NATIONAL SKIN CENTRE
National Healthcare Group

Singapore's journey in enhancing safe use of automated medication management systems

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Disclosure

I declare that I have no actual or potential conflict of interest in relation to the subject matter of this presentation

Automated Medication Management Systems (AMMS)

- Computerised drug repackaging or storage devices/machines that allow medications to be repackaged, stored, and/or dispensed in healthcare settings

- Common Promises of AMMS include but not limiting to:
  - Medication safety (e.g. less/zero errors)
  - Operational efficiency / Process reliability (e.g. accurate/timely administration, less/zero rework)
  - Optimised clinical manpower utilisation (e.g. reduce non-value-adding manual tasks)
  - Improved medication adherence (e.g. convenient multi-dose sachet)

- *E.g. Closed Loop Medication Management System (CLMMS), Outpatient Pharmacy Automation System (OPAS), Inpatient Pharmacy Automation System (IPAS), Automated Dispensing Cabinets (ADC), Pharmacy Robotics*

Singapore Healthcare System

	Private Healthcare	Public Healthcare
Primary Care	80% (General Practitioners)	20% (Polyclinics)
Specialist Care	20% (Private Hospitals, Private Specialists)	80% (Public Hospitals, National Specialty Centres)
Inpatient Care	20% (Private Hospitals)	80% (Public Hospitals)

Note:
Patient distribution is expected to change in upcoming years with the introduction of Healthier SG that focuses on improving population health in the regional health systems under 3 public healthcare clusters, greater public-private partnerships in healthcare services, empanelment of patients to designated primary care provider (GP/polyclinic) and regional health system

AMMS Use in Singapore

- Mainly in public healthcare institutions

	Care Settings and Areas of Public Healthcare Institutions
Primary Care	• Outpatient pharmacies of polyclinics
Specialist Care	• Outpatient pharmacies, Day surgery units, Procedure centres, Emergency departments of general hospitals and national specialty centres
Inpatient Care	• Inpatient wards, Inpatient satellite pharmacies, Operating theatres of general hospitals and national specialty centres
Intermediate and Long-Term Care (ILTC)	• Public healthcare cluster-owned community hospitals • Public healthcare institutions supporting medication review and supply to ILTC facilities (e.g. nursing homes)

The Beginning

- Unit-dose processing error by inpatient pharmacy automation system (IPAS) in a public healthcare institution in Singapore
- **What happened?**

Carvedilol 25mg Tablet was wrongly packed and labelled as 6.25mg Tablet by IPAS

Wrongly-labelled Unit Dose (4x higher dosage) was dispensed from IPAS and sent to inpatient wards

Barcode verification (Patient eRx List + Unit Dose Label Barcode) was unable to detect this error

Nurse administered the wrongly-labelled unit dose without being able to detect this error

The Beginning

- **Adverse Impact**

A handful of patients received the wrong dosage of Carvedilol (25mg instead of 6.25mg)

30% patients experienced hypotensive episodes that were resolved with minor interventions

- **Root cause analysis (RCA) was conducted to identify the failures and root causes**
  - High reject rate (~40%) that resulted in substantial manual reworks
  - Manual rework process to reload reject items created opportunities for errors
  - Tedious independent double-checking process led to staff's workarounds from protocols
  - Absence of monitoring mechanisms to track/alert the high reject rates
  - AMMS user interface design created high potential for parallax errors in item selection panel
  - Inadequate supervision of unit-dose processes to detect risk in timely manner

Looking beyond one incident

- Survey of risk assessment and management plans across all public healthcare institutions
- Review of top AMMS risks and error/near-miss data

- **Key Findings**
  - 15 institutions were using AMMS
  - Inpatient Settings = 7 different AMMS
  - Outpatient Settings = 5 different AMMS
  - Institutions could be using between 1 and 7 AMMS
  - Institutions have varying risk management processes (e.g. risk management approach, monitoring data)

- **Key Question - Can we prevent this incident from happening to our patients in Singapore?**

A Call to Action - NAMMST

- Ministry of Health Singapore (MOH) convened the National Automated Medication Management System Taskforce (NAMMST) to review the current AMMS used in healthcare institutions

- **Terms of Reference**
  - To review the current AMMS used in healthcare institutions, and to assess and identify at-risk areas
  - To provide national guidance and evidence-based recommendations to prevent medication errors related to AMMS

- **Deliverables**
  - System mapping of AMMS in public healthcare institutions to identify potential risks and best practices
  - Publications of national guidelines/standards

NAMMST Composition

Chairperson	Healthcare professional with expertise in patient safety, risk management, health informatics, and AMMS
Vice-Chairperson	Healthcare professional with expertise in health informatics and AMMS
Pharmacists (Informatics)	Different care settings; Expertise in different AMMS types
Nurses (Informatics)	Nursing officer grade; Expertise in AMMS supporting nursing care processes
Doctors (Governance)	Involved in governance of medication management and use in institution
Pharmacy Administrator	Pharmacy HOD
Human Factor Expert	Expertise in human factors - system-human and human-human interfaces
IT Representatives	Expertise in different AMMS types
MOH Representatives	MOH Clinical Quality, Performance, and Value (CQPV) Division
Advisor	Chairperson of National Medication Safety Committee
Resource Person	MOH Chief Pharmacist

NAMMST Plan

1) Survey of AMMS in Singapore

2) Site Visits - Gemba “Go and See”

3) Focus Group Discussion

4) System Mapping for AMMS

5) Develop National Guidelines

Duration: June 2019 to Jan 2023
(delayed due to COVID-19 pandemic)

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1) Survey of AMMS in Singapore

- MOH collated AMMS information from public healthcare institutions, and used them for site visit planning and risk identification in the system maps

- **AMMS Specifications**
  - E.g. model, functions, settings

- **Essential Documents**
  - Policies, work instructions, operating procedures
  - Vendor reports (e.g. commissioning reports, maintenance reports)
  - Risk management document (e.g. FMEA, safety self-assessment)
  - Error/Near-miss data, Incident reports

- **Outsourced service providers**
  - E.g. external vendors doing unit-dose packing processes

	A	B
1	**Automated medication management systems (Phase II survey)**	
2		
3	**Model**	*<<for input>>*
4	**Number of units**	*<<for input>>*
5	**Location**	*<<for input>>*
6	**Function**	*<<for input>>*
7	**Software** *(please include description if different software used for various functions e.g. for picking and restocking)*	*<<for input>>*
8	***Workflow/ Operating Procedure and Guidelines/ Work Instructions/ In-house mapping*** *(if any)*	*<<for input>>*
9	***Vendor's manual and reports:*** *(if any)* *- User manual from vendor* *- Last maintenance report* *- Commissioning report*	*<<for input>>*
10	***Relevant Risk assessment*** *e.g. FMEA or Value Stream Mapping (if any)*	*<<for input>>*
11	***Near misses/errors reported***	*<<for input>>*
12	***Remarks***	*<<for input>>*

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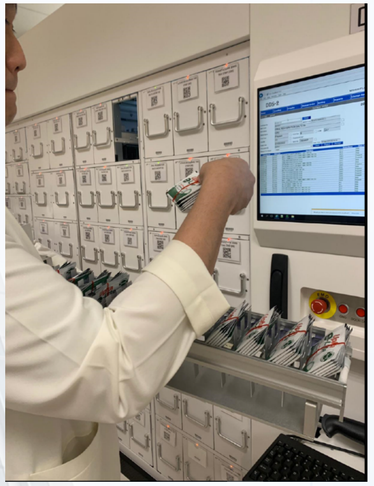
2) Site Visits - Gemba “Go and See”

- 17 site visits to public healthcare institutions and private repackaging facilities

- Observe and validate the work processes
- Understand and clarify the context of potential risks and challenges associated with AMMS
- Identify best practices



3) Focus Group Discussion

- 5 focus group discussion sessions with domain experts

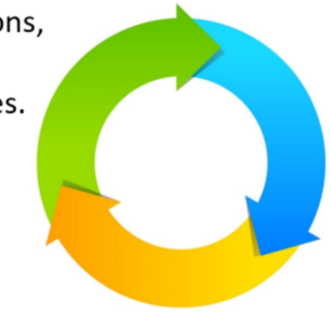
Agenda	NAMMST Focused Group Discussion Session #5	
	NAMMST Background	GeTech

Format of the Focused Group Discussion

1 For each equipment, secretariat will summarise the core processes; and

For each of the core processes (e.g. pre-processing), secretariat will describe the steps mapped out and highlight the:

- Variations observed in institutions,
- The risks/errors, and
- The existing mitigating measures.



2 For each core process, use the guiding questions to:

- Highlight any missing steps in the process map,
- Highlight and identify any additional risks,
- Recommend additional change ideas, control measures, monitoring requirements.

3 Move on to the next core process or equipment.

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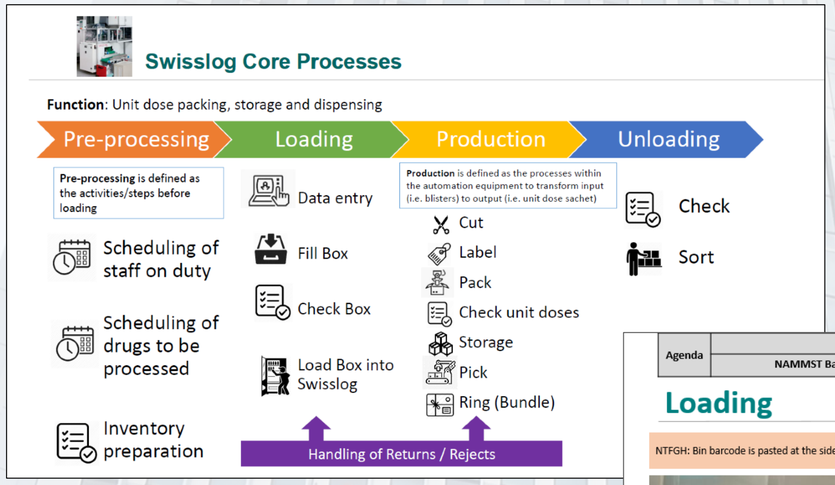
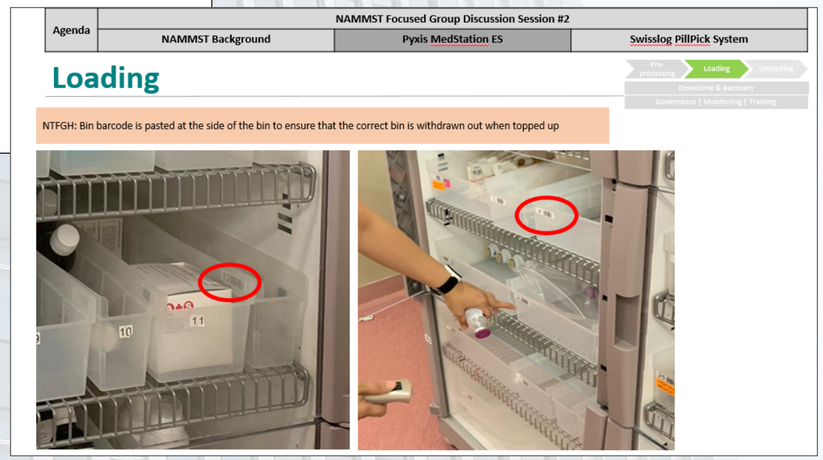
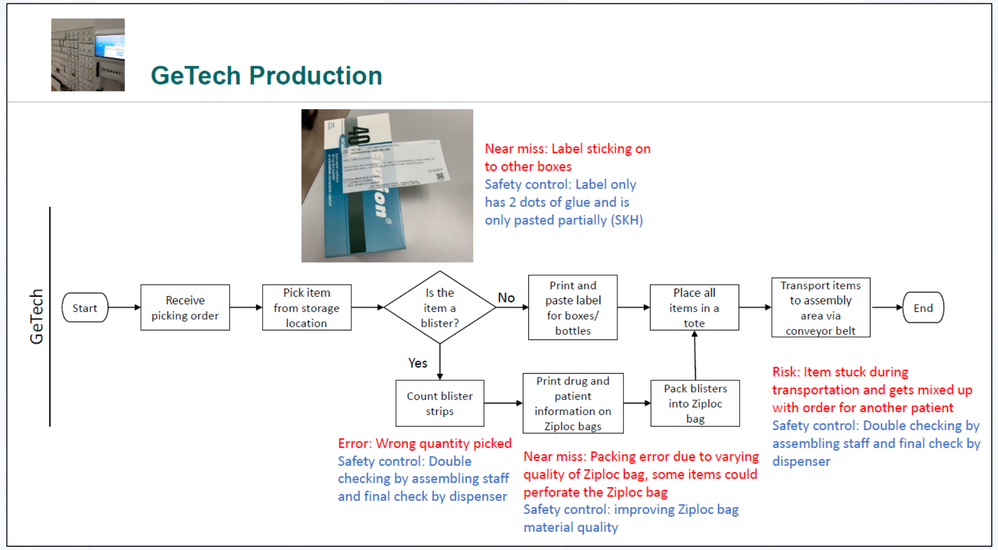
4) System Mapping for AMMS

- System mapping for AMMS in public healthcare institutions to identify potential risks and best practices







5) Develop National Guidelines

MINISTRY OF HEALTH
SINGAPORE

THE NATIONAL GUIDELINES
ON AUTOMATED MEDICATION MANAGEMENT SYSTEMS

27 April 2023

- Support healthcare institutions in enhancing the safe use of AMMS for safer and better outcomes
- Minimise AMMS-associated errors from resulting in patient harm

- Serve as reference guide for any healthcare institution with the intention to implement a new AMMS or review its existing AMMS

Project Management	**Downtime Process**
Operation of AMMS	**Monitoring**
Other Strategies to Minimise System-Human Errors	**Governance Operating Model**

National Guidelines on Automated Medication Management Systems

Project Management

- Provides guidance and recommendations to enable robust and systematic project management process at the key phases

- Selection and Procurement of AMMS
- Pre-implementation
- Implementation
- Post-implementation

National Guidelines on Automated Medication Management Systems

Operation of AMMS

- Identify the intended functions of various processes pertaining to AMMS operation and their potential risks, and formulate suitable measures to address these risks adequately
- Address risks at upstream processes to minimise risk magnification at downstream processes

- Selection of Raw Materials
- Data Item Setup and Calibration Process of Raw Materials
- Initiation of Batch Production Order
- Preparation of Raw Materials
- Production and Repackaging
- Quality Control Processes
- Management of Non-conforming AMMS Outputs
- Line Clearance
- Storage / Transfer to Storage
- Retrieval / Usage Process / Verification
- Returning Process / Management of Return Items

National Guidelines on Automated Medication Management Systems

Downtime Process

- Provides recommendations for developing a comprehensive set of downtime procedures, as well as the protocols for recovery from downtime
- Covers different AMMS types (e.g. unit-dose/multi-dose production, automated medication cabinets, medication carts, OPAS)

- Downtime Procedures
- Recovery from Downtime

National Guidelines on Automated Medication Management Systems

Monitoring

- Provides recommendations for developing a comprehensive plan for monitoring AMMS and the medications accessed through them, as well as the supporting mechanisms for risk management, patient safety and quality improvement

- Proactive Risk Management
- Continuous Quality Improvement
- Monitoring for Medication Safety
- Monitoring for Operational Efficiency
- Incident Management
- Data Management and Analytics

National Guidelines on Automated Medication Management Systems

Governance Operating Model

- Enhances the healthcare institutions' ability to implement and exercise the appropriate governance and oversight over AMMS and their associated functions
- Provides clarity in the organisation of the operational, financial, technological, human resources, risk management, performance reporting, and compliance aspects

- Establishing a governance operating model
- Staff qualifications and education
- Occupational health and safety considerations
- Information and system security
- Considerations for AMMS use during pandemic and disease outbreaks

Medication Management and Use (MMU)

Organisation, Management, and Governance

Selection & Procurement

Storage & Labelling

Prescribing & Transcribing

Preparing & Dispensing

Administration

Monitoring

High-Alert Medications (HAM)

Look-Alike-Sound-Alike (LASA) Medications

Research Medications

Sample Medications

Outsourced Services

Learning Pearls

Gemba “Go and See”
Versus
“Black and White” Policies

We can only Know and Analyse What We Measure

Let our Near-Misses Tell their Stories

Manage the Fine Balance of Standardisation and Contextualisation

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National Guidelines on Automated Medication Management Systems

https://www.moh.gov.sg/docs/librariesprovider4/default-document-library/national-guidelines-on-automated-medication-management-systems-2023.pdf

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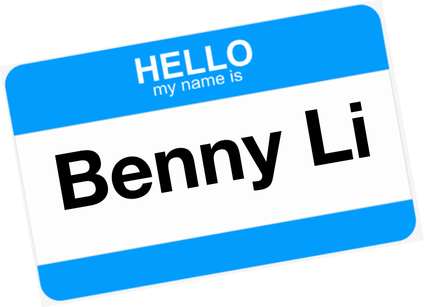

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