



香港中文大學醫院  
**CUHK**  
Medical Centre

# Digital Connectivity and IoT in Improving Flow and Logistics

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Executive Director and CEO, CUHK Medical Centre

28 August 2024



# Declaration of Interest

- CUHK Medical Centre
- The Chinese University of Hong Kong

**CUHK Medical Centre**  
**Hong Kong SAR, China**



# CUHK Medical Centre (CUHKMC)



A non-profit,  
private teaching  
hospital



Wholly owned by The  
Chinese University of  
Hong Kong (CUHK)

**To serve a  
Social Mission**



**Bridge the gaps  
between private &  
public healthcare  
services**



Offer *quality* healthcare at  
*affordable, transparent*  
package prices

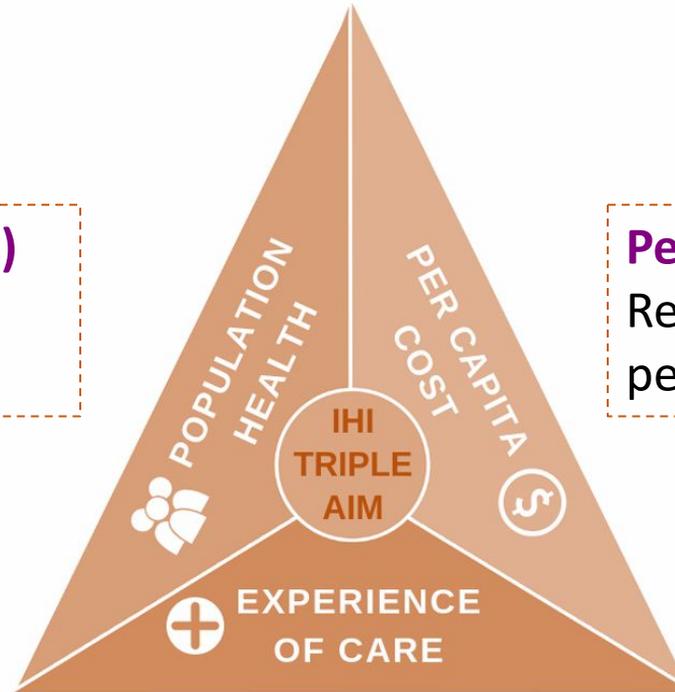


# Embracing the Triple Aim



## Population Health (Better Health)

Improve health of the defined population



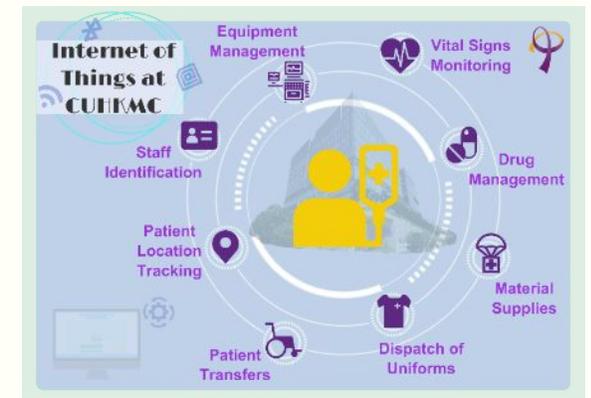
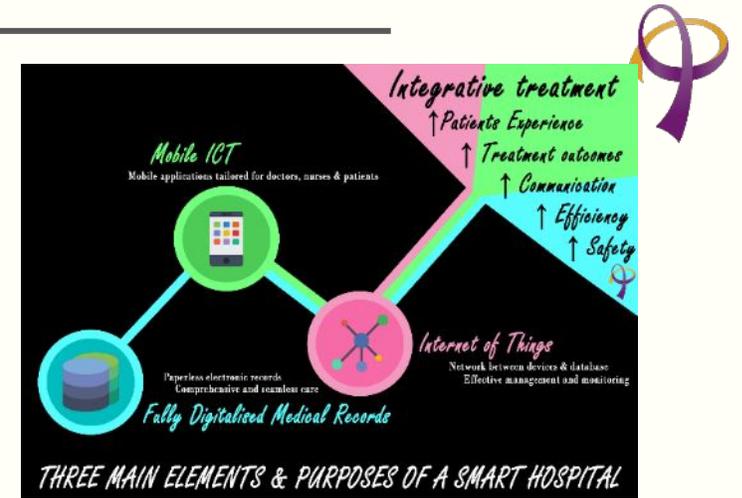
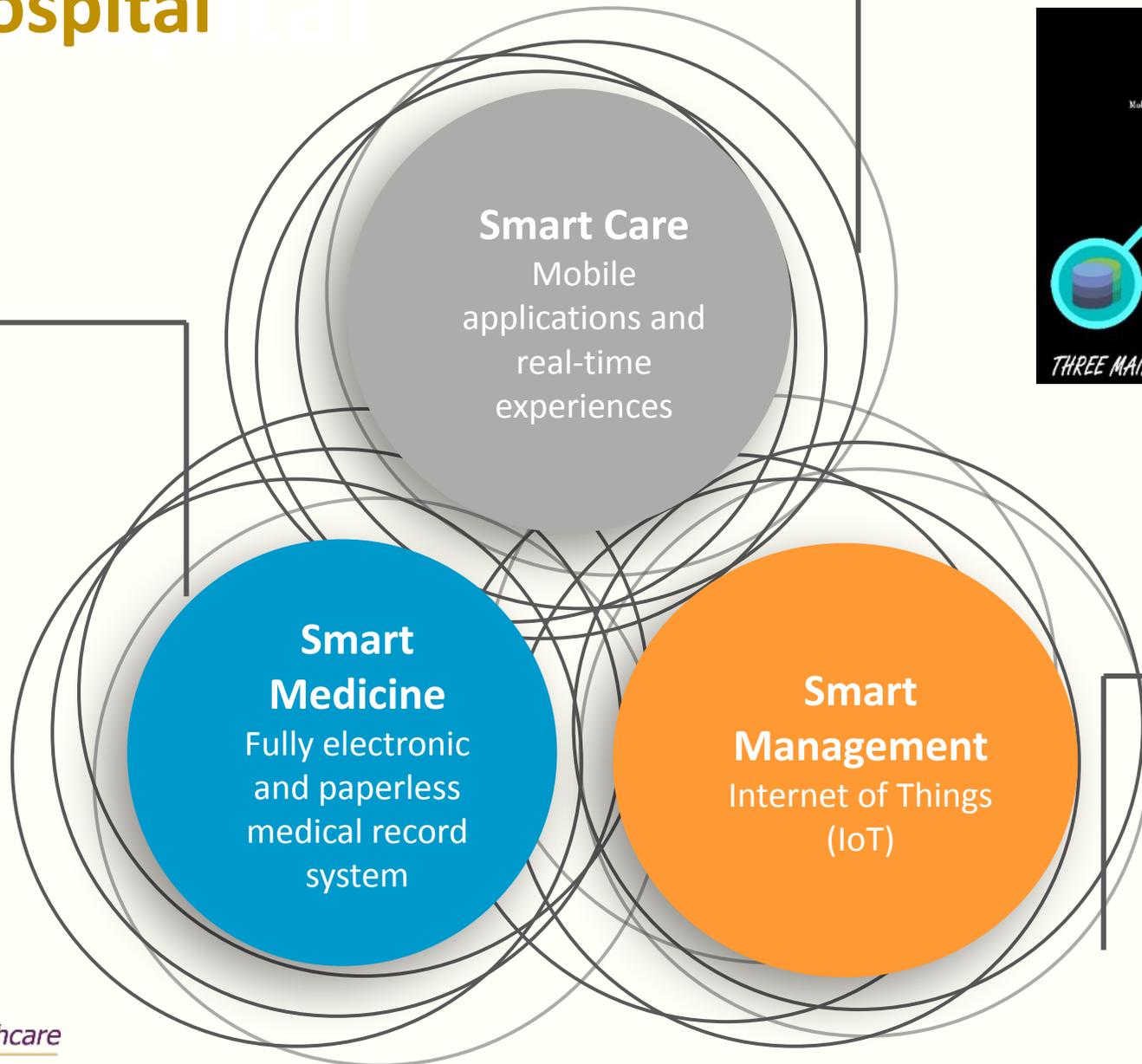
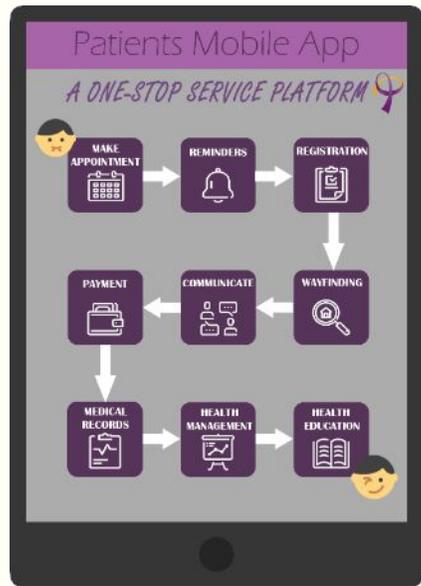
## Per Capita Cost (Better Value)

Reduce, or at least control, the per capita cost of care

## Experience of Care (Better Care)

Enhance patient care experience including quality, access and reliability

# Smart Hospital

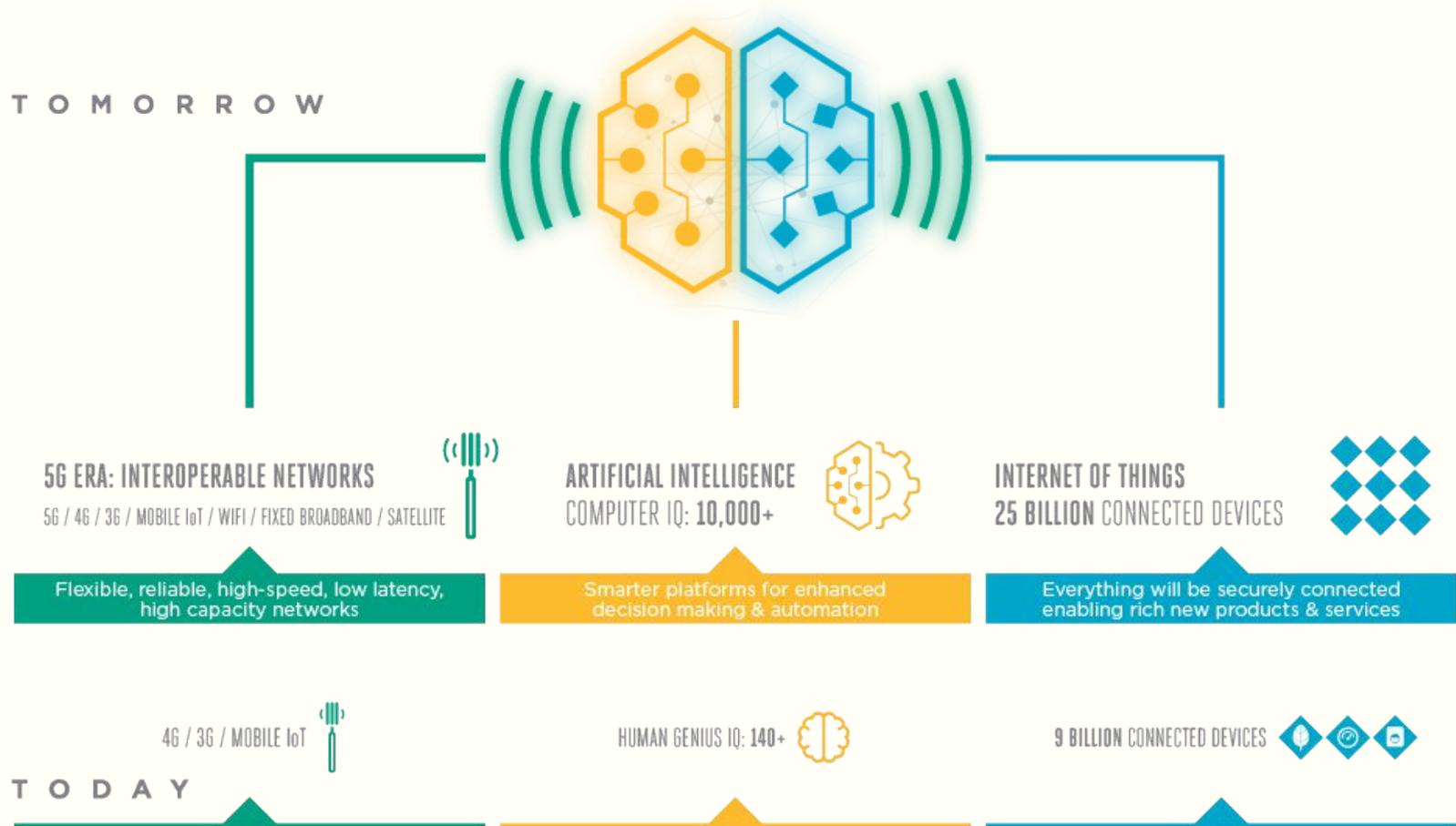




# INTELLIGENT CONNECTIVITY

The Fusion of 5G, AI and IoT

INTELLIGENTLY CONNECTING EVERYONE AND EVERYTHING TO A BETTER FUTURE



# Integrated Hospital Information System



Out-Patient / In-Patient/Day Patient



HIS

**HIS Mobile Applications**

- Drug admin, specimen collection, etc
- View patients' medical record, make verbal order, etc
- Picking, dispensing, etc

Appointment Booking via Patient App/Call Centre



Appointment Reminder via SMS/Email



Patient Registration/Check-in  
Queue Management (OP)  
Ward & Bed Assignment (IP/DP)



**Nursing Care e.g. Triage, Observation, Assessment, Care Plan Consultation**  
**Order Entry e.g. Lab, Radiology, Allied Health**  
**Diagnosis**  
**Treatment**  
**Procedures e.g. Pre-op Prep, Anae Assessment, OT Record**



Book F/U Appointment, Investigations, OT etc



Payment



Dispensing



Discharge

Orders    Results    Specimen Status    Orders    Results    Images, Reports, Videos, etc from OT, Endo, Eye ....    Prescription    PO    ASN

3<sup>rd</sup> Party Systems

- Laboratory (LIS)** (Icon: Test tube and blood drop)
- Specimen Tracking** (Icon: Test tubes)
- Radiology (RIS)** (Icon: X-ray image)
- Vendor Neutral Archive (VNA)** (Icon: Folder)
- Pharmacy related Systems e.g. ATDPS, Therapick, Pick-to-Light** (Icon: Pharmacy counter)
- ERP** (Icon: Shipping box)

# 3<sup>rd</sup> Party Integration



HIS

PMS  
EMR  
MDM  
Billing/ Payment  
Pharmacy  
Security

AIS  
 Weight  
 LIS  
 TeraMed  
 Document Scanning  
 Carestream  
 Patient Monitor  
 Certizen  
 eBirth  
 Infotainment  
 SMS Gateway

ORACLE PeopleSoft  
 Active Directory

Marvel Solution  
 Adobe Sign  
 Catering

Hang Seng Bank  
 WeChat Pay  
 支付宝 ALIPAY  
 ORACLE Financials

ORACLE SUPPLY CHAIN MANAGEMENT  
 swisslog healthcare  
 Omicell ADC  
 ATDPS  
 Medication Cart  
 fdb First Databank

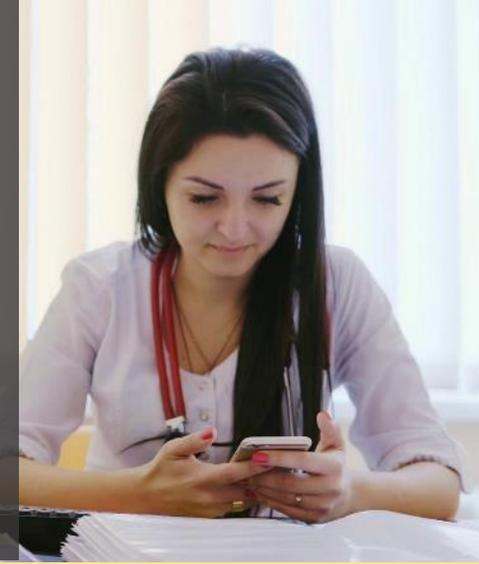
## Nursing – Medication Administration

- 5R (*right patient, right drug, right dose, right route, right time*)
- Track and reduce medication errors

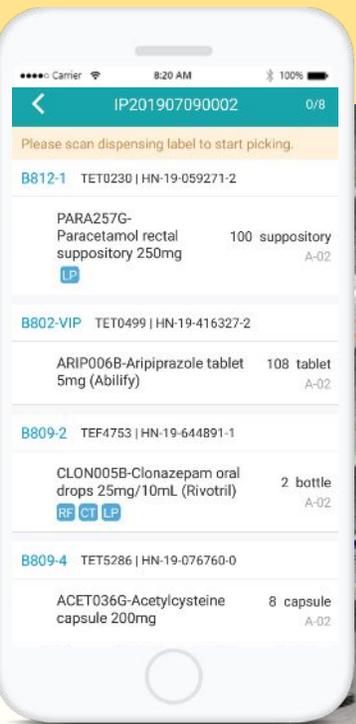


## Doctor Mobile App

- My schedule
- My patients
- Medication management

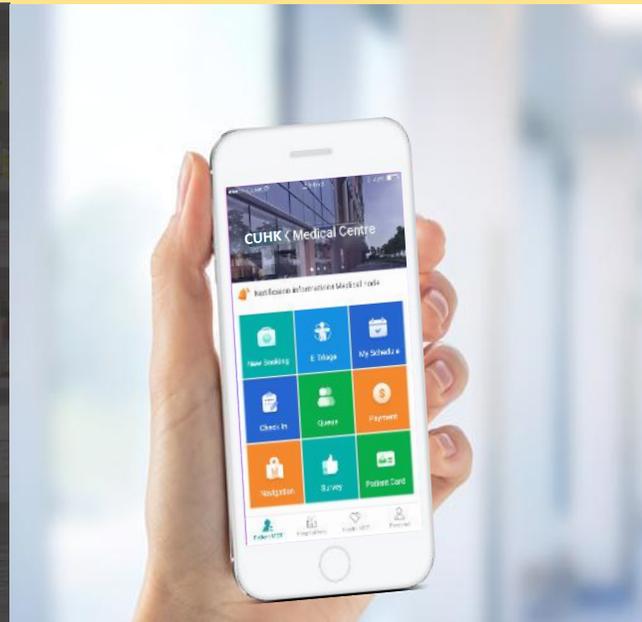


# Mobile Experiences



## Pharmacy Mobile App

- Drug picking & dispensing
- Inventory Management



## Patient Mobile App

- My schedule
- Appointment
- Medication
- Way finding
- Payment

# IoT and 5G Connectivity

# Wireless Network

## Full Coverage 5G, Wi-Fi, Bluetooth (BLE), Ultra-Wideband (UWB), RFID

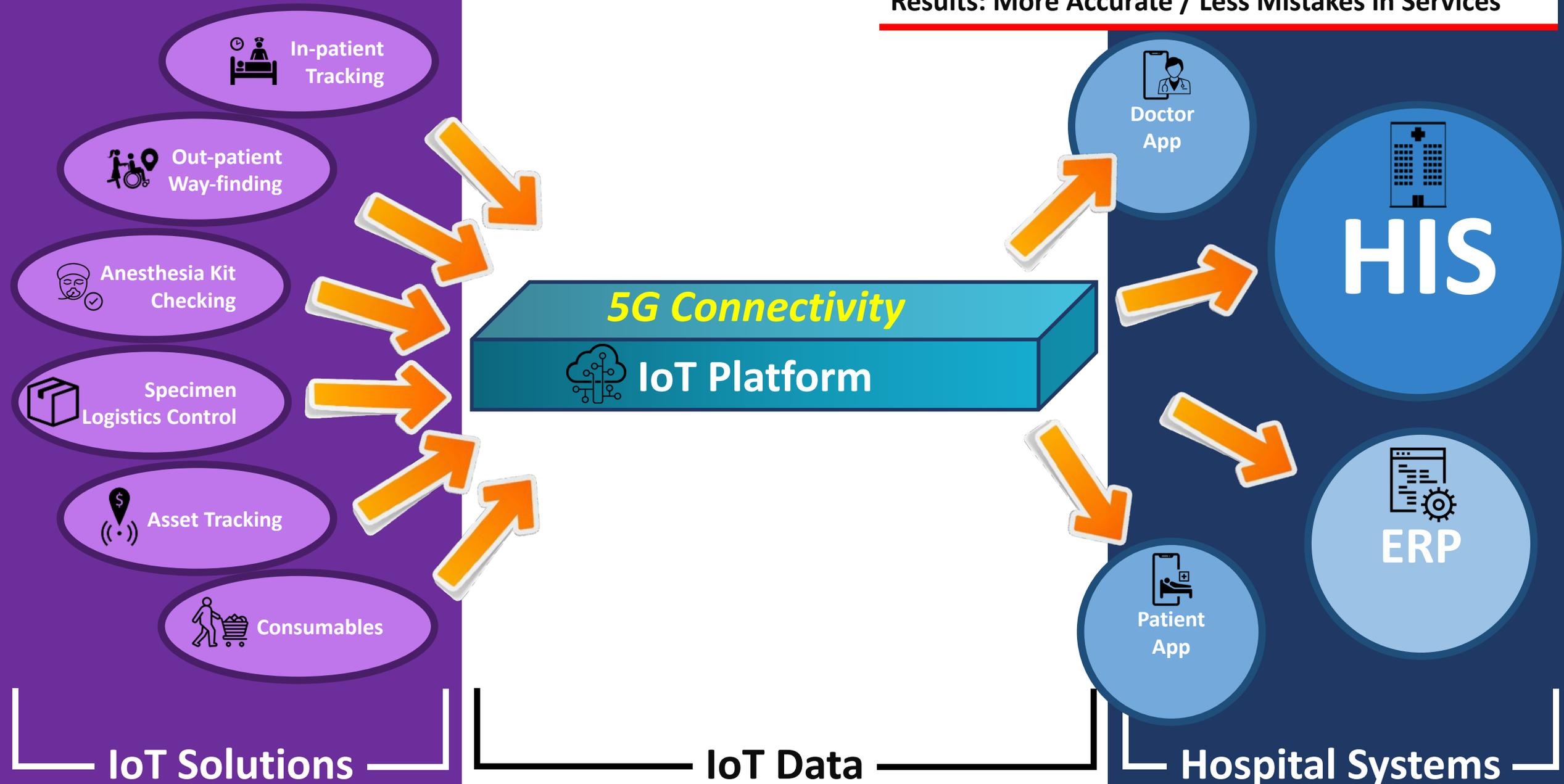


- Full Wi-Fi coverage
  - Total around 1000 access points
- Full UWB + Bluetooth Low Energy (BLE) coverage
  - Total around 1100 receivers
- Full 5G coverage
  - 3.6 GHz
  - 26/28 GHz for OT, Auditorium, Training Rooms
- RFID



# Integration with HIS

**Objective: Reduce Manual Data Entry**  
**Results: More Accurate / Less Mistakes in Services**



 In-patient Tracking

 Out-patient Way-finding

 Anesthesia Kit Checking

 Specimen Logistics Control

 Asset Tracking

 Consumables

**IoT Solutions**

**5G Connectivity**

**IoT Platform**

 Doctor App

**HIS**

 ERP

 Patient App

**Hospital Systems**

**IoT Data**

# IoT Solutions for Smart Hospital

- Patient Tracking & Wayfinding
- Asset Tracking & Management
- Linen Management
- Smart Bed Patient Information Display
- Locating Call System
- In-hospital Intelligent Navigation
- Facilities Status Monitoring
- Baby Tracking System
- Specimen Tracking System



Pioneering So

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# Connecting People, Machines, and Materials

I checked you have allergy of XXX and I prescribe YYY for you now. You can settle the payment online and get the drugs in the pharmacy directly.

The RFID solution enables the tracking of specimen data

The hospital provides location tracking and also remind me when I am the next one

The radiology report should be sent to EMR

The clinical decision support system checks you have drug-allergy in this medication order. The doctor overrides and I can keep dispensing the drugs.

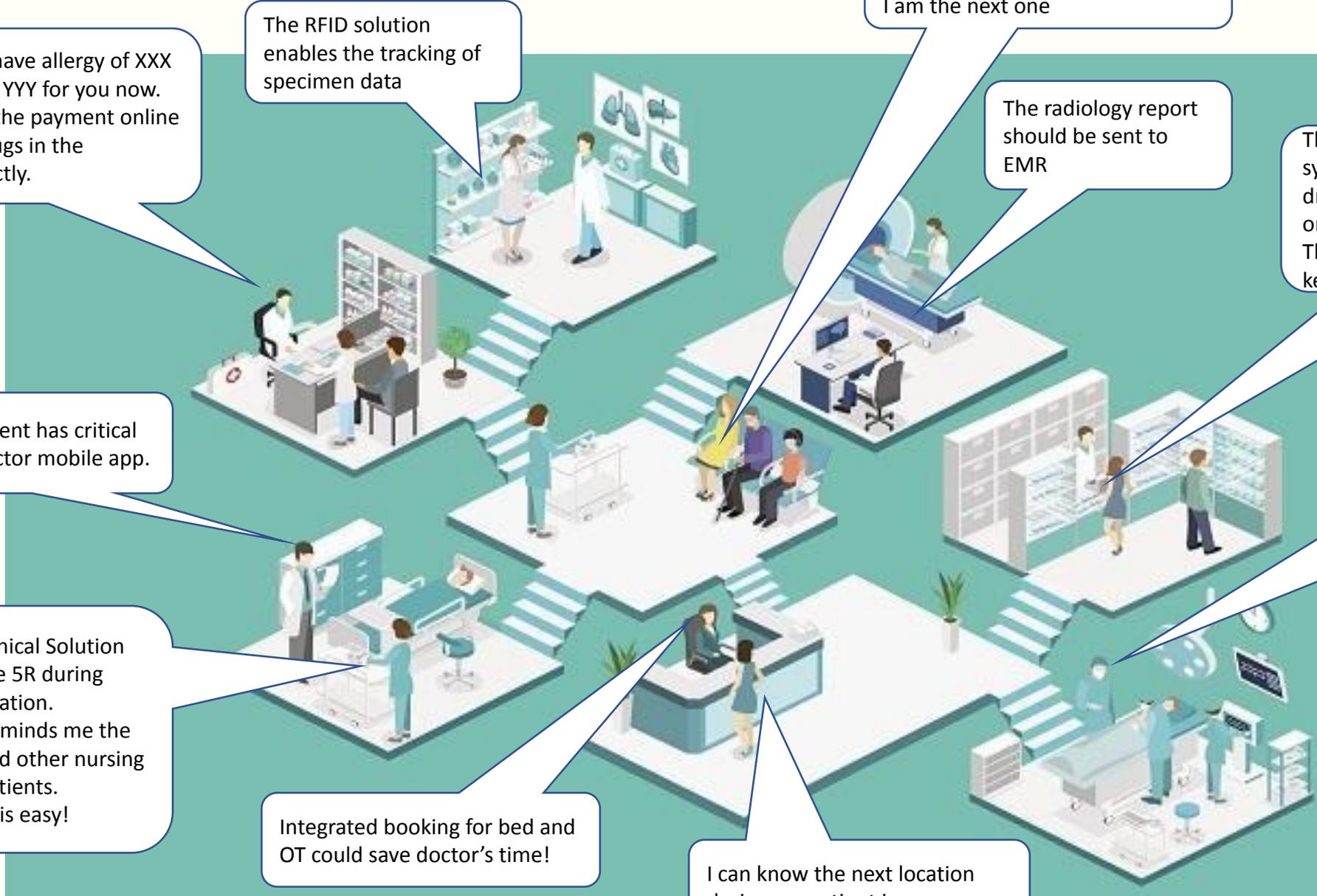
I found the patient has critical value in the doctor mobile app.

The OT rooms are fully booked today. The utilization rate is very high because of the system! We may consider to open an extra theatre 😊

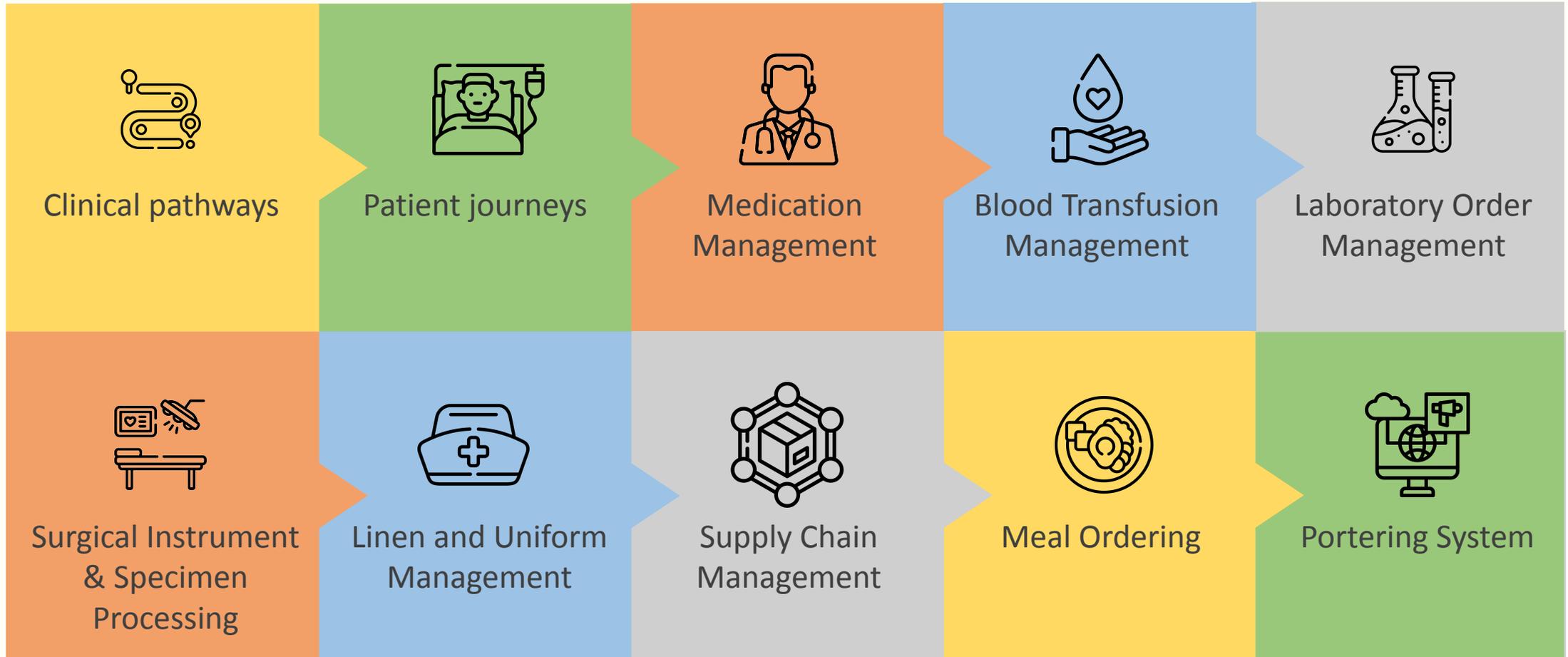
The Mobile Clinical Solution helps to ensure 5R during drug administration. Besides, NIS reminds me the assessment and other nursing tasks to the patients. And handover is easy!

Integrated booking for bed and OT could save doctor's time!

I can know the next location during my patient journey.



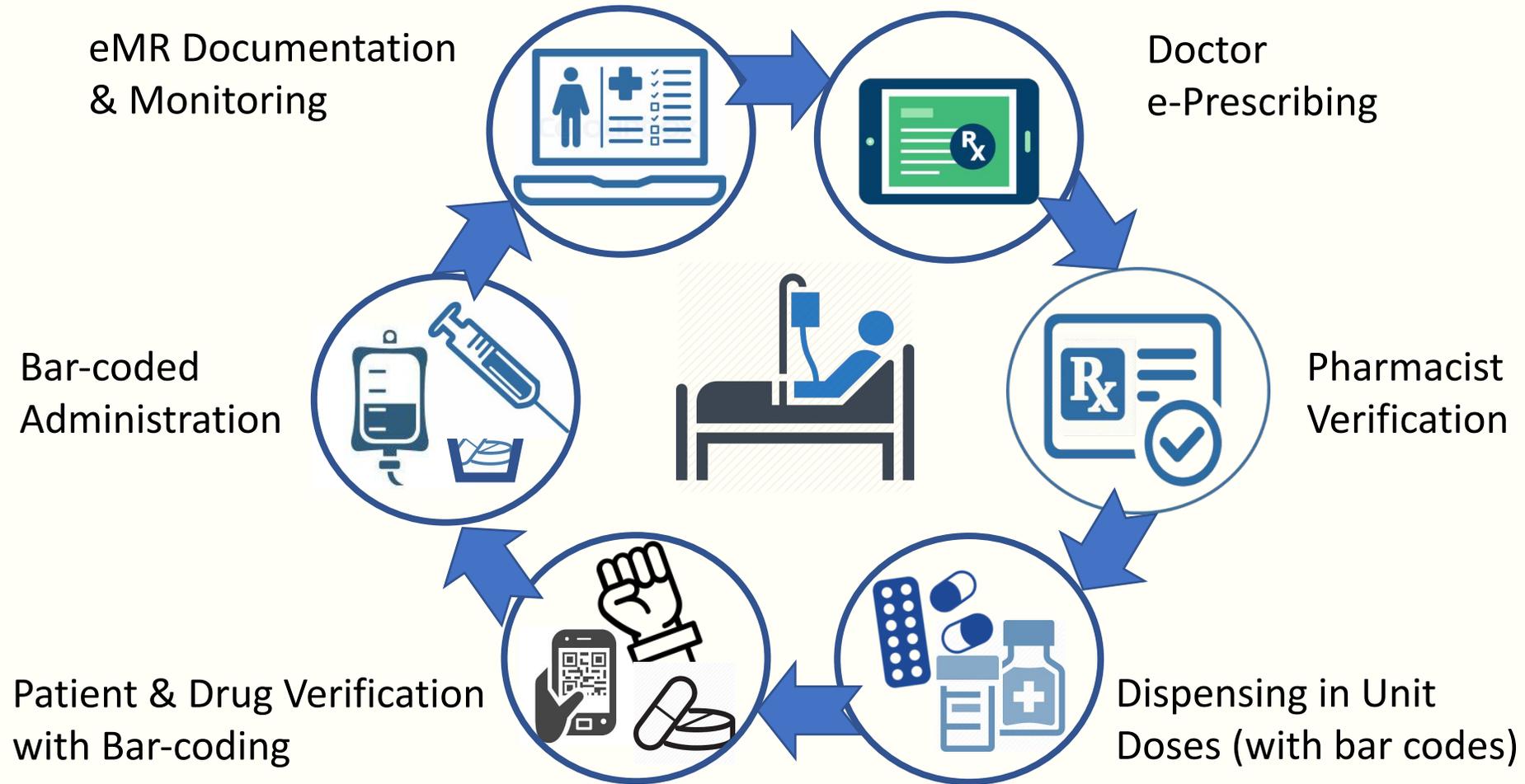
# Closed-loop Management







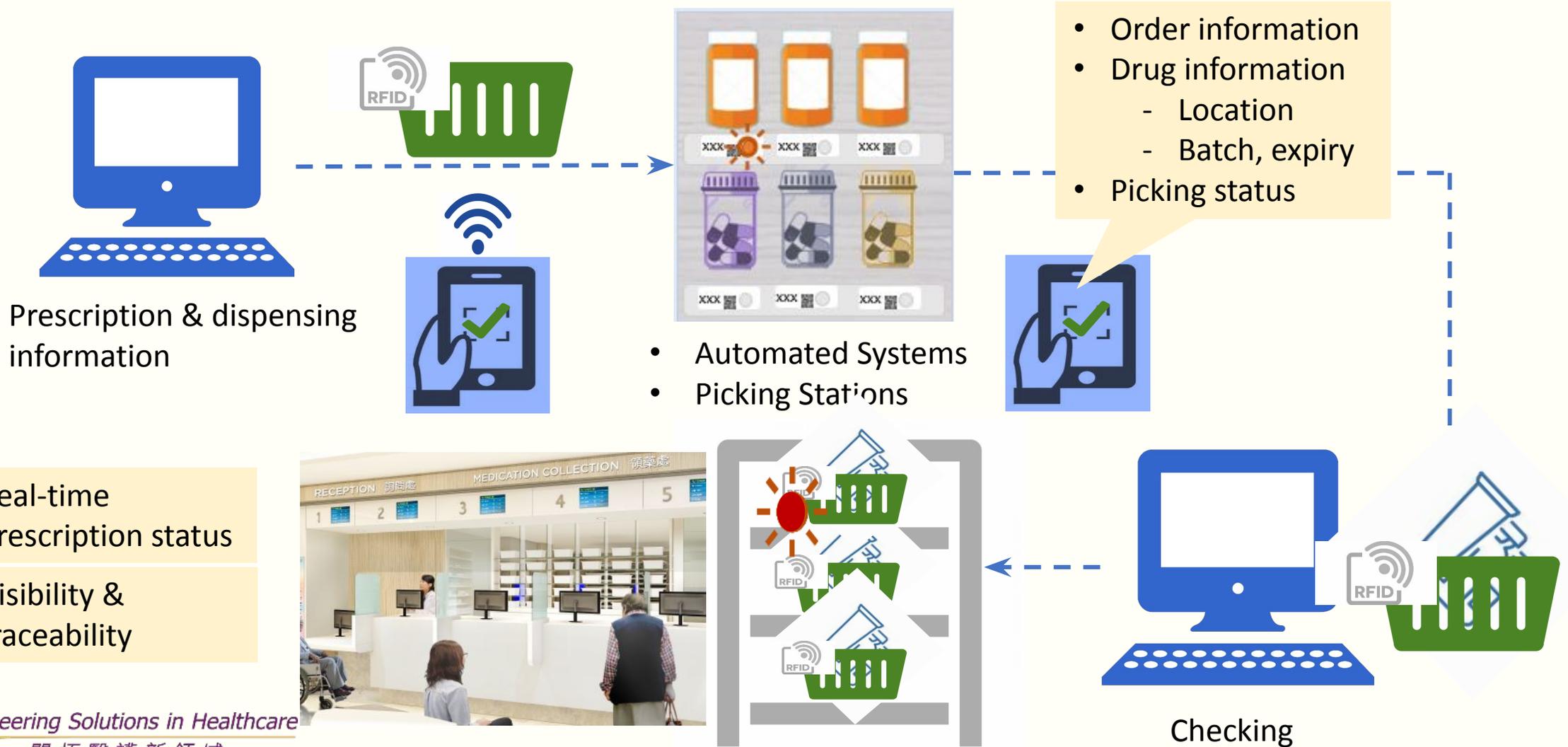
# Closed-Loop Medication Management



# IoT in Medication Management



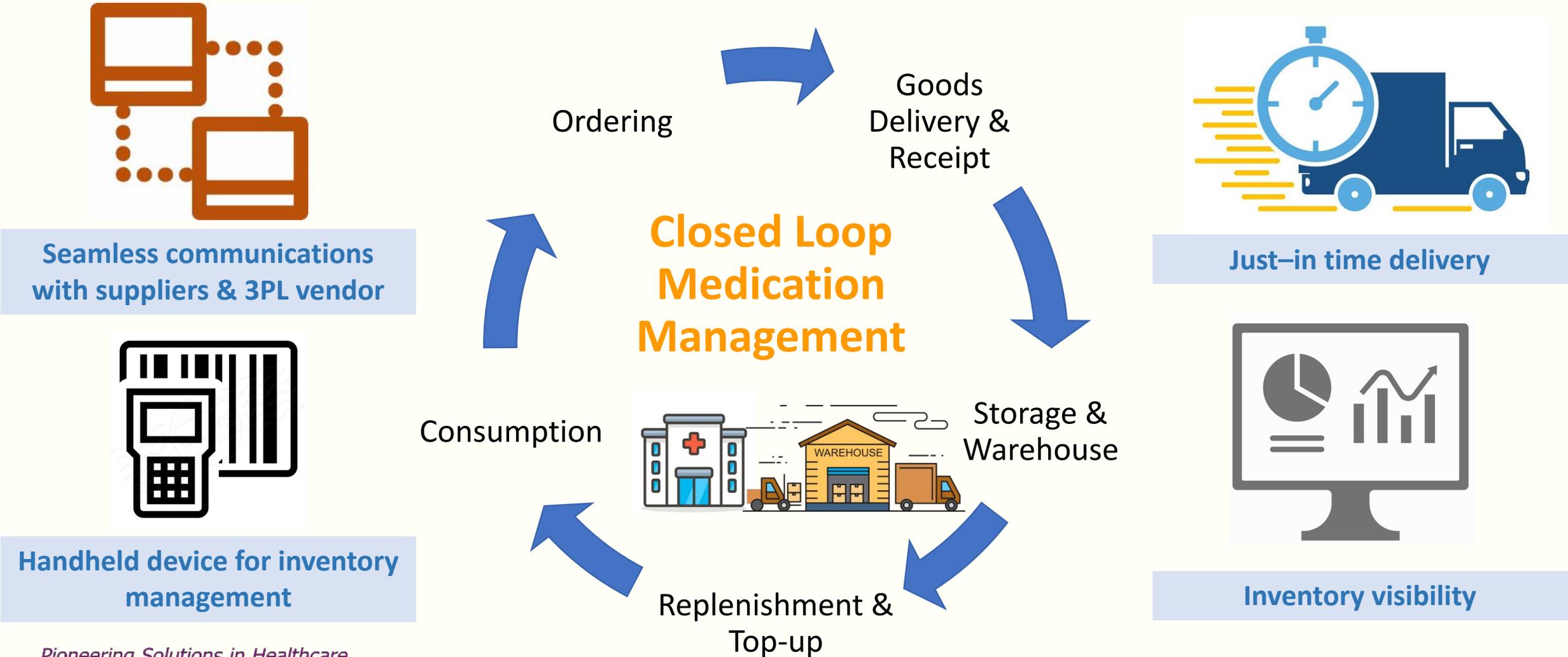
## RFID / Bluetooth Applications



- ✓ Real-time prescription status
- ✓ Visibility & traceability



# Supply Chain & Logistics



# Automations in Medication Management



Unit dose dispensing for inpatients



Multi-dose dispensing for outpatients



E-MedCart for inpatient drug administration



Pick-to-light dispensing for discharge inpatients



# Smart Drug Kit System



- RFID-tagged medications
- Smart drug kit preparation
  - Visual management
  - Track & trace
  - Inventory & expiry management
- Real-time tracking of usage during procedures (anaesthesia, resuscitation)



Drug Preparation	Kit Preparation	Drug Recall	Drug Restock & Disposal	Cross-Check	Kit Dispatch																
<b>Select Kit</b> <table border="1"> <thead> <tr> <th>Kit ID</th> <th>Descriptions</th> <th>Ass'd Procedure Codes</th> <th>Breakdown</th> </tr> </thead> <tbody> <tr> <td>ANE-KIT-0001</td> <td>General-purpose Anesthesia Kit</td> <td><a href="#">View Procedure Codes</a></td> <td><a href="#">View Breakdown</a></td> </tr> <tr> <td>ANE-KIT-0002</td> <td>General-purpose Anesthesia Kit</td> <td><a href="#">View Procedure Codes</a></td> <td><a href="#">View Breakdown</a></td> </tr> <tr> <td>ANE-KIT-0003</td> <td>General-purpose Anesthesia Kit</td> <td><a href="#">View Procedure Codes</a></td> <td><a href="#">View Breakdown</a></td> </tr> </tbody> </table>		Kit ID	Descriptions	Ass'd Procedure Codes	Breakdown	ANE-KIT-0001	General-purpose Anesthesia Kit	<a href="#">View Procedure Codes</a>	<a href="#">View Breakdown</a>	ANE-KIT-0002	General-purpose Anesthesia Kit	<a href="#">View Procedure Codes</a>	<a href="#">View Breakdown</a>	ANE-KIT-0003	General-purpose Anesthesia Kit	<a href="#">View Procedure Codes</a>	<a href="#">View Breakdown</a>	<b>Kit Search</b> By Keyword: <input type="text" value="Ventriculopuncture"/> <input type="button" value="Search"/>			
Kit ID	Descriptions	Ass'd Procedure Codes	Breakdown																		
ANE-KIT-0001	General-purpose Anesthesia Kit	<a href="#">View Procedure Codes</a>	<a href="#">View Breakdown</a>																		
ANE-KIT-0002	General-purpose Anesthesia Kit	<a href="#">View Procedure Codes</a>	<a href="#">View Breakdown</a>																		
ANE-KIT-0003	General-purpose Anesthesia Kit	<a href="#">View Procedure Codes</a>	<a href="#">View Breakdown</a>																		
Kit ID: <input type="text" value="ANE-KIT-0001"/> Tray ID: <input type="text" value="EC0E158A478B2011"/>		<b>Legend</b> <span style="background-color: #d9ead3; border: 1px solid #ccc; padding: 2px;">Drug OK</span> <span style="background-color: #f4cccc; border: 1px solid #ccc; padding: 2px;">Drug Over Qty</span> <span style="background-color: #fff2cc; border: 1px solid #ccc; padding: 2px;">Drug Below Qty</span> <span style="background-color: #f8d7da; border: 1px solid #ccc; padding: 2px;">Drug Expired</span> <span style="background-color: #d9ead3; border: 1px solid #ccc; padding: 2px;">Empty / N.A.</span>																			
Propofol 1mg/mL PROPT010PFZ1 <b>(5/4)</b>	Calcium Chloride Inj., USP <b>(2/3)</b>	Lidocaine HCl ... 300mg <b>(4/4)</b>	Etomidate 5mg/ML <b>(5/5)</b>	Frusemide Ing., 5mL																	
Tranexamic acid Inj., ... <b>(1/5)</b>	Benzodiazepines 5mg/mL <b>(3/5)</b>	8.4% Sodium Bicarbonate ... 300mg <b>(2/2)</b>	0.9% Sodium Chloride Inj., USP 250mL <b>(2/2)</b>	Ketamine (3/3)																	
Epinephrine Inj., USP <b>(1/1)</b>	Metoprolol 1mg ... <b>(4/4)</b>	Barbiturates <b>(2/2)</b>	Ketamine 5mg/5mL <b>(4/4)</b>																		
User: Chan Tai Ming <span style="float: right;"><input type="button" value="Reset"/> <input type="button" value="Complete"/></span>																					



# Real-time Location Tracking for In-patients & Geo-fencing



Inpatient Tracking (Tag)

- Technology Applied: UWB
- Queuing Status & Ticket Calling
- On-screen Instructions (Room/Counter Number)
- Geo-fencing against Surpass/Entry
- Call-for-Help Button



Geo-fencing Alert for Paediatric, Elderly Patients, Mortuary (via UWB)



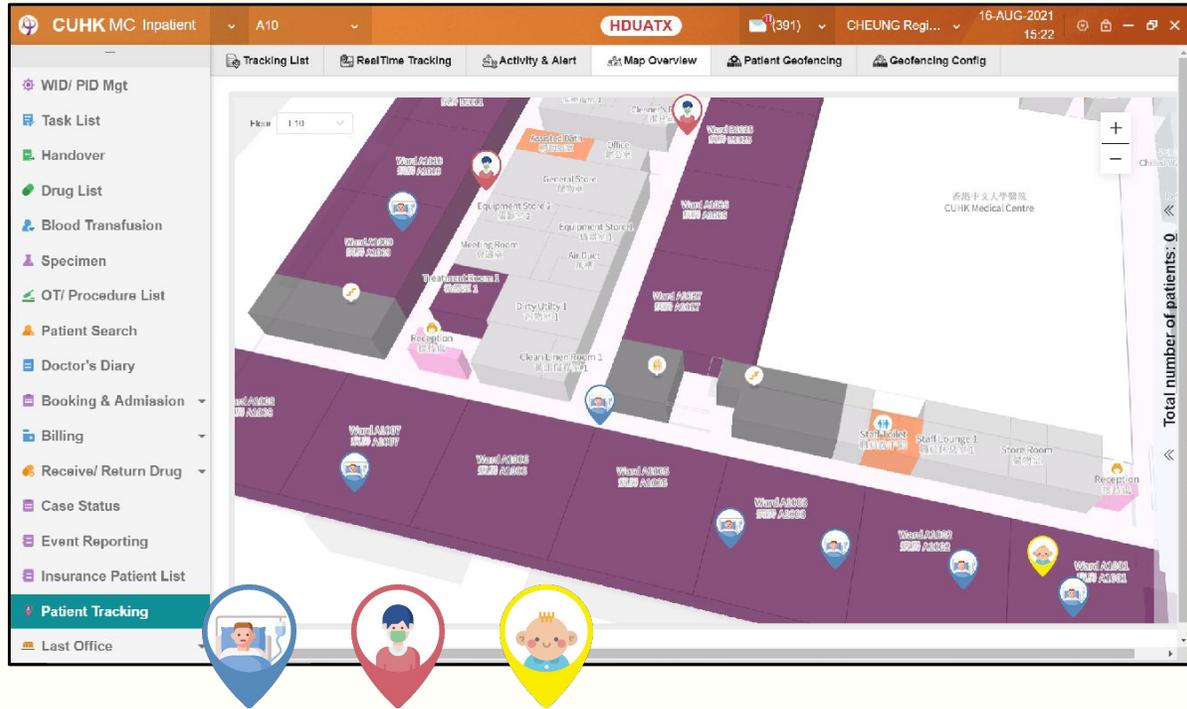
Baby Tracking (Tag)

- Technology Applied: UWB
- Mother-Baby Matching
- Band-break Alert
- Low-battery Alert
- Unnoticed/Overtime Bail Alert



Prevention of Baby Abduction (via UWB)

# Real-Time Location Tracking of Patients



## Smart Badge



**Smart Badge**

**Smart Wristband**

**Baby Tracking**

**Patient Tracking (OP)**

陳小姐  
請到 4號診室

4

UWB ALLIANCE

CUHK Medical Centre

- On-screen Episode Number
- Geo-fencing against Surpass/Entry
- Call-for-Help Button

## Smart Wristband



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# Geo-fencing at COVID Ward



# Real-time Location Tracking of Mobile Equipment



UWB general-purpose Asset Tag

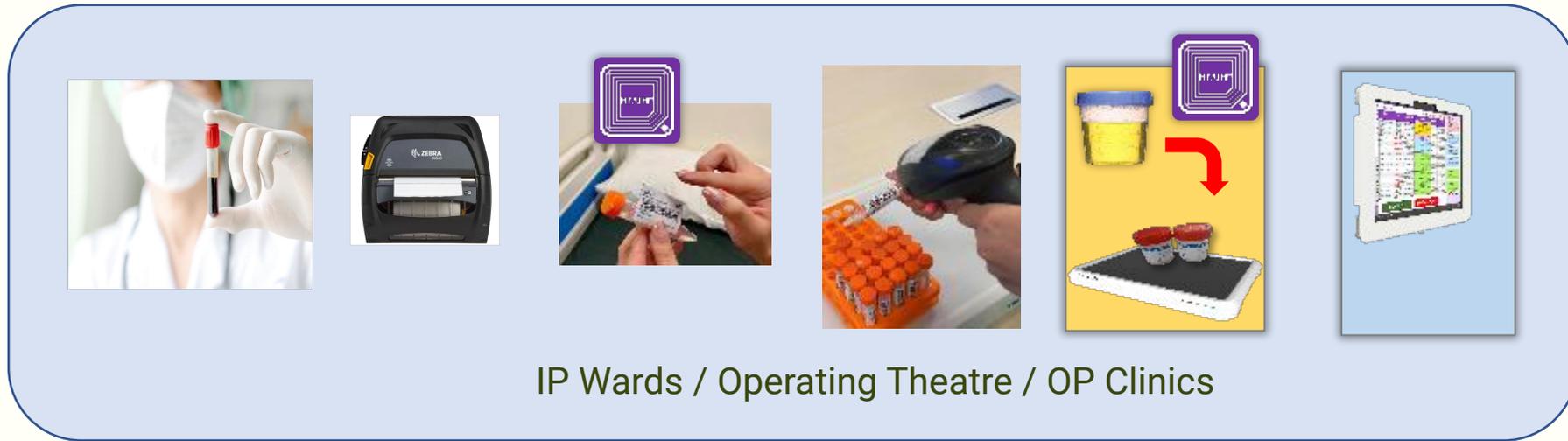
EWELL IoT Platform

Devices List | Real Time Location | Location Playback | Device Management | User Account Control

Device Category: 20 | Total No. of Devices: 500

Device SN	Device Category	Factory	Status	Normal	Last update time	Action
83314CP8185136	Covering Trolley	Vesta	Normal		2020-06-17 16:01:25	[Refresh] [Delete]
83314CP8185135	Covering Trolley	Vesta	Normal		2020-06-17 16:01:25	[Refresh] [Delete]
83314CP8185134	Covering Trolley	Vesta	Normal		2020-06-17 16:01:25	[Refresh] [Delete]
93304CS9185139	Covering Trolley	Vesta	Normal		2020-06-12 16:01:25	[Refresh] [Delete]
93304CS9185132	Covering Trolley	Vesta	Normal		2020-06-12 16:01:25	[Refresh] [Delete]
83314CP8185136	202278_Covering Barcode Scanner	Zebra	Normal		2020-06-17 16:01:25	[Refresh] [Delete]
83314CP8185145	202370_Portable Printer	Zebra	Normal		2020-06-17 16:01:25	[Refresh] [Delete]
83314CS9185134	202380_Portable Printer	Zebra	Normal		2020-06-12 16:01:25	[Refresh] [Delete]
93314CS9185132	202380_Portable Printer	Zebra	Normal		2020-06-12 16:01:25	[Refresh] [Delete]

# Specimen Tracking



Track and Trace  
whole Specimen  
Delivery Process



# Transportation Robots for Surgical Instruments in Operating Theatre and Sterile Supplies Unit



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# Challenges in Digital Transformation

- Private vs public healthcare system
  - Drive of business values – Data, AI, and business intelligence
- **Doctors are different**
  - Independent, visiting
- **Evolving workflow**
  - Scope of automation
  - Billing and payment – Interaction with payers
  - Business partners – Digital readiness
- **Technology application**
  - Integration with patient care processes
  - Integration with 3<sup>rd</sup> party systems
- Customer readiness

**THANK YOU!**