

Microscopic sections show a moderately differentiated squamous cell carcinoma with cystic change. The tumour extends to the visceral pleura but unequivocal pleural invasion is not seen in the routinely stained sections. An elastic stain has been requested for further evaluation of the pleura and a supplementary report will be issued with the result. Lymphatic invasion is not identified and blood vessel invasion is not seen. The bronchial resection margin shows squamous metaplasia but no evidence of in situ or invasive carcinoma. The vascular resection margin is negative for carcinoma. Non-neoplastic lung tissue shows centrilobular emphysema and smoker's-type macrophages. A section from the tip of the lobe confirms the presence of honeycomb change and shows associated bronchiolar metaplasia. Intrapleural thoracic dust macules are seen with associated emphysema. Additional sections of non-neoplastic lung tissue will be examined for further evaluation.

5. Microscopy shows profiles of lymph node tissue. Metastatic carcinoma is not identified.

SUMMARY

Left lower lobe, lung (lobectomy) with lymph node sampling

1. Moderately differentiated squamous cell carcinoma
2. Maximum tumour diameter: 45 mm.
3. An elastic stain to assess for visceral pleural invasion
4. Lymphatic invasion and blood vessel invasion are not seen
5. The resection margins are clear.
6. Lymph nodes (hilar): Negative.
7. Pathological stage: T2 N0 M0

DistantMetastasis (pM)	
AltId	G-F205
CTV3ID	
ConceptId	17076002
Descriptions	[pMX stage, pMX: Distant metastasis cannot be assessed, pMX s
FullySpecifiedName	pMX stage (finding)

▼ LungCancerCaseS

- ☐ ArterialInvasion
- ☒ DirectExtensionOfTum
- ☒ DistantMetastasis (pM)
- ☒ HistologicGrade
- ☒ HistologicType
- ☒ Laterality
- ☒ LymphaticInvasion
- ☒ Margins

A Simple Pipeline Application for Identifying and Negating SNOMED CT in Free Text

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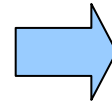
²Queensland Cancer Control Analysis Team, Queensland Health, Brisbane, Australia



Medical Free Text to SNOMED CT Mapping

Medical free text

- Non-standardised
- Individual & institutional variation
- Manual extraction of information



SNOMED CT

- Standard reference terminology¹
- Large formal ontology
- Aggregate clinical information for retrieval & analysis

¹ SNOMED CT is identified by NeHTA as the standard ontology to be used in systems within Australian Healthcare

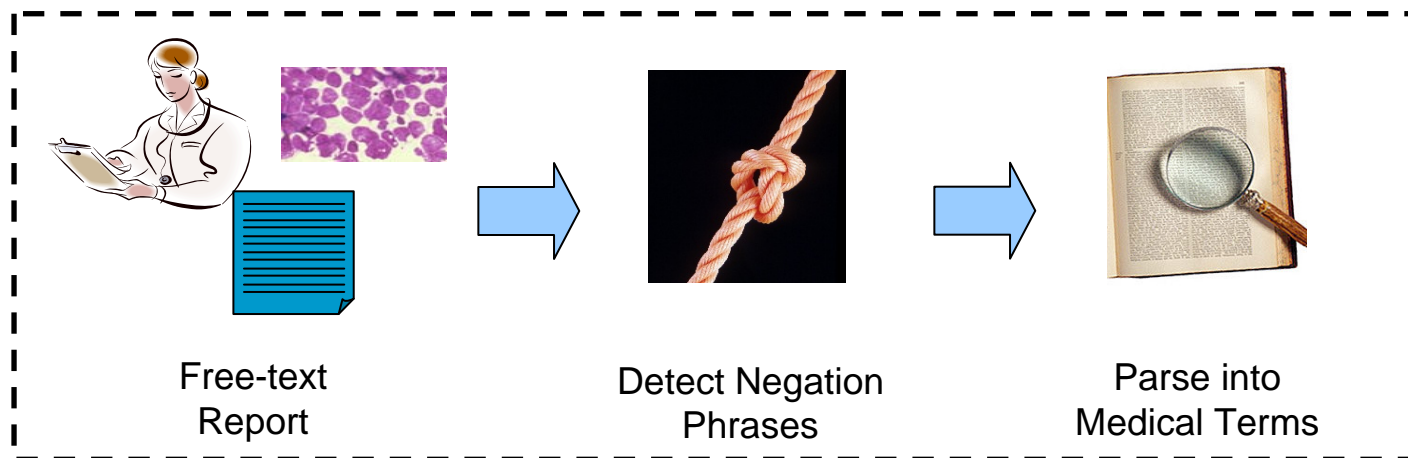


Figure 1. General methodology for coded biomedical terminology mapping from medical free text

Case Study: Cancer Notifications

- Manual review of (text based) medical records

HISTORY:
Specimen source: T10 vertebral mass. Smoker, history of progressive weakness. MRI revealed multiple spinal masses, cord compression at T10 demonstrated lung mass (at hilar). Clinical Diagnosis: Metastasis to t spine. Operative Procedure/Tissue Submitted: CT guided trucut biopsy o T10 vertebral mass. ? mets. ^

DIAGNOSIS:
1. Vertebra (T10), biopsy: Metastatic small cell carcinoma. ^
[REDACTED], M.D. and [REDACTED], M.D. ^
I, [REDACTED], M.D., the signing staff pathologist, have personally examined and interpreted the slides from this case. ^
Code: II ^
FC: 88305 ^
SNOMED CODES: M 80413 U 00120 T 10510 P 11400

Figure 2. De-identified pathology report demonstrating how cancer notifications was historically performed

- Multi-year cancer information reporting delay
- Expensive and labour intensive process
- Subject to omission errors
 - Cases inadvertently skipped / keywords missed

Goal

- Hypothesis: Automated computer system could automatically perform the time and labour intensive manual coding of clinical information
- Method: Automatically scan free-text medical documents for clinically relevant terms



Pipeline Application [Tools]

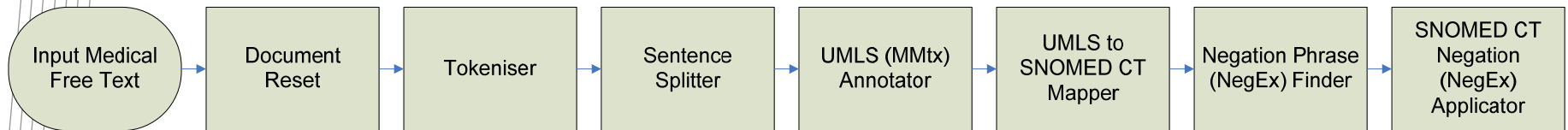
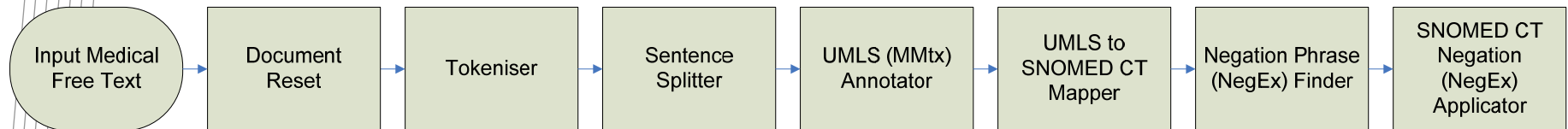


Figure 3. Pipeline application for the annotation of SNOMED CT concepts from free text

- **General Architecture for Text Engineering (GATE)**
 - Open source architecture for natural language processing (NLP)
- **MetaMap Transfer (MMTx) application**
 - Identify concepts in free text which are restricted to the SNOMED CT source
- **Negation detection algorithm (NegEx)**
 - Detection of negation phrases
- **Ontology server (OntoServer)**
 - SNOMED CT semantics to identify subsets of “findings” and “diseases” concepts for negation
- **Development corpus (AUSLAB)**
 - Lung cancer reports from state-wide pathology information system

Pipeline Application



- *Document Reset:*

- Restores the document to its original state by deleting existing annotations

- *Tokeniser:*

- Splits the document into:
 - Tokens
 - Length measurements & units
 - TNM cancer stages
 - Legacy SNOMED IDs
 - De-identified information

SUMMARY

Wedge resection of lesion in left lower lobe:

Mucinous bronchioloalveolar carcinoma, 12 mm in maximum diameter.

Pathological stage T1 Nx.

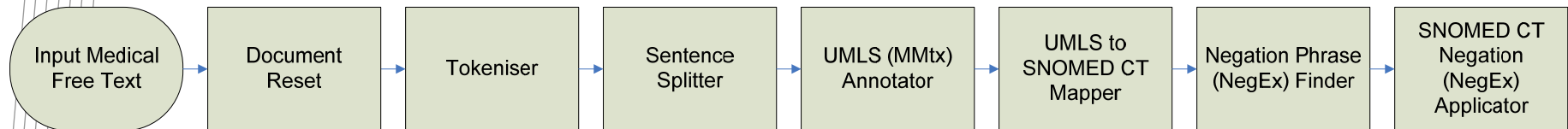
NAME _NAME_

FACILITYORPLACE

Reported _DATE_

T-28000 M-82503 P1-03000

Pipeline Application



- *Sentence Splitter:*
 - Segment text into sentences using regular expressions
- *UMLS (MMTx) Annotator:*
 - Map strings in free text to closest concepts in UMLS
 - UMLS concepts were restricted to the SNOMED CT source

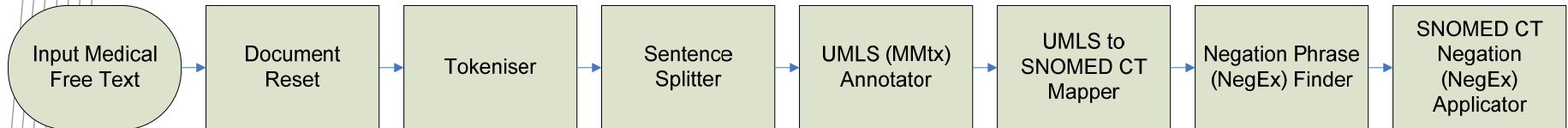
SUMMARY
Wedge resection of lesion in left lower lobe:
Mucinous bronchioloalveolar carcinoma, 12 mm in maximum diameter.
Pathologic

NAME
_FACILITY
Reported
T-28000 M
cc: Lung C

mmtx_Token			
C	CUI	C0007120	X
C	STR	Carcinoma, Bronchioloalveolar	X
C	SUI	S0022287	X
C	TUI	[T191]	X
C			X

► Open Search & Annotate tool

Pipeline Application



- *UMLS to SNOMED CT Mapper:*

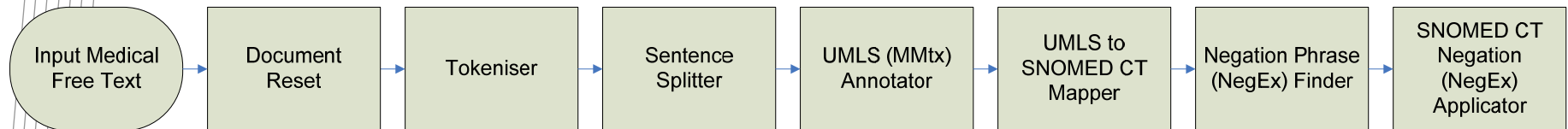
- UMLS concepts mapped to SNOMED CT using UMLS Metathesaurus database file
- Only active concepts were retained
- SNOMED ID tokens mapped to SNOMED CT concept

MICROSCOPIC
Sections show a subpleural mucinous bronchioloalveolar carcinoma. There is no evidence of pleural, lymphatic or vascular invasion. The wedge resection margin is well clear of malignancy.

SUMMARY
Wedge resection of lesion in left lower lobe:

SnomedConcept	
AltId	T-28700
CTV3ID	
ConceptId	41224006
Descriptions	[Left lower lobe of lung, Structure of left lower lobe of lung, Lower lobe of left lung, Struct
FullySpecifiedName	Structure of left lower lobe of lung (body structure)

Pipeline Application



- *Negation Phrase (NegEx) Finder*
 - Finds common medical negation phrases
- *SNOMED CT Negation (NegEx) Applicator*
 - Tags “negated” concepts by associating negation phrases with neighbouring SNOMED CT “findings” or “disease” concepts
 - SNOMED CT sub-hierarchies considered for negation:
 - 404684003|clinical finding| (e.g. “decreased capillary fragility,” “diabetes mellitus,” “dyspnea.”)
 - 49755003|morphologically abnormal structure| (e.g. “wallerian degeneration,” “carcinoma”)
 - 363787002|observable entity| (e.g. “status of invasion by tumour”)
 - 272379006|event| (e.g. “exposure to toxin,” “accident caused by bench saw”)

Results

GATE 4.0 build 2752

File Options Tools Help

Messages HIST000003_REP02.txt_0003C

Annotation Sets Annotations Co-reference Editor Ontology Text

HISTORY
Small lesion LLL. Previous BAC RUL. T2N0Mx 2002.

MACROSCOPIC
One specimen submitted.
The specimen is labelled 'wedge tumour' and consists of a wedge of lung tissue measuring 62 x 25 x 22 mm. Linear staple margins are trimmed prior to inking. The pleural surface is pink and mostly smooth except in one area where there is a small defect. The defect has a linear edge suggesting surgical artefact. Sectioning reveals a subpleural deposit of yellow tumour measuring 12 mm in maximum dimension. The tumour is located at least 6 mm from the inked resection margin. The tumour extends to the pleura but there is no obvious involvement of the pleural surface. No other lesions are seen. [1A-1C representative sections.]
[AD/It]

MICROSCOPIC
Sections show a subpleural mucinous bronchioloalveolar carcinoma. There is no evidence of pleural, lymphatic or vascular invasion. The wedge resection margin is well clear of malignancy.

SUMMARY
Wedge resection of lesion in left lower lobe:
Mucinous bronchioloalveolar carcinoma, 12 mm in maximum diameter.
Pathological stage T1 Nx.

NAME _NAME_
FACILITYORPLACE
Reported _DATE_

T-28000 M-82503 P1-03000

cc: Lung Cancer Registry

DeidentifiedToken
Dimension
NegationPhrases
NegativeSnomedConcept
☐ Sentence
☒ SnomedConcept
☒ SnomedIid
☐ SpaceToken
☐ Split
☒ TNMstage
☐ Token
☐ mmtx_Token
Original markups
SNOMEDCT
☐ BodyStructure
☐ ClinicalFinding
☐ LinkageConcept
☐ ObservableEntity
☐ PhysicalObject
☐ Procedure
☐ QualifierValue
☐ SituationWithExplicitContext
☐ SpecialConcept
☐ Specimen
☐ Substance

New

Document Editor Initialisation Parameters

Hide this view

Results

GATE 4.0 build 2752

File Options Tools Help

GATE

- Applications
 - MEDTEX
- Language Resources
 - HIST000003_REP02
- Processing Resources
 - Medtex SNOME CTN
 - Medtex NegEx Gazet
 - Medtex MMTx to SNO
 - Medtex Dimension Q
 - Medtex TNM Parser
 - Medtex MMTx Annot
 - Medtex Sentence Sp
 - Medtex Tokeniser
 - Medtex Document R
- Data stores

Messages HIST000003_REP02.txt_00026

Annotation Sets Annotations Co-reference Editor Ontology Text

HISTORY
Small lesion LLL. Previous BAC RUL. T2N0Mx 2002.

MACROSCOPIC
One specimen submitted.
The specimen is labelled 'wedge tumour' and consists of a wedge of lung tissue measuring 62 x 25 x 22 mm. Linear staple margins are trimmed prior to inking. The pleural surface is pink and mostly smooth except in one area where there is a small defect. The defect has a linear edge suggesting surgical artefact. Sectioning reveals a subpleural deposit of yellow tumour measuring 12 mm in maximum dimension. The tumour is located at least 6 mm from the inked resection margin. The tumour extends to the pleura but there is no obvious involvement of the pleural surface. No other lesions are seen. [1A-1C representative sections.] [AD/lt]

MICROSCOPIC
Sections show a subpleural mucinous bronchioloalveolar carcinoma. There is no evidence of pleural, lymphatic or vascular invasion. The wedge resection margin is well clear of malignancy.

SUMMARY
Wedge resection of le
Mucinous bronchiolo
Pathological stage T1

ObservableEntity

C AtId	G-F7A4
C CTV3ID	
C ConceptId	NEG_370052007
C Descriptions	[Tumor invasion, Status of invasion by tumor, Status of invasion by tumour, Tumour invasion,
C FullySpecifiedName	Status of invasion by tumor (observable entity)
C PreferredTerm	Status of invasion by tumor
C Primitive	true
C SemanticType	Observable entity (observable entity)
C SnomedId	
C Status	0

Document Editor Init

MimeType tex

Views built!

Original markups

SNOMEDCT

- ☒ BodyStructure
- ☒ ClinicalFinding
- ☐ LinkageConcept
- ☒ ObservableEntity
- ☐ PhyscialObject
- ☐ Procedure
- ☐ QualifierValue
- ☐ SituationWithExplicitContext
- ☐ SpecialConcept
- ☐ Specimen
- ☐ Substance

Symbolic Rule-Based Post-Coordination

Subsumption relationships can be taken advantage of to retrieve *concepts which relate to the same disease, anatomy or finding*, or infer if *two descriptions relate to the same concept*.

Example “Lung Resection” Subsumption Test

Test if following post-coordinated expression template

<procedure> :
{260686004|method| = *<procedure.method>*
,405813007|procedure site - Direct| = *<topology>* }

is subsumed by:

119746007|lung excision|

Symbolic Rule-Based Post-Coordination

MICROSCOPIC

1. Sections show a moderately differentiated squamous cell carcinoma with cystic change. The tumour extends to the visceral pleura but unequivocal pleural invasion is not seen in the routinely stained sections. An elastic stain has been requested for further evaluation of the pleura and a supplementary report will be issued with the result. Lymphatic invasion is not identified and blood vessel invasion is not seen. The bronchial resection margin shows squamous metaplasia but no evidence of in situ or invasive carcinoma. The vascular resection margin is negative for carcinoma. Non-neoplastic lung tissue shows centrilobular emphysema and smoker's-type macrophages. A section from the tip of the lobe confirms the presence of honeycomb change and shows associated bronchiolar metaplasia. Anthracotic dust macules are seen with associated emphysema. Additional sections of non-neoplastic lung tissue will be examined for further evaluation.

2-5. Microscopy shows profiles of lymph node tissue. Metastatic carcinoma is not identified.

SUMMARY

Left lower lobe, lung (lobectomy) with lymph node sampling

1. Moderately differentiated squamous cell carcinoma
2. Maximum tumour diameter: 4.5 mm.
3. An elastic stain to assess for visceral pleural invasion
4. Lymphatic invasion and blood vessel invasion are not seen
5. The resection margins are clear.
6. Lymph nodes (hilar): Negative.
7. Pathological stage: T2 N0 M0

NAME
QHPS, _FACILITYORPLACE_
Reported _DATE_

T-28000 M-80703 P1-03000

c.c. Lung Cancer Registry

LungCancerCaseSt

- ☐ ArterialInvasion
- ☒ DirectExtensionOfTumour
- ☒ DistantMetastasis (pM)
- ☒ HistologicGrade
- ☒ HistologicType
- ☒ Laterality
- ☒ LymphaticInvasion
- ☒ Margins

DistantMetastasis (pM)

C AtId	G-F205
C CTV3ID	
C ConceptId	17076002
C Descriptions	[pMX stage, pMX: Distant metastasis]
C FullySpecifiedName	pMX stage (finding)
C PreferredTerm	pMX stage
C Primitive	true
C SnomedId	
C Status	0
C	

Lung Resection Surgical Pathology Cancer Case Synoptic Report (MEDTEX)

Macroscopic

Specimen Type: Lobectomy [Specimen from lung obtained by lobectomy (122606006)]
Laterality: Left [Left lung structure (44029006)]
Tumour Site: Lower lobe [Structure of lower lobe of lung (90572001)]
Tumour Size: Greatest dimension = 4.5 [Tumor size, largest dimension (371479009)]

Microscopic

Histologic Type: Squamous cell carcinoma [Squamous cell carcinoma, no ICD-O subtype (28899001)]
Histologic Grade: G2 - Moderately differentiated [G2 grade (1663004)]

Pathologic Staging (pTNM)

Primary Tumour (pT): pT2 [pT2: Tumor of lung as per AJCC 6th Edition definition (lung) (384754004)]
Regional Lymph Nodes (pN): pN0 [pN0 category (21917009)]
- Number examined: 4 [Number of regional lymph nodes examined (372309006)]
- Number involved: 0 [Number of regional lymph nodes involved (372308003)]
Distant Metastasis (pM): pMX [pMX stage (17076002)]

Margins

Margins: Margins uninvolved by invasive carcinoma [Surgical margin uninvolved by malignant neoplasm (384690003)]

Extent of Invasion

Direct Extension of Tumour: Visceral pleura [Visceral pleura involved by direct extension of malignant neoplasm (384966001)]
Venous (Large Vessel) Invasion: Indeterminate [VX stage (6510002)]
Arterial (Large Vessel) Invasion: Indeterminate [Arterial (large vessel) invasion by tumor indeterminate (397211000)]
Lymphatic Invasion: Absent [L0 stage (44649003)]

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THE AUSTRALIAN



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