Introduction to Population Health (W2)

Introduction to Population Health (L1)

Preliminary discussion: the challenge of stroke

- We know that, nationally and globally, strokes (a loss of blood flow to part of the brain, which damages brain tissue - mainly ischaemic and haemorrhagic types) and their complications are a major cause of mortality and morbidity
  - Globally: >5.5 million deaths per annum
  - In Australia: >8000 deaths per annum
- Q: **How should we go about lowering these mortality rates and levels of morbidity**
- Depending on who you speak to, possible solutions might include any or all of the following:
  - **Provision of optimal management** (e.g. stabilisation of airway, breathing, and circulation/ thrombolytic therapy/thrombectomy) for each patient presenting to hospital with acute onset of stroke
  - Prompt **mobilisation**/access for all stroke patients to tertiary hospitals
  - More dedicated hospital and **rehab** beds/facilities for stroke patients (i.e. health funding, availability and access issues)
  - More advanced **medical specialist training** in **stroke management** (i.e. training and workforce issues)
  - Greater availability of **medications** for blood pressure control
  - **Screening** for high glucose levels
  - More urban areas for **recreation**
  - More **dietary** education
  - Tobacco taxation
  - Reduction in **air pollution levels** (indoor and outdoor)
- BUT why is there such a diversity of advice? Why does this all look so complicated?
  - We need to look at many complex health issues like this from BOTH a **clinical/patient** oriented level AND a **population** ("macro-") level

Major risk factors

- Looking at some of the major risk factors for stroke - there is no simple, single way to address all of these at a population level
- Metabolic risks: high body-mass index (**BMI**), **high fasting plasma glucose** (FPG), high total **cholesterol**, and **low glomerular filtration rates**
- Elevated **blood pressure**
- **Behavioural factors** (smoking, poor diet, and low physical activity) and **environmental risks** (air pollution and lead exposure)

What is "health" anyway?

- Health is the state of complete **physical, mental** and **social well-being**
  - And not merely the absence of disease or infirmity
- So health is about much **more than just being "disease-free"** - but this definition/goal is quite demanding for the average human

Defining "population (public) health"

- "Public health is the **science and art** of **preventing disease**, **prolonging life**, and **promoting health** through organised efforts of **society**"
- "Public health… is the combination of sciences, skills and beliefs that is directed to the **maintenance and improvement of heath** of all the people through collective or social actions

Defining "population (public) health"

- Focuses on the health outcomes of **populations**, including the **relative distribution** of such health outcomes (i.e. patterns of health and disease), the wide range of **factors** that influence health, and health-related policies and interventions

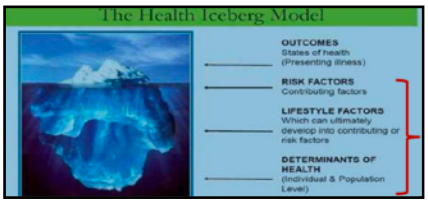
Taking all that together… key elements of population health

- Public health focuses on the **population** not the individual
- Public health involves **organised community effort** not just isolated individual efforts

- Mission is to ensure that these “organised efforts” to preserve health and prevent disease are **mobilised when needed**
- Long range goal of population health is optimal health of the **entire community**
- Note that it can sometimes be challenging to transfer or “generalise” the knowledge gathered from our everyday clinical encounters, experiences and decisions (usually at the patient- or practise-level) into “population-level” conclusions and interventions

A dangerous cliff: what can we do in health terms to prevent this tragically high mortality rate?
- No health care = just let the problem unfold with no kind of intervention
- Acute clinical care/aim to “cure” or manage cases where possible
- Population health/ aim to “prevent” cases arising in the first place

Why population health
- The Health Iceberg is a useful framework for identifying **firstly the behavioural and lifestyle factors** that contribute to health, and secondly the **social determinants** which have the **greatest impact** on health status
  - All these can influence the opportunities, exposures, and behaviours that contribute to health



- Yet, when we encounter a person in the clinical setting with good or poor health, you do not see this complex web of determinants, you just see the condition they present with - you see the tip of the iceberg
- Tip: outcomes (state of health, presenting illness)
- Below: risk factors, lifestyle factors, determinants of health

Why population health
- Determinants of health generally include all the physical, biological, social, cultural and behavioural factors that influence health
- These include major **social determinants**, such as the prevailing political, cultural, and economic forces that create the circumstances in which people grow, become educated, work, recreate, replicate, retire, and otherwise live their lives…these extend inward to affect or interact with other factors, including **health behaviours** and **biomedical factors** that are part of a person’s individual lifestyle and genetic make-up

Key terms in population health
- **Morbidity**: any **departure from state of physical or psychological wellbeing** (in a sense, any deviation from ideal ‘health’)
- **Mortality rate**: measure of the **frequency of occurrence of death in a defined population** during a **specific time interval**
  - e.g. crude mortality rate, infant mortality rate, under-five mortality rate
- **Life expectancy**: life expectancy at birth is, on **average**, the number of years a person just born is expected to live

Leading underlying causes of death in Australia in 2022
- Males:
  1. Coronary heart disease
  2. Dementia, including Alzheimer’s disease
  3. COVID-19
  4. Lung cancer
  5. Cerebrovascular disease
- Females
  1. Dementia including Alzheimer’s disease
  2. Coronary heart disease
  3. Cerebrovascular disease
  4. COVID-19
  5. Lung cancer

These preceding three terms relate to: burden of disease
- How can we conceptualise “burden of disease”?

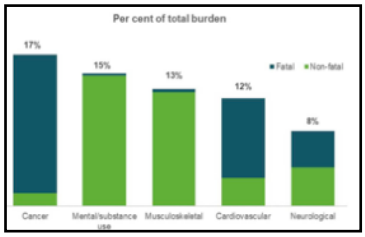
- Imagine that in an ideal world, you could live to the age of 75 completely free from any kind of disease or disability at any time in your life
- BUT in the cruel old "real world", you in fact hurt your back badly in a motor vehicle accident at the age of 20… thereafter you suffered from periodic but very severe episodes of back pain (usually lasting for weeks at a time) right up until the age of 75
- The "**gap" in your health status** between these "ideal/optimum" versus "real" world scenarios is broadly equivalent to what the burden of disease (up to the age of 75) is trying to capture
  - Although note that the burden of disease is expressed and estimated at a **population** (aggregate) **level** as opposed to an individual one

Burden of disease

- **Burden of disease**: expressed as a **DALY** (**Disability Adjusted Life Year**): measures the **"combined" health impacts of disease on a population**
- DALYs can provide an overall measure of burden of disease and allow comparisons between different diseases' impact on the health of a population
- So 1 DALY = 1 year of healthy life effectively lost: a healthy year of life lost either through **dying "early" or through living with disability due to illness or injury** = YLL (years of life lost) + YLD (years living with disability)
  - **DALY = YLL + YLD**

Burden of disease

- Which broad disease groups are at the top of the list? In Australia
- In 2023, Australians lost 5.6 million years of healthy life (total burden, DALY) due to:
  - Living with illness (non-fatal) 54% of total burden
  - Dying prematurely (fatal) 46% of total burden



Broad disease groups

- Fatal versus non-fatal component of the total burden by BROAD DISEASE GROUP - these disease groups include many chronic, or long-lasting conditions:
- Cancer 17%, Mental health and substance use 15%, musculoskeletal 13%, cardiovascular 12%, neurological 8%

But when we look at specific clinical conditions as opposed to broad disease groups

- The leading **5 diseases that caused burden** (% of total DALY) in 2023:
  1. Coronary heat disease (5.4%)
  2. Dementia (4.4%)
  3. Back pain and problems (4.3%)
  4. Anxiety disorders (3.9%)
  5. Chronic obstructive pulmonary disease (COPD) (3.6%)
  - BUT… why has "cancer" (which was at #1 before) now fallen off the lists?
  - Because the earlier **summary grouped together** (or aggregated) **EVERY TYPE OF CANCER**, whereas this ranking refers to **specific diseases**, such as specific cancer types (e.g. lung cancer, breast cancer, prostate cancer, colorectal cancer etc)

Difference in raking by sex

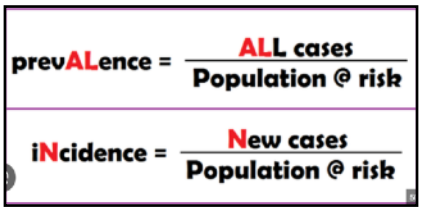
- Male
  1. Coronary heart disease 7%
  2. Back pain and problems 4.1%
  3. Suicide and self-inflicted injuries 4%
  4. Dementia 3.3%
  5. COPD 3.2%
- Female
  1. Dementia 5.6%
  2. Anxiety disorders 4.9%
  3. Back pain and problems 4.5%
  4. COPD 4.1%
  5. Coronary heart disease 3.7%

Burden of disease
- Which groups/conditions are at the top of the list?
- Q: how does this compare to Australia and why are there differences/similarities?
- Globally, leading causes of DALYs or health loss globally for both sexes combined, all ages:

Definition of epidemiology
- One of the main 'research/investigation' components of population health
- Epidemiology is the **study of the distribution and determinants of health-related states among specified populations**
- And the application of that study to the **control of health problems**

Overview of epidemiology
- Epidemiology is a population science:
  - Is the **research arm** of population health, providing the **scientific basis** upon which public health policy decisions are made
  - **Aggregates the health data, experience, outcomes** of groups of individuals
  - Can help in **identification of risk factors** on the basis of which interventions and prevention strategies can be planned and evaluated
  - Key aim is improvement of health for all

Incidence
- Often expressed as a rate
- The number of **new health-related events** emerging in a **defined population** within a **specified period of time**
- It is usually expressed as per 100, per 1000, per 10,000 or **per 100,000 persons** (e.g. per year) depending on how rare or common the disease is
- Incidence is good for determining the (dynamic) **rate of emergence**/ spread/transmission of a disease in a population



Prevalence
- A measure of occurrence or disease frequency, often used to refer to the **proportion of individuals** in a **population who have a disease or condition** (not a rate although some naughty people do refer to prevalence "rates")
- It includes all cases, both new and pre-existing, in the population at a specified time
- Prevalence = all new and pre-existing cases over period / population during same period

Prevalence
- Prevalence is often **measured for chronic diseases** (e.g. diabetes or osteoarthritis) which have long duration and for which dates of onset are often difficult to pinpoint
- Good for assessing **need for health care**: prevalence is good for **health planning** - what is the burden of disease on the community

Remember
- **Incidence** occurs when the **new case is diagnosed**
- And each new case diagnosed **increases the overall prevalence**
- **Prevalence decreases** when the patient **recovers**, or the patient **dies**
- Recovery from a (non-recurrent) disease or death of a patient does **not affect** the **incidence** of the disease

Epidemiology can help us out if we want to do things like this
- Assess whether a new high-intensity exercise program significantly lowers blood pressure vs some control (comparison/baseline) activity
  - Interventional/experimental

Epi study **categories I**: **descriptive epidemiology**
- Descriptive epidemiology is the collection and summary of observational data on health and disease

    - Allows us to **assess variations in disease frequency geographically** and over **time** and how disease varies **among individuals** based on **personal characteristics** (person, place, and time).
- **Time** = when are people getting sick: patterns may be annual, seasonal, weekly, etc
- **Place** = where are affected people or where were they when they got sick: patterns include geographic variation, urban/rural differences, and location of work sites or schools
- **Person** = who is getting sick: characteristics include demographic factors such as age, sex, marital status, and socioeconomic status, as well as behaviours and environmental exposures

Epi study **categories I: descriptive epidemiology**
- Descriptive epidemiology can be used to:
    - Monitor and report the health of a population (burden of disease)
    - Identify emerging health problems and identify trends in health and disease
    - Establish public health priorities for a population and plan health resources
    - Evaluate changes in public health policy
    - Explore potential associations (relationships) between “risk factors” and health outcomes in order to generate hypotheses about the determinants of disease (but not yet formally “test” these)

Descriptive versus analytic epidemiology
- Descriptive epidemiology:
    - Describes
    - **When** was the population affected?
    - **Where** was the population affected?
    - **Who** was affected?
- Analytic epidemiology:
    - Explains
    - **How** was the population affected?
    - **Why** was the population affected?
- From the **observations** gathered during the **descriptive process**, a hypothesis is generated about the causes of observed patterns and the factors that increase risk of disease or injury
- To formally test a hypothesis, epidemiologists must use an **analytical epidemiology** approach in which they ask **how and why the population was affected**

Epi study **categories II: analytic epidemiology**

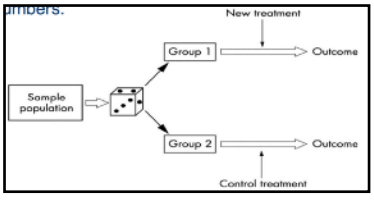


- Analytic epidemiology can be used to formally test our hypotheses about potential determinants (risk factors) and health or disease outcomes
- e.g. is there a link between regular tobacco use and the development of lung cancer?
- We often include some kind of comparator (or control) group in these studies
- e.g. in case-control studies and cohort studies

Epi study categories II: analytic epidemiology
- Analytic epidemiology can be used to:
    - **Quantify** (size and precision) the associations between exposures and outcomes
    - Identify risk factors associated with disease
    - Target public health prevention and control activities

Epi study **categories III: intervention(al)/experimental studies**
- Used in many clinical and population health settings
- A study in which conditions are under the **direct control** of the investigator -> intentional alters one or more factors and control the other study conditions in order to analyse the effects of so doing
- **Experimental** -> **RCTs or non-randomised control trials**

Randomised Controlled Trial (RCT)
- A major type of intervention(al)/experimental study
- **The highest level of evidence** in medical research comes from a particular set of **intervention(al)/experimental designs** called **RCT**



- In these designs patients are **randomly allocated** to treatment groups using a computer algorithm/computer generated lists of random numbers

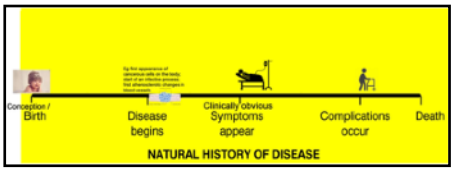
Principles of prevention
- **Prevention** (in a health context)
- One of the main 'action/intervention' components of population health
  - actions aimed at **eradicating, eliminating or minimising** the impact of disease and disability
  - And **impeding or delaying** the **progression** of a disease and disability

Definition of prevention
- It is closely connected with the concept of health promotion - describes the activities which help individuals and communities to **increase control over the determinants of their health**
  - Such as through health education, health legislation, or for example providing opportunities, environments and facilities for people to engage in sport and recreation

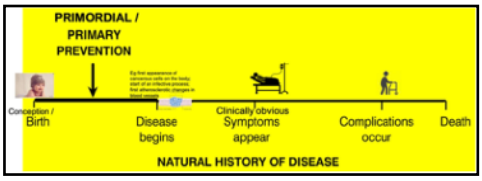
Risk factors definition
- In prevention, we often focus on addressing what are known as **risk factors** = these refer to 'any **attribute, characteristics or exposure** of an individual that **increases the likelihood of developing a disease or injury**'

A risk factor can be:
- An aspect of **behaviour or lifestyle** (such as diet, drinking and smoking behaviour, socioeconomic status and occupation)
- An **environmental** exposure
- An **inborn or inherited characteristic**
- Or a **clinical indicator** (e.g. high BP)
- This term 'risk factor' is widely used to cover factors which **influence the course of health**-related events

Principles of prevention
- At which points along the life span could preventive activities/ strategies be introduced to stop or delay disease emergence or progression?
  - Need to consider question this in terms of the **natural history of the disease**, initially assuming there is **no prevention** and **no complete cure** on offer



Principles of prevention
- At which points along the life span could preventive activities/ strategies be introduced to stop or delay disease emergence or progression?
  - How about before the disease even begins (primordial/primary)



Principles of prevention - **primordial prevention**
- Option 1
  - We could focus on actions and measures that limit or manage the emergence and establishment of the **wider-level environmental, economic, social and behavioural conditions** - including cultural patterns of living - that are known to increase the risk of disease
  - e.g. address **larger-scale issues such** as: housing and environment; water and food security; education; employment; laws and regulations; physical safety
- Known as "**primordial prevention**"
  - In fact this is a **form of primary prevention but** with **interventions at the population level** - i.e. this approach can help us think about how we might remove or mitigate the effects of risk factors operating at a community level

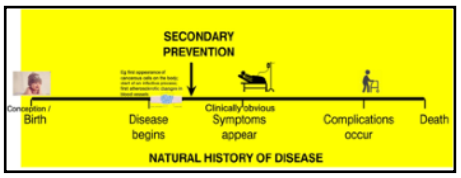
Principles of prevention - **primary prevention**
- Option 2

- We could focus on **interventions aimed at reducing the incidence**/development of new "cases" of ill-health
- i.e. **prevents disease/infection/injury from occurring IN FIRST PLACE**
- e.g. use of vaccinations, promoting health lifestyles/health education; address nutritional needs; seatbelts in cars - **INDIVIDUAL LEVEL**

- Known as "**primary prevention**"

Principles of prevention

- At which points along the life span could preventive activities/ strategies be introduced to **stop or delay disease emergence** or progression?
  - How about before the disease even begins?
  - Secondary

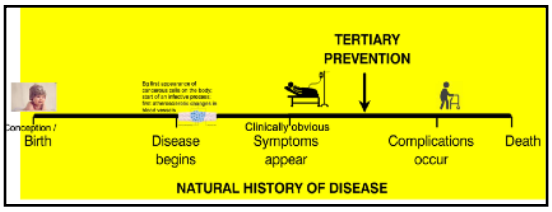


Principles of prevention - **secondary prevention**

- Option 3
  - Interventions aimed at those **with the condition before clinically obvious symptoms appear** e.g. **early diagnosis, screening for disease - individual level**
  - e.g. screening for breast, prostate, cervical cancers
  - Known as "**secondary prevention**"

Principles of prevention

- At which points along the life span could preventive activities/ strategies be introduced to stop or delay disease emergence or progression?
  - If we have not managed to stop the disease from developing, how about **preventing further disability** or complications arising from the disease?
  - Tertiary



Principles of prevention - **tertiary prevention**

- Option 4
  - Aims to **prevent later complications** of - or disability associated with - **existing conditions** to **minimise their impact**
    - e.g. **treatment** that aims to **prevent or limit disability**
    - **Rehabilitation**: retrain remaining capacities maximally
    - Known as "**tertiary prevention**"

Principles of prevention

- Or we may seek to **combine any or all of these different forms** of prevention in our health care programs, depending on the nature of the disease and our capacity for detecting and managing it

Example of major initiative relating to prevention in Australia: national preventive health strategy 2021-2030

- National initiative designed to secure our health, economic and social well-being in response to the range of health challenges we all face
  - such as addressing the increasing burden of disease, reducing health inequity and increasing preparedness for emerging health threats
  - Including through improving access to a health diet, reducing tobacco use, increasing cancer screening, reducing alcohol and other drug harm, and other goals

Summary

- Population health is the science and the art of preventing disease, prolonging life, and promoting physical and mental health through organised community efforts
- Epidemiology is one of the main 'research/investigation' components of population health -> involves the study of distribution and determinants of disease
- Prevention of disease and promotion of health are the main 'action/intervention' components of population health

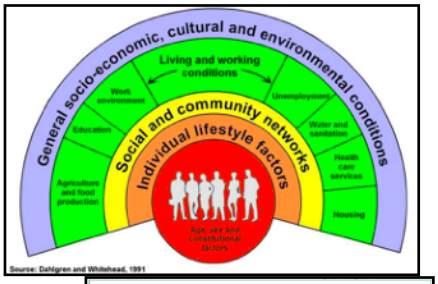
Social determinants of Health (L2)

What do we mean by social determinants of health?

- The social determinants of health (SDH) are the **non-medical factors** that influence health outcomes
- They are the conditions in which people are **born, grow, work, live, and age**, and the wider set of forces and systems shaping the conditions of daily life.
- These forces and systems include economic policies and systems, development agendas, social norms, social policies and political systems

Socio-ecological Framework

- Emphasis on the multiple determinants of health
- General socio-economic, cultural and environmental conditions
- Living and working conditions
  - Work environment, education, agriculture and food production, unemployment, water and sanitation, health care services, housing
- Social and community networks
- Individual lifestyle factors
- Age, sex and constitutional factors





Distribution of health

- While the categories of factors influencing health may be common across and within countries… **health is NOT equally distributed**

GDP and life expectancy:

Health, wealth and life expectancy

- It is the **income gap** within countries that explains most differences in life expectancy

Inequalities in health… socially determined?

- The gross inequality we see in the world, both within (a spread of 20 years in life expectancy) and between countries (a spread of up to 48 years) is not inevitable, but malleable and can be changed
- Social factors are at the root of much of these inequalities
- Fast forward to 2025:
  - Not much has changed
  - Inequality has increased in most developed countries and in some middle-income countries (incl. China and India) since 1990
  - Countries where inequality has grown are home to more than two thirds of the world population

Inequalities in health… socially determined?

- **Poorer people live shorter lives and are more often ill than the rich**
- This disparity has drawn attention to the remarkable sensitivity of health to the social environment
- Enormous **inequalities in physical, mental and social health** continue to exist between the most **advantaged and disadvantaged population** groups in many countries, including Australia
- Substantial evidence confirms that many of the underlying causes of poor health derive from social, environmental, economic and cultural factors that are embedded inner day to day lives

Inequalities in health… socially determined?

- **Social determinants** can be more **important than health care or lifestyle choices** in influencing health
- Social determinants account for 30-55% of health outcomes
- Contribution to population health of sectors outside health exceeds contribution from health sector