

**eTable 1:** International Classification of Diseases for Oncology, third edition (ICD-O-3) codes for each index potentially HPV-associated cancer

<b>Index malignancies</b>	<b>ICD-O-3 primary site codes</b>	<b>ICD-O-3 Histology codes</b>
Oropharyngeal	C10.0-C10.9, C09.0-C09.9, C01.9, C02.4, C14.2	8052, 8070-8076, 8078, 8083-8084
Anal	C20.9	8052, 8070-8076, 8078, 8083-8084
Uterine cervix	C53.0-C53.9	---
Vaginal	C52.9	8052, 8070-8076, 8078, 8083-8084
Vulva	C51.0-51.9	8052, 8070-8076, 8078, 8083-8084
Penile	C60.0-60.9	8052, 8070-8076, 8078, 8083-8084

**eTable 2:** Anatomic sites at elevated risks of SPMN<sup>#</sup> according to site of index potentially HPV-associated cancer, by gender, SEER 2000-2015

Site of index HPV-associated cancer	Site of SPM	Observed SPM	SIR Rate 95% CI	EAR per 10000 PYR	
<i>Overall</i>					
All index HPV-associated cancer	<b>All Sites excluding Non-Melanoma Skin Non-HPV-associated SPMN</b>	8,203	1.73 (1.69, 1.77)	70.72	
	Lung and Bronchus	1,828	2.93 (2.80, 3.07)	24.63	
	Oral Cavity and Pharynx	840	7.30 (6.82, 7.81)	14.83	
	Esophagus	188	4.09 (3.53, 4.72)	2.91	
	Pharynx	135	8.50 (7.13, 10.06)	2.44	
	Thyroid	218	1.80 (1.57, 2.05)	1.98	
	Kidney and Renal Pelvis	246	1.56 (1.37, 1.77)	1.81	
	Larynx	109	3.13 (2.57, 3.77)	1.52	
	Urinary Bladder	265	1.32 (1.17, 1.49)	1.31	
	<b>HPV-associated SPMN</b>				
	Vulva	409	26.76 (24.23, 29.48)	8.05	
	Vaginal	171	36.36 (31.11, 42.23)	3.40	
	Cervical	144	3.36 (2.83, 3.95)	2.07	
	Penile	60	17.56 (13.40, 22.61)	1.16	
	Anal	136	1.44 (1.21, 1.70)	0.85	
	Oropharynx	44	9.58 (6.96, 12.87)	0.81	
	<i>Both male and female</i>				
	<b>Oropharynx</b>	<b>All Sites excluding Non-Melanoma Skin Non-HPV-associated SPMN</b>	4,001	1.83 (1.78, 1.89)	109.78
		Lung and Bronchus	1,038	3.48 (3.27, 3.70)	44.67
		Tongue	344	14.83 (13.30, 16.48)	19.36
Esophagus		168	5.35 (4.57, 6.23)	8.25	
Pharynx		123	11.76 (9.78, 14.03)	6.79	
Larynx		94	3.84 (3.10, 4.70)	4.20	
Hypopharynx		58	12.31 (9.35, 15.91)	3.22	
Thyroid		78	2.75 (2.18, 3.43)	3.00	
Floor of Mouth		45	11.86 (8.65, 15.87)	2.49	
Kidney and Renal Pelvis		117	1.33 (1.10, 1.59)	1.75	
Nasopharynx		25	9.78 (6.33, 14.43)	1.35	
<b>HPV-associated SPMN</b>					
Anal		58	1.23 (0.94, 1.59)	0.66	
Vulvar		4	2.22 (0.60, 5.68)	0.13	
Cervical		5	1.53 (0.49, 3.56)	0.10	
Vaginal		2	3.64 (0.41, 13.13)	0.09	
Penile		3	1.03 (0.21, 3.01)	0.01	

**Anal**

<b>All Sites excluding Non-Melanoma Skin</b>	138	1.37 (1.15, 1.61)	45.32
<b>Non-HPV-associated SPMN</b>			
Lung and Bronchus	22	1.50 (0.94, 2.28)	9.02
Soft Tissue including Heart	3	5.39 (1.08, 15.75)	2.99
Acute Myeloid Leukemia	3	3.85 (0.77, 11.23)	2.72
Kidney and Renal Pelvis	5	1.61 (0.52, 3.75)	2.31
<b>HPV-associated SPMN</b>			
Vaginal	3	22.63 (4.55, 66.11)	3.51
Vulva	2	4.59 (0.52, 16.58)	1.92
Cervical	2	2.74 (0.31, 9.89)	1.56
Penile	0	0.00 (0.00, 68.92)	-0.07
Oropharynx	0	0.00 (0.00, 46.47)	-0.10

**Male****Oropharynx**

<b>All Sites excluding Non-Melanoma Skin</b>	3,318	1.76 (1.70, 1.82)	103.41
<b>Non-HPV-associated SPMN</b>			
Lung and Bronchus	849	3.33 (3.11, 3.57)	42.87
Tongue	268	12.27 (10.85, 13.84)	17.76
Esophagus	135	4.51 (3.78, 5.34)	7.58
Pharynx	100	10.06 (8.18, 12.23)	6.50
Larynx	77	3.28 (2.59, 4.10)	3.86
Thyroid	70	3.47 (2.71, 4.39)	3.60
Hypopharynx	47	10.41 (7.65, 13.84)	3.06
Floor of Mouth	31	8.80 (5.98, 12.50)	1.98
Kidney and Renal Pelvis	104	1.30 (1.06, 1.58)	1.74
Nasopharynx	21	8.79 (5.44, 13.44)	1.34
<b>HPV-associated SPMN</b>			
Anal	54	1.29 (0.97, 1.68)	0.87
Penile	3	1.03 (0.21, 3.01)	0.01
Cervical	NA	NA	NA
Vaginal	NA	NA	NA
Vulvar	NA	NA	NA

**Anal**

<b>All Sites excluding Non-Melanoma Skin</b>	40	1.28 (0.91, 1.74)	39.73
<b>Non-HPV-associated SPMN</b>			
Lung and Bronchus	8	1.78 (0.77, 3.51)	16.12
Acute Myeloid Leukemia	3	11.48 (2.31, 33.55)	12.57
Pancreas	2	2.25 (0.25, 8.12)	5.10
Colorectal	3	1.44 (0.29, 4.19)	4.18
Esophagus	1	2.08 (0.03, 11.60)	2.39
Stomach	1	1.64 (0.02, 9.10)	1.78
<b>HPV-associated SPMN</b>			
Oropharynx	0	0.00 (0.00, 82.02)	-0.21
Penile	0	0.00 (0.00, 68.92)	-0.24

	Cervical	NA	NA	NA
	Vaginal	NA	NA	NA
	Vulvar	NA	NA	NA
<b>Penile</b>				
	<b>All Sites excluding Non-Melanoma Skin</b>	361	1.41 (1.27, 1.57)	76.78
	<b>Non-HPV-associated SPMN</b>			
	Lung and Bronchus	83	2.12 (1.69, 2.63)	31.89
	Kidney and Renal Pelvis	18	1.91 (1.13, 3.02)	6.23
	Liver	8	1.64 (0.70, 3.23)	2.26
	Acute Myeloid Leukemia	5	2.17 (0.70, 5.05)	1.96
	Pancreas	10	1.34 (0.64, 2.46)	1.84
	Floor of Mouth	2	5.65 (0.63, 20.39)	1.20
	<b>HPV-associated SPMN</b>			
	Anal	7	1.35 (0.54, 2.77)	1.31
	Oropharynx	0	0.00 (0.00, 12.43)	-0.21
	Cervical	NA	NA	NA
	Vaginal	NA	NA	NA
	Vulvar	NA	NA	NA

*Female*

<b>Oropharynx</b>				
	<b>All Sites excluding Non-Melanoma Skin</b>	683	2.29 (2.12, 2.47)	142.42
	<b>Non-HPV-associated SPMN</b>			
	Lung and Bronchus	189	4.36 (3.76, 5.02)	53.90
	Tongue	76	55.68 (43.87, 69.69)	27.62
	Esophagus	33	22.66 (15.59, 31.82)	11.68
	Pharynx	23	44.93 (28.47, 67.42)	8.32
	Larynx	17	16.94 (9.86, 27.12)	5.92
	Floor of Mouth	14	51.34 (28.01, 86.14)	5.08
	Colorectal	28	1.33 (0.89, 1.93)	2.59
	Liver	9	3.41 (1.56, 6.48)	2.36
	Kidney and Renal Pelvis	13	1.62 (0.86, 2.77)	1.84
	Nasopharynx	4	23.66 (6.37, 60.59)	1.42
	Soft Tissue including Heart	5	3.19 (1.03, 7.45)	1.27
	Stomach	7	1.94 (0.78, 3.99)	1.25
	<b>HPV-associated SPMN</b>			
	Vulvar	4	2.22 (0.60, 5.68)	0.81
	Cervical	5	1.53 (0.49, 3.56)	0.64
	Vaginal	2	3.64 (0.41, 13.13)	0.54
	Anal	4	0.77 (0.21, 1.98)	-0.44
	Penile	NA	NA	NA
<b>Anal</b>				
	<b>All Sites excluding Non-Melanoma Skin</b>	98	1.41 (1.15, 1.72)	47.76
	<b>Non-HPV-associated SPMN</b>			
	Lung and Bronchus	14	1.38 (0.75, 2.31)	6.43
	Soft Tissue including Heart	3	8.15 (1.64, 23.81)	4.40

	Kidney and Renal Pelvis	4	2.15 (0.58, 5.49)	3.57
	Liver	2	3.30 (0.37, 11.93)	2.33
	Urinary Bladder	3	1.68 (0.34, 4.92)	2.03
	Larynx	1	4.35 (0.06, 24.22)	1.29
	<b>HPV-associated SPMN</b>			
	Vaginal	3	22.63 (4.55, 66.11)	4.79
	Vulva	2	4.59 (0.52, 16.58)	2.61
	Cervix Uteri	2	2.74 (0.31, 9.89)	2.12
	Oropharynx	0	0.00 (0.00, 107.21)	-0.06
	Penile	NA	NA	NA
<b>Cervical</b>				
	<b>All Sites excluding Non-Melanoma Skin</b>	2,498	1.50 (1.44, 1.56)	32.56
	<b>Non-HPV-associated SPMN</b>			
	Lung and Bronchus	478	2.49 (2.27, 2.72)	11.23
	Urinary Bladder	101	3.22 (2.62, 3.92)	2.73
	Thyroid	117	1.53 (1.27, 1.84)	1.60
	Kidney and Renal Pelvis	77	1.79 (1.41, 2.24)	1.33
	Ovary	76	1.52 (1.20, 1.90)	1.02
	Colorectal	131	1.24 (1.03, 1.47)	1.00
	<b>HPV-associated SPMN</b>			
	Vaginal	122	41.32 (34.31, 49.33)	4.67
	Vulva	45	4.80 (3.50, 6.43)	1.40
	Anal	50	1.63 (1.21, 2.14)	0.76
	Oropharynx	3	3.88 (0.78, 11.33)	0.09
	Penile	NA	NA	NA
<b>Vulvar</b>				
	<b>All Sites excluding Non-Melanoma Skin</b>	1,045	2.29 (2.16, 2.44)	150.28
	<b>Non-HPV-associated SPMN</b>			
	Lung and Bronchus	178	2.66 (2.28, 3.08)	28.30
	Kidney and Renal Pelvis	26	2.20 (1.44, 3.22)	3.62
	Urinary Bladder	20	1.57 (0.96, 2.42)	1.85
	Liver	9	2.24 (1.02, 4.25)	1.27
	Soft Tissue including Heart	7	2.84 (1.14, 5.84)	1.16
	Thyroid	15	1.38 (0.77, 2.28)	1.06
	Tongue	6	2.97 (1.08, 6.47)	1.02
	<b>HPV-associated SPMN</b>			
	Vagina	29	32.54 (21.79, 46.74)	7.17
	Cervix Uteri	16	3.42 (1.95, 5.56)	2.89
	Anal	9	1.10 (0.50, 2.09)	0.21
	Oropharynx	1	4.70 (0.06, 26.17)	0.20
	Penile	NA	NA	NA
<b>Vaginal</b>				
	<b>All Sites excluding Non-Melanoma Skin</b>	164	1.85 (1.57, 2.15)	103.70
	<b>Non-HPV-associated SPMN</b>			
	Lung and Bronchus	29	2.19 (1.47, 3.15)	21.74
	Colorectal	14	1.84 (1.01, 3.09)	8.82

Urinary Bladder	6	2.43 (0.89, 5.29)	4.87
Thyroid	5	2.58 (0.83, 6.02)	4.22
Female Breast	26	1.06 (0.69, 1.55)	2.01
Liver	2	2.32 (0.26, 8.37)	1.57
Floor of Mouth	1	12.86 (0.17, 71.56)	1.27
Lip	1	11.13 (0.15, 61.92)	1.26
<b>HPV-associated SPMN</b>			
Vulva	22	37.98 (23.79, 57.50)	29.55
Cervix Uteri	3	3.38 (0.68, 9.86)	2.91
Oropharynx	0	0.00 (0.00, 88.37)	-0.06
Anal	1	0.62 (0.01, 3.47)	-0.83
Penile	NA	NA	NA

SPMN = Second primary malignant neoplasm; SEER = Surveillance, Epidemiology, and End Results; SIR = Standardized incidence ratio; EAR = Excess absolute risk; PYR = Person-year at risk; CI = Confidence interval  
<sup>#</sup>Only non-HPV-associated SPMNs with EAR  $\geq$ 1 are shown