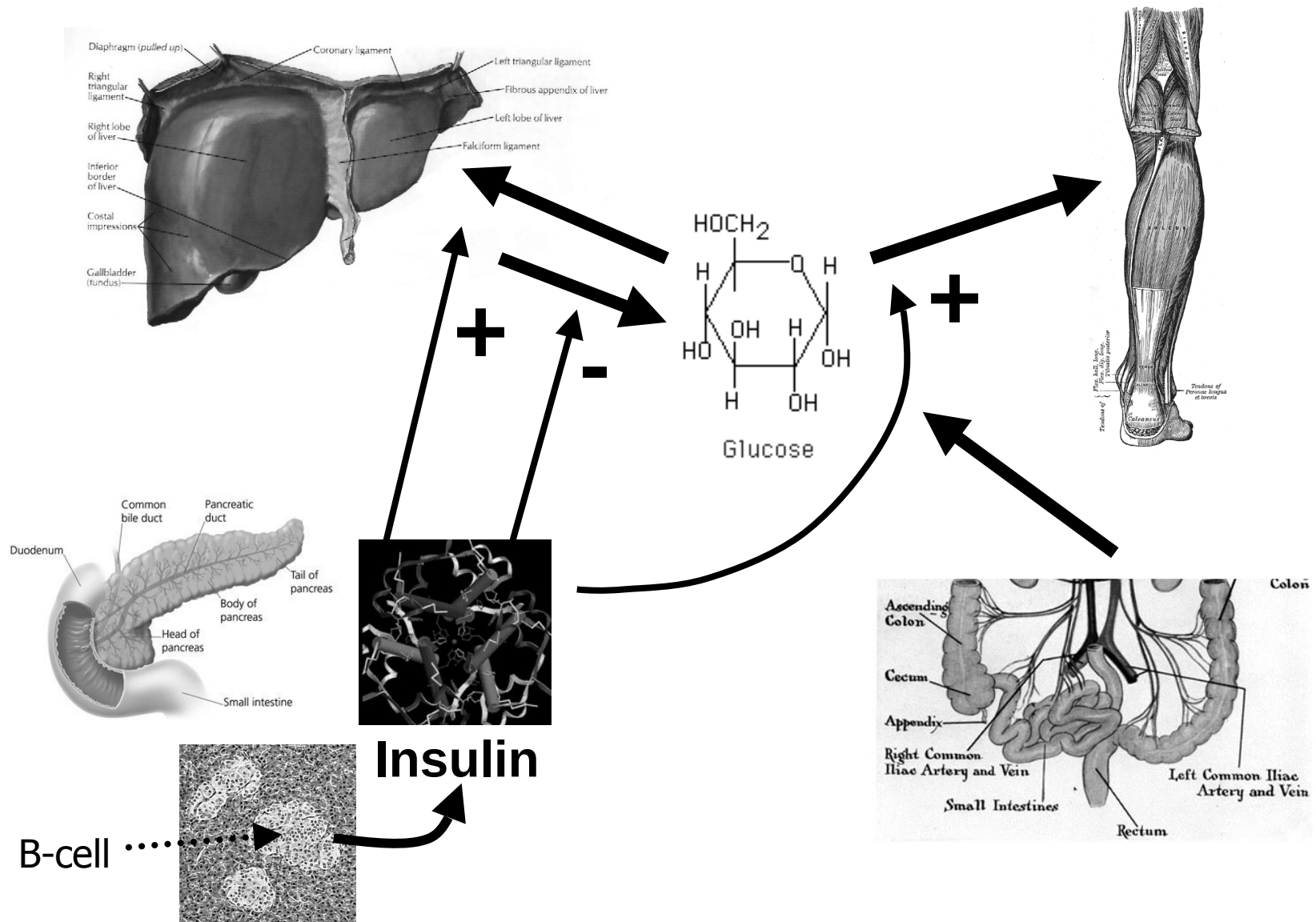


On the Formalisation of the Diabetes Type 2 Guideline

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

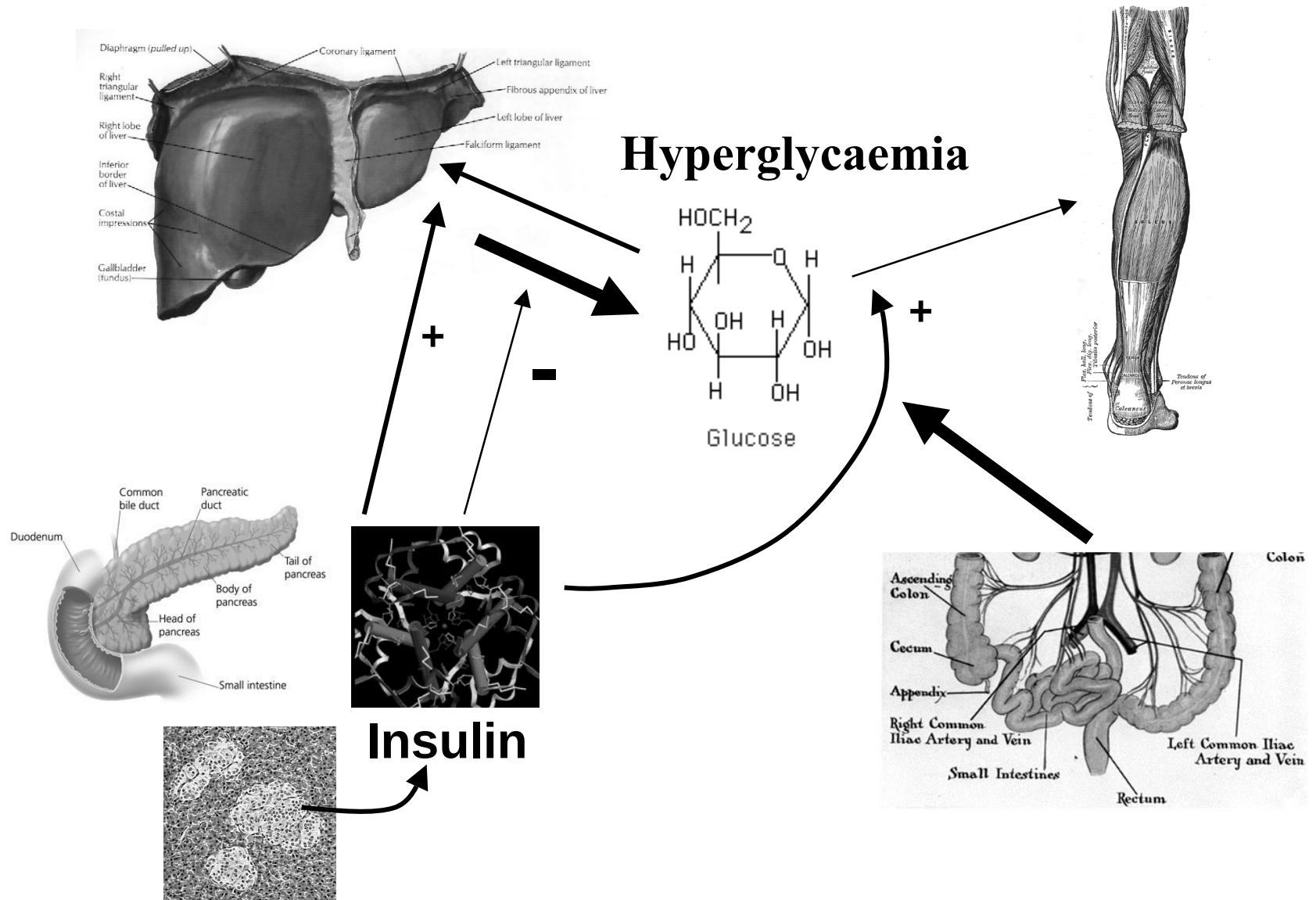
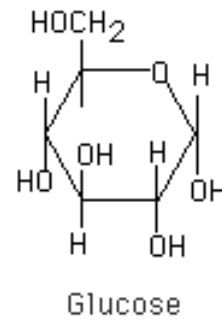
Glucose Metabolism (Normal)

Protocol



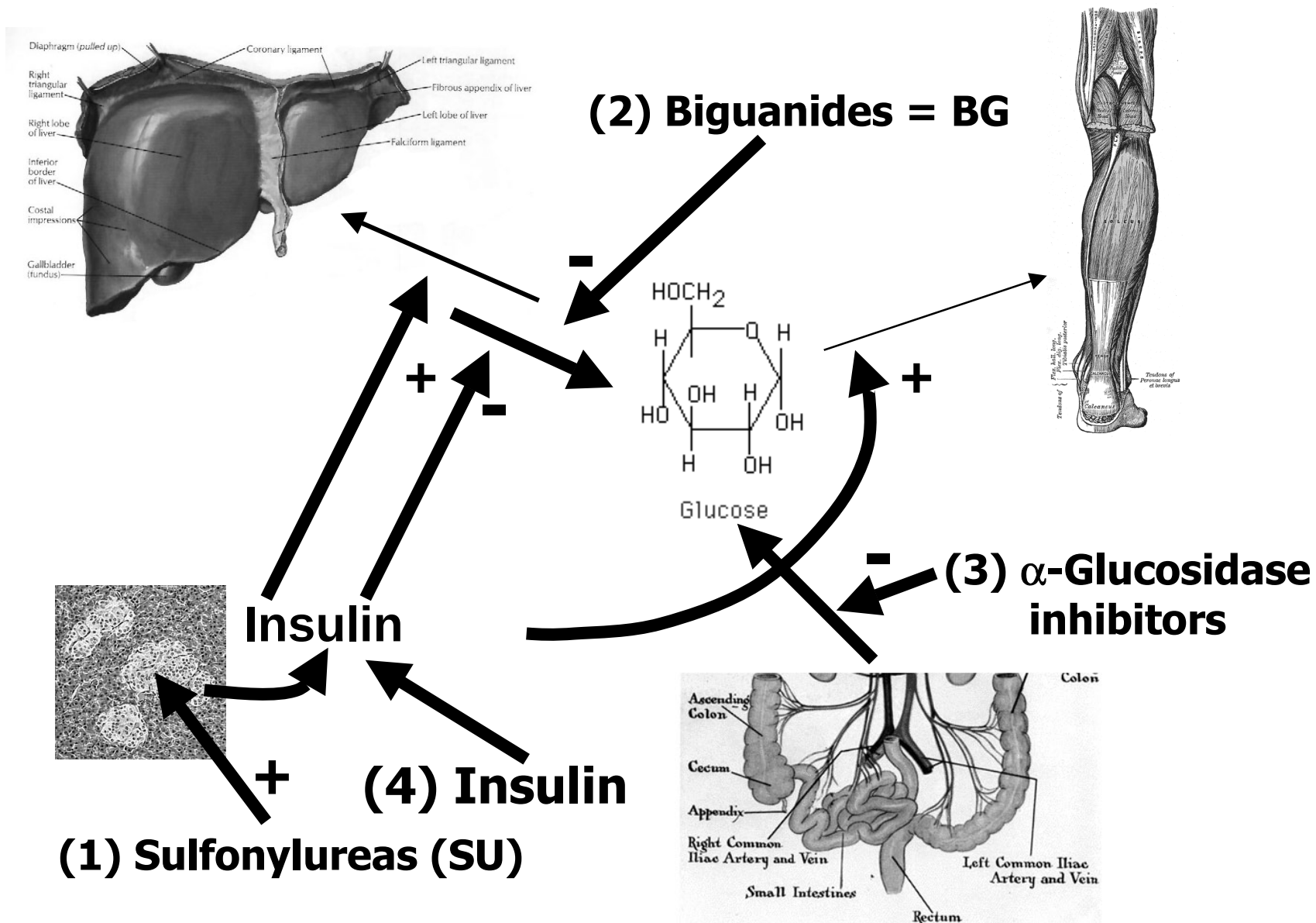
Glucose Metabolism (DM-2)

Hyperglycaemia



DM2 Treatment

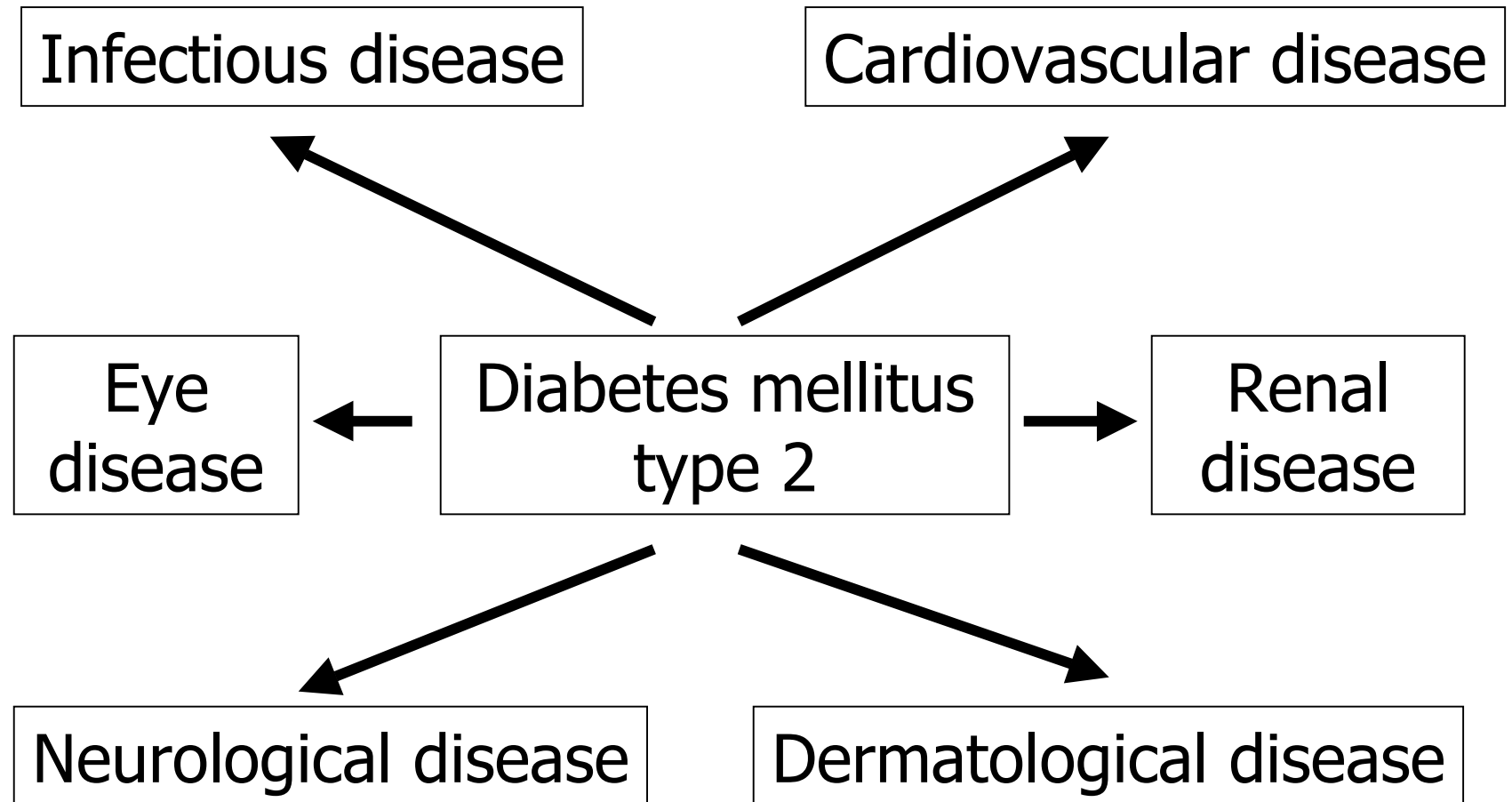
Protocol



NHG Guideline

- Step 1: diet therapy
- Step 2: if quetelet index (QI) ≤ 27 prescribe a sulfonulurea drug, otherwise prescribe a biguanide drug
- Step 3: combine a sulfonylurea and a biguanide drug (change one of those by an α -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*:

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

- 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)

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

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

Example Treatments

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

- $DM2T \cup \mathbf{T} \cup \{\text{capacity}(\text{B-cells}, \text{insulin}) = \text{exhausted}\} \cup \{\text{Condition}(\text{hyperglycaemia})\} \models \text{Condition}(\text{normoglycaemia})$
 - $\mathbf{T} = \{\text{Drug}(\text{SU}), \text{Drug}(\text{BG}), \text{Drug}(\text{insulin})\}$ 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