

NPCR's TNM Stage Calculator

A Tool for Central Registry Quality Control and Consolidation Assistance

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Acknowledgments

- Peter Kim, Northrop Grumman under contract to NPCR, Developer

Purposes of CDC's TNM Coding Software (1)

❑ Coding Assistance

Provide data and tools in the form of a DLL to be used by NPCR registries to generate site-specific **pick-lists** for the direct entry of clinical and path T, N, and M components and stage groups

❑ Stage Group Derivation

Provide an **algorithm for deriving clinical and path stage groups** from directly entered T, N, and M components (and other items as needed) to be used in the central registry

- For quality control
- For re-deriving stage groups based on consolidated TNM
- For submitting derived values to NPCR

Purposes of CDC's TNM Coding Software (2)

- ❑ NOT for replacing directly-coded stage group as entered by registrar



Features of CDC's TNM Software (1)

- ❑ CS SSFs needed for TNM are included in the TNM DLL
- ❑ Schema discriminators are referenced when needed
 - Example: C24.0 (Extrahepatic bile duct) can be staged from 3 chapters of AJCC 7th ed. depending on tumor location coded in SSF25

Code	Description	Schema
010	Perihilar bile duct(s) Proximal extrahepatic bile duct(s) Hepatic duct(s)	BileDuctsPerihilar
020	Stated as Klatskin tumor	BileDuctsPerihilar
030	Cystic bile duct; cystic duct	CysticDuct
040	Distal bile duct Common bile duct Common duct, NOS	BileDuctsDistal
050	Diffuse involvement More than one subsite involved, subsite of origin not stated	BileDuctsPerihilar

Features of CDC's TNM Software (2)

- ❑ Includes data items other than T, N, and M when needed for calculating stage group
 - Example: SSFs for PSA and Gleason score for Prostate stage group
- ❑ **“Business rules” are incorporated in derivation logic**
 - Example: pM1 is always Stage IV even if pT and pN are blank
- ❑ **AJCC is licensing CDC's use** of their manual contents for specific uses and limited distribution.

We cannot release copyrighted contents, i.e., pick lists, except to NPCR states using Registry Plus or their own internally developed software.

Features of Pick List Tables

- ❑ All tables display attribution in Note 1
- ❑ Categories and their descriptions are taken directly from AJCC manual, reformatted
- ❑ Additional notes are usually taken directly from AJCC manual or other official communication
- ❑ Any added words or codes are in square brackets

Sample Pick List Table

Notes from
AJCC manual
or CANSWER
Forum

Colon and Rectum TNM7 : Clinical M

Notes

Note 1: Source: Used with permission of the American Joint Committee on Cancer (AJCC), Chicago, Illinois. The original and primary source for this information is the AJCC Cancer Staging Manual, Seventh Edition (2010) published by Springer Science +Business Media, LCC. Use does not imply any endorsement of any particular organization, product, or service by the Centers for Disease [Control] and Prevention (CDC), Health and Human Services (HHS).

Content has been reformatted for online viewing. Words and codes added for clarity or to meet cancer registry data collection needs are enclosed in square brackets.

Note 2: For patients with rectal cancer, the pelvic extent of disease (TN categories) combined with the absence of extrapelvic metastasis (M) determines whether or not preoperative adjuvant treatment is appropriate. The primary imaging modalities to assess the preoperative pelvic extent of disease are endoscopic ultrasound (EUS), pelvic CT, and pelvic MRI alone or with endorectal coil.

AJCC Category	Code	Description
cM0	c0	[Clinical] No distant metastasis
cM1	c1	[Clinical] Distant metastasis
pM1	p1	[Pathologic] Distant metastasis
cM1a	c1A	[Clinical] Metastasis confined to one organ or site (e.g., liver, lung, ovary, nonregional node)
pM1a	p1A	[Pathologic] Metastasis confined to one organ or site (e.g., liver, lung, ovary, nonregional node)
cM1b	c1B	[Clinical] Metastases in more than one organ/site or the peritoneum
pM1b	p1B	[Pathologic] Metastases in more than one organ/site or the peritoneum

AJCC
category

Code stored in
cancer registry

Category description
from AJCC manual

Example of Reformatting and Added Words

From AJCC Manual, Lung, p. 263

T2 Tumor more than 3 cm but 7 cm or less or tumor with any of the following features (T2 tumors with these features are classified T2a if 5 cm or less); Involves main bronchus, 2 cm or more distal to the carina; Invades visceral pleura (PL1 or PL2); Associated with atelectasis or obstructive pneumonitis that extends to the hilar region but does not involve the entire lung

T2a Tumor more than 3 cm but 5 cm or less in greatest dimension

T2b Tumor more than 5 cm but 7 cm or less in greatest dimension

Lengthy description of T2 for Lung using continuous text with semicolons

Reformatted as bullet list to make conditions easier to find

Words added to make the implied condition explicit

Reformatted for Pick List

cT2	c2	Tumor more than 3 cm but 7 cm or less or tumor with any of the following features (T2 tumors with these features are classified T2a if 5 cm or less) - Involves main bronchus, 2 cm or more distal to the carina - Invades visceral pleura (PL1 or PL2) - Associated with atelectasis or obstructive pneumonitis that extends to the hilar region but does not involve the entire lung
cT2a	c2A	[Meets criteria for T2 and] Tumor more than 3 cm but 5 cm or less in greatest dimension
cT2b	c2B	[Meets criteria for T2 and] Tumor more than 5 cm but 7 cm or less in greatest dimension

Underlying DLL

- ❑ Library of functions and an Applications Program Interface (API) to allow the TNM software to be embedded in other software products
- ❑ CDC's licensing agreement with AJCC specifies the conditions under which the DLL can be released.

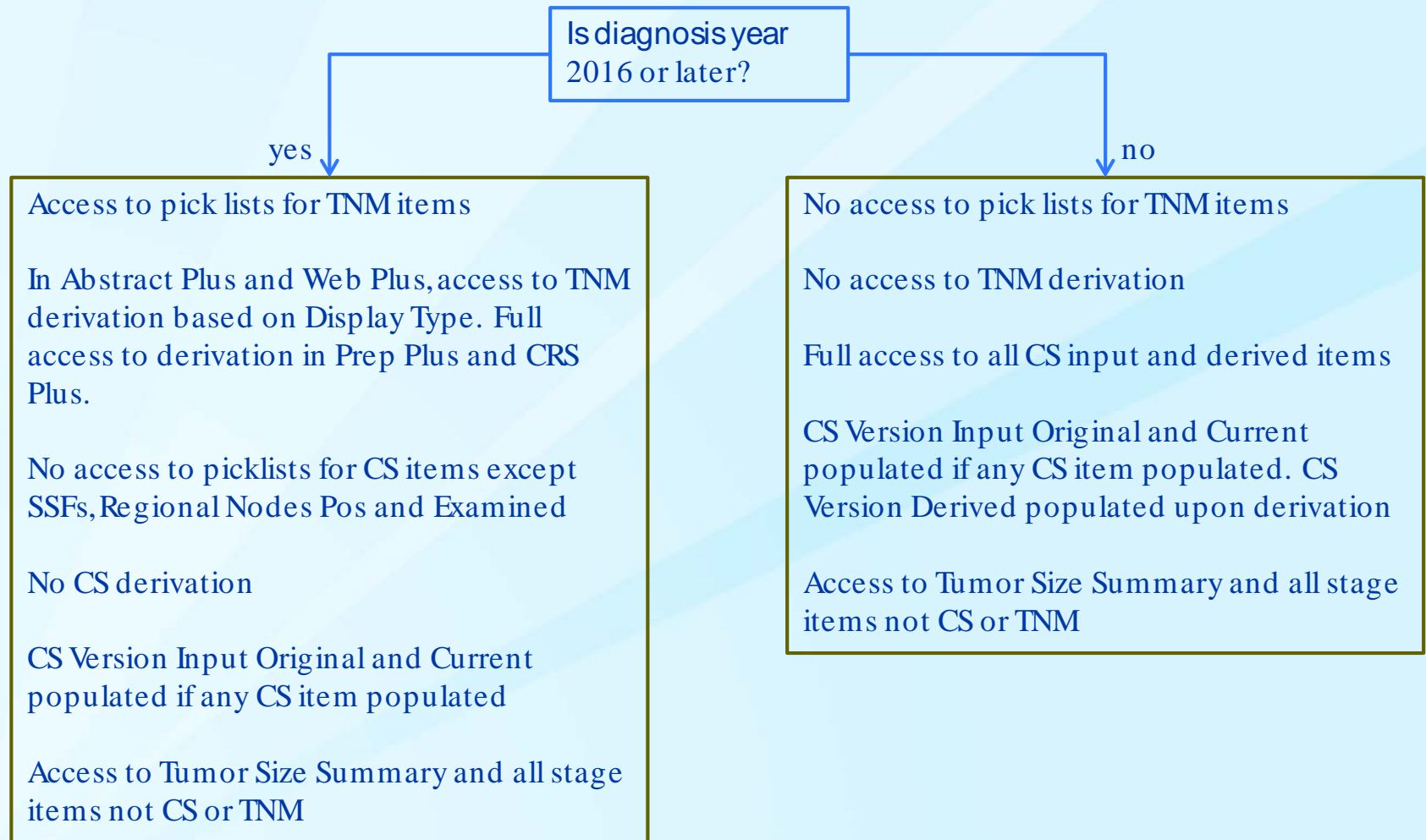


CDC/NPCR TNM Application Program Interface (API) (1)

- The API will be included in all Registry Plus software that require TNM staging
 - Abstract Plus
 - Web Plus
 - Prep Plus
 - CRS Plus

Coding Stage Data in 2016 in Registry Plus

Registry Plus products will contain both the CS and TNM DLLs, the use of which will depend on diagnosis year.



CDC/NPCR TNM Application Program Interface (API) (2)

- ❑ All CDC/NPCR grantees with homegrown software can request the API and technical documentation to use in their software
- ❑ CDC/NPCR grantees that use vendor-based software can only use a version of the API that has the copyrighted material disabled
 - Will only include TNM codes (for picklists) and the clinical and pathologic stage group data items function calls
- ❑ Commercial software vendors for central registries and hospitals should contact AJCC (Martin Madera, mmadera@facs.org) to discuss using copyright-protected AJCC content in their application

CDC/NPCR TNM Application Program Interface (API) (3)

- All NPCR grantees will be required to use the API to derive and submit the new NPCR calculated clinical and pathologic stage group data items on 2016 and later cases.
 - CDC/NPCR will develop a utility to populate these fields before data submission
- Additional details about CDC/NPCR Reporting Requirements can be found in section 6.2 of NAACCR Implementation Guidelines and Recommendations
 - <http://www.naacr.org/standardsandregistryoperations/implementationguidelines.aspx>

Features of Derivation Algorithm

- ❑ Points to a single stage group for a given combination of site-specific valid T, N, and M codes (and other required items)
- ❑ Collaborative Stage derivation tables were imported into Excel and modified to be aligned with AJCC manual
- ❑ One row per combination of T, N, and M (plus other items when needed)

Example of Stage Table from AJCC Manual

- From “Perihilar Bile Ducts,” chapter 21

ANATOMIC STAGE/PROGNOSTIC GROUPS			
Stage 0	Tis	N0	M0
Stage I	T1	N0	M0
Stage II	T2a-b	N0	M0
Stage IIIA	T3	N0	M0
Stage IIIB	T1-3	N1	M0
Stage IVA	T4	N0-1	M0
Stage IVB	Any T	N2	M0
	Any T	Any N	M1

Sample Rows from Stage Derivation Table for Perihilar Bile Ducts

T	N	M	Stage Code
T0	N0	M0	ERROR
T0	N0	M1	4B
T1	N1	M0	3B
T2a	N0	M0	2
T2b	N0	M0	2
T4	N0	M0	4A
T4	N1	M0	4A
TX	N1	M0	99
TX	N2	M0	4B
TX	NX	M1	4B

T2a and T2b are on separate rows. Category T2 (without a or b) is NOT defined by AJCC.

Error Messages from DLL that Need Special Processing

- ❑ **Combinations not in table return error code. Calling program must assign code 99, Unknown.**
- ❑ **Site/histology combinations that are not staged by AJCC return informational error message. Calling program must assign code 88, Not applicable.**

Using CDC's TNM DLL for QC NAACCR v16 Edits Metafile (1)

- ❑ **Stage tables from CDC's DLL were used to create the edits:**
 - Primary Site, TNM Clin Stage Valid A- Ed 7 (CoC)
 - Primary Site, TNM Clin Stage Valid B- Ed 7 (CoC)
 - Primary Site, TNM Path Stage Valid A- Ed 7 (CoC)
 - Primary Site, TNM Path Stage Valid B- Ed 7 (CoC)
- ❑ **Divided into A and B because the edits are very big. Stage group lookup table has 15K rows!**
- ❑ **Edits are site-specific with separate clin and path checks**
- ❑ **When T, N, and M are valid codes, check that the directly-coded corresponding stage group is the expected value**

Using CDC's TNM DLL for QC NAACCR v16 Edits Metafile (2)

□ Example:

Path TNM for a Breast cancer is **pT2 pN1a cM0**

c's and p's are irrelevant for stage derivation so row from breast table in CDC's DLL looks like this:

T2	N1a	M0	2B
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Row from Edits table, where all sites are in the same table, looks like this:

14635	032	2	1A	0		2B
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This shows row 14635 for site group/chapter 32, for the specific TNM values.

Directly entered TNM Path Stage Group Stage **IIB (coded 2B)** will pass the edit, any other stage group will fail.

Using CDC's TNM DLL for QC NAACCR v16 Edits Metafile (3)

Before you say, “But WAIT”

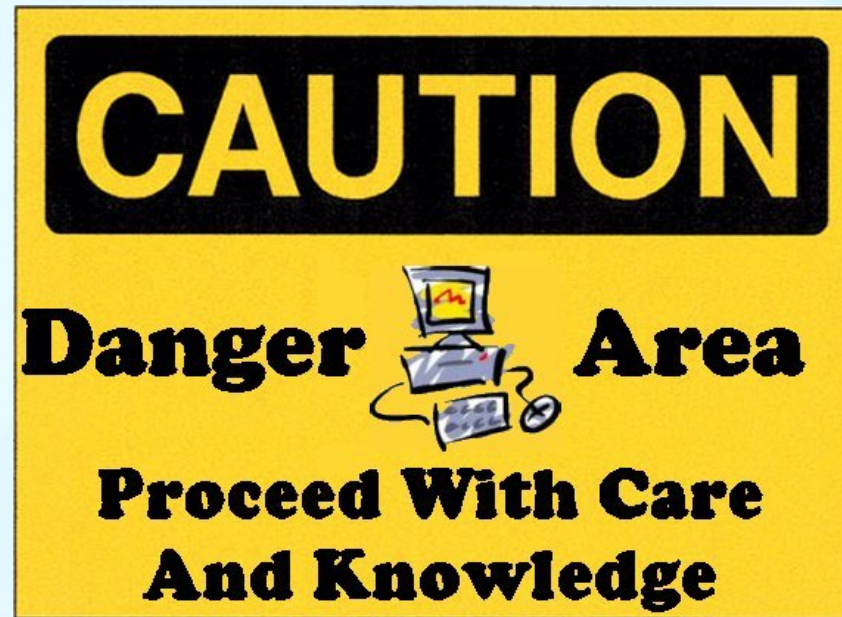
□ Edit is skipped if

- T, N, M, or stage group is blank
- Diagnosis date is before 2016 or blank or unknown
- Behavior is 0 or 1
- TNM Path Descriptor is 4 or 6 (yP staging)

Using CDC's TNM DLL for QC Using in Local Software (1)

- ❑ In contexts where the standard edits are not applied, NPCR grantees can use DLL to validate stage group, e.g.:
 - Other points in work flow
 - Pre-2016 cases
 - Special studies
- ❑ DLL for derivation can be used for all diagnosis years where TNM was entered, as long as data are converted to v16 standards with c's and p's. However there may be differences in rules used for missing data or other situations.

Using CDC's TNM DLL for QC Using in Local Software (2)



- ❑ There can be valid reasons why derived and directly entered stage groups do not match!

Using CDC's TNM DLL for Consolidation

- If your registry is consolidating each clinical and pathologic T, N, and M separately, you can use the DLL to derive a consolidated stage group.
- Example, colon cancer case:
 - Hosp. A submits clinical **T1 (c1)** **NX (cX)** **M0 (c0)**
 - Hosp. B submits clinical **T2 (c2)** **cN0 (c0)** **cM0 (c0)**
 - Derived values are determined to be **c2 c0 c0**
 - Derived clinical stage group from DLL

T2	N0	M0	1
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Stage I (code 1)

- **CRS Plus will be deriving the consolidated stage groups post-consolidation of the T, N, and M**

How to use the DLL

- ❑ Obtain copy of DLL and API Documentation from Joe Rogers at CDC
- ❑ Integrate DLL into your software such that you can
 - populate datacard values
 - make function calls
 - process returned values and error messages
 - store results

Function Calls Needed for Derivation (1)

□ GetSchemaNumber

Call this function first to get the number of the schema (site/type group) related to a chapter in the TNM manual.

NOTE: Schema numbers in DLL are NOT the same as group numbers assigned in the Editsmetafile. Schema numbers were assigned in the order of entry into the system. Editsmetafile group numbers were based on chapter numbers in the AJCC manual.

Pass primary site and histology codes to the function along with any needed schema discriminator, usually CS Site-Specific Factor 25

Function Calls Needed for Derivation (2)

□ GetRequiredDataElements

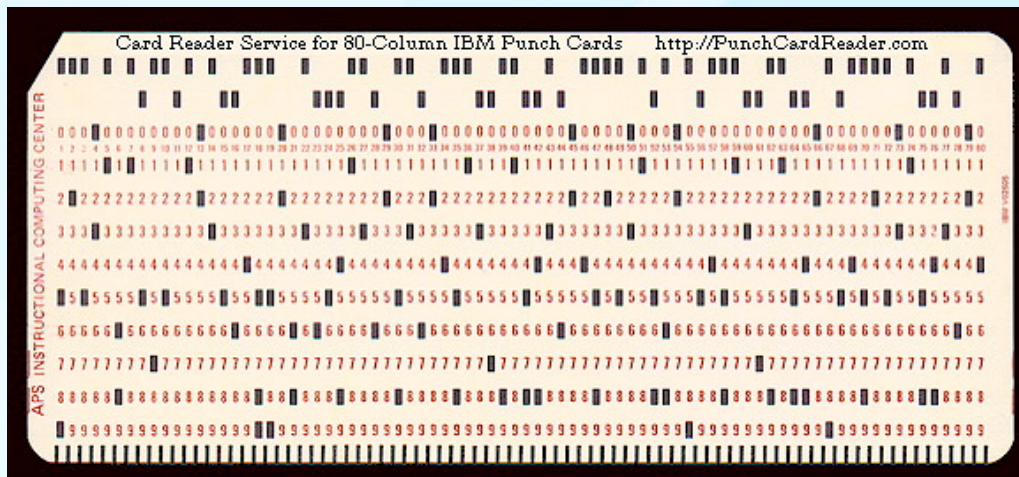
Using the SchemaNumber returned from the previous function, call this function to retrieve a list of the data items needed to derive stage for this schema.

Function will return a list of data elements required **IN ADDITION TO** schema number and the TNM values to derive stage group



Populate the Datacard

- Populate the defined data structure (datacard) with
 - Primary site and histologic type
 - Clinical and path T,N, and M values
 - Values for additional items identified by the previous function



If you recognize this, it's time for you to retire.

Function Calls Needed for Derivation (3)

❑ CalculateStage

Pass the populated datacard to this function to retrieve the stage groups.

If stage group cannot be derived for some reason, an error message will be returned.



Examples of Derivation Error Messages

❑ STAGE_GROUP_NOT_DEFINED

The schema is defined and T/N/M values can be supplied, but stage group is not calculated. Not an error. Message is informational. Example: carcinoma of the conjunctiva

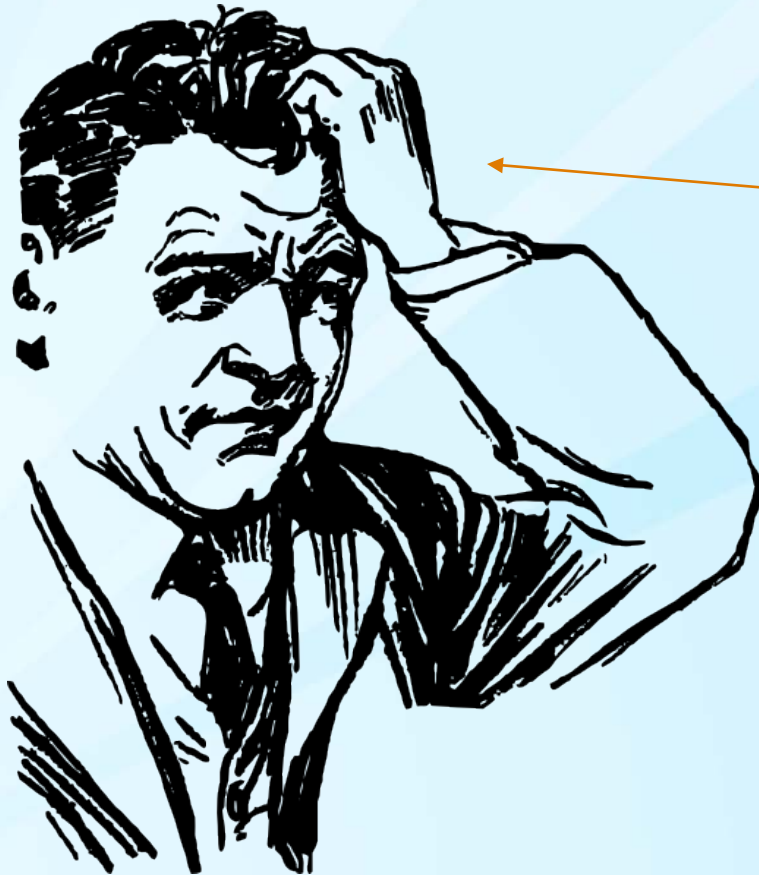
❑ STAGE_GROUP_IS_ERROR

Combination of TNM is logically or medically not possible. Example: T0 N0 M0



NPCR Stage Transition Questions?

- Email them to cancerstaging@cdc.gov



Confused person
scratching head

For more information contact:
Joseph D. Rogers
JRogers@cdc.gov

For more information please contact Centers for Disease Control and Prevention

1600 Clifton Road NE, Atlanta, GA 30333
Telephone, 1-800-CDC-INFO (232-4636)/TTY: 1-888-232-6348
E-mail: cdcinfo@cdc.gov Web: www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.



Example—Thyroid Cancer (1)

- 4 different stage groupings based on histology, grade, and age
 - Papillary or follicular carcinoma, differentiated
 - Under 45 years at diagnosis (#1)
 - 45 years and older (#2)
 - Medullary carcinoma, all ages (#3)
 - Anaplastic carcinoma (#4)
- Sample values for deriving stage group for Thyroid
 - Schema number **9**, **C739, 8340** (pap. follic. variant)
 - Path **pT2 pN1a cM0**
 - PLUSgrade **2**, age **50**

Example—Thyroid Cancer (2)

- Sample values for deriving stage group for Thyroid
 - Schema number **9**, **C739,8340** (pap.follic.variant)
 - Clinical **cT3 cN0 cM0**, path **pT2 pN1a cM0**
 - PLUSgrade **2**, age **50**
- Derivation function uses histology, grade, and age to select the correct stage group table, “Papillary or Follicular Carcinoma Age 45 and Older” and the TNM values to select this row, **Stage III (code 3)**

T2	N1a	M0	3
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- If this patient were age **44**, stage group would be **Stage I (code 1)**.
- If Anaplastic, would be **Stage IV (code 4)** regardless of age.