Overview of evidence of a link between air pollution and diabetes

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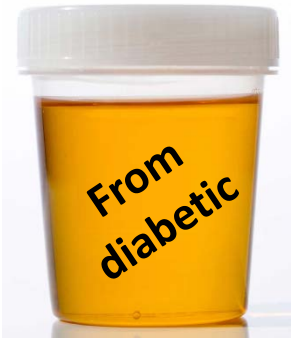
Diabetes mellitus or „Honey-sweet urine“

- Honey-tasting urine, attracts ants when spilled on floor (**India**, 600 BCE)
- Unquenchable thirst, excessive drinking, incessant flow of urine (**Aretaeus of Cappadocia,** 1st century CE)
- Ultimate proof of glucose in urine:
  Francis Home (Scot, 18th century)



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tastes like

Major types of Diabetes mellitus

Type 1 (T1DM)

- Autoimmune reaction
- Destruction of beta-cells in pancreas
- **Absolute** insulin deficiency
- Without insulin quick death
- Therapy requires daily insulin
- RF: Genetic susceptibility plus environmental triggers (viral, toxic, ?)
- Acute disease onset in childhood
- Infrequent, but rising

Type 2 (T2DM)

- Insulin resistance of cells
- **Relative** insulin deficiency, inadequate production of insulin
- RF: high BMI and poor diet, inactivity, ethnicity, genetic susceptibility
- Therapy: lifestyle modification and mostly oral medication
- Slow onset mostly in older adults, long predetection period
- Frequent (90%) and rising (children and adolescents)

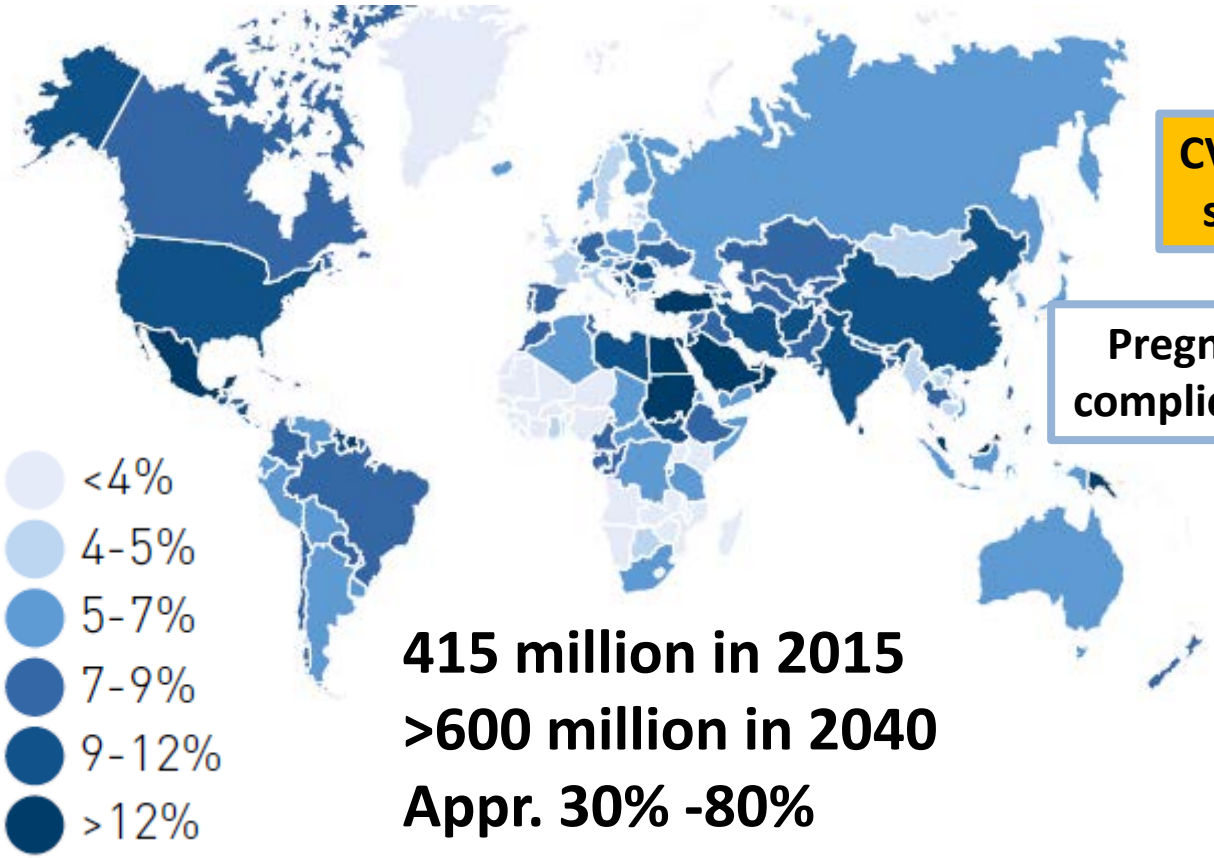
Major types of Diabetes mellitus

Gestational D.m. (GDM)

- Pathogenesis similar to T2DM
- Insulin resistance aggravated by hormones during pregnancy
- Risk factors similar to T2DM
- Often transient
- Risk for T2DM elevated in mothers and babies -> children/adolescents

Diabetes mellitus

Prevalence in adults



415 million in 2015
>600 million in 2040
Appr. 30% -80% undiagnosed

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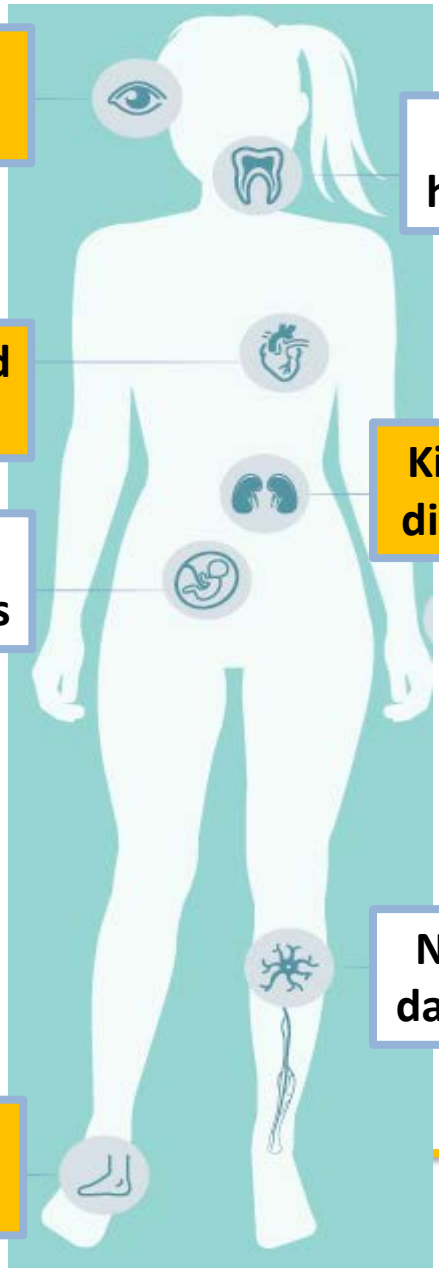
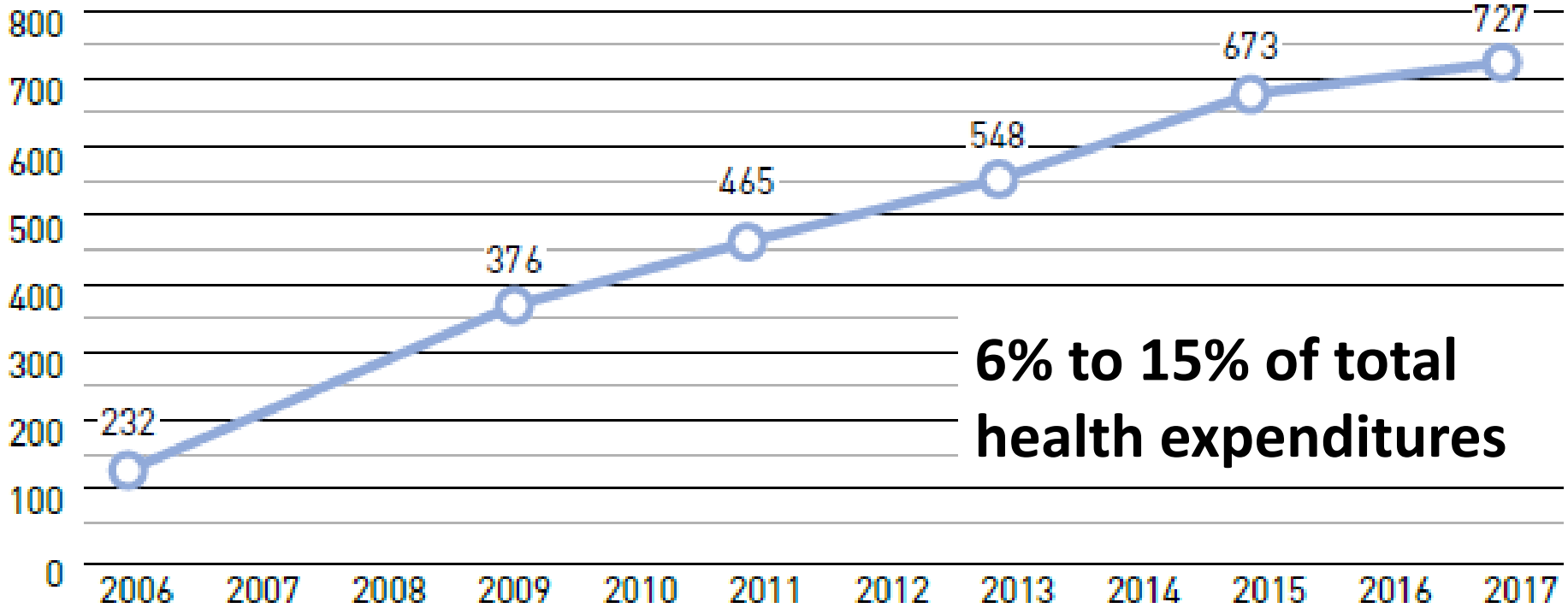
WHO 2009, IDF Atlas 2017

Complications



- Eye disease
- Oral health
- CVD and stroke
- Kidney disease
- Pregnancy complications
- Nerve damage
- Diabetic foot

Worldwide healthcare expenditure



*Billion USD

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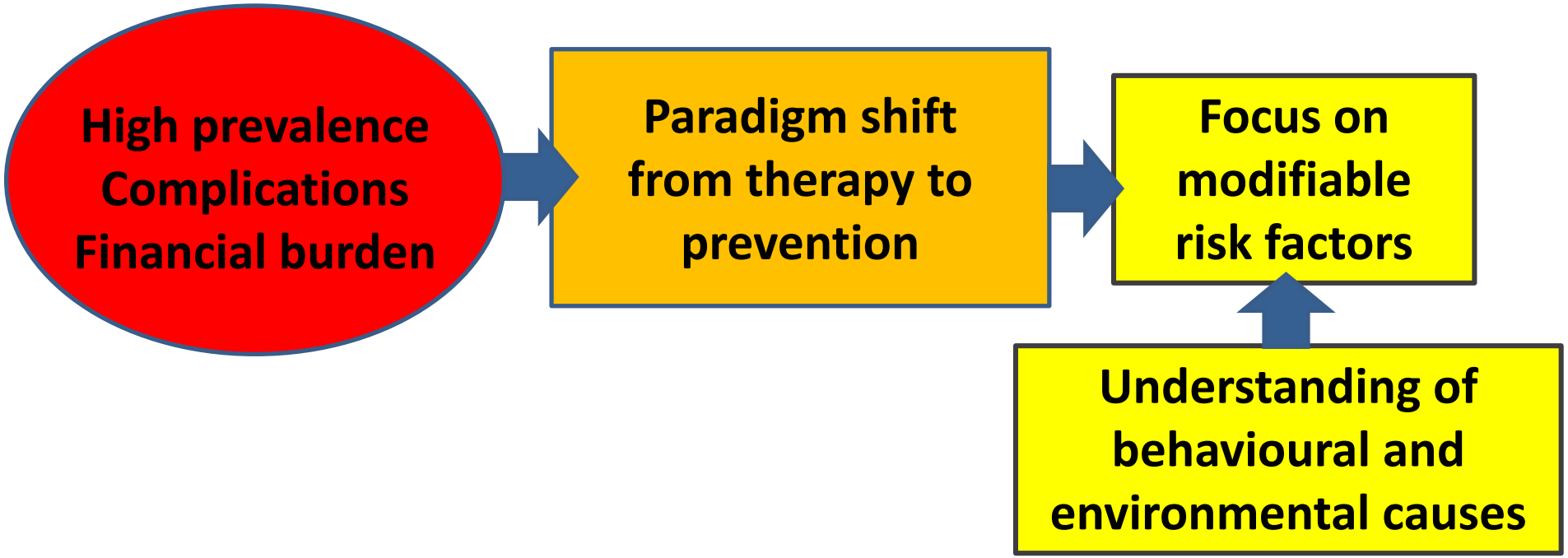
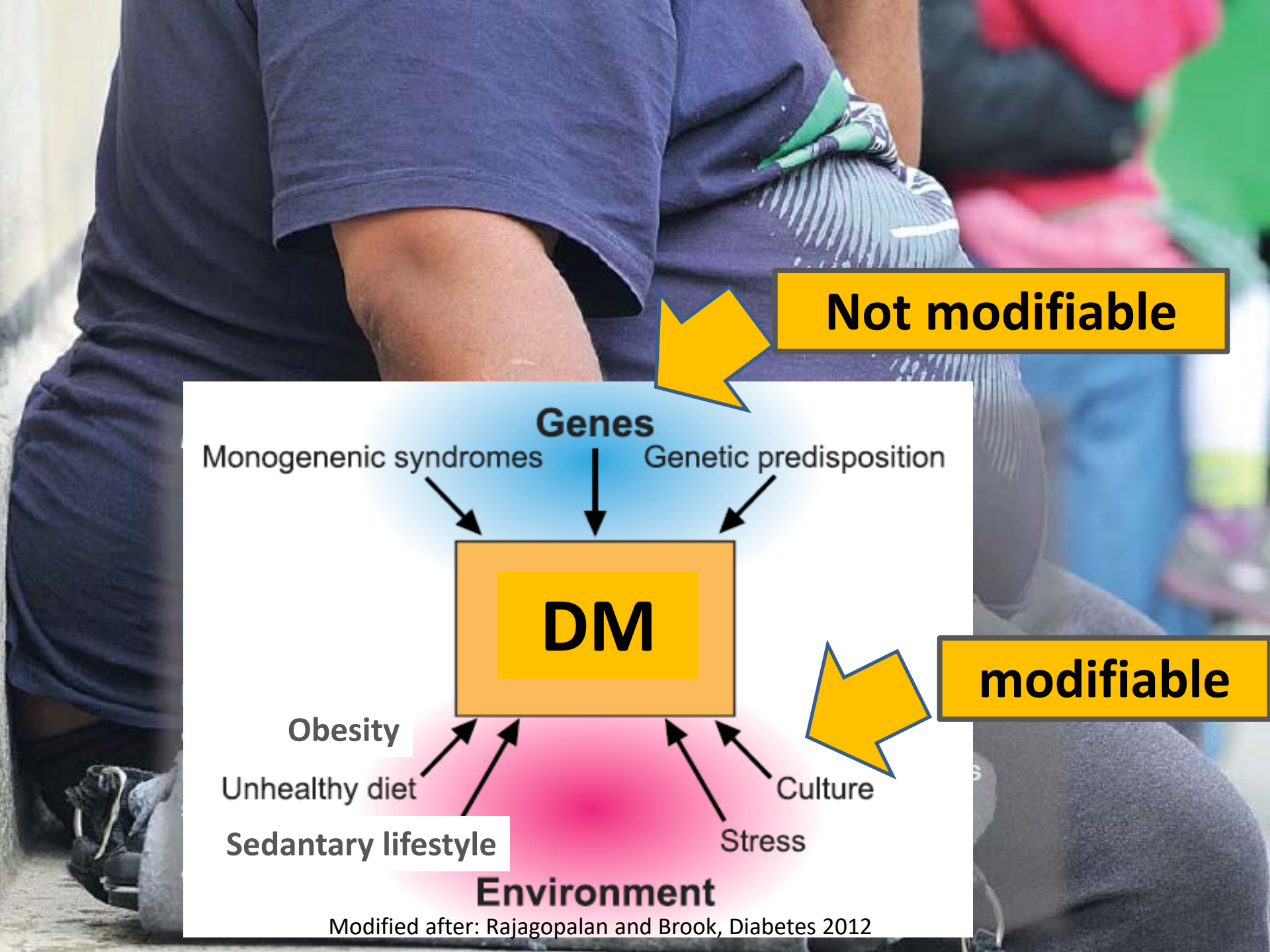
IDF Atlas 20157

Diabetes mellitus - prevention

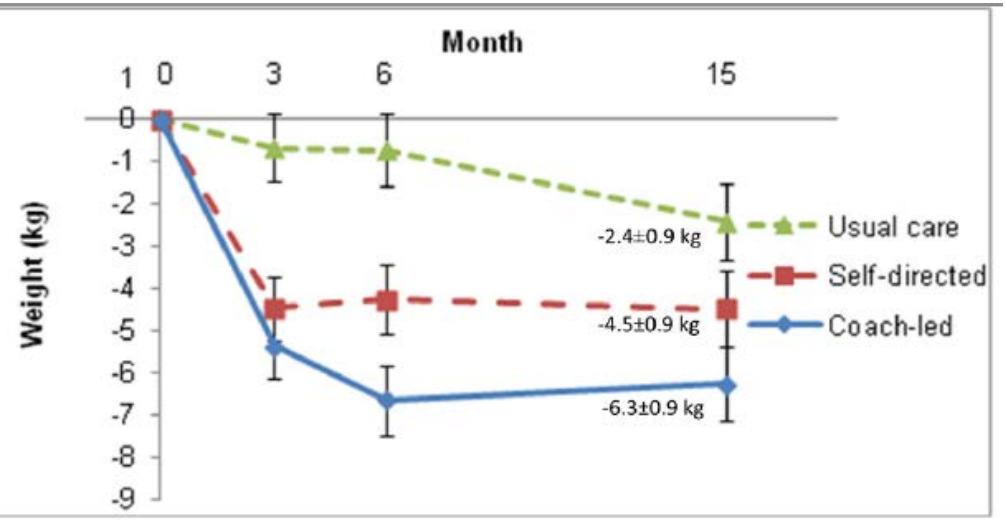




Modified after: Rajagopalan and Brook, Diabetes 2012

What can be done?

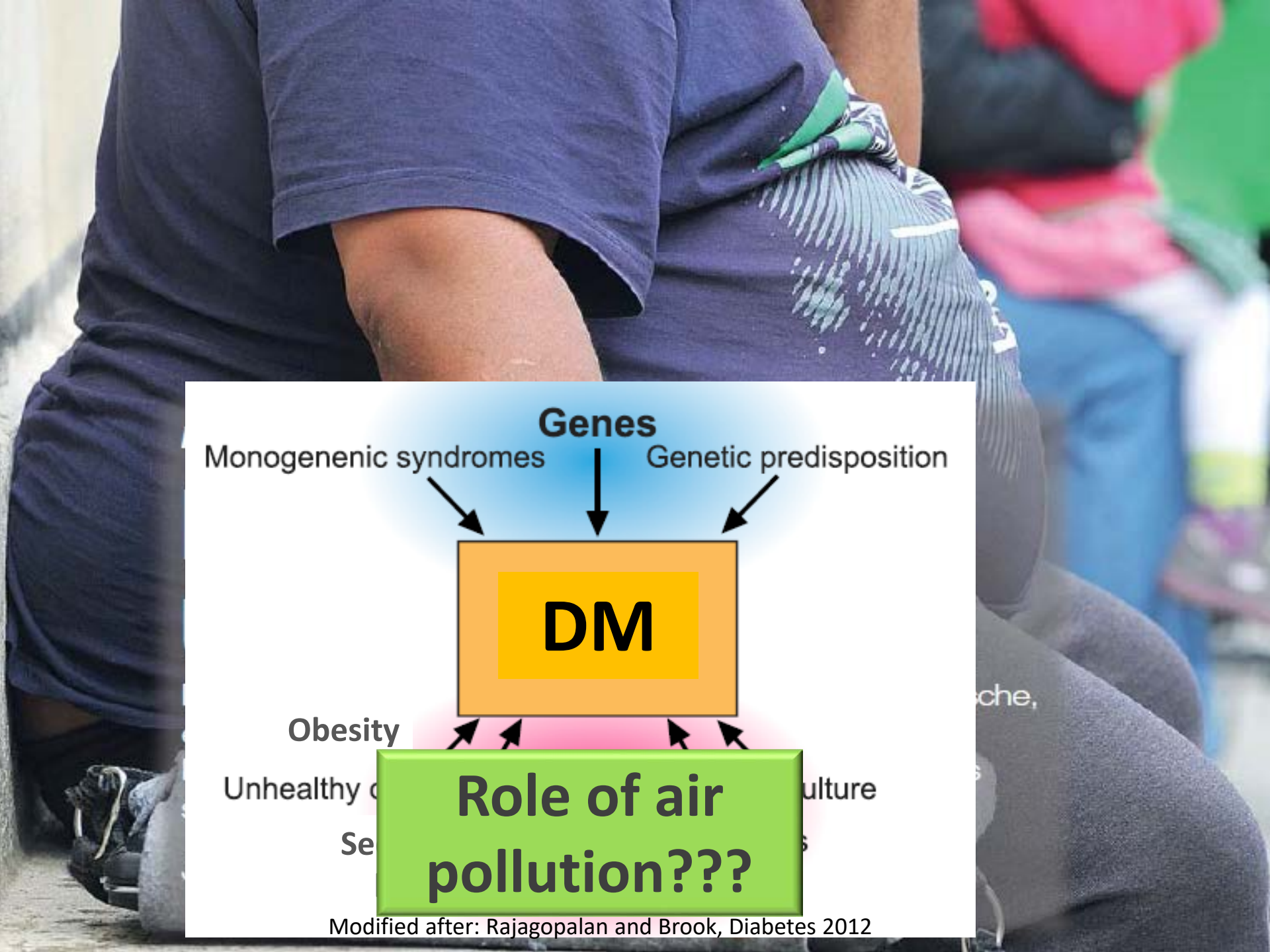
Randomized lifestyle intervention, 15 months in primary care setting



9-year follow-up of lifestyle intervention in low SES community

Outcomes	Analysis on dataset	Intention-to-treat analysis: intervention versus control			
Continuous		N	Δ	95% CI	p
BW (kg)	available	259	-2.1	-4.1 to -0.1	0.043
BW (kg)	imputed	-	-2.2	-4.6 to +0.2	0.073
BMI (kg/m²)	available	257	-0.79	-1.57 to -0.01	0.046
BMI (kg/m²)	imputed	-	-0.81	-1.69 to +0.08	0.074
WC (cm)	available	258	-2.9	-5.0 to -0.8	0.008
WC (cm)	imputed	-	-2.4	-4.7 to -0.0	0.046

Ma et al. JAMA 2013; Fianou et al. PlosOne 2016



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Role of air pollution in diabetic disease

Today

- **Etiologic factor**
  - Incidence of T2DM or prediabetes
  - Effects on glucose regulation in healthy individuals
  - Effects in vulnerable populations (i.e. pregnant women and their babies, other subgroups)
  - Incidence of T1DM

- **Susceptibility factor**
  - Stronger adverse effects of air pollution on diverse outcomes in diabetics

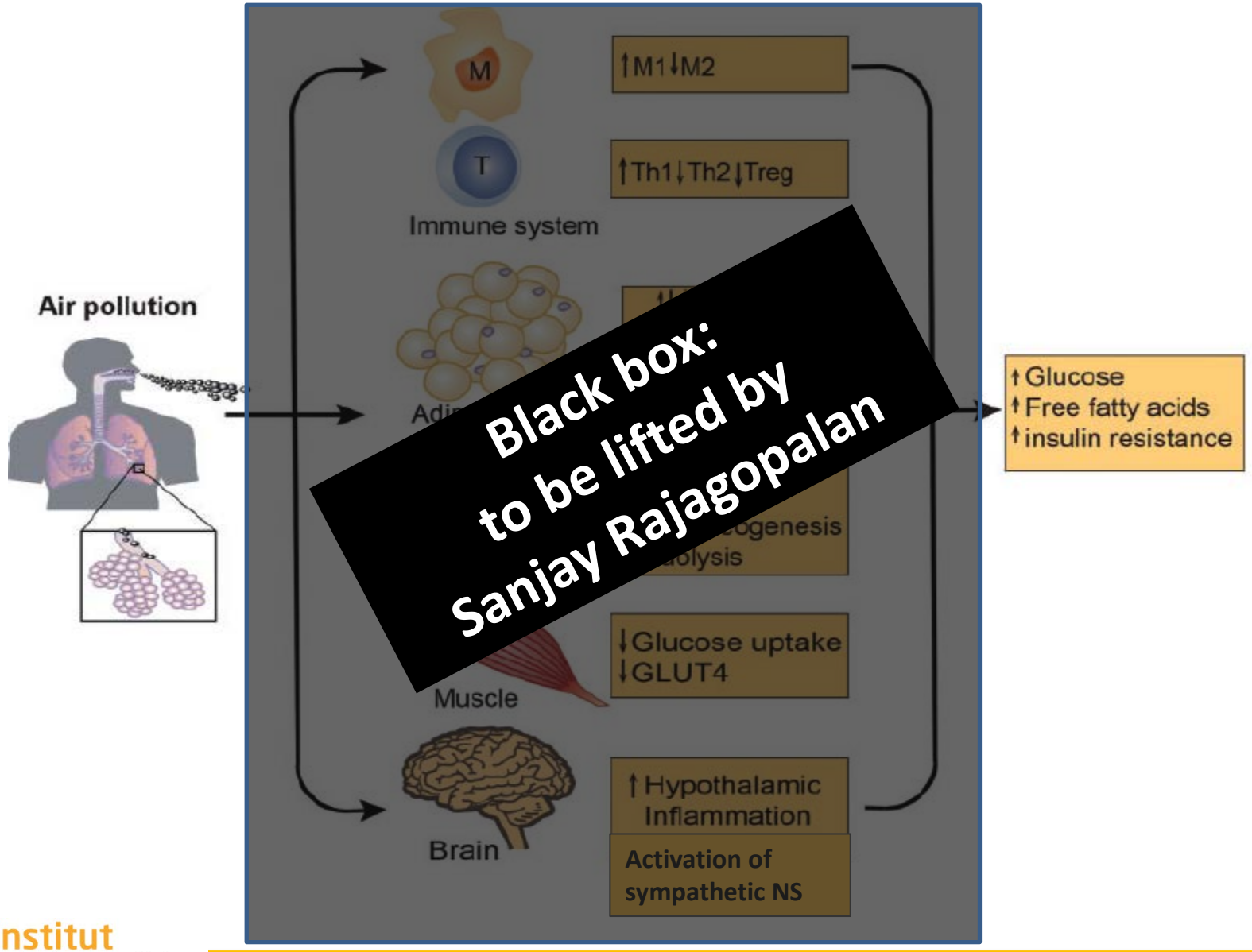
- **Possible intermediate**
  - Possible mediator of air pollution action on cardiovascular disease

Early measures – prediabetes and IR

Impaired glucose tolerance (IGT)	Impaired fasting glucose (IFG)	Insulin resistance (IR)
• Fasting glucose <126 mg/dL **and** • Glucose elevated (140-199 mg/dL at 2h oral glucose tolerance test (OGTT))	• Fasting glucose elevated, but not diabetic (110-125 mg/dL) **and** • OGTT normal	• (Glucose x insulin) elevated

- High risk for T2DM,
- IGT and IFG already increased insulin resistance
- Risk factors same as for T2DM

Proposed biological effects– air pollution



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Rao et al. Toxicol Sci 2015

Epidemiological evidence for etiological role

- Incidence of diabetes:
  - Relatively few prospective studies with diverse exposures and findings

    -> presented by Robin Puett

- What other clues do we have?
  - Metabolism in potentially vulnerable groups, i.e. children exposed to air pollution at young age

    -> presented by Abby Fleisch

Thank you





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