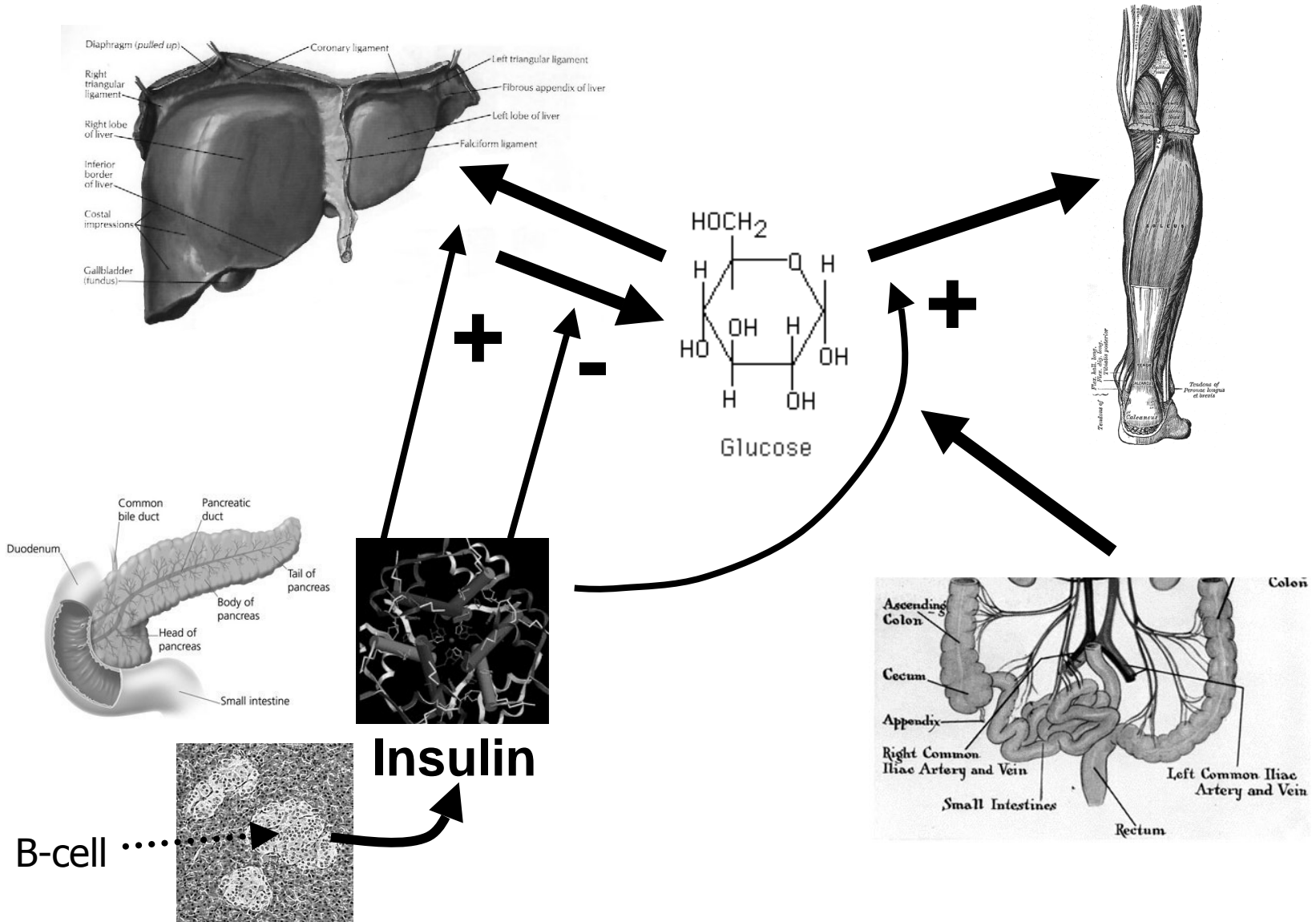


# On the Formalisation of the Diabetes Type 2 Guideline

- Diabetes mellitus type 2
- General practitioner's guideline
- ASBRU-like representation
- Logical formalisation of treatment selection

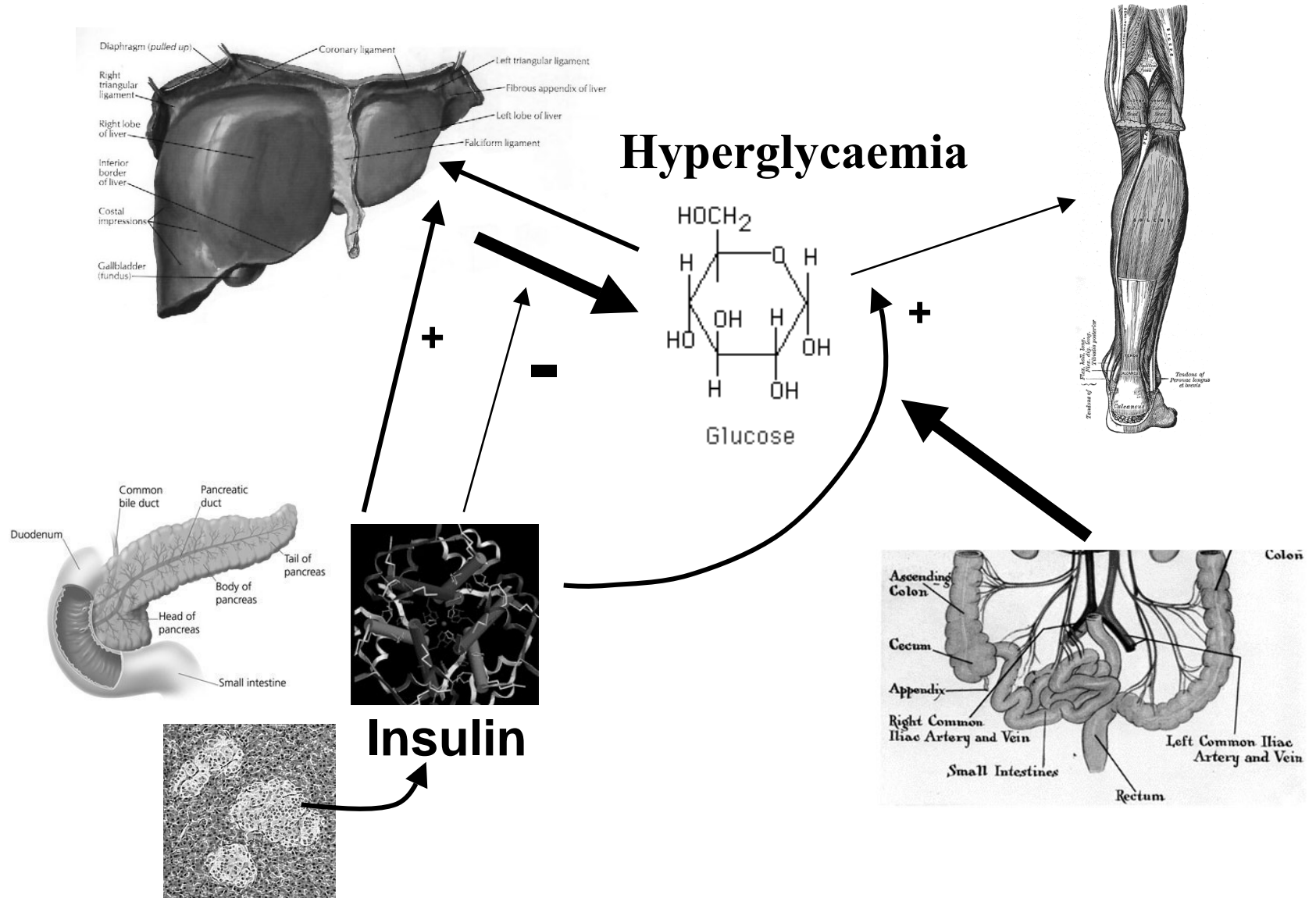
# Glucose Metabolism (Normal)

Protocol



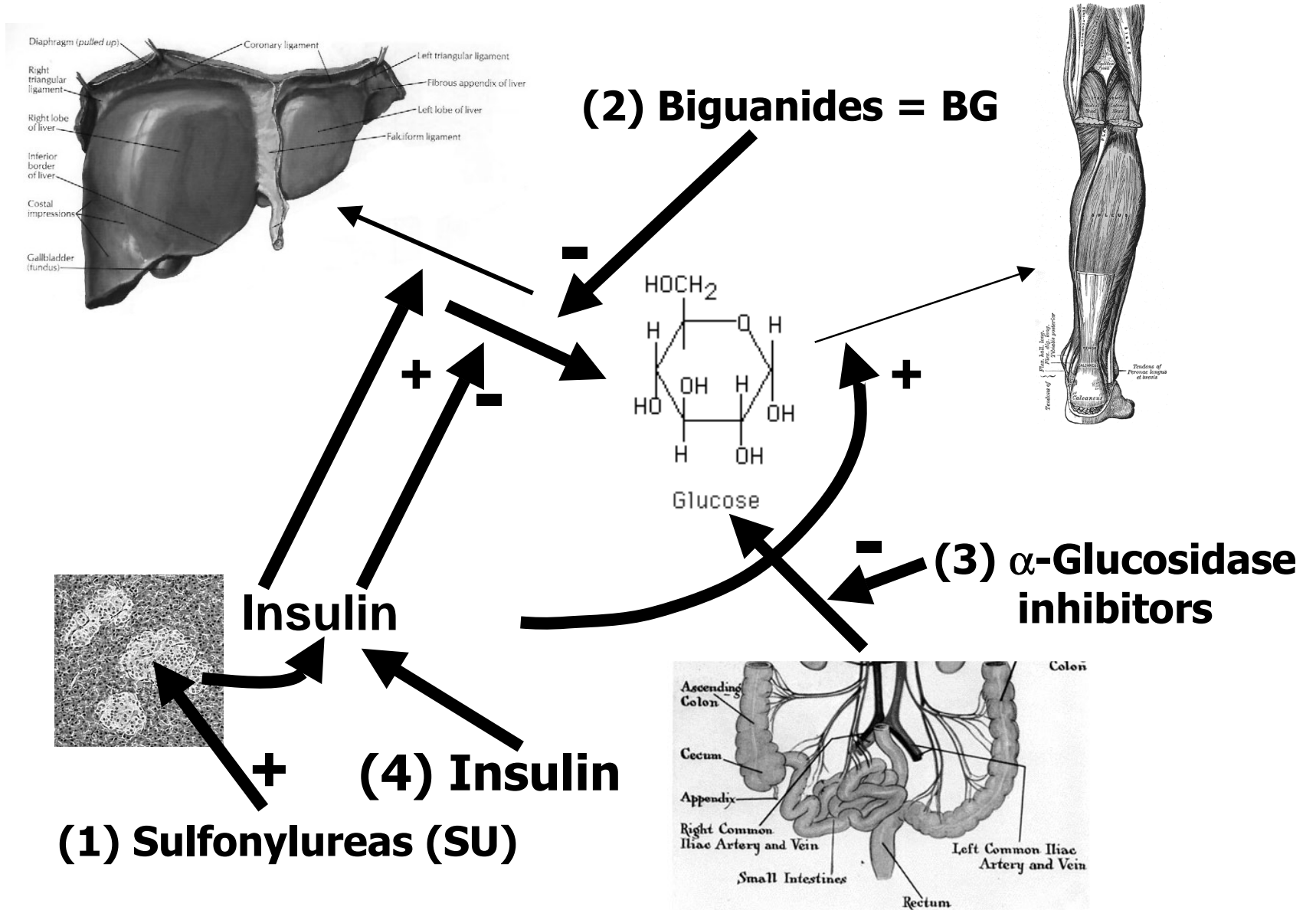
# Glucose Metabolism (DM-2)

Protocol



# DM2 Treatment

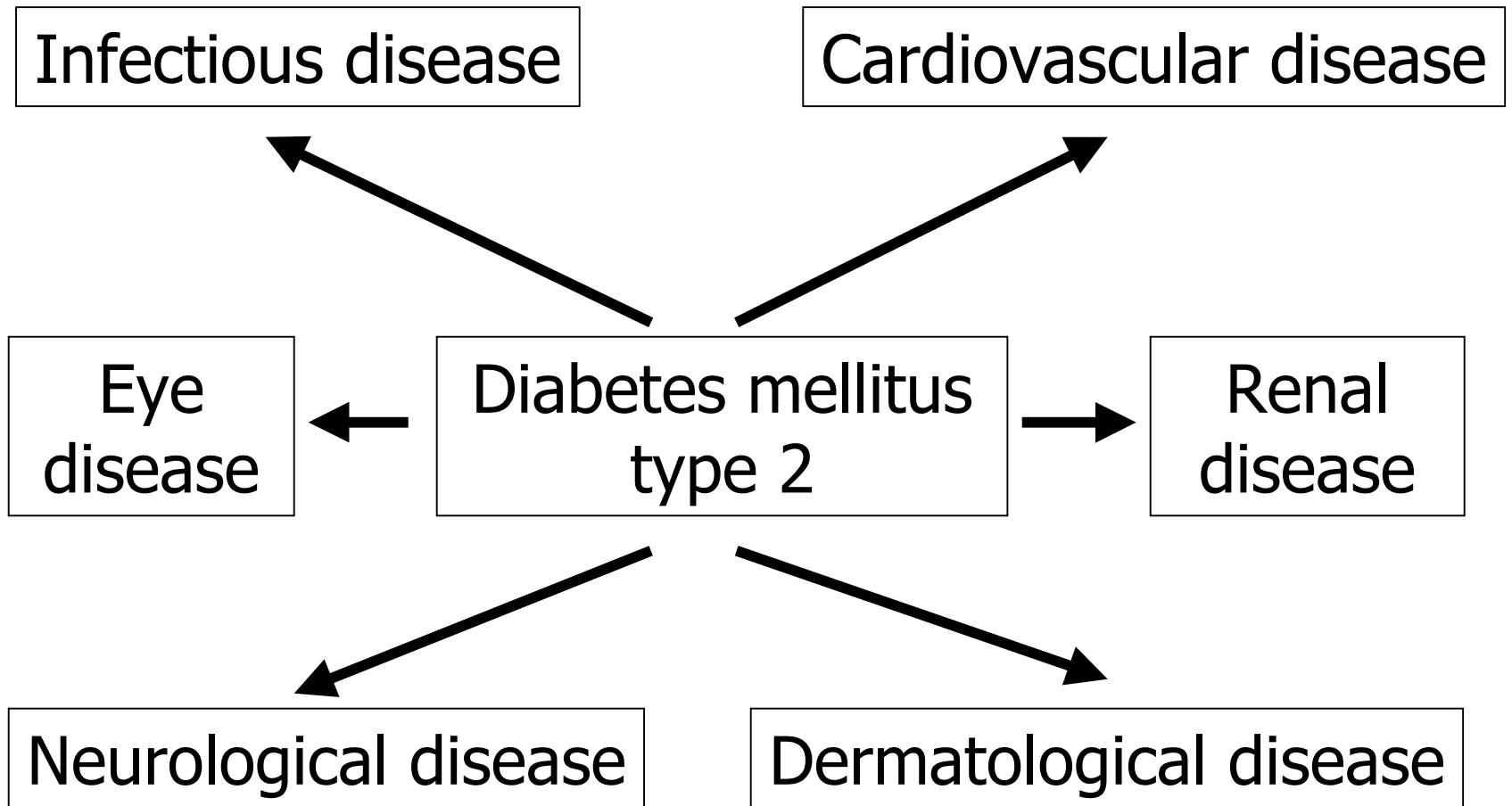
Protocolone



## NHG Guideline

- Step 1: diet therapy
- Step 2: if quetelet index (QI)  $\leq 27$  prescribe a sulfonurea drug, otherwise prescribe a biguanide drug
- Step 3: combine a sulfonylurea and a biguanide drug (change one of those by an  $\alpha$ -glucosidase inhibitor if side-effects occur)
- Step 4: one of the following:
  - Oral antidiabetics and insulin
  - Only insulin

# Associated and Related Disease



# ASBRU Plan

**plan** SU-derivative-or-metformin  
**intentions**

**avoid intermediate-state:**

(or (gastrointestinal-side-effect = true)

(and (hypoglycemia = true) (weight-gain = true)))

**conditions**

**filter-precondition:** (glucose-monitoring = bad)

**plan-body** type = sequentially

**wait-for all**

DMT2-treatment  $\leftarrow$  antidiabetics

**if** (quetelet-index  $\leq$  27) **then**

**ask** drug-name; **put-last**(drug-name, antidiabetics)

**else put-last**(metformin, antidiabetics)

antidiabetic-doses  $\leftarrow$  Initialise-drug-doses( ... )

antidiabetic-doses  $\leftarrow$  Find-antidiabetic-doses( ... )

# Rational Treatment Selection

- Drug's *mode of action*:

$d$  (drug)  $\rightarrow$   $(m_1 \wedge \dots \wedge m_n)$  (actions)

- Achieving *intentions*, taking into account requirements and patient conditions:

$(m_i \wedge \dots \wedge m_k \wedge \text{cond} \wedge \text{req}) \rightarrow \text{intention}$

- Treatment  $\mathbf{T} \subseteq \{d_1, \dots, d_m\}$  such that:

- $\mathbf{T} \cup \mathbf{C} \cup \mathbf{R} \models \text{intention}$
- $\mathbf{T}$  is subset minimal (Occam's razor), with least preferable drugs(treatment) omitted if possible

# Treatment Simplified: DM2T

Drug(insulin)  $\rightarrow$  (uptake(liver,glucose) = up  $\wedge$   
uptake(peripheral-tissues,glucose) = up)  
uptake(liver,glucose) = up  $\rightarrow$  release(liver,glucose) = down  
(Drug(SU)  $\wedge$   $\neg$ capacity(B-cells,insulin) = exhausted)  $\rightarrow$   
secretion(B-cells,insulin) = up  
Drug(BG)  $\rightarrow$  release(liver,glucose) = down

---

(secretion(B-cells,insulin) = up  $\wedge$   
capacity(B-cells,insulin) = subnormal  $\wedge$   
QI  $\leq$  27  $\wedge$  Condition(hyperglycaemia))  
 $\rightarrow$  Condition(normoglycaemia)

(release(liver,glucose) = down  $\wedge$   
capacity(B-cells,insulin) = subnormal  $\wedge$  QI  $>$  27  $\wedge$   
Condition(hyperglycaemia))  
 $\rightarrow$  Condition(normoglycaemia)

((release(liver,glucose) = down  $\vee$   
uptake(peripheral-tissues,glucose) = up)  $\wedge$   
capacity(B-cells,insulin) = nearly-exhausted  $\wedge$   
secretion(B-cells,insulin) = up  $\wedge$   
Condition(hyperglycaemia))  
→ Condition(normoglycaemia)

(uptake(liver,glucose) = up  $\wedge$   
uptake(peripheral-tissues,glucose) = up  $\wedge$   
capacity(B-cells,insulin) = exhausted  $\wedge$   
Condition(hyperglycaemia))  
→ Condition(normoglycaemia)

## Example Treatments

- $DM2T \cup \mathbf{T} \cup \{\text{capacity}(\text{B-cells,insulin}) = \text{nearly-exhausted}\} \cup \{\text{Condition}(\text{hyperglycaemia})\} \models \text{Condition}(\text{normoglycaemia})$ 
  - $\mathbf{T} = \{\text{Drug}(\text{SU}), \text{Drug}(\text{BG})\}$  satisfies the minimality and preference conditions
  
- $DM2T \cup \mathbf{T} \cup \{\text{capacity}(\text{B-cells,insulin}) = \text{exhausted}\} \cup \{\text{Condition}(\text{hyperglycaemia})\} \models \text{Condition}(\text{normoglycaemia})$ 
  - $\mathbf{T} = \{\text{Drug}(\text{SU}), \text{Drug}(\text{BG}), \text{Drug}(\text{insulin})\}$  is suggested by the guideline (SU is redundant)

## Conclusions

- Treatment intentions were only partially covered in the diabetes mellitus type 2 guideline
- Much of the required information was available in the guideline's background text (but not all)
- Proving that a guideline satisfies a particular rationale of medical management is not easy