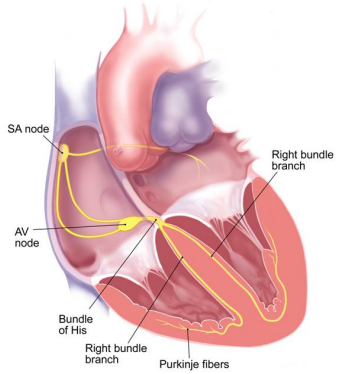
Quantified Self
self knowledge through numbers

What causes my heart rhythm disorders?



Mark Drangsholt, D.D.S. Ph.D.
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University of Washington
Department of Oral Medicine
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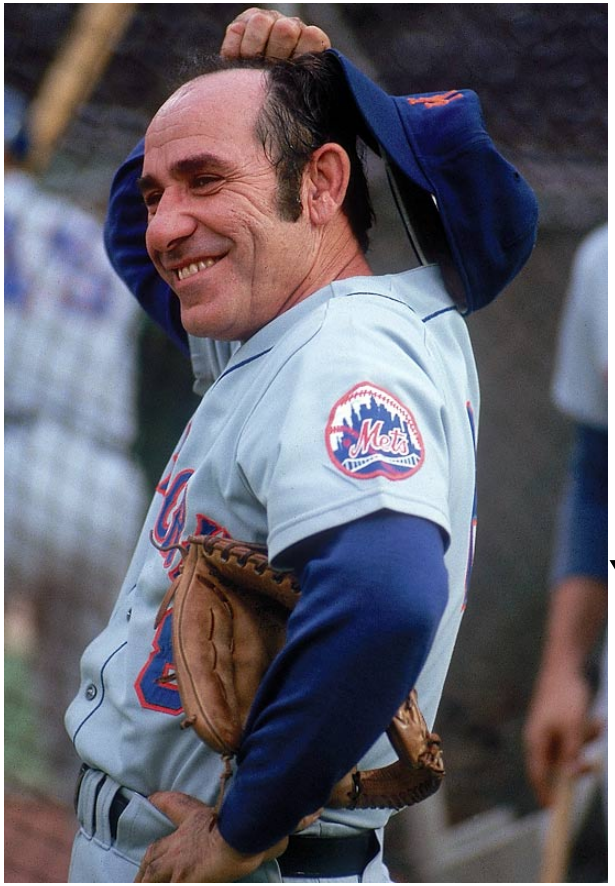
"You can observe a lot by just watching"



Yogi Berra

Some of my self-tracking over past 12 years

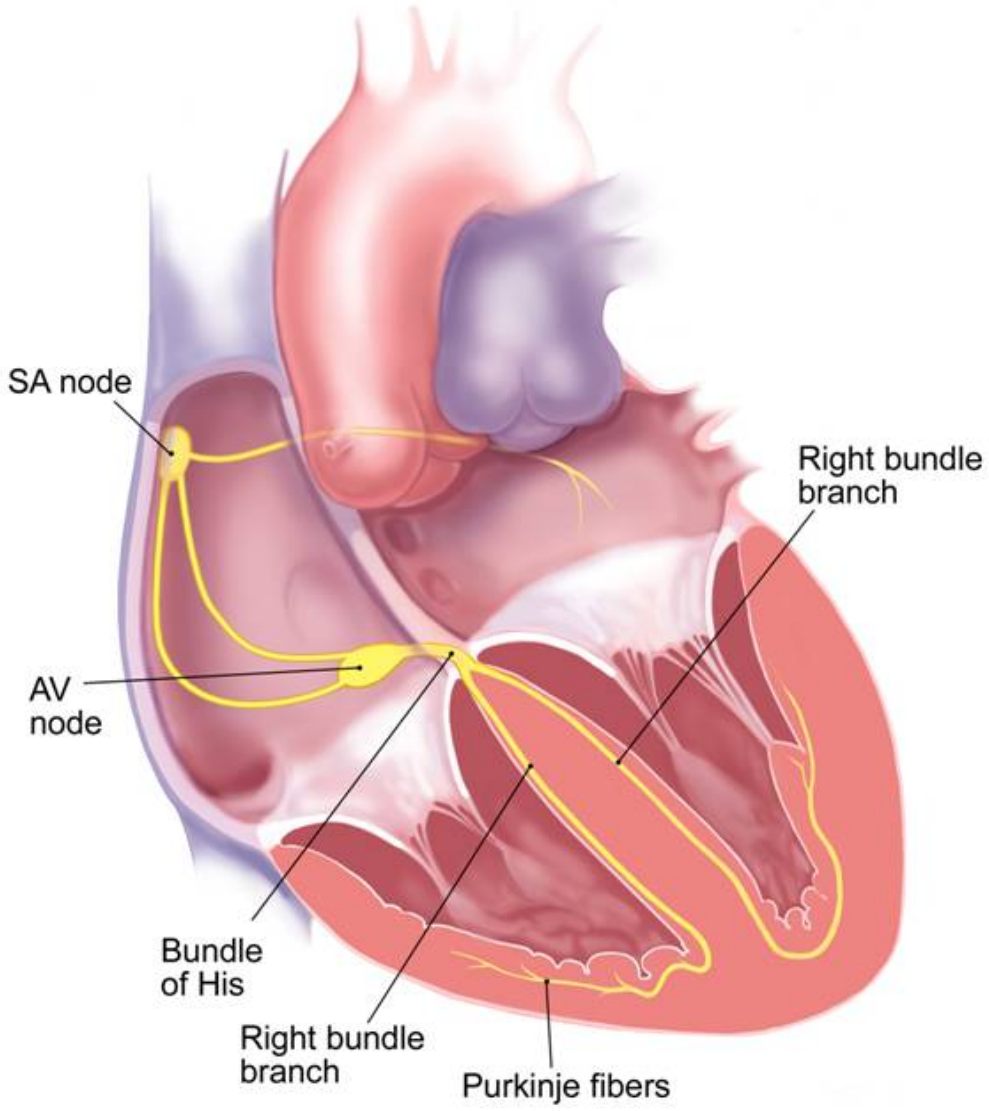
- Blood pressure vs. weight loss, exercise, medications
- Atrial fibrillation (cardiac rhythm disorder) vs. plausible transient daily triggers
- Deep sleep (ZEO) vs. aerobic exercise, caffeine, sex, other
- MyFitnessPal dietary tracking, exercise vs. body weight/percent body fat (Tanita).

Self-tracking over past 12 years

- Blood pressure vs. weight loss, exercise, medications
- Atrial fibrillation (cardiac rhythm disorder) vs. plausible transient daily triggers
- Deep sleep (ZEO) vs. aerobic exercise, caffeine, sex, other
- MyFitnessPal dietary tracking, exercise vs. body weight/percent body fat (Tanita).

Some Tachycardias (Heart Rate>100 beats per minute)

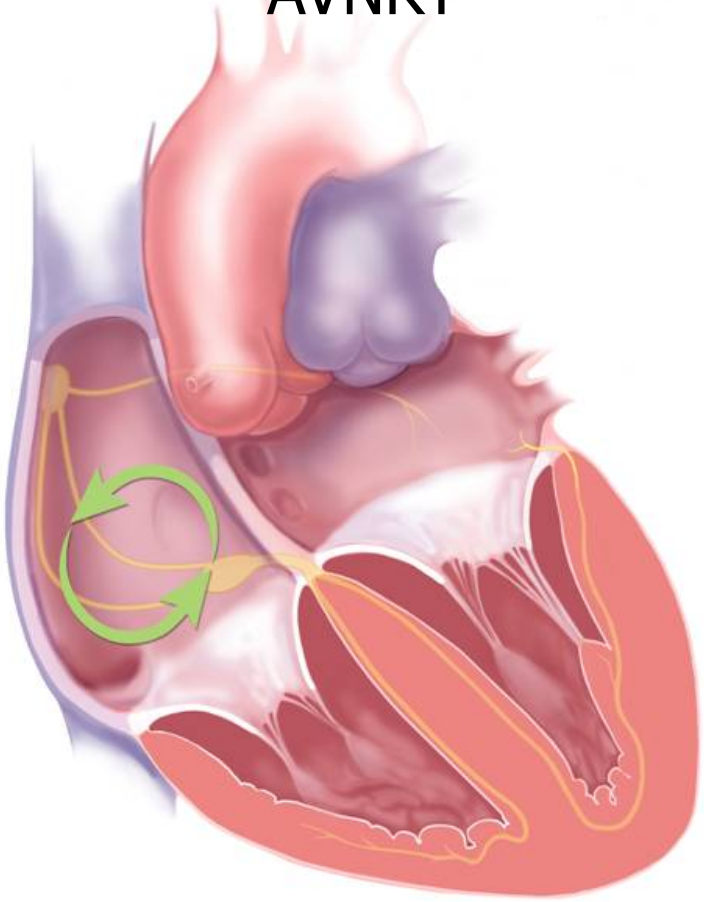
- Parosxymsal SupraVentricular Tachycardia (PSVT)- AV node Reentry (benign)
- PSVT AV Reentry (benign)
- Atrial flutter (relatively benign)
- Atrial fibrillation (stroke, heart failure)
- Wolff-Parkinson-White syndrome (sudden cardiac death)

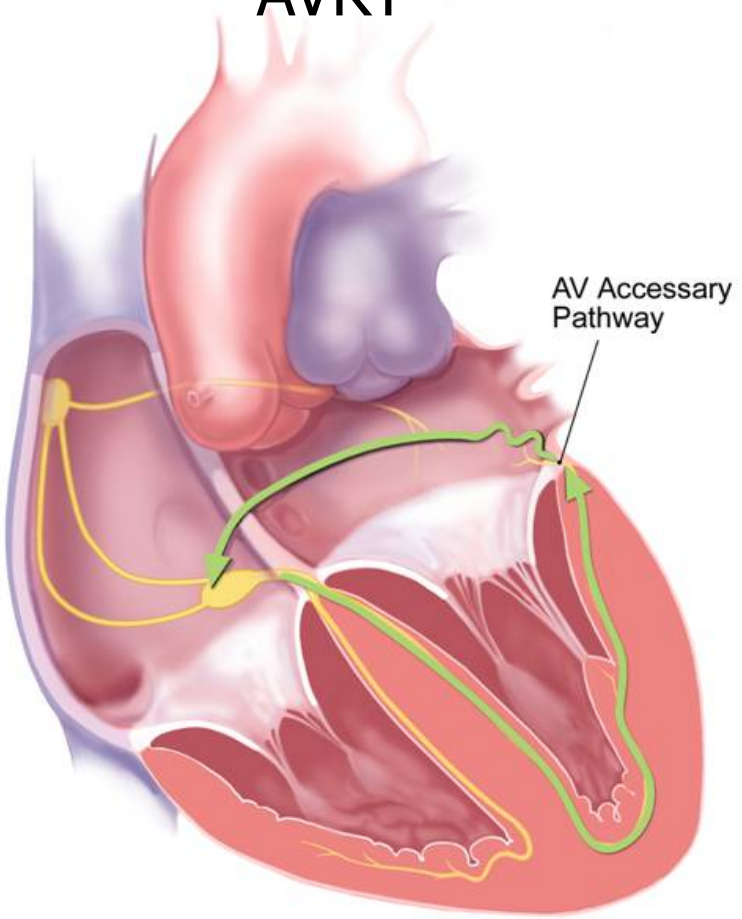


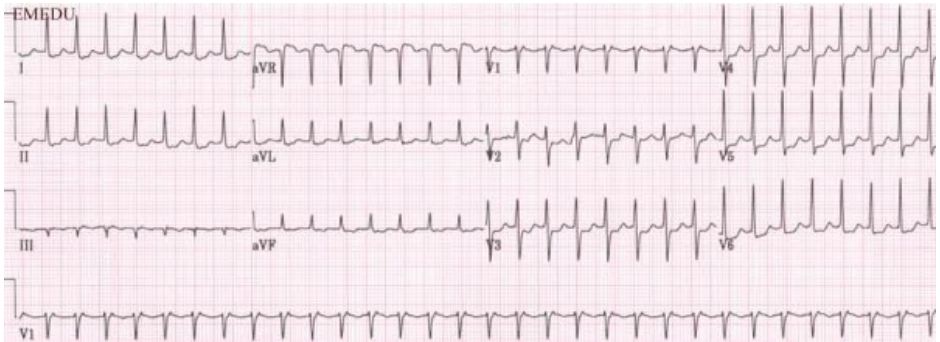
Normal electrical conduction through heart

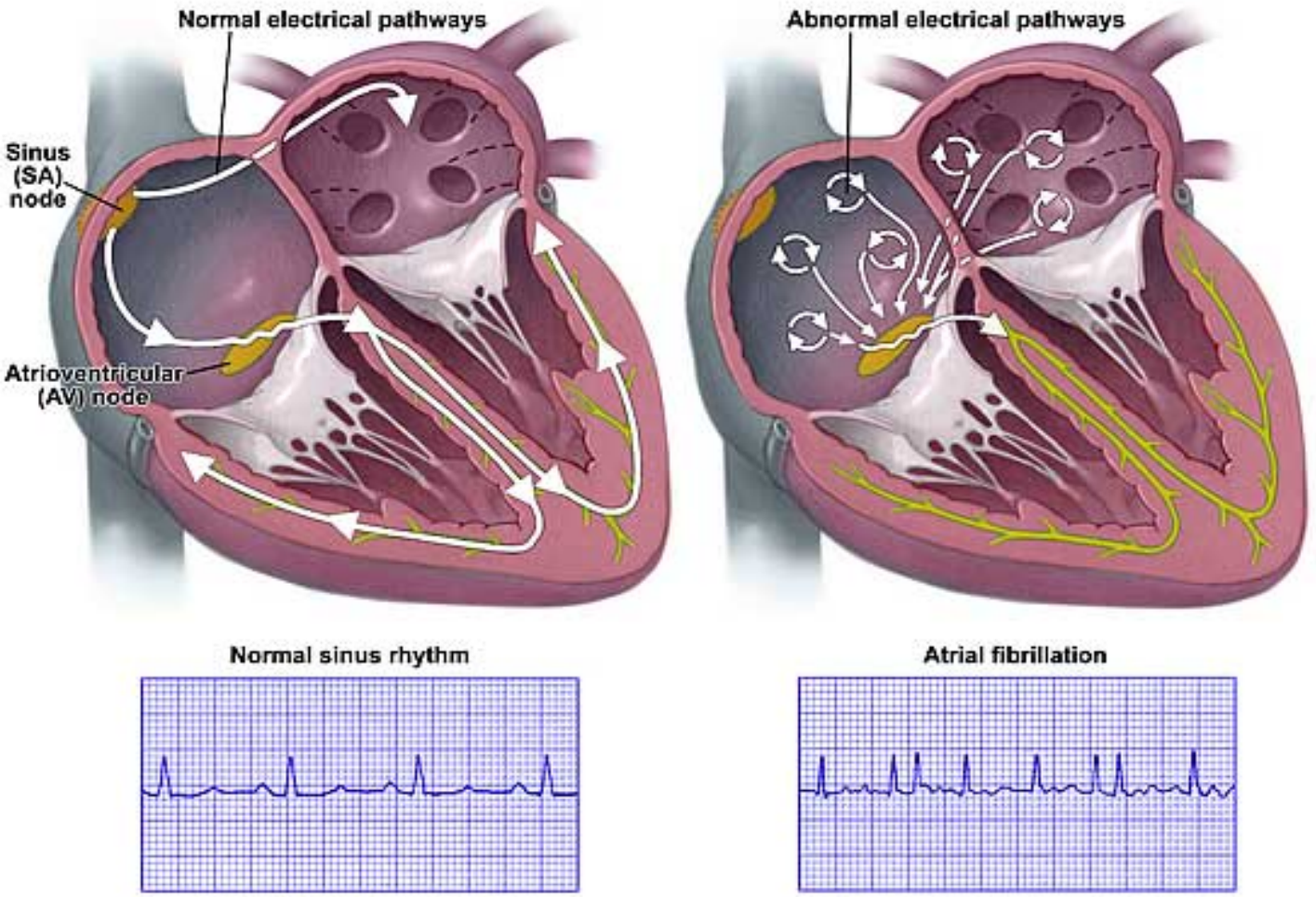
AVNRT

AVRT

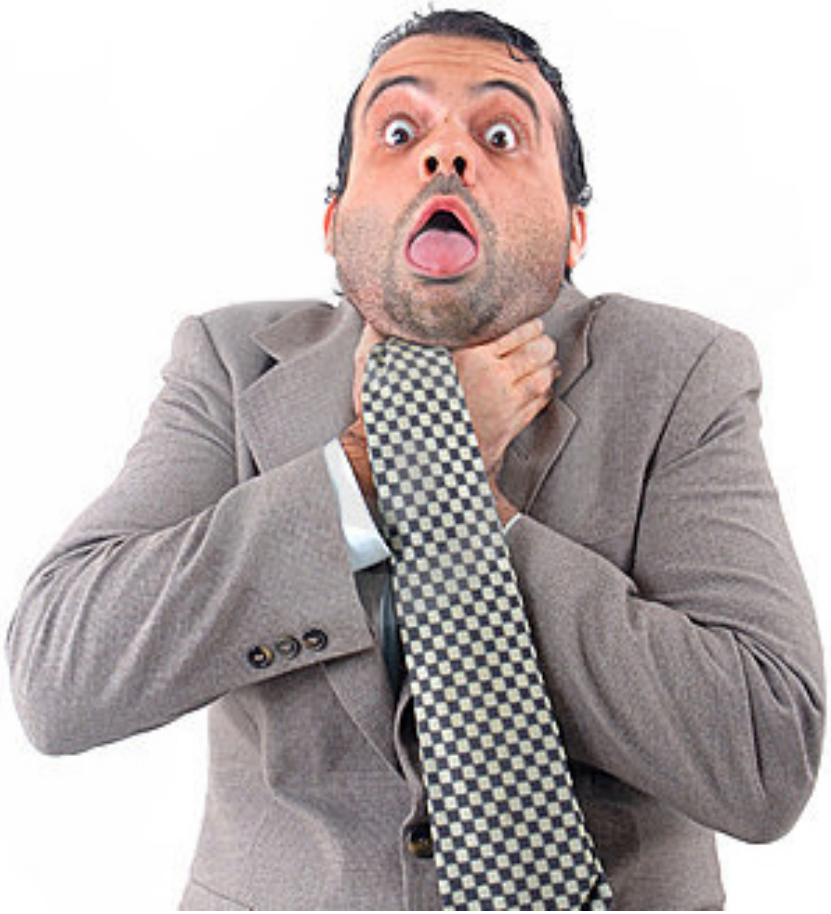



AV Accessary
Pathway


EMEDU
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1


Normal electrical pathways
Sinus (SA) node
Atrioventricular (AV) node
Abnormal electrical pathways
Normal sinus rhythm
Atrial fibrillation

Can I s, and
then a ecrease
these
dange



Created simple Excel table of all episodes for one year

Date	Time	Length	Where	Self dx	Onset	Offset	sympt oms

Est. Heart rate	Recorded with HRM?	Possible Triggers	comments				

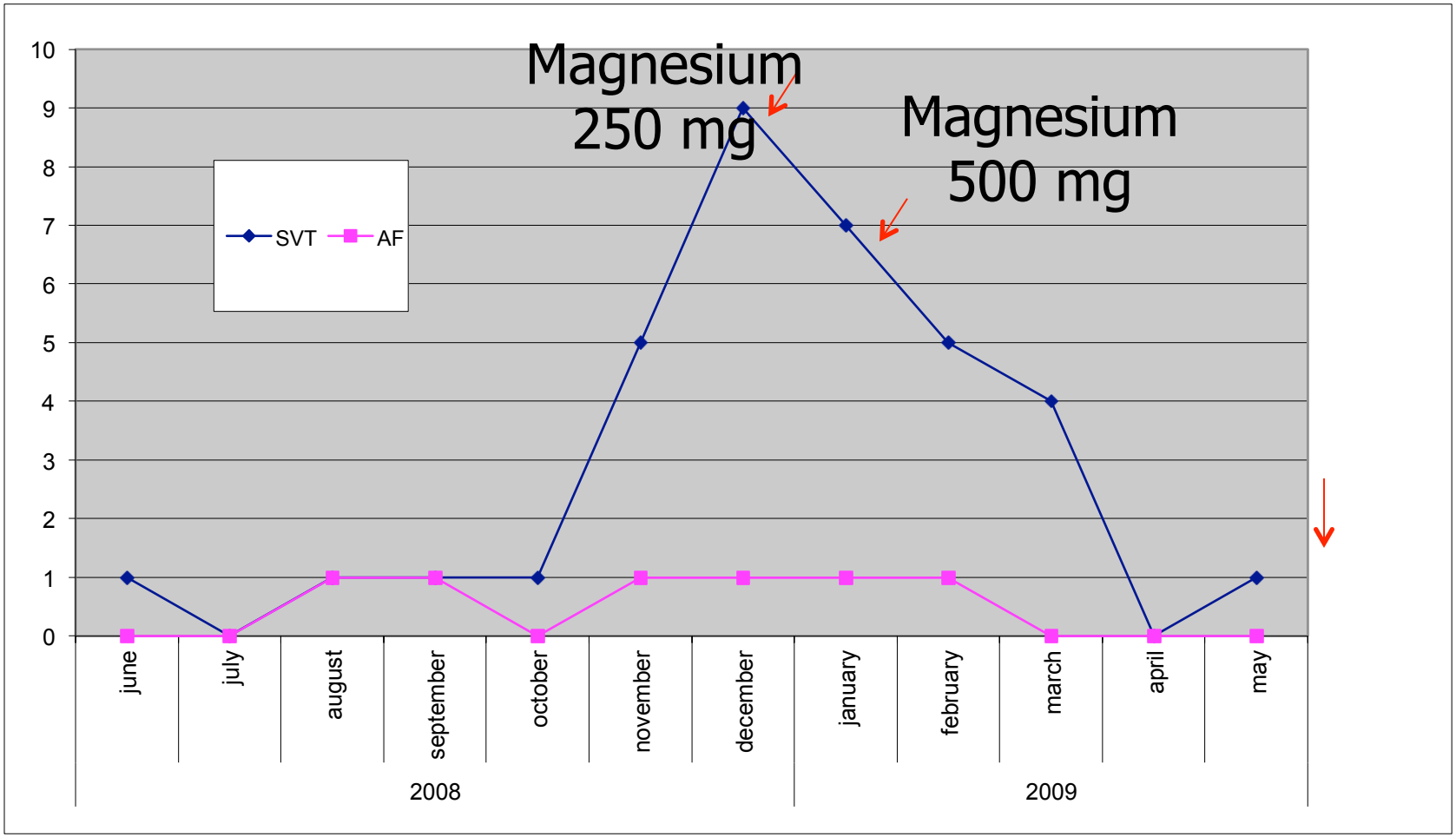
First, what type of arrhythmia?

- Used description of symptoms and signs to categorize as AF or PSVT
  - Choking feeling, irregular heart beat, impending doom, lightheaded - prodrome
  - Very rapid and regular heart beat, sometimes lightheaded

Attempted treatment trial

- Magnesium supplement 250 mg per day

Episodes per month



Conclusion from trial

- 7 to 8 fold decrease in SVT
- No decrease in AF
- Other factors at play
  - Seasonality
  - Decreased exercise level
  - Compare to previous year?
  - No control

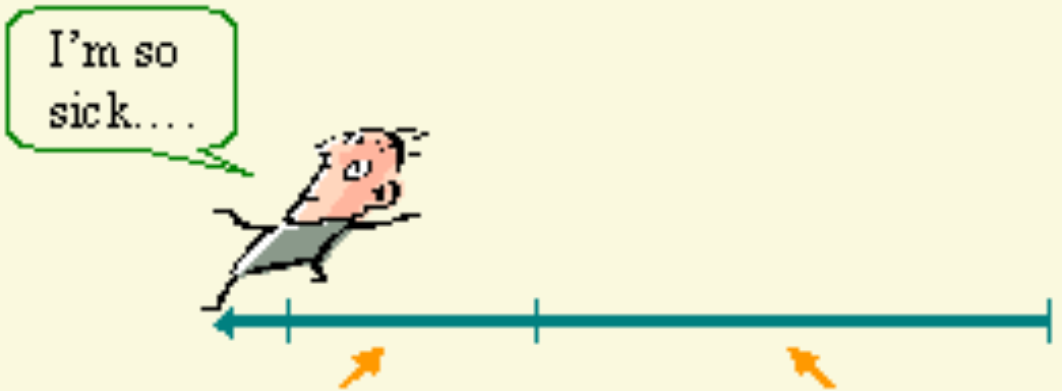
"The first principle is that you must not fool yourself, and you are the easiest person to fool"

Richard Feynman, PhD

What about the triggers?
Can they be described?
Can they be quantified?

Case-Crossover Design is a scientific way to ask and answer the question that "Was the patient doing anything unusual just before the onset of the disease?"

To answer this question, we need to do the comparison within the individual.



Did I do anything unusual right before the illness

in comparison to my usual routine?

It is a design that compares the exposure to certain agent during the interval when the event does not occur (control period), to the exposure during the interval when the event occurs (hazard period).

Control Data

The control data can be

(1). exposure information from a comparable time period; or

(2). exposure information in the past according to the individual's usual frequency of exposure.

Analysis

If the control data were from the past exposure …..

Step 1. Calculate the concurrence observed odds (a:b).

Odds that the exposure was during the hazard period right before the onset of disease.

(1:0) if there was exposure in hazard period.
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Analysis

If the control data were from a comparable control period .....

We will use the same method for a standard matched case-control study. But instead of case and control, we will have Hazard period and Control period.

Hazard Period	Control Period: Exposed	Control Period: Unexposed
Exposed	a	b
Unexposed	c	d

→ OR = b/c

SVT risk factors:

- Common events preceding attacks in the previous 1 hour:
  - High intensity exercise OR ~ 4.0
  - Afternoon caffeine OR ~ 3.0
  - Public speaking large groups OR ~ 3.0
- Common events in the previous 12 hours:
  - Inadequate sleep OR ~ 3.0

Atrial fibrillation risk factors

- Common events preceding attacks in the previous 2 hours:
  - Caffeine at any time
  - Air flight stress
  - >1 glass of wine
  - Public speaking large groups
- Common events preceding attacks in the previous 12+ hours:
  - Inadequate sleep

Take home message from tracking

- I used this information to minimize precipitants, and decreased the number of both types of episodes
- The additional information aided my cardiologists to make better decisions about which type of procedure to cure which rhythm problem

Where do self-tracking studies go in science, the levels of evidence?

The Evidence Pyramid: Types of Research Studies

Levels of Evidence: Treatment

Less bias

More bias

1 - 1 or more randomized controlled trials

2 - 1 or more cohort studies

3 - 1 or more case-control studies

4 - 1 or more case-series

5 - expert opinion without above evidence

Bias = systematic error

The Evidence Pyramid: Types of Studies

Levels of Evidence: Groups of people

Less bias

More bias

1 - 1 or more randomized controlled trials

2 - 1 or more cohort studies

3 - 1 or more case-control studies

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Bias = systematic error

What type of study design is this information?

What is the scientific level of evidence?

Levels of Evidence: Within one person

Less bias

More bias

1 - 1 or more randomized controlled trials – "n of 1" trial

2 - 1 or more cohort studies -

3 - 1 or more case-crossover studies

4 - 1 or more case-series -

5 - informed opinion without above evidence

Bias = systematic error

Summary

- Self tracking can aid in the identification of precipitating factors in a potentially life-threatening heart condition.
- Single subject designs as used by QS proponents deserve further study, validation and publication
- Single subject designs have their place in science and evidence-based medicine and

Thank you for your kind attention!

Mark Drangsholt
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Extra slides

AVRT risk factors

- Obesity
- Alcohol consumption
- Electrolyte imbalance
- Males
- Older than 40

Atrial flutter risk factors

- Obesity
- Alcohol consumption
- Electrolyte imbalance
- Males
- Older than 40

Known Atrial Fib risk factors

- Coronary heart disease
- Valve disease
- Inflamed heart muscle or lining
- Diabetes
- High blood pressure

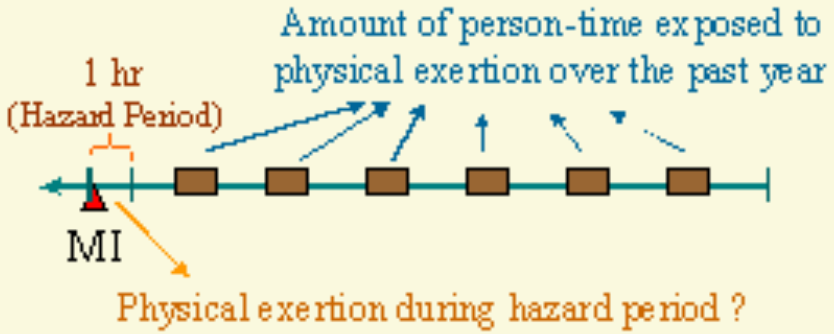
AF risk factors in healthy people…

- Stressed or fatigued
- Too much caffeine or alcohol
- High intensity exercise
- Too little magnesium, potassium
- “big meal”

Example MI and physical exertion

Control data 2:

The usual frequency of heavy physical exertion over the past year.



Case Crossover Design

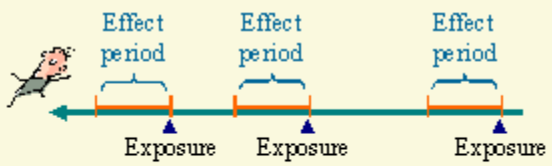
- It is related to prospective crossover design.
- It is a matched case-control study but involves cases only and each individual serves as his/her own control.
- The data from a case crossover design can also resemble cohort data if the control data are units of person-time.

Effect Period of the Exposure

"… the period of altered risk in a population, to be the difference between the minimum delay before impact and the maximum carry-over time."

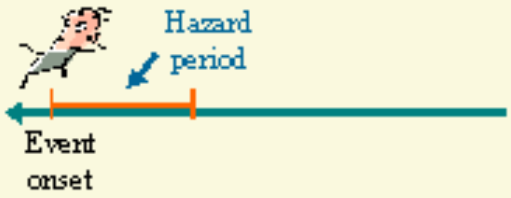
By Maclure M (AJE 1991;133:144-53)

Effect Period of the Exposure



Hazard Period

The period of time right before the onset of the event. Usually the length of hazard period is the same as the length of the exposure effect period.



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(2). exposure information in the past according to the individual's usual frequency of exposure.

Example

Triggering of MI by physical exertion

(NEJM 1993;329:1677-83)

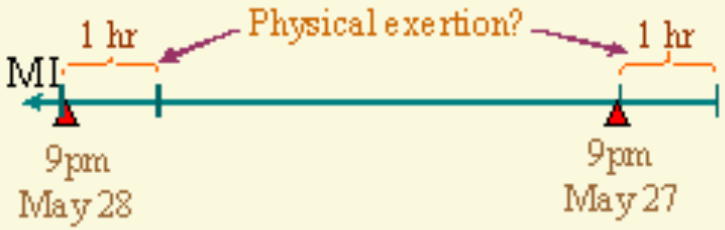
- Event: Myocardial Infarction (MI)
- Exposure: Heavy physical exertion
- Length of the exposure effect: 1 hour
- Hazard period: 1 hour before MI onset

2 sets of control data were used.

Example MI and physical exertion

Control data 1:

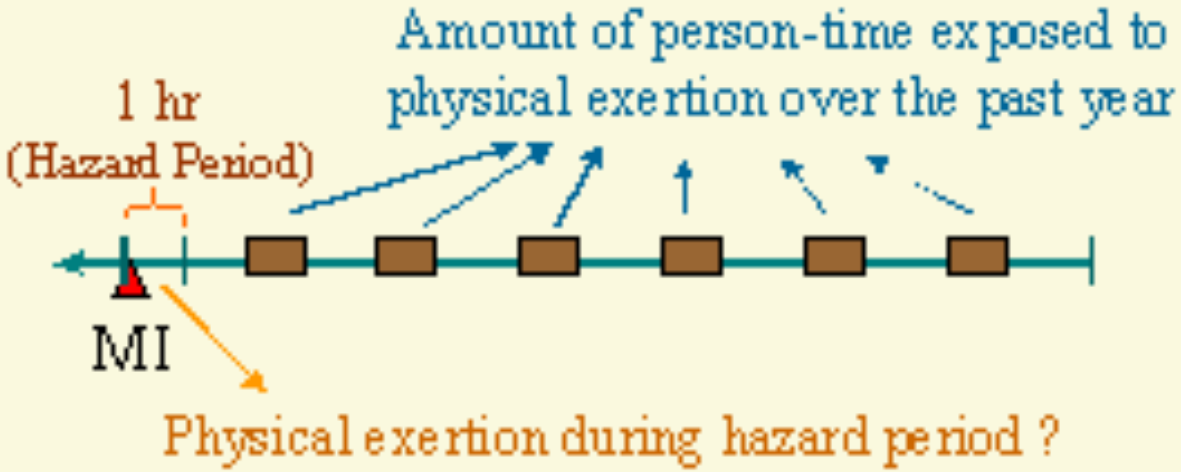
The physical exertion information from a 1 hour period at the same time on the day before the onset of MI.



Example MI and physical exertion

Control data 2:

The usual frequency of heavy physical exertion over the past year.



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Analysis

If the control data were from the past exposure …..

Step 2. Calculate the concurrence expected odds (x:y).

Odds that a random event (disease) would have fallen in the effect period after an episode of exposure.

Discussion
Case Crossover Design

- The design can only be applied when the time lag between exposure and outcome is brief and the exposure must have little carryover effect.
- The results of this analysis are short-term risks rather than cumulative risks.

Discussion
Case Crossover Design

- Recall bias may occur during data collection.
- If there is within-individual confounding, stratification of the data may resolve the problem. To control several confounders simultaneously, conditional logistic regression can be used.

Bibliography of Case Crossover Design Application

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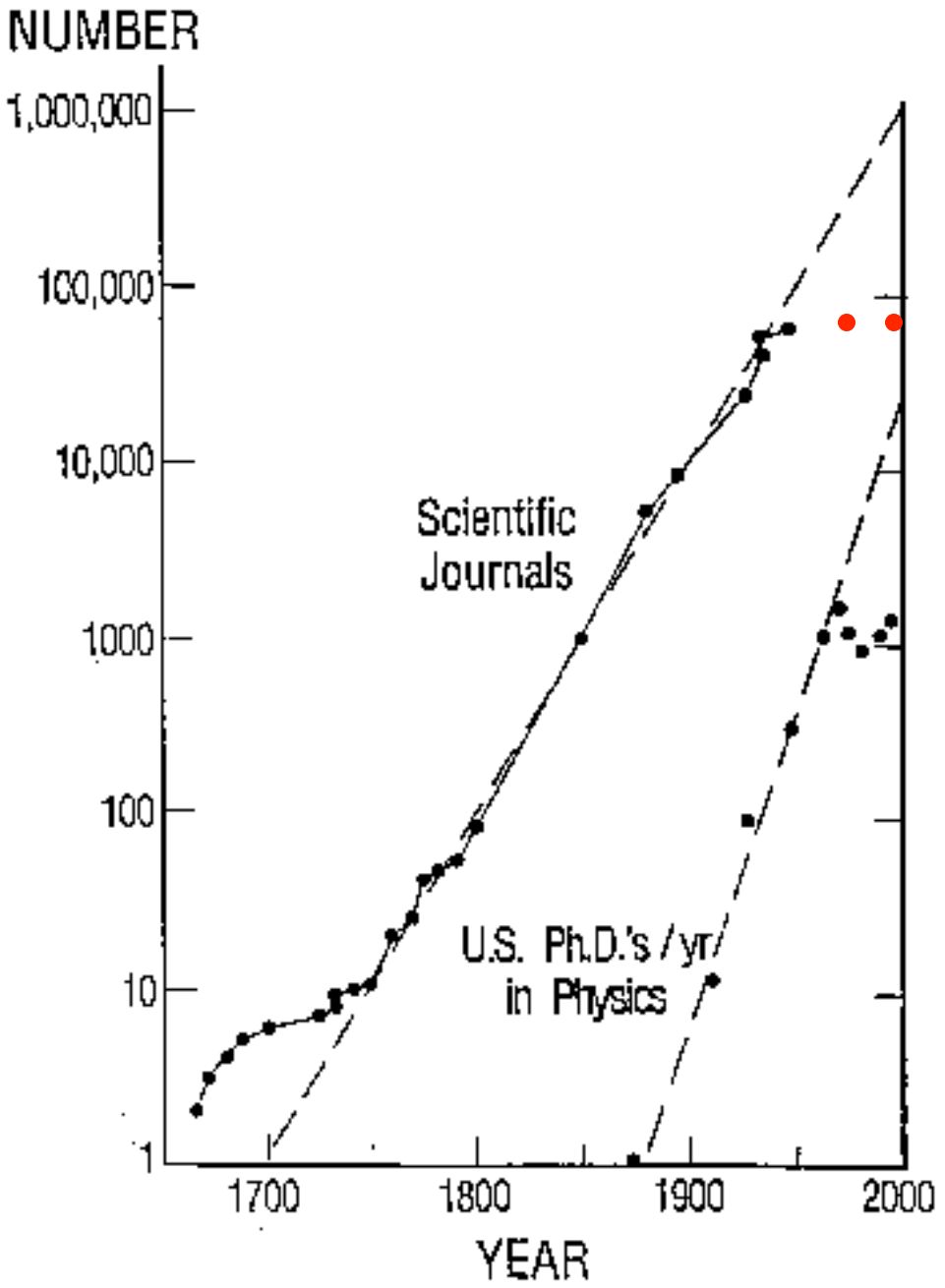
Mittleman MA, Maclure M, Sherwood JB, et al. Triggering of acute myocardial infarction onset by episodes of anger. Circulation 1995;92(7):1720-5.

Vinson DC, Mabe N, Leonard LL, et al. Alcohol and injury. A case-crossover study. Archives of Family Medicine 1995;4(6): 505-11.

- Explosion of scientists
- Explosion of journals



Science Since Babylon by Derek da Solla Price, 1961, updated by David Goodstein, CalTech, 2002

Science or Evidence-Based Medicine

- Aim is to apply the best available evidence gained from the scientific method to clinical decision-making
- Method assesses the strength of evidence
- Randomized controlled trials *or* a summary of such trials (Systematic Review) is the highest level of evidence
- Expert opinion, or uncontrolled studies, are lowest

Levels of Evidence: Treatment

Less bias

More bias

1 - 1 or more *randomized controlled trials*

2 - 1 or more *cohort studies*

3 - 1 or more *case-control studies*

4 - 1 or more *case-series*

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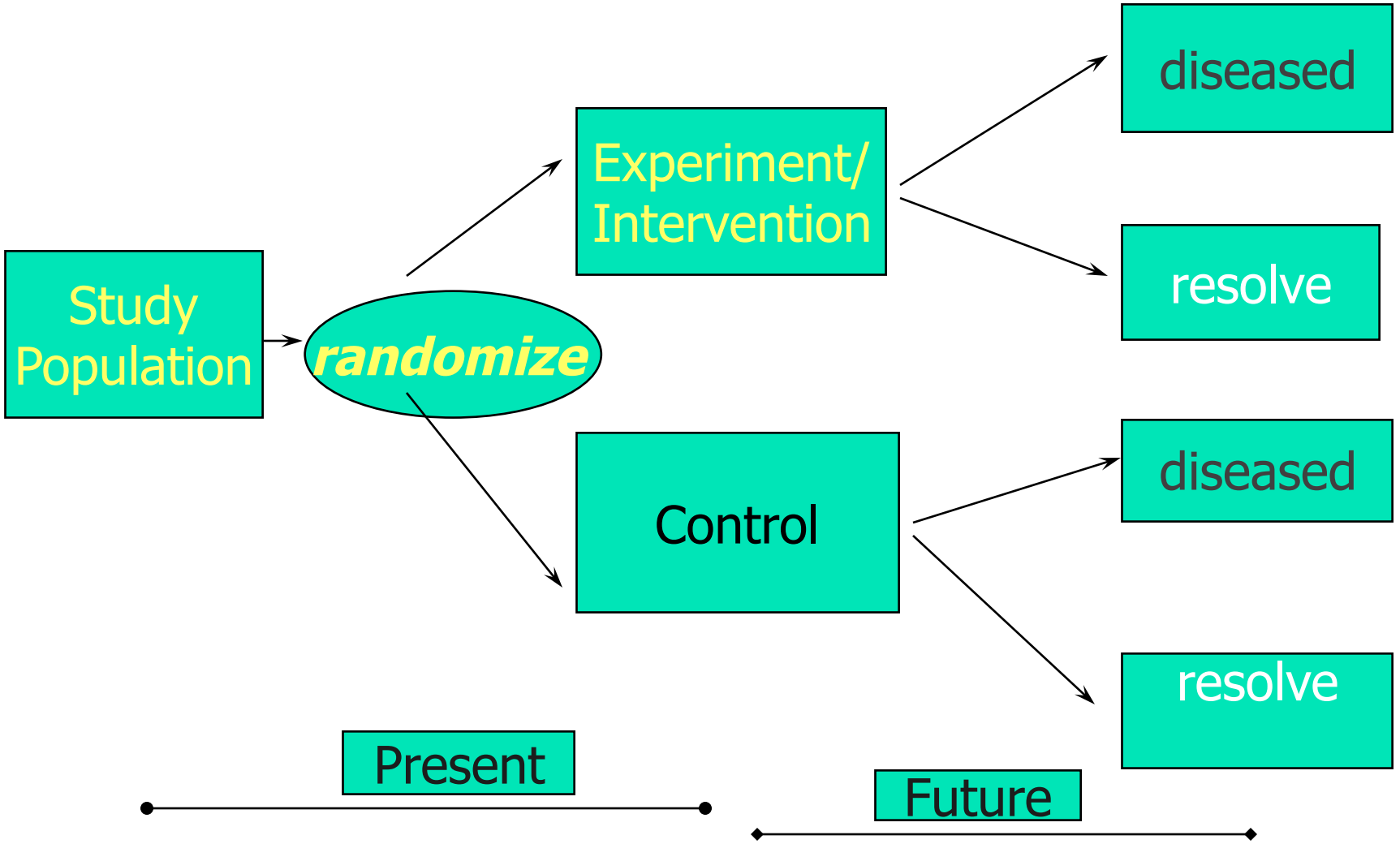
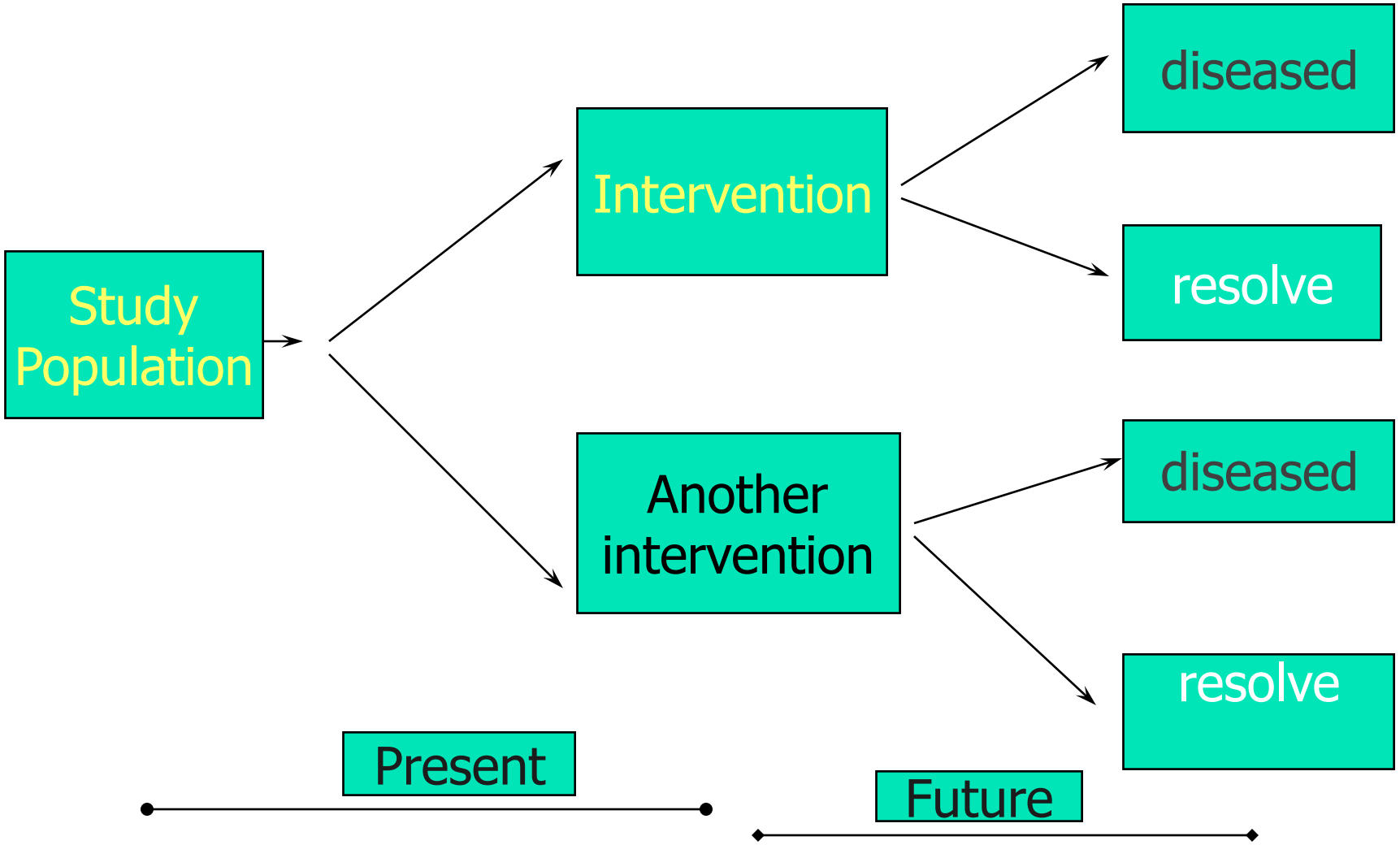
Experimental or Controlled Trial Design



Randomized Controlled Trials

- Resembles a true lab experiment
- Has a control group with an active or inactive intervention (placebo)
- Randomization creates equal groups on known AND unknown risk factors
- Neither patients nor observers commonly know which group they are in - blinding

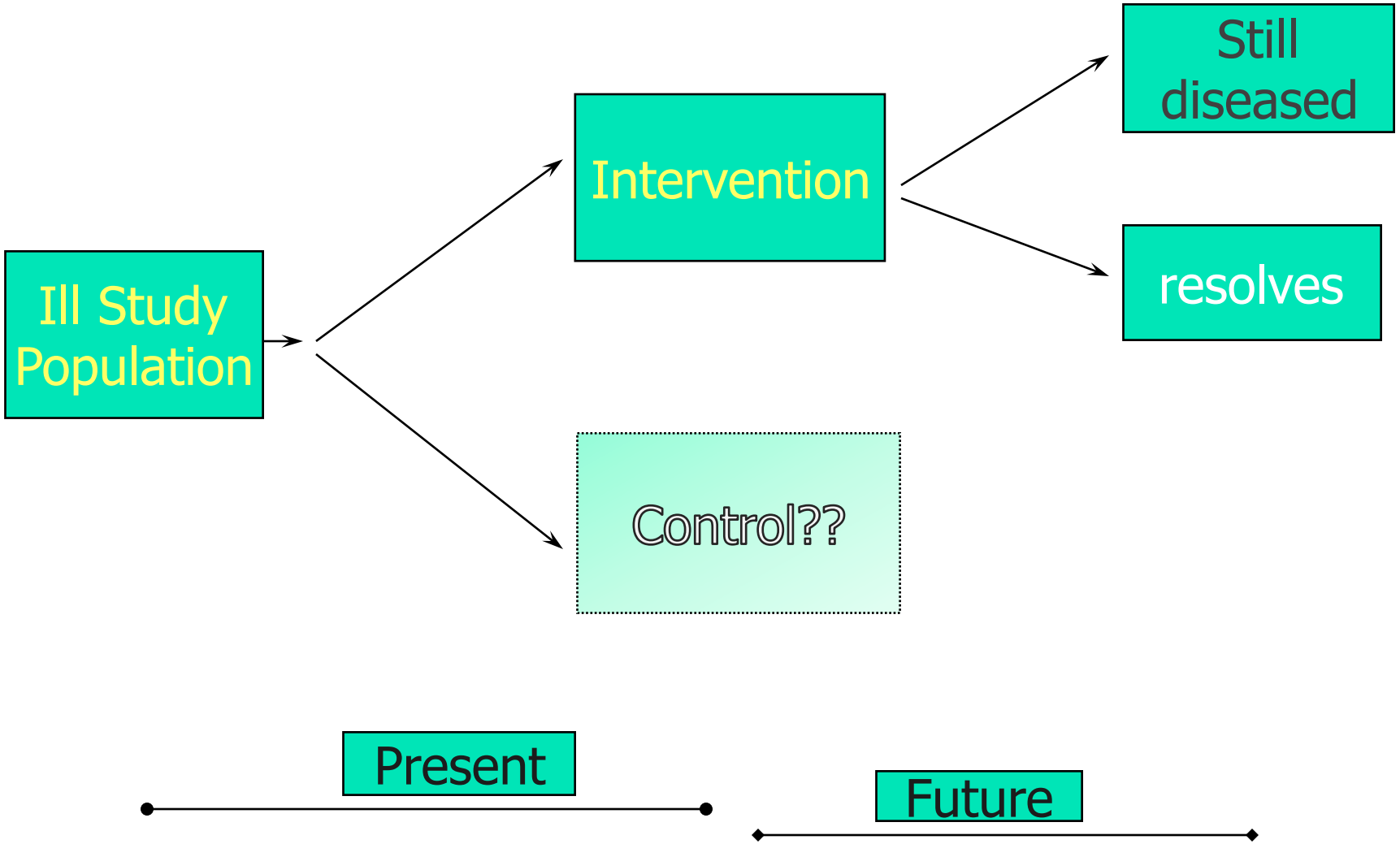
Controlled Trial or Cohort Design



Controlled Trials or cohort studies

- Some patients are given one treatment, some another
- No randomization - groups are not necessarily equal – statistical analyses may be done to equalize groups
- Blinding not commonly done
- Time sequence is clear
- Second best design

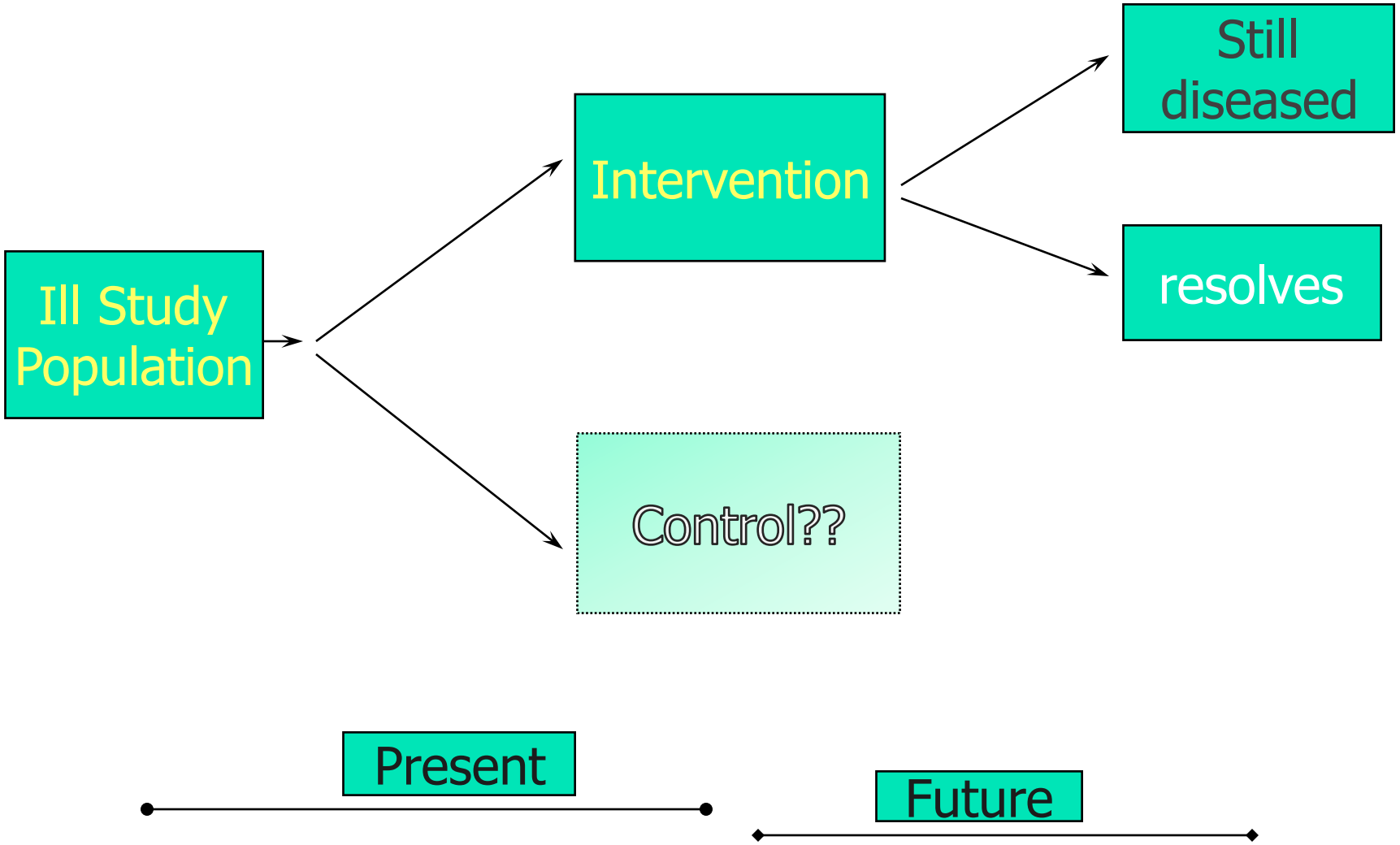
Case-series or follow-up of treated cases



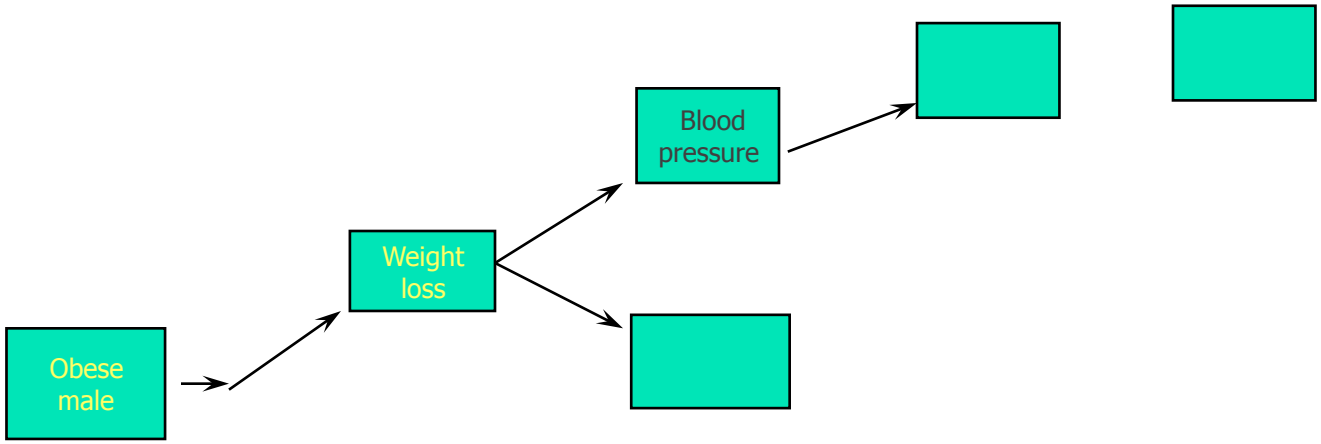
Case-series or follow-up of treated cases

- Common study design in clinical practice
- Lack of control group problematic esp. if clinical course of the condition is variable
- What would have happened in absence of treatment is not known
- Usually shows *inflated* estimates of true efficacy of therapy
- One of the weakest designs

Follow-up of treated case (self)



Follow-up of treated cases (self)



Control??

Other tests

- Shoe weight vs. running efficiency
- Heel strike/Forefoot vs. running efficiency
- Aero Helmet design, wheel design vs. bike speed.
- Gel use and cycling power output