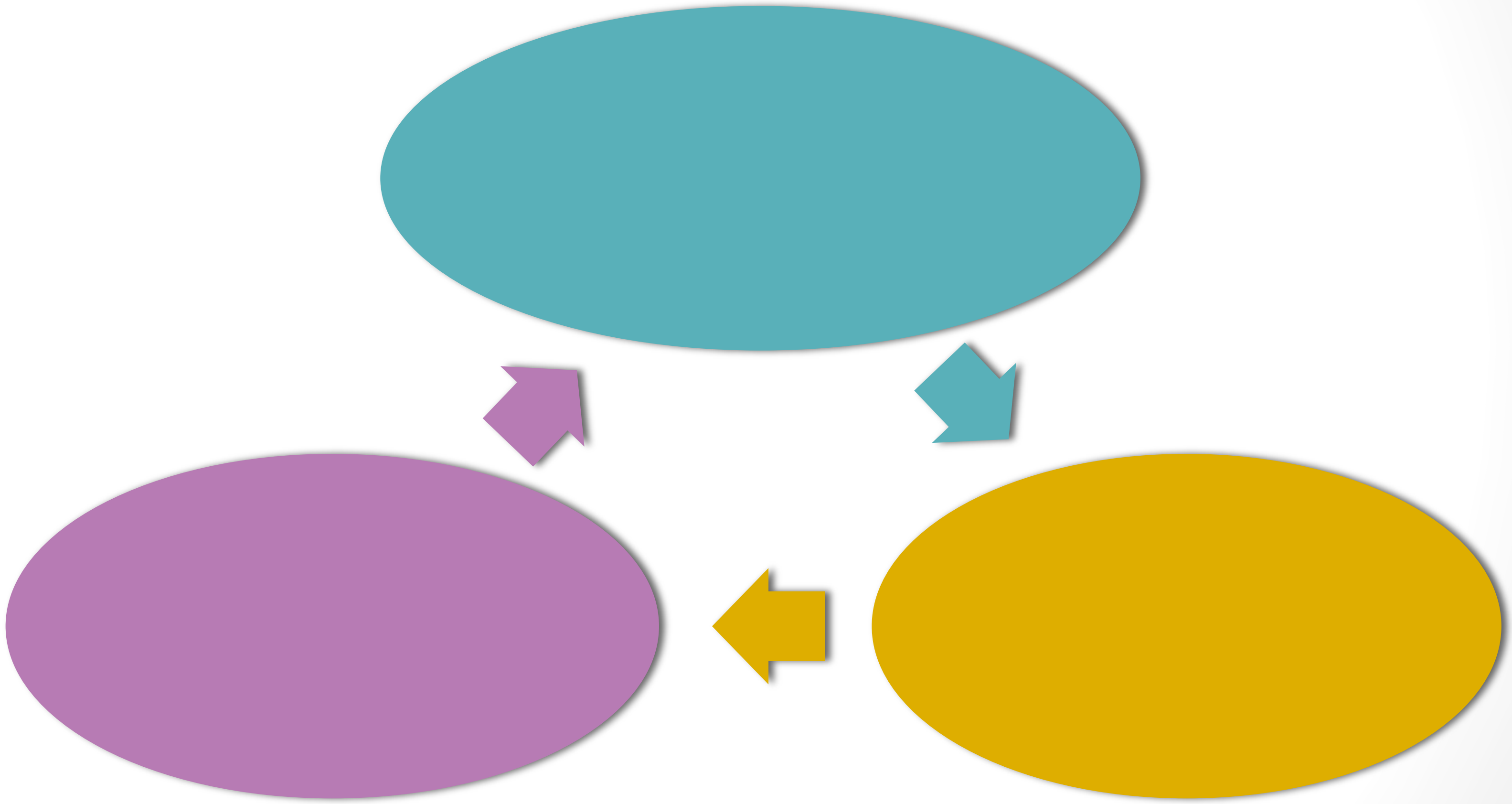
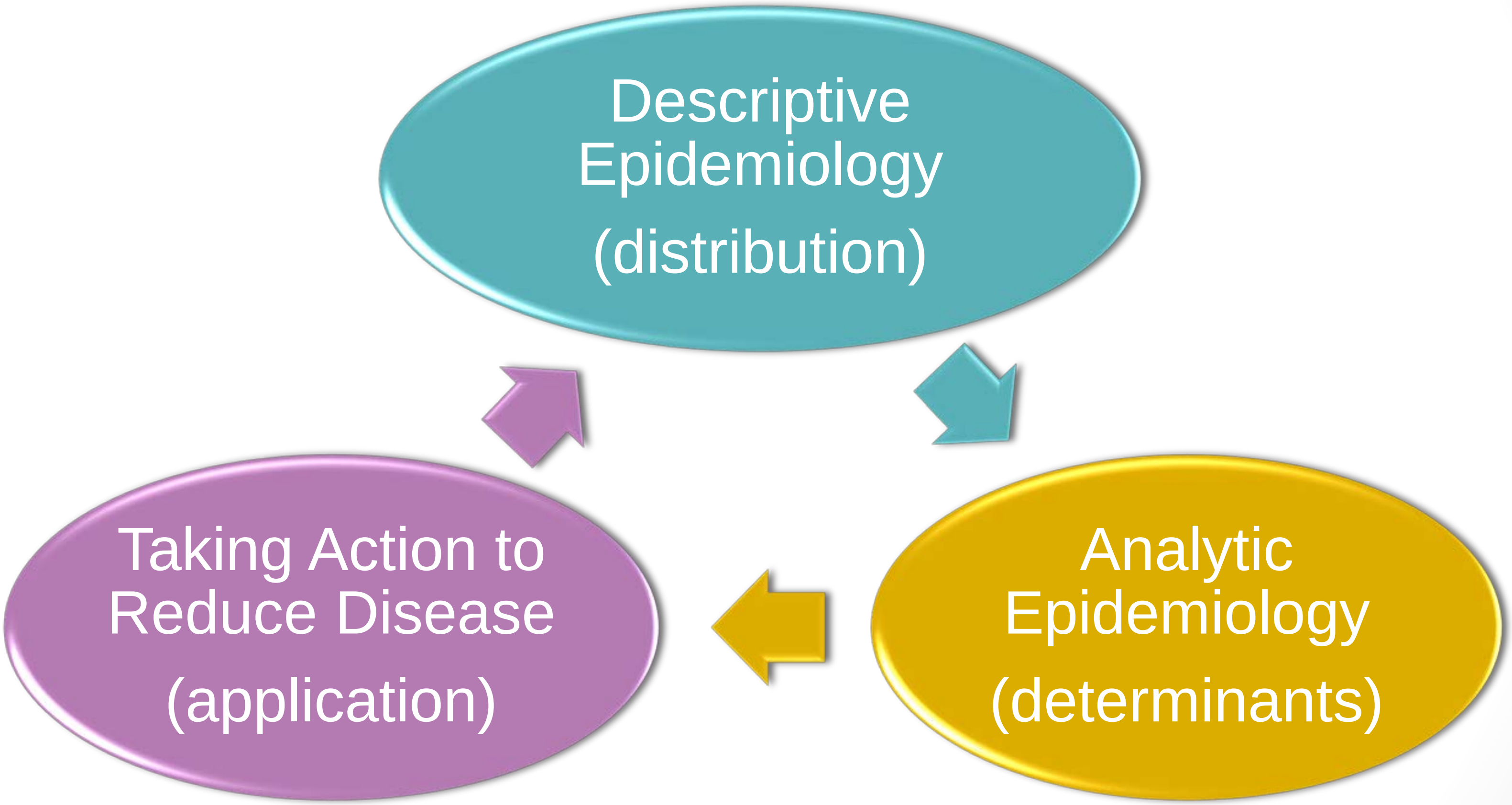
Class 2:
Key Concepts in Epidemiology

HLSC 2003
Spring 2016
Walker

Cycle in Epidemiologic Work



Cycle in Epidemiologic Work



Epi in the News

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Tobogganing bylaw in Calgary lists only 18 legal locations

Sledding elsewhere could bring $100 fine

By Devin Heroux, CBC News Posted: Jan 08, 2015 8:24 PM MT | Last Updated: Jan 10, 2015 9:58 AM MT

Tobogganing fines 1:43

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Tobogganing in Calgary 6:25

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It's a favourite winter pastime for many, but did you know that tobogganing in undesignated areas in Calgary could land you a ticket?

There are 18 designated spots in Calgary for the popular winter activity. Sledding anywhere else is illegal and could land you a $100 fine.

Todd Reichardt, an employee of Calgary's parks department, said the city has not issued any tickets to rogue tobogganers. He said the city's aim in restricting the activity to approved sites is to ensure a safe

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Canadian Institute for Health Information
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LINK to Report

Table 1: Number of Hospitalizations Due to Winter Sports and Recreational Activities, by Cause and Fiscal Year, 2006–2007 to 2010–2011

Table 1: Number of Hospitalizations Due to Winter Sports and Recreational Activities, by Cause and Fiscal Year, 2006–2007 to 2010–2011

Activity*	Fiscal Year				
	2006–2007	2007–2008	2008–2009	2009–2010	2010–2011
Ice Hockey	1,221	1,099	1,099	1,188	1,114
Ice Skating	888	863	853	870	889
Skiing/Snowboarding	2,364	2,573	2,464	2,443	2,329
Snowmobiling	1,195	1,295	1,231	1,228	1,126
Tobogganing	252	215	189	204	171
Total	**5,920**	**6,045**	**5,836**	**5,933**	**5,629**

Snow-Related Recreational Injuries in Children: Assessment of Morbidity and Management Strategies

By David J. Hackam, Margaret Kreller, and Richard H. Pearl
Toronto, Ontario

LINK

Purpose: The aim of this study was to investigate the causes, clinical course, and financial impact of snow-related sport injuries in children.

Methods: Reports of snow-related injuries (skiing, tobogganing, snowboarding) occurring in 147 consecutive children (≤16 years of age) admitted from 1991 through 1997 were collected prospectively and assessed retrospectively. During the last year of the study, outpatients treated and released from the emergency department (1996 through 1997) were examined in parallel (n = 101). Total financial impact was determined from the aggregate hospital, rehabilitation, and societal costs.

Results: One hundred thirty-seven patients (M:F, 2:1; mean age, 13 yrs) were admitted (toboggan [n = 74], ski [n = 59], snowboard [n = 16]), of which 66% occurred at licensed resorts, and 33% at parks or private property. There was one death. Although the pattern of injury was similar in all groups (head greater than long bone greater than intraabdominal injuries), mean injury severity scores (ISS) were significantly higher for snowboard injuries. Seventy-five percent of patients required at least one operation. Postdischarge, 15% of patients required institutional care. Of the 101 ambulatory patients (ski [n = 48], toboggan [n = 35], snowboard [n = 18]), 65% were injured at licensed resorts, and 56% required outpatient rehabilitation or home care. The per-patient costs were: hospital treatment, $27,936; outpatient services, $15,243; lost parental income, $1,500.

Conclusions: Snow sport injuries, particularly snowboarding, cause severe childhood morbidity. Helmet usage, training requirements, and regulation of licensed resorts may reduce the morbidity and staggering costs.

J Pediatr Surg 33:65-69.

INDEX WORDS: Trauma, ski, snowboard, toboggan, financial impact.

TRAUMATIC INJURY is by far the leading cause of disability and death in children.[1] A significant fraction of pediatric injuries occur in the context of recreational activities and reflect in part the increased resources and leisure time available to today's youth.[1,2] Snow-sports, which include skiing, tobogganing, and snowboarding, steadily have gained popularity in the general population and not surprisingly are enjoyed by increasing numbers of children.[3-7] The high speeds attained combined with the relative lack of control exerted over steering and braking have resulted in frequent and severe injuries when snow-sports equipment is used by children, particularly in the novice stage.[8,9] Despite the relatively frequent occurrence of snow-sport injuries in the pediatric population, little information is available regarding the causes and patterns of such injuries and appropriate prevention strategies. In addition, whereas the financial impact of such injuries to both the health treatment strategies involved, we examined the records of all children who were admitted to the hospital over the past 5 years who sustained a traumatic injury while participating in a snow-related recreational activity. To fully assess the overall impact of such injuries in the pediatric population, the emergency room visits of all patients who were treated for snow-related injuries and released from hospital during the last year of the study were also reviewed. From this information, we have attempted to characterize these potentially devastating injuries in detail, to estimate their financial impact, and to investigate potential prevention strategies.

MATERIALS AND METHODS

Inpatient Records

The charts of 147 consecutive patients admitted to the Hospital for Sick Children in Toronto, Canada after sustaining an injury while

Collections
June 2012 / Vol. 116 / No. 6 / Pages 133-138

ARTICLE

Performance analysis of winter activity protection headgear for young children
Laboratory investigation

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[1]Neurotrauma Impact Science Lab, University of Ottawa; and [2]Paediatric Neurosurgery Children's Hospital of Eastern Ontario, Ottawa, Ontario, Canada

Abbreviations used in this paper: MEP = modular elastomeric programmer; TBI = traumatic brain injury.

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Please include this information when citing this paper: DOI: 10.3171/2011.11.PEDS11299.

Abstract

OBJECT

The purpose of this study was to evaluate how currently used helmets would perform for winter play activities, such as tobogganing. In Canada and northern parts of the US, the advent of winter is followed by an increase in visits to hospital emergency departments by young children presenting with head injuries resulting from winter activities. Sliding, skating, skiing, and snowboarding all involve risks of head injury from situations such as falling on ice or sliding into stationary objects. This study compared the protective characteristics of helmets used by young children (< 7 years of age) participating in winter recreational activities.

Related Articles

By Keywords: pediatric head injury, helmet, traumatic brain injury, concussion

Safety Science 49 (2011) 433–437

Contents lists available at ScienceDirect

Safety Science

journal homepage: www.elsevier.com/locate/ssci

Is sledding safe? Beyond acute, traumatic injuries: Estimating the spine loads sustained by children while sledding

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A R T I C L E I N F O

Article history:
Received 18 August 2010
Received in revised form 22 October 2010
Accepted 27 October 2010

Keywords:
Snow sports
Play
Back injury
Sprain and strains
Athletic injuries
Safety
Winter sliding
Acceleration
Spinal injury
Low back pain
Athletic injury

A B S T R A C T

Objective: Compare acceleration level between two sleds used for downhill winter sliding. The hypotheses include (a) acceleration levels will differ significantly between sled types, (b) acceleration levels will be unsafe, (c) acceleration levels will not differ significantly between genders.
Design: Cross sectional study, within subject design. A cross correlation was used to verify similar terrain and path of travel between the two sleds. The trials with the highest correlation, between sleds, were then used in a *t*-test to analyze the differences in the mean, maximum, minimum, peak accelerations, average and maximum peak levels between the two sleds and genders. A one-way ANOVA evaluated the relationship among gender and all variables.
Setting: In a randomized order, participants slid down the hill three times with one sled, followed by three times with the other. Acceleration was captured with a PBC piezoelectric accelerometer connected to a Larson Davis Human Vibration Meter 100.
Participants: Five males and seven females, age 7–14 years, were recruited for this study. Participants were a sample of convenience.
Results: The measured accelerations exceeded safe levels with values ranging from 1.07 m/s^2 to 1330 m/s^2 (mean = 241.97 m/s^2). Two-tailed *t*-test showed no significant difference in acceleration between sleds. A one-way ANOVA determined that there is no significant difference between gender or sled for any measured variables.
Conclusion: Acceleration magnitudes did not differ significantly between sled types or between genders. Peak acceleration levels were determined to be unsafe, in particular with regard to the forces transmitted to the spine.

1. Introduction

1.1. Climate and the prevalence of injury

Forty-one to 66 percent of all pediatric injuries occur at home and 11–18% of these injuries are due to road accidents, 10–13% occur at school, 10% on playground/park and 7% on farms (Borzecki

1.2. Consequences of sledding injuries

Downhill sledding is a common winter activity: in 2005, the Consumer Product Safety Commission reports that 37,087 sledding related injuries were treated in the United States (CPSC). Obviously, many more than this participate without becoming injured. Sledding injuries are mainly the result of high velocity

Injury, Int. J. Care Injured 45 (2014) 338–341

Contents lists available at SciVerse ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

A 13-year analysis from Switzerland of non-fatal sledging (sledding or tobogganing) injuries

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ARTICLE INFO

Article history:
Accepted 3 August 2012

Keywords:
Sledging
Tobogganing
Sledding
Winter sport
Trauma

ABSTRACT

Introduction: Winter sports have evolved from an upper class activity to a mass industry. Especially sledging regained popularity at the start of this century, with more and more winter sports resorts offering sledge runs. This study investigated the rates of sledging injuries over the last 13 years and analysed injury patterns specific for certain age groups, enabling us to make suggestions for preventive measures.

Methods: We present a retrospective analysis of prospectively collected data. From 1996/1997 to 2008/2009, all patients involved in sledging injuries were recorded upon admission to a Level III trauma centre. Injuries were classified into body regions according to the Abbreviated Injury Scale (AIS). The Injury Severity Score (ISS) was calculated. Patients were stratified into 7 age groups. Associations between age and injured body region were tested using the chi-squared test. The slope of the linear regression with 95% confidence intervals was calculated for the proportion of patients with different injured body regions and winter season.

Results: 4956 winter sports patients were recorded. 263 patients (5%) sustained sledging injuries. Sledging injury patients had a median age of 22 years (interquartile range [IQR] 14–38 years) and a median ISS of 4 (IQR 1–4). 136 (51.7%) were male. Injuries (AIS $\geq$ 2) were most frequent to the lower extremities ($n = 91$, 51.7% of all AIS $\geq$ 2 injuries), followed by the upper extremities ($n = 48$, 27.3%), the head ($n = 17$, 9.7%), the spine ($n = 7$, 4.0%). AIS $\geq$ 2 injuries to different body regions varied from season to season, with no significant trends ($p > 0.19$). However, the number of patients admitted with AIS $\geq$ 2 injuries increased significantly over the seasons analysed ($p = 0.031$), as did the number of patients with any kind of sledging injury ($p = 0.004$). Mild head injuries were most frequent in the youngest age group (1–10 years old). Injuries to the lower extremities were more often seen in the age groups from 21 to 60 years ($p < 0.001$).

Conclusion: Mild head trauma was mainly found in very young sledgers, and injuries to the lower extremities were more frequent in adults. In accordance with the current literature, we suggest that sledging should be performed in designated, obstacle-free areas that are specially prepared, and that children should always be supervised by adults. The effect of routine use of helmets and other protective devices needs further evaluation, but it seems evident that these should be obligatory on official runs.

Preventing injuries for

TOBOGGANING & SLEDDING

TOP TIPS

- Wear a helmet. Because of the high incidence of head injuries, everyone should be properly fitted with a helmet: either a ski helmet, snowboard helmet, or hockey helmet.
- Hills should be regularly inspected and closed if conditions are dangerous.
- Hills should be free of obstacles such as rocks, fences, poles and trees. They should be located a safe distance from roads, rivers, lakes, and parking lots.
- Safe hills should have a sufficiently long, clear run-out at the bottom of the hill, free of obstacles
- Children should be supervised.

watch for oncoming sledders while ascending the hill.

- Teach children to move out of the way quickly when they reach the bottom of the hill.
- Don't use hills after dusk unless proper lighting is provided.
- There should be a designated area at the side of the hill for climbing up.
- Use the sitting position when going down hills. Do not go head first.
- Don't go out in icy or excessively cold conditions.
- Ensure that the sled is in good condition and does not have any broken parts.

RISK FACTORS TO CONSIDER

ALCOHOL: 7% of the cases studied involved alcohol.

SUPERVISION: Where information was available 93% of the cases of catastrophic injury did not involve supervision.

SLEDDING TERRAIN: close proximity to roads, icy conditions, and hills with obstacles increase the risk of injury.

TYPE OF SLED: some evidence suggests that snow racers increase the risk of injury.

Rant (humorous… something to think about)

Descriptive Epi Report (Ontario Alpine Injuries)

LINK to document

iclicker®

Epidemiology is focused on populations and, therefore, does not apply to individuals.

A. True

B. False

In epidemiology, we describe the distribution of disease by:

A. Gender, age, & population size
B. Disease, morbidity, & mortality
C. Person, place, & time
D. None of the above

What are the three leading causes of death in Canada:

A. Stroke, Infectious diseases, Cancer
B. Cancer, Heart Disease, Diabetes
C. Stroke, Heart Disease, Cancer
D. Lung Disease, Kidney Disease, Heart Disease.

The distribution of income within and between countries as been shown to be a determinant of poor health outcomes for those countries.

A. True
B. False

When considering Ebola, what type of determinant would an overcrowded urban setting and inability to access to health services be?

A. Individual

B. Environmental

C. Biologic

D. Social

Class 2: Learning Objectives

1. How disease is diagnosed and why it matters
2. 3 clinical endpoints in the natural history of disease
3. Terms and measures that underlie statistics in epidemiology:
   - Ratios, Proportions, and Rates
   - Prevalence
   - Cumulative incidence
   - Incidence rate

Are you Healthy?
Do you Have…?

How is Disease Diagnosed ?

- Epidemiology is interested in all health phenomena, not just disease
- Before we can start to measure health phenomena we must have a clear idea of how it is measured.
- In general, the diagnosis of a disease is based on a combination of:

1. **Symptoms** - Subjective indicators reported by person
2. **Signs** - Disease indicators apparent to a doctor
3. **Tests** – Tools used to determine diagnosis

What are We Measuring?

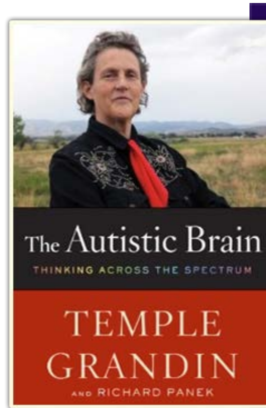
- Various combinations of symptoms, signs and tests are used to make a diagnosis.
  - Infection – test for antibodies against the infectious agent
  - Cancer – tissue histology
- **The Problem**: But for some disease diagnostic criteria can be complex – involving a combination of signs & symptoms (introduces subjectivity).
- Diagnostic criteria used **may differ** by place & time
- To compare health data, the first thing you must check is whether they are all using the same diagnostic criteria.

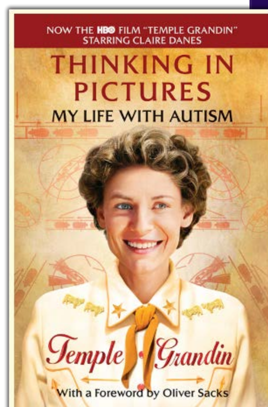
Examples :

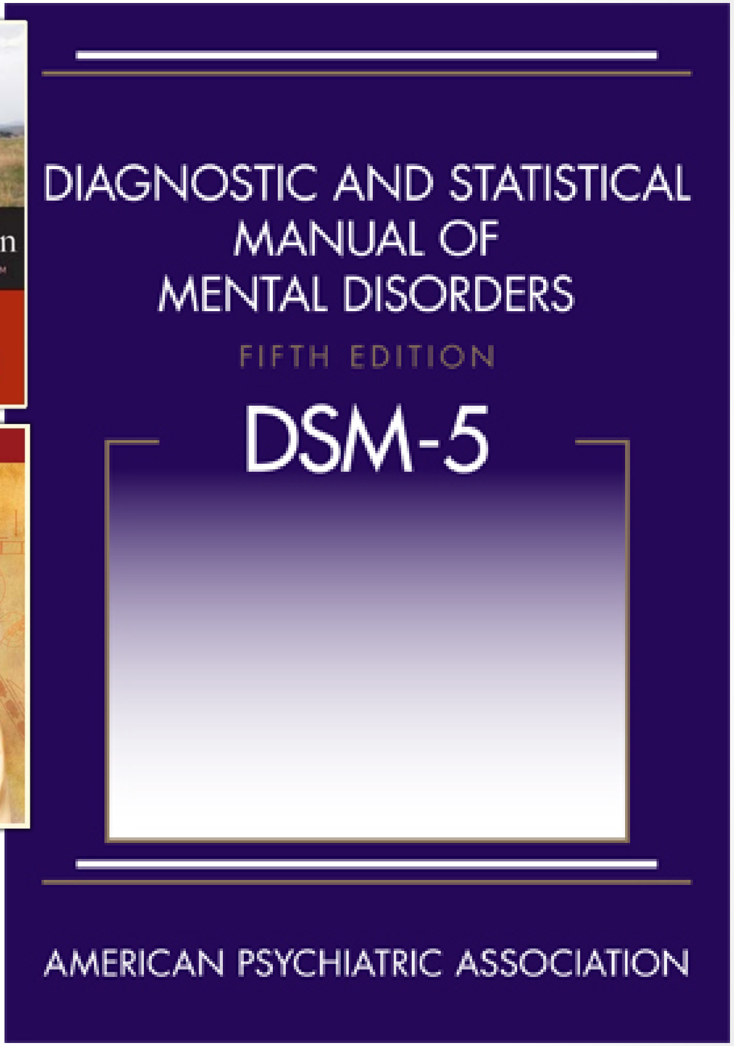
1. Diagnosing Mental Disorders
2. Diabetes

Interview with Temple Grandin

- Minute 5:00 to 7:40







Canadian Diabetes Association CLINICAL PRACTICE GUIDELINES

LINK

Case Definitions should be:

- Clearly stated
- Easy to use and measure
- Useable by different people and in diverse circumstances
- Reviewed and changed to reflect increased knowledge/technology

Clinical Endpoints of Disease

The natural history of disease has 3 final clinical endpoints:

1. **Death**
2. **Disability**
3. **Recovery (or remission)**

Counts

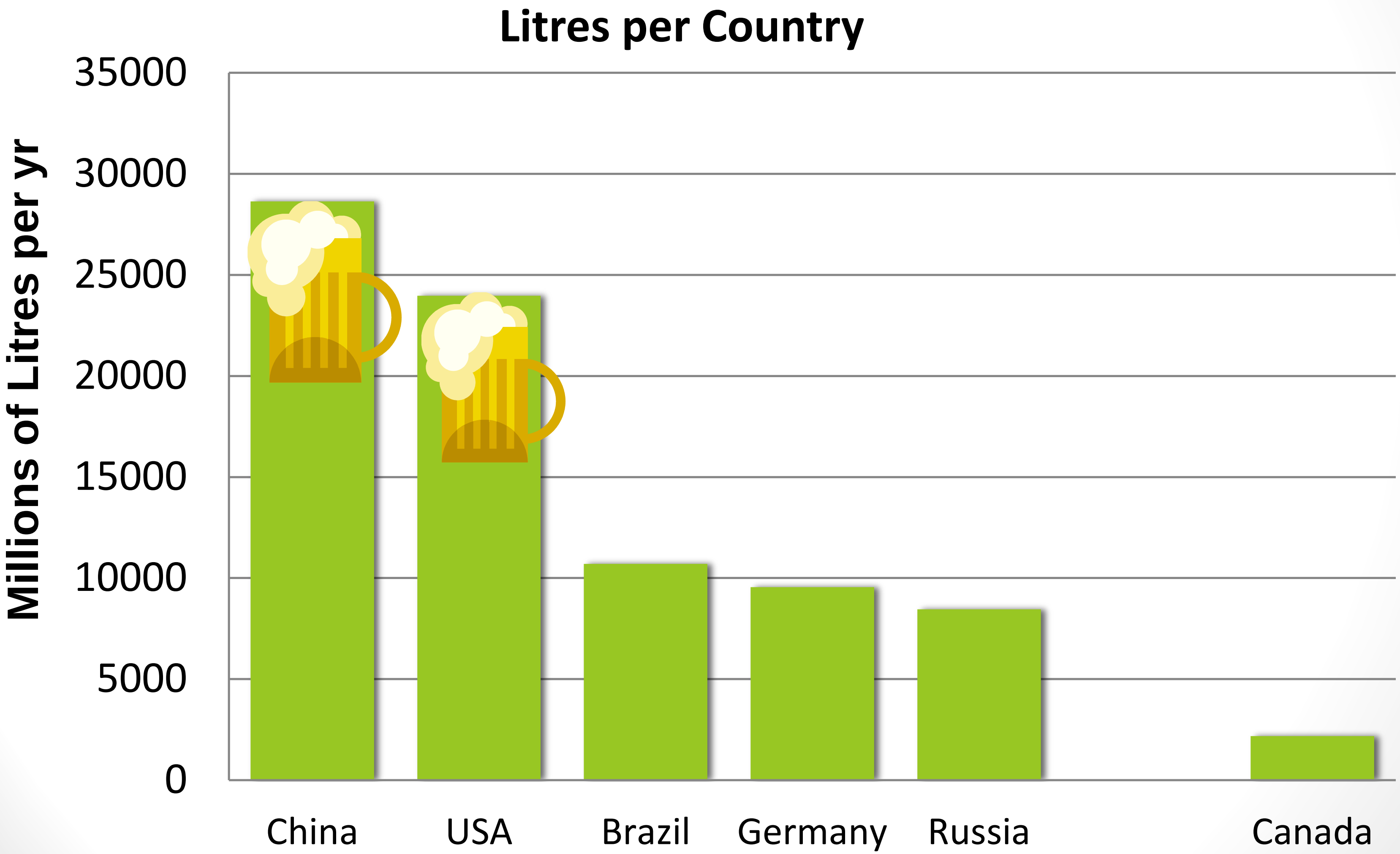
- Counts are the simplest measure in epidemiology and are simply the number of cases of morbidity or mortality
  - 1.3 million Canadians have **HEART DISEASE**
  - 70,000 Canadians have a heart attack each year

  - There are 178,000 new cases of **CANCER** each year
  - 75,000 Canadians die of cancer each year

  - 25,300 Canadians are diagnosed with **lung cancer** a yr and 20,600 will die of it

  - 25,500 men are diagnosed with **prostate cancer** a year and 4,100 will die of it

Example of Counts
What countries drink the most beer?



Measures of Frequency in epidemiology: Ratios, Proportions, and Rates

These terms have mathematical differences/characteristics which define them, but are sometimes used in epi language without strict adherence to these characteristics.

Ratios

- Ratios compare two values, which may or may not be related.
- Calculated by dividing one quantity by another (has a numerator and denominator): a/b
- Example: 754 men/771 women (sex ratio)

  = 0.98:1 or 97.8 %

- Types of ratios
  - Proportions
  - Rates

Proportions

- Proportions is a comparison of a part to the whole; they are a type of ratio in which the *numerator is also part of the denominator*: a/a+b

Example:

In a national study, which enrolled 7543 men, 189 of them were over 50 years old.

Proportion:

189/7543 = 0.024 * 100 = 2.4%

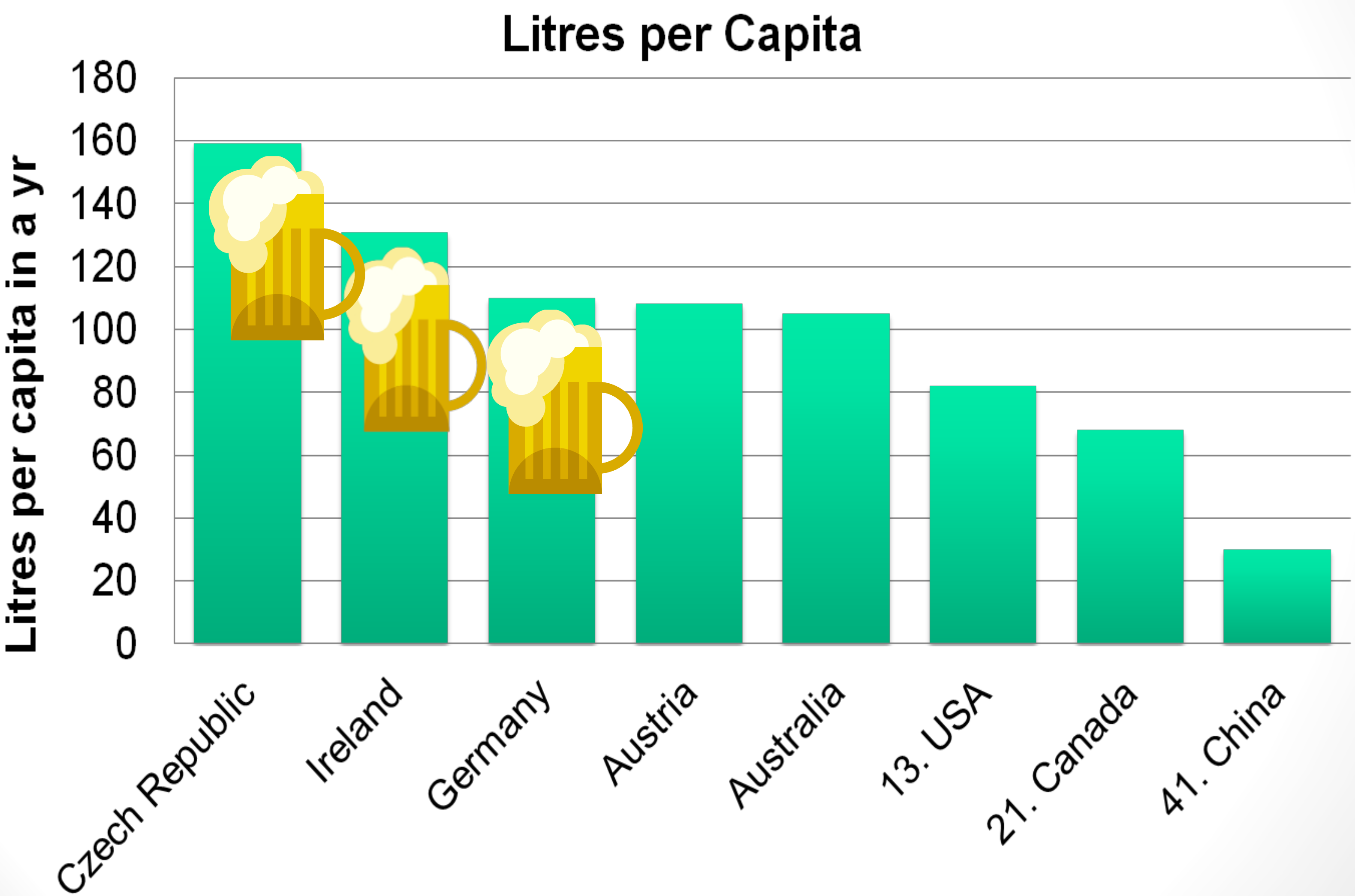
COUNTS vs PROPORTIONS

Who drinks the most beer: **Counts (slide 25)**

- China =
- Germany =

- Who drinks the most beer: **Proportions (slide 28)**
  - China =
  - Germany =

Proportions



Rates

- Rates are a type of ratio which differs from proportion because they include a measure of time. *A rate may or may not be a proportion.*

EXAMPLE:

In 2009, 238 418 Canadians died. The population of Canada at midpoint in 2009 was 33,580,000.

Crude Mortality Rate: 238 418/33 580 000 = 0.0071 *1000

= 7.1 deaths per 1000 people in 2009

Prevalence

- Tells us *what proportion* of the population **has/has had the disease** (includes both new and preexisiting cases) at:
  - a particular point in time **(point Prevalence)** or
  - over a specified period of time **(period Prevalence)** or
  - over an entire life span **(lifetime Prevalence)***
- It does not describe what is *new*, but **what *exists within a population***.
- Often reported as a percentage (*100), unless the frequency of a disease is very low…

Prevalence Calculation

$$\text{Prevalence} = \frac{\text{Number of persons with disease}}{\text{Total number in the population}}$$

***at a specific point in time; over a period of time (use mid-point population); or over an entire lifetime**

Is a Prevalence a rate? a Proportion? a Ratio?

Practice:

1. On December 15th, 2005, **507** Canadians had the flu. Population of Canada as of that date was **32,359,000**

2. Between November 1st and December 31st, **951** Canadians had the flu. (average population was **32,359,000**)

3. In a recent telephone survey of **1 877** people, **1 766** reported having had the flu in their lifetime.

Selecting a multiplier to express prevalence:

- Can express prevalence as a count, per 100 people (or as a percentage %), per 1000 people, 10 000 people, etc.

- Goal is to try to avoid reporting decimal fractions, while using smallest multiplier you can
  - Unnecessarily large multipliers appear less precise
  - **for this class, whole numbers or one decimal is the expectation*

- These rules also apply to calculating incidence rates (unless otherwise specified).

Factors influencing Prevalence:

Increased by:

- Longer duration of the disease
- Prolonged life of those with the disease, without cure
- Out-migration of healthy people
- Improved diagnostics
- Increase in new cases (incidence)

Decreased by:

- In-migration of healthy people
- Out-migration of cases
- Decrease in incidence (new cases)
- Improved cure rates
- Shorter duration of the disease
- High case-fatality rate

Incidence

Definition: The number of **new cases of a disease** that occur in a group during a certain time period.

- Measures how quickly people are catching a disease (what your **risk** of developing it is).
- Differs from prevalence because it considers only **new infections** or **new diagnoses** of disease.
- We call these the ***incident cases*** that occurred in a specific time period.

2 Types of Incidence

1. **Cumulative incidence – Discussed today**
   - Denominator is those at risk at beginning of time period
   - Can also call this simply incidence
   - Sometimes called attack rate (acute disease)

2. **Incidence rate – Discussed next class**
   - Also called Incidence Density
   - Measures rate of disease
   - Denominator is # persons*time
   - 2 ways to calculate it (using person-time or estimating using routine data)

Cumulative Incidence =

$$\frac{\text{Number of new cases over a time period}}{\text{Total population } \textit{at risk} \text{ at the beginning of same time period}} \text{ X multiplier (e.g., 100,000)}$$

- **Numerator** = the number of **new cases in that time period**
- **Denominator** = the **population at risk** at the *beginning* of the specified time period (exclude people who already have disease)
- **Time** = the period during which the cases occur.

Prevalence vs. Cumulative Incidence of Diabetes

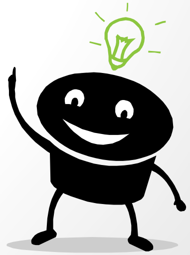
Prevalence of Diabetes:

$$\frac{\text{Total \# of people with diabetes in 2009 in Alberta}}{\text{Total AB population in 2009}}$$

Cumulative Incidence of Diabetes:

$$\frac{\text{Total \# of people diagnosed with diabetes in 2009 in AB}}{\text{Total AB pop at beginning of 2009 at risk of getting diabetes}}$$

- It is important to ***subtract existing cases before 2009*** from the denominator because those who have disease **are no longer at risk of getting it**.



Calculating Cumulative Incidence

- **206,000** Albertans had diabetes at the end of 2009.
- Among those, **19,300** were newly diagnosed in 2009.
- Population of Alberta in 2009: 3,632,000
- What was the incidence of diabetes in Alberta in 2009?

STEP 1. What is the numerator? (new cases in 2009) = 19,300

STEP 2. What is the denominator? (must exclude those who already had diabetes before 2009)

206, 000 – 19,300 = 186, 700 (this is the people who already had diabetes prior to 2009 and, therefore, must be excluded from the denominator)

Denominator = population – those who already had the disease = those "at risk" for getting the disease:

3,632,000 – 186,700 = 3,445,300

STEP 3. Calculate the Cumulative Incidence: 19,300/3,445,300 = 0.00056 * a multiplier (10,000) = 5.6

STEP 4. Interpret the results:

The cumulative incidence of diabetes in Alberta in 2009 is 5.6 cases per 10,000

What was the Cumulative Incidence of Diabetes in Alberta in 2009?

A. 5.6 cases of diabetes per 1000 Albertans

B. 56 cases of diabetes per 100 Albertans

C. 179 cases of diabetes per 100 Albertans

D. 17.9 cases of diabetes per 1000 Albertans

Cumulative Incidence

New cases / # of people at-risk at start of period

- Interpreted as *risk*
- Represents proportion of **people at risk** of developing a disease **who actually did so** in a specified period of time
- Denominator does not include accurate measure of time. We do not know extent to which people at risk at beginning of year were followed to the end of the year.
- If period of time is short, Cumulative incidence is often called an **attack rate** (for infectious disease). Attack rate measured the same way
  - Example - # of people at risk (i.e. exposed) for getting Ebola who actually became infected = attack rate

Cumulative Incidence

- 4500 male seniors in Alberta are included in a cohort study of prostate cancer in 2006.
- Tests confirm 7% already have prostate cancer and therefore are not at risk.
- The rest of the men are followed **for 5 yrs** to determine the cumulative incidence of prostate cancer.
- At end of the follow-up 156 men had developed the cancer. **The 5-yr cumulative incidence** is:
- **Numerator** = ____
- **Denominator** =

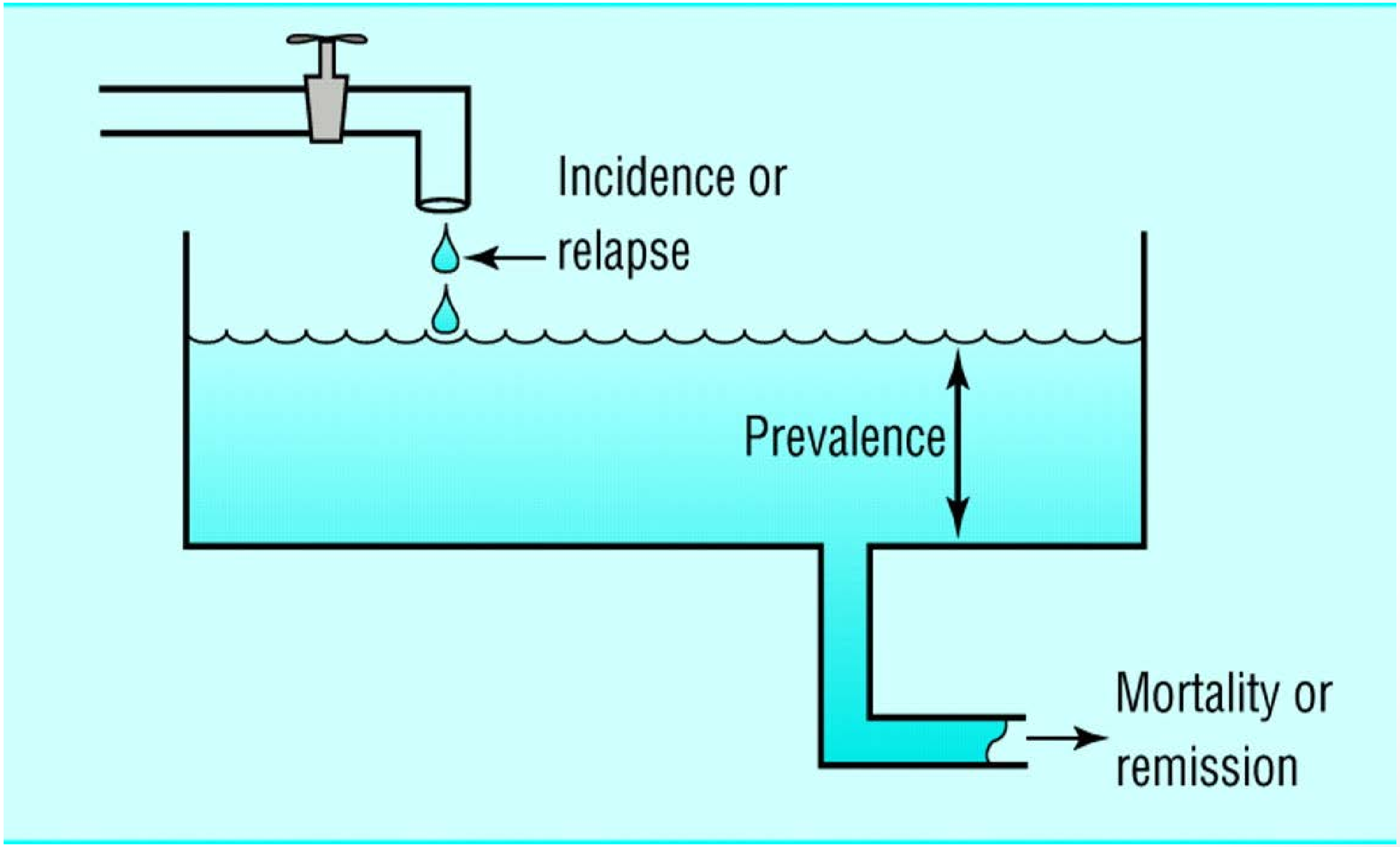
Cumulative Incidence

$$\frac{156}{4135} = 0.037 \quad X \;\; 1000$$

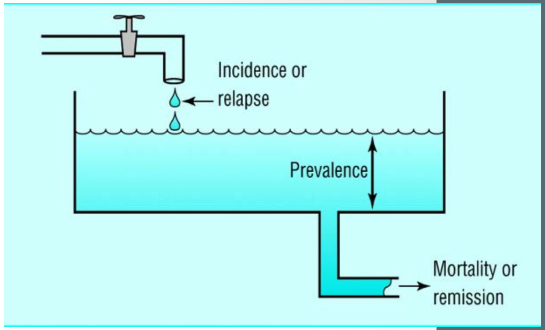
Answer: 37.2

Interpretation: The 5-year cumulative incidence for prostate cancer in this group is 37.2 per 1000 people.

Incidence & Prevalence



Relationship between Incidence & Prevalence



- There is a relationship between prevalence and Incidence

PREVELANCE (P) = INCIDENCE RATE (IR) X AVERAGE DURATION OF DISESASE (D)

- This is true assuming that prevalence is low (less than 10%) and does not vary significantly over time or is not altered by other influences (e.g. immigration)

Review Question

The diagnosis of a disease is based on:

1. ____________________
2. ____________________
3. ____________________

Review Question

What are the 3 clinical endpoints of disease?

1. ____________________
2. ____________________
3. ____________________