Supplementary Material

TEPAPA: a novel *in silico* feature learning pipeline for mining prognostic and associative factors from text-based electronic medical records

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List of contents

Table S1. Characteristics of the corpus used in the main study

Variable	Metric	Corpus type				
		MDT Report	**Medical oncology clinic Letters**	**Anatomical pathology reports**	**FDG-PET & Radiology reports**	**All inclusive**
		(N=77)	(N=14)	(N=75)	(N=74)	(N=82)
HPV/P16 status	Positive	46 (60%)	6 (43%)	45 (60%)	45 (61%)	50 (61%)
File size (lines)	corpus	5,106	1,220	22,312	10,588	77,278
	Per case	66	87	298	143	942
File size (bytes)	corpus	146,112	47,795	870,635	399,482	2,727,529
	Per case	1,898	3,414	11,609	5,398	33,263
Words	corpus	21,879	6,850	125,352	57,390	373,539
	Per case	284	489	1,671	776	4,555

Note: MDT: Multidisciplinary meeting.

Table S2. Full list of features listed mined by TEPAPA (MDT reports)

Table S2(a): Positive binary features (n-gram) without sequence-level annotation

Log (OR)	P	N	Pattern	Comments	Crossref.
2.35	4.1×10^{-5}	32	**base of**	SITE (Type IIIB MD)	(S2a.1)
3.13	0.0012	12	**the right tonsil**	SITE	(S2a.2)
3.02	0.0023	11	**M0 ,**	STAGE	(S2a.3)
1.74	0.0029	25	**positive**	HPV STATUS (Type IIIB MD)	(S2a.4)
2.90	0.0046	10	**glossotonsillar sulcus**	SITE	(S2a.5)

Table S2(b): Positive binary features (n-gram) with sequence-level annotation using UMLS vocabulary

Log (OR)	P	N	Pattern	Comments	Crossref.
2.35	4.1×10^{-5}	32	**base of tongue**	SITE	(S2b.1)
2.08	0.00027	29	**positive**	HPV STATUS (Type IIIB MD)	(S2b.2)
3.13	0.0012	12	**the right tonsil**	SITE	(S2b.3)
3.13	0.0012	12	**sulcus**	SITE (Type IIIB MD)	(S2b.4)

Table S2(c): Positive binary features (regular expressions) without sequence-level annotation

Log (OR)	P	N	Pattern	Comments	Crossref.
2.41	7.5×10^{-5}	28	**the (right|left)? base of**	SITE (Type IIIB MD)	(S2c.1)
2.32	0.0001	27	**the (right|left)? base of tongue**	SITE	(S2c.2)
2.59	0.00011	24	**of the (right|left)? base**	SITE (Type IIIB MD)	(S2c.3)
2.00	0.00059	28	**of the (right|left)? (base|floor) of**	SITE (Type IIIB MD)	(S2c.4)
2.32	0.00064	21	**base of (tongue|tongue.glossotonsillar sulcus) which crosses midline? .**	SITE	(S2c.5)
2.77	0.00075	17	**the (right|left) base**	SITE (Type IIIB MD)	(S2c.6)
2.06	0.00094	24	**irradiation (and|with) (or without|concurrent) chemotherapy**	MANAGEMENT	(S2c.7)
2.06	0.00094	24	**of (tongue|subclavicular disease)? (which crosses midline|tongue.glossotonsillar sulcus)? .**	SITE	(S2c.8)
3.13	0.0012	12	**SCC of the right (tonsil|base of tongue| glossotonsillar sulcus) -**	SITE	(S2c.9)
1.91	0.0013	27	**of the (right|left)? base of? tongue**	SITE	(S2c.10)
2.68	0.0015	16	**SCC of the (right|left)? base of tongue**	SITE	(S2c.11)
2.57	0.0029	15	**SCC of the (right|left) tonsil**	SITE	(S2c.12)
2.57	0.0029	15	**the left? base of tongue .**	SITE	(S2c.13)
1.88	0.004	22	**irradiation (and|with) concurrent**	MANAGEMENT	(S2c.14)
2.77	0.0092	9	**the (right|left)? glossotonsillar sulcus**	SITE	(S2c.15)
2.77	0.0092	9	**right (tonsil|IIA|base of tongue) ,**	SITE	(S2c.16)
2.77	0.0092	9	**, p16? positive ,? HPV? positive**	HPV STATUS	(S2c.17)
2.77	0.0092	9	**involving the (right|left)? base**	SITE (Type IIIB MD)	(S2c.18)

Table S2. Full list of features listed mined by TEPAPA (MDT reports) (Cont'd)

Table S2(d): Positive binary features (regular expressions) with sequence-level annotation using UMLS vocabulary

Log (OR)	P	N	Pattern	Comments	Crossref.
2.59	0.00011	24	**of the (right|left)? base of tongue**	SITE	(S2d.1)
2.77	0.00075	17	**the (right|left) base of tongue**	SITE	(S2d.2)
2.06	0.00094	24	**irradiation (and|with) (or without|concurrent) chemotherapy**	MANAGEMENT	(S2d.3)
3.23	0.0011	13	**SCC of the right (tonsil|base of tongue| glossotonsillar sulcus) -**	SITE	(S2d.4)
2.68	0.0015	16	**SCC of the (right|left)? base of tongue**	SITE	(S2d.5)
2.57	0.0029	15	**the (level II|left glossotonsillar sulcus|base of tongue|left tonsil) -**	NODAL, SITE	(S2d.6)
1.88	0.004	22	**irradiation (and|with) concurrent**	MANAGEMENT	(S2d.7)
2.77	0.0092	9	**the (right|left)? glossotonsillar sulcus**	SITE	(S2d.8)
2.77	0.0092	9	**right (tonsil|IIA|base of tongue) ,**	SITE	(S2d.9)
2.77	0.0092	9	**, p16? positive ,? HPV? positive**	HPV STATUS	(S2d.10)
2.77	0.0092	9	**involving the (right|left)? base of tongue**	SITE	(S2d.11)

Table S2(e): Negative binary features (n-gram) without sequence-level annotation

Log (OR)	P	N	Pattern	Comments	Crossref.
-3.35	0.0011	7	**management**		(S2e.1)
-2.75	0.0024	9	**than**		(S2e.2)
-2.75	0.0024	9	**radiation therapy .**	MANAGEMENT	(S2e.3)
-2.75	0.0024	9	**larynx**	SITE	(S2e.4)
-3.17	0.0031	6	**SCC of the oral tongue**	SITE	(S2e.5)
-3.17	0.0031	6	**disease with**		(S2e.6)
-3.17	0.0031	6	**supportive care**	MANAGEMENT	(S2e.7)
-2.57	0.0061	8	**less**		(S2e.8)
-2.57	0.0061	8	**tissues**		(S2e.9)
-2.57	0.0061	8	**posterior**	TUMOUR LOCATION	(S2e.10)
-2.57	0.0061	8	**of his**		(S2e.11)
-1.75	0.0068	15	**anterior**	TUMOUR LOCATION	(S2e.12)
-2.96	0.0086	5	**MRI scan shows**		(S2e.13)
-2.96	0.0086	5	**care .**		(S2e.14)
-2.96	0.0086	5	**is currently**		(S2e.15)
-2.96	0.0086	5	**laryngeal**		(S2e.16)
-2.96	0.0086	5	**partial**		(S2e.17)
-2.96	0.0086	5	**progressive**		(S2e.18)

Table S2. Full list of features listed mined by TEPAPA (MDT reports) (Cont'd)

Table S2(f): Negative binary features (n-gram) with sequence-level annotation using UMLS vocabulary

Log (OR)	P	N	Pattern	Comments	Crossref.
-2.91	0.00089	10	**oral tongue**	SITE	(S2f.1)
-3.35	0.0011	7	**management**		(S2f.2)
-3.35	0.0011	7	**supportive care**	MANAGEMENT	(S2f.3)
-2.75	0.0024	9	**larynx**	SITE	(S2f.4)
-2.57	0.0061	8	**Anterior**	TUMOUR LOCATION	(S2f.5)
-2.57	0.0061	8	**posterior**	TUMOUR LOCATION	(S2f.6)
-2.96	0.0086	5	**MRI scan shows**		(S2f.7)
-2.96	0.0086	5	**grade**		(S2f.8)
-2.96	0.0086	5	**is currently**		(S2f.9)

Table S2(g): Negative binary features (regular expressions) without sequence-level annotation

Log (OR)	P	N	Pattern	Comments	Crossref.
-3.52	0.00037	8	**SCC of the left? oral**	SITE (Type IIIB MD)	(S2g.1)
-2.91	0.00089	10	**the (right|left)? oral tongue**	SITE	(S2g.2)
-2.91	0.00089	10	**a (locally|locoregionally)? (p16 negative| advanced) SCC**	HPV STATUS	(S2g.3)
-3.35	0.0011	7	**SCC of the supraglottic? larynx**	SITE	(S2g.4)
-1.83	0.0013	21	**and (in excellent general health|neck dissection|nondrinker|well|review|adjuvant radiation therapy|base of tongue| dyslipidaemia|dysphagia for solids|gastro-oesophageal reflux disease|retromolar trigone|IV|ramipril) .**	Mixed concept: COMORBIDITY, MANAGEMENT, PERFORMANCE STATUS, SITE, SOCIAL HISTORY, SYMPTOM	(S2g.5)
-2.75	0.0024	9	**SCC of the left? oral? tongue**	SITE	(S2g.6)
-3.17	0.0031	6	**SCC of the supraglottic? (lower lip|larynx) .**	SITE	(S2g.7)
-1.43	0.0051	39	**is (a restored dentition|with palliative intent| SCC on biopsy|mobile|normal|poor|100 g daily|edentulous|clinically clear|known to the unit|required|intact) .**	Mixed concept: MANAGEMENT, ORAL HYGIENE, SOCIAL HISTORY	(S2g.8)
-1.49	0.0052	23	**He has? (will require|been|works as)? a**		(S2g.9)
-2.96	0.0086	5	**likely to? require adjuvant radiation therapy**	MANAGEMENT	(S2g.10)
-2.96	0.0086	5	**the supraglottic? larynx .**	SITE	(S2g.11)

Abbreviations: MD: Misdiscovery

Table S2. Full list of features listed mined by TEPAPA (MDT reports) (Cont'd)

Table S2(h): Negative binary features (regular expressions) with sequence-level annotation using UMLS vocabulary

Log (OR)	P	N	Pattern	Comments	Crossref.
-3.52	0.00037	8	**SCC of the left? oral tongue**	SITE	(S2h.1)
-3.52	0.00037	8	**SCC of the supraglottic? (oral tongue|larynx| lower lip) .**	SITE	(S2h.2)
-2.91	0.00089	10	**a (locally|locoregionally)? (p16 negative| advanced) SCC**	HPV STATUS	(S2h.3)
-1.91	0.001	19	**and (in excellent general health|neck dissection|nondrinker|review|adjuvant radiation therapy|base of tongue| dyslipidaemia|dysphagia for solids|gastro - oesophageal reflux disease|retromolar trigone|IV|ramipril) .**	COMORBIDITY, MANAGEMENT, PERFORMANCE STATUS, SITE, SOCIAL HISTORY, SYMPTOM	(S2h.4)
-3.35	0.0011	7	**SCC of the supraglottic? larynx**	SITE	(S2h.5)
-2.75	0.0024	9	**left (neck|level II|otalgia|level 1|cheek) .**	NODAL	(S2h.6)
-1.42	0.0048	34	**is (a restored dentition|with palliative intent| SCC on biopsy|mobile|generally fit and well| poor|100 g daily|edentulous|clinically clear| known to the unit|required) .**	MANAGEMENT, ORAL HYGIENE, PERFORMANCE STATUS, SOCIAL HISTORY	(S2h.7)
-2.57	0.0061	8	**the left (neck|level II|level 1|cheek) .**	NODAL	(S2h.8)
-2.96	0.0086	5	**likely to? require adjuvant radiation therapy**	MANAGEMENT	(S2h.9)
-2.96	0.0086	5	**the supraglottic? larynx .**	SITE	(S2h.10)

Note: In Tables S2(c), (d), (g), and (h), regular expressions that group only cardinal numbers as options [e.g. *“size (15|20|30|...) mm”*] are not shown for brevity.

Table S3: Full list of features listed mined by TEPAPA (Pathology reports)

Table S3(a): Positive binary features (n-gram) without sequence-level annotation

Log (OR)	P	N	Pattern	Comments	Crossref.
3.68	$4.5{\times}10^{-7}$	27	**: Positive**	HPV STATUS (Type IIIB MD)	(S3a.1)
3.14	$7.6{\times}10^{-7}$	30	**tonsillar**	SITE	(S3a.2)
3.04	$2.1{\times}10^{-6}$	29	**tongue base**	SITE	(S3a.3)
3.41	$7.7{\times}10^{-6}$	24	**tonsil**	SITE	(S3a.4)
3.62	$4.3{\times}10^{-5}$	17	**positive .**		(S3a.5)
3.14	$5.6{\times}10^{-5}$	21	**HPV related**	HPV STATUS	(S3a.6)
3.53	$9.3{\times}10^{-5}$	16	**indicate**		(S3a.7)
3.53	$9.3{\times}10^{-5}$	16	**Positive .**		(S3a.8)
2.87	0.00062	18	**Specimen 9 : Labelled " left**		(S3a.9)
2.06	0.00091	24	**: HPV**	HPV STATUS (Type IIIB MD)	(S3a.10)
2.23	0.0013	20	**lymphoid tissue**		(S3a.11)
1.54	0.0023	39	**carcinoma in**		(S3a.12)
3.01	0.0024	11	**Clinical Information : R**		(S3a.13)
2.89	0.0047	10	**HPV associated**		(S3a.14)
2.89	0.0047	10	**of the largest**		(S3a.15)
2.89	0.0047	10	**, non-keratinising**	PATHOLOGY FEATURE	(S3a.16)
2.89	0.0047	10	**tumour " , the specimen consists of**		(S3a.17)
2.47	0.0057	14	**(0/10**		(S3a.18)
2.47	0.0057	14	**related .**		(S3a.19)
2.76	0.0093	9	**x 30 x 10 mm .**		(S3a.20)
2.76	0.0093	9	**pharyngeal**		(S3a.21)
2.76	0.0093	9	**oropharyngectomy :**		(S3a.22)
2.76	0.0093	9	**associated squamous cell carcinoma**		(S3a.23)
2.76	0.0093	9	**Right oropharyngectomy**		(S3a.24)
1.33	0.0099	34	**dimension**		(S3a.25)

Table S3: Full list of features listed mined by TEPAPA (Pathology reports) – (Cont'd)

Table S3(b): Positive binary features (n-gram) with sequence-level annotation using UMLS vocabulary

Log (OR)	P	N	Pattern	Comments	Crossref.
3.68	4.5×10^{-7}	27	**: Positive**	HPV STATUS (Type IIIB MD)	(S3b.1)
3.04	2.1×10^{-6}	29	**tongue base**	SITE	(S3b.2)
3.32	2×10^{-5}	23	**tonsillar**	SITE	(S3b.3)
3.23	2.5×10^{-5}	22	**tonsil**	SITE	(S3b.4)
3.62	4.3×10^{-5}	17	**positive .**		(S3b.5)
3.14	5.6×10^{-5}	21	**HPV related**	HPV STATUS	(S3b.6)
3.53	9.3×10^{-5}	16	**Positive .**		(S3b.7)
3.53	9.3×10^{-5}	16	**indicate**		(S3b.8)
2.87	0.00062	18	**Specimen 9 : Labelled " left**		(S3b.9)
2.06	0.00091	24	**: HPV**	HPV STATUS (Type IIIB MD)	(S3b.10)
3.01	0.0024	11	**, non**		(S3b.11)
3.01	0.0024	11	**Clinical Information : R**		(S3b.12)
2.89	0.0047	10	**tumour " , the specimen consists of**		(S3b.13)
2.89	0.0047	10	**HPV associated**		(S3b.14)
2.89	0.0047	10	**of the largest**		(S3b.15)
1.65	0.0055	24	**Metastatic**		(S3b.16)
2.47	0.0057	14	**(0/ 10**		(S3b.17)
2.47	0.0057	14	**related .**		(S3b.18)
2.76	0.0093	9	**oropharyngectomy :**		(S3b.19)
2.76	0.0093	9	**x 30 x 10 mm .**		(S3b.20)
2.76	0.0093	9	**Right oropharyngectomy**		(S3b.21)
2.76	0.0093	9	**base of tongue**	SITE	(S3b.22)
2.76	0.0093	9	**tonsillar lymphoid tissue**	SITE	(S3b.23)
1.33	0.0099	34	**dimension**		(S3b.24)

Table S3: Full list of features listed mined by TEPAPA (Pathology reports) – (Cont'd)

Table S3(c): Positive binary features (regular expressions) without sequence-level annotation

Log (OR)	P	N	Pattern	Comments	Crossref.
3.50	3×10^{-6}	25	**HPV (studies|genotypes|status) :? P16 immunohistochemistry :? Positive**	HPV STATUS	(S3c.1)
3.89	6.2×10^{-6}	20	**HPV (positive|genotypes : Positive|associated squamous cell carcinoma|related) .**	HPV STATUS	(S3c.2)
3.89	6.2×10^{-6}	20	**for (high risk|High)? (HPV genotypes|P16) : Positive**	HPV STATUS	(S3c.3)
3.80	1.6×10^{-5}	19	**tongue base (tumour|biopsy)? .**	SITE	(S3c.4)
3.80	1.6×10^{-5}	19	**tongue base (tumour|biopsy)? .? ,**	SITE	(S3c.5)
3.71	2×10^{-5}	18	**base (of tongue|tumour|biopsy)? . ,**	SITE	(S3c.6)
3.23	2.5×10^{-5}	22	**P16 immunohistochemistry? : Positive**	HPV STATUS	(S3c.7)
3.62	4.3×10^{-5}	17	**risk (. is positive|HPV genotypes : Positive|probe- Negative) .**	HPV STATUS	(S3c.8)
3.14	5.6×10^{-5}	21	**Labelled . (right|left)? lateral? tongue base**	SITE, TUMOUR LOCATION	(S3c.9)
3.14	5.6×10^{-5}	21	**: (SCC R tonsil|1 and 2|Positive|See recent path|Reactive lymphoid hyperplasia|Not identified) .**	Mixed concept: SITE, HPV STATUS	(S3c.10)
3.53	9.3×10^{-5}	16	**tongue base (tumour|biopsy)? (: No evidence|. , the specimen consists) of**	SITE	(S3c.11)
3.53	9.3×10^{-5}	16	**tongue base (tumour|.)? .**	SITE	(S3c.12)
3.43	0.00021	15	**high risk (. is positive|HPV genotypes : Positive) .**	HPV STATUS	(S3c.13)
3.43	0.00021	15	**level (1B|3|4|5A neck dissection|IIa) 8**		(S3c.14)
3.43	0.00021	15	**level (3|4|2A|5A|5B neck dissection|Vb) 9**		(S3c.15)
3.34	0.00046	14	**tumour (. , the specimen consists|invades to a depth|deposit but no evidence) of**		(S3c.16)
3.34	0.00046	14	**: P16 immunohistochemistry :? (positive|Positive) In situ**	HPV STATUS	(S3c.17)
2.01	0.00055	28	**to (lateral|deep|inferior|this|follow|1C|2D|3G) .**	TUMOUR LOCATION	(S3c.18)
2.87	0.00062	18	**of (HPV studies|specimen 1|tissue|all margins|this finding is uncertain|bone|keratinization|fat|basaloid type . non-keratinizing .) .**	PATHOLOGY FEATURE	(S3c.19)
1.83	0.00081	30	**squamous cell carcinoma and squamous cell carcinoma? in**		(S3c.20)
2.06	0.00091	24	**and (2|1B|2B|squamous cell carcinoma in situ|both show cystic degeneration|all embedded Block 1A|3B|anterior|focal acute on chronic inflammation identified|bone|contains brown watery fluid|9D .|neutrophils|1H- epiglottis transverse sections) .**	Mixed concept: PATHOLOGY FEATURE, TUMOUR LOCATION	(S3c.21)
3.23	0.001	13	**P16 immunohistochemistry : (positive|Positive) In situ**	HPV STATUS	(S3c.22)
3.13	0.0012	12	**right (2A|tonsil|oropharyngectomy) .**	SITE	(S3c.23)
3.13	0.0012	12	**, (6|9 o.clock is black|poorly differentiated|16|tonsillar lymphoid tissue|bone|non-keratinising|therefore) ,**	PATHOLOGY FEATURE, SITE	(S3c.24)
3.13	0.0012	12	**HPV (studies indicate the|associated)**	HPV STATUS	(S3c.25)

Log (OR)	P	N	Pattern	Comments	Crossref.
			squamous cell carcinoma		
3.13	0.0012	12	Right lateral? tongue base	SITE	(S3c.26)
3.13	0.0012	12	The (HPV studies|results)? indicate the? (squamous cell carcinoma|tumour) is positive for? HPV	HPV STATUS	(S3c.27)
3.13	0.0012	12	The (HPV studies|results)? (indicate|true margin|roughened surface) is inked blue and? the		(S3c.28)
3.13	0.0012	12	carcinoma (,|is) (positive for|non-keratinising Differentiation.highest grade : Grade 3.poorly differentiated)? HPV	PATHOLOGY FEATURE, HPV STATUS	(S3c.29)
3.13	0.0012	12	tonsillar type? lymphoid? tissue and skeletal muscle? .	SITE	(S3c.30)
3.13	0.0012	12	tumour (.|present) ,		(S3c.31)
3.13	0.0012	12	. right (2A|oropharyngectomy|lateral)? tongue base? .	SITE, MANAGEMENT, TUMOUR LOCATION	(S3c.32)
3.13	0.0012	12	Clinical Information : SCC? R		(S3c.33)
2.77	0.0014	17	. (Right|Left|left)? tongue base	SITE	(S3c.34)
2.67	0.0015	16	, (poorly differentiated|non-keratinizing|non-keratinising|focally keratinizing)? squamous cell carcinoma	PATHOLOGY FEATURE	(S3c.35)
1.70	0.0018	32	cell carcinoma and squamous cell carcinoma? in		(S3c.36)
3.01	0.0024	11	HPV studies :? P16 immunohistochemistry : (positive|Positive) In situ	HPV STATUS	(S3c.37)
3.01	0.0024	11	Block 10A- (one|four)? (lymph|two .lymph)? (nodes|node) bisected? ; 10B-		(S3c.38)
3.01	0.0024	11	Positive In situ (hybridisation . Ventana INFORM ISH .|hybridization) for		(S3c.39)
3.01	0.0024	11	tonsillar type? lymphoid tissue	SITE	(S3c.40)
3.01	0.0024	11	the (squamous cell carcinoma|tumour) is HPV related	HPV STATUS	(S3c.41)
3.01	0.0024	11	right (2A|tonsil|oropharyngectomy) . ,	SITE	(S3c.42)
3.01	0.0024	11	. (right|left) neck? level 5A	NODAL	(S3c.43)
3.01	0.0024	11	P16 (is|immunohistochemistry : Positive|are both|+ve) positive? .	HPV STATUS	(S3c.44)
3.01	0.0024	11	: The? (HPV studies|results|Positivity for P53 on immunohistochemistry may) indicate		(S3c.45)
3.01	0.0024	11	: (Metastatic|The)? HPV (studies indicate the|associated|related) (moderately|moderate to poorly)? differentiated? squamous cell	HPV STATUS	(S3c.46)
3.01	0.0024	11	5B- (four|five) possible? lymph? nodes		(S3c.47)
3.01	0.0024	11	, (HPV studies|3|two of which show metastatic moderate|invading) to		(S3c.48)
3.01	0.0024	11	tongue base .? :	SITE	(S3c.49)
3.01	0.0024	11	squamous cell carcinoma (,|is) positive for? HPV	HPV STATUS	(S3c.50)
3.01	0.0024	11	. right (2A|oropharyngectomy|lateral)? tongue base? . ,	SITE, TUMOUR LOCATION	(S3c.51)
2.14	0.0026	19	2A (neck dissection|.)? : Metastatic		(S3c.52)
2.57	0.0029	15	seven lymph? nodes (.|identified are all negative for malignancy)? .		(S3c.53)

Log (OR)	P	N	Pattern	Comments	Crossref.
2.57	0.0029	15	pieces of (fatty|red|tan)? tissue		(S3c.54)
1.65	0.0033	28	of (three|seven|four|five|eight|twenty one|six|thirteen|seventeen)? lymph nodes		(S3c.55)
1.88	0.0038	22	the (posterior half|centre)? (of the|multiple levels examined .|entire) specimen		(S3c.56)
1.50	0.0043	33	the (tumour deposit but no evidence|largest|junction|area|centre|site|presence|floor|absence|remainder|significance) of		(S3c.57)
1.52	0.0044	30	of (three|seven|a|largest|four|involved|five|eight|six|thirteen|seventeen) lymph		(S3c.58)
2.89	0.0047	10	. (right|left) neck? level 5B	NODAL	(S3c.59)
2.89	0.0047	10	10 :? (.|Labelled)? .? (Left|left) neck		(S3c.60)
2.89	0.0047	10	12 : Labelled .? (right|left)? level? (3|2B)? (.|mm) ,		(S3c.61)
2.89	0.0047	10	The (HPV studies|results)? (indicate|roughened surface is inked blue and) the (squamous cell carcinoma|tumour|specimen) is		(S3c.62)
2.89	0.0047	10	ISH .? for high risk HPV genotypes : Positive	HPV STATUS	(S3c.63)
2.89	0.0047	10	indicate the (squamous cell carcinoma|tumour) is HPV related	HPV STATUS	(S3c.64)
2.89	0.0047	10	: (SCC|Left|.SCC|Suspected) right? tongue base	SITE	(S3c.65)
2.89	0.0047	10	2A (neck dissection|.|+ 3) :		(S3c.66)
2.89	0.0047	10	: (Right|Left|Labelled .) biopsy? right? tonsil	SITE	(S3c.67)
2.89	0.0047	10	the (inferior|other)? (deep|half|false) margin? is inked black	PATHOLOGY & SURGICAL CHARACTERISTICS	(S3c.68)
2.89	0.0047	10	, two of which show metastatic moderate to? (poorly|non-keratinising Differentiation. highest grade : Grade 3. poorly) differentiated	PATHOLOGY FEATURE	(S3c.69)
2.89	0.0047	10	squamous cell carcinoma (,|is) HPV? (present|studies to follow|related) .	HPV STATUS	(S3c.70)
2.89	0.0047	10	pieces of (fatty|red|tan)? tissue ,		(S3c.71)
2.89	0.0047	10	COMMENT : The? (HPV studies|results|Positivity for P53 on immunohistochemistry may) indicate		(S3c.72)
2.89	0.0047	10	in the (posterior half|centre)? (of the|multiple levels examined .) specimen		(S3c.73)
2.89	0.0047	10	fatty tissue ,? 35 x? 25		(S3c.74)
2.89	0.0047	10	Sections show (squamous mucosa with reactive lymphoid|fibrofatty|salivary gland|fragments of granulation|fibrotic|tonsilar) tissue	SITE	(S3c.75)
2.89	0.0047	10	P16 immunohistochemistry : (positive|Positive) In situ hybridisation	HPV STATUS	(S3c.76)
2.89	0.0047	10	2 : Right neck dissection? (level 1B|tonsil|oropharyngectomy) .	NODAL, SITE	(S3c.77)
2.89	0.0047	10	3 : Labelled . right level? 2B? neck dissection? level? (2B|5A|III)? .		(S3c.78)
2.89	0.0047	10	30 x 20 x? 10 mm in aggregate? .		(S3c.79)
2.04	0.0051	18	tumour (is present at|. ,|appears to extend to|invades into) the		(S3c.80)

Log (OR)	P	N	Pattern	Comments	Crossref.
2.04	0.0051	18	**the 3 o.clock? deep? (lateral|excision|surgical)? margin (in|is)? inked blue? (and|from)? the**	SURGICAL CHARACTERISTICS	(S3c.81)
2.04	0.0051	18	**the (specimen consists of a piece of firm|margin is inked blue|anterior|jugular vein|first cystic cavity ; 8E-) and**	SURGICAL CHARACTERISTICS	(S3c.82)
2.04	0.0051	18	**level (1B|4|2A +|Ib|IIb) 3**		(S3c.83)
2.04	0.0051	18	**. (tongue base|lateral|inferior|anterior|medial|superior|Negative|Deep) margin**	Mixed concept: SITE, HPV STATUS, SURGICAL CHARACTERISTICS	(S3c.84)
2.47	0.0057	14	**transverse sections , serially? (embedded|through the centre of the specimen)? from**		(S3c.85)
2.47	0.0057	14	**, (poorly differentiated|non-keratinizing|non-keratinising|focally keratinizing) squamous**	PATHOLOGY FEATURE	(S3c.86)
2.47	0.0057	14	**, (3|6 ,|the specimen consists of a piece of firm|deep margin inked black|skeletal muscle|keratinising) and**	PATHOLOGY FEATURE, SURGICAL CHARACTERISTICS	(S3c.87)
2.47	0.0057	14	**: The? (HPV studies|results)? (tumour invades into|indicate|Approximately 50% of) the**		(S3c.88)
2.47	0.0057	14	**and (the area|one|no evidence|fragments|fibrous clefts in keeping with base) of**	SITE	(S3c.89)
2.47	0.0057	14	**level (3|4|2A|IIa|IIb) 5**		(S3c.90)
2.47	0.0057	14	**studies :? P16 immunohistochemistry : Positive**	HPV STATUS	(S3c.91)
1.79	0.0077	21	**1B (3|6|8|.) .**		(S3c.92)
1.79	0.0077	21	**: (Inferior|Tongue base|No Margins . assessment in conjunction with separate|Medial|Deep|Lateral) margin**	Mixed concepts: SITE, TUMOUR LOCATION, SURGICAL CHARACTERISTICS	(S3c.93)
1.79	0.0077	21	**9 (:|.) .? Left**		(S3c.94)
1.43	0.0082	29	**three (lymph|possible|.lymph) nodes ;**		(S3c.95)
1.70	0.0083	20	**10 : Labelled . left? neck? (dissection|right)? level**		(S3c.96)
1.70	0.0083	20	**mm (in|at the) maximum**		(S3c.97)
2.76	0.0093	9	**7 (:|x 5 x) Labelled . right? (neck dissection|Right)? level? 3**		(S3c.98)
2.76	0.0093	9	**HPV studies P16 immunohistochemistry : (positive|Positive) In situ hybridisation**	HPV STATUS	(S3c.99)
2.76	0.0093	9	**No evidence of malignancy in eight lymph nodes? . 0.8**		(S3c.100)
2.76	0.0093	9	**cell carcinoma in one of? (three|two) of? (seven|five)? lymph nodes .? .**		(S3c.101)
2.76	0.0093	9	**cell carcinoma (,|is) HPV (studies to follow|related) .**	HPV STATUS	(S3c.102)
2.76	0.0093	9	**lymph node (,|. 0.1 . .|measuring 15 x)? 10**		(S3c.103)
2.76	0.0093	9	**2A- three lymph nodes ; 2B-? one? (largest|possible)? lymph? node**		(S3c.104)
2.76	0.0093	9	**: (Inferior|Medial|Lateral) margin .**	TUMOUR LOCATION	(S3c.105)
2.76	0.0093	9	**HPV (, and therefore|studies indicate) the**	HPV STATUS	(S3c.106)
2.76	0.0093	9	**, (the specimen consists of|39) (a|an orientated 58)? x? 28**		(S3c.107)

Log (OR)	P	N	Pattern	Comments	Crossref.
2.76	0.0093	9	: Positive In situ hybridisation? .		(S3c.108)
2.76	0.0093	9	tonsil tumour? . ,	SITE	(S3c.109)
2.76	0.0093	9	right lateral? tongue base	SITE	(S3c.110)
2.76	0.0093	9	measures (30|20|45|approximately 11 x 10 x 5) mm		(S3c.111)
2.76	0.0093	9	margin .? (: No evidence|a clearance|being) of? malignancy .? 3		(S3c.112)
2.76	0.0093	9	is (an infiltrate of non-keratinized|extensive|metastatic) squamous cell carcinoma		(S3c.113)
2.76	0.0093	9	base (: Reactive lymphoid hyperplasia|tumour|.|margin) .	SITE (Type IIIB MD)	(S3c.114)
2.76	0.0093	9	appears (involved|unremarkable|normal) .		(S3c.115)
2.76	0.0093	9	and (squamous cell carcinoma|6C- one lymph node bisected|tonsil T1 : Tumour 2 cm or less|fibrous clefts) in	SITE, STAGE	(S3c.116)
2.76	0.0093	9	. (R|right) oropharyngectomy		(S3c.117)
2.76	0.0093	9	Description : Specimen 1 :? Labelled .? (Right|right)? lateral? tongue base	SITE, TUMOUR LOCATION	(S3c.118)
2.76	0.0093	9	: Labelled . right (2A|tonsil|oropharyngectomy) . , the specimen consists	SITE	(S3c.119)
2.76	0.0093	9	: Labelled . right (2A|oropharyngectomy|tongue base) . , the specimen	SITE	(S3c.120)
2.76	0.0093	9	3 : .? Right level? 2B? neck dissection? level 2B? (5A|.)? .	NODAL	(S3c.121)
2.76	0.0093	9	2 : Labelled .? (Inferior|deep|inferior|Deep) margin	SURGICAL CHARACTERISTICS	(S3c.122)
2.76	0.0093	9	Positive In situ hybridization for? (high risk|High)? (HPV genotypes|Comment|Maxmum size) :	HPV STATUS	(S3c.123)
2.76	0.0093	9	Right (neck dissection 1|2A|oropharyngectomy) .		(S3c.124)
2.76	0.0093	9	Right (2A|and left neck dissection|oropharyngectomy) :		(S3c.125)
2.76	0.0093	9	The (HPV studies|results) indicate		(S3c.126)
2.76	0.0093	9	The (largest|smaller involved)? lymph node		(S3c.127)
2.76	0.0093	9	. (right|left) level 1B	NODAL	(S3c.128)
1.31	0.0093	44	is (HPV related|5 mm|tumour free|positive|a likely primary site|present|seen macroscopically|serially sectioned|normal|clear of all margins|found|lymphoid hyperplasia with reactive germinal centers|included|posterolateral|uncertain) .	Mixed concept: HPV STATUS, PATHOLOGY & SURGICAL CHARACTERISTICS	(S3c.129)
1.95	0.01	17	in one of? (three|two) of? (seven|five)? lymph nodes .? .		(S3c.130)
1.95	0.01	17	Labelled . (tongue base|lateral|inferior|anterior|medial|superior) margin	SITE, SURGICAL CHARACTERISTICS	(S3c.131)

Table S3: Full list of features listed mined by TEPAPA (Pathology reports) – (Cont'd)

Table S3(d): Positive binary features (regular expressions) with sequence-level annotation using UMLS vocabulary

Log (OR)	P	N	Pattern	Comments	Crossref.
3.50	3×10^{-6}	25	**HPV (studies|genotypes|status) :? P16 immunohistochemistry :? Positive**	HPV STATUS	(S3d.1)
3.89	6.2×10^{-6}	20	**for (high risk|High)? (HPV genotypes|P16) : Positive**	HPV STATUS	(S3d.2)
3.80	1.6×10^{-5}	19	**tongue base (tumour|biopsy)? .**	SITE	(S3d.3)
3.80	1.6×10^{-5}	19	**tongue base (tumour|biopsy)? .? ,**	SITE	(S3d.4)
3.80	1.6×10^{-5}	19	**HPV (positive|genotypes : Positive|related) .**	HPV STATUS	(S3d.5)
3.23	2.5×10^{-5}	22	**P16 immunohistochemistry? : Positive**	HPV STATUS	(S3d.6)
3.23	2.5×10^{-5}	22	**. (Right|Left|right|left|right lateral)? tongue base**	SITE	(S3d.7)
2.68	4.5×10^{-5}	25	**: (SCC R tonsil|1 and 2|Left inferior turbinate|Positive|One benign lymph node|Level 4|Level 5|See recent path|Reactive lymphoid hyperplasia|No malignancy|Not identified) .**	NODAL, SITE, HPV STATUS	(S3d.8)
3.53	9.3×10^{-5}	16	**tongue base (tumour|.)? .**	SITE	(S3d.9)
3.53	9.3×10^{-5}	16	**tongue base (tumour|biopsy)? . , the**	SITE	(S3d.10)
2.19	0.00011	30	**to (poorly differentiated squamous cell carcinoma . 2.9 .|lateral|deep|inferior|this|follow|squamous cell carcinoma in situ|2D|1C|3G) .**	TUMOUR LOCATION	(S3d.11)
3.05	0.00012	20	**Labelled . (right|left|right lateral)? tongue base**	SITE	(S3d.12)
3.43	0.00021	15	**high risk (. is positive|HPV genotypes : Positive) .**	HPV STATUS	(S3d.13)
2.96	0.00028	19	**of (HPV studies P16 immunohistochemistry : Positive In situ hybridisation|tumour|the specimen|all eight bocks|which show metastatic moderate to poorly differentiated squamous cell carcinoma|margins|human papilloma virus|basaloid type) .**	Mixed concepts: HPV STATUS, SURGICAL CHARACTERISTICS	(S3d.14)
2.96	0.00028	19	**: Labelled . (right|left|right lateral)? tongue base**	SITE	(S3d.15)
2.87	0.00062	18	**, (3|6 ,|the specimen consists of a piece of firm|deep margin inked black|skeletal muscle|minor salivary glands|keratinising|mucoserous glands) and**	PATHOLOGY FEATURE, SURGICAL CHARACTERISTICS	(S3d.16)
2.33	0.00064	21	**Labelled . (right|left|right lateral)? tongue**	SITE	(S3d.17)
1.83	0.00081	30	**of (HPV studies|seven lymph nodes|specimen 1|salivary gland|submandibular gland|tissue|all margins|this finding is uncertain|bone|non-keratinized squamous cell carcinoma|squamous cell carcinoma in situ|keratinization|fat) .**		(S3d.18)
3.23	0.001	13	**right (2A|tonsil|oropharyngectomy|tongue base) . , the specimen consists of**	SITE	(S3d.19)
3.23	0.001	13	**level (3|2A|5A|5B neck dissection|Vb) 9**		(S3d.20)
3.23	0.001	13	**: (SCC|Right|Left|Right lateral) tongue base**	SITE	(S3d.21)
3.13	0.0012	12	**HPV (studies indicate the|associated) squamous cell carcinoma**	HPV STATUS	(S3d.22)
3.13	0.0012	12	**level (1B|3|5A neck dissection|IIa) 8**		(S3d.23)
3.13	0.0012	12	**The (HPV studies|results)? indicate the?**	HPV STATUS	(S3d.24)

<table>
<tr><th>Log (OR)</th><th>P</th><th>N</th><th>Pattern</th><th>Comments</th><th>Crossref.</th></tr>
<tr><td></td><td></td><td></td><td>(tumour|squamous cell carcinoma) is positive for? HPV</td><td></td><td></td></tr>
<tr><td>3.13</td><td>0.0012</td><td>12</td><td>: The? (results|Metastatic)? HPV? studies? indicate the? (tumour|squamous cell carcinoma)? is HPV? related</td><td>HPV STATUS</td><td>(S3d.25)</td></tr>
<tr><td>3.13</td><td>0.0012</td><td>12</td><td>, (6|9 o.clock is black|poorly differentiated|non-keratinising|16|bone|tonsillar lymphoid tissue|therefore) ,</td><td>PATHOLOGY FEATURE, SITE</td><td>(S3d.26)</td></tr>
<tr><td>3.13</td><td>0.0012</td><td>12</td><td>Clinical Information : SCC? R</td><td></td><td>(S3d.27)</td></tr>
<tr><td>3.13</td><td>0.0012</td><td>12</td><td>mm (. macroscopic .|long|oriented mucosal excision with two sutures denoting anterior|tan|thick) and</td><td>TUMOUR LOCATION</td><td>(S3d.28)</td></tr>
<tr><td>3.13</td><td>0.0012</td><td>12</td><td>tumour (.|present) ,</td><td></td><td>(S3d.29)</td></tr>
<tr><td>2.23</td><td>0.0013</td><td>20</td><td>: Labelled . (right|left|right lateral)? tongue</td><td>SITE</td><td>(S3d.30)</td></tr>
<tr><td>2.67</td><td>0.0015</td><td>16</td><td>The (HPV studies|results)? (tumour|indicate) (appears to extend to|invades into)? the</td><td></td><td>(S3d.31)</td></tr>
<tr><td>3.01</td><td>0.0024</td><td>11</td><td>tongue base .? :</td><td>SITE</td><td>(S3d.32)</td></tr>
<tr><td>3.01</td><td>0.0024</td><td>11</td><td>the (tumour|squamous cell carcinoma) is HPV related</td><td>HPV STATUS</td><td>(S3d.33)</td></tr>
<tr><td>3.01</td><td>0.0024</td><td>11</td><td>squamous cell carcinoma (,|is) positive for? HPV</td><td>HPV STATUS</td><td>(S3d.34)</td></tr>
<tr><td>3.01</td><td>0.0024</td><td>11</td><td>Right (tonsil|oropharyngectomy)? (2A|tumour)? .</td><td>SITE</td><td>(S3d.35)</td></tr>
<tr><td>3.01</td><td>0.0024</td><td>11</td><td>. (right|left) neck? level 5A</td><td>NODAL</td><td>(S3d.36)</td></tr>
<tr><td>3.01</td><td>0.0024</td><td>11</td><td>P16 (is|immunohistochemistry : Positive|are both|+ve) positive? .</td><td>HPV STATUS</td><td>(S3d.37)</td></tr>
<tr><td>3.01</td><td>0.0024</td><td>11</td><td>: The? (HPV studies|results|Positivity for P53 on immunohistochemistry may) indicate</td><td></td><td>(S3d.38)</td></tr>
<tr><td>3.01</td><td>0.0024</td><td>11</td><td>: (Metastatic squamous cell carcinoma|Positive In situ hybridisation|Moderately differentiated) . (Ventana INFORM ISH|1.9|Grade 2 of 3) .</td><td></td><td>(S3d.39)</td></tr>
<tr><td>3.01</td><td>0.0024</td><td>11</td><td>: (The|Metastatic)? HPV (associated|related)? (studies indicate the|moderately differentiated|moderate to poorly differentiated)? squamous cell carcinoma</td><td>HPV STATUS</td><td>(S3d.40)</td></tr>
<tr><td>3.01</td><td>0.0024</td><td>11</td><td>: P16 immunohistochemistry :? Positive (In situ hybridisation . Ventana INFORM ISH .|In situ hybridization) for</td><td>HPV STATUS</td><td>(S3d.41)</td></tr>
<tr><td>3.01</td><td>0.0024</td><td>11</td><td>: The (HPV studies|results)? indicate the? (tumour|squamous cell carcinoma) is positive for? HPV</td><td>HPV STATUS</td><td>(S3d.42)</td></tr>
<tr><td>3.01</td><td>0.0024</td><td>11</td><td>, (HPV studies|3|two of which show metastatic moderate|invading) to</td><td></td><td>(S3d.43)</td></tr>
<tr><td>2.57</td><td>0.0029</td><td>15</td><td>seven (lymph nodes|nodes) (.|identified are all negative for malignancy)? .</td><td></td><td>(S3d.44)</td></tr>
<tr><td>2.57</td><td>0.0029</td><td>15</td><td>. (Right|Left|right|left|right lateral) tongue</td><td>SITE</td><td>(S3d.45)</td></tr>
<tr><td>2.57</td><td>0.0029</td><td>15</td><td>10 nodes? . .</td><td></td><td>(S3d.46)</td></tr>
<tr><td>1.88</td><td>0.0038</td><td>22</td><td>the (posterior half|centre)? (of the|multiple levels examined .|entire) specimen</td><td></td><td>(S3d.47)</td></tr>
<tr><td>2.89</td><td>0.0047</td><td>10</td><td>: (Metastatic|Squamous cell carcinoma .)? HPV related moderate to? (poorly|Grade 3 .poorly) differentiated</td><td>HPV STATUS</td><td>(S3d.48)</td></tr>
<tr><td>2.89</td><td>0.0047</td><td>10</td><td>5C- (four|five)? possible? lymph nodes ; 5D-?</td><td></td><td>(S3d.49)</td></tr>
</table>

Log (OR)	P	N	Pattern	Comments	Crossref.
			two? possible? lymph nodes		
2.89	0.0047	10	the (inferior|other)? (deep|half|false) margin? is inked black	SURGICAL CHARACTERISTICS	(S3d.50)
2.89	0.0047	10	right (neck level 4|tonsil|oropharyngectomy)? . , the specimen consists of a	NODAL, SITE	(S3d.51)
2.89	0.0047	10	lymph nodes (.|identified are all negative for malignancy)? . (0.|0.8|0.3) .? .? 10		(S3d.52)
2.89	0.0047	10	a large single lymph node exhibiting metastatic cystic? moderately differentiated non -keratinising? squamous cell carcinoma	PATHOLOGY FEATURE	(S3d.53)
2.89	0.0047	10	2A (neck dissection|.|+ 3) :		(S3d.54)
2.89	0.0047	10	10 :? (.|Labelled)? .? (Left|left) neck		(S3d.55)
2.89	0.0047	10	. (right|left) neck? level 5B	NODAL	(S3d.56)
2.89	0.0047	10	The (HPV studies|results)? (indicate|roughened surface is inked blue and) the (tumour|specimen|squamous cell carcinoma) is		(S3d.57)
2.89	0.0047	10	ISH .? for high risk HPV genotypes : Positive	HPV STATUS	(S3d.58)
2.89	0.0047	10	in the (posterior half|centre)? (of the|multiple levels examined .) specimen		(S3d.59)
2.89	0.0047	10	: (SCC R|Right|Labelled .) biopsy? right? tonsil	SITE	(S3d.60)
2.89	0.0047	10	: (1 Laterality|Squamous cell carcinoma|Results|Moderately differentiated . Grade 2|Approximately 50%) of		(S3d.61)
2.89	0.0047	10	, (poorly differentiated|non -keratinising) squamous cell carcinoma	PATHOLOGY FEATURE	(S3d.62)
2.89	0.0047	10	indicate the (tumour|squamous cell carcinoma) is HPV related	HPV STATUS	(S3d.63)
2.89	0.0047	10	pieces of (red|tan)? (fatty tissue|tissue) ,		(S3d.64)
2.89	0.0047	10	2 : Right neck dissection? (level 1B|tonsil|oropharyngectomy) .	NODAL, SITE	(S3d.65)
2.89	0.0047	10	30 x 20 x? 10 mm in aggregate? .		(S3d.66)
2.89	0.0047	10	4 : Labelled . right? neck dissection? (level 4|left level IIa) . ,	NODAL	(S3d.67)
2.89	0.0047	10	COMMENT : The? (HPV studies|results|Positivity for P53 on immunohistochemistry may) indicate		(S3d.68)
2.89	0.0047	10	P16 immunohistochemistry : (positive|Positive) In situ hybridisation	HPV STATUS	(S3d.69)
2.89	0.0047	10	Block 4A- (three|two|six possible) .? lymph nodes		(S3d.70)
2.04	0.0051	18	. (tongue base|lateral|inferior|anterior|medial|superior|Negative|Deep) margin	SITE, HPV STATUS, TUMOUR LOCATION, SURGICAL CHARACTERISTICS	(S3d.71)
2.04	0.0051	18	the (specimen consists of a piece of firm|margin is inked blue|anterior|jugular vein|first cystic cavity ; 8E-) and	Mixed concepts: TUMOUR LOCATION, SURGICAL CHARACTERISTICS	(S3d.72)
2.04	0.0051	18	tumour (is present at|. ,|appears to extend to|invades into) the		(S3d.73)
1.42	0.0053	35	and (2|1B|2B|3B|both show cystic degeneration|	Mixed concepts:	(S3d.74)

Log (OR)	P	N	Pattern	Comments	Crossref.
			all embedded Block 1A|anterior|skeletal muscle|focal acute on chronic inflammation identified|bone|contains brown watery fluid|minor salivary glands|9D .|squamous cell carcinoma in situ|neutrophils|tonsillar lymphoid tissue|1H - epiglottis transverse sections|mucoserous glands|skeletal muscles) .	PATHOLOGY FEATURE, SITE, TUMOUR LOCATION	
2.47	0.0057	14	**Right (level 4|2A|oropharyngectomy|tongue base) :**	NODAL, SITE	(S3d.75)
2.47	0.0057	14	**studies :? P16 immunohistochemistry : Positive**	HPV STATUS	(S3d.76)
2.47	0.0057	14	**: (SCC|Right|Left|Right lateral) tongue**	SITE	(S3d.77)
2.47	0.0057	14	**: The? (HPV studies|results)? (tumour invades into|indicate|Approximately 50% of) the**		(S3d.78)
1.56	0.0065	27	**of (three|seven|four|five|eight|six|thirteen|seventeen|twenty one) lymph nodes**		(S3d.79)
1.79	0.0077	21	**1B (3|6|8|.) .**		(S3d.80)
1.79	0.0077	21	**9 (:|.) .? Left**		(S3d.81)
1.79	0.0077	21	**: (Inferior|Tongue base|No Margins . assessment in conjunction with separate|Medial|Deep|Lateral) margin**	SITE, TUMOUR LOCATION, SURGICAL CHARACTERISTICS	(S3d.82)
1.43	0.0082	29	**three (possible nodes|.)? lymph nodes? ;**		(S3d.83)
1.70	0.0083	20	**right (level 4|2A|tonsil|oropharyngectomy|tongue base|level III) .**	NODAL, SITE	(S3d.84)
1.70	0.0083	20	**mm (in|at the) maximum**		(S3d.85)
2.76	0.0093	9	**, (the specimen consists of|39) (a|an orientated 58)? x? 28**		(S3d.86)
2.76	0.0093	9	**. (R|right) oropharyngectomy**	MANAGEMENT	(S3d.87)
2.76	0.0093	9	**The (HPV studies|results) indicate**		(S3d.88)
2.76	0.0093	9	**: (No evidence of|No dysplasia or)? (1 and|malignancy|Tumour) 2**	PATHOLOGY FEATURE	(S3d.89)
2.76	0.0093	9	**a (tumour|fibrofatty tissue|fatty tissue|poorly differentiated|P53 mutation) ,**	PATHOLOGY FEATURE	(S3d.90)
2.76	0.0093	9	**appears (involved|unremarkable|normal) .**		(S3d.91)
2.76	0.0093	9	**margin .? (: No evidence of malignancy .|a clearance of|being) 3**		(S3d.92)
2.76	0.0093	9	**: (Inferior|Medial|Lateral) margin .**	TUMOUR LOCATION	(S3d.93)
2.76	0.0093	9	**squamous cell carcinoma (,|is) HPV (studies to follow|related) .**	HPV STATUS	(S3d.96)
2.76	0.0093	9	**HPV studies P16 immunohistochemistry : (positive|Positive) In situ hybridisation**	HPV STATUS	(S3d.97)
2.76	0.0093	9	**. (right|left) level 1B**	NODAL	(S3d.98)
2.76	0.0093	9	**HPV (, and therefore|studies indicate) the**	HPV STATUS	(S3d.100)
2.76	0.0093	9	**2 : Labelled . right neck dissection level? (1B|level 4|1b) .**	NODAL	(S3d.101)
2.76	0.0093	9	**Positive (In situ hybridisation . Ventana INFORM ISH .|In situ hybridization) for high risk**	HPV STATUS	(S3d.102)
2.76	0.0093	9	**Positive In situ hybridization for? (high risk|High)? (HPV genotypes|Comment|Maxmum size) :**	HPV STATUS	(S3d.103)
2.76	0.0093	9	**2 : Labelled .? (Inferior|deep|inferior|Deep)**	SURGICAL	(S3d.104)

Log (OR)	P	N	Pattern	Comments	Crossref.
			margin	CHARACTERISTICS	
2.76	0.0093	9	**3 : .? Right level? 2B? neck dissection? level 2B? (5A|.)? .**	NODAL	(S3d.105)
2.76	0.0093	9	**4 : Right? neck dissection? (level 4|Left level IIa|Level 4) .**	NODAL	(S3d.106)
2.76	0.0093	9	**: Positive In situ hybridisation? .**		(S3d.107)
2.76	0.0093	9	**No evidence of malignancy in eight lymph nodes? . 0.8**		(S3d.109)
1.95	0.01	17	**Labelled . (tongue base|lateral|inferior|anterior|medial|superior) margin**	SITE, TUMOUR LOCATION, SURGICAL CHARACTERISTICS	(S3d.110)
1.95	0.01	17	**in one of? (three|two) of? (seven|five)? lymph nodes .? .**		(S3d.111)

Table S3: Full list of features listed mined by TEPAPA (Pathology reports) – (Cont'd)

Table S3(e): Negative binary features (n-gram) without sequence-level annotation

Log (OR)	P	N	Pattern	Comments	Crossref.
-2.37	0.00029	16	**: Negative**	HPV STATUS (Type IIIA MD)	(S3e.1)
-3.54	0.00035	8	**for decalcification**	TUMOUR LOCATION (Type IIIA MD)	(S3e.2)
-3.54	0.00035	8	**The sections of the**		(S3e.3)
-2.94	0.00081	10	**with mild**		(S3e.4)
-3.37	0.001	7	**Specimen 3 : " Left**		(S3e.5)
-3.37	0.001	7	**lobe of**		(S3e.6)
-3.37	0.001	7	**a depth of 3 mm**		(S3e.7)
-3.37	0.001	7	**: Sections**		(S3e.8)
-2.09	0.0018	14	**are clear**		(S3e.9)
-1.56	0.002	31	**This**		(S3e.10)
-2.77	0.0022	9	**o'clock margin**	SURGICAL CHARACTERISTICS	(S3e.11)
-2.77	0.0022	9	**posterior aspect**		(S3e.12)
-2.37	0.0023	12	**invasive malignancy .**		(S3e.13)
-3.18	0.0029	6	**the possibility of**		(S3e.14)
-3.18	0.0029	6	**soft tissue and**		(S3e.15)
-3.18	0.0029	6	**post**		(S3e.16)
-1.53	0.0034	29	**2 mm .**		(S3e.17)
-1.52	0.0044	45	**seen .**		(S3e.18)
-1.67	0.0049	17	**inflammation .**		(S3e.19)
-2.22	0.0053	11	**formation**		(S3e.20)
-2.22	0.0053	11	**mild chronic**		(S3e.21)
-2.59	0.0058	8	**5 x 5 x**		(S3e.22)
-2.59	0.0058	8	**differentiated , keratinising squamous cell carcinoma**	PATHOLOGY FEATURE	(S3e.23)
-2.59	0.0058	8	**involve**		(S3e.24)
-2.59	0.0058	8	**the soft**		(S3e.25)
-2.59	0.0058	8	**well differentiated**	PATHOLOGY FEATURE	(S3e.26)
-2.59	0.0058	8	**x 7 x 3 mm**		(S3e.27)
-1.78	0.0065	15	**focus**		(S3e.28)
-2.98	0.0083	5	**9 x 6**		(S3e.29)
-2.98	0.0083	5	**Block 2A- five**		(S3e.30)
-2.98	0.0083	5	**effect .**		(S3e.31)
-2.98	0.0083	5	**neural**		(S3e.32)
-2.98	0.0083	5	**suspicious for**		(S3e.33)
-1.34	0.0088	33	**area**		(S3e.34)
-1.31	0.0093	31	**features**		(S3e.35)
-1.33	0.0099	41	**show a**		(S3e.36)
-1.40	0.0099	22	**margins are**		(S3e.37)

Table S3: Full list of features listed mined by TEPAPA (Pathology reports) – (Cont'd)

Table S3(f): Negative binary features (n-gram) with sequence-level annotation using UMLS vocabulary

Log (OR)	P	N	Pattern	Comments	Crossref.
-2.37	0.00029	16	**: Negative**	HPV STATUS (Type IIIB MD)	(S3f.1)
-3.54	0.00035	8	**for decalcification**	PATHOLOGY FEATURE	(S3f.2)
-3.54	0.00035	8	**The sections of the**		(S3f.3)
-3.37	0.001	7	**a depth of 3 mm**		(S3f.4)
-3.37	0.001	7	**more**		(S3f.5)
-3.37	0.001	7	**: Sections**		(S3f.6)
-2.09	0.0018	14	**are clear**		(S3f.7)
-1.56	0.002	31	**This**		(S3f.8)
-2.77	0.0022	9	**posterior aspect**		(S3f.9)
-2.37	0.0023	12	**invasive malignancy .**		(S3f.10)
-1.74	0.0028	20	**invasion is**		(S3f.11)
-3.18	0.0029	6	**lobe of**		(S3f.12)
-3.18	0.0029	6	**the possibility of**		(S3f.13)
-3.18	0.0029	6	**soft tissue and**		(S3f.14)
-1.53	0.0034	29	**2 mm .**		(S3f.15)
-2.59	0.0058	8	**blue inked**		(S3f.16)
-2.59	0.0058	8	**lateral aspect of**		(S3f.17)
-2.59	0.0058	8	**well differentiated**	PATHOLOGY FEATURE	(S3f.18)
-2.59	0.0058	8	**, keratinising squamous cell carcinoma**	PATHOLOGY FEATURE	(S3f.19)
-2.59	0.0058	8	**5 x 5 x**		(S3f.20)
-2.59	0.0058	8	**involve**		(S3f.21)
-2.59	0.0058	8	**x 7 x 3 mm**		(S3f.22)
-1.78	0.0065	15	**focus**		(S3f.23)
-2.98	0.0083	5	**anterior commissure**		(S3f.24)
-2.98	0.0083	5	**, focal**		(S3f.25)
-2.98	0.0083	5	**with mild chronic inflammation**	PATHOLOGY FEATURE	(S3f.26)
-2.98	0.0083	5	**suspicious for**		(S3f.27)
-2.98	0.0083	5	**neural**		(S3f.28)
-2.98	0.0083	5	**effect .**		(S3f.29)
-2.98	0.0083	5	**Specimen 3 : " Left**		(S3f.30)
-2.98	0.0083	5	**and in**		(S3f.31)
-2.98	0.0083	5	**Block 2A - five**		(S3f.32)
-2.98	0.0083	5	**/2015 11 :**		(S3f.33)
-2.98	0.0083	5	**but the**		(S3f.34)
-2.98	0.0083	5	**9 x 6**		(S3f.35)
-1.34	0.0088	33	**area**		(S3f.36)
-1.31	0.0093	31	**features**		(S3f.37)
-1.33	0.0099	41	**Negative**	HPV STATUS (Type IIIB MD)	(S3f.38)
-1.33	0.0099	41	**show a**		(S3f.39)

Table S3: Full list of features listed mined by TEPAPA (Pathology reports) – (Cont'd)

Table S3(g): Negative binary features (regular expressions) without sequence-level annotation

Log (OR)	P	N	Pattern	Comments	Crossref.
-3.24	9.7×10^{-5}	12	**The paraffin? sections of**		(S3g.1)
-3.69	0.00011	9	**consists of (three|a|one|two)? 3 mm**		(S3g.2)
-2.21	0.00014	21	**The (sections|base|central portion|lesion is 2 mm clear|cut surface|edge|remainder|outside) of the**	SITE (Type IIIB MD)	(S3g.3)
-2.66	0.00016	14	**for (high risk HPV genotypes : Negative|decalcification) prior to further dissection? .**	HPV STATUS, TUMOUR LOCATION (Type IIIB MD)	(S3g.4)
-2.66	0.00016	14	**of metastatic moderate to? (poorly|moderately|well) differentiated**	PERFORMANCE STATUS	(S3g.5)
-3.09	0.00029	11	**, (invasive|moderately differentiated|keratinising) squamous cell carcinoma**	PATHOLOGY FEATURE	(S3g.6)
-3.54	0.00035	8	**medial tongue? (. ,|aspect of) the**	SITE	(S3g.7)
-3.54	0.00035	8	**. , the specimen consists of (9 x|three|one|two)? 3**		(S3g.8)
-2.52	0.00046	13	**mm (mucosal|pale|tan|punch) biopsy**	TUMOUR LOCATION (Type IIIB MD)	(S3g.9)
-2.06	0.00071	17	**the (lateral|inferior|medial|posterior) aspect**	TUMOUR LOCATION (Type IIIB MD)	(S3g.10)
-3.37	0.001	7	**with (high|low)? (grade|mild) dysplasia**	PATHOLOGY FEATURE	(S3g.11)
-3.37	0.001	7	**right (neck|temple) dissection? :**		(S3g.12)
-3.37	0.001	7	**of (moderately|metastatic moderate to poorly) differentiated , keratinising? squamous cell**	PATHOLOGY FEATURE	(S3g.13)
-3.37	0.001	7	**with mild (dysplasia|chronic inflammation) .**	PATHOLOGY FEATURE	(S3g.14)
-1.65	0.0014	26	**the (level|base|larger piece|surface|region|margins|majority|edge|edges|proximal margin|request|shape|possibility|rest|periphery) of**	SITE	(S3g.15)
-1.64	0.0019	35	**the (squamous epithelium|carcinoma|tumour|right|largest bisected|surface|maximum dimension|bone|other end|margins|lesion|report is missing|biopsy|multiple sections examined|stroma|lip|floor of mouth|thyroid cartilage|following features|diagnosis|opposite side) .**		(S3g.16)
-1.81	0.0021	18	**. (for high risk HPV genotypes : Negative|lymph nodes|.|dysplasia|margins|Alarm continuation sequencing error) .**	HPV STATUS, PATHOLOGY FEATURE	(S3g.17)
-2.77	0.0022	9	**12 o.clock superior? (. ,|and|margin of) the**		(S3g.18)
-2.77	0.0022	9	**sections of (the|salivary)? submandibular? (3 and 9 o.clock|the|gland) (are unremarkable|ends)? respectively? .**		(S3g.19)
-2.77	0.0022	9	**: (P16 immunohistochemistry :|Squamous cell carcinoma)? (An|Negative In)? in? situ**	HPV STATUS	(S3g.20)
-2.77	0.0022	9	**differentiated squamous cell? (carcinoma|adenocarcinoma) with**		(S3g.21)

Log (OR)	P	N	Pattern	Comments	Crossref.
-2.37	0.0023	12	**consists of (three|a|one|two)? 3**		(S3g.22)
-3.18	0.0029	6	**of (the|resection are clear) (right side|lesion appears complete and)? of? the**		(S3g.23)
-3.18	0.0029	6	**tissue (: No evidence of malignancy .|,) 6**		(S3g.24)
-3.18	0.0029	6	**the (carcinoma with|specimen show|lesion appears complete and) the**		(S3g.25)
-3.18	0.0029	6	**studies :? (for high risk HPV|P16 immunohistochemistry : Negative In situ hybridisation) .**	HPV STATUS	(S3g.26)
-3.18	0.0029	6	**of (tumour|the submandibular gland| resection) are**		(S3g.27)
-3.18	0.0029	6	**of one punch biopsy ,? 2 x 2? mm .**	TUMOUR LOCATION (Type IIIB MD)	(S3g.28)
-3.18	0.0029	6	**medial tongue? . , the specimen**	SITE	(S3g.29)
-3.18	0.0029	6	**biopsy of skin? (to|shows) a**		(S3g.30)
-3.18	0.0029	6	**a (small|large) area**		(S3g.31)
-3.18	0.0029	6	**4 (:|.) . Left**		(S3g.32)
-3.18	0.0029	6	**Block 2A- (four possible|five) lymph? nodes ; 2B-**		(S3g.33)
-3.18	0.0029	6	**1 : (.|Deep medial margin)? Right? (level IIb| vocal cord .)? .**	NODAL, SITE	(S3g.34)
-1.92	0.003	16	**of (three|one|two)? 3 mm**		(S3g.35)
-1.53	0.0034	29	**sections (of|; 3E-|from) the**		(S3g.36)
-1.49	0.0042	34	**2 mm (of extranodal spread|pale biopsy|from the deep margin|fragments|biopsies)? .**	PATHOLOGY FEATURE	(S3g.37)
-1.56	0.0044	21	**is (bisected|black|focal mild dysplasia|noted| pending|consistent with a recurrence| difficult|required|missing|1.2 mm| recommended) .**	PATHOLOGY FEATURE	(S3g.38)
-1.56	0.0044	21	**the (right|black inked|medial|surgical|distal tracheal|proximal) margin**		(S3g.39)
-1.95	0.0044	13	**of (three|the|one|two|malignancy . 0.2 . .| slice) 3**		(S3g.40)
-1.95	0.0044	13	**of (moderately|metastatic) moderate to poorly? differentiated? , keratinising? squamous cell carcinoma**	PATHOLOGY FEATURE	(S3g.41)
-1.95	0.0044	13	**HPV (studies|genotypes) :? P16 immunohistochemistry :? Negative**	HPV STATUS	(S3g.42)
-1.67	0.0049	17	**mm (.|right|deep|anterior|medial|superior| thick , extending|punch biopsy) to**	TUMOUR LOCATION (Type IIIB MD)	(S3g.43)
-2.22	0.0053	11	**Labelled . (medial tongue|posterior margin| total laryngectomy|larynx|subtotal glossectomy) . , the specimen consists of**	SITE	(S3g.44)
-2.22	0.0053	11	**Labelled . (right vocal cord|medial tongue| total laryngectomy|larynx|subtotal glossectomy) . , the**	SITE	(S3g.45)
-2.22	0.0053	11	**There is no evidence of? (in situ|high grade dysplasia)? or? invasive**	PATHOLOGY FEATURE	(S3g.46)
-2.22	0.0053	11	**of skin to? a (6 x|depth of)? 3**		(S3g.47)
-2.59	0.0058	8	**soft tissue margin? ;**		(S3g.48)
-2.59	0.0058	8	**evidence of high grade dysplasia or? invasive malignancy .**	PATHOLOGY FEATURE	(S3g.49)

Log (OR)	P	N	Pattern	Comments	Crossref.
-2.59	0.0058	8	**3 :? (.|Labelled)? . Left**		(S3g.50)
-2.59	0.0058	8	**SUMMARY 1 .? (:|.) Left**		(S3g.51)
-2.59	0.0058	8	**a (6 x|depth of) 3**		(S3g.52)
-2.59	0.0058	8	**no (invasive malignancy|dysplasia|perineural invasion|significant change) .**	PATHOLOGY FEATURE	(S3g.53)
-2.59	0.0058	8	**of (submandibular gland|resection are clear of)? (the lesion|margins)? ;**		(S3g.54)
-2.59	0.0058	8	**one (end|transverse section|edge) of the**		(S3g.55)
-1.60	0.006	19	**The (base|excision|central portion|focus|regions|presence|edge|remainder|outside) of**	SITE (Type IIIB MD)	(S3g.56)
-1.78	0.0065	15	**high grade dysplasia? (risk HPV genotypes : Negative|or invasive malignancy)? .**	HPV STATUS, PATHOLOGY FEATURE	(S3g.57)
-2.98	0.0083	5	**the closest (transverse|peripheral)? margin**		(S3g.58)
-2.98	0.0083	5	**: Labelled . (deep medial|posterior) margin . , the specimen**	TUMOUR LOCATION (Type IIIB MD)	(S3g.59)
-2.98	0.0083	5	**HPV studies :? P16 immunohistochemistry : Negative In situ**	HPV STATUS	(S3g.60)
-2.98	0.0083	5	**are clear (of|from) the**		(S3g.61)
-2.98	0.0083	5	**consists of (a|two pale tan biopsies ,) 4**		(S3g.62)
-2.98	0.0083	5	**punch biopsy of skin? to a depth**	TUMOUR LOCATION (Type IIIB MD)	(S3g.63)
-2.98	0.0083	5	**with (high|low) grade**		(S3g.64)
-2.98	0.0083	5	**well differentiated squamous cell carcinoma? ,**	PATHOLOGY FEATURE	(S3g.65)
-2.98	0.0083	5	**3 (mm|o.clock) to**		(S3g.66)
-2.98	0.0083	5	**. lesion? (right|left) posterior**	TUMOUR LOCATION (Type IIIB MD)	(S3g.67)
-2.98	0.0083	5	**and the? underlying skeletal**		(S3g.68)
-2.98	0.0083	5	**are (clear from the|biopsies of moderately differentiated , keratinising squamous cell) carcinoma**	PATHOLOGY FEATURE	(S3g.69)
-2.98	0.0083	5	**Both (ends|negative) .**		(S3g.70)
-2.98	0.0083	5	**of skin to? a depth of? 4**		(S3g.71)
-2.98	0.0083	5	**the (submandibular gland|appearances) are**		(S3g.72)
-1.40	0.0099	22	**differentiated ,? (invasive|keratinizing|keratinising) squamous cell carcinoma**	PATHOLOGY FEATURE	(S3g.73)

Table S3: Full list of features listed mined by TEPAPA (Pathology reports) – (Cont'd)

Table S3(h): Negative binary features (regular expressions) with sequence-level annotation using UMLS vocabulary

Log (OR)	P	N	Pattern	Comments	Crossref.
-3.98	1.1×10^{-5}	11	**of (two pale tan biopsies ,|slice|skin to)? a? depth of? 4**		(S3h.1)
-3.24	9.7×10^{-5}	12	**The paraffin? sections of**		(S3h.2)
-3.69	0.00011	9	**consists of (three|a|one|two)? 3 mm**		(S3h.3)
-2.08	0.00012	39	**the (tumour|right|largest bisected|salivary gland|surface|squamous epithelium|carcinoma|maximum dimension|bone|margins|nodes|lesion|report is missing|biopsy|multiple sections examined|stroma|lip|surgical margin|floor of mouth|thyroid cartilage|following features|other end|diagnosis|opposite side) .**		(S3h.4)
-2.21	0.00014	21	**The (sections|base|central portion|lesion is 2 mm clear|cut surface|edge|remainder|outside) of the**	SITE (Type IIIB MD)	(S3h.5)
-2.66	0.00016	14	**for (high risk HPV genotypes : Negative|decalcification) prior to further dissection? .**	HPV STATUS, TUMOUR LOCATION (Type IIIB MD)	(S3h.6)
-3.09	0.00029	11	**, (invasive|moderately differentiated|keratinising) squamous cell carcinoma**	PATHOLOGY FEATURE	(S3h.7)
-3.54	0.00035	8	**. , the specimen consists of (9 x|three|one|two)? 3**		(S3h.8)
-3.54	0.00035	8	**medial tongue? (. ,|aspect of) the**	SITE	(S3h.9)
-1.94	0.00039	26	**the (level|right half|base|larger piece|surface|region|margins|majority|right side|edge|edges|proximal margin|request|shape|possibility|rest|periphery) of**	SITE (Type IIIB MD)	(S3h.10)
-2.06	0.00071	17	**the (lateral|inferior|medial|posterior) aspect**	TUMOUR LOCATION (Type IIIB MD)	(S3h.11)
-2.23	0.00074	15	**with (squamous cell carcinoma|minor salivary gland|cyst formation|previous surgery|mild chronic inflammation|mild dysplasia|prominent nucleoli) .**	PATHOLOGY FEATURE	(S3h.12)
-1.66	0.0014	28	**sections (of|from) the**		(S3h.13)
-2.09	0.0018	14	**of (tumour|one punch biopsy|two pale tan biopsies|soft tissue|moderately differentiated|multiple unoriented pieces of fibrofatty tissue|nose|mucosal tissue) ,**	TUMOUR LOCATION (Type IIIA MD)	(S3h.14)
-1.81	0.0021	18	**. (lymph nodes|.|for high risk HPV genotypes : Negative|dysplasia|margins|Alarm continuation sequencing error) .**	HPV STATUS, PATHOLOGY FEATURE	(S3h.15)
-2.77	0.0022	9	**12 o.clock superior? (. ,|and|margin of) the**		(S3h.16)
-2.37	0.0023	12	**consists of (three|a|one|two)? 3**		(S3h.17)
-1.74	0.0028	20	**in (the stroma|extent|an addendum report|black|depth|-situ|thickness|diameter|length) .**		(S3h.18)
-3.18	0.0029	6	**1 : (Right level IIb|. Right vocal cord .|Deep medial margin) .**	NODAL, SITE	(S3h.19)
-3.18	0.0029	6	**the (specimen show|carcinoma with|lesion**		(S3h.20)

Log (OR)	P	N	Pattern	Comments	Crossref.
			appears complete and) the		
-3.18	0.0029	6	tissue (: No evidence of malignancy .|,) 6		(S3h.21)
-3.18	0.0029	6	studies :? (P16 immunohistochemistry : Negative In situ hybridisation|for high risk HPV) .	HPV STATUS	(S3h.22)
-3.18	0.0029	6	of (tumour|the submandibular gland|resection) are		(S3h.23)
-3.18	0.0029	6	of (the|resection are clear) (lesion appears complete and|right side)? of? the		(S3h.24)
-3.18	0.0029	6	medial tongue? . , the specimen	SITE	(S3h.25)
-3.18	0.0029	6	a (small|large) area		(S3h.26)
-3.18	0.0029	6	P16 immunohistochemistry : Negative In situ hybridisation .? (and HPV|Ventana INFORM)? ISH	HPV STATUS	(S3h.27)
-3.18	0.0029	6	4 (:|.) . Left		(S3h.28)
-3.18	0.0029	6	2A - (four possible|five) (lymph nodes|nodes) ; 2B -		(S3h.29)
-1.92	0.003	16	invasion is (identified|present|seen|not seen) .		(S3h.30)
-1.92	0.003	16	of (three|one|two)? 3 mm		(S3h.31)
-1.49	0.0042	34	2 mm (of extranodal spread|pale biopsy|from the deep margin|fragments|biopsies)? .	PATHOLOGY FEATURE	(S3h.32)
-1.56	0.0044	21	of (tumour|two lymph nodes|extranodal spread|dysplasia|soft tissue|squamous mucosa|lymphocytes|muscle|floor of mouth|thyroid|pink tissue|oral type with subepithelial stroma and skeletal muscle|malignant cells|poorly differentiated carcinoma) .	PATHOLOGY FEATURE	(S3h.33)
-1.95	0.0044	13	Block 6A -? one? (bisected|possible)? (two . lymph nodes|node)? (;|and) 6B-		(S3h.34)
-1.95	0.0044	13	HPV (studies|genotypes) :? P16 immunohistochemistry :? Negative	HPV STATUS	(S3h.35)
-1.95	0.0044	13	perineural space? invasion is (identified|present|seen) .		(S3h.36)
-1.67	0.0049	17	lateral tongue? (. , the specimen consists|aspect) of	SITE	(S3h.37)
-1.67	0.0049	17	mm (.|right|deep|anterior|medial|superior|thick , extending|punch biopsy) to	TUMOUR LOCATION (Type IIIB MD)	(S3h.38)
-2.22	0.0053	11	of skin to? a (6 x|depth of)? 3		(S3h.39)
-2.22	0.0053	11	There is no evidence of? (high grade dysplasia|in situ)? or? invasive	PATHOLOGY FEATURE	(S3h.40)
-2.59	0.0058	8	a (6 x|depth of) 3		(S3h.41)
-2.59	0.0058	8	sections of (the|salivary gland) 3 and 9 o.clock? (submandibular gland are unremarkable|ends)? respectively? .		(S3h.42)
-2.59	0.0058	8	no (invasive malignancy|dysplasia|perineural invasion|significant change) .	PATHOLOGY FEATURE	(S3h.43)
-2.59	0.0058	8	one (end|edge|transverse section) of the		(S3h.44)
-2.59	0.0058	8	of (submandibular gland|margins|resection are clear of)? the lesion? ;		(S3h.45)
-1.60	0.006	19	The (base|excision|central portion|focus|regions|presence|edge|remainder|outside) of	SITE (Type IIIB MD)	(S3h.46)
-1.39	0.0071	26	and (9 o.clock ends respectively|fatty tissue|all	PATHOLOGY	(S3h.47)

Log (OR)	P	N	Pattern	Comments	Crossref.
			embedded|subepithelial stroma|sinus|cartilage|lymphovascular invasion|fibrosis|plasma cells|chronic inflammation|CK5.6|hyperkeratosis|radiotherapy|mild chronic inflammation|venous invasion) .	FEATURE	
-2.98	0.0083	5	**- (two transverse sections|longitudinal sections|shave) of**		(S3h.48)
-2.98	0.0083	5	**the closest (transverse|peripheral)? margin**		(S3h.49)
-2.98	0.0083	5	**. . (Left level 4|Larynx|Right vocal cord|Left vocal cord) .**	NODAL, SITE	(S3h.50)
-2.98	0.0083	5	**right neck dissection? :**		(S3h.51)
-2.98	0.0083	5	**of moderately differentiated , keratinising? squamous cell carcinoma**	PATHOLOGY FEATURE	(S3h.52)
-2.98	0.0083	5	**consists of (a|two pale tan biopsies ,) 4**		(S3h.53)
-2.98	0.0083	5	**are clear (of|from) the**		(S3h.54)
-2.98	0.0083	5	**the (submandibular gland|appearances) are**		(S3h.55)
-2.98	0.0083	5	**studies :? P16 immunohistochemistry : Negative**	HPV STATUS	(S3h.56)
-2.98	0.0083	5	**punch biopsy of skin? to a depth**	TUMOUR LOCATION	(S3h.57)
-2.98	0.0083	5	**both (ends|negative) .**		(S3h.58)
-2.98	0.0083	5	**and the? underlying skeletal muscle**		(S3h.59)
-2.98	0.0083	5	**3 (mm|o.clock) to**		(S3h.60)
-1.40	0.0099	22	**. (No evidence of malignancy|medial tongue|No tumour|larynx|Larynx|total laryngectomy|subtotal glossectomy|Right vocal cord|Left vocal cord) .**	SITE	(S3h.61)

Note: In Tables S3(c), (d), (g), and (h), regular expressions that group only cardinal numbers as options [e.g. *"size (15|20|30|...) mm"*] are not shown for brevity.

Table S4: Full list of features listed mined by TEPAPA (FDG-PET/CT reports)

Table S4(a): Positive binary features (n-gram) without sequence-level annotation

Log (OR)	P	N	Pattern	Comments	Crossref.
2.95	$7.6{\times}10^{-7}$	34	**base**	SITE (Type IIIA MD)	(S4a.1)
4.03	$1.2{\times}10^{-6}$	22	**tonsillar**	SITE	(S4a.2)
3.30	0.00049	14	**vallecula**	SITE	(S4a.3)
1.79	0.0015	30	**bowel**		(S4a.4)
2.64	0.0029	16	**tonsil**	SITE	(S4a.5)
2.54	0.0033	15	**Previous**		(S4a.6)
2.98	0.005	11	**FDG avid pulmonary nodule**	METASTATIC DISEASE (Type IIIB MD)	(S4a.7)
2.98	0.005	11	**No FDG avid pulmonary**	METASTATIC DISEASE	(S4a.8)
2.98	0.005	11	**hypermetabolism in**		(S4a.9)
2.98	0.005	11	**remaining oropharynx**		(S4a.10)
2.86	0.0051	10	**Primary site : There**		(S4a.11)
2.01	0.0054	18	**No pulmonary**		(S4a.12)
2.01	0.0054	18	**soft tissue mass**		(S4a.13)
2.43	0.0062	14	**oropharyngeal**		(S4a.14)
1.48	0.0063	46	**or pleural**		(S4a.15)
1.52	0.0068	27	**, pancreas**		(S4a.16)
1.52	0.0068	27	**lesion is detected**		(S4a.17)
1.75	0.0077	21	**pancreas ,**		(S4a.18)
1.34	0.0089	40	**tongue**	SITE	(S4a.19)
1.59	0.0092	58	**REPORT**		(S4a.20)
2.73	0.0099	9	**lesion is demonstrated**		(S4a.21)
2.73	0.0099	9	**lymphadenopathy is demonstrated**		(S4a.22)

Table S4(b): Positive binary features (n-gram) with sequence-level annotation using UMLS vocabulary

Log (OR)	P	N	Pattern	Comments	Crossref.
3.02	0.00014	20	**tonsillar**	SITE	(S4b.1)
3.30	0.00049	14	**vallecula**	SITE	(S4b.2)
2.74	0.0014	17	**base of tongue**	SITE	(S4b.3)
2.54	0.0033	15	**Previous**		(S4b.4)
1.85	0.004	22	**tongue base**	SITE	(S4b.5)
2.98	0.005	11	**loops**		(S4b.6)
2.98	0.005	11	**hypermetabolism in**		(S4b.7)
2.98	0.005	11	**FDG avid pulmonary nodule**	METASTATIC DISEASE (Type IIIB MD)	(S4b.8)
2.98	0.005	11	**remaining oropharynx**		(S4b.9)
2.86	0.0051	10	**Primary site : There**		(S4b.10)
2.01	0.0054	18	**soft tissue mass**		(S4b.11)
2.43	0.0062	14	**oropharyngeal**		(S4b.12)
1.52	0.0068	27	**, pancreas**		(S4b.13)
1.52	0.0068	27	**lesion is detected**		(S4b.14)

Table S4: Full list of features listed mined by TEPAPA (FDG-PET/CT reports) - (Cont'd)

Table S4(c): Positive binary features (regular expressions) without sequence-level annotation

Log (OR)	P	N	Pattern	Comments	Crossref.
3.29	2×10^{-5}	23	**No FDG avid? pulmonary (nodules|nodule) or pleural**	METASTATIC DISEASE	(S4c.1)
1.94	0.00031	35	**the (body|nasopharynx|vallecula|epiglottis|retroperitoneum|skeleton|abdomen , pelvis inguinal regions|primary site|current study|oropharynx|hyoid bone|thorax|pharyngeal mucosal space|uterus|solid abdominal organs|trunk) .**	SITE, TUMOUR LOCATION (Type IIIA MD)	(S4c.2)
3.20	0.001	13	**avid pulmonary (nodules|nodule) or pleural**	METASTATIC DISEASE (Type IIIB MD)	(S4c.3)
3.20	0.001	13	**is (identified|detected) . both? on**		(S4c.4)
2.29	0.0012	21	**in the (right cubital fossa|body|base of tongue|skeleton|abdomen , pelvis inguinal regions|current study|thorax|trunk) .**	SITE	(S4c.5)
2.74	0.0014	17	**base of the? tongue**	SITE	(S4c.6)
1.75	0.0016	33	**pulmonary (nodules|nodule) or pleural**		(S4c.7)
1.94	0.002	23	**pulmonary nodule or pleural? (effusion|abnormality)? is**	METASTATIC DISEASE (Type IIIB MD)	(S4c.8)
1.94	0.002	23	**in the? (the|left|remaining) oropharynx**		(S4c.9)
3.09	0.0023	12	**lesion is (identified|detected) . both? on**		(S4c.10)
3.09	0.0023	12	**No FDG avid? pulmonary? (nodules|nodule)? (or pleural|new) abnormality**	METASTATIC DISEASE	(S4c.11)
3.09	0.0023	12	**avid (4 mm|pulmonary) nodule**	METASTATIC DISEASE (Type IIIB MD)	(S4c.12)
3.09	0.0023	12	**bowel (appear unremarkable|activity|loops) .**		(S4c.13)
3.09	0.0023	12	**right (tonsillar|tongue base|tonsil) SCC**	SITE	(S4c.14)
1.79	0.0026	26	**with (: >90% Probable OR Probably : approx|metastasis|altered usage|metastatic disease|central necrosis|high-grade malignancy|unknown primary) .**		(S4c.15)
2.20	0.0026	20	**No (FDG avid|new)? pulmonary nodule**	METASTATIC DISEASE	(S4c.16)
2.54	0.0033	15	**the (right|left)? base of**	SITE (Type IIIA MD)	(S4c.17)
2.54	0.0033	15	**No pulmonary (nodules|nodule) or**		(S4c.18)
1.61	0.0037	28	**the (vallecula|mediastinum|retroperitoneum|midline|mandible|abdomen|previous study|axillary|probability of that diagnosis) ,**	SITE	(S4c.19)
1.61	0.0037	28	**lymphadenopathy is (identified|detected|demonstrated|seen) in**		(S4c.20)
1.61	0.0037	28	**There is (no|an intensely|physiological|mild|marked) FDG**		(S4c.21)
1.85	0.004	22	**or enlarged? cervical? (lymph node|pleural) (effusion|abnormality)? is**		(S4c.22)
2.98	0.005	11	**the (right|left) tonsillar**	SITE	(S4c.23)
2.98	0.005	11	**for (staging|restaging) FDG-PET**		(S4c.24)

Log (OR)	P	N	Pattern	Comments	Crossref.
2.98	0.005	11	**the (neck ,|injection site)? (previous PET CT scan performed|particularly)? in**		(S4c.25)
2.98	0.005	11	**site (in|on) the**		(S4c.26)
2.86	0.0051	10	**is (identified|detected)? (. both on|complete) metabolic**		(S4c.27)
2.86	0.0051	10	**and (CT appearances within|in|at|inferiorly to| extends past) the**		(S4c.28)
2.86	0.0051	10	**spleen , (kidneys and|adrenals ,)? pancreas**		(S4c.29)
2.86	0.0051	10	**and bowel (appear unremarkable|loops) .**		(S4c.30)
2.86	0.0051	10	**No FDG avid pulmonary (nodules|nodule) or**	METASTATIC DISEASE	(S4c.31)
2.01	0.0054	18	**nodule or pleural (effusion|abnormality) is**		(S4c.32)
2.43	0.0062	14	**: No FDG avid? pulmonary**	METASTATIC DISEASE	(S4c.33)
2.43	0.0062	14	**in the (mediastinum|lungs , liver ,|axillae| proximal appendicular) or? (mediastinum| retroperitoneum|axial)? skeleton? or elsewhere? .**		(S4c.34)
2.43	0.0062	14	**for (staging|restaging)? (a progress PET CT| FDG-PET) scan**		(S4c.35)
2.43	0.0062	14	**in the? remaining? oropharynx , oral cavity ,? nasopharynx ,? hypopharynx**		(S4c.36)
2.43	0.0062	14	**the remaining? oropharynx ,**		(S4c.37)
2.73	0.0099	9	**: No FDG avid cervical? (lymphadenopathy| suspicious osseous lesion|new finding) is**	METASTATIC DISEASE	(S4c.38)
2.73	0.0099	9	**kidneys and (bowel loops|urinary bladder are of normal appearance) .**		(S4c.39)
2.73	0.0099	9	**No intracranial? (space|space-occupying)? (suspicious osseous|-occupying|occupying)? lesion is detected . both? on**	METASTATIC DISEASE	(S4c.40)
2.73	0.0099	9	**avid cervical? (lymphadenopathy|mucosal) , subcutaneous? or cutaneous lesion? is demonstrated**	TUMOUR LOCATION (Type IIIA MD)	(S4c.41)
2.73	0.0099	9	**avid pulmonary? (nodules|nodule|cutaneous)? or pleural? (effusion|destructive bone| subcutaneous)? lesion? is? (identified|detected| noted|effusions) .**	METASTATIC DISEASE (Type IIIB MD)	(S4c.42)
2.73	0.0099	9	**cutaneous or subcutaneous? lesion is (detected|demonstrated)? (identified|in the head and neck) .**		(S4c.43)
2.73	0.0099	9	**is (identified|detected) elsewhere? . (M0|both on metabolic and anatomic grounds) .**	STAGE	(S4c.44)
2.73	0.0099	9	**the (right|left|remaining) oropharynx**		(S4c.45)

Table S4: Full list of features listed mined by TEPAPA (FDG-PET/CT reports) – (Cont'd)

Table S4(d): Positive binary features (regular expressions) with sequence-level annotation using UMLS vocabulary

Log (OR)	P	N	Pattern	Comments	Crossref.
1.94	0.00028	38	the (body|nasopharynx|vallecula|retroperitoneum|skeleton|PET scan|abdomen , pelvis inguinal regions|right lower lobe|previous scan|current study|primary site|oropharynx|base of tongue|hyoid bone|thorax|pharyngeal mucosal space|uterus|solid abdominal organs|trunk) .	SITE, TUMOUR LOCATION (Type IIIB MD)	(S4d.1)
2.93	0.0003	19	avid (pulmonary nodules|lytic|pulmonary nodule|cutaneous) or	METASTATIC DISEASE (Type IIIA MD)	(S4d.2)
3.20	0.001	13	No FDG avid? (pulmonary nodules|pulmonary nodule) or pleural	METASTATIC DISEASE	(S4d.3)
3.20	0.001	13	is (identified|detected) . both? on		(S4d.4)
2.74	0.0014	17	, adrenal glands ,? spleen , adrenal glands ,? gallbladder ,? pancreas		(S4d.5)
1.94	0.002	23	in the? (the|left|remaining) oropharynx		(S4d.6)
3.09	0.0023	12	lesion is (identified|detected) . both? on		(S4d.7)
3.09	0.0023	12	No (pulmonary nodules|FDG avid)? pulmonary nodule? (or pleural|new) abnormality	METASTATIC DISEASE	(S4d.8)
2.20	0.0026	20	FDG avid (pulmonary nodules|lytic|pulmonary nodule|cutaneous)? or	METASTATIC DISEASE (Type IIIA MD)	(S4d.9)
2.64	0.0029	16	right (.|vallecula|tonsil SCC|cubital fossa) .	SITE	(S4d.10)
1.61	0.0037	28	lymphadenopathy is (identified|detected|demonstrated|seen) in		(S4d.11)
1.61	0.0037	28	There is (no|an intensely|physiological|mild|marked) FDG		(S4d.12)
2.98	0.005	11	No intracranial space? (suspicious osseous|-occupying|occupying) lesion is (identified|detected) . both? on	METASTATIC DISEASE	(S4d.13)
2.98	0.005	11	the (neck ,|injection site)? (previous PET CT scan performed|particularly)? in		(S4d.14)
2.98	0.005	11	for (staging|restaging) FDG-PET scan		(S4d.15)
2.98	0.005	11	normal (-appearing|appearing) liver		(S4d.16)
2.86	0.0051	10	is (identified|detected)? (. both on|complete) metabolic		(S4d.17)
2.86	0.0051	10	spleen , (kidneys and|adrenals ,)? pancreas		(S4d.18)
2.86	0.0051	10	bowel (activity|loops) .		(S4d.19)
2.86	0.0051	10	for (staging|restaging) FDG-PET scan .		(S4d.20)
2.01	0.0054	18	pulmonary nodule or (pleural effusion|pleural abnormality) is		(S4d.21)
2.43	0.0062	14	the remaining? oropharynx ,		(S4d.22)
2.43	0.0062	14	in the? remaining? oropharynx , oral cavity ,? nasopharynx ,? hypopharynx		(S4d.23)
2.43	0.0062	14	, in keeping with? a? (non|high) -		(S4d.24)
2.43	0.0062	14	No FDG avid (pulmonary nodules|pulmonary	METASTATIC	(S4d.25)

Log (OR)	P	N	Pattern	Comments	Crossref.
			nodule)? or	DISEASE	
2.73	0.0099	9	**: No FDG avid cervical? (lymphadenopathy|suspicious osseous lesion|new finding) is**	METASTATIC DISEASE	(S4d.26)
2.73	0.0099	9	**FDG avid (pulmonary nodules|pulmonary nodule|cutaneous)? or (pleural effusion|pleural effusions|destructive bone lesion|subcutaneous lesion) is? (identified|detected|noted)? .**	METASTATIC DISEASE (Type IIIA MD)	(S4d.27)
2.73	0.0099	9	**FDG avid cervical? (lymphadenopathy|mucosal) , subcutaneous? or cutaneous lesion? is demonstrated**	TUMOUR LOCATION (Type IIIB MD)	(S4d.28)
2.73	0.0099	9	**kidneys and (bowel loops|urinary bladder are of normal appearance) .**		(S4d.29)
2.73	0.0099	9	**No (other|new)? pulmonary nodule or pleural? abnormality is identified**	METASTATIC DISEASE (Type IIIA MD)	(S4d.30)
2.73	0.0099	9	**is (identified|detected) elsewhere? . (M0|both on metabolic and anatomic grounds) .**	STAGE	(S4d.31)
2.73	0.0099	9	**pulmonary nodules or pleural abnormality? (or pleural effusions|are detected) .**	METASTATIC DISEASE (Type IIIA MD)	(S4d.32)
2.73	0.0099	9	**right (level IIA|retropharyngeal|tonsil SCC|tonsil|paratracheal) and**	NODAL, SITE	(S4d.33)
2.73	0.0099	9	**the (right|left|remaining) oropharynx**		(S4d.34)
2.73	0.0099	9	**the (superior|apical) segment**		(S4d.35)

Table S4(e): Negative binary features (n-gram) without sequence-level annotation

Log (OR)	P	N	Pattern	Comments	Crossref.
-3.23	0.0026	6	**on the background of**		(S4e.1)
-3.23	0.0026	6	**and anterior**		(S4e.2)
-2.64	0.0049	8	**Distant Disease :**		(S4e.3)
-3.02	0.0074	5	**which may**		(S4e.4)
-3.02	0.0074	5	**subglottic**		(S4e.5)
-1.39	0.0083	36	**intense**		(S4e.6)
-1.84	0.0088	12	**moderately**		(S4e.7)

Table S4(f): Negative binary features (n-gram) with sequence-level annotation using UMLS vocabulary

Log (OR)	P	N	Pattern	Comments	Crossref.
-3.23	0.0026	6	**on the background of**		(S4f.1)
-2.64	0.0049	8	**Distant Disease :**		(S4f.2)
-3.02	0.0074	5	**and anterior**		(S4f.3)
-3.02	0.0074	5	**infiltration**		(S4f.4)
-3.02	0.0074	5	**which may**		(S4f.5)
-3.02	0.0074	5	**subglottic**		(S4f.6)
-3.02	0.0074	5	**- No hypermetabolic/ enlarged lymph nodes are detected**	NODAL	(S4f.7)
-1.39	0.0083	36	**intense**		(S4f.8)
-1.84	0.0088	12	**moderately**		(S4f.9)

Table S4: Full list of features listed mined by TEPAPA (FDG-PET/CT reports) – (Cont'd)

Table S4(g): Negative binary features (regular expressions) without sequence-level annotation

Log (OR)	P	N	Pattern	Comments	Crossref.
-1.98	0.0014	16	**intense (hypermetabolism|increased FDG activity) .**		(S4g.1)
-2.15	0.0016	14	**is (noted without abnormal|intense) hypermetabolism**		(S4g.2)
-2.64	0.0049	8	**the (right|left|true)? vocal cord**	SITE	(S4g.3)
-2.64	0.0049	8	**hilar lymph? (nodes|node) .**		(S4g.4)
-3.02	0.0074	5	**- No (hypermetabolic.enlarged|hypermetabolic. enlarged) lymph nodes are detected**		(S4g.5)
-3.02	0.0074	5	**the (right|left|true) vocal**		(S4g.6)
-3.02	0.0074	5	**nodes (, measuring up|are considered more likely) to**		(S4g.7)
-1.84	0.0088	12	**the (anterior|lateral|inferior) aspect**	TUMOUR LOCATION (Type IIIB MD)	(S4g.8)
-1.84	0.0088	12	**anterior (to|segment|margin|aspect) of? the**	TUMOUR LOCATION (Type IIIB MD)	(S4g.9)

Table S4(h): Negative binary features (regular expressions) with sequence-level annotation using UMLS vocabulary

Log (OR)	P	N	Pattern	Comments	Crossref.
-1.98	0.0014	16	**intense (hypermetabolism|increased FDG activity) .**		(S4h.1)
-2.15	0.0016	14	**is (noted without abnormal|intense) hypermetabolism**		(S4h.2)
-2.64	0.0049	8	**anterior (to|aspect of) the**	TUMOUR LOCATION (Type IIIB MD)	(S4h.3)
-1.84	0.0088	12	**the (anterior|lateral|inferior) aspect**	TUMOUR LOCATION (Type IIIB MD)	(S4h.4)
-1.84	0.0088	12	**- (No destructive bony lesion . -|There)? (CT findings|No hypermetabolic. enlarged lymph nodes)? are**		(S4h.5)
-1.59	0.0092	16	**, (III|retroperitoneum|axillary|mesenteric|2A|oropharynx) ,**		(S4h.6)

Note: In Tables S4(c), (d), (g), and (h), regular expressions that group only cardinal numbers as options [e.g. *“size (15|20|30|...) mm”*] are not shown for brevity.

Table S5. List of features mined by TEPAPA – other variables

Phenotype or variable	Measure	Est.	P	N	Pattern	Crossref.
Gender: Male	LOR	6.62	1.7×10^{-13}	69	**“He”**	(S5.1)
	LOR	4.86	8.3×10^{-9}	59	**“He (presents|attends)? now? (with|is|had)? (on|will require|underwent|requires)? a”**	(S5.2)
Gender: Female	LOR	8.26	1.6×10^{-15}	13	**“She is”**	(S5.3)
	LOR	7.08	1.2×10^{-13}	12	**“She is? (on|has)? (been|attends|presents)? now? with? a”**	(S5.4)
Age (years)	AUC	0.84	2.7×10^{-6}	21	**“at (both|the) (left|right)? lung”**	(S5.5)
	AUC	0.85	7.6×10^{-6}	18	**“AP (view of the chest|erect|semierect)? mobile? (film|projection)? .”**	(S5.6)
	AUC	0.75	0.00011	44	**“chronic”**	(S5.7)
	AUC	0.76	0.00025	22	**“retired”**	(S5.8)
Laterality: left	LOR	5.36	1.5×10^{-8}	16	**“SCC (of|involving) the left”**	(S5.9)
Laterality: right	LOR	3.96	3.3×10^{-5}	23	**“SCC of the right”**	(S5.10)
Node: positive	LOR	2.44	4.7×10^{-5}	41	**“one of”**	(S5.11)
	LOR	2.05	0.00029	46	**“Metastatic”**	(S5.12)
	LOR	2.81	0.00049	27	**“extranodal”**	(S5.13)
	LOR	3.15	0.00094	20	**“- cT2? (N1|T1|cT4)? (N2b|cT3|T3)? (N2c|cT1 N2a)? M0”**	(S5.14)
Node: negative	LOR	6.36	1×10^{-15}	21	**“N0 M0”**	(S5.15)
	LOR	2.98	7.3×10^{-5}	11	**“mm thick”**	(S5.16)
	LOR	2.79	0.00031	10	**“There is no lymphadenopathy”**	(S5.17)
Recurrent disease	LOR	4.00	1.6×10^{-11}	31	**“recurrent”**	(S5.18)
	LOR	3.33	2.7×10^{-7}	22	**“is well? known to the unit”**	(S5.19)
	LOR	3.98	5.6×10^{-6}	13	**“recurrent (SCC|squamous cell carcinoma)? (of|disease in) the”**	(S5.20)
	LOR	-2.13	7.7×10^{-5}	53	**“M0 (,|()? (p16|P16)? positive? ()|disease)? .”**	(S5.21)
Tumour site: Lip	LOR	6.96	1.3×10^{-5}	3	**“SCC of the lower? lip”**	(S5.22)
Tumour site: Nasal cavity	LOR	6.64	0.00033	2	**“: Labelled " right inferior turbinate " , the specimen consists of”**	(S5.23)
Tumour site:Oropharynx	LOR	3.45	1×10^{-8}	53	**“tongue”**	(S5.24)
	LOR	4.16	3.3×10^{-7}	33	**“tonsil”**	(S5.25)
	LOR	3.67	2.7×10^{-5}	26	**“oropharyngeal”**	(S5.26)
Tumour site: Skin	LOR	5.33	0.00013	3	**“carcinoma of skin”**	(S5.27)
Smoking: Current smoker	LOR	4.77	1×10^{-9}	17	**“cigarettes”**	(S5.28)
	LOR	4.34	2.6×10^{-6}	10	**“a (cigarette|heavy|current) smoker”**	(S5.29)
	LOR	3.60	2.3×10^{-5}	11	**“Inflammatory (pathology|scarring|in nature|changes).”**	(S5.30)
	LOR	2.64	1.7×10^{-5}	19	**“per day”**	(S5.31)
	LOR	-3.09	0.00011	24	**“nonsmoker”**	(S5.32)
Smoking: Ever smoker	LOR	3.46	6.1×10^{-6}	26	**“smoker”**	(S5.33)
	LOR	3.18	9.8×10^{-5}	23	**“cigarette”**	(S5.34)
	LOR	3.09	0.00011	22	**“consumption”**	(S5.35)
	LOR	3.85	1.4×10^{-5}	21	**“a reformed? (cigarette|heavy|current) smoker”**	(S5.36)
	LOR	-4.54	2.6e-11	24	**“nonsmoker”**	(S5.37)
Alcohol: Current user	LOR	3.65	6.7×10^{-5}	22	**“g of alcohol? daily .”**	(S5.38)
Alcohol: Never consumed	LOR	-5.36	3.5×10^{-7}	7	**“is a nonsmoker and? a? nondrinker”**	(S5.39)

The rediscovery of these concepts related to categorical clinicopathologic variables can be viewed as “positive controls”. NB: Est. Estimate; LOR: log odds ratios; AUC: area under the ROC curve.

Table S6. Numeric features mined by TEPAPA

Rediscovery of concepts related to clinicopathologic variables from the ranked patterns:

Variable	Corpus	ρ	P	N	Pattern	Crossref.
Age at diagnosis (years)	MDT	1	1.4×10^{-37}	30	**“id : <PATIENTID/> <DATE/>** *<NUMBER/>* **<DOCTOR/>”**	(S6.1)
	Path	-0.69	0.0029	16	**“depth of** *<NUMBER/>* **mm”**	(S6.2)
	PET	-0.69	0.0087	13	**“suv max** *<NUMBER/>*”**	(S6.3)
Alcohol amount (g/day)	MDT	1	$<1\times10^{-100}$	15	**“***<NUMBER/>* **g of alcohol daily”**	(S6.4)
	MDT	1	3.4×10^{-51}	7	**“consumes** *<NUMBER/>* **g of alcohol daily”**	(S6.5)
Ceased smoking (*X* years ago)	MDT	0.98	3.3×10^{-5}	8	**“***<NUMBER/>* **pack”**	(S6.6)
Last smoked (*X* years ago)	MDT	1	6.4×10^{-11}	3	**“ceasing** *<NUMBER/>*”**	(S6.7)
HPV/P16 status*	PET	1	0.02	9	**“SUV max** *<NUMBER/>* **) localised to the”**	(S6.8)
	MDT	0.81	0.0099	24	**“***<NUMBER/>* **cm”**	(S6.9)
	Path				*(None discovered)*	

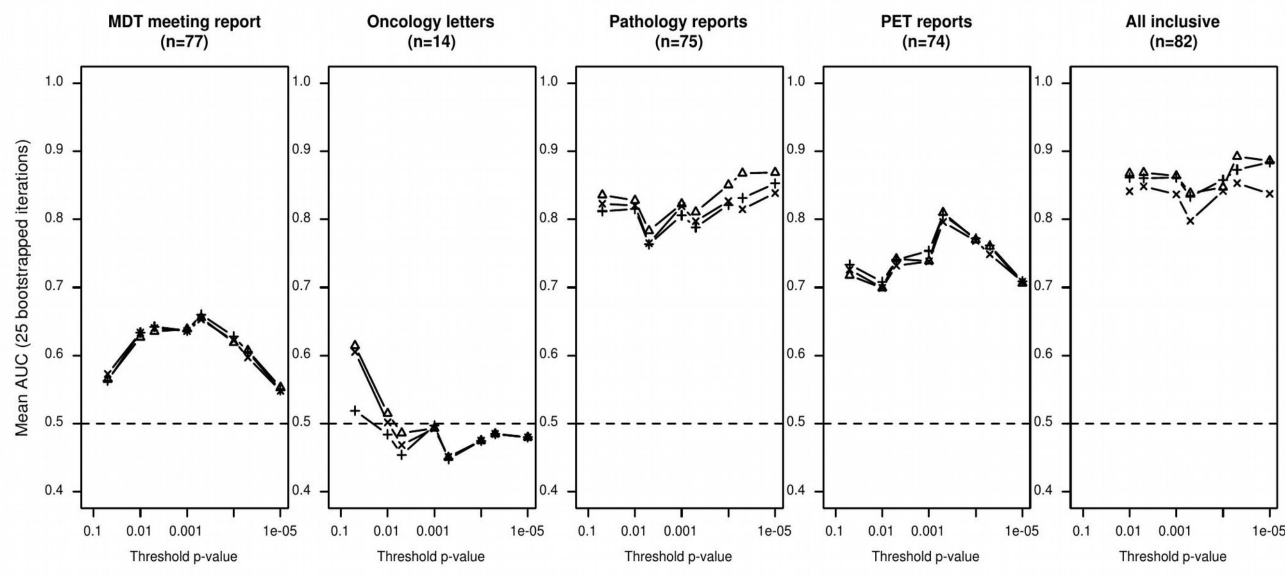
* Index phenotype

Table S7. Relative computational time by pipeline variation (annotation, sequence-level sequence-level annotation, threshold selection methods).

Pipeline variations	Corpus type									
	MDT reports (N=77)		**Oncology clinic letters (N=14)**		**Pathology reports (N=75)**		**FDG-PET reports (N=74)**		**All inclusive (N=82)**	
	Est.	P	Est.	P	Est.	P	Est.	P	Est.	P
Mean *(x reference)*	2.93		(Ref)		12.83		5.46		51.36	
Annotation method										
None	(Ref.)									
POSTAG	5.64	<0.001	3.04	<0.001	5.34	<0.001	2.27	<0.001	NA	
SPARSE	2.45	<0.001	1.91	<0.001	1.17	0.001	1.36	<0.001	NA	
STEM	2.14	<0.001	2.22	<0.001	2.11	<0.001	2.05	<0.001	2.18	<0.001
UMLS	0.89	0.012	1.50	<0.001	0.91	0.047	0.98	0.405	0.94	<0.001
Post-progressing										
None	(Ref)									
REGEXI	1.07	0.013	1.06	0.013	1.12	<0.001	1.06	<0.001	1.02	0.129
Threshold selection										
Dev. opt. thres.	0.99	0.259	0.99	0.004	1.03	<0.001	1.04	<0.001	0.99	0.180
Adjusted R^2	0.94		0.87		0.92		0.92		0.94	

Multiple regression analysis of the factors affecting relative computational time by pipeline variations. NB: Abbreviations: FDG-PET/CT:18F-fluorodeoxyglucose Positron Emission Tomography/ Computed Tomography; MDT: multidisciplinary team; POSTAG: Part-of-speech tagging with word lemmatization; REGEXI: regular expression induction algorithm; SPARSE: syntactic parsing; STEM: token-level annotation by word stemming using Snowball algorithm; UMLS: sequence-level annotation using Meta-thesaurus from the United Medical Language System (UMLS) version 2016 AA.

Figure S8. Average predictive performance by classifier and feature filtering threshold


MDT meeting report
(n=77)
Oncology letters
(n=14)
Pathology reports
(n=75)
PET reports
(n=74)
All inclusive
(n=82)
Mean AUC (25 bootstrapped iterations)
1e-05
Threshold p-value