



# Tuberculosis and Diabetes

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# Accreditation Statement



## Accreditation Statement

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**UAN Number:** UAN JA0000238-0000-26-089-L99-P.

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### Available Credit

- 18.25 ACPE,
- 18.25 *AMA PRA Category 1 Credit™*
- 18.25 ANCC
- 18.25 Attendance
- 18.25 IPCE

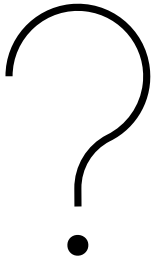
## Disclosure:

No relevant financial disclosures to report and no mention of off-label use of any medications or products

# Learning Objectives

1. Review the global and U.S. epidemiology of diabetes and tuberculosis co-occurrence
2. Describe key pathophysiology of TB in patients with diabetes
3. Identify practical ways to address common challenges in concurrent TB and diabetes care

# Question 1



Based on current evidence, which estimate below best describes the risk of developing TB disease in people with diabetes compared with people without diabetes?

- A. About 1.2-fold
- B. No meaningful increase after accounting for age and local TB epidemiology
- C. About 1.6-fold
- D. About 3.1-fold

# Learning Objective

## 1

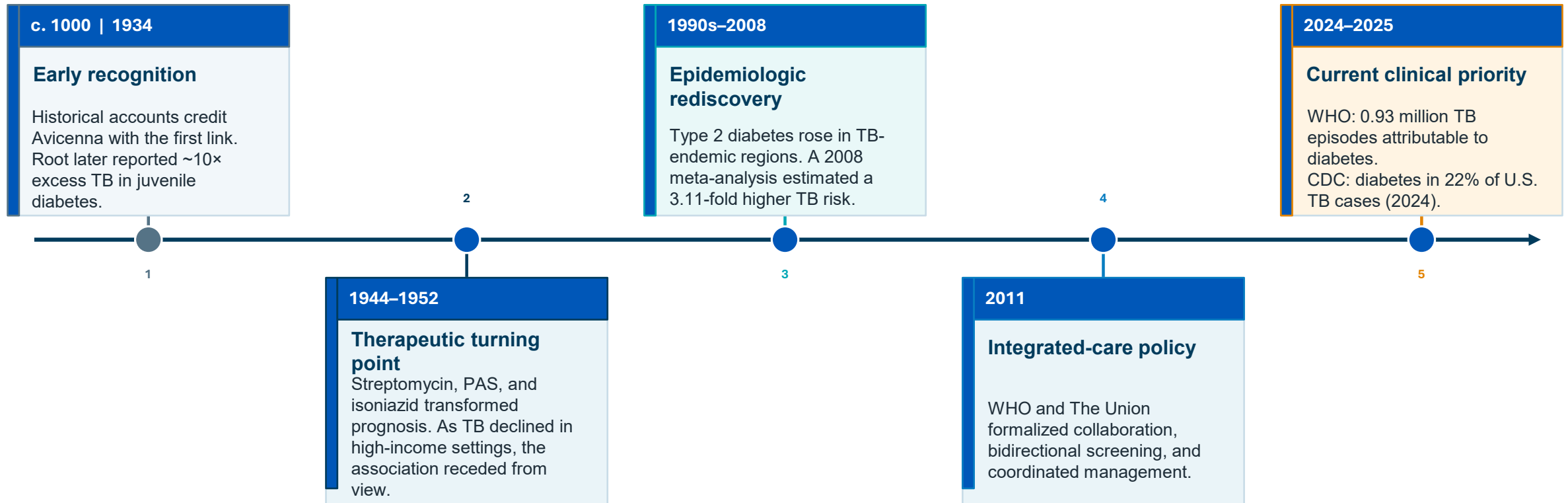
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# TB and Diabetes: a syndemic

*Syndemic* = situation in which two or more interrelated biological factors work together to make a disease or health crisis worse

“synergy” and “epidemic”

# TB and diabetes: across the ages



Sources: Barry 2024 • Root 1934 • Jeon & Murray 2008 • WHO / The Union 2011 • WHO 2025 • CDC 2024 surveillance

# Diabetes screening yield in people with tuberculosis

Results of a systematic review and meta-analysis

N = 19,581; 21 countries represented

## Overall pooled yield

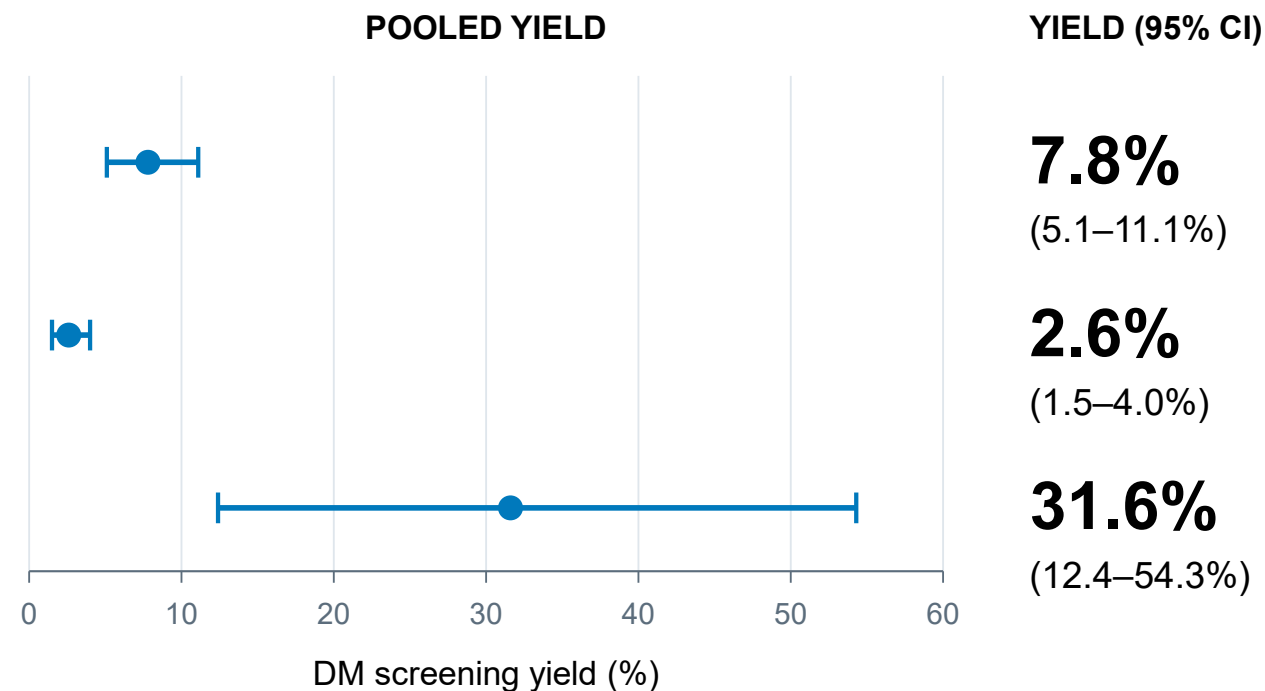
33 studies from 21 countries

## Western Pacific

Lowest reported regional yield  
3 studies; 1 country

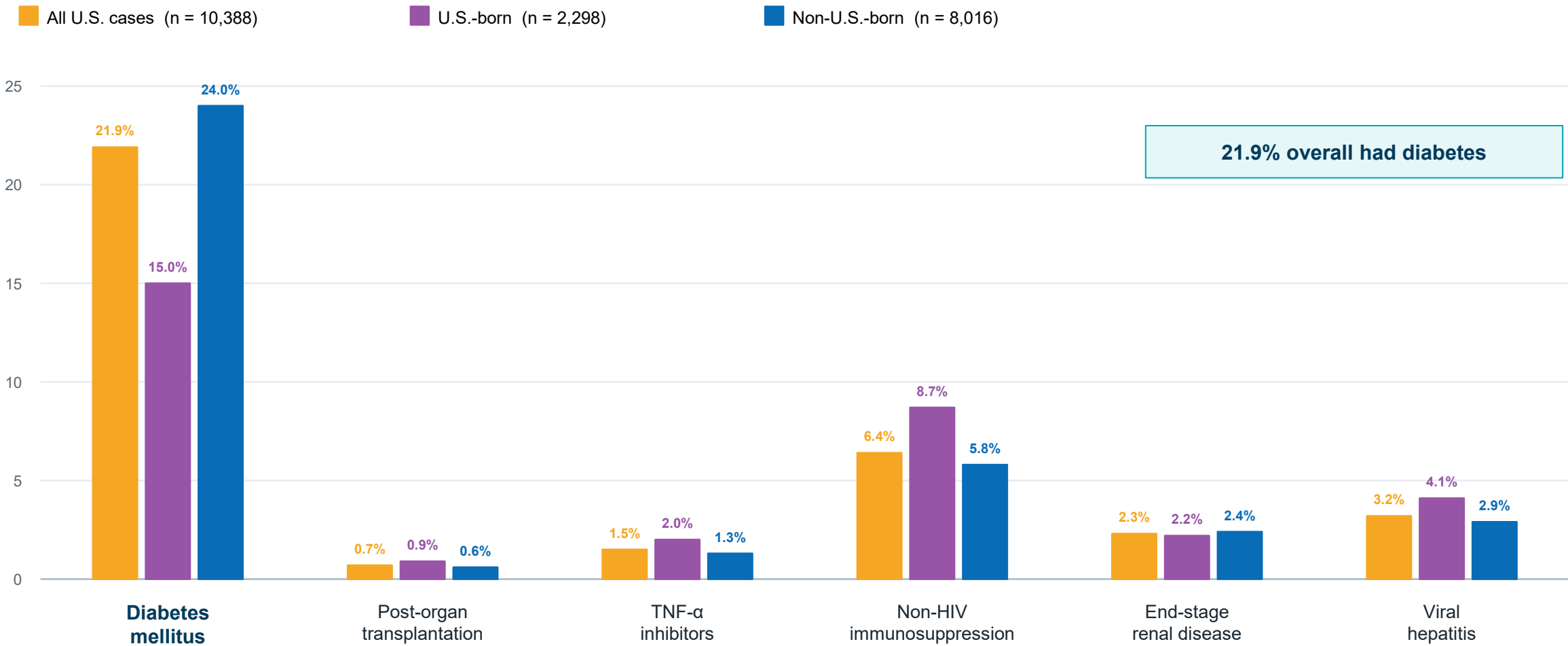
## Eastern Mediterranean

Highest reported regional yield  
3 studies; 2 countries



# Diabetes is the leading non-HIV medical risk factor in U.S. TB

Percent of reported tuberculosis cases with each condition or therapy, by origin of birth, 2024



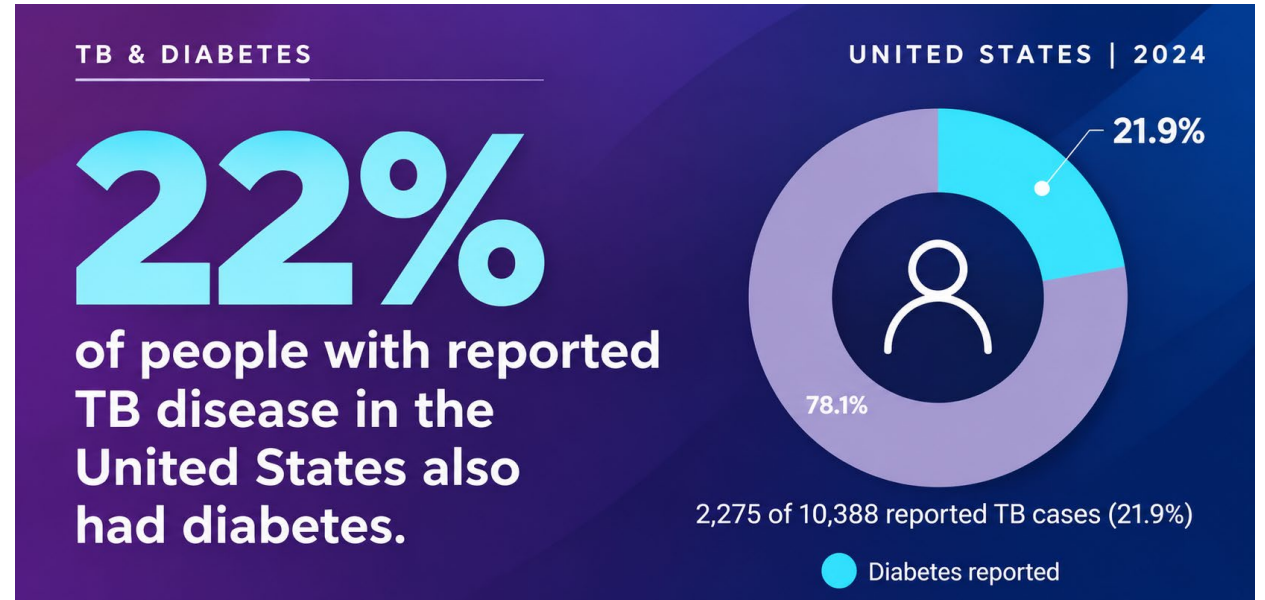
Source: [CDC. Reported Tuberculosis in the United States. 2024](#) | final detailed surveillance; data updated July 10, 2025

# Risk of developing TB disease in people with diabetes

- Current evidence: roughly 1.6- to 1.9-fold higher TB disease risk
- Factors that modify the risk:
  - Local TB Exposure
  - Duration/Severity Of Diabetes
  - Glycemic Control
  - Age
  - Comorbidity
  - Access To Diagnosis

# Diabetes among patients with TB

## US



# TB-DM compared to TB-non DM

- Higher risk of developing **MDR-TB**
- Higher risk of **treatment failure**
- Higher risk of **extended treatment duration**
- Higher risk of TB **reoccurrence**
- Higher odds of **mortality**

# Learning Objective

## 2

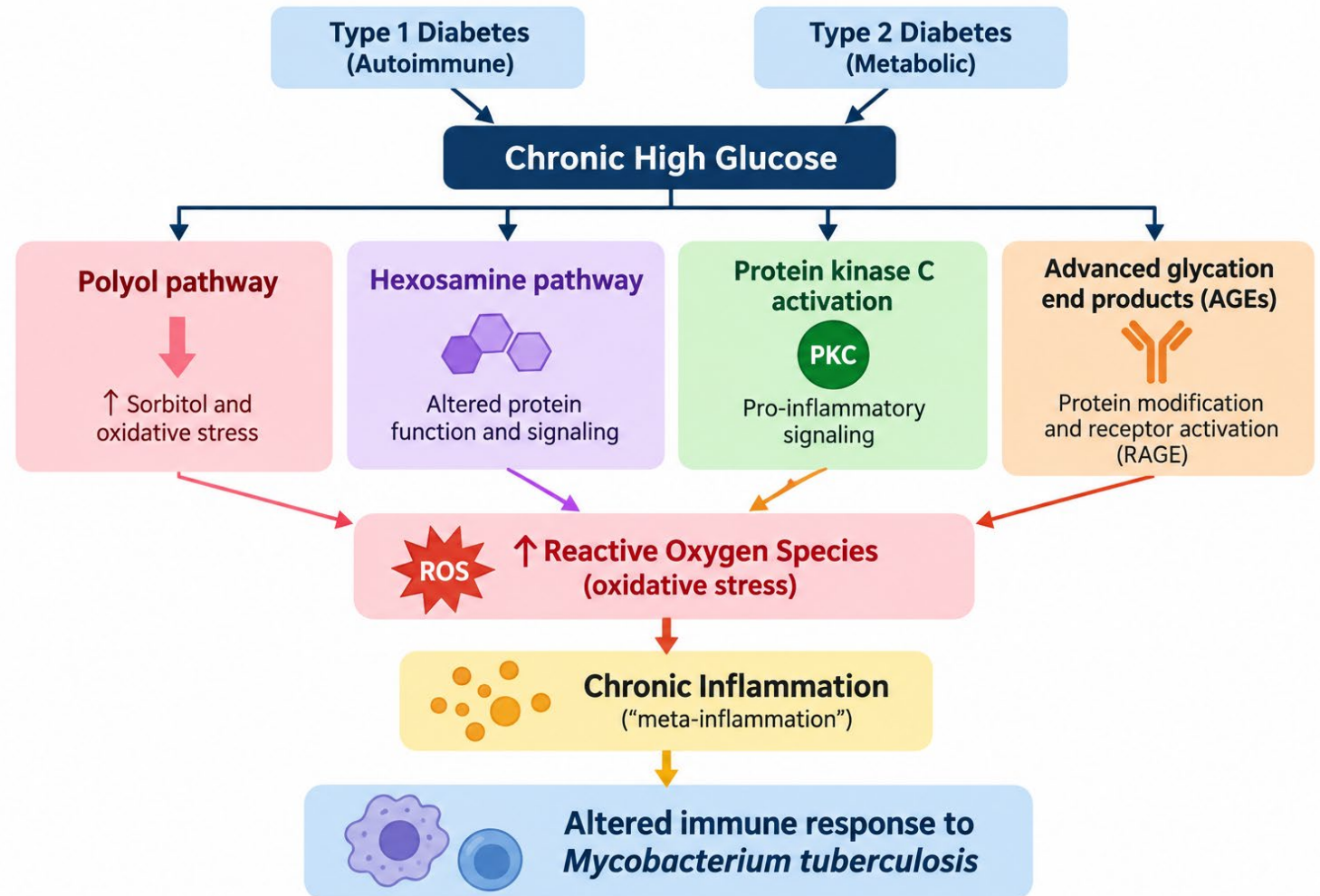
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# Diabetes and altered immunity

From chronic glucose excess

→ glucotoxicity

→ compromised immunity



# Effects of Diabetes on TB

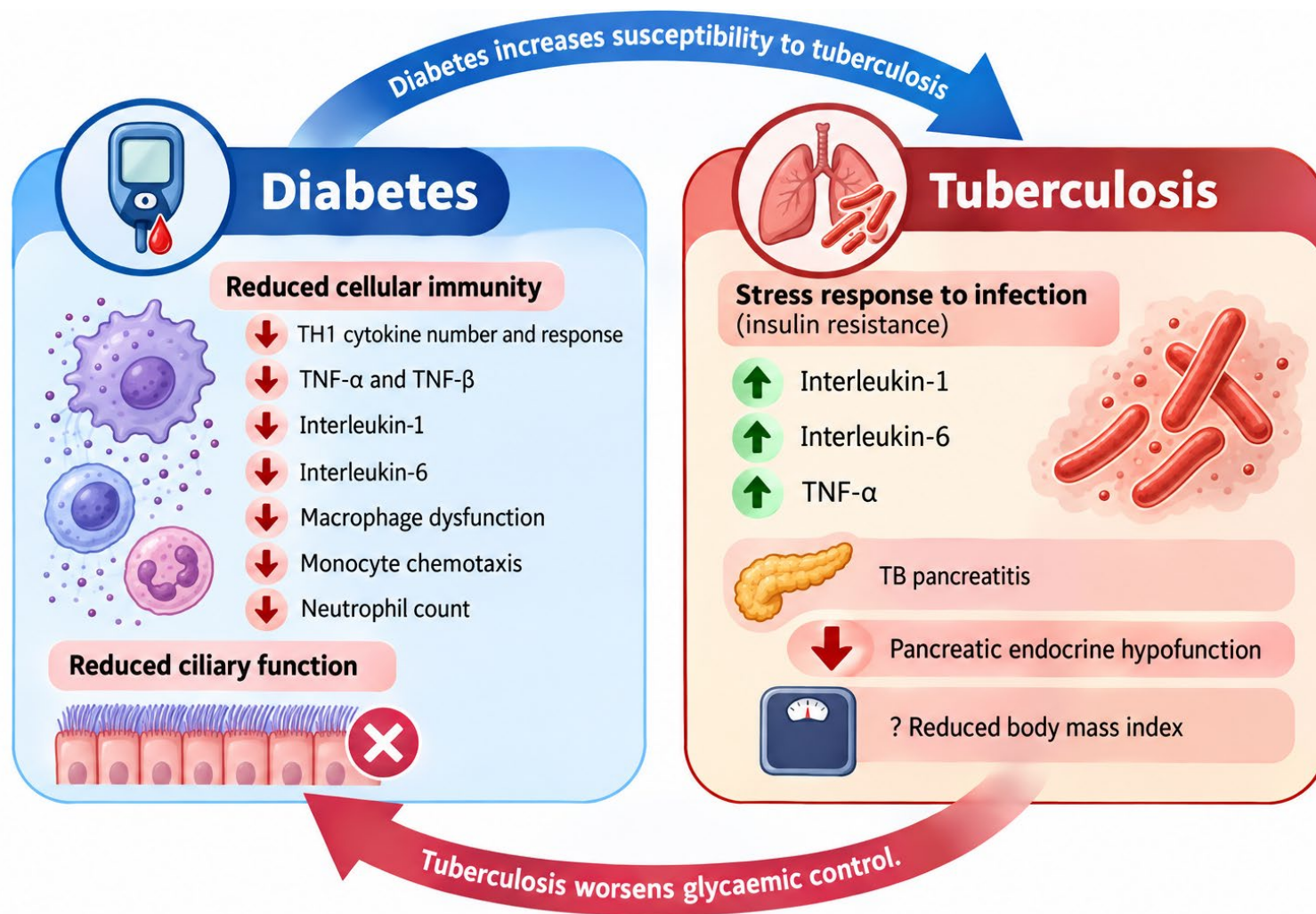
- **Immune Dysfunction:**
  - Impaired macrophage and T-cell function
  - Decreased IFN- $\gamma$ , IL-12, TNF- $\alpha$  → weak granuloma formation
- **Hyperglycemia:**
  - Enhances Mtb survival inside macrophages
  - Promotes oxidative stress and tissue injury
- **Microvascular Damage:**
  - Reduced lung perfusion and healing
  - Facilitates progression from latent to active TB

# Effects of TB on Diabetes

- **Inflammation and Stress Response:**
  - Cytokines (TNF- $\alpha$ , IL-1 $\beta$ , IL-6) cause insulin resistance
  - Chronic infection triggers stress hyperglycemia via cortisol and catecholamines
- **Effect on pancreas:**

TB may occasionally infect the, impairing insulin secretion

# Pathophysiologic Loop

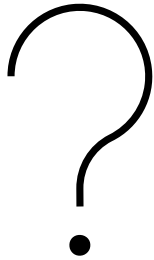


# Learning Objective

## 3

1. Review the global and U.S. epidemiology of diabetes and tuberculosis co-occurrence
2. Describe key pathophysiology of TB in patients with diabetes
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## Question 2



57-year-old man born in the Philippines; in the U.S. for 20 years. No recent travel. Type 2 diabetes; HbA1c 10.2%; CKD stage 3; distal neuropathy.

2 weeks of cough, fever, night sweats.

Results of a CXR are pending. Which of the following statements is true?

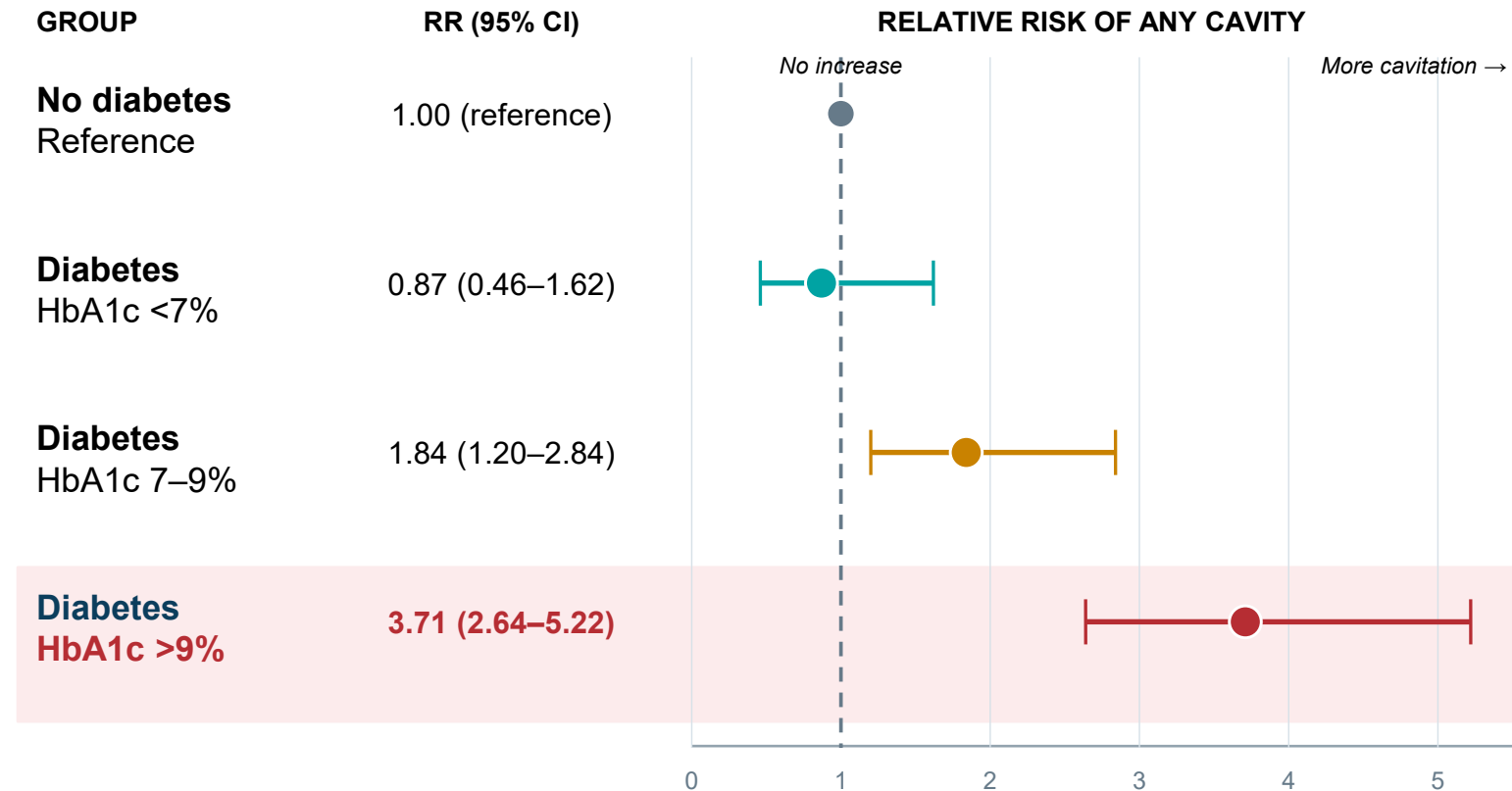
- A. Treat for community acquired pneumonia.
- B. Upper lobe opacities are more likely in patients with TB-DM than those with TB and no DM.
- C. Multilobar disease is more likely in patients with DM.
- D. A negative IGRA should exclude TB.

# Pulmonary TB with diabetes: the chest X-ray phenotype

| RADIOGRAPHIC FINDING                   | WHAT IS MORE LIKELY WITH DIABETES                                                                                    | EVIDENCE CONSISTENCY            |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------|
| <b>Cavitary disease</b>                | Any cavity is more frequent.                                                                                         | <b>MOST CONSISTENT</b>          |
| <b>Cavity burden</b>                   | Multiple cavities and large cavities (>3 cm).                                                                        | <b>MODERATE</b>                 |
| <b>Parenchymal extent</b>              | More extensive disease, with more lung zones involved.                                                               | <b>MODERATE</b>                 |
| <b>Cavity distribution</b>             | Cavities outside the classic upper zones; lower-zone cavitation is reported particularly with poor glycemic control. | <b>MODERATE / HETEROGENEOUS</b> |
| <b>Multilobar or bilateral disease</b> | Reported more often in some cohorts, but not consistently.                                                           | <b>INCONSISTENT</b>             |
| <b>Lower- or middle-zone opacities</b> | Reported more often, especially in patients with poor glycemic control.                                              | <b>INCONSISTENT</b>             |

# Glycemic control matters: cavitation rises with HbA1c

Relative risk of any cavity compared with patients who had pulmonary TB without diabetes.



2024 systematic review and meta-analysis of 7 observational studies

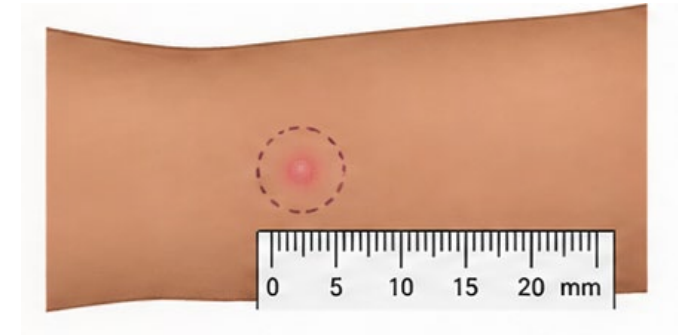
n=6,919

- Less cavitation with optimal glycemic control (RR – 0.59)

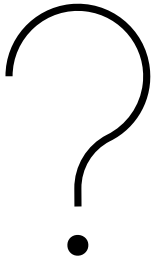
Sources: [Chiang et al., 2014](#) • [Zhao et al., 2024 meta-analysis](#)

# Other testing considerations at diagnosis:

- Higher rates of false-negative tuberculin skin test results
- The negative predictive value of the enzyme-linked immunosorbent spot assay is lower in patients with poor glycemic control



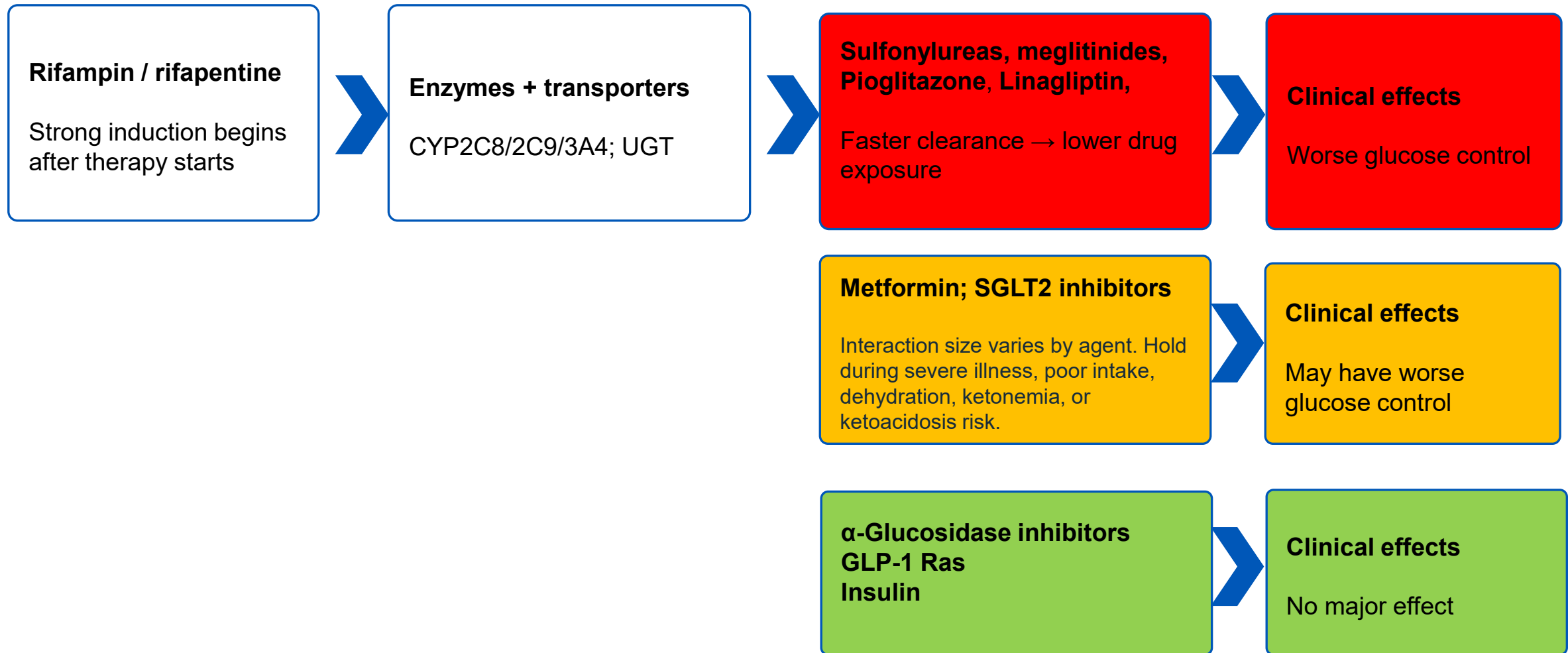
# Question 3



The 57-year-old patient is on metformin, glyburide and sitagliptin for diabetes. A1c is 10.2%. He is standard on RIPE TB therapy. The following should be considered for his medication management:

- A. Isoniazid can increase the effects of metformin, leading to a higher risk of hypoglycemia
- B. Rifampin may precipitate hyperglycemia
- C. Pyrazinamide will affect glyburide levels and lead to increased risk of hypoglycemia
- D. Rifampin will potentiate the efficacy of glyburide and cause hypoglycemia

# TB and DM medication interactions: rifamycins



# Other TB medications

## Isoniazid

- In combination with rifampicin is associated with an increased risk of **hepatotoxicity**
- May worsen glycemia, but the effect is less predictable than rifamycin enzyme induction

## Pyrazinamide

- DM patients with a higher HbA1c increased the risk of not achieving therapeutic targets for pyrazinamide, due to increased levels of **xanthine oxidase**.

## Ethambutol

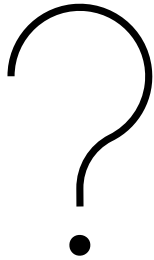
- In TB-DM patients with reduced kidney function, a **dosage decrease** is required
- **Neuritis optica** should be suspected particularly in patients with complicated diabetes

Glucose changes ← drug interactions, active infection, nutritional changes, renal/hepatic function, or all of these at once

# TB-DM other medications considerations

- Diabetes-related neuropathy often affects the enteric nervous system, leading to compromised gut motility and subsequent delayed drug absorption
- Hyperglycemia in DM can alter gut permeability through the disruption of tight junction proteins → allow increased penetration of the MTB pathogens and hinders adequate absorption of the TB medications
- Concomitant use of anti-TB and DM drugs poses a challenge in treatment adherence

# Polling Question



He is tolerating his RIPE therapy well. Now glucose 250–320 mg/dL with a variable appetite. No missed doses. Symptoms improved, but culture remains positive at 2 months of therapy.

- A. Automatically extend treatment to 9 months because he has diabetes.
- B. Stop rifampin because it is causing hyperglycemia.
- C. The diabetes is causing delayed bacteriologic response.
- D. A CT chest should be obtained for further evaluation.

# Therapeutic drug monitoring

- Days to sputum culture conversion and total treatment duration significantly shorter in TDM vs. non-TDM patients
- Patients who underwent TDM significantly more likely to achieve sputum culture conversion at 2 months ( $P = 0.007$ )
- TDM hastened microbiological cure from TB among people with DM

# TB and diabetes: Treatment response and outcomes

| Outcome and study                                                                                                                                                    | WITH DIABETES                                 | WITHOUT DIABETES                               | <ul style="list-style-type: none"><li>2019 systematic review of 104 studies.</li><li>Pooled odds ratios for diabetes vs no diabetes:<br/><br/><u>All-cause mortality:</u><br/><b>1.88</b> (95% CI 1.59-2.21)<br/><br/><u>Relapse after treatment:</u><br/><b>1.64</b> (95% CI 1.29-2.08)</li></ul> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Culture-positive sputum At 2 months</b><br><small>Taiwan, 2018; n = 1,323 with follow-up cultures<br/>Adjusted OR 1.72 (95% CI 1.25-2.38)</small>                 | <b>23.9%</b>                                  | <b>14.2%</b>                                   |                                                                                                                                                                                                                                                                                                    |
| <b>Smear-positive sputum At 2 months</b><br><small>India, 2025; n = 381 with follow-up smears<br/>p = 0.857: no statistically clear difference</small>               | <b>2.9%</b><br><small>2 / 68 patients</small> | <b>2.6%</b><br><small>8 / 313 patients</small> |                                                                                                                                                                                                                                                                                                    |
| <b>Unfavorable outcome At 12 months</b><br><small>Study 31/A5349, 2025; all 3 regimens combined<br/>Microbiologically eligible population; composite outcome</small> | <b>22.9%</b>                                  | <b>15.4%</b>                                   |                                                                                                                                                                                                                                                                                                    |

# TB and diabetes: summary

## 1 RECOGNIZE THE BURDEN

≈22%

of reported U.S. TB cases  
had diabetes in 2024

Screen both ways

## 2 EXPECT A MORE SEVERE PHENOTYPE

CXR

More cavitation  
and greater radiographic  
extent

Poor glycemic control tracks  
with higher cavitation.

## 3 INTERPRET TESTS IN CONTEXT

TST / IGRA  
NEGATIVE

A negative immune-based test  
does not exclude active TB

Let symptoms, imaging, and  
microbiology drive the  
evaluation.

## 4 TREAT AND MONITOR

TB

DM

- Anticipate rifamycin interactions
- Track glucose
- Monitor drug levels
- Monitor bacteriology
- Reassess at transitions and after cure

Coordinated care plan

# Questions and Answers





Thank you