SNOMED DK drug terminology and Decision Support Services

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Medication Decision Support - why ?

- **Difficult to get an overview of all relevant information**
  - large amounts of data available about patients and drugs:

    physiological data, investigations, lab data, disease- and treatment data, guidelines, SPC's, internet site, interaction databases, commercial databases, terminologies and classifications etc..

  - polypharmacy – 10 drugs prescribed at the same time doesn't make it easier
  - many different, generics and analogical, drugs on the market

- **A busy clinic:**
  – Lack of time for in-depth investigation of drug side effects, interactions, allergies, contraindications, etc.
  – Lack of time for in-depth investigation of interaction between drugs and the patients physiology, diseases, foods, etc.

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# Decision Support System: base and module components

BASE

- Structured SNOMED DK terminology
- Decision support engine
- Physicians preferences DB
- Mapping table
- Webservices
- Common Drug Database – central medication service
- National Service Platform infrastructure

MODULES

- Allergy register
- Allergy check
- Interaction DB
- MaxDose DB
- Risk situation DB
- Cross allergy
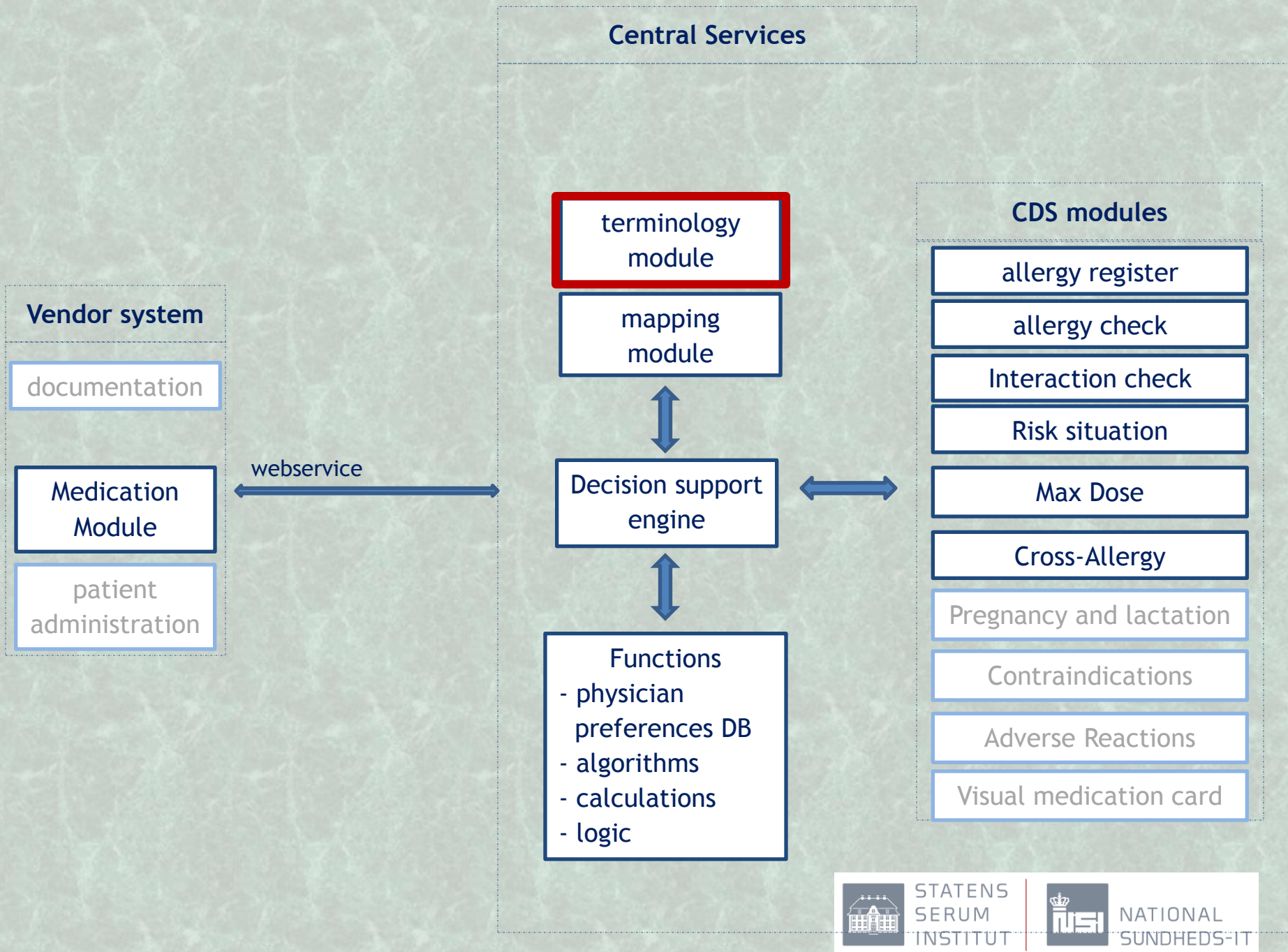
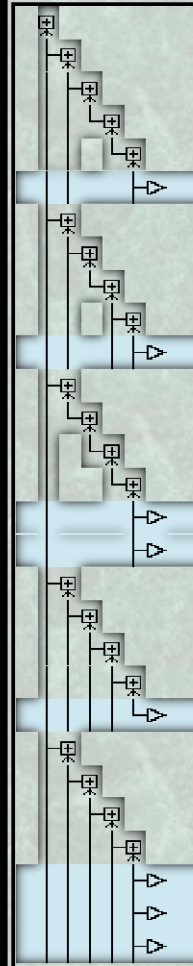# Is there a <u>local</u> terminology we can use ?

- **Medicin Price (Taksten)**

    – Contains a product ID (DrugID)
    – Published by National Board of Health
    – Covers many other things than substances and drugs
    – Doesn't covers al drugs on the Danish market
    – Meant for prices and stockhandling
    – 32 data tablets – no attribute relationships
    – Combination drugs strengths give problems doing calculation
    – No substance ID
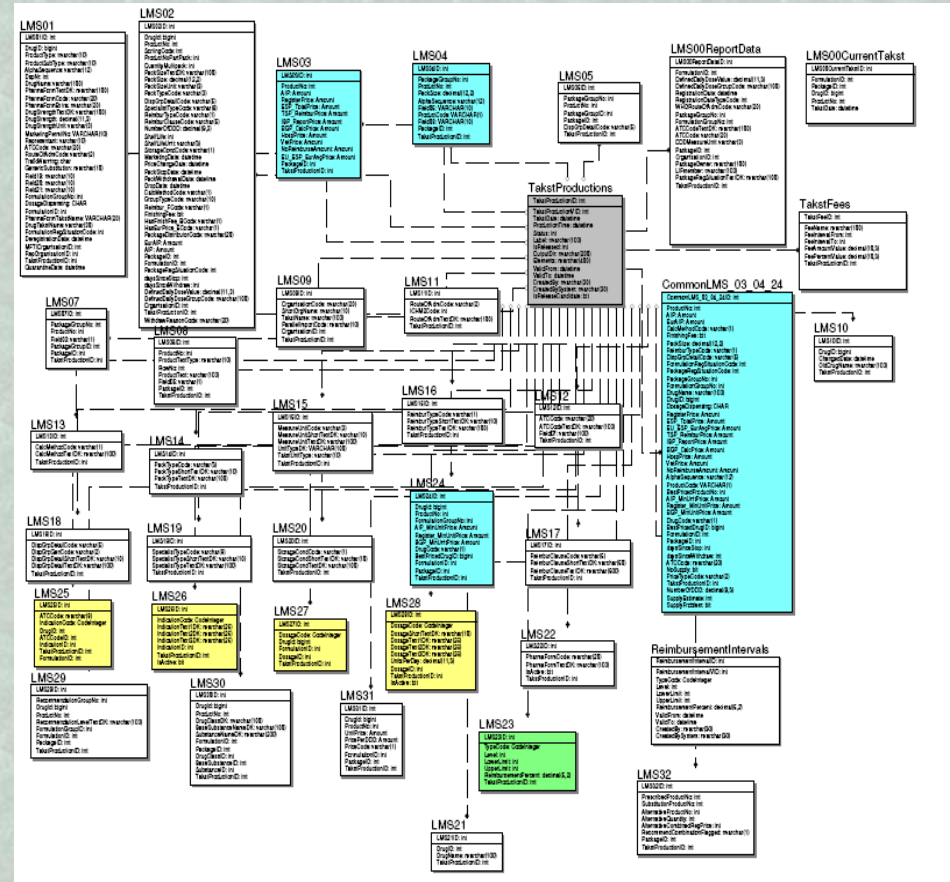
Is there an <u>international</u> terminology we can use ?

- ATC:

  – Published by WHO
  – Covers only substances in 5 levels
  – Made for statistics on drug comsumption in terapeutic areas
  – mono-hierarchical classification
  – substances can be represented many places in the ATC hierarchy
  – Its necessary to know indication/diagnosis to know which ATC code to use
  – Many combination drugs can't be properly identified
  – Drug can have different ATC codes in different countries

Lægemiddelstofklassifikation ATC	M
Fordøjelsesorganer og stofskifte	MA
midler mod sygdomme i mundhulen	MA01
stomatologica	MA01A
andre midler til lokal behandling i mundhulen	MA01AD
acetylsalicylsyre	MA01AD05
Blod og bloddannende organer	MB
antithrombosemidler	MB01
antithrombosemidler	MB01A
blodplade-aggregationshæmmere excl. heparin	MB01AC
acetylsalicylsyre	MB01AC06
cardiovaskulære system	MC
lipid-modificerende midler	MC10
lipid-modificerende midler, komb.	MC10B
hmg coa reductase-inhibitorer, andre kombinationer	MC10BX
simvastatin og acetylsalicylsyre	MC10BX01
pravastatin og acetylsalicylsyre	MC10BX02
musculo-skeletal system	MM
antiinflammatoriske og antirheumatiske midler	MM01
antiinflammatoriske/antirheumatiske midler i komb.	MM01B
antiinflam./antirheum. midler i komb. m. corticosteroider	MM01BA
acetylsalicylsyre og corticosteroider	MM01BA03
nervesystemet	MN
analgetica	MN02
andre analgetica og antipyretica	MN02B
salicylsyre-derivater	MN02BA
acetylsalicylsyre	MN02BA01 [$]
acetylsalicylsyre, komb. excl. psycholeptica	MN02BA51 [$]
acetylsalicylsyre, komb. med psycholeptica	MN02BA71 [$]

Why should Denmark have a new drug terminology ?

- Problems with combination drugs in ATC

- Same substance can be found several places in ATC

- Different ATC codes in different countries

...so how about SNOMED ?

- Problems with combination drugs strengths in DrugID

- DrugID is local

- No substance ID in DrugID

- No built in knowledge in attributes in DrugID

- A structured terminologi is required to have better handling of CDS

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A few good reasons to choose SNOMED C T

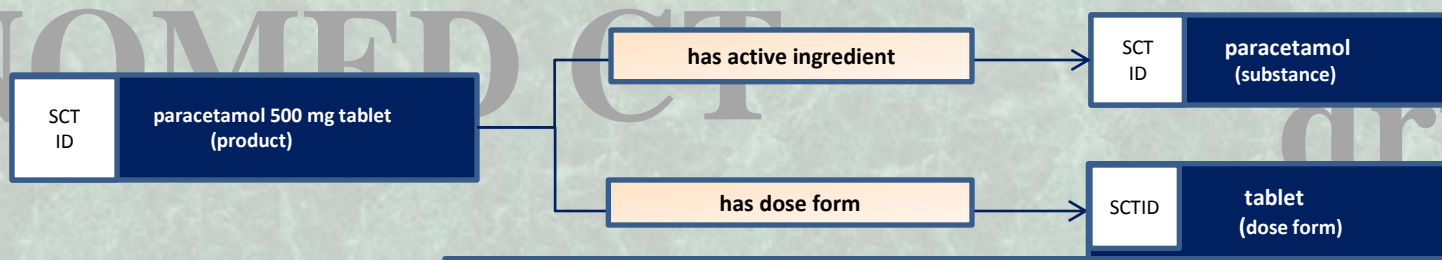- **structured**
- ~~unique ID's~~

...so how do we create a SNOMED CT based Danish terminology

- **customisable**

...but first a small lesson in drug terminology – SNOMED style

- **accessable - workbench**
- **standardiset**

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SNOMED CT drugs

Current hierarchies

paracetamol 500 mg tablet (product) — has active ingredient → paracetamol (substance)

paracetamol 500 mg tablet (product) — has dose form → tablet (dose form)

1. hierarchy:

pharmaceutical/biological product

fx: "paracetamol 500 mg tablet (product)"

attributes:

paracetamol 500 mg tablet (product) *has active ingredient* paracetamol (substance)

paracetamol 500 mg tablet (product) *has dose form* tablet (qualifyer)

2. hierarchy:

substances

fx: "paracetamol (substance)"

attributes :

paracetamol 500 mg tablet (product) *has active ingredient* paracetamol (substance)

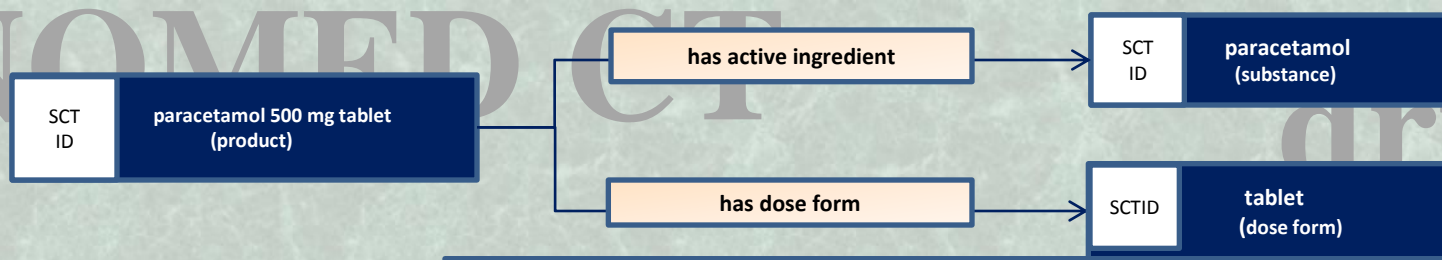paracetamol allergy (disorder) *has causative agent* paracetamol (substance)

3. hierarchy:

qualfyer

fx: "tablet (qualifyer)"

attributes :

paracetamol 500 mg tablet (product) *has dose form* tablet (qualifyer)

Future hierarchies

4. Hierarchy

strength

fx: "500 (strength)"

attributes:

paracetamol 500 mg tablet (product) *has strength* 500 (strength)

…so back to how to create a SNOMED CT based Danish terminology

measurement unit

fx: "mg (measurement unit)"

6. Hierarchy

ATC-code

fx: "N02AA59 (ATC code)"

Base component: SNOMED DK drug terminology

Part **1** One : Data extraction and cleaning

Danish Medicines Database

DrugID; trade name; substances,
dose form, strengths, ATC code

Data sheet

	A	B	C	D	E	F	H	I
1	DrugID	BegrebsID	Kommentarer	Skal oprettes i SNOMED (sæt kryds)	Salgsnavn	Form	Styrke 1 (numerisk)	Styrke 1, enhed
6169	28103379402				Pangaba	kapsler, hårde	400	mg
6170	28100173055				Pankreatin "Recip"	enterogranulat	0	Ph.Eur. enheder
6171	28100636073				Panodil	filmovertrukne tabletter	500	mg
6172	28101041380				Panodil	suppositorier	500	mg
6173	28101279286				Panodil	suppositorier	1000	mg
6174	28101674394				Panodil	filmovertrukne tabletter	1000	mg
6175	28100907676				Panodil Brus	brusetabletter	500	mg
6176	28101594294				Panodil Hot	pulver til oral opløsning, breve	500	mg
6177	28100902976				Panodil Junior	oral suspension	24	mg
6178	28101041280				Panodil Junior	suppositorier	125	mg
6179	28101143688				Panodil Junior	suppositorier	250	mg

Base component: SNOMED DK drug terminology

Part **2** Two : Mapping

data sheet with drug information from the Danish Medicines Agency DB

Automated procedure
- finds 100% matches
- suggestions on possible matches
- suggestion on missing concepts in SNOMED CT

SNOMED CT database

Base component: SNOMED DK drug terminology

Part 3 three: SNOMED DK creation

Enhanced data sheet …now with SNOMED ID's

Script

Using the found concept ID as a super concept with IS_A relation

let me illustrate

Adding concept ID's, attribute relationships, trade name, substances, strengths, dose form, measurement unit, ATC code

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Base component: SNOMED DK drug terminology

Part 3 three: SNOMED DK creation

SNOMED CT

| SCTID | oral form paracetamol (product) |

is a

| SCT ID | paracetamol 500 mg tablet (product) |

has active ingredient → | SCTID | paracetamol (substance) |

has dose form → | SCT ID | tablet (qualifier value) |
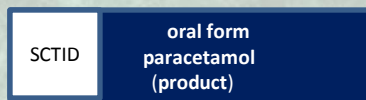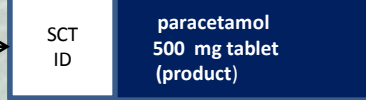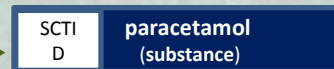
let me show you a combination trade name product...

| DK ID | Pamol 500 mg tablet (product) |

| DK ID | Panodil 500 mg tablet (product) |
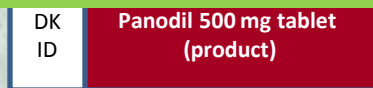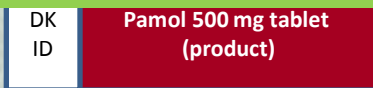
map

create

SNOMED DK drug terminology

| Drug ID | Pamol 500 mg tablet |

| Drug ID | Panodil 500 mg tablet |

Danish Medicines Agency DB

| Panodil |
| tablet | paracetamol | 500 |

extract

| Pamol |
| tablet | paracetamol | 500 |
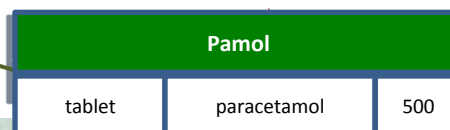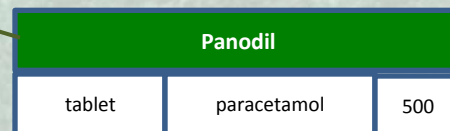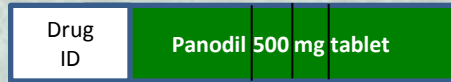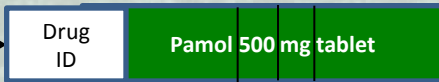
Base component: SNOMED DK drug terminology

Trade name combination product finished

SNOMED CT

SCT ID	paracetamol 500 mg + codeine 30 mg tablet (product)

has active ingredient → SCT ID | paracetamol (substance)

has activ ingredient → SCT ID | codeine (substance)

has dose form → SCTID | tablet (dose form)

is a

DK ID	Kodipar tablet (product)

has active ingredient → SCT ID | paracetamol (substance)

has strength → DK ID | 500 (strength)

has active ingredient → SCT ID | codeine (substance)

has strength → DK ID | 30 (strength)

has dose form → SCTID | tablet (dose form)

has measurement unit → SCT ID | mg (qualifyer)

has ATC code → DK ID | N02AA59 (ATC code)

SNOMED DK drug terminology

Decision support component: Allergy register

What information should an allergy register contain ?

Sources: Report, HL7, OpenEHR archetypes...

Expert groups and the medical societies will discuss it

Content   ...so how will it work

- Allergy   SNOMED coded name
- Reaction type   SNOMED or MeDRA
- Frequency   SNOMED coded qualifyer
- Severity   SNOMED coded qualifyer
- Verification   SNOMED coded qualifyer ?

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Decision support component: Allergy register

Fulde navn
John doe

✔ Gem!

Advarsel	Allergi	Reaktion	Alvorlighedsgrad	Reaktionshyppighed	Verifikationsmåde		
⚠	allergi over for NSAID	Hoste	Livstruende	Lejlighedsvis	Priktest	☑	🗑
⚠	allergi over for paracetamol	Udslæt	Harmful	Hyppig	Patient-oplyst	☑	🗑
	allergi over for bredspektrede penicilliner	Hoste	Harmful	Lejlighedsvis	Blodprøve	☑	🗑
⚠		Udslæt	Generende	Hyppig	Patient-oplyst	☑	🗑

➕ Ny registrering

| Cloxacillin | 🔍 Søg |

☑ ⚠ Advarsel

⊖ allergi over for antibakterielt lægemiddel
  ⊖ allergi over for penicillin
    ⊖ allergi over for penicillinaseresistente penicilliner
      allergi over for cloxacillin
      allergi over for flucloxacillin
      allergi over for methicillin

Reaktion

| Udslæt | ▼ |

Alvorlighedsgrad

| Generende | ▼ |

Reaktionshyppighed

| Hyppig | ▼ |

Verifikationsmåde

| Patient-oplyst | ▼ |

X

Allergy register demo
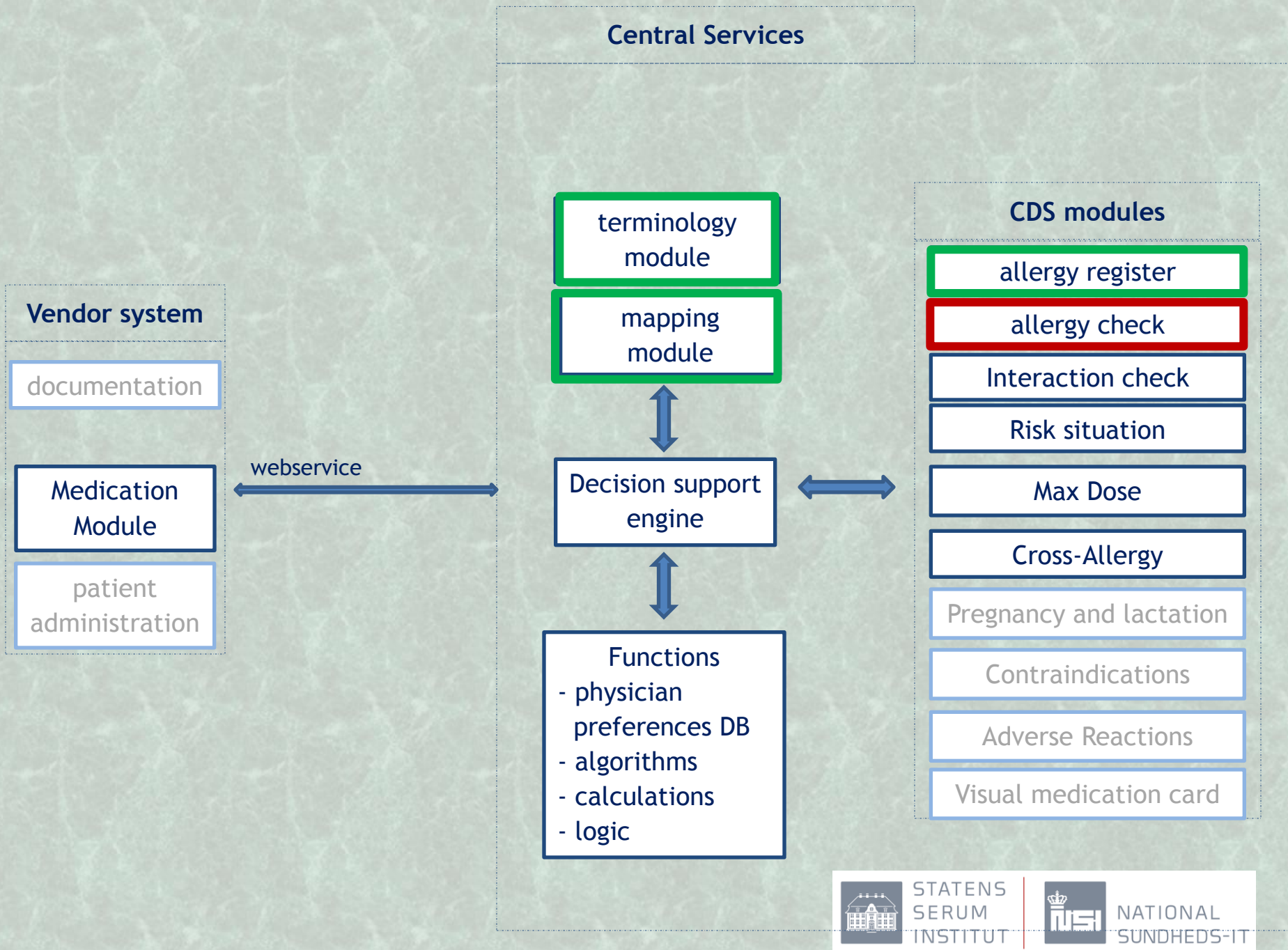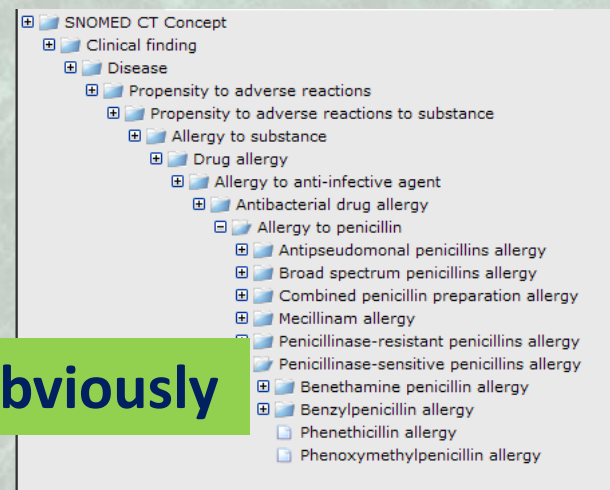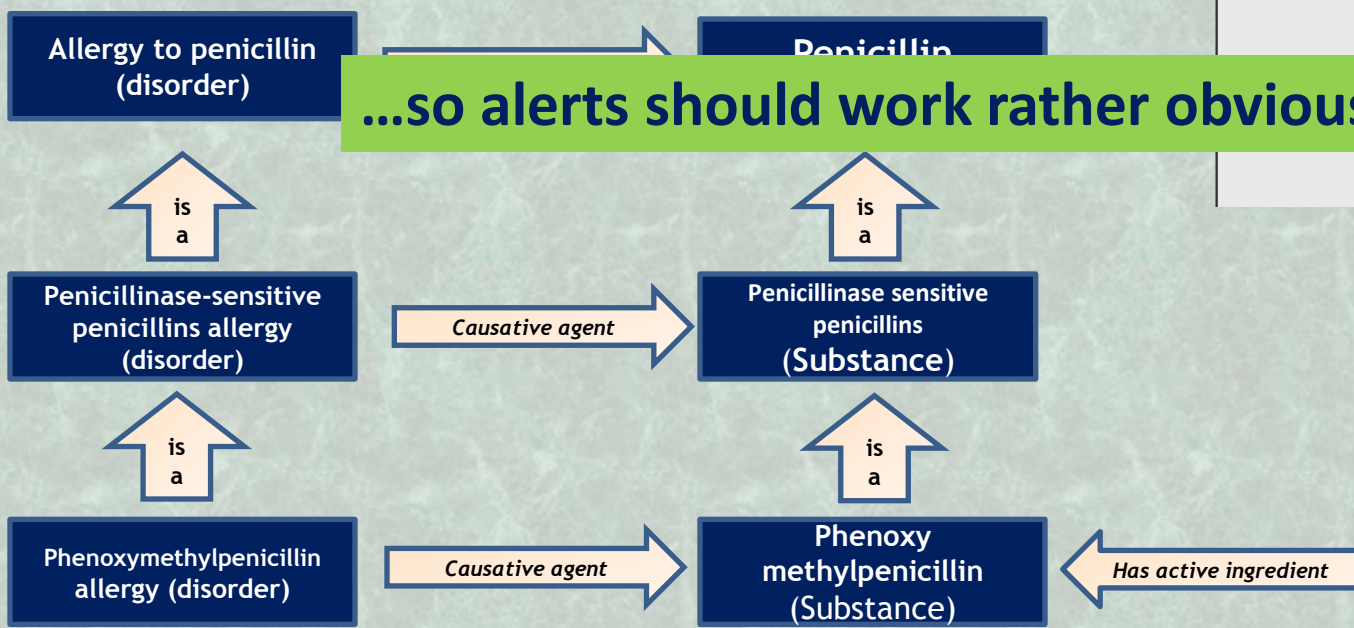
SNOMED CT allergy structure

- 1472 concepts reading "[substance] allergy"
- attribute: *"causative agent" pointing to* [substance]

- can easily be made into a subset

SNOMED CT Concept
- Clinical finding
  - Disease
    - Propensity to adverse reactions
      - Propensity to adverse reactions to substance
        - Allergy to substance
          - Drug allergy
            - Allergy to anti-infective agent
              - Antibacterial drug allergy
                - Allergy to penicillin
                  - Antipseudomonal penicillins allergy
                  - Broad spectrum penicillins allergy
                  - Combined penicillin preparation allergy
                  - Mecillinam allergy
                  - Penicillinase-resistant penicillins allergy
                  - Penicillinase-sensitive penicillins allergy
                  - Benethamine penicillin allergy
                  - Benzylpenicillin allergy
                  - Phenethicillin allergy
                  - Phenoxymethylpenicillin allergy

SNOMED CT

Allergy to penicillin (disorder) → **Penicillin**

...so alerts should work rather obviously

is a

Penicillinase-sensitive penicillins allergy (disorder) — *Causative agent* → **Penicillinase sensitive penicillins (Substance)**

is a

is a

Phenoxymethylpenicillin allergy (disorder) — *Causative agent* → **Phenoxy methylpenicillin (Substance)** ← *Has active ingredient* — **Pen-V 500 mg tablet (product)**

SNOMED DK

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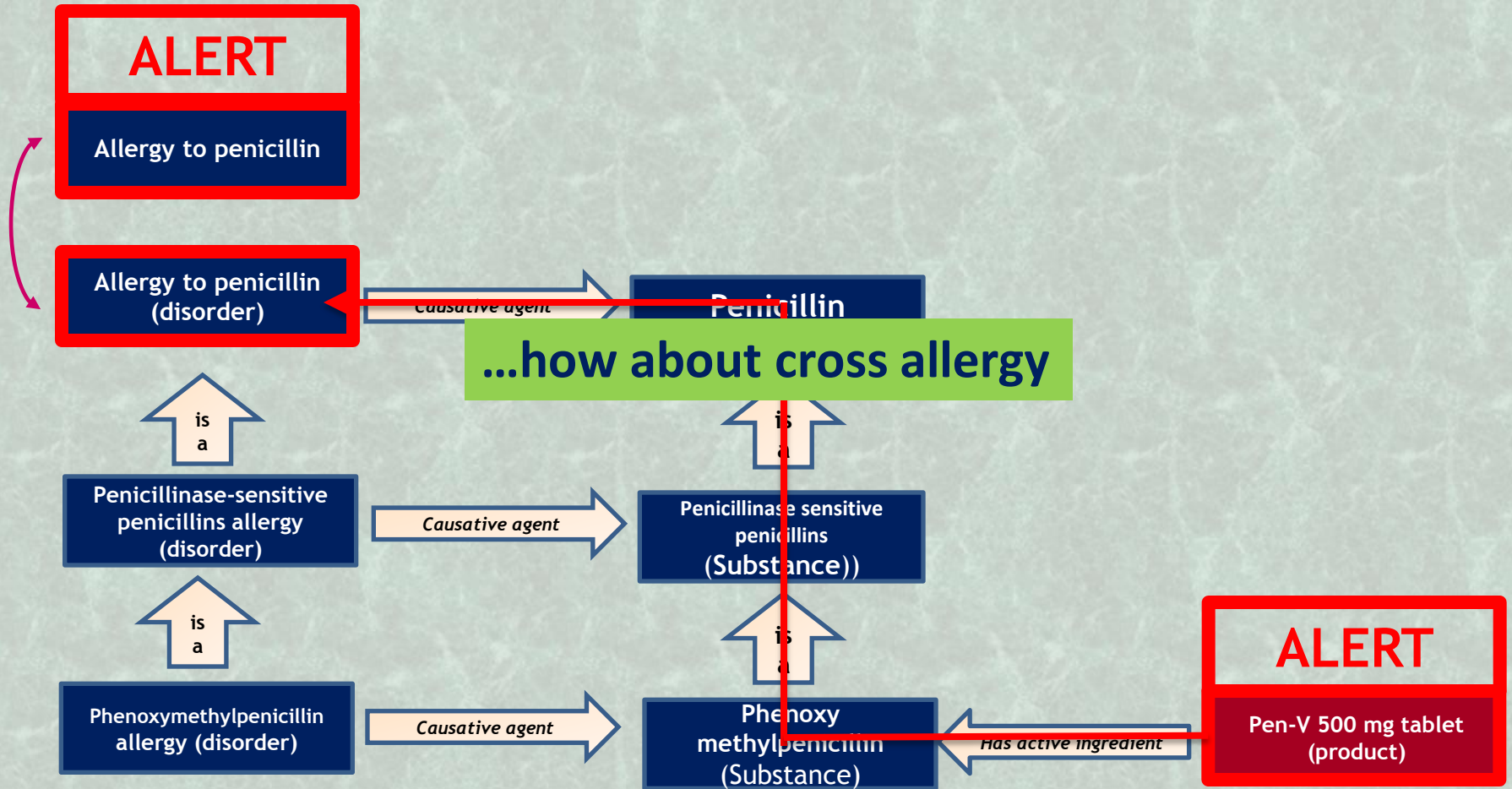
Stofnr_ A	Indholdsstof _A	ATC_A	Stofnr_B	Indholdsstof _B	ATC_B	Refer encer	Gruppe navn	Gruppetekst_kun_til_ A	Gruppetekst _A_og_B_Advarsel	Gruppetekst _A_og_B_Rek ommandation	Stofspecifik_tekst_in kl_evt_testmetode
169	benzylpenicillin (G-penicillin)	J01CE01	2145	meropenem	J01DH02	1411, 1412, 1413	penicillin	Betalactamantibiotika bør generelt undgås ved svær overfølsomhed for #A. Ved mindre alvorlige reaktioner, hvor type 1-allergi for #A mistænkes, kan måling af specifikt IgE, prik- og intradermaltest med andet betalactamantibiotika være vejledende (specialistopgave). Er disse negative, kan	Ved overfølsomhed for #A, bør #B sædvanligvis undgås.	Betalactamantibiotika bør generelt undgås ved svær overfølsomhed for #A. Ved mindre alvorlige reaktioner, hvor type 1-allergi for #A mistænkes, kan prik- og intradermaltest med #B være vejledende (specialistopgave). Er	#B har været givet til en større gruppe med anafylaktiske eller ikke-anafylaktiske reaktioner på #A uden problemer.
836	phenoxymethylpenicillin (V penicillin)	J01CE02	2145	meropenem	J01DH02	1411, 1412, 1413	penicillin	Betalactamantibiotika bør generelt undgås ved svær overfølsomhed for #A. Ved mindre alvorlige reaktioner, hvor type 1-allergi for #A mistænkes, kan måling af specifikt IgE, prik- og intradermaltest med andet betalactamantibiotika være vejledende (specialistopgave). Er disse negative, kan behandling med dette stof	Ved overfølsomhed for #A, bør #B sædvanligvis undgås.	Betalactamantibiotika bør generelt undgås ved svær overfølsomhed for #A. Ved mindre alvorlige reaktioner, hvor type 1-allergi for #A mistænkes, kan prik- og intradermaltest med #B være vejledende (specialistopgave). Er disse negative, kan	#B har været givet til en større gruppe med anafylaktiske eller ikke-anafylaktiske reaktioner på #A
125	ampicillin	J01CA01	2145	meropenem	J01DH02	1411, 1412, 1413	penicillin	Betalactamantibiotika bør generelt undgås ved svær overfølsomhed for #A. Ved mindre alvorlige reaktioner, hvor type 1-allergi for #A mistænkes, kan måling af specifikt IgE, prik- og intradermaltest med andet betalactamantibiotika være vejledende (specialistopgave). Er disse negative, kan behandling med dette stof	Ved overfølsomhed for #A, bør #B sædvanligvis undgås.	Betalactamantibiotika bør generelt undgås ved svær overfølsomhed for #A. Ved mindre alvorlige reaktioner, hvor type 1-allergi for #A mistænkes, kan prik- og intradermaltest med #B være vejledende (specialistopgave). Er disse negative, kan	#B har været givet til en større gruppe med anafylaktiske eller ikke-anafylaktiske reaktioner på #A uden problemer.
855	pivampicillin	J01CA02	2145	meropenem	J01DH02	1411, 1412, 1413	penicillin	Betalactamantibiotika bør generelt undgås ved svær overfølsomhed for #A. Ved mindre alvorlige reaktioner, hvor type 1-allergi for #A mistænkes, kan måling af specifikt IgE, prik- og	Ved overfølsomhed for #A, bør #B sædvanligvis undgås.	Betalactamantibiotika bør generelt undgås ved svær overfølsomhed for #A. Ved mindre alvorlige reaktioner, hvor type 1-allergi for #A	#B har været givet til en større gruppe med anafylaktiske eller ikke-anafylaktiske reaktioner på #A uden problemer.

Ark1 / Ark2 / Ark3

…let me show you how all this allergy information works together
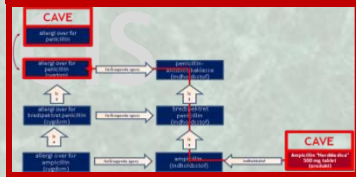
Allergy and Cross allergy check

Function

The allergy structure in SCT can match allergy to a substance or a class with the prescribed substance

Allergy register:

"allergy to broadspectrum penicillins"

SCT

Allergy chec k with SCT structure

SCT : flucloxacilline

SCT : flucloxacilline

allergy / no allergy

Crossing drugs is found in the cross allergy table where substances are SCT **c**odet

Crossing drugs is checket against the allergy set : "allergy to broadspectrum penicillins" using SCT allergy structure

Cross allergy Decision Support Module

SCT Substance 1	SCT Substance 2	Text
ampicilline	flucloxacilline	ALERT

Output will be sent back to the mediciation module if the allergy check is positive

If there is no allergy – cross allergy will be checket

If there is cross allergy an alert and specific crossallergy text will be sent back to the medication module
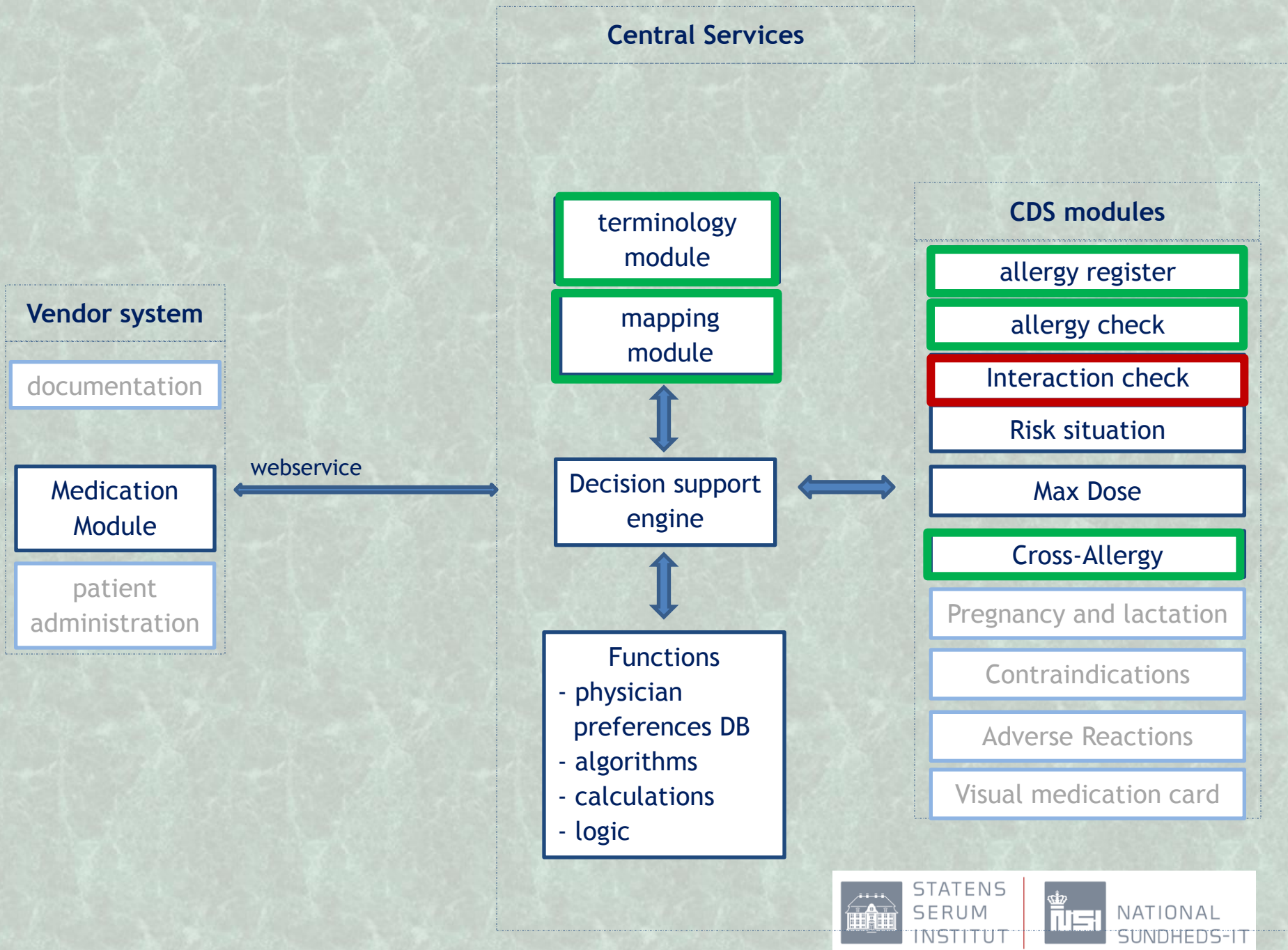
Decision support component: Interaction database

Baset on the existing service:

The interaction database describes 2,500 interaktions between different drugs based on their substances

The database contains a short description of all interactions and a recommendation of how the physician can handle the interaction

Primarily based on publiced, peer-reviewed, original litterature

...and more technological improvements

– with improved content:

- **Notifications of "not enough information" to deliver a verdict**

- **Includes more classspecific effects**

- **More interactions included from earlier clinical trials**

The Physicians preferences DB

Interactions

- Turn of alerts for certain interaction types (green, yellow, red)
- Turn of alerts with specific dose forms (e.g. topical, eyedrops)
- Turn of alerts for a specifik drug combination (don't tell me again)

Allergies

…back to interactions - let me show you how a check is performed

- Turn of alerts with a specific dose forms (e.g. topical, eyedrops)

Risk situation drugs and Max Dose

- Turn of all alerts
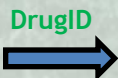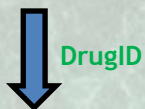- Turn of alerts for a specifik drug (don't tell me again)

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Interaction control

funktion

The database checks for interaction

SCT : warfarin

SDK
Marevan
has dose form
tablet

SDK
Xefo
has dose form
tablet

SCT : lornoxicam

SCT : warfarin

SCT : lornoxicam

Interaction
Decision support module

SCT Sub 1	SCT Sub 2	Text
lornoxicam	warfarin	ALERT

Physician Preference Database

Type	Pre-ference
Green	NO
Yellow	NO
Red	YES

Route of administration check

Output is sent back to the medication module if in accordance with the physicians preference

Module component: Risk Situation DB

The Patient Safety law in 2004 made it mandatory for health workers in hospitals to report adverse events – anonymously.

September 2010 primary practice was included

From 2011 the National Agency for Patients' Rights and Complaints handles the patient safety database.

WHO's ICPS-classification is used to classify the risk.

Drugs that have been involved in serious life threatening situations will be evaluated by a group of experts and possibly placed in the Risk Situation Database.

Alerts will be generated when a specific drug in a specific doseform triggers it during prescription

Central Services

Vendor system

documentation

Medication Module

patient administration

webservice

terminology module

mapping module

Decision support engine

Functions
- physician preferences DB
- algorithms
- calculations
- logic

CDS modules

allergy register

allergy check

Interaction check

Risk situation

Max Dose

Cross-Allergy

Pregnancy and lactation

Contraindications

Adverse Reactions

Visual medication card
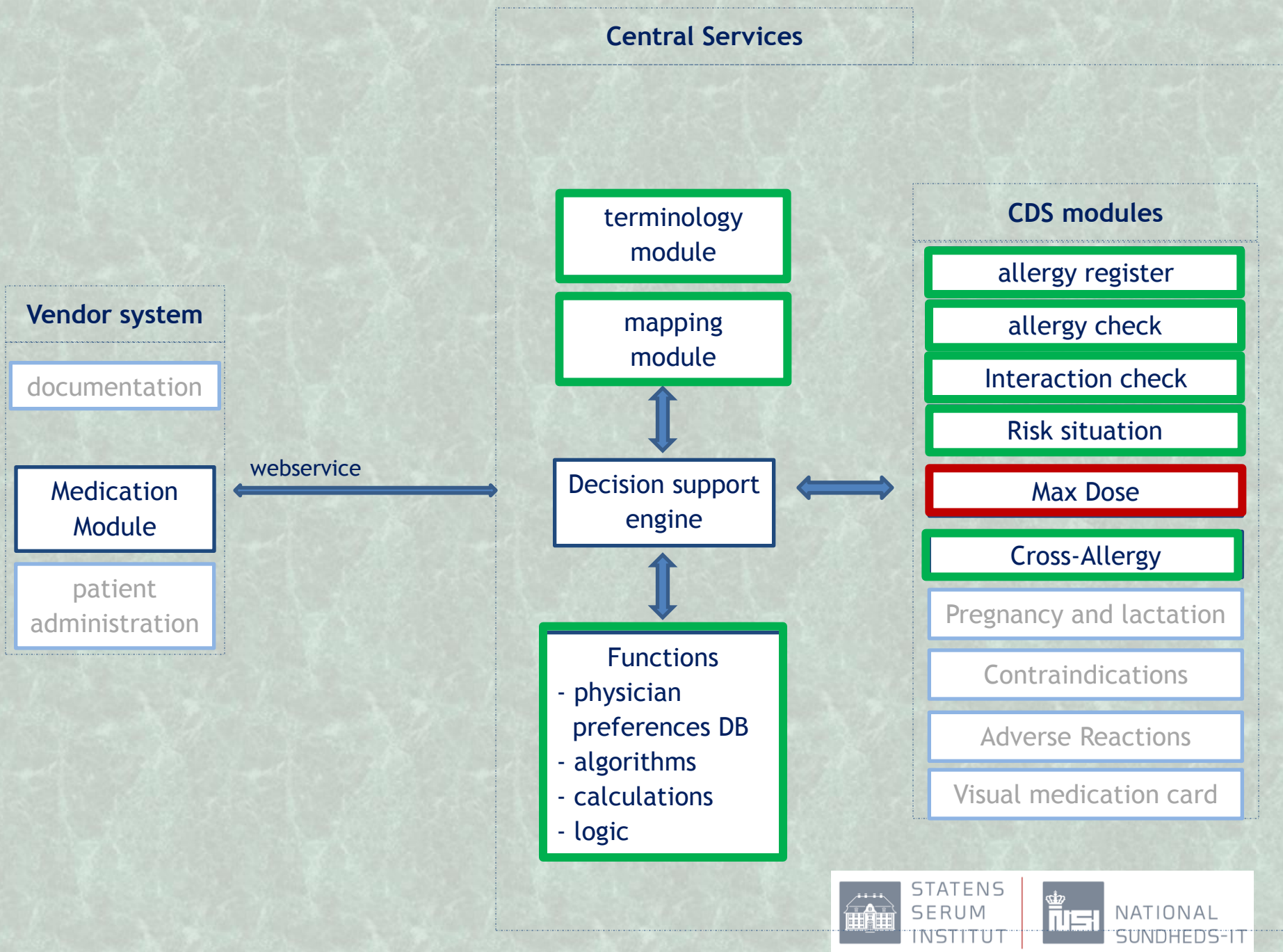
Module component: MaxDose DB

The MaxDose CDS will compare the amount of substance a patient is prescribed and the amount already prescribed, with the MaxDose limet to prevent overdosing.

The substance can be in same or differently named drugs, or as part of a combination drug

Categories:

- Adults - oral drugs, nose sprays and –powders etc
- Adults - I.V. drugs
- Children
- Patients with reduced kidney function

Module component: MaxDose DB

The function of MaxDose for patients with reduced kidney function require additional information from the vendors system.

Kidney function	GFR (ml/min/1,73 m²)
Normal kidney function	> 90
Mildly reduced kidney function	60-90
Moderately reduced kidney function	30 - < 60
Severely reduced kidney function	15 - < 30
Terminal renal insufficiency	< 15 or dialysis

The lab data required for this function for patients with reduced kidney is placed outside the medication module in the vendor system and requires local implementation.
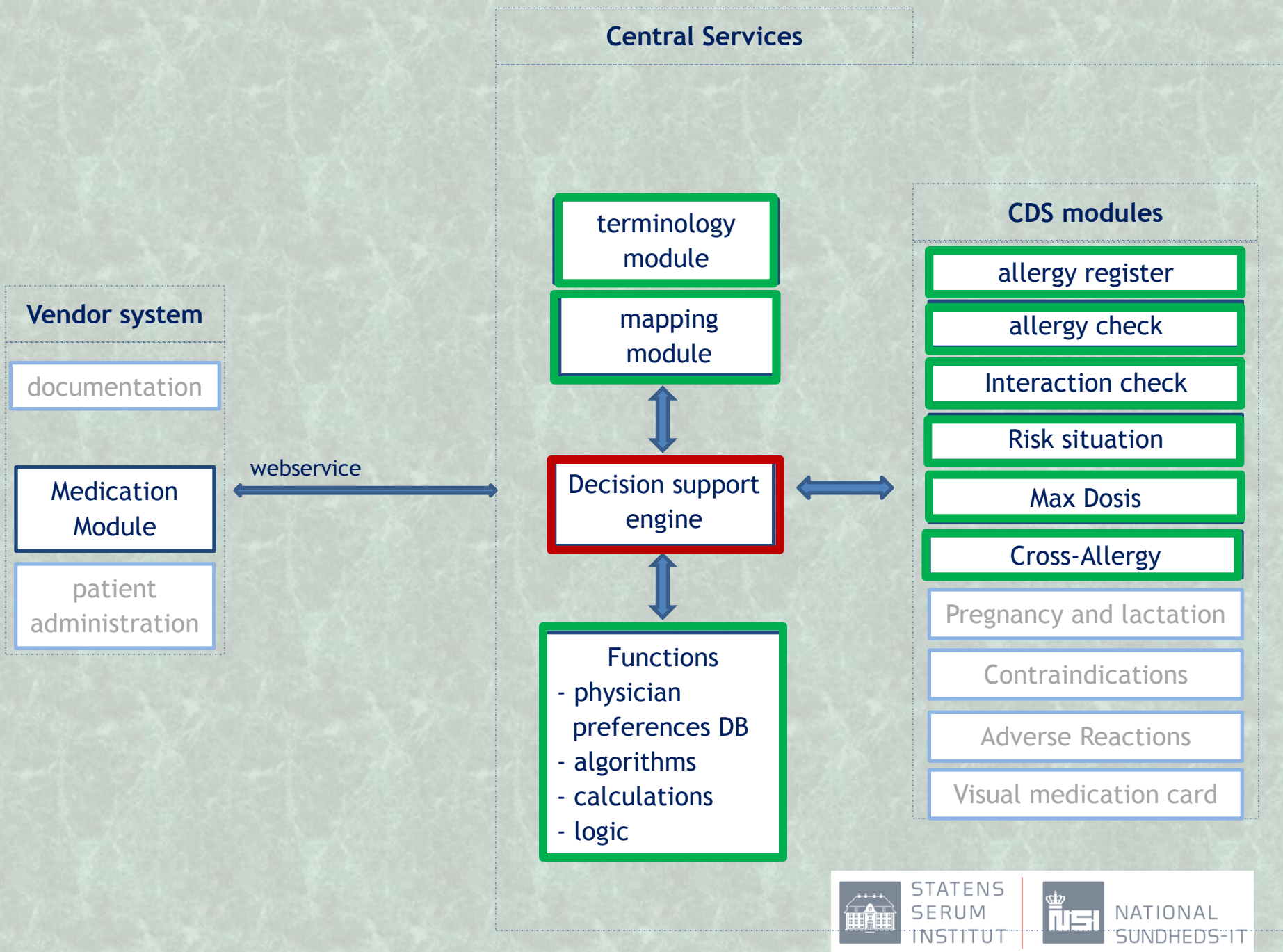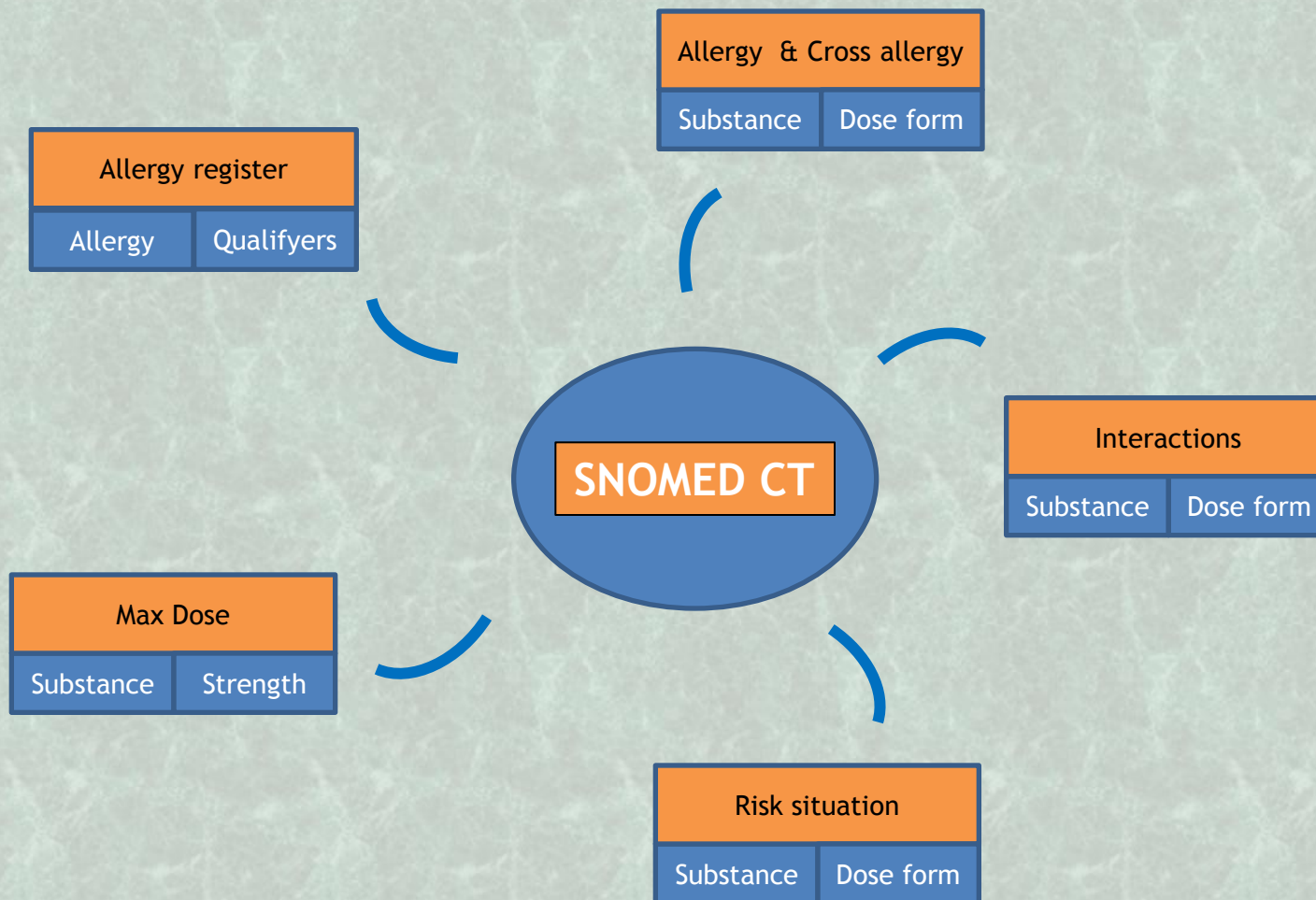
Central Services

Vendor system

documentation

Medication Module

patient administration

webservice

terminology module

mapping module

Decision support engine

Functions
- physician preferences DB
- algorithms
- calculations
- logic

CDS modules

allergy register

allergy check

Interaction check

Risk situation

Max Dosis

Cross-Allergy

Pregnancy and lactation

Contraindications

Adverse Reactions

Visual medication card

SNOMED DK a Danish drug terminology based on SNOMED CT
> a functional, structured drug terminology with built-in knowledge - a tool for decision support.

Features ...

- drug specific hierarchies with structured data

- attributes with useful knowledge - substances, dose form, units, strength, allergies caused by drugs

- Danish drugs linked to generics through SNOMED

- semantic consistent construction of terms

- ISO structured names with trade name, strength and dose form

- unique <u>global</u> ID for all drugs

- unik identification of substances - incl. combinations

- mapped to DrugID with all links to DMA DB preserved

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SNOMED DK a Danish drug terminology based on SNOMED CT

> a functional, structured drug terminology with built-in knowledge - a tool for decision support.

Possibilities ...

- central intelligent decision support via websevices

- enhancement of local systems

- dose calculation, control and overview

- overview of the patients, patient group or the departmental use of specific drugs, dose, frequency, indication, diagnosis, results etc

- mapning to ATC for practical or statistical use

- indication mapning to SNOMED CT, ICPC and DKMA indications

- international cooperation with IHTSDO, OpenEHR, WHO, EU epSOS

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SNOMED DK a Danish drug terminology based on SNOMED CT

> a functional, structured drug terminology with built-in knowledge - a tool for decision support.

Implementation advantages …

	Advantages
Patients	Increased quality and safety, reduces adverse events
Phycisians	Saves time, gives safety and ease of mind
Medical societies	A good way to get their expert knowledge out to everybody who needs it
Vendors	Better services to the phycisians, better systems, competition
Regiones counties	Saves money from less errors Allergy information does not disappear between sectors
State	Centrally controled coherent cross sector service Statistics and feedback from use
Politicians	Increased quality of treatment and lowering of healthcare costs

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SNOMED DK drug terminology and Decision Support Services

Thank you – any questions ?

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