

Polygenic Risk Score – Predict for Array module v1.1.3 Release Notes

In BaseSpace™ Sequence Hub

November 2023

Introduction

Polygenic Risk Score – Predict module provides comprehensive, easy to implement and versatile cloud-based analysis for polygenic risk score (PRS) predictions using microarrays. The easy-to-use interface on BaseSpace Sequence Hub simplifies the process of setting up, running, and reviewing analysis results.

Highlights include:

COMPREHENSIVE

The only commercially available genotype-to-risk prediction toolkit.

EASY TO IMPLEMENT

User-friendly, out-of-the-box software simplifies the work typically done by bioinformaticians. Automated PRS calculations based on high-performing algorithms and published data.

VERSATILE

Enables a variety of research needs by supporting multiple disease areas of study. Scalable to enable small- and large-scale studies.

These Release Notes detail the key features and changes to software components for the release of the Predict module. For information on how to use the system for PRS analysis, see the [Polygenic Risk Score Software Online Help](#). Predict module is an efficient solution for array analysis, including features such as:

- Simple two-step process for analysis kick-off in BaseSpace Sequence Hub
 - Includes Configuration and Sample Selection
- iScan™ integration allows data to be sent directly to cloud platform removing the need for manual upload
- Polygenic Risk Score – Predict Analysis Type to create PRS predictions.
 - User defined name and project to identify the analysis
- Create Configuration settings
 - Select from commercially available Infinium products or upload semi-custom or custom product files
 - Upload a Polygenic Score ID File that contains up to 24 custom or built-in PRS to calculate
- Select samples by either importing a sample sheet or selecting BeadChips
 - Selecting BeadChips makes analysis setup easy and removes the need for manual sample sheet generation

- View analysis results on BaseSpace or download to review locally.
- Demo data available on the Demo Data tab in BaseSpace as an example of expected results.

FEATURES IN DETAIL

- Addition of Polygenic Risk Score - Predict version 1.1.3 pipeline
 - Key outputs include PRS CSV, PRS PDF, SNV VCF (imputed per batch and un-imputed per sample), Genotype Summary File and PRS log file
 - Utilizes Illumina Connected Analytics (ICA) version 2 platform
- Ability to run Predict with built-in PRS, custom PRS, or one downloaded from the PGS catalog
 - When running custom PRS, a custom_results.csv is generated (no PDF report is generated)
- Includes access to 11 Allelica specific scores. Please review further details of these scores including their Polygenic Score ID in Appendix A.
 - Coronary artery disease
 - Breast cancer (available for females only)
 - Prostate cancer (available for males only)
 - Diabetes Type 2
 - Polygenic hypercholesterolemia (LDL Cholesterol)
 - Alzheimer's
 - Atrial fibrillation
 - Early menopause (available for females only) \
 - Hypertension
 - Triglycerides
 - High-density lipoprotein (HDL) cholesterol
- Includes access to over 2700 PRS representing over 550 different traits from the public PGS Catalog (www.pgscatalog.org)
 - Includes scores released in the PGS Catalog on or before Oct 19, 2022 with some exceptions. Please see Appendix B for complete list of scores included from the PGS Catalog.
 - Please note, PGS obtained from the Catalog should be cited appropriately, and used in accordance with any licensing restrictions set by the authors. See EBI Terms of Use (<https://www.ebi.ac.uk/about/terms-of-use/>) for additional details.
- The following products have product files, including manifests (*.csv and *.bpm formats) and cluster file (*.egt), already available within the system:

- Global Diversity Array with PRS content
- Global Diversity Array
- Global Diversity Array with enhanced PGx
- Global Screening Array version 3

KNOWN ISSUES AND LIMITATIONS

- Manifests (*.csv and *.bpm) and cluster files (*.egt) may take several minutes or longer to upload. Slow or instable network connections may lead to system timeout or failed uploads.
- Samples with the same Sample ID cannot be run in the same analysis. This will result in error and prevent analysis from proceeding.
- The Polygenic Score ID File should be saved and uploaded in CSV format. Files in UTF-8 CSV format will result in error.
- If one requested Polygenic Score ID is not valid for any reason, such as not available from the catalog, typed incorrectly, etc., it will stop output from being generated for all requested PGS Catalog scores.

APPENDIX A – INFORMATION ON ALLELICA DEVELOPED SCORES

Polygenic Score FileID	Disease/Trait	PRS method (number of variants)	Ancestry	AUC (95%CI)	ORxSTD (95%CI)	Number (cases/total)	Literature Summary
ALLELICA_CAD_2019	Coronary Artery Disease (CAD)	SCT + metaPRS 1,926,521	European	0.79 (0.79-0.8)	1.77 (1.75-1.79)	16,257 293,286	<ul style="list-style-type: none"> - Nikpay et al 2015 Nature Genetics - Bolli et al 2019 biorxiv - Bolli et al 2021 Circulation - Prive et al 2019 AJHG - Inouye et al 2018 JACC - Khara et al 2018 Nature Genetics - Weale et al 2021 Am J Cardiol - Mujwara et al 2021 medrxiv - Riveros-Mckay et al 2021 Circ Genom Precis Med - Sun et al 2021 PLoSMed
			African	0.67 (0.62-0.73)	1.24 (1.14-1.36)	222 7,646	
			South Asian	0.8 (0.78-0.82)	1.81 (1.71-1.92)	903 9,417	
			East Asian	0.73 (0.6-0.85)	1.27 (1.09-1.5)	39 1,503	
ALLELICA_AF_2020	Atrial Fibrillation (AF)	SCT 445,014	European	0.76 (0.76-0.77)	1.53 (1.51-1.56)	14,063 286,192	<ul style="list-style-type: none"> - Christopherson et al 2017 Nat Gen - Prive et al 2019 AJHG
			African	0.76 (0.73-0.80)	1.13 (0.93-1.34)	147 7,554	
			South Asian	0.76 (0.73-0.79)	1.38 (1.20-1.60)	194 7,551	
			East Asian	0.77 (0.66-0.88)	1.31 (0.81-2.09)	19 1,484	
ALLELICA_LDL_2020	Low Density Lipoprotein (LDL)	Lassosum 3,036	European	0.72 (0.71-0.72)	2.23 (2.2-2.25)	18,828 279,815	<ul style="list-style-type: none"> - Willer et al 2013 Nature Genetics - Mak et al 2017 Genetic Epidemiology - Sinnott-Armstrong et al 2021 Nature Genetics - Bolli et al 2021 Circulation - Medeiros and Bourbon 2021 Curr Opin Lipidol
			African	0.68 (0.63-0.72)	1.91 (1.76-2.1)	236 7,161	
			South Asian	0.66 (0.62-0.71)	1.82 (1.7-1.96)	307 8,927	

			East Asian	0.65 (0.53-0.76)	1.82 (1.57-2.11)	44 1,425	
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ALLELICA_T2D_2019	Type 2 Diabetes (T2D)	SCT 620,612	European	0.71 (0.71-0.72)	1.66 (1.64-1.68)	14,314 293,286	<ul style="list-style-type: none"> - Scott et al 2017 Diabetes - Prive et al 2019 AJHG - Vujkovic et al 2020 Nature Genetics - Mahajan et al 2018 Nature Genetics - Li et al 2021 Diabetes - Emdin et al 2017 JAMA - Udler et al 2019 Endocr Rev - Padilla-Martinez et al 2020 Int J Mol Sci 	
			African	0.69 (0.66-0.72)	1.3 (1.2-1.41)	751 7,646		
			South Asian	0.69 (0.67-0.71)	1.44 (1.38-1.5)	1,522 9,417		
			East Asian	0.69 (0.59-0.78)	1.11 (0.95-1.31)	75 1,503		
ALLELICA_BC_2019	Breast Cancer (BC)	SCT 577,113	European	0.67 (0.66-0.68)	1.71 (1.68-1.73)	10,986 278,323	<ul style="list-style-type: none"> - Michailidou et al 2017 Nature - Prive et al 2019 AJHG - Bolli et al 2019 bioRxiv - Busby et al 2021 medRxiv - Mavaddat et al 2019 AJHG - Fahed et al 2020 Nature Communications - Mars et al 2020 Nature Medicine - Mars et al 2020 Nature Communications - Kramer et al 2020 AJHG - Kapoor et al 2021 J Natl Cancer Inst - Barnes et al 2020 Genet Med 	
			South Asian	0.65 (0.59-0.71)	1.55 (1.43-1.7)	218 9,351		
		Mavaddat 313	East Asian	0.63 (0.51-0.74)	1.45 (1.22-1.79)	45 937		
			African	0.6 (0.54-0.67)	1.41 (1.27-1.55)	161 4,360		
ALLELICA_PC_2019	Prostate Cancer (PC)	SCT 682,397	European	0.8 (0.79-0.8)	2.13 (2.09-2.17)	6,219 278,323		<ul style="list-style-type: none"> - Schumacher et al 2018 Nature Genetics - Prive et al 2019 AJHG - Conti et al 2021 Nature Genetics - Black et al 2020 Prostate - Karunamuni et al 2021 Prostate Cancer Prostatic Dis - Plym et al 2021 J Natl Cancer Inst - Darst et al 2021 Eur Urol - Szulkin et al 2015 Prostate - Zhang et al 2020 Nature Communications - Xu and Isaacs 2021 Eur Urol - Huynh-Le et al 2021 Nature Communications
			South Asian	0.8 (0.75-0.86)	2.78 (2.11-3.62)	93 9,351		
		Schumacher 149	East Asian	0.79 (0.37-0.95)	1.24 (1.08-1.5)	8 565		
			African	0.83 (0.78-0.86)	1.57 (1.41-1.74)	196 3,283		

ALLELICA_AZ_2020	Alzheimer's Disease (AD)	SCT 136, 337	European	0.82 (0.8-0.85)	1.91 (1.84-1.98)	600 293,286	<ul style="list-style-type: none"> - Lambert et al 2013 Nature Genetics - Prive et al 2019 AJHG - Andrews et al 2020 Lancet Neurol - Kunkle et al 2019 Nature Genetics - Lennenko et al 2019 Ann Clin Transl Neurol - Chaudhury et al 2019 Transl Psychiatry
			African	0.93 (0.89-0.97)	1.52 (1.18-1.81)	13 7,646	
			South Asian	0.8 (0.61-0.94)	1.29 (0.93-1.62)	12 9,417	
			East Asian	NA	NA	1 1,503	
ALLELICA_EM_2018	Early Meno- pause (EM)	SCT 523, 372	European	0.64 (0.63-0.65)	1.67 (1.65-1.7)	9,275 83,070	<ul style="list-style-type: none"> - Perry et al 2013 Hum Mol Genet - Zhao et al 2021 Menopause - Ruth et al 2021 Nature
			African	0.66 (0.6-0.71)	1.13 (1.04-1.24)	319 1,559	
			South Asian	0.64 (0.6-0.69)	1.51 (1.4-1.62)	424 2,028	
			East Asian	0.53 (0.39-0.66)	1.34 (1.11-1.6)	43 399	
ALLELICA_HT_2020	Hypertension (SBP>160 mmHg) (HT)	Lassosum 247,151	European	0.72 (0.71-0.72)	1.57 (1.56-1.58)	30,032 41,329	<ul style="list-style-type: none"> - Warren et al 2017 Nature Genetics - Mak et al 2017 Genetic Epidemiology - Padmanabhan and Dominiczak 2020 Nat Rev Cardiol - Sinnott-Armstrong et al 2021 Nature Genetics - Sakaue et al 2020 Nature Medicine
			African	0.67 (0.64-0.7)	1.23 (1.17-1.3)	797 6,572	
			South Asian	0.72 (0.69-0.75)	1.35 (1.28-1.43)	727 7,926	
			East Asian	0.74 (0.67-0.81)	1.43 (1.25-1.64)	102 1,263	

ALLELICA_HDL_2020	High Density Lipoprotein (HDL<=1.164 mmol/l)	Lasso sum 322,564	European	0.75 (0.75-0.76)	1.84 (1.82-1.85)	59,800 233,486	<ul style="list-style-type: none"> - Willer et al 2013 Nature Genetics - Mak et al 2017 Genetic Epidemiology - Sinnott-Armstrong et al 2021 Nature Genetics
			African	0.71 (0.69-0.74)	1.34 (1.26-1.42)	773 5,866	
			South Asian	0.73 (0.71-0.75)	1.69 (1.62-1.75)	2,070 6,103	
			East Asian	0.75 (0.69-0.82)	1.60 (1.42-1.82)	141 1,162	
ALLELICA_TG_2020	Triglycerides (TG>=2.258 mmol/l)	Lasso sum 68,800	European	0.68 (0.67-0.68)	1.65 (1.64-1.66)	62,157 231,129	<ul style="list-style-type: none"> - Willer et al 2013 Nature Genetics - Mak et al 2017 Genetic Epidemiology - Sinnott-Armstrong et al 2021 Nature Genetics
			African	0.63 (0.42-0.81)	1.29 (1.03-1.60)	23 7,150	
			South Asian	0.75 (0.69-0.80)	2.30 (2.10-2.52)	204 8,733	
			East Asian	0.76 (0.62-0.88)	1.88 (1.54-2.3)	26 1,400	

APPENDIX B – INCLUDED PRS FROM THE PGS CATALOG

Scores listed below can be included in the Polygenic Score ID file. If a score is not listed below, it cannot be used in the Polygenic Score ID file but could be uploaded as a custom score. Custom scores are output in a separate .csv output and are not included in the PDF output.

PGS000001	PGS000002	PGS000003	PGS000004	PGS000005	PGS000006	PGS000007	PGS000008	PGS000009
PGS000010	PGS000011	PGS000012	PGS000013	PGS000014	PGS000015	PGS000016	PGS000017	PGS000018
PGS000019	PGS000020	PGS000021	PGS000022	PGS000023	PGS000024	PGS000025	PGS000026	PGS000027
PGS000028	PGS000029	PGS000030	PGS000031	PGS000032	PGS000033	PGS000034	PGS000035	PGS000036
PGS000037	PGS000038	PGS000039	PGS000040	PGS000041	PGS000042	PGS000043	PGS000044	PGS000045
PGS000046	PGS000047	PGS000048	PGS000049	PGS000050	PGS000051	PGS000052	PGS000053	PGS000054
PGS000055	PGS000056	PGS000057	PGS000058	PGS000059	PGS000060	PGS000061	PGS000062	PGS000063
PGS000064	PGS000065	PGS000066	PGS000067	PGS000068	PGS000069	PGS000070	PGS000071	PGS000072
PGS000073	PGS000074	PGS000075	PGS000076	PGS000077	PGS000078	PGS000079	PGS000080	PGS000081
PGS000082	PGS000083	PGS000084	PGS000085	PGS000086	PGS000087	PGS000088	PGS000089	PGS000090
PGS000091	PGS000092	PGS000093	PGS000094	PGS000095	PGS000096	PGS000097	PGS000098	PGS000099
PGS000100	PGS000101	PGS000102	PGS000103	PGS000104	PGS000105	PGS000106	PGS000107	PGS000108
PGS000109	PGS000110	PGS000111	PGS000112	PGS000113	PGS000114	PGS000115	PGS000116	PGS000117
PGS000118	PGS000119	PGS000120	PGS000121	PGS000122	PGS000123	PGS000124	PGS000125	PGS000126
PGS000127	PGS000128	PGS000129	PGS000130	PGS000131	PGS000132	PGS000133	PGS000134	PGS000135
PGS000136	PGS000137	PGS000138	PGS000139	PGS000140	PGS000141	PGS000142	PGS000143	PGS000144
PGS000145	PGS000146	PGS000147	PGS000148	PGS000149	PGS000150	PGS000151	PGS000152	PGS000153
PGS000154	PGS000155	PGS000156	PGS000157	PGS000158	PGS000159	PGS000160	PGS000161	PGS000162
PGS000163	PGS000164	PGS000165	PGS000166	PGS000167	PGS000168	PGS000169	PGS000170	PGS000171
PGS000172	PGS000173	PGS000174	PGS000175	PGS000176	PGS000177	PGS000178	PGS000179	PGS000180
PGS000181	PGS000182	PGS000183	PGS000184	PGS000185	PGS000186	PGS000187	PGS000188	PGS000189
PGS000190	PGS000191	PGS000192	PGS000193	PGS000194	PGS000195	PGS000196	PGS000197	PGS000198
PGS000199	PGS000200	PGS000201	PGS000202	PGS000203	PGS000204	PGS000205	PGS000206	PGS000207
PGS000208	PGS000209	PGS000210	PGS000211	PGS000212	PGS000213	PGS000214	PGS000215	PGS000216
PGS000217	PGS000218	PGS000219	PGS000220	PGS000221	PGS000222	PGS000223	PGS000224	PGS000225
PGS000226	PGS000227	PGS000228	PGS000229	PGS000230	PGS000231	PGS000232	PGS000233	PGS000234
PGS000235	PGS000236	PGS000237	PGS000238	PGS000239	PGS000240	PGS000241	PGS000242	PGS000243
PGS000244	PGS000245	PGS000246	PGS000247	PGS000248	PGS000249	PGS000250	PGS000251	PGS000252
PGS000253	PGS000254	PGS000255	PGS000256	PGS000257	PGS000258	PGS000259	PGS000260	PGS000261
PGS000262	PGS000263	PGS000264	PGS000265	PGS000266	PGS000267	PGS000268	PGS000269	PGS000270
PGS000271	PGS000272	PGS000273	PGS000274	PGS000275	PGS000276	PGS000277	PGS000278	PGS000279
PGS000280	PGS000281	PGS000282	PGS000283	PGS000284	PGS000285	PGS000286	PGS000287	PGS000288
PGS000289	PGS000290	PGS000291	PGS000292	PGS000293	PGS000294	PGS000295	PGS000296	PGS000297
PGS000298	PGS000299	PGS000300	PGS000301	PGS000302	PGS000303	PGS000304	PGS000305	PGS000306
PGS000307	PGS000308	PGS000309	PGS000310	PGS000311	PGS000312	PGS000313	PGS000314	PGS000315

PGS000316	PGS000317	PGS000318	PGS000319	PGS000320	PGS000321	PGS000322	PGS000324	PGS000325
PGS000326	PGS000327	PGS000328	PGS000329	PGS000330	PGS000331	PGS000332	PGS000333	PGS000334
PGS000335	PGS000336	PGS000337	PGS000338	PGS000339	PGS000340	PGS000341	PGS000342	PGS000344
PGS000345	PGS000346	PGS000347	PGS000348	PGS000349	PGS000350	PGS000351	PGS000352	PGS000353
PGS000354	PGS000355	PGS000356	PGS000357	PGS000358	PGS000359	PGS000360	PGS000361	PGS000362
PGS000363	PGS000364	PGS000365	PGS000366	PGS000367	PGS000368	PGS000369	PGS000370	PGS000371
PGS000372	PGS000373	PGS000374	PGS000375	PGS000376	PGS000377	PGS000378	PGS000379	PGS000380
PGS000381	PGS000382	PGS000383	PGS000384	PGS000385	PGS000386	PGS000387	PGS000388	PGS000389
PGS000390	PGS000391	PGS000392	PGS000393	PGS000394	PGS000395	PGS000396	PGS000397	PGS000398
PGS000399	PGS000400	PGS000401	PGS000402	PGS000403	PGS000404	PGS000405	PGS000406	PGS000407
PGS000408	PGS000409	PGS000410	PGS000411	PGS000412	PGS000413	PGS000414	PGS000415	PGS000416
PGS000417	PGS000418	PGS000419	PGS000420	PGS000421	PGS000422	PGS000423	PGS000424	PGS000425
PGS000426	PGS000427	PGS000428	PGS000429	PGS000430	PGS000431	PGS000432	PGS000433	PGS000434
PGS000435	PGS000436	PGS000437	PGS000438	PGS000439	PGS000440	PGS000441	PGS000442	PGS000443
PGS000444	PGS000445	PGS000446	PGS000447	PGS000448	PGS000449	PGS000450	PGS000451	PGS000452
PGS000453	PGS000454	PGS000455	PGS000456	PGS000457	PGS000458	PGS000459	PGS000460	PGS000461
PGS000462	PGS000463	PGS000464	PGS000465	PGS000466	PGS000467	PGS000468	PGS000469	PGS000470
PGS000471	PGS000472	PGS000473	PGS000474	PGS000475	PGS000476	PGS000477	PGS000478	PGS000479
PGS000480	PGS000481	PGS000482	PGS000483	PGS000484	PGS000485	PGS000486	PGS000487	PGS000488
PGS000489	PGS000490	PGS000491	PGS000492	PGS000493	PGS000494	PGS000495	PGS000496	PGS000497
PGS000498	PGS000499	PGS000500	PGS000501	PGS000502	PGS000503	PGS000504	PGS000505	PGS000506
PGS000507	PGS000508	PGS000509	PGS000510	PGS000511	PGS000512	PGS000513	PGS000514	PGS000515
PGS000516	PGS000517	PGS000518	PGS000519	PGS000520	PGS000521	PGS000522	PGS000523	PGS000524
PGS000525	PGS000526	PGS000527	PGS000528	PGS000529	PGS000530	PGS000531	PGS000532	PGS000533
PGS000534	PGS000535	PGS000536	PGS000537	PGS000538	PGS000539	PGS000540	PGS000541	PGS000542
PGS000543	PGS000544	PGS000545	PGS000546	PGS000547	PGS000548	PGS000549	PGS000550	PGS000551
PGS000552	PGS000553	PGS000554	PGS000555	PGS000556	PGS000557	PGS000558	PGS000559	PGS000560
PGS000561	PGS000562	PGS000563	PGS000564	PGS000565	PGS000566	PGS000567	PGS000568	PGS000569
PGS000570	PGS000571	PGS000572	PGS000573	PGS000574	PGS000575	PGS000576	PGS000577	PGS000578
PGS000579	PGS000580	PGS000581	PGS000582	PGS000583	PGS000584	PGS000585	PGS000586	PGS000587
PGS000588	PGS000589	PGS000590	PGS000591	PGS000592	PGS000593	PGS000594	PGS000595	PGS000596
PGS000597	PGS000598	PGS000599	PGS000600	PGS000601	PGS000602	PGS000603	PGS000604	PGS000605
PGS000606	PGS000607	PGS000608	PGS000609	PGS000610	PGS000611	PGS000612	PGS000613	PGS000614
PGS000615	PGS000616	PGS000617	PGS000618	PGS000619	PGS000620	PGS000621	PGS000622	PGS000623
PGS000624	PGS000625	PGS000626	PGS000627	PGS000628	PGS000629	PGS000630	PGS000631	PGS000632
PGS000633	PGS000634	PGS000635	PGS000636	PGS000637	PGS000638	PGS000639	PGS000640	PGS000641
PGS000642	PGS000643	PGS000644	PGS000645	PGS000646	PGS000647	PGS000648	PGS000649	PGS000650
PGS000651	PGS000652	PGS000653	PGS000654	PGS000655	PGS000656	PGS000657	PGS000658	PGS000659
PGS000660	PGS000661	PGS000662	PGS000663	PGS000664	PGS000665	PGS000666	PGS000667	PGS000668



PGS000669	PGS000670	PGS000671	PGS000672	PGS000673	PGS000674	PGS000675	PGS000676	PGS000677
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PGS000687	PGS000688	PGS000689	PGS000690	PGS000691	PGS000692	PGS000693	PGS000694	PGS000695
PGS000696	PGS000697	PGS000698	PGS000699	PGS000700	PGS000701	PGS000702	PGS000703	PGS000704
PGS000705	PGS000706	PGS000707	PGS000708	PGS000709	PGS000710	PGS000711	PGS000712	PGS000713
PGS000714	PGS000716	PGS000717	PGS000718	PGS000719	PGS000720	PGS000721	PGS000722	PGS000723
PGS000724	PGS000725	PGS000726	PGS000727	PGS000728	PGS000729	PGS000730	PGS000731	PGS000732
PGS000733	PGS000734	PGS000735	PGS000736	PGS000737	PGS000738	PGS000739	PGS000740	PGS000741
PGS000742	PGS000743	PGS000744	PGS000745	PGS000746	PGS000747	PGS000748	PGS000749	PGS000750
PGS000751	PGS000752	PGS000753	PGS000754	PGS000755	PGS000756	PGS000757	PGS000758	PGS000759
PGS000760	PGS000761	PGS000762	PGS000763	PGS000764	PGS000765	PGS000766	PGS000767	PGS000768
PGS000769	PGS000770	PGS000771	PGS000772	PGS000773	PGS000774	PGS000775	PGS000776	PGS000777
PGS000778	PGS000779	PGS000780	PGS000781	PGS000782	PGS000783	PGS000784	PGS000785	PGS000786
PGS000787	PGS000788	PGS000789	PGS000790	PGS000791	PGS000792	PGS000793	PGS000794	PGS000795
PGS000796	PGS000797	PGS000798	PGS000799	PGS000800	PGS000801	PGS000802	PGS000803	PGS000804
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PGS002477	PGS002478	PGS002479	PGS002480	PGS002481	PGS002482	PGS002483	PGS002484	PGS002485
PGS002486	PGS002487	PGS002488	PGS002489	PGS002490	PGS002491	PGS002492	PGS002493	PGS002494

