Electronic health record research: eHealth examples from the UK and Russia

David Leon[1,2,3] and Alexander Kudryavtasev[2,4]

1 London School of Hygiene and Tropical Medicine, UK
2 UiT, Arctic University of Norway, Tromsø, Norway
3 International Laboratory for Population and Health,
National Research University, Higher School of Economics, Russian Federation
4 Northern State Medical University, Arkhangelsk

"New Challenges of Demographic, Epidemiological and Medical-Technological Development: Search for New Models of Healthcare Development"
The Human Capital Multidisciplinary Research Center, HSE University
15 December 2021

WHO definition of eHealth

The cost-effective and secure use of information and communications technologies in support of ….

- health-care services
- health surveillance
- health literature, and health education
- knowledge and research

http://www.emro.who.int/health-topics/ehealth/

Requirements for a mature eHealth system

- Widespread (universal) use of digital / computer systems as part of routine clinical care
- Completeness of information collected
- Validity of information collected
- Capacity for individual digital linkage of different databases/sources
- Strong governance : data protection/confidentiality
- Patient / public consent
- Secure systems to facilitate use by clinical and public health researchers

Example uses of eHealth in surveillance and research

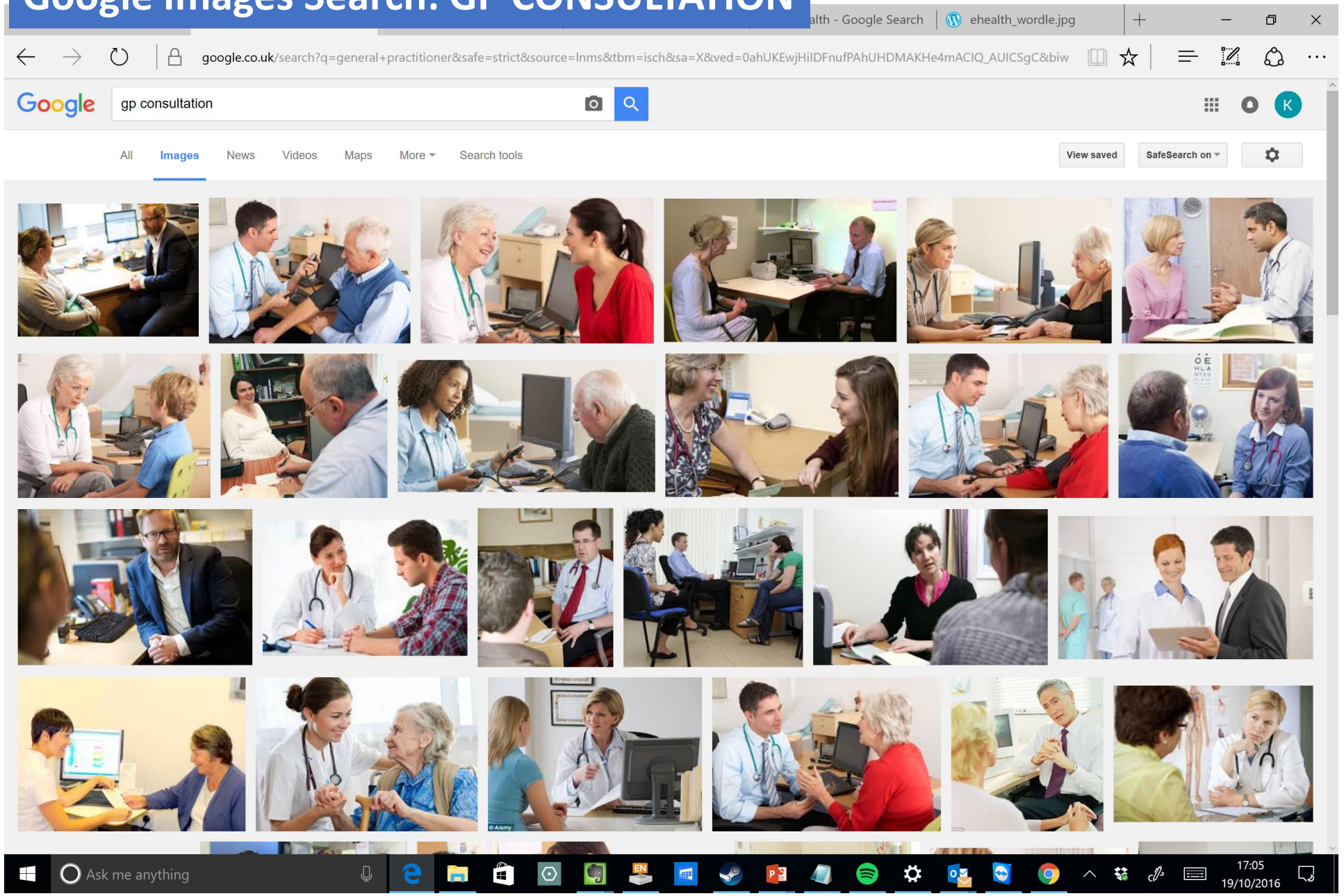
- COVID-19 *[rapid data/analtic response]*
  - “real world” (vs clinical trial) data on vaccine efficacy
  - estimating severity and fatality
  - predictors of infection / hospitalisation / death
- Survival from MI and stroke
- Aetiological studies
  - Body mass index (BMI) and cause-specific mortality
- Endpoints for ad hoc epidemiological cohort studies
- Trial emulation (using observational data when trial data not available)

Example uses of eHealth in surveillance and research

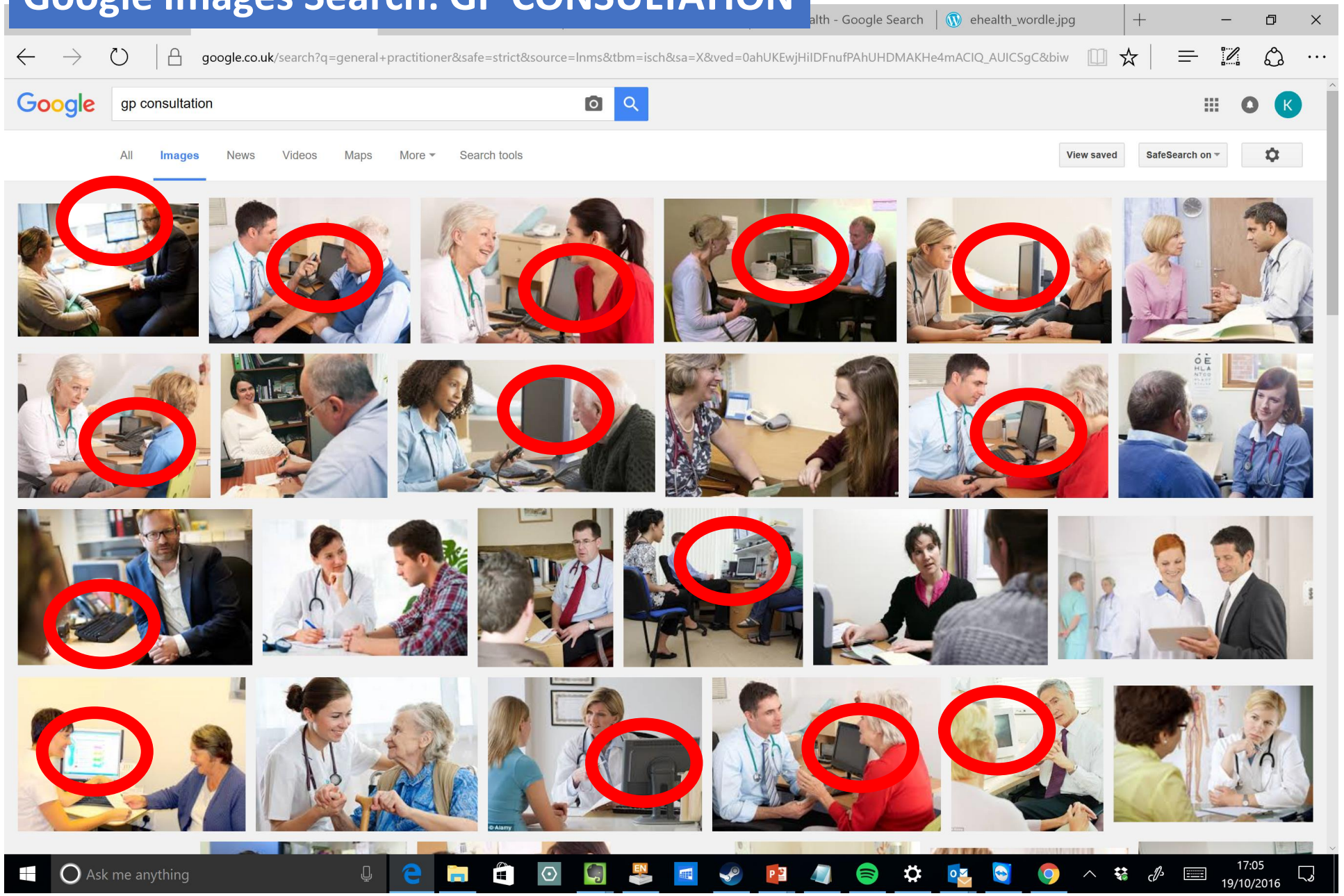
- COVID-19 *[rapid data/analytic response]*
  - "real world" (vs clinical trial) data on vaccine efficacy
  - estimating severity and fatality
  - **Predictors of infection / hospitalisation / death**
- **Survival from MI and stroke**
- Aetiological studies
  - Body mass index (BMI) and cause-specific mortality
- **Endpoints for ad hoc epidemiological cohort studies**
- Trial emulation (using observational data when trial data not available)

UK example

Google Images Search: GP CONSULTATION



Google Images Search: GP CONSULTATION



Evolution of electronic health records in general practice

- Early 1980s : <5% of GP practices used electronic records
- 1992 : 80% with government incentives
- 1996 : 96% of general practices used computerized record systems (*but completeness still being improved*)

McMillan, Brian et al. “Primary Care Patient Records in the United Kingdom: Past, Present, and Future Research Priorities.” Journal of medical Internet research vol. 20,12 e11293. 19 Dec. 2018, doi:10.2196/11293

2018 UK government policy to facilitate sharing and use of electronic health care records (primary and secondary care)

https://www.nhs.uk/using-the-nhs/about-the-nhs/sharing-your-health-records/

Q : What was impact did pre-existing disease/morbidity have on relative mortality during the COVID pandemic?

Q : What was impact did pre-existing disease/morbidity have on relative mortality during the COVID pandemic?

Requires linkage of data on pre-pandemic morbidity with mortality in pandemic (*uses unique NHS number*)

PLOS MEDICINE

In press – to be published January 2022

RESEARCH ARTICLE

Factors associated with excess all-cause mortality in the first wave of COVID-19 pandemic in the UK: A time series analysis using the Clinical Practice Research Datalink

Helen Strongman[1‡*], Helena Carreira[1‡], Bianca L. De Stavola[1,2], Krishnan Bhaskaran[1], David A. Leon[1,3,4]

1 London School of Hygiene & Tropical Medicine, London, United Kingdom, **2** University College London, London, United Kingdom, **3** UiT The Arctic University of Norway, Tromsø, Norway, **4** National Research University Higher School of Economics, Moscow, Russia

‡ These authors share first authorship on this work.
* helen.strongman@lshtm.ac.uk

https://www.cprd.com/

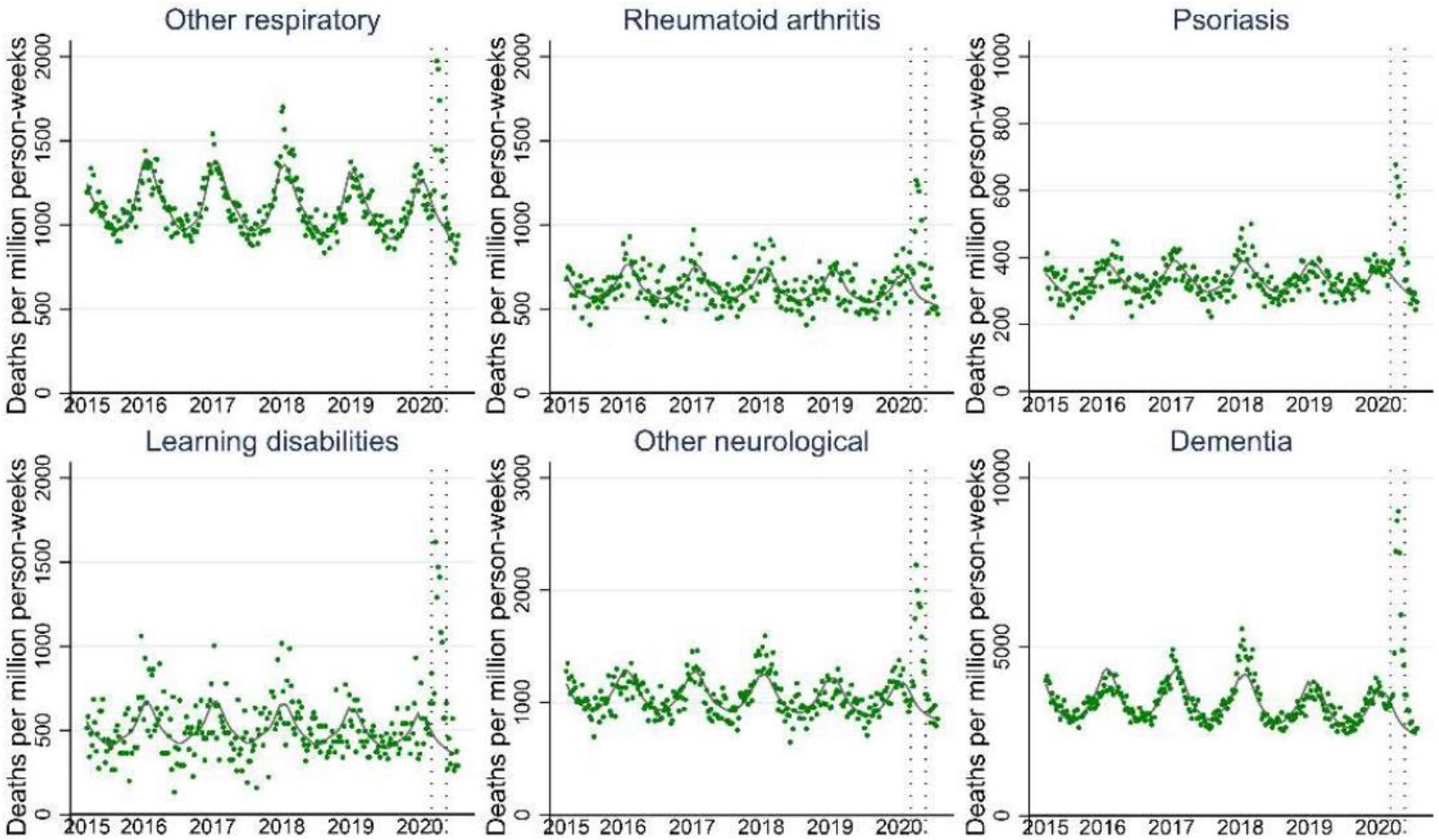
Practices contributing to
CPRD on 31st July 2020

1754 practices

Individuals Aged >40 registered with GP during the study period (5th March 2015-31st July 2020) and for at least a year prior to start of individual study follow-up

9,635,613 individuals

Observed and predicted weekly deaths per million person-weeks for CPRD sub-groups according to various morbidities (2015-2019)



Did association of all cause mortality with pre-existing morbidity change during pandemic?

Example of impact of having had a previous diagnosis of stroke (cerebrovascular disease)

- Rate ratio (RR) for stroke $= \frac{\text{Mortality rate among those with previous stroke}}{\text{Mortality rate among those without stroke}}$

- Did RR for stroke change during pandemic?

Rate ratios for selected morbidities *pre-pandemic* compared to *wave 1*

Morbidity	Pre-pandemic	Wave 1
Stroke	2.02 (2.00 – 2.04)	2.15 (2.07 – 2.24)

Rate ratios for selected morbidities *pre-pandemic* compared to *wave 1*

Morbidity	Pre-pandemic	Wave 1
Stroke	2.02 (2.00 – 2.04)	2.15 (2.07 – 2.24)
Chronic heart disease	2.03 (2.01 – 2.05)	2.05 (1.98 – 2.13)
Asthma	1.11 (1.10 – 1.12)	1.11 (1.06 – 1.15)

Rate ratios for selected morbidities *pre-pandemic* compared to *wave 1*

Morbidity	Pre-pandemic	Wave 1
Stroke	2.02 (2.00 – 2.04)	2.15 (2.07 – 2.24)
Chronic heart disease	2.03 (2.01 – 2.05)	2.05 (1.98 – 2.13)
Asthma	1.11 (1.10 – 1.12)	1.11 (1.06 – 1.15)

Very minor changes in rate ratios

Rate ratios for selected morbidities *pre-pandemic* compared to *wave 1*

Morbidity	Pre-pandemic	Wave 1
Stroke	2.02 (2.00 – 2.04)	2.15 (2.07 – 2.24)
Chronic heart disease	2.03 (2.01 – 2.05)	2.05 (1.98 – 2.13)
Asthma	1.11 (1.10 – 1.12)	1.11 (1.06 – 1.15)
Dementia	3.48 (3.44 – 3.51)	5.02 (4.82 – 5.23)
Learning difficulties	3.54 (3.43 – 3.65)	5.04 (4.56 – 5.58)

Rate ratios for selected morbidities *pre-pandemic* compared to *wave 1*

Morbidity	Pre-pandemic	Wave 1
Stroke		(2.07 – 2.24)
Chronic heart disease		(1.98 – 2.13)
Asthma	1.11 (1.10 – 1.12)	1.11 (1.06 – 1.15)
Dementia	3.48 (3.44 – 3.51)	5.02 (4.82 – 5.23)
Learning difficulties	3.54 (3.43 – 3.65)	5.04 (4.56 – 5.58)

Much larger changes in rate ratios

Russian examples

International seminar

Using eHealth data for informed decision-making and increased quality of health care in Russia

October 15th 2021, Moscow, Russia

Venue: HSE University, 11 Myasnitskaya Ulitsa, Moscow

Survival following myocardial infarction and stroke in Arkhangelsk and Norway – an eHealth demonstration project

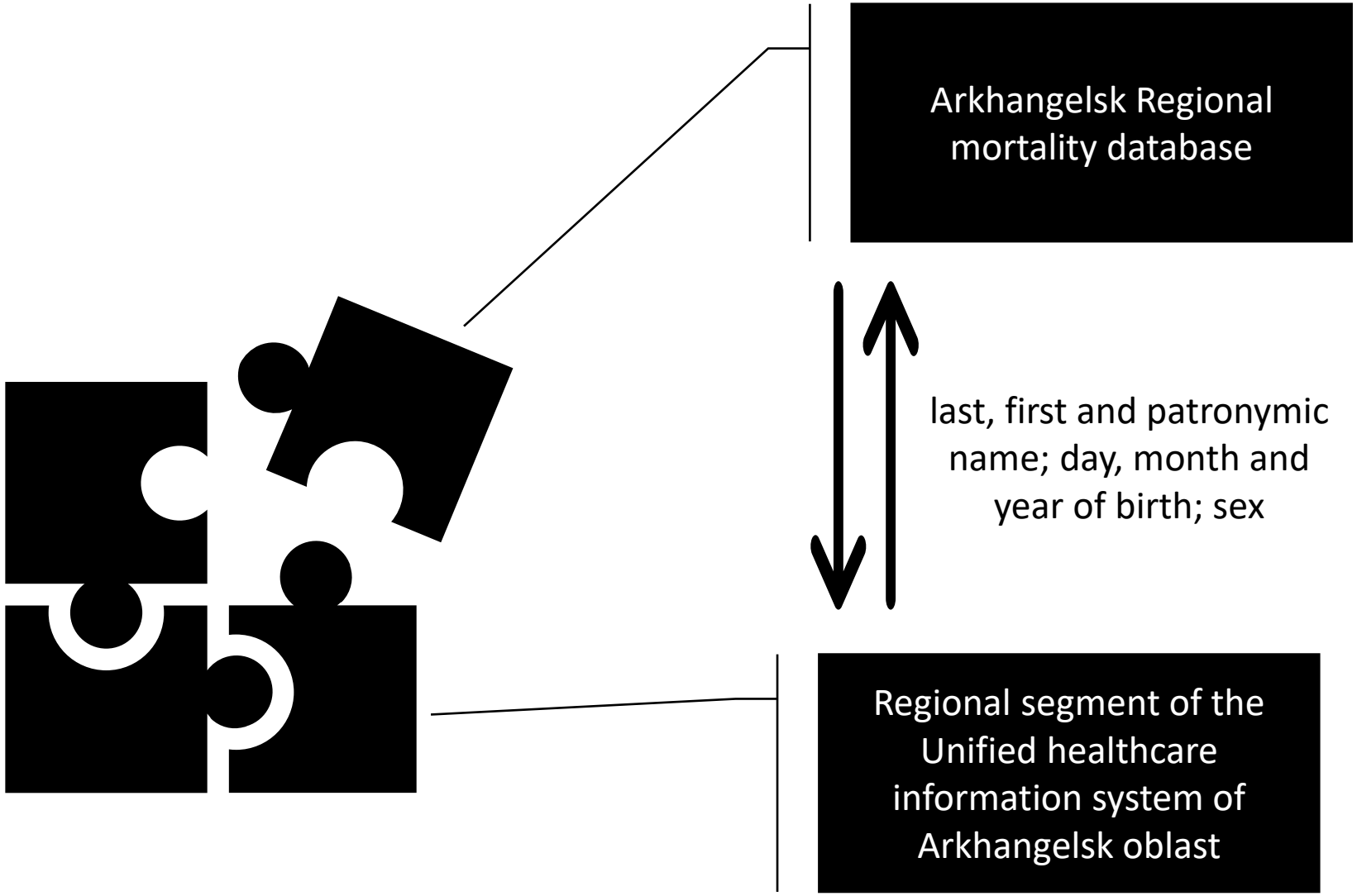
Alexander Kudryavtsev, Olga Kharkova
Northern State Medical University, Arkhangelsk, Russia

Aage Tverdal
Norwegian Institute of Public Health (NIPH), Oslo, Norway

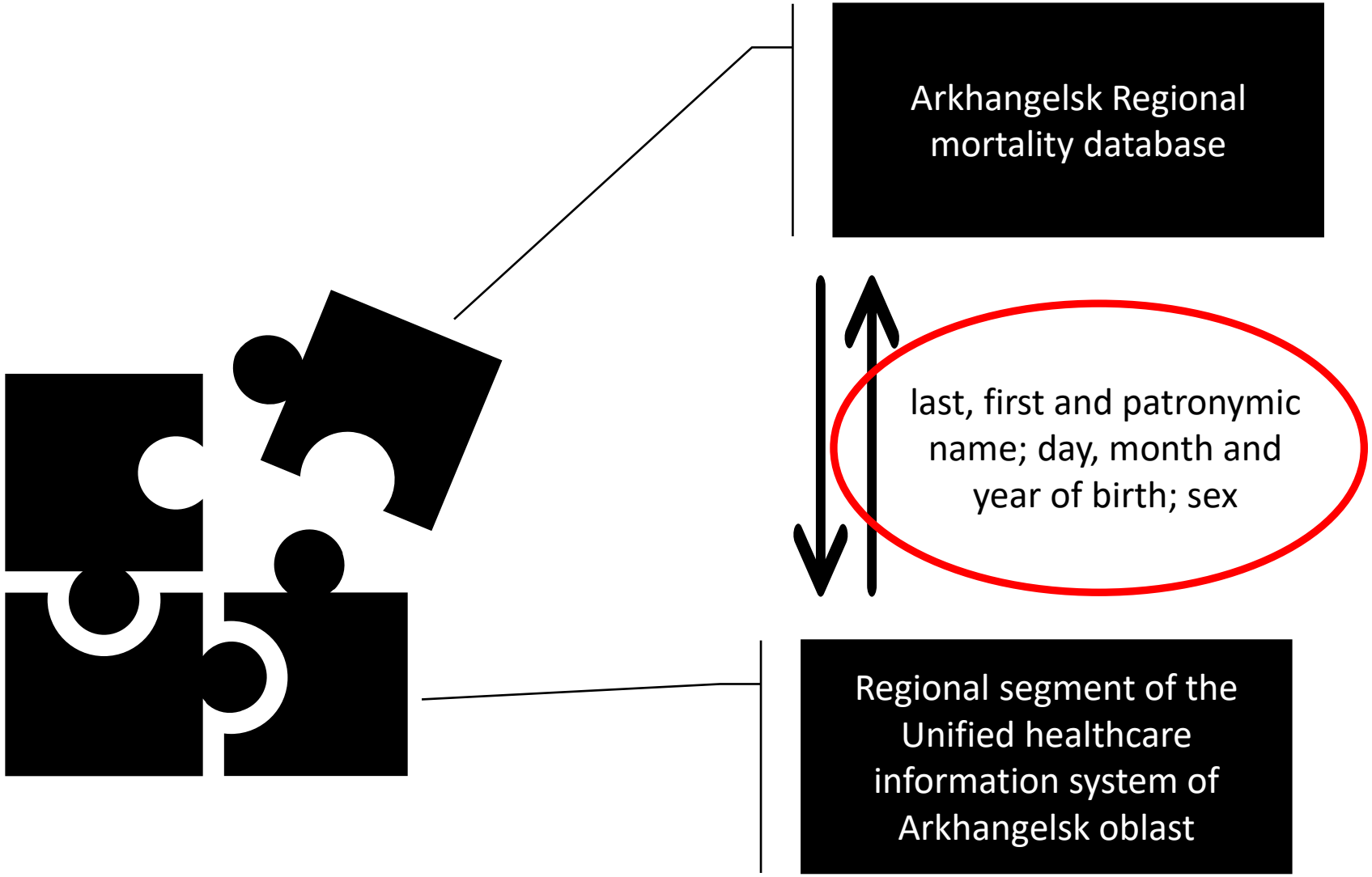
Data

- **Study population**:
  - Incident cases of first MI (ICD-10 code I21) and first stroke (ICD-10 codes I60-I64) in the Arkhangelsk region and Norway registered in the period from 01.07.2017 to 31.12.2018
  - Follow-up until 28.02.2020
- **Data sources**:
  - *Arkhangelsk region*
    - Cases of MI and stroke: Regional segment of the Unified healthcare information system of Arkhangelsk oblast (RS UHIS AO)
    - Mortality data: Arkhangelsk Regional mortality database (ARMD) at the Arkhangelsk Regional Medical Information Analytical Centre (MIAC)
  - *Norway*: Norwegian Cardiovascular Disease Registry

Arkhangelsk methods



Arkhangelsk methods



Legal permissions

- **Legal basis**: The access to the data is organized using VipNet secure communication channel and is regulated by the formal agreement between NSMU and MIAC on data exchange and the associated confidentiality agreement, both having the required legal approvals

Percentage of hospitalized patients with myocardial infarction and stroke captured by eHealth system 2016-2019

Year	Norway			Arkhangelsk region		
	Official statistics*	eHealth data**	% recorded in eHealth data	Official statistics*	eHealth data**	% recorded in eHealth data
2016	15943	14137	**88,7**	2040	334	**16,4**
2017	15534	13823	**89**	2337	916	**39,2**
2018	15005	13247	**88,3**	2027	956	**47,2**
2019	14765	13173	**89,2**	1830	386	**21,1**
Total	61247	54380	**88,8**	8234	2592	**31,5**

Year	Norway			Arkhangelsk region		
	Official statistics*[a]	eHealth data**[a]	% recorded in eHealth data	Official statistics*	eHealth data**	% recorded in eHealth data
2016	13867	13661	**98,5**	4149	654	**15,8**
2017	13635	13715	**100,6**	3912	1504	**38,4**
2018	13956	14186	**101,6**	3888	1777	**45,7**
2019	14395	14002	**97,3**	3812	905	**23,7**
Total	55853	53662	**96,1**	15761	4840	**30,7**

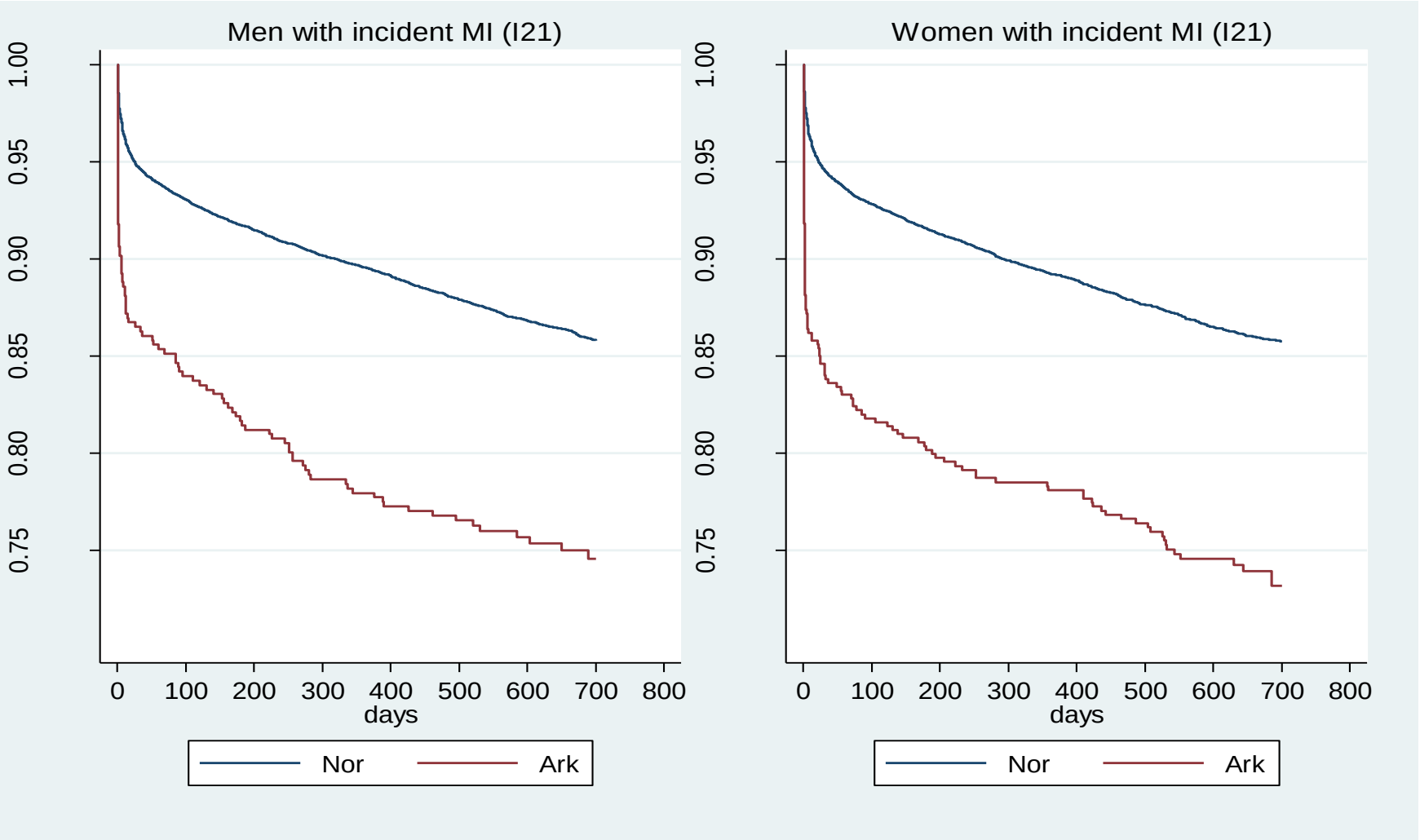
Low % in Arkhangelsk

** Statistics Norway for Norway and MIAC reports for Arkhangelsk region*

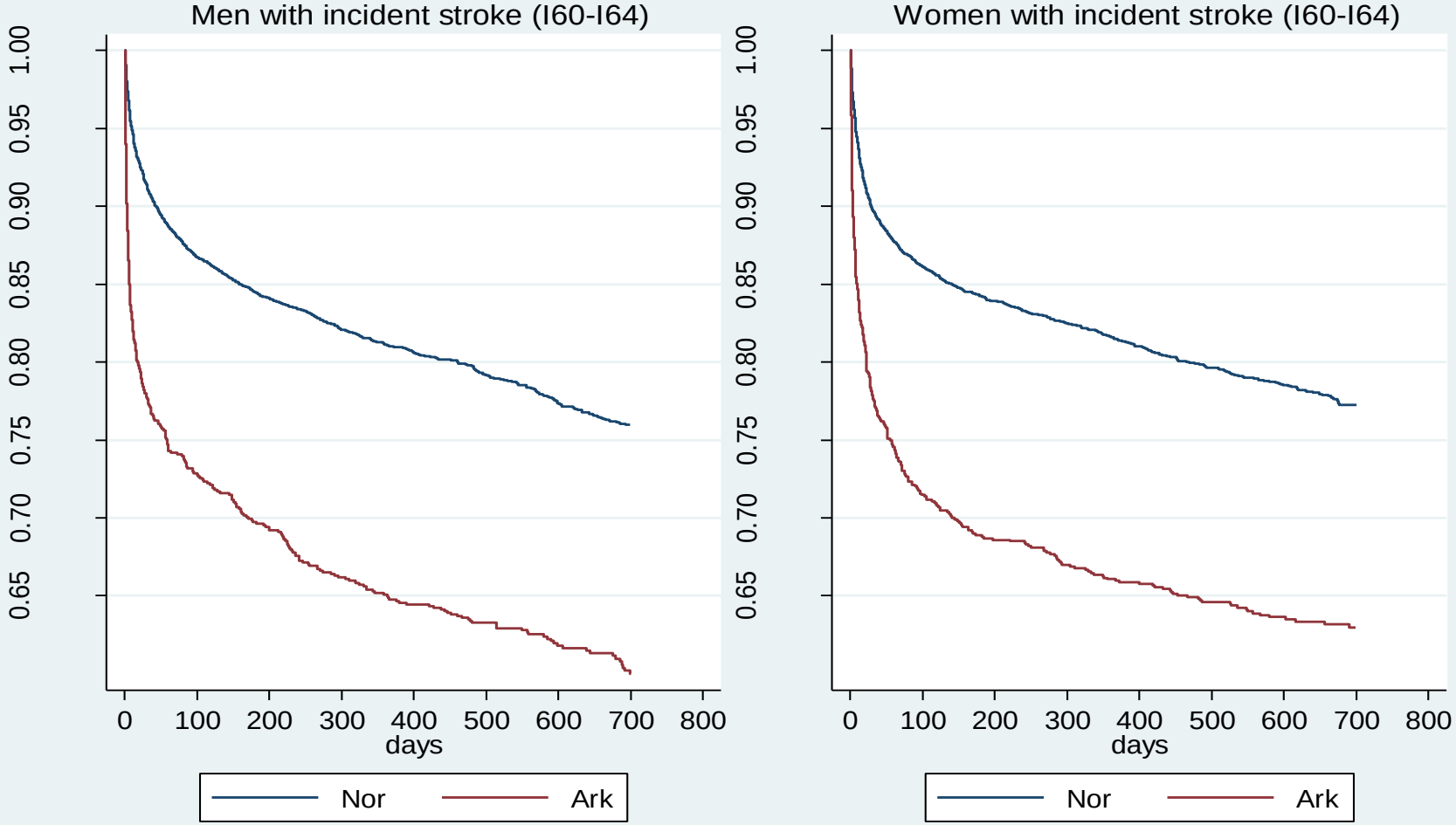
*** Norwegian CVD registry for Norway; RS UHIS AO and ARMD for Arkhangelsk region*

[a] I61, I63, I64

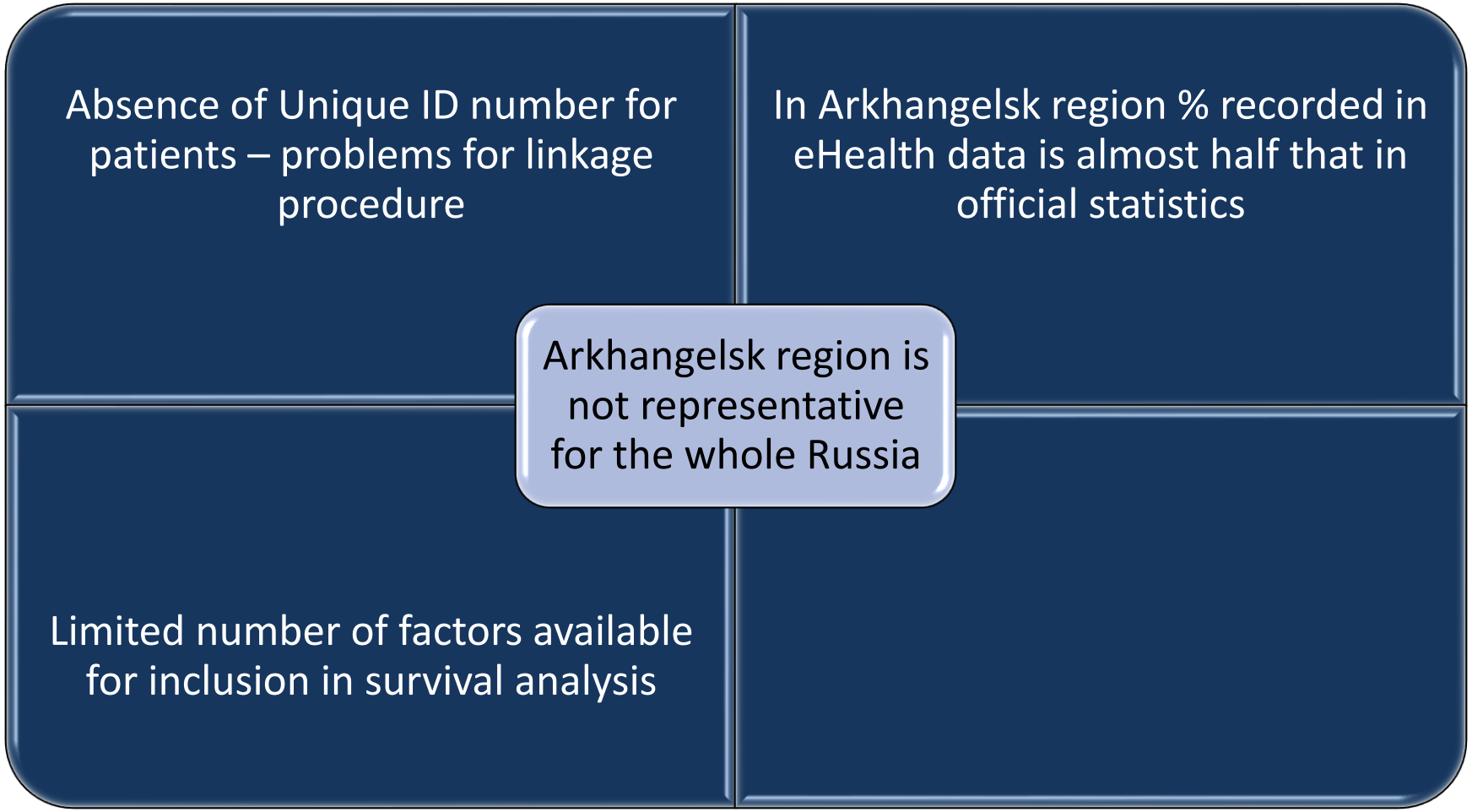
Survival following incident myocardial infarction hospital admission, adjusted for age at start of follow-up. Arkhangelsk vs Norway



Survival following incident stroke hospital admission, adjusted for age at start of follow-up. Arkhangelsk vs Norway



Conclusions – Limitations and Challenges

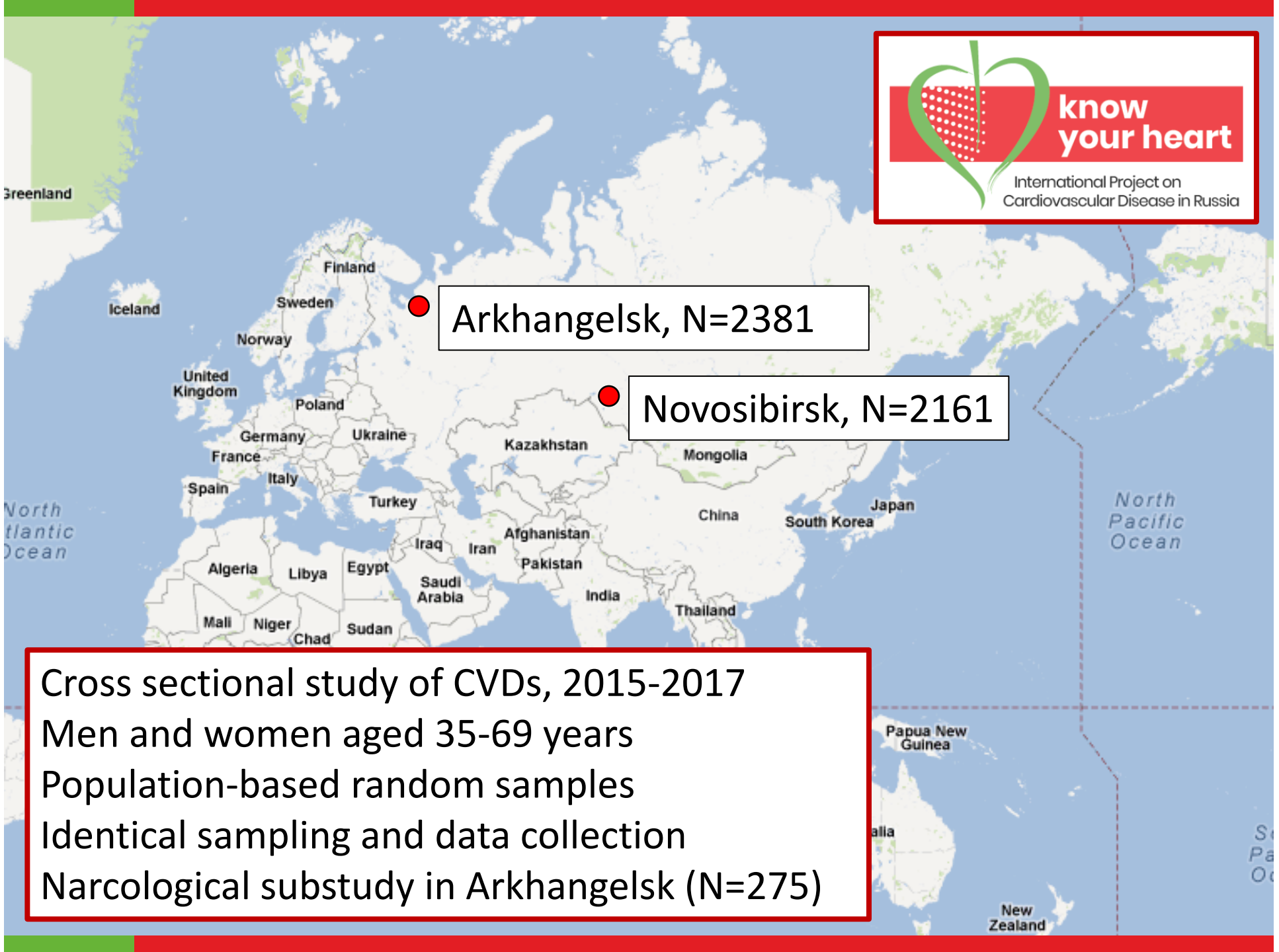


Follow-up of the Know Your Heart cross-sectional study in Arkhangelsk for all-cause mortality – a demonstration project

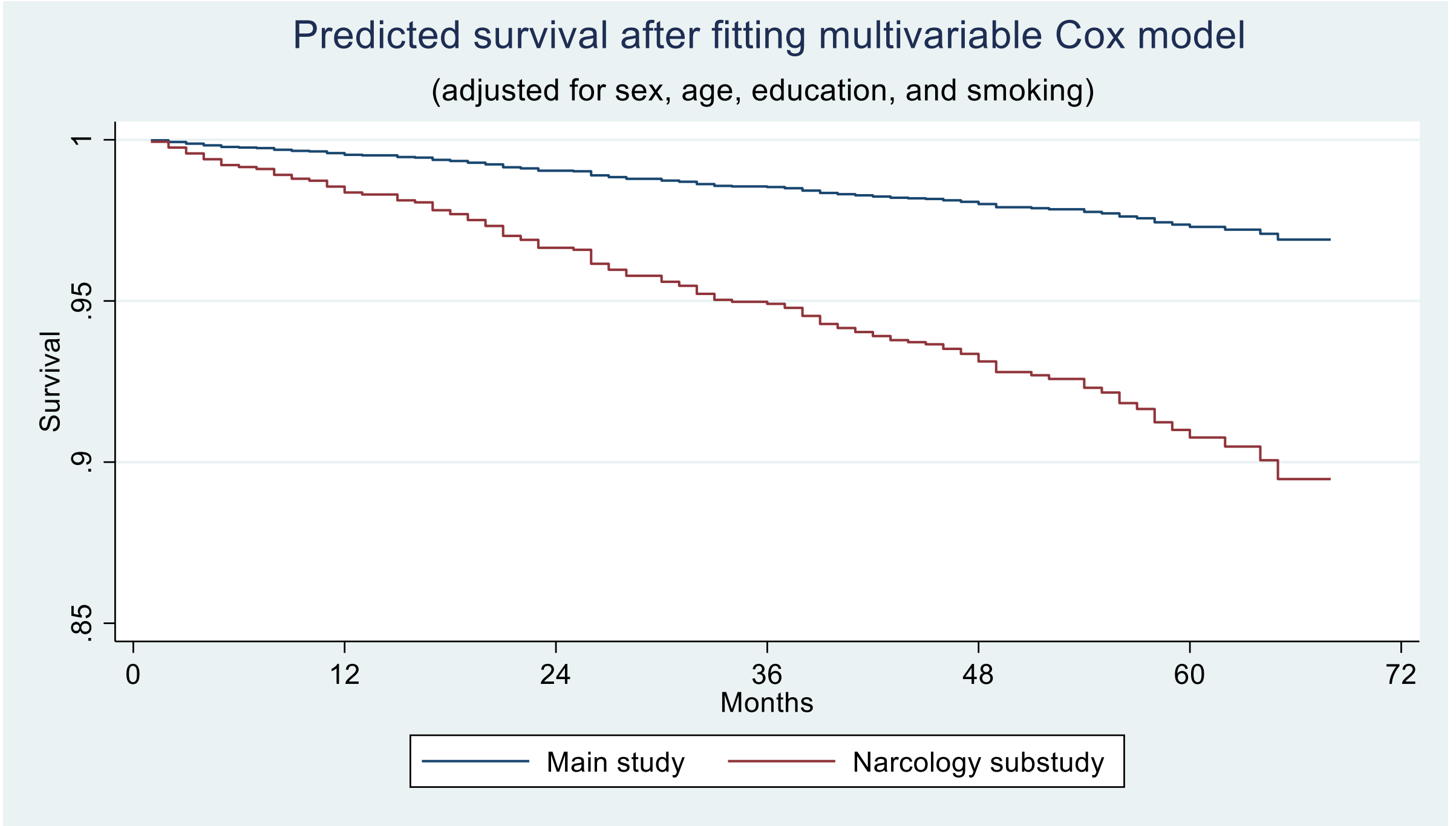
Alexander V. Kudryavtsev, PhD

Head, Dept. of Innovative Programs, Central Scientific Research Laboratory,
Northern State Medical University, Arkhangelsk, Russia /

Ass. Professor, Arctic Health Research, Dept. of Community Medicine,
Faculty of Health Sciences, UiT The Arctic University of Norway, Tromsø, Norway



Cross sectional study of CVDs, 2015-2017
Men and women aged 35-69 years
Population-based random samples
Identical sampling and data collection
Narcological substudy in Arkhangelsk (N=275)


Predicted survival after fitting multivariable Cox model
(adjusted for sex, age, education, and smoking)
Survival
1
.95
.9
.85
0
12
24
36
48
60
72
Months
Main study
Narcology substudy

Summary

1. Linkage of KYH and Arkhangelsk Regional Mortality Database records allows longitudinal studies of mortality and its causes

2. There are limitations due to the imperfect record-linkage (based on name, date of birth etc.) and unaccounted out-migration

Conclusions

Further development of eHealth in Russia depends on :

1. Incentivised expansion of routine clinical use of computerised systems in clinical practice (primary, secondary, laboratory etc)
2. Development of a unique ID that can be used to link records
3. Creation of and access to national mortality data base
4. Establishment of procedures and policies to protect confidentiality but not to stop use of data for improving individual and population health
5. Engagement of community to build trust

Thank you