B.C. 220

Standardised Chinese Characters

<table>
<thead>
<tr>
<th>齐</th>
<th>楚</th>
<th>燕</th>
<th>韩</th>
<th>赵</th>
<th>魏</th>
<th>秦</th>
</tr>
</thead>
<tbody>
<tr>
<td>书同文</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Emperor Ying Zheng
Total Expenditure on Health as Percentage of GDP

%  

18  

16  

14  

12  

10  

8  

6  

4  

2  

1991  

1993  

1995  

1997  

1999  

2001  

2003  

2005  

2007  

2009  

2011  

USA  

France  

New Zealand  

Sweden  

UK  

Australia  

Japan  

Hong Kong  

2011  

5.4% = 2.4% + 3.0%  

GDP  

Public  

Private  

Sources: (1) Census and Statistics Department, 2011 GDP  
(2) OECD Health Data October 2012
“...net savings from national implementation of fully standardized interoperability between providers... could yield $77.8 billion annually”

“...We suspect that the clinical payoff in improved patient safety and quality of care could dwarf the financial benefits projected...”
Key Message

A standardised eHealth system can achieve better, safer, more efficient care delivery on an industrial scale at a reasonable cost.
Established 1991
- 42 Public Hospitals
- 47 Specialist Outpatient Clinics (SOPD)
- 73 General Outpatient Clinics (GOPC)
- Close to 27,500 Beds
- Around 67,600 Staff
- Around 22,700 Nurses
- Around 5,700 Doctors
- Around HK$ 46b Annual Operating Budget (~US$6 billion)
- 6.10m GOPC Attendances
- 9.37m SOPD Attendances
- 2.24m A&E Attendances
- 1.57m Inpatient and Day Patient Discharges

Source:
1. HA Statistical Report 2012/13
2. HA Information Fact Sheet Jun 2014
3. www.ha.org.hk
eHealth in the HA - The Road Less Travelled

1990 “Green fields”
1991 Patient administration + Departmental systems
1995 Clinical Management System (CMS)
2000 Electronic Patient Record (ePR)
2003 eSARS
2004 ePR Image Distribution
2006 PPI ePR sharing
2008 CMS Phase III
2009 Filmless HA
Hong Kong wide eHR
2010 Inpatient MOE
2013 Mobile CMS
### Electronic Patient Record

**Patient Name:** MO, SIU YUEN

**Hospital Code:** UCH

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume, Urine, 24 hr</td>
<td>1705</td>
</tr>
<tr>
<td>Sodium</td>
<td>141</td>
</tr>
<tr>
<td>Potassium</td>
<td>3.8</td>
</tr>
<tr>
<td>Urea</td>
<td>6.6</td>
</tr>
<tr>
<td>Creatinine</td>
<td>77</td>
</tr>
<tr>
<td>Protein, Total</td>
<td>70</td>
</tr>
<tr>
<td>Albumin</td>
<td>44</td>
</tr>
<tr>
<td>Globulin</td>
<td>26</td>
</tr>
<tr>
<td>Bilirubin, Total</td>
<td>8</td>
</tr>
<tr>
<td>Alkaline Phosphatase, Total</td>
<td>51</td>
</tr>
<tr>
<td>Alanine Aminotransferase</td>
<td>25</td>
</tr>
<tr>
<td>Calcium</td>
<td>2.27</td>
</tr>
<tr>
<td>Phosphate</td>
<td>1.23</td>
</tr>
<tr>
<td>Urate</td>
<td>0.426</td>
</tr>
<tr>
<td>Glucose, Fasting</td>
<td>8.5↑</td>
</tr>
<tr>
<td>Protein, Urine, 24 hr</td>
<td>0.10</td>
</tr>
<tr>
<td>Creatinine, Urine, 24 hr</td>
<td>12233</td>
</tr>
<tr>
<td>Creatinine Clearance, Urine</td>
<td>110</td>
</tr>
<tr>
<td>Time</td>
<td>24</td>
</tr>
</tbody>
</table>

**Click the test name for single test view**
HA’s Clinical Management System
- An essential clinical tool

- **9M** patients
- **223M** episodes of care
- **1B** laboratory results
- **115M** radiology studies
- **388M** drug items
- **3.5M** updates / day
- **700K** hits / day
- **Sub-second** response time
- **7x24 >99.98%** uptime since live run
The Seven Principles of Highly Effective Informaticians

1. The customer is always right
2. Medicine is an art and a science
3. Win - Win - Win - Win - Win - Win
4. One step at a time
5. Use it or lose it
6. Focus and prioritize
7. Embrace your informaticians
Principle 4: One Step at a Time

“Crossing the river, feeling one stone at a time”

Deng Xiaoping
Clinical documentation in the CMS: (1st Generation) Clinical coding

- ICD codes with extensions
- Clinician friendly terms attached to these codes
- Multiple input mechanisms
Clinical documentation in the CMS:
(2nd Generation) Clinical Data Framework (CDF)

- Document disease
- No coding required
- Generic framework with disease specific data
Clinical documentation in the CMS: (3rd Generation) Generic Clinical Documentation (GCD)

- Flexible forms
- Structured data linked to terminology
- Automatic documentation with code generation
- Reuse of data previously entered

<table>
<thead>
<tr>
<th>Case: HN300779381</th>
<th>Req. Date: 24/04/2006</th>
<th>Status: Ready</th>
</tr>
</thead>
</table>

12. Multiple birth: *  
   - Yes
   - No
   - Unknown
   No. of infants delivered (both live birth & stillbirth): *

13. Birth weight:*  
   - 965 grams

14. Head circumference at birth  
   - 34.5 cm
   - unknown

15. Obstetrical maturity:*  
   - 29 weeks
   - 3 days
   - unknown
   Best est. of maturity:*  
   - Same as obs
   - +/- 2 wks diff.

Fill in Section (LDW 1,2,3,4) if birth weight between 401 grams and 1500 grams (inclusive) or maturity between 22 weeks 0 days and 29 weeks 6 days (inclusive)

16. Died in Delivery Room: *  
   - Yes
   - No

17. Neonatal screening:  
   - G6PD: Normal, Deficiency, Borderline
   - TSH: Normal, Abnormal
   - Value: mIU/L
   - rechecked Value: mIU/L

18. Hearing screening:  
   - Method: Automated ABR
   - Right: Fail and refer out
   - Left: Fail and refer out

19. Major congenital anomaly:*  
   - Yes
   - No
   - Suspected
   - Unknown

He was initially hypothermic with warming. HR and blood pressure were stable. Chest, abdomen and CVS exam were normal. Hûtix on arrival was 1.0, D10 40 mg/kg/min
Principle 5: Use it or Lose it

- Data use
- Low data use
- Data quality
- Poor data quality
Management data should be a byproduct of clinical documentation

Documentation becomes knowledge

- Diseases & Procedures
- Departmental data
- Clinical documentation

Data warehouse

ePR

Clinical Data Analysis & Reporting (CDARS)

Reports & Analytics
CMS III: A sustainable architecture

- Security & privacy framework
- Clients & displays
- Service layer
- Information standards & architecture
- Electronic Patient Record

[Diagram showing the layers of CMS III architecture]
HA Information Architecture

**Entities - facts**
What does the data mean?

**Forms - context**
How should it be interpreted?

**Format - display**
How should it be displayed?

Design  Enter  Store  Display  Reuse  Analyze
Generic Clinical Documentation (GCD) Thru’ Train

- Clinical requirements & form creation
- Entity definition and assignment
- Data capture and storage
- Ad-hoc inquiry & analysis

Forms

IAMS FORM

ePR

CDR

CDARS
Example: Nursing Patient Assessment

Patient Assessment Form

- Physical Examination
  - Vital signs
  - Body measurement
  - Urinalysis
  - Level of consciousness
  - MEWS
- Social History
  - Education
  - Religion
  - Household members, etc
- Risk Assessment
  - Infection
  - FTOCC
  - Fall
  - Pressure Ulcer
  - Missing
  - Suicide
- Functional Assessment
Step 1: Define each entity on the form
- Reuse existing entity if appropriate, or
- Create new entity if the existing entity is not suitable
Select the criteria in 'Criteria List'

- Risk of pressure ulcer
  - At risk
  - Not at risk

Selected Criteria

Risk of pressure ulcer in (1. At risk 2. Not at risk)
[Edit]
### CDARS Report

<table>
<thead>
<tr>
<th>Institution (EIS)</th>
<th>At risk</th>
<th>Not at risk</th>
<th>Row Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Forms - Patient Assessment Form - nursing (PAS) (By Date of assessment)</td>
<td>4944</td>
<td>41737</td>
<td>46681</td>
</tr>
</tbody>
</table>

**Pending update**

No. of forms with Pressure ulcer risk = 4944

No. of forms with no Pressure ulcer risk = 41737

1 + 2
Standardisation for better presentation

<table>
<thead>
<tr>
<th></th>
<th>TMH</th>
<th>NDH</th>
<th>PWH</th>
<th>AHN</th>
<th>PYN</th>
<th>KWH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
<td>---</td>
<td>134</td>
<td>140</td>
<td>---</td>
<td>138</td>
<td>142</td>
</tr>
<tr>
<td>Potassium</td>
<td>---</td>
<td>4.6</td>
<td>4.7</td>
<td>---</td>
<td>5.0</td>
<td>4.6</td>
</tr>
<tr>
<td>Chloride</td>
<td>---</td>
<td>102</td>
<td>107</td>
<td>---</td>
<td>106</td>
<td>110</td>
</tr>
<tr>
<td>Urea</td>
<td>---</td>
<td>6.2</td>
<td>7.9</td>
<td>---</td>
<td>8.1</td>
<td>7.8</td>
</tr>
<tr>
<td>Creatinine</td>
<td>---</td>
<td>77</td>
<td>75</td>
<td>---</td>
<td>76</td>
<td>80</td>
</tr>
<tr>
<td>Protein, Total</td>
<td>51</td>
<td>---</td>
<td>50</td>
<td>47</td>
<td>---</td>
<td>44</td>
</tr>
<tr>
<td>Albumin</td>
<td>26</td>
<td>---</td>
<td>26</td>
<td>25</td>
<td>---</td>
<td>22</td>
</tr>
<tr>
<td>Bilirubin, Total</td>
<td>6</td>
<td>---</td>
<td>6</td>
<td>4</td>
<td>---</td>
<td>6</td>
</tr>
</tbody>
</table>

Without Standardisation

<table>
<thead>
<tr>
<th></th>
<th>TMH</th>
<th>NDH</th>
<th>PWH</th>
<th>AHN</th>
<th>PYN</th>
<th>KWH</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIL</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>TBIL</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>
Roles of Terminology in HA

- Supports information architecture
- Improves data presentation
- Assist data retrieval/reporting
- Facilitate decision support
- Facilitate hospital management
- Enables new modes of care delivery
HARRPE
(Hospital Admission Risk Reduction Programme for the Elderly)

Risk stratification for elderly Patients

Targeted intervention by call centre nurses
Hospital Admission Risk Reduction Programme for the Elderly (HARRPE)

Model development and validation

14 Predictor Variables
HARRPE score

Model building

Model

Training Dataset
1.37 million index episodes of target subjects in 2005

4 Validation Datasets
4 quarterly cohorts in 2006 each with a complete data of over 0.3 million index episodes

Model validation
Community Health Call Centre (CHCC)

Identifying at-risk patients from the total population

Delivering the patient lists to appropriate care providers in a timely fashion

Enabling new models of care delivery
Community Health Call Centre (CHCC)

- **2007**: High risk elderly (HARRPE)
- **2011**: Mental Health Direct
- **2012**: Chronic Disease Management
- **2013**: Defaulter tracing
Data Retrieval Using SNOMED Hierarchy

Selected Organism Criteria List:

- Organism in:
  - Fungus

LIS Culture - Reference Date (Calendar Year)

<table>
<thead>
<tr>
<th>LIS Culture - Organism (ePR Description)</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspergillus niger</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Aureobasidium species</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Candida albicans</td>
<td>94</td>
<td>91</td>
</tr>
<tr>
<td>Candida dubliniensis</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Candida famata</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Candida glabrata</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>Candida guilliermondii</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Candida kruzei</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Candida lipolectica</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Candida lusitaniense</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Candida parapsilosis</td>
<td>31</td>
<td>27</td>
</tr>
<tr>
<td>Candida species</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Candida tropicalis</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>Cryptococcus neoformans</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>Fusarium solani</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Histoplasma capsulatum</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Malassezia pachydermatis</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Malassezia species</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Penicillium marneffi</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Trichosporon species</td>
<td></td>
<td>34</td>
</tr>
</tbody>
</table>

Grand Total: 214 206 198
Moving Forward

• SNOMED CT for clinical decision support
  • e.g. antibiotic stewardship
• To explore referencing all clinical data and entities using SNOMED CT / LOINC
<table>
<thead>
<tr>
<th>Entity ID</th>
<th>Full Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1001726</td>
<td>Home systolic blood pressure (mmHg) monitoring - maximum</td>
</tr>
<tr>
<td>1001725</td>
<td>Home systolic blood pressure monitoring (mmHg) - minimum</td>
</tr>
<tr>
<td>102215</td>
<td>Systolic blood pressure (mmHg)</td>
</tr>
<tr>
<td>102396</td>
<td>Systolic blood pressure (mmHg) - 1 month follow up</td>
</tr>
<tr>
<td>102495</td>
<td>Systolic blood pressure (mmHg) - 12 month follow up</td>
</tr>
<tr>
<td>102334</td>
<td>Systolic blood pressure (mmHg) - 1st visit</td>
</tr>
<tr>
<td>102429</td>
<td>Systolic blood pressure (mmHg) - 3 month follow up</td>
</tr>
<tr>
<td>102462</td>
<td>Systolic blood pressure (mmHg)</td>
</tr>
<tr>
<td>104109</td>
<td>Worst blood pressure systolic (mmHg) - 72 hours after Intensive Care Unit</td>
</tr>
<tr>
<td>104110</td>
<td>Worst blood pressure systolic (mmHg) - 72 hours after Intensive Care Unit</td>
</tr>
</tbody>
</table>
Big Gun Antibiotics Utilization
- Moving from retrospective to prospective review

Big gun antibiotics refer to:

<table>
<thead>
<tr>
<th>Antibiotics Group</th>
<th>DDD per 1000 BDO (Acute)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cefepime</td>
<td></td>
</tr>
<tr>
<td>Ceftazidime</td>
<td></td>
</tr>
<tr>
<td>Meropenem</td>
<td></td>
</tr>
<tr>
<td>Sulperazon</td>
<td></td>
</tr>
<tr>
<td>Tazocin</td>
<td></td>
</tr>
<tr>
<td>Tienam</td>
<td></td>
</tr>
</tbody>
</table>

[Graph showing DDD per 1000 BDO for different institutions and specialties from Jan 2012 to Dec 2012]
The Hong Kong Wide Electronic Health Record
With eHR

Doctors and Nurses

Other Healthcare Professionals

Private Hospitals

Patients

Family Medicine

Primary Care

eHR

Patients

Private Clinics

Laboratory

X-ray

HA

DH
Organisation Structure for eHR Information Standards

Steering Committee on eHealth Record Sharing

WG-IA  WG-ERP  WG-LPS

Working Group on eHealth Record & Information Standards

Technical Task Force

Co-ordinating Group on eHR Content & Information Standards

Domain Group on eHR Content & Information Standards

Note:
WG-LPS  Working Group on Legal, Privacy & Security Issues
WG-IA   Working Group on Institutional Arrangement
WG-ERP  Working Group on eHealth Record Partnership
Hospital Authority
Clinical Vocabulary Table (HACVT)
Hong Kong Clinical Terminology Table (HKCTT)
Hong Kong Clinical Terminology Table (HKCTT)
Roles of Terminology in eHR

- Support clinical documentation
- Facilitate decision support
- Provide organised data in eHR Viewer
- Assist data retrieval/reporting
Defining eHR Sharable Data using SNOMED

**eHR Allergy Form**

<table>
<thead>
<tr>
<th>Name</th>
<th>Entity/Term ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>eHR Allergy</td>
<td>1003131</td>
</tr>
<tr>
<td>Page 1</td>
<td></td>
</tr>
<tr>
<td>- Type of allergen code</td>
<td>1003138</td>
</tr>
<tr>
<td>- Type of allergen description</td>
<td>1003139</td>
</tr>
<tr>
<td>- Type of allergen local description</td>
<td>1003140</td>
</tr>
<tr>
<td>- Allergen - recognised terminology name</td>
<td>1003133</td>
</tr>
<tr>
<td>- Allergen identifier - recognised terminology</td>
<td>1003134</td>
</tr>
<tr>
<td>- Allergen description - recognised terminology</td>
<td>1003135</td>
</tr>
<tr>
<td>- Allergen local code</td>
<td>1003136</td>
</tr>
<tr>
<td>- Allergen local description</td>
<td>1003137</td>
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<tr>
<td>- Level of certainty code</td>
<td>1003369</td>
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<tr>
<td>- Level of certainty description</td>
<td>1003370</td>
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<tr>
<td>- Level of certainty local description</td>
<td>1003371</td>
</tr>
<tr>
<td>- Allergic reaction code</td>
<td>1003372</td>
</tr>
<tr>
<td>- Allergic reaction description</td>
<td>1003373</td>
</tr>
<tr>
<td>- Allergic reaction local description</td>
<td>1003374</td>
</tr>
<tr>
<td>- Allergy reason</td>
<td>1003145</td>
</tr>
<tr>
<td>- Allergy note</td>
<td>1003147</td>
</tr>
</tbody>
</table>

**HKCTT Concepts for Allergic Reaction**

<table>
<thead>
<tr>
<th>Term ID</th>
<th>Nature</th>
<th>eHR Description</th>
<th>ICD10</th>
<th>ICD10 Asso</th>
<th>SNOMED CT</th>
</tr>
</thead>
<tbody>
<tr>
<td>33388</td>
<td>Diagnosis</td>
<td>Allergic contact dermatitis</td>
<td>L23.9</td>
<td></td>
<td>238575004</td>
</tr>
<tr>
<td>8394</td>
<td>Diagnosis</td>
<td>Allergic rhinitis</td>
<td>J30.4</td>
<td></td>
<td>61582004</td>
</tr>
<tr>
<td>30561</td>
<td>Diagnosis</td>
<td>Angioedema</td>
<td>T78.3</td>
<td>Y34</td>
<td>41291007</td>
</tr>
<tr>
<td>4545</td>
<td>Diagnosis</td>
<td>Aplastic anaemia</td>
<td>D61.9</td>
<td></td>
<td>306058006</td>
</tr>
<tr>
<td>8502</td>
<td>Diagnosis</td>
<td>Asthma</td>
<td>J45.9</td>
<td></td>
<td>195967001</td>
</tr>
</tbody>
</table>
Aliases supporting clinical data capture

<table>
<thead>
<tr>
<th>Term ID</th>
<th>Nature</th>
<th>Diagnosis (Dx)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9659</td>
<td></td>
<td>Gastrointestinal bleeding</td>
</tr>
</tbody>
</table>

- **Alias**: GI - Gastrointestinal bleed
- **Alias**: GI - Gastrointestinal haemorrhage
- **Alias**: GI - Gastrointestinal hemorrhage

**Search panel**

- **Search Terminologies**
- **Term**: Gastrointestinal bleeding
- **ICD10 (2001)**: K92.2
- **ICD10 (2010+MBD)**: K92.2
- **SNOMED CT**: 74474003

**Diagnosis**

- **Per rectal bleeding**
- **Melaena**
- **Haematemesis**
- **Duodenal ulcer, chronic, with haemorrhage**
- **Mallory-Weiss syndrome**
- **Oesophageal varices with haemorrhage**
- **Rectal haemorrhage**
## HKCTT for eHR Viewer

<table>
<thead>
<tr>
<th>Date</th>
<th>Provider</th>
<th>Description</th>
<th>Code</th>
<th>System</th>
<th>Term ID</th>
<th>Group</th>
<th>Local Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Jan 2004</td>
<td>Hospital A</td>
<td>Chronic viral hepatitis B infection</td>
<td>B18.1</td>
<td>ICD10</td>
<td>1008</td>
<td><strong>Hepatitis</strong></td>
<td></td>
</tr>
<tr>
<td>9 Sep 2002</td>
<td>Dr Ho</td>
<td>Chronic type B viral hepatitis</td>
<td>61977001</td>
<td>SNOMED CT</td>
<td>1008</td>
<td></td>
<td></td>
</tr>
<tr>
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For Grouping in eHR Viewer

Local Description
Problem

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Hepatitis

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Automapping

eHR-IAMS

DM-MTT Auto-Mapper

HA-PHS

MTT Product Concept

CMSMOE

AUGMENTIN TABLET

PMS

AUGM05

HA-ePR

ePR receives information via CDR

Generated mapping table

eHR Record

ePR receives information via CDR

HA-ePR

6003119 AUGMENTIN

AUGMENTIN

eHR Record
Final remarks

• Standardization and terminology are essential for modern healthcare

• SNOMED is useful in a single provider EMR environment, but is indispensable in a multi-provider EHR environment

• This is difficult and we are all learning - global sharing is required
Key Message

A standardised eHealth system can achieve better, safer, more efficient care delivery on an industrial scale at a reasonable cost.
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In fact it may be the only thing that can do so.