

**General Thoracic Surgery Database
of the
Society of Thoracic Surgeons
Software Specifications
Version 2.2**

Note: Some portions of this document are highlighted in gray. Although it is critical for the success of the developer's software that all of the information in this document be understood and followed, the highlights are used to point out areas that have changed since previous versions or areas of extreme importance to the functionality of the software.

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Purpose of Software Specifications:

The purpose of this document is to describe the features that are required to exist in software approved by The Society of Thoracic Surgeons (STS) for the collection and submission of General Thoracic Surgery data. The STS is making an effort to set minimum standards for the software to be used by its members, while allowing enough flexibility so that developers can produce competitive features for the members' benefit.

The intended audience for this document is the software developers who are designing and maintaining the code used by participants to collect and submit data to the STS database. This information will be essential for developers working for vendors who will distribute their software to many members as well as developers working for an individual member designing a package to be used only by themselves (Participant Generated Software).

Note: All software used to collect data to be submitted to the STS Data Warehouse must go through an approval process before data will be accepted into the national database. Developers must also have a signed contract on file with the STS before the approval process can begin.

Since the functionality of the software will revolve around the data specifications, this document will start by providing some information about the specifications.

Data Specifications:

1. Purpose of the Data Specifications

The data specifications describe the data fields that are required to exist in approved software. It details the field names, definitions, dependencies, acceptable values, the harvest codes associated with those values, etc. Software developers should use the data specifications to ensure their software:

- a. includes all core fields in the application (see description of core fields below)
- b. follows the defined field dependency rules (see description of Parent / Child relationships below)
- c. accepts only the defined valid values appropriate to each field and ensures that the values are in the correct format
- d. provides the user with appropriate warnings or error messages for unusual or missing values.

2. Structural Changes to the Data Specifications Between v2.081 and v2.2

Several changes were made to the structure and the information presented in the Data Specifications database and document between versions 2.081 and 2.2. Many of the changes were made to align the structure of the specifications database with those of the STS Adult Cardiac and Congenital Heart Surgery databases. Changes include but are not limited to:

- a. The field "HarvestCoding" was dropped. The information that was contained in this field is now located in a new table called tblThoracicDataSpecsV2_2_HarvestCodes. The data in this table is linked to the data in tblThoracicDataSpecsV2_2 through the compound key of the fields DBTableName and ShortName.
- b. The format of the information in the "ParentValue" field was changed to make it consistent with the format used in the specifications for the other STS databases.
- c. The field "ParentHarvestCodes" was added to provide a way to handle parent/child relationships programatically.
- d. The field "FieldStatus" was added to indicate the status of each field compared to the previous version.
- e. The names of several fields ("DCFSection", "FieldName", "TableName", "ParentField") were renamed (to "SectionName", "LongName", "DBTableName", "ParentLongName" respectively) to make them consistent with the field names used in the other STS databases.
- f. The field "ValidData" was removed and replaced with two new fields "LowValue" and "HighValue".
- g. The field "UsualRange" was removed and replaced with two new fields "UsualRangeLow" and "UsualRangeHigh".

3. Data Version Numbers

As medicine, technology and interest in research areas change, the data specifications have and will change to collect the additional and more detailed information. A Data Version number is assigned by the STS to each official version of the data specifications. This number will play a key role in how the data is handled and processed (see Software Specifications below).

Starting with version 2.2 of the data specifications, there is a change in the way version numbers (DataVrsn) are assigned to operation data records. Beginning with this upgrade, when users create a new operations data record, the software must first prompt the user for the surgery date. If the date supplied by the user is on or after January 1, 2009 and on or before December 31, 2011, the new record must follow the v2.081 specifications. If the date is on or after January 1, 2012, the data record must follow the v2.2 specifications. This process will ensure that all records in the national

database for procedures performed during a specific time period will follow the same data version, regardless of when the record was created.

For the General Thoracic Database, there are two data version fields: one for the Demographics table (DemogDataVrsn) and one for the Operations table (DataVrsn). A description of these fields is as follows:

Demographics Data Version (DemogDataVrsn):

The DemogDataVrsn fields was added as a new field in the 2.07 data specifications. This field is necessary because the data version followed to create the patient's demographics record may not match the version followed to create all of their associated operations records. For example, when a new patient comes to a facility, a Demographics record is created for the patient and an Operations record is created for the operation. In this case, the two data version values will be the same. The same patient can come back to this facility years later to have another procedure performed. By this time, one or more upgrades may have been made to the database software and data specifications. In this case, the original Demographics record is used, which still contains the old data version value, and a new operations record will be created, which will contain the new data version.

There is no correlation between the value of the demographic data version number and the operation record's data version number. For example, it is possible to have a demographic record with a DemogDataVrsn value of 2.08 associated with an operations record with a DataVrsn value of 2.2. It is also possible, if a site is entering data retrospectively, to have a demographic record with a DemogDataVrsn value of 2.2 associated with an operations record with a DataVrsn value of 2.08. The version number determines how the fields in that record are handled and have no effect on the way records in the other tables are handled.

Operations Data Version (DataVrsn):

For the 2003 data harvest, all data submitted to the database was collected using one software package that was distributed by the STS and was formatted to the 1.3 version of the data specifications.

In early 2004, the data specifications were upgraded to version 2.06. At that time, the STS software package was modified to record new data records in the 2.06 format. The 2004 data harvest included data in both 1.3 and 2.06 data versions.

In January of 2005, version 2.07 was released to vendors to allow them to develop commercial software packages for collecting General Thoracic

data and submitting it to the STS database. It was decided that the shareware software package distributed by the STS would not be upgraded to this new data version. Participants using the STS software were required to purchase one of the commercial packages to continue collecting and submitting data to the STS database.

It was also decided that commercial software packages will handle all data records collected in the past as well as newly created records according to the 2.07 data specifications. This means that if a participant has their data that was collected under versions 1.3 or 2.06 pulled over into a commercial package, those records will be handled by the new software following the 2.07 specifications. This is a different procedure from how data with different data versions is normally handled by commercial packages, but this change was necessary to allow participants to carry their old data over to the new software systems.

To enable the commercial software packages to handle the older data, records with a data version of 1.3 or 2.06 were required to go through a conversion process. The STS provided participants with a software utility to extract the data from the shareware software package, convert it to the 2.07 format, change the data version numbers from 1.3 to 1.31 and from 2.06 to 2.061, and save the data in a format that allowed it to be imported into the new commercial packages. The commercial packages treat records with data versions 1.31 and 2.061 as if they were version 2.07 records. New records created in the commercial packages are given the latest version number.

All data records with a procedure date between January 1, 2006 and December 31, 2008 are required to be in the 2.07 format.

All data records with a procedure date between January 1, 2009 and December 31, 2011 are required to be in the 2.081 format.

All data records with a procedure date from January 1, 2012 forward are required to be in the 2.2 format.

4. Sequence Number

The sequence number field (SeqNo) is provided in the data specifications solely for identifying fields and sorting fields within the specific version of the data specification database. They are not intended as a permanent identifier for individual fields as a number assigned to a field in one version of the data specifications might be assigned to a different field in another version. Because of this, it is highly recommended that developers should not use the SeqNo value as a field identifier in any of their programs.

5. Fields Required For Record Inclusion

Starting with version 2.081, specific fields are required to contain data for the entire record to be included in the analysis performed at the data warehouse. These fields are indicated in the data specifications by the field "RequiredForRecordInclusion" set to "Yes". All of these fields must contain valid data for the entire record to be accepted into the data warehouse. If any one of these fields is missing data (with the exception of the Race fields as described below), the entire record will be excluded from the analysis.

In the 2.081 version of the data specifications, there were 29 fields defined as required for record inclusion. In version 2.2, there are 31. Several of these fields are part of the "check all that apply" fields to collect the patient's race information ("RaceCaucasian", "RaceBlack", "RaceAsian", "RaceNativeAm", "RaceNativePacific", "RaceOther" and "RaceUnk"). Only one of these fields must contain a value of "Yes" to meet the "required for inclusion" criteria. All of the other fields must contain data for the record to be included.

It is highly recommended that software developers provide their users with reports indicating which, if any, records do not meet these criteria. If this is included as part of a larger data quality report, this information should be in a separate section to help emphasize the importance of this issue.

6. Future Upgrades

As the need arises, new versions of the data specifications will be distributed by the STS. In the interest of keeping major software upgrades and testing down to a minimum, the STS does not expect to upgrade the specifications more frequently than once every other year. Developers should anticipate these upgrades and design their software in such a way that the new versions can be incorporated with minimal software changes and that records created under different data versions will be handled properly, as described below.

When upgrades are made to the data specifications, the older versions of the data will not be converted to a newer version. Instead, the software will be required to handle data in all of the valid data versions as described below.

7. Data Specifications Field Descriptions:

The data specifications are maintained in a table in an Access database to allow the information to be cut and pasted, sorted and reported on in a variety of ways and to make incorporating the information into applications

easier. The 2.2 version of the specifications contains the following tables and fields:

Table name: tblThoracicDataSpecsV2_2

- A. SectionName – The title of the section of the DCF in which the field can be found
- B. SectionSeqNo - The order number of the section of the DCF where the field is located.
- C. SeqNo – An arbitrary number (sequence number) used for ordering the fields within a specific version of the data specifications. The ordering of the numbers is set to loosely follow the order in which the fields appear on the DCF. As described above, the value for one field can change from one version of the specifications to the next. The values, therefore, should never be used in any reports, queries or programs to refer to a specific field.
- D. LongName – The longer and more descriptive name of the field. In most cases, the FieldName does not change from one version of the specifications to the next, but they do change in some instances. Because of this, the LongName value should never be used to refer to a field in reports, queries or programs.
- E. ShortName – The short programmatic name assigned to the field. The ShortName value should be used in all reports, queries and programs to refer to a given field as this value will not change from one version of the specifications to another.
- F. Core – This field contains a value of Yes or No to define whether or not the field should be available to the users for data entry. These values have the following meanings:
 - Yes = Field must be available to the users for entering data for records following this version of the data specifications.
 - No = Field is not required to be available to the users for entering data for records following this version of the data specifications. Whether or not the field is included in data files exported for submission to the STS database depends on the Harvest value described below and on what other data versions are being included in the data extract. (See the “Data Export for Harvest to the Data Warehouse” section of the Software Specifications below.)

- G. Harvest – This field contains a value of Yes, No or Optional to define whether or not the data for this field is included in the export file to be submitted to the data warehouse. (See the “Data Export for Harvest to the Data Warehouse” section of the Software Specifications below for more details about the contents of the submitted files.) The values for this field have the following meanings:
- Yes – Data from this field must be included in the data file for all records following this version of the data specifications.
 - No – Data from this field must not be included in the data file for all records following this version of the data specifications.
 - Optional – The individual users determine whether or not the data from this field is included in the data file. By default, the software should treat this as a Yes and include the data in the extract. The users must explicitly state that they do not want the data for this field included.
- H. Format – The format in which the values for the field should be collected.
- I. DBTableName – The name of the table in the export data file where the field is located. (See “Data Export for Harvest to the Data Warehouse” section of the Software Specifications below).
- J. DataSource – This field defines how the data is entered into the field. The options for this field are:
- User – The user enters the value, otherwise it is left missing (null).
 - Automatic – The software automatically inserts a value for every record. This is usually assigned to administrative fields that must contain a value, such as the DataVrsn field.
 - Automatic or User – The value can be entered automatically by the software based on values in other fields or the user can enter the value manually. This usually applies to fields such as Hospital Postal Code where the value can be automatically inserted by the software after the user has selected the hospital name.
 - Lookup – The software automatically inserts a value after looking up the information kept in a table maintained by the user (for example, HospStat is filled in based on which HospName value is selected).
- K. Definition – A description of the information to be collected in the data field.

- L. LowValue – The lowest valid value that can be accepted for the specified field. This is used only in fields that accept numeric values.
- M. HighValue – The highest valid value that can be accepted for the specified field. This is used only in fields that accept numeric values.
- N. UsualRangeLow - The lowest value that is likely to be entered by the user. If the user enters a value that is below this number, but still greater than or equal to the value defined in LowValue, the value should be accepted, but the user should be given a message that the value they entered is unusually low and that they should verify the value.
- O. UsualRangeHigh - The highest value that is likely to be entered by the user. If the user enters a value that is above this number, but still less than or equal to the value defined in HighValue, the value should be accepted, but the user should be given a message that the value they entered is unusually high and that they should verify the value.
- P. ParentLongName – The long name of the “parent” field on which this field (the “child” field) is dependant. The parent field must contain a value that is specified in the ParentValue field before data can be entered into this field.
- Q. ParentShortName – The STS short name of the parent field.
- R. ParentValue – The list of values the parent field must have before this field can be available for data entry. This field may also contain general instructions instead of specific values, such as “Not null”.
- S. ParentHarvestCodes – A bar-delimited list of the harvest codes associated with the values listed in the ParentValue field. This field may also contain general instructions instead of specific values, such as “Not null”.
- T. FieldStatus – The status of the field as it relates to the previous version of the data specifications. This field has one of three values:
 - New – Field is new to this data version and did not exist in the previous version of the specifications.

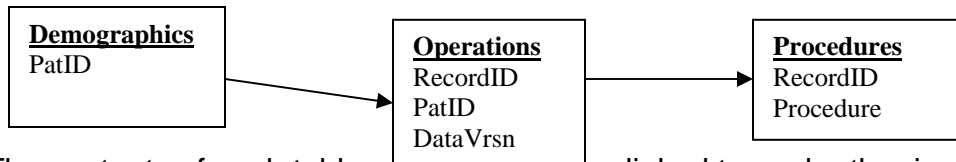
- Dropped – Field was a core field in the previous version of the data specifications, but is not a core field in this version.
 - Continued – Field was a core field in the previous version of the data specifications and is also a core field in this version. These fields may or may not have undergone changes between the two versions.
- U. RequiredForRecordInclusion – This field contains a value of Yes or No and defines whether a value must be present in the field for the entire data record to be included in the analysis performed at the Data Warehouse.
- V. NonAnalyzedProcField – Indicates whether the field is collected for “Non-analyzed Procedures”. (See “Software Specifications”, “General Features” section below.)

Table name: tblThoracicDataSpecsV2_2_HarvestCodes

- A. DbTableName - The name of the table in the export data file where the field is located.
- B. ShortName – The short programmatic name assigned to the field.
- C. HarvestCode – The numerical code that is assigned to each choice in the valid data. These are the values that are used in the exported data file that is submitted to the Data Warehouse.
- D. Description – The text description of the choice. This is the value the user sees while doing data entry.
- E. DisplayOrder – The order in which the choices are displayed to the user for this field.
- F. Definition – The official definition of the specified choice for this field. Note that not all choices will have a definition.

Database Structure:

The General Thoracic database has a relational structure made up of three tables: Demographics, Operations, and Procedures. The following diagram depicts how the tables relate to each other. (Note, each table contains more fields than are depicted here. Only the fields involved in the table relationships are included in this diagram.)



The contents of each table and how they are linked to each other is described below:

Demographics: This table contains one record for each patient. The Patient ID (PatID) field is the primary key for each record to link to the associated Operations records.

Operations: This table contains one record for each operation performed on a patient. There can be many operation records in this table for each one patient record in the Demographics table. The Patient ID (PatID) field is the foreign key field linking this table to the Demographics table. The RecordID field is the primary key for each operation record linking it to the Procedures table.

Procedures: This table can contain multiple records for every patient in the Demographics table, one for each procedure performed. It can also contain multiple records for each Operations record since more than one procedure can be performed during a single operation. The RecordID field is the foreign key linking each record to the associated record in the Operations table.

For more information about the tables and records, see the “Record Management” section of the “Software Specifications” below.

Software Specifications:

It is not the intention of the STS to regulate the algorithms and methodologies the developers use to produce their software. However, there are specific features and functionalities that are needed in the software to allow data to be collected and submitted in a uniform format and to enable the warehouse to communicate with the members about individual records and data items. The purpose of this section is to describe those features and functions.

1. General Features

The approved software must have the following minimum features:

- a. A user-friendly interface that can be used on a current personal computer operating system.
- b. Allow users to be able to view and select the actual data values for each field. If the data is coded internally, user should, by default, view the non-coded values.
- c. Ensure all date values are year 2000 compliant having a 4-digit year format.
- d. The STS General Thoracic database has a relational structure composed of 3 tables. Regardless of the method of internal storage, the software must be able to export the data into one data file in the format specified by the STS. (See “Data Export for Harvest to the Data Warehouse”, below.)
- e. Software must accept and integrate data previously collected and maintained in other software products or data versions. (See “Data Import”, below).
- f. The user’s data must be accessible for ad hoc queries either through the software package or by common third party software (e.g., Microsoft Access, Crystal Reports, etc.) If the data is not directly accessible, then the software must provide the ability for the user to export the data in a standard file format which can be queried using common third party query software. (See “Data Export for Analysis by Users”, below). When users are querying their data, grouping records that were created under multiple data version numbers must be invisible to the user. For example, if a user wants to analyze the average patient age in their data for a time period of two years, the fact that their data was recorded under two different version numbers during that period must not require any additional steps for the user to build the query. We strongly

recommend ensuring this by keeping all data in one database regardless of the version number. This requirement is the result of feedback from many frustrated users.

- g. Users must be able to select specific records in their database via key fields including patient's name, Patient ID (PatID), and the Record ID (RecordID). The data warehouse communicates specific record problems with the sites using the PatID and RecordID fields. Therefore, these specific fields must be visible to the user and labeled with these field names.

Along with the above required minimum features, starting with version 2.2, it is recommended that developers add a feature to their data entry utility to help facilitate users entering "non-analyzed procedure" records. In the General Thoracic surgery field, clinicians often perform procedures that are not considered "major" procedures. Many of the core fields in the data specifications do not apply to these types of procedures (for example, many of these procedures are performed on an outpatient basis so Discharge Date does not apply). Even though these procedures will not be included in the analysis of the participant's data, some participants have specified that they still want to be able to track information about these cases.

To help facilitate this, the STS has identified the fields in the data specifications that do apply to these "non-analyzed procedures", as well as the choices in the "Procedure" field (ShortName=Proc) that are minor procedures. The field "NonAnalyzedProcField" in the data specifications table contains a "Yes" for the fields that should be collected for non-analyzed procedures. All of the fields that do not apply to non-analyzed procedures contain a "No" in this field. Also, Appendix B below identifies the choices for the Procedure field that are non-analyzed procedures.

It is recommended that developers use this information to provide a method within their data entry utility that will allow users to "hide" the fields and choices that do not apply to non-analyzed procedures. This will allow the users who want to collect data on these procedures to do so without having to skip through all of the fields that do not apply to the case. Although this is not a required feature, it is recommended that developers incorporate this ability into their software.

2. Record Management

Demographics

Each record in the Demographics table of the database describes one patient. On each Demographics record, there are two key field used for record management:

- a. Patient identification number (PatID): The PatID field contains a unique, arbitrary alphanumeric value to uniquely and permanently identify each patient in the Demographics table and is required for each Demographics record. Regardless of the number of operations or admissions to the hospital, only one Demographics record should exist for each patient. The value, once assigned to a patient, can not be edited or reused if the patient records are ever deleted. In order to avoid issues of patient confidentiality, the PatID value should not include any known identifier such as Social Security Number or Medical Record Number.

Beginning with version 2.2 of the data specification, the values generated by the software for the PatID field must be a combination of a vendor specific code followed by an alphanumeric value that makes the identifier unique. The vendor-specific code will consist of three characters and will be assigned to each vendor and Participant Generated Software site by the STS. The codes will be in a format similar to "V01". For example, the software will generate a PatID value of V01000001 for the first demographic record and V01000002 for the second demographic record. The purpose of this feature is to allow sites to move their data from one version of a software package to another, or from one vendor package to another, and maintain the referential integrity of their data records.

- b. Demographics Data Version Number (DemogDataVrsn): The DemogDataVrsn field contains the data specifications version number under which the record is created. The value is automatically entered into the record by the software at the time the record is created. Note that the DemogDataVrsn value may not always match the DataVrsn value in Operations records that are associated with this Demographics record.

Operations

Each record in the Operations table of the database describes one trip to the Operating Room (OR) for a patient. On each Operations record, there are four key fields used for record management:

- a. Record identification number (RecordID): The RecordID field contains a unique, arbitrary alphanumeric value to uniquely and permanently identify each operation in the Operations table and is

required for each Operations record. A new Operations record should be created for each operation or operating room visit and linked to the patient via the PatID field (see PatID below). Once the RecordID is assigned to a record, it can not be edited or reused if the record is ever deleted. In order to avoid issues of patient confidentiality, the RecordID value should not contain any known identifier such as Social Security Number or Medical Record Number.

Beginning with version 2.2 of the data specification, the values generated by the software for the RecordID field must be a combination of a vendor specific code followed by an alphanumeric value that makes the identifier unique. The vendor-specific code will consist of three characters and will be assigned to each vendor and Participant Generated Software site by the STS. The codes will be in a format similar to "V01". For example, the software will generate an RecordID value of V01000001 for the first operations record and V01000002 for the second operations record. The purpose of this feature is to allow sites to move their data from one version of a software package to another, or from one vendor package to another, and maintain the referential integrity of their data records.

- b. Patient identification number (PatID): The PatID field contains the patient identification number from the Demographics table that identifies the corresponding patient. For patients with multiple operations or hospital admissions, the same identifying PatID should be used to link these operations to the appropriate patient. The PatID is required for each Operations record. See PatID under Demographics (above) for more information.
- c. Participant identification number (ParticID): Each group of surgeons collecting and entering data into a database for submission to the STS is assigned a 5-digit ParticID number by the STS. In most cases, all data being entered into a database will be for one participating group, in which case all records will have the same value in this field. In these situations, the developer can have the software enter the value into the record automatically for the user.

In some situations however, more than one participating group will be entering their data into a single database. In these situations, the user should select the appropriate ParticID value from a drop down list (see "Categorical values specified by user" under the Data Source description in the "Explanation of Data Specification Terms", below).

The developer should consult with the users to determine how many participants will be entering data into a single database and adjust the programs accordingly. In either case, a value for ParticID is required and the software should ensure one exists for every Operations record.

- d. Data Version Number (DataVrsn): The DataVrsn field contains the data specifications version number under which the record is created. The value is automatically entered into the record by the software at the time the record is created.

The data version value that is assigned to a record is determined by the surgery date of the procedure. Once a data version value has been assigned to a record, the value should never be changed by the software or the user.

In general, once an Operations record is created and it has been assigned a data version number, that record will always follow the rules defined by that version of the data specifications. If the software is upgraded to follow a newer version of the data specifications, when a user selects a record for editing that has an older data version number, the software must follow the older data specification rules for editing that record. This includes controlling which fields are available to the user, which values are available for each field and the appropriate parent/child dependencies. The exceptions to this rule are the data versions 1.31 and 2.061. As described in the Data Version Numbers section of the Data Specifications portion of this document above, commercial vendor software packages will handle these records using the version 2.07 rules.

For more information about the DataVrsn field, see the “Database Structure” section above.

Note that the DataVrsn value on this table will also define which fields and values are available to the user for any records in the Procedures table that are associated with this Operations record.

Procedures

Each record in the Procedures table of the database describes one procedure for an operation. Each operation record can be linked to multiple procedure records. On each Procedures record, the RecordID field is the key field used for record management. The RecordID field in the Procedures table contains the RecordID value from the associated record in the Operations table. For patients with multiple procedures for a given operation, the same identifying RecordID would be used to link

these procedures to the appropriate operation. The RecordID is required for each Procedure record. See RecordID under Operations for more information.

3. Data Entry

The software must have the following features to control the data being entered by the users:

- a. For data entry purposes the site and vendor may choose to institute internal codes for "Missing" values. As the site drives the needs for this feature, the STS data specifications do not define standard codes for "Missing" values during data entry. If a site applies data entry "Missing" codes, the harvest process must include a step that maps the missing code to the STS specification for "Missing" values (null or blank). Note: zero is never used to indicate missing data.
- b. The user should always be able to delete entered data, and return the field's value to the null or blank "Missing" value.
- c. For any field having "Valid Data" specified, software must restrict data entries to this set of values.
- d. Documentation including data definitions and help should be easily accessible to the user, preferably on-line.
- e. The primary and secondary Category of Disease fields and the Procedure field all contain rather long lists of valid choices. As it can be difficult for users to find the desired choice from such a long list, software developers should develop a method to help users drill down to the appropriate selection.

Although the exact method of doing this is at the discretion of the developer, one suggestion is to have the users first indicate the group to which the desired choice belongs. After the user selects the group, the Category of Disease field or Procedure field could be restricted to show only those choices that are appropriate for the specified group. To help developers with this approach, Appendix A and Appendix B of this document contains listings of the groups to which each Category of Disease and Procedure belongs.

- f. Some categorical text fields are designed to have data values controlled by the user. This applies primarily to a few site-specific fields such as hospital name and surgeon name. The user should

be able to maintain the pick list of valid data for these fields including the ability to add, change, or delete list elements. During data entry, the user should be able to enter only values that are in this pick list.

The process of maintaining the list should be separate from the data entry process. In other words, if a user doing data entry needs to enter a value that is not already on the list, they should not be able to add the value to the list without first exiting out of entering data for that case. If a user attempts to enter a value during data entry that is not already on the list, it should be rejected and not automatically added to the list. The idea here is to avoid the possibility of users entering "free text" which causes unacceptable data quality issues at the warehouse.

It is important that the vendor support the site's ability to control these fields. Items in the user list should not have more than one choice for the same entity. For example, the hospital names "General Memorial Hospital" and "GMH" should not represent select choices for the same hospital.

4. Field Dependencies

Field dependencies exist where one field ("parent" fields) controls whether or not one or more other fields ("child" fields) can contain data. Child fields are indicated in the specifications by having their immediate parent field named in the "Parent Field" section of their specification. For example, Diabetes is a parent field to its child Diabetes Control. The following guidelines must be followed to handle dependent fields:

- a. If the data value of a parent field indicates that no data should be in its dependent fields, then those dependent fields should be skipped or unavailable on the data entry screen. In the example above, only if Diabetes = "Yes" should Diabetes Control be available for data entry. Otherwise, Diabetes Control should be unavailable for data entry.
- b. If a parent field contains a "No" value, vendors can choose one of two methods for handling the values in the associated child fields:
 - i) set all child field values to Null, or
 - ii) set child field values to "No" as is appropriate.

Note that the STS highly recommends following the first method of setting all child fields to Null.

Vendors must keep in mind that the first method is required in the export file created for submission to the data warehouse. In other words, regardless of what is in the user's database, the export file must contain Nulls in child fields when the parent is No.

Also, vendors must notify the STS and the data warehouse if their software will insert No values into child fields when the parent is No. This will allow the warehouse to know that the data received by a site during a data harvest will not look exactly like what the user has in their database.

- c. If a parent field is originally set to "Yes", then values can be entered into its child fields. If the record is subsequently edited by the user and the parent value is changed to "No", the values in the child fields must be automatically changed to Null or No depending on the method being used by the vendor as described above. This will avoid the possibility of conflicting information being left in the data record (for example Diabetes is "No" but Diabetes Control is "Oral").

5. Data Quality and Completeness Checks

The software must provide the users with a utility for checking the accuracy and completeness of their data that includes the following features:

Data quality checks can be run during data entry and/or on demand for groups of records as specified by the user. This utility produces a data quality report indicating which records and fields failed the data checks. This report is used by the site data manager to review and potentially repair the data.

- a. Certified software must contain a utility for checking and reporting on data completeness. This utility must include the following features:
 - i) The user must be able to identify in a list the fields that they want to have checked for completeness. The user should be able to select just one field, all fields, or any number of fields desired (by default, the utility should report on ALL fields). It is recommended that user should be able to save the selected list so as not to have to go through the selection process again the next time data quality is being checked.
 - ii) The utility should report on individual records or groups of records (recommend grouping by surgery date range) as specified by the user.

iii) The utility must take into consideration dependent fields when checking for completeness. For fields defined as “child” fields of a “parent” field, the child is considered missing only if the parent is answered “Yes” (or in a way that would allow the user to enter data into the child field) and the child field contains no data. Following this guideline will restrict reporting missing data to only those situations where data is clinically expected.

6. Data Import

- a. Software must be able to import data in standard file formats from third party applications. At a minimum, this must include delimited, ASCII text files. Other common formats (e.g., Excel or MS Access) are also recommended. This functionality is to only be used on a one-time basis. For example, this utility should only be used when a user first purchases a new certified software package and wants to import the data they had been collecting up to that time in a different package. Once the old data has been imported into the new package, all future data should be entered directly into the new package via the data entry screens and no additional data should be imported. Using the import feature to regularly import data so that it can be exported in the STS format for submission to the Data Warehouse is strictly against the STS policies.
- b. Data that is imported will require controlled conversion to an acceptable STS data version. The conversion process must include reviewing the data for consistency with the STS data (i.e., mapping the categorical values in the imported data to the appropriate STS values). The site data manager and software vendor hold responsibility for the accuracy (both clinical definition and harvest format) of all imported data harvested to the warehouse. The software will assign to each imported record the STS data version number to which the data is converted. The warehouse will handle data according to the STS data version number on each observation in a harvest file regardless of whether it was created in the software’s data entry utility or imported from another source.
- c. Special consideration is needed for the values in the PatID and RecordID fields when importing data. This is especially true when importing data that was previously submitted to the data warehouse (i.e., data from another certified software package). PatID and RecordID values must never change once they are assigned to a record. The software developers and data

managers must ensure that the values in the imported data do not change in the conversion process, and that they do not cause duplication of values with any existing records. If the PatID and RecordID values being imported contain the vendor codes for the previous vendor, keeping the old values as they are will help maintain this data integrity. In other words, do not change the vendor codes in the records being imported.

Developers must also ensure that new records created after the data has been imported are not assigned RecordID or PatID values that already exist in the data. If data is to be imported that would cause a conflict in this manner, the software developer and/or data manager must contact the data warehouse to determine what steps need to be taken.

5. Record Subsets and Queries

- a. Software must allow users to search for Individual records selected by RecordID, PatID . This is to help users with their data quality actions and to increase the usability of the database.
- b. Software should allow groups of records to be selected (e.g., filter function) by multiple fields, which minimally include operation type, surgeon, hospital name, date of surgery, date of admission, and date of discharge.
- c. Users should be able to name, save, copy and modify record selection criteria.
- d. Users should also be able to construct more general queries including field selection, record selection, sorting, and summarizing. It is acceptable if this function is provided by a third party application (e.g., MS Access or Crystal Reports).

6. Reporting

Software should provide the users with reporting abilities that can do the following:

- a. View and print listing of records (either all records or a selected subset) with basic information such as, but not limited to, RecordID, PatientID, patient name, SSN, operation type, medical record number, date of birth, date of surgery, surgeon, and hospital.

- b. Build, save, copy, and modify more general reports with capability to select fields, record subsets, sorting, and summary statistics. (It is acceptable if this function is provided by a third party application, such as MS Access or Crystal Reports).
- c. Data harvest procedure provides the site with a report documenting the following:
 - i) whether or not the extract completed successfully
 - ii) number of records extracted
 - iii) time frame of the data extracted (by date of surgery)
 - iv) date the data extraction was performed
 - v) name of the person who performed the data extraction

7. Data Export for Analysis by Users

The software must allow users to export their data for their own use in the following manner:

- a. Software must be able to export data in standard file formats suitable for transfer into third party applications. This must include at a minimum delimited, ASCII text, and optionally other common formats such as Excel and Access. Developers should keep in mind that sites may need to export their data for reasons other than the STS data harvests.
- b. User should be able to choose whether an export includes all data or selected records and fields.
- c. If data is coded for internal storage (i.e., text string is stored as a number), the data must be decoded when written to the export file so that actual values (full text strings) are contained in export file.
- d. Export files must have short field names in the first header row in the same order as the data in subsequent rows.
- e. User can build, save, copy, and modify named export configurations.
- f. User can control export file naming convention.

8. Data Export for Harvest to the Data Warehouse

As one of the key reasons for having certified software, the software must allow users to export their data for submission to the STS data warehouse following these exact guidelines:

- a. The user must be able to specify the records to be exported for harvest by using range limits for the surgery date.
- b. The data for each of the three tables must be exported to one file precisely as indicated here:
 - i) The harvest data file will be a bar (a.k.a. “pipe”) delimited ASCII text file. It will not, however, be a “standard flat file” since different records will contain different numbers of fields
 - ii) The data of each relational table will be included in the file. Each table will be separated by one line containing a “table delimiter” followed by another line with the table’s header record. The table delimiter is defined as three asterisks followed by the table name (e.g., ***Demographics). The header record consists of the field (short) names in the order in which they appear on each data record, separated by the bar delimiter.
 - iii) Each of the three tables should be present in the data file in the order specified below. The resulting data file should be in the following format:

```

***Demographics
(... header record for the Demographics table ...)
(... data records for the Demographics table ...)
***Operations
(... header record for the Operations table ...)
(... data records for the Operations table ...)
***Procedures
(... header record for the Procedures table ...)
(... data records for the Procedures table ...)

```

- c. What records are included in the extract file varies depending on the table:
 - i) For the Operations table, all records with a surgery date between the starting and ending dates specified by the user must be included in the export file.
 - ii) For the Procedures table, all records linked to the included Operations records must be included in the export file.
 - iii) For the Demographics table, ALL database records must be extracted, regardless of whether or not they are linked to the included Operations records. This is necessary due to the nature of thoracic operation procedures and the “rolling harvest” procedures used at the data warehouse. This method ensures that patients with multiple admissions to the hospital over several years are captured correctly over each data harvest.

- d. Only a single harvest file for each participant can be submitted to the warehouse for processing. Participants may submit repeatedly during a harvest, but each submission must consist of only one file.
- e. The extracted file must contain data for only one ParticID. If the site's database contains data for more than one participant, all of which is to be submitted to the warehouse, the software must extract the data for each ParticID into separate data files each with an appropriate file name (see below).
- f. The harvest file must include all fields, and only those fields, defined in the data specifications where Core is "Yes" and Harvest is "Yes" or "Optional" for all STS data versions within the harvest file. Fields with Core="No" or Harvest="No" and site-specific or custom fields must not be included in the export file.
- g. Fields that are defined as Core is "Yes" and Harvest is "Optional" must be included in the data file. What is "optional" is whether or not the field contains data. By default, the software should include all data for optional fields. If the user specifies that an optional field should not be included, the data file will include the field but every record will contain a blank (null) in that field. This is necessary for the warehouse to be able to tell the difference between a field being left out by mistake and a site opting not to include that data.
- h. The values in the harvest file must be the "Harvest Coding" of the data values and not the full text strings.
- i. A harvest report should be produced whenever a data harvest is performed (see "Reporting", above).
- j. The software must create the exported data file using the file naming convention of XXXXXthr.dat where "XXXXX" is the 5-digit ParticID for the data contained in the file. The users should not specify the file naming convention. Files not using this naming convention can not be accepted by the automated process at the data warehouse and may be returned to the participant.

When records from more than one data version are being exported for an STS data harvest, the file must adhere to the following format:

- k. All data records for a single participant must be exported into one and only one data file.

- l. For each of the three tables included in the export file, there must be only one "header" record containing the STS short field names in the same sequence as the data fields in subsequent rows.
- m. Every data record for each table in the file must contain the same fields which will consist of a superset of the Core, Harvested fields from all included data versions.
- n. On each data record, the fields that are Core and Harvested for the data version specified in the DataVrsn field will contain data values as available and appropriate. The fields that are not Core or not Harvested for that data version will contain nulls (blanks). When the data is being processed by the warehouse, only the fields appropriate for the data version specified on the record will be included.

9. Customization

It is up to the developer's discretion as to whether or not the users will have the ability to add customized fields to their software and database. If the user will have this ability, the following items must be considered:

- a. In no case can the field names, short field names, or categorical data values specified by the STS be customized or modified by the users. (Please note however in the STS specifications that users can build the categorical data values for certain fields, see "Data entry", above.)
- b. Fields added by users must not be included in the data file exported for submission to the STS data warehouse.
- c. Developers should make clear to the potential users whether users can add custom fields themselves, or if they will require contracted work by the developer.
- d. It should be possible for users of customizable software to import custom fields that they might have created in a previous database or software package.
- e. Most importantly, developers who allow users to add customized fields must keep in mind that software upgrades will be necessary from time to time as new versions of the data specifications become available. It is the developer's responsibility to handle how a user's customization is incorporated when their software is being upgraded.

Appendix A: Groupings for Category of Disease (primary and secondary)

Group	Valid data choices for primary and secondary category of disease
Trachea & Larynx	10 = Tracheomalacia-congenital (748.3, Q32.0)
Trachea & Larynx	20 = Tracheomalacia-acquired (519.1, J39.8)
Trachea & Larynx	30 = Tracheostenosis-congenital (748.3, Q32.1)
Trachea & Larynx	40 = Tracheostenosis-acquired (post intubation) (519.1, J39.8)
Trachea & Larynx	50 = Tracheostomy-hemorrhage (519.09, J95.01)
Trachea & Larynx	60 = Tracheostomy related stenosis (519.02, J95.03)
Trachea & Larynx	70 = Tracheal tumor, malignant (162.0, C33)
Trachea & Larynx	80 = Tracheal tumor, benign (212.2, D14.2)
Trachea & Larynx	90 = Tracheal tumor, metastatic (197.3, C78.30)
Trachea & Larynx	100 = Subglottic stenosis-congenital (748.3, Q31.1)
Trachea & Larynx	110 = Subglottic stenosis-acquired (post intubation) (478.74, J38.6)
Trachea & Larynx	120 = Vocal cord paralysis unspecified (478.3, J38.00)
Trachea & Larynx	1040 = Vocal cord paralysis , unilateral (478.31, J38.01)
Trachea & Larynx	1050 = Vocal cord paralysis, bilateral (478.33, J38.02)
Lung	130 = Lung tumor, metastatic (197.0, C78.00)
Lung	140 = Lung tumor, benign (212.3, D14.30)
Lung	150 = Lung cancer, main bronchus, carina (162.2, C34.00)
Lung	160 = Lung cancer, upper lobe (162.3, C34.10)
Lung	170 = Lung cancer, middle lobe (162.4, C34.2)
Lung	180 = Lung cancer, lower lobe (162.5, C34.30)
Lung	190 = Lung cancer, location unspecified (162.9, C34.90)
Lung	1060 = Acute respiratory failure (518.81, J96.00)
Lung	300 = Hemothorax (511.8, J94.2)
Lung	1070 = Pulmonary sequestration (748.5, Q33.2)
Lung	290 = Pulmonary insufficiency following surgery/trauma (ARDS) (518.5, J95.82)
Lung	310 = Lung nodule, benign (not a tumor, e.g., granuloma, subpleural lymph node, pulmonary infarct) (518.89, J98.4)
Lung	200 = Lung abscess (513.0, J85.2)
Lung	1080 = Gangrene and necrosis of lung (513.0, J85.0)
Lung	210 = Pneumothorax (512.8, J93.1)
Lung	220 = Bronchiectasis (494.0, J47.9)
Lung	230 = Empyema with fistula (510.0, J86.0)
Lung	240 = Empyema without fistula (510.9, J86.9)
Lung	250 = Emphysema (492.8, J43.8)
Lung	260 = Emphysematous bleb (492.0, J43.9)
Lung	270 = Interstitial lung disease/fibrosis (516.3, J84.1)
Lung	280 = Pneumonia (486.0, J18.9)
Mediastinum	320 = Mediastinitis (519.2, J98.5)
Mediastinum	1090 = Mediastinal abscess (513.1, J85.3)
Mediastinum	440 = Mediastinal cyst, Bronchogenic (519.3, J98.5)
Mediastinum	450 = Mediastinal cyst, Foregut duplication (519.3, J98.5)
Mediastinum	330 = Mediastinal nodes, metastatic (196.1, C77.1)

Mediastinum	430 = Myasthenia gravis (358.0, G70.00)
Mediastinum	360 = Anterior mediastinal tumor-metastatic (197.1, C78.1)
Mediastinum	370 = Anterior mediastinal tumor-benign-(e.g., teratoma) (212.5, D15.2)
Mediastinum	380 = Anterior mediastinal tumor-thymus tumor (thymoma, thymic carcinoma) (164.0, C37)
Mediastinum	350 = Anterior mediastinal tumor primary(germ cell cancer, seminoma) (164.2, C38.1)
Mediastinum	460 = Mediastinal cyst, Pericardial (519.3, J98.5)
Mediastinum	470 = Mediastinal cyst, Thymic (519.3, J98.5)
Mediastinum	340 = Mediastinal nodes, benign (229.0, D36.0)
Mediastinum	390 = Lymphoma, intrathoracic (202.82, C85.92)
Mediastinum	400 = Posterior mediastinal malignant tumor- primary (164.3, C38.2)
Mediastinum	410 = Posterior mediastinal tumor-metastatic (197.1, C78.1)
Mediastinum	420 = Posterior mediastinal tumor-benign(neurogenic)(212.5,D15.2)
Thyroid	830 = Goiter, nodular (241.9, E04.9)
Thyroid	840 = Thyroid neoplasm, malignant (193.0, C73)
Thyroid	850 = Thyroid neoplasm, benign (226.0, D34)
Pleura	480 = Pleural effusion sterile (511.9, J90)
Pleura	490 = Pleural effusion, infected- (empyema) (511.1, J86.9)
Pleura	500 = Pleural effusion, malignant (197.2, C78.2)
Pleura	510 = Pleural tumor, malignant (e.g., mesothelioma)(163.9, C45.0)
Pleura	520 = Pleural tumor, metastatic (197.2, C78.2)
Pleura	530 = Pleural tumor, benign (212.4, D19.0)
Pleura	540 = Pleural thickening (511.0, J94.9)
Chest Wall	550 = Pectus excavatum (754.81, Q67.6)
Chest Wall	560 = Pectus carinatum (754.82, Q67.7)
Chest Wall	570 = Sternal tumor, malignant (170.3, C41.3)
Chest Wall	580 = Sternal tumor, metastatic (198.5, C79.51)
Chest Wall	600 = Rib tumor, malignant-(e.g., osteosarcoma, chondrosarcoma) (170.3, C41.3)
Chest Wall	610 = Rib tumor, metastatic (198.5, C79.51)
Chest Wall	620 = Rib tumor, benign-(e.g., fibrous dysplasia) (213.3, D16.7)
Chest Wall	630 = Thoracic outlet syndrome (353.0, G54.0)
Chest Wall	590 = Sternal tumor, benign (213.3, D16.7)
Diaphragm	1100 = Diaphragmatic hernia without obstruction or gangrene (553.3, K44.9)
Diaphragm	1110 = Diaphragmatic hernia with gangrene (551.3, K44.1)
Diaphragm	1120 = Diaphragmatic hernia with obstruction, without gangrene (552.3, K44.0)
Diaphragm	640 = Diaphragmatic paralysis (519.4, J98.6)
Diaphragm	650 = Diaphragm tumor, malignant (171.4, C49.3)
Diaphragm	660 = Diaphragm tumor, metastatic (198.89, C79.89)
Diaphragm	670 = Diaphragm tumor, benign (215.4, D21.3)
Esophagus	680 = Esophageal cancer-lower third (150.5, C15.5)
Esophagus	690 = Esophageal cancer, middle third (150.4, C15.4)
Esophagus	700 = Esophageal cancer, upper third (150.3, C15.3)
Esophagus	710 = Esophageal cancer, esophagogastric junction (cardia) (151.0, C16.0)
Esophagus	1130 = Malignant other part esophagus (150.8, C15.8)
Esophagus	1140 = Malignant neo stomach unspecified (151.9, C16.9)
Esophagus	720 = Esophageal tumor-benign (i.e., leiomyoma) (211.0, D13.0)

Esophagus	730 = Esophageal stricture (530.3, K22.2)
Esophagus	740 = Barrett's esophagus (530.85, K22.70)
Esophagus	1150 = Barrett's esophagus with High Grade Dysplasia (530.85, K22.711)
Esophagus	750 = Achalasia of esophagus (530.0, K22.0)
Esophagus	800 = Tracheoesophageal fistula (530.84, J86.)
Esophagus	810 = Gastric outlet obstruction, pyloric stenosis, acquired (537.0, K31.1)
Esophagus	1160 = Esophagitis (530.1, K20.9)
Esophagus	1170 = Reflux esophagitis (530.11, K21.0)
Esophagus	1180 = Stricture and stenosis of esophagus (530.3, K22.2)
Esophagus	1190 = Dyskinesia/spasm of esophagus (530.5, K22.4)
Esophagus	1200 = Mallory Weiss tear (530.7, K22.6)
Esophagus	1210 = Foreign body esophagus (935.1, T18.108a)
Esophagus	1220 = Ulcer esophagus without bleeding (530.2, K22.10)
Esophagus	1230 = Ulcer esophagus with bleeding (530.21, K22.11)
Esophagus	760 = Esophageal perforation (530.4, K22.3)
Esophagus	770 = Zenkers diverticulum (530.6, K22.5)
Esophagus	780 = Epiphrenic diverticulum (530.6, K22.5)
Esophagus	790 = Esophageal reflux (GERD) (530.81, K21.9)
Esophagus	820 = Acquired absence of esophagus (post esophagectomy) (V45.79, Z90.89)
Trauma	860 = Rib fracture (807.0, S22.39xa)
Trauma	1240 = Multiple rib fractures (807.0, S22.49xa)
Trauma	870 = Sternal fracture (807.2, S22.20xa)
Trauma	880 = Flail chest (807.4, S22.5xxa)
Trauma	890 = Tracheal injury (807.5, S12.8xxa)
Trauma	900 = Traumatic pneumothorax (860.0, S27.0xxa)
Cardiovascular	980 = Pericarditis with effusion (420.9, I30.9)
Cardiovascular	990 = Pericardial effusion, malignant (198.89, C79.89)
Cardiovascular	1000 = SVC Syndrome (459.2, I87.1)
Miscellaneous	1250 = Hyperhidrosis, focal axilla (705.21, L74.510)
Miscellaneous	1260 = Hyperhidrosis, focal, face (705.21, L74.511)
Miscellaneous	1270 = Hyperhidrosis, focal, palms (705.21, L74.512)
Miscellaneous	1290 = Chylothorax (457.8, 189.8)
Miscellaneous	1020 = Lymphadenopathy (785.6, R59.9)
Miscellaneous	1030 = Abnormal radiologic finding (793.1, R91)
Miscellaneous	1280 = Other unlisted category of disease

Appendix B: Procedure Groupings and Non-analyzed Procedure Flag

Group	Valid data choices for Procedure	Non-analyzed procedure
Trachea and Bronchi	3980 = Tracheostomy (31600)	Yes
Trachea and Bronchi	2300 = Unlisted procedure, trachea, bronchi (31899)	Yes
Trachea and Bronchi	2200 = Tracheoplasty; cervical (31750)	No
Trachea and Bronchi	2210 = Tracheoplasty; intrathoracic (31760)	No
Trachea and Bronchi	2220 = Carinal reconstruction (31766)	No
Trachea and Bronchi	2230 = Bronchoplasty; excision stenosis and anastomosis (31775)	No
Trachea and Bronchi	2240 = Excision tracheal stenosis and anastomosis; cervical (31780)	No
Trachea and Bronchi	2250 = Excision tracheal stenosis and anastomosis; cervicothoracic (31781)	No
Trachea and Bronchi	2260 = Excision of tracheal tumor or carcinoma; cervical (31785)	No
Trachea and Bronchi	2270 = Excision of tracheal tumor or carcinoma; thoracic (31786)	No
Trachea and Bronchi	2280 = Suture of tracheal wound or injury; cervical (31800)	No
Trachea and Bronchi	2290 = Suture of tracheal wound or injury; intrathoracic (31805)	No
Trachea and Bronchi	3880 = Partial laryngectomy (31370)	No
Bronchoscopy	2960 = Tracheobronchoscopy through established tracheostomy incision (31615)	Yes
Bronchoscopy	2970 = Endobronchial ultrasound (EBUS) during bronchoscopy diagnostic or therapeutic intervention(s) (31620)	Yes
Bronchoscopy	2980 = Bronchoscopy, diagnostic, with or without cell washing (31622)	Yes
Bronchoscopy	2990 = Bronchoscopy, with brushing or protected brushings (31623)	Yes
Bronchoscopy	3000 = Bronchoscopy, with bronchial alveolar lavage (BAL) (31624)	Yes
Bronchoscopy	3010 = Bronchoscopy, with bronchial or endobronchial biopsy(s), single or multiple sites (31625)	Yes
Bronchoscopy	3990 = Bronchoscopy, with placement of Fiducial markers (31626)	Yes
Bronchoscopy	4000 = Bronchoscopy, navigational (31627)	Yes
Bronchoscopy	3020 = Bronchoscopy, with transbronchial lung biopsy(s), single lobe (31628)	Yes
Bronchoscopy	3030 = Bronchoscopy, with transbronchial needle aspiration biopsy(s) (31629)	Yes
Bronchoscopy	3040 = Bronchoscopy, with tracheal/bronchial dilation or closed reduction of fracture (31630)	Yes
Bronchoscopy	3050 = Bronchoscopy, with placement of tracheal stent(s) (includes tracheal/bronchial dilation as required) (31631)	Yes
Bronchoscopy	3060 = Bronchoscopy, with transbronchial lung biopsy(s), each additional lobe (31632)	Yes
Bronchoscopy	3070 = Bronchoscopy, with transbronchial needle aspiration biopsy(s), each additional lobe (31633)	Yes
Bronchoscopy	3080 = Bronchoscopy, with removal of foreign body (31635)	Yes
Bronchoscopy	3090 = Bronchoscopy, with placement of bronchial stent(s) (includes tracheal/bronchial dilation as required), initial bronchus (31636)	Yes
Bronchoscopy	3100 = Bronchoscopy, each additional major bronchus stented (31637)	Yes
Bronchoscopy	3110 = Bronchoscopy, with revision of tracheal or bronchial stent inserted at previous session (31638)	Yes
Bronchoscopy	3120 = Bronchoscopy, with excision of tumor (31640)	Yes
Bronchoscopy	3130 = Bronchoscopy, with destruction of tumor or relief of stenosis by any method other than excision (e.g., laser therapy) (31641)	Yes

Bronchoscopy	3140 = Bronchoscopy, with placement of catheter(s) for intracavitary radioelement application (31643)	Yes
Bronchoscopy	3150 = Bronchoscopy, with therapeutic aspiration of tracheobronchial tree, initial (drainage of lung abscess) (31645)	Yes
Bronchoscopy	3160 = Bronchoscopy, with therapeutic aspiration of tracheobronchial tree, subsequent (31646)	Yes
Pleural Space and Lung	2610 = Thoracoscopy, diagnostic lungs and pleural space, without biopsy (32601)	Yes
Pleural Space and Lung	2670 = Thoracoscopy, surgical; with pleurodesis (e.g., mechanical or chemical) (32650)	Yes
Pleural Space and Lung	2700 = Thoracoscopy, surgical; with removal of intrapleural foreign body or fibrin deposit (32653)	Yes
Pleural Space and Lung	4010 = Thoracoscopy, diagnostic; with biopsy(ies) of lung infiltrate(s) (eg wedge), unilateral (3260X)	Yes
Pleural Space and Lung	4020 = Thoracoscopy, diagnostic; with biopsy(ies) of lung nodule(s) or mass(es) (eg incisional), unilateral (3260X1)	Yes
Pleural Space and Lung	4030 = Thoracoscopy, diagnostic; with biopsy(ies) of pleura (3260X2)	Yes
Pleural Space and Lung	2310 = Thoracostomy; with rib resection for empyema (32035)	Yes
Pleural Space and Lung	2320 = Thoracostomy; with open flap drainage for empyema (32036)	Yes
Pleural Space and Lung	4040 = Thoracotomy with biopsy(ies) lung infiltrate(s) (eg wedge), unilateral (32095X)	Yes
Pleural Space and Lung	4050 = Thoracotomy with biopsy(ies) lung nodule(s) or masses (eg incisional), unilateral (32095X1)	Yes
Pleural Space and Lung	4060 = Thoracotomy with biopsy(ies) of pleura (32095X2)	Yes
Pleural Space and Lung	2400 = Thoracotomy with cardiac massage (32160)	Yes
Pleural Space and Lung	2410 = Pleural scarification for repeat pneumothorax (32215)	Yes
Pleural Space and Lung	2830 = Insertion indwelling tunneled pleural catheter (32550)	Yes
Pleural Space and Lung	2680 = Thoracoscopy, surgical; with partial pulmonary decortication (32651)	No
Pleural Space and Lung	2690 = Thoracoscopy, surgical; with total pulmonary decortication (32652)	No
Pleural Space and Lung	2710 = Thoracoscopy, surgical; with control of traumatic hemorrhage (32654)	No
Pleural Space and Lung	2720 = Thoracoscopy, surgical; with excision-plication of bullae, including any pleural procedure (32655)	No
Pleural Space and Lung	2730 = Thoracoscopy, surgical; with parietal pleurectomy (32656)	No
Pleural Space and Lung	2800 = Thoracoscopy, surgical; with lobectomy (32663)	No
Pleural Space and Lung	4070 = Thoracoscopy with therapeutic wedge resection (eg mass or nodule, initial, unilateral) (3266X)	No
Pleural Space and Lung	4080 = Thoracoscopy with therapeutic wedge resection(eg mass or nodule) each additional resection, ipsilateral (3266X1)	No
Pleural Space and Lung	4090 = Thoracoscopy with diagnostic wedge resection followed by anatomic lung resection (3266X2), List separately in addition to primary proc code	No
Pleural Space and Lung	4100 = Thoracoscopy with removal of a single lung segment (segmentectomy) (3266X4)	No
Pleural Space and Lung	4110 = Thoracoscopy with removal of two lobes (bilobectomy) (3266X3)	No
Pleural Space and Lung	4120 = Thoracoscopy with removal of lung, pneumonectomy (3266X5)	No
Pleural Space and Lung	4130 = Thoracoscopy with resection-plication for emphysematous lung (bullous or non-bullous) for lung volume reduction- LVRS, unilateral including any pleural procedure (3266X7)	No
Pleural Space and Lung	4140 = Thoracotomy with therapeutic wedge resection (eg mass nodule) initial (3250X)	No

Pleural Space and Lung	4150 = Thoracotomy with therapeutic wedge resection (eg mass nodule) each additional resection, ipsilateral (+3250X1)	No
Pleural Space and Lung	4160 = Thoracotomy with diagnostic wedge resection followed by anatomic lung resection (+3250X2), List separately in addition to primary proc code	No
Pleural Space and Lung	2340 = Thoracotomy, with exploration (32100)	No
Pleural Space and Lung	2350 = Thoracotomy, major; with control of traumatic hemorrhage and/or repair of lung tear (32110)	No
Pleural Space and Lung	2360 = Thoracotomy, major; for postoperative complications (32120)	No
Pleural Space and Lung	2370 = Thoracotomy, major; with cyst(s) removal, with or without a pleural procedure (32140)	No
Pleural Space and Lung	2380 = Thoracotomy, major; with excision-plication of bullae, with or without any pleural procedure (32141)	No
Pleural Space and Lung	2390 = Thoracotomy, major; with removal of intrapleural foreign body or hematoma (32150)	No
Pleural Space and Lung	2420 = Decortication, pulmonary, total (32220)	No
Pleural Space and Lung	2430 = Decortication, pulmonary, partial (32225)	No
Pleural Space and Lung	2440 = Pleurectomy, parietal (32310)	No
Pleural Space and Lung	2450 = Decortication and parietal pleurectomy (32320)	No
Pleural Space and Lung	2460 = Thoracotomy, with biopsy of pleura 32095X2	No
Pleural Space and Lung	2470 = Removal of lung, total pneumonectomy; (32440)	No
Pleural Space and Lung	2480 = Removal of lung, sleeve (carinal) pneumonectomy (32442)	No
Pleural Space and Lung	2490 = Removal of lung, total pneumonectomy; extrapleural (32445)	No
Pleural Space and Lung	2500 = Removal of lung, single lobe (lobectomy) (32480)	No
Pleural Space and Lung	2510 = Removal of lung, two lobes (bilobectomy) (32482)	No
Pleural Space and Lung	2520 = Removal of lung, single segment (segmentectomy) (32484)	No
Pleural Space and Lung	2530 = Removal of lung, sleeve lobectomy (32486)	No
Pleural Space and Lung	2540 = Removal of lung, completion pneumonectomy (32488)	No
Pleural Space and Lung	2550 = Removal of lung, excision-plication of emphysematous lung(s) for lung volume reduction (LVRS) (32491)	No
Pleural Space and Lung	2570 = Resection and repair of portion of bronchus (bronchoplasty) when performed at time of lobectomy or segmentectomy (32501)	No
Pleural Space and Lung	2580 = Resection of apical lung tumor (e.g., Pancoast tumor), including chest wall resection, without chest wall reconstruction(s) (32503)	No
Pleural Space and Lung	2590 = Resection of apical lung tumor (e.g., Pancoast tumor), including chest wall resection, with chest wall reconstruction (32504)	No
Lung Other	2840 = Repair lung hernia through chest wall (32800)	Yes
Lung Other	2850 = Closure of chest wall following open flap drainage for empyema (Clagett type procedure) (32810)	Yes
Lung Other	2890 = Total lung lavage (for alveolar proteinosis) (32997)	Yes
Lung Other	2900 = Radio-frequency ablation (RFA) lung tumor (32998)	Yes
Lung Other	2950 = Unlisted procedure, lung (32999)	Yes
Lung Other	2860 = Open closure of major bronchial fistula (32815)	No
Lung Other	2870 = Major reconstruction, chest wall (posttraumatic) (32820)	No
Lung Other	2880 = Thoracoplasty with closure of bronchopleural fistula (32906)	No
Lung Other	2910 = Single lung transplant (32851)	No
Lung Other	2920 = Single lung transplant with CPB (32852)	No
Lung Other	2930 = Double lung transplant (32853)	No

Lung Other	2940 = Double lung transplant with CPB (32854)	No
Mediastinum and Diaphragm	2660 = Thoracoscopy, diagnostic; mediastinal space, with biopsy (32606)	Yes
Mediastinum and Diaphragm	3180 = Mediastinotomy with exploration or biopsy; cervical approach (39000)	Yes
Mediastinum and Diaphragm	3190 = Mediastinotomy with exploration or biopsy; transthoracic approach (39010)	Yes
Mediastinum and Diaphragm	3220 = Mediastinoscopy, with or without biopsy (39400)	Yes
Mediastinum and Diaphragm	3230 = Unlisted procedure, mediastinum (39499)	Yes
Mediastinum and Diaphragm	3310 = Unlisted procedure, diaphragm (39599)	Yes
Mediastinum and Diaphragm	2790 = Thoracoscopy, surgical; with excision of mediastinal cyst, tumor, or mass (32662)	No
Mediastinum and Diaphragm	4170 = Thoracoscopy with mediastinal and regional lymphadectomy (+3266X6) List separately in addition to primary proc code	No
Mediastinum and Diaphragm	3170 = Thoracic lymphadenectomy, regional, including mediastinal and peritracheal nodes (38746)	No
Mediastinum and Diaphragm	3200 = Excision of mediastinal cyst, open, Transthoracic approach (39200)	No
Mediastinum and Diaphragm	3210 = Excision of mediastinal tumor(open, Transthoracic approach) (39220)	No
Mediastinum and Diaphragm	4180 = Thoracoscopy with resection of thymus, unilateral or bilateral (3266X8)	No
Mediastinum and Diaphragm	3840 = Thymectomy, transcervical approach (60520)	No
Mediastinum and Diaphragm	3850 = Thymectomy, transthoracic approach (60521)	No
Mediastinum and Diaphragm	3860 = Thymectomy, transthoracic approach, with radical mediastinal dissection (60522)	No
Mediastinum and Diaphragm	3240 = Repair, laceration of diaphragm, any approach (39501)	No
Mediastinum and Diaphragm	3260 = Repair, diaphragmatic hernia (other than neonatal), traumatic; acute (39540)	No
Mediastinum and Diaphragm	3270 = Repair, diaphragmatic hernia (other than neonatal), traumatic; chronic (39541)	No
Mediastinum and Diaphragm	3280 = Imbrication (i.e., plication) of diaphragm (39545)	No
Mediastinum and Diaphragm	3290 = Resection, diaphragm; with simple repair (e.g., primary suture) (39560)	No
Mediastinum and Diaphragm	3300 = Resection, diaphragm; with complex repair (e.g., prosthetic material, local muscle flap) (39561)	No
Esophagoscopy	3640 = Esophagoscopy (43200)	Yes
Esophagoscopy	3650 = Esophagoscopy with biopsy (43202)	Yes
Esophagoscopy	3660 = Esophagoscopy with removal of foreign body (43215)	Yes
Esophagoscopy	3670 = Esophagoscopy with insertion of stent (43219)	Yes
Esophagoscopy	3680 = Esophagoscopy with balloon dilation (43220)	Yes
Esophagoscopy	3690 = Esophagoscopy with insertion of guide wire followed by dilation over guide	Yes

	wire (43226)	
Esophagoscopy	3700 = Esophagoscopy with ablation of tumor (43228)	Yes
Esophagoscopy	3710 = Esophagoscopy with endoscopic ultrasound examination (EUS) (43231)	Yes
Esophagoscopy	3720 = Esophagoscopy with transendoscopic ultrasound-guided fine needle aspiration (43232)	Yes
Esophagoscopy	3730 = Upper gastrointestinal endoscopy, diagnostic (43235)	Yes
Esophagoscopy	3740 = Upper gastrointestinal endoscopy with endoscopic ultrasound examination limited to the esophagus (43237)	Yes
Esophagoscopy	3750 = Upper gastrointestinal endoscopy with transendoscopic ultrasound-guided FNA (43238)	Yes
Esophagoscopy	3760 = Upper gastrointestinal endoscopy with biopsy (43239)	Yes
Esophagoscopy	3770 = Upper gastrointestinal endoscopy with dilation of gastric outlet for obstruction (43245)	Yes
Esophagoscopy	3780 = Upper gastrointestinal endoscopy with directed placement of percutaneous gastrostomy tube (43246)	Yes
Esophagoscopy	3790 = Upper gastrointestinal endoscopy with removal of foreign body (43247)	Yes
Esophagoscopy	3800 = Upper gastrointestinal endoscopy with insertion of guide wire followed by dilation of esophagus (43248)	Yes
Esophagoscopy	3810 = Upper gastrointestinal endoscopy with balloon dilation of esophagus (43249)	Yes
Esophagoscopy	3820 = Upper gastrointestinal endoscopy with transendoscopic stent placement (43256)	Yes
Esophagoscopy	3830 = Upper gastrointestinal endoscopy with ablation of tumor (43258)	Yes
Esophagus Resection	3320 = Transhiatal-Total esophagectomy, without thoracotomy, with cervical esophagogastrostomy (43107)	No
Esophagus Resection	3330 = Three hole-Total esophagectomy with thoracotomy; with cervical esophagogastrostomy (43112)	No
Esophagus Resection	3340 = Ivor Lewis-Partial esophagectomy, distal two-thirds, with thoracotomy and separate abdominal incision (43117)	No
Esophagus Resection	3350 = Thoracoabdominal-Partial esophagectomy, thoracoabdominal approach (43122)	No
Esophagus Resection	4190 = Minimally invasive three hole esophagectomy (43XXX)	No
Esophagus Resection	3360 = Minimally invasive esophagectomy, Ivor Lewis approach (43XXX)	No
Esophagus Resection	3370 = Minimally invasive esophagectomy, Abdominal and neck approach (43XXX)	No
Esophagus Resection	3380 = Total esophagectomy without thoracotomy; with colon interposition or small intestine reconstruction (43108)	No
Esophagus Resection	3390 = Total esophagectomy with thoracotomy; with colon interposition or small intestine reconstruction (43113)	No
Esophagus Resection	3400 = Partial esophagectomy, cervical, with free intestinal graft, including microvascular anastomosis (43116)	No
Esophagus Resection	3410 = Partial esophagectomy, with thoracotomy and separate abdominal incision with colon interposition or small intestine (43118)	No
Esophagus Resection	3420 = Partial esophagectomy, distal two-thirds, with thoracotomy only (43121)	No
Esophagus Resection	3430 = Partial esophagectomy, thoracoabdominal with colon interposition or small intestine (43123)	No
Esophagus Resection	3440 = Total or partial esophagectomy, without reconstruction with cervical esophagostomy (43124)	No
Esophagus Other Procedures	3450 = Cricopharyngeal myotomy (43030)	Yes

Esohpagus Other Procedures	3460 = Diverticulectomy of hypopharynx or esophagus, with or without myotomy; cervical approach (43130)	Yes
Esohpagus Other Procedures	3530 = Esophagostomy, fistulization of esophagus, external; cervical approach (43352)	Yes
Esohpagus Other Procedures	3590 = Closure of esophagostomy or fistula; cervical approach (43420)	Yes
Esohpagus Other Procedures	4200 = Excision esophageal lesion with primary repair, cervical approach (43100)	Yes
Esohpagus Other Procedures	4210 = Unlisted laparoscopy, esophagus (43289)	Yes
Esohpagus Other Procedures	3630 = Unlisted procedure, esophagus (43499)	Yes
Esohpagus Other Procedures	4220 = Laparoscopy, surgical with repair of paraesophageal hernia (fundoplasty) without mesh (43281)	No
Esohpagus Other Procedures	4230 = Laparoscopy, surgical with repair of paraesophageal hernia (fundoplasty) with mesh (43282)	No
Esohpagus Other Procedures	4240 = Laparoscopy, surgical, esophageal lengthening procedure (Collis) (43283) Secondary Procedure code	No
Esohpagus Other Procedures	3480 = Laparoscopy, surgical, esophagogastric fundoplasty (e.g., Nissen, Toupet procedures) (43280)	No
Esohpagus Other Procedures	3490 = Laparoscopic esophageal myotomy (Heller Myotomy, with or without fundoplication) (43279)	No
Esohpagus Other Procedures	2820 = Thoracoscopy, surgical; with esophagomyotomy (Heller type) (32665)	No
Esohpagus Other Procedures	4250 = Nissen fundoplasty- laparotomy (includes partial fundoplication/wrap) (43327)	No
Esohpagus Other Procedures	4260 = Transthoracic Fundoplication- open thoracotomy (includes Belsey/Nissen) (43328)	No
Esohpagus Other Procedures	4270 = Repair, paraesophageal hiatal hernia via laparotomy without mesh (43332)	No
Esohpagus Other Procedures	4280 = Repair, paraesophageal hiatal hernia via laparotomy with mesh (43333)	No
Esohpagus Other Procedures	4290 = Repair, paraesophageal hiatal hernia via thoracotomy without mesh (43334)	No
Esohpagus Other Procedures	4300 = Repair, paraesophageal hiatal hernia via thoracotomy with mesh (43335)	No
Esohpagus Other Procedures	4310 = Repair, paraesophageal hiatal hernia via thoracoabdominal approach without mesh (43336)	No
Esohpagus Other Procedures	4320 = Repair, paraesophageal hiatal hernia via thoracoabdominal approach with mesh (43337)	No
Esohpagus Other Procedures	4330 = Esophageal lengthening procedure - open (Collis) Secondary Procedure code (43338)	No
Esohpagus Other Procedures	3470 = Diverticulectomy of esophagus, with or without myotomy; thoracic approach (43135)	No
Esohpagus Other Procedures	4340 = Excision Esophageal lesion with primary repair, thoracic approach (eg: leiomyoma) (43101)	No
Esohpagus Other Procedures	4350 = Esophagoplasty with repair of TEF, cervical approach (43305)	No
Esohpagus Other Procedures	4360 = Esophagoplasty with repair TEF, thoracic approach (43312)	No

Esohpagus Other Procedures	4370 = Esophagomyotomy (Heller type); thoracic approach (43331)	No
Esohpagus Other Procedures	3540 = Gastrointestinal reconstruction for previous esophagectomy with stomach (43360)	No
Esohpagus Other Procedures	3550 = Gastrointestinal reconstruction for previous esophagectomy with colon interposition or small intestine (43361)	No
Esohpagus Other Procedures	3560 = Ligation or stapling at gastroesophageal junction for esophageal perforation (43405)	No
Esohpagus Other Procedures	3570 = Suture of esophageal wound or injury; cervical approach (43410)	No
Esohpagus Other Procedures	3580 = Suture of esophageal wound or injury; transthoracic or transabdominal approach (43415)	No
Esohpagus Other Procedures	3600 = Free jejunum transfer with microvascular anastomosis (43496)	No
Esohpagus Other Procedures	3610 = Total gastrectomy with esophagoenterostomy (43620)	No
Esohpagus Other Procedures	3620 = Total gastrectomy with Roux-en-Y reconstruction (43621)	No
Chest Wall and Neck	2040 = Excision tumor, soft tissue of neck or thorax; subcutaneous (21555)	Yes
Chest Wall and Neck	2050 = Excision tumor, soft tissue of neck or thorax; deep, subfascial, intramuscular (21556)	Yes
Chest Wall and Neck	2070 = Excision of rib, partial (21600)	Yes
Chest Wall and Neck	2080 = Excision first and/or cervical rib (21615)	Yes
Chest Wall and Neck	2090 = Excision first and/or cervical rib; with sympathectomy (21616)	Yes
Chest Wall and Neck	2130 = Division of scalenus anticus; without resection of cervical rib (21700)	Yes
Chest Wall and Neck	2140 = Division of scalenus anticus; with resection of cervical rib (21705)	Yes
Chest Wall and Neck	2180 = Open treatment of sternum fracture with or without skeletal fixation (21825)	Yes
Chest Wall and Neck	2120 = Hyoid myotomy and suspension (21685) secondary procedure code	Yes
Chest Wall and Neck	2190 = Unlisted procedure, neck or thorax (21899)	Yes
Chest Wall and Neck	2000 = Muscle flap, neck (15732)	No
Chest Wall and Neck	2010 = Muscle flap; trunk (i.e., intercostal, pectoralis or serratus muscle) (15734)	No
Chest Wall and Neck	2020 = Excision of chest wall tumor including ribs (19260)	No
Chest Wall and Neck	2030 = Excision of chest wall tumor involving ribs, with reconstruction (19271)	No
Chest Wall and Neck	2060 = Radical resection of tumor (e.g., malignant neoplasm), soft tissue of neck or thorax (21557)	No
Chest Wall and Neck	2100 = Radical resection of sternum (21630)	No
Chest Wall and Neck	2110 = Radical resection of sternum; with mediastinal lymphadenectomy (21632)	No
Chest Wall and Neck	2150 = Reconstructive repair of pectus excavatum or carinatum; open (21740)	No
Chest Wall and Neck	2160 = Reconstructive repair of pectus, minimally invasive approach (Nuss procedure), without thoracoscopy (21742)	No
Chest Wall and Neck	2170 = Reconstructive repair of pectus, minimally invasive approach (Nuss procedure), with thoracoscopy (21743)	No
Miscellaneous	2640 = Thoracoscopy, diagnostic pericardial sac, with biopsy (32604)	Yes
Miscellaneous	2750 = Thoracoscopy, surgical; with removal of clot or foreign body from pericardial sac (32658)	Yes
Miscellaneous	2760 = Thoracoscopy, surgical; with creation of pericardial window or partial resection of pericardial sac for drainage (32659)	Yes
Miscellaneous	2810 = Thoracoscopy, surgical; with thoracic sympathectomy (32664)	Yes

Miscellaneous	3940 = Tube pericardiostomy (33015)	Yes
Miscellaneous	3950 = Pericardial window (33025)	Yes
Miscellaneous	3930 = Removal substernal thyroid, cervical approach (60271)	Yes
Miscellaneous	4380 = Application of wound vac (XXXX)	Yes
Miscellaneous	4390 = Stereotactic radiosurgery (SRS) and stereotactic body radiotherapy (SBRT),surgeon participation (XXXX)	Yes
Miscellaneous	4400 = Other Minor Procedure (XXXX)	Yes
Miscellaneous	2770 = Thoracoscopy, surgical; with total pericardiectomy (32660)	No
Miscellaneous	2780 = Thoracoscopy, surgical; with excision of pericardial cyst, tumor, or mass (32661)	No
Miscellaneous	3890 = Ligation thoracic duct (38381)	No
Miscellaneous	3900 = Intraoperative jejunostomy (44015)	No
Miscellaneous	3910 = Omental flap (49904)	No
Miscellaneous	3920 = Transthoracic thyroidectomy (60270)	No
Miscellaneous	3960 = SVC resection and reconstruction (34502)	No
Miscellaneous	3970 = Other (XXXX)	No