Appendix A. Dataset for evaluation

Table 1: ICD-9 procedures and CPT codes mapping dataset

Concept Group	Procedure type	CPT	ICD-9 procedure
1	Excisional biopsy	19120 19125 19126	8512 8520 8521 8522 8524 8525
2	Lumpectomy/segmental mastectomy	19160 19301	8520 8521 8522 8523 8524 8525
3	Masctectomy	19180 19303 19182 19304	8542 8541 8534 8536
4	Mastectomy and lymph node combined procedures	19240 19307 19220 19306 19200 19305	8543 8544 8545 8546 8547
5	Lymph node excision procedures	38500 38525 38530 38740 38745	4011 4022 4023 4029 403 4051
6	Sentinel node injections	38792 38790 78195	4019 8519 9216
7	General reconstruction	19324 19366	857
8	Implant reconstruction	19325 19340 19357	8533 8535 8553 8554 8595 8599
9	Autogenous tissue flap reconstruction	19364 19361 19367 19369 69990	8571 8572 8573 8579 8584 8585
10	Chemotherapy administration	96400 96401 96402 96405 96408 96409 96410 96411 96412 96413 96414 96415 96416 96417 96420 96422 96423 96425 96445 96450 96520 96521 96522 96523 96530 96542 96545 96549	9925
11	Mammography	76082 76083 76085 76090 76091 76092 77051 770557 7056 77057 G0202 G0203 G0204 G0205 G0206 G0207 G0236	8736 8737
12	Ductography galactography	19030 76086 76088 77053 77054	8519
13	Breast and axillary ultrasound	76645 76880	8873
14	Breast MRI	76093 76094 77058 77059 76376 76377	8897
15	CT	70450 70460 70470 70480 70481 70482 70486 70487 70488 70490 70491 70492 71250 71260 71270 72125 72126 72127 72128 72129 72130 72131 72132 72133 72192 72193 72194 73200 73201 73202 73700 73701 73702 74150 74160 74170 76497	8703 8741 8771 8801 8838
16	PET and PET-CT	78811 78812 78813 78814 78815 78816 78890 78891 78999 G0235 G0253 G0254	9218 9219
17	Bone scan	78300 78305 78306 78315	9214
18	Brain MRI	70551 70552 70553	8891

Appendix B. Normalized Discounted Cumulative Gain (NDCG) for every concept group

Table 2: Average $NDCG_{50}$ of every concept groups on Task 1

	SVD	Skip-gram	CBOW	Glove	Type SVD	Type Skip-gram
Group1	0.594	0.685	0.667	0.666	0.709	0.717
Group2	0.747	0.721	0.586	0.737	0.602	0.59
Group3	0.641	0.785	0.586	0.695	0.742	0.795
Group4	0.77	0.764	0.83	0.859	0.818	0.763
Group5	0.688	0.871	0.722	0.767	0.89	0.876
Group6	0.674	0.606	0.664	0.686	0.486	0.726
Group7	0.221	0.207	0.104	0.315	0.298	0.125
Group8	0.71	0.799	0.806	0.727	0.608	0.755
Group9	0.556	0.592	0.656	0.592	0.589	0.545
Group10	0.426	0.419	0.295	0.365	0.802	0.576
Group11	0.533	0.645	0.642	0.82	0.758	0.694
Group12	0.296	0.493	0.21	0.097	0.487	0.47
Group13	0.482	0.473	0.593	0.531	0.466	0.667
Group14	0.225	0.301	0.04	0.254	0.286	0.42
Group15	0.314	0.391	0.37	0.458	0.455	0.411
Group16	0.601	0.42	0.223	0.567	0.646	0.408
Group17	0.612	1	1	1	1	1
Group18	0.81	1	1	0.877	0.833	1
Average	0.55	0.621	0.555	0.612	0.638	**0.641**

Table 3: Average $NDCG_{50}$ of every concept groups on Task 2

	SVD	Skip-gram	CBOW	Glove	Type SVD	Type Skip-gram
Group1	0.369	0.564	0.323	0.295	0.449	0.526
Group2	0.578	0.484	0.266	0.281	0.488	0.215
Group3	0.648	0.666	0.404	0.584	0.578	0.612
Group4	0.812	0.736	0.693	0.816	0.676	0.728
Group5	0.449	0.605	0.432	0.519	0.523	0.69
Group6	0.31	0.635	0.597	0.454	0.499	0.705
Group7	0.275	0.228	0.215	0.27	0.315	0.224
Group8	0.506	0.644	0.475	0.397	0.492	0.585
Group9	0.694	0.805	0.895	0.64	0.576	0.671
Group10	0.292	0.324	0.225	0.241	0.779	0.367
Group11	0.33	0.595	0.576	0.623	0.811	0.75
Group12	0.272	0	0	0	0.462	0.177
Group13	0.224	0.631	0.315	0.315	1	1
Group14	0	0	0	0.301	0	0.366
Group15	0.42	0.471	0.448	0.651	0.584	0.7
Group16	0.188	0.296	0.098	0.369	0.213	0.327
Group17	0.62	0.84	0.827	0.944	0.851	0.877
Group18	0.967	0.665	0.374	0.514	0.947	1
Average	0.442	0.51	0.398	0.456	0.569	**0.585**