# CLASS 16: THE ROLE OF EPIDEMIOLOGY IN DISEASE PREVENTION

HLSC 2003

*Walker*

*Faculty of Health Sciences*

*University of Lethbridge*

# PREVENTION OR CURE?

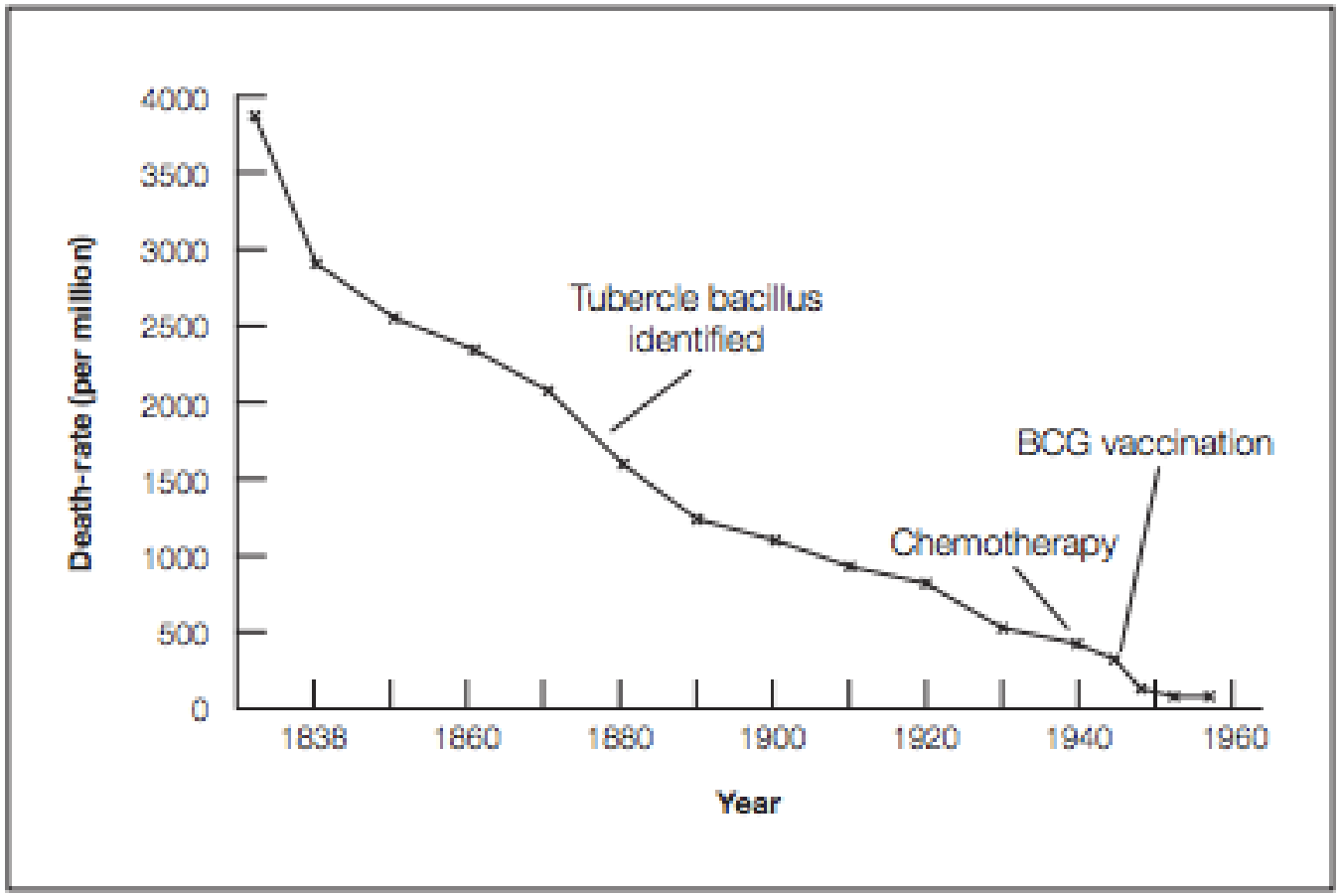
Which is more important?

What is the potential role of Epidemiology in both?

# INITIATIVES TO IMPROVE HEALTH

Discuss with your neighbour two specific interventions that are promoted for the purpose of improving health. Make note of them.

**FIGURE 1:** Respiratory tuberculosis—mean annual death rates (standardised to 1901 population, England and Wales)

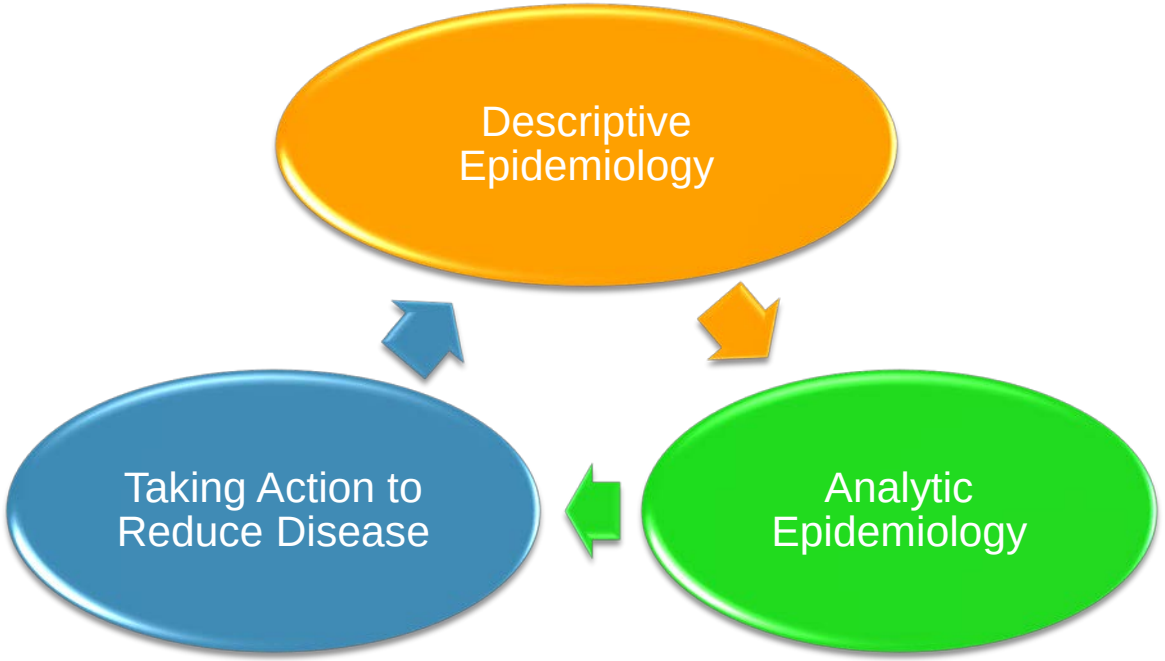



*Source: McKeown 1979:92*

# THE “UPSTREAM” APPROACH

Epidemiology studies the **DISTIRUBUTION** and **DETERMINANTS** of morbidity and mortality in human populations, and **APPLIES** this study to control health problems.

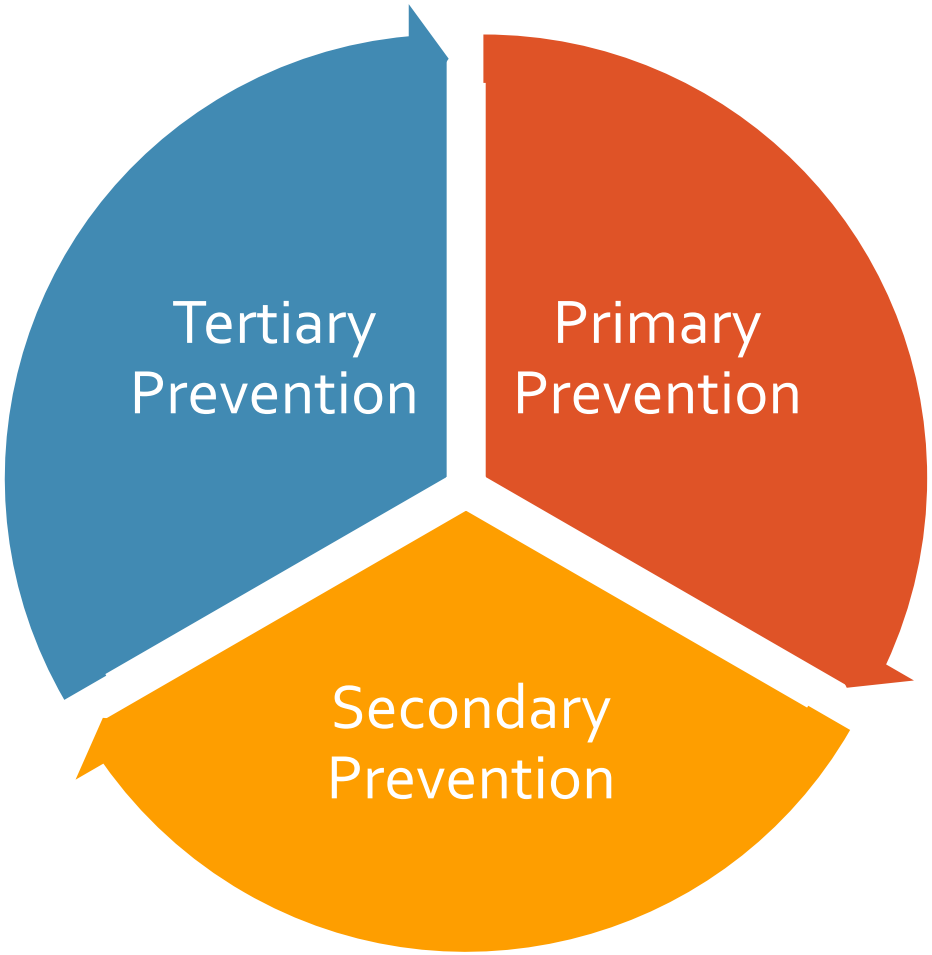
A world with No Ill-health



# The role of Epidemiology in disease prevention:

1) Identifies patterns and trends in disease within populations
2) Identifies causes of disease that we can change (and those we cannot)
3) Provides quantitative measures of risk that can direct preventative action
4) Evaluates preventative strategies/programmes to determine if they actually work in practice

# THREE LEVELS OF *PREVENTION*



# LEVELS of PREVENTION


1. **Primary** – efforts to prevent the occurrence of disease (prevent exposure to risk factors)

2. **Secondary**– efforts to detect disease/behaviours leading to disease early (in subclinical stages) to decrease rate of disease progression. Also known as screening.

3. **Tertiary** – efforts to limit complications, disability caused by disease and improve functioning. Also known as improved treatment and management of disease.

# 1. Primary Intervention

- Safe Drinking water
- Immunization
- Prenatal care
- Family planning
- Sun protection
- Anti-smoking campaigns

*interventions that take place ***before*** the disease or outcome has occurred

# 2. Secondary Prevention (i.e. screening)

- Detection of risk factors (e.g. hypertension)
- Screening for colon/breast/cervical cancer
- Cholesterol screening
- Newborn screening (e.g. PKU, Sickle cell disease, congenital abnormalities)
- Hearing loss, visual impairment
- Antenatal screening (e.g. blood group, down's syndrome, fetal abnormalities)

- *Used ***after the disease process has begun, but before*** there are symptoms of disease in order to intervene early (and potentially prevent full blown disease or reduce effects)

# 3. Tertiary Prevention

- Cardiac rehabilitation programs
- Treatment/management of diabetes (or other chronic diseases)
- Palliative care
- Development of new treatments for melanoma
- Adapting environments to accommodate people with disabilities

*Targets those who ***already have*** the disease with the intention of reducing complications or long-term effects

# Irradiation of food would be an example of which level of prevention?

A. Primary
B. Secondary
C. Tertiary

Routine blood sugar testing in clinics for adults over 40 years of age to detect diabetes is an example of what type of prevention?

A. Primary
B. Secondary
C. Tertiary

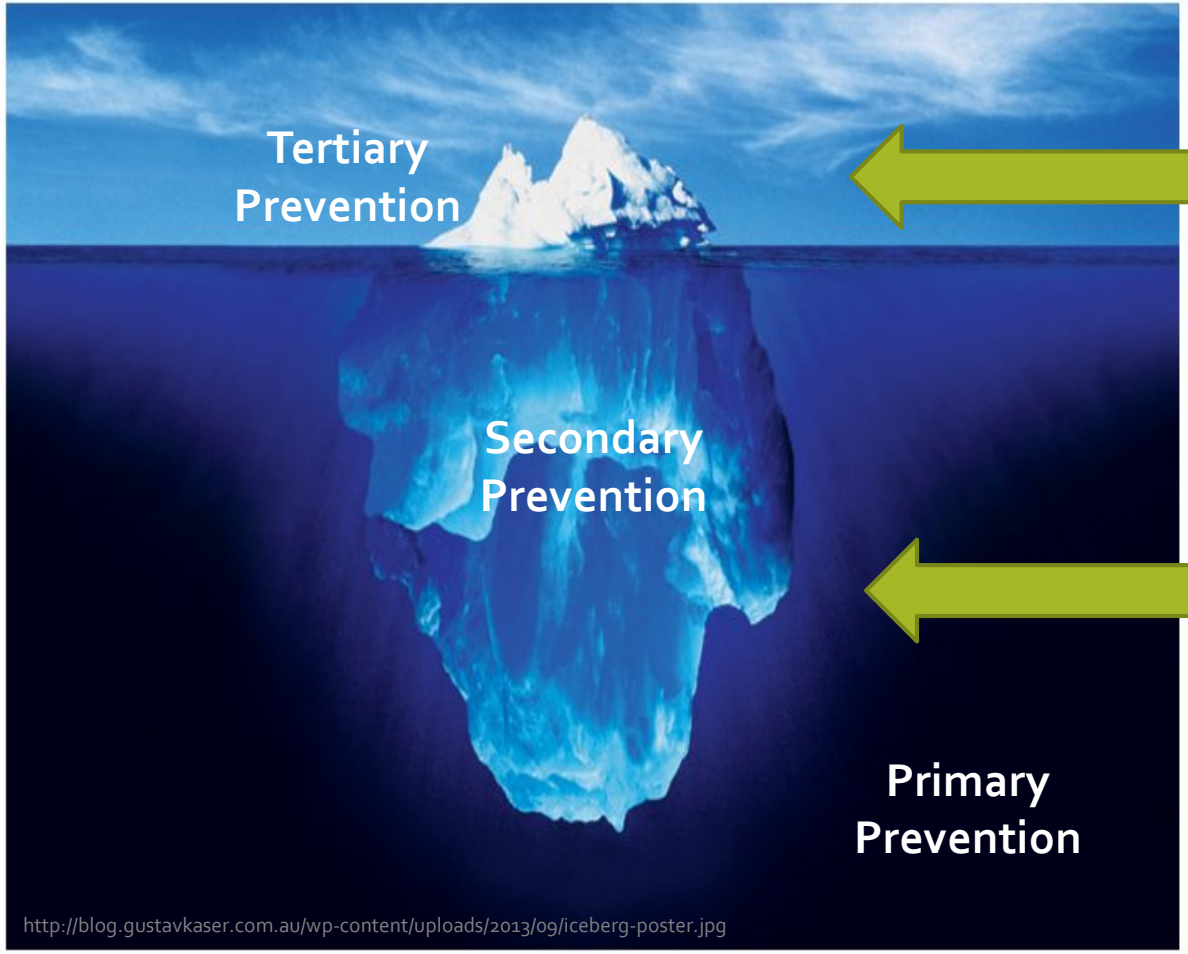
A healthy eating program for individuals with type 2 diabetes is an example of:

A. Primary prevention

B. Secondary prevention

C. Tertiary prevention

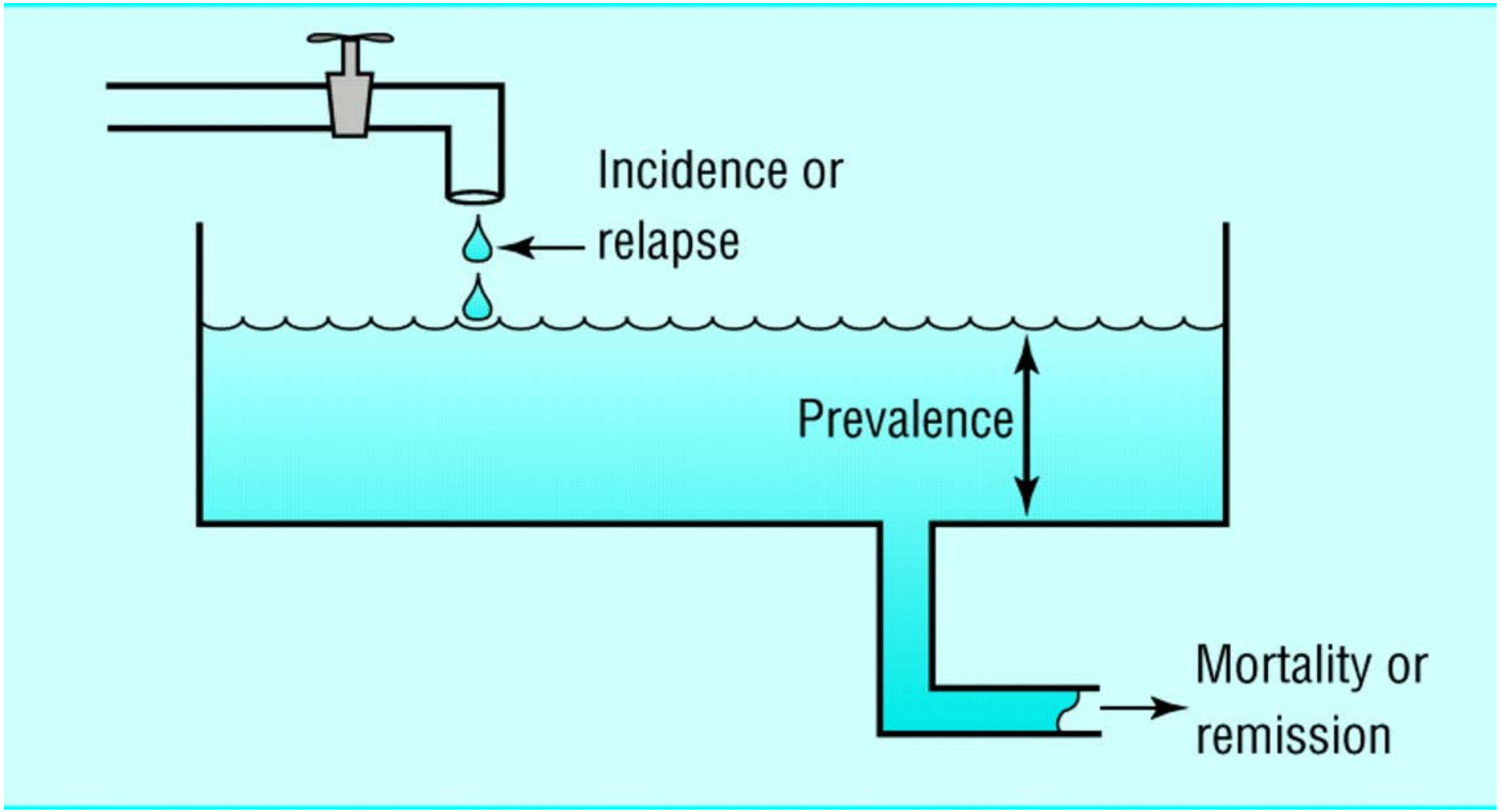
# The Iceberg concept of Disease




Clinical Phase of Disease: Symptomatic disease

Pre-Clinical Phase of Disease: No symptoms, but pathogenesis may be occurring.

# Effects of Primary, Secondary, and Tertiary Prevention on Incidence and Prevalence:



Decisions about what level of intervention to use, should be disease-specific and based on evidence of effectiveness:

| Intervention | Lung Cancer | Breast Cancer |
|---|---|---|
| Prevention (primary) | YES | NO |
| Screening (secondary) | NO | YES |
| Improved Treatment (tertiary) | NO | YES |

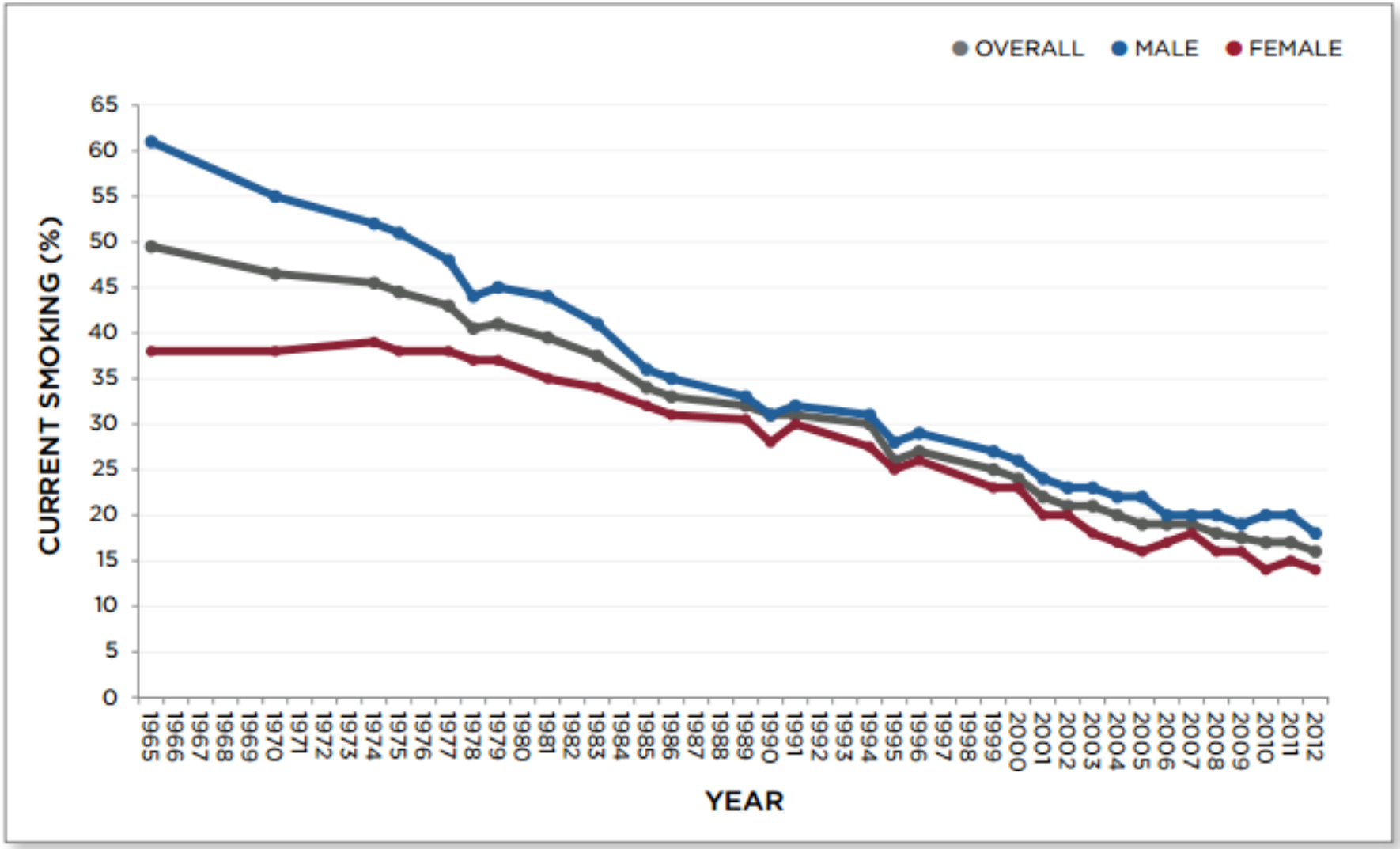
Humankind's favourite substances…not ruining your fun, just using evidence to understand the risk of exposure and make recommendations about prevention.

"decline in smoking rates a significant reason for the overall drop in cancer death rates in Canada. Lung ca mortality rate among men was down 30% between 1988 and 2007…and has stabilized in women"

-Canadian Cancer Society

LINK to report

**FIGURE 1.1:** SMOKING PREVALENCE* IN CANADA, ADULTS AGED 15+, 1965-2012



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Home » Harvard Health Blog » Alcohol: a heart disease-cancer balancing act - Harvard Health Blog

# Alcohol: a heart disease-cancer balancing act

POSTED FEBRUARY 15, 2013, 12:04 PM

Howard LeWine, M.D., Chief Medical Editor
Internet Publishing, Harvard Health Publications

The message that drinking a little alcohol is good for the heart has gotten plenty of attention. A new study linking alcohol with increased risk of dying from various cancers may temper that message a bit.

About 4% of cancer deaths worldwide are related to alcohol use. No one has done a major study of this issue in the United States for more than 30 years. During that time, we've learned a lot about alcohol and cancer, and powerful statistical methods have been developed for estimating risk.

Researchers from the National Cancer Institute and other institutions delved into many studies and information databases. They calculated that alcohol causes 3.5% of U.S. cancer deaths, or about 20,000 cancer-related deaths each year. The study was published online yesterday in the *American Journal of Public Health*.

The most common alcohol-related cancers were mouth, throat, and esophageal cancer in men, and breast cancer in women.

Experts still aren't completely sure how alcohol causes cancer. Possibilities include:

- toxic effects from chemicals produced when the body breaks down alcohol
- increased production of cell- and DNA-damaging free radicals
- changes in the way the body handles vitamin $B_6$ (folic acid)
- boosting estrogen levels, which can increase the risk of breast and other cancers

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## Alcohol and your health: less is more when it comes to healthy living

### Wondering what to make of the claim that drinking alcohol leads to a healthier heart?

You're not alone. The media is abuzz with both good and bad news about alcohol, making it hard to know which facts are worth swallowing. But rather than pound back the pale ale in either celebration or confusion, consider this fact: while alcohol does indeed have some health benefits, the scope of those benefits is limited. The harmful effects of alcohol – on the body as well as on society – far outweigh the good.

### What alcohol can add to your health

**Heart help**

Moderate alcohol consumption – one or two drinks per day – raises good cholesterol and blood protein levels, thus lowering the risk of coronary heart disease, in men over 45 and women over 55. In France, where red wine plays a regular role in the everyday diet, researchers note consistently low rates of heart disease among the population.

**Stress relief**

Alcohol also serves as a stress reliever for a great many people in our ever-on-the-go society. After one drink, at a blood alcohol concentration of 0.02% (0.02 grams per 100ml of blood), many people feel a bit more relaxed and at ease with the world.

So, what's wrong with kicking back with a cool one after a long day? Nothing, say alcohol experts. It's what happens after more than one drink that is troubling. And all too often, 'having a drink' in fact amounts to two, three, or even more visits to the liquor cabinet. Additional drinks can boost confidence levels in some people, and can free others from the shackles of shyness. But most consumers experience the depressant effects of alcohol, leading to fatigue and negativity.

Alcohol shouldn't be considered a health measure. If you've never been much of a drinker, there's no health-related reason to add the substance to your routine. According to health experts, a strong heart and stress-free existence are better achieved through adequate exercise and a healthy diet.

### How alcohol can compromise good health

**Women's bodies more vulnerable to harm from alcohol**

When it comes to alcohol consumption, men and women are anything but equal, and women are particularly vulnerable to the physical effects of alcohol.

- Lower body weight and less water in the body mean women cannot safely consume the same amount of alcohol as men.
- Women drinkers develop liver cancer and damage to their brain structure after fewer

LINK

Descriptive Epidemiology

Distribution

Analytic Epidemiology

Determinants

Action

Prevention

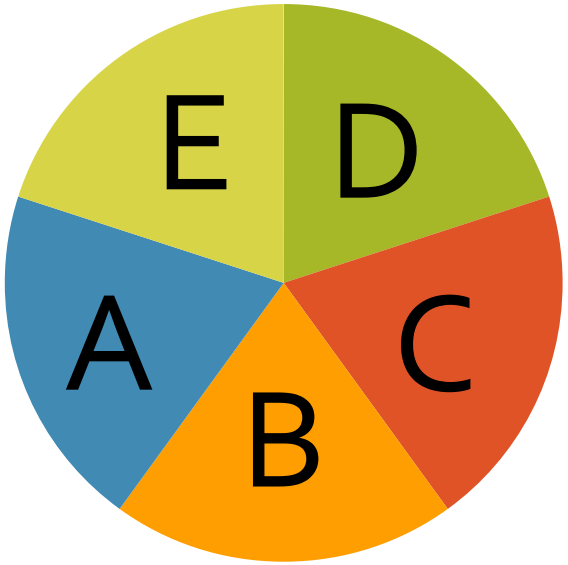
# Cause:

*An event, condition, or characteristic or, more often, a combination of these factors that plays an essential role in producing an occurrence of the disease* –Webb and Bain (2011), as cited in Rothman (1986).

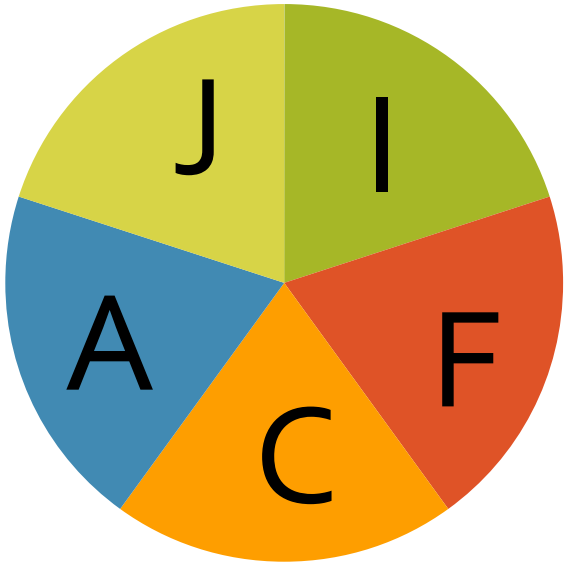
- Component cause: a factor that contributes towards disease causation, but is not sufficient to cause disease on its own. (i.e. risk factors)
- Sufficient cause: a factor (or combination of several factors) that will inevitably produce disease
- Necessary cause: any agent (or component cause) that is *required* for the development of a disease.

-Webb & Bain (2011)

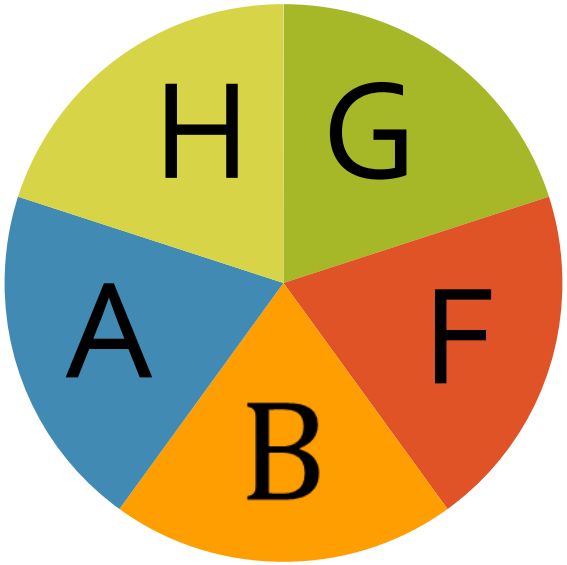
**Sufficient Cause I**




**Sufficient Cause III**



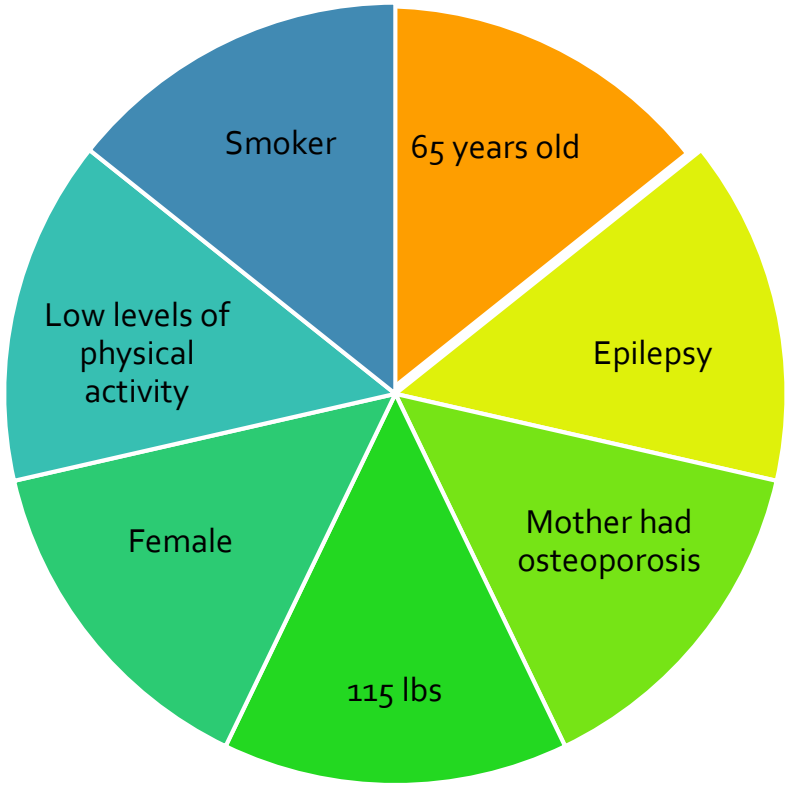

**Sufficient Cause II**



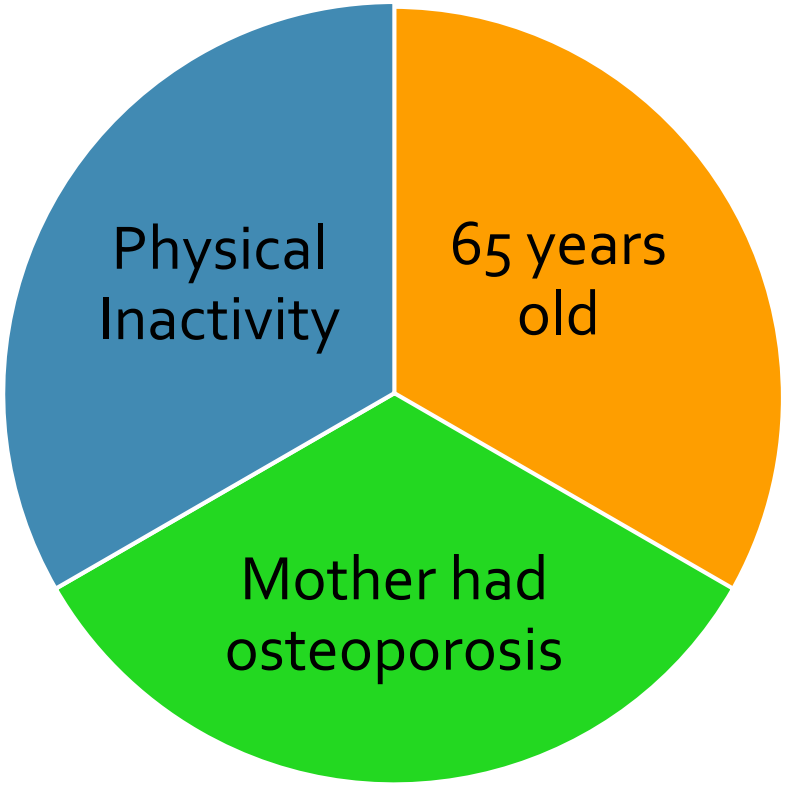

- Rothman & Greenland (2005)

# Osteoporosis Risk Factors:

- Women
- Older age
- Ethnicity
- Family History
- History of fracture
- Early Menopause
- Poor diet
- Physical inactivity
- Smoking
- Medications
- Low body weight
- Medical conditions affecting balance
- Disability



Osteoporosis: Sufficient Cause #2



What epidemiologic measurement allows us to determine the proportion of disease in a population which could have been avoided if there had been no exposure?

A. Relative Risk
B. Attributable Risk
C. Population Attributable Fraction
D. Cumulative Incidence Rates

Who should the prevention target? Those at

# HIGH RISK OR EVERYONE?

# AREAS OF PRIMARY PREVENTION FOCUS

1. **High-risk population**
2. Whole population

# High-Risk Population Focus

- Focus on segment of the population that is most likely to experience health problems based on their:
  - **Current behaviours** (smoking, exercise/ eating habits, alcohol/drug use)
  - **Current biological markers** (BMI, blood pressure, blood sugar control, immune system function)

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Health

# High blood pressure found in 19% of Canadians

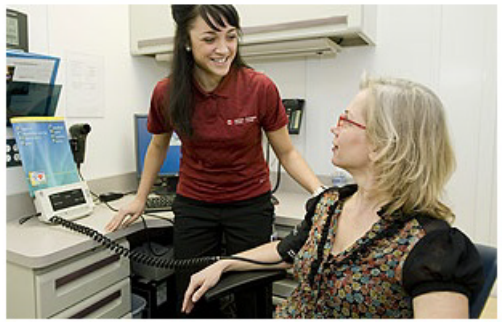
Last Updated: Wednesday, February 17, 2010 | 9:49 PM ET CBC News

1 in 5 Canadians has high blood pressure, Statistics Canada says

Blood pressure stats 2:58

Nearly one in five Canadians adults — about 4.6 million people between the ages of 20 and 79 — has high blood pressure, Statistics Canada reported Wednesday.

The study was based on automated measurements of blood pressure and self-reported use of blood pressure medication, the department said in its publication Health Reports.



Jennifer Patry-Parisien, of Statistics Canada, demonstrates a blood pressure test on Josee Savoie at a mobile examination centre in Laval, Que., in January 2009. (Graham Hughes/Canadian Press)

When blood pressure is too high, it puts stress on the body's entire vascular system, forcing the heart to work harder, and increasing the risk of death from a variety of causes including heart disease and stroke.

As part of the broader Canadian Health Measures Survey, researchers surveyed and tested 5,600 Canadians aged six to 79 years between March 2007 and February 2009 at mobile examination centres.

Participants were classified as having hypertension or high blood pressure if their systolic pressure, the top number, was 140 or higher, their diastolic pressure, or bottom number, was 90 or higher, or they reported they had used medication for high blood pressure in the past month.

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**Internal Links**
- Canadians' fitness levels plummet
- P.O.V.: High blood pressure: How do you control it?
- IN DEPTH: High blood pressure: Canada's crisis in the making
- High blood pressure linked to dementia

**External Links**
- Blood pressure in Canadian adults, Statistics Canada

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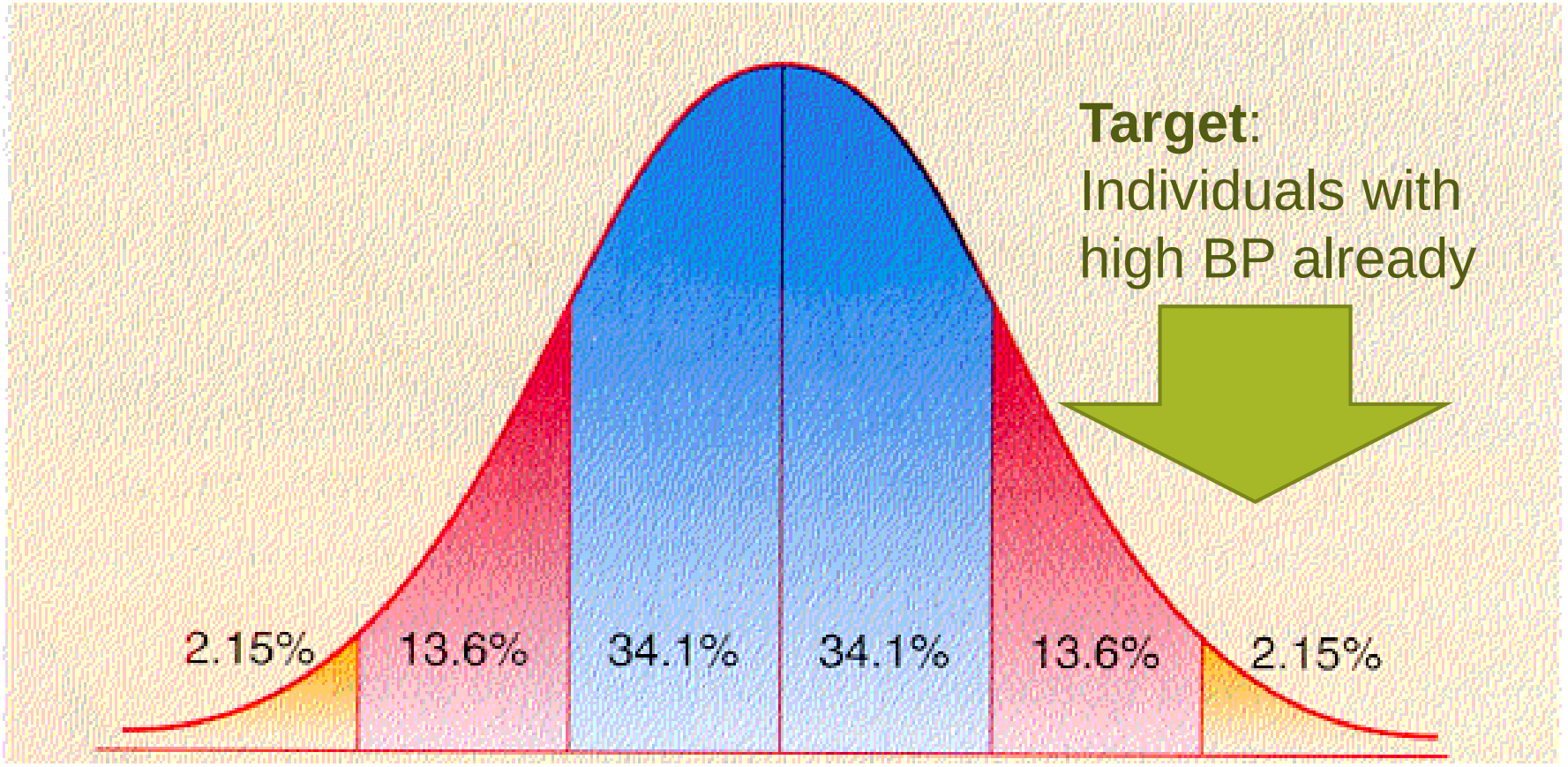
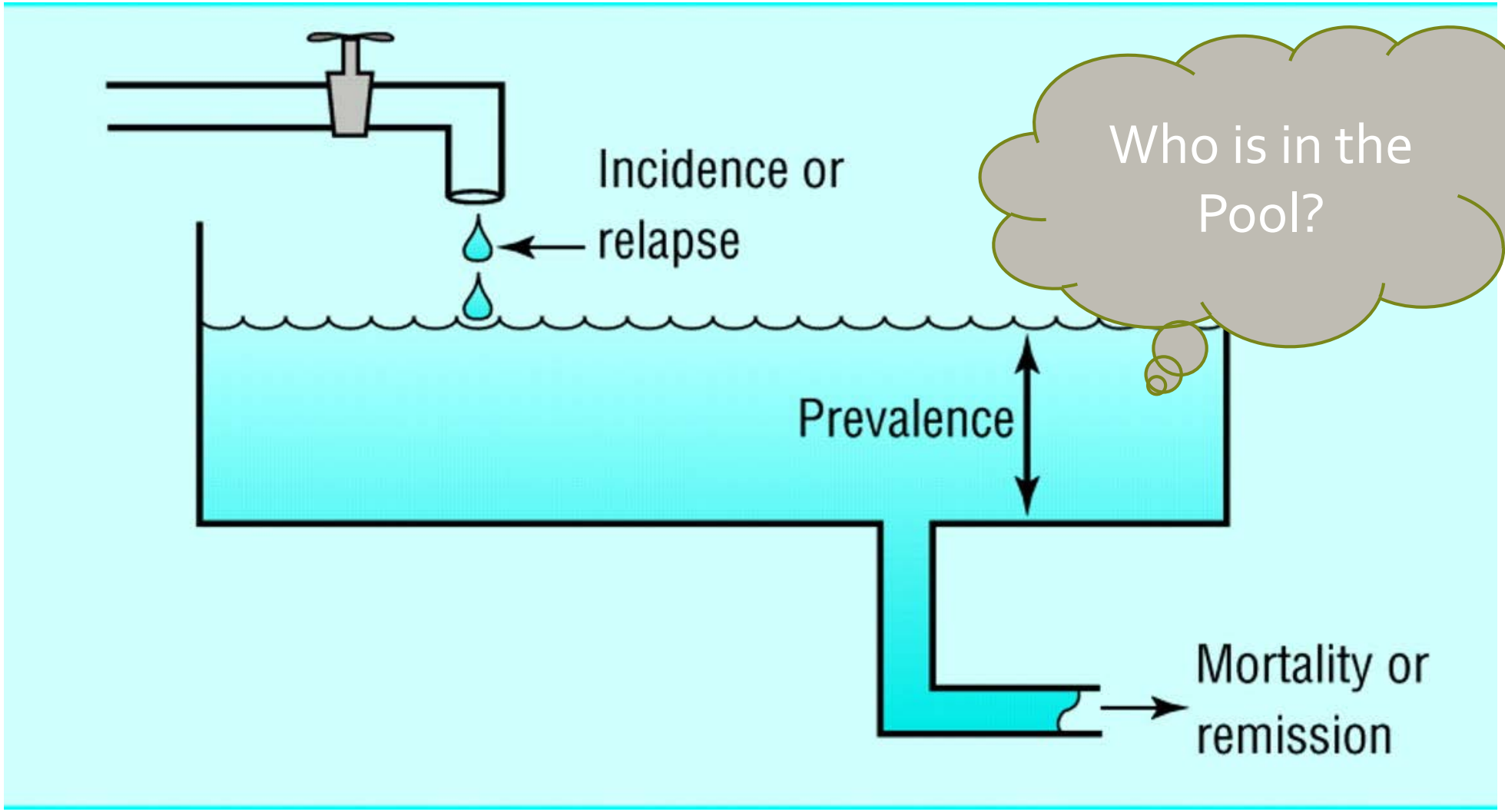
Example - **High blood pressure**

# 1. High-Risk Focus



# Key Problem with High-Risk Focus?



# Strategy 1
# **High-Risk Focus**

**Strengths**

- Large benefit to those most likely to experience health problems in future.

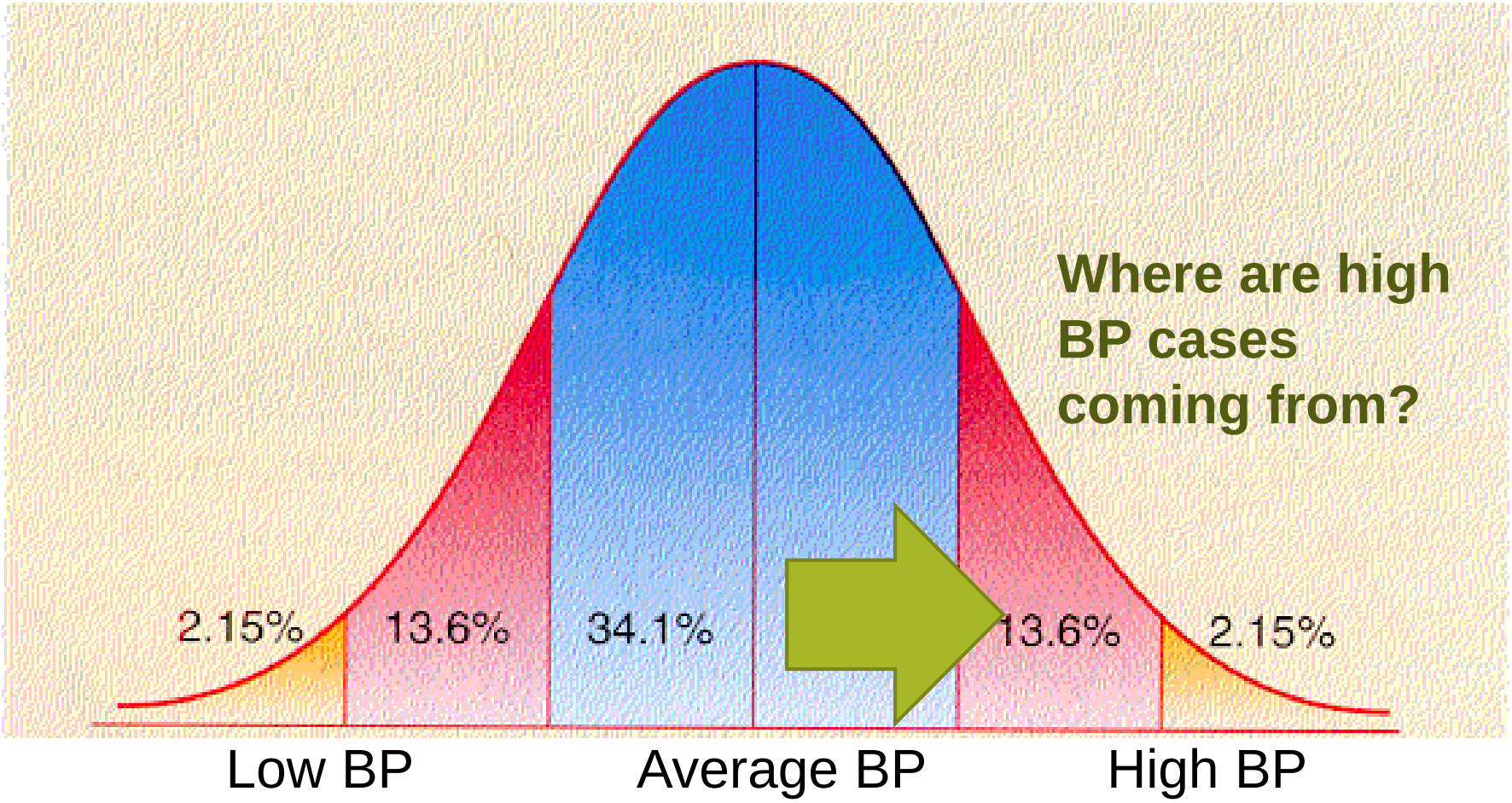
**Weaknesses**

- Focus on a small part of population – there is little benefit to population as a whole
- ****Does not reduce** incidence** (tap on at same strength)

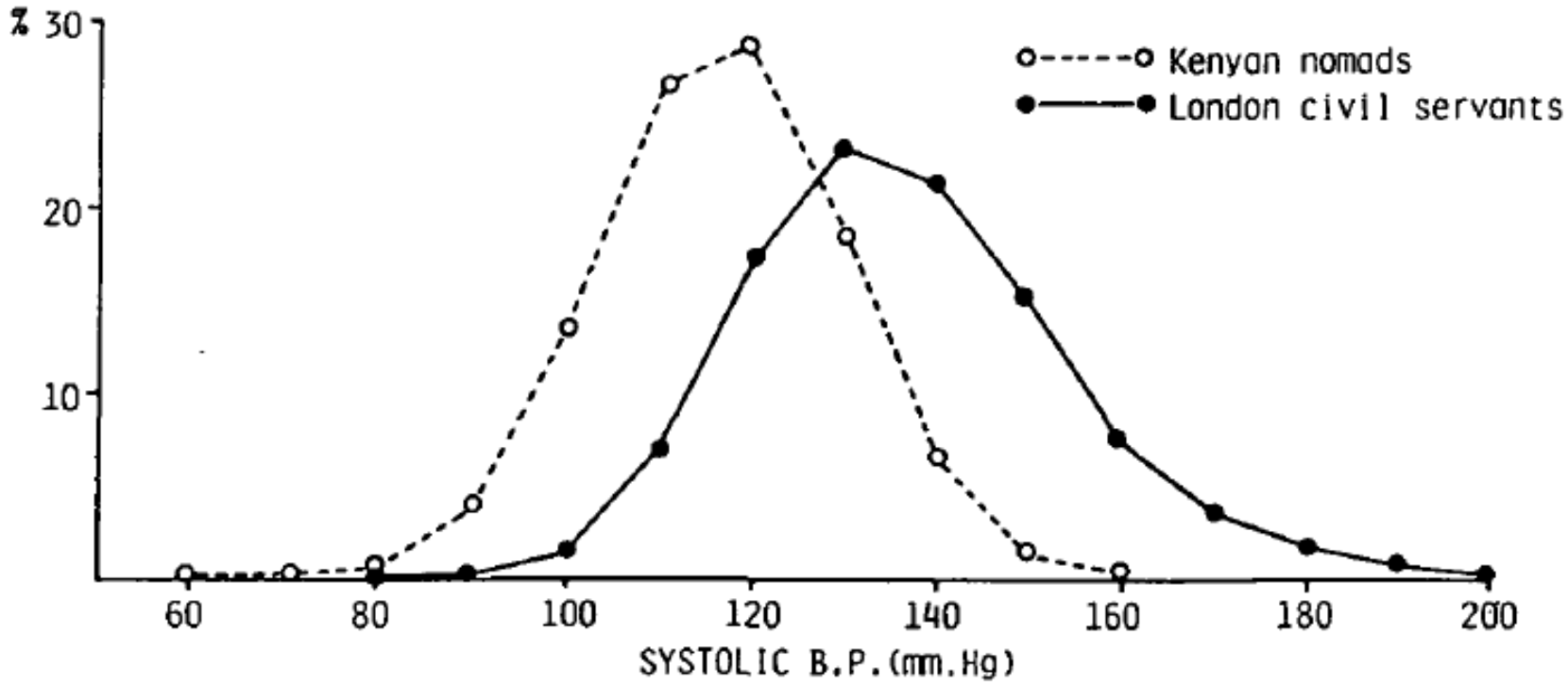
# AREAS OF PRIMARY PREVENTION FOCUS

1. High-risk population
2. **Whole population**

# What is Determining High Incidence?



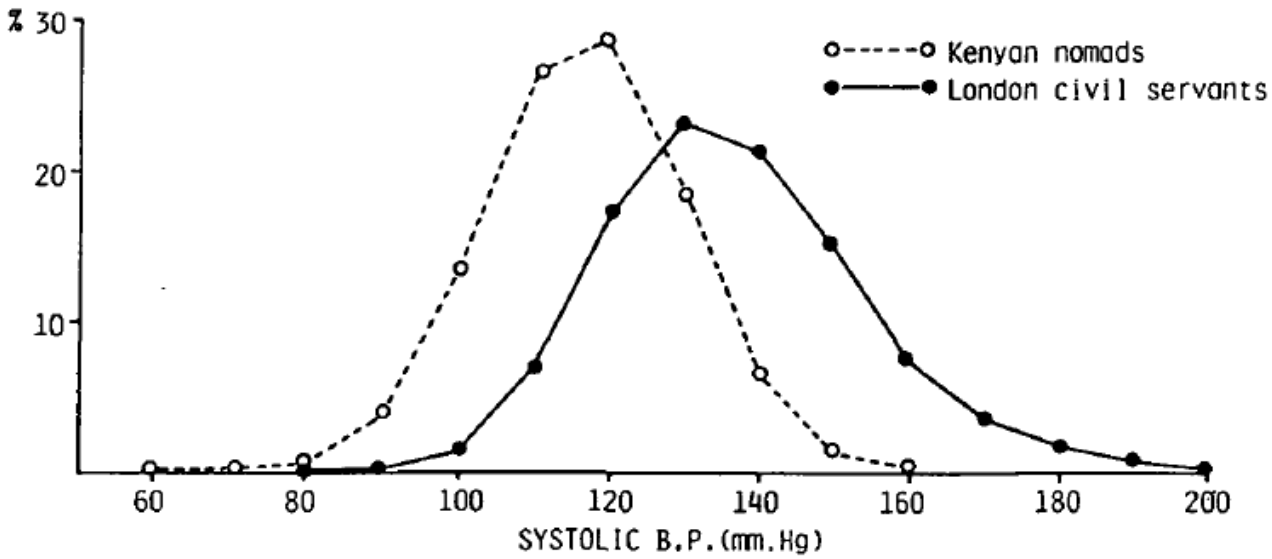
# What is causing average blood pressure to be higher in some populations?




Link to full reference

# Whole Population Focus

- Are we focused on the causes of cases *or* causes of incidence? These 2 questions are asking *very different things*:
  - Why do some individuals have high blood pressure
  - Why do some populations have more high blood pressure

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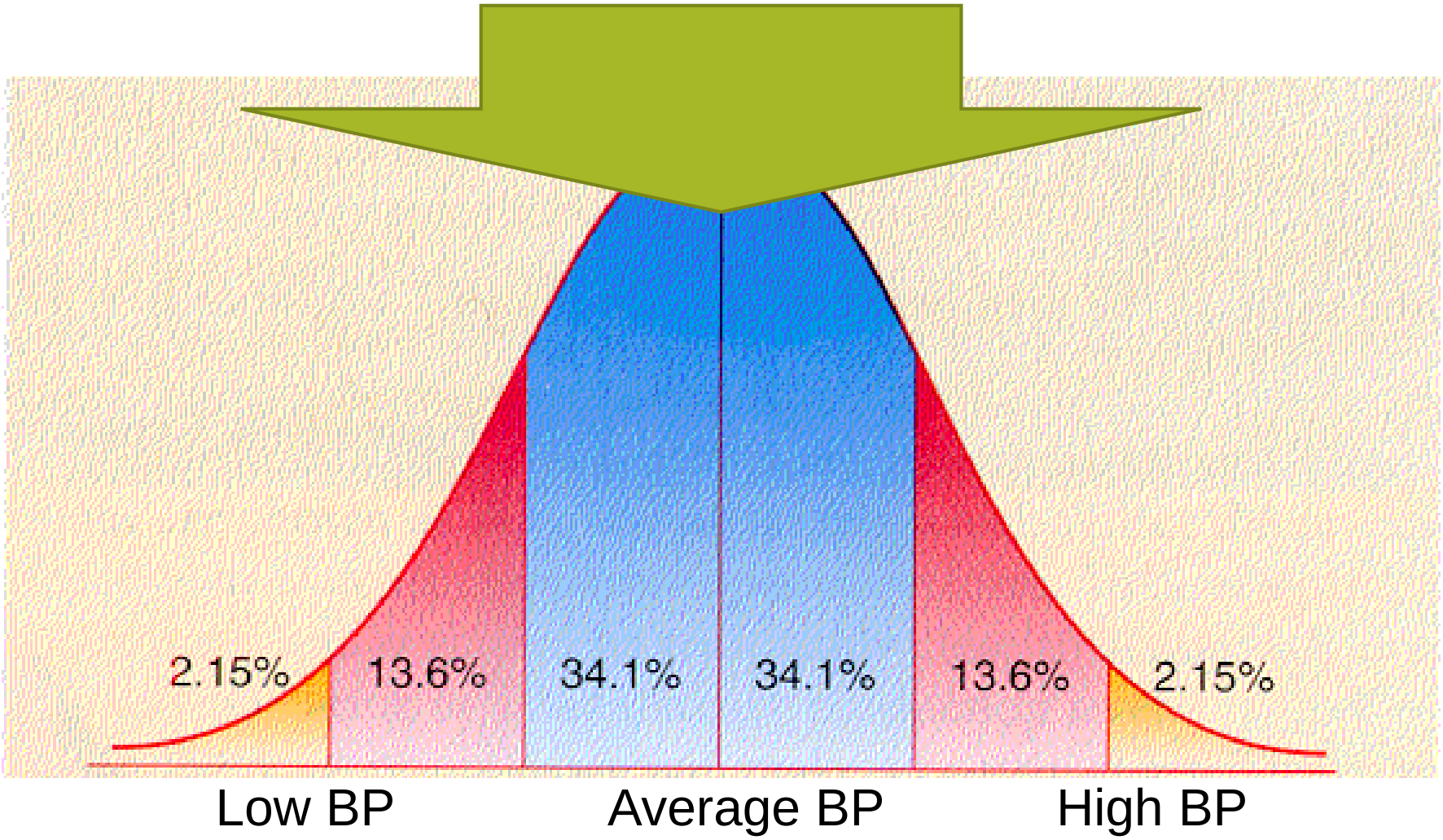
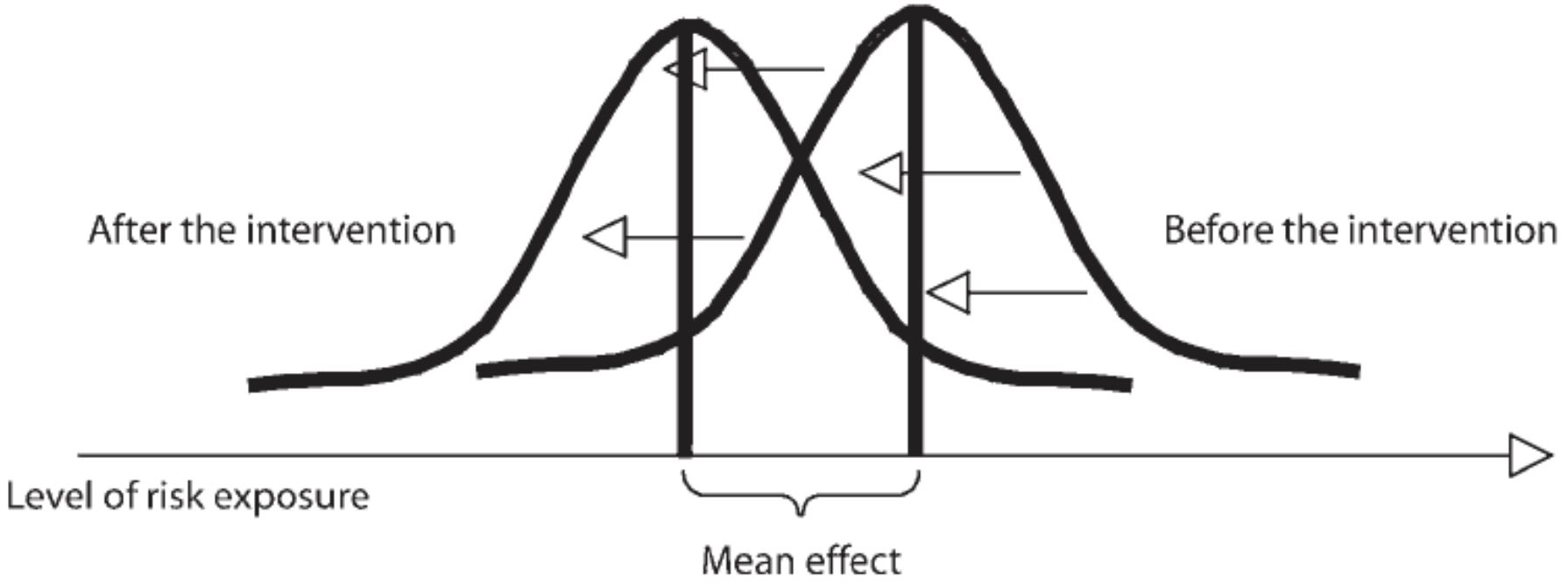
# 2. Whole Population Focus



# 2. Whole Population Focus




*Note.* Arrows indicate where the lines of the distribution would be after a population-level approach.

# 2. Whole Population Focus

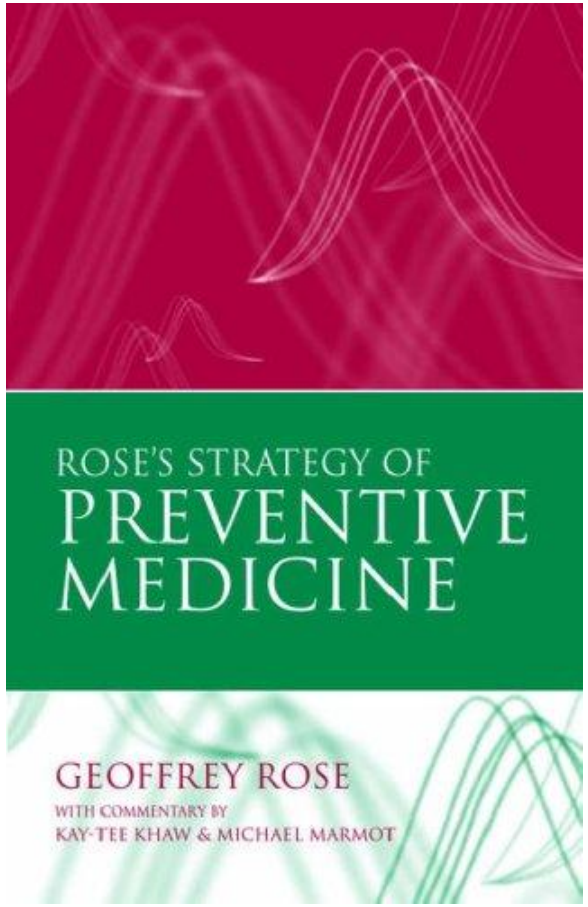
**Strengths**

- Small benefit to large number of people.
- Targets incidence of disease

**Weaknesses**

- May be controversial (fluoridation of water)
- Offers little benefit for each individual
- Hard to change public behaviour – need strategic approach that goes beyond education

# Dr. Geoffrey Rose




- Personal lifestyle is socially conditioned.
- It makes little sense to expect individuals to behave differently than their peers.
- It is more appropriate to **seek a general change in the circumstances which facilitate the adoption of behaviours**. (Geoffrey Rose, 2008)


Link to commercial

# Rose's Two Approaches to Prevention:

# Benefits

## The individual or "high risk" approach

(the causes of cases)

*Benefits:*

-Intervention is appropriate to the individual

-Greater motivation of the subject (due to risk)

-Incentive or motivation of the Physician

-Cost-effective use of resources – directed at those who need them most

-Benefit to risk ratio is favourable

## The population approach

(the causes of incidence)

*Benefits:*

-Radical

-Reduced illness in the whole population, including those at low or average risk

-Behaviourally and socially appropriate as behaviours are accepted based on the status quo

-Addresses conditions at their earliest stage, when interventions are more effective.

# Rose's Two Approaches to Prevention:
# Limitations

## The individual or "high risk" approach

(the causes of cases)

*Limitations:*

-difficulty and cost of identifying and screening high risk individuals.

-reaches those at most risk, but little impact on the overall disease burden

-Palliative and temporary

-limited potential for individual and populations

-behaviourally inappropriate

## The population approach

(the causes of incidence)

*Limitations:*

-small benefit to the individual (prevention paradox)

-poor motivation of subjects

-poor motivation of physicians

-Benefit to risk ratio minimal

-question of ethics (social engineering)

Arguing for population based approaches to prevention, Geoffrey Rose suggests that…

*"a large number of people at a small risk may give rise to more cases of disease than the small number who are at high risk"*

*(i.e. the cause of the incidence)*

# Example: incidence of down's syndrome

## Sick individuals and sick populations

**Table 4**
Incidence of Down's syndrome according to maternal age[7]

| Maternal age (years) | Risk of Down's syndrome per 1000 births | Total births in age group (as % of all ages) | % of total Down's syndrome occurring in age group |
|---|---|---|---|
| <30 | 0.7 | 78 | 51 |
| 30–34 | 1.3 | 16 | 20 |
| 35–39 | 3.7 | 5 | 16 |
| 40–44 | 13.1 | 0.95 | 11 |
| ≥45 | 34.6 | 0.05 | 2 |
| All ages | 1.5 | 100 | 100 |

http://ije.oxfordjournals.org/content/30/3/427/T4.expansion.html

**Table 4.1: Examples of primary, secondary, and tertiary prevention interventions targeting individuals and populations**

| Disease | Intervention level | Primary | Secondary | Tertiary |
|---|---|---|---|---|
| Colorectal cancer | Individual | Counselling on healthy lifestyles: dietary counselling for people at risk of colorectal cancer, etc. | Hemoccult stool testing to detect colorectal cancer early | Follow-up exams to identify recurrence or metastatic disease: physical examination, liver enzyme tests, chest x-rays, etc. |
| | Population | Publicity campaigns alerting the public to the benefits of lifestyle changes in preventing colorectal cancers; promotion of high fibre diets; subsidies to help people access exercise programmes; anti-smoking campaigns | Organized colonoscopy screening programs | Implementation of health services organizational models that improve access to high-quality care |
| Infectious diseases: hepatitis C | Individual | Counselling on safe drug use to prevent hepatitis C virus (HCV) transmission; counselling on safer sex | Screening for HCV infection of patients with a history of injection drug use | HCV therapy to cure infection and prevent transmission |
| | Population | HCV prevention includes safer sex practices, programmes to discourage needle sharing among intravenous drug users, etc. | Establish a universal testing system for HCV in high risk groups | (Similar to primary prevention): ensuring close control of high risk sites such as tattoo parlours that have been associated with outbreaks |
| Metabolic syndrome | Individual | Nutrition and exercise counselling | Screening for diabetes | Referral to cardiac rehabilitation clinics |
| | Population | Built environment favourable for active transport (walking, bicycling rather than using a car) | Community level weight loss and exercise programs to control metabolic syndrome | Implementation of multidisciplinary clinics |

(The Association of Faculties of Medicine in Canada, n.d.)

http://phprimer.afmc.ca/Part1-TheoryThinkingAboutHealth/Chapter4BasicConceptsInPreventionSurveillanceAndHealthPromotion/Thestagesofprevention

Effective primary prevention interventions will reduce _____ in a population:

A. Incidence
B. Prevalence
C. Both incidence and prevalence

Tertiary prevention interventions will have no influence on incidence, and will potentially increase prevalence.

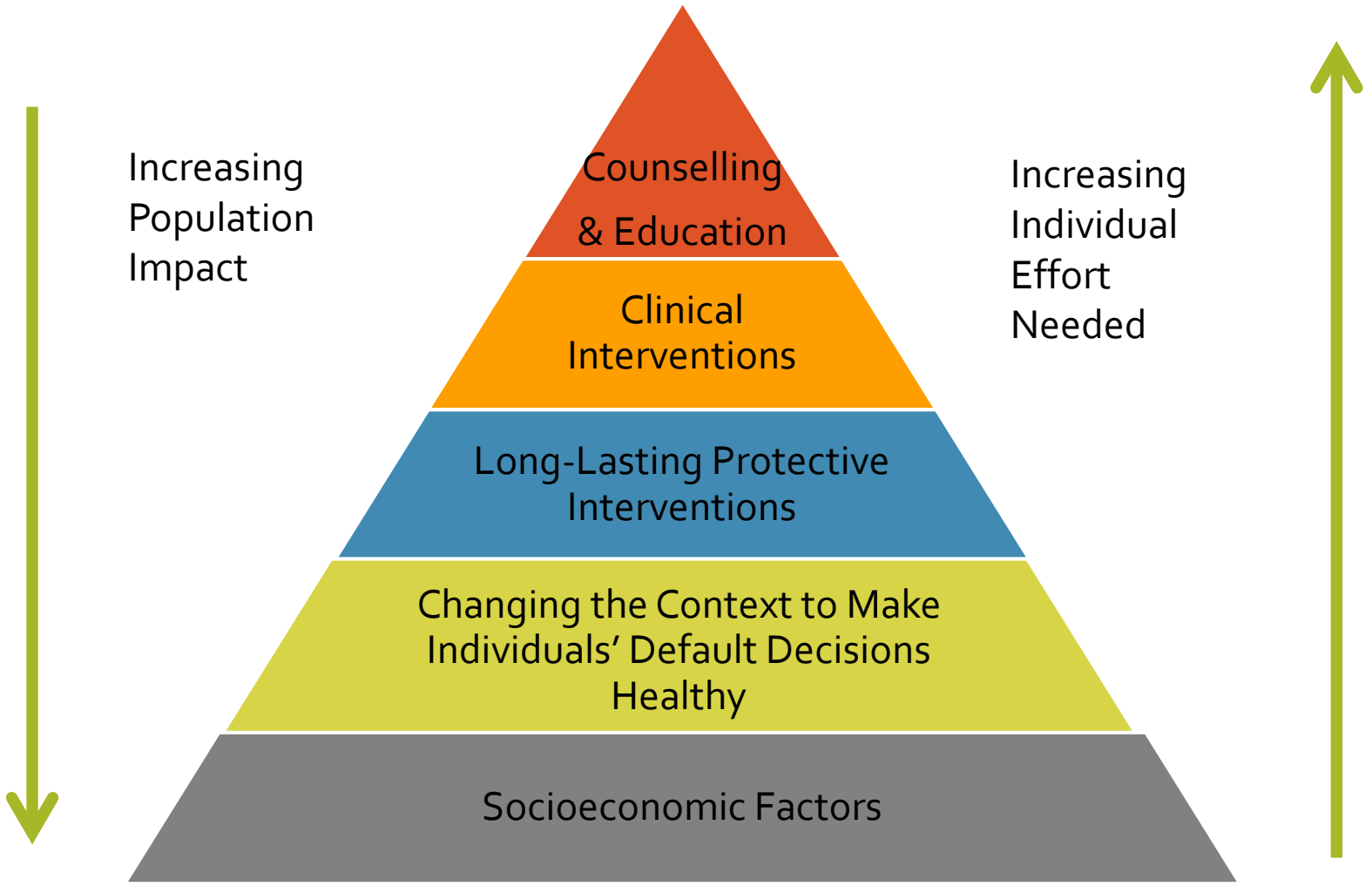
A. True

B. False

# Health Impact Pyramid: (Frieden, 2010)

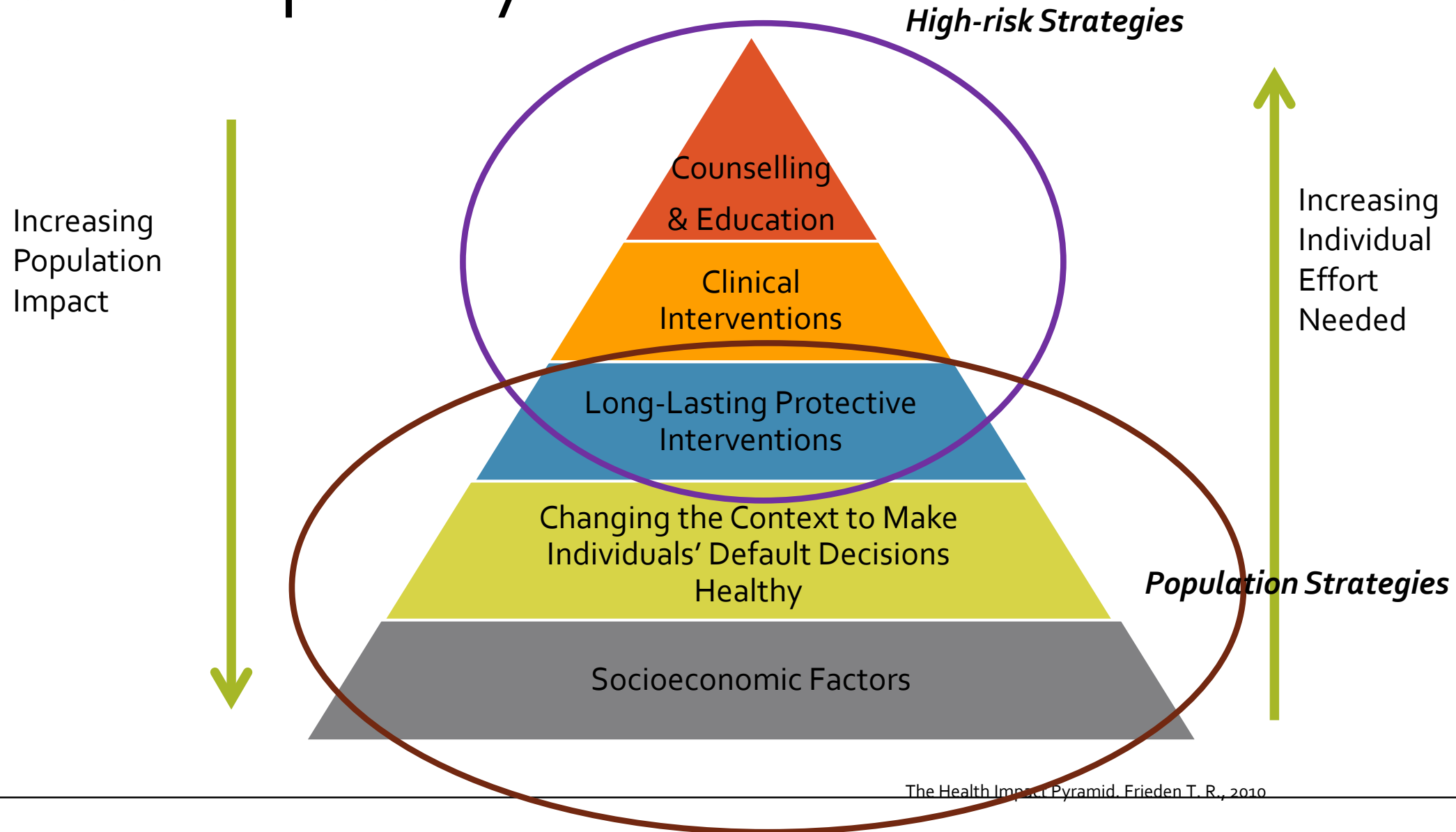
- A 5 –tiered pyramid describing the impact of different public health interventions
- Interventions at the bottom of the pyramid have greater public health impact because they reach a broader segment of society.
- Greatest effectiveness would be implementing interventions at all levels of the pyramid to maximize public health benefit

# Health Impact Pyramid




The Health Impact Pyramid. Frieden T. R., 2010

# Health Impact Pyramid




The Health Impact Pyramid. Frieden T. R., 2010

# AN EVIDENCE-BASED APPROACH TO PRIMARY PREVENTION

Montana Meth Project

# Primary Prevention Example
# The Montana Meth Project

- Founded by billionaire Tom Seibel – he invested more than $25 million between 2005-07. The project was given $3.5 million by governments in 2007.
- Since 2007, the project has been expanded into 7 additional US states.
- Montana was saturated with 45 000 TV ads, 35 000 radio ads, 10 000 print impressions & 1000 billboards between 2005-07.
- The ads portray the consequences of meth use, depicting rape, robbery, prostitution and various disfigurements, including rotten teeth, severe weight loss, scars and scabs.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# Does information matter? The effect of the Meth Project on meth use among youths☆

D. Mark Anderson*

*Department of Economics, University of Washington, Box 353330, Savery 305, Seattle, WA 98195-3330, USA*

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ABSTRACT

Are demand-side interventions effective at curbing drug use? To the extent demand-side programs are successful, their cost effectiveness can be appealing from a policy perspective. Established in 2005, the Montana Meth Project (MMP) employs a graphic advertising campaign to deter meth use among teens. Due to the MMP's apparent success, seven other states have adopted Meth Project campaigns. Using data from the Youth Risk Behavior Surveys (YRBS), this paper investigates whether the MMP reduced methamphetamine use among Montana's youth. When accounting for a preexisting downward trend in meth use, effects on meth use are statistically indistinguishable from zero. These results are robust to using related changes of meth use among individuals without exposure to the campaign as controls in

# Findings – Anderson (2010)

- "…the effects on meth use are statistically indistinguishable from zero."
- "…the Montana Meth Project's campaign **did not contribute to a decrease** in meth use among Montana's youth."
- "…this study calls for future research to **focus on the determinants of youth meth use** so as to better guide the allocation of resources towards effective policies."

LINK to article
LINK to original study

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For Immediate Release: Thursday, December 22, 2011

## HIV study named 2011 Breakthrough of the Year by Science

*NIH-funded treatment-as-prevention study heralded as a major advance*

Institute/Center

National Institute of Allergy and Infectious Diseases (NIAID)

Contact

Kathy Stover
301-402-1663

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he journal Science has chosen the HPTN 052 clinical trial, an international HIV prevention trial sponsored by the National Institute of Allergy and Infectious Diseases (NIAID), part of the National Institutes of Health, as the 2011 Breakthrough of the Year. The study found that if HIV-infected heterosexual individuals begin taking antiretroviral medicines when their immune systems are relatively healthy as opposed to delaying therapy until the disease has advanced, they are 96 percent less likely to transmit the virus to their uninfected partners. Findings from the trial, first announced in May, were published in the New England Journal of Medicine in August. The complete top 10 list of 2011 scientific breakthroughs appears in the Dec. 23, 2011 issue of Science.

"The HPTN 052 study convincingly demonstrated that antiretroviral medications can not only treat but also prevent the transmission of HIV infection among heterosexual individuals," said NIAID Director Anthony S. Fauci, M.D. "We are pleased that Science recognized the extraordinary public health significance of these study results. This recognition also is a credit to the hard work and dedication of the HPTN 052 researchers and the more than 3,000 study participants who selflessly gave their time and energy to make such a significant contribution to the fight against HIV/AIDS."

Led by study chair Myron Cohen, M.D., director of the Institute for Global Health and Infectious Diseases at the University of North Carolina at Chapel Hill, HPTN 052 began in 2005 and enrolled 1,763 heterosexual couples in Botswana, Brazil, India, Kenya, Malawi, South Africa, Thailand, the United States and Zimbabwe. Each couple included one partner with HIV infection. The investigators randomly assigned each couple to either one of two study groups. In the first group, the HIV-infected partner immediately began taking a combination of three antiretroviral drugs. The participants infected with HIV were extensively counseled on the need to consistently take the medications as directed. Outstanding compliance resulted in the nearly complete suppression of HIV in the blood (viral load) of the treated study participants in group one.

# TREATMENT AS PREVENTION

HIV Prevention Trials Network (HPTN) 052

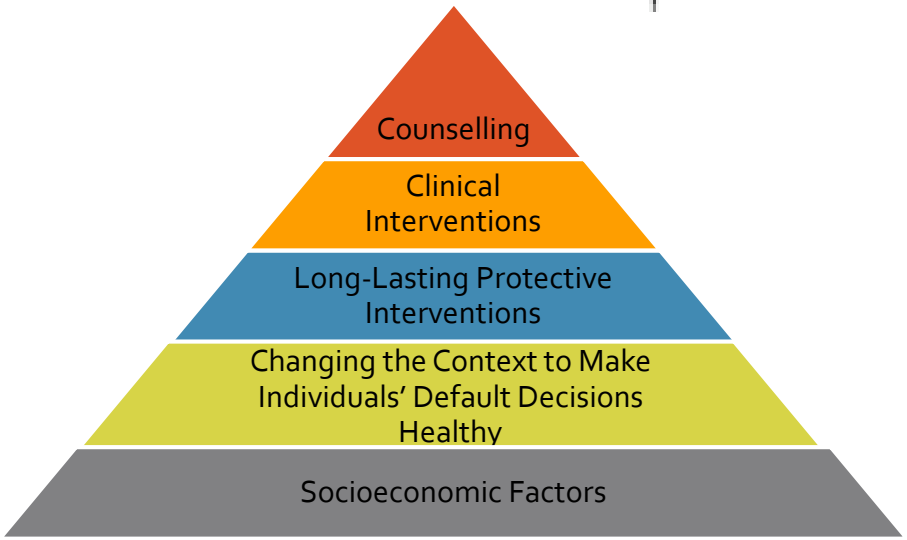
# What level of prevention would early initiation of ART be?

A. Primary
B. Secondary
C. Tertiary

# Is this a high-risk or a population approach to prevention?

A. High-risk
B. Population
C. Both

"On its own, treatment as prevention is not going to solve the global HIV/AIDS problem," said Dr. Fauci. "Yet when used in combination with other HIV prevention methods – such as knowing one's HIV status through routine testing, proper and consistent condom use, behavioral modification, needle and syringe exchange programs for injection drug users, voluntary, medically supervised adult male circumcision, preventing mother-to-child transmission, and, under some circumstances, antiretroviral use among HIV-negative individuals – we now have a remarkable collection of public health tools that can make a significant impact on the HIV/AIDS pandemic."



**Featured Research** *from universities, journals, and other organizations*

# 'Distracted driving' at an all-time high; new approaches needed, experts say

*Date:* March 17, 2015

*Source:* Oregon State University

*Summary:* The advent of cell phones, text messaging and heavy urban traffic has taken the issue of 'distracted driving' to a historic level, a new report says, although it also identifies some training approaches that may be of value in educating young drivers about these special risks.

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Young, inexperienced drivers have always gotten into more automobile accidents, but if you add in a lot of distractions, it's a recipe for disaster -- and a new Pacific Northwest research program is learning more about these risks while identifying approaches that may help reduce them.

Distractions have been an issue since the age of the Model T, whether a driver was eating a sandwich or talking to a passenger. But the advent of cell phones, text messaging and heavy urban traffic has taken those distractions to a historic level, say researchers, who emphasize that there appears to be value in educating young drivers about these special risks.

A new study of 3,000 teenage drivers in Alaska, Washington, Idaho and Oregon has found that interactive presentations administered to young drivers in a classroom or auditorium -- more than passive listening -- can have some ability to raise their

**Related Articles**

- Cyber-bullying
- Mobile phone
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- Road-traffic safety
- Automobile safety

A *high-risk* or *population based* approach to prevention needed?

# IN-CLASS ASSIGNMENT #5

## BASED ON THE TWO INTERVENTIONS YOU SELECTED:

1. How "upstream" are your interventions?
2. Would it fall under Primary, secondary, tertiary prevention (or more than one)?
3. Are they high risk or population focus?
4. Where do they fit on the health impact pyramid?
5. Do you feel that this intervention is supported by strong evidence? (rate on a scale of 1-10 and justify)

# MIDTERM REVIEW

20 minutes