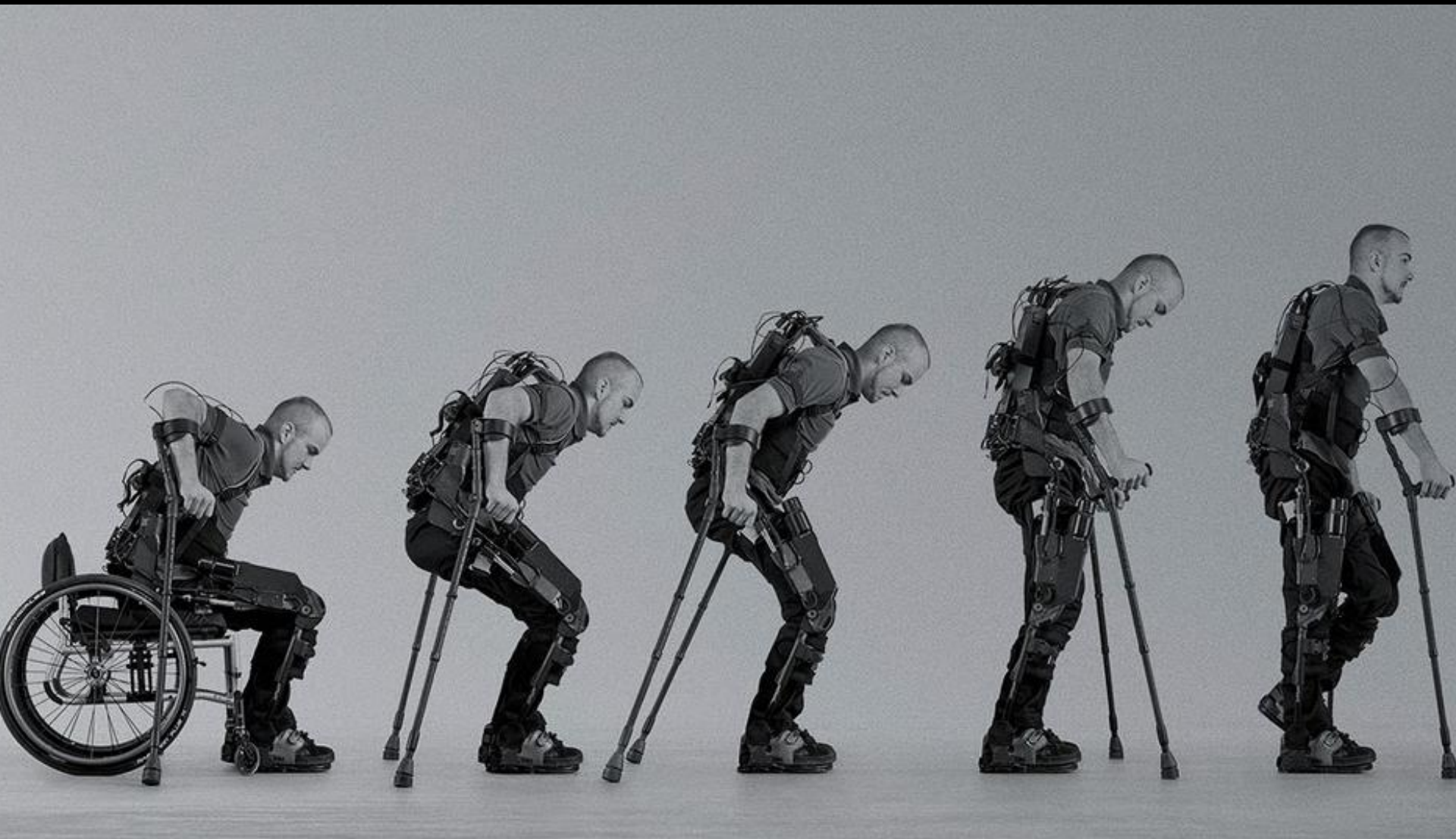
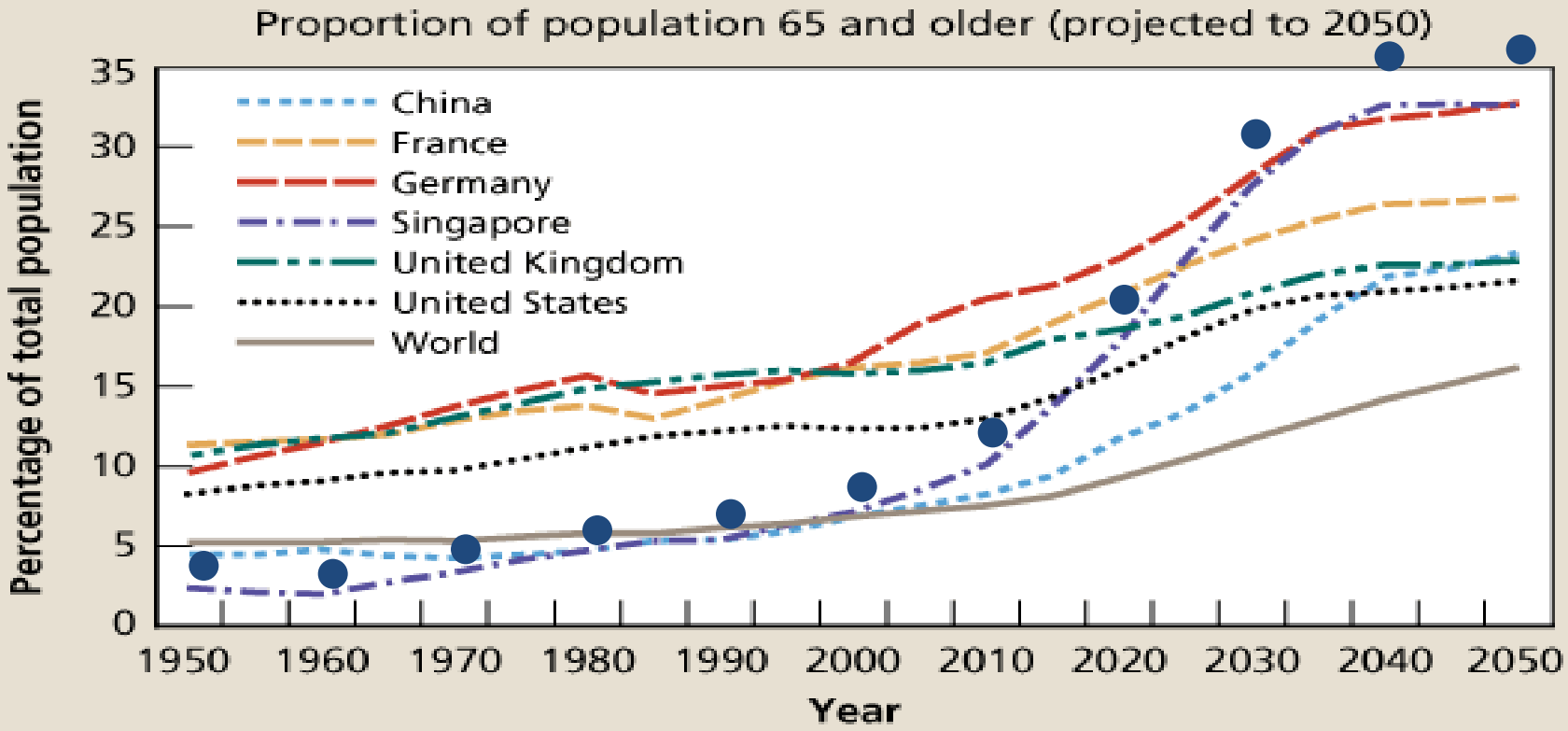
Centre for Healthcare Assistive & Robotics Technology

Charting Future Healthcare Delivery



Rapidly aging population of Singapore

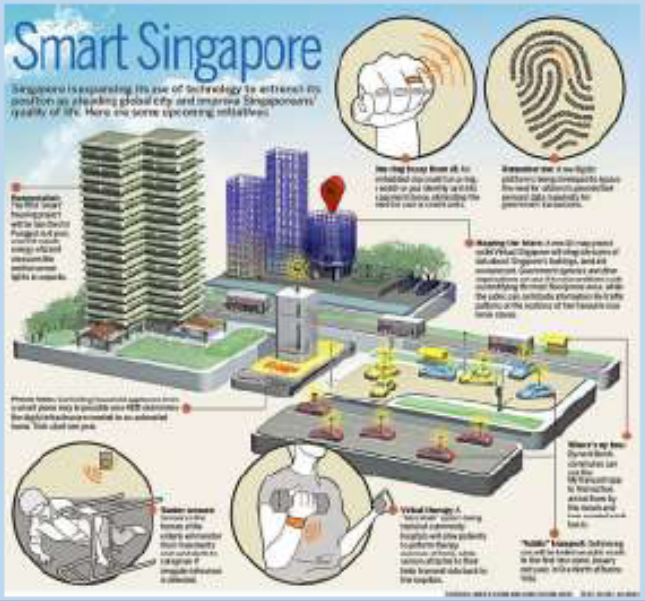
Singapore and China Are Aging More Rapidly Than Other Countries Studied



SOURCE: United Nations Population Division, *World Population Prospects: The 2008 Revision*, database, 2008. As of February 22, 2010: http://esa.un.org/UNPP/

There is National Interest to Drive Smart Technologies, Including thru Robotics

- **Smart Nation initiative was launched in 2014 to coordinate national efforts in planning, developing and adopting smart technologies across sectors/settings**
- National interest to plan and effect smart technologies through research and implementation
  - Research, Innovation and Enterprise (RIE) will be key in Singapore's transition. RIE 2020 will focus on areas where Singapore has a competitive advantage, strategic need and where we can best leverage R&D to support Singapore's future economic growth and build a resilient nation.
- **National Robotics R&D Taskforce set up to propose Singapore's robotics strategy moving ahead; DS (D) is a member of the national taskforce**
  - Recognise tremendous growth in the use of robots globally and potentially in Singapore
  - Address demographic shifts (e.g. ageing), shortages of skilled manpower (e.g. healthcare staff) and demands for better quality of life



PM launched the **Smart Nation** initiative in Nov 2014. PM explained that bringing the current piecemeal uses of technology into a cohesive, nationwide whole "will make our economy more productive, our lives better, and our society more responsive to people's needs and aspirations".

The Smart Nation plan is motivated by concern and opportunity. Pressures driving demand include increased urban density and ageing population. In turn, three priorities have been identified: smart health care, transport, and housing.

PMO's new Smart Nation Programme Office will drive the effort.

Meeting the Challenges

i. **Enabling Productivity Gains and Supporting Aging Workforce**– Enabling manpower across care settings to discharge their clinical and operational duties more efficiently. Augmenting /substituting labour-intensive and occupational hazardous aspects of operations, allowing them to work longer. Also to help increase job value and thus able to attract more locals into the professions.

ii. **Improving Health and Clinical Outcomes** – Assisting care teams to extend human capabilities and deliver improved health and clinical outcomes, indirectly increasing staff and patient/caregiver satisfaction.

iii. **Smart health facilities** – Interoperability for machines, IOT and building management to decrease installation and operating costs

iv. **Supporting our ageing population and facilitating care in the community**– Reducing the overall demand for our healthcare facilities like nursing homes. Aims to connect individuals at home with society and health services.

Paving the Future for Healthcare

By co-developing technologies

- The Centre for Healthcare Assistive and Robotics Technology (CHART) is designated to build prototypes of smart systems and the ecosystem for development of suitable technologies to enable “Hospitals of the future” and “ Hospital to Home”.

1. Hospitals of Future

Robotics-enabled precision care and medicine, with smaller scales for Community Hospitals, Nursing Homes and Day residential care

Aim

Equip “smart healthcare institutions” that can deliver care with fewer manpower per bed

Smart Ward integrated with Smart Logistics

2. Hospital to Home

Robotics-enabled care and aging in place at home, with home grade equipment for consumer use

Aim

Enable seniors to age in place for longer at home, with the help of technology to support transitions in care and complement or replace the lack of full time caregivers

Robotics Assisted Community Enabled Support

Robotics Middleware Framework | Decision support Algorithms| Artificial Intelligence

Standards and Conformance for accreditation and testing of technology developed

Collaborative Platforms - Healthcare

Healthcare robotics collaboration platform

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Centre for Healthcare Assistive Robotics Technology (CHART)

Identification of Focus Areas

- Robotics systems to automate manual work and optimise business processes
- Rehabilitation technology to restore functionality and point of care diagnostic tools
- Robotics-enabled "smart wards" and healthcare systems
- Assistive technology for Aged and Dementia Care

Supports → **Innovation**

Align R&D roadmap with public research institutions

Drives → **Product Development**

Work with companies to develop solutions that effectively address healthcare needs

Enables → **Adoption**

Take lead in pilot deployment of solutions; influence adoption mind-set & share on successes

Commercialization Pathway

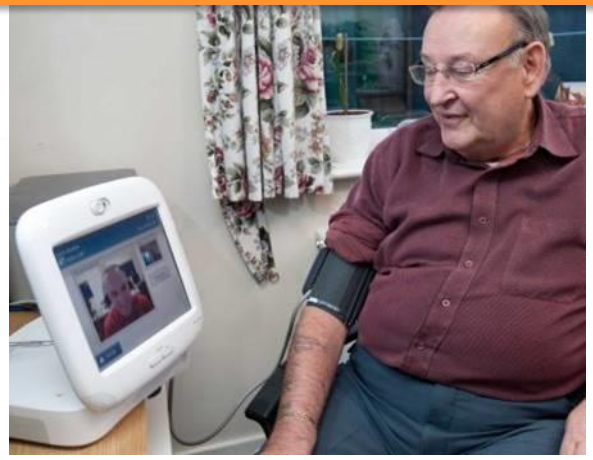
Robotics in Healthcare
Areas for Application

1. Assistive technology for independent living and dementia care

2. Rehabilitation technology to restore functionality

5. Medical Procedures & Training

3. Virtual hospital



4. Automation of process and manual labour

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Robotics in Healthcare - Rehabilitation

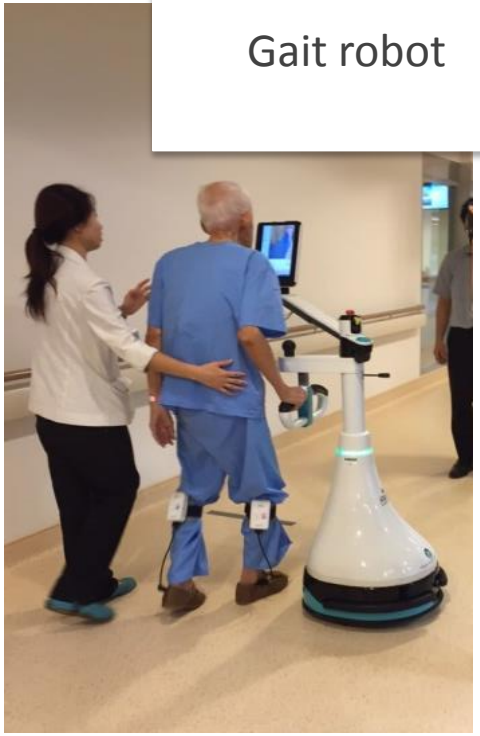
- Rehabilitative technologies to empower patients to train and re-gain functional independence.

- Suitability for Asia population & cultural context.

Rehab games

Braces

Gait robot



Smart technologies coupled with healthcare process innovation

Standalone technologies

Physical process of nurse measuring and recording patient's physiological parameters

Manual rounding & documentation with standalone medical technology

Integrated Systems

Captured parameters automatically sent to centralised dashboard; no nurse in data capture process

Digitalising collection of health & medical data to Electronic Medical Records (EMR)

IoT

Use of robotics and assistive technology to reduce time spent on manual and repetitive tasks for more direct patient care

Process transformation coupled with IoT technology to drive automation through electronic ordering

Artificial Intelligence Robotics

Predictive analytics supporting autonomous activation of care and logistics based on prescribed clinical pathway

Care transformation by integrating clinical pathways with predictive analytics to deliver personalised & precision medicine

SMART WARD

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CLMM – Closed Loop Medication Management

1 Doctor orders medication

Places medication order in Electronic Medical Record System

2 Pharmacist verifies orders

Verifies orders using Electronic Medical Record System

3 Robot packs medication

Verified orders are packed and dispensed to Ward (IPAS / Robot)

4 Nurse prepares medication

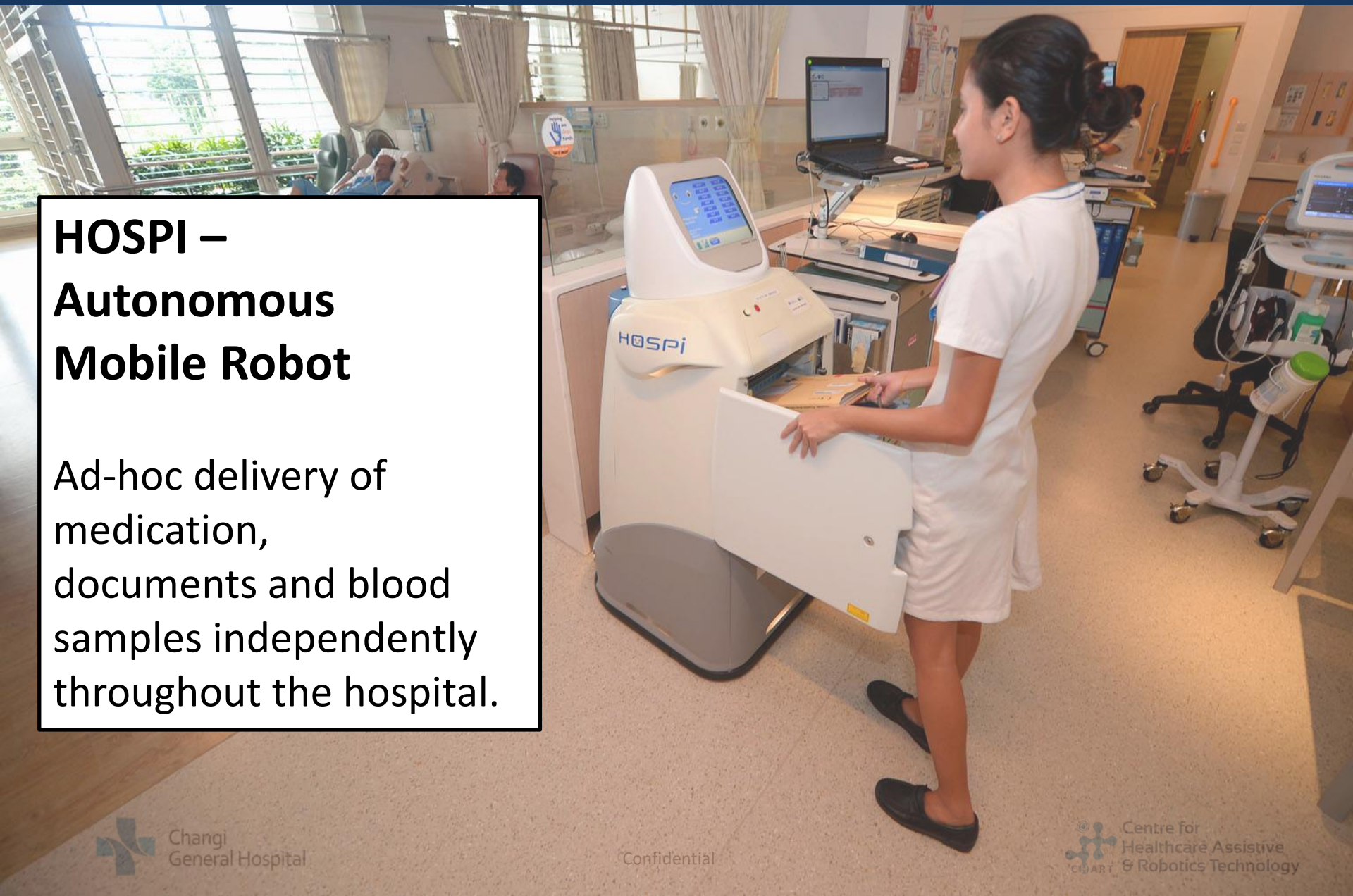
Takes medication from Automated Medication Cabinet (AMC) and prepare medication into Automated Medication Cart

5 Nurse administers medication

Using wireless/RFID with Electronic Medical Record System to meet 5 rights

Closed Loop Medication Management (CLMM)

Robotics in Healthcare – Logistics



HOSPI – Autonomous Mobile Robot

Ad-hoc delivery of medication, documents and blood samples independently throughout the hospital.

Reducing non-core work through technology and job redesign

- Allow nurses to perform at top of license
- More time to provide direct patient care
- Expanded nursing roles

- Pharmacists have more time for medication reconciliation and patient education at frontline
- Reduction in rework rates
- Improvement in patient safety and waiting time

Our robots highway

Integration needs

- Enormous Diversity of Robotics Platforms.
- Most of them proprietary.
- Challenging to integrate.
  - Robot to Robot.
  - Robot to Infra.
  - Robot to Medical Devices and Systems.

Hardware modularity

- Compatible Robotic Arm
- Sensors
- Mobile Base
- Standardised controllers

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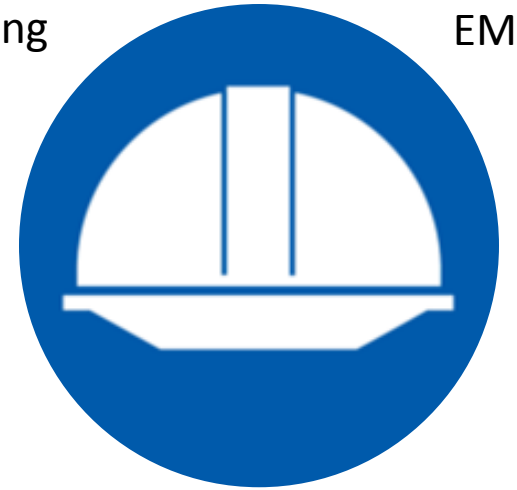
What can be standardised?



Charging

EMI/EMC

Terrain

Human Interaction

Cybersecurity

Safety

Middleware framework

Processes/ Procedures

Speed/ Endurance/ Durability

Hardware Interfaces

Communication Protocols

Performance

Work ahead

- Robots moving out of cages and working beside humans – how do we ensure adequate standards and risk assessments, safety through testing (eg. Human contact force limits) and insurance?
- Continuous efforts to provide evidence-based cost-effective care, driving both personalised and population health management. Can machines learn wrongly?
- More elderly patients are living alone, and with caregivers getting older. Many countries envisage a robot in every home. Do we need new laws for privacy and cyber-security?
- Need to prepare our population to work productively longer in their lives both in healthcare and in the general population. Need for process re-designs, infrastructure upgrades and workforce transformation to happen in tandem.
- Need for open-source codes to drive innovation, balanced with clinical validation/certification for proven care

Changi General Hospital

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Thank You