Day 1: Big Data

**Learning Objectives**
- Describe existing big data sources for musculoskeletal research
- Evaluate the opportunities and challenges of data linkage
- Recognise emerging types of big data from patients
- Design studies employing big data

0900 **Welcome**
  Overview of course
  Overview of day

0930 **Big datasets**
  - Anonymised electronic medical records, and their use in musculoskeletal research
  - UK Biobank: opportunities for musculoskeletal research
  - Whole countries as cohorts

1030 **Coffee**

1100 **Linkage of big data**
  Examples of linkage success:
  - National registers
  - Health and social care
  - Governance for linkage

1200 **Practical exercise**

1300 **Lunch**

1400 **Big data from patients**
  Electronic patient reported outcomes
  Sensors, wearables and continuous telemetry
  Social media data: access and analysis

1530 **Coffee**

1600 **Practical exercise**

1730 **End**
Day 2: Longitudinal studies

Learning Objectives

- To apply the right model for longitudinal data analysis
- To understand the impact of missing data in longitudinal studies
- To gain understanding of multi-state models

0900 Welcome
  Overview of day
  Practical

1000 Introduction longitudinal data analysis
  - Repeated measurement analysis

1100 Coffee

1130 Longitudinal data analysis
  - Examples longitudinal data analysis
  - Feedback practical

1300 Lunch

1400 Latent Class Growth Models
  - Introduction in latent class growth modelling and applied examples

1530 Coffee

1600 Time to event analysis
  - Introduction time to event analysis
  - Multi-state models

1730 End
Day 3: Pharmacoepidemiology

Learning Objectives
- Give examples of common pitfalls in pharmacoepidemiological studies
- Recognise a range of analytic tools and understand their practical application
- Propose and justify study designs for future pharmacoepidemiological research

0900 Welcome
Overview of day

0910 The importance of time
- Immortal time bias
- Switching
- Risk windows and risk attribution (e.g. steroids and DM)
- Time-varying confounding
- Selection bias/attrition
- Competing risks

1030 Coffee

1100 The ingredients
- Pros and cons of different data sources for pharmacoepidemiology
- Data preparation
- Missing data
- Case only designs
- Competing risk analyses

1300 Lunch

1400 The recipe
- On drug/ lag window/ ever exposed
- Weighted cumulative dose
- Propensity scores and PS analytics
- Time-varying confounding
- Unmeasured confounding, including Missing Cause analysis
- Effect modification for stratified medicine (scales, multiple modifiers)

1530 Coffee

1600 Practical exercise

1730 End
Day 4: Clinical Trials

Learning objectives
Students will develop
- A theoretical and practical understanding of the issues involved in the design, conduct, analysis and interpretation of randomised controlled trials of MSK interventions
- Skills to critically appraise randomized clinical trials
- An understanding of the scope and rationale for different trial designs in determining effectiveness of MSK interventions

0900 Welcome & overview of day

0905 Clinical Trials – introduction

1000 Practical exercise - trial design

1100 Coffee

1130 Critical appraisal of randomised trials

1200 Practical exercise – Critical Appraisal

1300 Lunch

1400 Alternate trial designs
  - Cluster Randomised Trials
  - Pragmatic
  - Adaptive Trial Designs

1530 Coffee

1600 Trials of Complex interventions

1630 Practical exercise: Study design

1730 End
Day 5: Causal inference in epidemiological studies

**Learning objectives**
- Understand different concepts and descriptions of causation in epidemiological research
- Understand graph theory that relates to causal models
- Understand the construction, application and analysis of Directed Acyclic Graphs
- Describe the similarities and differences in causal inference between observational and randomised studies
- Design a study to test a question around causal inference

09.00  **Welcome and overview of day**

09.10  Practical session #1

10.00  Causal inference theory

11.00  Coffee

11.30  Graph theory and Directed Acyclic Graphs

12.30  Lunch

13.30  Causal inference in observational and randomised studies

14.30  Coffee

15.00  Practical session #2

16.00  Panel Q & A and feedback on practical

17.00  Close of Summer School