Past, Present & Future Clinical Management System (CMS) for Hospital Authority in Hong Kong - a Journey of 20+ years

HA Convention 2016

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May 2016

Hong Kong Healthcare System - Dual System

Public

Highly subsidized by govt

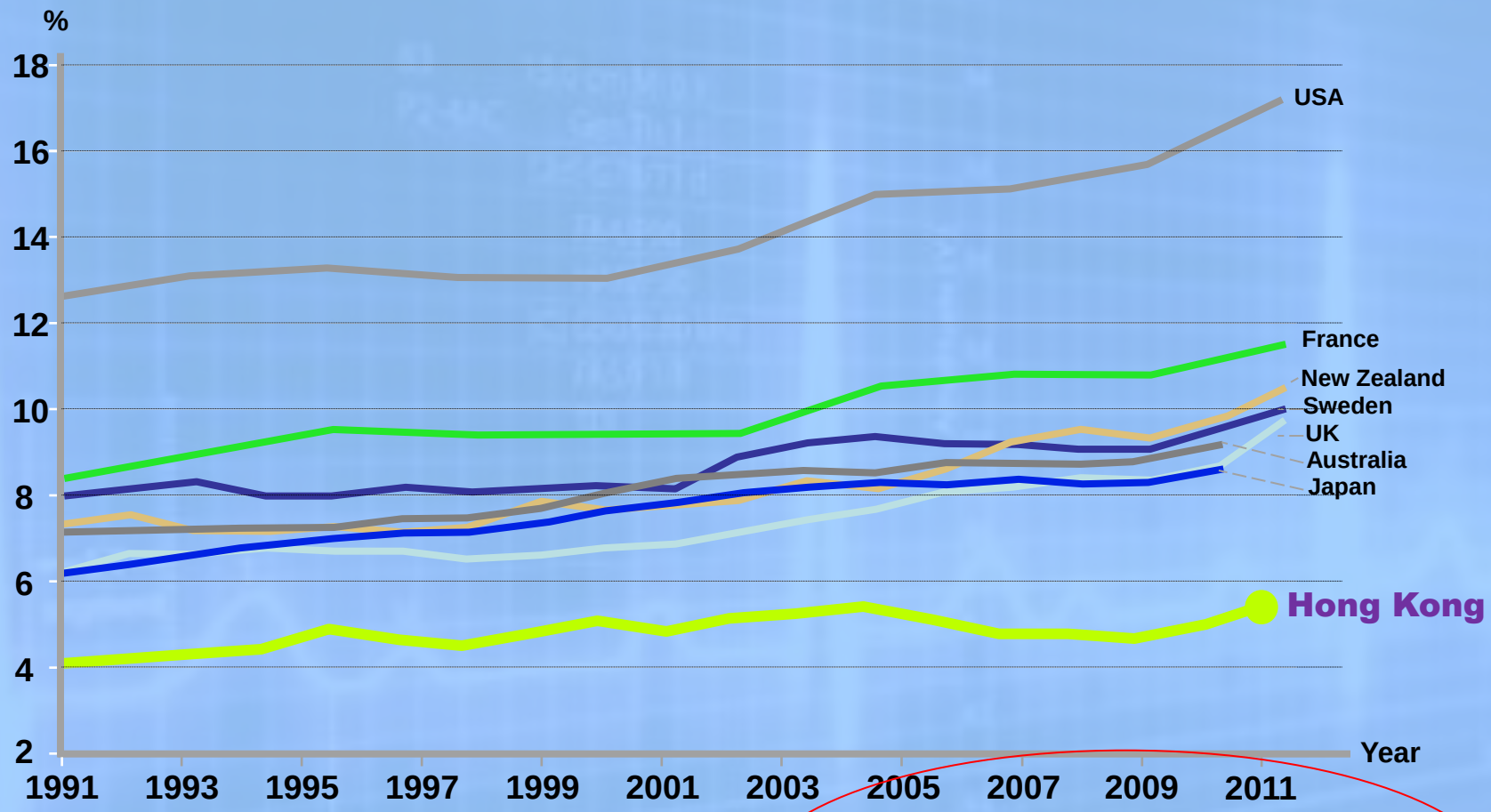
- **2.5% GDP**
- **88% inpatients**
- **31% outpatients**
- **Public Health**

Private

Self-financed by patients

- **2.6% GDP**
- **12% inpatients**
- **69% outpatients**

Total Expenditure on Health as Percentage of GDP

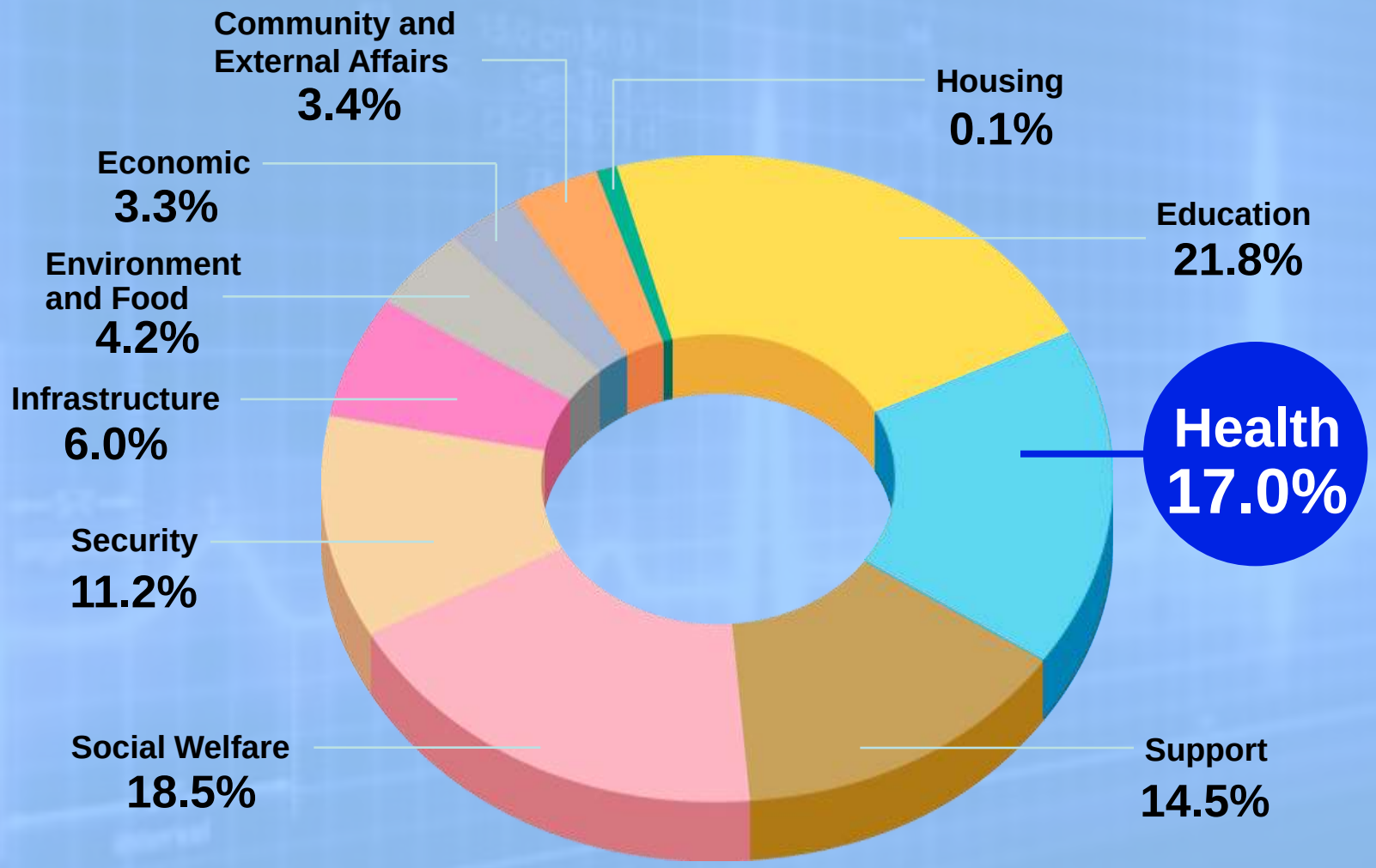


5.1% = 2.5% + 2.6%

GDP **Public** **Private**

Source: 1. Food and Health Bureau – Hong Kong's Domestic Health Accounts (HKDHA) - Estimate of Domestic Health Expenditure, 1989/90 – 2010/11
2. OECD Health Data June 2013

Government Expenditure on Health – 2014/15 Estimate



Source:
The 2014-15 Budget - Recurrent Government Expenditure: 2014-15 Estimate

Hospital Authority

- Established in 1991

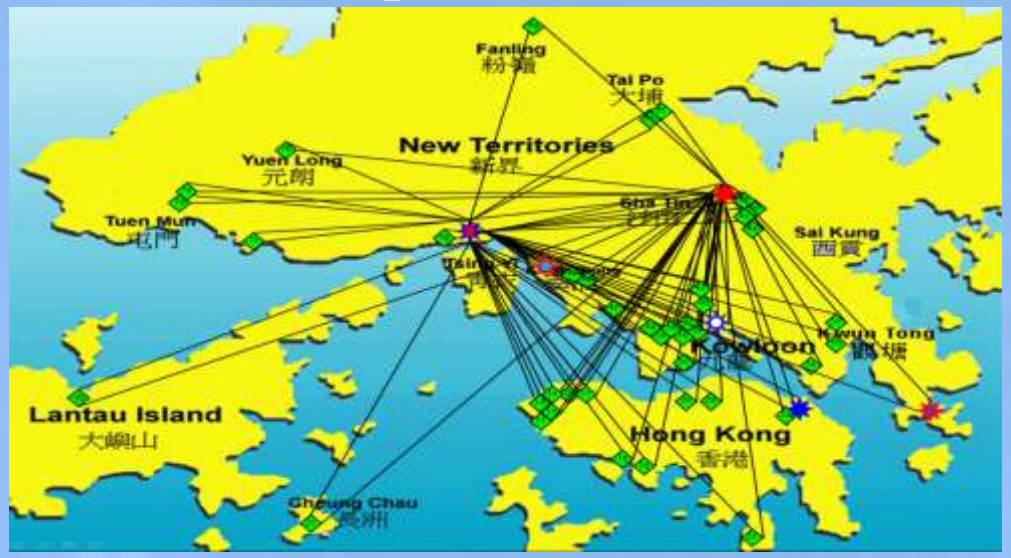
162 sites
- 42 Public Hospitals
- 47 Specialist Outpatient Clinics (SOPD)
- 73 General Outpatient Clinics (GOPC)
- Around 28,000 Beds

Annual Workload
- 6,300,000 GOPC Attendances
- 7,300,000 SOPD Attendances
- 2,200,000 A&E Attendances
- 1,700,000 Inpatient and Day Patient

Source:
1. HA Statistical Report 2012/13
2. HA Information Fact Sheet Jun 2014
3. www.ha.org.hk

IT Service Delivery & Technology

Scope of IT Service Delivery



- **HA IT Services 2014/15**
- Employees: **852 (63%)**
- Contractors: **511 (37%)**
- **5** Corporate Data Centers*
- **16** Hospital Data Centers

Who Do We Support

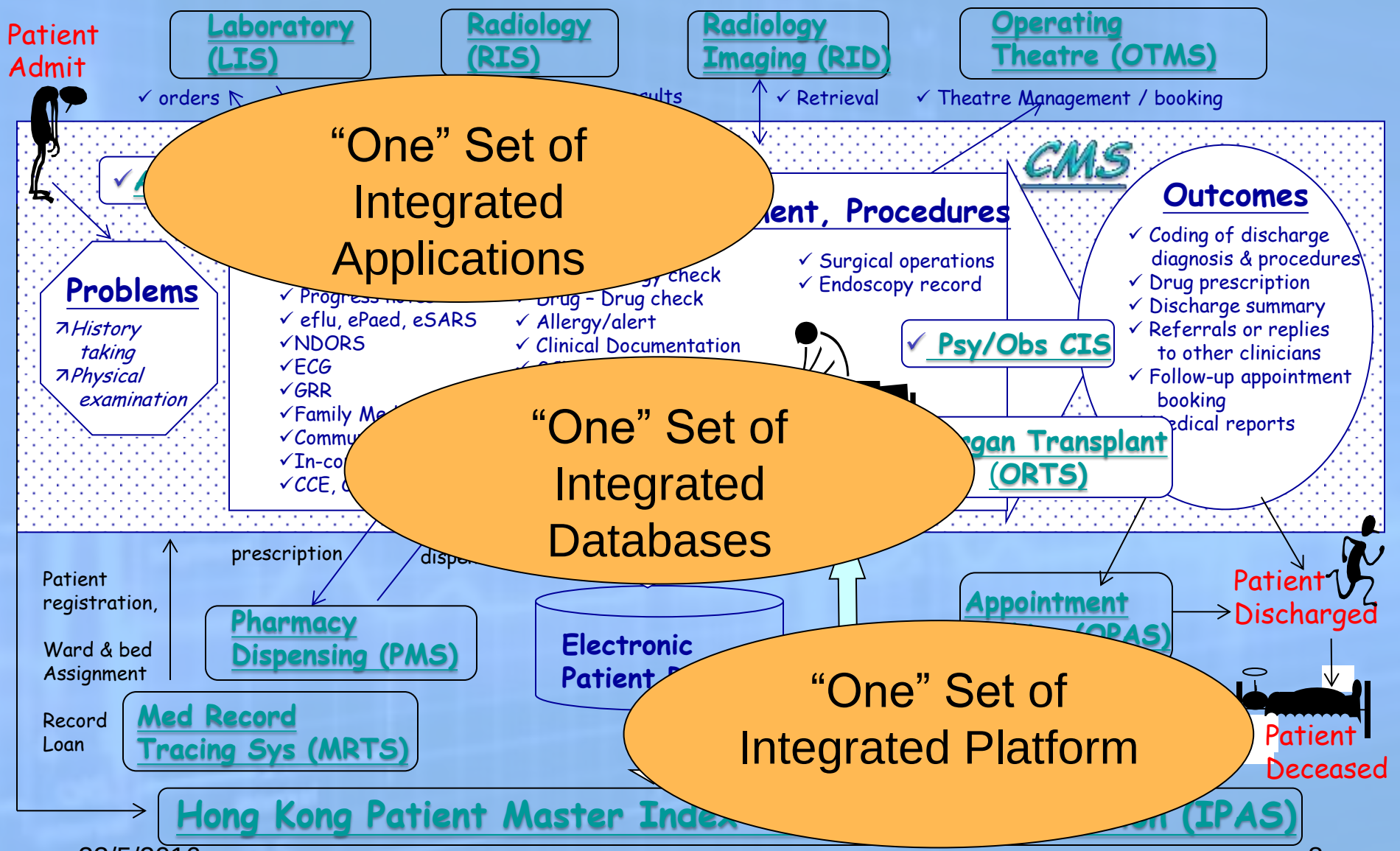
- **7+ mil** HK Residents
- **70,293** HA Employees
- **42** Hospital/Institutions
- **120** HA Clinics in **200** Buildings
- **18,091** Suppliers to HA

- IT OPEX: **$1,088M (83%), 2.2%** of Total HA OPEX**
- IT CAPEX: **$226M (17%), 28.3%** of Total HA CAPEX**
- IT Expenditure is **2.6%** of Total HA Expenditure**
- IT Employees is **1.2%** of Total HA Employees**

** 2 for Development and Testing*
*** Expenditure include e-HR. Employees refer to HA staff only*

Electronic Transactions	
CMS transactions	**11.0M** per day
ePR transactions	**1.8M** per day
OPAS/IPAS transactions	**0.86M** per day
Laboratory requests per annum	**23.7M**
Dispensing transactions per annum	**65.8M**
Radiology examinations per annum	**4.6M**
Financial transactions per annum	**156.9M**
HR/Payroll transactions per annum	**9.4M**
Procurement/SCM transactions per annum (including Drugs and Non-Drugs)	**22.2M**
Network Infrastructure	
Desktop PCs	**45,000**
LANs / Wireless LAN Access Points	**2,474** / **3,750**
WAN Lines	**250**
Servers (Processors)	**1,650** (**7,100**)
Data stored on the network	**2,450** Terabytes
Messaging	
Intranet / Internet mailboxes	**60,600** / **47,200**
Intranet messages per month	**28M**
IN / OUT Internet messages per month	**834K** / **899K**
Spam messages blocked per month	**1.1M**
Viruses / Attacks blocked per month	**291** / **183K**

Clinical Systems – Patient Care Delivery Journey

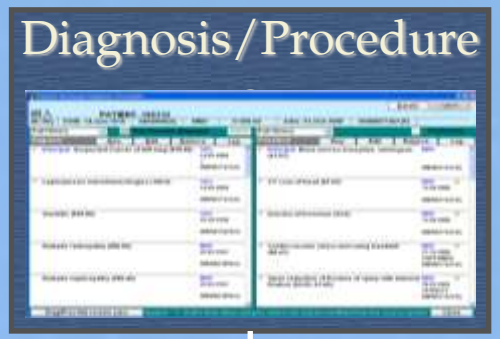


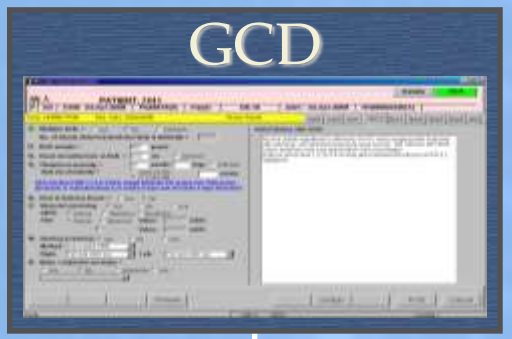
Unique Patient Identifier

- Using Hong Kong Identity Number **(HKID #)**
- PMI, Admissions/Discharges and Appointments Booking implemented **across all HA hospitals and clinics**
- HA PMI contains **10 million people's records**

Uniquely identify all patients and facilitate linking together episodes of care

Standards & Medical Terminology



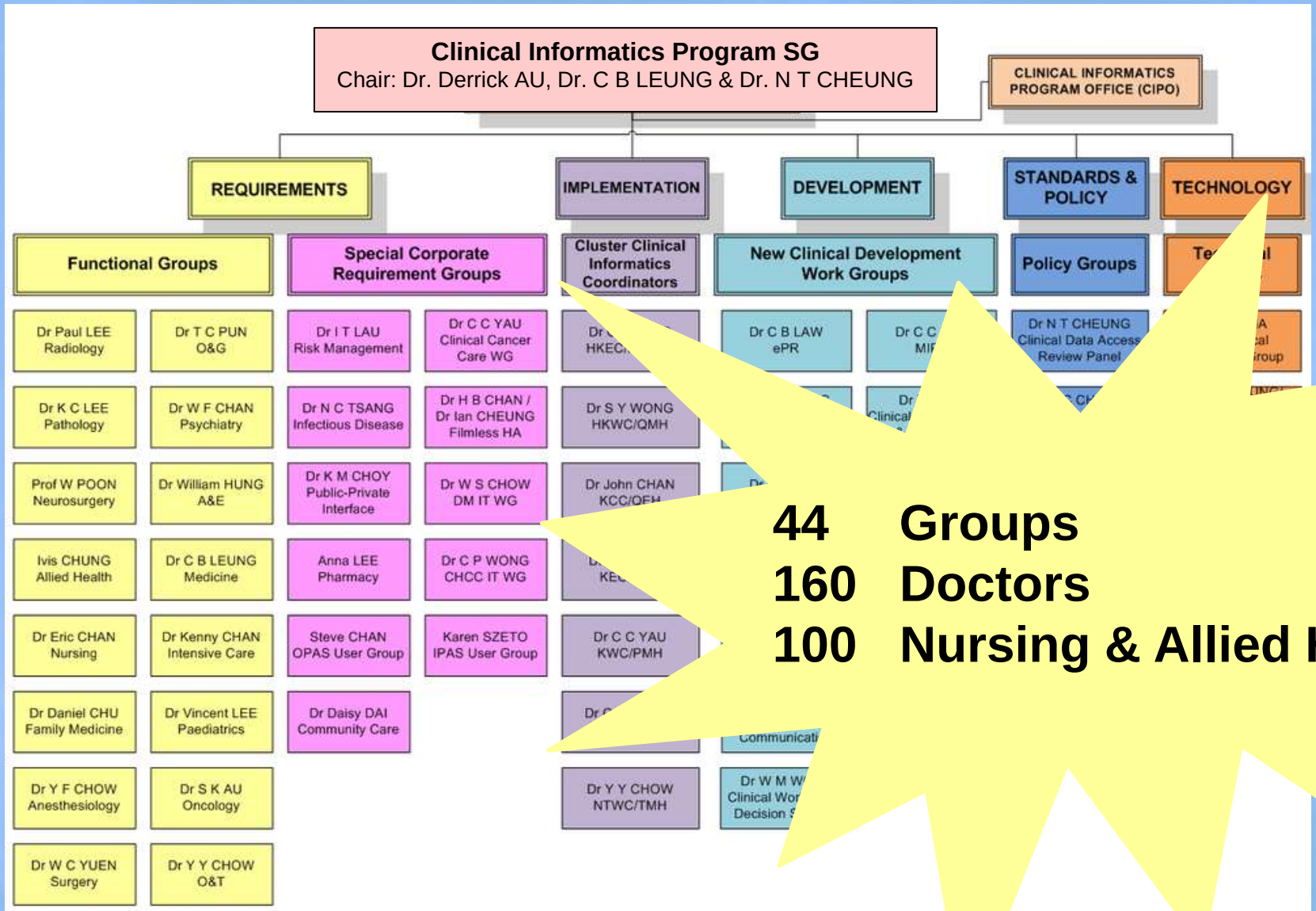


ICD9CM
ICD 10
ICPC
ICF

SNOMED
LOINC

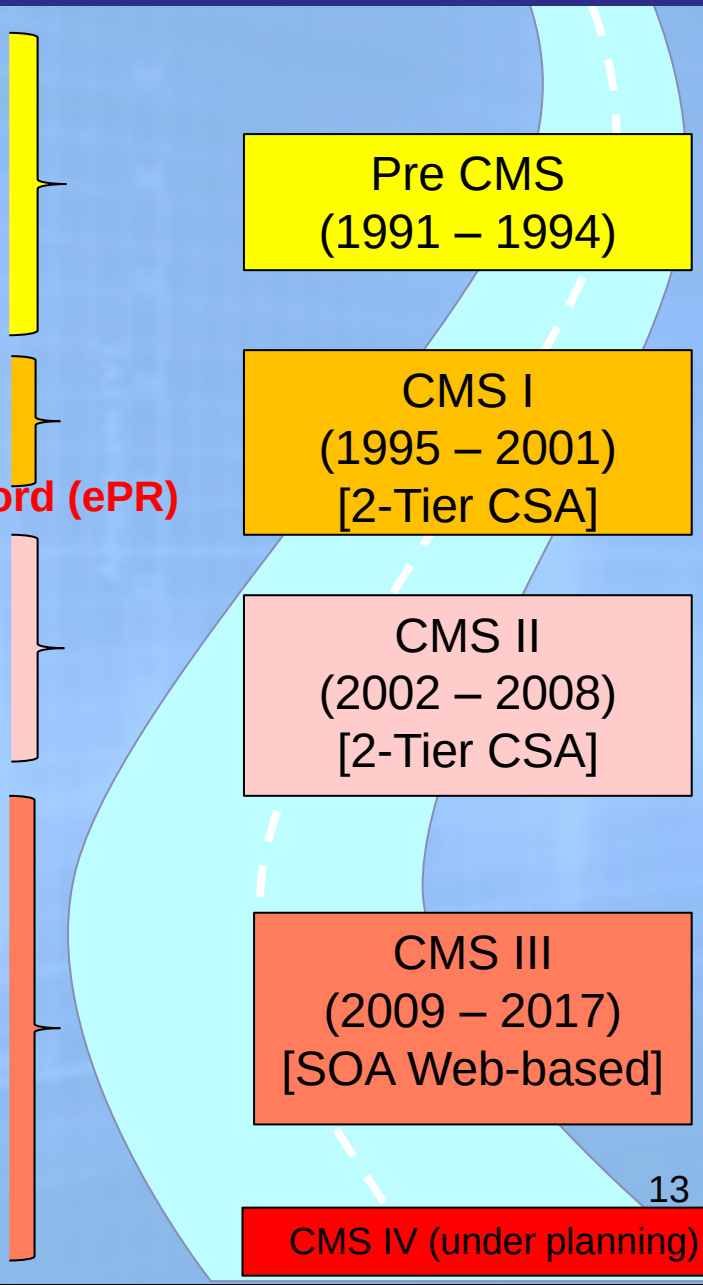
CMS Governance & Roadmap

Clinical Informatics Governance



CMS Development In HA (20+ years)

- **1990** – "**Green fields**"
- **1991** – **Patient Administration**
- **1992** – Pharmacy system
- **1993** – Pathology system
- **1994** – Radiology information system
- **1995** – **CMS I**
- **2002** – **CMS II – incl. Electronic Patient Record (ePR)**
- **2003** – eSARS
- **2004** – **Image Distribution**
- **2006** – ePR sharing with private sector
- **2009** – **CMS III Ph 1**
- **2010** – **Filmless Hospital**
- **2011** – **InPatient Medication Order Entry**
- **2012** – Web-based CMS
- **2013** – **CMS III Ph 2**
- **2014** - Filmless OT
- **2016** – **Launch of eHR**



Clinical Management System

CMS: Integrated clinical workstation for direct use by all 40,000+ clinical users in HA

- Phase I (1995-2001) – The Collector
- Phase II (2002-2008) – The Documenter
- *Phase III (2009-2017) – The Helper*
- Phase IV – The Colleague
- Phase V – The Mentor

Evolution of CMS I & II

CMS I (Year 1995 – 2001)

- Discharge summary
- Clinician coding of diagnosis & procedure codes
- Ordering of medications & laboratory tests
- Retrieving laboratory & radiology results
- Medication history
- E-booking of appointments
- Referral / reply letters and reports
- Cross hospital information enquiry

CMS II (Year 2002 – 2008)

- Generic Clinical Requests (Order Entry)
- Generic Results Reporting (Clinical Forms)
- Clinical Data Framework
- Outcome Documentation
- Medication Decision Support
- Clinical Data Analysis and Reporting
- *Electronic Patient Record (ePR)*

Evolution of CMS III

CMS III (Year 2009 - 2017)

- Full Web Based, Service Oriented Architecture (SOA)
  - Access anywhere
- Imaging Solution
  - Radiology & Others
- Filmless Hospital
  - Nursing Wards (Wifi)
- Mobile Solution
  - Apps (Patient Assessment, Nursing outreach service, Care Model, ….)
- Nursing & Allied Health
  - More electronics
- Closed Loop Inpatient Medication Order Entry
  - Prescription, Dispensing & Administration
  - eCert, Mobile Tablets, Wifi
- Support for electronic Health Record (Government program)
  - Launched in Mar 2016

CMS is essential in HA

Each Day…

- 100,000+ patients treated with CMS
- 11,000,000+ Clinical online trans
  - Peak: 600 Tran / sec

To Date…

- 22,000+ Clinical workstations
- 40,000+ Clinical users
- 10,000,000+ patient records
- 700,000,000 Lab records
- 1,000,000,000 MB clinical data & rad images

Key Benefits

1st Benefit: System Efficiency from Speeding up Process

Average time with doctor per specialist outpatient attendance : **7 Minutes**

Average wait time for dispensed drugs: **15 Minutes**

Contribution to Patient Safety

2nd Benefit:

Drug Allergy Checking	
Drug Allergy Alerts Raised	69,000
Alert Accepted	32,000 (47%)
Alert Overridden	37,000 (53%)
Drug Drug Interaction Checking	
DDI Alerts Raised	11,000
Alert Accepted	4,000 (35%)
Alert Overridden	7,000 (65%)

Incidents of Misidentifications in Laboratory Tests

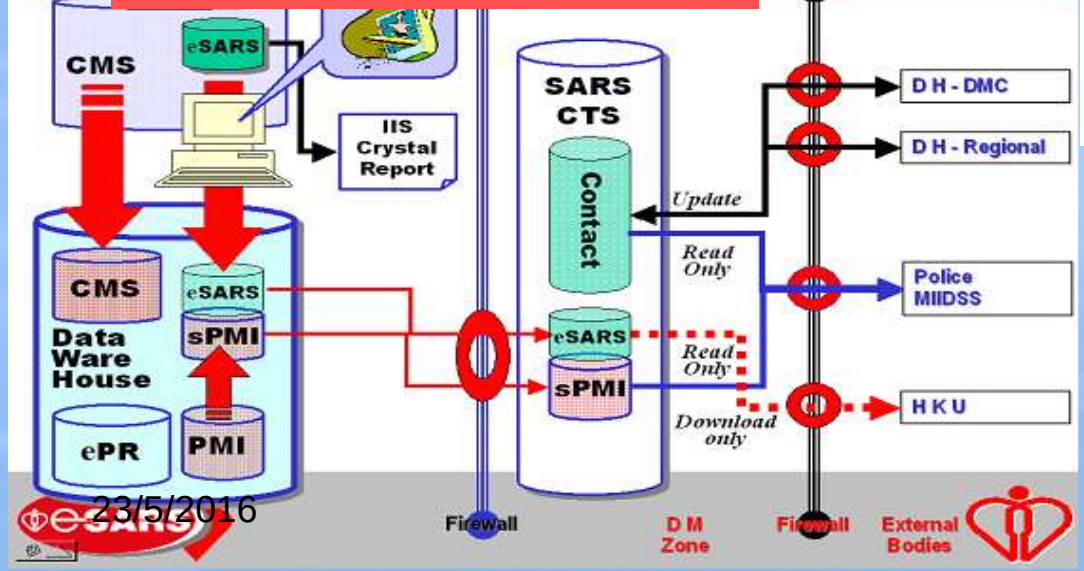
	Hospital A	Hospital B	Hospital C	Hospital D	All hospitals
Before introduction of 2D barcode system					
No. of cases	132	4	59	42	697
After introduction of 2D barcode system					
No. of cases	2	1	2	0	

3rd Benefit: Manage Emergencies (e.g. eSARS > eFLU > eMILK)

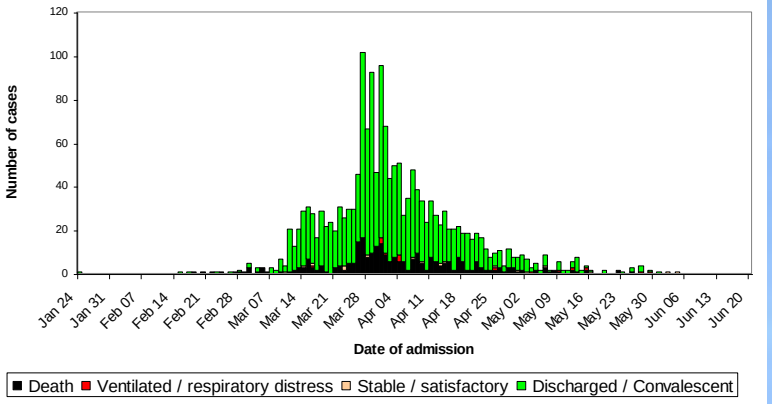
Fatality Rate by Age

Age	25-29	30-34	35-44	45-59	60-74	75+
%	*7.0*	*11.6*	*14.7*	*28.0*	*44.1*	*73.3*

eSARS Architecture 建築



The Hong Kong epidemic



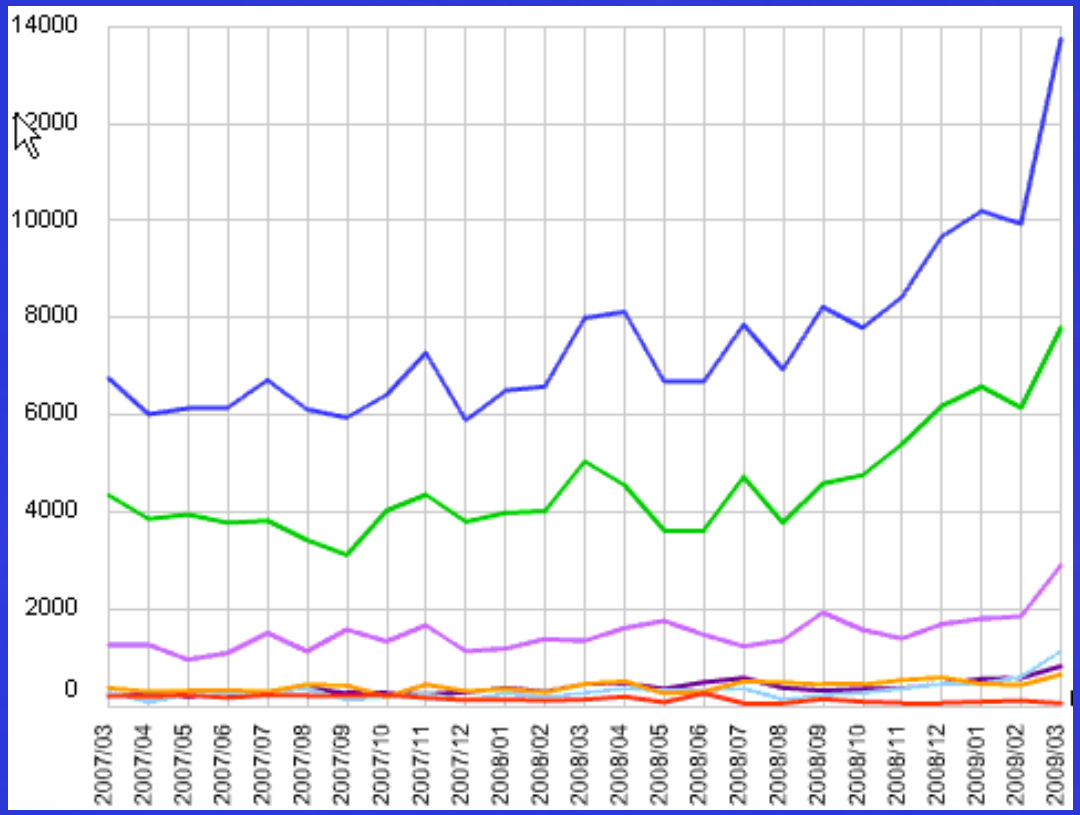
Video Conferencing

21

4th Benefit:

Enterprise Wide Analytics…

leveraging Corporate Clinical Data Warehouse and Clinical Data Analysis and Reporting System (CDARS)

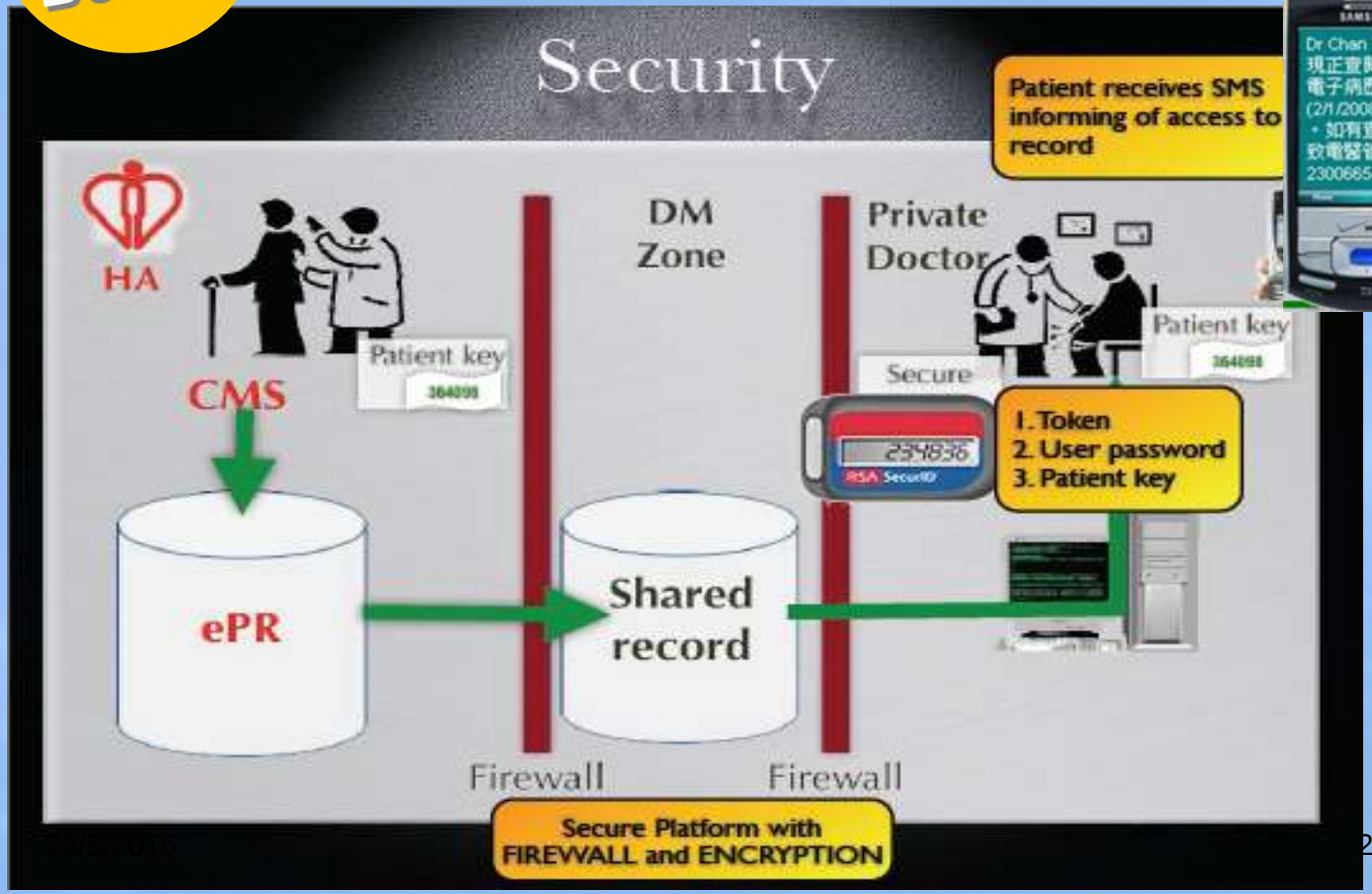


Clinicians run **56,000** queries per month

5th Benefit:

New Business Models - PPI

Sharing ePR with Private Sector Clinicians



6th Benefit:

Clinicians like IT and use IT

SO WHAT IS CMS IN HA?

- One of the most important investment supporting our core business of clinical care
- One of the largest CIS in the world with the highest penetration and clinician buy-in
- Facilitates clinical operations, making it more efficient and safer
- For the doctors, it is arguably the single most important tool in our daily practice
- A goldmine of largely unexplored data for clinical research and management reviews
- We need to move on to the next stage – exciting!

WHY WE ARE SPECIAL

- Clinician designed system for clinicians
- We did it in our own way, in-house, perhaps ignorant of what others are doing outside HK in the early days
- We use it, and use it a lot, and it is everywhere, almost 24/7
- We depend on it, and addicted to it
- Our core business is so dependent on it that system availability, data integrity and security is becoming a major risk management issue

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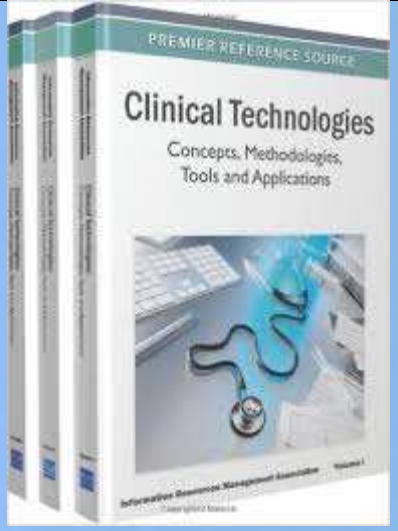
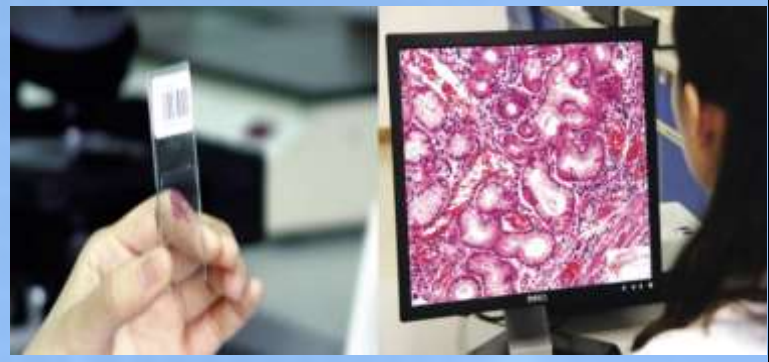
CISPG & CIPEG Member



CMS IV - New Clinical Technology for year 2017 to 2022 & beyond

#1
- New Pathology Technology

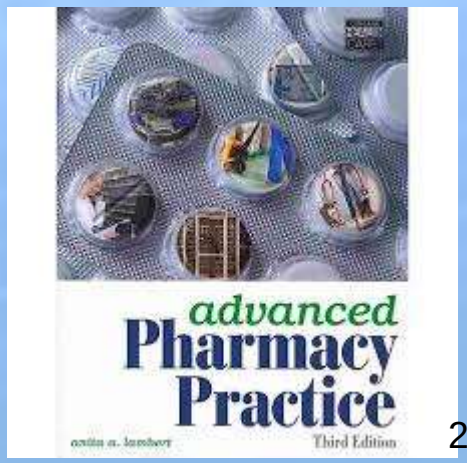
- **Emerging laboratory investigation technologies**
  - Enhancing reporting structure, analyzer interfacing, data analysis etc. for new technologies,
    - E.g. 1 Next Generation Sequencing (NGS)
    - E.g. 2 genomic medicine…
- **Digital Pathology**
  - Developing pathology slide-less infrastructure
  - Integrating with Digital Pathology for analysis & reporting
- **Laboratory Management System**
  - Supporting laboratory operations and workflow management, e.g. sample tracking, real-time operations monitoring, reagent management…



Smart Lab
Laboratory Management System

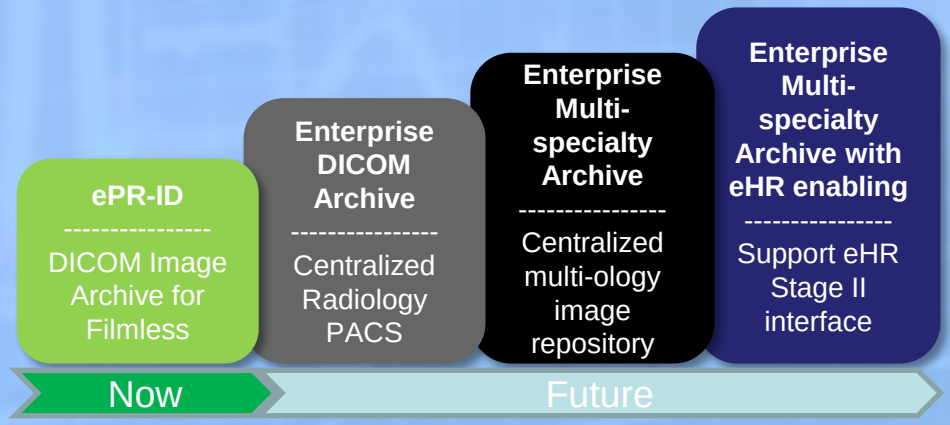
#2
- New Pharmacy Technology

- **Pharmacy Operation Modernization**
  - Pharmacy automation
  - Cross institution service
  - Flexible pharmacy operation
- **Workflow Re-engineering for Pharmacy Dispensing**
  - Triage of priority dispensing
  - Pharmacy dashboard
  - Management of waiting time
- **Drug Information Mobile Platform**
  - Mobile Apps
  - Drug administration schedule
  - Patient empowerment



#3
- New Imaging Technology

- **Enterprise Image Archive**
  - Multi-ology, cloud-based image repository
  - Zero-footprint universal viewer for delivering anytime, anywhere image viewing
  - Extend image sharing across enterprise
    - E.g.1: Image Navigation Assisted Surgery
    - E.g.2: Image interface with robotic surgery
  - Enable support to eHR (Imaging)

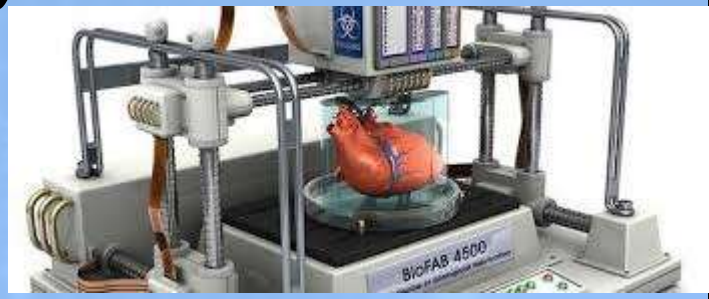


- **Enterprise Imaging Workflow Engine**
  - Enterprise work list and workflow engine to support multi-ology imaging workflows
  - Enable to launch appropriate reporting and visualization tool based on pre-defined criteria
  - Interoperate with enterprise universal viewer for sharing
  - Enable central reporting system for radiology images

#4
Modern Clinical Technology

Clinical Innovation + Technology

- **Modern Clinical Technology**
  - 3D Bio-printing systems for organ transplant
    - E.g.1 : 3DP Hip/Knee Implants
    - E.g.2 : 3D visualization
  - Track & Trace Technology
    - RFID / Blue Tooth / iBeacon
  - Healthcare Robotics Device
  - Biomedical



#5
Smart Consultation Technology

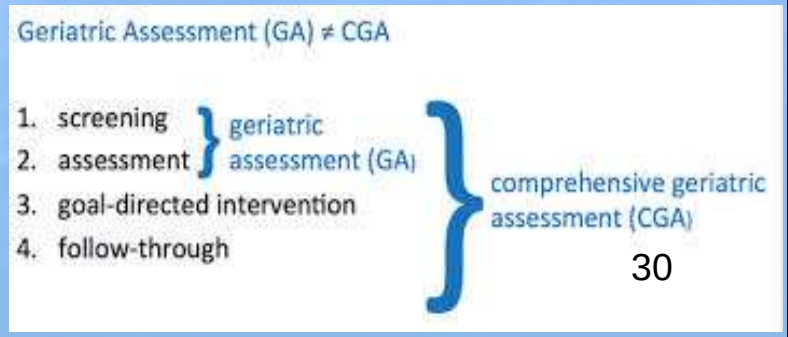
- **Clinical Protocol Driven Care**
  - Patient Care Plan
  - Assessment, Intervention & Outcome
  - Pre-op risk assessment

- **Smart Clinical Documentation**

Clinical Protocols and Order Sets

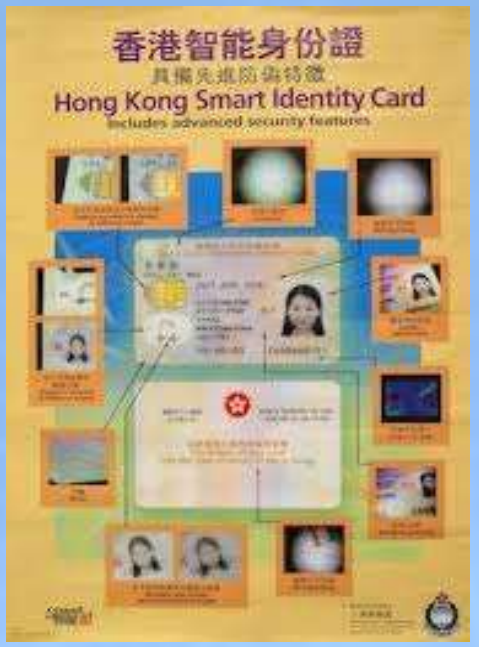
Here's a collection of clinical protocols and order sets, hospitalist-tested and designed to streamline management of common inpatient conditions.

- **Precision Medicine**
  - Emerging approach for disease diagnosis, treatment and prevention
  - Context of genes, physiology, anatomy, environment & lifestyle



#6
Patient Management Technology

- **Patient Registration Technology**
  - New generation of smart HK ID Card
- **User Log-in Technology**
  - Biomedical identification
- **New Bed Management Technology**
  - Exploration of use: RFID/iBeacon on bed and patient
- **Location & Condition Sensing Technology**
  - Sensor Devices and Wireless Network



#7
Mobile Medicine Technology

- **Mobile Medicine / Telemedicine**
  - Support Community Care
- **Bed-side setting**
  - Vital Sign automatic capture / alert
- **Patient Self-monitoring at home**
  - Vital Sign capture / alert

Acknowledgement

Clinicians

Dr. FUNG Hong
Dr. S F LUI
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Dr. Y C CHU
Dr. Lilian LEUNG
Dr. Chris TSE
Dr. C B LAW
Dr. I T LAU
Dr. W L NG
Dr. John CHAN
Dr. S Y WONG…..

Clinicians

Dr. C B LEUNG
Dr. Damon CHOY
Dr. Y Y CHOW
Dr. Jimmy CHAN
Dr. C P WONG
Dr. Betty YOUNG
Dr. K C LI
Dr. Susan CHAN
Dr. C Y WONG
Dr. C Y TAM
Dr. Ashley CHENG
Dr. H B CHAN
Dr. W Y SHEN……

and hundreds of clinicians / nursing teams / allied health teams …….. & HI teams (led by Dr. N T CHEUNG) and IT teams (led by Kevin CAI)

Thank You

Key Learning Points - Achieving Healthcare IT in HA

Key IT Issues/Challenges

1. Inherent IT Risks
2. Ongoing Technology Refreshment
3. Rising Internal Demand for IT
4. Significant External Demands on HA IT Services
5. Growth in Facilities: Data Centers & WiFi
6. Developing IT Organisation
7. Developing Health Informatics/IT capability in HK
8. Safeguarding Data Security and Privacy

Recognition & Validation

Awards

China Top 5 CIO Award in 2008

Gold Award in HK ICT Award in 2007

APICTA Gold Award in 2006

HA Outstanding Staff & Team Award n 2006

Asian Hospital Management Merit Award in 2006

HKCS IT Excellence Bronze Award in 2005

Winner Asian Hospital Management Award 2005

Stockholm Challenge Award in 2004

Informatics Insight Award in 2004

Best presented paper in APAMI in 2003

Special invited presentation in AMIA in 2003

Benchmarking

HA total annual IT expenditure was only 10% of the comparable NHS London Region in UK

HA total IT investment of HK$2.4B since 1991 against HK$32.6B for Clinical Systems at comparable Kaiser Permanente in USA

HK$1B project in Singapore to share all public hospitals electronic patient records by 2012 (that HA has been doing since 2001)

15 Areas of Architecture, Technology and Infrastructure

1. Advanced Database & Database Consolidation	6. Authentication and Security	**11. Advanced System Monitoring and Trouble Shooting**
2. Advanced Wireless Connectivity	7. Advanced Application Integration	12. Advanced Architecture and Design
3. Real-time Data Support	8. Enhanced Availability / Serviceability	13. Clinical Imaging Platform
4. Tracking and Identification	9. Service Center Management	14. Advanced Software Configuration Management
5. Advanced Workstation and Mobile Access	10. Datawarehouse and Management Information	15. Smarter Implementation

Clinical Applications Strategy 2012-17

Planning framework

- Build on Clinical System Strategy 2007-12
- Make Reference to
  - HA Strategic Service Plan 2009-12
  - Forthcoming HA SSP 2012-17
- Align / enable HAVMV
  - Healthy People
  - Happy Staff
  - Trusted by the community

Development

Engagement

- CMS III Advanced Strategic Planning Workshop (Oct 2010)
- CIPSG & CIPEG forums
- Briefing to senior executives

Working

- Multiple CIPO & other internal forums

Internal control & QA

- CMT / CET meetings
- Briefing to D's meeting
- ITGC comment & input (June '11)

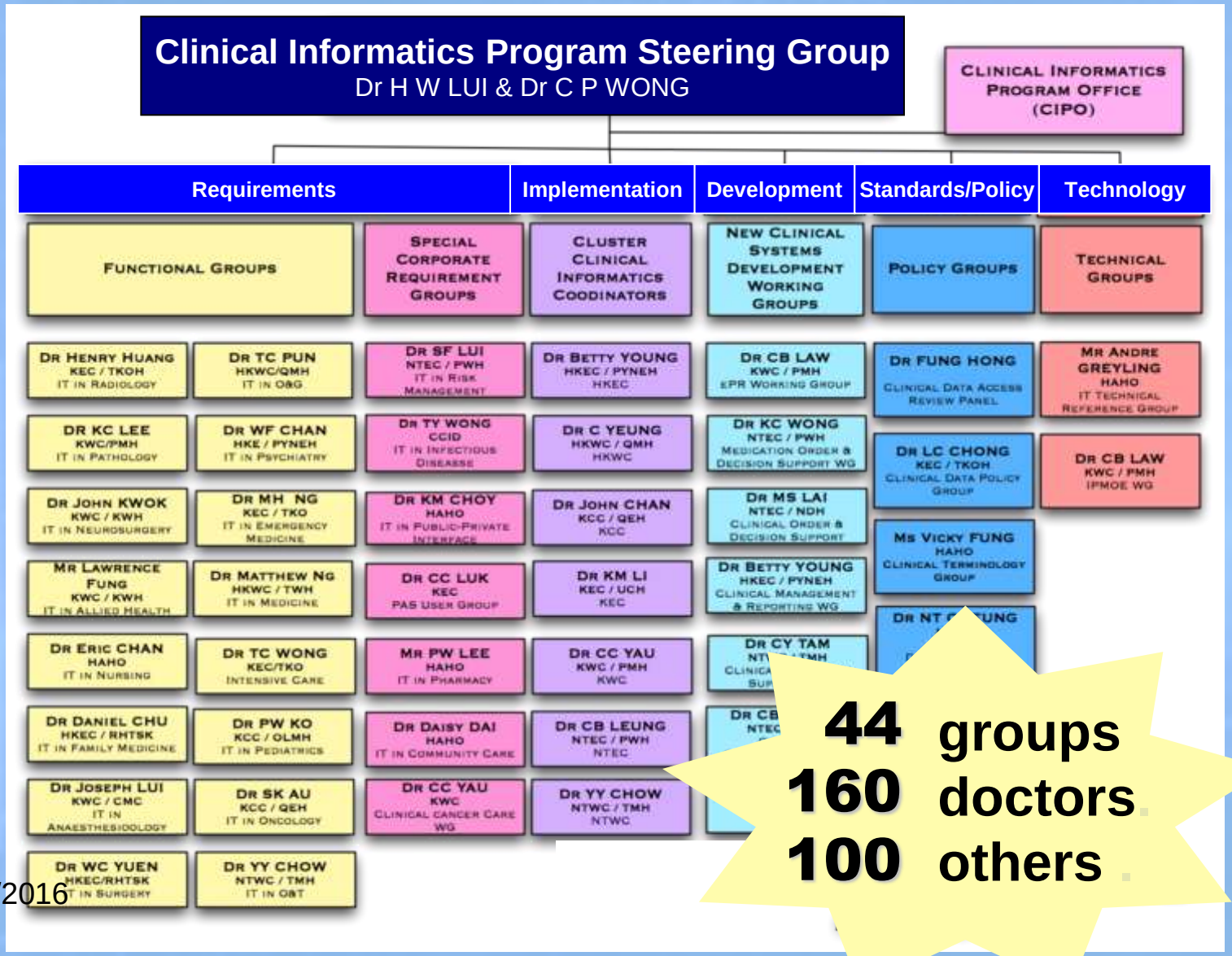
Key Initiatives (Clinical)

1. Adopt the Computerized Patient Record (CPR) Architecture for future clinical systems
2. Evaluate and acquire, (if risk and cost-justified), commercially available tools, components and applications before developing in-house
3. Redevelop legacy PAS & CMS Systems to facilitate Workflow and Decision Support (Gartner CPR Level 3/4)
4. Progress Corporate Imaging Solution
5. Progress Sharing HA ePR with the Private Sector

Future CMS Phase III - Objectives

1. Develop the content
   - Standards-based, comprehensive, multimedia patient-based ePR
2. Facilitate the process
   - Support for operational care processes
   - Workflow management and communication tools
3. Improve the outcome
   - Clinical decision support at point of care
   - Support for QA activities
4. *Extend to the Community*

Clinician Ownership, Leadership and Engagement



Hospital Authority

病房 WARD

門診 CLINIC

常用連結 USEFUL LINK

- Staff Early Sickness Alert System
- CMS Newsletter NEW!
- Clinical Data Access – FAQ NEW!

- User Guide

Hospital Authority Clinical Management System

Version 2.0.0104.037

Logon:

Password:

OK

Shutdown

Reboot

Important Notes

1. All patient information is strictly confidential
2. Staff may only use the CMS for authorised purposes
3. All access to CMS is logged
4. Please logoff immediately after use
5. Please ensure you have verified the content before you sign the computer printouts

The HK Patient Master Index

- Using Hong Kong Identity Number (HKID #)
- HKPMI, Admissions/Discharges and Appointments Booking implemented across all HA hospitals and clinics
- HA HKPMI contains 8 million records

Uniquely identify all patients and can facilitate linking together episodes of care

2.2 Clinical Systems Strategy (5-year plan)

IT Strategic Plan for 5 years

IT Program	Key Initiatives
1. Clinical	➢ CMS3- Modernising CMS2 + Closed Loop Meds Mgt.
	➢ *Supporting Government's CDIS & eHR*
2. Non-Clinical	➢ ERP- Enterprise Resources Planning System
	➢ PBRC – Patient Billing & Revenue Collection
3. Infrastructure	➢ RAS- Improve Reliability, Availability & Serviceability
	➢ CRS- Consolidation, Rationalization & Standardization
4. Organization	➢ IT/IS Organization as a Shared Service

Currently developing the next 5 year IT Strategic Plan!

ePR Image Distribution

- **Reference quality images**
  - Images acquired from Radiology PACSs
  - Selected key images
  - Compressed → reference quality images kept in Central Archive
  - Share with clinical depts via CMS / ePR platform
  - As at March 2007, 11 Radiology PACSs connected
  - 22 millions of 5 Terabytes lossy images archived

- **Limited lossless image distribution**
  - Leverage the same architecture
  - Add local server to keep lossless images
  - Facilitate filmless operation

Image Distribution Project - Architecture

existing
orkstations)

Limited
lossless
Option

Radiology Dept. mini PACS

online

DICOM
via WAN

Local Gateway

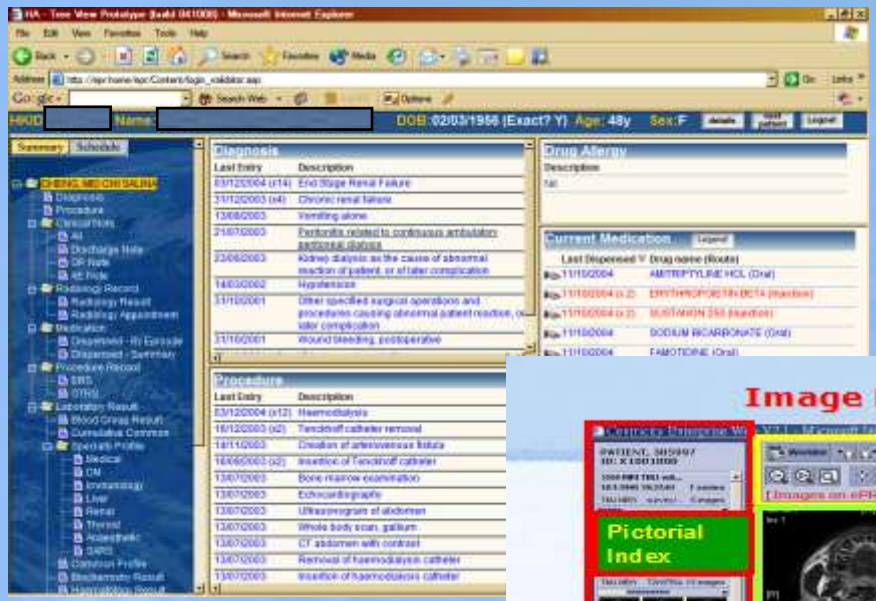
Central
Archive

Central
Web Servers

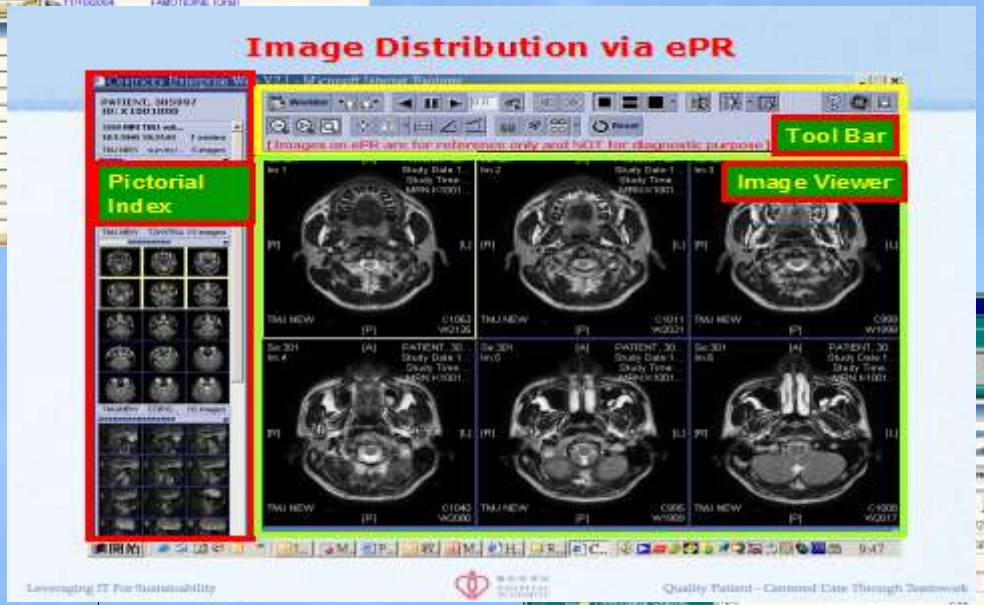
Clinical quality
images
(life long)

ePR
(with RIS / Images
link)

Enterprise-wide Electronic Patient Record (ePR)



⬅ Patient Summary



Radiology Images

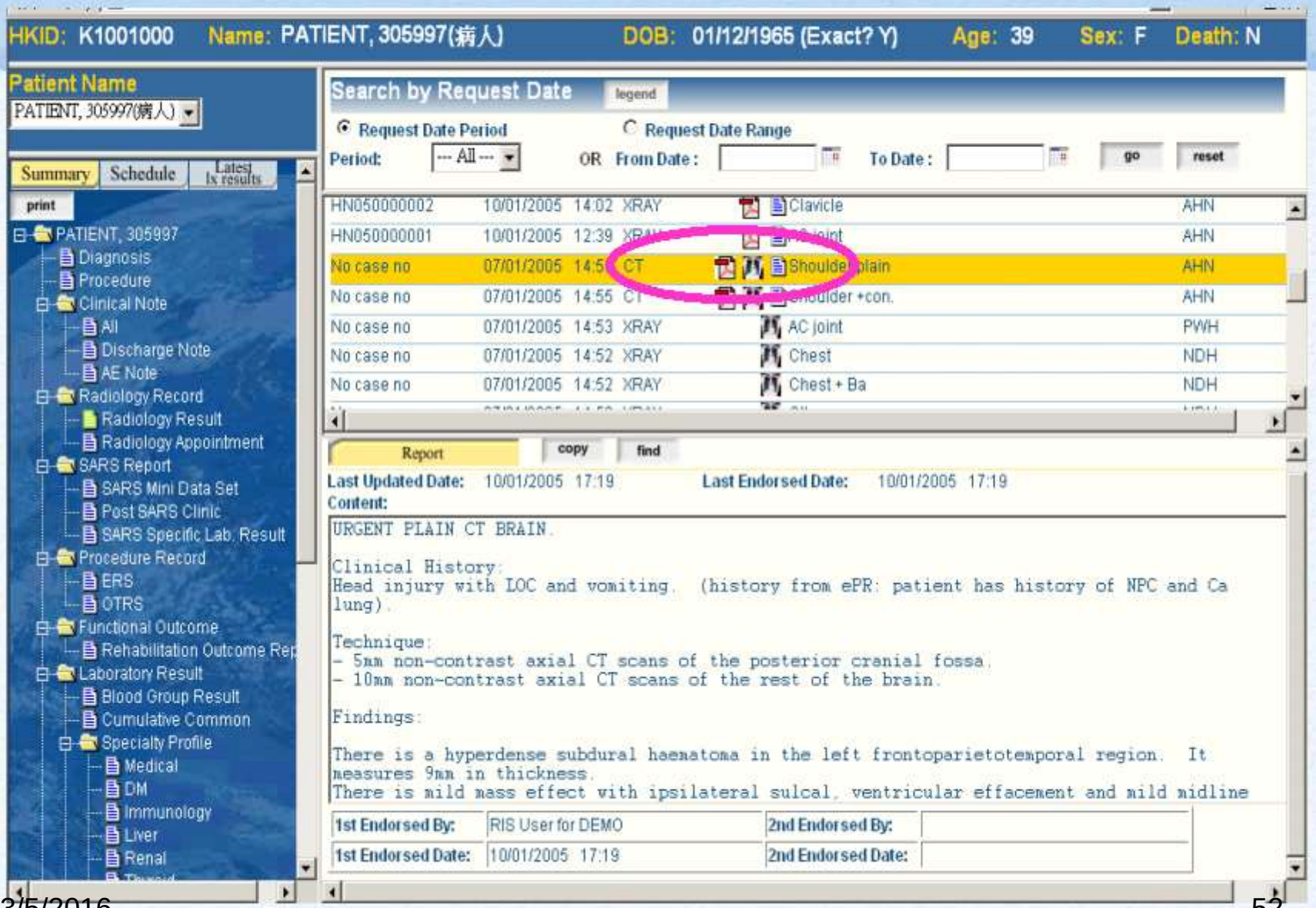
Laboratory Results ➡

ePR Contents

- Patient demographics
- Admissions & outpatient visits
- Allergies & Alerts
- Laboratory results
- Radiology results
- Diagnoses
- Discharge summaries

- Medications
- Operation & procedures
- Rehabilitation & therapy
- Obstetric history
- Other specialty data
- Scanned documents
- Diagnostic images

Image Distribution via ePR



Electronic Patient Record - ePR

- **Web-based lifelong longitudinal record of all healthcare transactions for all Hong Kong citizens**
- **Many data formats (textual, numerical and digital images)**
- **Patient privacy protected with access controls and full audit logs**
- **Available at all 162 facilities in HA**

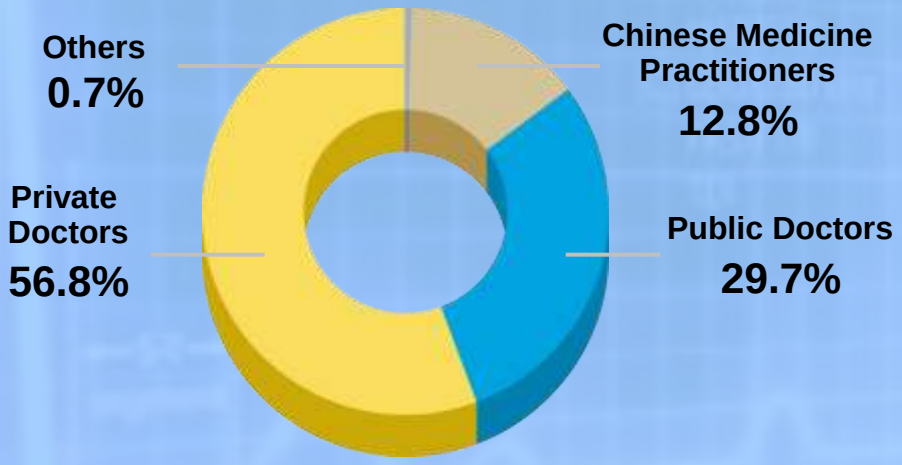
Hong Kong Public Healthcare

Public Health and Screening Services

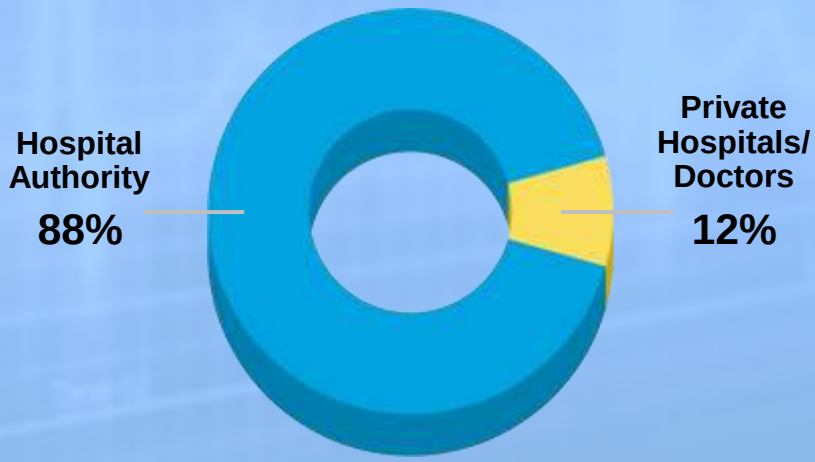
Hospitals, Specialist Outpatient Clinics, and General Outpatient Clinics

Healthcare Structure in Hong Kong

Primary Care (distribution of consultations)



Secondary and Tertiary Care
(distribution of in-patient bed days)



Source:

1. "Thematic Household Survey Report No.50", Census and Statistics Department, January 2013
2. Public/private share by in-patient bed day occupied in 2012 (HA & Department of Health)

IPMOE - New Technology

1. Doctors prescribe via IPMOE

2. Nurses login and view MAR via IPMOE

A "closed loop" Inpatient Medication Order Entry project among Doctors, Nurses & Pharmacist using E-Cert, Wifi, Mobile Devices, Tablet, Drug Trolley,…..

Administration record can be seen in pharmacy to facilitate drug refill

Pharmacists receive the order, vet and dispense drugs to ward

4. Nurses scan Barcode on patient wristband to verify Right patient

Drug administration details are clearly documented in the system

Filmless Hospital – New Technology

Film Saving : 5.3million per year

$$ Saving: $ 53m per year

Basic viewing technology

processing system

Image processing system