



HEALTHCARE GROUP

# PRESCRIBING DECISION SUPPORT USING SNOMED CT

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**CSC**

# Outline

- SNOMED CT and Decision Support
- LORENZO
  - Medication Management Functionality
  - Prescribing Decision Support
- Experience to date

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**SNOMED CT**



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# SNOMED CT and its Benefits

- Comprehensive clinical terminology
- One of its key stated benefits is to facilitate decision support<sup>1</sup>
- However there is very limited published literature about the implementation of decision support based on SNOMED CT

<sup>1</sup><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

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LORENZO



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# 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

LORENZO - Windows Internet Explorer provided by CSC Healthcare

Help Back Forward Refresh Print Hide Pane Not specified Exit

**NHS**

Action My work Patients Ward view Enquiry

Standard LORENZO

Patients

Enter Identifier to search

- Patient lists
- Find record
- Break seal
- Override Dissent
- Override sensitive ...
- Manage PDS consent
- Expressed consent...
- Add patient to list
- Convert to full regi...
- Linked records

Seen(1) Remaining(0)

**GREEN , Gavin (Master) Male DOB: 12-Nov-2004 8 Yrs Patient ID: HPSID-000000000386**  
Allergies/ADRs - None Recorded (Not Checked On 27-Sep-2013)

Encounter context: Inpatient, Burton Emily, PAEDIATRICS, PAEDIATRIC ... EPR filtered by: (None)

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

Problems Registers Allergies/ADRs Alerts Advance Directives

Display inactive problems  Display struck out problems

**Master problem list**

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

**Details** Additional details Status Links Scope Modification history

Problem type:  Scope:  All encounters and episodes

Inactive:

Problem name /code:

Onset date:  Not known

27 Sep 2013

Bodysite	Laterality
<input type="checkbox"/> Eyeball	Left

Sub type:

Problem description:

02/Sep/13 PAEDIATRICS, ...

Working prob

Procedures

- Overview
- Care Events
- Clinical Charts
- Forms
- General Details
- Procedures Interventions
- Health Issues
- Observations
- Related People
- Patient services

**CSC**  
Return to Wizard

DANIEL, Williams, administrator Role

HUMBER NHS FOUNDATION TRUST



# Recording Allergies in LORENZO

Record allergy/ADR - LORENZO - Windows Internet Explorer provided by CSC Healthcare

**GREEN , Gavin (Master) Male DOB: 12-Nov-2004 8 Yrs Patient ID: HPASID-00000000386**  
**Allergies/ADRs - None Recorded (Not Checked On 27-Sep-2013)**

Record allergy/ADR

### Record allergy/ADR

**Allergy type** Drug Allergy

**Allergen** Penicillin

**Reaction** Anaphylactic reaction

**Severity** Moderate to severe

Record multiple reactions/severities

+ Add Update X Remove

Reaction	Severity
There are no records to show	

**Onset date** Not known

Date

Month/Year Not specified

**Confidence level** Term not selected

Manage problem

**MHRA form:** Fill in MHRA form

MHRA form: completed

Recorded by daniel,williams

Recorded date/time 27 September 2013 10:06

Is significant

**Information source**

**Comments**

Status Open

Closed date

Date

Month/Year Not specified

+ Add Update X Remove

Suspend Reassign Finish now Cancel

# Recording Procedures in LORENZO

Record procedure - LORENZO - Windows Internet Explorer provided by CSC Healthcare

**GREEN , Gavin (Master) Male DOB: 12-Nov-2004 8 Yrs Patient ID: HPASID-00000000386**  
Allergies/ADRs - None Recorded (Not Checked On 27-Sep-2013)

Record procedure

### Record procedure

**Performed date and time**

Complete date  
27/09/2013  
Not specified

**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

**Performed service point**

**Performed by**  
daniel,williams

**Body site**  
Lens of eye

**Laterality**  
Left

+ Add Update Remove

Body site	Laterality
There are no records to show	

**Problems (Onset date)**

<input checked="" type="checkbox"/>	Age-related cataract(27/09/2013)
<input type="checkbox"/>	Acute Q fever(03/08/2013)
<input type="checkbox"/>	Allergic asthma

**Comments**

Suspend Reassign Finish now Cancel

# Prescribing in LORENZO – Searching

LORENZO - Windows Internet Explorer

>> Create/amend discharge prescription >>> Print

Create/amend discharge prescription Prescribing Considerations

Recorded medication **Search**

Quick links Common Medicines

Search  [Search drug catalogue](#)

Begins with  Any word

Search result

- ♦ warfarin sodium
- ♦ (wartex) salicylic acid
- (warticon) podophyllotoxin

Expected date of Discharge

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

Discharge prescription  Include cancelled items

	Prescription item	Start date
<input type="checkbox"/>	ASPIRIN <b>DOSE</b> 75 mg Oral every MORNING	19-Sep-2010
<input type="checkbox"/>	Co-amoxiclav <b>DOSE</b> 375 milligram Oral THREE times a DAY 7 days	19-Sep-2010
<input type="checkbox"/>	OMEPRAZOLE - <b>DOSE</b> 40 milligram Oral every MORNING swallow whole	19-Sep-2010
<input type="checkbox"/>	Prednisolone Stepped Oral	19-Sep-2010

# Prescribing in LORENZO

Outpatient medication - LORENZO - Windows Internet Explorer

**Alex Alex 01-Jan-1981 29 Yrs Male Temp-000000015**  
 Allergies / ADRs **Active Allergies/ADRs (Last Checked On 10-Dec-2010)**

» Create/Amend outpatient prescription » Print

Create/Amend outpatient prescription Prescribing considerations

**Recorded medication** Search

Outpatient Encounter - Start date:06-Dec-2010-ACCIDENT & EMERGENCY-monalisa -Open  Include cancelled items

**Clerked**

→	Ⓡ	ⓘ	Clerked medication item	Other information	Start date
→	Ⓡ		type-in- dolo local		
→	Ⓡ		(cromogen) sodium cromoglicate		
→	Ⓡ		lansoprazole DOSE 30mg - oral - twice a day		
→	Ⓡ		metronidazole DOSE 400mg - oral - three times a day		
→	Ⓡ		aspirin DOSE 75mg - oral - every morning		
→	Ⓡ		ferrous sulphate DOSE 200mg - oral - twice a day		
→	Ⓡ		ferrous sulphate		

Outpatient Encounter - Start date:06-Dec-2010-ACCIDENT & EMERGENCY-monalisa -Open  Include cancelled items

**Outpatient prescription**

	Ⓡ	ⓘ	Prescription item	Other information	Start date
<input type="checkbox"/>	Ⓡ		morphine hydrochloride DOSE 50mg - oral - every morning		06-Dec-2010
<input type="checkbox"/>	Ⓡ		methotrexate DOSE 2.5mg - tablet - oral - once a week		06-Dec-2010
<input type="checkbox"/>	Ⓡ		(dolomite + d) dolomite with vitamin d		06-Dec-2010
<input type="checkbox"/>	Ⓡ		simvastatin DOSE 40mg - oral - every night		06-Dec-2010

Other Links ▶ Links ▶ Results ▶ Dose calculator ▶ Reconcile

Add to favourites Hold/Unhold Discontinue/cancel Remove

Suspend Finish now Next Cancel

# 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

New prescription - LORENZO - Microsoft Internet Explorer provided by iSOFT

TOMS Tiera Mrs Female DoB: 11-Nov-1939 69 Yrs PASID: PS-0005  
Encounter: Inpatient; 15-Aug-2008 Allergies: **Active Allergies/ADRs (Last Checked On 10-Nov-2008)**  
Address: 123, Parklane Drive Stoke-On-Trent

>> New prescription >> Post resolution

New prescription Prescribing considerations ?

Prescription properties Group by (None) Filter by (None) Options

## 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

Penicilin

Aspirin

Nuts

Smoke

## Problems


Angina

Hypertension

# LORENZO Active Drug Allergy Checking

LORENZO - Windows Internet Explorer

## Inpatient medication - LORENZO

 JOHN , Mib Female DOB: 20-Oct-1977 35 Yrs Patient ID: PASID-000000000278

Active

[Create/Amend inpatient prescription](#) [Print](#)

## Create/Amend inpatient prescription

Recorded medication  [Search](#)


Quick links

Search

amorphine

### LORENZO--Webpage Dialog

amorphine

[Basic details](#) [Technically validate](#) **Conflicts**  [Record administration](#)

Type	Details	Prescriber acknowledgement...	Acknowledged
▶ Drug allergy - Ingredient	Patient record shows potential sensitivity to Amorphine. You have selected amorphine which contains amorphine. Severity (Reaction): .	<a href="#">Select reason*</a>	<input type="checkbox"/> *



# 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

New prescription - LORENZO - Microsoft Internet Explorer provided by iSOFT

TOMS Tiera Mrs Female DoB: 11-Nov-1939 69 Yrs PASID: PS-0005  
Encounter: Inpatient; 15-Aug-2008 Allergies: **Active Allergies/ADRs (Last Checked On 10-Nov-2008)**  
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Nuts

Smoke

## Problems


Angina

Hypertension

# LORENZO Active Drug Contraindication Checking

LORENZO - Windows Internet Explorer

Inpatient medication - LORENZO

 JOHN , Mib Female DOB: 20-Oct-1977 35 Yrs Patient ID: PASID-000000000278

Active A

>> Create/Amend inpatient prescription >> Print

Create/Amend inpatient prescription


Recorded medication


Quick links

Search

warfarin 1mg tablets

warfarin 3mg tablets


warfarin 500microgram tablets 

warfarin 5mg tablets 

(warfarin wbp 1mg tablets) warfarin 1mg table

LORENZO--Webpage Dialog

warfarin 1mg tablets

Basic details | Technically validate **Conflicts**  Record administration

Type	Details	Prescriber acknowledgement...	Acknowledged
▶ Drug contraindication - Related	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.	<a href="#">Select reason*</a>	<input type="checkbox"/> *
Drug contraindication - Related	Your patient has Accessory 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.	<a href="#">Select reason*</a>	<input type="checkbox"/> *



# 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

LORENZO - Windows Internet Explorer

## Inpatient medication - LORENZO

 JOHN , Mib Female DOB: 20-Oct-1977 35 Yrs Patient ID: PASID-000000000278

Active

>> Create/Amend inpatient prescription >> Print

## Create/Amend inpatient prescription

Recorded medication

Quick links

Search

warfarin 1mg tablets

warfarin 3mg tablets

warfarin 500microgram tablets

warfarin 5mg tablets

(warfarin wbp 1mg tablets) warfarin 1mg table

(warfarin wbp 3mg tablets) warfarin 3mg table

(warfarin wbp 5mg tablets) warfarin 5mg table

### LORENZO--Webpage Dialog

warfarin 1mg tablets

Basic details Technically validate **Conflicts** Record administration

Type	Details	Prescriber acknowledgement...	Acknowledged
Drug interaction - Moderate ★★	prescribed drug warfarin 1mg tablets. Anticoagulant effect may be increased or reduced	<a href="#">Select reason</a>	<input type="checkbox"/>
Drug interaction - Significant ★★★	The existing drug eptifibatide interacts with prescribed drug warfarin 1mg tablets. Increased risk of bleeding	<a href="#">Select reason</a>	<input type="checkbox"/>
Drug interaction - Significant ★★★	The existing drug aspirin interacts with prescribed drug warfarin 1mg tablets. Increased risk of bleeding	<a href="#">Select reason</a>	<input type="checkbox"/>
Drug interaction - Significant ★★★	The existing drug aspirin interacts with prescribed drug warfarin 1mg tablets. Increased risk of bleeding	<a href="#">Select reason</a>	<input type="checkbox"/>
Drug interaction - Significant ★★★	The existing drug aspirin interacts with prescribed drug warfarin 1mg tablets. Increased risk of bleeding	<a href="#">Select reason</a>	<input type="checkbox"/>
Drug interaction - Significant ★★★	The existing drug aspirin interacts with prescribed drug warfarin 1mg tablets. Increased risk of bleeding	<a href="#">Select reason</a>	<input type="checkbox"/>
Drug interaction - Significant ★★★	The existing drug ibuprofen interacts with prescribed drug warfarin 1mg tablets. May increase anticoagulant effect and increased risk of gi bleeding	<a href="#">Select reason</a>	<input type="checkbox"/>
Warning	Discontinue if moderate or severe side effects occur	<a href="#">Select reason</a>	<input type="checkbox"/>



# LORENZO Drug Duplication Checking

- The system checks if 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)

# LORENZO Drug Duplication Checking

LORENZO - Windows Internet Explorer

Inpatient medication - LORENZO

MARK, Melbourne Male DOB: 11-Apr-1965 48 Yrs Patient ID: TEMPID-00000000062

LORENZO--Webpage Dialog

simvastatin

Basic details | Technically validate | **Conflicts** | Record administration

Type	Details	Prescriber acknowledgement...	Acknowledged
Drug duplication - Doubling	The patient is already receiving an equivalent product in their existing medication. simvastatin Prescribed on: 20-Jun-2013 10:20:42	<a href="#">Select reason</a>	<input type="checkbox"/> *
Precaution - Always show	General precautions apply, review <a href="#">monograph</a> .	<a href="#">Select reason</a>	<input type="checkbox"/> *
Warning	General warnings apply, review <a href="#">monograph</a> .	<a href="#">Select reason</a>	<input type="checkbox"/>

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# 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





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