

Supplementary Online Content

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eAppendix 1. Cancer Diagnosis Codes

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This supplementary material has been provided by the authors to give readers additional information about their work.

eAppendix 1. Cancer Diagnosis Codes

Patients were grouped based on the cancer type and the expected future metastatic location and identified as having cancers with a high prevalence or likelihood of pain based on expected metastatic progression.

Group 1: Bony (these will eventually impact the nervous system as well)

- 170.0-176.9 Malignant neoplasm of bone, connective tissue, skin, and breast
- 185 Malignant neoplasm of prostate
- 189 Malignant neoplasm of kidney and other and unspecified urinary organs
- 193 Malignant neoplasm of thyroid gland
- 194 Malignant neoplasm of other endocrine glands and related structures
- 203 Multiple myeloma and immunoproliferative neoplasms
- 204 Lymphoid leukemia
- 205 Myeloid leukemia
- 206 Monocytic leukemia
- 207 Other specified leukemia
- 208 Leukemia of unspecified cell type
- 195.0 Malignant neoplasm of head, face, and neck
- 195.1 Malignant neoplasm of thora
- 195.3 Malignant neoplasm of pelvis
- 195.4 Malignant neoplasm of upper limb
- 195.5 Malignant neoplasm of lower limb
- 198.2 Secondary malignant neoplasm of skin
- 198.5 Secondary malignant neoplasm of bone and bone marrow
- 198.81 Secondary malignant neoplasm of breast
- 198.82 Secondary malignant neoplasm of genital organs
- 235.0 Neoplasm of uncertain behavior of major salivary glands
- 235.1 Neoplasm of uncertain behavior of lip, oral cavity, and pharynx
- 235.6 Neoplasm of uncertain behavior of larynx
- 236.3 Neoplasm of uncertain behavior of other and unspecified female genital organs
- 236.4 Neoplasm of uncertain behavior of testis
- 236.6 Neoplasm of uncertain behavior of other and unspecified male genital organs

- 238.0 Neoplasm of uncertain behavior of bone and articular cartilage
- 238.1 Neoplasm of uncertain behavior of connective and other soft tissue
- 238.2 Neoplasm of uncertain behavior of skin
- 238.3 Neoplasm of uncertain behavior of breast
- 238.5 Neoplasm of uncertain behavior of histiocytic and mast cell
- 238.6 Neoplasm of uncertain behavior of plasma cells
- 238.71 Essential thrombocythemia
- 238.72 Low grade myelodysplastic syndrome lesions
- 238.73 High grade myelodysplastic syndrome lesions
- 238.74 Myelodysplastic syndrome with 5q deletion
- 238.75 Myelodysplastic syndrome, unspecified
- 238.76 Myelofibrosis with myeloid metaplasia
- 238.77 Post-transplant lymphoproliferative disorder (PTLD)
- 238.79 Other lymphatic and hematopoietic tissues
- 239.2 Neoplasm of unspecified nature of bone, soft tissue, and skin
- 239.3 Neoplasm of unspecified nature of breast

Group 2: Visceral

- 150 Malignant neoplasm of esophagus
- 151 Malignant neoplasm of stomach
- 152 Malignant neoplasm of small intestine including duodenum
- 153 Malignant neoplasm of colon
- 155 Malignant neoplasm of liver and intrahepatic bile ducts
- 156 Malignant neoplasm of gallbladder and extrahepatic bile ducts
- 157 Malignant neoplasm of pancreas
- 158 Malignant neoplasm of retroperitoneum and peritoneum
- 159 Malignant neoplasm of other and ill-defined sites within the digestive organs and peritoneum
- 162 Malignant neoplasm of trachea bronchus and lung
- 163 Malignant neoplasm of pleura
- 164 Malignant neoplasm of thymus heart and mediastinum
- 165 Malignant neoplasm of other and ill-defined sites within the respiratory system and intrathoracic organs
- 179 Malignant neoplasm of uterus, part unspecified
- 180 Malignant neoplasm of cervix uteri
- 181 Malignant neoplasm of placenta

- 182 Malignant neoplasm of body of uterus
- 183 Malignant neoplasm of ovary and other uterine adnexa
- 186 Malignant neoplasm of testis
- 188 Malignant neoplasm of bladder
- 196 Secondary and unspecified malignant neoplasm of lymph nodes
- 197 Secondary malignant neoplasm of respiratory and digestive systems
- 200 Lymphosarcoma and reticulosarcoma and other specified malignant tumors of lymphatic tissue
- 201 Hodgkin's disease
- 202 Other malignant neoplasms of lymphoid and histiocytic tissue
- 209 Neuroendocrine tumors
- 195.1 Malignant neoplasm of thorax
- 195.2 Malignant neoplasm of abdomen
- 195.3 Malignant neoplasm of pelvis
- 198.0 Secondary malignant neoplasm of kidney
- 198.1 Secondary malignant neoplasm of other urinary organs
- 198.6 Secondary malignant neoplasm of ovary
- 198.7 Secondary malignant neoplasm of adrenal gland
- 199.2 Malignant neoplasm associated with transplant organ
- 235.2 Neoplasm of uncertain behavior of stomach, intestines, and rectum
- 235.3 Neoplasm of uncertain behavior of liver and biliary passages
- 235.4 Neoplasm of uncertain behavior of retroperitoneum and peritoneum
- 235.5 Neoplasm of uncertain behavior of other and unspecified digestive organs
- 235.7 Neoplasm of uncertain behavior of trachea, bronchus, and lung
- 235.8 Neoplasm of uncertain behavior of pleura, thymus, and mediastinum
- 235.9 Neoplasm of uncertain behavior of other and unspecified respiratory organs
- 236.0 Neoplasm of uncertain behavior of uterus
- 236.1 Neoplasm of uncertain behavior of placenta
- 236.2 Neoplasm of uncertain behavior of ovary
- 236.5 Neoplasm of uncertain behavior of prostate
- 236.7 Neoplasm of uncertain behavior of bladder
- 236.90 Neoplasm of uncertain behavior of urinary organ, unspecified
- 236.91 Neoplasm of uncertain behavior of kidney and ureter
- 237.2 Neoplasm of uncertain behavior of adrenal gland
- 237.4 Neoplasm of uncertain behavior of other and unspecified endocrine glands
- 239.0 Neoplasm of unspecified nature of digestive system

- 239.1 Neoplasm of unspecified nature of respiratory system
- 239.4 Neoplasm of unspecified nature of bladder
- 239.5 Neoplasm of unspecified nature of other genitourinary organs
- 239.7 Neoplasm of unspecified nature of endocrine glands and other parts of nervous system

Group 3: Nervous system

- 140-149 Malignant Neoplasm Of Lip, Oral Cavity, And Pharynx
- 154 Malignant neoplasm of rectum rectosigmoid junction and anus
- 160 Malignant neoplasm of nasal cavities middle ear and accessory sinuses
- 161 Malignant neoplasm of larynx
- 184 Malignant neoplasm of other and unspecified female genital organs
- 187 Malignant neoplasm of penis and other male genital organs
- 190 Malignant neoplasm of eye
- 191 Malignant neoplasm of brain
- 192 Malignant neoplasm of other and unspecified parts of nervous system
- 195.0 Malignant neoplasm of head, face, and neck
- 195.1 Malignant neoplasm of thora
- 195.3 Malignant neoplasm of pelvis
- 198.3 Secondary malignant neoplasm of brain and spinal cord
- 198.4 Secondary malignant neoplasm of other parts of nervous system
- 237.0 Neoplasm of uncertain behavior of pituitary gland and craniopharyngeal duct
- 237.1 Neoplasm of uncertain behavior of pineal gland
- 237.3 Neoplasm of uncertain behavior of paraganglia
- 237.5 Neoplasm of uncertain behavior of brain and spinal cord
- 237.6 Neoplasm of uncertain behavior of meninges
- 237.70 Neurofibromatosis, unspecified
- 237.71 Neurofibromatosis, type 1 [von recklinghausen's disease]
- 237.72 Neurofibromatosis, type 2 [acoustic neurofibromatosis
- 237.73 Schwannomatosis
- 237.79 Other neurofibromatosis
- 237.9 Neoplasm of uncertain behavior of other and unspecified parts of nervous system
- 239.6 Neoplasm of unspecified nature of brain
- 239.7 Neoplasm of unspecified nature of endocrine glands and other parts of nervous system
- 239.81 Neoplasms of unspecified nature, retina and choroid

eAppendix 2. Chemotherapy and Radiation Therapy

The following procedure codes were used to identify patients who were receiving chemotherapy or radiation treatment.

Chemotherapy:

- CPT codes:
96401, 96402, 96405, 96406, 96409, 96411, 96413, 96415, 96416, 96417, 96420, 96422, 96423, 96425, 96440, 96450, 96542, 96549, 36823, 51720, 61517
- ICD-9 procedure codes:
99.25, 99.28, 00.10, 00.15, 17.70

Radiation therapy:

- CPT codes:
0073T, 77401, 77402, 77403, 77404, 77406, 77407, 77408, 77409, 77411, 77412, 77413, 77414, 77416, 77418, 77422, 77423, 77424, 77425, 77520, 77522, 77523, 77525, 77750, 77761, 77762, 77763, 77776, 77777, 77778, 77785, 77786, 77787, 77789, 77790, 77799, 0182T, G0458, 79005, 79101, 79200, 79300, 79403, 79440, 79445, 79999, 32701, 51020, 52250, 61796, 61797, 61798, 61799, 63620, 63621, 67218, 77371, 77372, 77373, G0173, G0251, G0339, G0340, 19296, 19297, 19298, 20555, 31643, 32553, 41019, 49327, 49411, 49412, 55860, 55862, 55865, 55875, 55876, 55920, 57155, 57156, 58346, 61770, 61800, 92974, 0190T, C9725, C9726, C9728, 77261, 77262, 77263, 77280, 77285, 77290, 77295, 77299, 77300, 77301, 77305, 77310, 77315, 77321, 77326, 77327, 77328, 77331, 77332, 77333, 77334, 77336, 77338, 77370, 77399, 77427, 77431, 77432, 77435, 77469, 77470, 77499
- ICD-9 procedure codes:
V58.0, 92.21, 92.22, 92.23, 92.24, 92.25, 92.26, 92.29, 92.20, 92.27, 92.28, 92.30, 92.31, 92.32, 92.33, 92.39, 92.41

eAppendix 3. Tumor Ablation, Biopsy, Tumor Destruction, Tumor Excision, and Tumor Resection

The CPT code list of tumor excision, destruction, ablation, resection and biopsy is below.

Tumor Excision:

11600, 11601, 11602, 11603, 11604, 11606, 11620, 11621, 11622, 11623, 11624, 11626, 11620, 11641, 11642, 11643, 11644, 11646, 17311, 17312, 17313, 17314, 17315, 19120, 19260, 19271, 19272, 21011, 21012, 21013, 21014, 21015, 21034, 21044, 21045, 21552, 21554, 21555, 21556, 21557, 21930, 21931, 21932, 21933, 22100, 22101, 22102, 22110, 22112, 22114, 22900, 22901, 22902, 22903, 23071, 23073, 23075, 23076, 23077, 24071, 24073, 24075, 24076, 24077, 25071, 25073, 25075, 25076, 25077, 25170, 26111, 26113, 26115, 26116, 26117, 25170, 26111, 26113, 26115, 26116, 26117, 26250, 26260, 26261, 26262, 27043, 27045, 27047, 27048, 27049, 27075, 27076, 27077, 27078, 27079, 27327, 27328, 27337, 27339, 27616, 27618, 27619, 27632, 27634, 28039, 28041, 28043, 28045, 28046, 31300, 31540, 31541, 31578, 31640, 31785, 31786, 32503, 32504, 32661, 32662, 33050, 33120, 33130, 39220, 41825, 41826, 41827, 42410, 42415, 42420, 42425, 42426, 43216, 43217, 43228, 43250, 43251, 43611, 44364, 44365, 44392, 44394, 45160, 45170, 45171, 45172, 45308, 45309, 45315, 45333, 45338, 45384, 45385, 46610, 46611, 46612, 47711, 47712, 49215, 51530, 52234, 52235, 52240, 52355, 53220, 54530, 54535, 57135, 58943, 60252, 60254, 60545, 61500, 61510, 61518, 61520, 61521, 61526, 61530, 61545, 61546, 61548, 62164, 62165, 68540, 68550, 69550, 69552, 69554, 69970, 0184T

Tumor Destruction:

17260, 17261, 17262, 17263, 17264, 17266, 17270, 17271, 17272, 17273, 17274, 17276, 17280, 17281, 17282, 17283, 17284, 17286, 31641, 43272, 44393, 45190, 45320, 45383, 46938, 49203, 49204, 49205, 0341T

Tumor Ablation:

20982, 20983, 32998, 43229, 43258, 43270, 43278, 44369, 44401, 45339, 45346, 45388, 45615, 47370, 47371, 47380, 47381, 47382, 47383, 50250, 50542, 50592, 50593, 0340T

Tumor Resection:

21016, 21558, 21935, 21936, 22904, 22905, 23078, 23200, 23210, 23220, 23221, 23222, 24079, 24150, 24151, 24152, 24153, 25078, 26118, 27059, 27329, 27364, 27365, 27615, 27645, 27646, 27647, 28047, 28171, 28173, 28175, 32505, 32506, 32507, 32666, 32667, 32668, 50562, 58957, 58958, 61600, 61601, 61605, 61606, 61607, 61608, 61615, 61616, 63101, 63102, 63103

Biopsy:

11100, 11101, 11755, 19081, 19082, 19083, 19084, 19085, 19086, 19100, 19101, 19102, 19103, 20200, 20205, 20206, 20220, 20225, 20240, 20245, 20250, 20251, 21550, 21920, 21925, 23065, 23066, 23100, 23101, 24065, 24066, 24100, 24101, 25065, 25066, 25100, 25101, 26100, 26105, 26110, 27040, 27041, 27050, 27052, 27323, 27324, 27330, 27331, 27613, 27614, 27620, 28050, 28052, 28054, 29800, 29805, 29830, 29840, 29860, 29870, 29900, 30100, 31050, 31051, 31237, 31510, 31535, 31536, 31576, 31625, 31628, 31629, 31632, 31633, 32095, 32096, 32097, 32098, 32100, 32400, 32402, 32405, 32604, 32606, 32607, 32608, 32609, 37200, 37609, 38221, 38500, 38505, 38510, 38520, 38525, 38530, 38570, 38572, 39400, 40490, 40808, 41100, 41105, 41108, 42100, 42400, 42405, 42800, 42802, 42804, 42806, 43193, 43198, 43202, 43232, 43238, 43239, 43242, 43261, 43600, 43605, 44010, 44020, 44025, 44100, 44322, 44361, 44377, 44382, 44386, 44389, 44407, 45100, 45305, 45331, 45342, 45380, 45392, 46606, 46607, 47000, 47001, 47100, 47553, 47561, 48100, 48102, 49000, 49010, 49180, 49321, 50200, 50205, 50555, 50557, 50574, 50576, 50955, 50957, 50974, 50976, 52204, 52224, 52250, 52354, 53200, 54100, 54105, 54500, 54505, 54800, 54865, 55700, 55705, 55706, 56605, 56606, 56821, 57100, 57105, 57421, 57454, 57455, 57460, 57500, 58100, 58110, 58558, 58900, 59015, 60100, 60540, 60545, 61140, 61332, 61575, 61576, 61750, 61751, 62269, 63275, 63276, 63277, 63278, 63820, 63281, 63282, 63283, 63285, 63286, 63287, 63290, 63615, 64795, 6540, 67346, 67400, 67415, 67450, 67810, 68100, 68510, 68525, 69100, 69105, 93505

eTable. Charlson Comorbidity Index

Charlson Comorbidity	ICD-9 Diagnosis Code
Myocardial Infarction	410.x, 412.x
Congestive Heart Failure	398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 425.4–425.9, 428.x
Peripheral Vascular Disease	093.0, 437.3, 440.x, 441.x, 443.1–443.9, 47.1, 557.1, 557.9, V43.4
Cerebrovascular Disease	362.34, 430.x–438.x
Dementia	290.x, 294.1, 331.2
Chronic Pulmonary Disease	416.8, 416.9, 490.x–505.x, 506.4, 508.1, 508.8
Rheumatic Disease	446.5, 710.0–710.4, 714.0–714.2, 714.8, 725.x
Peptic Ulcer Disease	531.x–534.x
Mild Liver Disease	070.22, 070.23, 070.32, 070.33, 070.44, 070.54, 070.6, 070.9, 570.x, 571.x, 573.3, 573.4, 573.8, 573.9, V42.7
Diabetes without Chronic Complication	250.0–250.3, 250.8, 250.9
Diabetes with Chronic Complication	250.4–250.7
Paraplegia and Hemiplegia	334.1, 342.x, 343.x, 344.0–344.6, 344.9
Renal Disease	403.01, 403.11, 403.91, 404.02, 404.03, 404.12, 404.13, 404.92, 404.93, 582.x, 583.0–583.7, 585.x, 586.x, 588.0, V42.0, V45.1, V56.x

Cancer	140.x–172.x, 174.x–195.8, 200.x–208.x, 238.6
Moderate or Severe Liver Disease	456.0–456.2, 572.2–572.8
Metastatic Carcinoma	196.x–199.x
AIDS/HIV	042.x–044.x