodology, feasibility, and power of the STS-SSDMF link. The data provided here are designed to demonstrate to the reader that (1) the STS-SSDMF link functions across a wide variety of cardiac surgical operations, and (2) the STS-SSDMF link is a powerful tool that has the potential to be a tremendous source of new knowledge.

As the demand and expectation of public reporting of outcomes increases, the ability to verify data in the STS Database with other databases and with national death registries such as the SSDMF will become increasingly important [23]. Verification of survival at 30 days after an operation is crucial to assure the accuracy of publicly reported STS data. Verification of 30-day survival status in the STS Database with the SSDMF will assure the accuracy of 30-day survival status used in calculating the STS CABG composite score. Furthermore, the linkage of the STS Database to the SSDMF will enable determination and publication of long-term survival rates for patients. Clearly, the ability for the

STS Database to function as a tool for longitudinal follow-up will also take on additional importance as the demand and expectation of public reporting of outcomes increases.

Public acceptance of the STS outcomes data will be substantially enhanced by increasing the number of STS Database Participants who provide unique identifiers (including SSNs) when data are harvested. The methodology used by STS and the Duke Clinical Research Institute to harvest, analyze, and report these data is compliant with all federal regulations [9]. The bimodal distribution of sites that share unique identifiers, as demonstrated in Figure 1, reveals that 87.48% of sites share greater than 90% of their SSN or else share 0% of their SSNs. Meanwhile, the very fact that STS and the Duke Clinical Research Institute now have SSNs for 114,872 patients who underwent cardiac operations in 2008 alone supports the argument that sharing of these data is widely regarded as safe and legal. To improve the ability of the STS Database to support comparative effectiveness research and public reporting of outcomes, it is critical to increase the number of sites that share unique identifiers (including SSNs) and to transform the STS Database into a platform for longitudinal follow-up.

In conclusion, the successful linking of the STS Database to the SSDMF has substantially increased the power of the STS Database. The resulting data on longitudinal survival rates from hospital discharge to 1 year provide reassurance about the durability and long-term benefits of cardiac operations. The results of this large multi-institutional longitudinal analysis of survival after cardiac operations, reported here, can serve as a contemporary benchmark for survival after cardiac operations. Linking STS and SSDMF Data will facilitate studying long-term survival after cardiothoracic operations. By establishing a methodology for determination of intermediate and potentially long-term survival outcomes, this tool has the potential to provide important new knowledge concerning the efficacy of cardiac surgical treatment strategies.

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DISCUSSION

DR PETER K. SMITH (Durham, NC): It is an honor and a privilege to be able to discuss this paper, tempered somewhat by the fact that I think I'm the last person standing who is not an author on the paper and is therefore qualified. I appreciate your respecting the 22-author limit on this paper and on an excellent presentation.

This is obviously an extraordinary event to present these linked data and provides an unparalleled opportunity for clinical research and process improvement. I really have no criticisms, and I appreciate the ability to look at the manuscript in advance.

One thing that I noticed was your 1-year outcome for the largest proportion of patients having coronary bypass showed a mortality of 4.8%. When you compare that to the Synergy between PCI with Taxus and Cardiac Surgery (SYNTAX) 1-year outcome, it is 3.5% for the randomized population and 2.5% for the registry. So I wonder if it would be worth looking at those comparisons.

Moving on to the next question, it really relates to future plans for this effort. We are in desperate need of 1-year outcome and longer-term outcome results for 3-vessel disease coronary patients, and for patients who have left main disease, in order to participate in guideline creation, appropriateness criteria, comparing coronary artery bypass grafting (CABG) to percutaneous coronary intervention (PCI), and I think I will just ask you in general what your plans are for future research, because obviously there are any number of critical analyses, that being one of them that need to be done.

I would also like to ask you if there is going to be an ability to retrospectively enter Social Security data by sites who have not done so thus far and the possibility of entering these data back further in time to give us an ability to better model these long-term outcomes, which are going to be important. And then I would ask you what your immediate plans are for propagating this information to the sites. I think most sites are in a position where they don't know their own long-term outcomes, and knowing that will be absolutely imperative in the future and one of the biggest values of participation.

But, again, congratulations, Jeff, on a great presentation.

DR JACOBS: Thank you, Dr Smith, for your kind words. You raise three very important questions. First, I would like to answer your question about potential future research using the linkage of the STS Database to the Social Security Death Master File (SSDMF). This tool is one of several strategies that STS is using to transform the STS Database into a platform for longitudinal follow-up. Ultimately, the STS Adult Cardiac Surgery Database will be transformed into a platform for longitudinal follow-up of adults with cardiac disease through linkages with three other databases: (1) The American College of Cardiology (ACC) National Cardiovascular Data Registry (NCDR), (2) The Medicare database of the Centers for Medicare and Medicaid Services (CMS Medicare Database), and (3) the SSDMF.

We have already successfully linked the STS Database not only to the SSDMF but also to the CMS Medicare Database, and our initial analysis using our linkage to CMS was recently published in the October 2010 issue of *The Annals of Thoracic Surgery*. Linkages of the STS Database to CMS and the SSDMF will allow us to get longitudinal follow-up data from the STS Database not just for mortality, which the SSDMF will provide, but also for morbidity, length of stay, length of ventilation, complications, and even health care economics and resource utilization. All of these long-term longitudinal follow-up strategies will then transform the ability to use the STS database not only as a tool for the assessment of short-term outcomes but also long-term outcomes.

Currently, two important studies are underway involving STS and Duke Clinical Research Institute (DCRI) that are examining late outcomes after treatment of coronary artery disease and valvar cardiac disease. The ASCERT Study (The American College of Cardiology Foundation-The Society of Thoracic Surgeons Collaboration on the Comparative Effectiveness of Revascularization sTrategies) involves STS, ACC, and DCRI, and is examining long-term outcomes of the treatment of coronary artery disease with both CABG and percutaneous interventions. The ASCERT Study is using the STS Database, the ACC-NCDR, and the CMS Medicare Database. STS and DCRI are also examining longitudinal outcomes after aortic valve replacement in an analysis funded by the Agency for Healthcare Research and Quality (AHRQ) through the DEcIDE (Developing Evidence to Inform Decisions about Effectiveness) Network. The ASCERT Study and the DEcIDE aortic valve study exemplify the power of these linkages of databases. Ultimately, I believe that these linkages will allow us to assess detailed long-term outcomes of the treatments of patients with coronary artery disease, valvar cardiac disease, lung cancer, and congenital heart disease.

Next, regarding your question about the retrospective entry of Social Security Numbers into the STS Database, STS started capturing Social Security Numbers in the STS Adult Cardiac Surgery Database in 2008, in the STS General Thoracic Database in 2009, and in the STS Congenital Heart Surgery Database in 2010. It is possible for any site to enter Social Security numbers in the STS Adult Cardiac Surgery Database going back to January 1, 2008. We are currently exploring options to be able to gather, retrospectively, Social Security Numbers going back to the beginning of the STS Database in 1989. If we can create a methodology, and establish a source of funding, to obtain these retrospective Social Security Numbers of over 20 years of cardiac surgical patients, we would then be able to create Kaplan-Meier survival curves with 20-years of follow-up using STS data.

And, finally, your last question was about adding the information obtained, from this linkage of the STS Database to the SSDMF, to the STS Database Feedback Reports provided to STS Database Participants. We are currently working with DCRI to create a methodology where STS Database Participants will be informed of the comparison of the data that they report to DCRI to the data in the SSDMF. So that at the time an STS Database Participant gets their STS Database Feedback Report, they will get three tables: (1) a table that shows when the STS Database Participant reports to the STS Database that the patient is dead and the SSDMF also says that the patient is dead, (2) a table that shows when the STS Database Participant reports to the STS Database that the patient is dead and the SSDMF says the patient is alive, and (3) a table that shows when the STS Database Participant reports to the STS Database that the patient is alive and the SSDMF says the patient is dead. Of perhaps greater importance, we plan to implement a strategy where sites will be provided information in the STS Database Feedback Reports about the longitudinal survival of their patients as ascertained from the SSDMF. By propagating this information about long-term survival to STS Database Participants, STS will clearly provide a great service to our members.

DR W. RANDOLPH CHITWOOD, JR (Greenville, NC): Dr Jacobs this was a great presentation and an excellent demonstration of the power of the STS database. Could you make any sense out of the demographic or comorbidity data? Regarding mitral valve surgery, you have shown us three or four different death rates. Are these related to different patient cohorts?

DR JACOBS: Thank you, Dr Chitwood, for your kind words. You raise another very important question. In this study, our primary goals were (1) to demonstrate the feasibility of linking the STS Database to the SSDMF and (2) to use the linkage of the STS Database to the SSDMF to examine postoperative survival after nine common cardiac operations at discharge from the hospital, at 30 days, and at 1 year. In other words, our objective was to prove that the link works and ascertain the type of data that we can get from the link. It is a fact that one of the next steps in this analysis is to go back and look at the risk factors associated with the different subgroups of patients and their impact on late survival. It is pretty clear from the data that the outcomes of patients undergoing mitral valve replacement with a biological valve are very different from the outcomes of patients who have mitral valve repair; certainly, performing an analysis with formal risk modeling with the preoperative factors associated with these patients is really the next step of the analysis.

DR WADE L. KNIGHT (Temple, TX): I think somebody should compliment the surgeons. The STS Database is a voluntary database. And I am personally a cynic. I have always worried about the reliability of the STS Database, but I think that this gives us renewed confidence. I am excited about the long-term follow-up data, but I think the most exciting thing about this data is the consistency that you have shown between the voluntary reporting and the government statistics, if you will. And so I think that we need to have renewed confidence in the validity of the database, and it will give us great power and strength, as you have reported. Thank you.

DR JACOBS: Thank you, Dr Knight. I agree completely.