NHSS Dose Syntax Recommendation

Final Report 15.4.15

Key Goals

To create a computable drug direction representation capable of supporting a substantial majority of "prescriptions" or "medication orders" generated or received in primary care, community care, retail pharmacy, and hospital discharge and outpatients. "Prescription" is used here to include the concept of medication order as a type of Request to Supply.

The key drivers are to enable

1. Easier transition of medication information across the primary/secondary care divide, in particular to enable primary care 'product-based' prescriptions to be easily converted to hospital-based 'dose-based' prescriptions and vice-versa, particularly to help automate medicines reconciliation both at admission and discharge. Medication and medication reconciliation archetypes are being developed as a separate, but related piece of work
2. Automatic calculation of 'total daily dose' to support quality measurement and audit.

Safer and easier handling of prescriptions by retail pharmacy systems is a likely secondary benefit but is out of scope as a formal goal.

Support of inpatient prescribing, which is more complex, is also out-of-scope, other than at the transitions of care as noted above. The developed product may act as a solid baseline for further extension into inpatient prescribing and secondary care input but this is explicitly out of scope for this project.

Where design issues have arisen that are currently out-of-scope as above, these are *[marked thus]* for future reference.

Review of University of Dundee EBNF2 Dose syntax

An analysis was undertaken of the EBNF2 (Extended_Backus–Naur_Form) dose syntax developed around 2000 by Mark McGilchrist of Univ. Dundee with contributions from Iain Herbert, based on GP prescriptions. The dose syntax was used to convert the narrative dose instructions on each prescription into a computable format wherever possible, primarily for research purposes. Data entry clerks read each prescription and manually converted the narrative to the computable syntax, using the syntax to confirm its scope supports these GP prescriptions, and as an abbreviation to facilitate rapid data entry.

The EBNF2 syntax is associated with an underlying UML model.

The scope of the current analysis was to:

a) Understand the EBNF2 syntax / dose instruction model
b) Analyse a set of exemplar prescription data (400 out of 700 example prescriptions) that had been marked up using the EBNF2 syntax
    a. Identify those dose syntax elements that could be proposed as a highly minimalist approach i.e. something that is likely to feel very comfortable to implementers
    b. Define aspects of the syntax that should definitely be considered ' out-of-scope'
    c. Define borderline aspects that might be taken to implementers for further discussion.
c) Make contact with original EBNF2 authors and clarify any licensing issues.
d) Cross-reference the EBNF2 models with the 'NHS Information authority (Blue Wave) Dose syntax model' and subsequently refined by NHS CFH along with other approaches such as 'order sentences'.

The scope analysis was guided by

1. Commonality of the dose instruction in GP/community/ambulatory care settings [*i.e. excluding complex acute hospital prescribing or weight- related dosing as currently out of scope]*

2. The computable utility of the instruction. i.e. where there is a high ratio of quantifiable/processable elements vs. textual/ coded text elements

3. *Instructions which mix computable quantities/timings with textual instructions were initially considered out-of-scope.* However some were found to be supportable by splitting into serial Dose instructions logically sequenced by "THEN" or "AND" functions.

4. Where the textual elements could be carried as an addendum 'Additional Instruction' (possibly multiple) this was considered to be 'in-scope'.

5. The syntax must be easy to support and incorporate as an update to existing GP systems' GUI to avoid GP users having to work in a significantly more complex manner. All three of the major UK GP systems suppliers employ a single narrative dose instruction data entry mechanism, facilitated by the use of 'Dose abbreviations', which are expanded to human-readable text e.g. 1 tid => Take one three times per day. Although there is considerable commonality between the abbreviation sets, neither the abbreviations nor the dose strings to which they expand are standardised. It is also a recognised safety risk that some of these abbreviations are not always correctly expanded by the dispenser and may appear on patient-facing medication labels. Samples of GP systems' Dose abbreviations are included in Appendix 4.
   The proposed Dose Syntax should represent as many as possible of these common Dose instructions.

Specific patient directions such as 'chew' 'apply' or 'take with water' should be regarded as 'out-of-scope'. The approach taken was that the Dose instruction should reflect the original prescription by the GP which would now normally omit administration details, since this

information is now by default handled separately via the BNF's systems of Cautionary and Advisory labels used in all pharmacy dispensing systems, and supported also by the Patient Information Leaflet, now mandatory with every dispensed item. This may need revision in light of experience from current GP systems: most support rapid entry of patient directions as if 'dose abbreviations' in the user interface, and this work should therefore maximise alignment with existing GP systems data entry methods.

Review of 'English NHSIA Dose syntax model'

This work remains the de-facto 'official' English NHS model but has not been implemented widely because of perceived complexity, and the lack of publication as a formal standard.

The original NHS Information Authority ('Blue Wave') report was re-formulated as a set of class models as the "NHS CFH Abstract Dose Syntax Model". There appears to have been some uptake in the US and Netherlands (HL7 Pharmacy messaging). The syntax itself has been implemented in HL7-based XML. However a particular barrier to implementation of the original model appeared to be the use of GTS (General Timing Specification). This is a powerful representation of timing intended for purposes well beyond dose timing, e.g. scheduling. It is comprehensive but highly complex and requires specific extension for use in dose instructions. Although using a different approach, the 2008 abstract dose syntax model for dose timings remained complex.

Many aspects of the original Blue Wave medication order statements, described in the 'NHS Dose Syntax model' are already reflected in the UK Medication archetypes and align with RCP HIU eMedication standards.

In spite of its complexity, the 'English NHSIA Dose syntax' model and subsequent revision remain the most comprehensive analyses of dose syntax requirements and it is recommended as the framework on which a limited implementation should be based.

Analyses of sample data

The 4 analyses summarised here represent the main results of an iterative process of testing the original Dundee syntax against various sample datasets, to develop its scope and content to that now detailed in Appendix 2.

1 Review of Order sentences from Newcastle Hospital NHS Foundation Trust

The first 1000 of 12750 randomly mixed inpatient or discharge prescriptions were checked.
699 Dose instructions with timings were found, and the following issues inferred:

1. 35 instances of “Once” which is not yet supported: it is not the same as “Immediately”
2. 2 instances of no syntax for Named weekdays
3. 1 instance of no syntax for Minimum interval between doses
4. 3 instances of an intermediate numeric value (3 hours)
5. 4 instances of no syntax for Delay to start time
6. 3 Dose instructions were considered too complex, even after the other components of the archetype are considered to carry the full Order sentence.

The Dose timing clause is now extended to support # 1-4, so that from these 49, only 7 of 699 remain unsuitable for the proposed Dose syntax.

The proposed Dose syntax in a Medication archetype successfully represents 99% of these real life Dose instructions with valid timings from Secondary Care.

2 Review of NWIS prescription data from Primary Care

A random sample of 100 Dose instructions was checked for compliance with the syntax. Of these, 2 were not clinically valid, 2 had probable typo errors, and 3 were too complex.
38 had other text content that should be represented elsewhere in the archetype.
3 had terms that might be introduced to the dose syntax:

"with main meal"	include
"days 1,3,and 5"	include "virtual day numbering" as timing for hormone Rx
"frequent use"	exclude?

The proposed Dose syntax in a Medication archetype successfully represents 93% of these real-life prescriptions from Primary Care.

3 Review of CFH ‘Order sentence’ Project - see Appendix 3

A separate but related piece of work has been carried out by Ann Slee, when ePrescribing Lead at CfH, where a set of ‘pre-fabricated’ order sentences was created for use in Acute Care, with each element in the sentence represented as a SNOMED CT term. There is very considerable alignment of the scope of this work and related model with that proposed here. Mapping between the fixed order sentences and the NSS Dose Syntax has been carried out for the first 100 order sentences, excluding injectables, with no exceptions required.

The proposed Dose syntax in a Medication archetype is able to represent 100% of the ‘order sentences’ formally tested with full equivalence.

4 Review of GP System Dose abbreviation interfaces - see Appendix 4

All major GP systems provide abbreviations for commonly used terms in text dose descriptions, as aids to usability. We infer that these represent a frequency ordering of the terms most often used in GP prescribing practice. They also represent the status quo for rapid text entry for prescription ordering, for reference in development of any implementations of a Dose syntax.

There are 105 text elements:
25 refer to administration, 13 to dm+d details, and 13 are site directions, which can all be carried elsewhere in the medication archetype.

18 are Indications or "as required reasons", combining the concepts of Precondition and Trigger. It is yet to be decided if these should:
1 all be carried elsewhere in the medication archetype
2 have some most common ones supported in dose syntax.

For the 72 elements common to both systems, 32 dose syntax terms are required to represent all those not carried elsewhere in the archetype e.g. as Additional Instructions, or already in dm+d. On inspection, all of these are supported by the proposed dose syntax.

Of the unique elements, 13 are unique to TPP:
6 are administration details, of which 2 are also site directions, 2 are admin (dispensing details);
6 are complex dose timing details; 1 is in dm+d data.
The remaining 6 are timing elements that are all represented by terms in the dose syntax.

20 are unique to InPS:
6 are already in dm+d data , 10 are Indications. Of the 5 Admin details:
- "of each" is a detail as per PIL ;
- "Month" (not "monthly) is a timing detail suitable for Additional Information .
- "Increasing to" or "reducing to" usually refers to conjoining of 2 sequential dose instructions, so could be represented by a simple "THEN." But if it implies a conditionality on response, such as in a clinical titration, it is too complex for this dose syntax: it is commonly supported elsewhere in the Medication archetype i.e. in the Additional Instructions, and often in a PIL.
- "every fortnight" is supported by the dose syntax

A sample set of similar abbreviations from EMIS has also been referenced.

The proposed Dose syntax in a Medication archetype successfully represents 100% of these real-life prescription texts from Primary Care.

Other considerations

Administration Method

For topical preparations, "a" for "apply" was considered as there is on occasion a sense of quantity, often qualified by adjectives e.g. thinly/thickly, regularly.
In comparison to the metered doses delivered as puff drop or spray, as a definition of "amount" this could be considered vague, so out of scope because this and its textual variations cannot be computed e.g. to form a Defined Daily Dose.
This and other verbs such as "take," insert" are represented elsewhere in the archetype as Administration Method

Dose durations and range

There was one example found (in all the test data) of a range of durations "for 3-4 months." This could be supported by use of "-" or "\" for range (as in other parts of the syntax).

We were not sure that it is clinically valid to use a range for duration, and if so, and also technically problematic, if frequent enough to require support.

Additional Instructions

This includes the concepts of Precondition and Trigger from the English NHS models. This is not intended to hold the clinical indication for the medication, which is generally coded e.g. “Angina pectoris” and held elsewhere in the medication record. This is simply carried as an Additional Instruction, since in practice computability is likely to be low and users may find it difficult to reliably differentiate triggers and preconditions from other "Additional instructions."

Dose syntax integrity

Some potential ambiguities require clarification e.g. can ‘om’ safely mean either ‘once in the morning’ or ‘once a month’ depending on the clause in which it is used? Similarly the use of spaces as separators may compromise parsing, although it does improve human-readability. These do not appear to have been technical barriers in the original implementation but need clarification by testing.

Conclusions

1. Use the 'English NHSIA Dose syntax model' and subsequent revision as the base framework for discussion.
   This does not imply that implementation necessarily requires the use of the associated class models (though this is possible) but simply that the model clearly labels components of the dose instruction in a way that helps guide further discussion.

2. Many elements of the English dose syntax model are already represented in the NHSS/GP2GP/RCP archetypes e.g. Medication name, form, dose quantity, additional instruction, site, route, method, supply quantity.
   Separation of these elements from the scope of the Dose syntax enables it to address over 95% of the prescriptions shared between Primary and Secondary Care.

3. The Dundee EBNF2 syntax, expressed as a parsable text, should be used to represent the syntax of a computable dose direction.

4. The scope of the syntax has been iteratively developed using lists of real Dose directions. We conclude that Dose direction components should include (with examples):

   Dose amount: "1"; "5-10mls"

   Dose timing: "three times daily", "8am 2pm 10 pm", "4-6hrly", "As required"

   Daily repetition should be extended to include:
   - multiples in months or years;
   - intermediate numerical values

   Named timings should be extended to include
   "Once" and "With main meal".
   "Virtual day numbering" may be desirable but also more complex.

   Direction duration: "for 7 days", 'indefinitely'

   Maximum dose: "max 6 tabs in 24 hrs"

   Other aspects of the Medication instruction such as name, form, route, site, additional instructions, duration and indication we recommend be carried as part of the medication archetype or equivalent structural model.

   e.g. Additional Instruction: "for chest pain"
   This is to be supported elsewhere in the Medication model.

5. Specified sequential directions should be supported, i.e.
   i) Dose Duration Directions separated by 'THEN' e.g.
   1 tab three times per day for 1 week, THEN 2 tabs three times per day indefinitely, and
   ii) daily Dose Timing directions separated by "AND" e.g. 1 mane and 2 nocte.

6. Other multiple directions e.g. conjoined by 'OR,' should not be supported.
   Titrated directions i.e. with conditionality should not be supported.
   In general, multiple directions can be divided into separate prescriptions.

7. There is a small number of errors and inconsistencies in the EBNF2 syntax e.g. the separate handling of Maximum dose limits vs. "up to" statements, which would appear to overlap.

8. *All* dose directions should be displayed to the user in their full human-readable narrative form as a safety feature, even where the full prescription could be fully presented in a computable structure and dose syntax. This general principle accords with the CfH/GP2GP approach to processing non-computable data: where a medication dose direction cannot be **wholly represented** in accordance with the proposed dose syntax, only the human-readable narrative instruction should be carried. Thus for safety partially-computable instructions should not be created. The user interface should show where data is non-computable, and so must be processed by the user using the legacy system functionality, very similar to that already established in use.

9. The dose syntax is intended to be computer-interpreted and not for front-line clinical use or viewing. Many of the computable statements appear to be human-readable, but are not reliably so except by those with skills such as those used in development and testing.
   It is not a primary goal or requirement for the syntax to be generally human-readable.

Next Steps to “Product”

1 Create a simple ‘dose direction framework’ to represent the scope of the computable dose directions in recommendation (5). See Appendix 1 *Now done*

2 Adjust the current NSS/GP2GP medication archetypes to align with the framework. *Now done*

3 Propose an associated “reduced EBNF2 syntax” to align with the dose direction framework. See Appendix 2 *Now done*

4 Rename aspects of the EBNF syntax to align with the English NHS Dose syntax framework. e.g. QuantityPattern=> Dose_Quantity *Now done*

5 Review the proposed product against a sample of approx. 500 GP system derived prescriptions as captured by NHS Wales.

6 Review the proposed product against a sample of approx. 500 Secondary Care prescriptions as captured by Newcastle Hospital NHS Foundation Trust. *Now done*

7 Review proposed product against dose sentence work done by Anne Slee, (now Chief Pharmacy Adviser NHS England) *Now done*

8 Appropriate dose unit symbols needs cross-checked and extended to fit with dm+d ‘units of measure ’. This is largely non-contentious. Discussion with vendors is needed to resolve some minor issues such as whether to use ‘mcg’ , ‘ug’ or ‘micrograms’.

9 Develop draft of implementation guidance for system vendors, for their consideration and feedback. This is intended as a guide to development of the existing dose-abbreviation interfaces in all 3 main UK GP systems, which output as text, but are not yet structured enough to output a computable dose syntax.

10 Consider commissioning development of an open source "reference" implementation of the EBNF parser. The scope should include validation of the syntax e.g. clarify any duplications of abbreviations within the syntax.
This may be possible through the NHS England open source openEp project.

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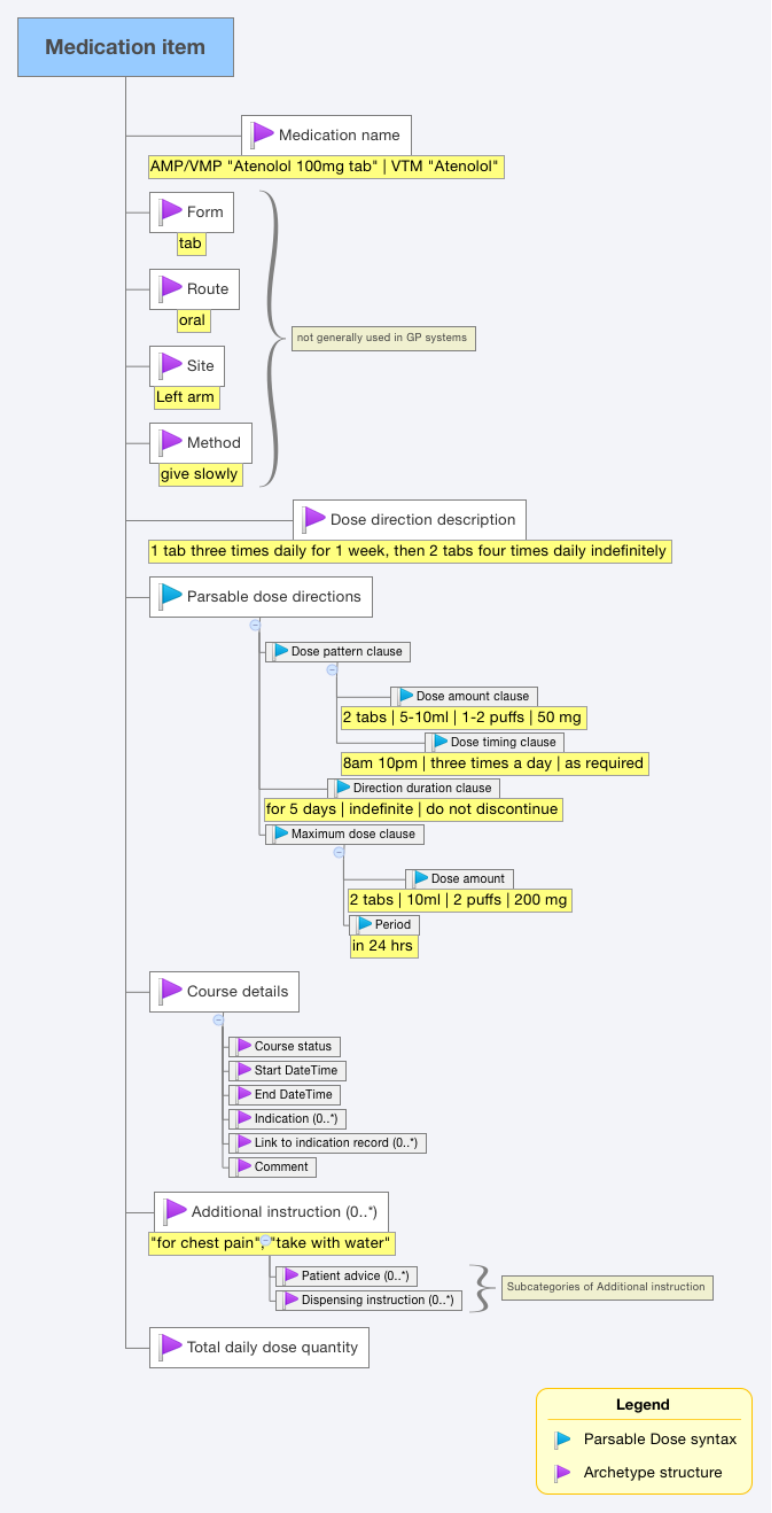
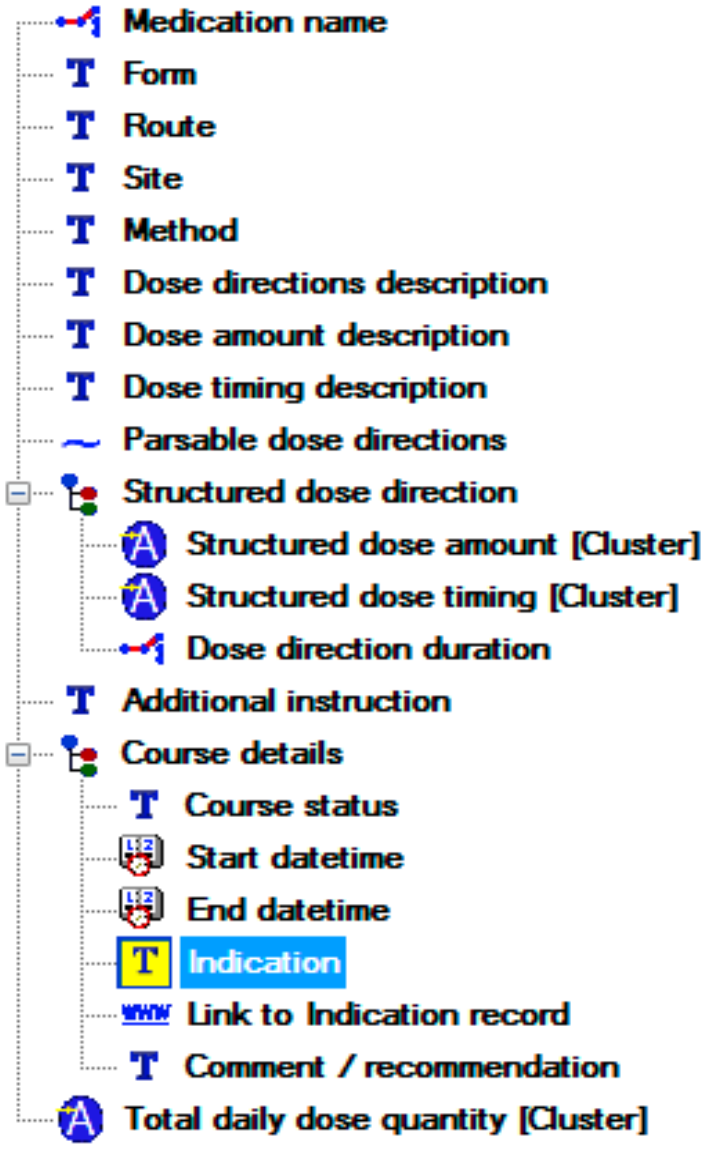
Appendix 1

Proposed Structured Dose Direction Framework



Associated Medication Item archetype



Appendix 2

Summary of Proposed Parsable Dose Directions (Dose Syntax)

Overview of clauses

The Parsable Dose Directions element carries a Dose Instruction composed of one or more Dose Directions, each direction being composed of optional "clauses": a Dose Amount and Dose Timing, which combine to form a Dose Pattern; a Dose Direction Duration; and a Maximum Dose. The clauses always appear in the sequence defined below:

Dose Instruction

- Dose Direction:
  - Dose Pattern:
    - Dose Amount: “2 tabs”, “20mg”, “20-40mg”
    - Dose Timing: “one in the morning”, “6hrly”, “at 8am, 2pm”
  - Dose Direction Duration: “for 7 days”, “indefinitely”
- Maximum Dose: “maximum 4 tabs in 24 hours”

This diagram shows how the types of clause are related, and how multiple Dose Directions and Dose Patterns are supported for the example:

"1 tablet at night for 3 days, then 1 tab morning and afternoon, with 2 tablets at night for 4 days.”

Dose Instruction								
Dose direction (1)			**Dose direction (2)**					**Maximum dose**
Dose pattern		**Dose direction duration**	**Dose pattern (1)**		**Dose pattern (2)**		**Dose direction duration**	
Dose amount	**Dose timing**		**Dose amount**	**Dose timing**	**Dose amount**	**Dose timing**		
1 tablet	**at night**	**for 3 days**	**1 tablet**	**in the morning and afternoon**	**2 tablets**	**at night**	**for 4 days**	
1	**n**	**3d**	**1**	**m+pm**	**2**	**n**	**4d**	

Worked Example 1:

"1-2 tabs 4-6hourly for 7 days, maximum 8 tabs daily"

Dose Instruction

Dose Direction:

Dose Pattern:

Dose Amount: "1-2 tabs"

Dose Timing: "up to 4-6 hourly, as required"

Dose Direction Duration: "for 7 days"

Maximum Dose: "maximum 8 tabs in 24 hours"

Equivalent Parsable Dose Syntax: "1-2 ^h4\h6 prn:7d [8 h24]"

Worked Example 2:

"1 tablet at night for 3 days, then 1 tab morning and afternoon, with 2 tablets at night for 4 days."

Dose Instruction

Dose Direction

Dose Pattern:

Dose Amount: "1 tablet"

Dose Timing: "at night"

Dose Direction Duration: "for 3 days"

Dose Direction

Dose Pattern:

Dose Amount: "1 tablet"

Dose Timing: "in the morning and in the afternoon"

Dose Pattern:

Dose Amount: "2 tablets"

Dose Timing: "at night"

Dose Direction Duration: "for 4 days"

Equivalent Parsable Dose Syntax: "1 n:3d;1 m+pm&2 n:4d"

Overview of separators

Dose Pattern clause

Within each Dose Pattern clause, Dose Amount and Dose Timing are separated by a **space** character.

e.g. 10mg twice a day: "`10mg bd`"

Multiple Dose Pattern clauses

Where the Dose Amount varies within each 24 hour period, multiple Dose Pattern clauses can be joined with an **ampersand "&"** character:

e.g. 1 dose in the morning, 2 doses in the evening : "`1 m&2 e`"

Dose Direction Duration clause

Dose Pattern and Direction Duration are separated by a **colon ":"** character.

e.g. 1 dose in the morning for 14 days: "`1 m:14d`"

Multiple Dose direction clauses

Multiple Dose Directions are only allowable if they are sequential in time i.e. xxx THEN yyy

These are separated by a **semicolon ";"** character

e.g. 1 tab daily for 7days then 1 tab twice daily for 7days then 2 tabs twice daily indefinitely:

"`1 od:7d;1 bd:7d;2 bd:ind`"

Maximum Dose clause

The Maximum Dose clause is preceded by a **space** character *and* surrounded by **square brackets [].**

"`1-2 ^h4\h6 prn:7d [8 h24]`"

1 Dose Amount clause

The amount clause may represent fixed dose amounts or dose amount ranges, ranges being separated by a **"-"** character.

Where the medication name is a product and the dose unit is identical to the dose form e.g. "tablet", "capsule", the dose unit may be omitted. In other cases, for example inhalers, the dose unit 'puffs' is not identical to the dose form "inhaler," so the following additional dose units are available:

p puff
d drop
s spray

Examples

Atenolol 40mg tablets one tablet in the morning

```
"Medication Name" : "Atenolol 40mg tabs"

"Parsable dose direction" :  "1 m"
```

Atenolol – oral - 40mg in the morning

```
"Medication Name": "Atenolol"

"Route": "oral"

"Parsable dose direction" :"40mg m"
```

Salbutamol inhaler 1-2 puffs as required for wheeze

```
"Medication Name": "Salbutamol"

"Route": "inhaled"

"Parsable dose direction":"1-2p prn"

"Additional instruction": "for wheeze"
```

Paracetamol liquid oral 125mg/5mls 5-10mls up to every 4-6 hours as required for pain or fever, maximum 40mls in 24 hrs

```
"Medication Name": "Paracetamol liquid 125mg/5mls"

"Route": "oral"

"Parsable dose direction": " 5-10ml ^4h\6h prn [40ml h24]

"Additional instruction": "for pain or fever"
```

Enalapril – oral - 2.5mg once daily for 2 days, then 5mg once daily for 7 days, then 10 mg once daily indefinitely

```
"Medication Name": "Enalapril"

"Route": "oral"

"Parsable dose direction": "2.5mg od:2d;5mg od:7d;10mg od:ind"
```

Enalapril 2.5mg tablets once tab daily for 2 days, then 2 tabs daily for 7 days then 4 tabs daily, do not discontinue

```
"Medication Name": "Enalapril tablets 2.5mg"

"Parsable dose direction": "1 od:2d;2 od:7d;4 od:dnd"
```

2 Dose Timing Clause

Dose Timing is expressed as one or more Daily time points e.g. “in the morning”, or as an Interval Frequency/Range e.g. “4-6 hourly”. Dose timing can contain these elements:

a DailyTimePoint
- Named TimePoint or
- Hour Timepoint

b Interval Frequency
- Interval Frequency Range

c Daily repetitions

d Timing Modifiers
- Maximum frequency prefix
- As required suffix

2a Specific Daily Time Points

Dose timing may be expressed as specific daily time points, either:
Named Time Points “in the morning” or at Hour Time Points “at 10pm”

Minute can also be specified, following a fullstop separator.

Named Time points *complete list*

```
!     now,_immediately (traditionally "stat")
m     in the morning
n     at night
mn    in the morning_and_at night
pm    in the afternoon
e     in the evening
b     at breakfast
l     at lunch
t     at tea
d     at dinner
c     with each meal
mm    with main meal
```

Hour Time Points

```
0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23
```

Specifies the hour according to the 24 hour clock. Minutes may be specified after a decimal point e.g. 23.15

The hour timepoint should be preceded by an @ sign

```
e.g.  @0 = 12 am
      @8 = 08.25
      @23 = 23.00
```

Multiple specific time points, either named or hour or mixed, may be specified, each separated by “+” e.g. @0+@23

Examples:

Dose syntax	Human Readable form
1 m	1 dose in the morning
20mg @16	20mg at 4pm
2 b+d+@21+@23.15	2 doses at breakfast, at dinner, at 9pm and at 23.15
1 !+@18.30	1 dose now and one at 18.30

2b Interval frequency

```
hh    every 30 minutes
h1    every hour
h2    every 2 hours
h3    every 3 hours
h4    every 4 hours
h5    every 5 hours
h6    every 6 hours
h7    every 7 hours
h8    every 8 hours
h12   every 12 hours
h18   every 18 hours
h24   every 24 hours
od    once a day; daily
bd    twice a day
td    three times a day
qd    four times a day
pd    five times a day
hd    six times a day
```

Interval Frequency range

Frequencies may be expressed as a range, separated by '\'

e.g. `h6\h8` `6 to 8 hours`
`od\bd` `once daily to twice daily`

This "Interval frequency" is defined within a 24-hr dosage pattern

Examples

Dose syntax	Human Readable form
1 od	1 dose once a day
20mg h4\h6	20mg every four to six hours
6 h18	6 doses every 18 hours

2c Daily Repetitions

Each set of dose pattern clauses is assumed to represent the dosage pattern to be repeated on a daily basis. If this is not the case, a 'daily repetition' may be specified, introduced by a **comma ,** character.

```
d     daily (default)
oo    one single dose only
ad    alternate days
d3    every 3 days
d4    every 4 days
```

```
d5     every 5 days
d6     every 6 days
ow     once a week
bw     twice a week
tw     three times a week
qw     four times a week
pw     five times a week
hw     six times a week
om     once a month
w2     every 2 weeks
w3     every 3 weeks
```

Examples

Dose syntax	Human Readable form
1 od,ad	1 dose once daily, alternate days
20mcg h12,d5	20 micrograms every 12 hours, every 5 days
1-2 h12,ow	1-2 tablets every 12 hours, once per week
1 m&2 e,ad	1 dose in the morning and 2 in the evening, alternate days
1 !+@18.30	1 dose now and one at 18.30

2d Timing Modifiers

Maximum frequency prefix

Frequencies may have a prefix of " **^** " as "up to" or "maximum"

```
e.g.   ^h6          up to every 6 hours
       ^bd\td       maximum of twice daily to three times daily
```

'As required' qualifier

An "as required" qualifier clause may be added "**prn**", separated from the preceding clause by a space character.

```
e.g.   4h\6h prn    Every 4 to 6 hours as required
       1 prn        1 dose as required
```

The related reason or trigger for the 'as required' clause should be carried in the 'Additional instruction' element of the medication archetype. Note that this is normally the symptom or other trigger that should prompt the patient to take the medication e.g. 'for headache', 'for nausea' rather than the clinical 'indication' e.g. 'Migraine', 'on chemotherapy', though in practice there may be considerable crossover. The 'Indication' is carried as part of the parent Medication Order archetype.

2 Dose Timing summary : examples

Dose syntax	Human Readable form
3 od	3 doses once a day
20mg td\qd	20mg three to four times
2p h8	2 puffs every 8 hours
1-2 ^h4\h6 prn	1-2 doses up to every 4-6 hours as required
2d ^td prn	2 drops, up to 3 times a day as required
2 b+d+@21+@23.20	2 doses at breakfast, at dinner, at 9pm & at 11.20pm

3 Dose Direction Duration Clause

The 'Dose Direction Duration' applies to the length of time for which the Dose Direction applies, not the duration of the whole course of medication (Course Duration) or the duration of time over which a single dose of the medication should be given (Dose Duration)

Dose Direction Duration is separated from the preceding Dose Pattern clauses by a **colon ":"** character.

Dose Direction Durations

```
d days
w weeks
h hours
m months
ind Continue indefinitely
dnd Do not discontinue
```

Multiple Dose Duration Directions are separated by semicolon **";"** character.

Examples

Dose syntax	**Human Readable form**
1 td:7d	1 dose three times daily for 7 days
40mg @9:ind	40mg at 9am, continue indefinitely
2m&3n:dnd	2 doses in the morning and three doses at night; Do not discontinue.
1 td:1w;2 td:ind	1 tab three times per day for 1 week, THEN 2 tabs three times per day indefinitely

4 Maximum Dose Clause

The Maximum Dose clause specifies the maximum quantity of medication that should be administered within a defined period of time. The maximum amount is specified using the same syntax as for the Dose Amount clause, and the duration to which the maximum amount is applied is expressed using the same syntax as the Dose Duration clause.

Maximum Dose is separated from the preceding clause by square brackets

```
e.g.  [4 24h]          Maximum 4 doses in 24 hours
      [80g 1w]         Maximum 80g in 1 week
      [6 LIFE]         Maximum 6 doses life-long]
```

Example

Dose syntax	**Human Readable form**
1-2 4h\6h [8 24h]	1 to 2 doses every 4 to 6 hours. Maximum of 8 doses in 24 hours

Full instruction examples

These examples show the full dose direction expressed in the context of the medication item archetype in both XML and JSON formats with dm+d/ Snomed CT coding included.

A. "Paracetamol 500mg tablet 1-2 tablets up to 4-6 hourly as required for knee pain for 14 days [Maximum 8 tablets in 24 hrs]. Take with food.

– product-based prescription (as per Primary Care)

JSON

```
"Medication Item"
      {
      "Medication name": "|322236009|Paracetamol 500mg tablets|"
       "Dose direction description" :"1-2 tablets, up to 4-6
       hourly for 14 days, maximum 8 tablets in 24 hours, for
       knee pain, take with food",
       "Parsable dose direction": "1-2 ^h4\h6 prn:7d [8 h24]
      "Additional instruction":
            [
            "for knee pain",
            "take with food"
            ]
      }
```

XML

```
<Medication Item>
      <Medication Name>|322236009|Paracetamol 500mg
tablets|</Medication Name>
      <Dose direction description>1-2 tablets, up to 4-6 hourly
for 14 days, maximum 8 tablets in 24 hours, for knee pain, take
with food </Dose direction description>
      <Parsable dose direction>1-2 ^h4\h6 prn:7d [8 h24]</Parsable
dose direction>
</Medication Item>
```

B. Simvastatin 20mg one tablet at night – product-based prescription (as per Primary Care)

JSON

```
"Medication Item":
      {
      "Medication Name": "|319997009|Simvastatin 20mg tablets|",
      "Dose direction description" :"one tablet at night",
      "Parsable dose direction": "1 n"
       }
```

XML:

```
<Medication Item>
      <Medication Name>|319997009|Simvastatin 20mg
tablets|</Medication Name>
      <Dose direction description>one tablet at night</Dose
direction description>
      <Parsable dose direction>1 n</Parsable dose direction>
</Medication Item>
```

C. Simvastatin oral 20mg at night – product-based prescription (as per Primary Care)

{

JSON

```
 "Medication Item":
      {
      "Medication Name": "|96304005|Simvastatin|",
      "Route": "| 26643006 |oral|",
      "Dose direction description": "20mg at night",
      "Parsable dose direction": "20mg n"
       }
```

XML

```
<Medication Item>
   <Medication Name>|96304005|Simvastatin|</Medication Name>
      <Dose direction description>20mg at night</Dose direction description>
      <Parsable dose direction>20mg n</Parsable dose direction>
</Medication Item>
```

D. Salbutamol 100 micrograms breath actuated inhaler CFC free, two puffs as required for wheeze – product-based prescription (as per Primary Care)

JSON

```
"Medication Item":
      {
      "Medication Name": "|320151000|Salbutamol 100micrograms/dose breath actuated inhaler CFC free|",
      "Dose direction description" : "two puffs as required; for wheeze",
      "Parsable dose direction": "2p prn",
      "Additional instruction":
      [
      "for wheeze"
      ]
```

XML

```
<Medication Item>
      <Medication Name>|320151000|Salbutamol 100micrograms/dose breath actuated inhaler CFC free|</Medication Name>
      <Dose direction description>two puffs as required; for wheeze</Dose direction description>
      <Parsable dose direction>2p prn</Parsable dose direction>
      <Additional instruction>for wheeze</Additional instruction>
</Medication Item>
```

E. Enalapril - oral - 2.5mg at night for 2 days, then 2.5mg in the morning and 5mg at night for 1 week, then 10mg at night indefinitely – product-based prescription (as per Primary Care)

JSON

```
 "Medication Item":

      {

"Medication Name": "| 25835014|Enalapril|",

      "Route": "| 26643006 |oral|",

      "Dose direction description": "2.5mg at night for 2 days,
then 2.5mg in the morning and 5mg at night for 1 week, then 10mg
at night indefinitely",

      "Parsable dose direction": "2.5mg n:2d;2.5mg m&5mg n:1w;10mg
n:ind"

       }
```

XML

```
<Medication Item>

   <Medication Name>| 25835014|Enalapril |</Medication Name>

      <Dose direction description>2.5mg at night for 2 days, then
2.5mg in the morning and 5mg at night for 1 week, then 10mg at
night indefinitely </Dose direction description>

      <Parsable dose direction>2.5mg n:2d;2.5mg m&5mg n:1w;10mg
n:ind </Parsable dose direction>

</Medication Item>
```

F1. Gabapentin – oral - 300mg - dose-based prescription (as per hospital)

Oral 300mg at night for one day, then 300mg in the morning and at night for one day, then 300mg three times a day for one day, then 300mg in the morning, 300mg in the afternoon and 600mg at night for 4 days, then 600mg in the morning, 300mg in the afternoon and 600mg at night for 1 day, then 600mg three times a day indefinitely.

{

JSON


```
 "Medication Item":

      {

      "Medication Name":|172936018 | Gabapentin",

      "Route": "| 26643006 |oral|",

      "Dose direction description": "300mg at night for one day, then 300mg in the morning and at night for one day, then 300mg three times a day for one day, then 300mg in the morning, 300mg in the afternoon and 600mg at night for 4 days, then 600mg in the morning, 300mg in the afternoon and 600mg at night for 1 day, then 600mg three times a day indefinitely",

      "Parsable dose direction": "300mg n:1d;300mg m+n:1d;300mg td:1d;300mg m+pm&600mg n:4d;600mg m&300mg a&600mg n;600mg td:ind"

       }
```


XML


```
<Medication Item>

   <Medication Name> |172936018 | Gabapentin |</Medication Name>

      <Dose direction description>300mg at night for one day, then 300mg in the morning and at night for one day, then 300mg three times a day for one day, then 300mg in the morning, 300mg in the afternoon and 600mg at night for 4 days, then 600mg in the morning, 300mg in the afternoon and 600mg at night for 1 day, then 600mg three times a day indefinitely>

      <Parsable dose direction>300mg n:1d;300mg m+n:1d;300mg td:1d;300mg m+pm&600mg n:4d;600mg m&300mg a&600mg n;600mg td:ind
</Parsable dose direction>

</Medication Item>
```

F2. Gabapentin 300mg capsule – product-based prescription (as per Primary Care)

1 capsule at night for one day, then 1 capsule in the morning and at night for one day, then 1 capsule three times a day for one day, then 1 capsule in the morning, 1 capsule in the afternoon and 2 capsules at night for 4 days, then 2 capsules in the morning, 1 capsule in the afternoon and 2 capsules at night for 1 day, then 2 capsules three times a day indefinitely.

JSON

```
 "Medication Item":

{

      "Medication Name: "|464738012 | Gabapentin 300mg capsule |",

      "Route": "| 26643006 |oral|",

      "Dose direction description": "1 capsule at night for one day,
      then 1 capsule in the morning and at night for one day, then 1
      capsule three times a day for one day, then 1 capsule in the
      morning, 1 capsule in the afternoon and 2 capsules at night for 4
      days, then 2 capsules in the morning, 1 capsule in the afternoon
      and 2 capsules at night for 1 day, then 2 capsules three times a
      day indefinitely",

      "Parsable dose direction": "1 n:1d;1 m+n:1d;1 td:1d;1 m+pm&2
      n:4d;2 m&1 a&2 n;2 td:ind"

             }
```

XML

```
      <Medication Item>

         <Medication Name>

            |464738012 | Gabapentin 300mg capsule |

        </Medication Name>

            <Dose direction description>1 capsule at night for one day,
      then 1 capsule in the morning and at night for one day, then 1
      capsule three times a day for one day, then 1 capsule in the
      morning, 1 capsule in the afternoon and 2 capsules at night for 4
      days, then 2 capsules in the morning, 1 capsule in the afternoon
      and 2 capsules at night for 1 day, then 2 capsules three times a
      day indefinitely >

            <Parsable dose direction>1 n:1d;1 m+n:1d;1 td:1d;1 m+pm&2
      n:4d;2 m&1 a&2 n;2 td:ind</Parsable dose direction>

      </Medication Item>
```

Appendix 3 CfH Medicines Order Sentences for Acute Adult Care (extract)

Abacavir	600	mg	Oral	once a day	600mg od
Abacavir	300	mg	Oral	twice a day	300mg bd
Abacavir 20mg/ml oral solution sugar free	600	mg	Oral	once a day	30ml od
Abacavir 20mg/ml oral solution sugar free	300	mg	Oral	twice a day	15ml bd
Abacavir 300mg tablets	600	mg	Oral	once a day	2 od
Abacavir 300mg tablets	300	mg	Oral	twice a day	1 bd
Abacavir 600mg / Lamivudine 300mg tablets	1	tablet	Oral	once a day	1 od
[Abatacept 250mg powder for solution for injection vials	*500*	*mg*	*Intravenous*	*once only*	*Out-of-scope]*
[Abatacept 250mg powder for solution for injection vials	*750*	*mg*	*Intravenous*	*once only*	*Out-of-scope]*
[Abatacept 250mg powder for solution for injection vials	*1*	*G*	*Intravenous*	*once only*	*Out-of-scope]*
Abidec Multivitamin drops (Chefaro UK Ltd)	0.6	mL	Oral	once a day	0.6ml od
Acamprosate	666	mg	Oral	three times a day	666mg td
Acamprosate 333mg gastro-resistant tablets	666	mg	Oral	three times a day	2 td
Acarbose	50	mg	Oral	once a day	50mg od
Acarbose	50	mg	Oral	twice a day	50mg bd
Acarbose	50	mg	Oral	three times a day	50m td
Acarbose	100	mg	Oral	three times a day	100mg td
Acarbose	200	mg	Oral	three times a day	200mg td
Acarbose 100mg tablets	100	mg	Oral	three times a day	1 td
Acarbose 100mg tablets	200	mg	Oral	three times a day	2 td

Appendix 4 – GP System Dose abbreviations or "Shortcut codes"

These abbreviations are used as text expansion macros to aid data entry, and are generally user-configurable. This table lists these with their expanded text supplied by 2 major GP systems to accelerate the keyboard entry of text medication directions.
These therefore are the text elements that have evolved as most frequently used by GPs.

The further columns show if each text item is used by either or both system suppliers, and if
"Admin": administrative content that would now be normally addressed by the dispensing pharmacist, e.g. via the BNF's systems of Cautionary and Advisory labels used in all pharmacy dispensing systems, or supported by the mandatory Patient Information Leaflet
"dm+d": pharmaceutical information on the drug: this is now already carried in the dm+d data at AMP level or below, and may also be in the PIL
"Indicn": refers to an "indication" or "as required reason": that is normally also in the PIL.
"Site": refers to a site: this is generically in the PIL
If any of the above are specified other than generically i.e. other than in dm+d or PIL data, this can be held elsewhere in the archetype as an Additional instruction.

INPS "Code"	Expansion InPS	TPP "Dose Shortcuts"	Expansion TPP	Admin e.g. PIL	dm+d	Indicn	Site
cc	with meals	cc	with food				
tu	when cough troublesome	tu	when cough is troublesome			1	
prn	when required	prn	when required				
wk	week	w/wy	week(s)				
ad	up to	ad	up to				
*	to	*	up to				
sl	dissolved under the tongue	sl	under the tongue	1			1
bb	twice	bb	twice				
tid/tds	three times a day	tid/tds	to be taken three times a day				
qds	four times a day	qds	to be taken four times daily				
qqh	every four hours	qqh	to be taken every four hours				
mane	in the morning	mane	to be taken each morning				
ac	before food	ac	to be taken before food				
paa	to be applied to affected part	paa	to be applied to affected part	1			
x	times	x	times				
th	then	th	then				
liq	the solution	liq	the solution		1		
oc	the eye ointment	oc	the eye ointment		1		
tab	tablet(s)	tab	tablet		1		
sp	sparingly	sp	sparingly				
rn	to right nostril	rn	right nostril				1

INPS "Code"	Expansion InPS	TPP "Dose Shortcuts"	Expansion TPP	Admin e.g. PIL	dm+d	Indic n	Site
re	to right eye	re	right eye				1
ra	to right ear	ra	right ear				1
puf	puff(s)	p/puf	puff(s)				
pv	per vagina	pv	per vagina	1			1
pr	per rectum	pr	per rectum	1			1
-	or	-	or	1			
es	on an empty stomach	es	on an empty stomach	1			
eax	not in water	ax	not in water	1			
min	minutes	m	minute(s)				
midd	at midday	mid	midday				
ln	to left nostril	ln	left nostril	1			1
le	to left eye	le	left eye	1			
	to left ear	la	left ear	1			
ins	insert	ins	insert	1			
inh	to be inhaled	inh	inhale	1			
ms	in the usual manner	ms	in the usual manner	1			
stat	immediately	stat	immediately				
hr	hour	h	hour(s)				
ss	half	ss	half				
fv	for vomiting	fv	for vomiting			1	
fl	for loose motions	fl	for loose motions			1	
fi	for indigestion	fi	for indigestion			1	
fg	for giddiness	fg	for giddiness			1	
ff	for fluid retention	ff	for fluid retention			1	
fch	for chest pain	fch	for chest pain			1	
fb	for breathing	fb	for breathing			1	
ah	every other hour	ah	every other hour				
alt	every other day	alt	every other day				
om	every morning	om/am	every morning				
ol	every month	ol	every month				
oh	every hour	oh	every hour				
od	every day	od	every day				
ev	every	ev	every				
eve	evening	pm	evening				
en	to each nostril	en	each nostril	1			1
ee	to each eye	ee	each eye	1			1
ea	to each ear	ea	each ear	1			1
ai/exaq/aq	dissolved in /with water	ai/aq	dissolved in water/with water	1			
dir/mds/mdu	directed / as dir	dir	directed				
dy	day	d/dy	day(s)/daily				
hd	at bedtime	hd	at bedtime				
apl/ applic	to be applied	apl/ applic	apply / to be applied				
&	and	&	and				

INPS "Code"	Expansion InPS	TPP "Dose Shortcuts"	Expansion TPP	Admin e.g. PIL	dm+d	Indic n	Site
amp	ampoule	amp	ampoule		1		
pc	after food	pc	after food				
af	after	af	after				
on/nocte	at night	noc/nocte	(to be taken each) night				
bd/bis	twice a day	(a)bd	(apply) to be taken twice daily				
aur	to the ear	aa/aur	(affected) ear	1			1
ao	as shown on the pack	ao	as shown on the pack	1			
		s	without	1			
		c	with	1			
		pds	to be taken five times daily				
		ml	ml		1		
		hy	hourly				
		dd	dispense on date prescribed	1			
		atds	apply three times a day				
		aod	apply once a day				
		aqds	apply four times a day				
		ap	affected part	1			1
		ae	affected eye	1			1
		1n	1 to be taken at night				
		mnip	***not in possession***	1			
rt	reducing to	rt	reducing to	1			
it	increasing to			1			
aa	of each			1			
of	every fortnight						
mds/mdu	as directed			1			
mh	Month			1			
neb	the spray				1		
collut	the mouth-wash				1		
crem	the cream				1		
comp	the compound				1		
fn	for the nerves					1	
fh	for the heart					1	
ft	for tension					1	
fr	for rheumatism					1	
pain	for pain					1	
fj	for joints					1	
fe	for eczema					1	
fd	for diabetes					1	
fc	for constipation					1	
fa	for asthma					1	
gtt	drops				1		
an	antibiotic				1		

Appendix 5

Proposed Reduced EBNF2 dose syntax *[technical description]*

The revised syntax has not been checked for technical parsibility.
It is possible that a more modern parsing formalism such as ANTLR is preferred.

Example BNF dosage specification (ISO/IEC 14977 format) compliant with object model

The example dosage specification is described using the syntactic meta-language: Extended BNF. The defining document for EBNF is ISO/IEC 14977: 1996(E) and there is an overview at:

http://en.wikipedia.org/wiki/Extended_Backus%E2%80%93Naur_Form

The following BNF rules are intended to permit a parser to create a set of object instances that can then be transformed or interpreted as required.

The DayTimePoint
defines a specific time of day, possibly multiple, at which the medication should be taken

The DayTimePointSymbol may be a NamedTimePoint or an HourTimePoint

NamedTimePoint

```
(*
Terminals implement attribute time_in_day of class DayTimePointSymbol
!     immediately ('stat')
@     at directed time (e.g @8 = at 0800, @19 = at 1900)
m     in the morning
n     at night
mn    in the morning_and_at night
pm    in the afternoon
e     in the evening
b     at breakfast
l     at lunch
t     at tea
d     at dinner
c     with each meal
mm    with main meal
*)

NamedTimePoint =
      ('!'|'@'|'m'|'n'|'mn'|'pm'|'m'|'e'|'b'|'l'|'t'|'d'|'c'|'mm');

(* HourTimePoint Terminals implement attribute hour_of_day*)
HourTimePoint = '0'|'1'|'2'|…|'23';

(* DailyTimePoint Generalisation (superclass) of NamedTimePoint and
HourTimePoint.*)

DailyTimePoint = NamedTimePoint | HourTimePoint;

(* TimePointFrequency  This rule implements the multiplicity 1..* for
the role times_of_day *)

TimePointFrequency = DailyTimePoint, {'+', DailyTimePoint};
```

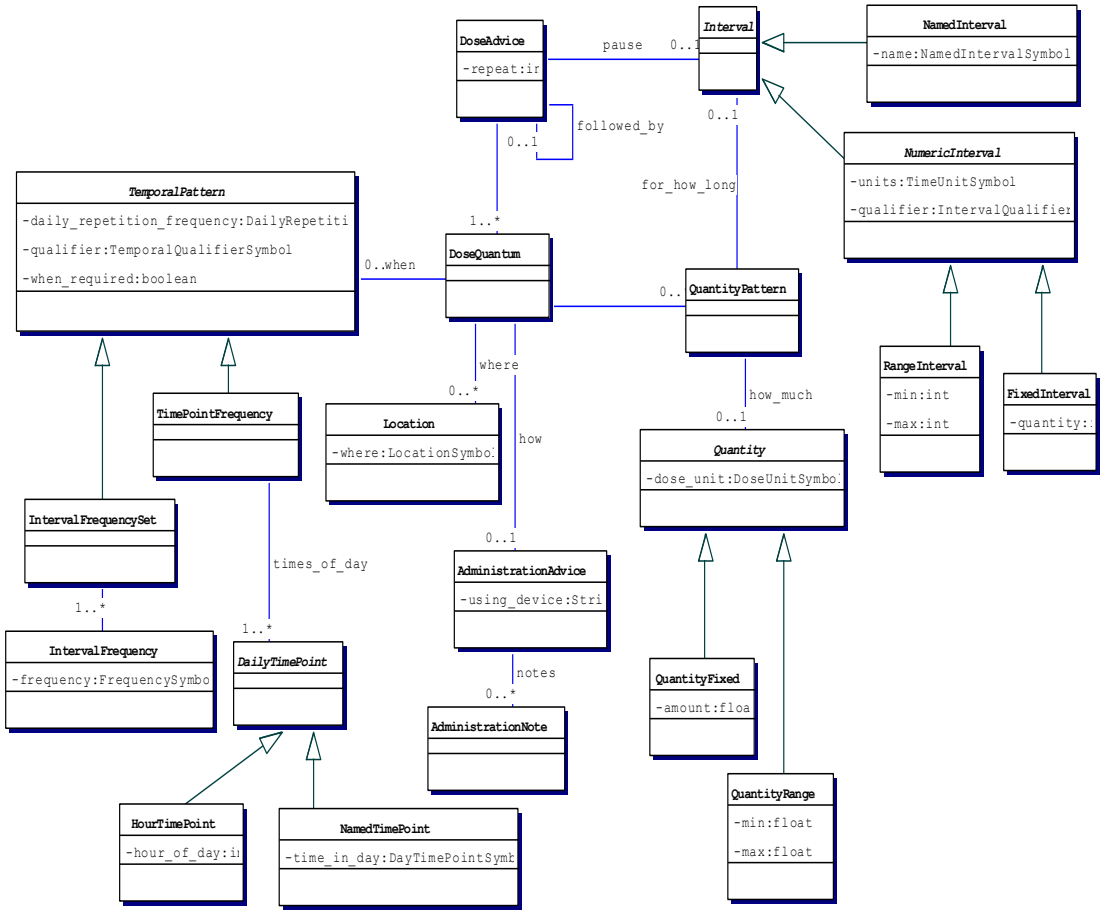
```
(* IntervalFrequency Terminals implement attribute frequency of class
FrequencySymbol
hh    every 30_minutes
h1    every hour
h2    every 2 hours
h3    every 3 hours
h4    every 4 hours
h5    every 5 hours
h6    every 6 hours
h8    every 8 hours
h12   every 12 hours
h18   every 18 hours
h24   every 24 hours
od    once a day
bd    twice a day
td    three times a day
qd    four times a day
pd    five times a day
hd    six times a day
*)

IntervalFrequency
      ('hh'|'h1'|'h2'|'h3'|'h4'|'h5'|'h6'|'h8'|'h12'|'h18'|'h24'|'hd'|'
      pd'|'qd'|'td'|'bd'|'od');


(* IntervalFrequencySet
This rule implements the multiplicity 1..* for the role
selected_frequencies
*)

IntervalFrequencySet =
      IntervalFrequency, {'\', IntervalFrequency};


(* DailyRepetition Terminals implement attribute
daily_repetition_frequency of class DailyRepetitionSymbol
d     daily (default)
oo    once only
ad    alternate days
d3    every 3 days
d4    every 4 days
d5    every 5 days
mwf   Monday, Wednesday, Friday
tts   Tuesday, Thursday, Saturday
ow    once a week
bw    twice a week
tw    three times a week
qw    four times a week
om    once a month
*)

DailyRepetition =
      ('d'|'oo'|'ad'|'d3'|'d4'|'d5'|'qw'|'tw'|'bw'|'ow'|'om'|'mwf'|'tts'
);
```

```
(* TemporalPattern
The attributes qualifier of class TemporalQualifierSymbol and
when_required of class Boolean are built into this TemporalPattern rule:
prn   when required
*)

TemporalPattern =
      (TimePointFrequency|IntervalFrequencySet),[DailyRepetition],
['prn'];

(* DoseUnitSymbol
Terminals implement attribute dose_unit of class DoseUnitSymbol
NB: List incomplete*)

DoseUnitSymbol =
'g'|'ug'|'mg'|'kg'|'l'|'ml'|'p'|'d'|'s'|'OP'|'CP'|'Mu'|'u'|'cm'|'in';

(* Quantity*)

Quantity =
      (QuantityFixed | QuantityRange), [DoseUnitSymbol];

(* TimeUnitSymbol
Terminals implement attribute units of class TimeUnitSymbol
*)

TimeUnitSymbol = 'h'|'d'|'w'|'m';

(* NumericInterval
The attribute qualifier of class IntervalQualifierSymbol is built into
NumericInterval.
^     up to
*)

NumericInterval =
      ['^',
      (FixedInterval | RangeInterval), TimeUnitSymbol


(* Interval
Generalisation (superclass) of NamedInterval and NumericInterval
*)

Interval =
      ':', (NamedInterval | NumericInterval);

(* DosePattern
NB: Both Quantity and TemporalPattern can be null
*)

DosePattern = [Quantity], [TemporalPattern];

DoseDirection =
      DosePattern, {'&', DosePattern},

DoseInstruction =
      DoseDirection, {';', DoseDirection}, DoseMaximum;
```

Appendix 6

Original Univ. Dundee EBNF2 dose syntax and class model *[technical description]*

Class model diagram



Example BNF dosage specification (ISO/IEC 14977 format) compliant with object model

MMM – 12/07/2000

The example dosage specification is described using the syntactic meta-language: Extended BNF. The defining document for EBNF is ISO/IEC 14977: 1996(E) the original of which can be found at:

http://www.cl.cam.ac.uk/~mgk25/iso-14977.pdf

The following BNF rules are intended to permit a parser to create a set of object instances that can then be transformed or interpreted as required.

```
(* NamedTimePoint
Terminals implement attribute time_in_day of class DayTimePointSymbol
!     now_immediate
?     patient_choice
at    at_directed_time
m     (early) morning
n     night
mn    morning_and_night
am    am (morning)
pm    afternoon
e     evening
b     breakfast
l     lunch
t     tea
d     dinner
c     any_meal
os    onset_of_symptom
es    end_of_symptom
ms    menstruation
bm    bowel_movement
ai    after_intercourse
*)

NamedTimePoint =
      ('!'|'?'|'at'|'m'|'n'|'mn'|'pm'|'am'|'e'|'b'|'l'|'t'|'d'|'c'|'os'|'es
      '|'ms'|'bm'|'ai');

(* HourTimePoint Terminals implement attribute hour_of_day*)
HourTimePoint = '0'|'1'|'2'|…|'23';

(* DailyTimePoint Generalisation (superclass) of NamedTimePoint and
HourTimePoint.*)

DailyTimePoint = NamedTimePoint | HourTimePoint;

(* TimePointFrequency  This rule implements the multiplicity 1..* for the
role times_of_day *)

TimePointFrequency = DailyTimePoint, {'+', DailyTimePoint};


(* IntervalFrequency Terminals implement attribute frequency of class
FrequencySymbol
hh    every_30_minutes
h1    every_hour
h2    every_2_hours
…
od    once_a_day
```

```
bd    twice_a_day
td    three_times_a_day
qd    four_times_a_day
pd    five_times_a_day
hd    six_times_a_day
*)

IntervalFrequency
      (|'hh'|'h1'|’h2’|'h3'|'h4'|’h5’|'h6'|'h8'|’h12’|’h18’|’h24’|‘hd’|'
      pd'|'qd'|'td'|'bd'|'od');

(* IntervalFrequencySet
This rule implements the multiplicity 1..* for the role
selected_frequencies
*)
IntervalFrequencySet =
      IntervalFrequency, {'\', IntervalFrequency};

(* DailyRepetition Terminals implement attribute daily_repetition_frequency
of class DailyRepetitionSymbol
d     daily (default)
ad    alternate_days
d3    every_3_days
…
mwf   Monday, Wednesday, Friday
ow    once_a_week
bw    twice_a_week
…
om    once_a_month
*)

DailyRepetition =
      (‘d’|'ad'|'d3'|'d4'|'d5'|'qw'|'tw'|'bw'|'ow'|'om'|'w2'|'mwf');

(* TemporalPattern
The attributes qualifier of class TemporalQualifierSymbol and when_required
of class Boolean are built into this TemporalPattern rule:
^     up to
!     maximum!
prn   when_required
*)

TemporalPattern =
      [‘^’|’!’],
      (TimePointFrequency|IntervalFrequencySet),[DailyRepetition], [‘prn’];

(* DoseUnitSymbol
Terminals implement attribute dose_unit of class DoseUnitSymbol
NB: List not complete*)
DoseUnitSymbol =
'g'|'ug'|'mg'|'kg'|'l'|'ml'|'p'|'d'|'s'|'OP'|'CP'|'Mu'|'u'|'mg/kg'|'ml/kg’|
'/kg’|'cm'|'in';

(* Quantity*)
Quantity =
      (QuantityFixed | QuantityRange), [DoseUnitSymbol];

(* TimeUnitSymbol
Terminals implement attribute units of class TimeUnitSymbol
*)
TimeUnitSymbol = ‘h’|’d’|’w’|’m’;
```

```
(* NumericInterval
The attribute qualifier of class IntervalQualifierSymbol is built into
NumericInterval.
^     up to
[     no more than!
*)
NumericInterval =
      ['^'|'['],
      (FixedInterval | RangeInterval), TimeUnitSymbol

(* NamedInterval
Terminals implement attribute name of class NamedIntervalSymbol
i     initially
ub    until_better
req   while_required
*)
NamedInterval = 'i'|'ub'|'req';

(* Interval
Generalisation (superclass) of NamedInterval and NumericInterval
*)
Interval =
      ':', (NamedInterval | NumericInterval);

(* AdministrationSymbol
Terminals implement attribute caution of class AdministrationSymbol
us    use_sparingly
cc    with_food
pc    after_food
ac    before_food
pc1   up_to_one_hour_after_food
ic    between_meals
vs    on_an_empty_stomach
dw    dissolved_in_water
wf    with_fluid
sd    as_a_single_dose
bc    added_to_food
sw    swallow_whole
md    as_directed
mdd   as_directed_by_your_doctor
mdi   follow_instructions_in_pack
*)
AdministrationSymbol =
'us'|'cc'|'pc'|'ac'|'pc1'|'ic'|'vs'|'dw'|'wf'|'sd'|'bc'|'sw'|'md'|'mdd'|'md
i';

(* UsingDevice
NB: Device list from dictionary?
NB: Not implemented in this BNF
*)
UsingDevice = string;

(* AdministrationAdvice*)
AdministrationAdvice =
      [UsingDevice], {AdministrationSymbols};

(* Location
Arbitrary user string? Implements attribute where of class LocationSymbol
NB: Not implemented in this BNF
*)
```

```
Location = string;

(* QuantityPattern
NB: Both Quantity and TemporalPattern can be null
*)
QuantityPattern = [Quantity], [TemporalPattern];

RepeatCount = positive integer;

(* DoseQuantum
Basic dose instruction.
*)
DoseQuantum =
      QuantityPattern, {'&', QuantityPattern},
      {Location}, [AdinistrationAdvice], [Interval];

(* DoseRegimen
For reasons of simplicity the object model class DoseAdvice has been broken
into two rules: DoseRegimen and DoseAdvice.
*)
DoseRegimen =
      DoseQuantum, ['*', RepeatCount, Interval];

(* DoseAdvice *)
DoseAdvice =
      DoseRegimen, {';', DoseRegimen};
```