Singapore Drug Dictionary and Dose Forms

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Agenda

- Background
- SDD Model and Examples
- Dose Form Hierarchy
- Implementation and Tooling
- Conclusions
Background
Strategic vision of patients moving seamlessly across the healthcare system, receiving coordinated patient-centric care at the most appropriate settings.

Enabled by the National Electronic Health Record (EHR)
Background

• Different in-house drug terminologies, codes and IT systems
• Limits the extent to which information can be exchanged—
  for post-market monitoring, integrated care, healthcare
  efficiency, decision support and patient safety;

Singapore Drug Dictionary

• A national standard to unambiguously identify, code &
  interpret medicines
• Includes standardised, consistent descriptions for each drug
• Facilitates seamless exchange
• Needs to meet diverse requirements of different users and
  cater for new innovative products
Objectives of Singapore Drug Dictionary

Improvements in clinical care activities, patient management and safety

- Semantic interoperability across use cases
- Semantic interoperability across care settings
- National / international decision support rules
- Medication safety initiatives including:
  - Medication management
  - Adverse drug event surveillance.
- Data mining, analysis and research
Interoperability Across Care Settings

- Community Hospital/Nursing Home
- General Practice
- Hospital
- Community Pharmacy
- Specialist Centre
- Polyclinic
- Singapore Drug Dictionary
- Aged Care
Interoperability Across Use Cases

- Registration
- Inventory Management
- Supply Chain
- Prescribing
- Dispensing
- Administration

Medication Lists / Allergies / Research / Decision Support etc
The SDD has been developed with the following principles in mind:

- **Extensibility**
  In both the drug content and data model to allow for innovations in pharmaceutical and device technology over time.

- **Ontology**
  Based on ontological principles to support Singapore’s growing need for Biomedical research.

- **Patient Safety, Semantic Interoperability and Decision Support**
  These must be facilitated by the SDD and be the focus of clinician review and initial EMR vendor uptake.

- **Hide Complexity**
  Complexity to be hidden from clinicians and most Electronic Medical Record (EMR) vendors.

- **Informed by Existing Clinical Practice**
  Models tested against several thousand existing medication terms from hospital and GP prescribing/dispensing systems, PRIOR to finalisation of model.
Model and Examples
Core Medication Classes

Singapore Medicinal Product (SG product)
is a
Medicinal Product (MP)
is a
Medicinal Product Form (MPF)
is a
Medicinal Product Preparation (MPR)
is a
Medicinal Product Quantity (MPQ)
is a
Medicinal Product Pack (MPP)
is a
Medicinal Product Pack in Container (MPPC)
is a
Medicinal Trade Product (MTP)
is a
Medicinal Trade Product Form (MTPF)
is a
Medicinal Trade Product Preparation (MTPR)
is a
Medicinal Trade Product Quantity (MTPQ)
is a
Medicinal Trade Product Pack (MTPP)
is a
Medicinal Trade Product Pack in Container (MTPPC)

Brand

20 tablets
2 x 10 tablets
2 x 10 tablets per blister strip
The Structure of an SDD Drug

Multi Pack (e.g. 2 packs)

(Super) Pack

Subpack in Container (e.g. blister strip)

Subpack in Container (e.g. bottle)

Component

Ingredient + Ingredient

&

Component

Ingredient + Ingredient

Component

Ingredient
Use Case Driven Abstractions – based on:

- **Ingredient Level**
  - Specific (S) E.g. Amoxicillin Trihydrate
  - Clinically Relevant (CR) E.g. Amitriptyline Hydrochloride
  - Clinically Significant (CS) E.g. Amitriptyline, Calcium Carbonate
  - Base E.g. Calcium

- **Dose Form Level**
  - Specific (S) E.g. Intramuscular Injection Solution
  - Clinically Relevant (CR) E.g. Intramuscular Injection
  - Top (T) E.g. Injection

- **Other Defining Information**
  - Flavour E.g. Strawberry flavour
  - Freeness E.g. Preservative-free
  - Other E.g. Southern Hemisphere

- **Ingredient Qualifiers**
  E.g. Bovine, Micronised
Specific ING – Specific DF

- MP
  - Kanamycin Sulfate

- MPF
  - Kanamycin Sulfate Intramuscular Injection Solution

- MPR
  - Kanamycin (as Sulfate) 0.3333 g/ mL Intramuscular Injection Solution

- MPQ
  - Kanamycin (as Sulfate) 0.3333 g/ mL Intramuscular Injection Solution (3 mL)

- MPP
  - Kanamycin (as Sulfate) 1 g/ 3 mL Intramuscular Injection Solution

- MPPC
  - Kanamycin (as Sulfate) 1 g/ 3 mL Intramuscular Injection Solution (3 mL per vial)

- MTP
  - KANAMYCIN SULFATE (MEIJI) [Kanamycin Sulfate]

- MTPF
  - KANAMYCIN SULFATE (MEIJI) [Kanamycin Sulfate] Intramuscular Injection Solution

- MTPR
  - KANAMYCIN SULFATE (MEIJI) [Kanamycin (as Sulfate)] 0.3333 g/ mL Intramuscular Injection Solution

- MTPQ
  - KANAMYCIN SULFATE (MEIJI) [Kanamycin (as Sulfate)] 0.3333 g/ mL Intramuscular Injection Solution (3 mL)

- MTPP
  - KANAMYCIN SULFATE (MEIJI) [Kanamycin (as Sulfate)] 1 g/ 3 mL Intramuscular Injection Solution

- MTPPC
  - KANAMYCIN SULFATE (MEIJI) [Kanamycin (as Sulfate)] 1 g/ 3 mL Intramuscular Injection Solution (3 mL per vial)
Interoperability Across Use Cases

**Prescribing (CR-T)**

**Dispensing (CR-CR)**

**Administration (CR-CR)**
Use Case Reference Sets (and Linkages)

**Prescribing**
- **MPR**
  - Erythromycin (as Ethyl Succinate) 250 mg Tablet

**Administration**
- **MTPR**
  - **E.E.S.** [Erythromycin (as Ethyl Succinate)] 250 mg Tablet
  - **ERYCYN** [Erythromycin (as Ethyl Succinate)] 250 mg Tablet

**Dispensing**
- **MTPPC**
  - **E.E.S.** [Erythromycin (as Ethyl Succinate)] 250 mg Tablet
    - (2 x 10 tablets per blister strip)
  - **ERYCYN** [Erythromycin (as Ethyl Succinate)] 250 mg Tablet
    - (10 x 10 tablets per blister strip)
  - **ERYCYN** [Erythromycin (as Ethyl Succinate)] 250 mg Tablet
    - (1 x 30 tablets per bottle)
Medicinal Product Form (MPF)
Medicinal Product (MP)
Medicinal Trade Product Form (MTPF)
Medicinal Trade Product (MTP)

Medicinal Product Quantity (MPQ)
Medicinal Product Pack (MPP)
Medicinal Product Pack in Container (MPPC)

Medicinal Trade Product Quantity (MTPQ)
Medicinal Trade Product Pack (MTPP)
Medicinal Trade Product Pack in Container (MTPPC)

Prescribing
Administration
Dispensing
Defining Medications in SDD

Pharmaceutical/biologic product

is a

Singapore Medicinal Product

is a

Ingredient (ING)

Amoxicillin

has active ingredient

Dose Form (DF)

Capsule

has dose form

Ingredient (ING)

Amoxicillin

has active ingredient

MP

is a

Amoxicillin

MTP

is a

STRIMOX [Amoxicillin]

tradeNameRoot = “STRIMOX”

MTPF

is a

STRIMOX [Amoxicillin] Capsule

MPF

is a

Amoxicillin Capsule

MPR

is a

Amoxicillin 250 mg Capsule

MTPR

is a

STRIMOX [Amoxicillin] 250 mg Capsule

MPR.activeIngredient

definingStrength1NumeratorValue = 250 mg

has defining strength1 numerator units

Unit of Measure (UOM)

mg
Additional Classes and Relationships

- **Containered Classes**
  - Introduced to support clinical terms that use Container at all levels of hierarchy – e.g.
    - Salbutamol Powder Inhaler
    - Salbutamol Injection Ampoule
    - Salbutamol 2 mg/ mL Ampoule

- **Groupers**
  - Introduced to support clinical prescribing terms that group specific products:
    - Ingredient Group – e.g. Analgesic, Influenza Virus Vaccine, Chlorhexidine Salt
    - Dose Form – e.g. Aspirin Tablet/Capsule
    - Strength – e.g. Methyl Salicylate 10 - 20 % Cream
    - Strength Units – e.g. Tetanus Immunoglubulin 250 unit Injection
    - Total Pack Size
    - Container Quantity/Size – e.g. Aqueous Cream (15 g; 30 g)
    - Container
    - Trade Name Root/Group – e.g. PANADOL Tablet, TRIDERM/ COMBIDERM [Betamethason Diproprionate + Clotrimazole + Gentamicin] Cream

- **Relationships**
  - Manufactured vs Administrable Products
    - Has administrable product
  - Formulations – recipe linked to resulting drug
    - Formulates
  - In device vs With device
    - Has loaded product
class SNOMED Concept

SNOMED CT concept
- sctId: conceptID
- sourceld: string [1..*]
- fullySpecifiedName: descriptionID
- fullName: descriptionID
- preferredTerm: descriptionID
- synonym: descriptionID [0..*]

Organism (organism)

Pharmaceutical / biologic product (product)

Physical object (physical object)

Body structure (body structure)

Qualifier value (qualifier value)

Substance (substance)

Singapore medicinal product (SG product)

Singapore medicinal product group (SG product group)
class MP

Medicinal Product (MP)
- activeIngredient: conceptID (ING) [0..*]
- isVaccine: boolean
- otherProductDefiningInformation: string [0..1]
- parentProduct: conceptID (MP) [0..*]
- componentProduct: conceptID (MP) [0..*]
- withDevice: conceptID (DD) [0..1]
- mpCollectiveName: string [0..1]
- loadedProduct: conceptID (MPC) [0..1]
- formulatesProduct: conceptID (MP) [0..1]
- medicationGroup: conceptID (MPG) [0..1]
- semanticGroup: conceptID (SG) [0..1]
- coreAtcCode: conceptID (ATC) [0..1]

Medicinal Trade Product (MTP)
- medicinalProduct: conceptID (MP)
- activeIngredient: conceptID (ING) [0..*]
- bossIngredient: conceptID (ING) [0..1]
- preferredOrder: int

Anatomical Therapeutic Chemical Classification (ATC)
- has core ATC classification [0..1]

SDD Semantic Group (SG)
- has semantic group [0..1]
- has loaded product [0..1]

Medicinal Product Group (MPG)
- has medication group [0..*]
- is a [0..*]

Medicinal Product in Container (MPC)
- has loaded product [0..1]
- is a [0..*]

Drug Device (DD)
- is with devices a [0..1]
- is a [0..*]

Medicinal Product Form (MPF)
- is a [0..1]

Medicinal Product Form Group (MPFG)
- is a [0..*]

Medicinal product in Container group (MPCG)
- is a [0..*]
SDD
Dose
Forms
<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
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<td><strong>L1</strong></td>
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<td><strong>L3</strong></td>
<td><strong>L4</strong></td>
<td><strong>L5</strong></td>
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</table>
# Dose Form – Defining Characteristics

- **State of Matter**
  - e.g. Solid, Semi-Solid, Liquid, Gas

- **Primitive Dose Form**
  - e.g. Tablet, Capsule, Solution

- **Release Characteristic**
  - e.g. Extended-Release

- **Delivery Device**
  - e.g. Powder Inhaler

- **Administration Method**
  - e.g. Injection, Nebulisation

- **Transformation Method**
  - e.g. Reconstitution, Dispersion

- **Formulated Route**
  - e.g. Oral, Rectal, Intramuscular

- **Site Prepared For**
  - e.g. Eye, Scalp

- **Administrable Dose Form**
  - e.g. Oral Suspension

- **Dose Form Qualifier**
  - e.g. Film-Coated, Soft

- **Proprietary Name**
  - e.g. TESTOCAP, DIVULE
DF Example: *Prolonged-Release Film-Coated Oral Tablet*

*Product: HARNAL OCAS [Tamsulosin]*

- State of Matter: *Solid*
- Primitive Dose Form: *Tablet*
- Release Characteristic: *Prolonged-Release*
- Delivery Device
- Administration Method
- Transformation Method
- Formulated Route: *Oral*
- Site Prepared For: *Mouth*
- Administrable Dose Form
- Dose Form Qualifier: *Film-Coated*
- Proprietary Name
DF Example: *Intramuscular Injection Solution*

*Product: KANAMYCIN MEIJI [Kanamycin]*

- **State of Matter**: Liquid
- **Primitive Dose Form**: Liquid ⇔ Solution
- **Release Characteristic**: 
- **Delivery Device**: 
- **Administration Method**: Injection
- **Transformation Method**: 
- **Formulated Route**: Intramuscular
- **Site Prepared For**: Muscle
- **Administrable Dose Form**: 
- **Dose Form Qualifier**: 
- **Proprietary Name**: 

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DF Example: *Vaginal & Rectal Suppository*

*Product: CYCLOGEST [Progesterone]*

- **State of Matter**: Solid
- **Primitive Dose Form**: Suppository
- **Release Characteristic**: 
- **Delivery Device**: 
- **Administrable Dose Form**: 
- **Transformation Method**: 
- **Formulated Route**: Vaginal, Rectal
- **Site Prepared For**: Vagina, Rectum
- **Administration Method**: 
- **Dose Form Qualifier**: 
- **Proprietary Name**: 

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**DF Example: Intravenous Infusion & Nebulisation Solution**

*Product: RELENZA [Zanamivir]*

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>State of Matter</td>
<td>Liquid</td>
</tr>
<tr>
<td>Primitive Dose Form</td>
<td>Liquid ↔ Solution</td>
</tr>
<tr>
<td>Release Characteristic</td>
<td></td>
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<tr>
<td>Delivery Device</td>
<td>Nebuliser</td>
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<tr>
<td>Administrable Dose Form</td>
<td></td>
</tr>
<tr>
<td>Transformation Method</td>
<td></td>
</tr>
<tr>
<td>Formulated Route</td>
<td>Intravenous</td>
</tr>
<tr>
<td>Site Prepared For</td>
<td>Vein</td>
</tr>
<tr>
<td>Administration Method</td>
<td>Infusion</td>
</tr>
<tr>
<td>Administration Method</td>
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<tr>
<td>Dose Form Qualifier</td>
<td></td>
</tr>
<tr>
<td>Proprietary Name</td>
<td></td>
</tr>
</tbody>
</table>
class DF
Dose Form (DF)
+ parentDoseForm: conceptID (DF) [0..*]
+ releaseCharacteristic: conceptID (RC) [0..1]
+ formulatedRoute: conceptID (RA) [0..*]
+ administrationMethod: conceptID (AM) [0..*]
+ sitePreparedFor: conceptID (BS) [0..*]
+ deliveryDevice: conceptID (DD) [0..1]
+ administrableDoseForm: conceptID (DF) [0..*]
+ transformationMethod: conceptID (TM) [0..*]
+ doseFormQualifier: conceptID (DFQ) [0..*]
- doseFormLevel: conceptID (DFL)
- productTerm: descriptionID (DF) [0..1]
- waterProductTerm: descriptionID (DF) [0..1]
- discreteDoseFormUnits: conceptID (UOM) [0..1]
- isDiscrete: boolean
- shortName: string [0..1]
## Dose Form Descriptions

<table>
<thead>
<tr>
<th>Fully Specified Name</th>
<th>Full Name</th>
<th>Preferred Term</th>
<th><strong>Product Term</strong></th>
<th>Short Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral Tablet dose form (qualifier value)</td>
<td>Oral Tablet</td>
<td>Oral Tablet</td>
<td><strong>Tablet</strong></td>
<td>Tab</td>
</tr>
<tr>
<td>Ophthalmic Liquid: Drops dose form (qualifier value)</td>
<td>Ophthalmic Liquid: Drops</td>
<td>Ophthalmic Drops</td>
<td><strong>Eye drops</strong></td>
<td>Eye/d</td>
</tr>
<tr>
<td>Liquid: For Intravenous Injection dose form (qualifier value)</td>
<td>Liquid: For Intravenous Injection</td>
<td>Intravenous Injection Liquid</td>
<td><strong>Intravenous Injection</strong></td>
<td>IV Inj</td>
</tr>
<tr>
<td>Powder: For Reconstitution To Liquid: For Injection dose form (qualifier value)</td>
<td>Powder: For Reconstitution To Liquid: For Injection</td>
<td>Powder For Injection Liquid</td>
<td><strong>Injection Powder</strong></td>
<td>Inj Pwdr</td>
</tr>
<tr>
<td>Oral Capsule: For Oral Inhaler dose form (qualifier value)</td>
<td>Oral Capsule: For Oral Inhaler</td>
<td>Oral Inhaler Capsule</td>
<td><strong>Inhaler Capsule</strong></td>
<td>INH Cap</td>
</tr>
</tbody>
</table>
Prescribing
Medication Use Cases
Linking Prescribing with Dispensing

Prescribing System
- Patient: 1234567
- Drug: Amoxicillin Capsule
- Route: Oral
- Dose: 500 mg
- Frequency: Three times per day
- Duration: 10 days

Dispensing System
- ?

Prescribing

Dispensing
Linking Prescribing with Dispensing

**Prescribing System**
- **Patient:** 1234567
- **Drug:** Amoxicillin Capsule
- **Route:** Oral
- **Dose:** 500 mg
- **Frequency:** Three times per day
- **Duration:** 10 days

**Dispensing System**
- **Patient:** 1234567
- **Item:** AMOXICAP [Amoxicillin] 500 mg Capsule
- **Quantity:** 30 capsules
- **Route:** Oral
- **Dose:** 1 capsule
- **Frequency:** Three times per day
- **Dose Duration:** 10 days

**Dispensing System**
- **Patient:** 1234567
- **Item:** STRIMOX [Amoxicillin] 250 mg Capsule
- **Quantity:** 60 capsules
- **Route:** Oral
- **Dose:** 2 capsules
- **Frequency:** Three times per day
- **Dose Duration:** 10 days

Prescribing  →  Dispensing
Linking Prescribing with Dispensing

Prescribing System
- Patient: 1234567
- Drug: Amoxicillin Capsule
- Route: Oral
- Dose: 500 mg
- Frequency: Three times per day
- Duration: 10 days

Dispensing System
- Patient: 1234567
- Item: AMOXICAP [Amoxicillin] 500 mg Capsule
- Quantity: 30 capsules
- Route: Oral
- Dose: 1 capsule
- Frequency: Three times per day
- Dose Duration: 10 days

Dispensing System
- Patient: 1234567
- Item: STRIMOX [Amoxicillin] 250 mg Capsule
- Quantity: 60 capsules
- Route: Oral
- Dose: 2 capsules
- Frequency: Three times per day
- Dose Duration: 10 days

Prescribing

Dispensing
Linking Prescribing with Dispensing

 Prescribed Drug

- Ingredient (ING): Amoxicillin
- Dose Form (DF): Capsule
- Route (R): Oral
- Frequency (F): Three times per day

- MPF:
  - Dose: 500 mg
  - Duration: 10 days
  - Amoxicillin Capsule
  - MPR
  - Amoxicillin 500 mg Capsule

 Dispensed Drug

- MTPR
  - Amoxicillin 500 mg Capsule
  - Dose: 1 capsule
  - Duration: 10 days

- MTPR
  - StriMoX [Amoxicillin] 250 mg Capsule
  - Dose: 2 capsules
  - Duration: 10 days

 Prescribing System

- Patient: 1234567
- Drug: Amoxicillin Capsule
- Route: Oral
- Dose: 500 mg
- Frequency: Three times per day
- Duration: 10 days

 MPR activeIngredient

- deferringStrength = 500 mg

 Ingredient (ING)

- Amoxicillin

 Dose Form (DF)

- Capsule

 Route (R)

- Oral

 Frequency (F)

- Three times per day

 MPR activeIngredient

- deferringStrength = 250 mg

 MTPR

- Amoxicillin

 Capsule

 Oral

 Three times per day

 Amoxicillin
Linking Prescribing with Dispensing

Prescribing System:
- Patient: 1234567
- Drug: Amoxicillin Capsule
- Route: Oral
- Dose: 500 mg
- Frequency: Three times per day
- Duration: 10 days

Dispensing System:
- Patient: 1234567
- Item: AMOXICAP [Amoxicillin] 500 mg Capsule
- Quantity: 30 capsules
- Route: Oral
- Dose: 1 tablet
- Frequency: Three times per day
- Dose Duration: 10 days
Implementation and Tooling
Currently

- **Agency for Integrated Care (AIC)**
  - Step-down-care from hospitals to nursing homes
  - Used for documentation of medication lists

- **Medication Advancement Fund (MAF)**
  - Used for submission of subsidy data

In Development

- **National Electronic Health Record (NEHR)**
  - Mapping from source systems to SDD for consistency

- **General Practice System (CLEO)**
  - SDD reference sets for prescribing, dispensing and inventory (+trans closure)

- **Community Hospitals (CHCS)**
  - SDD reference sets for prescribing, dispensing and inventory (+trans closure)

- **Acute Care Use**
  - Prescribing and dispensing reference sets (based on automated rules)

- **Standard Drugs List (SDL)**
  - To standardise descriptions for publishing list of subsidized drugs
  - Analysis of data submitted by institutions will use SDD
Tooling Journey (1 of 2)

• AT FIRST we:
  – Used Excel spreadsheets
  – For internal data development (e.g. dose forms)
  – NOT for producing releases (limited ability to safely create/maintain SNOMED CT extension ids)

• CURRENTLY we:
  – Use an internally developed Access database
  – Have developed processes to:
    • Create SDD concepts, relationships and descriptions
    • Perform dual-independent reviews
    • Map existing drug terms to SDD concepts
    • Create and maintain SNOMED CT extension ids
    • Support versioning of codes and releases
    • Perform quality checks on data prior to release
  – However, concepts, descriptions and relationships created manually.
NEXT we will move to:

- Import data from a number of sources (including regulatory data)
- Allow source data for each product to be edited and cleaned
- Automatically create/update hierarchies
- Automatically create descriptions (e.g. FSN, FN, PT, SN)
- Perform more sophisticated quality checks
- Provide extended support for mapping of existing drug terms
- Automatically generate use-case-specific reference sets
- Automatically build transitive closures to link use-case-specific reference sets
- Allow healthcare orgs to add local extemporaneous drugs
Demonstration and Questions