

Streamlining Disease-Disease Associations Using a Deep-Learning-driven Text-Mining Approach

Nícia Rosário-Ferreira ^{1,2,†}, Victor Guimarães ^{3,4,†}, Vitor S. Costa ^{3,4}, Irina S. Moreira ^{5,6}

¹CQC - Coimbra Chemistry Center, Chemistry Department, Faculty of Science and Technology, University of Coimbra,
3004-535 Coimbra, Portugal

²CNC - Center for Neuroscience and Cell Biology, University of Coimbra, Coimbra, Portugal

³Department of Sciences, University of Porto, Porto, Portugal

⁴INESC-TEC - Centre of Advanced Computing Systems, Porto, Portugal

⁵Department of Life Sciences, University of Coimbra, Calçada Martim de Freitas, 3000-456 Coimbra, Portugal

⁶CNC - Center for Neuroscience and Cell Biology, CIBB - Center for Innovative Biomedicine and Biotechnology,
University of Coimbra, Coimbra, Portugal

[†]Co-first authors

^{*}Correspondence: nicia.ferreira@student.uc.pt (NR-F) and irina.moreira@cnc.uc.pt (ISM)

Table 1 - SicknessMiner full results (organized by decreasing number of co-mentions)

SicknessMiner				
<i>Identifier 1</i>	<i>Name 1</i>	<i>Identifier 2</i>	<i>Name 2</i>	<i>Co-mentions</i>
<i>D008223</i>	Lymphoma	<i>D009369</i>	Neoplasms	31915
<i>D007938</i>	Leukemia	<i>D009369</i>	Neoplasms	28614
<i>D008223</i>	Lymphoma	<i>D030342</i>	Genetic Diseases, Inborn	25278
<i>D007938</i>	Leukemia	<i>D030342</i>	Genetic Diseases, Inborn	21078
<i>D009101</i>	Multiple Myeloma	<i>D030342</i>	Genetic Diseases, Inborn	17621
<i>D007938</i>	Leukemia	<i>D015470</i>	Leukemia, Myeloid, Acute	17065
<i>D008223</i>	Lymphoma	<i>D008228</i>	Lymphoma, Non-Hodgkin	14826
<i>D007938</i>	Leukemia	<i>D054198</i>	Precursor Cell Lymphoblastic Leukemia-Lymphoma	12625
<i>D009101</i>	Multiple Myeloma	<i>D009369</i>	Neoplasms	12205
<i>D007938</i>	Leukemia	<i>D008223</i>	Lymphoma	8721
<i>D008223</i>	Lymphoma	<i>D016403</i>	Lymphoma, Large B-Cell, Diffuse	7768
<i>D007938</i>	Leukemia	<i>D015464</i>	Leukemia, Myelogenous, Chronic, BCR- ABL Positive	7289
<i>D006689</i>	Hodgkin Disease	<i>D008223</i>	Lymphoma	6205
<i>D008223</i>	Lymphoma	<i>D016393</i>	Lymphoma, B-Cell	5987
<i>D007938</i>	Leukemia	<i>D019337</i>	Hematologic Neoplasms	5124

D008223	Lymphoma	D008224	Lymphoma, Follicular	4816
D008223	Lymphoma	D016399	Lymphoma, T-Cell	4667
D008223	Lymphoma	605027	-	4618
D007938	Leukemia	D015451	Leukemia, Lymphocytic, Chronic, B-Cell	4336
D008223	Lymphoma	D015451	Leukemia, Lymphocytic, Chronic, B-Cell	4179
D008223	Lymphoma	D020522	Lymphoma, Mantle-Cell	3533
D007938	Leukemia	D007951	Leukemia, Myeloid	3528
D008223	Lymphoma	D018442	Lymphoma, B-Cell, Marginal Zone	3256
D008223	Lymphoma	D008232	Lymphoproliferative Disorders	2993
D008223	Lymphoma	D020031	Epstein-Barr Virus Infections	2985
D008223	Lymphoma	D009101	Multiple Myeloma	2983
D007938	Leukemia	D009190	Myelodysplastic Syndromes	2943
D008223	Lymphoma	D019337	Hematologic Neoplasms	2921
D002051	Burkitt Lymphoma	D008223	Lymphoma	2884
D002869	Chromosome Aberrations	D007938	Leukemia	2834
D001943	Breast Neoplasms	D007938	Leukemia	2734
D007938	Leukemia	D015473	Leukemia, Promyelocytic, Acute	2727
D009101	Multiple Myeloma	D019337	Hematologic Neoplasms	2715
D007938	Leukemia	D008228	Lymphoma, Non-Hodgkin	2687
D007938	Leukemia	D054218	Precursor T-Cell Lymphoblastic Leukemia-Lymphoma	2597
D008223	Lymphoma	D015458	Leukemia, T-Cell	2387
D001943	Breast Neoplasms	D008223	Lymphoma	2361
D000163	Acquired Immunodeficiency Syndrome	D008223	Lymphoma	2358
D007938	Leukemia	D009101	Multiple Myeloma	2329
D009101	Multiple Myeloma	D010265	Paraproteinemias	2212
D008223	Lymphoma	D017728	Lymphoma, Large-Cell, Anaplastic	2194
D008223	Lymphoma	D054198	Precursor Cell Lymphoblastic Leukemia-Lymphoma	2134
D008206	Lymphatic Diseases	D008223	Lymphoma	2090
D002277	Carcinoma	D008223	Lymphoma	2027
D006086	Graft vs Host Disease	D007938	Leukemia	1982
D008228	Lymphoma, Non-Hodgkin	D009101	Multiple Myeloma	1948
D008223	Lymphoma	D015658	HIV Infections	1939
D007938	Leukemia	D007945	Leukemia, Lymphoid	1906
D005334	Fever	D008223	Lymphoma	1878
D007938	Leukemia	D054221	Classical Lissencephalies and Subcortical Band Heterotopias	1836
D007938	Leukemia	D015458	Leukemia, T-Cell	1812
D007938	Leukemia	D015456	Leukemia, Biphenotypic, Acute	1784
D006402	Hematologic Diseases	D007938	Leukemia	1751
D001327	Autoimmune Diseases	D008223	Lymphoma	1680
D008223	Lymphoma	D015470	Leukemia, Myeloid, Acute	1633
D008175	Lung Neoplasms	D008223	Lymphoma	1599
D001847	Bone Diseases	D009101	Multiple Myeloma	1548

D008223	Lymphoma	D008545	Melanoma	1524
D008223	Lymphoma	D015459	Leukemia-Lymphoma, Adult T-Cell	1521
D008223	Lymphoma	D016410	Lymphoma, T-Cell, Cutaneous	1489
D007938	Leukemia	D007948	Leukemia, Monocytic, Acute	1478
D009101	Multiple Myeloma	D010954	Plasmacytoma	1469
D006689	Hodgkin Disease	D007938	Leukemia	1434
D007938	Leukemia	D008545	Melanoma	1381
D007938	Leukemia	D008175	Lung Neoplasms	1379
D008223	Lymphoma	D016411	Lymphoma, T-Cell, Peripheral	1373
D009101	Multiple Myeloma	D051437	Renal Insufficiency	1356
D004194	Disease	D008223	Lymphoma	1346
D003110	Colonic Neoplasms	D008223	Lymphoma	1318
D009101	Multiple Myeloma	D015451	Leukemia, Lymphocytic, Chronic, B-Cell	1297
D008223	Lymphoma	D012509	Sarcoma	1284
D007938	Leukemia	D009503	Neutropenia	1253
D008223	Lymphoma	D054391	Lymphoma, Extranodal NK-T-Cell	1219
D008998	Monoclonal Gammopathy of Undetermined Significance	D009101	Multiple Myeloma	1215
D001943	Breast Neoplasms	D009101	Multiple Myeloma	1197
D004194	Disease	D007938	Leukemia	1185
D005334	Fever	D007938	Leukemia	1184
D007938	Leukemia	D012509	Sarcoma	1164
D002869	Chromosome Aberrations	D008223	Lymphoma	1161
D000686	Amyloidosis	D009101	Multiple Myeloma	1108
D007938	Leukemia	D010051	Ovarian Neoplasms	1099
D008223	Lymphoma	D013274	Stomach Neoplasms	1077
D007938	Leukemia	D009196	Myeloproliferative Disorders	1071
D008223	Lymphoma	D015464	Leukemia, Myelogenous, Chronic, BCR-ABL Positive	1056
D007938	Leukemia	D015448	Leukemia, B-Cell	1056
D008223	Lymphoma	D016543	Central Nervous System Neoplasms	1054
D006689	Hodgkin Disease	D009101	Multiple Myeloma	1047
D007938	Leukemia	D016399	Lymphoma, T-Cell	1041
D003110	Colonic Neoplasms	D007938	Leukemia	1024
D009101	Multiple Myeloma	D015470	Leukemia, Myeloid, Acute	1023
D007945	Leukemia, Lymphoid	D008223	Lymphoma	1013
D007938	Leukemia	D013921	Thrombocytopenia	1012
D000230	Adenocarcinoma	D008223	Lymphoma	1007
D000740	Anemia	D007938	Leukemia	992
D008223	Lymphoma	D012514	Sarcoma, Kaposi	969
D008223	Lymphoma	D016609	Neoplasms, Second Primary	944
D007938	Leukemia	D016393	Lymphoma, B-Cell	910
D008223	Lymphoma	D009503	Neutropenia	909
C538324	3-Hydroxy-3-Methylglutaryl-CoA Lyase Deficiency	D008223	Lymphoma	907

D000163	Acquired Immunodeficiency Syndrome	D007938	Leukemia	906
D008223	Lymphoma	D010051	Ovarian Neoplasms	901
D008223	Lymphoma	D013577	Syndrome	898
D009101	Multiple Myeloma	D054219	Neoplasms, Plasma Cell	890
D002294	Carcinoma, Squamous Cell	D008223	Lymphoma	874
D000740	Anemia	D009101	Multiple Myeloma	867
D000741	Anemia, Aplastic	D007938	Leukemia	866
D007938	Leukemia	D055728	Primary Myelofibrosis	863
D008223	Lymphoma	D013921	Thrombocytopenia	838
D001932	Brain Neoplasms	D007938	Leukemia	832
D007674	Kidney Diseases	D009101	Multiple Myeloma	828
D001260	Ataxia Telangiectasia	D008223	Lymphoma	827
D001260	Ataxia Telangiectasia	D007938	Leukemia	820
D002051	Burkitt Lymphoma	D007938	Leukemia	819
D007938	Leukemia	D016609	Neoplasms, Second Primary	806
D002869	Chromosome Aberrations	D009101	Multiple Myeloma	806
D009101	Multiple Myeloma	D015464	Leukemia, Myelogenous, Chronic, BCR-ABL Positive	805
D002277	Carcinoma	D007938	Leukemia	795
D007239	Infections	D007938	Leukemia	766
D001932	Brain Neoplasms	D008223	Lymphoma	762
D001855	Bone Marrow Diseases	D007938	Leukemia	736
D007938	Leukemia	D011471	Prostatic Neoplasms	731
D009101	Multiple Myeloma	D054198	Precursor Cell Lymphoblastic Leukemia-Lymphoma	721
D009101	Multiple Myeloma	D013921	Thrombocytopenia	712
D007938	Leukemia	D008232	Lymphoproliferative Disorders	710
D007938	Leukemia	D016403	Lymphoma, Large B-Cell, Diffuse	703
D007154	Immune System Diseases	D008223	Lymphoma	703
D000208	Acute Disease	D007938	Leukemia	703
D008107	Liver Diseases	D008223	Lymphoma	701
D006528	Carcinoma, Hepatocellular	D007938	Leukemia	694
D002908	Chronic Disease	D007938	Leukemia	694
D006934	Hypercalcemia	D009101	Multiple Myeloma	693
D008171	Lung Diseases	D008223	Lymphoma	690
D007938	Leukemia	D018805	Sepsis	687
D008223	Lymphoma	D015179	Colorectal Neoplasms	682
D001172	Arthritis, Rheumatoid	D008223	Lymphoma	677
D006402	Hematologic Diseases	D008223	Lymphoma	676
D007938	Leukemia	605027	-	673
D007938	Leukemia	D013163	Splenomegaly	667
D008223	Lymphoma	D015448	Leukemia, B-Cell	664
D000740	Anemia	D008223	Lymphoma	663
D008223	Lymphoma	D013163	Splenomegaly	661
D004194	Disease	D009101	Multiple Myeloma	659

D008223	Lymphoma	D054218	Precursor T-Cell Lymphoblastic Leukemia-Lymphoma	654
D007938	Leukemia	D009447	Neuroblastoma	652
D008223	Lymphoma	D012878	Skin Neoplasms	648
D008258	Waldenstrom Macroglobulinemia	D009101	Multiple Myeloma	641
D007938	Leukemia	D007943	Leukemia, Hairy Cell	633
D008232	Lymphoproliferative Disorders	D009101	Multiple Myeloma	625
D007938	Leukemia	D015459	Leukemia-Lymphoma, Adult T-Cell	625
D009101	Multiple Myeloma	D009503	Neutropenia	623
D008223	Lymphoma	D012595	Scleroderma, Systemic	600
D006528	Carcinoma, Hepatocellular	D008223	Lymphoma	596
D009101	Multiple Myeloma	605027	-	595
D006333	Heart Failure	D008223	Lymphoma	588
D007938	Leukemia	D015658	HIV Infections	582
D008223	Lymphoma	D009447	Neuroblastoma	577
D008223	Lymphoma	D008258	Waldenstrom Macroglobulinemia	577
D006402	Hematologic Diseases	D009101	Multiple Myeloma	572
D008223	Lymphoma	D011014	Pneumonia	566
D007951	Leukemia, Myeloid	D008223	Lymphoma	559
D007938	Leukemia	D015179	Colorectal Neoplasms	554
D009101	Multiple Myeloma	D009190	Myelodysplastic Syndromes	553
D007938	Leukemia	D011014	Pneumonia	546
D008223	Lymphoma	D009190	Myelodysplastic Syndromes	543
D007674	Kidney Diseases	D008223	Lymphoma	536
D007938	Leukemia	D013274	Stomach Neoplasms	530
D006086	Graft vs Host Disease	D008223	Lymphoma	515
D008223	Lymphoma	D011471	Prostatic Neoplasms	514
D008223	Lymphoma	D010265	Paraproteinemias	509
D007239	Infections	D008223	Lymphoma	504
D001327	Autoimmune Diseases	D007938	Leukemia	498
D009101	Multiple Myeloma	D011471	Prostatic Neoplasms	497
D008175	Lung Neoplasms	D009101	Multiple Myeloma	493
D005221	Fatigue	D009101	Multiple Myeloma	487
D009101	Multiple Myeloma	D016609	Neoplasms, Second Primary	474
D007938	Leukemia	D016543	Central Nervous System Neoplasms	473
D008223	Lymphoma	D018805	Sepsis	466
D006333	Heart Failure	D007938	Leukemia	463
D007943	Leukemia, Hairy Cell	D008223	Lymphoma	462
D007938	Leukemia	D008206	Lymphatic Diseases	454
D009101	Multiple Myeloma	D016393	Lymphoma, B-Cell	453
D007938	Leukemia	D020031	Epstein-Barr Virus Infections	447
D001172	Arthritis, Rheumatoid	D007938	Leukemia	445
D008223	Lymphoma	D010146	Pain	440
D007938	Leukemia	D008107	Liver Diseases	438

D005221	Fatigue	D008223	Lymphoma	433
D008223	Lymphoma	D010954	Plasmacytoma	430
D003110	Colonic Neoplasms	D009101	Multiple Myeloma	430
D007154	Immune System Diseases	D007938	Leukemia	429
D009101	Multiple Myeloma	D016403	Lymphoma, Large B-Cell, Diffuse	419
D008545	Melanoma	D009101	Multiple Myeloma	419
D007938	Leukemia	D013577	Syndrome	417
D009101	Multiple Myeloma	D012595	Scleroderma, Systemic	404
D006086	Graft vs Host Disease	D009101	Multiple Myeloma	402
D007938	Leukemia	D008224	Lymphoma, Follicular	393
D009101	Multiple Myeloma	D010146	Pain	391
D008223	Lymphoma	D051437	Renal Insufficiency	390
D009101	Multiple Myeloma	D020522	Lymphoma, Mantle-Cell	384
D007938	Leukemia	D020522	Lymphoma, Mantle-Cell	381
D007938	Leukemia	D008171	Lung Diseases	361
D002908	Chronic Disease	D008223	Lymphoma	361
D005334	Fever	D009101	Multiple Myeloma	353
D007938	Leukemia	D012878	Skin Neoplasms	348
D006333	Heart Failure	D009101	Multiple Myeloma	325
D002294	Carcinoma, Squamous Cell	D007938	Leukemia	319
D009101	Multiple Myeloma	D010051	Ovarian Neoplasms	308
D001327	Autoimmune Diseases	D009101	Multiple Myeloma	302
D000230	Adenocarcinoma	D007938	Leukemia	297
D001855	Bone Marrow Diseases	D008223	Lymphoma	296
D006934	Hypercalcemia	D008223	Lymphoma	295
D001172	Arthritis, Rheumatoid	D009101	Multiple Myeloma	293
D008224	Lymphoma, Follicular	D009101	Multiple Myeloma	284
D007938	Leukemia	D016410	Lymphoma, T-Cell, Cutaneous	281
D005221	Fatigue	D007938	Leukemia	276
D000208	Acute Disease	D008223	Lymphoma	272
D007938	Leukemia	D010146	Pain	269
D002277	Carcinoma	D009101	Multiple Myeloma	269
D007938	Leukemia	D051437	Renal Insufficiency	262
D002051	Burkitt Lymphoma	D009101	Multiple Myeloma	259
D007674	Kidney Diseases	D007938	Leukemia	246
D009101	Multiple Myeloma	D055728	Primary Myelofibrosis	242
D007154	Immune System Diseases	D009101	Multiple Myeloma	240
D001855	Bone Marrow Diseases	D009101	Multiple Myeloma	240
D008223	Lymphoma	D055728	Primary Myelofibrosis	238
D008223	Lymphoma	D054221	Classical Lissencephalies and Subcortical Band Heterotopias	238
D000163	Acquired Immunodeficiency Syndrome	D009101	Multiple Myeloma	234
D000686	Amyloidosis	D008223	Lymphoma	233
D009101	Multiple Myeloma	D011014	Pneumonia	232

D008223	Lymphoma	D009196	Myeloproliferative Disorders	231
D007938	Leukemia	D012595	Scleroderma, Systemic	231
D001847	Bone Diseases	D008223	Lymphoma	227
D009101	Multiple Myeloma	D013577	Syndrome	224
D009101	Multiple Myeloma	D015179	Colorectal Neoplasms	223
D008223	Lymphoma	D015456	Leukemia, Biphenotypic, Acute	220
D007951	Leukemia, Myeloid	D009101	Multiple Myeloma	216
D009101	Multiple Myeloma	D054221	Classical Lissencephalies and Subcortical Band Heterotopias	212
D009101	Multiple Myeloma	D015658	HIV Infections	208
D002908	Chronic Disease	D009101	Multiple Myeloma	202
D006934	Hypercalcemia	D007938	Leukemia	198
D007938	Leukemia	D017728	Lymphoma, Large-Cell, Anaplastic	196
D009101	Multiple Myeloma	D016399	Lymphoma, T-Cell	188
D008107	Liver Diseases	D009101	Multiple Myeloma	187
D000741	Anemia, Aplastic	D008223	Lymphoma	182
D007938	Leukemia	D010265	Paraproteinemias	181
D007945	Leukemia, Lymphoid	D009101	Multiple Myeloma	179
D008223	Lymphoma	D015473	Leukemia, Promyelocytic, Acute	177
D009101	Multiple Myeloma	D013274	Stomach Neoplasms	175
D007938	Leukemia	D016411	Lymphoma, T-Cell, Peripheral	175
D007239	Infections	D009101	Multiple Myeloma	175
D009101	Multiple Myeloma	D018805	Sepsis	169
D009101	Multiple Myeloma	D009196	Myeloproliferative Disorders	169
D009101	Multiple Myeloma	D020031	Epstein-Barr Virus Infections	163
D007943	Leukemia, Hairy Cell	D009101	Multiple Myeloma	162
D009101	Multiple Myeloma	D012509	Sarcoma	160
D006528	Carcinoma, Hepatocellular	D009101	Multiple Myeloma	160
D000208	Acute Disease	D009101	Multiple Myeloma	156
D009101	Multiple Myeloma	D012514	Sarcoma, Kaposi	153
D007938	Leukemia	D010954	Plasmacytoma	147
D007948	Leukemia, Monocytic, Acute	D008223	Lymphoma	145
D007938	Leukemia	D018442	Lymphoma, B-Cell, Marginal Zone	144
D001847	Bone Diseases	D007938	Leukemia	144
D008223	Lymphoma	D054219	Neoplasms, Plasma Cell	140
D009101	Multiple Myeloma	D018442	Lymphoma, B-Cell, Marginal Zone	137
D008171	Lung Diseases	D009101	Multiple Myeloma	135
D002294	Carcinoma, Squamous Cell	D009101	Multiple Myeloma	132
D001932	Brain Neoplasms	D009101	Multiple Myeloma	120
D008223	Lymphoma	D008998	Monoclonal Gammopathy of Undetermined Significance	119
D009101	Multiple Myeloma	D012878	Skin Neoplasms	112
D000741	Anemia, Aplastic	D009101	Multiple Myeloma	110
D007938	Leukemia	D012514	Sarcoma, Kaposi	108
D009101	Multiple Myeloma	D015473	Leukemia, Promyelocytic, Acute	106

<i>C538324</i>	3-Hydroxy-3-Methylglutaryl-CoA Lyase Deficiency	<i>D009101</i>	Multiple Myeloma	105
<i>C538324</i>	3-Hydroxy-3-Methylglutaryl-CoA Lyase Deficiency	<i>D007938</i>	Leukemia	102
<i>D009101</i>	Multiple Myeloma	<i>D009447</i>	Neuroblastoma	100
<i>D000230</i>	Adenocarcinoma	<i>D009101</i>	Multiple Myeloma	96
<i>D007938</i>	Leukemia	<i>D008258</i>	Waldenstrom Macroglobulinemia	95
<i>D009101</i>	Multiple Myeloma	<i>D015458</i>	Leukemia, T-Cell	94
<i>D007938</i>	Leukemia	<i>D054391</i>	Lymphoma, Extranodal NK-T-Cell	94
<i>D008206</i>	Lymphatic Diseases	<i>D009101</i>	Multiple Myeloma	91
<i>D009101</i>	Multiple Myeloma	<i>D015448</i>	Leukemia, B-Cell	80
<i>D009101</i>	Multiple Myeloma	<i>D013163</i>	Splenomegaly	76
<i>D001260</i>	Ataxia Telangiectasia	<i>D009101</i>	Multiple Myeloma	71
<i>D009101</i>	Multiple Myeloma	<i>D054218</i>	Precursor T-Cell Lymphoblastic Leukemia-Lymphoma	70
<i>D009101</i>	Multiple Myeloma	<i>D017728</i>	Lymphoma, Large-Cell, Anaplastic	68
<i>D009101</i>	Multiple Myeloma	<i>D016410</i>	Lymphoma, T-Cell, Cutaneous	67
<i>D009101</i>	Multiple Myeloma	<i>D015459</i>	Leukemia-Lymphoma, Adult T-Cell	60
<i>D007938</i>	Leukemia	<i>D054219</i>	Neoplasms, Plasma Cell	57
<i>D007948</i>	Leukemia, Monocytic, Acute	<i>D009101</i>	Multiple Myeloma	46
<i>D000686</i>	Amyloidosis	<i>D007938</i>	Leukemia	45
<i>D009101</i>	Multiple Myeloma	<i>D016411</i>	Lymphoma, T-Cell, Peripheral	42
<i>D007938</i>	Leukemia	<i>D008998</i>	Monoclonal Gammopathy of Undetermined Significance	42
<i>D009101</i>	Multiple Myeloma	<i>D016543</i>	Central Nervous System Neoplasms	39
<i>D009101</i>	Multiple Myeloma	<i>D054391</i>	Lymphoma, Extranodal NK-T-Cell	29
<i>D009101</i>	Multiple Myeloma	<i>D015456</i>	Leukemia, Biphenotypic, Acute	22

Table 2 - DisGeNET full results (organized by decreasing number of Jaccard Index)

DisGeNET				
<i>Identifier 1</i>	Name 1	<i>Identifier 2</i>	Name 2	Jaccard Index
<i>C0023418</i>	Leukemia	<i>C1332977</i>	Childhood Leukemia	0.80
<i>C0024299</i>	Lymphoma	<i>C1332206</i>	Adult Lymphoma	0.76
<i>C0024299</i>	Lymphoma	<i>C1332979</i>	Childhood Lymphoma	0.75
<i>C0023418</i>	Leukemia	<i>C0023449</i>	Acute lymphocytic Leukemia	0.36
<i>C0023418</i>	Leukemia	<i>C0023467</i>	Leukemia. Myelocytic. Acute	0.35
<i>C0023418</i>	Leukemia	<i>C0024299</i>	Lymphoma	0.33
<i>C0024299</i>	Lymphoma	<i>C0079731</i>	B-Cell Lymphomas	0.33
<i>C0024299</i>	Lymphoma	<i>C1332977</i>	Childhood Leukemia	0.31
<i>C0024299</i>	Lymphoma	<i>C0079744</i>	Diffuse Large B-Cell Lymphoma	0.31
<i>C0023434</i>	Chronic Lymphocytic Leukemia	<i>C0026764</i>	Multiple Myeloma	0.31
<i>C0024299</i>	Lymphoma	<i>C0026764</i>	Multiple Myeloma	0.31
<i>C0023418</i>	Leukemia	<i>C0023452</i>	Childhood Acute Lymphoblastic Leukemia	0.31
<i>C0023434</i>	Chronic Lymphocytic Leukemia	<i>C0024299</i>	Lymphoma	0.30
<i>C0023449</i>	Acute lymphocytic Leukemia	<i>C0024299</i>	Lymphoma	0.30

C0023418	Leukemia	C0023473	Myeloid Leukemia. Chronic	0.30
C0024299	Lymphoma	C0024305	Lymphoma. Non-Hodgkin	0.29
C0023418	Leukemia	C0598766	Leukemogenesis	0.29
C0023418	Leukemia	C0026764	Multiple Myeloma	0.28
C0026764	Multiple Myeloma	C0079731	B-Cell Lymphomas	0.28
C0026764	Multiple Myeloma	C1332206	Adult Lymphoma	0.28
C0026764	Multiple Myeloma	C1332979	Childhood Lymphoma	0.28
C0023418	Leukemia	C1332206	Adult Lymphoma	0.28
C0023418	Leukemia	C1332979	Childhood Lymphoma	0.28
C0023418	Leukemia	C0751606	Adult Acute Lymphocytic Leukemia	0.28
C0023418	Leukemia	C0025202	melanoma	0.28
C0026764	Multiple Myeloma	C1332977	Childhood Leukemia	0.28
C0023418	Leukemia	C0235974	Pancreatic carcinoma	0.28
C0023418	Leukemia	C0023434	Chronic Lymphocytic Leukemia	0.27
C0023418	Leukemia	C1961102	Precursor Cell Lymphoblastic Leukemia Lymphoma	0.27
C0023418	Leukemia	C0346647	Malignant neoplasm of pancreas	0.27
C0023418	Leukemia	C1621958	Glioblastoma Multiforme	0.27
C0017636	Glioblastoma	C0023418	Leukemia	0.27
C0023452	Childhood Acute Lymphoblastic Leukemia	C0024299	Lymphoma	0.27
C0025202	melanoma	C0026764	Multiple Myeloma	0.27
C0023418	Leukemia	C0079731	B-Cell Lymphomas	0.27
C0007097	Carcinoma	C0023418	Leukemia	0.26
C0026764	Multiple Myeloma	C0079744	Diffuse Large B-Cell Lymphoma	0.26
C0007137	Squamous cell carcinoma	C0023418	Leukemia	0.26
C0023418	Leukemia	C0027819	Neuroblastoma	0.26
C0023418	Leukemia	C1140680	Malignant neoplasm of ovary	0.26
C0024299	Lymphoma	C0598766	Leukemogenesis	0.26
C0023418	Leukemia	C0280474	Childhood Glioblastoma	0.26
C0023418	Leukemia	C0278878	Adult Glioblastoma	0.26
C0023418	Leukemia	C4721610	Carcinoma. Ovarian Epithelial	0.26
C0023418	Leukemia	C0699790	Colon Carcinoma	0.26
C0023418	Leukemia	C0700095	Central neuroblastoma	0.26
C0023418	Leukemia	C4086165	Childhood Neuroblastoma	0.26
C0026764	Multiple Myeloma	C0029463	Osteosarcoma	0.26
C0003873	Rheumatoid Arthritis	C0023418	Leukemia	0.26
C0023418	Leukemia	C0178874	Tumor Progression	0.26
C0026764	Multiple Myeloma	C1621958	Glioblastoma Multiforme	0.26
C0023418	Leukemia	C1458155	Mammary Neoplasms	0.26
C0023467	Leukemia. Myelocytic. Acute	C0026764	Multiple Myeloma	0.25
C0023418	Leukemia	C3463824	MYELODYSPLASTIC SYNDROME	0.25
C0026764	Multiple Myeloma	C0278878	Adult Glioblastoma	0.25
C0026764	Multiple Myeloma	C0585442	Osteosarcoma of bone	0.25
C0026764	Multiple Myeloma	C0280474	Childhood Glioblastoma	0.25

C0023418	Leukemia	C0919267	ovarian neoplasm	0.25
C0026764	Multiple Myeloma	C0235974	Pancreatic carcinoma	0.25
C0019829	Hodgkin Disease	C0024299	Lymphoma	0.25
C0007134	Renal Cell Carcinoma	C0023418	Leukemia	0.25
C0026764	Multiple Myeloma	C1332986	Childhood Osteosarcoma	0.25
C0023449	Acute lymphocytic Leukemia	C0026764	Multiple Myeloma	0.25
C0026764	Multiple Myeloma	C1168401	Squamous cell carcinoma of the head and neck	0.25
C0026764	Multiple Myeloma	C0279702	Conventional (Clear Cell) Renal Cell Carcinoma	0.25
C0017636	Glioblastoma	C0026764	Multiple Myeloma	0.25
C0026764	Multiple Myeloma	C0346647	Malignant neoplasm of pancreas	0.25
C0024299	Lymphoma	C0376545	Hematologic Neoplasms	0.25
C0023418	Leukemia	C1306460	Primary malignant neoplasm of lung	0.25
C0001418	Adenocarcinoma	C0023418	Leukemia	0.25
C0023418	Leukemia	C0279702	Conventional (Clear Cell) Renal Cell Carcinoma	0.25
C0023473	Myeloid Leukemia. Chronic	C0026764	Multiple Myeloma	0.25
C0026764	Multiple Myeloma	C2939419	Secondary Neoplasm	0.25
C0007134	Renal Cell Carcinoma	C0026764	Multiple Myeloma	0.25
C0023418	Leukemia	C0684249	Carcinoma of lung	0.25
C0026764	Multiple Myeloma	C0699885	Carcinoma of bladder	0.25
C0007102	Malignant tumor of colon	C0023418	Leukemia	0.25
C0003873	Rheumatoid Arthritis	C0026764	Multiple Myeloma	0.25
C0007097	Carcinoma	C0026764	Multiple Myeloma	0.25
C0023418	Leukemia	C0242379	Malignant neoplasm of lung	0.25
C0024299	Lymphoma	C0751606	Adult Acute Lymphocytic Leukemia	0.25
C0023418	Leukemia	C0600139	Prostate carcinoma	0.25
C0005695	Bladder Neoplasm	C0023418	Leukemia	0.25
C0007131	Non-Small Cell Lung Carcinoma	C0023418	Leukemia	0.25
C0017638	Glioma	C0023418	Leukemia	0.25
C0023418	Leukemia	C0376545	Hematologic Neoplasms	0.25
C0023418	Leukemia	C0029463	Osteosarcoma	0.25
C0005695	Bladder Neoplasm	C0026764	Multiple Myeloma	0.24
C0023418	Leukemia	C4722085	Malignant neoplasm of colon and/or rectum	0.24
C0026764	Multiple Myeloma	C0699790	Colon Carcinoma	0.24
C0026764	Multiple Myeloma	C0280100	Solid Neoplasm	0.24
C0004364	Autoimmune Diseases	C0024299	Lymphoma	0.24
C0023418	Leukemia	C0280100	Solid Neoplasm	0.24
C0026764	Multiple Myeloma	C4721610	Carcinoma. Ovarian Epithelial	0.24
C0026764	Multiple Myeloma	C0700095	Central neuroblastoma	0.24
C0026764	Multiple Myeloma	C4086165	Childhood Neuroblastoma	0.24
C0023418	Leukemia	C0376358	Malignant neoplasm of prostate	0.24
C0005684	Malignant neoplasm of urinary bladder	C0023418	Leukemia	0.24
C0026764	Multiple Myeloma	C0027819	Neuroblastoma	0.24

C0023418	Leukemia	C2939419	Secondary Neoplasm	0.24
C0026764	Multiple Myeloma	C1140680	Malignant neoplasm of ovary	0.24
C0026764	Multiple Myeloma	C0376545	Hematologic Neoplasms	0.24
C0023467	Leukemia. Myelocytic. Acute	C0024299	Lymphoma	0.24
C0023418	Leukemia	C0699885	Carcinoma of bladder	0.24
C0023418	Leukemia	C0699791	Stomach Carcinoma	0.24
C0007137	Squamous cell carcinoma	C0026764	Multiple Myeloma	0.24
C0024299	Lymphoma	C0280100	Solid Neoplasm	0.24
C0005684	Malignant neoplasm of urinary bladder	C0026764	Multiple Myeloma	0.24
C0024141	Lupus Erythematosus. Systemic	C0024299	Lymphoma	0.24
C0026764	Multiple Myeloma	C1458155	Mammary Neoplasms	0.24
C0023473	Myeloid Leukemia. Chronic	C0024299	Lymphoma	0.24
C0001418	Adenocarcinoma	C0026764	Multiple Myeloma	0.24
C0007097	Carcinoma	C0024299	Lymphoma	0.24
C0007137	Squamous cell carcinoma	C0024299	Lymphoma	0.24
C0007131	Non-Small Cell Lung Carcinoma	C0026764	Multiple Myeloma	0.24
C0007102	Malignant tumor of colon	C0026764	Multiple Myeloma	0.24
C0023418	Leukemia	C0585442	Osteosarcoma of bone	0.24
C0023418	Leukemia	C1332986	Childhood Osteosarcoma	0.24
C0024299	Lymphoma	C0025202	melanoma	0.24
C0026764	Multiple Myeloma	C1306460	Primary malignant neoplasm of lung	0.24
C0004364	Autoimmune Diseases	C0023418	Leukemia	0.24
C0023418	Leukemia	C0024623	Malignant neoplasm of stomach	0.24
C0026764	Multiple Myeloma	C0919267	ovarian neoplasm	0.24
C0026764	Multiple Myeloma	C4722085	Malignant neoplasm of colon and/or rectum	0.24
C0026764	Multiple Myeloma	C0178874	Tumor Progression	0.24
C0026764	Multiple Myeloma	C0242379	Malignant neoplasm of lung	0.24
C0017638	Glioma	C0026764	Multiple Myeloma	0.24
C0003873	Rheumatoid Arthritis	C0024299	Lymphoma	0.24
C0026764	Multiple Myeloma	C0684249	Carcinoma of lung	0.24
C0026764	Multiple Myeloma	C2931822	Nasopharyngeal carcinoma	0.24
C0024299	Lymphoma	C1961102	Precursor Cell Lymphoblastic Leukemia Lymphoma	0.24
C0023418	Leukemia	C0476089	Endometrial Carcinoma	0.23
C0024299	Lymphoma	C0235974	Pancreatic carcinoma	0.23
C0023418	Leukemia	C0596263	Carcinogenesis	0.23
C0023418	Leukemia	C0024141	Lupus Erythematosus. Systemic	0.23
C0019196	Hepatitis C	C0026764	Multiple Myeloma	0.23
C0026764	Multiple Myeloma	C3539878	Triple Negative Breast Neoplasms	0.23
C0024299	Lymphoma	C3463824	MYELODYSPLASTIC SYNDROME	0.23
C0024299	Lymphoma	C0346647	Malignant neoplasm of pancreas	0.23
C0024299	Lymphoma	C0027819	Neuroblastoma	0.23
C0024299	Lymphoma	C0700095	Central neuroblastoma	0.23
C0024299	Lymphoma	C4086165	Childhood Neuroblastoma	0.23

C0007134	Renal Cell Carcinoma	C0024299	Lymphoma	0.23
C0026764	Multiple Myeloma	C4722518	Triple-Negative Breast Carcinoma	0.23
C0026764	Multiple Myeloma	C4048328	cervical cancer	0.23
C0023452	Childhood Acute Lymphoblastic Leukemia	C0026764	Multiple Myeloma	0.23
C0019196	Hepatitis C	C0024299	Lymphoma	0.23
C0026764	Multiple Myeloma	C3463824	MYELODYSPLASTIC SYNDROME	0.23
C0026764	Multiple Myeloma	C0152013	Adenocarcinoma of lung (disorder)	0.23
C0019163	Hepatitis B	C0026764	Multiple Myeloma	0.23
C0009402	Colorectal Carcinoma	C0023418	Leukemia	0.23
C0026764	Multiple Myeloma	C0029408	Degenerative polyarthritis	0.23
C0001418	Adenocarcinoma	C0024299	Lymphoma	0.23
C0023418	Leukemia	C0042769	Virus Diseases	0.23
C0026764	Multiple Myeloma	C0600139	Prostate carcinoma	0.23
C0023418	Leukemia	C2239176	Liver carcinoma	0.23
C0019829	Hodgkin Disease	C0026764	Multiple Myeloma	0.23
C0026764	Multiple Myeloma	C0699791	Stomach Carcinoma	0.23
C0023418	Leukemia	C4048328	cervical cancer	0.23
C0023418	Leukemia	C0678222	Breast Carcinoma	0.23
C0023418	Leukemia	C1168401	Squamous cell carcinoma of the head and neck	0.23
C0023418	Leukemia	C0302592	Cervix carcinoma	0.23
C0024299	Lymphoma	C0042769	Virus Diseases	0.23
C0026764	Multiple Myeloma	C0042769	Virus Diseases	0.23
C0019163	Hepatitis B	C0024299	Lymphoma	0.22
C0026764	Multiple Myeloma	C0376358	Malignant neoplasm of prostate	0.22
C0024299	Lymphoma	C0279702	Conventional (Clear Cell) Renal Cell Carcinoma	0.22
C0011849	Diabetes Mellitus	C0023418	Leukemia	0.22
C0004153	Atherosclerosis	C0023418	Leukemia	0.22
C0026764	Multiple Myeloma	C0302592	Cervix carcinoma	0.22
C0023418	Leukemia	C0027627	Neoplasm Metastasis	0.22
C0003850	Arteriosclerosis	C0023418	Leukemia	0.22
C0026764	Multiple Myeloma	C0476089	Endometrial Carcinoma	0.22
C0011847	Diabetes	C0023418	Leukemia	0.22
C0023418	Leukemia	C0079744	Diffuse Large B-Cell Lymphoma	0.22
C0004364	Autoimmune Diseases	C0026764	Multiple Myeloma	0.22
C0004153	Atherosclerosis	C0026764	Multiple Myeloma	0.22
C0003850	Arteriosclerosis	C0026764	Multiple Myeloma	0.22
C0026764	Multiple Myeloma	C0345904	Malignant neoplasm of liver	0.22
C0024623	Malignant neoplasm of stomach	C0026764	Multiple Myeloma	0.22
C0007847	Malignant tumor of cervix	C0026764	Multiple Myeloma	0.22
C0023418	Leukemia	C0686619	Secondary malignant neoplasm of lymph node	0.22
C0026764	Multiple Myeloma	C1832661	ANOPHTHALMIA AND PULMONARY HYPOPLASIA	0.22
C0023418	Leukemia	C0033578	Prostatic Neoplasms	0.22

C0006142	Malignant neoplasm of breast	C0023418	Leukemia	0.22
C0026764	Multiple Myeloma	C0026769	Multiple Sclerosis	0.22
C0017636	Glioblastoma	C0024299	Lymphoma	0.22
C0024299	Lymphoma	C1140680	Malignant neoplasm of ovary	0.22
C0024141	Lupus Erythematosus. Systemic	C0026764	Multiple Myeloma	0.22
C0024299	Lymphoma	C1621958	Glioblastoma Multiforme	0.22
C0023418	Leukemia	C2931822	Nasopharyngeal carcinoma	0.22
C0024299	Lymphoma	C4721532	Lymphoma. Non-Hodgkin. Familial	0.22
C0019196	Hepatitis C	C0023418	Leukemia	0.22
C0007847	Malignant tumor of cervix	C0023418	Leukemia	0.22
C0023418	Leukemia	C0152013	Adenocarcinoma of lung (disorder)	0.22
C0005695	Bladder Neoplasm	C0024299	Lymphoma	0.22
C0024299	Lymphoma	C0029463	Osteosarcoma	0.22
C0026764	Multiple Myeloma	C0279626	Squamous cell carcinoma of esophagus	0.22
C0023418	Leukemia	C3539878	Triple Negative Breast Neoplasms	0.22
C0024299	Lymphoma	C2939419	Secondary Neoplasm	0.22
C0023418	Leukemia	C0279626	Squamous cell carcinoma of esophagus	0.22
C0024299	Lymphoma	C0699790	Colon Carcinoma	0.22
C0024299	Lymphoma	C1458155	Mammary Neoplasms	0.22
C0024299	Lymphoma	C0079772	T-Cell Lymphoma	0.22
C0024299	Lymphoma	C0280474	Childhood Glioblastoma	0.22
C0026764	Multiple Myeloma	C0686619	Secondary malignant neoplasm of lymph node	0.22
C0024299	Lymphoma	C0278878	Adult Glioblastoma	0.22
C0024299	Lymphoma	C0919267	ovarian neoplasm	0.22
C0024299	Lymphoma	C4721610	Carcinoma. Ovarian Epithelial	0.22
C0024299	Lymphoma	C0699885	Carcinoma of bladder	0.22
C0023418	Leukemia	C0024121	Lung Neoplasms	0.22
C0024299	Lymphoma	C0585442	Osteosarcoma of bone	0.22
C0019163	Hepatitis B	C0023418	Leukemia	0.22
C0005684	Malignant neoplasm of urinary bladder	C0024299	Lymphoma	0.22
C0021051	Immunologic Deficiency Syndromes	C0024299	Lymphoma	0.21
C0023418	Leukemia	C4722518	Triple-Negative Breast Carcinoma	0.21
C0023418	Leukemia	C1306459	Primary malignant neoplasm	0.21
C0024299	Lymphoma	C1332986	Childhood Osteosarcoma	0.21
C0002395	Alzheimer's Disease	C0023418	Leukemia	0.21
C0024299	Lymphoma	C2931822	Nasopharyngeal carcinoma	0.21
C0009324	Ulcerative Colitis	C0026764	Multiple Myeloma	0.21
C0023418	Leukemia	C1269955	Tumor Cell Invasion	0.21
C0024299	Lymphoma	C0476089	Endometrial Carcinoma	0.21
C0024121	Lung Neoplasms	C0024299	Lymphoma	0.21
C0011849	Diabetes Mellitus	C0026764	Multiple Myeloma	0.21
C0026764	Multiple Myeloma	C2239176	Liver carcinoma	0.21
C0024299	Lymphoma	C1168401	Squamous cell carcinoma of the head and neck	0.21

C0024305	Lymphoma. Non-Hodgkin	C0026764	Multiple Myeloma	0.21
C0007102	Malignant tumor of colon	C0024299	Lymphoma	0.21
C0024299	Lymphoma	C1306460	Primary malignant neoplasm of lung	0.21
C0011847	Diabetes	C0026764	Multiple Myeloma	0.21
C0017638	Glioma	C0024299	Lymphoma	0.21
C0024299	Lymphoma	C0684249	Carcinoma of lung	0.21
C0023418	Leukemia	C1832661	ANOPHTHALMIA AND PULMONARY HYPOPLASIA	0.21
C0021051	Immunologic Deficiency Syndromes	C0023418	Leukemia	0.21
C0024121	Lung Neoplasms	C0026764	Multiple Myeloma	0.21
C0024299	Lymphoma	C0242379	Malignant neoplasm of lung	0.21
C0007131	Non-Small Cell Lung Carcinoma	C0024299	Lymphoma	0.21
C0024299	Lymphoma	C0026769	Multiple Sclerosis	0.21
C0024299	Lymphoma	C0178874	Tumor Progression	0.21
C0026764	Multiple Myeloma	C0033578	Prostatic Neoplasms	0.21
C0026764	Multiple Myeloma	C0751606	Adult Acute Lymphocytic Leukemia	0.20
C0009402	Colorectal Carcinoma	C0026764	Multiple Myeloma	0.20
C0026764	Multiple Myeloma	C0598766	Leukemogenesis	0.20
C0023418	Leukemia	C0029408	Degenerative polyarthritis	0.20
C0024299	Lymphoma	C3539878	Triple Negative Breast Neoplasms	0.20
C0023418	Leukemia	C0345904	Malignant neoplasm of liver	0.20
C0024299	Lymphoma	C0302592	Cervix carcinoma	0.20
C0024299	Lymphoma	C4048328	cervical cancer	0.20
C0023418	Leukemia	C0026769	Multiple Sclerosis	0.20
C0024299	Lymphoma	C0699791	Stomach Carcinoma	0.20
C0023418	Leukemia	C0024305	Lymphoma. Non-Hodgkin	0.20
C0024299	Lymphoma	C4722085	Malignant neoplasm of colon and/or rectum	0.20
C0024299	Lymphoma	C4722518	Triple-Negative Breast Carcinoma	0.20
C0004153	Atherosclerosis	C0024299	Lymphoma	0.20
C0026764	Multiple Myeloma	C0596263	Carcinogenesis	0.20
C0009324	Ulcerative Colitis	C0024299	Lymphoma	0.20
C0026764	Multiple Myeloma	C0027627	Neoplasm Metastasis	0.20
C0024299	Lymphoma	C0024623	Malignant neoplasm of stomach	0.20
C0003850	Arteriosclerosis	C0024299	Lymphoma	0.20
C0024299	Lymphoma	C0600139	Prostate carcinoma	0.20
C0024299	Lymphoma	C1832661	ANOPHTHALMIA AND PULMONARY HYPOPLASIA	0.20
C0021051	Immunologic Deficiency Syndromes	C0026764	Multiple Myeloma	0.20
C0024299	Lymphoma	C0152013	Adenocarcinoma of lung (disorder)	0.20
C0024299	Lymphoma	C0376358	Malignant neoplasm of prostate	0.20
C0024299	Lymphoma	C0029408	Degenerative polyarthritis	0.20
C0026764	Multiple Myeloma	C1961102	Precursor Cell Lymphoblastic Leukemia Lymphoma	0.20
C0026764	Multiple Myeloma	C0678222	Breast Carcinoma	0.19
C0019829	Hodgkin Disease	C0023418	Leukemia	0.19

C0009324	Ulcerative Colitis	C0023418	Leukemia	0.19
C0007847	Malignant tumor of cervix	C0024299	Lymphoma	0.19
C0024299	Lymphoma	C0279626	Squamous cell carcinoma of esophagus	0.19
C0002395	Alzheimer's Disease	C0026764	Multiple Myeloma	0.19
C0024299	Lymphoma	C0033578	Prostatic Neoplasms	0.19
C0024299	Lymphoma	C0345904	Malignant neoplasm of liver	0.19
C0011847	Diabetes	C0024299	Lymphoma	0.19
C0006142	Malignant neoplasm of breast	C0026764	Multiple Myeloma	0.19
C0024299	Lymphoma	C0686619	Secondary malignant neoplasm of lymph node	0.19
C0011849	Diabetes Mellitus	C0024299	Lymphoma	0.19
C0026764	Multiple Myeloma	C1269955	Tumor Cell Invasion	0.19
C0026764	Multiple Myeloma	C1306459	Primary malignant neoplasm	0.18
C0002395	Alzheimer's Disease	C0024299	Lymphoma	0.18
C0024299	Lymphoma	C2239176	Liver carcinoma	0.18
C0009402	Colorectal Carcinoma	C0024299	Lymphoma	0.18
C0024299	Lymphoma	C0596263	Carcinogenesis	0.18
C0024299	Lymphoma	C0678222	Breast Carcinoma	0.17
C0024299	Lymphoma	C0027627	Neoplasm Metastasis	0.17
C0006142	Malignant neoplasm of breast	C0024299	Lymphoma	0.17
C0024299	Lymphoma	C1306459	Primary malignant neoplasm	0.16
C0026764	Multiple Myeloma	C4721532	Lymphoma. Non-Hodgkin. Familial	0.16
C0024299	Lymphoma	C1269955	Tumor Cell Invasion	0.16
C0026764	Multiple Myeloma	C0079772	T-Cell Lymphoma	0.15
C0023418	Leukemia	C4721532	Lymphoma. Non-Hodgkin. Familial	0.15
C0023418	Leukemia	C0079772	T-Cell Lymphoma	0.14