

# Cancer Overdiagnosis Explained: A Simple Graphical Model

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# Disclosure

- Images to be shared today are from my book/decision aid, *Cancer Screening Decisions: A Patient-Centered Approach*, which will be published in November.

# The Challenges

- Overdiagnosis in cancer screening remains poorly understood by patients, policy-makers, and clinicians.
- “Early detection saves lives” is widely accepted as fact.
- People are often surprised to learn that there can be harms associated with cancer screening. These include:
  - The harms and burdens associated with screening
  - False positive results and the downstream effects
  - Detection of indolent cancers (= overdiagnosis)
- Cancer screening is uncritically promoted, and PCPs are incentivized to do it.
- Overdiagnosis is “invisible.”
- Overdiagnosis is difficult to understand and explain.

# Cancer Overdiagnosis Defined

- Diagnosis of a cancer which was not destined to ever cause symptoms, harm, or death in the person's lifetime.
- Harms result from:
  - The diagnosis itself (psychological, financial)
  - Treatment, and the attendant harms and costs
- There is no opportunity to benefit from diagnosing an indolent cancer.
- Yet there are always harms associated with it.

# Understanding Overdiagnosis in Cancer Screening Requires:

- Understanding the heterogeneity of cancer progression

**Analogy + Timeline**

- Understanding that screening is particularly good at detecting indolent cancers

**Timeline**

- Adopting a population-level view

**Pictogram**

- At least a basic understanding of probabilities

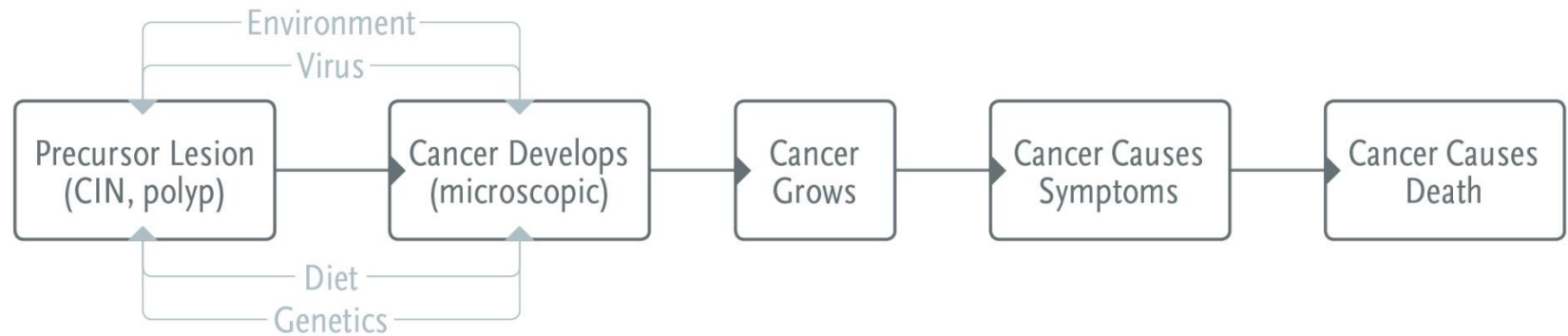
**Pictogram**

## OVERDIAGNOSIS EXPLAINED

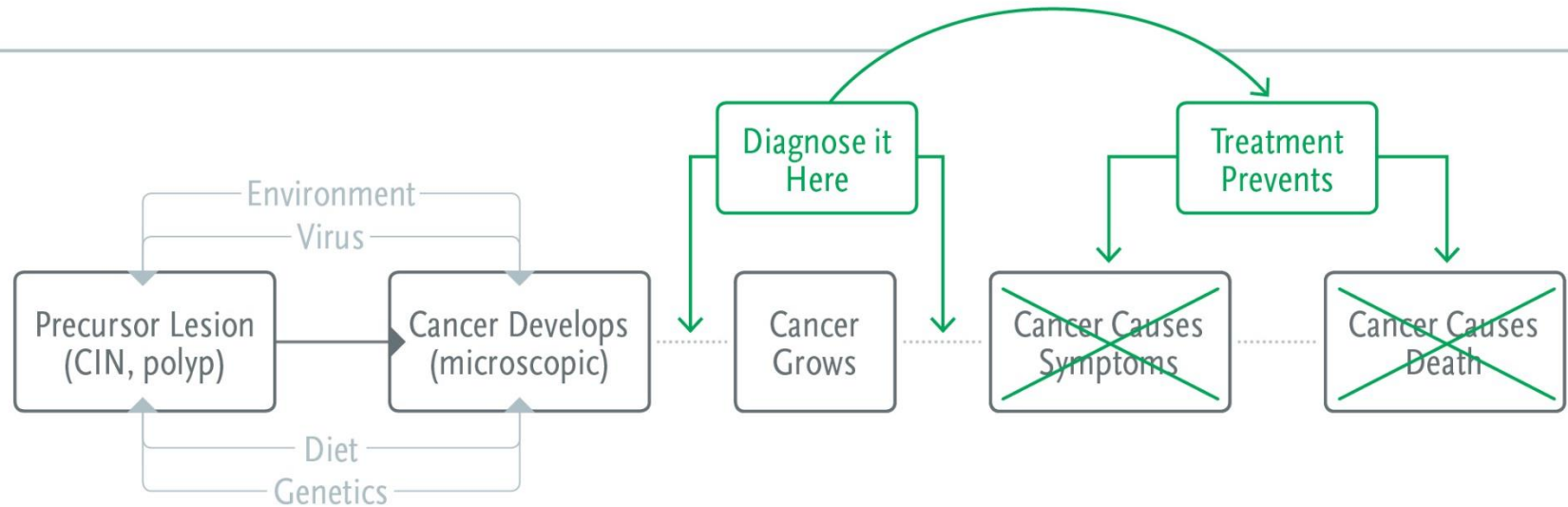


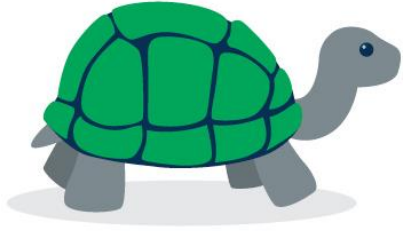
This chart shows how screening can be **helpful**.

This diagram, a conventional model of inevitable cancer progression, illustrates how we would expect a **bear-type cancer** to behave over time.



With this in mind, we can see the **value of cancer screening**, which is based on the idea that **early detection saves lives**.

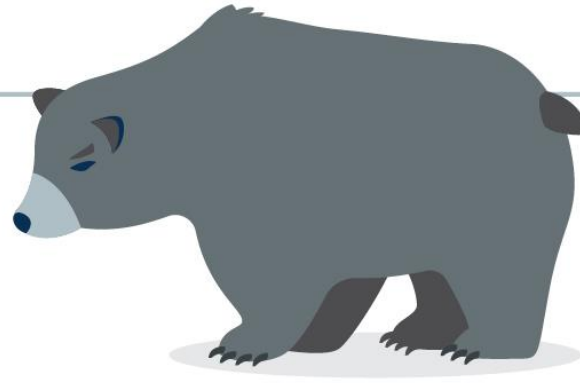




## “TURTLES”

*Cancers that are surprisingly common — they move slowly and are non-threatening. They never cause death and don't even cause symptoms.*

Finding it early (or at all) is  
**NEVER HELPFUL**



## “BEARS”

*Cancers that are potentially lethal, but often treatable, especially when found early.*

Finding it early  
**MAY BE HELPFUL**

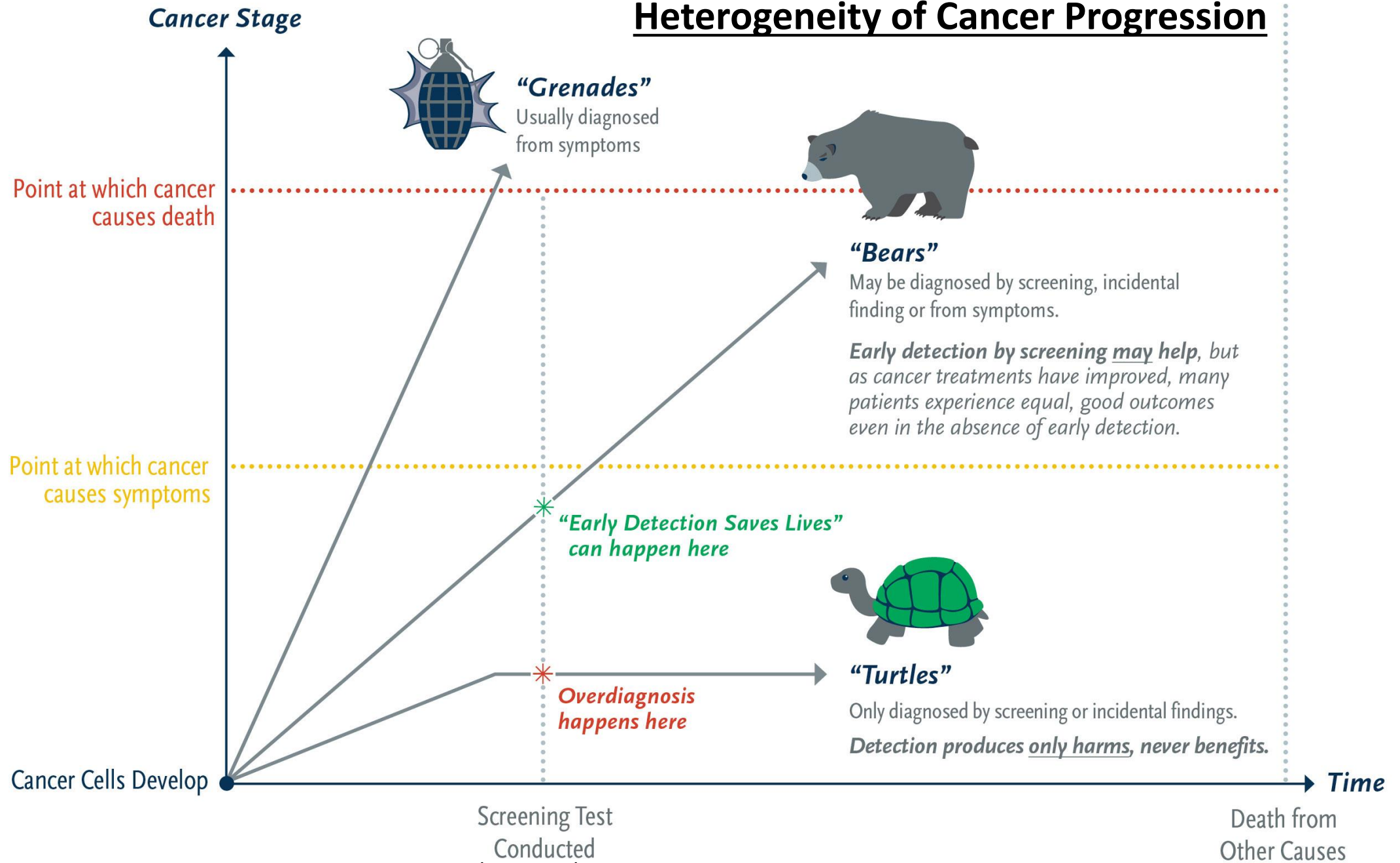


## “GRENADES”

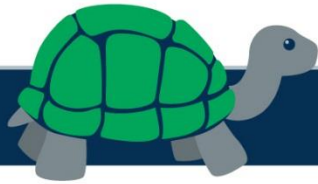
*Cancers that are very aggressive—they grow fast and are almost always deadly, even when found early.*

Finding it early is  
**RARELY HELPFUL**

# Heterogeneity of Cancer Progression

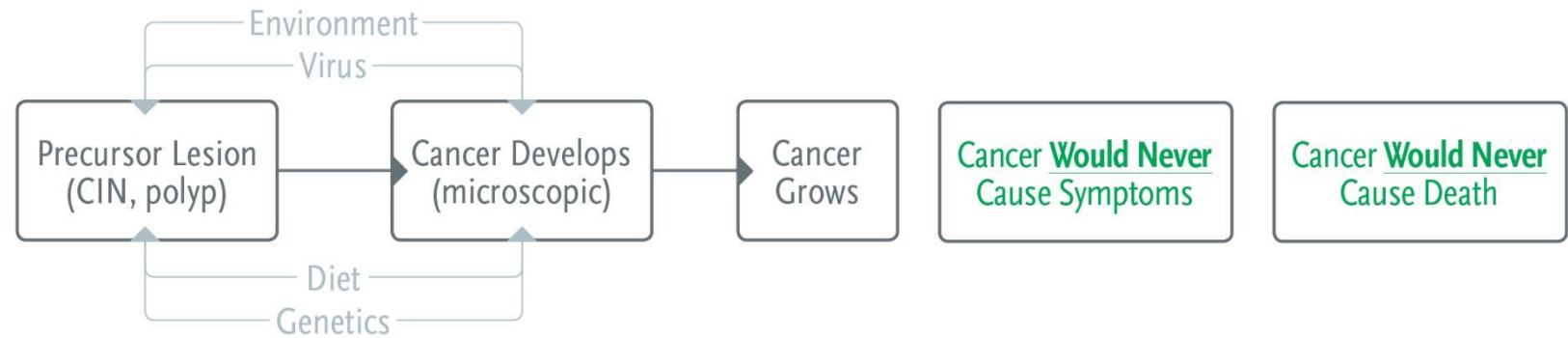






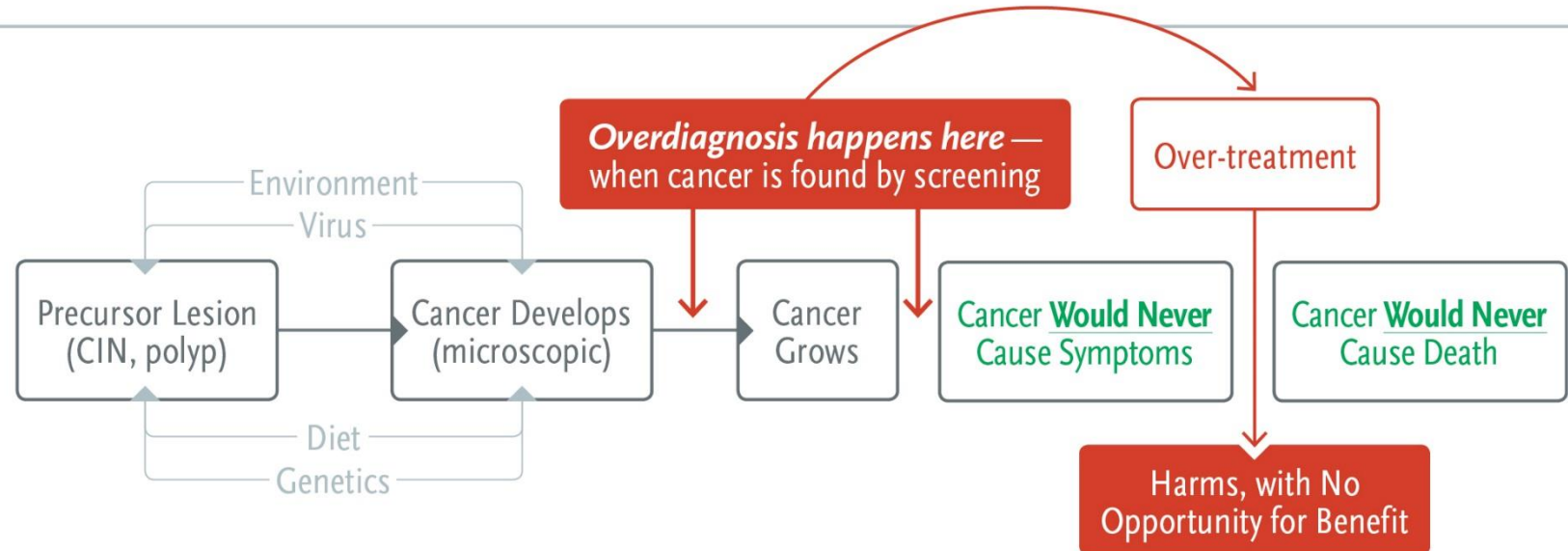
This chart shows how screening can be **harmful**, when it leads to overdiagnosis.

There are also many **turtle-type cancers** that would **never cause any symptoms or harm**.

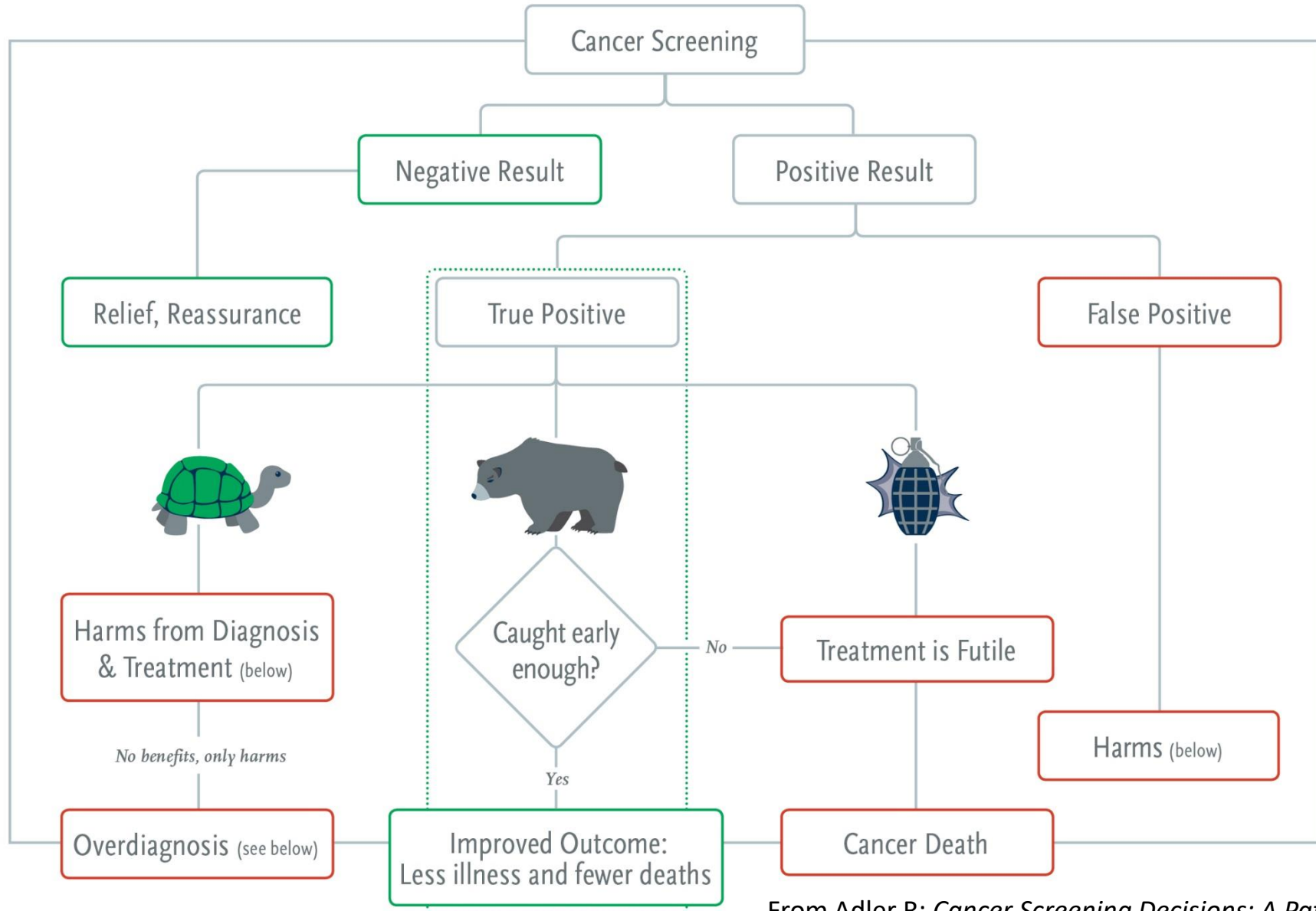


Finding a turtle type cancer cannot possibly help. It can **only cause harm**.

**This is overdiagnosis.**



# Cancer Screening: Possible Outcomes



(False Negatives Ignored)

## Cancer screening is **helpful** when:

- 1 A person without cancer has a negative (normal) screening test result  
This is a small benefit that many people get to experience
- 2 A person with cancer has a positive (abnormal) test result, and
  - the cancer they have is treatable, and
  - they receive successful treatment, and
  - the treatment is **more successful** than it would have been if the cancer was diagnosed later because of symptomsThis is a huge benefit that a relatively small number of people get to experience  
This can only occur for Bear-type cancers.

## Cancer screening is **harmful** when:

- 1 A person experiences **burdens of testing**, such as inconvenience, discomfort, or large expenses
- 2 A person without cancer receives a **false positive** test result, in which her/his cancer screening test is abnormal, raising worries about cancer, resulting in:
  - **additional tests**, which may cause more inconvenience, discomfort, and expense
  - **problems from more invasive tests**, such as biopsies (minor surgery to remove a piece of the body for more precise testing)
  - **cancer anxiety**, which can last for years after the false positive test result
- 3 A person experiences **overdiagnosis and overtreatment**: the diagnosis and treatment of a cancer that — if not for the screening test — would have never caused the patient any problem in their lifetime

From Adler R: *Cancer Screening Decisions: A Patient-Centered Approach*  
Philadelphia: Wolters Kluwer, 2018

Key:

Benefit

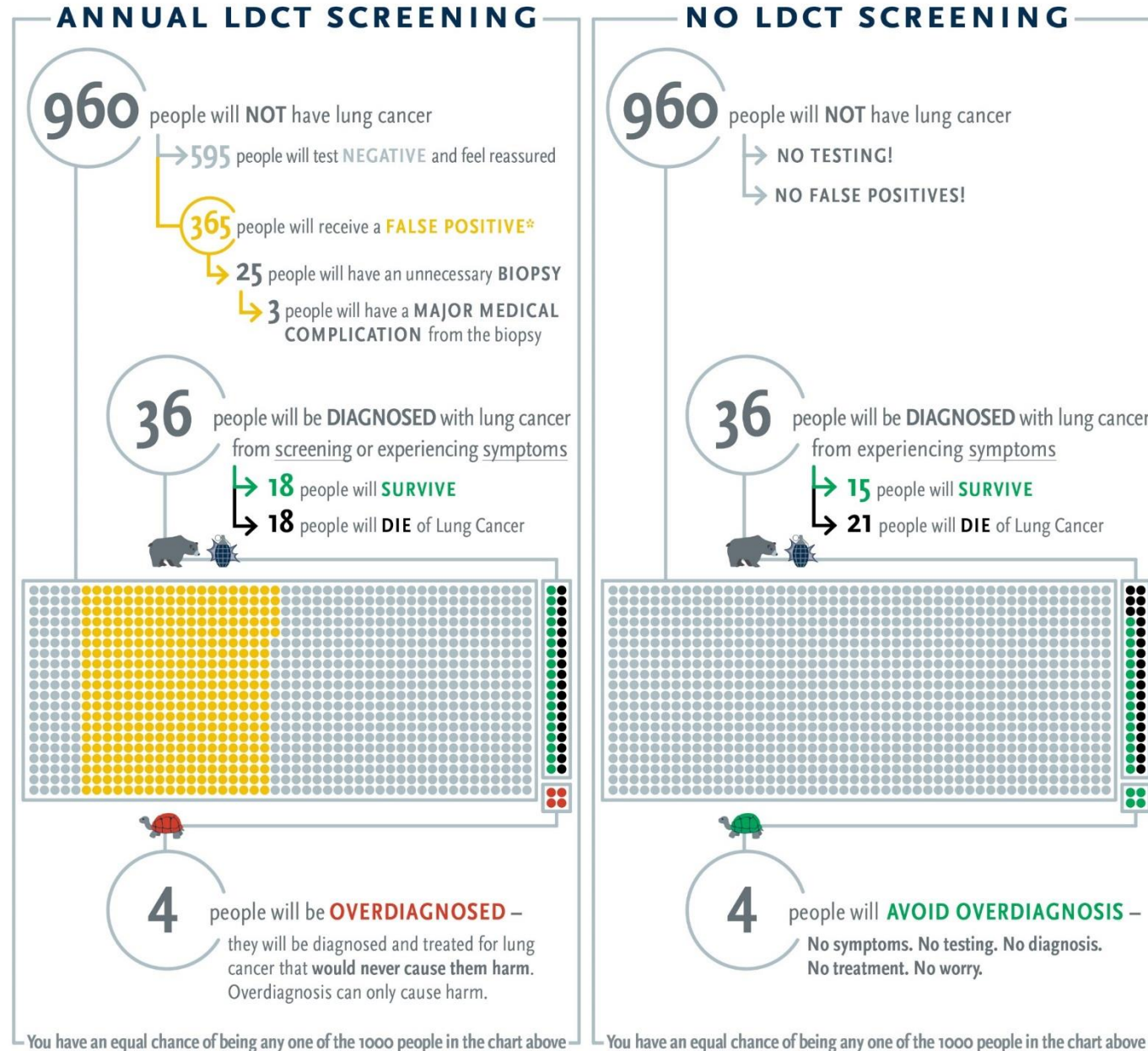
Harm

IMAGINE COMPARING 2 GROUPS OF 1000 PEOPLE ELIGIBLE FOR LUNG CANCER SCREENING.

1 group chooses screening (annual LDCT scan for 3 years), while the other group chooses not to be screened.

All people are followed for 6.5 years. What happens?

Lung Cancer



Low-Dose CT Scan

From Adler R: *Cancer Screening Decisions: A Patient-Centered Approach* Philadelphia: Wolters Kluwer, 2018

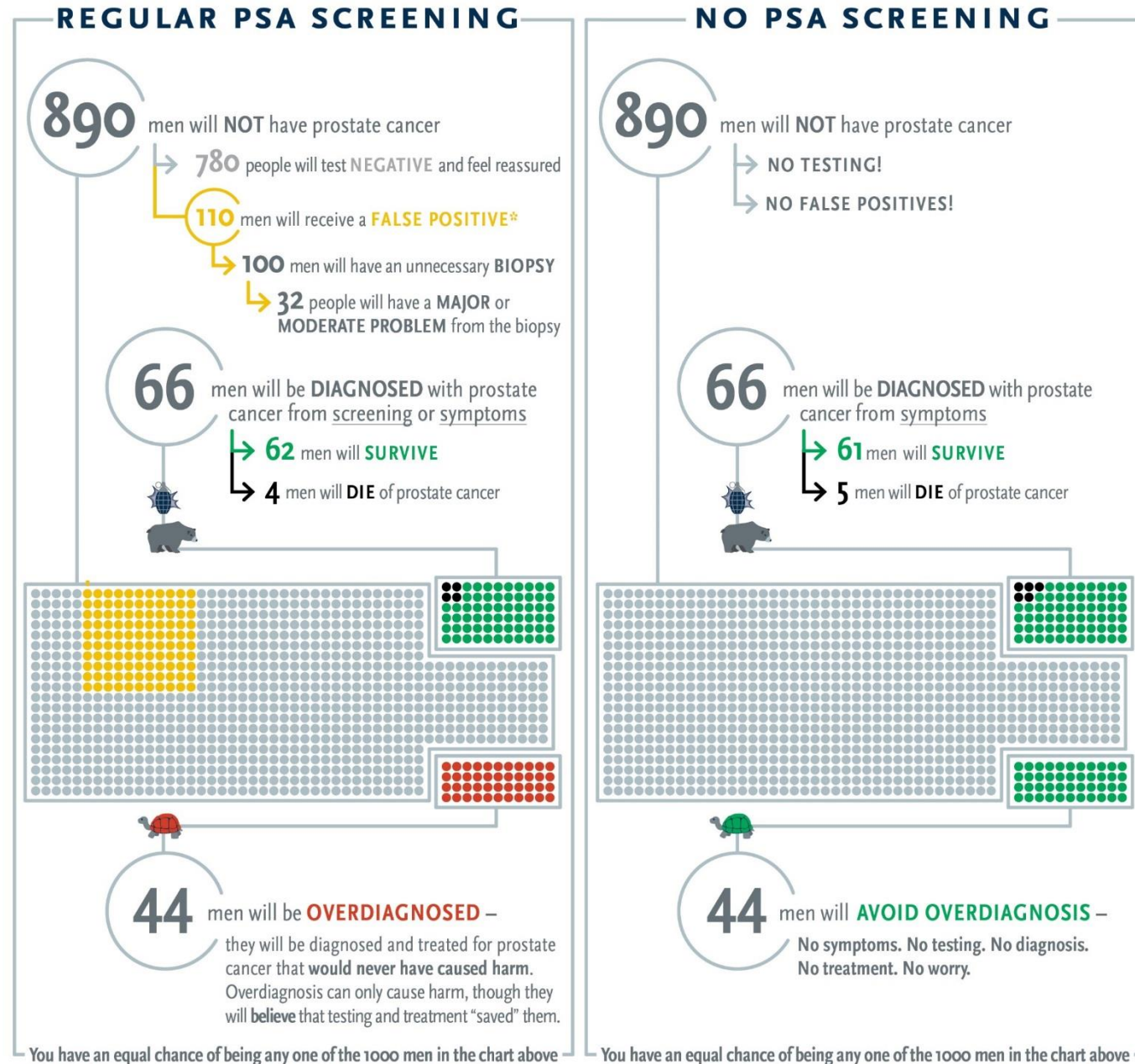


# IMAGINE COMPARING 2 GROUPS OF 1000 MEN.

1 group chooses regular PSA screening (every 1-4 years), while the other group chooses no screening

All men are followed for 11 years. What happens?

## Prostate Cancer



From Adler R: *Cancer Screening Decisions: A Patient-Centered Approach* Philadelphia: Wolters Kluwer, 2018

IMAGINE COMPARING 2 GROUPS OF 10,000 WOMEN IN THEIR 50s.

1 group chooses to have annual mammograms, and the other group does not.

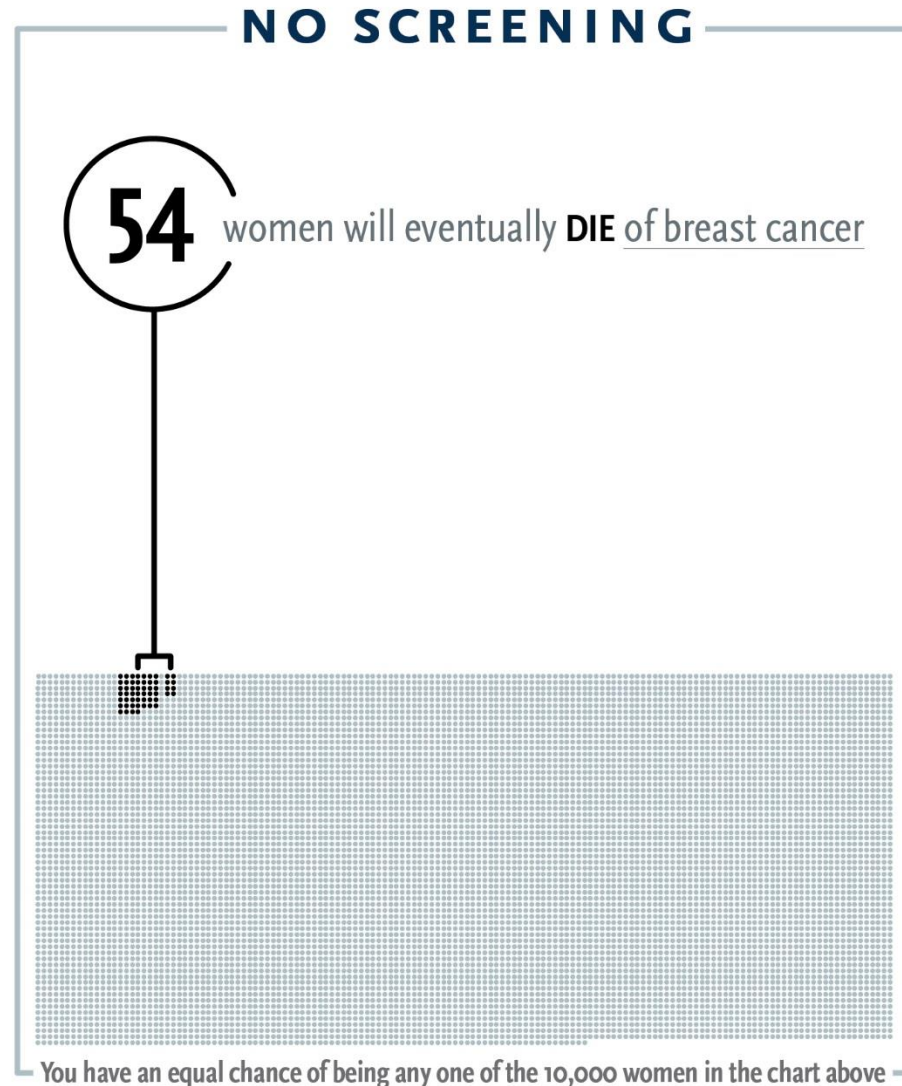
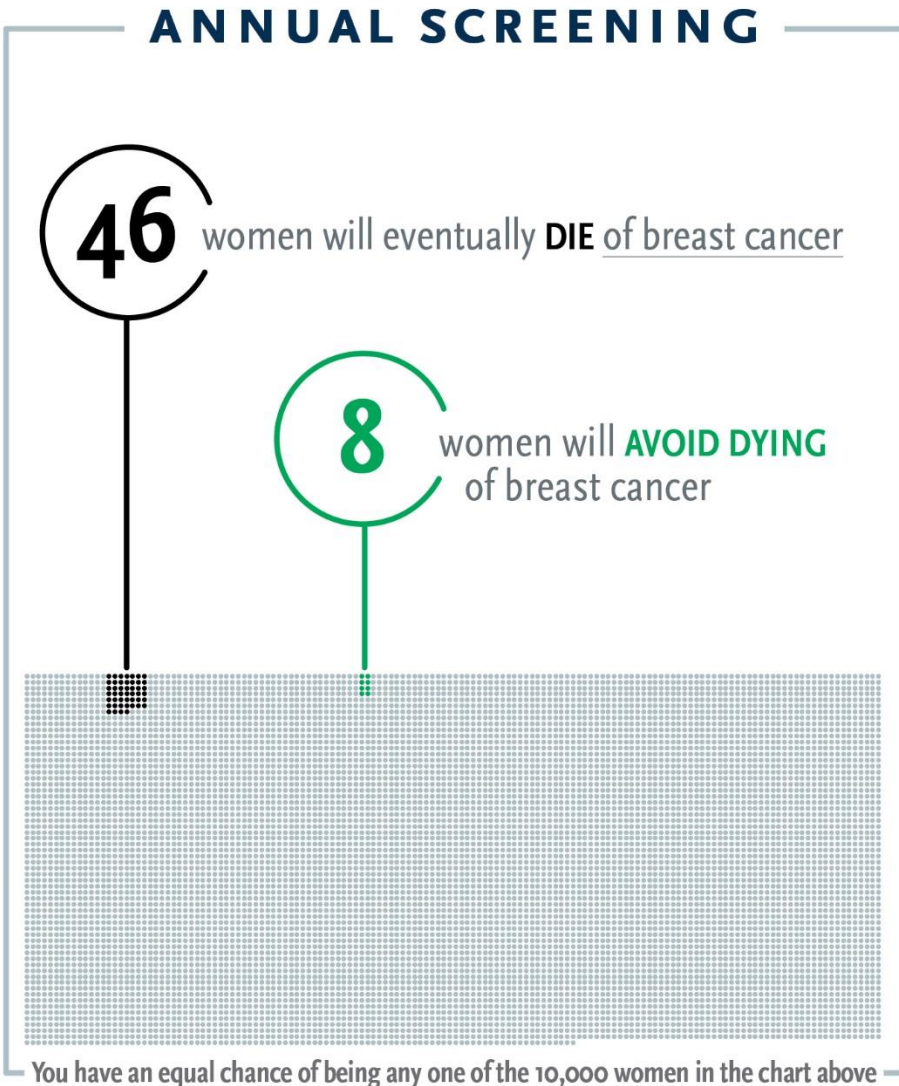
What happens?

From Adler R: *Cancer Screening Decisions:*

*A Patient-Centered Approach*

Philadelphia: Wolters Kluwer, 2018

# Breast Cancer (50s)

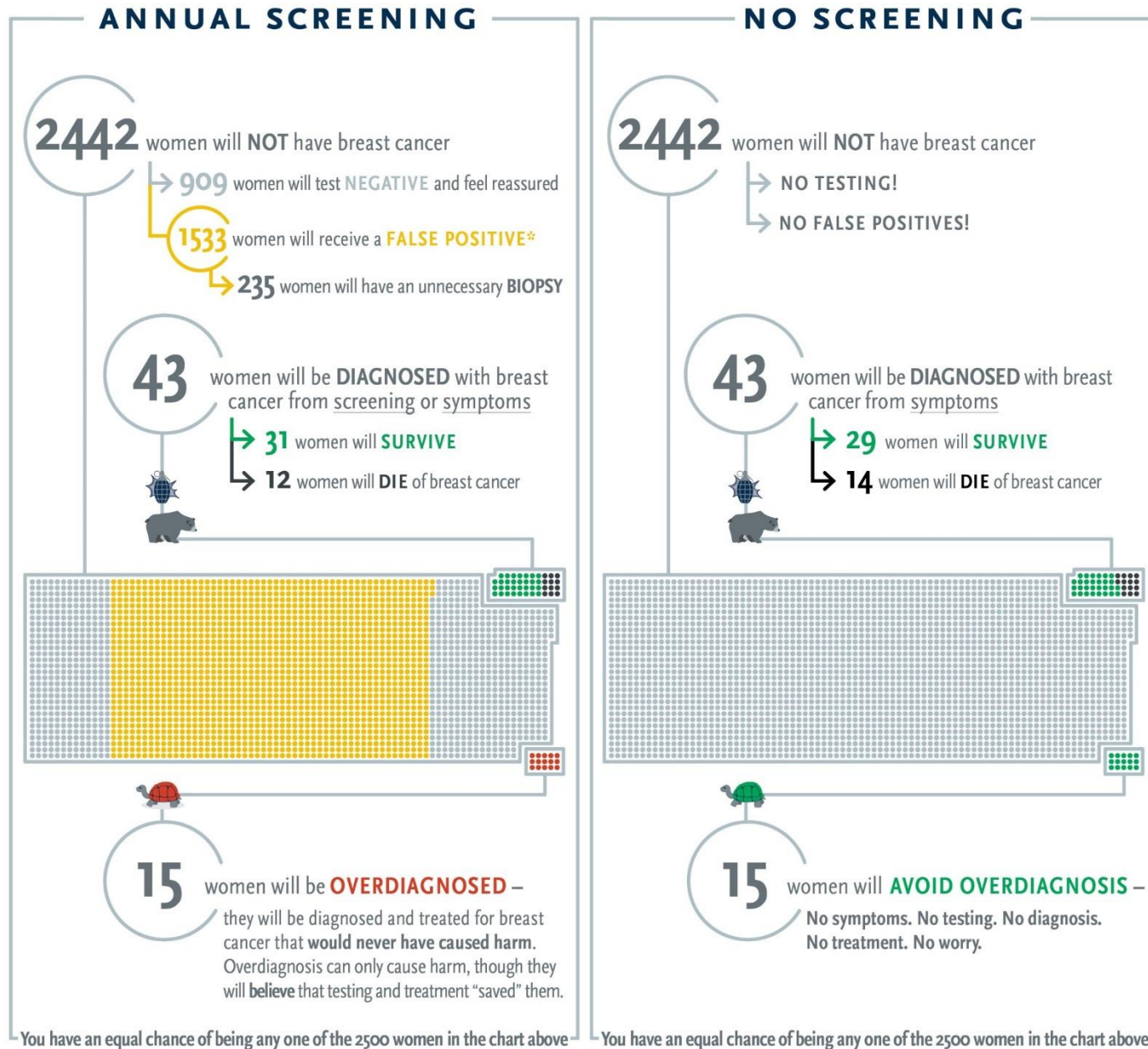




# Breast Cancer (50s)

IMAGINE COMPARING 2 GROUPS OF 2500 WOMEN IN THEIR 50s.  
1 group chooses annual mammograms for 10 years, and the other group does not.

What happens?



From Adler R: *Cancer Screening Decisions: A Patient-Centered Approach*  
Philadelphia: Wolters Kluwer, 2018

# Breast Cancer (50s)

## IMAGINE COMPARING 3 GROUPS OF 2500 WOMEN IN THEIR 50s.

1 group chooses to have a mammogram every year, while 1 group chooses to have a mammogram every other year, and the other group chooses not to be screened. What happens?

From Adler R: *Cancer Screening Decisions: A Patient-Centered Approach*  
Philadelphia: Wolters Kluwer, 2018

### REGULAR SCREENING

#### Women who have mammograms EVERY YEAR

**1,533** women will receive **FALSE POSITIVES**



**235** women will have an **UNNECESSARY BIOPSY**



**15** women will be **OVERDIAGNOSED**



**12** women will **DIE** of breast cancer



#### Women who have mammograms EVERY OTHER YEAR\*

**1,050** women will receive **FALSE POSITIVES**



**160** women will have an **UNNECESSARY BIOPSY**



**15** women will be **OVERDIAGNOSED**



**12** women will **DIE** of breast cancer



\*Having mammograms every other year preserves most of the benefits, while reducing some of the harms.

2500 women followed for 10 years

### NO SCREENING

#### Women who **DO NOT HAVE** mammograms

**0** women will receive **FALSE POSITIVES**



**0** women will have an **UNNECESSARY BIOPSY**



**0** women will be **OVERDIAGNOSED**



**14** women will **DIE** of breast cancer



2500 women followed for 10 years



# Conclusions

- One cannot adequately weigh the benefits and harms of cancer screening without considering the risk of overdiagnosis.
- Most people will require some pictorial representation to understand:
  - The heterogeneity of cancer progression
  - The concept of overdiagnosis
  - The likelihood of overdiagnosis for a given proposed cancer screen

Questions/Discussion

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