Global burden of diabetes and WHO guidance on prevention and management

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Priority NCDs

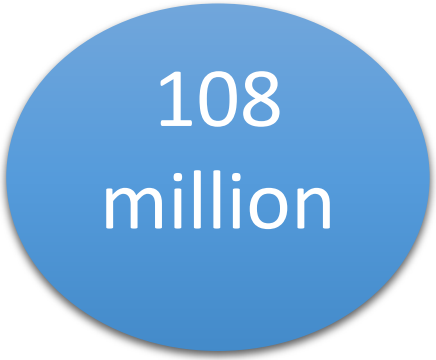
		Causative risk factors			
		Tobacco use	Unhealthy diets	Physical inactivity	Harmful use of alcohol
Noncommunicable diseases	Heart disease and stroke	✓	✓	✓	✓
	Diabetes	✓	✓	✓	✓
	Cancer	✓	✓	✓	✓
	Chronic lung disease	✓			

Main types of diabetes

- **Type 1 (~3-10% of all diabetes)**
- **Type 2**
  - **Combination of insulin resistance and insulin secretory defects**
- **Gestational diabetes**
  - **Non-diabetic hyperglycaemia first detected in pregnancy**

BURDEN OF DIABETES

Rise in diabetes



1980

2014

WORLD HEALTH DAY 2016
GLOBAL REPORT ON DIABETES

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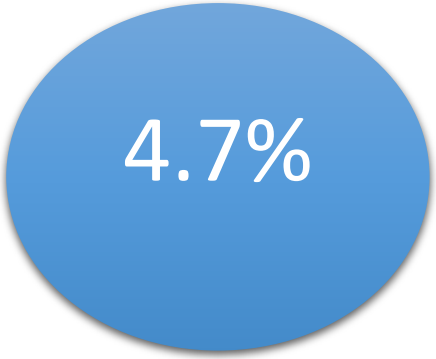
Age-adjusted diabetes prevalence in adults



1980

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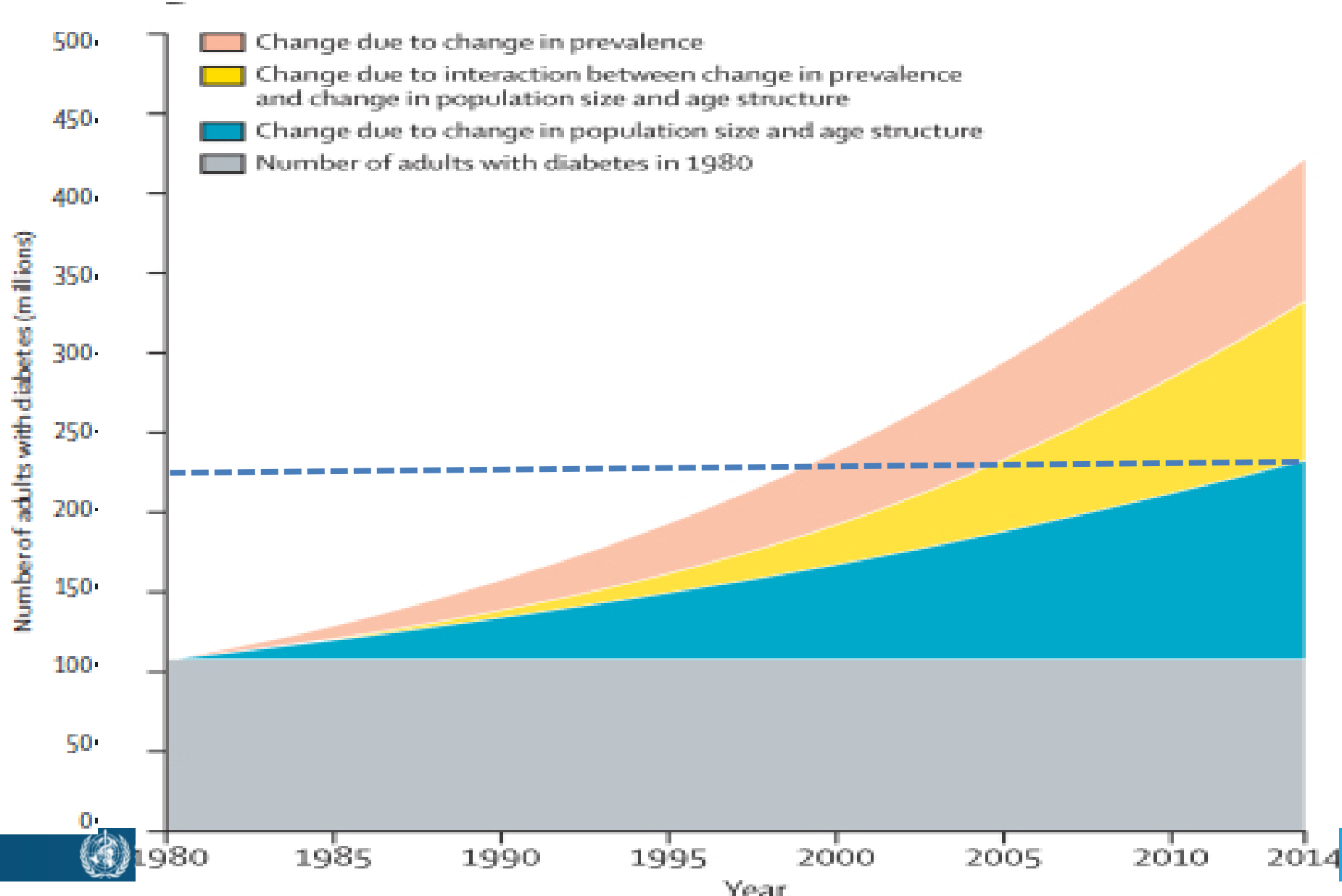
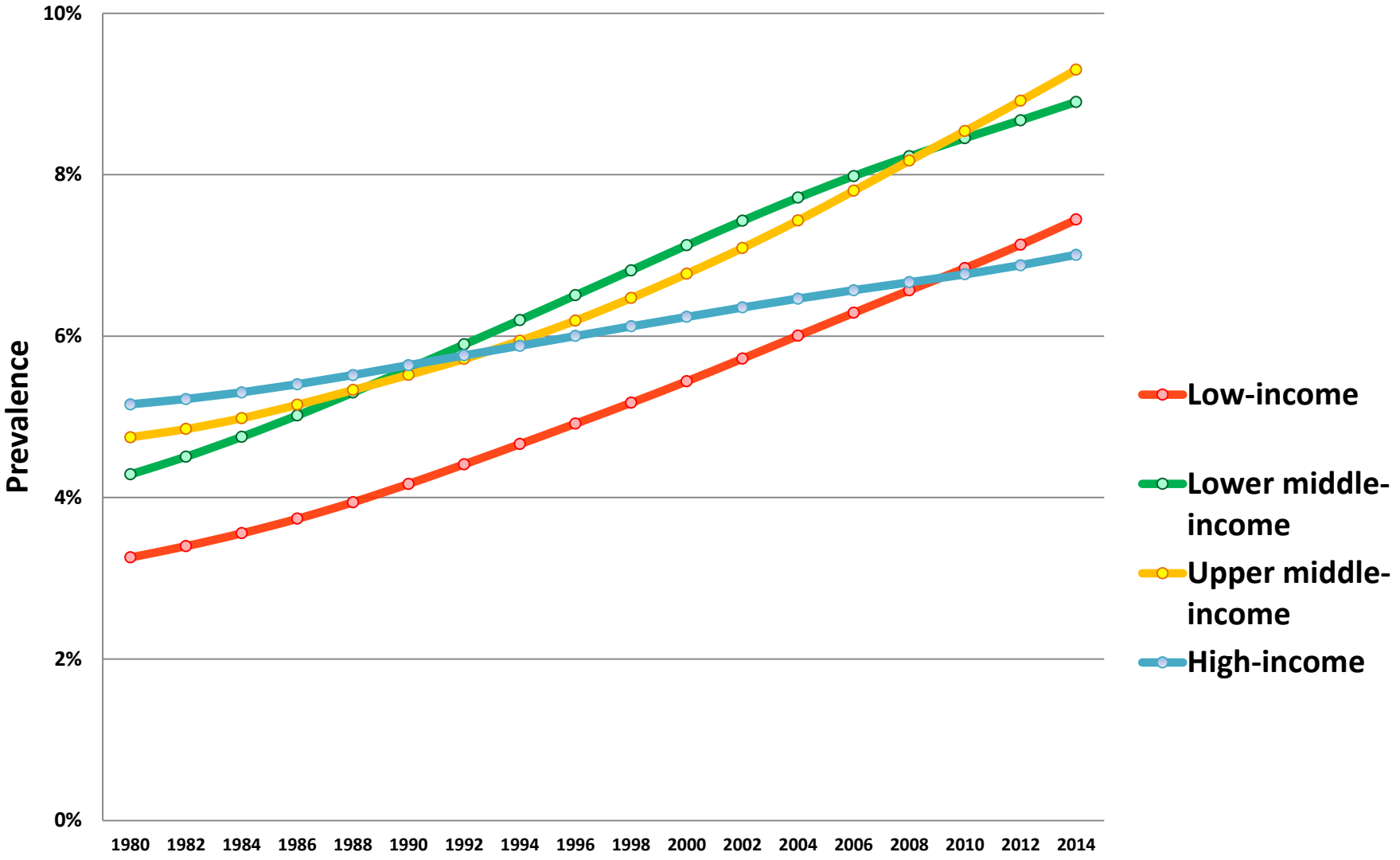
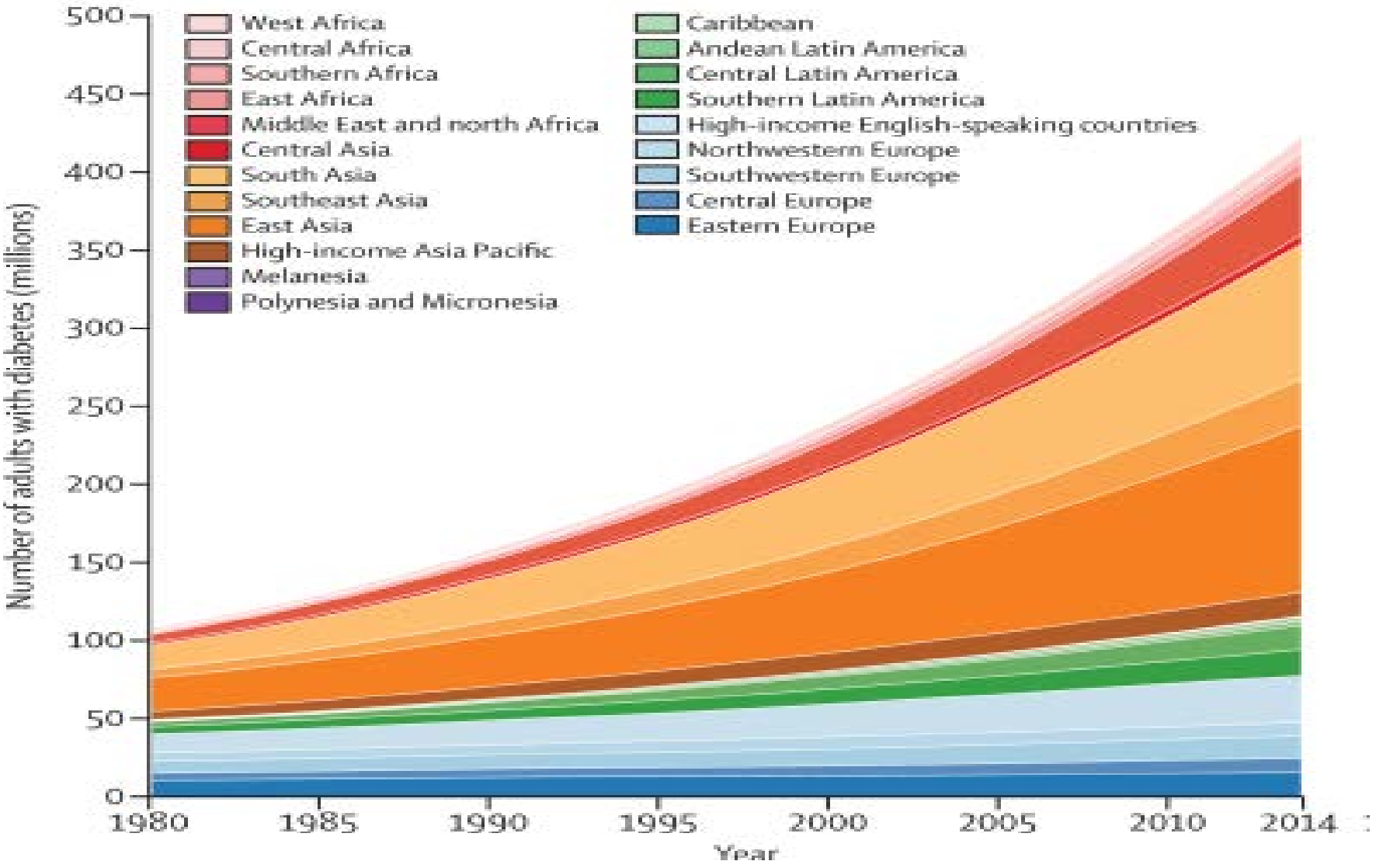
Global diabetes prevalence trends 1980 -2014 in the number of adults with diabetes by contributing factor (NCD-RisC 2016)



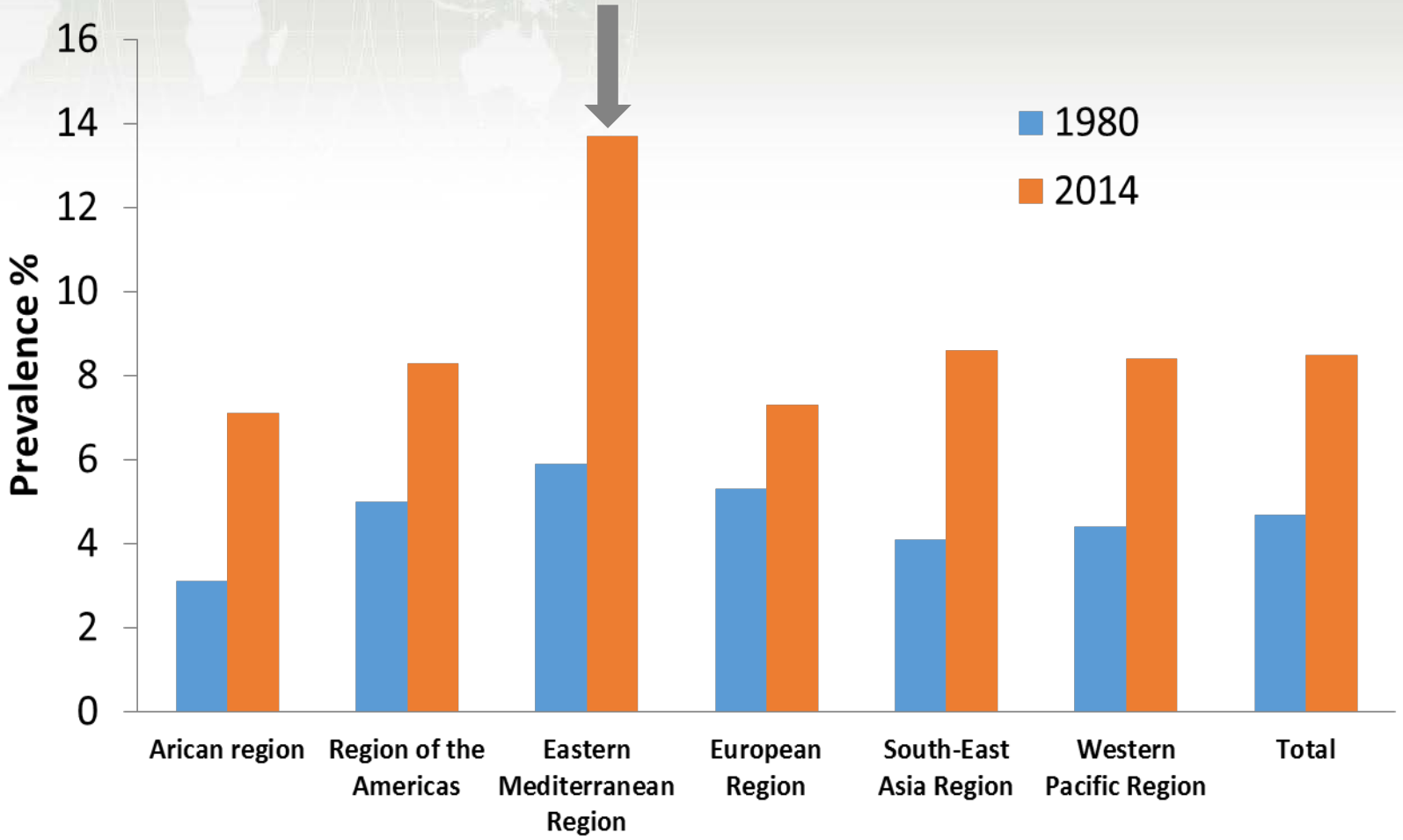
Rise is faster in low- and middle - income countries



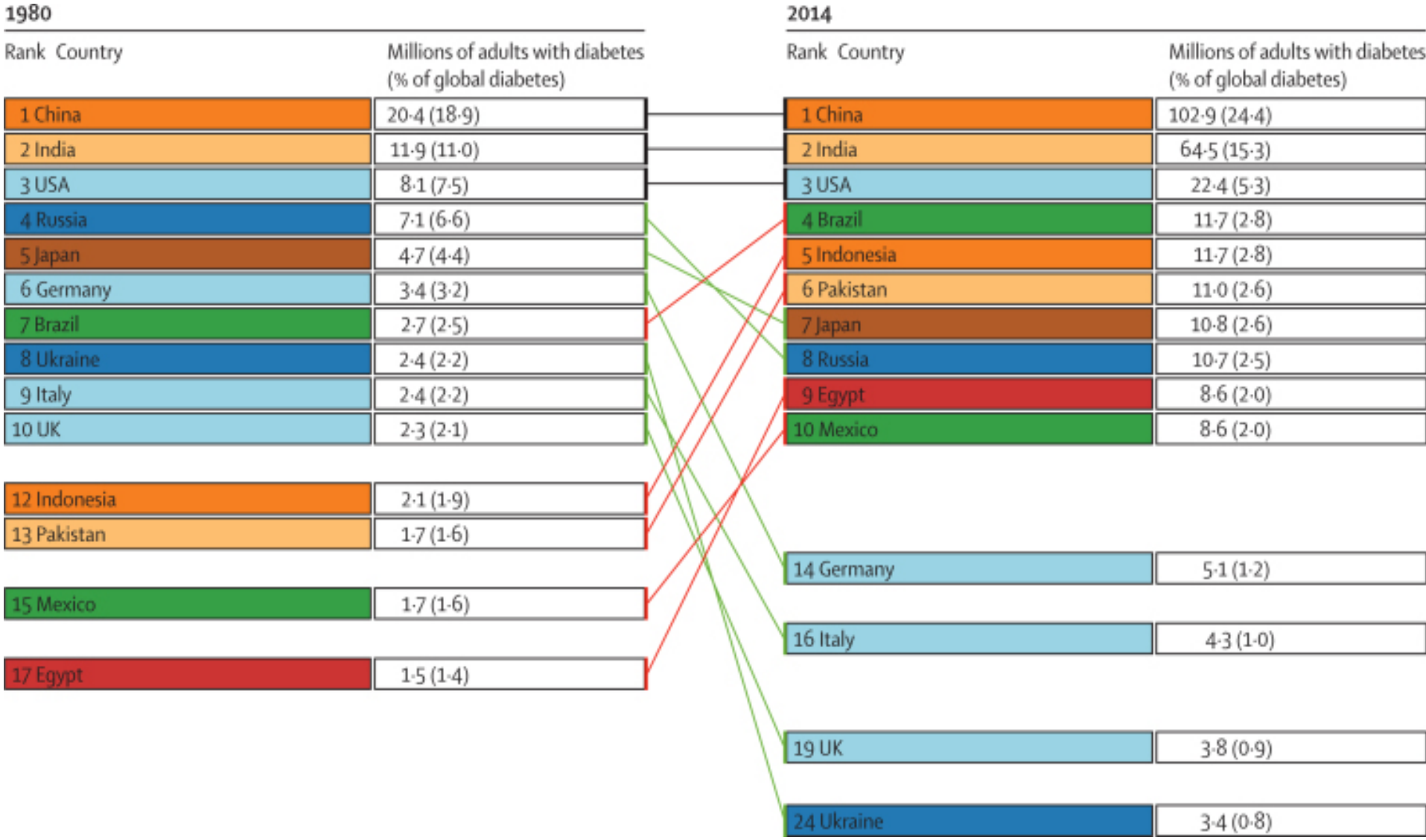
Trends 1980 -2014 in the number of adults with diabetes by region (NCD-RisC 2016)



Increase in diabetes is most marked in the WHO Eastern Mediterranean Region



Number of people with diabetes – top 10 countries 1980 and 2014 (NCD-RisC 2016)



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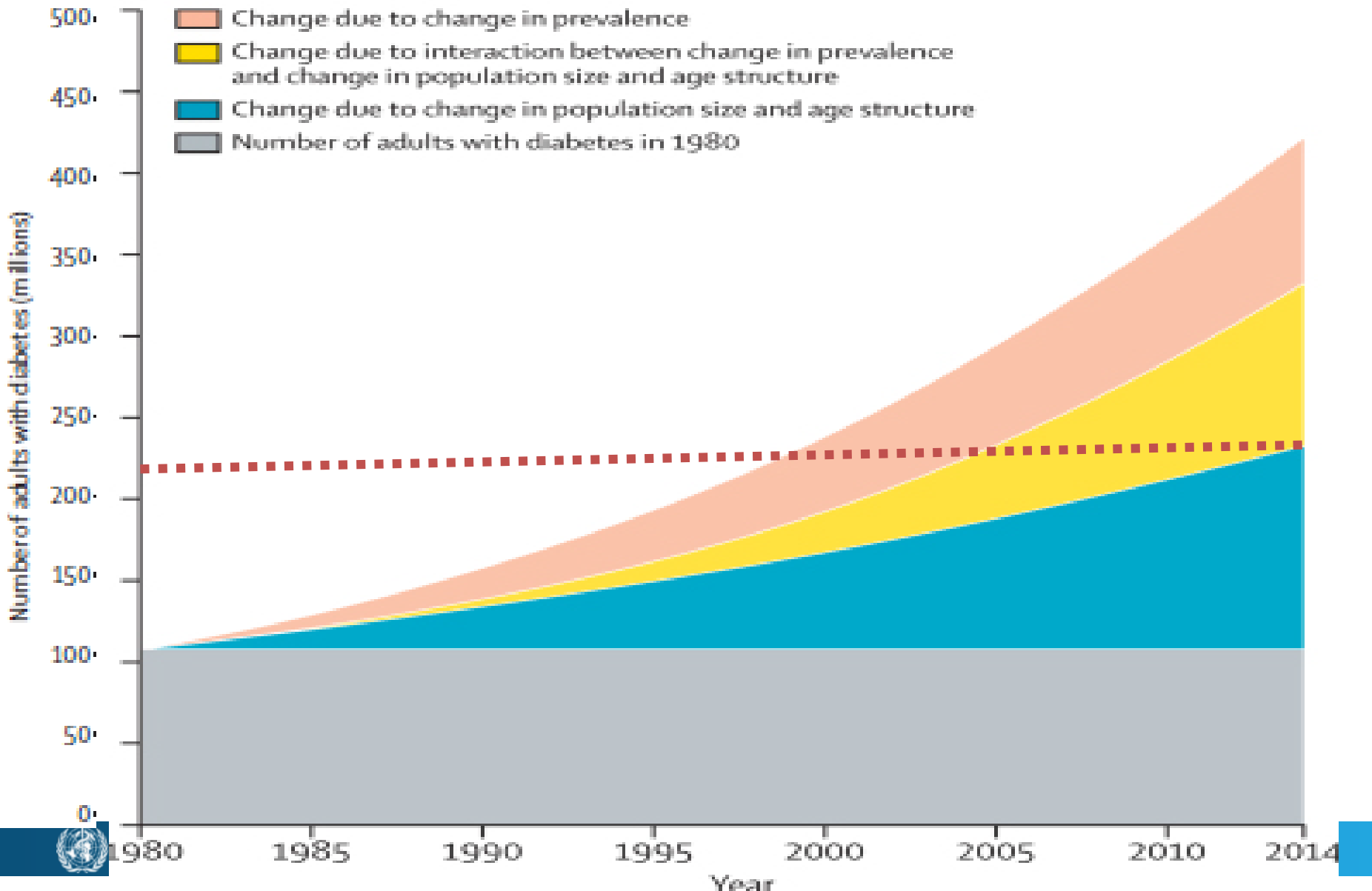
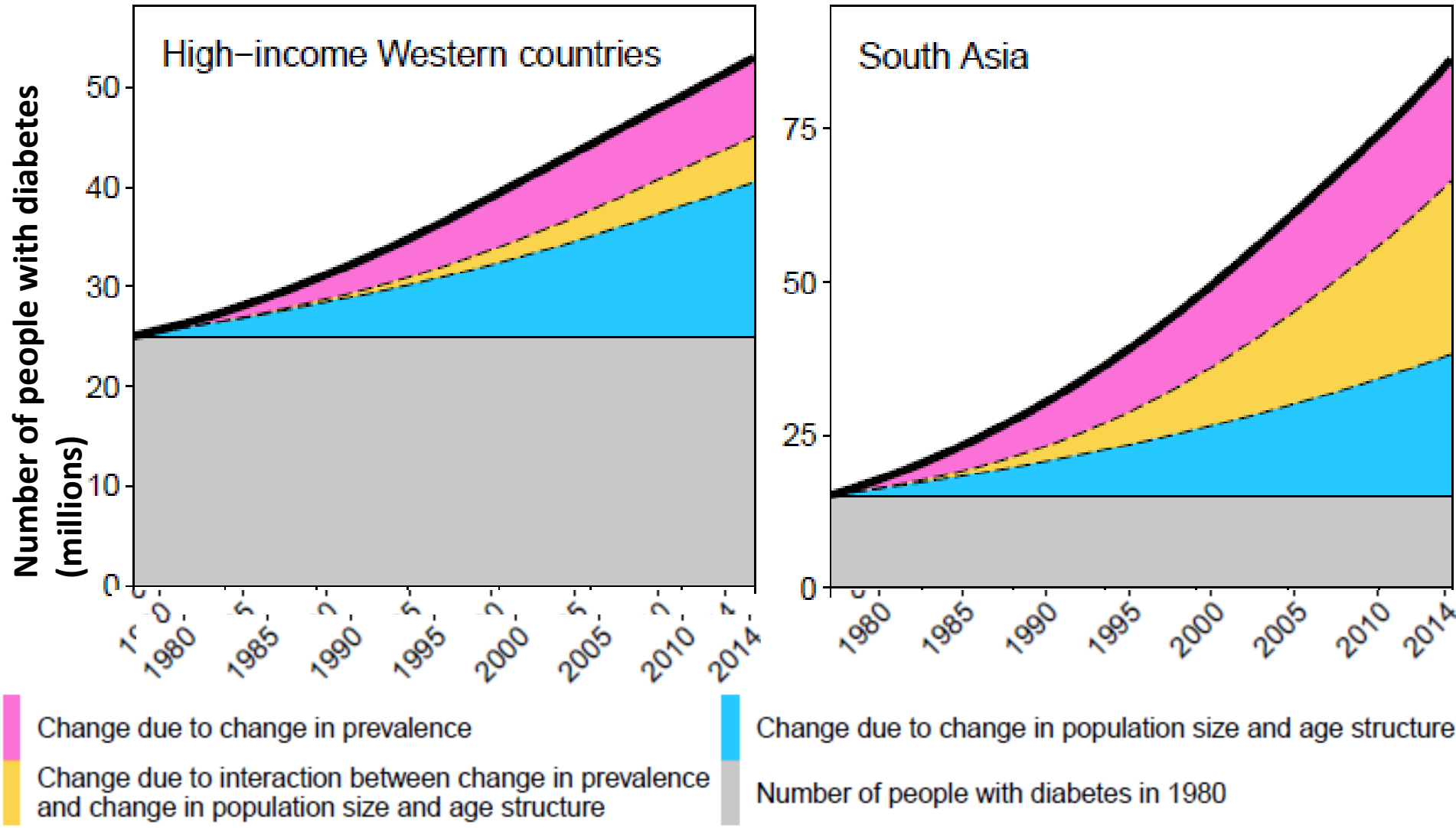


Number of people with diabetes (millions) 1980-2014 (NCD-RisC 2016)



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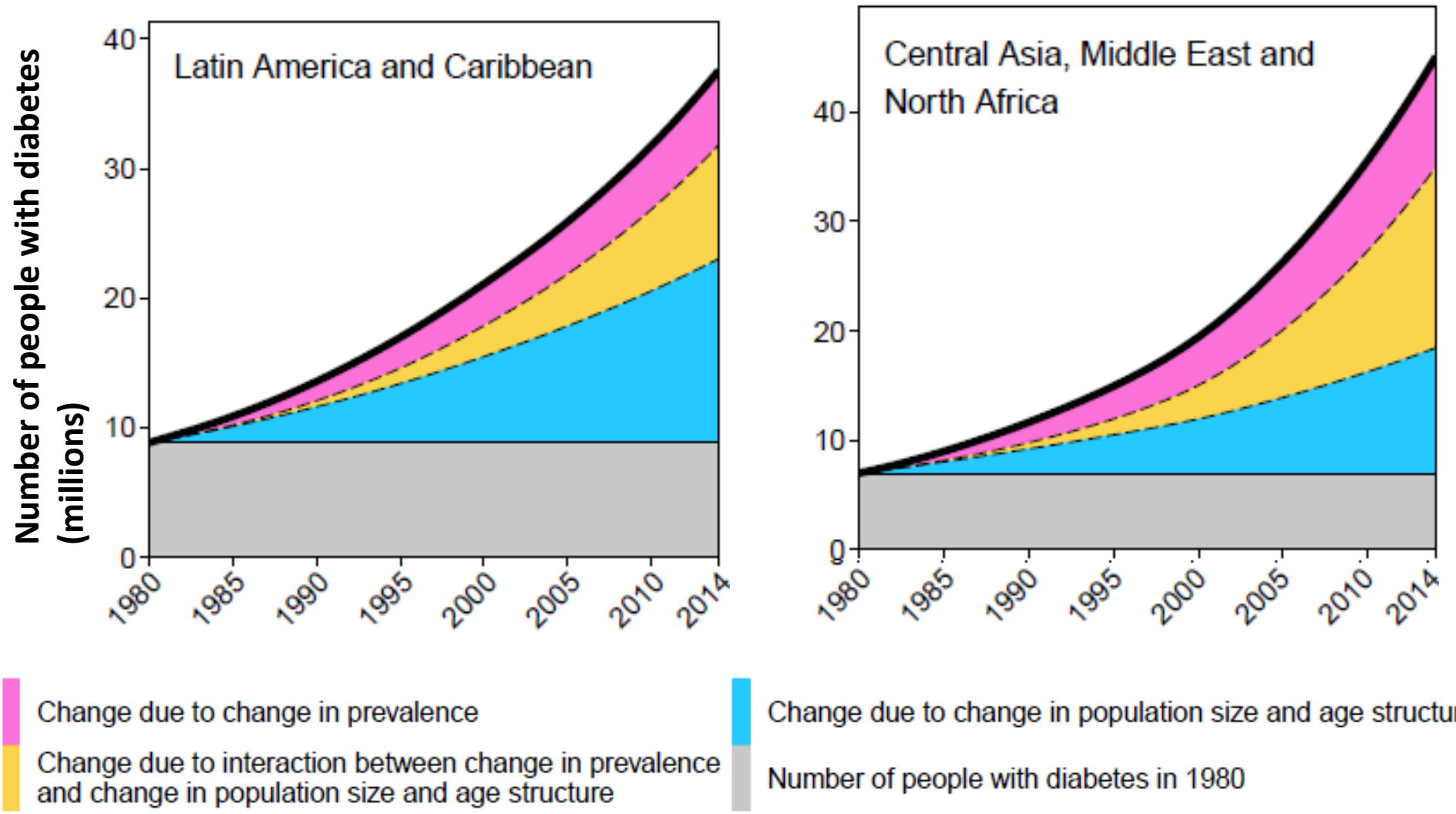
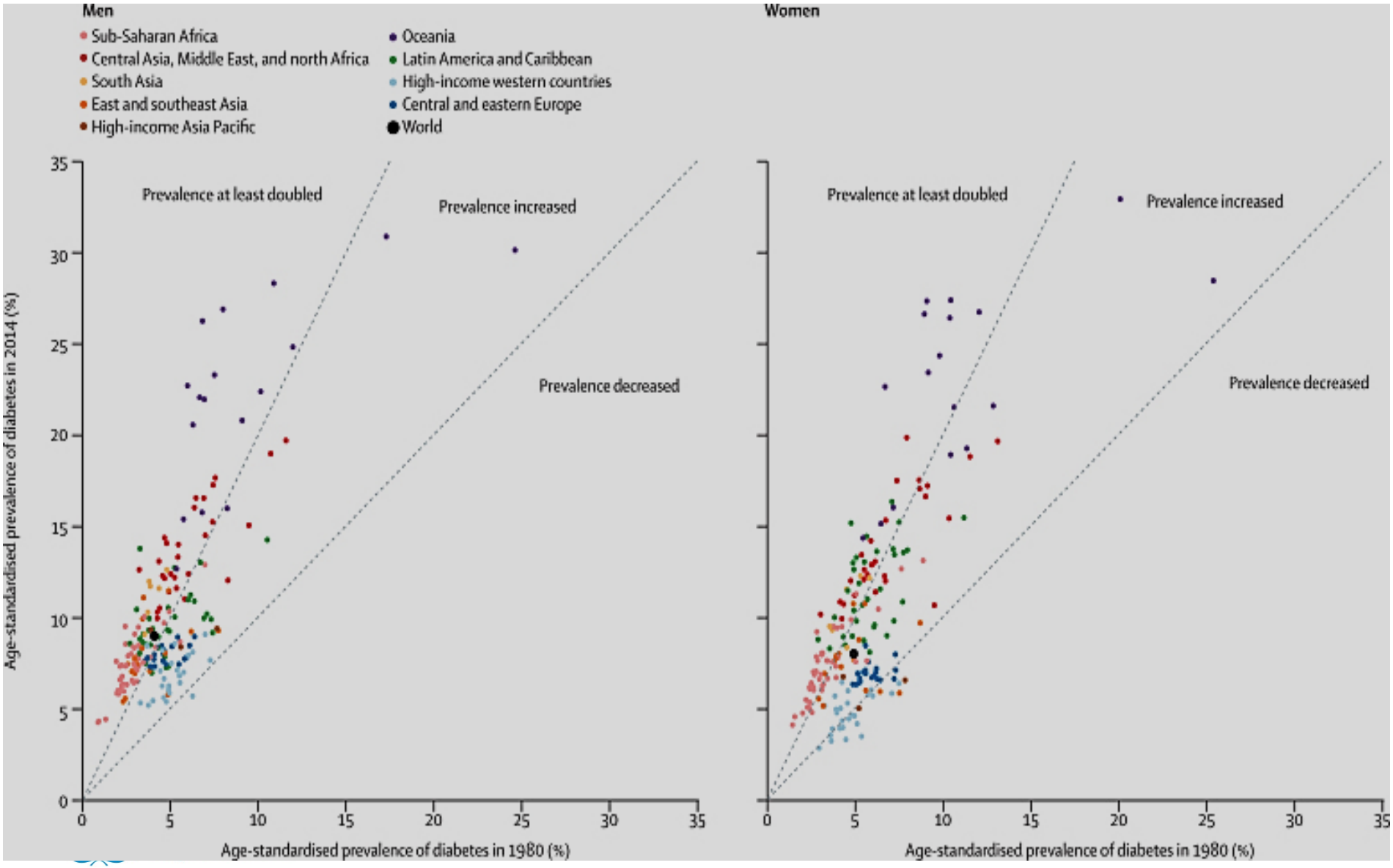


Age-standardized prevalence of diabetes in adults 1980 vs. 2014 (NCD-RisC 2016)



Hyperglycaemia in pregnancy (IDF, 2013)

IDF Region	Prevalence %	Proportion due to diabetes in pregnancy %
AFRICA	14.4	19.6
EUROPE	12.6	10.9
Middle E & North Afr	17.5	17.7
N America & Caribb	10.4	24.9
South&Central Am	11.4	17.3
South-East Asia	25.0	9.5
Western Pacific	11.9	14.1

Undiagnosed diabetes (IDF 2017)

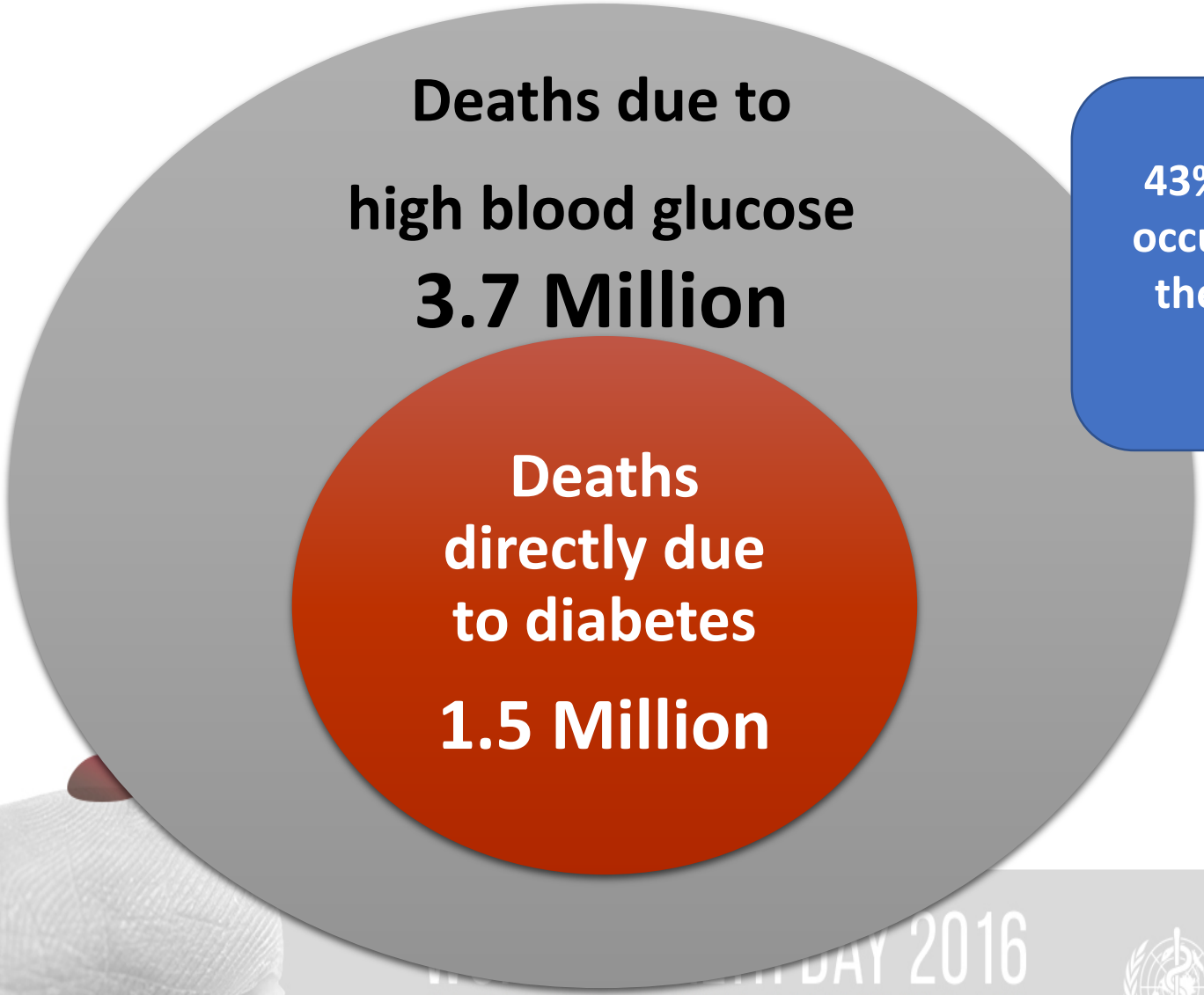
Rank	IDF region	Proportion undiagnosed
1	Africa	69.2%
2	South-East Asia	57.6%
3	Western Pacific	54.1%
4	Middle East and North Africa	49.0%
5	South and Central America	40.0%
6	Europe	37.9%
7	North America and Caribbean	37.6%

World Bank income classification	Proportion undiagnosed
High income countries	37.3%
Middle income countries	52.5%
Low income countries	76.5%

Predicted number of persons with diabetes in the world (IDF, 2017)

- 629 million in 2045

Mortality from diabetes



43% of deaths occurred under the age of 70 years

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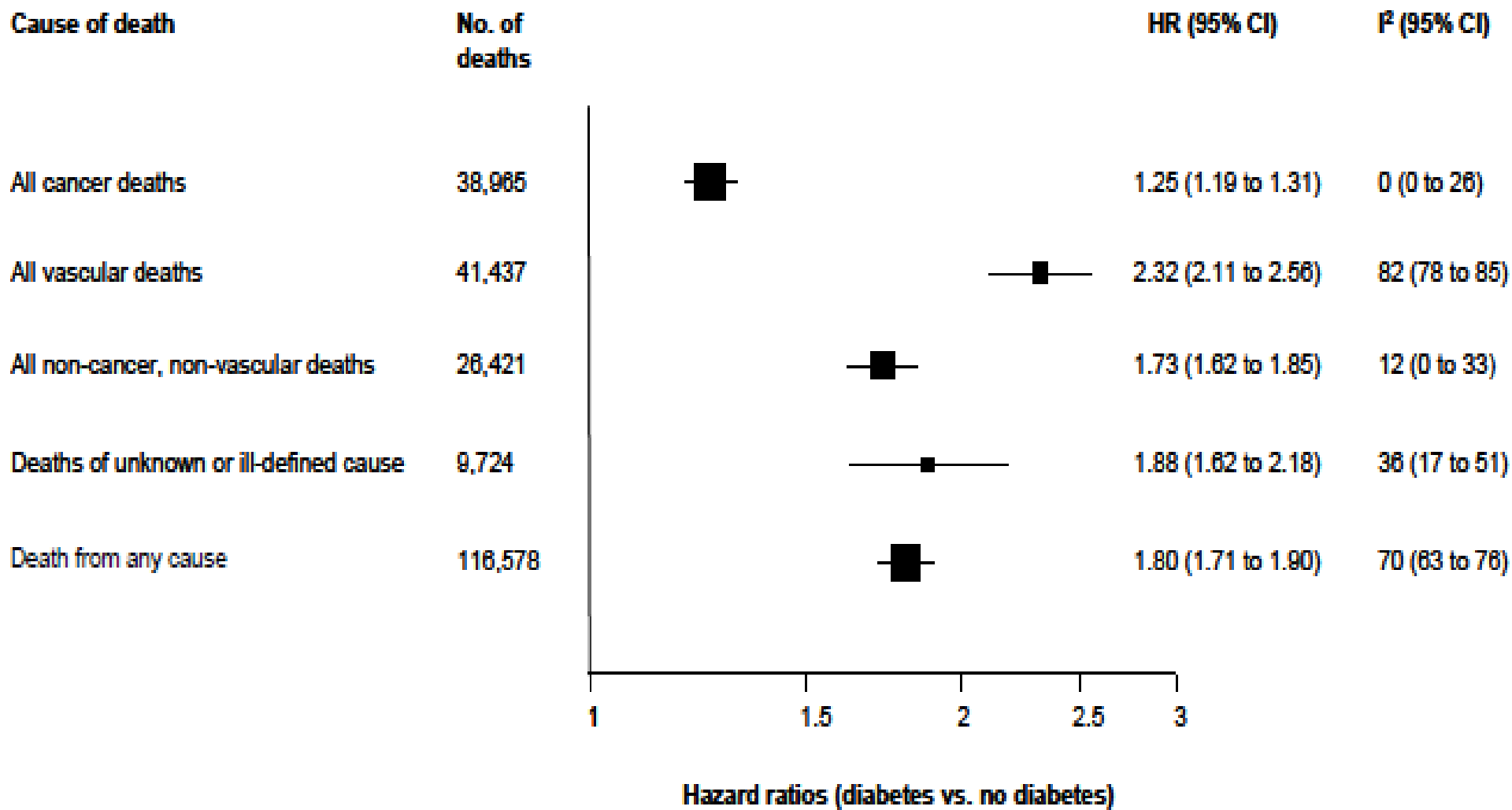
Hazard ratios for major causes of death associated with diabetes (Emerging Risk Factors Collaboration, 2011)



High blood glucose age-standardized mortality rates per 100 000 by WHO region, age 20+ years (2012)

	Both sexes	Female	Male
African Region	111.3	110.9	111.1
Region of the Americas	72.6	63.9	82.8
Eastern Mediterranean Region	139.6	140.2	138.3
European Region	55.7	46.5	64.5
South-East Asia Region	115.3	101.8	129.1
Western Pacific Region	67.0	65.8	67.8

PERCENTAGE OF DEATHS ATTRIBUTED TO HIGH BLOOD GLUCOSE THAT OCCUR AT AGES 20–69 YEARS, BY SEX AND COUNTRY INCOME GROUP, 2012

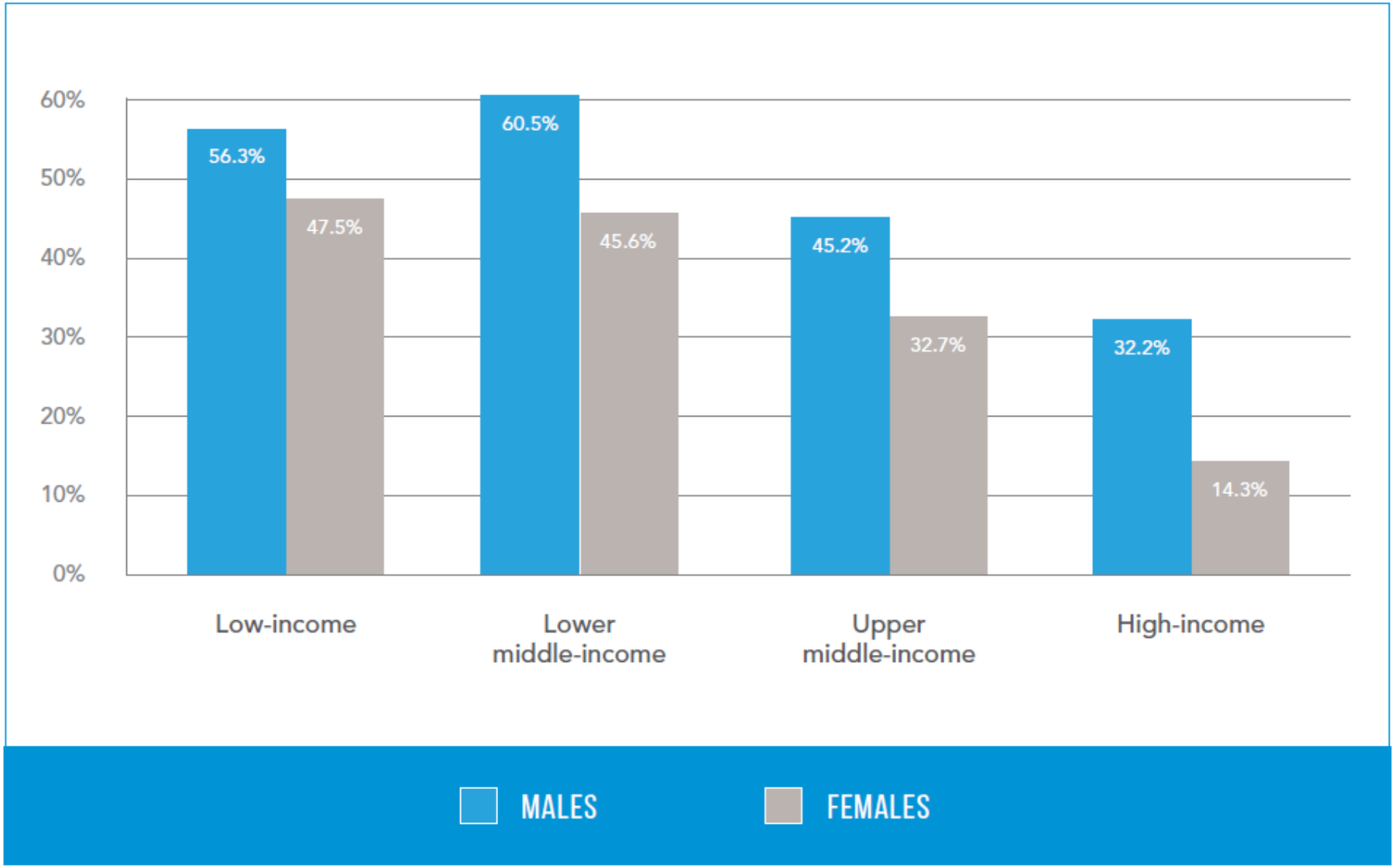
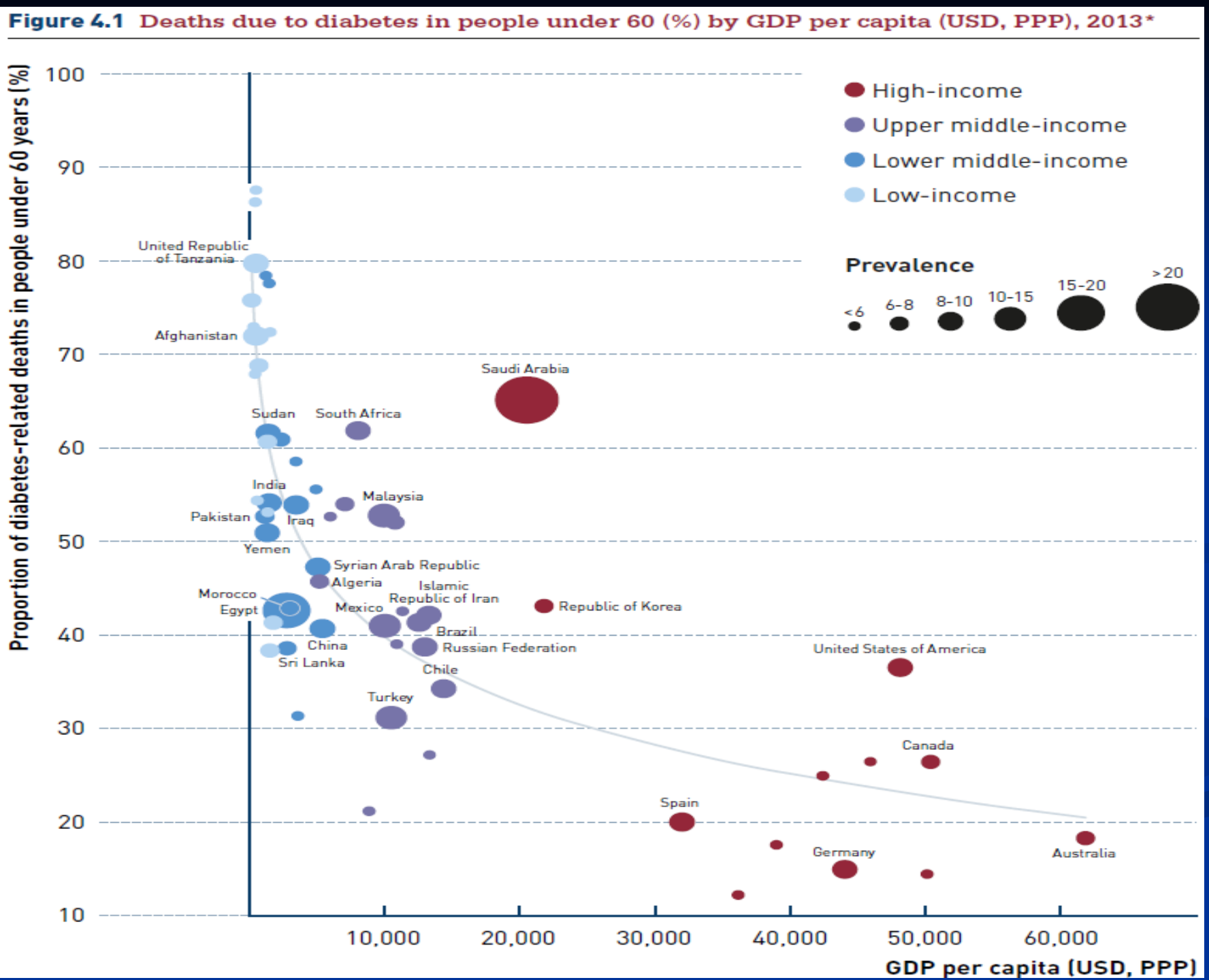
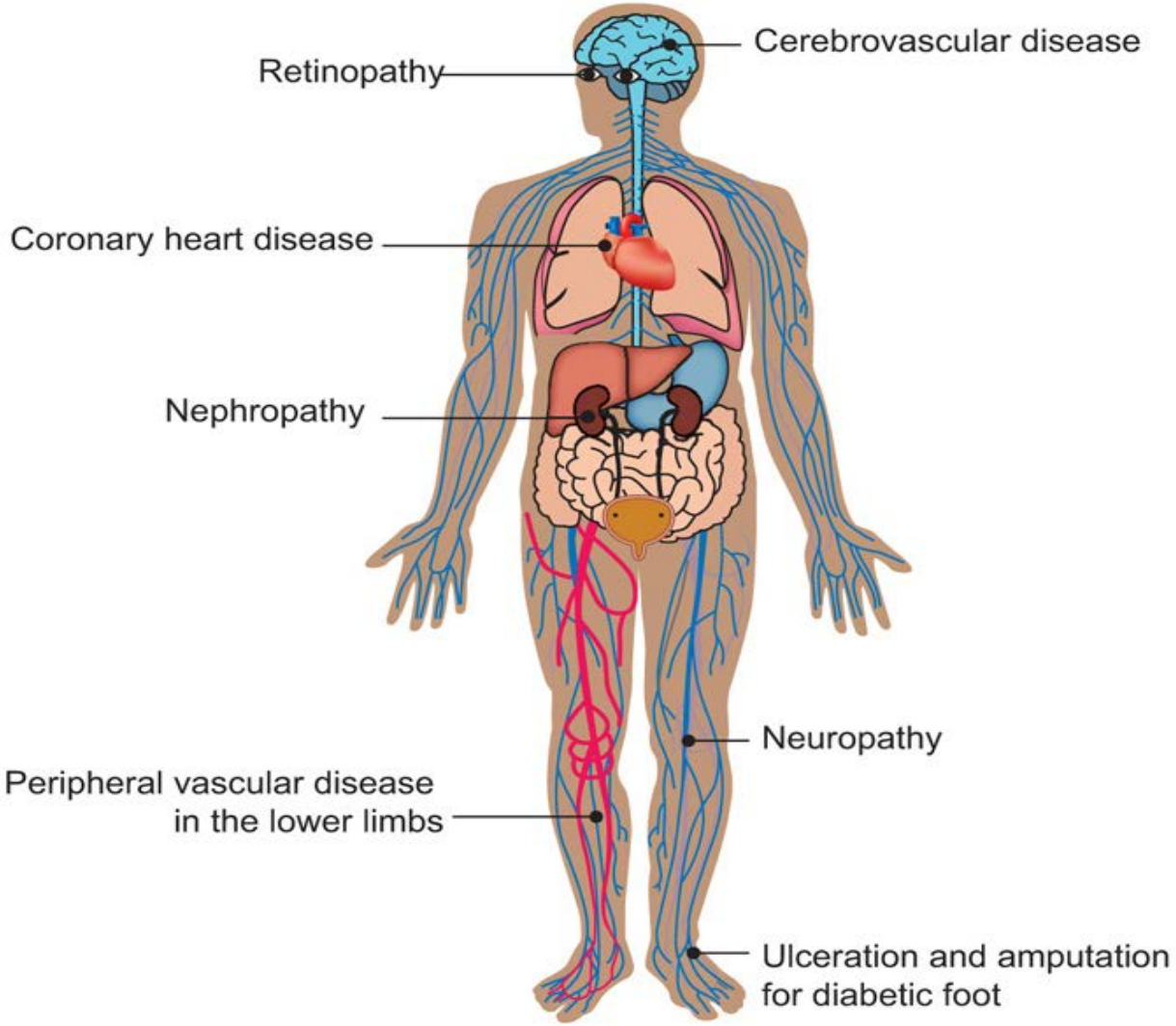


Figure 4.1 Deaths due to diabetes in people under 60 (%) by GDP per capita (USD, PPP), 2013*

IDF, 2013



Complications of diabetes



Complications of diabetes

- **2.6%** of all blindness and 1.9% of poor vision in 2010
- **12-55%** of end-stage renal disease is due to diabetes
- **2-3 times** increased risk of cardiovascular disease
- **10-20 times** higher risk of lower limb amputation than people without diabetes

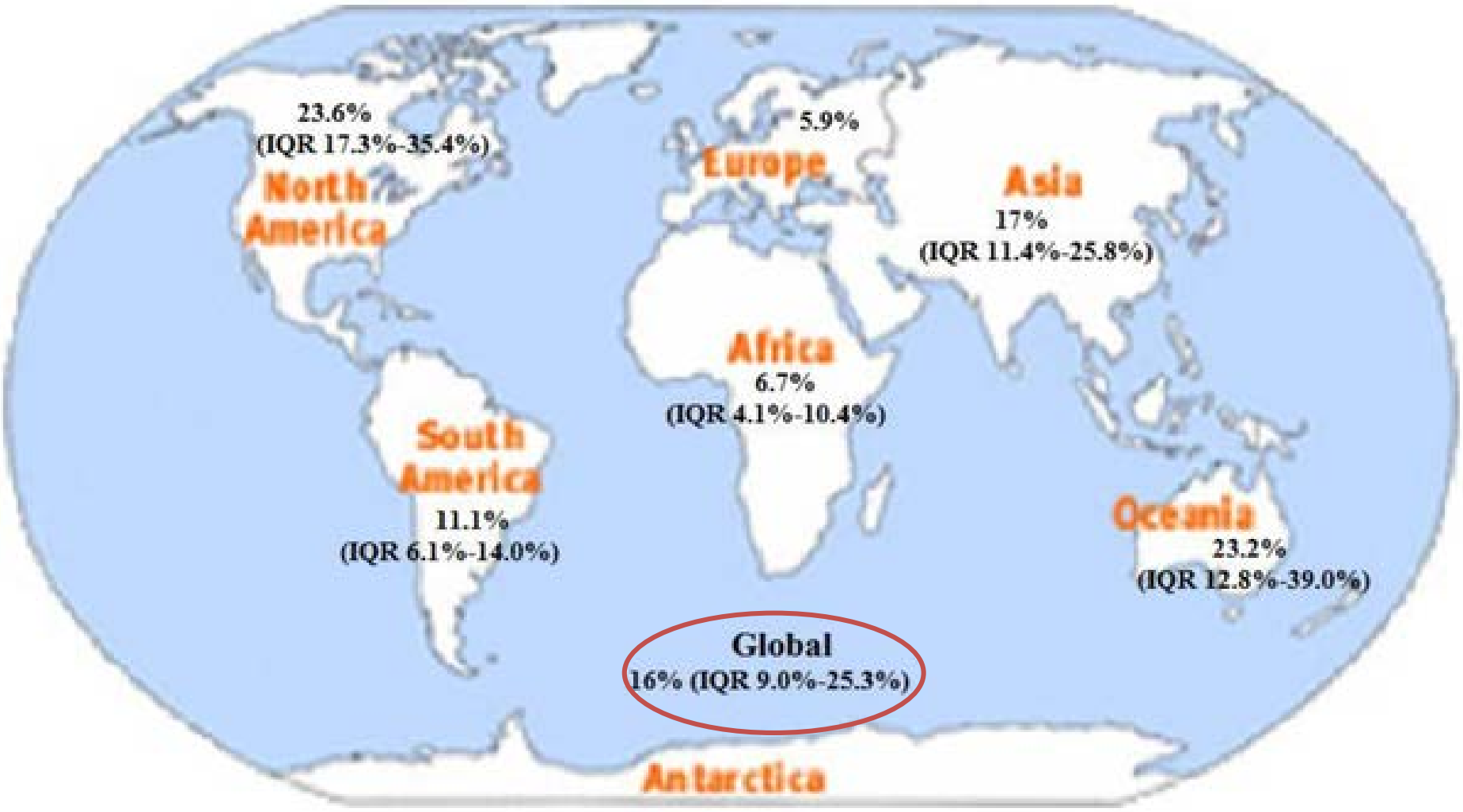
Economic impact of diabetes

- Catastrophic medical expenditure significantly higher in people with diabetes.
- Direct annual cost of diabetes globally > US$ 827 billion.
- Losses in GDP worldwide estimated to be US$ 1.7 trillion from 2010 to 2030

Comorbidities: diabetes and TB

- Diabetes triples the risk of active TB (Jeon, 2008)
- Diabetes doubles the risk of TB treatment failure or death (Baker, 2011)

Median prevalence of DM among TB patients by region (Workneh, 2017)



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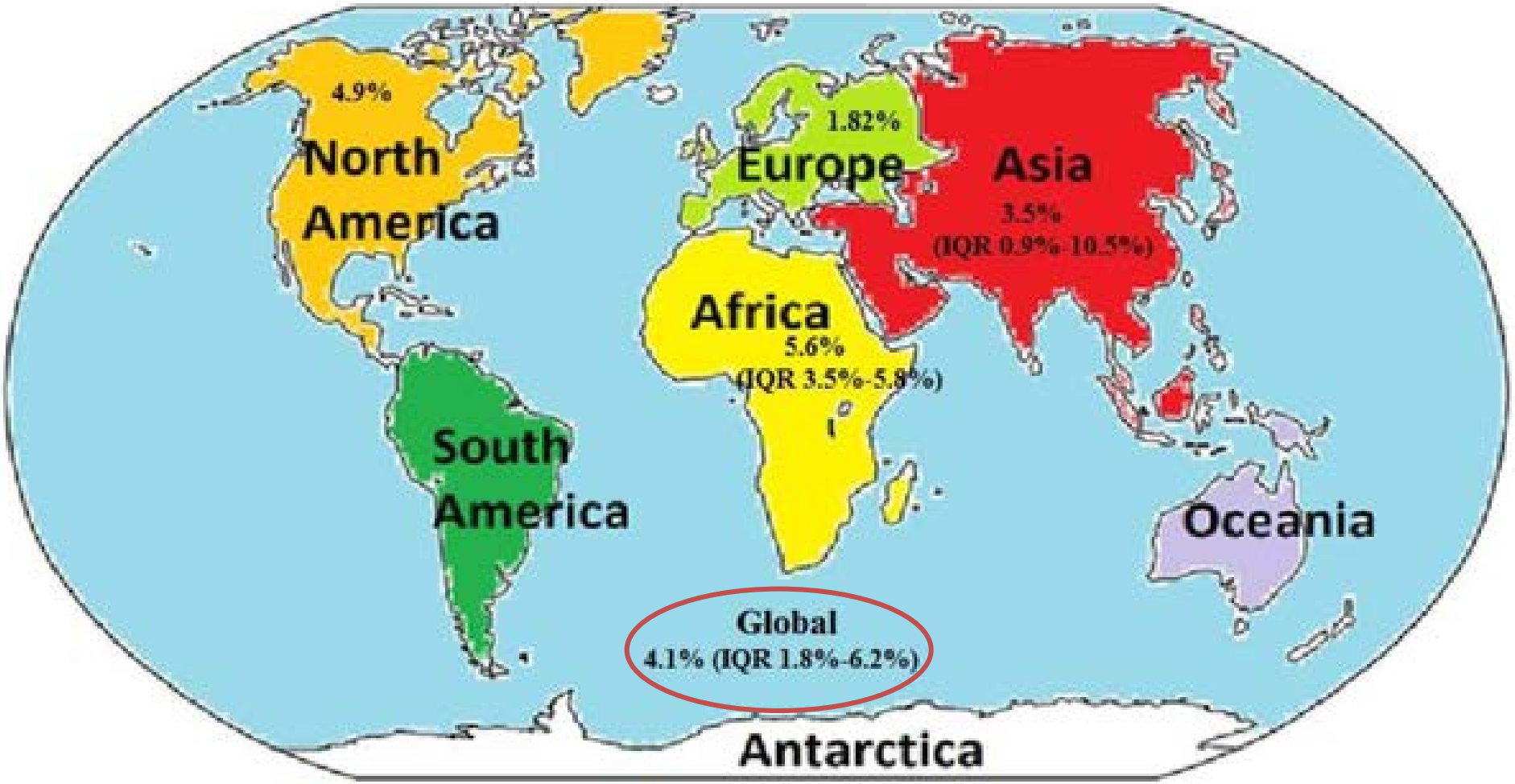
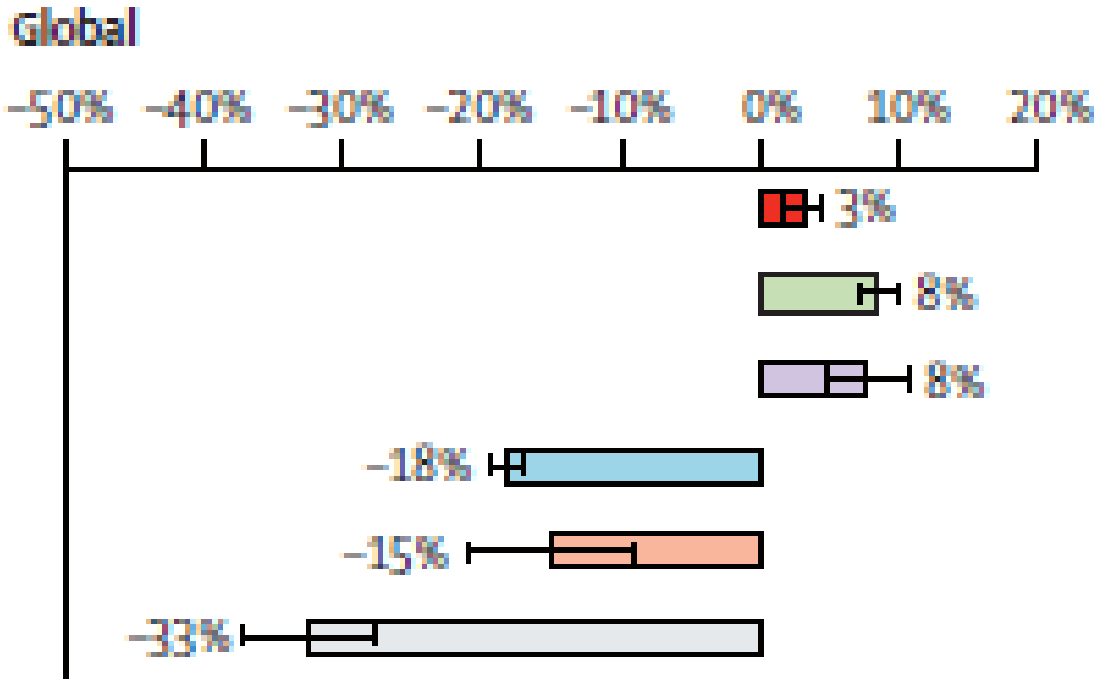


Estimated tuberculosis and diabetes burden, and tuberculosis burden attributable to diabetes (Lonnroth, 2014)

	TB incidence per 100,000 (all age groups)*	Fraction of adult TB cases attributable to diabetes	Total number of diabetes-associated adult TB cases
World	122	15%	1,042,000
Regions			
Africa	255	9%	194,000
The Americas	29	17%	41,000
Eastern Mediterranean	109	17%	94,000
Europe	40	15%	51,000
South-East Asia	187	14%	423,000
Western Pacific	87	16%	238,000
22 high TB burden countries	159	15%	957,000

World Health Organization

Effect of diabetes and undernutrition scenarios on tuberculosis incidence in 2035 (Odone, 2014)



- Scenario 1: diabetes increase and no undernutrition change
- Scenario 2: increase in diabetes and undernutrition
- Scenario 3: large increase in diabetes
- Scenario 4: undernutrition eradication
- Scenario 5: effect of diabetes mitigated
- Scenario 6: effect of diabetes mitigated and undernutrition eradication

World Health Organization

World Health Assembly 2013: 9 global NCD targets to be attained by 2025 (against a 2010 baseline)

A 25% relative reduction in risk of premature mortality from cardiovascular disease, cancer, diabetes or chronic respiratory diseases

A **30%** relative reduction in prevalence of current tobacco use

Halt the rise in diabetes and obesity

At least a **10%** relative reduction in the harmful use of alcohol

A **30%** relative reduction in mean population intake of salt/sodium

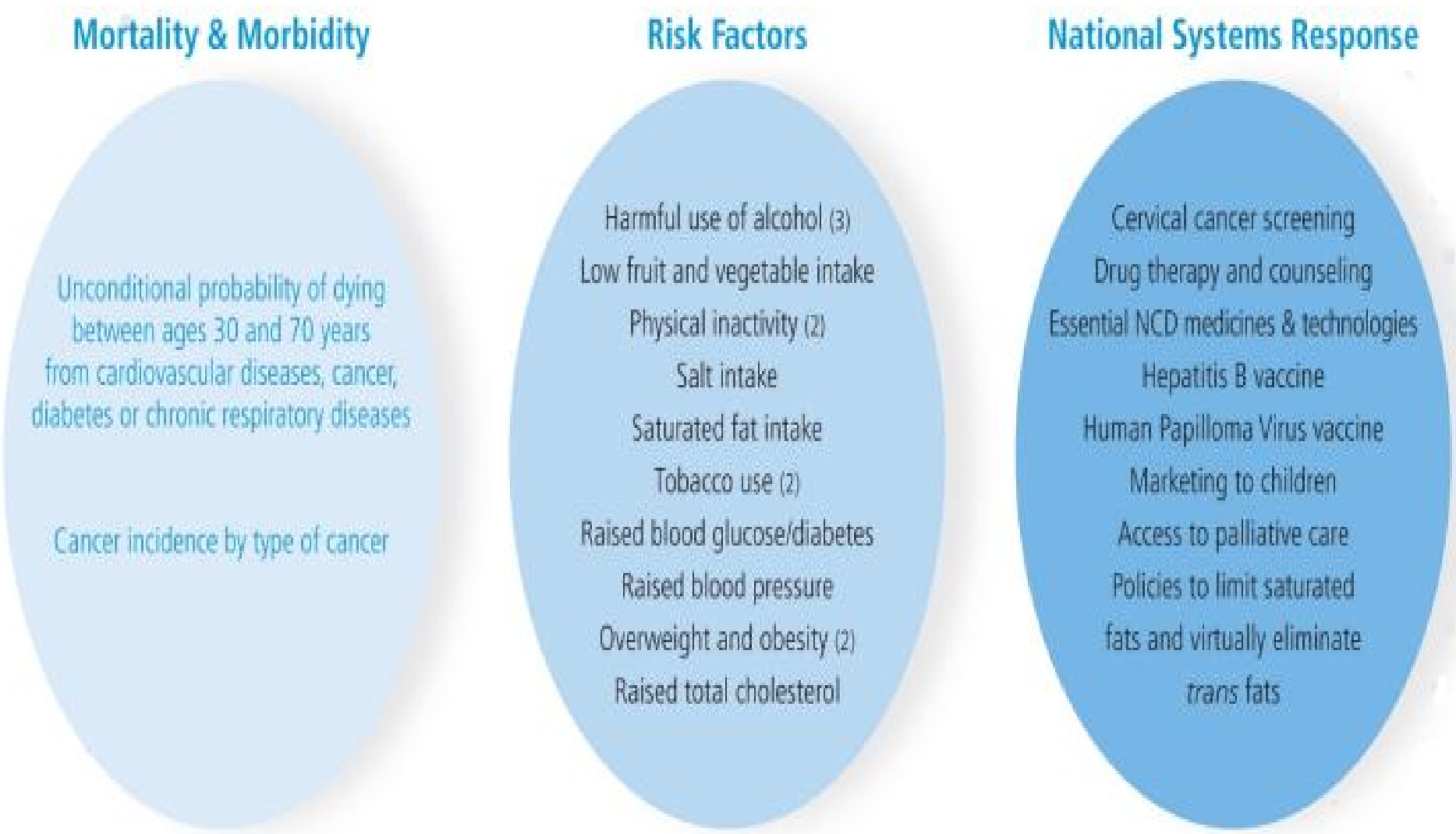
A 10% relative reduction in prevalence of insufficient physical activity

An 80% availability of the affordable basic technologies and essential medicines, incl. generics, required to treat NCDs

A **25%** relative reduction in prevalence of raised blood pressure or contain the prevalence of raised blood pressure

At least 50% of eligible people receive drug therapy and counselling to prevent heart attacks and strokes

Global Monitoring Framework with 25 indicators



WHO Global NCD Action Plan 2013-2020

Objective 1
To raise the priority accorded to the prevention and control of NCDs in global, regional and national agendas and internationally agreed development goals, through strengthened international cooperation and advocacy

Objective 2
To strengthen national capacity, leadership, governance, multisectoral action and partnerships to accelerate country response for the prevention and control of NCDs

Objective 3
To reduce modifiable risk factors for NCDs and underlying social determinants through creation of health-promoting environments

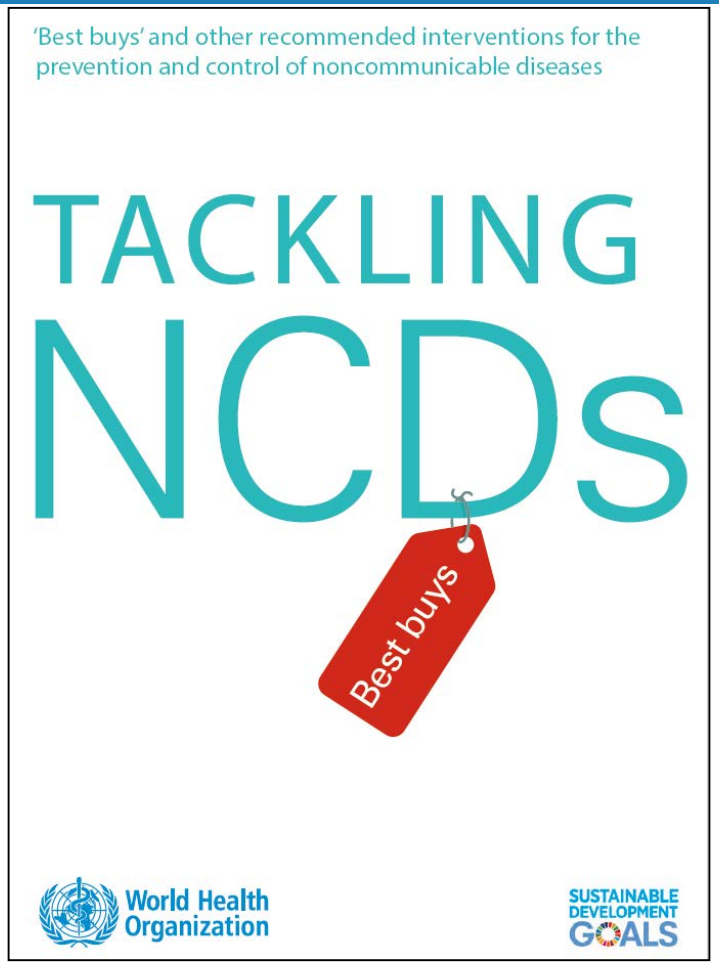
Objective 4
To strengthen and orient health systems to address the prevention and control of NCDs and the underlying social determinants through people-centred primary health care and universal health coverage

Objective 5
To promote and support national capacity for high-quality research and development for the prevention and control of NCDs

Objective 6
To monitor the trends and determinants of NCDs and evaluate progress in their prevention and control

Prevention and management of diabetes – WHO recommendations

“Noncommunicable diseases “Best buys”



"Best buys" and other interventions

'Best buys': Effective interventions with cost effectiveness analysis
≤ I$ 100 per DALY averted in LMICs

Effective interventions with cost effectiveness analysis
>I$ 100 per DALY averted in LMICs.

Other recommended interventions from WHO guidance
(cost effective analysis not available).

Reduce unhealthy diet

A healthy diet (WHO)

For adults

A healthy diet includes the following:

Fruit, vegetables, legumes (e.g. lentils and beans), nuts and whole grains (e.g. unprocessed maize, millet, oats, wheat and brown rice).

At least 400 g (i.e. five portions) of fruit and vegetables per day *(2)*, excluding potatoes, sweet potatoes, cassava and other starchy roots.

Less than 10% of total energy intake from free sugars *(2, 7)*, which is equivalent to 50 g (or about 12 level teaspoons) for a person of healthy body weight consuming about 2000 calories per day, but ideally is less than 5% of total energy intake for additional health benefits *(7)*. Free sugars are all sugars added to foods or drinks by the manufacturer, cook or consumer, as well as sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates.

Less than 30% of total energy intake from fats *(1, 2, 3)*. Unsaturated fats (found in fish, avocado and nuts, and in sunflower, soybean, canola and olive oils) are preferable to saturated fats (found in fatty meat, butter, palm and coconut oil, cream, cheese, ghee and lard) and *trans*-fats of all kinds, including both industrially-produced *trans*-fats (found in baked and fried foods, and pre-packaged snacks and foods, such as frozen pizza, pies, cookies, biscuits, wafers, and cooking oils and spreads) and ruminant *trans*-fats (found in meat and dairy foods from ruminant animals, such as cows, sheep, goats and camels). It is suggested that the intake of saturated fats be reduced to less than 10% of total energy intake and *trans*-fats to less than 1% of total energy intake *(5)*. In particular, industrially-produced *trans*-fats are not part of a healthy diet and should be avoided *(4, 6)*.

Less than 5 g of salt (equivalent to about one teaspoon) per day *(8)*. Salt should be iodized.

Reduce unhealthy diet

'Best buys': effective interventions with cost effectiveness analysis (CEA) ≤ I$100 per DALY averted in LMICs 	Reduce salt intake through the reformulation of food products to contain less salt and the setting of target levels for the amount of salt in foods and meals[12] Reduce salt intake through the establishment of a supportive environment in public institutions such as hospitals, schools, workplaces and nursing homes, to enable lower sodium options to be provided Reduce salt intake through a behaviour change communication and mass media campaign Reduce salt intake through the implementation of front-of-pack labelling[13]
Effective interventions with CEA >I$100 per DALY averted in LMICs 	Eliminate industrial trans-fats through the development of legislation to ban their use in the food chain[13] Reduce sugar consumption through effective taxation on sugar-sweetened beverages

Reduce unhealthy diet

Other recommended interventions from WHO guidance (CEA not available)	Promote and support exclusive breastfeeding for the first 6 months of life, including promotion of breastfeeding
	Implement subsidies to increase the intake of fruits and vegetables
	Replace trans-fats and saturated fats with unsaturated fats through reformulation, labelling, fiscal policies or agricultural policies
	Limiting portion and package size to reduce energy intake and the risk of overweight/obesity
	Implement nutrition education and counselling in different settings (for example, in preschools, schools, workplaces and hospitals) to increase the intake of fruits and vegetables
	Implement nutrition labelling to reduce total energy intake (kcal), sugars, sodium and fats
	Implement mass media campaign on healthy diets, including social marketing to reduce the intake of total fat, saturated fats, sugars and salt, and promote the intake of fruits and vegetables

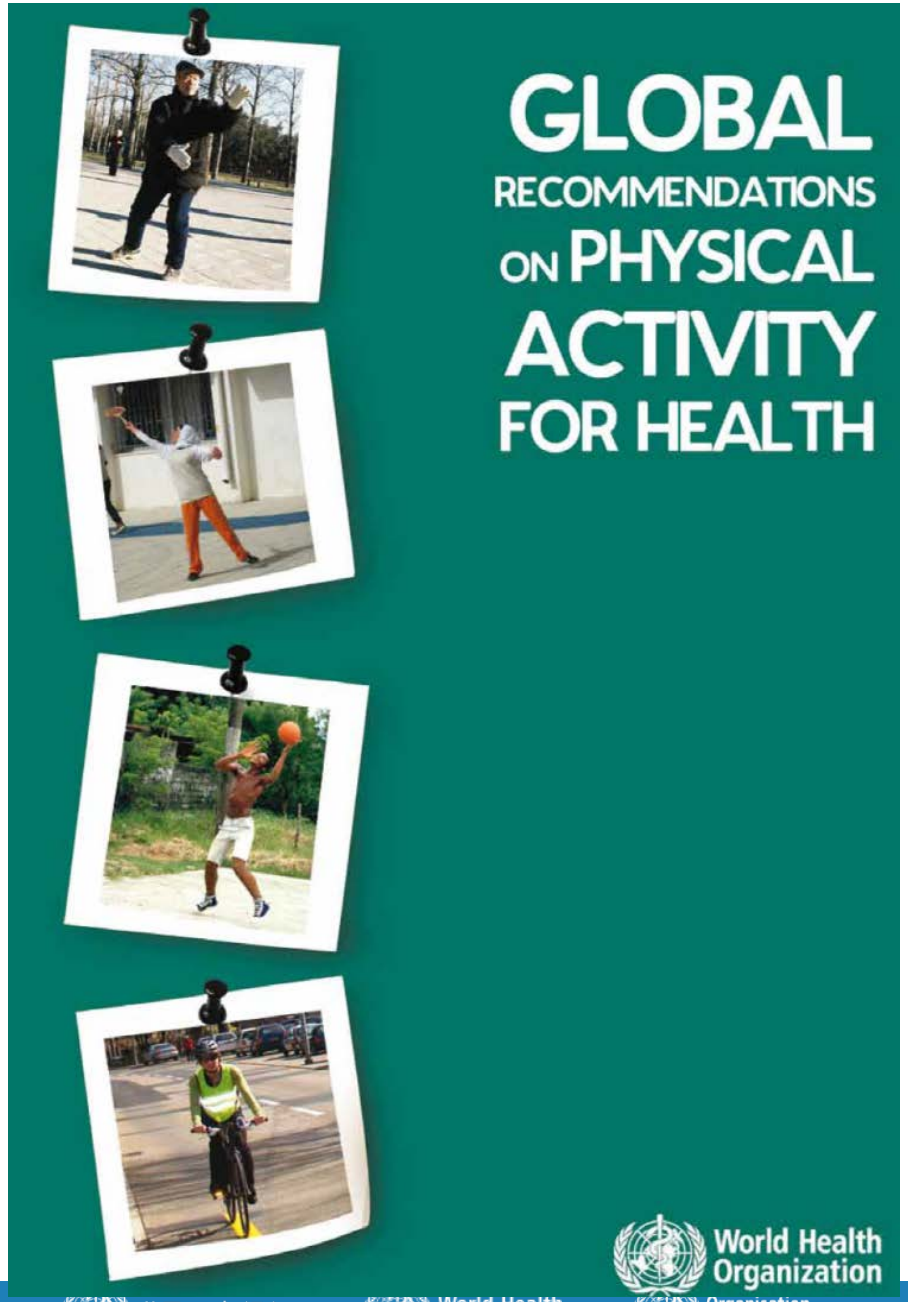
Reduce physical inactivity

Reduce physical inactivity

'Best buys': effective interventions with cost effectiveness analysis (CEA) ≤ I$100 per DALY averted in LMICs	Implement community wide public education and awareness campaign for physical activity which includes a mass media campaign combined with other community based education, motivational and environmental programmes aimed at supporting behavioural change of physical activity levels*
Effective interventions with CEA >I$100 per DALY averted in LMICs	Provide physical activity counselling and referral as part of routine primary health care services through the use of a brief intervention[14]

Reduce physical inactivity

Other recommended interventions from WHO guidance (CEA not available)	Ensure that macro-level urban design incorporates the core elements of residential density, connected street networks that include sidewalks, easy access to a diversity of destinations and access to public transport[15]
	Implement whole-of-school programme that includes quality physical education, availability of adequate facilities and programs to support physical activity for all children
	Provide convenient and safe access to quality public open space and adequate infrastructure to support walking and cycling
	Implement multi-component workplace physical activity programmes
	Promotion of physical activity through organized sport groups and clubs, programmes and events



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Global Recommendations on Physical Activity for Health

Recommendations for 5-17 years old:

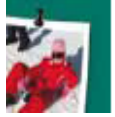
For children and young people, physical activity includes play, games, sports, transportation, chores, recreation, physical education, or planned exercise, in the context of family, school, and community activities.

The recommendations to improve cardiorespiratory and muscular fitness, bone health, and cardiovascular and metabolic health biomarkers are:

1. Children and youth aged 5–17 should accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity daily.
2. Amounts of physical activity greater than 60 minutes provide additional health benefits.
3. Most of the daily physical activity should be aerobic. Vigorous-intensity activities should be incorporated, including those that strengthen muscle and bone, at least 3 times per week.

The benefits of being physically active outweigh the harms. Any existing risk can be reduced by a progressive increase in the activity level, especially in children and young people who are inactive.

For activities that can pose risks of injuries, the use of protective equipment such as helmets should be encouraged.



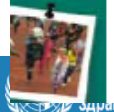
Recommendations for 18-64 years old:

In adults aged 18–64, physical activity includes leisure time physical activity, transportation (e.g. walking or cycling), occupational (i.e. work), household chores, play, games, sports or planned exercise, in the context of daily, family, and community activities.

The recommendations to improve cardiorespiratory and muscular fitness, bone health, reduce the risk of NCDs and depression are:

1. Adults aged 18–64 should accumulate at least 150 minutes of moderate-intensity aerobic physical activity throughout the week or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity activity.
2. Aerobic activity should be performed in bouts of at least 10 minutes duration.
3. For additional health benefits, adults should increase their moderate-intensity aerobic physical activity to 300 minutes per week, or engage in 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate- and vigorous-intensity activity.
4. Muscle-strengthening activities should be done involving major muscle groups on 2 or more days a week.

Recommendations for 65 years and above:



In older adults of the 65 years and above age group, physical activity includes leisure time physical activity, transportation (e.g. walking or cycling), occupational (if the individual is still engaged in work), household chores, play, games, sports or planned exercise, in the context of daily, family, and community activities.

The recommendations to improve muscular and cardiorespiratory fitness, bone and functional health, reduce the risk of NCDs, depression and cognitive decline are:

1. Older adults should accumulate at least 150 minutes of moderate-intensity aerobic physical activity throughout the week or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity activity.
2. Aerobic activity should be performed in bouts of at least 10 minutes duration.
3. For additional health benefits, older adults should increase their moderate-intensity aerobic physical activity to 300 minutes per week, or engage in 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate-and vigorous-intensity activity.
4. Older adults, with poor mobility, should perform physical activity to enhance balance and prevent falls on 3 or more days per week.
5. Muscle-strengthening activities, involving major muscle groups, should be done on 2 or more days a week.
6. When older adults cannot do the recommended amounts of physical activity due to health conditions, they should be as physically active as their abilities and conditions allow.

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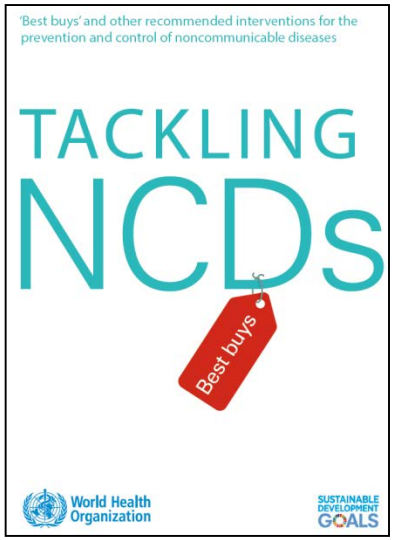
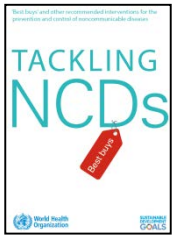
Commission on Ending Childhood Obesity

Prevention of type 2 diabetes in individuals at high risk?



- Lists lifestyle interventions for preventing type 2 diabetes as a policy option
- No cost-effectiveness analysis
- No guidance on "how"

Manage cardiovascular disease and diabetes



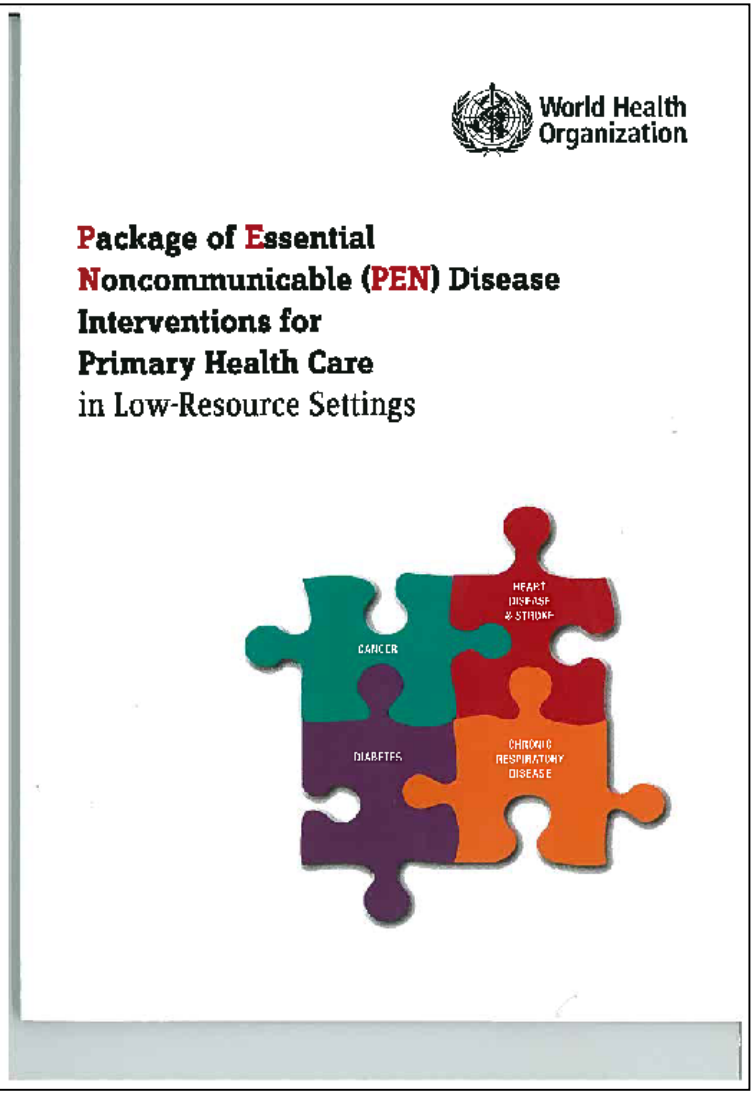
Manage CVD and Diabetes

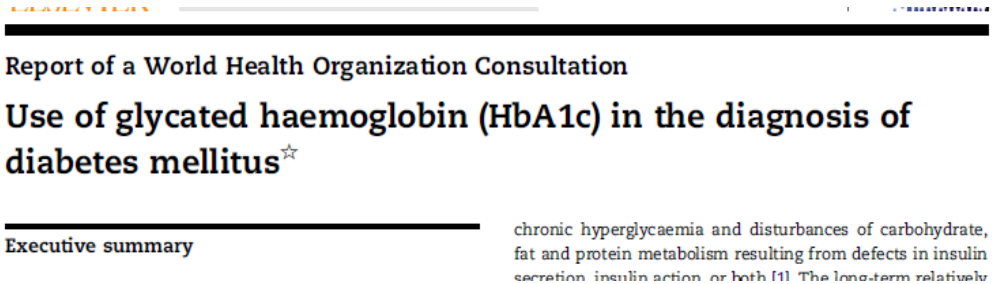
'Best buys': effective interventions with cost effectiveness analysis (CEA) ≤ I$100 per DALY averted in LMICs

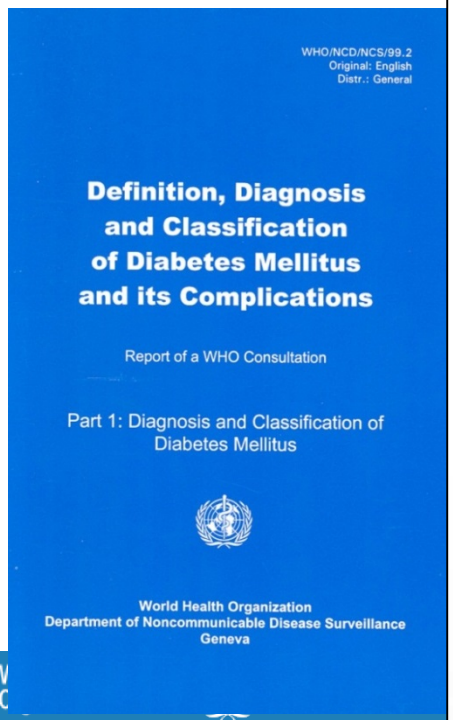
Drug therapy (including glycaemic control for diabetes mellitus and control of hypertension using a total risk* approach) and counselling to individuals who have had a heart attack or stroke and to persons with high risk (≥ 30%) of a fatal and non-fatal cardiovascular event in the next 10 years[16]

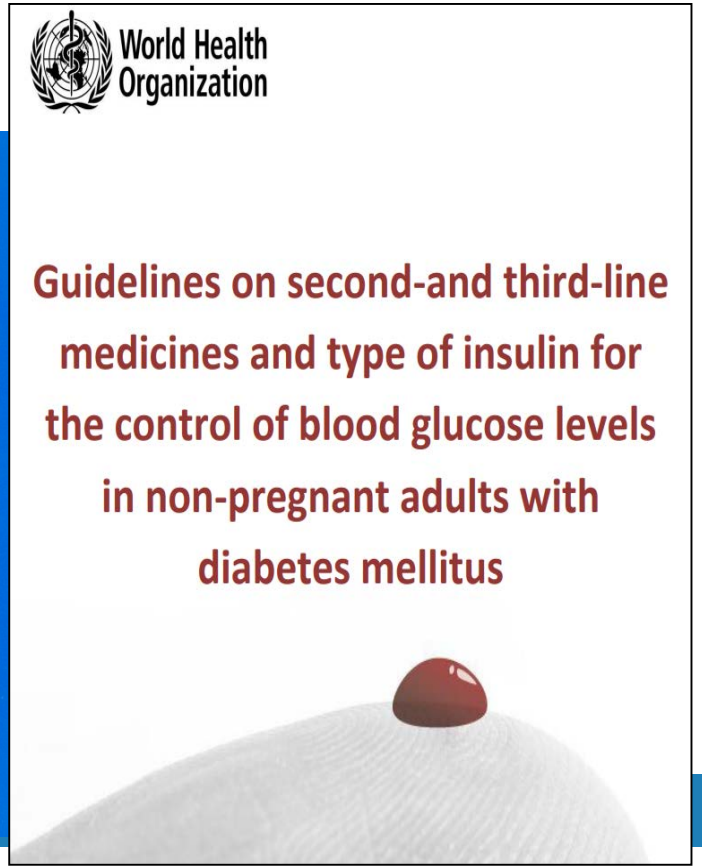
Drug therapy (including glycaemic control for diabetes mellitus and control of hypertension using a total risk approach) and counselling to individuals who have had a heart attack or stroke and to persons with moderate to high risk (≥ 20%) of a fatal and non-fatal cardiovascular event in the next 10 years[17]

WHO guidance on diabetes diagnosis and management









Essential Medicines for WHO-PEN NCD Interventions

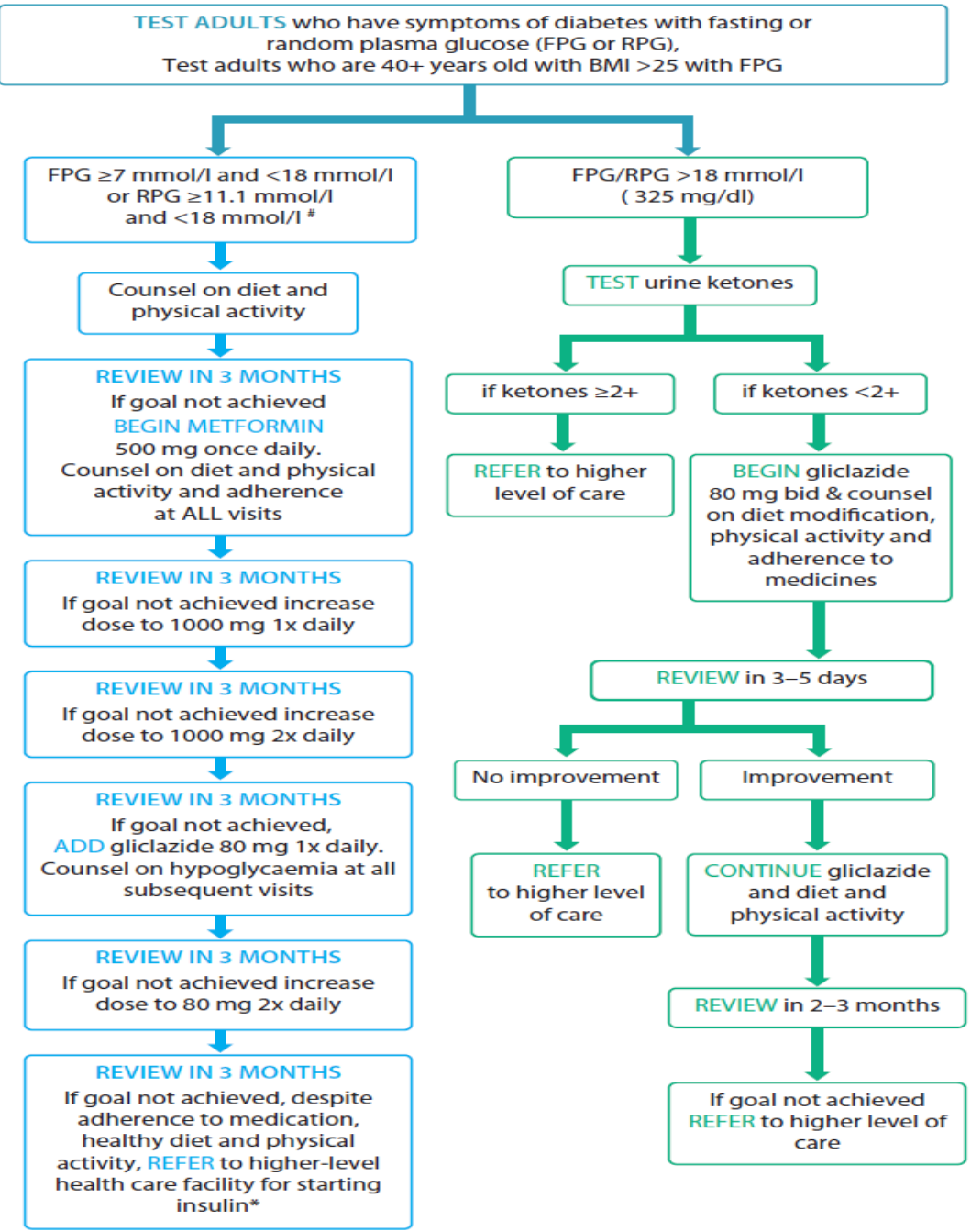
Medicines *	
Thiazide diuretic	Aspirin
Calcium channel blocker (amlodipine)	Paracetamol
Beta-blocker (atenolol)	Ibuprofen
Angiotensin inhibitor (enalapril)	Codeine
Statin (simvastatin)	Morphine
Human insulin	Penicillin
Metformin	Erythromycin
Glibenclamide/gliclazide	Amoxicillin
Isosorbide dinitrate	Hydrocortisone
Glyceryl trinitrate	Epinephrine
Furosemide	Heparin
Salbutamol	Diazepam
Prednisolone	Sodium chloride infusion

* Indicative list

Essential Technologies and Tools for WHO-PEN NCD Interventions

Technologies *	Tools
• Thermometer • Stethoscope • **Blood pressure measuring device** • **Measurement tape** • **Weighing machine** • Peak flow meter • Spacers for inhalers • **Glucometer** • Nebulizer • Pulse oximeter • **Blood cholesterol assay** • **Lipid profile**	• WHO/ISH CVD risk prediction charts • Evidence based clinical protocols • Flow charts with referral criteria • Patient clinical record • Medical information register • Audit tools

Diagnosis, early detection and type 2 blood glucose control protocol



Management of CVD risk factors in diabetes (WHO-PEN)

Blood pressure control

- **Thiazide diuretics** and **angiotensin-converting enzyme** (ACE) inhibitors are **recommended**
- Target blood pressure < 130/80 mmHg

Lipid control

- **Statins** for people >= 40 yrs

Antiplatelet treatment

- 75-100 mg of acetylsalicylic acid daily for survivors of a CVD event who have no history of major bleeding

Treatment goals, screening and management of complications (WHO – PEN)

SCREENING FOR CHRONIC COMPLICATIONS

- Measure blood pressure at every scheduled visit, review medication as per hypertension protocol
- REFER for dilated-pupil retinal exam upon diagnosis, and every two years thereafter, or as per ophthalmologist recommendation
- Examine feet for ulcers at every visit. REFER to higher level of care if ulcer present
- Assess risk of lower limb amputation annually (foot pulses, sensory neuropathy by monofilament, presence of healed or open ulcers, calluses). REFER to higher level of care if ulcer present or pulse absent
- Test for proteinuria annually. REFER to higher level of care if positive.

MANAGEMENT OF ACUTE COMPLICATIONS

Severe hypoglycaemia (plasma glucose <50 mg/dl or 2.8 mmol/l) or signs:

- If conscious, give a sugar-sweetened drink
- If unconscious, give 20–50 ml of 50% glucose (dextrose) IV over 1–3 minutes.

Severe hyperglycaemia (plasma glucose >18 mmol/l (325 mg/dl) and urine ketone 2+) or signs and symptor of severe hyperglycaemia:

- Set up intravenous drip 0.9% NaCl 1 litre in 2 hours; continue at 1 litre eve 4 hours, REFER to hospital.

Goal for glycaemic control	Plasma glucose**
Fasting	≤7.0 mmol/l (126mg/dl)†

\# refer to table on diagnostic values for other tests which can be used to diagnose diabetes.

* If they are more affordable than insulin, DPP4-inhibitors, SGLT2-inhibitors or pioglitazone can be used before insulin in cases of treatment failure with metformin and gliclazide. Introduce and titrate insulin treatment according to local practices.

** HbA1c should be used where available.

† Consider less stringent glycaemic control in patients with frequent severe hypoglycaemia, advanced complications, serious comorbidities and/or limited life expectancy.

World Health Organization

The Global Hearts Initiative

Working Together to Promote Cardiovascular Health

World Health Organization | American Heart Association | American Stroke Association | International Diabetes Federation | International Society of Hypertension | RESOLVE TO SAVE LIVES | Pan American Health Organization | World Health Organization | WORLD HEART FEDERATION | World Stroke Organization | CDC

COUNTRY PLANS- Endorsed by the MOH

WHO provides technical support and facilitation

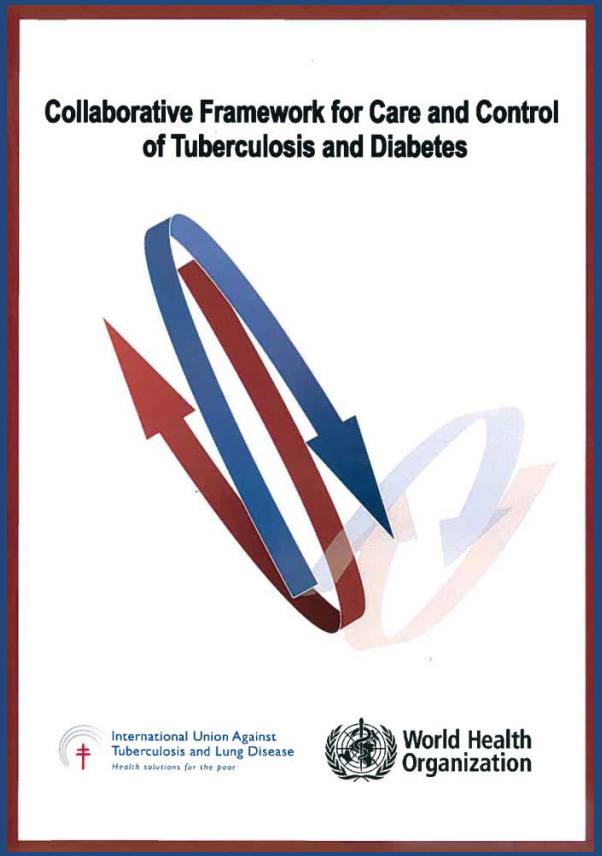
Implementation through Ministries of Health

Supported by partners

Tools
Protocols
Indicators
Capacity building
Monitoring

Diabetes and comorbidities: TB

Collaborative Framework for Care and Control of Tuberculosis and Diabetes (WHO/IUATLD, 2011)



- Promotes enhanced collaboration between diabetes and TB prevention and care programmes

World Health Organization

Diabetes – TB comorbidity

THREE ACTION AREAS IN THE COLLABORATIVE FRAMEWORK

- A-	**ESTABLISH MECHANISMS FOR COLLABORATION**
1	Set up a means of coordinating diabetes and TB activities
2	Conduct surveillance of TB disease prevalence among people with diabetes in medium and high-TB burden settings
3	Conduct surveillance of diabetes prevalence in TB patients in all countries
4	Conduct monitoring and evaluation of collaborate diabetes and TB activities
- B-	**DETECT AND MANAGE TB IN PATIENTS WITH DIABETES**
1	Intensify detection of TB among people with diabetes
2	Ensure TB infection control in health-care settings where diabetes is managed
3	Ensure high-quality TB treatment and management in people with diabetes
- C-	**DETECT AND MANAGE DIABETES IN PATIENTS WITH TB**
1	Screen TB patients for diabetes
2	Ensure high-quality diabetes management among TB patients

World Health Organization

Diabetes – TB comorbidity

Screening of patients with tuberculosis for diabetes mellitus in China

Liang Li[1], Yan Lin[2], Fengling Mi[1], Shouyong Tan[3], Bing Liang[3], Chaojun Guo[4], Lian Shi[5], Li Liu[6], Fang Gong[3], Yuanyuan Li[4], Jingyu Chi[7], Rony Zachariah[8], Anil Kapur[9], Knut Lönnroth[10] and Anthony D. Harries[11,12]

1 *Clinical Center on Tuberculosis, China CDC, Beijing, China*
2 *China Office, International Union Against Tuberculosis and Lung Disease, Beijing, China*

Tropical Medicine and International Health doi:10.1111/j.1365-3156.2012.03069.x

VOLUME 17 NO 10 PP 1302–1308 OCTOBER 2012

Screening patients with Diabetes Mellitus for Tuberculosis in China

Yan Lin[1], Liang Li[2], Fengling Mi[2], Juan Du[3], Yaqiong Dong[3], Zhaoliang Li[4], Wenbo Qi[4], Xiangling Zhao[5], Ying Cui[6], Fengying Hou[7], Rony Zachariah[8], Anil Kapur[9], Knut Lönnroth[10] and Anthony D. Harries[11,12]

1 *China Office, International Union Against Tuberculosis and Lung Disease, Beijing, China*
2 *Clinical Center on Tuberculosis, China CDC, Beijing, China*

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PLOS | ONE

Results of the Implementation of a Pilot Model for the Bidirectional Screening and Joint Management of Patients with Pulmonary Tuberculosis and Diabetes Mellitus in Mexico

Martín Castellanos-Joya[1], Guadalupe Delgado-Sánchez[2], Leticia Ferreyra-Reyes[2], Pablo Cruz-Hervert[2], Elizabeth Ferreira-Guerrero[2], Gabriela Ortiz-Solís[3], Mirtha Irene Jiménez[1], Leslie Lorena Salazar[1]

Health ization

Zero increase in diabetes and obesity prevalence?

Criteria recommended for selection of targets

- **High epidemiological and public health relevance**
- **Coherence with major strategies**
- **Availability of evidence-based effective and feasible public health interventions ?**
- **Evidence of achievability at the country level, including in low- and middle-income countries ?**
- **Existence of unambiguous data collection instruments for monitoring**

Zero increase in diabetes and obesity prevalence

- Achievability uncertain
- Some data indicating leveling off of childhood obesity prevalence in a few HIC

Thank you!

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World Health Organization