



## Design and Analysis of Epidemiologic studies for causal inference

Course in Epidemiology arranged by Centre for Intervention Science in Maternal and Child Health, [CISMAC](#) and Bergen Centre for Ethics and Priority Setting in Health, [BCEPS](#) 21-27 May 2024, University of Bergen

### Rationale, goals and target group

This 7-day course in the principles and methods of epidemiologic research aims to provide participants with a coherent foundation for the design, analysis, and interpretation of epidemiologic studies.

The course is primarily intended for PhD students, postdoctoral fellows, and researchers/scientists/faculty members at the University of Bergen (UiB), the Norwegian Institute of Public Health, Innlandet Hospital Trust, the Indian Council of Medical Research, the Society of Applied Studies, Makerere University and their partner institutions.

### Faculty

[Krista F. Huybrechts](#), M.S., Ph.D. is an Associate Professor of Medicine at Harvard Medical School, Associate Professor of Epidemiology at Harvard T.H. Chan School of Public Health, and an epidemiologist in the Division of Pharmacoepidemiology and Pharmacoeconomics at the Brigham and Women's Hospital. She also holds an appointment as adjunct faculty at Boston University School of Public Health and teaches Pharmacoepidemiology at the Harvard T.H. Chan School of Public Health. Dr. Huybrechts is an Associate Editor for Pharmacoepidemiology and Drug Safety and serves on the editorial board of JAMA Psychiatry. She served on the Board of Directors of the International Society of Pharmacoepidemiology (ISPE) as Vice President Finance from 2017-2020. She currently serves on the board of Marcé of North America (MONA, Perinatal Mental Health Society) and is a voting member for the FDA Drug Safety and Risk Management Advisory Committee. She co-authored the third edition of the textbook Epidemiology – and Introduction, which is forthcoming in 2024.

Dr. Huybrechts co-founded and co-directs the [Harvard Program on Perinatal and Pediatric Pharmacoepidemiology](#). Her research centers on generating evidence regarding the safety and effectiveness of prescription medications during pregnancy. Her work, which is funded primarily by the National Institutes of Health, focuses on the use of advanced epidemiological and statistical methods applied to large databases derived from health data collected in the context of routine medical care to help address the unique questions regarding benefit-risk trade-off for prescription medication use faced by women of reproductive age, including during their pregnancies.

### Course Content

This course will present the conceptual foundations of epidemiologic research, and the methodologic approaches that stem from these foundations. Its objective is to unify the approach to epidemiologic research around a coherent set of concepts. Topics include a discussion of component and sufficient causes, causal inference, measurement of disease frequency and exposure effects, the principles of epidemiologic study design, cohort studies, case-control studies, epidemiologic data analysis, precision and validity, assessment and control of confounding, stratified analysis, multivariable analysis, the evaluation of effect measure modification, and the evaluation of dose-response trends. It also covers an introduction to some advanced topics in causal inference that will serve as an onramp into further study, including:

- Approaches to deal with missing data
- Directed Acyclic Graphs (DAGs)



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- Target Trial Emulation
- Handling of Time-Dependent Variables
- Instrumental Variables
- Quantitative Bias Analyses

### Learning outcomes

Upon completing this course, participants will be able to:

- apply measures of disease occurrence and of association to quantify the causal effects of exposures on disease outcomes.
- critically evaluate and compare different epidemiologic study designs
- apply epidemiologic concepts for causal inference.
- identify different types of biases in epidemiological studies and apply strategies to reduce bias in study design and data analysis.
- appropriately interpret p-value functions, confidence intervals and p-values
- identify and interpret interaction based on an understanding of causal components in disease mechanisms
- critically assess papers reporting on causal inference based on analyses of epidemiologic data.
- explain causal inference in epidemiology using:
  - DAGs,
  - instrumental variables,
  - target trial emulation,
  - propensity scores
  - quantitative bias analyses
- conduct analysis of epidemiologic data for causal inference using Stata® or R.

### Who can attend and how?

PhD students, postdoctoral fellows, researchers, scientists, and faculty members with a background in epidemiology or statistics. Master students with training in epidemiology or statistics will also be considered as course participants, if recommended by their institutions. All participants must be well versed with analyzing epidemiologic data using either Stata® or R. For those who do not have such skills, we may open a course in the use of Stata®, [MEDSTATA](#), which, with adequate prior knowledge in statistics, can be undertaken/digitally remotely with self-studies in 1-3 working days (depending on prior experience with Stata® so that all participants can ensure they are up to speed in data analysis).

The applicants will need to share the following when submitting their online applications by the 2<sup>nd</sup> of April:

1. “Statement of Purpose” briefly (max 300 words) describing their expectations from the course, including how it may benefit their career path.
2. Brief CV with details of educational qualifications, work experience, and up to 5 of the best peer reviewed scientific publications (if any).

While there will be several deserving applicants, we will prioritize candidates whose publications, if any, or teaching experience reflect strengths in epidemiology and/or statistics.

### Compulsory requirements

Before coming to Bergen, participants need to carefully study the course textbook. [Webinars](#) covering several topics from the textbook will be made available to the participants in advance. Further, they must have installed Stata® (version 14 or higher) or R (with R studio) on their laptops, which they bring along to Bergen, and by 21<sup>st</sup> of May have done a few data analysis exercises which will be sent to them by the 7<sup>th</sup> of May.

#### CENTRE FOR INTERVENTION SCIENCE IN MATERNAL AND CHILD HEALTH (CISMACH)

is anchored at the Centre for International Health (CIH), University of Bergen, Norway. CISMACH is a consortium of CIH and research institutions in Ethiopia, India, Nepal, South Africa, Uganda and Zambia. The consortium also includes Chr. Michelsens Institute, the Norwegian Institute of Public Health and the World Health Organization.





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To obtain credits or a course diploma, at least 80% attendance during the face-to-face activities in Bergen and passing the course test on the 27<sup>th</sup> of May are required. Students will be given an assignment to be completed by the 10<sup>th</sup> of June.

### Course structure

The course will be held over a period of 7 days from the 21<sup>st</sup> to the 27<sup>th</sup> May 2024 from 08:15 to 17:00, including a break on Saturday 25<sup>th</sup> of May. A detailed schedule is available at the end of this page; it may see slight modifications.

Pre-lunch lectures by Dr. Huybrechts will be supported by hands-on computer exercises or other supervised group work after lunch. Co-facilitators of CISMACH's new epidemiology capacity strengthening program, [EpiCap](#), will coordinate these exercises.

### Course language

A good command of English is required.

### Reading material

Course textbook: [Epidemiology: An Introduction by Kenneth J. Rothman](#)

Additional reading material, such as scientific articles may be provided ahead of the course.

### Course Fee

The course fee for all participants is covered by CISMACH and BCEPS. The cost of travel to and stay in Bergen is to be covered by the participants or their institutions.

### ECTS credits

With at least 80% attendance during the face-to-face activities and passing the test on the 27<sup>th</sup> of May, the course will give 2 ECTS (course code CISMACH900A-5). The participants will get another 3 ECTS if their home assignment due 10<sup>th</sup> of June is approved (course code CISMACH900-5). To obtain ECTS credits, a semester fee of NOK 690 needs to be paid to the University of Bergen.

### Notice:

Course description and timetable may seem modifications, the updated version will be kept on our webpage: <https://www.uib.no/en/cismach/161483/epicap-strengthening-capacity-analytic-epidemiology-teaching-learning>

### Contact:

If you have any questions about the course, please email us at [cismach@uib.no](mailto:cismach@uib.no)

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# CENTRE FOR INTERVENTION SCIENCE IN MATERNAL AND CHILD HEALTH

## Design and Analysis of Epidemiologic studies for causal inference - Course Schedule (subject to change)

Date/Day	Timing	Topic [Chapter in K. J. Rothman: Epidemiology – an Introduction <sup>1</sup> ]	Responsible	
Tuesday, 21st May	08:00 to 08:15	Welcome and Introduction	HS/IS	
	08:15 to 09:00	Causation [3]	KH	
	09:15 to 10:00	Disease occurrence, Measures of association, including Attributable fraction and Population Attributable Fraction [4]		
	10:15 to 11:00	Causal effects [4]		
	11:15 to 12:00	Causal effects, including implications for Effect measure modification (EMM) [4, (11)]		
	12:10 to 12:40	Randomized Controlled Trials and other cohort studies [(5]		
	12:45 to 13:30	Lunch		
	13:30 to 14:15	Case control (CC) studies [5]	KH	
	14:30 to 15:15	CC studies [5]		
		15:30 to 17:00	Recap of exercises done by participants before coming to Bergen: Preventing and adjusting for confounding in small Randomized controlled trials. Identifying and assessing EMM.	HS/IFS (Stata®) [ELS/TSC (R)]
Wednesday, 22nd May	08:15 to 09:00	Matching in Cohort studies and in Case control studies [5]	KH	
	09:15 to 10:00	Selection/Confounding bias [7]		
	10:15 to 11:00	Directed acyclic graphs (DAGs) [15.2]		
	11:15 to 12:00	Bias due to misclassification (I) [7]		
	12:10 to 12:40	Summary and Q&A		
	12:45 to 13:30	Lunch		
		13:30 to 14:15	Exercises	CoF
		14:30 to 15:15		
		15:30 to 16:15		
		16:30 to 17:00		
Thursday, 23rd May	08:15 to 09:00	Bias due to misclassification (II) [7]	KH	
	09:15 to 10:00	Random error and p-value function, (not) significance testing [8]		
	10:15 to 11:00	Analysis of simple epidemiological data [9]		
	11:15 to 12:00	Use of Episheet in analysis of epidemiologic data		
	12:10 to 12:40	Summary and Q&A		
	12:45 to 13:30	Lunch		
		13:30 to 14:15	Exercises	CoF
		14:30 to 15:15		
		15:30 to 16:15		
		16:30 to 17:00		

<sup>1</sup>Epidemiology-an introduction 2<sup>nd</sup> ed, except for chapter 15, which is in the upcoming 3<sup>rd</sup> edition

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## Course schedule -ctd.

Date and Day	Timing	Topic [Chapter in K. J. Rothman: Epidemiology – an Introduction 2 <sup>nd</sup> ed.]	Responsible
Friday, 24th May	08:15 to 09:00	Stratified analysis [10]	KH
	09:15 to 10:00	Stratified analysis [10]/Regression models [12]	
	10:15 to 11:00	Regression models [12]	
	11:15 to 12:00	Time-dependent variables [15.3]	
	12:10 to 12:40	Summary and Q&A	
	12:45 to 13:30	Lunch	
	13:30 to 14:15	Exercises	CoF
	14:30 to 15:15		
	15:30 to 16:15		
	16:30 to 17:00		
Sunday 26th May	08:15 to 09:00	Epidemiology in clinical settings [13]	KH
	09:15 to 10:00	Propensity Scores (PS), including High-dimensional PS	
	10:15 to 11:00	Target Trial Emulation (TTE)	
	11:15 to 12:00	TTE	
	12:10 to 12:40	Summary and Q&A	
	12:45 to 13:30	Lunch	
	13:30 to 14:15	Exercises	CoF
	14:30 to 15:15		
	15:30 to 16:15		
	16:30 to 17:00		
Monday, 27th May	08:15 to 09:00	Missing data and how to handle them [15.1]	KH
	09:15 to 10:00	Instrumental Variable Analysis [15.4]	
	10:15 to 11:00	Quantitative Bias Analysis [15.5]	
	11:15 to 12:00	Recap	
	12:10 to 12:40	Summary and Q&A	
	12:45 to 13:30	Lunch	
	13:30 to 14:15	Exercises	CoF/KH
	14:30 to 15:15		
	15:30 to 16:15		
	16:30 to 17:00	Course test	CoF/KH

**Teacher:** Krista F. Huybrechts (KH)

**Co-facilitators:** Bireshwar Sinha (BS), Dagrun S Daltveit (DD), Eleni Papadopoulou (EP), Eskindir Loha Shumbullo (ELS), Ingvild F. Sandøy (IFS), Halvor Sommerfelt (HS), Hugo Cogo Moreira (HCM), Jannicke Igland (JI), Kjersti Sletten Bakken (KSB), Kjersti Mørkrid Blom-Bakke (KMB), Madhanraj Kalyanasundaram (MK), Mahima Venkateswaran (MV), Ramachandran Thiruvengadam (RT), Ranadip Chowdhury (RC), Ravi Upadhyay (RU), Rizwan Abdulkader (RA), Tarun Shankar Choudhary (TSC), Uma Chandra Mouli Natchu (UN) | All Co-facilitators (CoF)

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