九龍中聯網智慧醫院
KCC SMART HOSPITAL
以智慧 作改變

The road to digital transformation in
Kowloon Central Cluster - Command Centre and beyond

Dr Eric CHEUNG
Cluster Chief Executive, Kowloon Central Cluster
Hospital Chief Executive, Queen Elizabeth Hospital
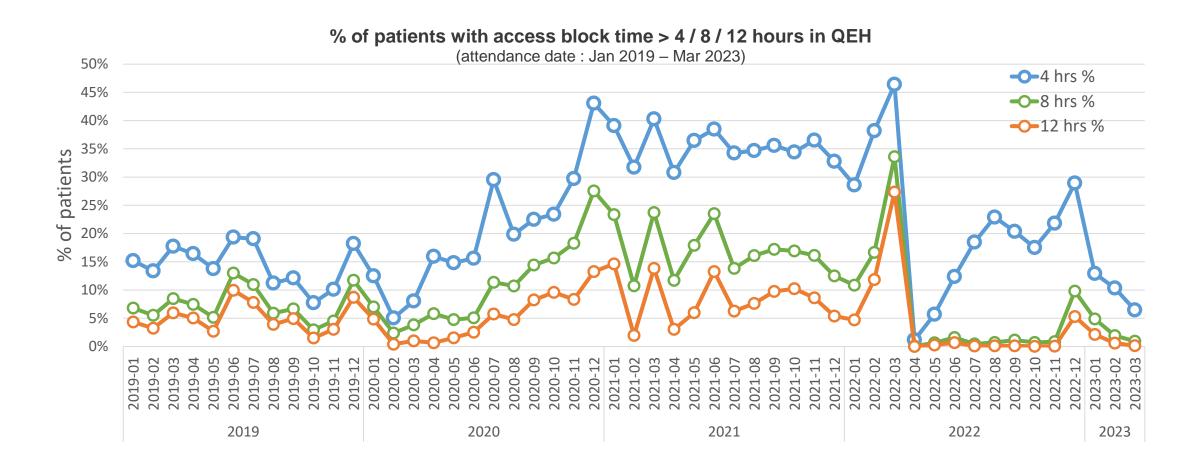
Access block in Queen Elizabeth Hospital

Patients waiting for admission in QEH A&E

- Queen Elizabeth Hospital (QEH) is **one of the busiest hospitals** in Hong Kong.

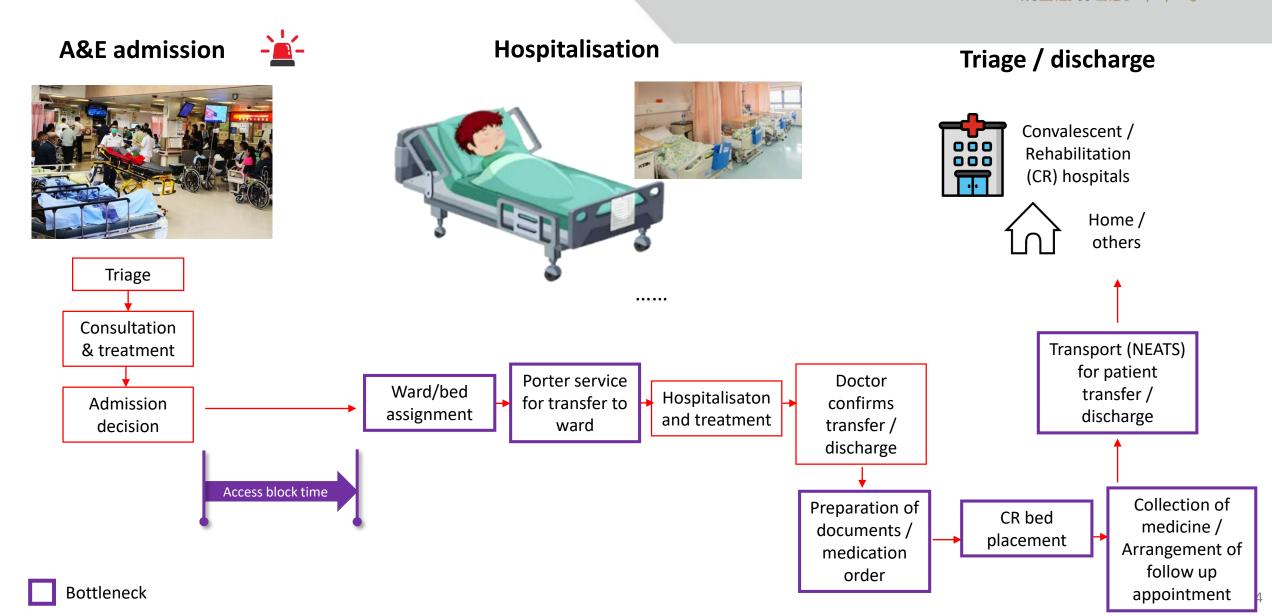- The Accidents and Emergency Department (A&E) is often **packed with patients** waiting for admission.

Access block in Queen Elizabeth Hospital

% of patients with access block time > 4 / 8 / 12 hours in QEH
(attendance date : Jan 2019 – Mar 2023)

Bottleneck in patient journey

A&E admission

Hospitalisation

......

Triage / discharge

Convalescent / Rehabilitation (CR) hospitals

Home / others

Triage

↓

Consultation & treatment

↓

Admission decision

→ Ward/bed assignment → Porter service for transfer to ward → Hospitalisaton and treatment → Doctor confirms transfer / discharge

Access block time

Preparation of documents / medication order → CR bed placement → Collection of medicine / Arrangement of follow up appointment → Transport (NEATS) for patient transfer / discharge

☐ Bottleneck

4

Integrated Airport Centre (IAC) at the Hong Kong International Airport (HKIA)

The Airport Emergency Centre (AEC) at the IAC is activated during a typhoon to help business partners maintain effective communication and coordination.

- Anticipation and prevention-based proactive management of potential disruption
- Raise reactivity
- Enhanced cooperation between the different operational areas
- Communication that is improved and speedier
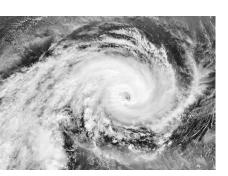

HKIA has been affected by increasingly intense typhoon in recent years (Source: Airport Authority Hong Kong)

IAC acting as nerve centre of the HKIA
(Source: Airport Authority Hong Kong)

Improving airport flow management
- Passengers
- Aircraft
- Baggage
- Sea and Landside Transport
- Information flow

Rapid incident response
- Co-located with the Airport Emergency Centre (AEC), allowing for a more rapid and coordinated response.

Hospital command centres

What Is an Operational Command Center?

Technology Most Commonly Involved

- Patient flow/bed mgmt. tools
- Transfer center tools
- ED systems
- Core capabilities from EMR
- Staffing/scheduling tools
- Communication/alerting tools

Command Center

A centralized operational control center in which real-time and predictive analytics are aggregated from various data sources and used as part of a coordinated approach to manage logistics, provide enterprise visibility, and improve coordination for multiple departments within a single hospital or across multiple facilities within a health system.

Reported Outcomes

- Improved patient flow
- Positive financial outcomes
- Improved patient experience
- Improved staff experience
- Better analytics visibility

THE MID AND SOUTH ESSEX UNIVERSITY HOSPITALS GROUP (MSE)

Billericay, United Kingdom

Acute and community based service ~ 1,800 beds with 400K population. 1,150 sq. ft, 24/7, 365 by 52 nursing staff

Nurse back to care: 406 hours per week
Bed assignment time: 18% reduction
Cancel operation: 18% reduction

2 staff 1,700 bed-months with AI automated (300+ rules)

Singapore Tan Tock Seng Hospital has built an "artificial brain"

Korea University Hospital

1,000-bed medical facility

Bradford Teaching Hospitals NHS

800-bed hospital 125,000 A&E attendances each year

Johns Hopkins Hospital

Patient transfer time improvement
Bed assignment time: 30% faster
OT transfer delay: 70% reduction

Our vision

CLINICAL COMMAND CENTRE
臨床作業系統指揮中心
To estimate wait times and minimize delays in care, make a better experience for the patient and allow for better patient safety.

CAPACITY COMMAND CENTRE
床位調配指揮中心
To improve patient flow, maximizing the ward / bed capacity and providing predictive analysis for better healthcare.

RESOURCES COMMAND CENTRE
資源調配指揮中心
Designed with deployment of various technologies to facilitate communication, management and decision making process.

- QEH has been designated as one of the HA's Smart Hospital pilots to develop and deploy a comprehensive Hospital Command Centre Product with **a view to exceling in clinical outcomes**, **enhancing patient experience** and **increasing efficiency**, so that these products can be **enhanced and fine-tuned prior to widespread deployment across HA**.

Co-development and co-delivery approach & Minimum Viable Product (MVP)

HAHO: SH Governance

QEH Governance

Business Leadership

IT Enablement

IT&HI Platform & Standards

Dashboard with Configurable Features

Standardized Data Hub and Platform

Scalable and Standardized for future Rollout

Business Lead, Co-location, Cluster IT

Minimum Viable Product (MVP)

1   2   3   4

Major milestones

Major Milestone

✓ **QEH Hospital Command Centre inaugurated on** *23 Oct 2020*
✓ **Development of local IT portals**

✓ **System development and user evaluation** of HA Corporate Capacity Command Centre Dashboards in *May 2021*
✓ **Implementation of the pilot scheme on patient discharge model** for stepdown cases **to CR hospitals** in **4 medical wards** (C6, F10, C5 and E7) from *7 June 2021* in collaboration **with the Resource Command Centre**
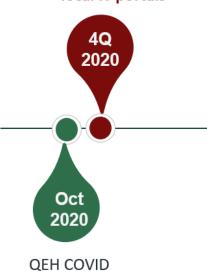
✓ Implementation of the **pilot discharge model to all discharge cases by NEATS** in **4 medical wards** from *6 Jul 2021*
✓ Subsequently **extended to 8 medical wards** from *23 Jul 2021*
✓ Implementation of the patient discharge model to **all medical wards** from *13 Sep 2021*
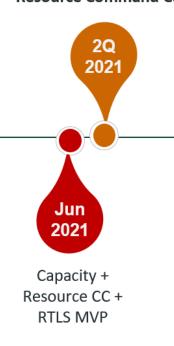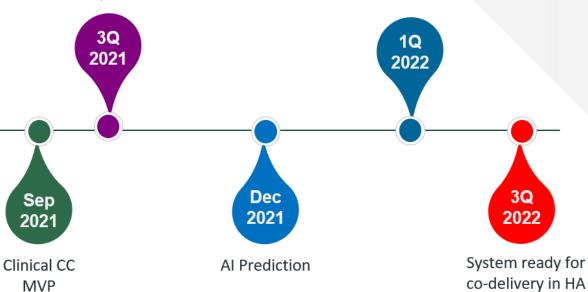
✓ Implementation of the patient discharge model to **all medical and surgery wards** (Total: 34 wards)
✓ Development of **proof of concept(POC) for automated bed assignment and COVID dashboards** with local and HOIT

4Q 2020

2Q 2021

3Q 2021

1Q 2022

Oct 2020

Jun 2021

Sep 2021

Dec 2021

3Q 2022

QEH COVID Bed Management

Capacity + Resource CC + RTLS MVP

Clinical CC MVP

AI Prediction

System ready for co-delivery in HA
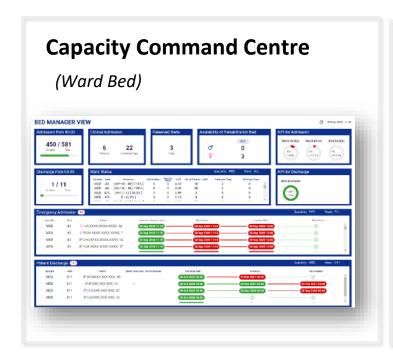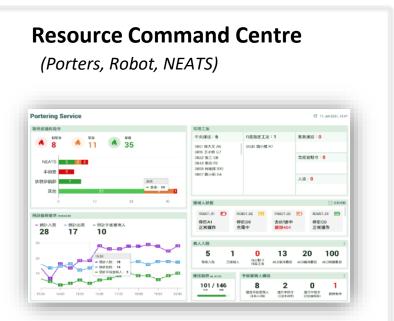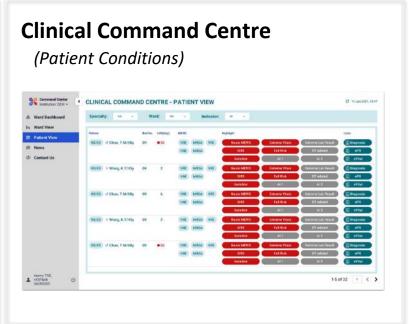
Command centre solutions

Capacity Command Centre
(Ward Bed)

Resource Command Centre
(Porters, Robot, NEATS)

Clinical Command Centre
(Patient Conditions)

Centralised operation control over real time data

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KCC SMART HOSPITAL
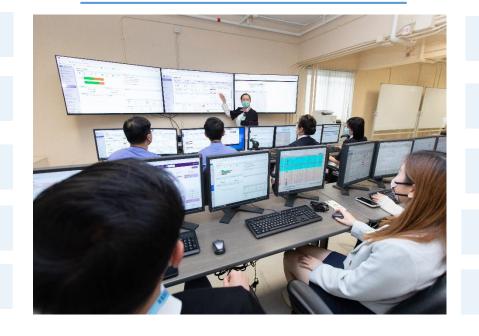以智慧 作改變

Source data

Patient admission

Ward and specialty

Bed information

Porter & NEATS

Pharmacy

Centralise & visualise

Decision

Assign ward

Assign bed

Assign CR hospital

Assign porter

Assign NEATS

Patient discharge flow

Prioritise resource

Remove bottlenecks
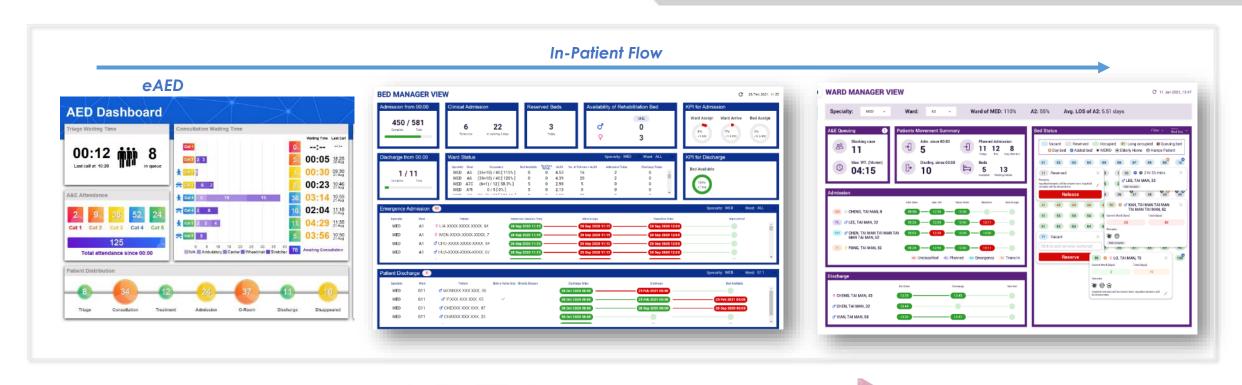
Capacity command centre

Dashboards to manage ward beds

In-Patient Flow

A&E Department → **A&E admission** → **Central nursing / bed manager** → **Ward & bed assignment** → **Ward manager** → **Discharge / CR bed transfer planning and monitoring**

A&E admission to ward
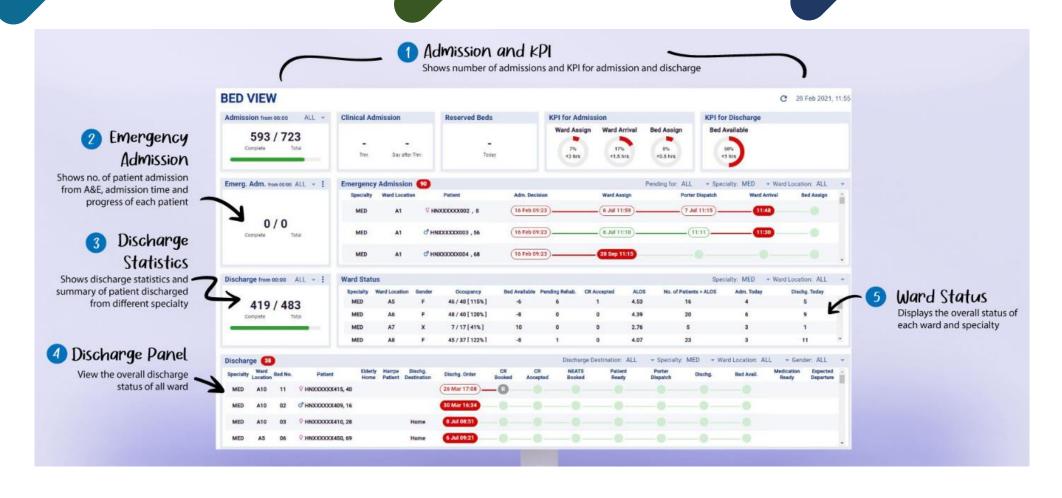
AI prediction view

This dashboard provides prediction of number of A&E attendances and in-patient discharges

1 A&E attendance
Next 24-hour prediction of A&E attendance using historical data

2 Ambulance arrival & triage prediction
Daily prediction of ambulances arriving A&E and number of patients under Triage 1 to 5

3 IP Discharge Table
Predicts patients' likeliness of being discharged through patient's medical history and unplanned readmission probability

Capacity management
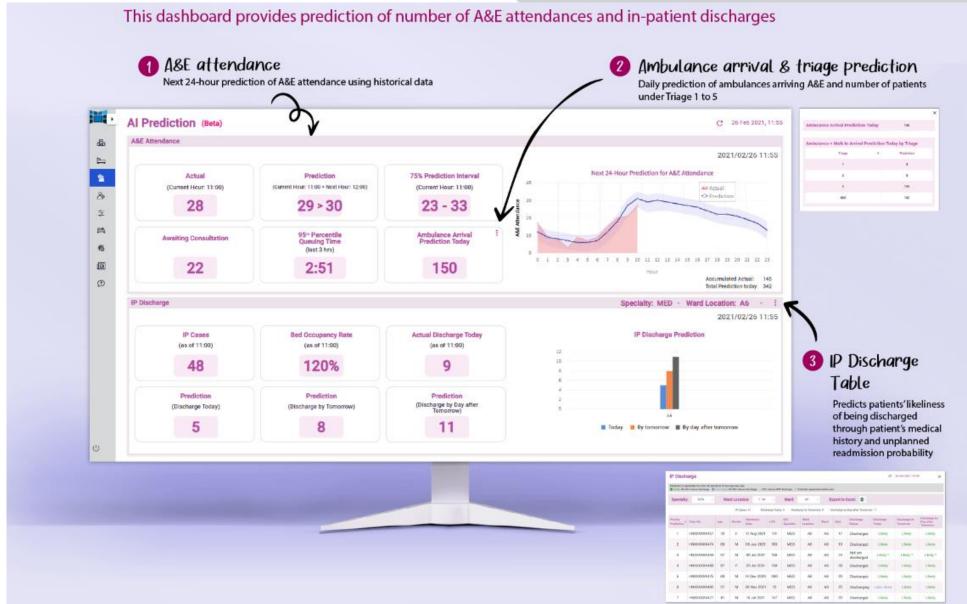
✓ Live in June 2021

Consolidated view on beds and wards
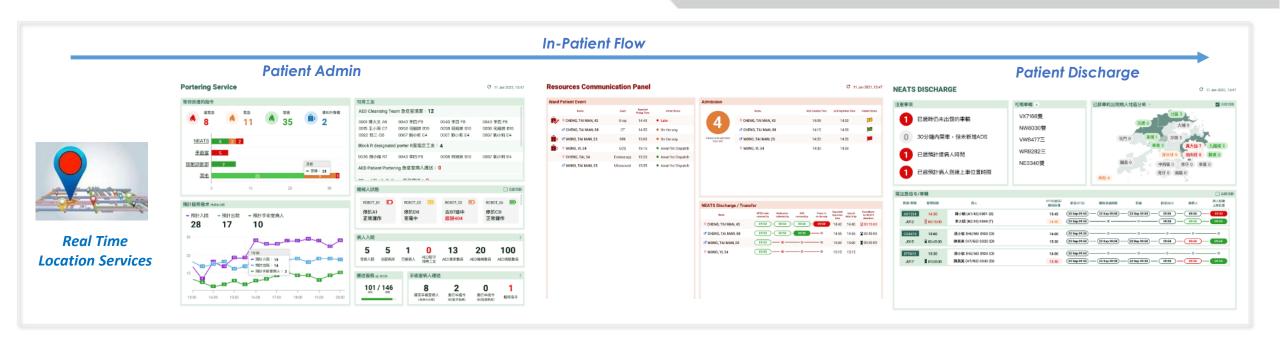
Service Improvement		
Improvement	**Before**	**After**
A&E waiting time	9.9hrs	**7.5hrs (↓24%)**
Patients picked up and discharged to C/R hospitals by 13:00 hours	47%	**55% (↑8%)**
Average discharge processing time	3.5 hrs	**2.5 hrs (↓29%)**
Reduce searching time for patient	-	**↓3 mins per search**
Reduce nurses' clinical handover time	-	**Saved ↓1,143 mins**

Resource command centre
Porter & NEATS services for inpatient admission & discharge

In-Patient Flow

Patient Admin → *Patient Discharge*

Real Time Location Services

A&E admission

A&E

Porter services
(Co-Locate w/ central nursing)

Patient admission

Ward manager
(Total view of hospital support activities)

Discharge (via NEATS)

NEATS managers

Clinical command centre

15 mins for COVID lab data

LIS

OTRS

ePR

60mins

OTMS

CDB

Nearly real time

PAcF

Nearly real time

Command centre database

E Vitals

DataRobot

CDR T-1

Hospital Authority
CMS
Clinical Management System

Patient status & highlight on exceptions

Monitor patients on-the-go

Improve patient care
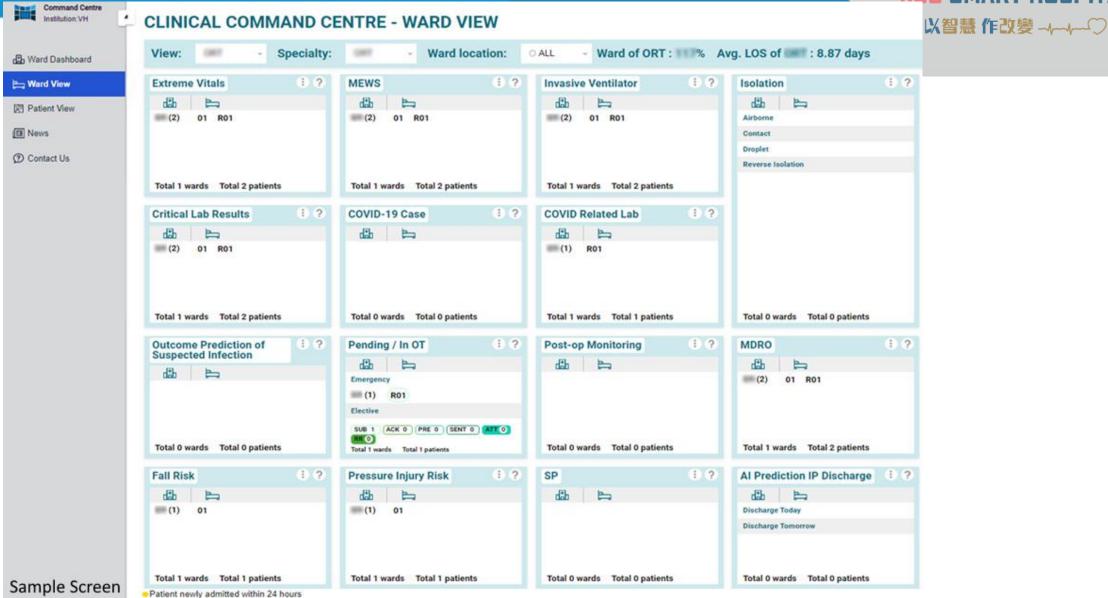
✓ Able to monitor patients on-the-go

✓ Identify risk areas and patients at-risk

✓ Prioritise care upon ward round

Better resource utilisation

✓ Improve efficiency in overseeing ward situation

✓ Save time from manually obtaining data from different clinical systems

Clinical command centre
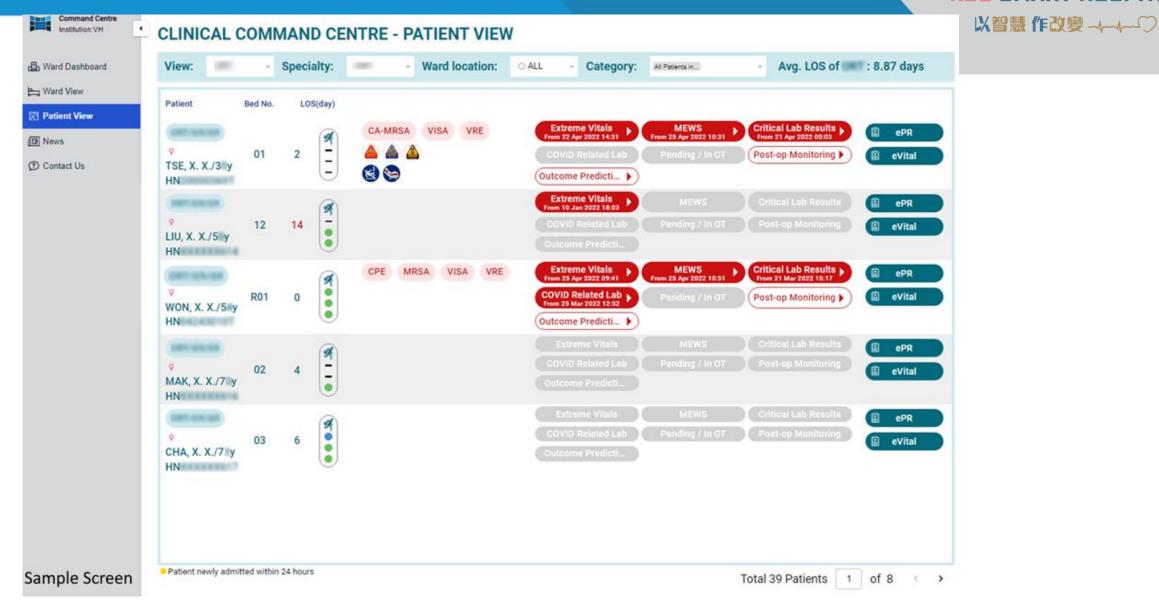
Clinical command centre - ward view

Clinical command centre

Clinical command centre - patient view

Right time, right place, right resource

Management

- ✓ Improve efficiency
- ✓ Better planning
- ✓ Resilience

Resource

- ✓ Better utilisation
- ✓ Locate beds easily
- ✓ Reduce wastage

Centralise & visualise

Staff

- ✓ Prioritise work
- ✓ Fewer phone calls / handover
- ✓ Easier to find patients and equipment

Fifth wave of COVID-19 outbreak in Hong Kong
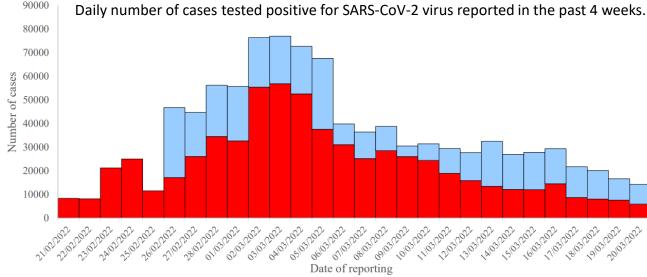
Daily number of cases reported in Hong Kong

Daily number of cases tested positive for SARS-CoV-2 virus reported in the past 4 weeks.

(Source: Central for Health Protection, Hong Kong)

- During the unprecedented fifth wave of the COVID pandemic, overcrowding at A&E became a pressing issue.

- QEH was converted into a designated hospital for COVID-19 patients in early March 2022.

- The conversion created around 1,300 dedicated beds for COVID-19 patients at QEH.

- Different levels of beds were categorised for treatment according to patients' clinical condition.

- Such kind of large-scale conversion has never been attempted in Hong Kong public hospitals before.

COVID-19 command centre module

QEH COVID Command Centre

- COVID Command Center Suite
  - Hospital Dashboard
  - Specialty/Ward Dashboard
  - COVID Patient Dashboard
- COVID Patient Discharge Plan Summary
- COVID Patient Appointment List
- Real-Time Bed Utilization Summary
- Bed Demand Supply Summary
- Patient Transfer Request System (PTRS)
- PMI Generator
- One-off checker for test exemption for persons recovered from COVID-19

Hospital dashboard
(for management and bed management team)
Level 1

Specialty/ward dashboard
(for COS/DOM/WM)
Level 2

QEH PCR results and CT values API

Latest COVID positive status from HA and DH API

Patient dashboard
(for doctors/nurses)
Level 3

Elderly home status API
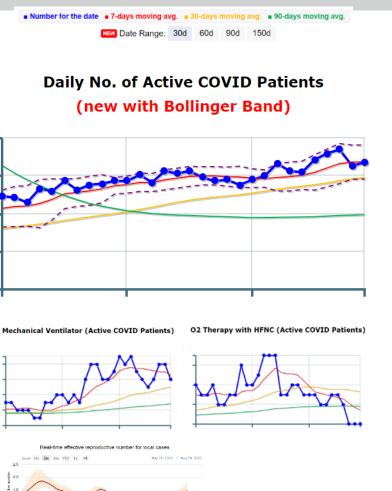
Patient demographics API

Hospital dashboard (Level 1)
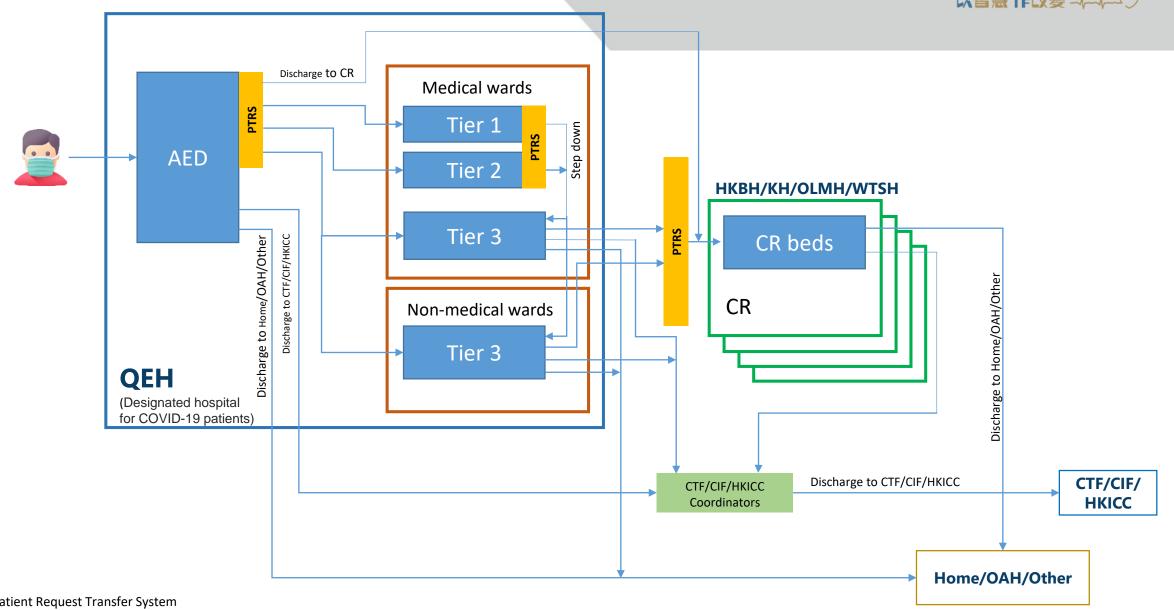
Trends

Total Active COVID Patient *		383	348	281	253	246 ↓
COVID Patient Status	Suspected	5	4	4	6	9 ↗
	Confirmed	378	344	277	247	237 ↓
	Recovered	444	438	464	439	414 ↓
Non-COVID Patient Status	Close Contact	20	19	28	33	32 ↗
ALOS in QEH (Days)	COVID	9.51	9.39	9.58	10.00	9.78 ↗
	Non-COVID	34.50	30.95	29.65	31.30	30.46 ↓
COVID Patient	Admitted	76	89	90	86	59 ↓
	Discharged	89	91	146	150	98 ↓
	Death	14	11	9	12	12 ↗
Non-COVID Patient	Admitted	82	110	131	83	96 ↗
	Discharged	49	105	91	93	65 ↓
Active COVID Patient at A&E	Average waiting time	0 hr(s) 50 min(s)	1 hr(s) 16 min(s)	0 hr(s) 44 min(s)	0 hr(s) 33 min(s)	0 hr(s) 20 min(s) ↓
	Maximum number of waiting	8	9	5	5	3 ↓
Discharge Plan	CR	17	17	21	18	21 ↗
	CIF	0	0	0	0	0 →
	CTF	2	3	2	3	3 ↗
	HKICC	0	0	0	0	0 ↓
Mechanical Ventilator	Active COVID Patient	21	21	17	13	14 ↓
	Recovered COVID Patient	12	13	13	16	16 ↗
Oxygen Therapy of Active COVID Patient	High-Flow Nasal Cannula	17	14	13	10	8 ↓
	> 6L	8	8	7	9	6 ↓
	<= 6L	92	81	73	52	57 ↓
	No	264	243	188	182	175 ↓

* "Active COVID Patient" is defined according to patient status as "Confirmed", "Confirmed in A&E", "Suspected" as recorded in COVID Patient Dashboard.

COVID-19 patient flow and discharge pathways

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QEH
(Designated hospital for COVID-19 patients)

AED

PTRS

Discharge to CR

Medical wards

Tier 1

Tier 2

PTRS

Step down

Tier 3

Non-medical wards

Tier 3

Discharge to Home/OAH/Other

Discharge to CTF/CIF/HKICC

PTRS

HKBH/KH/OLMH/WTSH

CR beds

CR

Discharge to Home/OAH/Other

CTF/CIF/HKICC Coordinators

Discharge to CTF/CIF/HKICC

CTF/CIF/ HKICC

Home/OAH/Other

PTRS: Patient Request Transfer System

Specialty/ward dashboard (Level 2) – heat map

Patient dashboard (Level 3) – list view

COVID-19 Patient Dashboard - [C10 ▾] (Specialty: MED)

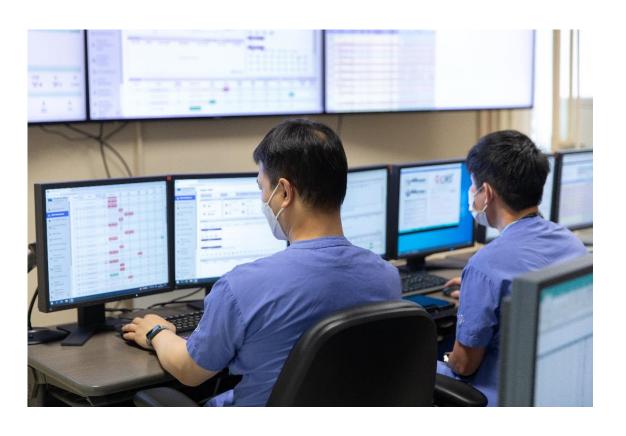Total no. of patients in C10 : 9 (M: 4 F: 5)

Please be reminded to compile with HA data privacy policies and principles in use of this system. User activities may be logged.

Bed	Name	Age/Sex	Elderly Home	D0	#COVID Day(s)	Spec	Team / MO i/c	LOS / Ward LOS	Diagnosis	DOA	Condition	O2 therapy	Discharge Plan	CT Value	(Beta) Latest data from QEH Lab for reference only		(Beta) Positive Result in latest 14 days	ADL	DNACPR	Remarks
															CT result	PCR result				
01			N	--	--	MED			Dx: Tuberculosis Comorbidities: DM, IHD, haemophilia A	26-4-22	Stable	1 Litre	Not Fit		--			Partial Dependent	No	
02			N	--	--	MED			Dx: COPD Comorbidities: HT, DM, LIpid,Hx of TB, COPD	27-4-22	Serious	2 Litre	Not Fit		--			Partial Dependent	No	
03			N	30-3-22	D37	MED			Dx: APO (Recovered over D28) Comorbidities: anaemia,chronic DVT, hyperglobulinemia	4-5-22	Serious	3 Litre	Not Fit			Not detected / 2022-05-05;		Partial Dependent	No	
04			N	02-5-22	D4	MED			Dx: PE,haemoptsis (Confirmed) Comorbidities: old PTB. Bronchiectasis	2-5-22	Serious	1 Litre	Not Fit		25.40 / 2022-05-02;	Detected / 2022-05-02;	PCR:Detected 2022-05-02; RAT:Positive 2022-05-02; PCR:Detected 2022-05-02;	Totally Dependent	No	
05			N	05-4-22	D31	MED			Dx: COVID-19,pneumonia (Recovered over D28) Comorbidities: lymphoma	26-4-22	Critical	0.45 High-Flow Nasal Cannula	Not Fit		22.13 / 2022-05-03;	Detected / 2022-05-03;		Partial Dependent	No	
06			N	18-3-22	D49	MED			Dx: ? Ca rectum,Aspiration pneumonia,COVID-19,PRB (Recovered over D28) Comorbidities: HT, Dementia	8-4-22	Serious	No	Not Fit		--			Totally Dependent	No	
08			Y	05-4-22	D31	MED			Dx: COVID-19,Sputum Retention (Recovered over D28) Comorbidities: Brain Tumour, MR,	25-4-22	Critical	2 Litre	Not Fit		--			Totally Dependent	Yes	
09			Y	21-2-22	D74	MED			Dx: Bronchitis,Recovered COVID-19 (Recovered over D28) Comorbidities: DVT, Dementia, DM, HT	4-5-22	Stable	1 Litre	Not Fit		--			Totally Dependent	Yes	
12			N	25-2-22	D70	MED			Dx: COVID-19,SOB (Recovered over D28) Comorbidities: HT, CVA, Ca gallbladder	15-4-22	Stable	No	Not Fit		32.53 / 2022-05-06;	Detected / 2022-05-06;		Partial Dependent	Yes	

Close

(Sample Screen)

Way forward

01 Cluster command centre

02 Initiatives to drive efficiency
- Doctor Dashboard

03 Clinical prediction

1. Cluster command centre

Timely and accurate understanding:

a) *Cluster resources view*

b) *Integrated resource management*

Acute hospitals

Queen Elizabeth Hospital

Kwong Wah Hospital

Kowloon Hospital

Hong Kong Buddhist Hospital

Our Lady of Maryknoll Hospital

TWGHs Wong Tai Sin Hospital

Convalescent/Rehabilitation hospitals
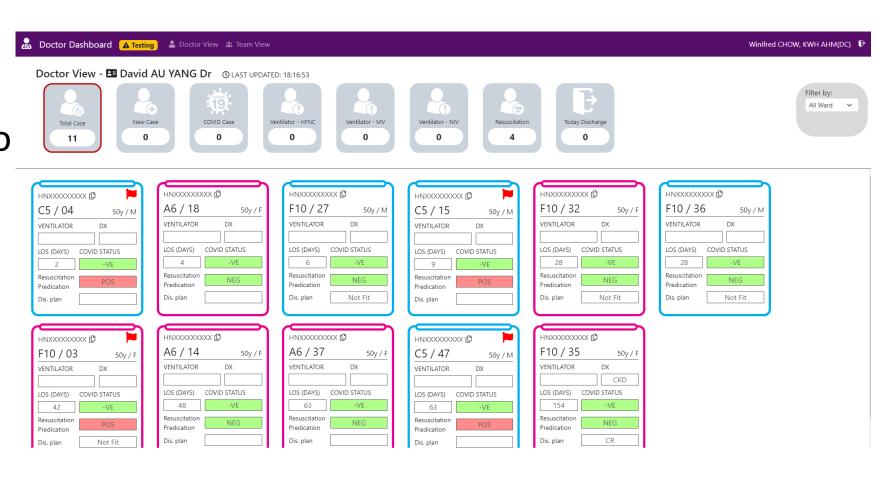
29

Doctor dashboard developed by KCC IT Development Centre to provide a holistic view of patients under care by specific doctor / team, to facilitate timely clinical care and to drive efficiency to ease access block.
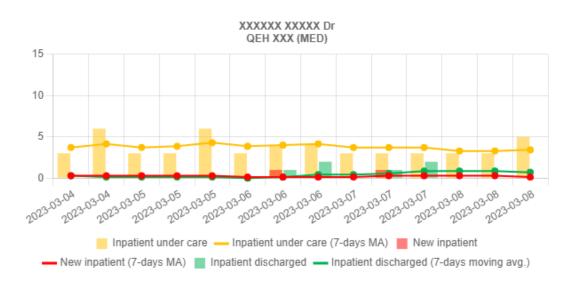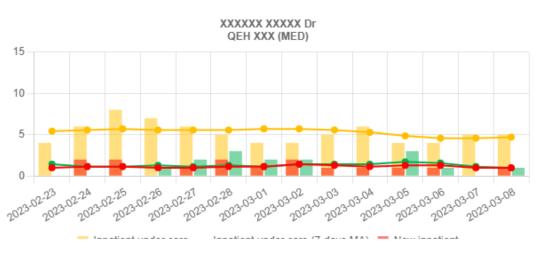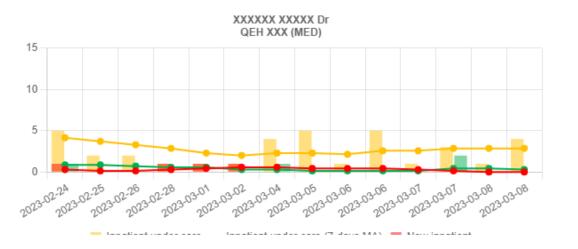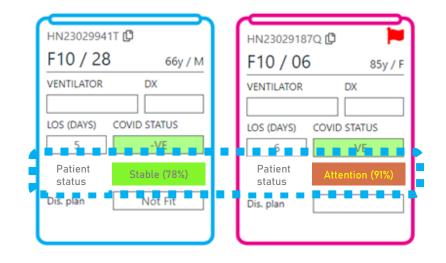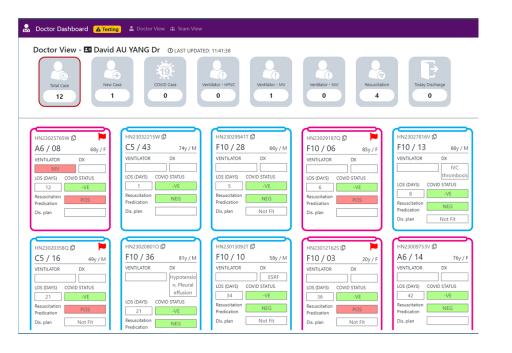
- AI "patient status prediction indicator" to indicate if a patient is stable or need attention.
- Collaboration with local universities supported by AI Lab.

Acknowledgements

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