

How to be more creative in your PhD and beyond

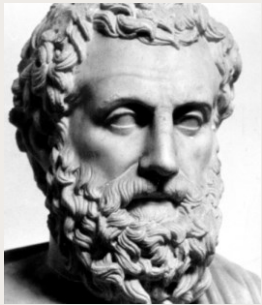
Carl Baravelli, PhD, PostDoc, FHI

Scientific Revolutions

*«Different Sciences undergo «**revolutions**» when scientists gather enough data that they can't explain using their current **paradigm**, or unstated, world-organising theory about how the universe works.»*

Thomas Kuhn

Paradigm shift - Thomas Kuhn



Aristotle

PARADIGM



Galileo & Newton



Normal science

Observe
abnormalities

CRISIS

Revolutionary science

Normal science



Paradigm shift - Thomas Kuhn



Galileo & Newton

PARADIGM

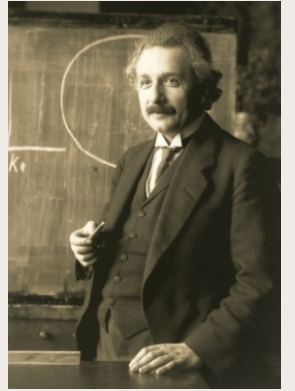
Observe
abnormalities

CRISIS



Normal science

Revolutionary science



Einstein

Normal science

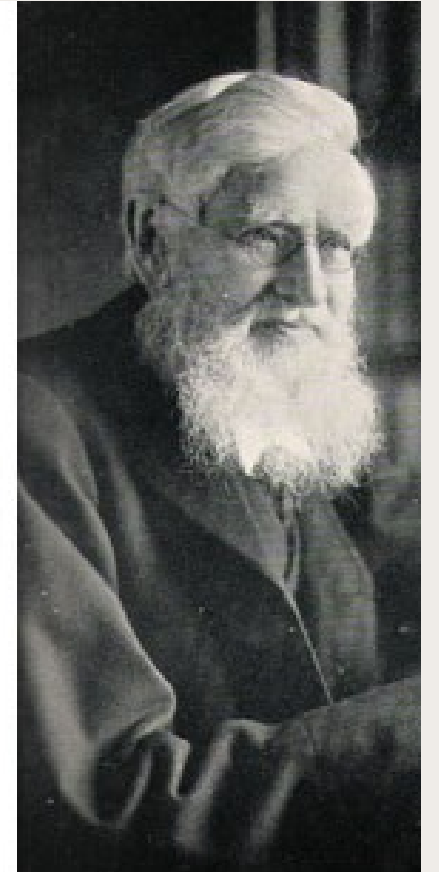
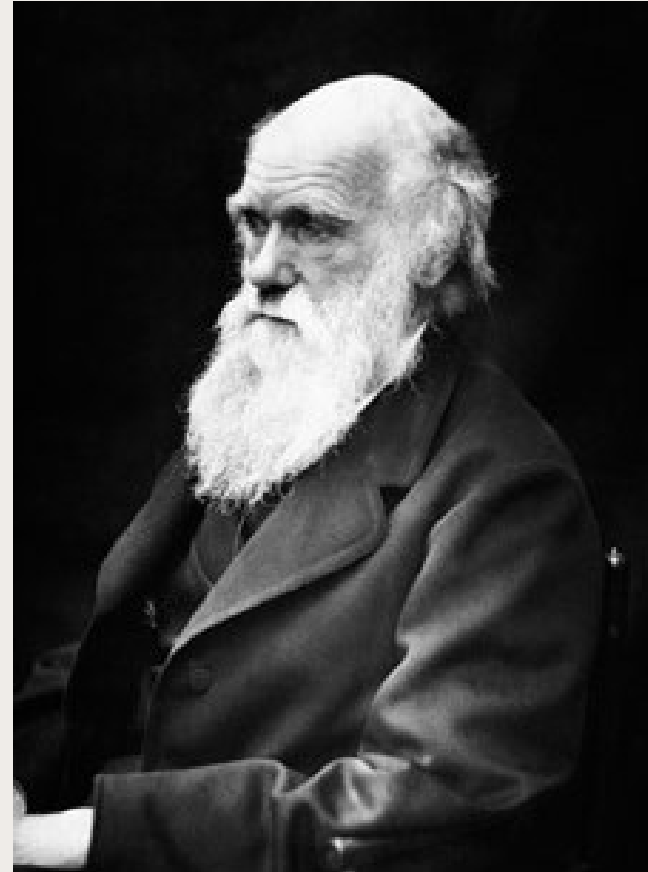
- Normal science (that's us)
- We work in a paradigm
- Worst, we work for people who work in a paradigm
- How is it that we will contribute original knowledge?
- How can we be creative in our PhD?

Criticisms of The Structure of Scientific Revolutions

- Revisions in science take place much more frequently, and are much less dramatic than can be explained by the model of revolution/normal science
- Scientific revolutions that completely shift the paradigm like Einstein's theory of relativity from Newtonian physics are built on years and years of assertions made before them

The concept of natural selection

- Natural historians in the 16th and 17th centuries:
- Genus (general category) and species (specific characterisation)
- Species changed over time
- Species became extinct
- The world predated the time of human history
- Alfred Russel Wallace



YOU MATTER

Unless you multiply yourself by the speed of light squared
...then YOU ENERGY

- Your ideas matter. You do not have to be Einstein or John Snow to make an important contribution to the area of knowledge of public health or epidemiology

What is meant by creativity in research?

- Definition: “Creativity as the production of ideas, solutions, or products that are novel and appropriate in a given situation”
 - Finding innovative ways of solving problems
 - Making novel associations between existing ideas
- Creativity is the heart of research:
 - Identifying new problems worth solving
 - Explaining unexplained phenomena
 - Solving problems that haven't been solved before
 - Developing new methods

So how can we be more creative as researchers?

“There is no such thing as a logical method of having new ideas or a logical reconstruction of this process”

Karl Popper

Method and design

- Which method can you use to answer your research question
 - Prospective cohort design
 - Matched-cohort design
- DAGs and counterfactual methods
- Taking courses in advanced methods
 - Cox regression
 - Poisson regression
 - Zero-inflated negative binomial regression
 - Competing risks regression
 - Random effects regression models for panel data

Statistical Programming

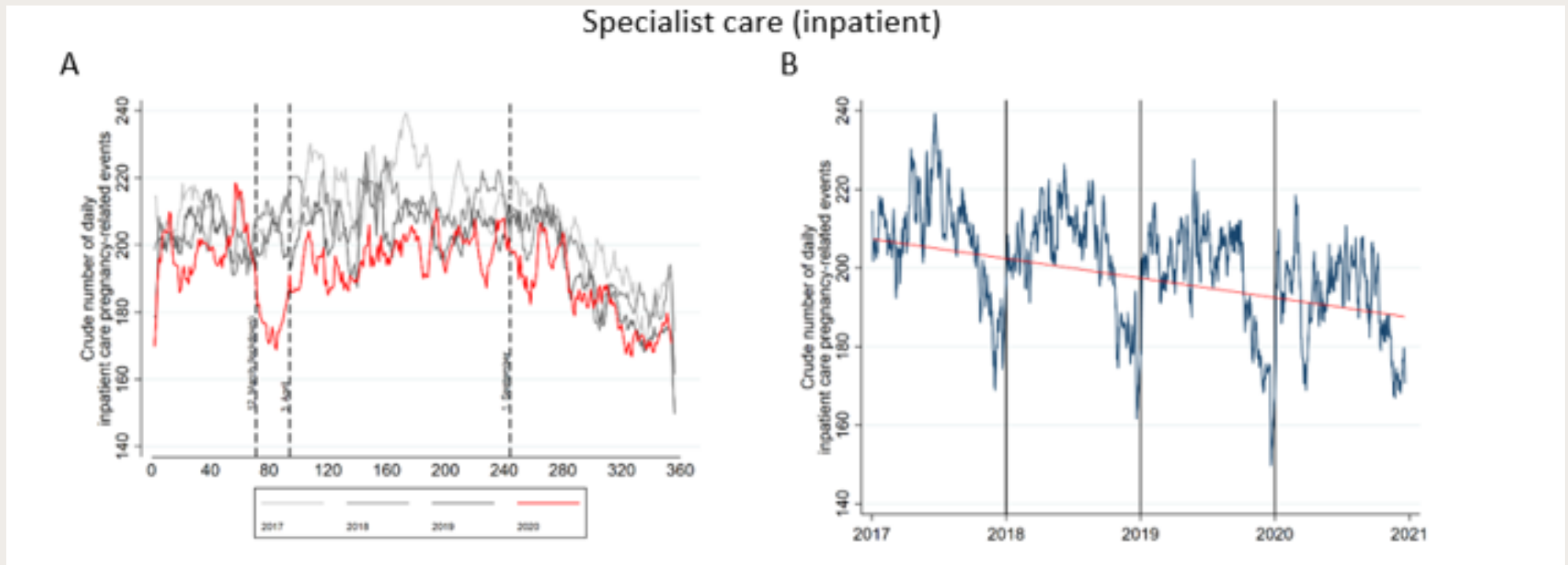
- Data management
- Working with big data
- Simulating your problem in a simplified fake dataset

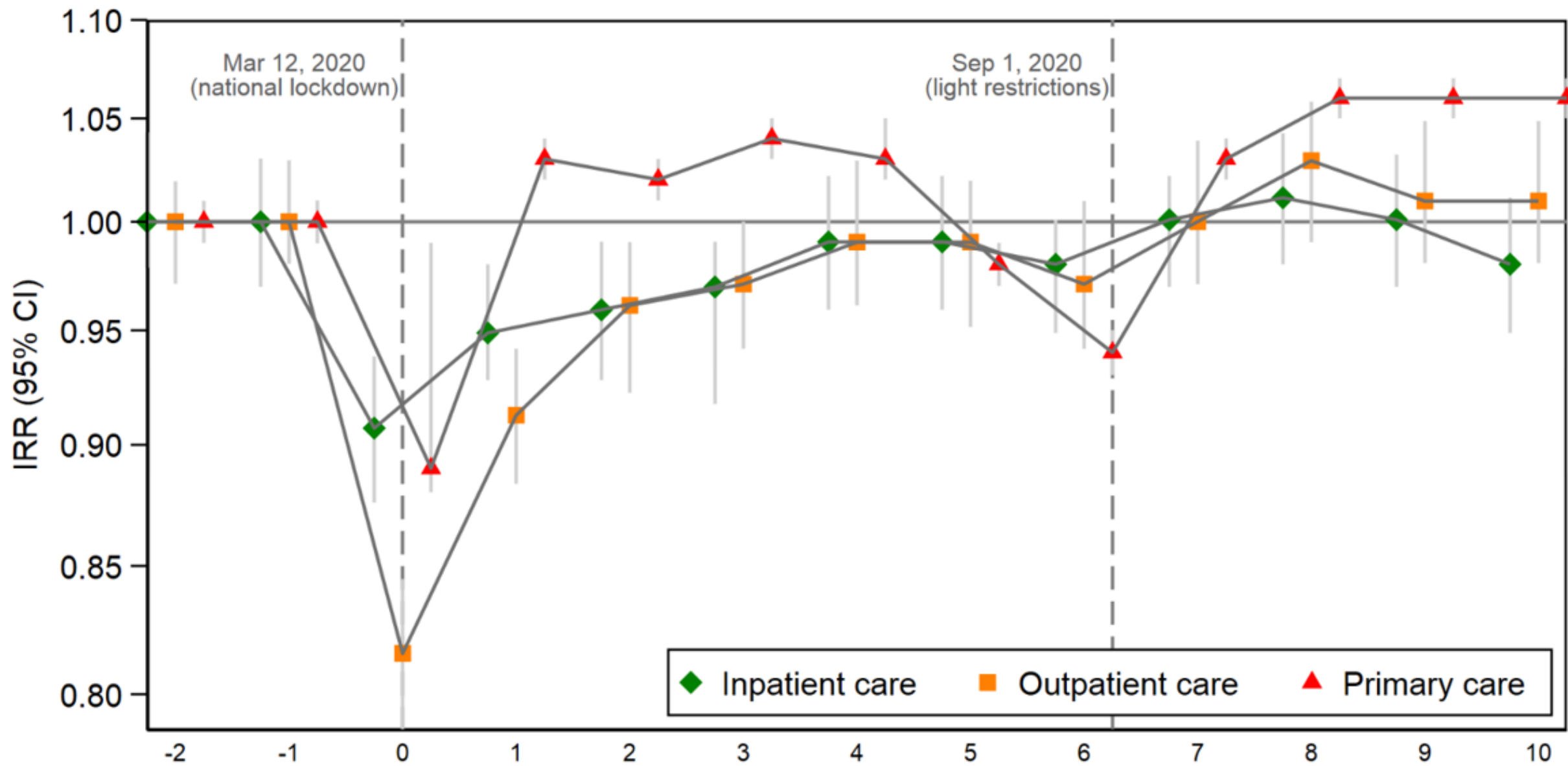
Sensitivity analysis

- How are your estimates affected by what ifs
 - Exposure and the outcome were infrequent
 - Including all known persons with the exposure in the denominator while specifying no new cases of the outcome in those who were exposed

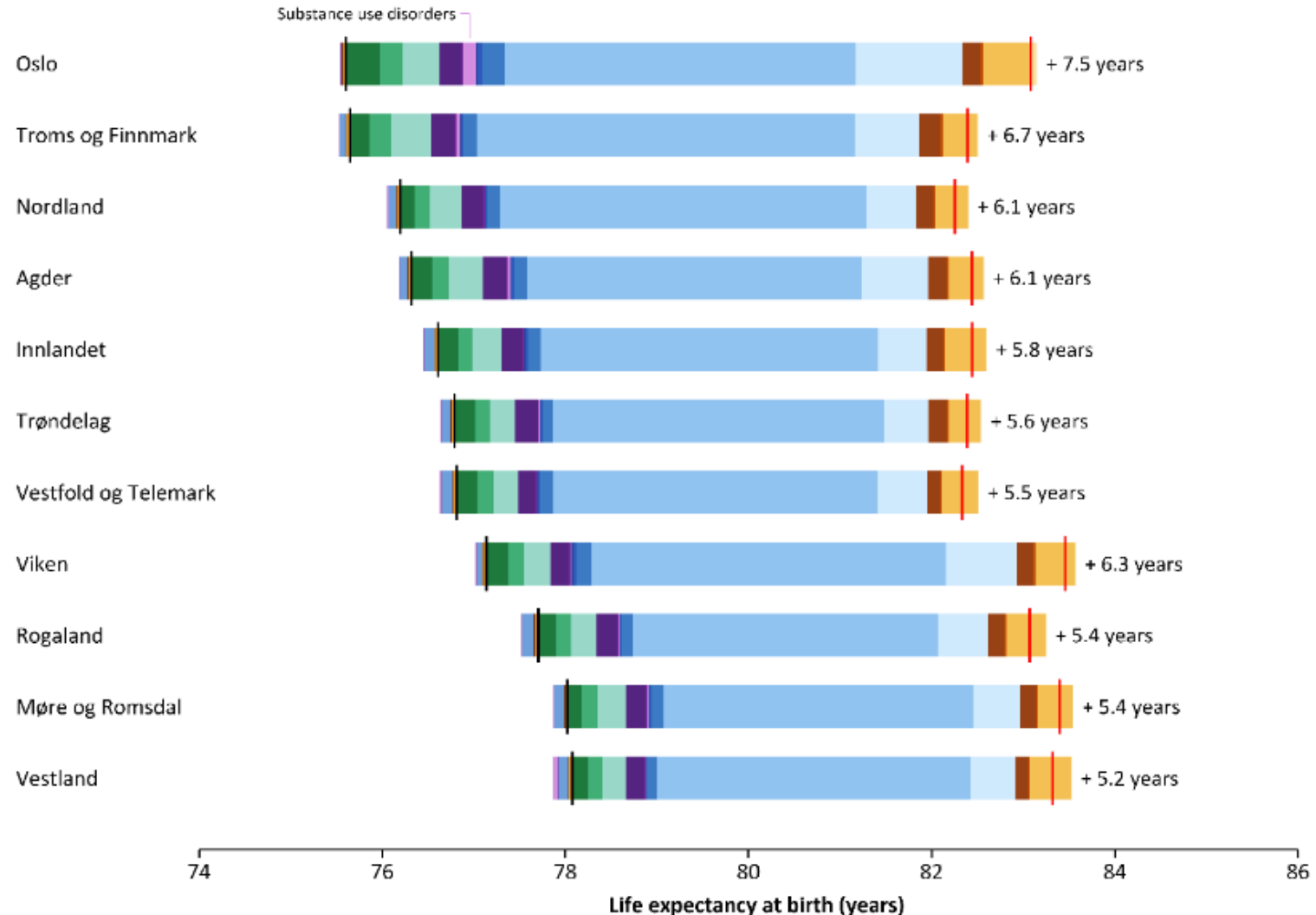
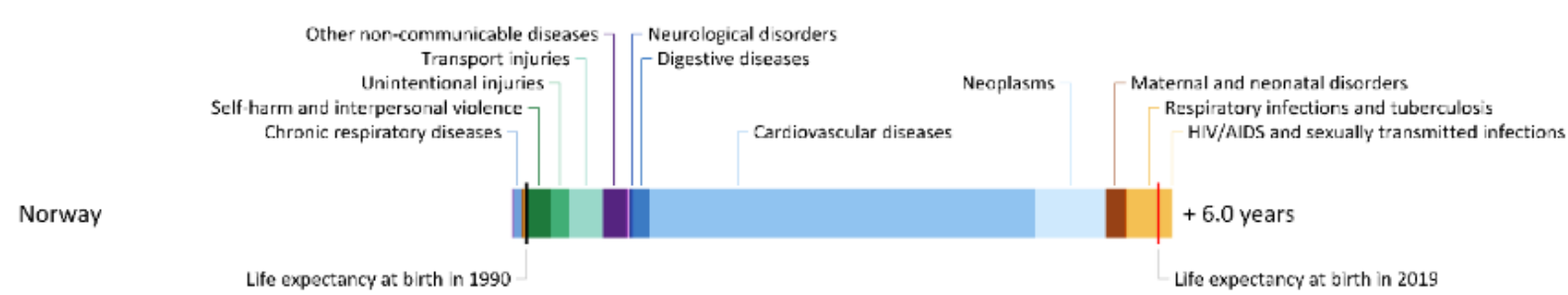
Tables and graphs

- A picture tells a thousand stories
- Don't be limited. Use colours





Specialist care (inpatient)					
Groups	Time period	Daily IR events per 100,000 (2020/ 2017-19)	Crude IRR (95% CI)	Adjusted for confounding IRR (95% CI)	Adjusted for confounding and calibrated to 1.0 at time 1 IRR (95% CI)
Overall	Time 1	15.06/15.29	0.93 (0.90, 0.96)	0.91 (0.88, 0.93)	1.00 (reference)
	Time 2	14.10/16.26	0.82 (0.79, 0.86)	0.81 (0.77, 0.84)	0.89 (0.85, 0.92)
	Time 3	14.60/15.67	0.90 (0.88, 0.92)	0.89 (0.87, 0.90)	0.98 (0.96, 0.99)
	Time 4	13.42/14.25	0.91 (0.89, 0.93)	0.90 (0.88, 0.92)	0.99 (0.97, 1.01)
Age groups					
15-25	Time 1	8.28/10.12	0.82 (0.77, 0.87)	0.79 (0.74, 0.83)	1.00 (reference)
	Time 2	7.54/10.14	0.74 (0.68, 0.82)	0.72 (0.65, 0.79)	0.91 (0.82, 1.00)
	Time 3	7.20/9.48	0.76 (0.73, 0.79)	0.73 (0.70, 0.76)	0.92 (0.89, 0.96)
	Time 4	6.95/8.76	0.79 (0.76, 0.83)	0.76 (0.73, 0.80)	0.96 (0.92, 1.01)
26-35	Time 1	35.78/35.37	1.01 (0.99, 1.04)	1.00 (0.97, 1.02)	1.00 (reference)
	Time 2	34.38/38.53	0.89 (0.85, 0.93)	0.88 (0.84, 0.92)	0.88 (0.84, 0.92)
	Time 3	34.88/36.76	0.95 (0.93, 0.96)	0.94 (0.92, 0.95)	0.94 (0.92, 0.95)
	Time 4	31.86/32.99	0.97 (0.94, 0.99)	0.95 (0.93, 0.97)	0.95 (0.93, 0.97)
36-50	Time 1	6.07/5.69	1.07 (1.01, 1.13)	1.05 (1.00, 1.11)	1.00 (reference)
	Time 2	5.44/6.04	0.90 (0.82, 0.98)	0.90 (0.82, 0.99)	0.86 (0.78, 0.94)
	Time 3	5.98/5.73	1.04 (1.01, 1.08)	1.03 (0.99, 1.07)	0.98 (0.94, 1.02)
	Time 4	5.56/5.57	1.00 (0.96, 1.04)	0.96 (0.94, 0.98)	0.91 (0.90, 0.93)
Country/region of birth					
Norway	Time 1	15.36/15.71	0.98 (0.95, 1.00)	0.98 (0.96, 1.01)	1.00 (reference)
	Time 2	14.89/16.68	0.89 (0.86, 0.93)	0.89 (0.85, 0.93)	0.91 (0.87, 0.95)
	Time 3	15.27/16.11	0.95 (0.93, 0.96)	0.95 (0.94, 0.97)	0.97 (0.96, 0.99)
	Time 4	13.74/14.32	0.96 (0.94, 0.98)	0.96 (0.94, 0.98)	0.98 (0.96, 1.00)
EU/EEA, USA, Canada, Australia, NZ	Time 1	10.78/10.97	0.98 (0.92, 1.05)	0.93 (0.87, 1.00)	1.00 (reference)
	Time 2	9.52/11.61	0.82 (0.73, 0.92)	0.78 (0.69, 0.88)	0.84 (0.74, 0.95)
	Time 3	10.11/11.30	0.89 (0.86, 0.93)	0.86 (0.82, 0.89)	0.92 (0.88, 0.96)
	Time 4	9.69/10.55	0.92 (0.86, 0.97)	0.85 (0.80, 0.90)	0.91 (0.86, 0.97)
Asia, Africa, Latin America	Time 1	18.80/18.52	1.01 (0.96, 1.07)	0.93 (0.87, 0.98)	1.00 (reference)
	Time 2	16.04/19.83	0.81 (0.74, 0.88)	0.75 (0.68, 0.81)	0.81 (0.73, 0.87)
	Time 3	16.90/18.89	0.89 (0.86, 0.93)	0.82 (0.79, 0.85)	0.88 (0.85, 0.91)
	Time 4	16.49/18.33	0.90 (0.86, 0.94)	0.82 (0.79, 0.86)	0.88 (0.85, 0.92)



Discussion

- Here is your opportunity to shine (take the assumptions you presented in your introduction and speak about this in light of your findings)
- What are the wider implications and clinical implications
- Interpretation
- Here we need to switch our brain back to the creative mode (why often people find it hard to write the discussion)

Generating new hypotheses

- Here is where the 'true' creativity happens in research
- You usually have to be familiar with the field (difficult for PhD candidates in epidemiology)
- But too much expertise and you are constrained
- We are in truth usually just handed our project from our supervisor

- But maybe you are lucky and are invited onto a project with big data but no specified research topic
- Or you have freedom to look into new things following your first or second paper
- Starting a Postdoc position following your PhD

Take the risk of trying to think innovatively

- Original research is tough, often it is easier just to travel the path of least resistance
- Narcissism of small differences, by which multiple authors seek to differentiate their work
- To 're-see' will just produce more of the same

Be less critical of your own ideas

- Falsification
- Ideas need space to flourish
- Possibly correct
- Might be wrong, but worth keeping
- Likely wrong, but interesting

Look harder

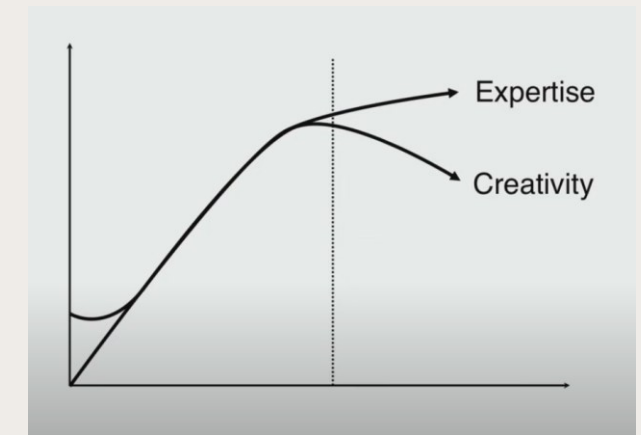
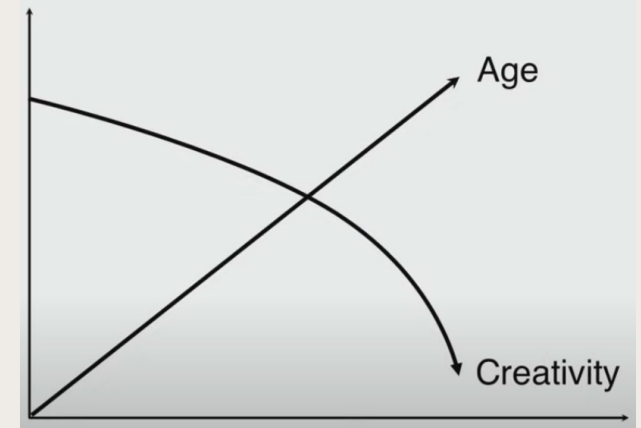
- Be alert for anomalies and paradoxes, things that are accepted but perhaps should not be
- Finding a good idea in another field and then working out how to transpose it to your own
- Work with people from different fields

Look widely

- Journals are 3 to 4 years old
- Academic blogs
- Social media: Google alerts, Research Gate
- Look beyond your discipline

You are (sometimes) the most creative person in the room

- With age people become less creative
- With expertise people become less creative
 - Caught in the paradigm of rules in the area of expertise
- You think about the problems differently and in a unique way
- You also bring with you the skills from others areas



Epidemiology and Covid

- Epidemiology was supercharged under the pandemic
- Academic concepts like herd immunity became social discourse
- Needed answers fast to important questions
 - Infection rates, mortality rates, age groups, effect to health care utilisation, effects on mental health due to job loss or lock downt...
- Natural experiment
- Need good data capturing systems at the national level (registry data)
- Emergency Preparedness Register (Beredt C19)