QMWS - Survival Analysis
Other considerations in survival analysis

Instructor: Kevin McGregor

York University
Department of Mathematics and Statistics

Other considerations

In this lecture, we will discuss some additional considerations in survival analysis.

In particular, there are certain biases that can arise when attempting to do survival analysis.

These biases can be minor, or the could completely change the outcome and conclusion of the study.

Non-informative censoring

In every kind of analysis we've done before, we were implicitly assuming **non-informative censoring**.

- Non-informative censoring means that the distribution of event times gives no information about the distribution of censoring times.
- E.g. **informative censoring** would happen when someone who is less likely to have an event is more likely to be censored.
  - This would be the case if more healthy individuals were more likely to stop showing up for their appointments.

Independent censoring

We've also implicitly assumed **independent censoring**.

- This means that the random variable for survival time T is **independent** of the random variable for censoring time C.

Biases

What about bias? Recall the definition of **bias**. Assume we have a parameter θ that we're interested in estimating, and that we do so using estimator $\widehat{\theta}$.

Bias is when we **systematically** over- or under-estimate θ.

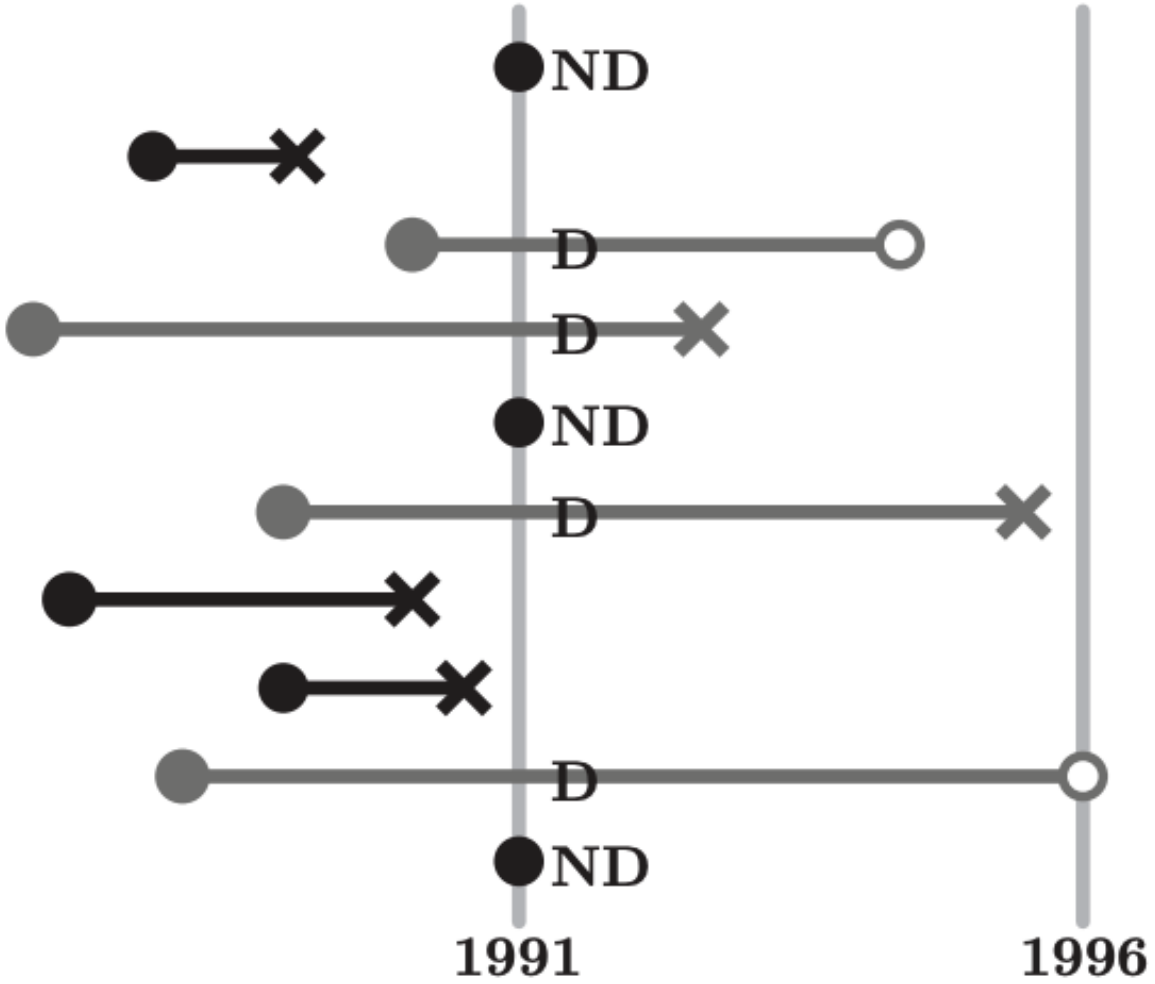
Dementia example

Bias example: Canadian Study of Health and Aging: Progression of Dementia Study.

- In 1991, around 10,000 Canadians 65 or older recruited.
- Each one was screened for dementia.
- 820 were diagnosed with current dementia.
- Study looked at time to death after diagnosis.

Problem: Anyone who was diagnosed **and** died prior to study recruitment in 1991 would not be included in the study.

Dementia example



Analysis of Biased Survival Data: The Canadian Study of Health and Aging and beyond. Asgharian, Wolfson, and Wolfson.

Lead-time bias

A specific type of bias is called **lead-time bias**.

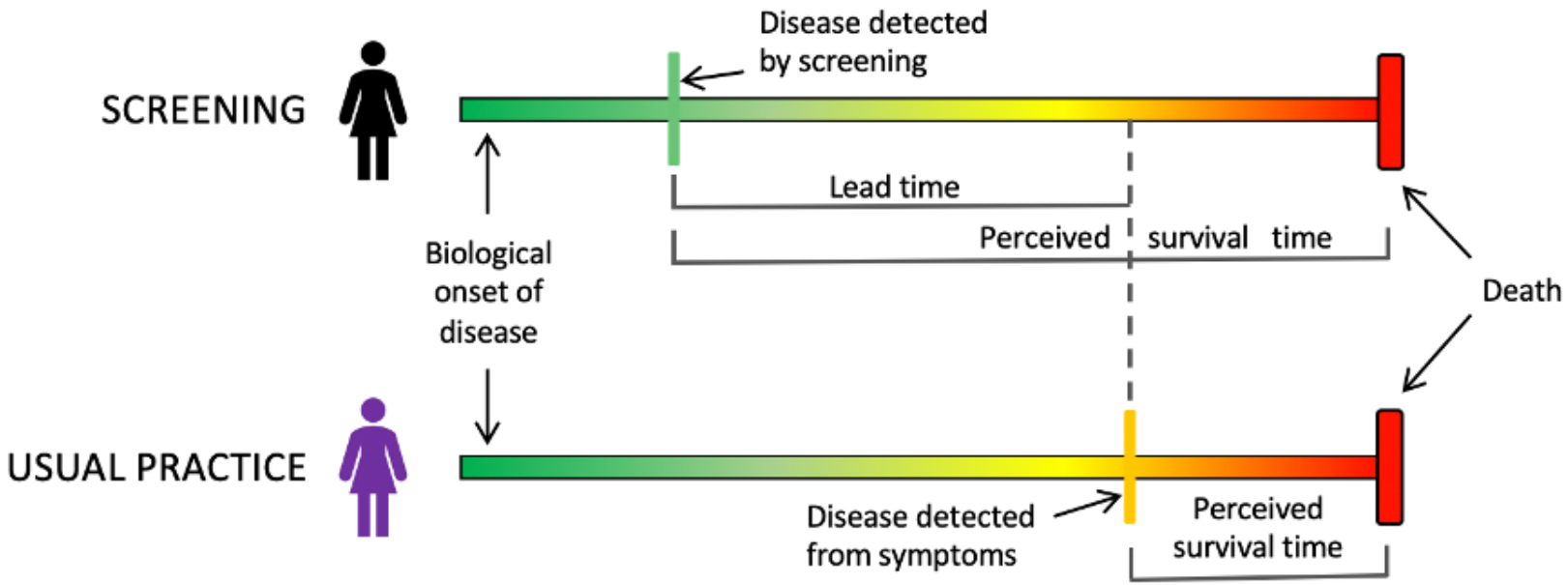
This occurs when we want to study survival of individuals of a particular disease.

- Ideally, we would set $t = 0$ as the time of disease onset.
- However, this is usually unobserved

In practice, we would have to **detect** the disease. This could happen one of two ways:

- Patient develops symptoms, gets diagnosed from a test.
- **Screening.** A doctor identifies a patient as high risk for a disease and does a test (even though no symptoms are present).
- With screening, we usually detect the disease earlier. Does this lead to better survival?

Lead-time bias



Catalogue of Bias Collaboration. Oke J, Fanshawe T, Nunan D. Lead time bias. In Catalogue of Bias. 2021.

Selection bias

A common type of bias is **selection bias**. In this kind of bias, the way participants are recruited or selected into a study might exaggerate or diminish the true effect of interest.

Example: Examining effect of hormone replacement therapy (HRT) on coronary heart disease (CHD) in women.

- Study showed HRT was effective in reducing incidence of CHD.
- Study was observational; **not** randomized!
- It turns out that women who took HRT were more health conscious and more healthy generally.
- Later randomized trials showed the effect was actually the **opposite**. HRT users were **more likely** to develop CHD.

Observer bias

Observer bias arises when there is natural variation in how an observer records measurements.

- In clinical studies, medical professionals take measurements using various tools that may be used imperfectly.
- Could be due to poor training.
- Clinicians could be impacted by what they think the measurement **should be** based on the characteristics of the patient.

Example: Blood pressure measurement using mercury sphygmomanometers. Observers tend to round up or down.

Example: In medical imaging, one doctor might record an abnormality, another doctor might not.

Difficult to account for! Blinding is one possibility.

Recall bias

Recall bias occurs when a patient is asked to recall past events that might be relevant to the study.

- Ex: A patient with a particular disease might be very much aware of previous infections.
- Conversely, a healthier patient might not as easily be able to recall a previous infection (even if they did have one!).
- This could make it seem as if there is an association between past infections and the disease of interest.

Competing risks censoring bias

We previously talked about **competing risks**. In some studies, researchers might treat a subject having a competing event as being **right-censored**.

Problem: The competing risk might be **correlated** with the event of interest!

- This would violate **independent censoring**.

Immortal time bias

Huge kind of bias, and very common.

Immortal time bias occurs when there is a delay to when treatment starts. In order for an individual to be included in the treatment group, they cannot have died before the treatment start time. If they do die, then they would be part of the **untreated** group.