HEALTHCARE GROUP

PRESCRIBING DECISION SUPPORT USING SNOMED CT

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Outline

• SNOMED CT and Decision Support

• LORENZO
  – Medication Management Functionality
  – Prescribing Decision Support

• Experience to date
SNOMED CT and its Benefits

• Comprehensive clinical terminology

• One of its key stated benefits is to facilitate decision support\(^1\)

• However there is very limited published literature about the implementation of decision support based on SNOMED CT

\(^1\)http://www.ihtsdo.org/snomed-ct/whysnomedct/benefits/
Prescribing Decision Support Benefits

• Numerous studies have proven the actual and potential benefits of the implementation of computerised prescribing decision support

• One US study showed that serious medication error rate can be reduced by 55-80% through computerisation

• In 2007, the National Patient Safety Agency in England estimated that medication error rates cost GBP774m annually to the NHS
  – Of these, 72% are avoidable through computerised prescribing and use of prescribing decision support
Key Prescribing Decision Support Features

- Drug interaction checking
- Drug allergy checking
- Drug contraindication checking
- Drug duplication checking
LORENZO

- LORENZO is CSC’s strategic electronic patient record system
- Multi-professional multi-specialty multi-care setting
- Deployed in UK and the Netherlands to date
- Comprises both administrative and clinical functionality
Key LORENZO Clinical Functionality

• Clinical statements
  – Allergies
  – Problems
  – Procedures

• Medication management
  – Outpatient prescribing
  – Discharge prescribing
  – Inpatient prescribing
  – Electronic medicines administration
SNOMED CT in LORENZO

- First release of LORENZO targeted for NHS in England

- National Programme for Information Technology (NPfIT) in England stipulated use of SNOMED CT

- Hence SNOMED CT was chosen as clinical terminology for clinical data in LORENZO in NHS England

- SNOMED CT is used to support LORENZO clinical statements like allergies, problems and procedures as well as prescription recording
  - Prescription recording is based on Dictionary of Medicines and Devices (dm+d) which forms part of the SNOMED CT UK Drug Extension
Recording Problems in LORENZO

GREEN, Gavin (Master) Male DOB: 12-Nov-2004 8 Yrs Patient ID: HPASID-00000000386

Allergies/ADRs - None Recorded (Not Checked On 27-Sep-2013)

Information is only available from your own organisation because this patient is locally registered.

Master problem list

- Problem name: Acute Q fever
- Problem code: 409553007
- Problem type: Diagnosis
- Status: Active
- Onset date: 03/08/2013

Details

- Problem type: Diagnosis
- Inactive: 
- Problem name/code: Age-related cataract[39450006]
- Onset date: Not known
- Onset date: 27 Sep 2013

Bodysite

- Eyeball

Laterality

- Left

Sub type

- Problem description

Scope

02/Sept/13 PAEDIATRICS, ...

Return to Wizard

DANIEL, Williams, administrator Role

HUMBER NHS FOUNDATION TRUST
Recording Allergies in LORENZO

**GREEN, Gavin (Master) Male DOB: 12-Nov-2004 8 Yrs Patient ID: HPASID-000000000386**

**Allergies/ADRs - None Recorded (Not Checked On 27-Sep-2013)**

<table>
<thead>
<tr>
<th>Allergy type</th>
<th>Drug Allergy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allergen</td>
<td>Penicillin</td>
</tr>
<tr>
<td>Reaction</td>
<td>Anaphylactic reaction</td>
</tr>
<tr>
<td>Severity</td>
<td>Moderate to severe</td>
</tr>
</tbody>
</table>

**Confidence level**
- Term not selected

**Manage problem**
- Not selected

**MHRA form**
- Fill in MHRA form

**Recorded by**
- daniel.williams

**Recorded date/time**
- 27 September 2013 10:06

**Is significant**
- Not selected

**Information source**
- Not selected

**Comments**
- Not selected

**Status**
- Open

**Closed date**
- Not selected

**Date**
- Not selected

**Month/Year**
- Not specified
Recording Procedures in LORENZO

**Patient Information**
- **Name:** GREEN, Gavin (Master)
- **Gender:** Male
- **DOB:** 12-Nov-2004
- **Age:** 8 yrs
- **Patient ID:** HPASID-000000000386
- **Allergies/Adverse Reactions:** None recorded (not checked on 27-Sep-2013)

**Procedure Details**
- **Date and Time:** 27/09/2013
- **Body Site:** Lens of eye
- **Laterality:** Left
- **Procedure:** Phacoemulsification of cataract with intraocular lens implantation
- **Approach:** Term not selected
- **Direct Device:** Term not selected
- **Method:** Term not selected
- **Priority:** Term not selected

**Problems (Onset Date)**
- **Age-related cataract:** 27/09/2013
- **Acute Q fever:** 03/08/2013
- **Allergic asthma:**

**Comments**

Source: CSC Healthcare
Prescribing in LORENZO – Searching

Inpatient Encounter - Start date: 07-Sep-2010 - General medicine - Dr James Kent - Closed

- Warfarin sodium
- (wartex) salicylic acid
- (warticon) podophyllotoxin

Discharge prescription

<table>
<thead>
<tr>
<th>Prescription item</th>
<th>Start date</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASPIRIN DOSE 75 mg Oral every MORNING</td>
<td>19-Sep-2010</td>
</tr>
<tr>
<td>Co-amoxiclav DOSE 375 milligram Oral THREE times a DAY 7 days</td>
<td>19-Sep-2010</td>
</tr>
<tr>
<td>OMEPRAZOLE DOSE 40 milligram Oral every MORNING swallow whole</td>
<td>19-Sep-2010</td>
</tr>
<tr>
<td>Prednisolone Stepped Oral</td>
<td>19-Sep-2010</td>
</tr>
</tbody>
</table>
Prescribing in LORENZO

Outpatient prescription

<table>
<thead>
<tr>
<th>Medication Item</th>
<th>Other Information</th>
<th>Start Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>morphine hydrochloride</td>
<td></td>
<td>06-Dec-2010</td>
</tr>
<tr>
<td>methotrexate</td>
<td>DOSE 2.5mg - oral - once a week</td>
<td>06-Dec-2010</td>
</tr>
<tr>
<td>(dolomite + d) dolomite with vitamin d</td>
<td></td>
<td>06-Dec-2010</td>
</tr>
<tr>
<td>simvastatin</td>
<td>DOSE 40mg - oral - every night</td>
<td>06-Dec-2010</td>
</tr>
<tr>
<td>type-in- dolo local</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(cromogen) sodium cromoglicate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lansoprazole</td>
<td>DOSE 30mg - oral - twice a day</td>
<td></td>
</tr>
<tr>
<td>metronidazole</td>
<td>DOSE 400mg - oral - three times a day</td>
<td></td>
</tr>
<tr>
<td>aspirin</td>
<td>DOSE 75mg - oral - every morning</td>
<td></td>
</tr>
<tr>
<td>ferrous sulphate</td>
<td>DOSE 200mg - oral - twice a day</td>
<td></td>
</tr>
<tr>
<td>ferrous sulphate</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
LORENZO Prescribing Decision Support

• LORENZO medication management functionality supports the following prescribing decision support features
  – Drug allergy checking
  – Drug contraindication checking
  – Drug interaction checking
  – Drug duplication checking

• SNOMED CT plays a fundamental role in both data recording as well as the knowledge base for most of these features
LORENZO Prescribing Catalogue

- Data on all drugs which can be prescribed through LORENZO
- Knowledge base for prescribing decision support
- Links to drug information monographs
- Support for generic prescribing where appropriate
- Support for prescribing high risk drugs (e.g. methotrexate), controlled drug prescriptions (e.g. morphine), and other flagged drugs
- For NHS, this is sourced from First Databank Europe’s Multilex Drug Data File (MDDF) which is mapped to dm+d and includes
  - SNOMED CT-based substance codes for allergy checking
  - SNOMED CT-based conditions for contraindication checking
LORENZO Drug Allergy Checking

- This is done in two ways
- Passive allergy checking
  - User can choose to see the list of patient allergies and make appropriate prescribing decisions
- Active allergy checking – performed upon selecting drug to prescribe
  - Ingredient – an active ingredient of a patient allergen and active ingredient (including the base ingredient) of the drug being prescribed are the same
  - Cross reactor group – an active ingredient of a patient allergen and active ingredient (including the base ingredient) of the drug being prescribed belong to the same cross reactor group
  - Ingredient class group – an active ingredient of a patient allergen and active ingredient (including the base ingredient) of the drug being prescribed belong to the same ingredient class group
LORENZO Passive Drug Allergy Checking

TOMS Tiera Mrs Female DoB: 11-Nov-1939 69 Yrs PASID: PS-0005
Encounter: Inpatient; 15-Aug-2008
Address: 123, Parklane Drive · Stoke-On-Trent

Allergies: Active Allergies/ADRs (Last Checked On 10-Nov-2008)

Considerations
- Weight: 70 kg (20 Sep 2009)
- Height: 170 cm (20 Sep 2009)
- BSA: 1.9
- Expected date of discharge: 22 Sep 2009 20:30
- Expected date of patient leave: 20 Sep 2009 16:00

Allergies/ADRs
- Penicillin
- Aspirin
- Nuts
- Smoke

Problems
- Angina
- Hypertension
LORENZO Active Drug Allergy Checking

Create/Amend inpatient prescription

Recorded medication: Search

Search: amorolfine

Basic details | Technically validate | Conflicts | Record administration

<table>
<thead>
<tr>
<th>Type</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drug allergy - Ingredient</td>
<td>Patient record shows potential sensitivity to Amorolfine. You have selected amorolfine which contains amorolfine. Severity (Reaction):</td>
</tr>
</tbody>
</table>

Prescriber acknowledgement... | Acknowledged

Select reason
LORENZO Drug Contraindication Checking

• This is done in two ways
  • Passive contraindication checking
    – User can choose to see the list of patient problems and make appropriate prescribing decisions
  • Active contraindication checking
    – Performed upon selecting drug to prescribe
    – Alerts when drug is contraindicated for a patient condition (problem or procedure)
    – Also takes patient age and gender into account
    – Absolute/specific – the relevance of the contraindication is very high to the drug item
    – Related – the relevance of the contraindication is low, but chances do exist of potential harm to the patient
LORENZO Passive Drug Contraindication Checking

**TOMS Tiera Mrs Female**  
DoB: **11-Nov-1939**  69 Yrs  
PASID: **PS-0005**

- **Encounter:** Inpatient; 15-Aug-2008
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**Problems**
- Angina
- Hypertension
LORENZO Active Drug Contraindication Checking

<table>
<thead>
<tr>
<th>Type</th>
<th>Details</th>
<th>Prescriber acknowledgement</th>
<th>Acknowledged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drug contraindication - Related</td>
<td>Your patient has Acute gastric ulcer with bleeding designated on their problem list. This may be related to Haemorrhage. Warfarin 1mg tablets is contraindicated in Haemorrhage.</td>
<td>Select reason*</td>
<td></td>
</tr>
<tr>
<td>Drug contraindication - Related</td>
<td>Your patient has Accessary surgical procedure performed on 29-Aug-2013 13:18:28 designated on their procedure list. This may be related to Within 72 hours of surgery with risk of severe bleeding. Warfarin 1mg tablets is contraindicated in Within 72 hours of surgery with risk of severe bleeding.</td>
<td>Select reason*</td>
<td></td>
</tr>
</tbody>
</table>
LORENZO Drug Interaction Checking

- The system checks if the drug being prescribed and a drug in the patient’s current medication list belong to an interaction group pair.

- Details on interaction group pairs are held in the prescribing catalogue.

- These include the severity of the interaction which is denoted by the number of stars:
  - High – 4 stars
  - Significant – 3 stars
  - Moderate – 2 stars
  - Low – 1 star
## LORENZO Drug Interaction Checking

**Patient Information**

- **Name:** JOHN, Mba
- **Gender:** Female
- **DOB:** 20-Oct-1977
- **Age:** 35 Yrs
- **Patient ID:** PASID-0000000000278

**Current Medications**
- **warfarin 1mg tablets**
- **warfarin 3mg tablets**
- **warfarin 500microgram tablets**
- **warfarin 5mg tablets**

**Recorded Medication**

<table>
<thead>
<tr>
<th>Type</th>
<th>Details</th>
<th>Prescriber acknowledgement...</th>
<th>Acknowledged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drug interaction - Moderate</td>
<td>Prescribed drug warfarin 1mg tablets. Anticoagulant effect may be increased or reduced</td>
<td>Select reason</td>
<td></td>
</tr>
<tr>
<td>Drug interaction - Significant</td>
<td>The existing drug ophibatide interacts with prescribed drug warfarin 1mg tablets. Increased risk of bleeding</td>
<td>Select reason</td>
<td></td>
</tr>
<tr>
<td>Drug interaction - Significant</td>
<td>The existing drug aspirin interacts with prescribed drug warfarin 1mg tablets. Increased risk of bleeding</td>
<td>Select reason</td>
<td></td>
</tr>
<tr>
<td>Drug interaction - Significant</td>
<td>The existing drug aspirin interacts with prescribed drug warfarin 1mg tablets. Increased risk of bleeding</td>
<td>Select reason</td>
<td></td>
</tr>
<tr>
<td>Drug interaction - Significant</td>
<td>The existing drug aspirin interacts with prescribed drug warfarin 1mg tablets. Increased risk of bleeding</td>
<td>Select reason</td>
<td></td>
</tr>
<tr>
<td>Drug interaction - Significant</td>
<td>The existing drug ibuprofen interacts with prescribed drug warfarin 1mg tablets. May increase anticoagulant effect and increased risk of gi bleeding</td>
<td>Select reason</td>
<td></td>
</tr>
<tr>
<td>Warning</td>
<td>Discontinue if moderate or severe side effects occur</td>
<td>Select reason</td>
<td></td>
</tr>
</tbody>
</table>

**Homepage:** [CSC](https://www.csc.com)
LORENZO Drug Duplication Checking

• The system checks of the drug being prescribed duplicates a drug in the patient’s current medication list

• There are three types of duplicate checking
  – Doubling – when both drugs are the same or share the same Virtual Product (this is a dm+d concept which equates to generic drug + form e.g. aspirin tablets)
  – Ingredient – when both drugs share the same active ingredient
  – Hierarchy – when both drugs belong to the same node within the drug node hierarchy (this is based on the SNOMED CT drug hierarchy)
HEALTHCARE GROUP

EXPERIENCE TO DATE
Live Use

- The discharge prescribing capability has now been in live use for nearly two years

- Deployment started at the Royal Lancaster Infirmary (which is part of the University Hospitals of Morecambe Bay NHS Trust in England)

- The system is now in use in 6 wards at this hospital

- Over 40,000 discharge prescriptions were written in the past year
Decision Support Metrics

• A sample of approximately 15000 prescriptions was analysed
  – Multiple items per prescription

• Drug allergy alerts
  – Over 500 alerts
  – Nearly 400 of them acknowledged by clinicians

• Drug contraindication alerts
  – Over 24000 alerts
  – Over 7000 of them acknowledged by clinicians
Feedback

- Feedback has been very positive

- A number of other NHS hospitals have visited Lancaster to see this functionality in live use

- The system is being used by both clinical and pharmacy staff

- They are all looking forward to the forthcoming deployment of the inpatient prescribing and electronic medicines administration functionality
Summary

- Prescribing decision support has been proven to be beneficial

- A key benefit of SNOMED CT is the facilitation of decision support

- However there is very limited published literature about the implementation of decision support based on SNOMED CT

- CSC’s LORENZO incorporates medication management functionality including prescribing decision support underpinned by SNOMED CT

- This functionality has now been in live use for nearly two years