

## Supplementary Material

**Supplementary Table 1.** ICD definition of autoimmune conditions

Condition	ICD-9-CM Diagnosis Code	ICD-10-CM Diagnosis Code
Addison's disease	<ul style="list-style-type: none"> <li>• 255.41 Glucocorticoid deficiency               <ul style="list-style-type: none"> <li>○ Addisonian crisis</li> <li>○ Addison's disease NOS</li> <li>○ Adrenal atrophy (autoimmune)</li> <li>○ Adrenal calcification</li> <li>○ Adrenal crisis</li> <li>○ Adrenal hemorrhage</li> <li>○ Adrenal infarction</li> <li>○ Adrenal insufficiency NOS</li> <li>○ Combined glucocorticoid and mineralocorticoid deficiency</li> <li>○ Corticoadrenal insufficiency NOS</li> </ul> </li> <li>• 255.42 Mineralocorticoid deficiency               <ul style="list-style-type: none"> <li>○ Hypoaldosteronism</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• E27.1 Primary adrenocortical insufficiency               <ul style="list-style-type: none"> <li>○ Addison's disease</li> <li>○ Autoimmune adrenalitis</li> </ul> </li> <li>• E27.2 Addisonian crisis               <ul style="list-style-type: none"> <li>○ Adrenal crisis</li> <li>○ Adrenocortical crisis</li> </ul> </li> <li>• E27.40 Unspecified               <ul style="list-style-type: none"> <li>○ Adrenocortical insufficiency NOS</li> <li>○ Hypoaldosteronism</li> </ul> </li> </ul>
Alopecia areata	<ul style="list-style-type: none"> <li>• 704.01 Alopecia areata</li> </ul>	<ul style="list-style-type: none"> <li>• L63 Alopecia areata</li> </ul>
Ankylosing spondylitis	<ul style="list-style-type: none"> <li>• 720.0 Ankylosing spondylitis</li> </ul>	<ul style="list-style-type: none"> <li>• M45 Ankylosing spondylitis</li> </ul>
Crohn's disease	<ul style="list-style-type: none"> <li>• 555 Regional enteritis               <ul style="list-style-type: none"> <li>○ Crohn's disease</li> <li>○ Granulomatous enteritis</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• K50 Crohn's disease</li> </ul>
Celiac disease	<ul style="list-style-type: none"> <li>• 579.0 Celiac disease</li> </ul>	<ul style="list-style-type: none"> <li>• K90.0 Celiac disease</li> </ul>
Other and unspecified noninfective gastroenteritis and colitis	<ul style="list-style-type: none"> <li>• 558.9 Other and unspecified noninfectious gastroenteritis and colitis</li> </ul>	<ul style="list-style-type: none"> <li>• K52.3 Indeterminate colitis</li> <li>• K52.8 Other specified noninfective gastroenteritis and colitis</li> <li>• K52.9 noninfective gastroenteritis and colitis, unspecified</li> </ul>
Multiple sclerosis	<ul style="list-style-type: none"> <li>• 340 Multiple sclerosis</li> <li>• 323.61 Infectious acute disseminated encephalomyelitis</li> <li>• 323.81 Other causes of encephalitis and encephalomyelitis</li> </ul>	<ul style="list-style-type: none"> <li>• G04.0 Acute disseminated encephalitis and encephalomyelitis</li> <li>• G04.8 Other encephalitis, myelitis and encephalomyelitis</li> </ul>

	<ul style="list-style-type: none"> <li>• 323.82 Other causes of myelitis</li> <li>• 323.9 Unspecified causes of encephalitis, myelitis and encephalomyelitis</li> </ul>	<ul style="list-style-type: none"> <li>• G04.9 Encephalitis, myelitis and encephalomyelitis, unspecified</li> <li>• G35 Multiple sclerosis</li> </ul>
Myasthenia gravis	<ul style="list-style-type: none"> <li>• 358.0 Myasthenia gravis</li> <li>• 358.1 Myasthenic syndromes in diseases classified elsewhere</li> </ul>	<ul style="list-style-type: none"> <li>• G70.0 Myasthenia gravis</li> <li>• G73.3 Myasthenic syndromes in other diseases classified elsewhere</li> </ul>
Myocarditis	<ul style="list-style-type: none"> <li>• 422.0 Acute myocarditis in diseases classified elsewhere</li> <li>• 422.91 Idiopathic myocarditis</li> <li>• 422.93 Toxic myocarditis</li> <li>• 422.99 Other acute myocarditis</li> <li>• 422.90 Acute myocarditis, unspecified</li> <li>• 429.0 Myocarditis, unspecified</li> <li>• 429.81 Other disorders of papillary muscle</li> <li>• 429.82 Hyperkinetic heart disease</li> <li>• 429.83 Takotsubo syndrome</li> <li>• 429.89 Other ill-defined heart diseases</li> <li>• 429.9 Heart disease, unspecified</li> </ul>	<ul style="list-style-type: none"> <li>• I40.0 Infective myocarditis</li> <li>• I40.1 Isolated myocarditis</li> <li>• I40.8 Other acute myocarditis</li> <li>• I40.9 Acute myocarditis, unspecified</li> <li>• I41 Myocarditis in diseases classified elsewhere</li> <li>• I51.4 Myocarditis, unspecified</li> <li>• I51.8 Other ill-defined heart diseases</li> <li>• I51.9 Heart diseases, unspecified</li> </ul>
Myositis	<ul style="list-style-type: none"> <li>• 376.12 Orbital myositis</li> <li>• 710.3 Dermatomyositis</li> <li>• 710.4 Polymyositis</li> <li>• 728.81 Interstitial myositis</li> <li>• 729.1 Myalgia and myositis, unspecified</li> </ul>	<ul style="list-style-type: none"> <li>• H05.12x Orbital myositis</li> <li>• M33.03 Dermatomyositis, juvenile without myopathy</li> <li>• M33.13 Other dermatomyositis without myopathy</li> <li>• M33.2 Polymyositis</li> <li>• M33.9 Dermatopolymyositis, unspecified</li> <li>• M60.1 Interstitial myositis</li> <li>• M60.8 Other myositis</li> <li>• M60.9 Myositis, unspecified</li> <li>• M79.1 Other and unspecified soft tissue disorders, not elsewhere classified Myalgia</li> </ul>

		<ul style="list-style-type: none"> <li>• M79.7 Other and unspecified soft tissue disorders, not elsewhere classified Fibromyalgia</li> </ul>
Psoriatic arthropathy	<ul style="list-style-type: none"> <li>• 696.0 Psoriatic arthropathy</li> </ul>	<ul style="list-style-type: none"> <li>• L40.5x Arthropathic psoriasis</li> </ul>
Psoriasis, other	<ul style="list-style-type: none"> <li>• 696.1 Other psoriasis</li> </ul>	<ul style="list-style-type: none"> <li>• L40.0 Psoriasis vulgaris</li> <li>• L40.1 Generalized pustular psoriasis</li> <li>• L40.2 Acrodermatitis continua</li> <li>• L40.3 Pustulosis palmaris et plantaris</li> <li>• L40.4 Guttate psoriasis</li> <li>• L40.8 Other psoriasis</li> <li>• L40.9 Psoriasis, unspecified</li> </ul>
Other unspecified systemic disorders of connective tissue	<ul style="list-style-type: none"> <li>• 710.5 Eosinophilia myalgia syndrome</li> <li>• 710.8 Other specified diffuse diseases of connective tissue</li> <li>• 710.9 Unspecified diffuse connective tissue disease</li> <li>• 713.8 Arthropathy associated with other conditions classifiable elsewhere</li> <li>• 716.20 Allergic arthritis, site unspecified</li> <li>• 716.50 unspecified polyarthropathy or polyarthritis, site unspecified</li> <li>• 716.6 Unspecified monoarthritis</li> </ul>	<ul style="list-style-type: none"> <li>• M13.0 polyarthritis, unspecified</li> <li>• M13.1 Monoarthritis, not elsewhere classified</li> <li>• M13.8 Other specified arthritis</li> <li>• M35.1 Other overlap syndromes</li> <li>• M35.8 Other specified systemic involvement of connective tissue, unspecified</li> <li>• M35.9 Systemic involvement of connective tissue, unspecified</li> <li>• M36.0 Demato(poly)myositis in neoplastic disease</li> <li>• M36.1 Arthropathy in neoplastic disease</li> <li>• M38.8 Systemic disorders of connective tissue in other diseases classified elsewhere</li> </ul>
Rheumatoid arthritis	<ul style="list-style-type: none"> <li>• 714 Rheumatoid arthritis and other inflammatory polyarthropathies</li> </ul>	<ul style="list-style-type: none"> <li>• M05 Rheumatoid arthritis with rheumatoid factor</li> <li>• M06 Other rheumatoid arthritis</li> </ul>
Sarcoidosis	<ul style="list-style-type: none"> <li>• 135 Sarcoidosis</li> </ul>	<ul style="list-style-type: none"> <li>• D86 Sarcoidosis</li> </ul>

Scleroderma/Systemic sclerosis	<ul style="list-style-type: none"> <li>• 710.1 Systemic sclerosis</li> </ul>	<ul style="list-style-type: none"> <li>• M34 Systemic sclerosis [scleroderma]</li> </ul>
Sjögren's syndrome	<ul style="list-style-type: none"> <li>• 375.15 Tear film insufficiency, unspecified</li> <li>• 710.2 Sicca syndrome</li> </ul>	<ul style="list-style-type: none"> <li>• H04.12 Dry eye syndrome</li> <li>• M35.0 Sicca syndrome [Sjögren]</li> </ul>
Systemic lupus erythematosus	<ul style="list-style-type: none"> <li>• 710.0 Systemic lupus erythematosus</li> </ul>	<ul style="list-style-type: none"> <li>• M32 Systemic lupus erythematosus (SLE)</li> </ul>
Thyroid disease	<ul style="list-style-type: none"> <li>• 240 Simple and unspecified goiter</li> <li>• 241 Nontoxic nodular goiter</li> <li>• 242 Thyrotoxicosis with or without goiter</li> <li>• 244 Acquired hypothyroidism</li> <li>• 245 Thyroiditis</li> <li>• 246 Other disorders of thyroid</li> <li>• 376.30 Exophthalmos, unspecified</li> </ul>	<ul style="list-style-type: none"> <li>• E03.2 Hypothyroidism due to medicaments and other exogenous substances</li> <li>• E03.4 Atrophy of thyroid (acquired)</li> <li>• E03.8 Other specified hypothyroidism</li> <li>• E03.9 Hypothyroidism, unspecified</li> <li>• E04 Other nontoxic goiter</li> <li>• E05 Thyrotoxicosis [hyperthyroidism]</li> <li>• E06 Thyroiditis</li> <li>• E07.89 Other specified disorders of thyroid</li> <li>• E07.9 Other disorders of thyroid</li> <li>• H05.2 Exophthalmic conditions</li> </ul>
Type 1 diabetes	<ul style="list-style-type: none"> <li>• 250.x1 Diabetes type I [juvenile type], not stated as uncontrolled</li> <li>• 250.x3 Diabetes type I [juvenile type], uncontrolled</li> </ul>	<ul style="list-style-type: none"> <li>• E10 Type 1 diabetes mellitus</li> </ul>
Ulcerative colitis	<ul style="list-style-type: none"> <li>• 556 Ulcerative colitis</li> </ul>	<ul style="list-style-type: none"> <li>• K51 Ulcerative colitis</li> </ul>
<p><i>Abbreviations: ICD-9-CM, International Classification of Diseases, 9<sup>th</sup> Revision, Clinical Modification; ICD-10-CM, International Classification of Diseases, 10<sup>th</sup> Revision, Clinical Modification; NOS, not otherwise specified.</i></p>		

**Supplementary Table 2.** LOINC codes for laboratory values and vital signs

<b>Laboratory Tests/Vital Signs</b>	<b>LOINC Codes</b>	<b>SNOMED Codes</b>
<b>Vital Signs</b>		
Temperature	8310-5	386725007
Pulse		78564009
Respiratory Rate	9279-1	86290005
O <sub>2</sub> Saturation	20564-1, 2711-0	
Systolic Blood Pressure		271649006
Diastolic Blood Pressure		271650006
Weight	29463-7, 3141-9	27113001
Body Mass Index		60621009
<b>Basic Metabolic Panel</b>		
Sodium	2951-2	
Potassium	2823-3	
Chloride	2075-0	
Bicarbonate	2028-9	
Creatinine	2160-0	
Blood urea nitrogen	3094-0	
Magnesium	19123-9	
Calcium	17861-6	
Phosphorous	2777-1	
<b>Complete Blood Count Panel</b>		
White Blood Cell Count	6690-2, 26464-8	
Platelets	777-3, 26515-7	
Hemoglobin	718-7	
Hematocrit	4544-3	
% Neutrophils	770-8, 26511-6	
% Eosinophils	713-8, 714-6, 26450-7	
% Lymphocytes	737-7, 731-0, 736-9, 26478-8	
<b>Liver Function Tests</b>		
Aspartate Aminotransferase	1920-8	
Alanine Aminotransferase	1742-6	
Alkaline Phosphatase	6768-6	
Total Bilirubin	1975-2	
Direct Bilirubin	1968-7, 15152-2	
Indirect Bilirubin	1971-1	
<b>Lactate Dehydrogenase</b>	2532-0, 14804-9	
<b>Cardiac Enzymes</b>		

Troponin	10839-9, 42757-5, 6598-7, 49563-0	
BNP	30934-4	
ProBNP	33762-6	
<b>Inflammatory Markers</b>		
Erythrocyte sedimentation rate	4537-7, 30341-2, 43402-7	
C-reactive protein	1988-5, 30522-7	
<b>Coagulation Factors</b>		
Prothrombin Time	5902-2	
Partial Thromboplastin Time	14979-9	
International Normalized Ratio	34714-6	
<b>D-dimer and Fibrinogen Split Products</b>		
D-Dimer	48065-7	
Fibrinogen	3255-7	
<i>Abbreviations:</i> BNP, B-type natriuretic peptide; LOINC, Logical Observation Identifiers Names and Codes; <i>SNOMED</i> , <i>Systematized Nomenclature, of Medicine</i> .		

**Supplementary Table 3.** Description of Model Variables

<b>Characteristic</b>	<b>Missing</b>	<b>Mean (SD)</b>
Age	818	64.7 (10.8)
Weight Change	1952	-0.1 (0.3)
ECOG Performance Score	1406	1.1 (0.8)
<b>Laboratory Values, mean (SD)</b>		<b>Mean (SD)</b>
Alkaline Phosphatase	223	105.0 (67.5)
Alanine Aminotransferase	251	24.3 (28.3)
Aspartate Aminotransferase	284	24.7 (24.2)
B-type Natriuretic Peptide	4907	506.5 (966.6)
Blood Urine Nitrogen	241	16.8 (8.1)
Calcium	3232	9.3 (0.6)
Chloride	238	101.3 (4.5)
Creatinine	2712	1.0 (0.4)
C-Reactive Protein	4872	75.3 (78.2)
D-Dimer	4946	46.4 (192.9)
Direct Bilirubin	4524	0.2 (0.6)
Eosinophils Percent	1089	2.3 (3.2)
Erythrocyte Sedimentation Rate	4950	56.9 (37.9)
Fibrinogen	4941	426.8 (184.0)
Hemoglobin	188	11.8 (2.0)
Bicarbonate	3811	27.0 (5.3)
Hematocrit	4884	35.3 (5.5)
Indirect Bilirubin	4950	0.5 (0.4)
International Normalized Ratio	4366	1.2 (0.7)
Potassium	211	4.2 (0.5)
Lactate Dehydrogenase	3125	287.4 (273.2)
Lymphocytes Percent	1081	17.8 (10.4)
Magnesium	2809	1.9 (0.3)
Sodium	202	138.1 (3.7)
Neutrophils Percent	688	70.0 (12.8)
Phosphate	4285	3.5 (0.7)

Platelets		270	263.5 (113.8)
N-Terminal Pro-B-Type Natriuretic Peptide		4946	656.4 (1237.8)
Prothrombin Time		3664	13.6 (5.8)
Partial Thromboplastin Time		4613	30.4 (8.4)
Total bilirubin		363	0.5 (0.4)
Troponin		4904	0.1 (0.5)
White Blood Cells		851	8.3 (4.7)
<b>Vital Signs, mean (SD)</b>			Mean (SD)
Body Mass Index		1496	26.3 (6.2)
Diastolic Blood Pressure		1381	72.5 (11.0)
Heart Rate		1189	86.3 (17.5)
Respiratory Rate		581	17.4 (2.1)
Systolic Blood Pressure		1381	126.3 (19.2)
Temperature		485	97.7 (0.7)
Weight		1912	167.2 (44.9)
<b>Characteristic, n (%)</b>			
Number of Immunotherapies	1	0	4739 (95.5)
	2		215 (4.3)
	3		6 (0.1)
Chest RT	0	0	3794 (75.4)
	1		1166 (24.6)
Charlson Co-morbidity Index	0	0	6 (0.1)
	2-3		683 (13.8)
	3+		4278 (86.1)
Male	0	0	2252 (45.3)
	1		2715 (54.7)
<b>Medication, n (%)</b>			
5-Alpha Reductase Inhibitor, n (%)	0	0	4934 (99.5)
	1+		27 (0.5)
Adenosine Receptor Agonist, n (%)	0	0	4948 (99.7)



	1+		13 (0.3)
Aldosterone Antagonist, n (%)	0	0	4910 (99.0)
	1+		51 (1.0)
Alkylating Drug, n (%)	0	0	4925 (99.3)
	1+		36 (0.7)
Aluminum Complex, n (%)	0	0	4907 (98.9)
	1+		54 (1.1)
Amide Local Anesthetic, n (%)	0	0	4865 (98.1)
	1+		96 (1.9)
Aminoglycoside Antibacterial, n (%)	0	0	4927 (99.3)
	1+		34 (0.7)
Aminoketone, n (%)	0	0	4870 (98.2)
	1+		91 (1.8)
Aminosalicylate, n (%)	0	0	4957 (99.9)
	1+		4 (0.1)
Androgen Receptor Inhibitor, n (%)	0	0	4951 (99.8)
	1+		10 (0.2)
Angiotensin 2 Receptor Blocker, n (%)	0	0	4790 (96.6)
	1+		171 (3.4)
Angiotensin Converting Enzyme Inhibitor, n (%)	0	0	4623 (93.2)
	1+		338 (6.8)
Anthracycline Topoisomerase Inhibitor, n (%)	0	0	4946 (99.7)
	1+		15 (0.3)
Anti-Epileptic Agent, n (%)	0	0	4784 (96.4)
	1+		177 (3.6)
Antiarrhythmic, n (%)	0	0	4523 (91.2)
	1+		438 (8.8)
Anticholinergic, n (%)	0	0	4403 (88.8)
	1+		558 (11.2)
Antiemetic, n (%)	0	0	4933 (99.4)
	1+		28 (0.6)
Antihistamine, n (%)	0	0	4944 (99.7)
	1+		17 (0.3)
Antihypoglycemic Agent, n (%)	0	0	4931 (99.4)
	1+		30 (0.6)
Antimalarial, n (%)	0	0	4957 (99.9)

	1+		4 (0.1)
Antimycobacterial, n (%)	0	0	4956 (99.9)
	1+		5 (0.1)
Antirheumatic Agent, n (%)	0	0	4959 (100.0)
	1+		2 (0.0)
Antiseptic, n (%)	0	0	4945 (99.7)
	1+		16 (0.3)
Aromatase Inhibitor, n (%)	0	0	4918 (99.1)
	1+		43 (0.9)
Arteriolar Vasodilator, n (%)	0	0	4751 (95.8)
	1+		210 (4.2)
Atypical Antipsychotic, n (%)	0	0	4878 (98.3)
	1+		83 (1.7)
Azole Antifungal, n (%)	0	0	4850 (97.8)
	1+		111 (2.2)
Barbiturate, n (%)	0	0	4947 (99.7)
	1+		14 (0.3)
Benzodiazepine, n (%)	0	0	4455 (89.8)
	1+		506 (10.2)
Benzodiazepine Antagonist, n (%)	0	0	4957 (99.9)
	1+		4 (0.1)
Biguanide, n (%)	0	0	4917 (99.1)
	1+		44 (0.9)
Bile Acid, n (%)	0	0	4957 (99.9)
	1+		4 (0.1)
Bile Acid Sequestrant, n (%)	0	0	4957 (99.9)
	1+		4 (0.1)
Bismuth, n (%)	0	0	4956 (99.9)
	1+		5 (0.1)
Bisphosphonate, n (%)	0	0	4569 (92.1)
	1+		392 (7.9)
Blood Coagulation Factor, n (%)	0	0	4936 (99.5)
	1+		25 (0.5)
Cd20-Directed Cytolytic Antibody, n (%)	0	0	4941 (99.6)
	1+		20 (0.4)

Ctla-4-Directed Blocking Antibody, n (%)	0	0	4746 (95.7)
	1+		215 (4.3)
Calcineurin Inhibitor Immunosuppressant, n (%)	0	0	4956 (99.9)
	1+		5 (0.1)
Calcitonin, n (%)	0	0	4957 (99.9)
	1+		4 (0.1)
Calcium Channel Blocker, n (%)	0	0	4873 (98.2)
	1+		88 (1.8)
Calcium-Sensing Receptor Agonist, n (%)	0	0	4959 (100.0)
	1+		2 (0.0)
Cannabinoid, n (%)	0	0	4924 (99.3)
	1+		37 (0.7)
Carbonic Anhydrase Inhibitor, n (%)	0	0	4956 (99.9)
	1+		5 (0.1)
Cardiac Glycoside, n (%)	0	0	4945 (99.7)
	1+		16 (0.3)
Catecholamine, n (%)	0	0	4958 (99.9)
	1+		3 (0.1)
Central Nervous System Stimulant, n (%)	0	0	4940 (99.6)
	1+		21 (0.4)
Central Alpha-2 Adrenergic Agonist, n (%)	0	0	4939 (99.6)
	1+		22 (0.4)
Cephalosporin Antibacterial, n (%)	0	0	4539 (91.5)
	1+		422 (8.5)
Cholinergic Muscarinic Agonist, n (%)	0	0	4867 (98.1)
	1+		94 (1.9)
Cholinergic Muscarinic Antagonist, n (%)	0	0	4938 (99.5)
	1+		23 (0.5)
Cholinergic Nicotinic Agonist, n (%)	0	0	4909 (99.0)
	1+		52 (1.0)
Cholinergic Receptor Agonist, n (%)	0	0	4957 (99.9)
	1+		4 (0.1)
Cholinesterase Inhibitor, n (%)	0	0	4841 (97.6)
	1+		120 (2.4)
Corticosteroid, n (%)	0	0	1153 (23.2)
	1+		

	1+		3808 (76.8)
Depolarizing Neuromuscular Blocker, n (%)	0	0	4914 (99.1)
	1+		47 (0.9)
Dietary Cholesterol Absorption Inhibitor, n (%)	0	0	4953 (99.8)
	1+		8 (0.2)
Dihydropyridine Calcium Channel Blocker, n (%)	0	0	4785 (96.5)
	1+		176 (3.5)
Dipeptidyl Peptidase 4 Inhibitor, n (%)	0	0	4951 (99.8)
	1+		10 (0.2)
Dopamine-2 Receptor Antagonist, n (%)	0	0	4908 (98.9)
	1+		53 (1.1)
Epidermal Growth Factor Receptor Antagonist, n (%)	0	0	4925 (99.3)
	1+		36 (0.7)
Erythropoiesis-Stimulating Agent, n (%)	0	0	4885 (98.5)
	1+		76 (1.5)
Ester Local Anesthetic, n (%)	0	0	4956 (99.9)
	1+		5 (0.1)
Estrogen Agonist/Antagonist, n (%)	0	0	4947 (99.7)
	1+		14 (0.3)
Factor Xa Inhibitor, n (%)	0	0	4919 (99.2)
	1+		42 (0.8)
Folate Analog, n (%)	0	0	4949 (99.8)
	1+		12 (0.2)
Folate Analog Metabolic Inhibitor, n (%)	0	0	3108 (62.6)
	1+		1853 (37.4)
General Anesthetic, n (%)	0	0	4769 (96.1)
	1+		192 (3.9)
Glycopeptide Antibacterial, n (%)	0	0	4885 (98.5)
	1+		76 (1.5)
Gonadotropin Releasing Hormone Receptor Agonist, n (%)	0	0	4945 (99.7)
	1+		16 (0.3)
Her2/Neu Receptor Antagonist, n (%)	0	0	4948 (99.7)
	1+		13 (0.3)
Hmg-Coa Reductase Inhibitor, n (%)	0	0	4722 (95.2)
	1+		239 (4.8)
	0	0	4920 (99.2)

Herpesvirus Nucleoside Analog Dna Polymerase Inhibitor, n (%)	1+		41 (0.8)
Histamine-1 Receptor Antagonist, n (%)	0	0	2461 (49.6)
	1+		2500 (50.4)
Histamine-2 Receptor Antagonist, n (%)	0	0	4653 (93.8)
	1+		308 (6.2)
Human Serum Albumin, n (%)	0	0	4951 (99.8)
	1+		10 (0.2)
Insulin, n (%)	0	0	4916 (99.1)
	1+		45 (0.9)
Insulin Analog, n (%)	0	0	4883 (98.4)
	1+		78 (1.6)
Interferon Alpha, n (%)	0	0	4949 (99.8)
	1+		12 (0.2)
Kinase Inhibitor, n (%)	0	0	4341 (87.5)
	1+		620 (12.5)
Leukocyte Growth Factor, n (%)	0	0	4119 (83.0)
	1+		842 (17.0)
Leukotriene Receptor Antagonist, n (%)	0	0	4939 (99.6)
	1+		22 (0.4)
Lincosamide Antibacterial, n (%)	0	0	4836 (97.5)
	1+		125 (2.5)
Lipid Emulsion, n (%)	0	0	4954 (99.9)
	1+		7 (0.1)
Loop Diuretic, n (%)	0	0	4354 (87.8)
	1+		607 (12.2)
Low Molecular Weight Heparin, n (%)	0	0	4690 (94.5)
	1+		271 (5.5)
Lymphocyte Growth Factor, n (%)	0	0	4948 (99.7)
	1+		13 (0.3)
Macrolide, n (%)	0	0	4951 (99.8)
	1+		10 (0.2)
Macrolide Antimicrobial, n (%)	0	0	4863 (98.0)
	1+		98 (2.0)
Microtubule Inhibitor, n (%)	0	0	3237 (65.2)
	1+		1724 (34.8)

Mood Stabilizer, n (%)	0	0	4951 (99.8)
	1+		10 (0.2)
Muscle Relaxant, n (%)	0	0	4845 (97.7)
	1+		116 (2.3)
N-Methyl-D-Aspartate Receptor Antagonist, n (%)	0	0	4948 (99.7)
	1+		13 (0.3)
Neuraminidase Inhibitor, n (%)	0	0	4929 (99.4)
	1+		32 (0.6)
Nicotinic Acid, n (%)	0	0	4954 (99.9)
	1+		7 (0.1)
Nitrate Vasodilator, n (%)	0	0	4889 (98.5)
	1+		72 (1.5)
Nitrofurantoin Antibacterial, n (%)	0	0	4958 (99.9)
	1+		3 (0.1)
Nitroimidazole Antimicrobial, n (%)	0	0	4900 (98.8)
	1+		61 (1.2)
Non-Standardized Chemical Allergen, n (%)	0	0	4956 (99.9)
	1+		5 (0.1)
Non-Narcotic Antitussive, n (%)	0	0	4832 (97.4)
	1+		129 (2.6)
Nondepolarizing Neuromuscular Blocker, n (%)	0	0	4842 (97.6)
	1+		119 (2.4)
Nonergot Dopamine Agonist, n (%)	0	0	4948 (99.7)
	1+		13 (0.3)
Nonsteroidal Anti-Inflammatory Drug, n (%)	0	0	4524 (91.2)
	1+		437 (8.8)
Nucleoside Analog Antiviral, n (%)	0	0	4959 (100.0)
	1+		2 (0.0)
Nucleoside Metabolic Inhibitor, n (%)	0	0	4549 (91.7)
	1+		412 (8.3)
Opioid Agonist, n (%)	0	0	2390 (48.2)
	1+		2571 (51.8)
Opioid Agonist/Antagonist, n (%)	0	0	4941 (99.6)
	1+		20 (0.4)
Opioid Antagonist, n (%)	0	0	4607 (92.9)

	1+		354 (7.1)
Osmotic Laxative, n (%)	0	0	4784 (96.4)
	1+		177 (3.6)
Oxidation-Reduction Agent, n (%)	0	0	4953 (99.8)
	1+		8 (0.2)
P2Y12 Platelet Inhibitor, n (%)	0	0	4922 (99.2)
	1+		39 (0.8)
Parenteral Iron Replacement, n (%)	0	0	4957 (99.9)
	1+		4 (0.1)
Partial Cholinergic Nicotinic Agonist, n (%)	0	0	4948 (99.7)
	1+		13 (0.3)
Partial Opioid Agonist, n (%)	0	0	4959 (100.0)
	1+		2 (0.0)
Penem Antibacterial, n (%)	0	0	4959 (100.0)
	1+		2 (0.0)
Penicillin-Class Antibacterial, n (%)	0	0	4824 (97.2)
	1+		137 (2.8)
Phenothiazine, n (%)	0	0	3786 (76.3)
	1+		1175 (23.7)
Phosphate Binder, n (%)	0	0	4958 (99.9)
	1+		3 (0.1)
Phosphodiesterase 3 Inhibitor, n (%)	0	0	4956 (99.9)
	1+		5 (0.1)
Phosphodiesterase 5 Inhibitor, n (%)	0	0	4938 (99.5)
	1+		23 (0.5)
Platelet Aggregation Inhibitor, n (%)	0	0	4634 (93.4)
	1+		327 (6.6)
Platinum-Based Drug, n (%)	0	0	1680 (33.9)
	1+		3281 (66.1)
Poly(Adp-Ribose) Polymerase Inhibitor, n (%)	0	0	4958 (99.9)
	1+		3 (0.1)
Polyene Antifungal, n (%)	0	0	4884 (98.4)
	1+		77 (1.6)
Polymyxin-Class Antibacterial, n (%)	0	0	4956 (99.9)

	1+		5 (0.1)
Potassium-Sparing Diuretic, n (%)	0	0	4922 (99.2)
	1+		39 (0.8)
Progestin, n (%)	0	0	4678 (94.3)
	1+		283 (5.7)
Programmed Death Ligand-1 Blocker, n (%)	0	0	4841 (97.6)
	1+		120 (2.4)
Programmed Death Receptor-1 Blocking Antibody, n (%)	0	0	110 (2.2)
	1+		4851 (97.8)
Proteasome Inhibitor, n (%)	0	0	4957 (99.9)
	1+		4 (0.1)
Proton Pump Inhibitor, n (%)	0	0	4626 (93.2)
	1+		335 (6.8)
Provitamin D2 Compound, n (%)	0	0	4934 (99.5)
	1+		27 (0.5)
Quinolone Antimicrobial, n (%)	0	0	4228 (85.2)
	1+		733 (14.8)
Rank Ligand Inhibitor, n (%)	0	0	4851 (97.8)
	1+		110 (2.2)
Rna Synthetase Inhibitor Antibacterial, n (%)	0	0	4934 (99.5)
	1+		27 (0.5)
Radiographic Contrast Agent, n (%)	0	0	4885 (98.5)
	1+		76 (1.5)
Recombinant Human Deoxyribonuclease 1, n (%)	0	0	4959 (100.0)
	1+		2 (0.0)
Rifamycin Antibacterial, n (%)	0	0	4956 (99.9)
	1+		5 (0.1)
Serotonin Reuptake Inhibitor, n (%)	0	0	4542 (91.6)
	1+		419 (8.4)
Serotonin And Norepinephrine Reuptake Inhibitor, n (%)	0	0	4874 (98.2)
	1+		87 (1.8)
Serotonin-1B And Serotonin-1D Receptor Agonist, n (%)	0	0	4957 (99.9)
	1+		4 (0.1)
Serotonin-3 Receptor Antagonist, n (%)	0	0	1004 (20.2)
	1+		3957 (79.8)



Standardized Chemical Allergen, n (%)	0	0	4945 (99.7)
	1+		16 (0.3)
Stimulant Laxative, n (%)	0	0	4721 (95.2)
	1+		240 (4.8)
Substance P/Neurokinin-1 Receptor Antagonist, n (%)	0	0	4560 (91.9)
	1+		401 (8.1)
Sulfonylurea, n (%)	0	0	4927 (99.3)
	1+		34 (0.7)
Tetracycline-Class Drug, n (%)	0	0	4893 (98.6)
	1+		68 (1.4)
Thalidomide Analog, n (%)	0	0	4956 (99.9)
	1+		5 (0.1)
Thiazide Diuretic, n (%)	0	0	4721 (95.2)
	1+		240 (4.8)
Thiazide-Like Diuretic, n (%)	0	0	4932 (99.4)
	1+		29 (0.6)
Topoisomerase Inhibitor, n (%)	0	0	4680 (94.3)
	1+		281 (5.7)
Tricyclic Antidepressant, n (%)	0	0	4900 (98.8)
	1+		61 (1.2)
Tuberculosis Skin Test, n (%)	0	0	4954 (99.9)
	1+		7 (0.1)
Typical Antipsychotic, n (%)	0	0	4943 (99.6)
	1+		18 (0.4)
Uncompetitive N-Methyl-D-Aspartate Receptor Antagonist, n (%)	0	0	4946 (99.7)
	1+		15 (0.3)
Unfractionated Heparin, n (%)	0	0	4728 (95.3)
	1+		233 (4.7)
Vascular Endothelial Growth Factor Inhibitor, n (%)	0	0	4354 (87.8)
	1+		607 (12.2)
Vascular Endothelial Growth Factor Receptor 2 Antagonist, n (%)	0	0	4868 (98.1)
	1+		93 (1.9)
Vasoconstrictor, n (%)	0	0	4946 (99.7)
	1+		15 (0.3)
Vasopressin Analog, n (%)	0	0	4959 (100.0)

	1+		2 (0.0)
Vinca Alkaloid, n (%)	0	0	4862 (98.0)
	1+		99 (2.0)
Vitamin B12, n (%)	0	0	4667 (94.1)
	1+		294 (5.9)
Vitamin C, n (%)	0	0	4951 (99.8)
	1+		10 (0.2)
Vitamin D, n (%)	0	0	4917 (99.1)
	1+		44 (0.9)
Vitamin D3 Analog, n (%)	0	0	4958 (99.9)
	1+		3 (0.1)
Vitamin K Antagonist, n (%)	0	0	4921 (99.2)
	1+		40 (0.8)
Xanthine Oxidase Inhibitor, n (%)	0	0	4927 (99.3)
	1+		34 (0.7)
Alpha-1 Adrenergic Agonist, n (%)	0	0	4770 (96.1)
	1+		191 (3.9)
Alpha-Adrenergic Agonist, n (%)	0	0	4798 (96.7)
	1+		163 (3.3)
Alpha-Adrenergic Blocker, n (%)	0	0	4798 (96.7)
	1+		163 (3.3)
Beta-Adrenergic Agonist, n (%)	0	0	4956 (99.9)
	1+		5 (0.1)
Beta-Adrenergic Blocker, n (%)	0	0	4443 (89.6)
	1+		518 (10.4)
Beta2-Adrenergic Agonist, n (%)	0	0	4564 (92.0)
	1+		397 (8.0)
Gamma-Aminobutyric Acid-Ergic Agonist, n (%)	0	0	4895 (98.7)
	1+		66 (1.3)
L-Thyroxine, n (%)	0	0	4916 (99.1)
	1+		45 (0.9)
<b>Race, n (%)</b>	<b>Category</b>	<b>Missing</b>	<b>n (%)</b>
Black or African American	0	0	4274 (86.0)
	1		693 (14.0)
Other Race	0	0	4296 (86.5)

	1		671 (13.5)
White	0	0	1484 (29.9)
	1		3483 (70.1)
Unknown	0	0	4847 (97.6)
	1		120 (2.4)
<b>Ethnicity, n (%)</b>	<b>Category</b>	<b>Missing</b>	<b>n (%)</b>
Hispanic or Latino	0	0	4847 (97.6)
	1		120 (2.4)
Not Hispanic or Latino	0	0	1087 (21.9)
	1		3880 (78.1)
Unknown	0	0	4000 (80.5)
	1		967 (19.5)
<b>Cancer Type, n (%)</b>	<b>Category</b>	<b>Missing</b>	<b>n (%)</b>
Lung	0	0	860 (17.3)
	1		4107 (82.7)
Melanoma	0	0	4433 (89.2)
	1		534 (10.8)
Renal Cell Carcinoma	0	0	4641 (93.4)
	1		326 (6.6)
<b>Cancer Stage, n (%)</b>	<b>Category</b>	<b>Missing</b>	<b>n (%)</b>
0	0	236	4729 (100.0)
	1		2 (0.0)
1	0	236	4552 (96.2)
	1		179 (3.8)
2	0	236	4537 (95.9)
	1		194 (4.1)
3	0	236	4008 (84.7)
	1		723 (15.3)
4	0	236	1098 (23.2)
	1		3633 (76.8)
<b>Smoking Status, n (%)</b>	<b>Category</b>	<b>Missing</b>	<b>n (%)</b>

Ex-Smoker	0	0	2948 (59.4)
	1		2019 (40.6)
Never Smoker	0	0	4301 (86.6)
	1		666 (13.4)
Smoker	0	0	3306 (66.6)
	1		1661 (33.4)
Unknown	0	0	4346 (87.5)
	1		621 (12.5)
<b>PD-1/PD-L1 Therapy, n (%)</b>			
Atezolizumab	Category	Missing	n (%)
	0	0	4662 (93.9)
Avelumab	0	0	4960 (99.9)
	1		7 (0.1)
Durvalumab	0	0	4863 (97.9)
	1		104 (2.1)
Nivolumab	0	0	1729 (34.8)
	1		3238 (65.2)
Pembrolizumab	0	0	3661 (73.7)
	1		1306 (26.3)
<b>PD Test, n (%)</b>			
Negative	Category	Missing	n (%)
	0	0	4704 (94.7)
Not Interpretable	0	0	4733 (95.3)
	1		234 (4.7)
Positive	0	0	4420 (89.0)
	1		547 (11.0)
<b>Disease, n (%)</b>			
Addison's	Category	Missing	n (%)
	0	0	4956 (99.8)
Alcoholism	0	0	4901 (98.7)
	1		66 (1.3)
Alopecia Areata	0	0	4967 (100.0)

Anemia	0	0	3796 (76.4)
	1		1171 (23.6)
Ankylosing Spondylitis	0	0	4965 (100.0)
	1		2 (0.0)
Asthma	0	0	3552 (71.5)
	1		1415 (28.5)
Atrial Fibrillation	0	0	4724 (95.1)
	1		243 (4.9)
Celiac Disease	0	0	4965 (100.0)
	1		2 (0.0)
Chron's Disease	0	0	4961 (99.9)
	1		6 (0.1)
Depression	0	0	4628 (93.2)
	1		339 (6.8)
Diabetes	0	0	4598 (92.6)
	1		369 (7.4)
Glaucoma	0	0	4946 (99.6)
	1		21 (0.4)
Heart Disease	0	0	4528 (91.2)
	1		439 (8.8)
Hyperlipidemia	0	0	4357 (87.7)
	1		610 (12.3)
Hypertension	0	0	3890 (78.3)
	1		1077 (21.7)
Lupus	0	0	4962 (99.9)
	1		5 (0.1)
Multiple Sclerosis	0	0	4958 (99.8)
	1		9 (0.2)
Myasthenia Gravis	0	0	4967 (100.0)
	1		0 (0.0)
Myocardial Infarction	0	0	4932 (99.3)
	1		35 (0.7)
Myositis	0	0	4824 (97.1)
	1		143 (2.9)

Osteoporosis	0	0	4876 (98.2)
	1		91 (1.8)
Pros Hplasia	0	0	4829 (97.2)
	1		138 (2.8)
Psoriasis	0	0	4946 (99.6)
	1		21 (0.4)
Psoriatic Arthritis	0	0	4966 (100.0)
	1		1 (0.0)
Rheumatoid Arthritis	0	0	4914 (98.9)
	1		53 (1.1)
Sarcoidosis	0	0	4961 (99.9)
	1		6 (0.1)
Scleroderma	0	0	4966 (100.0)
	1		1 (0.0)
Sjogren's	0	0	4941 (99.5)
	1		26 (0.5)
Thyroid Disease	0	0	4573 (92.1)
	1		394 (7.9)
Type 1 Diabetes Mellitus	0	0	4954 (99.7)
	1		13 (0.3)
Ulcerative Colitis	0	0	4956 (99.8)
	1		11 (0.2)

Supplementary Table 4. Comparison of Model Performance Across Sensitivity Analyses

Model	AUC-ROC at 100 days	Concordance Index
All Features	0.65	0.66
Top 20 Features Only	0.65	0.65
Missing Features Imputed with MICE	0.66	0.66
Exclude Features > 70% Missing	0.66	0.68
Exclude Features > 80% Missing	0.65	0.64
Exclude Features > 90% Missing	0.64	0.65



**Supplementary Table 5.** Summary of SHAP Interpretations

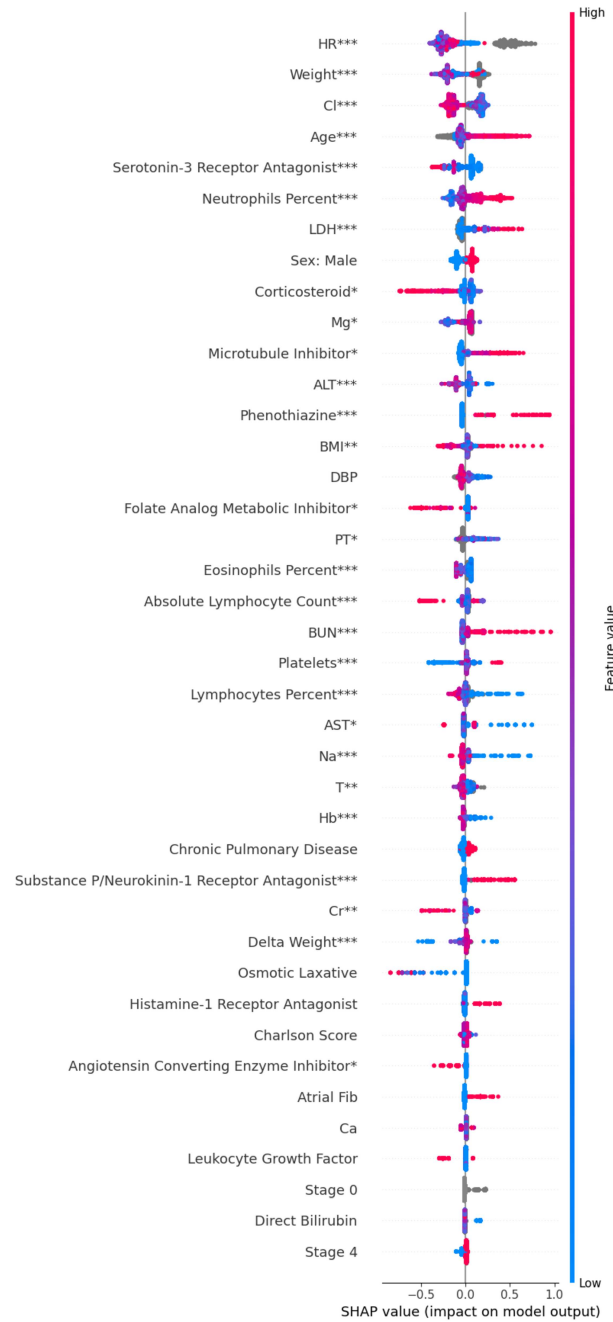
<b>Variable</b>	<b>Direction</b>	<b>P-values</b>
Age	↑	0
Race		
White	-	0.548
Black or African American	-	0.978
Other Race	-	0.268
Missing	-	1
Ethnicity		
Hispanic or Latino	-	0.99
Not Hispanic or Latino	-	0.95
Unknown	-	0.944
Cancer Type		
Lung	-	0.486
Melanoma	-	0.998
RCC	-	0.696
Stage		
Stage 1	-	0.92
Stage 2	-	0.936
Stage 3	-	0.93
Stage 4	-	0.31
Smoking Status		
Smoker	-	0.776
Ex-Smoker	-	0.878
Never Smoker	-	0.934
Performance Status	-	0.23
Charlson Score	-	0.118
Comorbidities		
Cerebrovascular Disease	-	0.988
Chronic Pulmonary Disease	-	0.71
Congestive Heart Failure	-	0.376
Diabetes With Chronic Complication	-	0.964
Diabetes Without Chronic Complication	-	0.966
Hemiplegia Or Paraplegia	-	1
Metastatic Solid Tumor	-	0.994



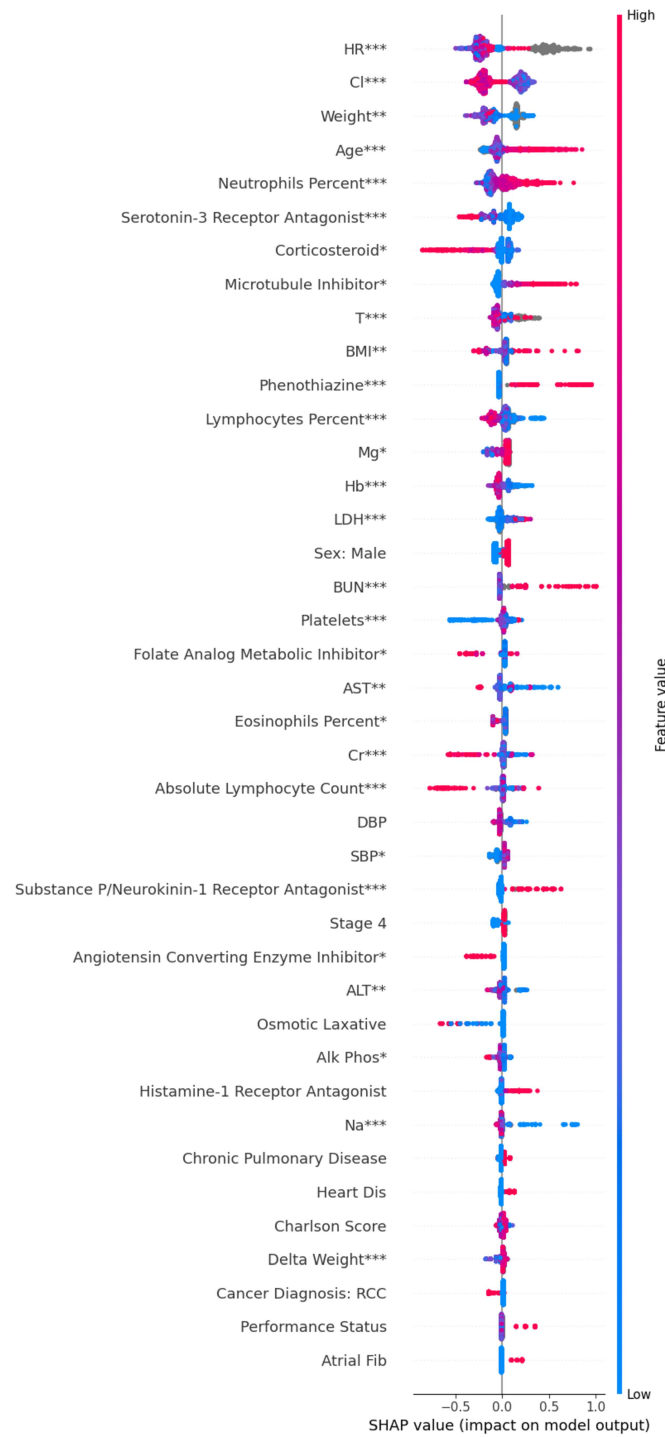
Mild Liver Disease	-	0.972
Moderate Or Severe Liver Disease	-	1
Myocardial Infarction	-	0.848
Peptic Ulcer Disease	-	0.996
Peripheral Vascular Disease	-	0.816
Renal Disease	-	0.75
Rheumatic Disease	-	0.998
PD-1/PD-L1 Therapy		
Atezolizumab	-	0.906
Avelumab	-	1
Durvalumab	-	1
Nivolumab	-	0.872
Pembrolizumab	-	0.972
PD-L1 Test Result		
Positive	-	0.272
Negative	-	0.968
Not interpretable	-	0.99
Other Significant Variables		
Neutrophils Percent	↑	0
Substance P/Neurokinin-1 Receptor Antagonist	↑	0
Absolute Lymphocyte Count	↓	0
Platelets	↑	0
T	~	0
Cl	↓	0
Lymphocytes Percent	↓	0
HR	~	0
Hb	↓	0
Cr	↓	0
Na	↓	0.002
BUN	↑	0.002
Delta Weight	↑	0.002
ALT	↓	0.002
Serotonin-3 Receptor Antagonist	↓	0.002
Phenothiazine	↑	0.002
LDH	↑	0.004
PT	~	0.004

Absolute Neutrophil Count	~	0.006
Corticosteroid	↓	0.008
Vinca Alkaloid	↑	0.008
Weight	~	0.008
Eosinophils Percent	↓	0.01
AST	↓	0.01
Loop Diuretic	↓	0.01
BMI	~	0.01
Alk Phos	↓	0.022
Phos	↑	0.024
WBC	↑	0.024
Angiotensin Converting Enzyme Inhibitor	↓	0.026
Programmed Death Receptor-1 Blocking Antibody	↓	0.028
Microtubule Inhibitor	↑	0.028
Folate Analog Metabolic Inhibitor	↓	0.048
Abbreviations: CoA, co-enzyme A; CTLA-4, cytotoxic T-lymphocyte-associated protein 4; ECOG, Eastern Cooperative Oncology Group; HER, human epidermal growth factor receptor; HMG, hemoglobin; PD-1, programmed death receptor-1; PD-L1, programmed death ligand-1; SD, standard deviation.		

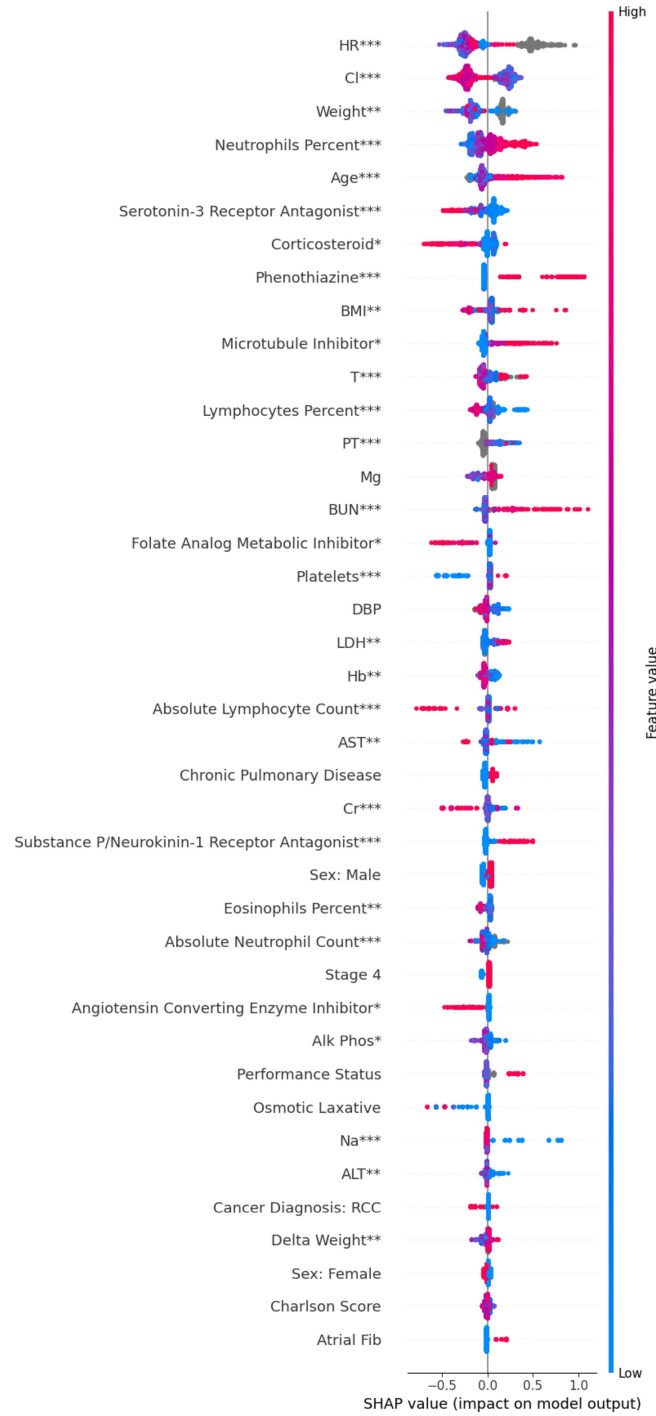
**Supplementary Figure 1.** Summary of SHAP Interpretations – Only Use Variables from Before Index



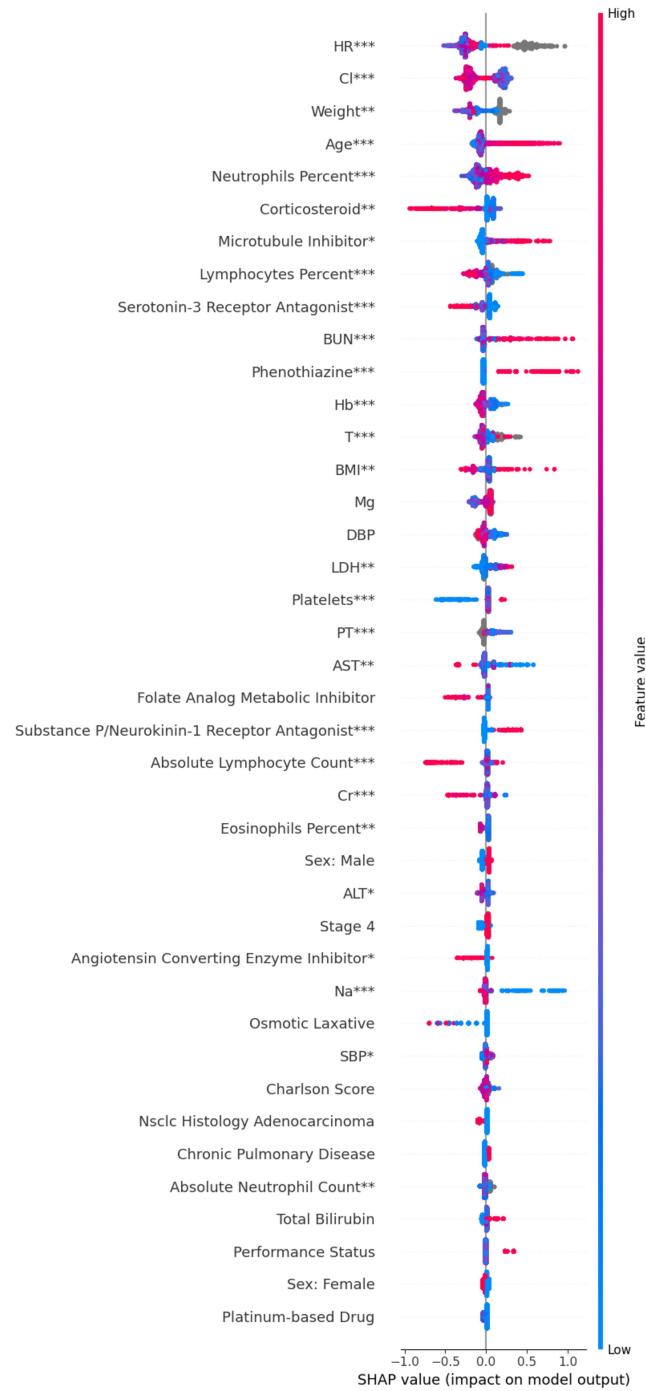
**Supplementary Figure 2.** Summary of SHAP Interpretations – Remove Features with > 70% Missingness



**Supplementary Figure 3.** Summary of SHAP Interpretations – Remove Features with > 80% Missingness



**Supplementary Figure 4.** Summary of SHAP Interpretations – Remove Features with > 90% Missingness



**Supplementary Figure 5.** Summary of SHAP Interpretations – Features Imputed with MICE

