

Aarno Palotie, M.D., Ph.D.



FINNGEN





500,000 individuals
10% of the population

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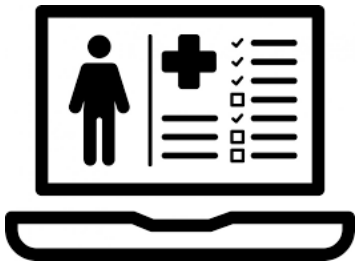
Existing sample collections:
200,000 Finns

300,000 new sample donors
within the coming 6 years

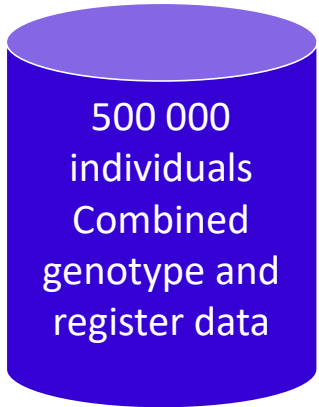
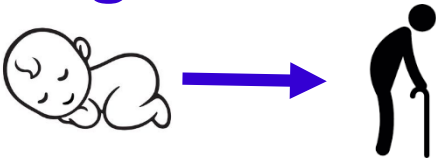
FinnGen



500 000 individuals
~10 % of the
population



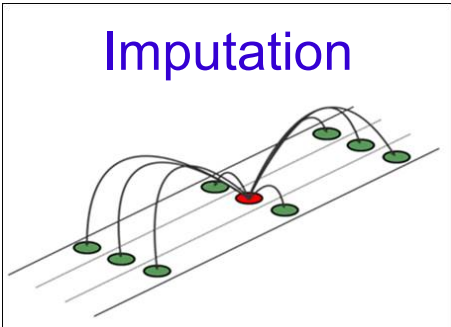
National Health
Register data



Association analyses



Axiom GWA array



Public - Private Partnership

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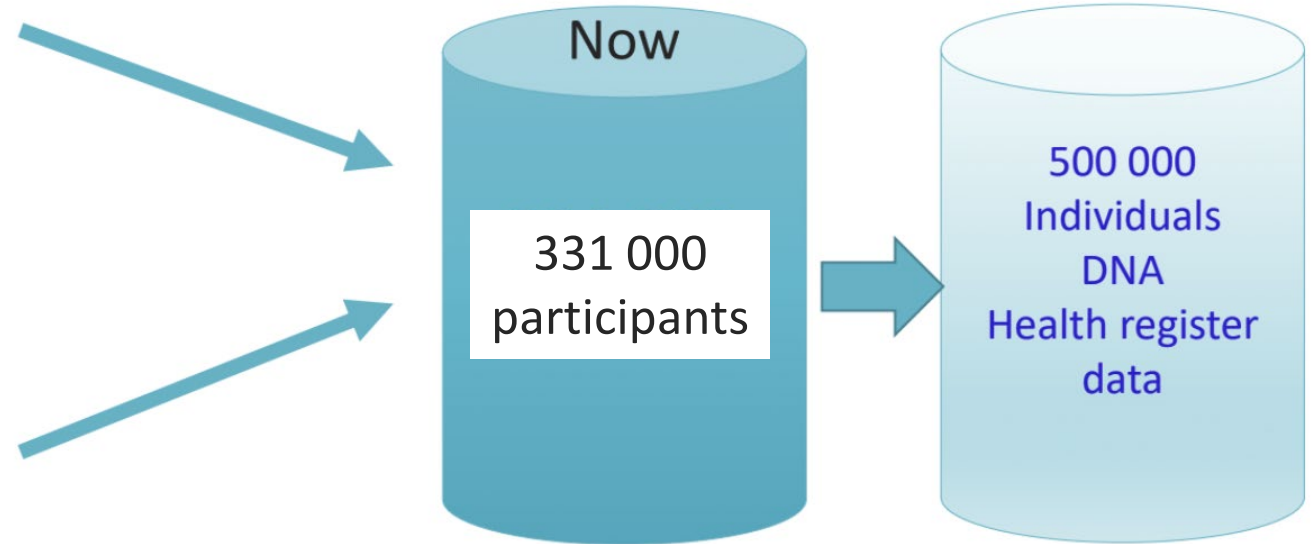
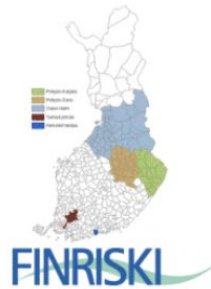
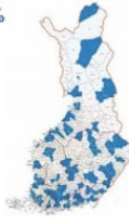
+2 new partners

Prospective collections 300 000



Hospital biobanks

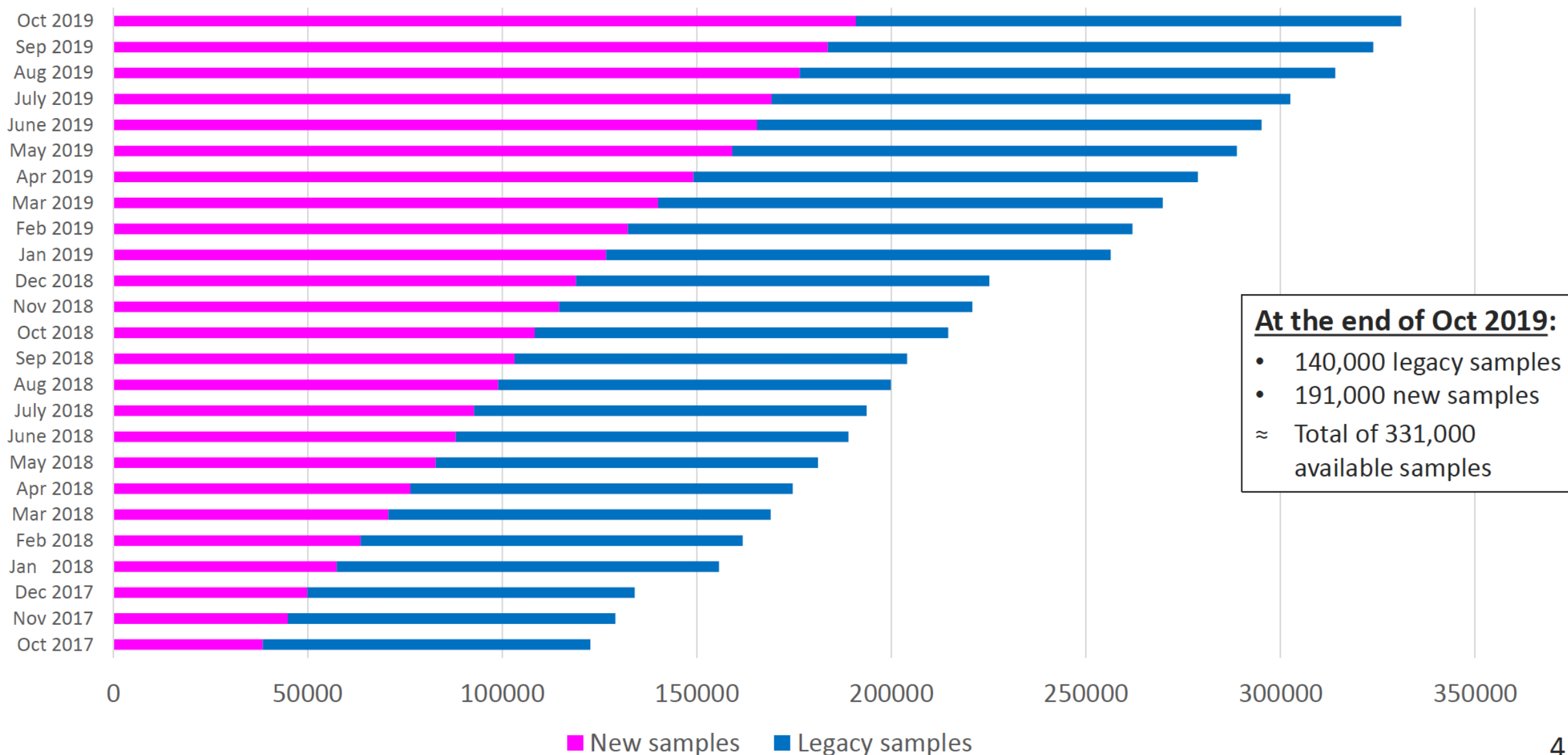
Legacy collections 200 000



331 000 participants, so far

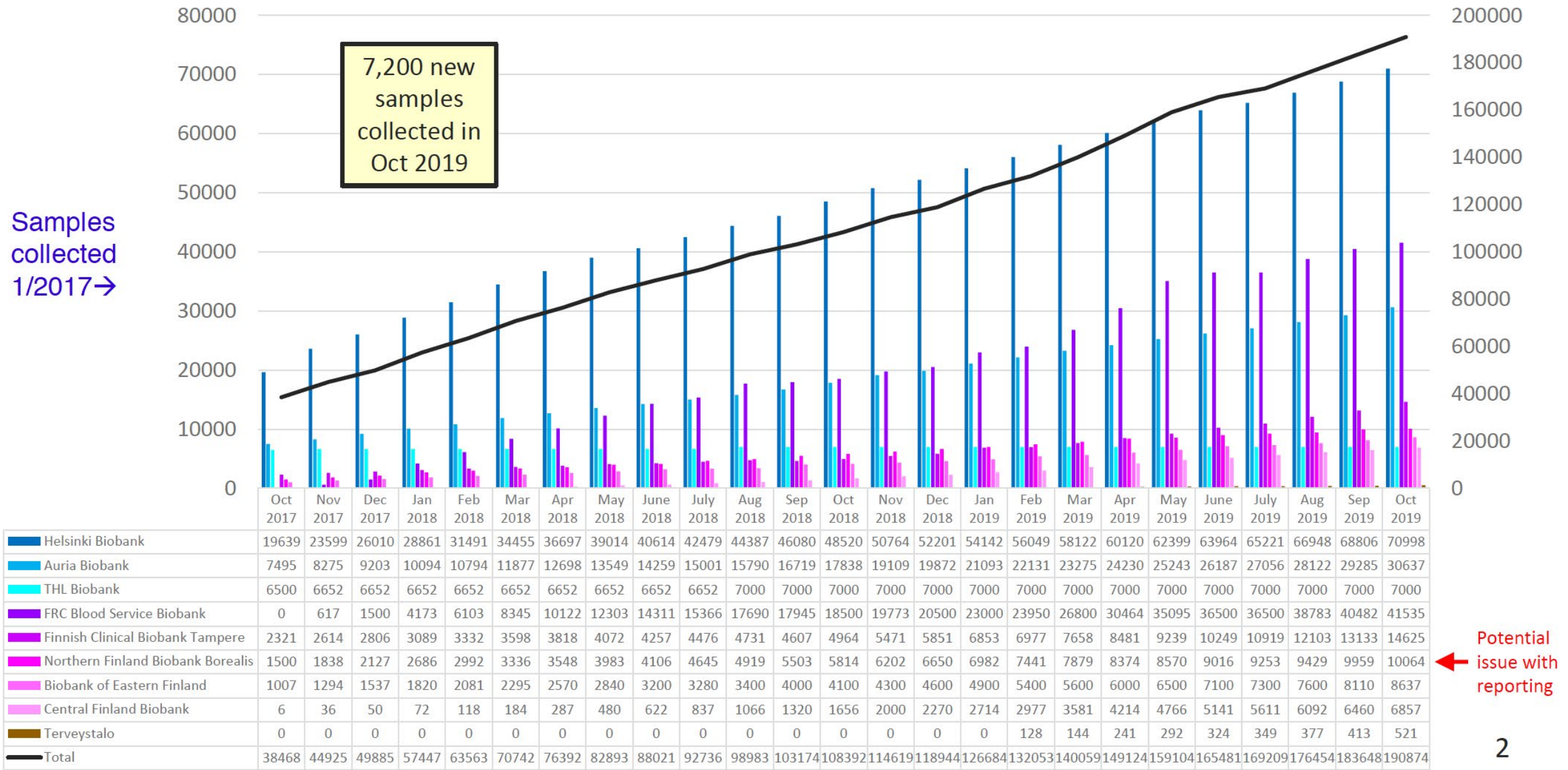


Available new biobank samples and legacy samples (10/2019)



Progression of new biobank sample collection 10/2017 – 10/2019

Samples collected 1/2017→



Potential issue with reporting

New sample collection proportional to catchment area



FINNGEN

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Biobank	Catchment area*	New samples collected per 100,00 inhabitants		
		8/2019	9/2019	10/2019
Helsinki	2 148 143	1727 (0.80)	1858 (0.87)	2192 (1.02)
Auria	870 395	1066 (1.23)	1163 (1.34)	1352 (1.55)
Blood Service	5 503 297	2283 (0.42)	1699 (0.31)	1053 (0.19)
Tampere	900 251	1184 (1.32)	1030 (1.14)	1492 (1.66)
Borealis	741 807	176 (0.24)	530 (0.71)	105 (0.14)
Eastern Finland	560 836	300 (0.54)	510 (0.91)	527 (0.94)
Central Finland	252 651	481 (1.90)	368 (1.46)	397 (1.57)
Terveystalo	800 000	28 (0.04)	36 (0.05)	108 (0.14)

Potential issue with reporting

Helsinki: **Helsinki ja Uusimaa**, Etelä-Karjala, Kymenlaakso, Päijät-Häme (areas of active recruitment in bold)

Auria: **Varsinais-Suomi, Satakunta, Vaasa** (areas of active recruitment in bold)

Blood Service: whole country; N=120,000 unique blood donors / year

Tampere: **Pirkanmaa**, Etelä-Pohjanmaa, Kanta-Häme (areas of active recruitment in bold)

Borealis: **Pohjois-Pohjanmaa**, Kainuu, Keski-Pohjanmaa, **Lappi, Länsi-Pohja** (areas of active recruitment in bold)

Eastern Finland: **Pohjois-Savo, Etelä-Savo, Itä-Savo, Pohjois-Karjala** (areas of active recruitment in bold)

Central Finland: **Keski-Suomi** (areas of active recruitment in bold)

Terveystalo: whole country; N=800,000 info letters sent

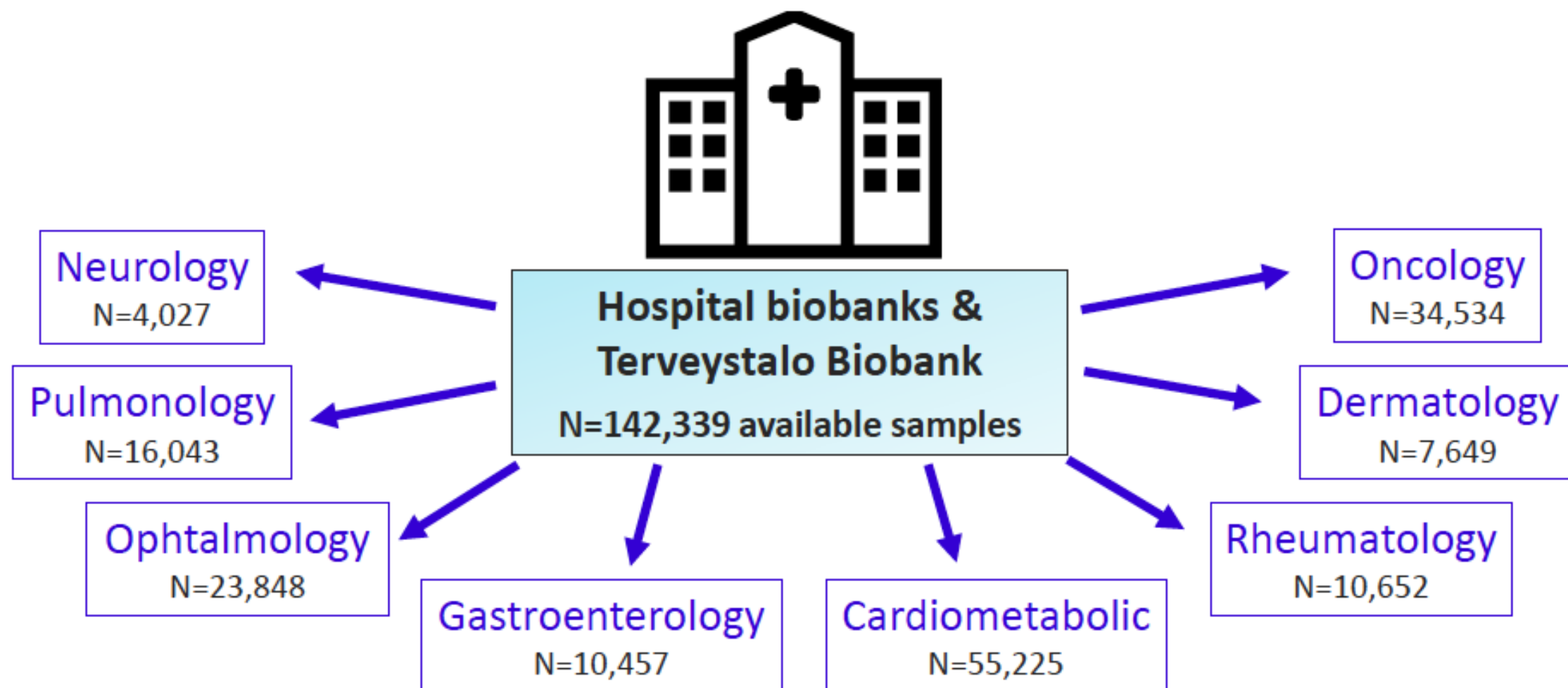
* Size of the catchment area from
https://www.kuntaliitto.fi/sites/default/files/media/file/Ervat_Sairaanhoitopiirit2018.pdf

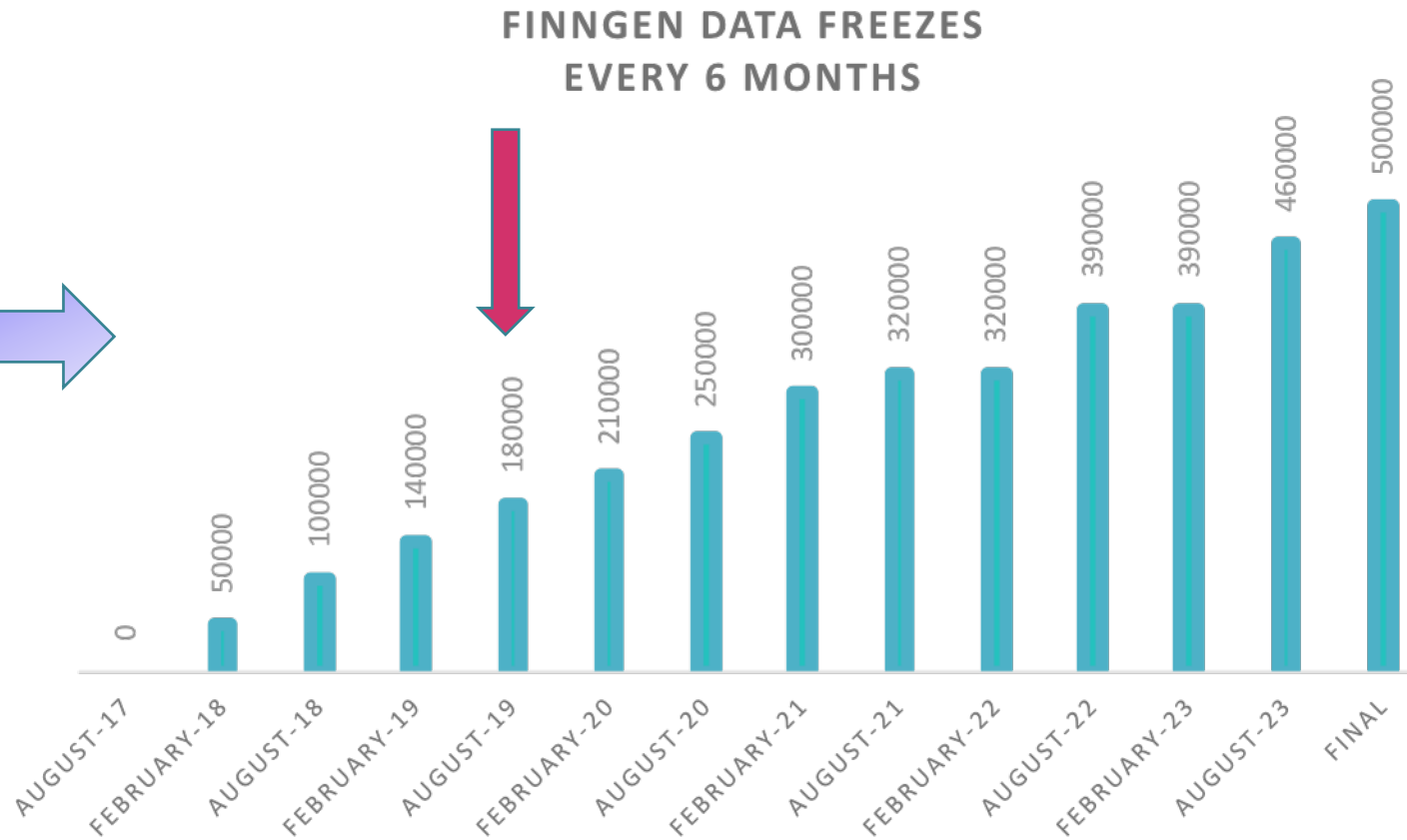
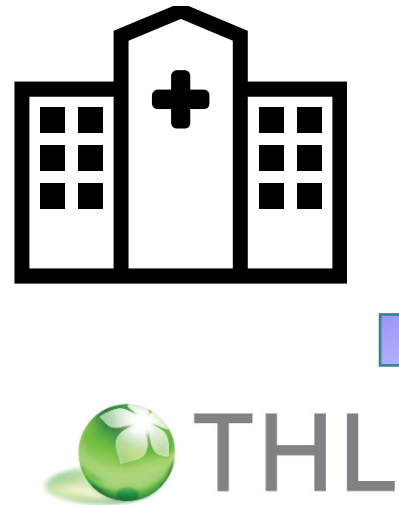
FinnGen disease groups of interest (10/2019)



FINNGEN

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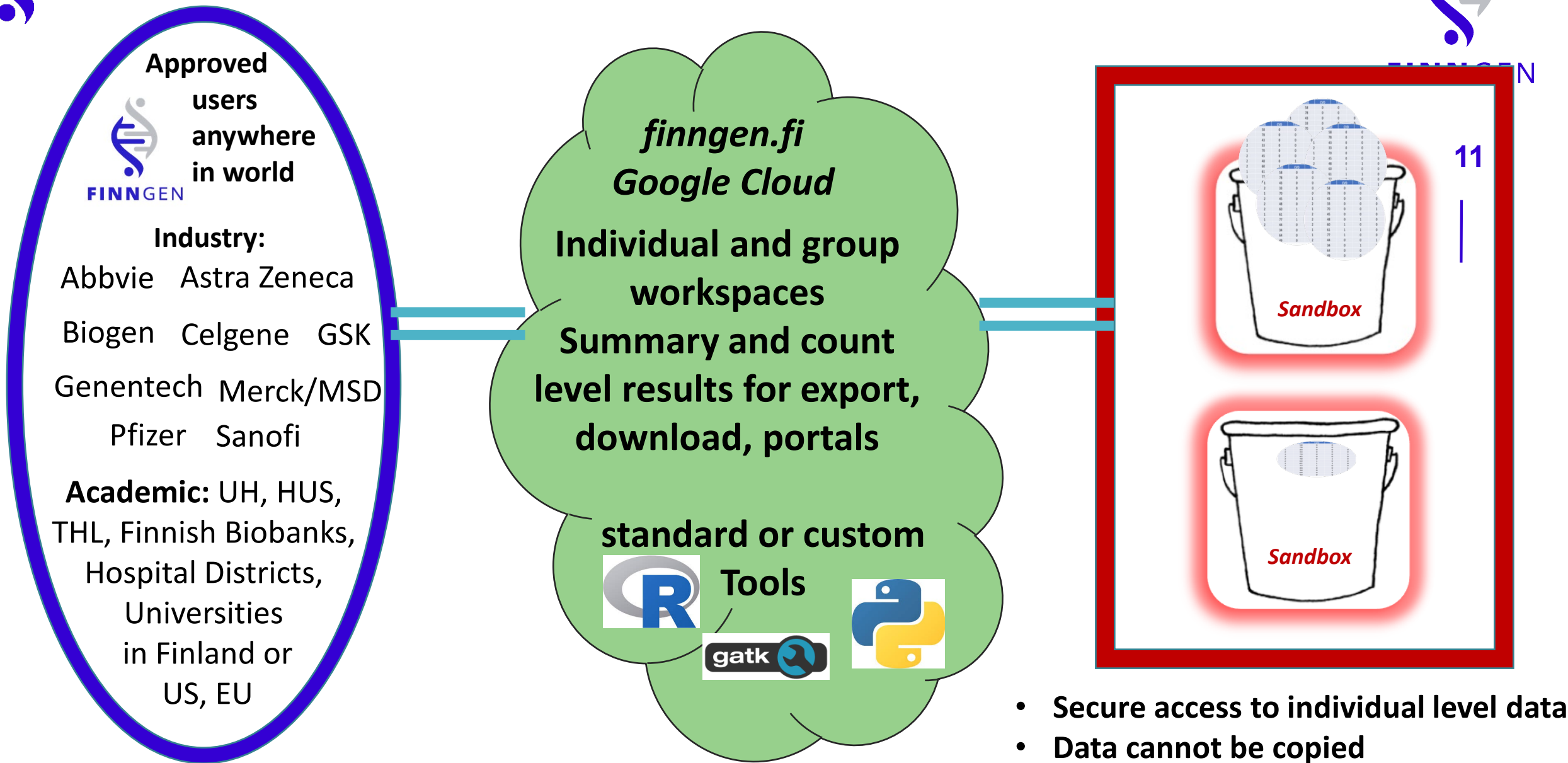


August 2019 data freeze 181 000
individuals



FINNGEN

Sandbox for Data Analysis, version 2





Success with from analyzing first 181,000 participants

Data release 4 in numbers

- 181,821 individuals with genotypes and phenotypes
- 2,443 endpoints (n>100)
- Detailed longitudinal data in the Sandbox, 40 million drug purchases and ICD codes, 72 million health care events

Examples:
New loci discovered based on
the Finnish population structure

Inflammatory bowel disease, strict (require KELA)

RISTEYS

Category: Digestive system

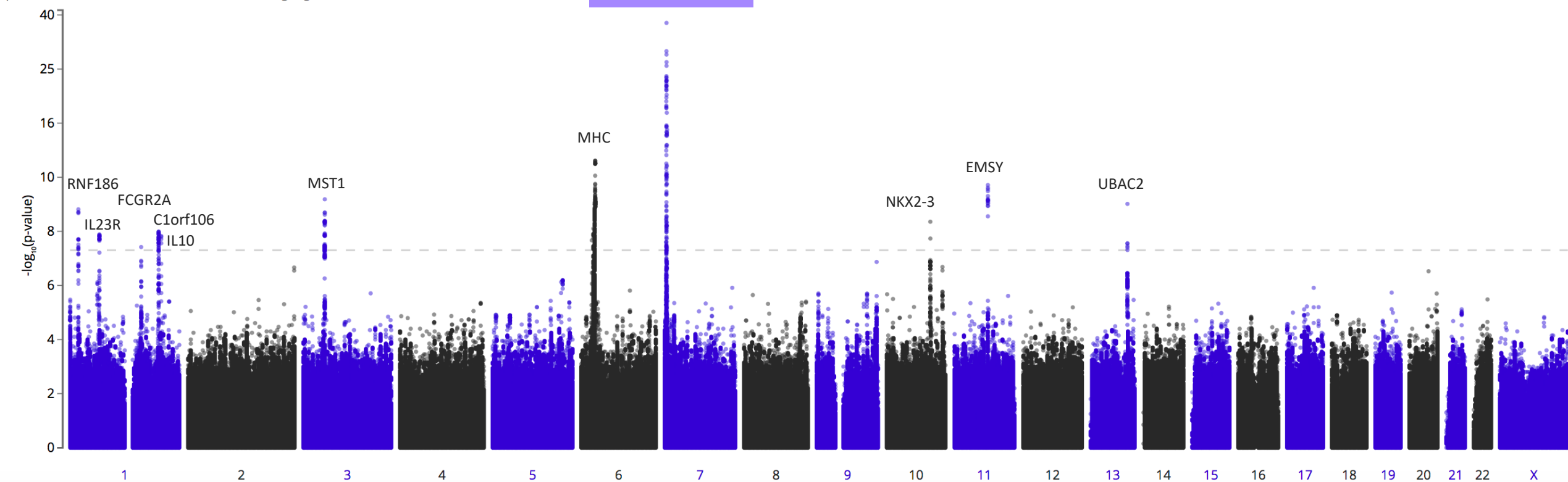
FINNGEN: **2813** cases, **170386** controls

Phenotype not found in UKBB results

p-values smaller than 1e-10 are shown on a log-log scale



Novel locus



Mitja Kurki

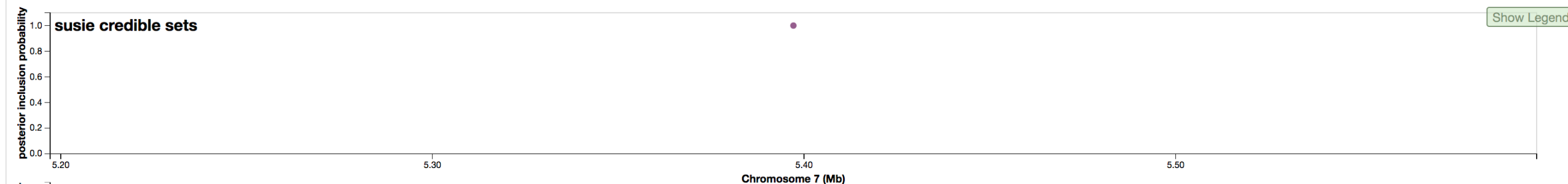
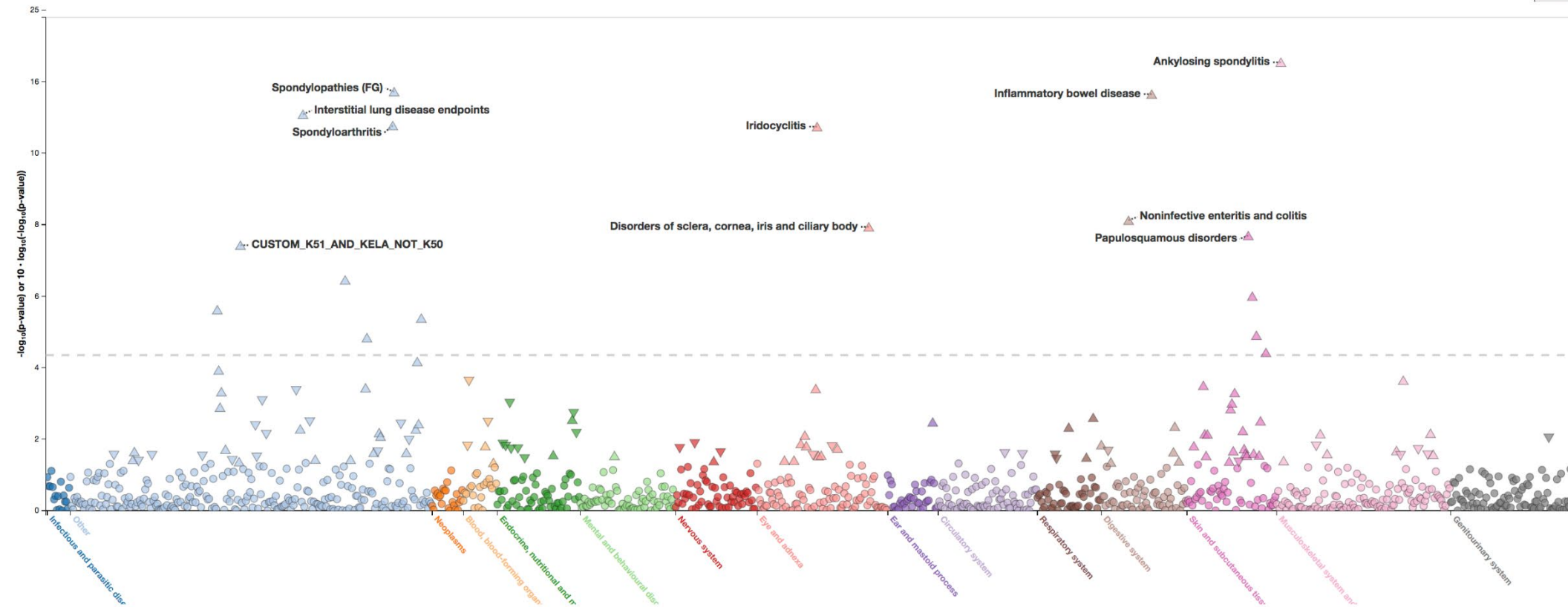


Juha Karjalainen

Very consistent inflammatory association signal

Genomewide significant in Ankylosing Spondylitis, strong signal in UC/IBD and iridocyclitis

PheWas & Fine Mapping



Type 2 diabetes

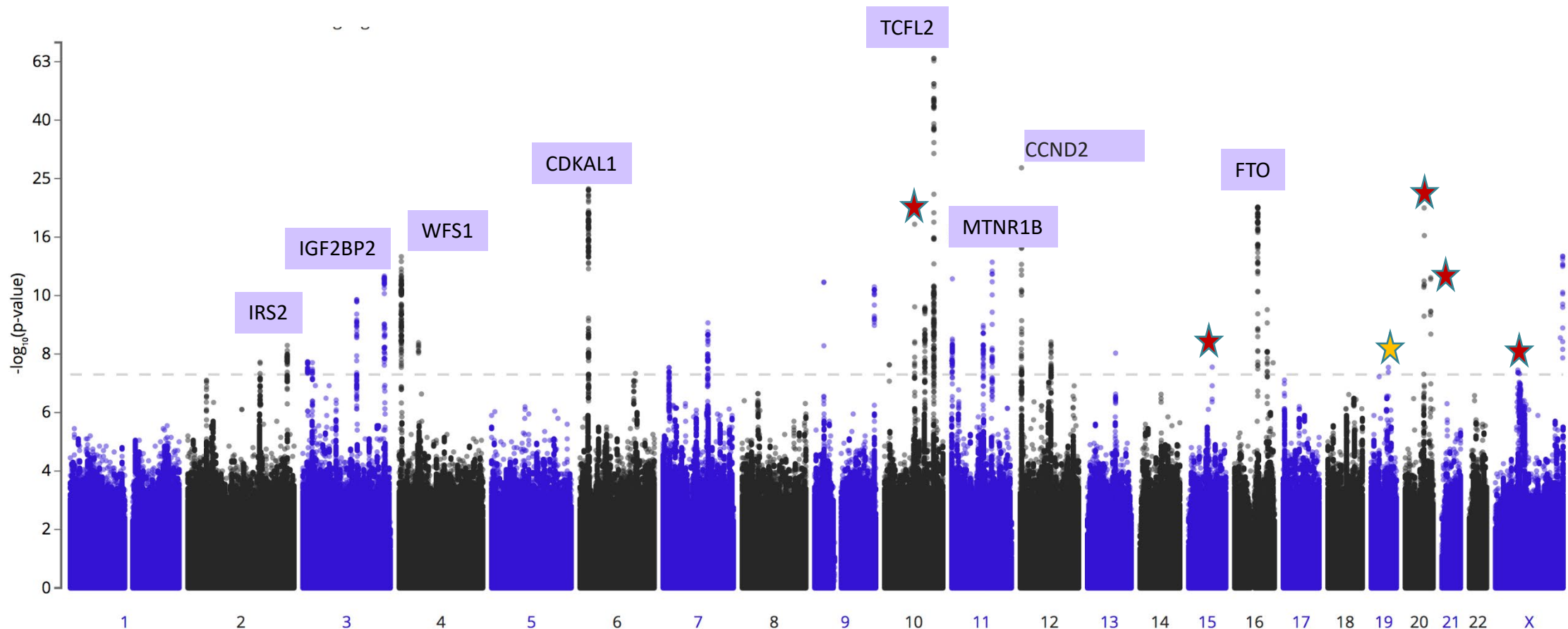
17512 cases, 114083 controls - >30 independent hits

★ = Finnish-enriched low-frequency hits, not in Majeed 2018



FINNIGEN

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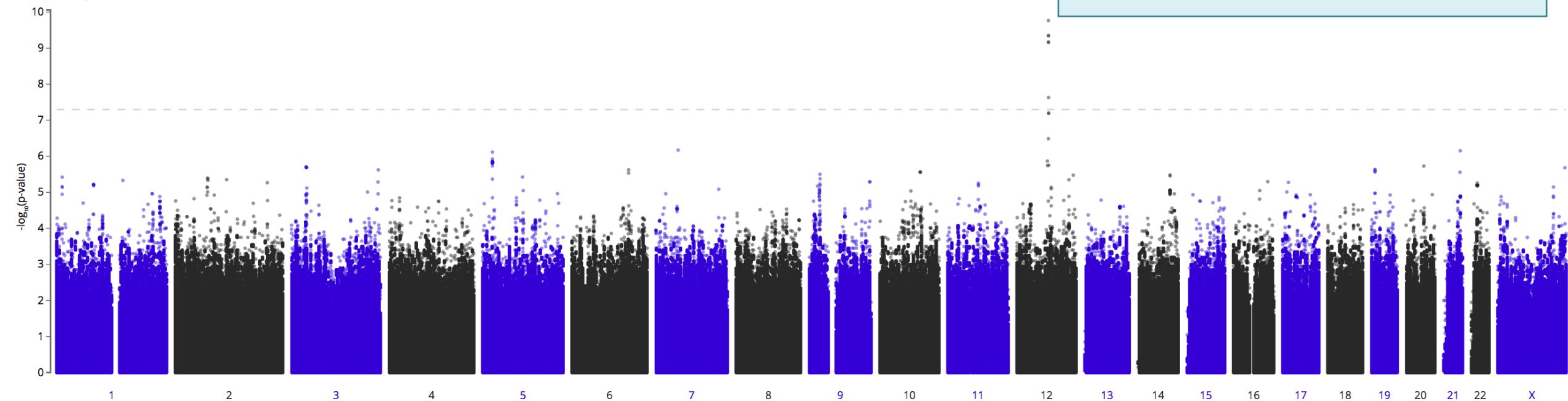
Malignant neoplasm of small intestine

RISTEYS

Category: Neoplasms from cancer register

FINNGEN: 207 cases, 176692 controls

UKBB: 141 cases, 361053 controls



Missense variant

Carrier frequency:

0.38 % Finland

0.25 % Estonia

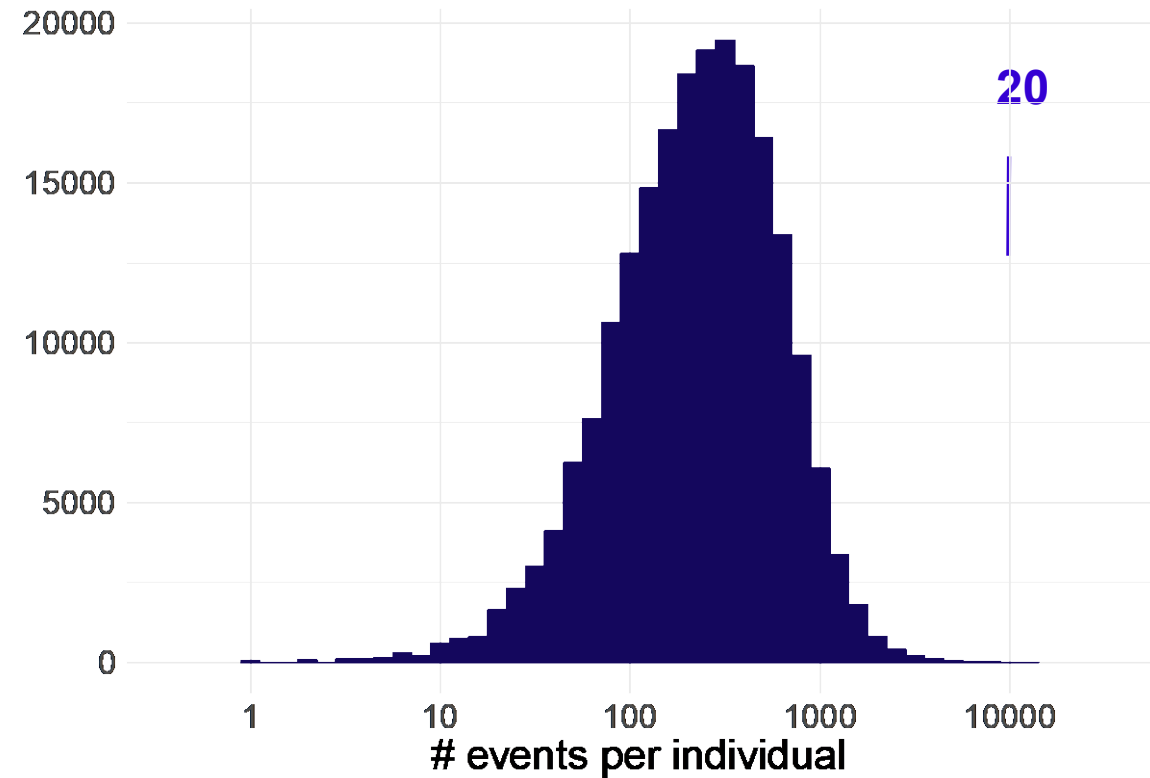
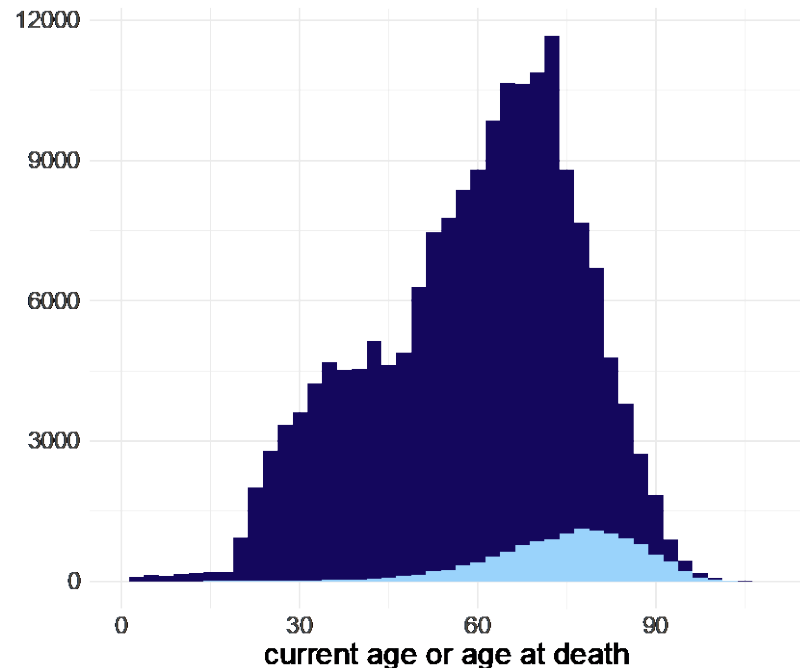
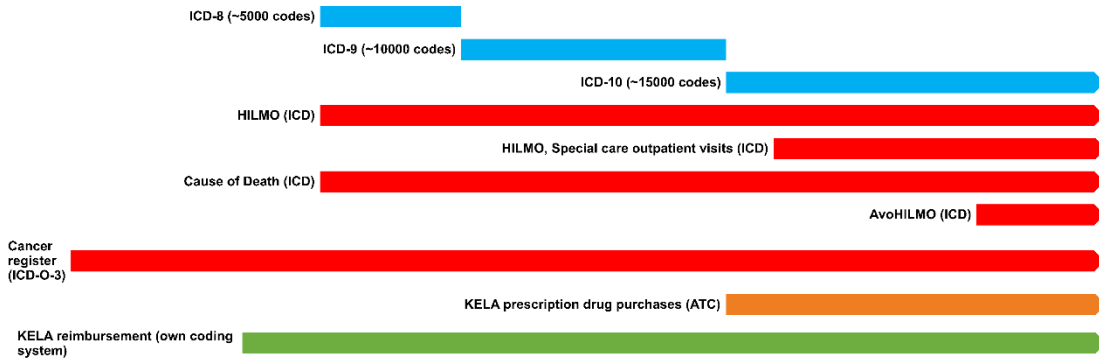
0.012% in NW Europe

New analyses possible with lifelong medical data

Expanded Phenotype Potential



FINNGEN



Mean 340 health events per individual
(including 186 drug purchases)

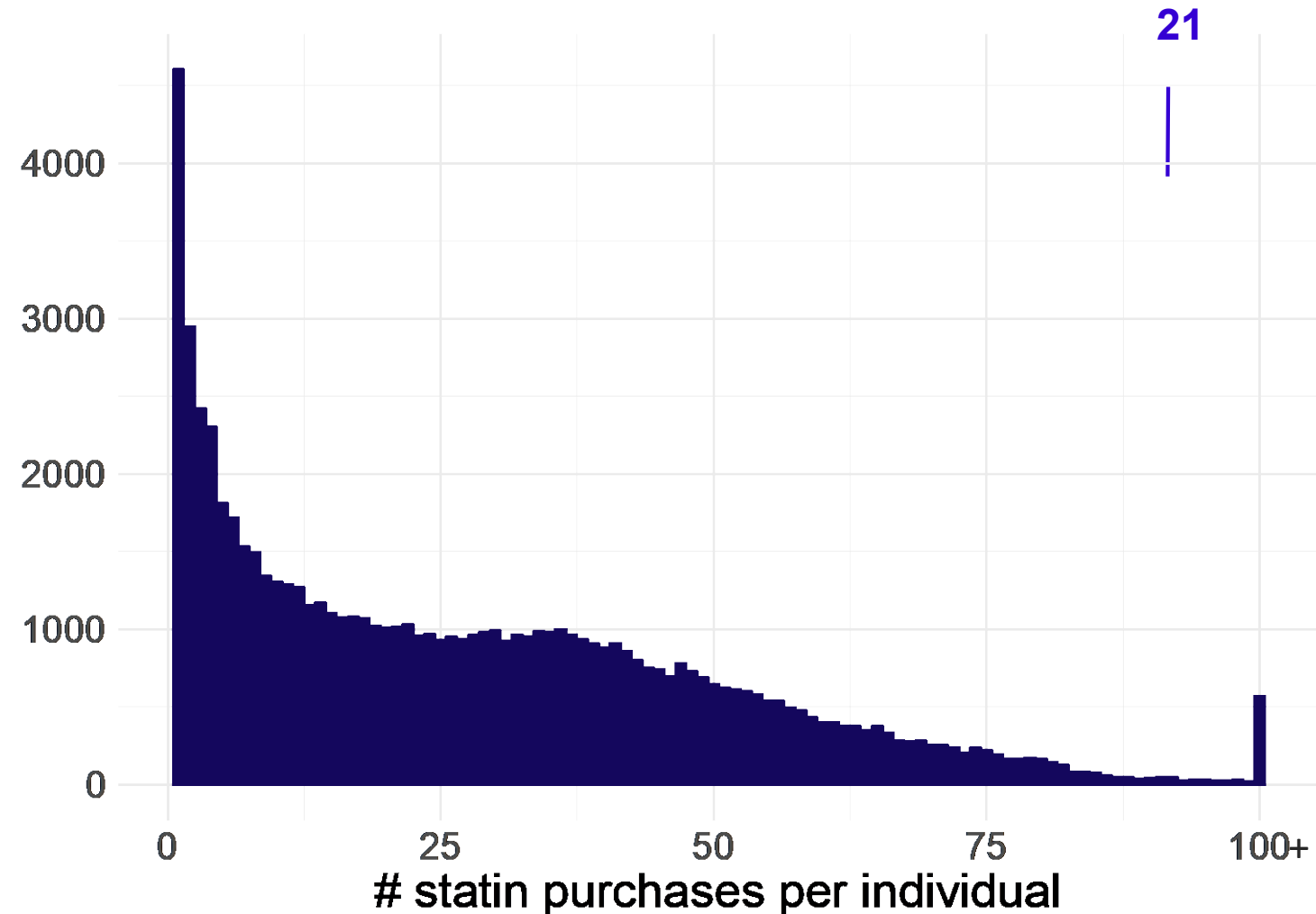
Response to longterm use of common drugs



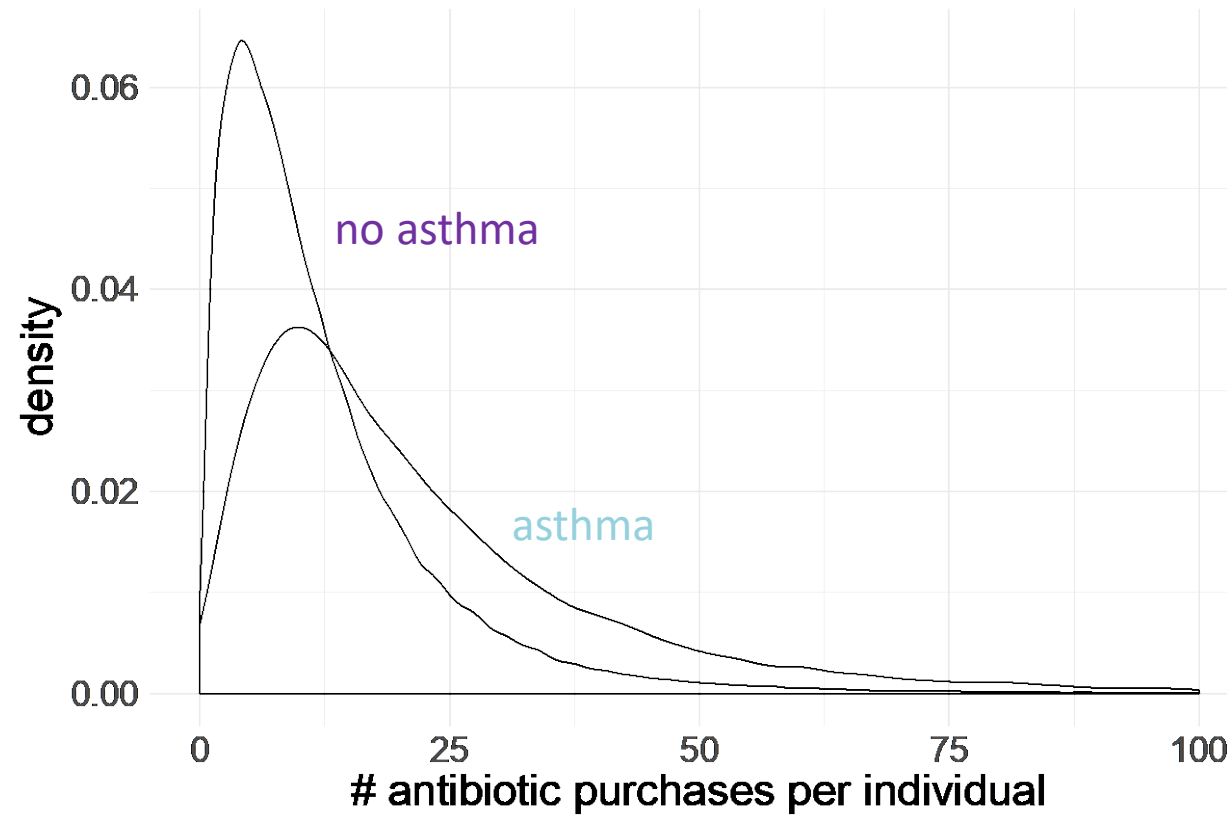
FINNGEN

71,994 individuals have bought
statins at least once

statin	# individuals
simvastatin	56172
atorvastatin	36338
rosuvastatin	15038
fluvastatin	7957
pravastatin	5844
lovastatin	3221
cerivastatin	240



Asthma and antibiotics use



Antibiotic Use Scan

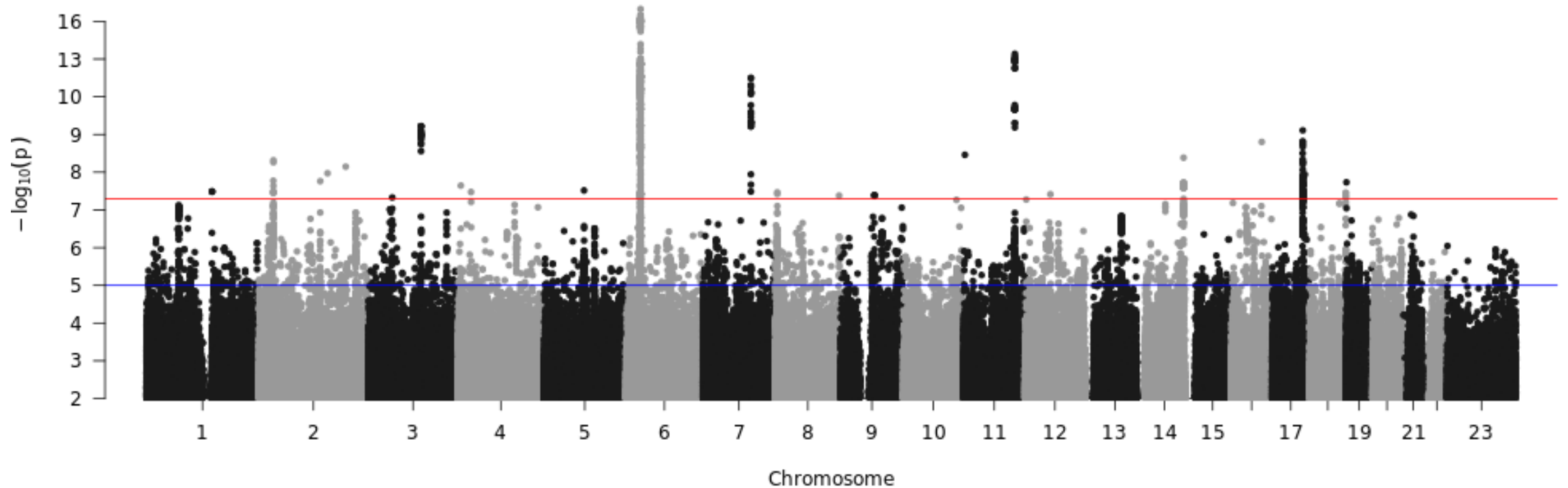


FINNGEN

Scan: Inverse rank normalized # purchases since 1995

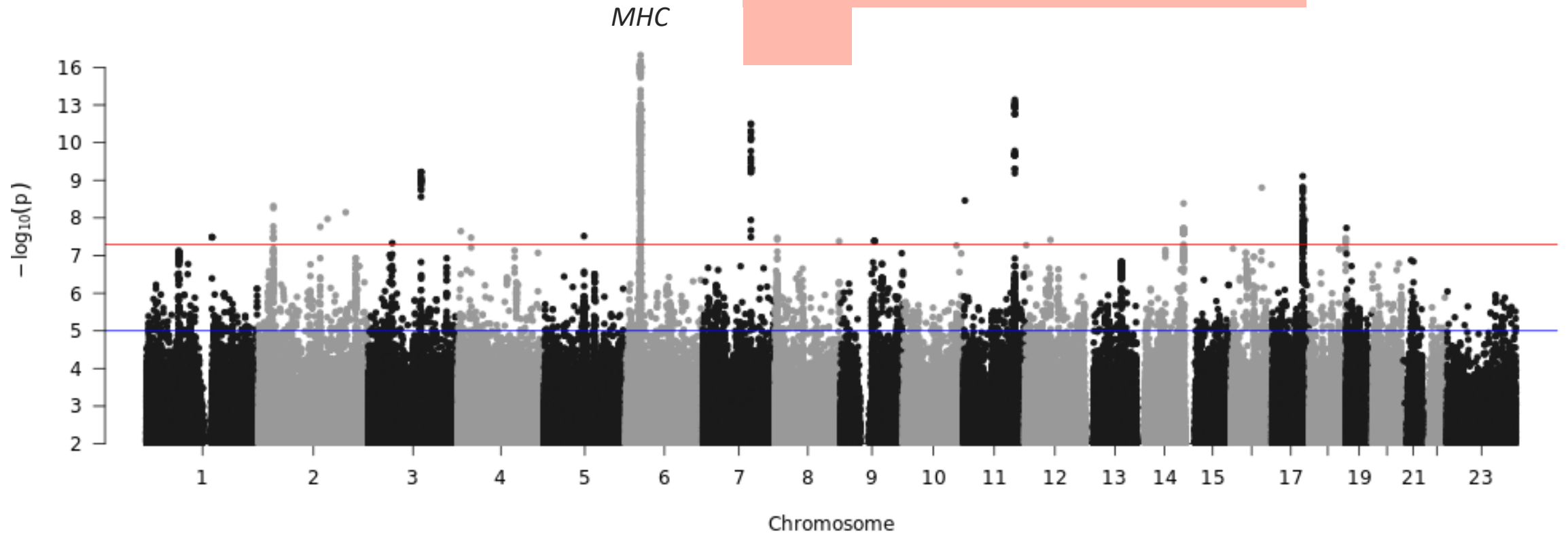
Covariates: age, age², sex, PCs, batches

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Antibiotic Use Scan

missense variant
Previously characterized to
Increase human rhinovirus C infection
of ciliated cells



Longitudinal analyses

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**Can prediction have potential
public health impact?**

Rare penetrant and common polygenic signal both assessed

FinnGen arrays cover coding variation down to .01% frequency and offer complete coverage of disease alleles enriched through the founding bottleneck



Malignant neoplasm of breast

Category: Neoplasms

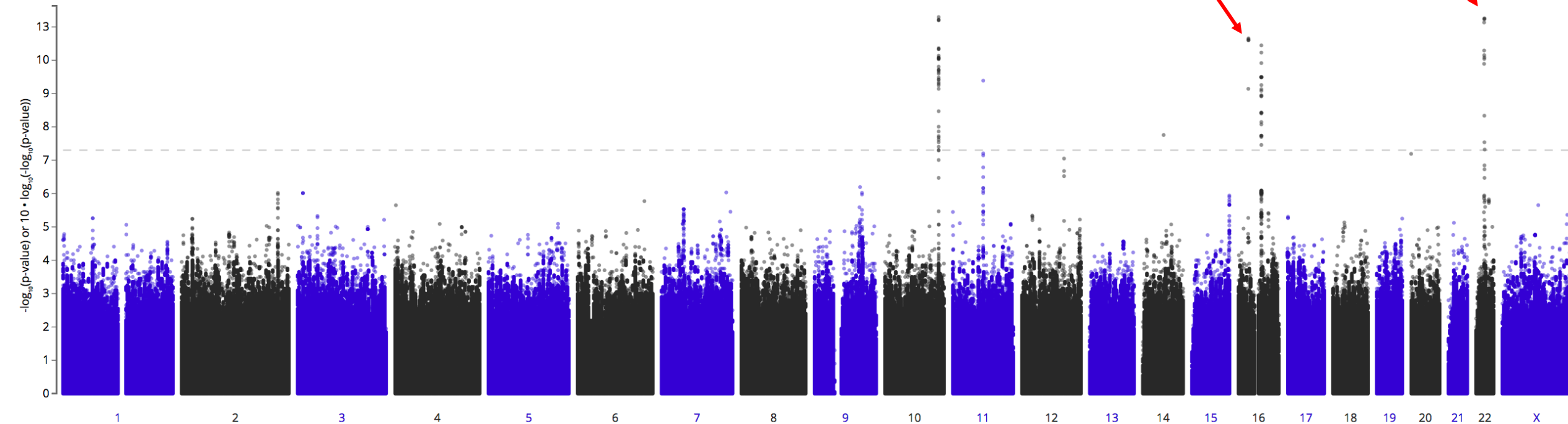
Includes endpoints: Malignant neoplasm of breast

[Detailed info on endpoint definition](#)

FINNGEN: **2589** cases, **93910** controls

Phenotype not found in UKBB results

p-values smaller than 1e-10 are shown on a log-log scale



Global Biobank Network

Towards Global Partnership



Meta-analysis

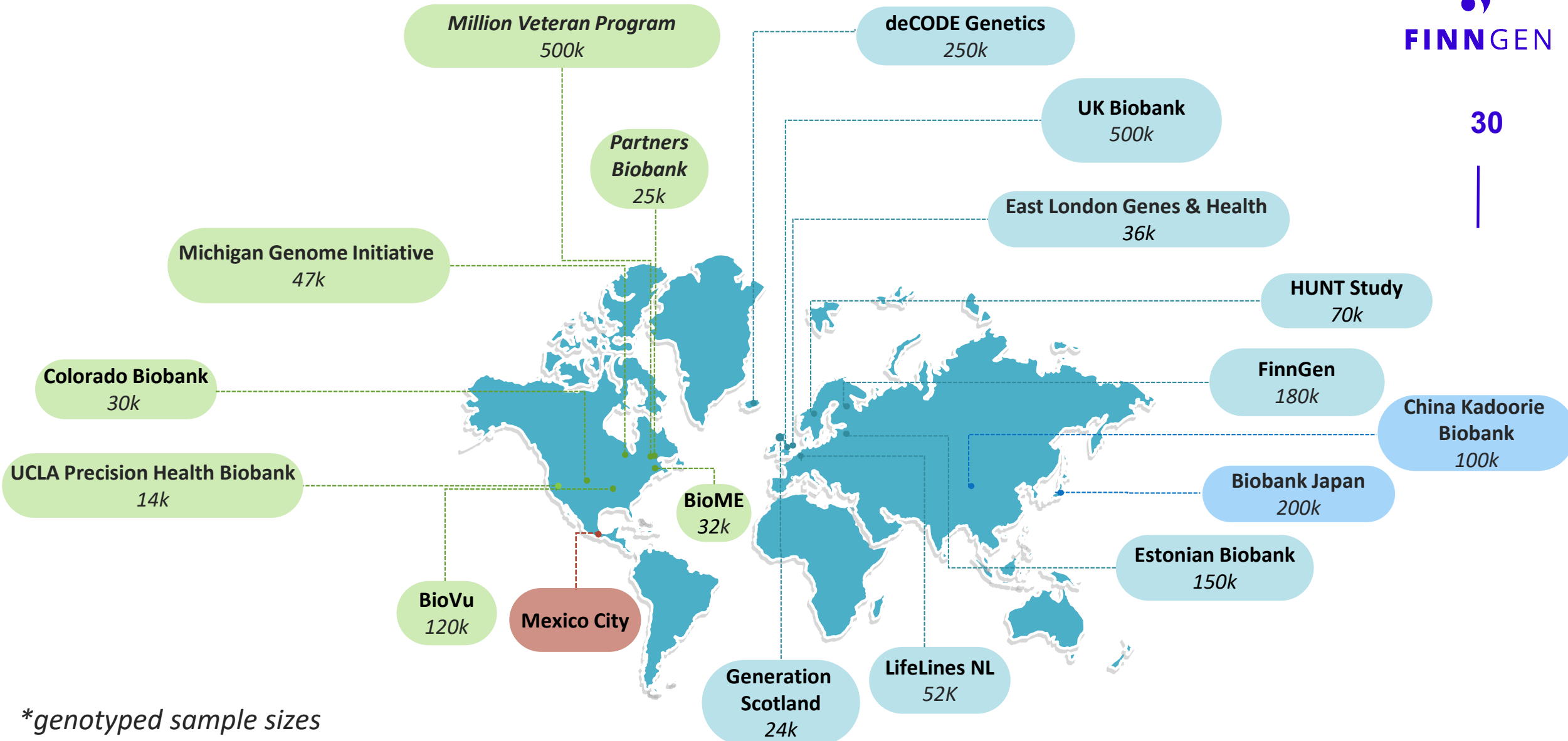
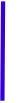
Biobank Meta-analysis Initiative

> 2 million genotyped samples



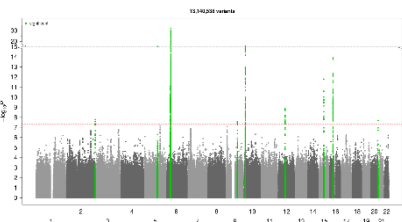
FINNGEN

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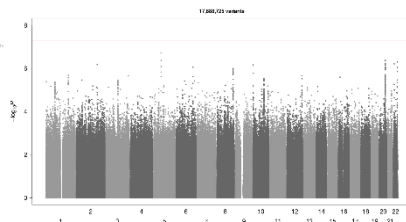


Asthma

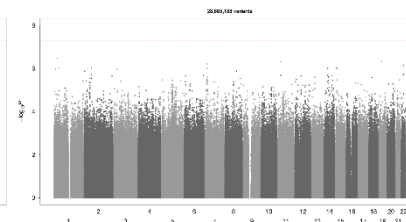
 Biobank Japan
8,204 cases, 10 loci



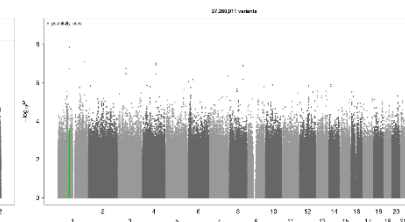
 BioMe-EA
455 cases, 0 loci



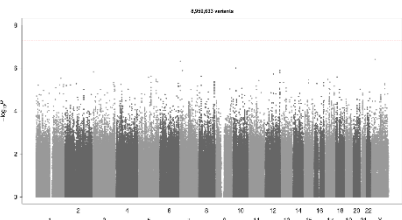
 BioMe-AA
842 cases, 0 loci



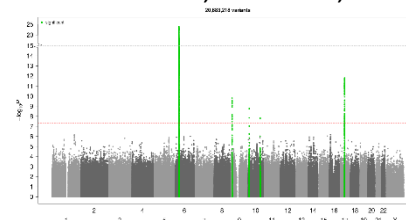
 BioMe-HA
1,459 cases, 1 locus



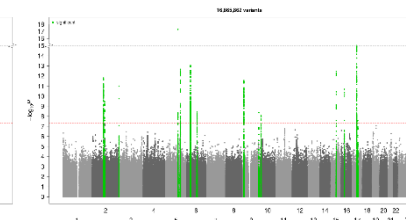
 China Kadoorie Biobank
990 cases, 0 loci



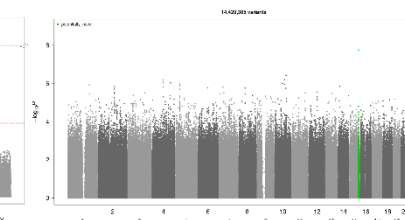
 deCODE
16,767 cases, 5 loci



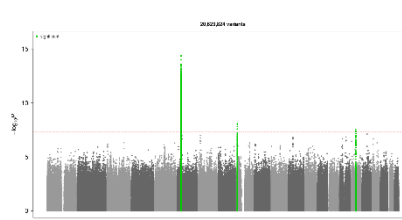
 FinnGen
15,926 cases, 14 loci



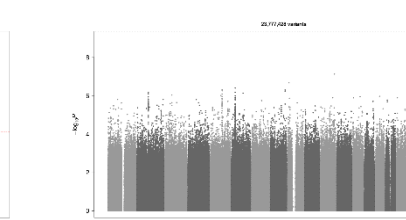
 Generation Scotland
196 cases, 1 locus



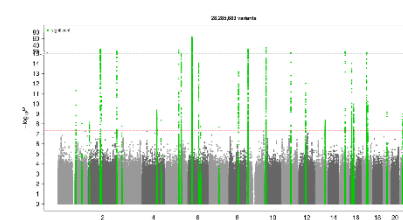
 HUNT
5,587 cases, 3 loci



 Michigan Genomics Initiative
6,079 cases, 0 loci



 UK Biobank
26,332 cases, 31 loci



Wei Zhou, Masa Kanai, Juha Karjalainen

Asthma



 Biobank Japan
8,204 cases, 10 loci

 BioMe-EA
455 cases, 0 loci

 BioMe-AA
842 cases, 0 loci

 BioMe-HA
1,459 cases, 1 locus

Combined
82,837 cases, 82 loci

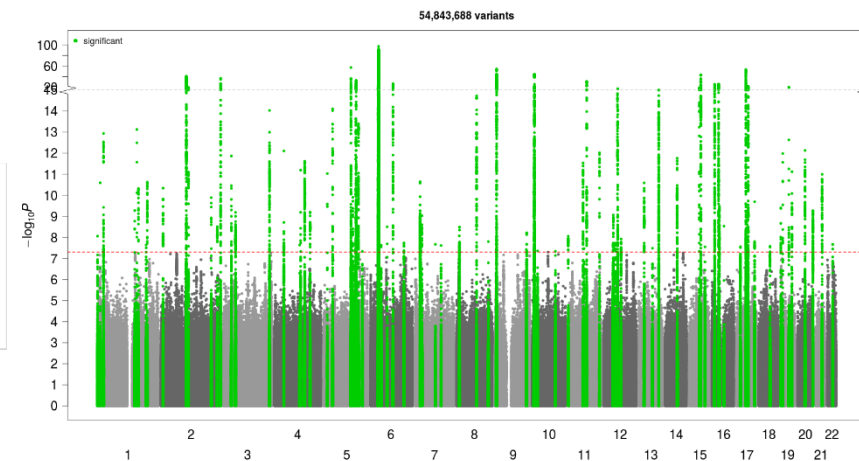
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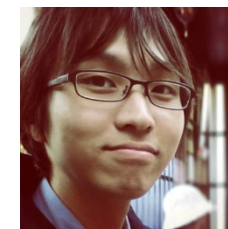
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Wei Zhou, Masa Kanai, Juha Karjalainen

Towards FinnGen 2

- FinnGen 2 scheduled to start in August 2020
- Industry partners should state if they are in or out in February
- As there are new funding partners, FinnGen2 will expand its activities
 - -> pilots

FinnGen Pilots

- **Clinical data: FinnGen ejection fraction pilot** (Aarno Palotie)
- **Omics studies of Finnish alleles**
 - Transcriptomics (Taru Tukiainen and Mark Daly)
 - Other omics??? (TBC)
- **Tumor data** (Olli Carpen, Tomi Mäkelä)
- **Questionnaire study**
 - LACONICS cognitive study (Andrea Ganna)
 - Baseline questionnaire and biobank portal (Markus Perola and FINBB)
- **Blood donors in FinnGen**(Mikko Arvas)

Acknowledgements

