

DTU





**DTU Health Technology
Bioinformatics**

Metagenomics and Microbiome Analysis: Introduction to study design

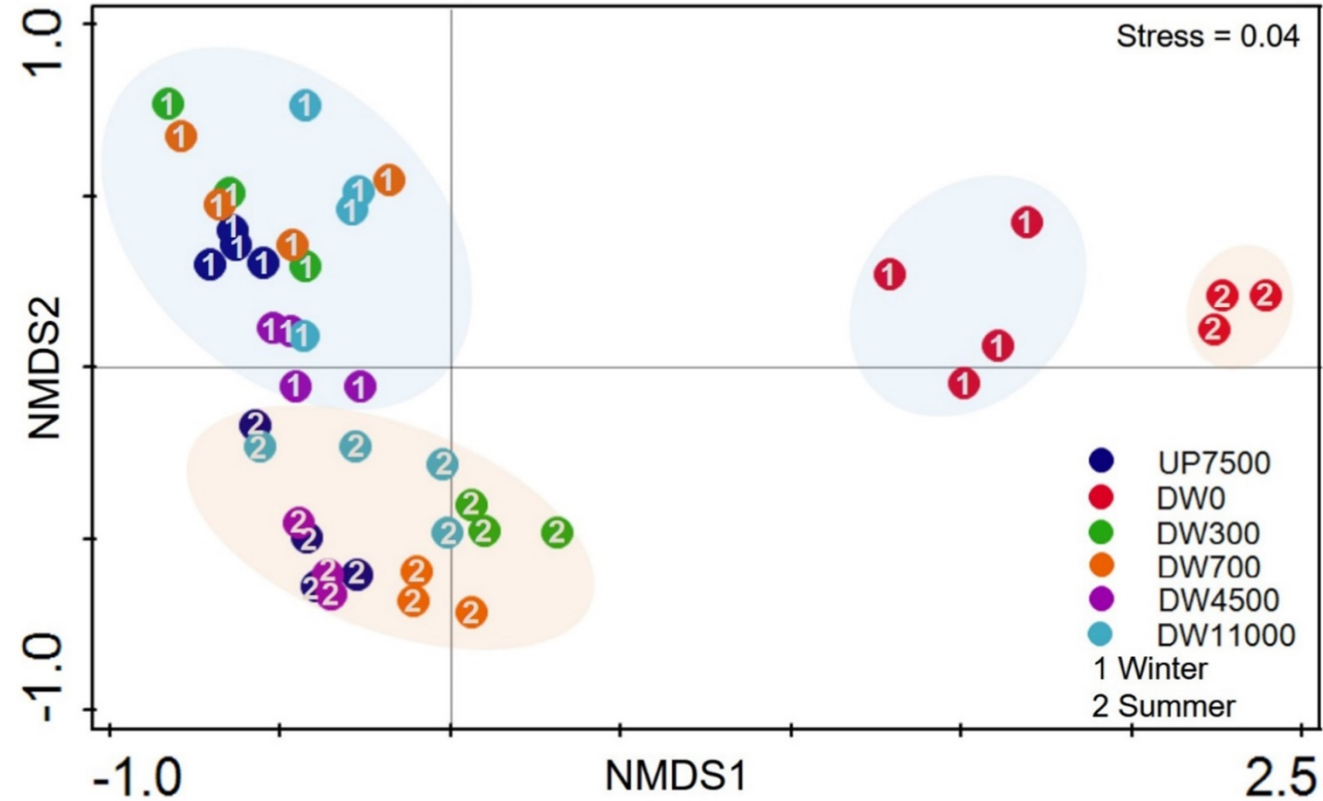
*Gisle Vestergaard
Associate professor
Section of Bioinformatics
Technical University of Denmark
gisves@dtu.dk*

Menu

- Study design matters!
- Comparative studies
- Intervention studies
- Previous course studies

Comparative studies

- Most microbiome studies are comparative
- Microbiome composition of a river around an antibiotics factory



Intervention study

Generally, in a randomised controlled trial, study participants are randomly assigned to one of two groups:

- the experimental group receiving the intervention that is being tested
- comparison group (controls) which receives a conventional treatment or placebo.

Types of intervention studies

- Therapeutic trials:

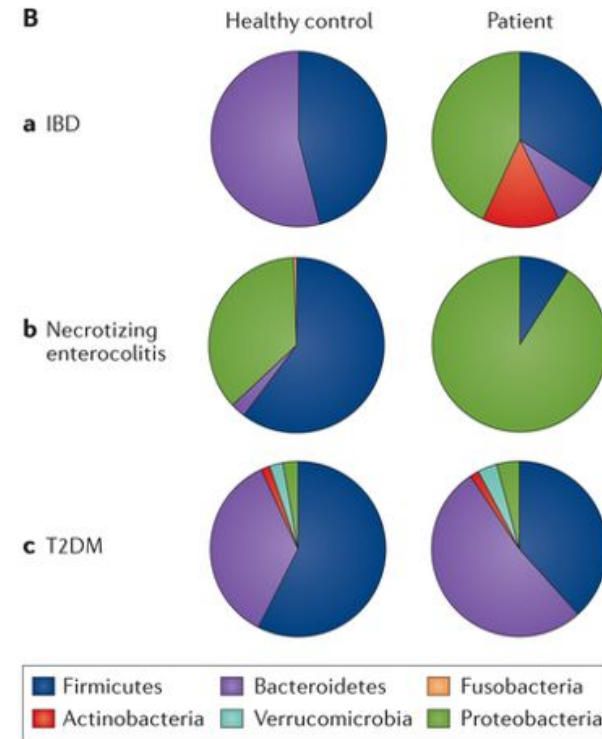
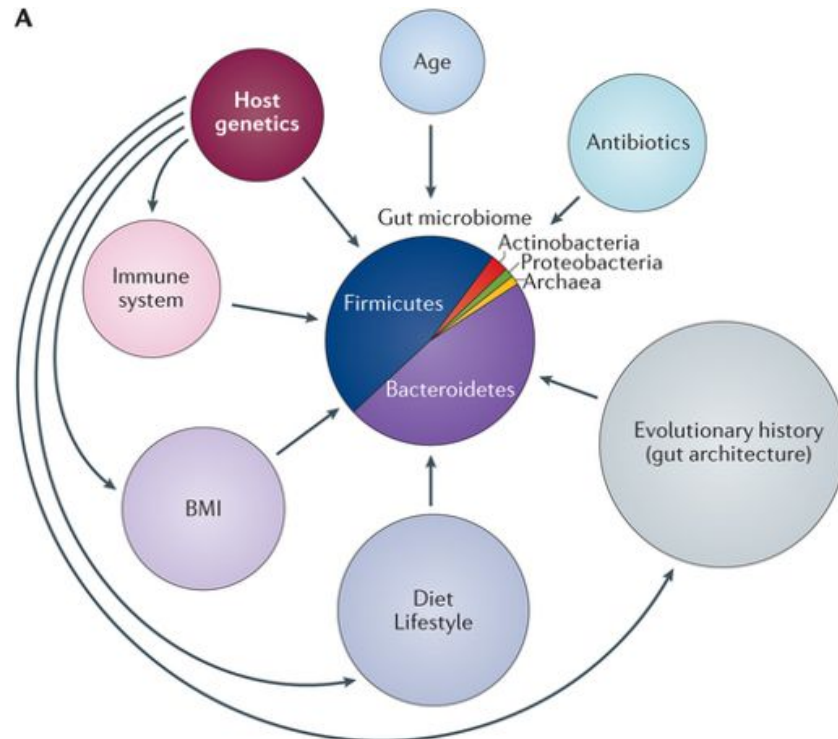
Conducted among **individuals with a particular disease** to assess the effectiveness of an agent or procedure to diminish symptoms, prevent recurrence, or reduce mortality from the disease.

- Preventative trials:

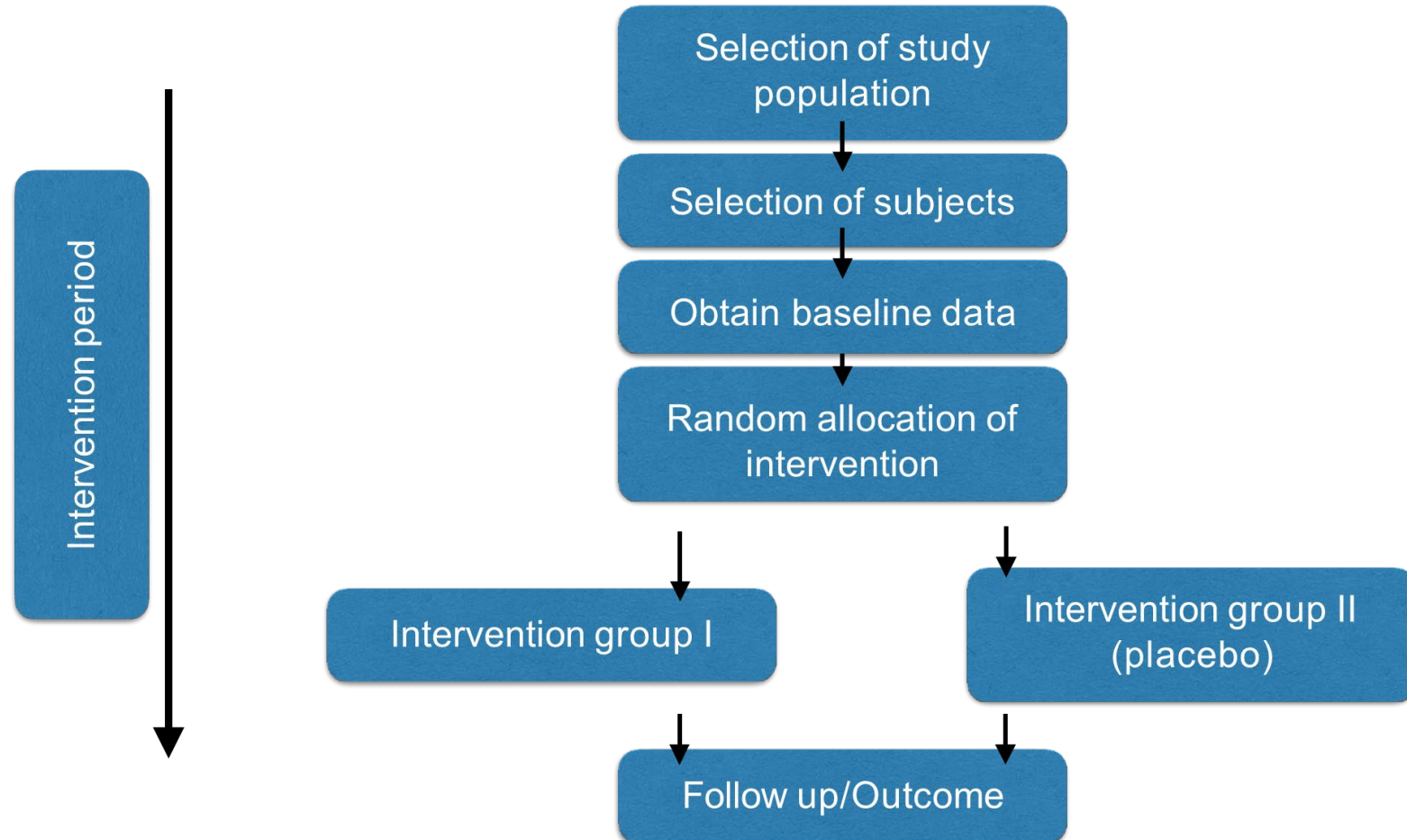
Conducted to evaluate whether an agent or procedure **reduces the risk of developing a particular disease** among individuals free from that disease at the beginning of the trial, for example, vaccine trials. Preventative trials may be conducted among individuals or among entire communities

Humans are different

- More **between-person variation** than **within-person variation** leading to the conclusion that adults have an average unique microbial signature that is largely stable over time
- To get statistical power we need lots of people or establish a baseline



Outline of intervention study



Design your own study

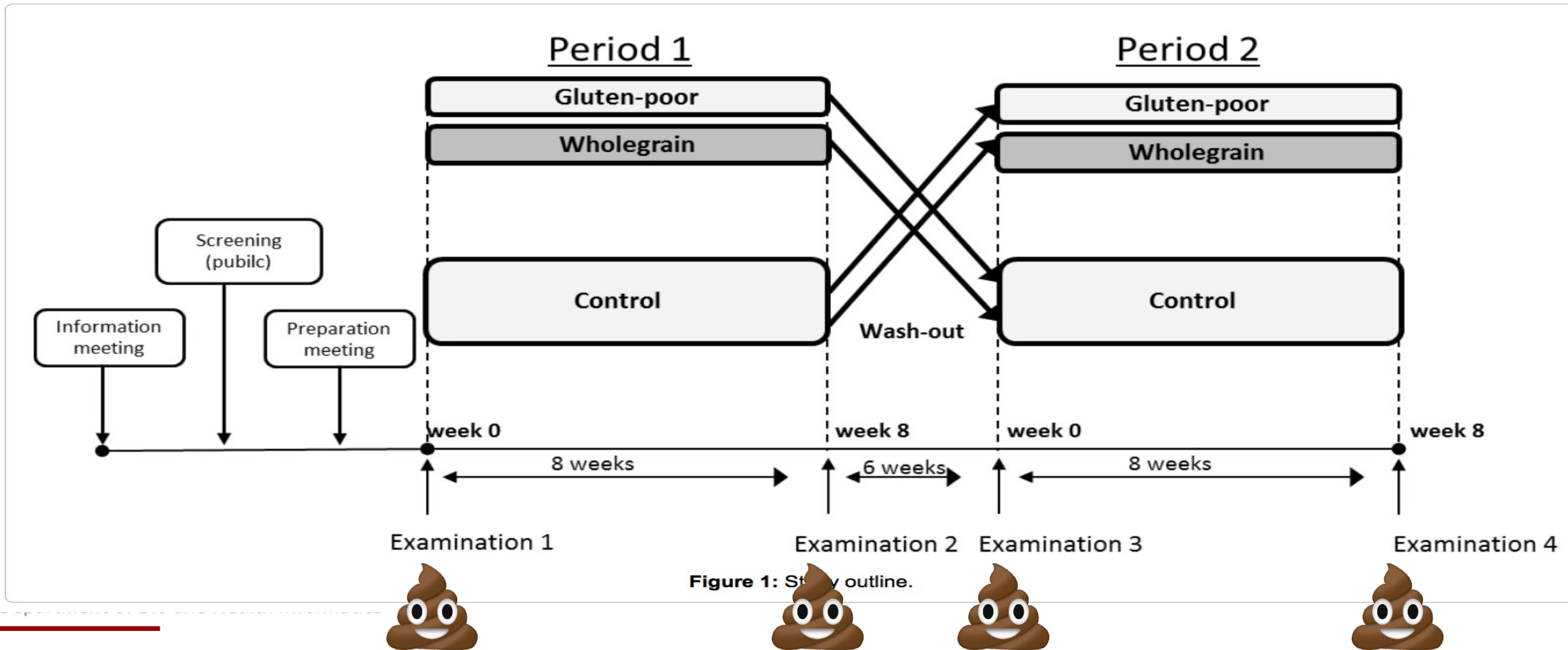
- Sequence microbiome samples (Max 40 samples)
- What could be an hypothesis?
- Setup of design
- What metadata would be useful?



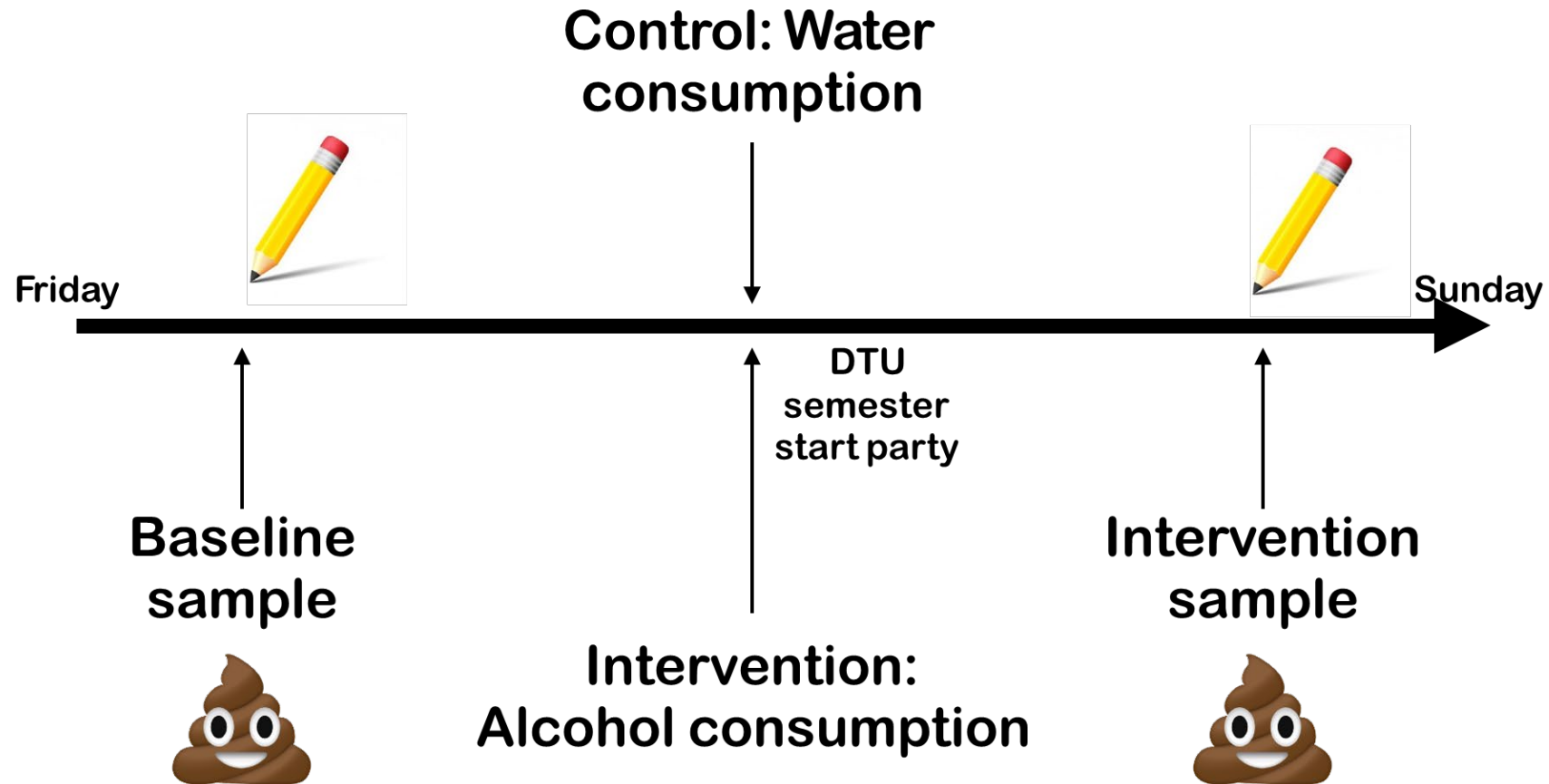
Example: 3G project

- 3G - Gut, Grain & Greens
- Hypothesis is that the interplay between human host genome expression and gut microbiota (GM) affects the development of chronic metabolic disorders, and that interventions targeting the microbiome and mucosa can therefore reduce the risk of developing metabolic dysfunctions such as obesity, Type 2 Diabetes (T2D), and cardiovascular diseases (CVD).

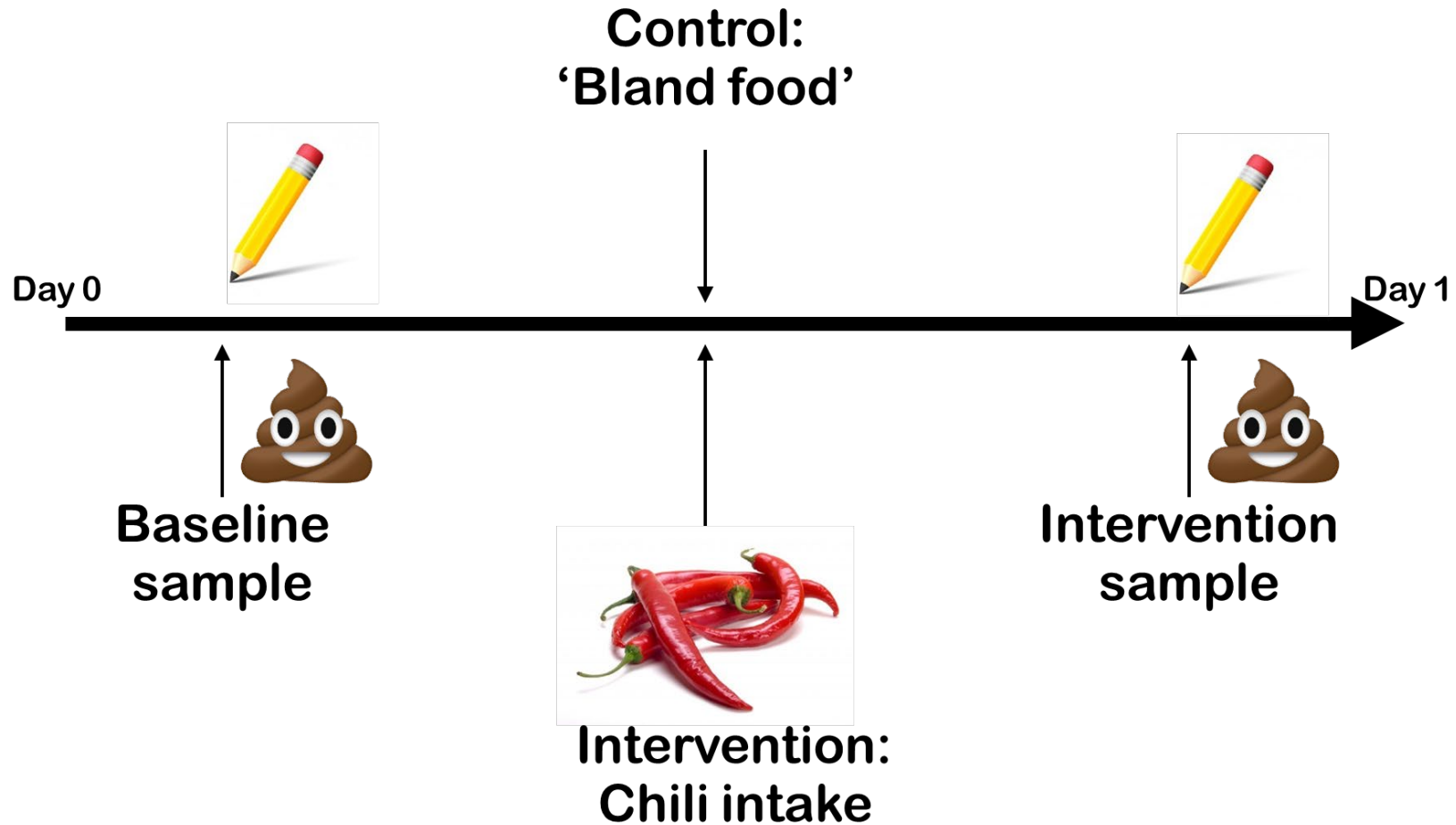
3G Design



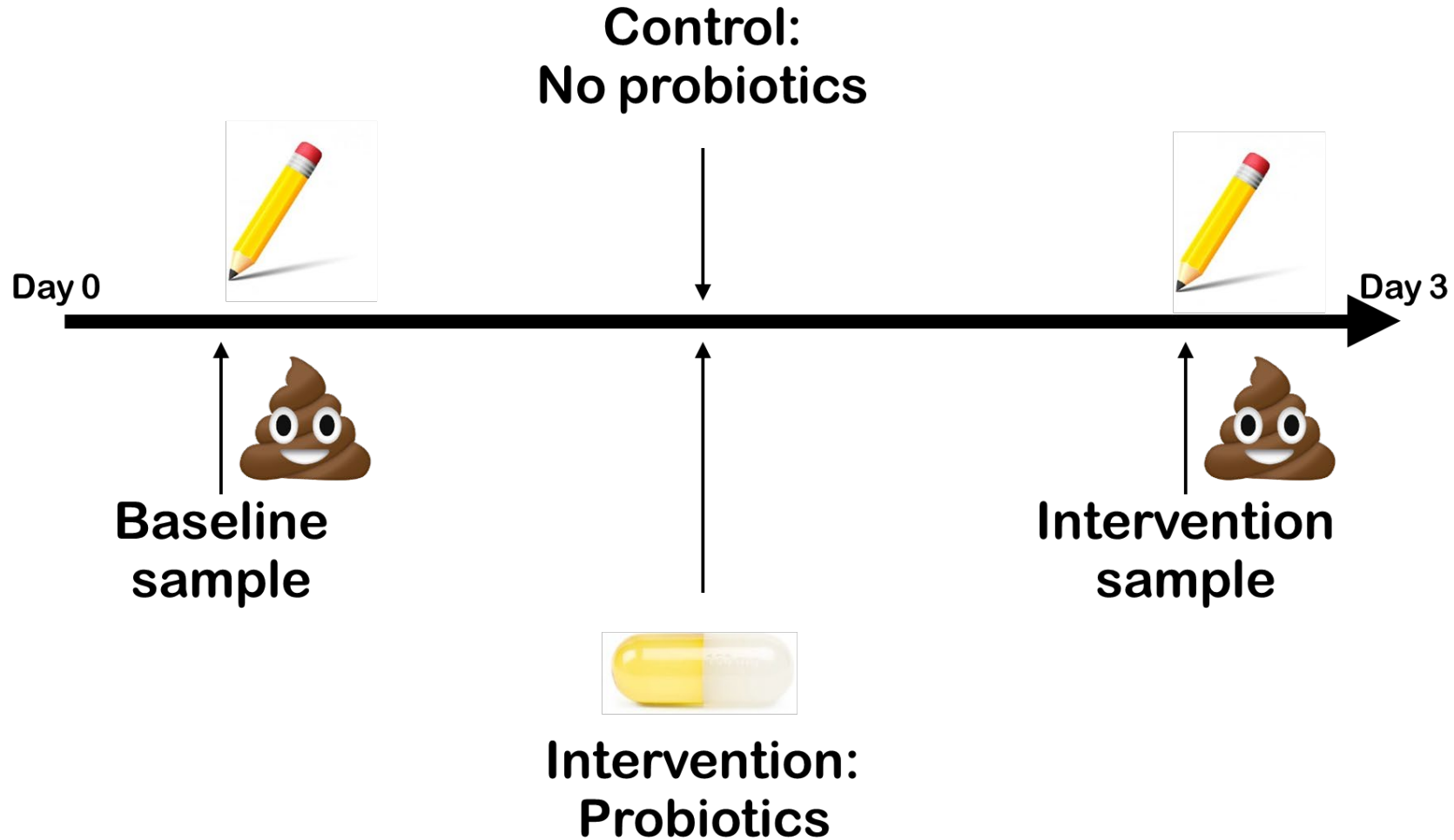
2015 Course study: Alcohol intervention



2016 Course study: Chili intake



2017 Course study: Probiotics



Metadata is Megaimportant

- Collect metadata for samples and intervention cohort participants

2019 Study design

- You are completely free to decide!
- You can do an intervention study on yourselves OR
- Sequence any metagenome that you would like BUT

MUST HAVE AN HYPOTHESIS THAT CAN BE TESTED

- A maximum of 40 samples can be sequenced

Exercise I for this afternoon

- Define study, literature search (e.g. Ibruegge et al.)
- Define hypothesis
- Prepare questionnaire questions, find inspiration at the uploaded spreadsheet (questionnaire from last 2017)

- Presentation:
 - Prepare ~2 slides with your intervention design (upload to Campus net as deliverable)