

# Cause-specific mortality

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# Objectives

- Understand epidemiologic concepts that can explain patterns in cause-specific mortality data
  - Epidemiologic transition (cause); Demographic transition (age – cause)
- Calculate and explain trends in mortality data using key concepts and measures
  - Cause-specific mortality fraction; cause-specific death rate
- Understand the different cause lists and when/how to use them
- Understand the sources of cause of death data and how to effectively present leading causes of death
- Provide the necessary knowledge, skills and tools to analyse cause-specific mortality data and complete a vital statistics report

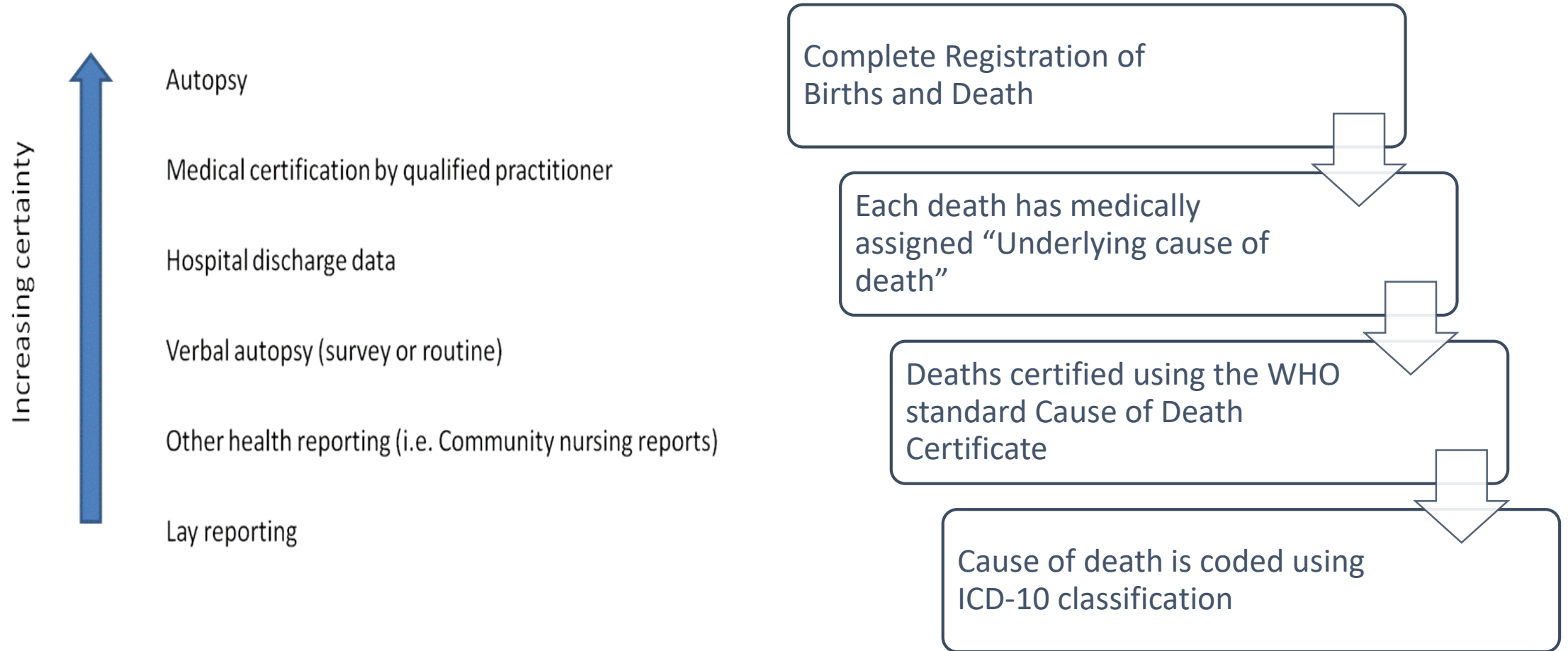
# Structure

Session	Topics covered and activities (main group)	Topics covered and activities (break-out group)
Morning (10am-12pm)	Fundamentals of cause-specific mortality analysis Cause-specific mortality concepts and measures	-
Early afternoon (1-3pm)	Tools to assist with analysing mortality data: ANACoD	Data lab: Presenting leading causes of death in your vital statistics report
Late afternoon (3-4pm)	Data lab: Presenting leading causes of death in your vital statistics report	Data lab: Advanced mortality analysis (multiple causes of death)

# Fundamentals of cause-specific mortality analysis

Overview

# Sources of cause of death data



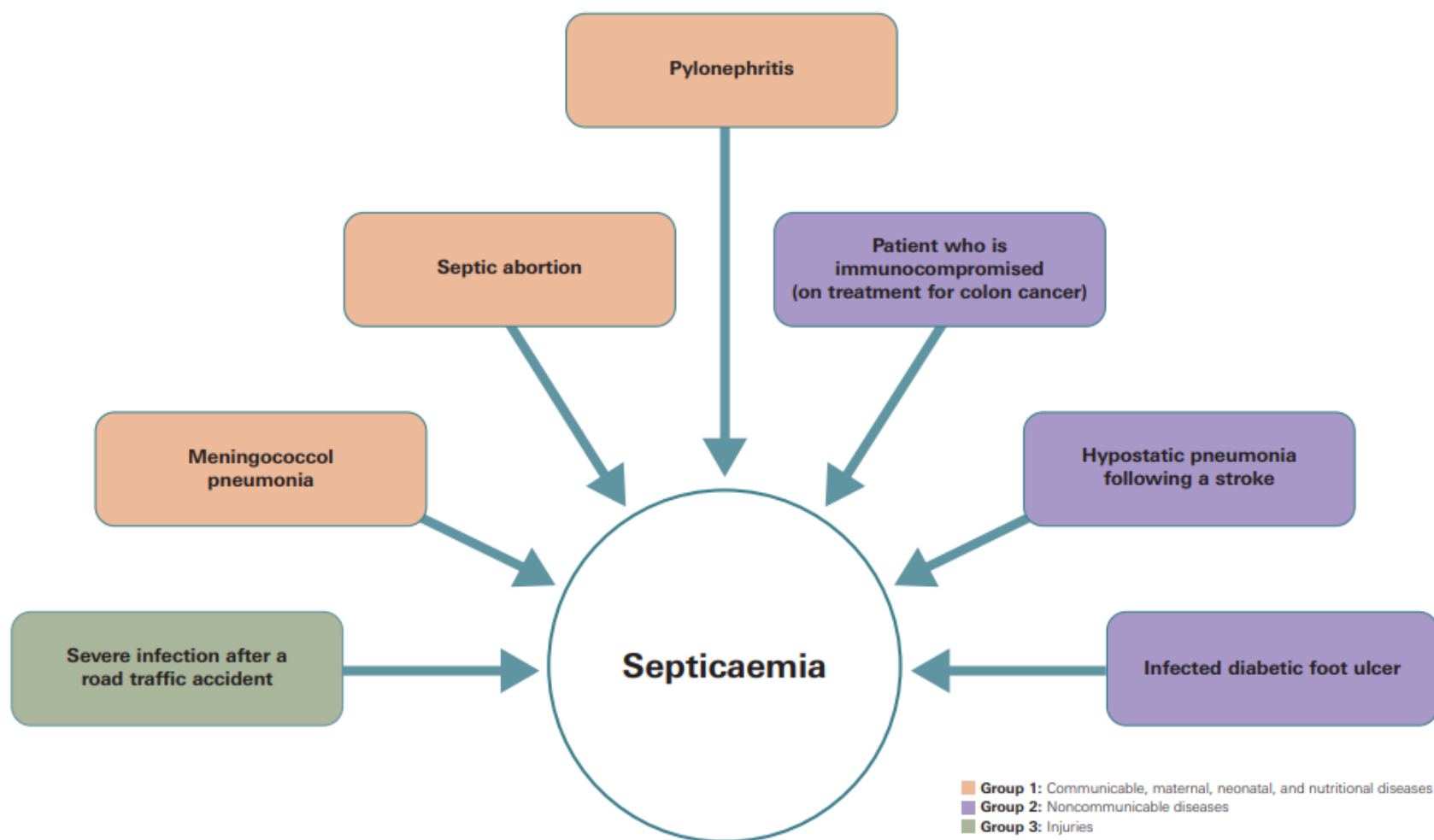
# Cause of death data needs to...

- Be comparable
  - Over time
  - Between countries
- Provide an overview of total mortality burden
- Identify vulnerable populations (where possible)
- Be disaggregated by **age and sex**
- Include numbers, rates and proportions
- Why don't we just use **morbidity** data?

# Why is cause of death data important?

Who needs COD data?	What kinds of data?	Why?
National/international agencies	Global and cause-specific mortality estimates ICD coding	Standardised, comparable estimates over time and place
Local public health managers	Top-ranking causes of death and public health priorities	Monitoring trends over time and evaluating public health interventions
Epidemiologists and health services researchers	Relating to specific populations and subgroups	Interpreting particular situations in terms of mortality patterns
Institutional managers and clinical auditors	Patterns of deaths within institutions and health care systems	Monitoring trends over time and within departments
Medical and legal practitioners	Individual causes for particular cases	Following-up consequences of individual deaths

# What does it mean to die from 'septicaemia'?





# Garbage codes (GBD)

- The 1990 GBD study first identified and defined a series of ICD 'garbage codes' and proposed rules to reallocate them to specific causes of death
- 'Garbage codes' are defined as 'deaths assigned to causes that *cannot or should not* be considered underlying causes of death, e.g.
  - Type 1: Impossible UCOD (migraine) and signs, symptoms and ill-defined conditions (R-codes)
  - Type 2: Intermediate causes (septicaemia)
  - Type 3: Immediate causes (cardiac arrest)
  - Type 4: Insufficiently specified within ICD chapters (e.g. cancer without specification of primary site)

# Garbage codes by type and ICD-10 code (GBD)

GC Type	ICD-10 Codes
Type 1	A31.1, A59, A60.0, A71-A74, A63.0, B00.0, B08.1, B08.8, B30, B35-B36, F32-F33.9, F40-F42.9, F45-F48.9, F51-F53.9, F60-F98.9, G43-G45.9, G47-G52.9, G54-G54.9, G56-G58.9, H00-H04.9, H05.2-H69.9, H71-H80.9, H83-H93, J30, J33, J34.2, J35, K00-K11.9, K14, L04-L08.9, L20-L25.9, L28-L87.9, L90-L92, L94, L98.0-L98.3, L98.5-L98.9, M03, M07, M09-M12, M14-M25, M35.3, M40, M43.6-M43.9, M45.9, M47-M60, M63-M71, M73-M79, M95-M99, N39.3, N40, N46, N60, N84-N93, N97, Q10-Q18, Q36, Q38.1, Q54, Q65-Q74, Q82-Q84, R00-R99, B94.8, B949.9, G80-G83, Y86, Y87.2, Y89, I10, I15, I70
Type 2	A40-A41, A48.0, A48.3, E85.3-E85.9, E86-E87, G91.1, G91.3-G91.8, G92, G93.1-G93.6, I26, I27.1, 144-I45, I49-I50, I74, I81, J69, J80-J81, J86, J90, J93, J93.8-J93.9, J94, J98.1-J98.3, K65-K66, K71-K72 (except K71.7), K75, K76.0-K76.4, K92.0-K92.2, M86, N14, N17
Type 3	D65, 145-146, J96
Type 4	C80, C26, C39, C57.9, C64.9, C76, D00-D13, D16-D18, D20-D24, D28-D48, A49.9, B83.9, B99, E88.9 I51, I99, X59, Y10-Y34

Note: These garbage codes are based on the public health analysis cause list of 56 causes.

# Ill-defined and unspecified codes (WHO)

- Deaths classified as ill-defined (Chapter XVIII of ICD-10)
- Deaths classified to any one of the following vague or unspecific diagnoses:
  - A40-A41, Streptococcal and other septicaemia
  - C76, C80, C97, Ill-defined cancer sites
  - D65, Disseminated intravascular coagulation [defibrination syndrome]
  - E86, Volume depletion
  - I10, Essential (primary) hypertension
  - I269, Pulmonary embolism without mention of acute cor pulmonale
  - I46, Cardiac arrest
  - I472, Ventricular tachycardia
  - I490, Ventricular fibrillation and flutter
  - I50, Heart failure
  - I514, Myocarditis, unspecified
  - I515, Myocardial degeneration
  - I516, Cardiovascular disease, unspecified
  - I519, Heart disease, unspecified
  - I709, Generalized and unspecified atherosclerosis
  - I99, Other and unspecified disorders of circulatory system
  - J81, Pulmonary oedema
  - J96, Respiratory failure, not elsewhere classified
  - K72, Hepatic failure, not elsewhere classified
  - N17, Acute renal failure
  - N18, Chronic renal failure
  - N19, Unspecified renal failure
  - P285, Respiratory failure of newborn
  - Y10-Y34, Y872, External cause of death not specified as accidentally or purposely inflicted

# Methods for correcting unusable causes (GBD)

- All ICD codes identified as “unusable causes” should be reassigned to a specific “target code” if they are to inform public policy
- Each unusable cause should be redistributed across selected ICD ‘target’ causes by age, sex, year, and country
- Four approaches to unusable cause redistribution:
  - **Proportionally:** Ill defined codes are simply redistributed proportionately across all (usable) causes (the ‘default’ option)
  - **Fixed proportion:** unusable causes reallocated to specific causes according to pre-defined (and fixed) proportions: based on literature review, multiple cause analysis, follow back studies (e.g. use for sepsis, peritonitis, renal failure); use when have sufficient *a priori* knowledge to improve on proportionality method
  - **Negative correlation (Regression method):** between target cause and one or more unusable cause (e.g. non-specific sites of cancer; undetermined injuries; most CVD unusable cause)
  - **Multiple causes of death:** use information from all lines on the ICD death certificate to identify mis-coded drug and alcohol abuse deaths

# Medical records review

- A more detailed investigation of the quality of medical certification can be conducted with a medical records review
- Can be used to assess quality of medical certification and to evaluate the effectiveness of training of doctors in certification
- Hospital medical records are extracted for deaths with an existing medical certificate of COD
- Trained doctors:
  1. review extracted medical records
  2. determine underlying cause
  3. re-write a death certificate
  4. assess the quality of death certificates

	GOLD STANDARD DIAGNOSIS																							
VITAL REGISTRATION DIAGNOSIS	Certain infectious and parasitic diseases	Cancers of the GI tract	Liver cancer	Trachea, bronchus and lung cancer	All other neoplasms	Blood and immune disorders	Diabetes mellitus	Other diseases of the nervous system	Hypertensive diseases	Ischaemic heart diseases	Cerebrovascular diseases	Other heart diseases	Pneumonia	Chronic lower respiratory diseases	Other diseases of the respiratory system	Diseases of the liver	Diseases of the skin	Genitourinary diseases	Perinatal conditions	Congenital malformations	Symptoms and ill-defined conditions	External causes	All other codes	Total
Certain infectious /parasitic diseases	9		1	1	1	1	1					2		1		1					1	2	2	23
Cancers of the GI tract		4			1																		1	6
Liver cancer			4													2							1	7
Trachea, bronchus and lung cancer	1			2			1				1													5
All other neoplasms				1	22	1				2	2			4										32
Blood and immune disorders	1					2	1			2		1												7
Diabetes mellitus	3				3		34	1	4	22	9	1	3	2		3	1					1	7	94
Other diseases of the nervous system	2							3		2			1		1	2								11
Hypertensive diseases	4						2		12	9	10		1	3		1		1					1	44
Ischaemic heart diseases	2						9		2	54	5	3	1	5		4				1		1	2	89
Cerebrovascular diseases					1	1	1	1	2	1	17	1		1	1	1								28
Other heart diseases	1	1	1		2		3		2	17	4	21	1	4	1	3	1	1	1	2	1		3	70
Pneumonia					1	1	1	2		1	1		9	2							2		3	23
Chronic lower respiratory diseases	1			1			1			7	1	1	1	13						1			1	28
Other diseases of the respiratory system				1			1	1		1	1		1		3	2		2				1	1	15
Diseases of the liver	4		2				2	1	2	2		3		1		39	1	1					2	60
Diseases of the skin		1								1							1						1	4
Diseases of the genitourinary system											1													1
Perinatal conditions																			4					4
Congenital malformations	1																			3				4
Symptoms and ill-defined conditions																1								1
External causes of mortality	3			1	2		3		2	3		1		1		2		1		1		1	3	24
All other causes		1			1		2	2	1	3	2	1	1	1		2		1					4	22
<b>Total</b>	<b>32</b>	<b>7</b>	<b>8</b>	<b>7</b>	<b>34</b>	<b>6</b>	<b>62</b>	<b>11</b>	<b>27</b>	<b>127</b>	<b>54</b>	<b>35</b>	<b>19</b>	<b>38</b>	<b>6</b>	<b>64</b>	<b>3</b>	<b>7</b>	<b>5</b>	<b>8</b>	<b>4</b>	<b>6</b>	<b>32</b>	<b>602</b>

Are ill-defined deaths redistributed in your country?

What method do you use (or have you used)?

# Understanding the distribution of deaths by cause

- The thousands of possible causes of death in the ICD-10 can be condensed into three broad groups:
  - Group 1: infectious and parasitic diseases; maternal and neonatal conditions; malnutrition
  - Group 2: non-communicable diseases
  - Group 3: injuries
- The expected distribution of COD into these three groups varies according to the stage of the 'epidemiological transition' a country is in



# Epidemiological transition

- Describes global long-term trends in life expectancy and causes of death
  - Based on experiences of countries over the past 200+ years
- *Stage 1: Age of pestilence and famine:*
  - High mortality (especially in childhood)
  - Life expectancy fluctuates between 20 and 40 years due to droughts and famine
  - Most of human history has been spent in this stage
  - Deaths caused by infectious disease

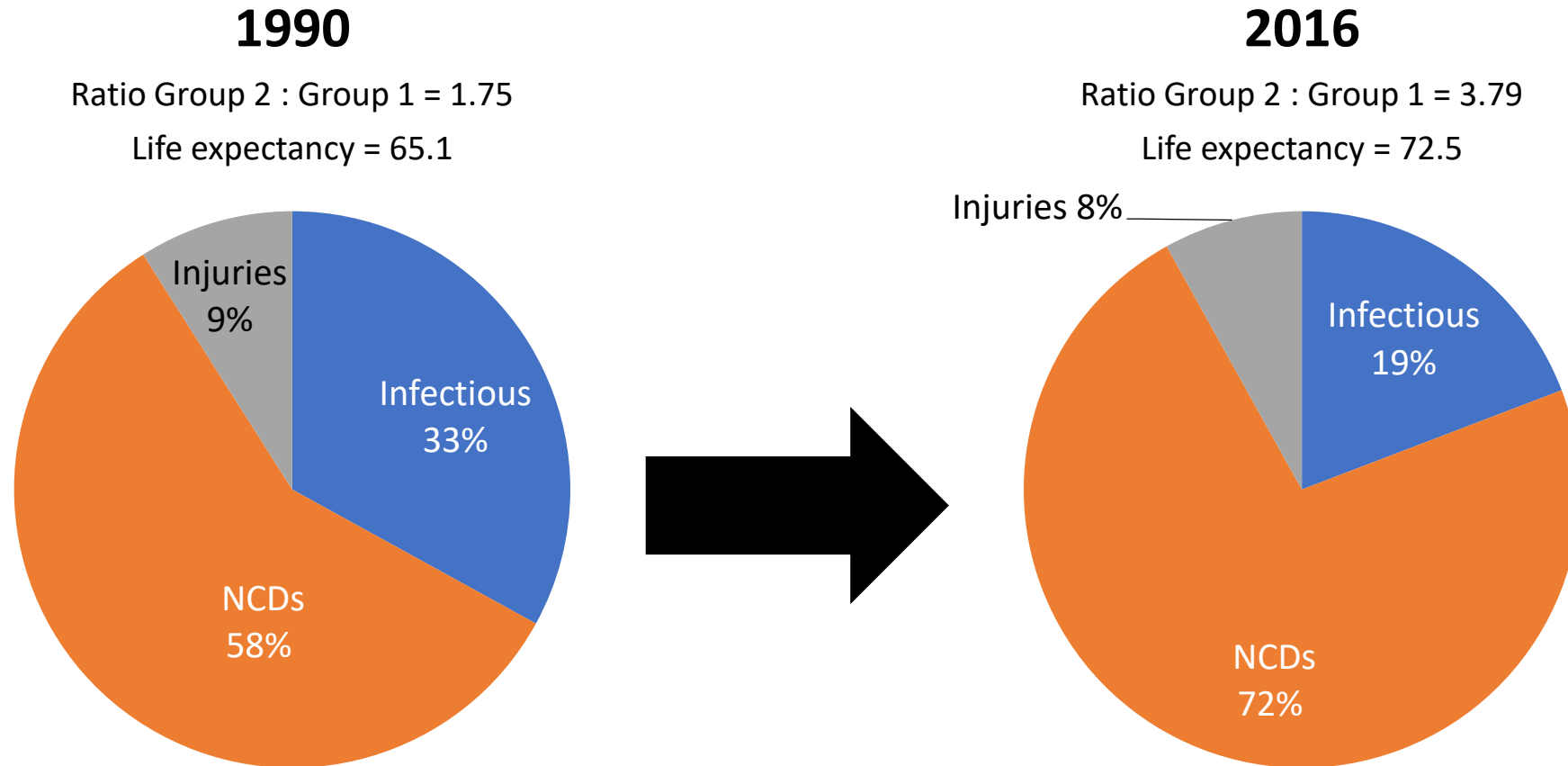
# Epidemiological transition

- *Stage 2: Age of receding pandemics*
  - Mortality begins to decline, especially in children
  - Improved nutrition, improved sanitation, declines in infectious diseases – occurred in the 19<sup>th</sup> century in Western countries
  - Improved education, especially among females
- *Stage 3: Age of degenerative and man-made diseases*
  - Mortality continues to decline, especially at older ages
  - NCDs such as heart disease and cancers become an increasing proportion of deaths
  - Occurred in mid-20th century in Western countries and is presently occurring in many low- and middle-income countries

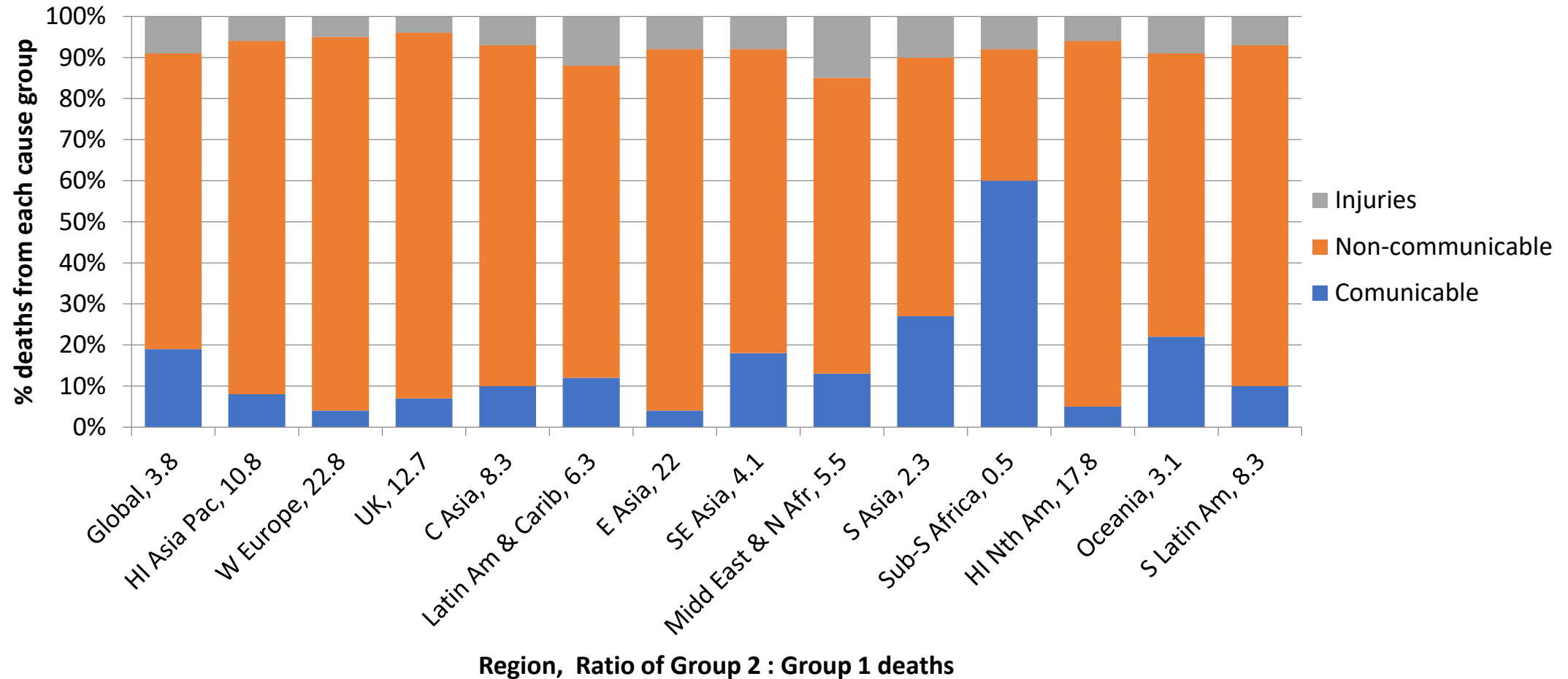
# Epidemiological transition

- *Stage 4: Age of delayed degenerative diseases*
  - Further decline in death rates and ages at death become even older
  - Increased prevalence of degenerative diseases such as Alzheimer's and Parkinson's disease
  - This stage is found in many Western countries today
- In summary
  - As mortality rates decline, the ratio of Group 2 to Group 1 causes of death should increase (more deaths from NCDs, less from infectious)

# Shift in global causes of death, 1990-2016



# Stage of epidemiological transition in various regions of the world, 2016



# Understanding the distribution of deaths by **age**

- The risk of dying from different diseases and injuries varies with age
- Most common causes of deaths follow a predictable age pattern that has been identified from decades of epidemiological research
- They can be understood in three ways:
  - As the **likelihood** of a person of a certain age dying from a particular cause – the denominator is the population (who are at risk of dying) – measured using a cause-specific death rate (CSDR)
  - As the **proportion** of all deaths that are from a particular cause – denominator is deaths in an age group – a cause-specific mortality fraction (CSMF)
  - As the **proportion** of all deaths from a particular cause that occur at each age – denominator is deaths from a particular cause

# Cause-specific death rate (CSDR)

- *I am a man aged 55-64; how likely am I to die from a certain cause?*
- The cause-specific death rate is measured for a certain cause and often for a certain age. Population at risk is the denominator.

IHD cause – specific death rate for males aged 55 – 64 in 2015

$$= \frac{\text{IHD male deaths aged 55 – 64 in 2015}}{\text{Male population aged 55 – 64 at 30 June 2015}} \times 100,000$$

$$= \frac{269}{152,021} \times 100,000 = 176.9 \text{ per } 100,000$$

# Cause-specific mortality fractions (CSMFs)

- *Of the men aged 55-64 who died; what proportion died from a specific cause?*
- This is simply the proportion of deaths within a population (or subset of a population) from each cause

IHD male CSMF at age 55 – 64 in 2015

$$= \frac{\text{IHD male deaths aged 55–64 in 2015}}{\text{Total male deaths aged 55–64 in 2015}}$$

$$= \frac{269}{3,005} = 0.0895 \text{ or } 9.0\%$$

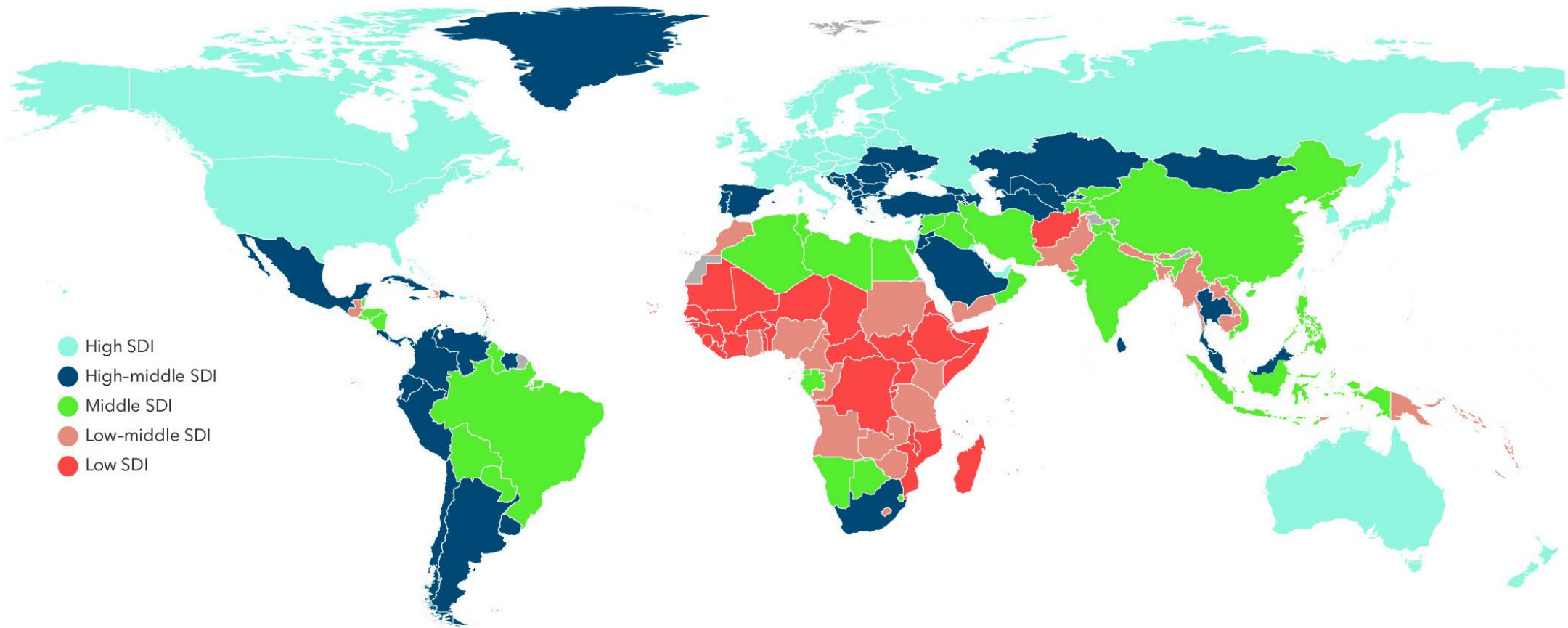


# Distribution of deaths from each broad cause *within* each age

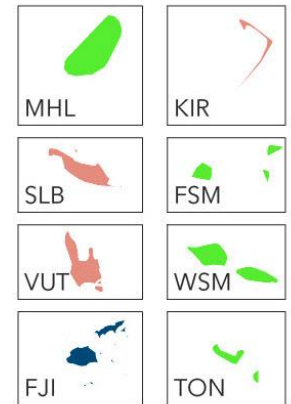
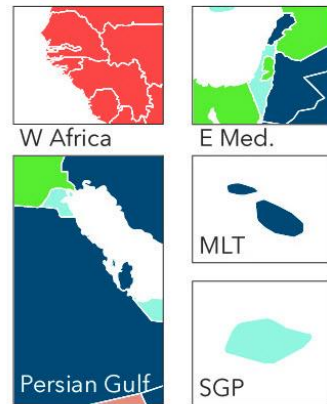
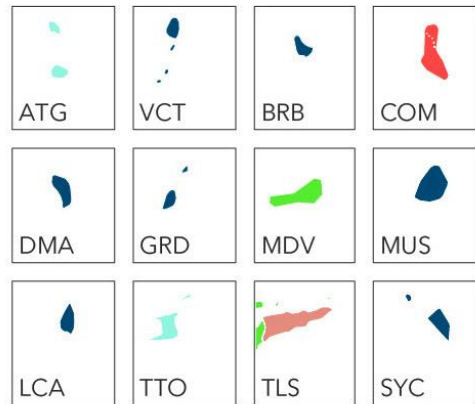
- The proportion of deaths due to Group 1 should be highest at ages <1 year, and then be less than 15% at all other ages
  - Except for countries where there is high HIV
- Deaths from Group 2 should comprise an increasing proportion of deaths above age 30 or so
  - Keep in mind that many unusable causes are actually Group 2, so Group 2 causes may be under-reported, especially at older ages
- Group 3 causes should comprise over 20% of deaths from ages 5-30, but then decline at older ages
- Unusable causes should increase with age above ages 20. They should be very high at the oldest ages because of the reporting of senility.

# CSMF by age and Socio-Demographic Index (SDI)

- The next few charts show the proportion of deaths at each age group that due to causes in Groups 1, 2 or 3 (cause-specific mortality fraction)
  - We exclude unusable causes of death from this analysis
- The results are shown for five levels of the Socio-Demographic Index (SDI)
  - This is an Index that measures a country based on its average income per person, educational attainment, and total fertility rate
- Mortality levels differ according to the SDI level (high SDI = lower mortality and vice versa)



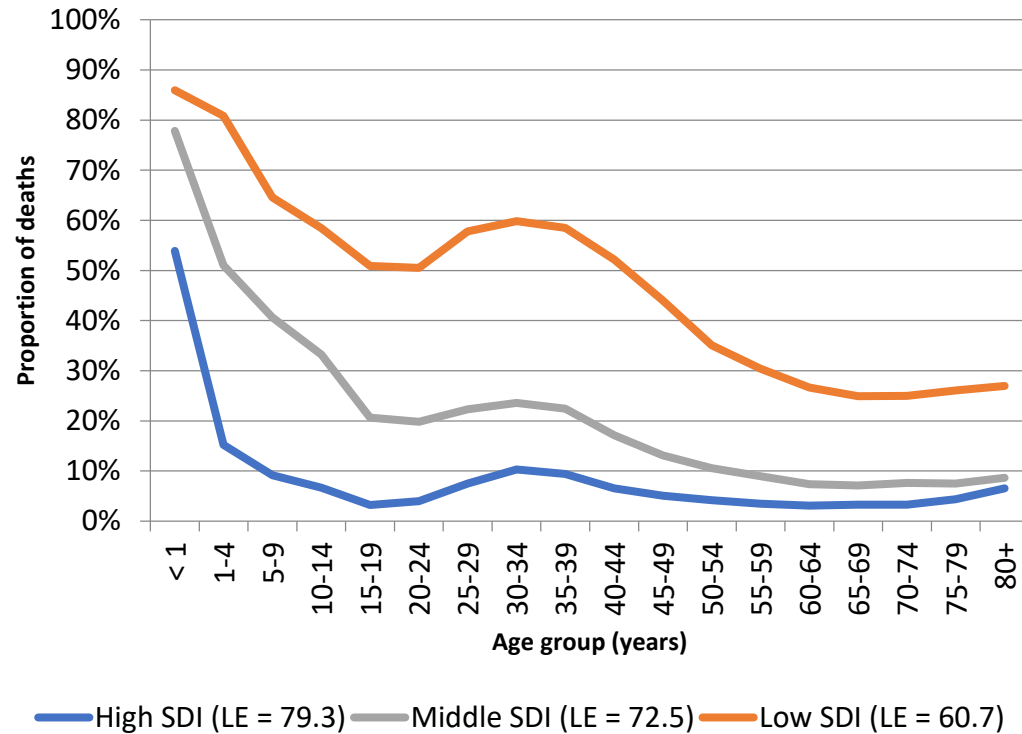
- High SDI
- High-middle SDI
- Middle SDI
- Low-middle SDI
- Low SDI



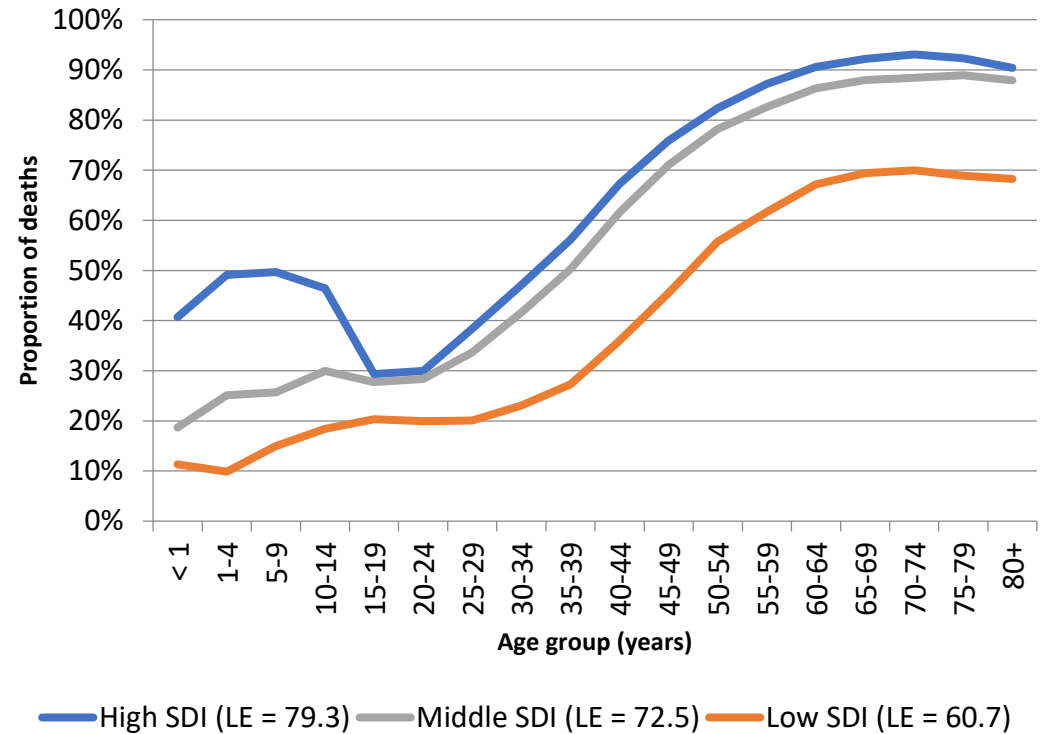
Source: <http://www.healthdata.org/acting-data/new-way-measuring-development-helps-assess-health-system-performance>

# CSMF by age group and SDI

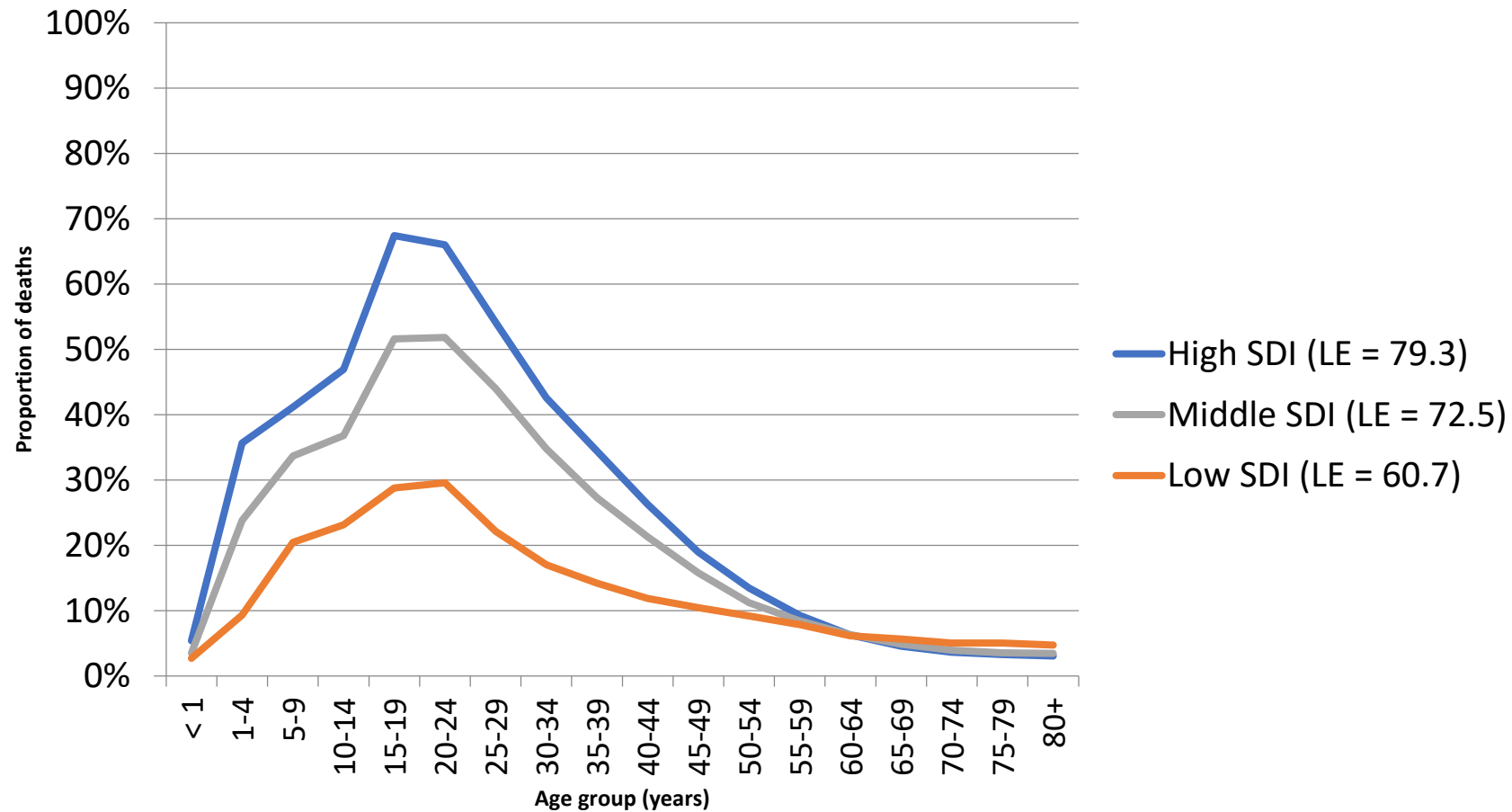
## Group 1



## Group 2



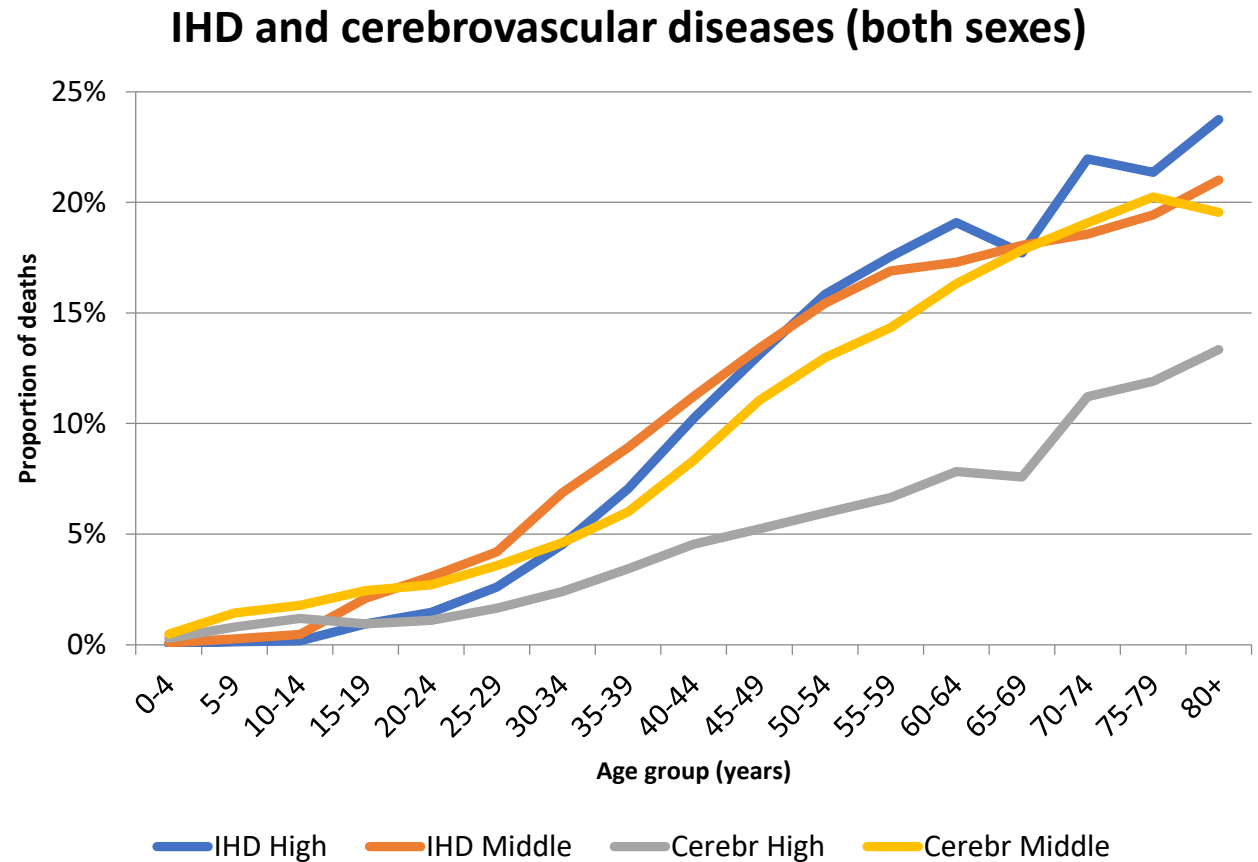
# Group 3 CSMF by age group and SDI



Source: IHME, GHDx, GBD Results Tool

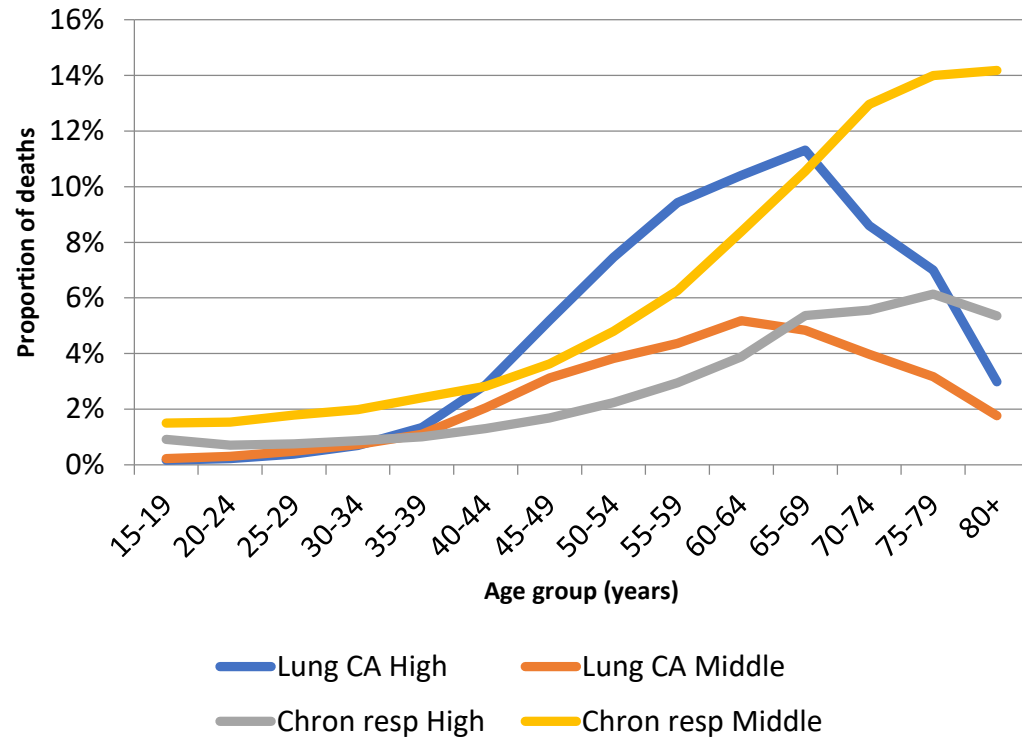
# Age patterns of specific causes of death

- The next few slides show, for leading causes of death in high and middle SDI countries:
  - The CSMFs by age
  - The % of deaths of each cause that occur at each age

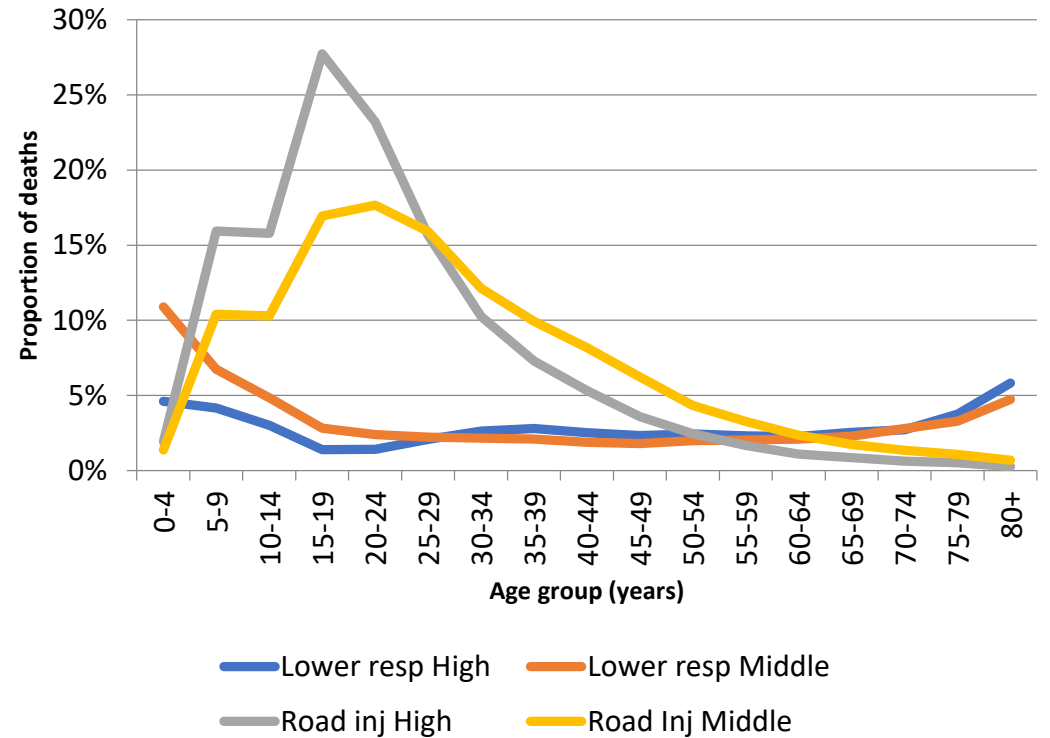


# CSMF age patterns, both sexes

## Lung cancer and chronic respiratory diseases



## Lower respiratory diseases and road injuries

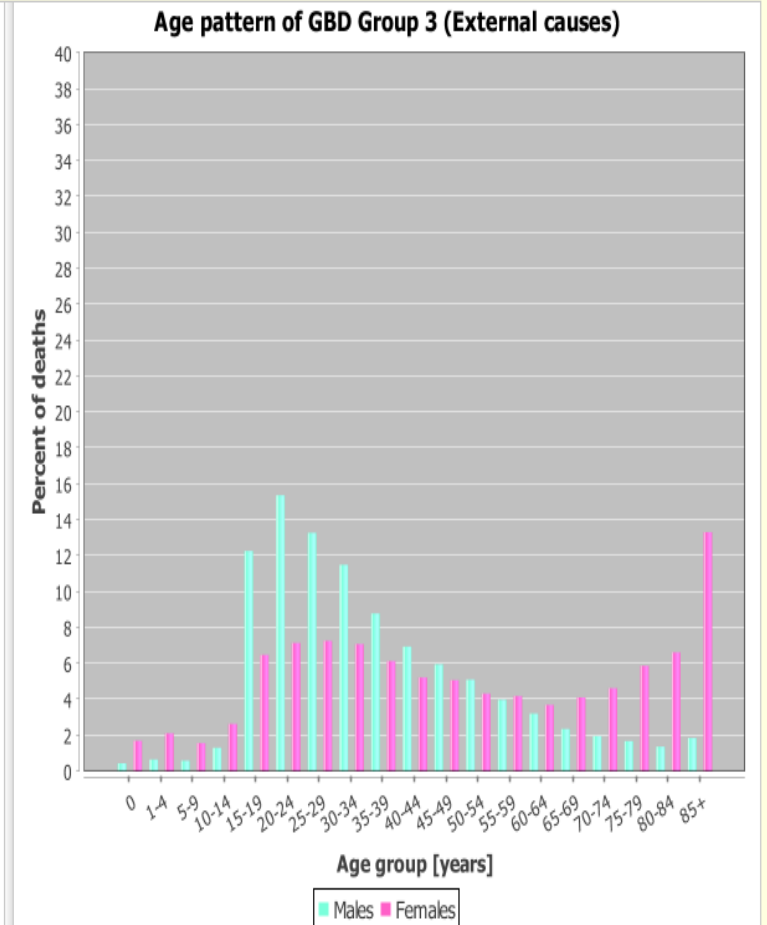
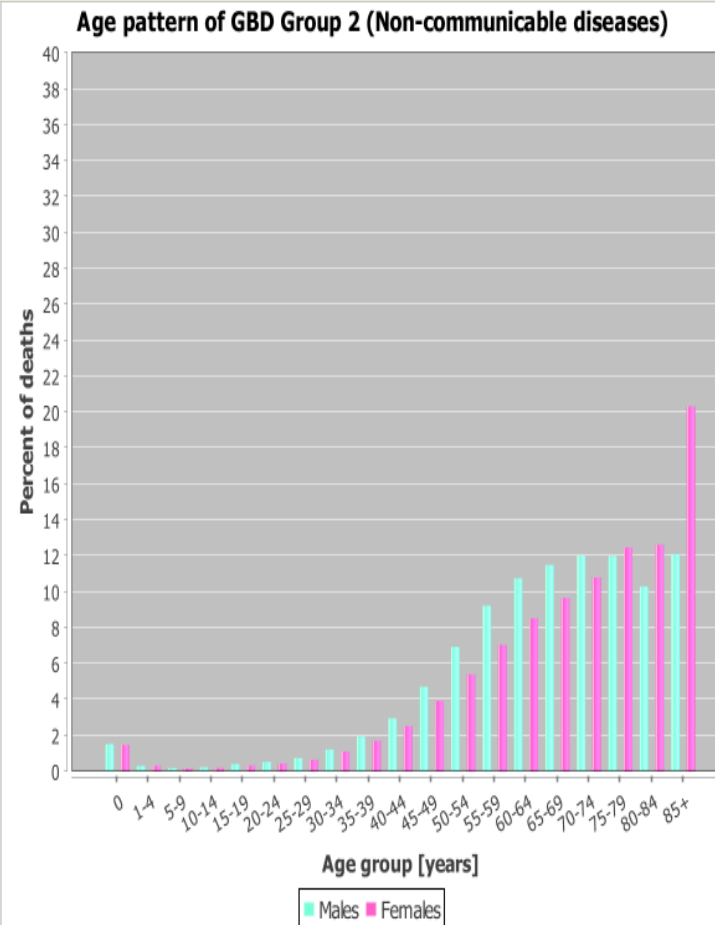
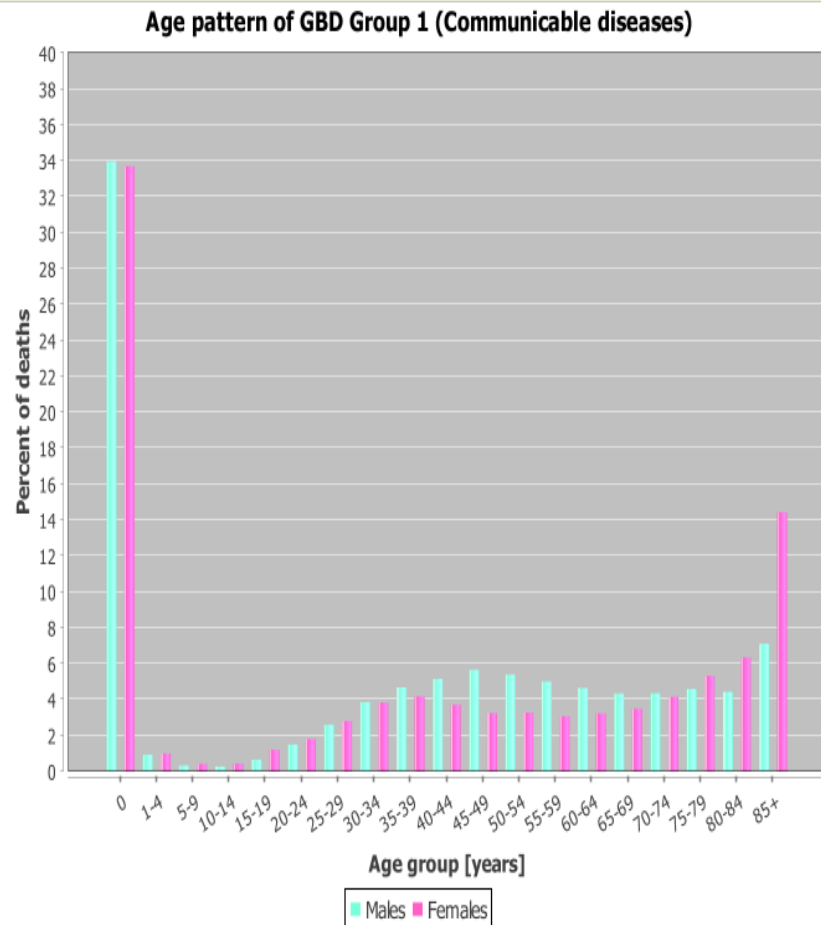


# Distribution of deaths at each age *within* each broad cause

- Based on epidemiological research, the general age patterns for broad COD are:
  - Highest share of deaths due to communicable diseases is among children
    - An exception is in countries with high HIV among adults
  - Highest share of deaths due to external causes is among people aged 10-40 years, especially males
  - Majority of deaths from age 40 plus is due to non-communicable diseases
  - General increase in unusable and insufficiently specified codes as age increases (though also often quite high among children)
- Important to remember: the distribution of deaths at each age *within* each broad cause is determined by the age distribution of deaths, which itself is determined by the age structure of the whole population



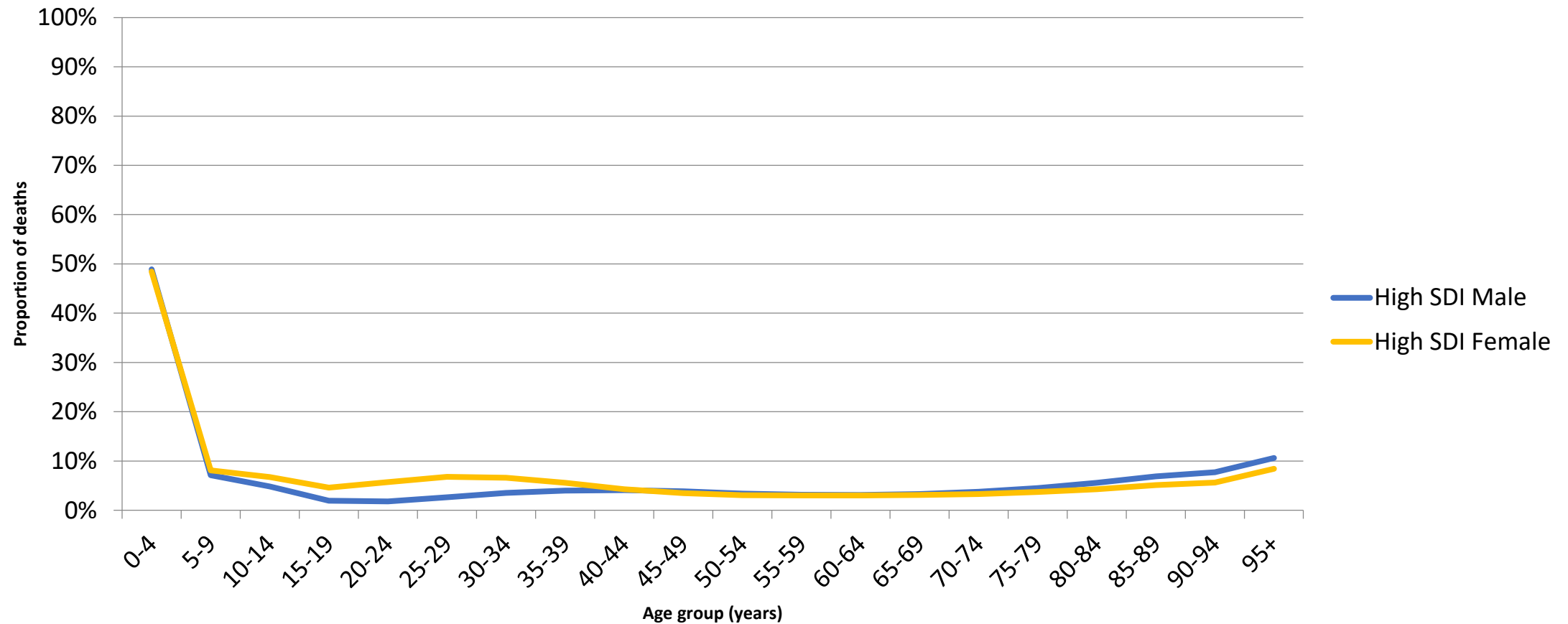
# The distribution of deaths at each age *within* each broad cause, example country



# Distribution by age and sex, and broad cause (Group 1)

- This proportion of deaths at each age group from each broad cause will differ between males and females
- A higher proportion of female than males deaths in adulthood are from Group 1 causes, primarily because of maternal causes of death
- This is more an issue in low and middle SDI countries than high SDI countries
- Again, we are presenting CSMFs. However, these **are not the risk of dying** from that cause. Remember, the risk of dying is higher for males than females at each age, especially young adulthood (in almost all countries)

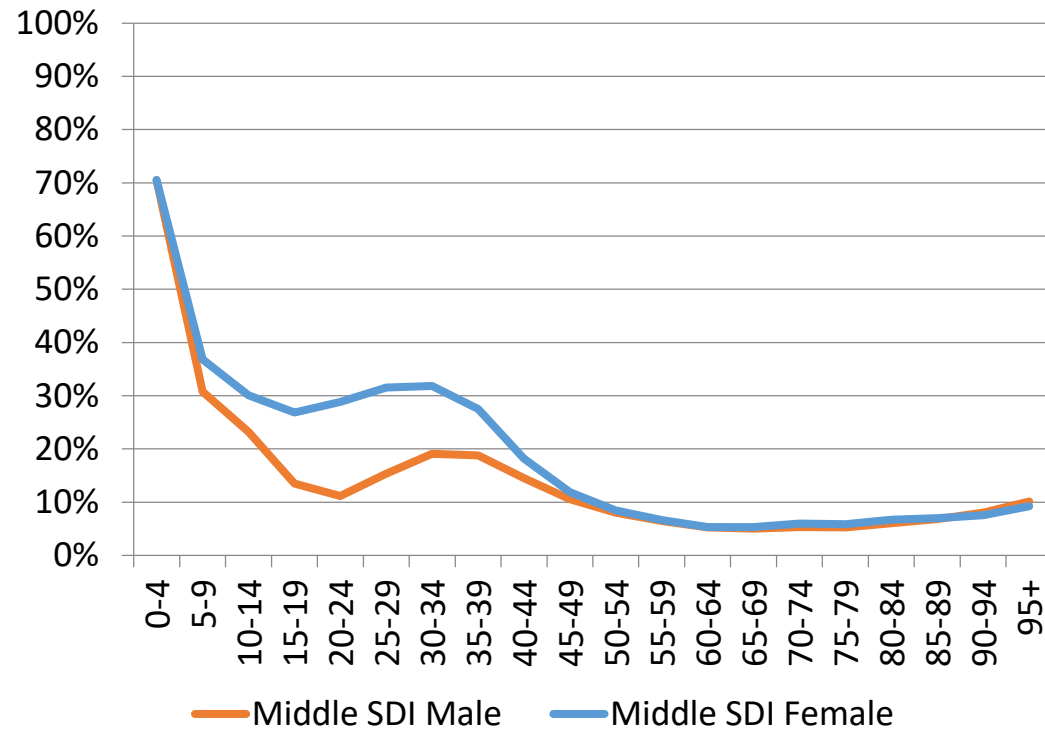
# CSMF distribution by age and sex, and broad cause (Group 1)



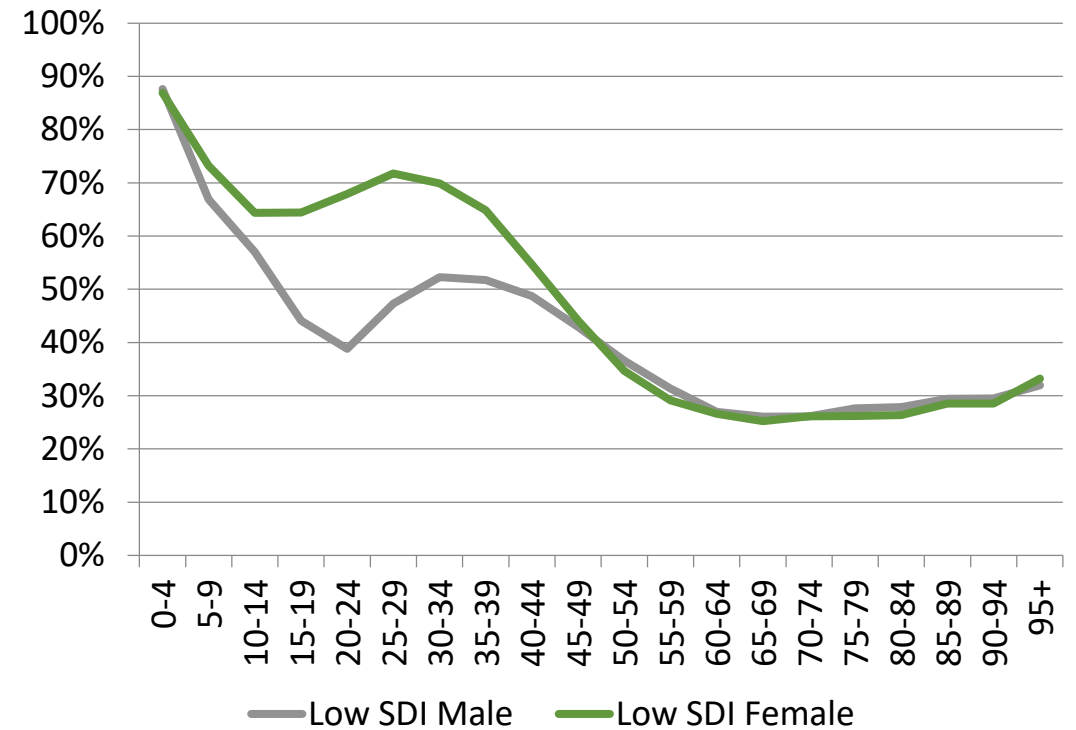
Source: IHME, GHDx, GBD Results Tool

# CSMF distribution by age and sex, and broad cause (Group 1)

## Middle SDI

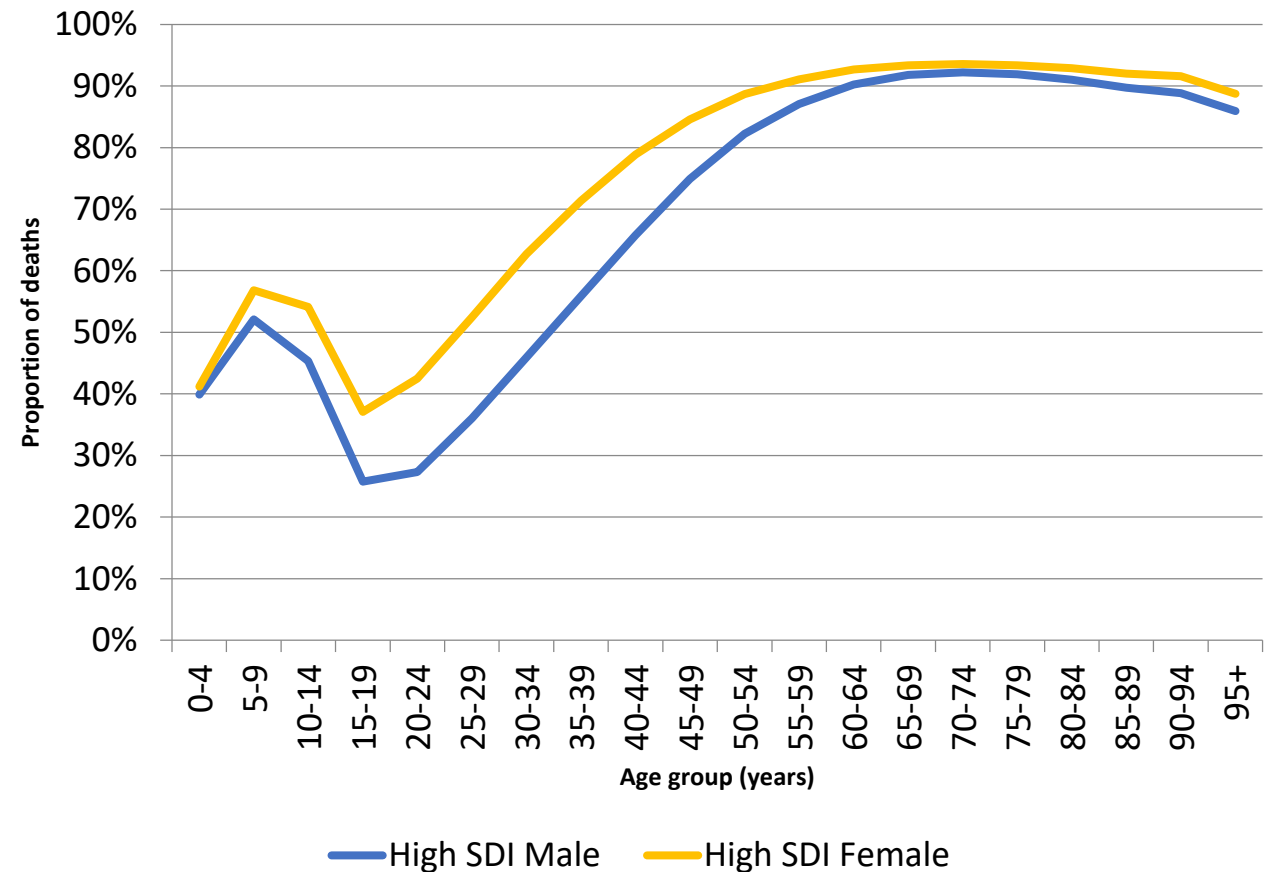


## Low SDI

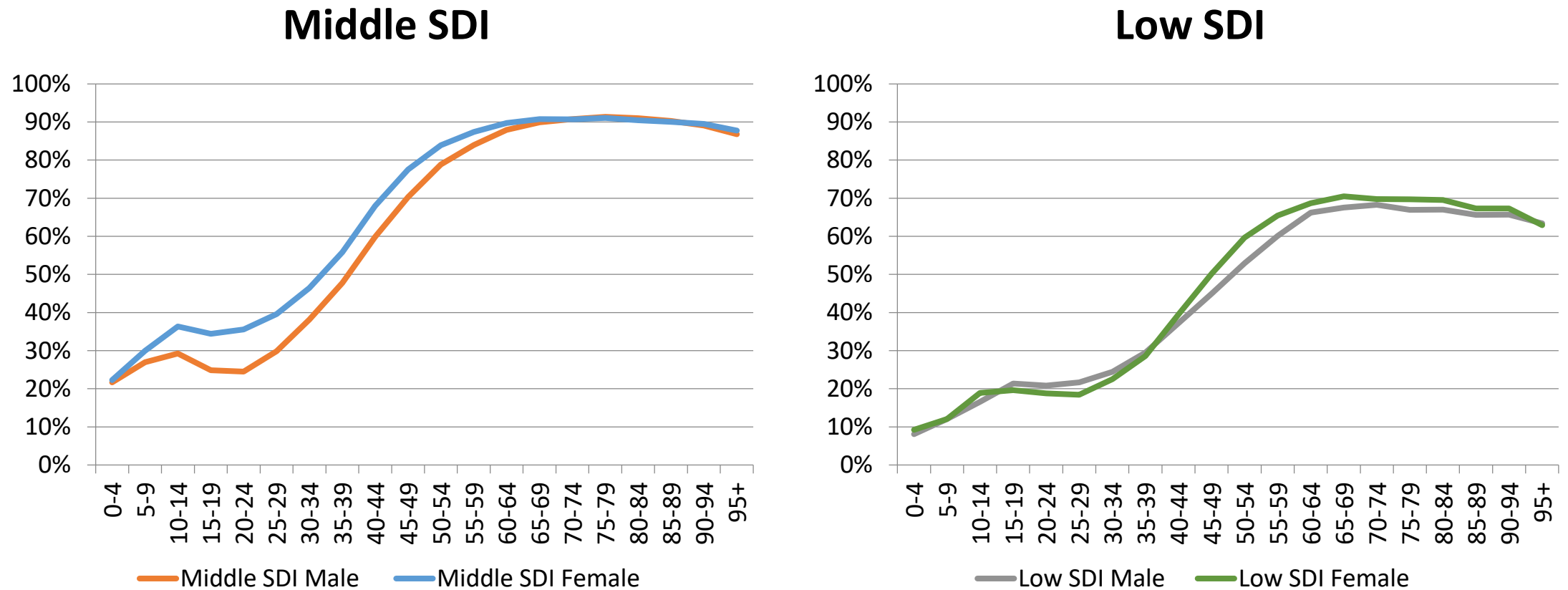


# CSMF distribution by age and sex, and broad cause (Group 2)

- In general, a higher proportion of female than male deaths at each age are due to non-communicable diseases
- This is particularly the case in high SDI countries



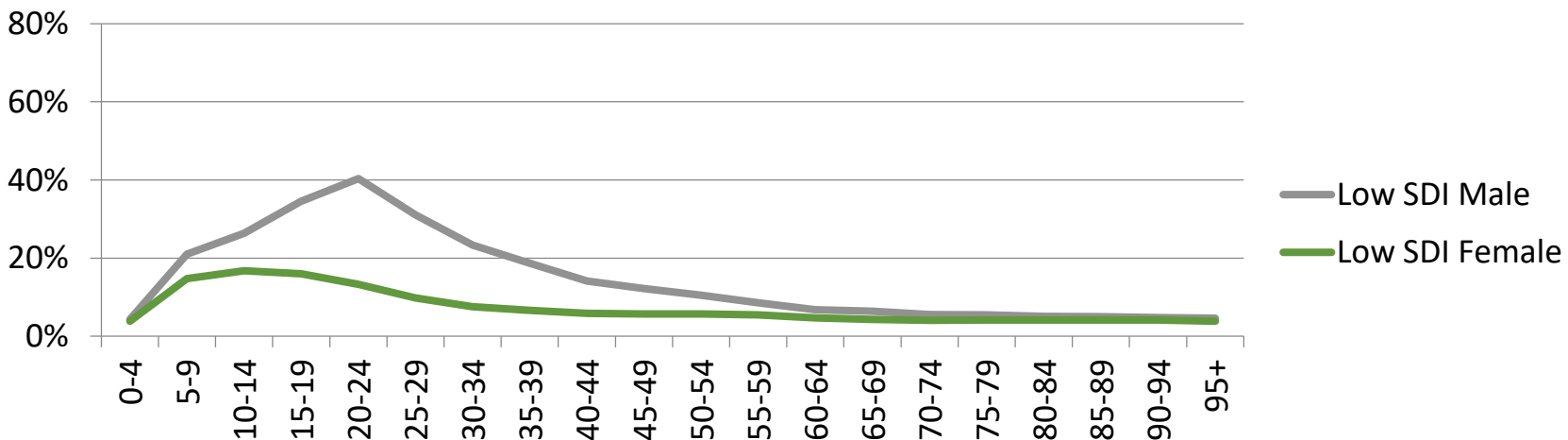
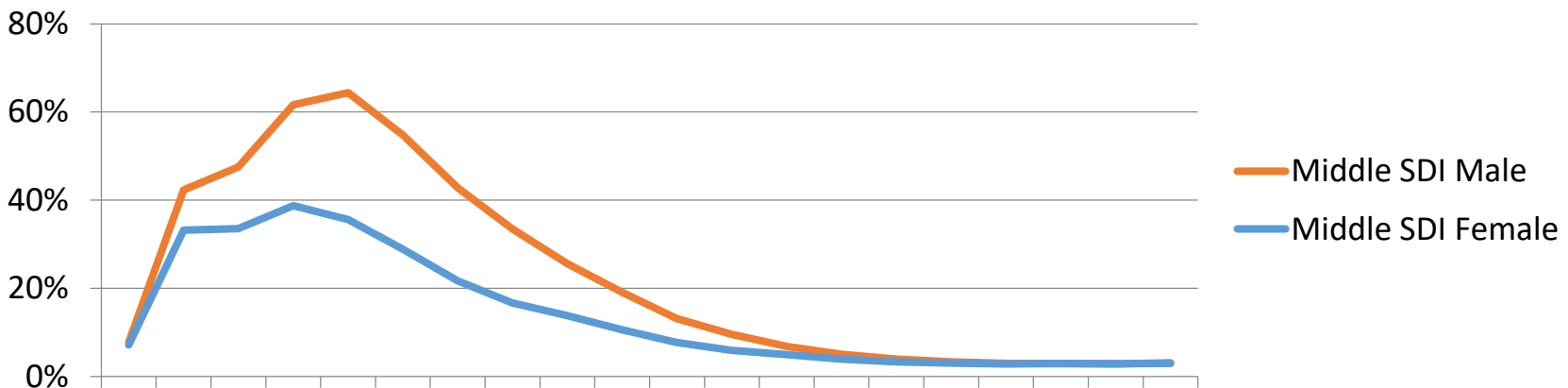
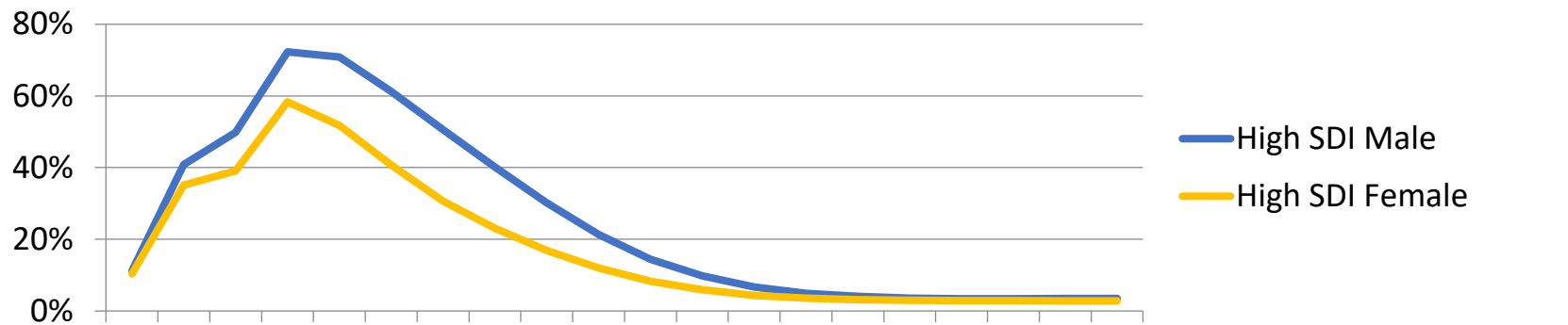
# CSMF distribution by age and sex, and broad cause (Group 2)



Source: IHME, GHDx, GBD Results Tool

# CSMF distribution by age and sex, and broad cause (Group 3)

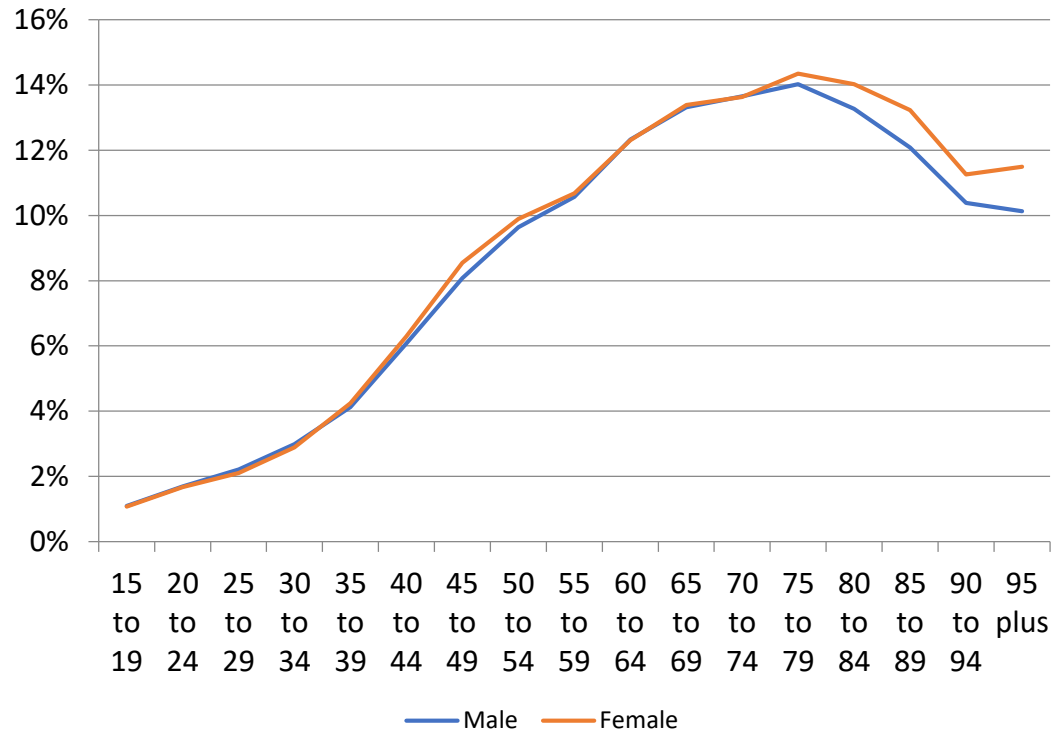
- The proportion of male deaths from injuries is higher than for females at almost every age
- The difference is largest in low SDI countries, although the actual proportion of deaths from injuries for both males and females is highest in high SDI countries
  - This is because there are less “competing” causes of death in high SDI countries (i.e. less people die from Communicable and non-communicable diseases)



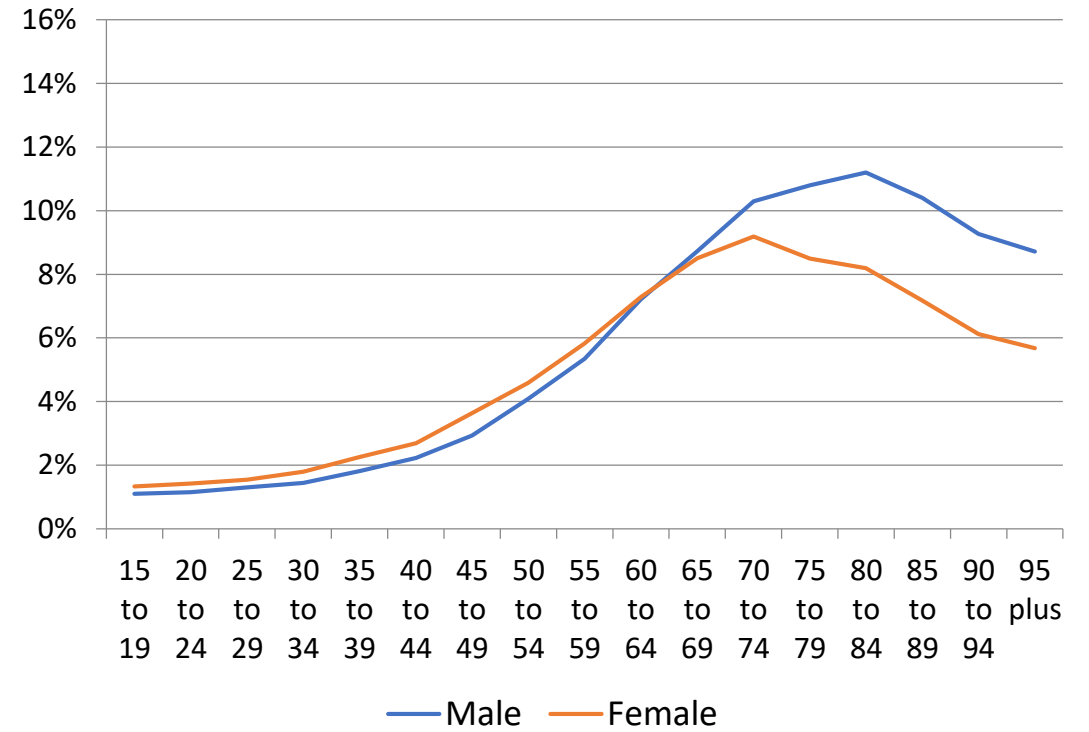


# CSMF distribution by age and sex, and specific cause

## IHD



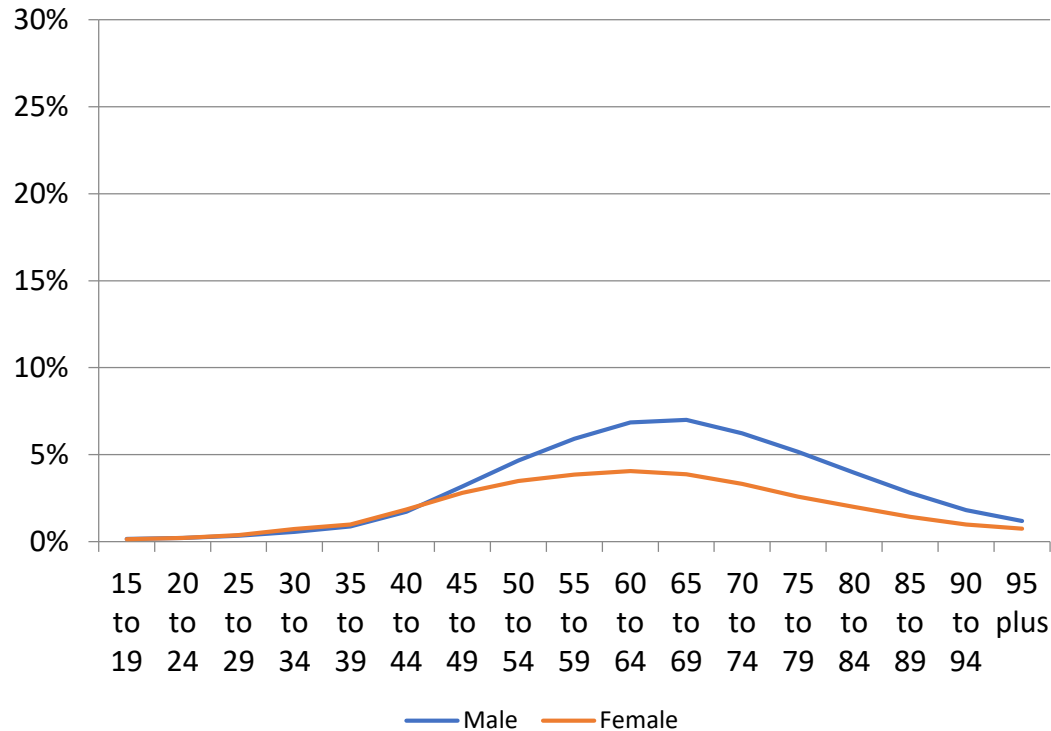
## Stroke



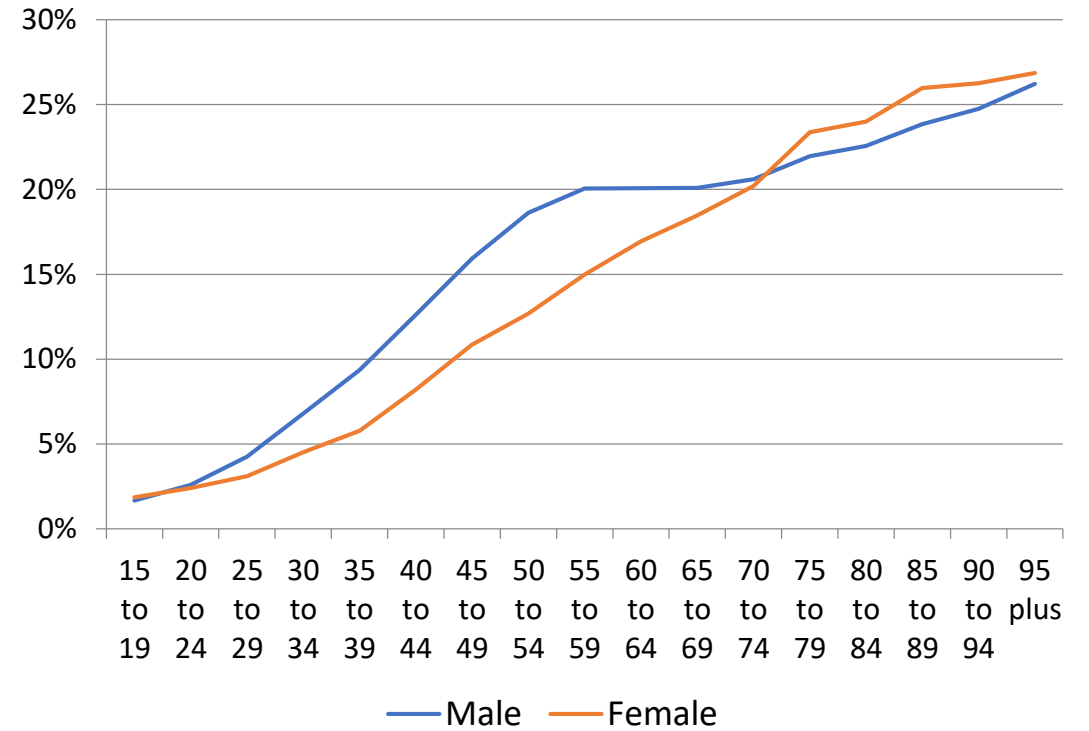
Source: IHME, GHDx, GBD Results Tool

# CSMF distribution by age and sex, and specific cause

## Lung cancer



## Chronic respiratory diseases



Source: IHME, GHDx, GBD Results Tool

Why are these **fundamentals** important?

A good vital statistics report will not only report on key measures, it will assess their plausibility – always remember to ask yourself, *does this look right for my country or region?*

# Cause-specific mortality concepts and measures

Explaining trends in your mortality data

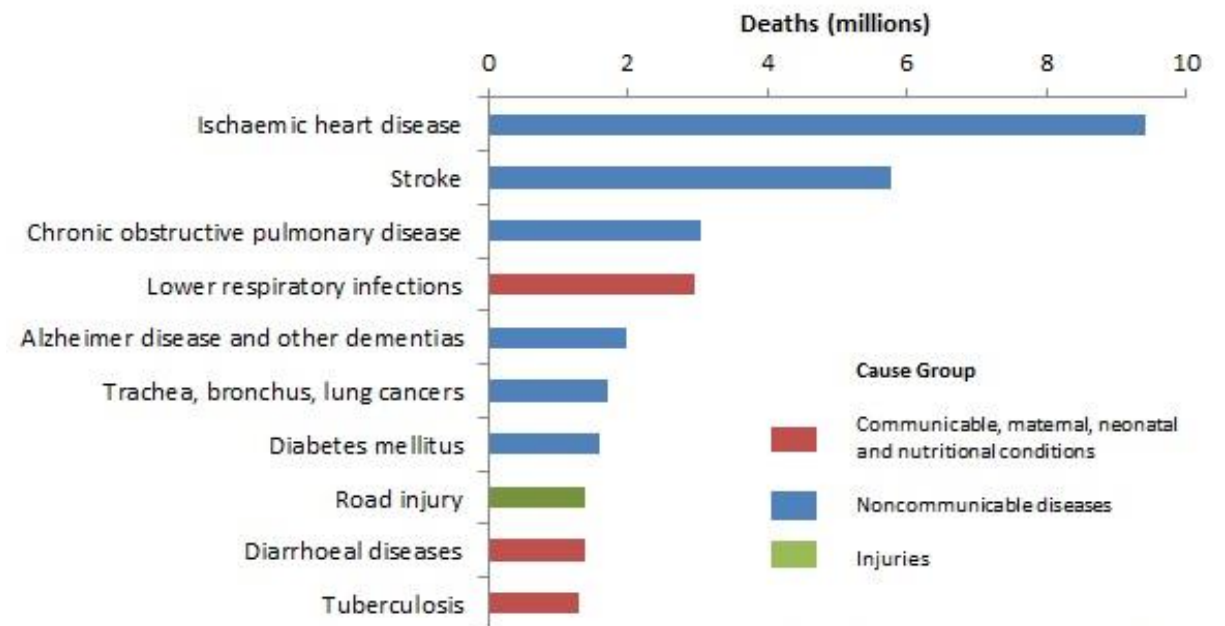
# Essential items: vital statistics report template

- System for the classification of causes of death (ie. ICD-10)
- Reported causes of death
- Method of ascertaining the cause of death
- **Broad groups of underlying causes of death**
- **Deaths by cause, age and sex**
- **Major groups of causes of death according to GBD**
- **Broad groups of natural causes of death**
- **Non-natural causes of death**

# Leading causes of death

- The simplest way to present cause of death data is to show the leading causes of death
- Can be age-standardised using cause-specific death rates by age and sex and the methods described earlier
  - Important when comparing between populations or over time, otherwise age confounding of causes will occur

Top 10 global causes of deaths, 2016



Source: Global Health Estimates 2016: Deaths by Cause, Age, Sex, by Country and by Region, 2000-2016. Geneva, World Health Organization, 2018.

# Cause tabulation lists

- When presenting cause of death data, you need to select a tabulation list
  - Each list can be mapped to ICD codes
- Tabulation lists (WHO):
  - General mortality, condensed list (103 groups of causes)
  - General mortality, selected list (80)
  - Infant and child mortality, condensed (67)
  - Infant and child mortality, selected (51)
- Global Burden of Disease
  - 300 causes
- Cause lists for verbal autopsy

# Disaggregation of cause of death

- As we have seen, the leading causes of death and the risk of dying from different causes of death varies by age and sex
- It makes sense that when presenting causes of death, we should always disaggregate by age and sex
  - 4 to 5 age groups can be useful– e.g. 0-14, 15-44, 45-64, 65-84, 85+
- Many policy interventions are targeted at specific ages or for males or females



# Leading causes of death at ages below 15 years, Thailand, 2005

Cause of death	% of deaths
Birth asphyxia and birth trauma	12.7
Road traffic accidents	11.6
Drowning	10.0
Low birth weight	9.6
Congenital heart anomalies	6.0
HIV/AIDS	4.1
Anencephaly	3.7
Down syndrome	3.2
Leukaemia	1.6
Other causes	37.3
Total (N)	22,103
<i>Ill-defined*</i>	0.6

\* Redistributed across specific causes

# Leading causes of death at ages 15-49 years, Thailand, 2005

Males		Females	
Cause of death	% of deaths	Cause of death	% of deaths
HIV/AIDS	22.6	HIV/AIDS	30.7
Road traffic accidents	19.0	Road traffic accidents	6.5
Cirrhosis of the liver	6.6	Cervix cancer	5.8
Suicide	5.7	Stroke	4.1
Homicide	4.8	Diabetes mellitus	3.6
Stroke	3.9	Suicide	3.3
Liver cancer	3.2	Cirrhosis of the liver	3.0
Ischaemic heart disease	2.7	Liver cancer	2.9
Drowning	2.3	Breast cancer	2.8
Lower respiratory infections	1.9	Nephritis and nephrosis	2.5
Other causes	27.3	Other causes	34.9
Total (N)	83,419	Total (N)	36,503
<i>Ill-defined*</i>	1.7	<i>Ill-defined*</i>	0.3

\* Redistributed across specific cause

# Leading causes of death at ages 50-74 years, Thailand, 2005

Males		Females	
Cause of death	% of deaths	Cause of death	% of deaths
Stroke	12.3	Diabetes mellitus	12.3
Ischaemic heart disease	11.1	Stroke	10.5
Liver cancer	7.5	Ischaemic heart disease	9.6
COPD	6.8	Nephritis and nephrosis	5.4
Lung cancer	6.0	Cervix cancer	4.8
Cirrhosis of the liver	5.7	Liver cancer	4.8
Diabetes mellitus	5.4	Lung cancer	3.7
Road traffic accidents	3.1	COPD	3.6
Nephritis and nephrosis	2.9	Hypertensive disease	3.6
Lower respiratory infections	2.5	Cirrhosis of the liver	3.3
Other causes	36.8	Other causes	38.5
Total (N)	98,602	Total (N)	71,902
<i>Ill-defined*</i>	2.5	<i>Ill-defined*</i>	2.3

\* Redistributed across specific causes

# Leading causes of death at ages 75 years and over, Thailand, 2005

Males		Females	
Cause of death	% of deaths	Cause of death	% of deaths
Stroke	15.1	Stroke	19.4
COPD	12.5	Ischaemic heart disease	12.1
Ischaemic heart disease	8.8	Diabetes mellitus	7.3
Lower respiratory infections	5.4	Lower respiratory infections	7.2
Lung cancer	3.8	Nephritis and nephrosis	4.3
Diabetes mellitus	3.7	Hypertensive disease	4.1
Nephritis and nephrosis	3.6	COPD	3.5
Hypertensive disease	3.3	Diarrhoeal diseases	2.6
Cirrhosis of the liver	3.2	Falls	2.6
Tuberculosis	2.8	Liver cancer	1.8
Other causes	37.8	Other causes	35.3
Total (N)	60,146	Total (N)	74,429
<i>Ill-defined*</i>	9.4	<i>Ill-defined*</i>	15.2

\* Redistributed across specific causes

Should I present original data (with ill-defined) or after redistribution?

# Leading causes of death (original and redistributed)

ICD Females				GBD Females			
Rank	% of causes	ICD code	Name of category	Rank	% of causes	GBD classification	Name of category
1	11.3	J18.-	Pneumonia, organism unspecified	1	15.9	cvd_ihd	Ischemic heart disease
2	7.3	I21.-	Acute myocardial infarction	2	12.4	cvd_stroke	Cerebrovascular disease
3	4.2	I11.-	Hypertensive heart disease	3	11.4	lri	Lower respiratory infections
4	4.1	I64.-	Stroke, not specified as haemorrhage or infarction	4	4.6	diabetes	Diabetes mellitus
5	3.5	E11.-	Non-insulin-dependent diabetes mellitus	5	4.4	ckd	Chronic kidney disease
6	3.2	I25.-	Chronic ischaemic heart disease	6	3.3	neo_breast	Breast cancer
7	3.1	C50.-	Malignant neoplasm of breast	7	3.2	cvd_htn	Hypertensive heart disease
8	3.1	E14.-	Unspecified diabetes mellitus	8	3.1	tb	Tuberculosis
9	2.9	A16.-	Respiratory tuberculosis, not confirmed bacteriologically or histologically	9	2.3	neuro_dementia	Alzheimer disease and other dementias
10	2.6	I61.-	Intracerebral haemorrhage	10	2.2	resp_copd	Chronic obstructive pulmonary disease
11	2.3	I46.-	Cardiac arrest	11	2.1	cong	Congenital birth defects
12	2.0	I50.-	Heart failure	12	1.8	resp_asthma	Asthma
13	1.9	I10.-	Essential (primary) hypertension	13	1.6	neonatal_sepsis	Neonatal sepsis and other neonatal infections
14	1.8	R54.-	Senility	14	1.5	neonatal_preterm	Neonatal preterm birth complications
15	1.6	I51.-	Complications and ill-defined descriptions of heart disease	15	1.5	neo_lung	Tracheal, bronchus, and lung cancer
16	1.4	I67.-	Other cerebrovascular diseases	16	1.3	neo_colorectal	Colon and rectum cancer
17	1.4	R99.-	Other ill-defined and unspecified causes of mortality	17	1.1	neo_cervical	Cervical cancer
18	1.4	A41.-	Other septicaemia	18	1.1	inj_trans_road	Road injuries
19	1.3	J44.-	Other chronic obstructive pulmonary disease	19	1.0	neo_other	Other neoplasms
20	1.3	N18.-	Chronic renal failure	20	1.0	diarrhea	Diarrheal diseases

# Presenting leading causes of death in your vital statistics report

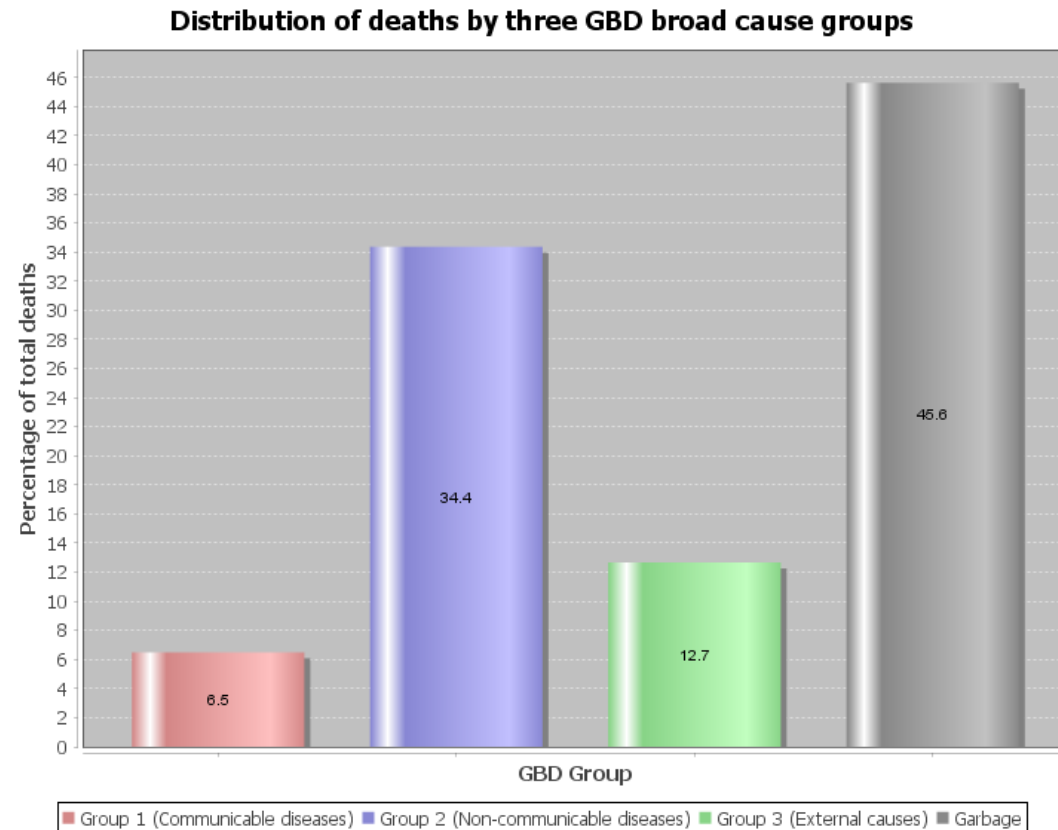
Data lab

# Data lab: Create your broad death distribution graphs/tables

Total deaths distributed into ICD chapters					
ICD chapter	Description	ICD code range	Total deaths	% of total deaths	Total unusable causes
1	Chapter I: Certain infectious and parasitic diseases	A00-B99	290	1.0	97
2	Chapter II: Neoplasms	C00-D48	8,957	29.6	554
3	Chapter III: Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	D50-D89	59	0.2	21
4	Chapter IV: Endocrine, nutritional and metabolic diseases	E00-E90	1,061	3.5	26
5	Chapter V: Mental and behavioural disorders	F00-F99	1,150	3.8	36
6	Chapter VI: Diseases of the nervous system	G00-G99	1,293	4.3	78
7	Chapter VII: Diseases of the eye and adnexa	H00-H59	1	0.0	1
8	Chapter VIII: Diseases of the ear and mastoid process	H60-H95	3	0.0	2
9	Chapter IX: Diseases of the circulatory system	I00-I99	10,541	34.8	2,632
10	Chapter X: Diseases of the respiratory system	J00-J99	2,723	9.0	748
11	Chapter XI: Diseases of the digestive system	K00-K93	940	3.1	170
12	Chapter XII: Diseases of the skin and subcutaneous tissue	L00-L99	92	0.3	3
13	Chapter XIII: Diseases of the musculoskeletal system and connective tissue	M00-M99	251	0.8	78
14	Chapter XIV: Diseases of the genitourinary system	N00-N99	435	1.4	87
15	Chapter XV: Pregnancy, childbirth and the puerperium	O00-O99	7	0.0	0
16	Chapter XVI: Certain conditions originating in the perinatal period	P00-P96	151	0.5	11
17	Chapter XVII: Congenital malformations, deformations and chromosomal abnormalities	Q00-Q99	181	0.6	0
18	Chapter XVIII: Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	R00-R99	119	0.4	97
19	Chapter XIX: Injury, poisoning and certain other consequences of external causes	S00-T98	0	0.0	0
20	Chapter XX: External causes of morbidity and mortality	V01-Y98	2,025	6.7	162
21	Chapter XXI: Factors influencing health status and contact with health services	Z00-Z99	0	0.0	0
22	Chapter XXII: Codes for special purposes	U00-U85	0	0.0	0
<b>Total</b>			<b>30,279</b>	<b>100.0</b>	<b>4,803</b>



# Data lab: Create your broad death distribution graphs/tables



- Group 1

- ICD-10:A00-B99, G00-G04, N70-N73, J00-J06, J10-J18, J20-J22, H65-H66, O00-O99, P00-P96, E00-E02, E40-E46, E50, D50-D53, D64.9, E51-64

- Group 2

- ICD-10:C00-C97, D00-D48, D55-D64 (minus D 64.9) D65-D89, E03-E07, E10-E16, E20-E34, E65-E88, F01-F99, G06-G98, H00-H61, H68-H93, I00— I99, J30—J98, K00-K92, N00-N64, N75-N98, L00-L98, M00-M99, Q00-Q99

- Group 3

- ICD-10: V01-Y89

# General tips for making leading cause of death tables more useful

- Make sure the total number of deaths is reported
- Report separately for males and females, and by broad age group (where possible)
- Lists are only comparable if they use the same level of categorisation. It is recommended to use the General Mortality List 1
- It is always useful to report the proportion of deaths for which cause of death data was known ('all other causes')
- Always report the proportion of deaths for which no cause of death data was available, or if the cause of death was ill-defined

# Data lab: Create your leading cause of death tables (*example of country with poor quality data*)

Table 17: Causes of death (number and percent distribution) by ICD-10 chapter and sex: 2009-2013

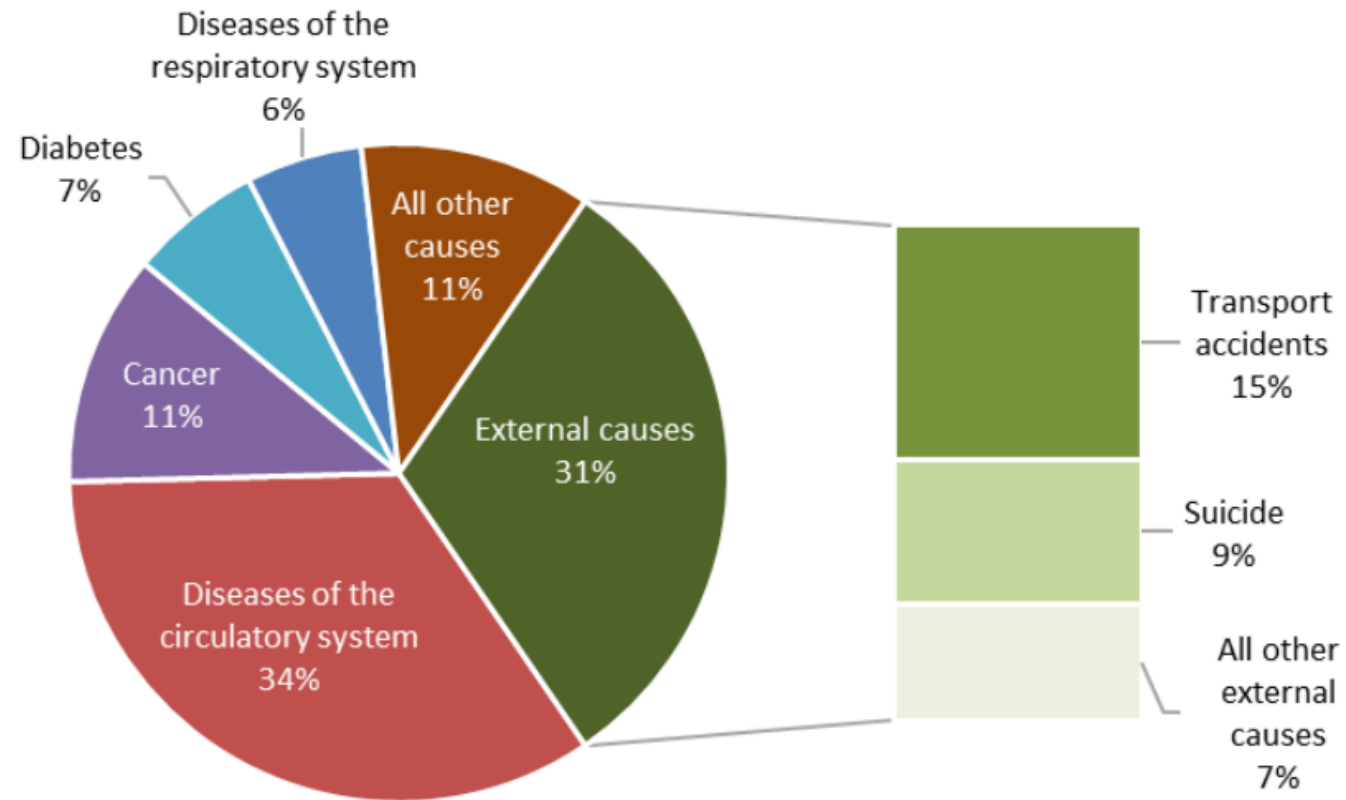
Leading Causes of Death (all ages)	Males	Females	Total	Percent distribution (both sexes)*
Diseases of the circulatory system	98	68	166	34.9
Neoplasms	56	30	86	18.1
Endocrine, nutritional and metabolic diseases	35	31	66	13.9
External causes of morbidity and mortality	43	9	52	10.9
Diseases of the respiratory system	25	22	47	9.9
Diseases of the digestive system	10	9	19	4.0
Diseases of the genitourinary system	7	8	15	3.2
Certain infectious and parasitic diseases	3	8	11	2.3
Certain conditions originating in the perinatal period	2	3	5	1.1
Symptoms, signs & abnormal findings	17	9	26	-
All other causes	5	4	9	1.9
<b>Total</b>	<b>301</b>	<b>201</b>	<b>502</b>	<b>100.0</b>

\*Excludes 26 ill-defined deaths.

Source: The Cook Islands Vital Statistics Report 1999-2013

# Data lab: Create a graph showing leading causes

Figure 13: Mortality in adults aged 15-59: main causes of death, % distribution: 2009 – 2013



Source: The Cook Islands Vital Statistics Report 1999-2013

# Data lab: Create one or two cause-specific tables

## How many females died from breast cancer in 2007?

In 2007, breast cancer was the second most common cause of cancer deaths of females, with 2,680 females dying from the disease (Table 3.1). This means that on average, 7 females in Australia died from breast cancer every day in 2007.

The age-standardised mortality rate for breast cancer was 22 per 100,000. Moreover, deaths from breast cancer accounted for 16% of deaths from cancer in females and for 4% of deaths from any cause in females.

Table 3.1: The five most common types of cancer death, females, Australia, 2007

Cancer type (ICD-10 codes)	Number of deaths	Percentage of all cancer deaths in females	Percentage of all deaths in females	Age-standardised rate <sup>(a)</sup>	95% confidence interval
Lung (C33–C34)	2,911	16.8	4.3	24.0	23.1–24.9
Breast (C50)	2,680	15.5	4.0	22.1	21.2–22.9
Bowel (C18–C20)	1,856	10.7	2.8	14.6	13.9–15.3
Total lymphoid cancers (C81–C85, C88, C90, C91)	1,129	6.5	1.7	8.8	8.3–9.3
Unknown primary site (C77–C80)	1,097	6.3	1.6	8.5	8.0–9.1
All cancers <sup>(b)</sup>	17,322	100.0	25.7	139.1	137.0–141.2

(a) Standardised to the Australian population as at 30 June 2001 and expressed per 100,000 females.

(b) Includes cancers coded in ICD-10 as C00–C97, D45, D46, D47.1 and D47.3.

Source: AIHW National Mortality Database.

# Advanced mortality analysis

Data lab

# Multiple causes of death

- We are usually interested in the underlying cause of death
- Medical certificates also record other causes of death (often called intermediate or contributing causes of death)
- Increasing interest and relevance for study of epidemiological transition
- Useful for planning health services to address intermediate and immediate causes
  - Explore the natural history of disease and causal pathways leading to death
  - Particularly useful for chronic diseases with several concurrent disease processes
  - Measure the frequency of associations between different conditions
  - To assess consistency in certification and coding practices from different sources

# Diagnostic “fashions” – multiple causes of death

- Australia – increased reporting of diabetes in Part I of the MCCOD where a cardiovascular disease (IHD or stroke) is also reported.
  - Previously reported in Part II (associated cause)
  - Diabetes is UCOD if it is reported in Part I, but cardiovascular disease is UCOD if diabetes is reported in Part II
- If ratio of diabetes being reported in Part I v Part II remained steady from 1999 to 2006, **diabetes** as an **UCOD** would be **12% lower** in 2006 than what official statistics showed (Adair and Rao 2010)



# Trend of diabetes reported in Part I with CVDs

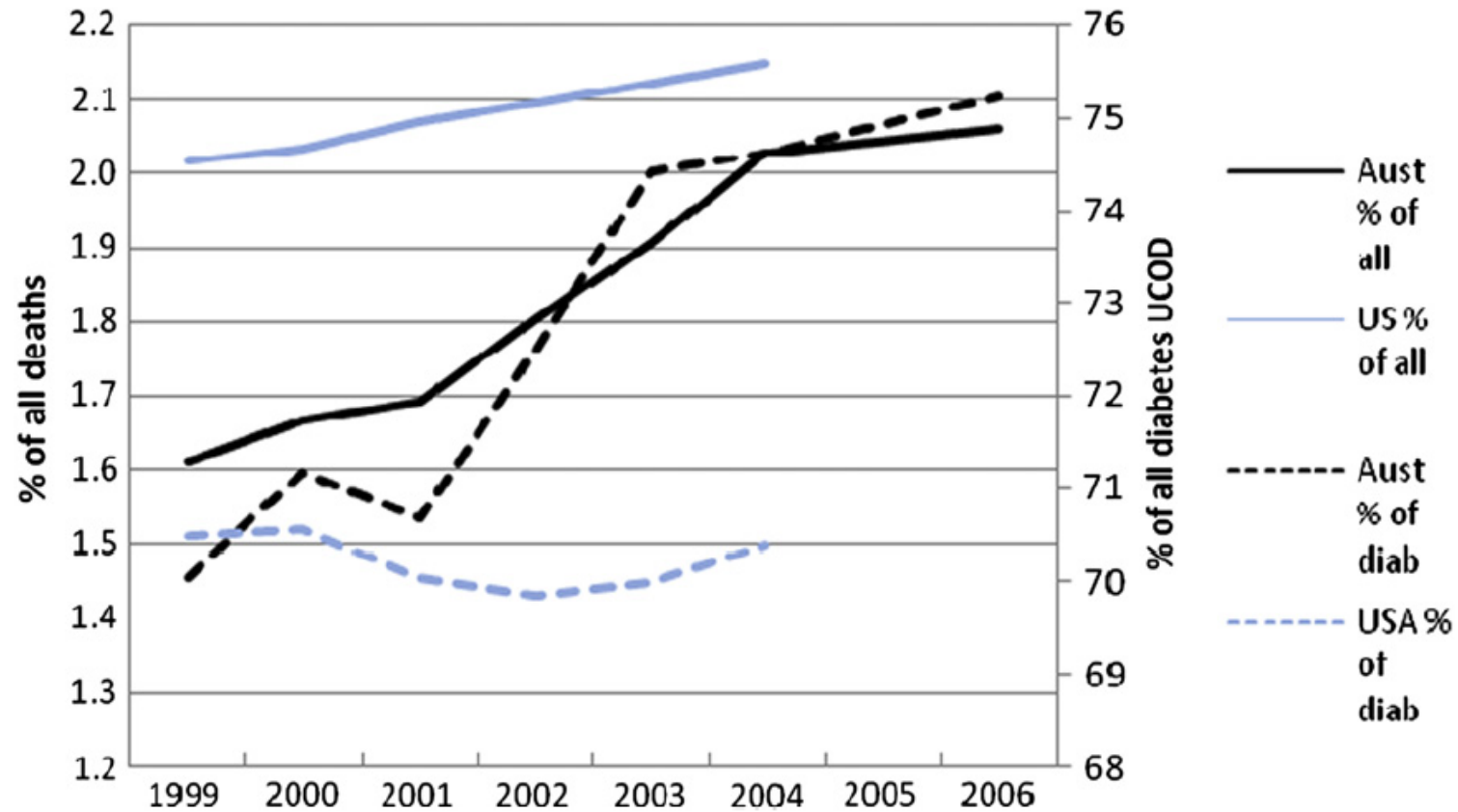
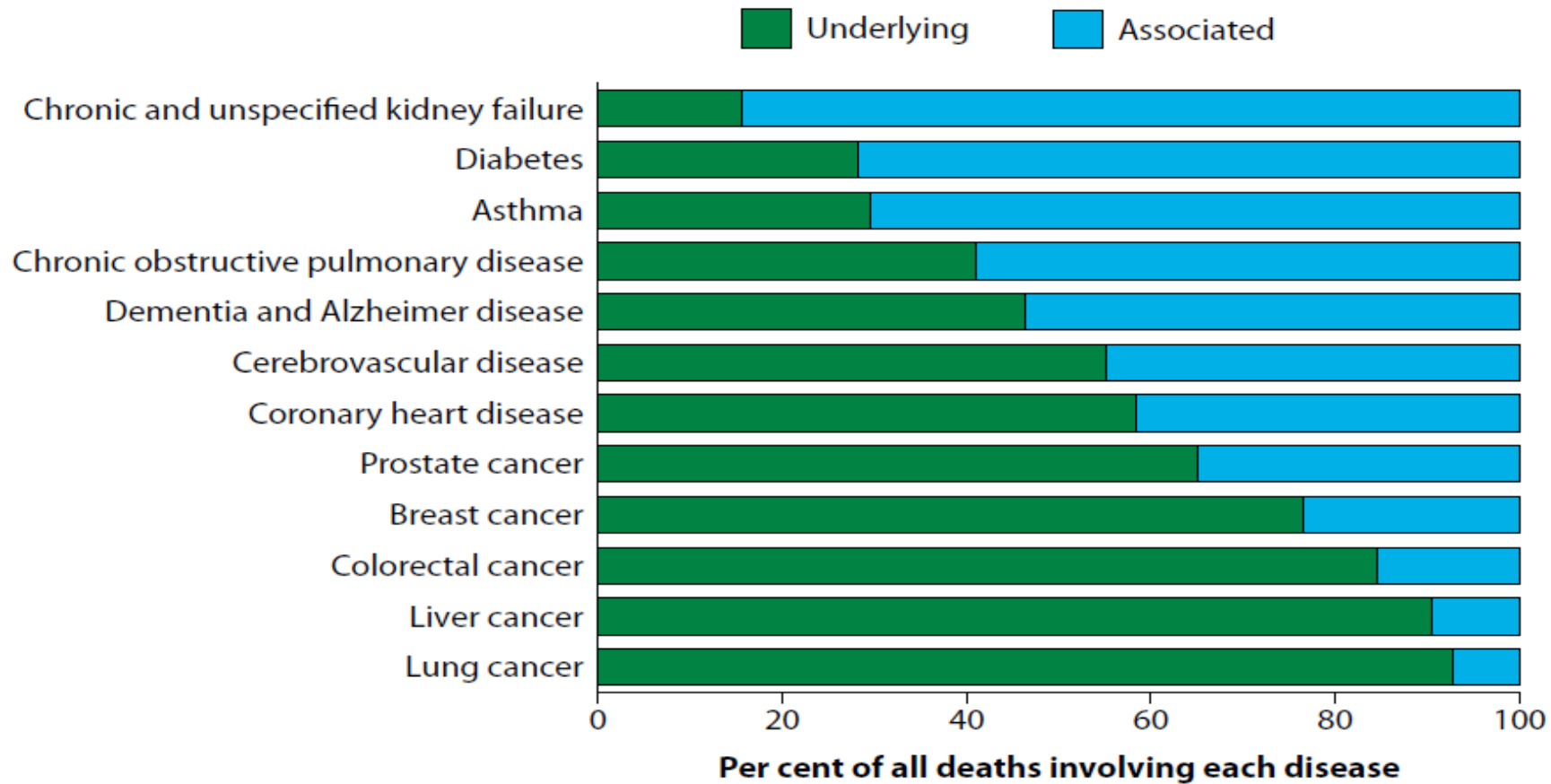


Fig. 1. Diabetes UCOD with CVDs also reported in Part I: % of all deaths and % of all diabetes UCOD, Australia and USA, 1999–2006.

### Figure 3.3



*Notes*

1. Deaths registered in 2011 are based on the preliminary version of cause of death data and are subject to further revision by the ABS.
2. Underlying refers to deaths with the disease recorded as the underlying cause of death, regardless of whether the disease was also recorded as an associated cause of death. Associated refers to deaths with the disease recorded only as an associated cause of death.

Source: AIHW National Mortality Database.

**Selected chronic diseases as underlying and associated causes of death, 2011 (per cent)**

**Table 4.16: Number and percentage of deaths selected as underlying or reported as immediate or contributing causes of death, 2014**

Causes of death (ICD-10)	Underlying rank	Number of deaths			Percentage of any mention		
		Underlying	Immediate or contributing	Total recorded	Underlying	Immediate or contributing	Total recorded
Tuberculosis (A15-A19)**	1	37 878	16 766	54 644	69,3	30,7	100,0
Cerebrovascular diseases (I60-I69)	2	23 088	10 393	33 481	69,0	31,0	100,0
Diabetes mellitus (E10-E14)	3	22 747	3 542	26 289	86,5	13,5	100,0
Influenza and pneumonia (J09-J18)	4	22 035	22 961	44 996	49,0	51,0	100,0
Human immunodeficiency virus [HIV] disease (B20-B24)	5	21 938	928	22 866	95,9	4,1	100,0
Other forms of heart disease (I30-I52)	6	21 339	30 238	51 577	41,4	58,6	100,0
Hypertensive diseases (I10-I15)	7	17 770	30 368	48 138	36,9	63,1	100,0
Intestinal infectious diseases (A00-A09)	8	14 472	5 997	20 469	70,7	29,3	100,0
Other viral diseases (B25-B34)	9	13 996	11 925	25 921	54,0	46,0	100,0
Chronic lower respiratory diseases (J40-J47)	10	12 096	5 902	17 998	67,2	32,8	100,0

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