

Robotized Compounding of Anticancer Drugs in Oncology Pharmacy

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2. Multi-Robot System in SMC

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Robotized Compounding System

- **About SMC**
- **Background for Implementation of IV Compounding Robot**
- **Chemotherapy Compounding Robot in the Market and Our Choice; APOTECACHemo**
- **Ready for Robot System**
- **Robotic Compounding Process**

- **Founded at November 9, 1994**
- Change the paradigm of the domestic medical world with the advanced concepts “**Patient-centered**” and “**Customer satisfaction**”
- **Infrastructure**
 - Main building (1994) Annex (1998)
 - Samsung Comprehensive Cancer Center (2008)
 - Proton Therapy Center (2015)
 - Research Institute of Future Medicine (2016)
- **Awards**
 - National Customer Satisfaction Index (NCSI) 14 times
 - Korea Customer Satisfaction Index (KCSI) 16 times
 - Korean Standard-Service Quality Index (KS-SQI) 12 times





Doctors	Approximately 1,400 persons
Nurses	Approximately 2,600 persons
Researchers	Approximately 200 persons
Pharmacists and Medical engineers	Approximately 3,700 persons



Outpatients	2,027,211 patients
Emergency patients	76,496 patients(210/1day)
Inpatients	85,208 patients(233/1day)
Surgeries	45,800 case
Beds	1,979 beds



Publications in SMC SCI	1,135
Planned research projects	1,305
Ongoing research projects	2,457

*Pharmacists 114
Interns 9
Assistants 30*

Director
Kim, JM

**Pharmacy
Administration**

**Dispensing
& Distribution
Services**

**Clinical
Pharmacy
Services**

**Administrative
Responsibilities**

Pharmacist 3
Assistant 1

**Medication
Information
Services**

Pharmacist 6
Assistant 1

**Outpatient
Pharmacy**

Pharmacist 16
Assistant 4

**Inpatient
Pharmacy**

Pharmacist 43
Assistant 20

**Clinical Trial
Pharmacy**

Pharmacist 7

**Clinical
Pharmacy**

Pharmacist 13

**IV
Admixture
Services**

Pharmacist 18
Assistant 3

Main Building

**Pediatric,
Gynecologic
cancer center**
Inpatients & Outpatients

**Sterile
Compounding**
Chemotherapy drugs,
antibiotics, TPN

**4 BSC
1 LAFW
1 Robot (2nd)**

Inpatient
Oncology Pharmacy

Cancer Center

Outpatient
Oncology Pharmacy

**Hemato-
Oncology**
Inpatients

**Sterile
Compounding**
Chemotherapy drugs,
antibiotics

**4 BSC
3 LAFW**

**Hemato-
Oncology**
Outpatients

**Sterile
Compounding**
Chemotherapy drugs

**2 BSC
2 Robot (1st,3rd)**

Medication Errors

Incorrect dosage of drugs
Incorrect volume of diluents
Leakage in the process of preparation

Compounder's safety

Injury risk
Contamination risk
Hazardous drugs

Heavy workload

Hazardous drug preparation's increase
Staffing issue : high turnover rate

Implementation of IV Compounding Robot !

Chemotherapy Compounding Robot in the Market and Our Choice; APOTECA chemo



Brand Name	IV STATION ONCO ®	APOTECAchemo ®	RIVA ®
Manufacturer	Omnicell Inc.(US)	Loccioni Inc. (Italy)	ARxIUM Inc. (US)
WxDxH (m)	1.71 x 1.13 x 2.32	2.15 x 1.58 x 2.43	3.0 x 1.5 x 2.3
Weight (kg)	1,110	1,630	3,130

Purchasing criteria

Size

Weight

Work space

Disposables

Design

Suitability for SMC system



■ Visit Hospitals

- Review and analyze the automation compounding system
- Planning to modify the system adjusted to SMC

■ Learn about APOTECACHemo

: Overall understanding of robot system

Discussion about the issues that may occur

- Disposables, Drug formulations, Label modification, etc.



- **Date** : 18th Aug. – 24th Aug. 2015 (5 days)
- **Trainer** : Loccioni inc. Customer Care Technician, PM
- **Trainee** : 5 pharmacists working at IV admixture team
- **Activities** : Training on standard use of APOTECACHemo and APOTECAManager



Hospital Information System



HL7 message
Prescribing information

APOTECA manager



- Robot Software
- Control robot hardware, APOTECAchemo

1 st Drug List 24 Active Ingredients & 30 Formulations		At Present 30 & 39	To be Added 32 & 40
BENDAMUSTINE	FLUOROURACIL	NIVOLUMAB	IPILIMUMAB RITUXIMAB SC
BEVACIZUMAB	GEMCITABINE	BRENTUXIMAB	
BUSULFAN	IFOSFAMIDE	VEDOTIN	
CARBOPLATIN	LEUCOVORIN CALCIUM	PERTUZUMAB	
CETUXIMAB	METHOTREXATE	PEMBROLIZUMAB	
CYCLOPHOSPHAMIDE	OXALIPLATIN	RAMUCIRUMAB	
CYTARABINE	PACLITAXEL	CARFILZOMIB	
DACARBAZINE	PEMETREXED		
DOCETAXEL	RITUXIMAB		
DOXORUBICIN	TRASTUZUMAB		
ERIBULIN	VINOURELBINE		
ETOPOSIDE	IRINOTECAN		

1. Prescription Review

- Label printed
- Patient's EMR & drug review
- Send the prescribing information



2. Preparation

- Load components

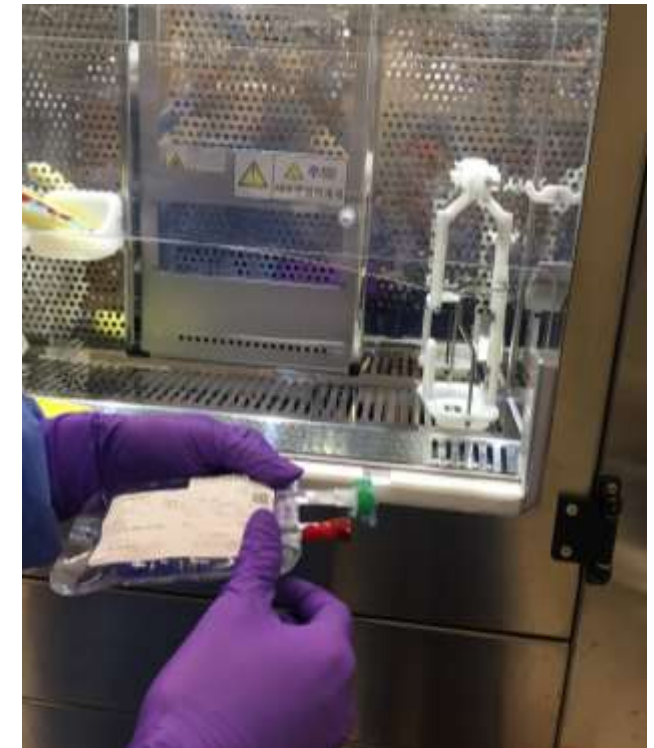
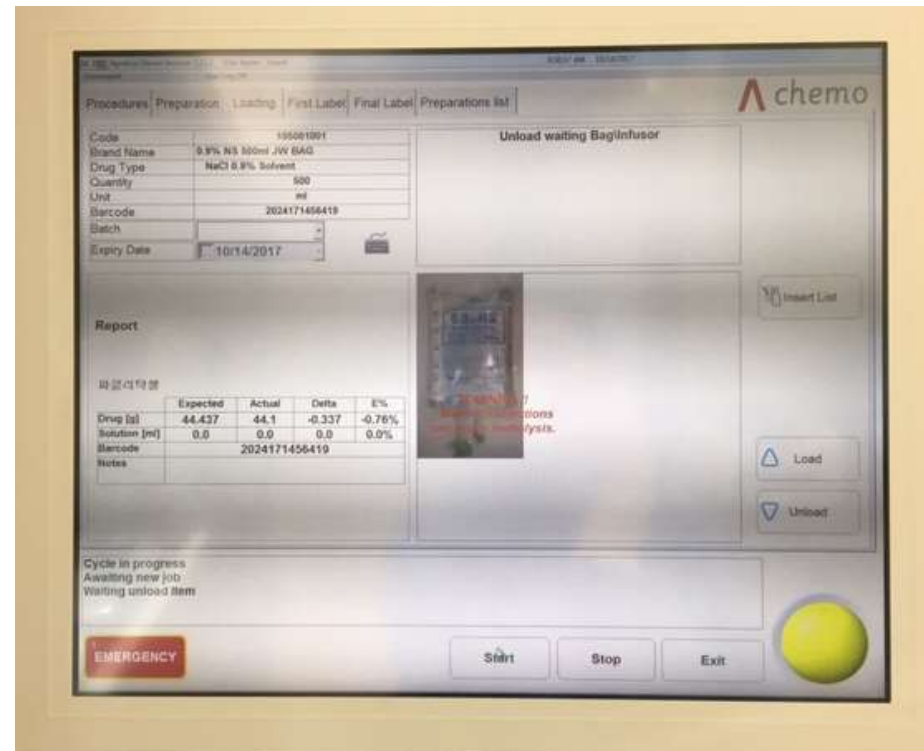


- Robot Preparation



3. Preparation Check & Delivery

- Unload the final product
- Check the dosage accuracy
- Quality control by a different staff



“Robot Procedure” Video Play

2

Multi-Robot System in SMC

- **Time Line**
- **Multi-Robot System**
- **Efforts to increase the efficiency**

2014

Oct.

Preparation
Analysis

Final containers
Dose distribution
Dosage form modification

2015

May.

User Training

Robot implemented hospital visit
Understanding of robot system

Aug.

1st Robot Installation

Outpatient oncology pharmacy
in the Cancer center
Software integration development

Sep.

1st Robot Operation Start

2016

Sep.

2nd Robot
Operation Start

IV admixture pharmacy
in the Main building

2017

Jan.

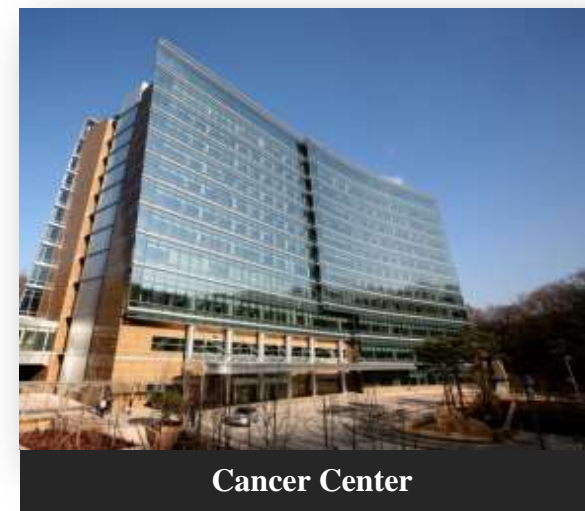
3rd Robot
Operation Start

Outpatient oncology
pharmacy
in the Cancer center



Main Building

■ APOTECA #2

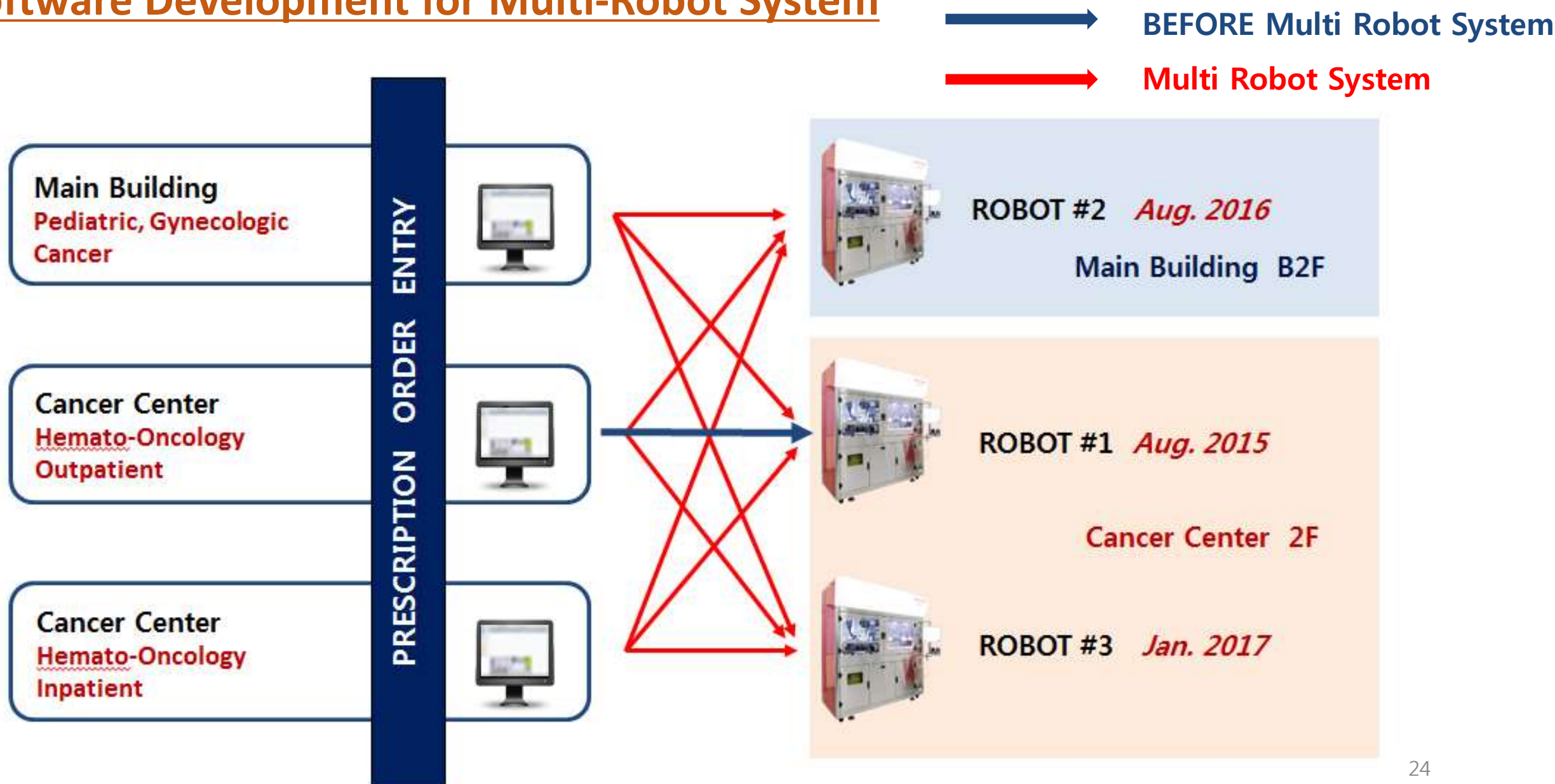


Cancer Center

- APOTECA #1
- APOTECA #3



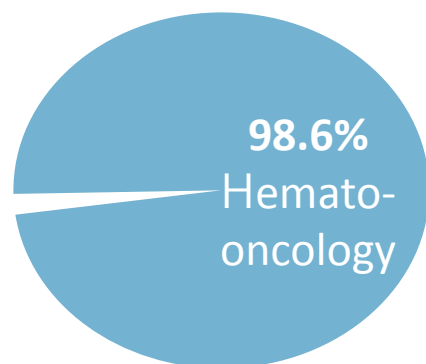
Software Development for Multi-Robot System



1st and 3rd Robot In Outpatient Oncology Pharmacy

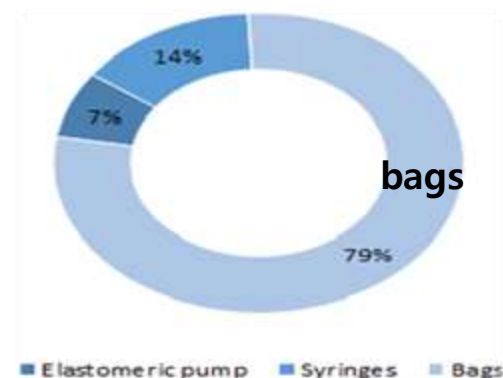


Major Departments



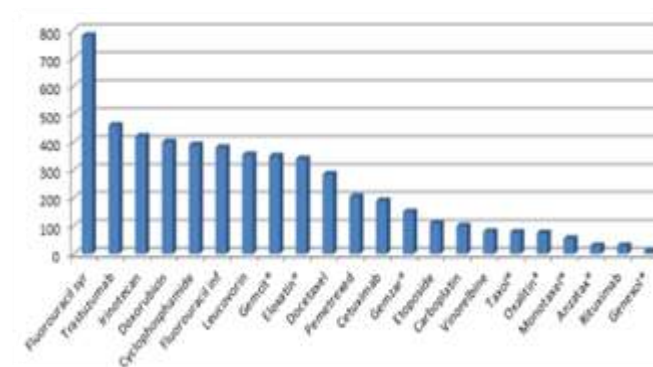
- 100% outpatients
- Hemato-oncology 98.6%
- pancreatobiliary and gastric cancer 1.4%

Final Containers



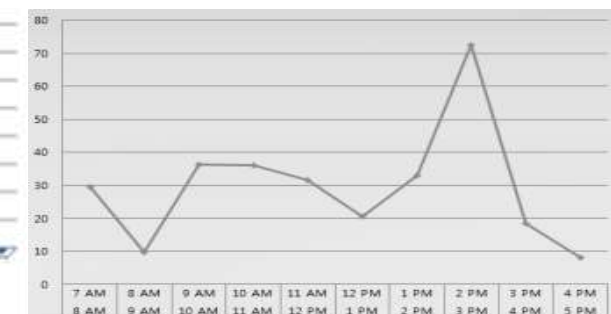
- **78.6%** of doses are prepared in **bags**
- Syringes 14.2%
- Elastomeric pump 7.2%

Drugs



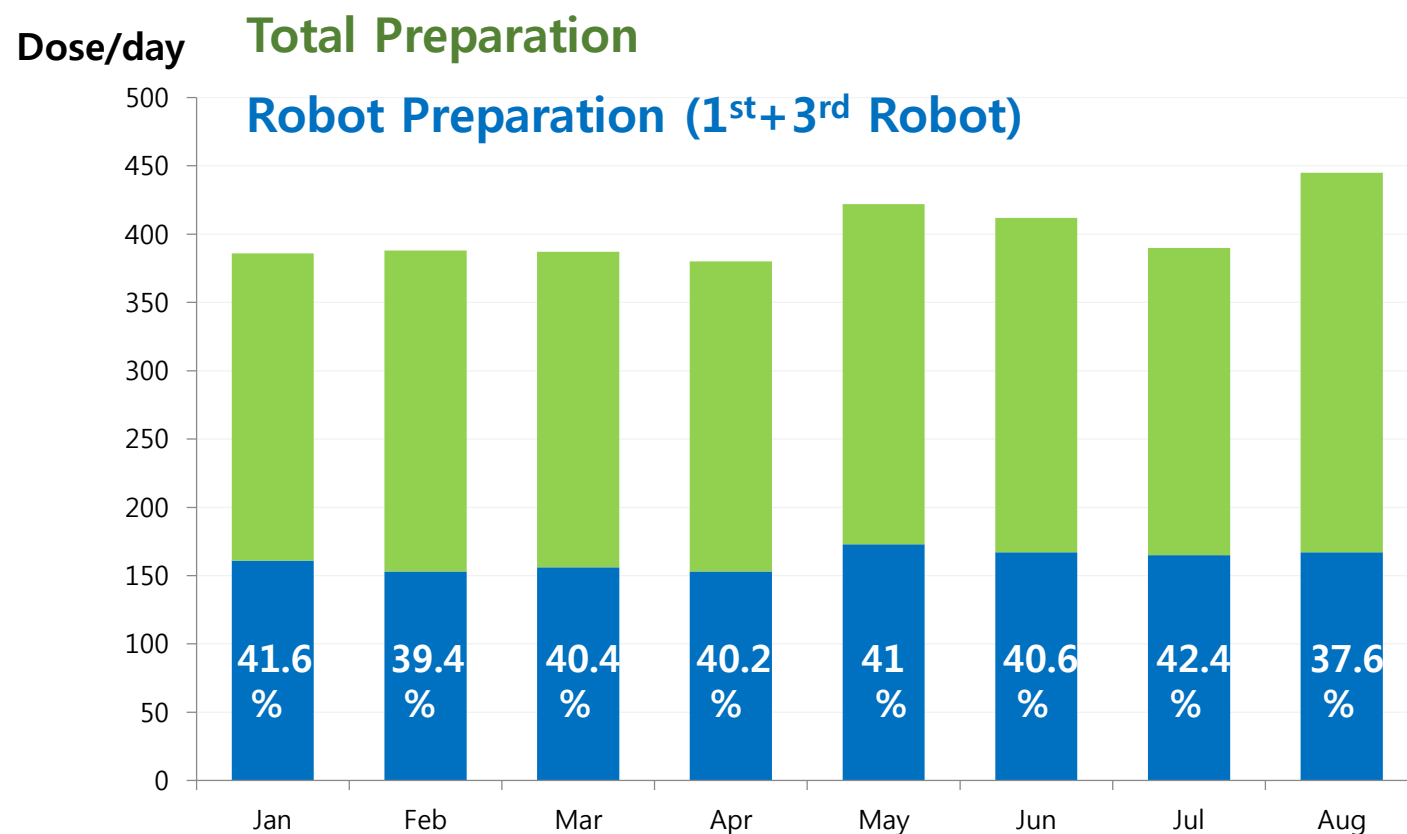
- The 5 most-used drugs cover 50% of the total activity
1. Fluorouracil
 2. Trastuzumab
 3. Irinotecan
 4. Doxorubicin
 5. Cyclophosphamide

Dose Distribution



- Irregular distribution of doses
- Two busy moments
 - 9am~11am
 - 2pm~3pm

■ Production volume in Outpatient Oncology Pharmacy and **Ratio of Robot Preparation**



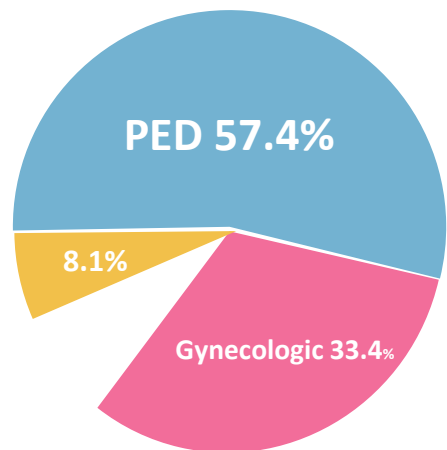
Analysis of Jan.2017~Aug.2017

*In Outpatient Oncology Pharmacy,
Two Robot Covers about 40% of
Total Preparation*

2nd Robot in the Main Building



Major Departments



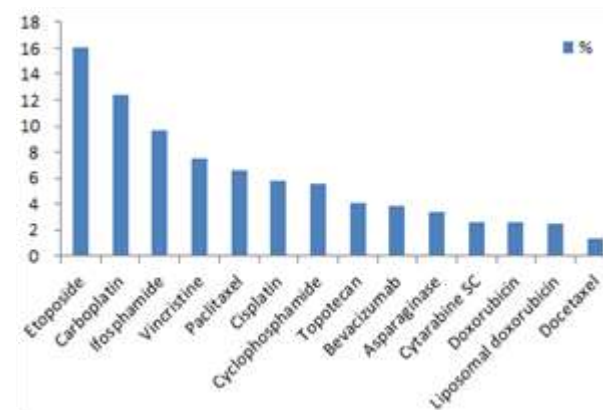
- Inpatient 74%, outpatients 26%
- Pediatric cancer 57.4%
- Gynecologic cancer 33.4%
- Hemato-oncology 8.1%

Final Containers



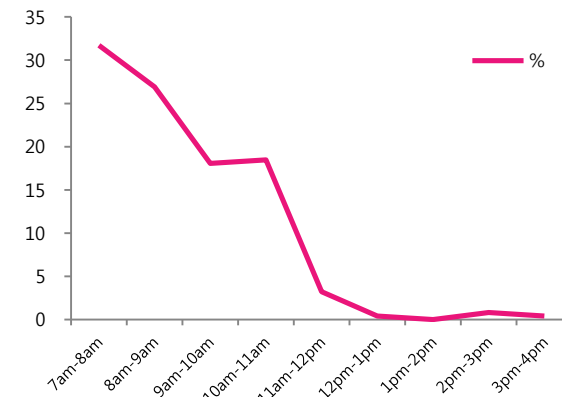
- Bags 61.5%
- **Adjusted bags 16.5%**
- Syringes 9%
- Bottles 8.5%
- Intrathecal preparations 4.5%

Drugs



- The most-used drugs
 1. Etoposide
 2. Carboplatin
 3. Ifosfamide
 4. Vincristine
 5. Paclitaxel
 6. Cisplatin
 7. Cyclophosphamide
 8. Topotecan

Dose Distribution



- The frequency leans too much toward to **before 12pm.**

Limitations in the Main Building & Optimizing

Final Containers

1. Variety of infusion bags, bottles and syringes
2. Adjusted bags 16.5%, etoposide
3. Intrathecal administration 4.5%

Drugs

Ruled-out drugs and the reasons

Cisplatin

→ Using final container as bottles

Vincristine, Topotecan, Asparaginase, Cytarabine, Aldesleukin, Bortezomib, etc.

→ Too small volume for 1 vial

Dose Distribution

1. The outpatients' prescriptions usually occur from 9am to 1pm.
2. The inpatient's regular preparations need to be prepared before 1pm.

Pediatric etoposide preparation

Use the fluid withdrawn function

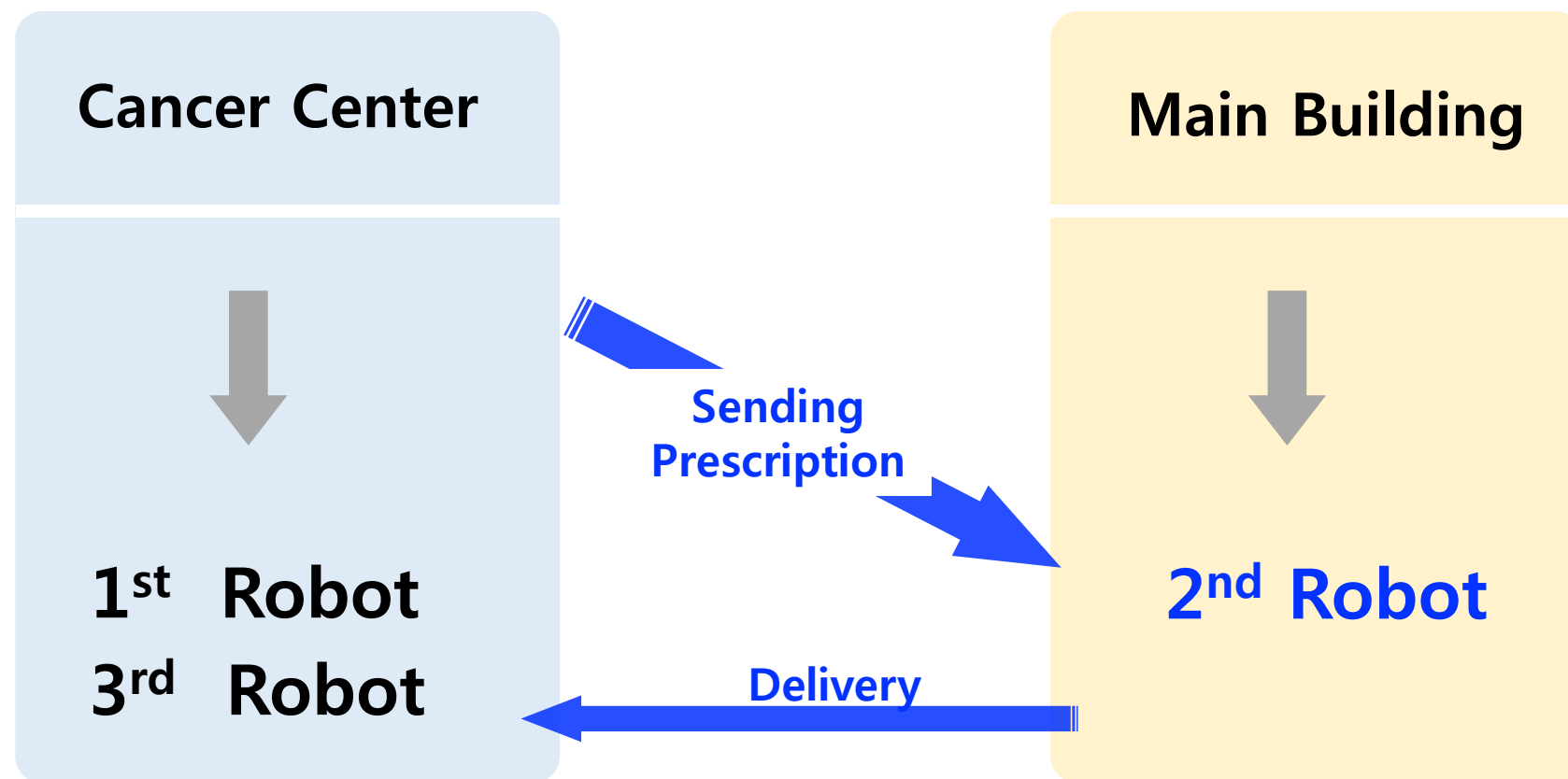
Increase the robot eligible drugs

Add liposomal doxorubicin to "SMC Drug list for robot"

Bring cancer center's prescription

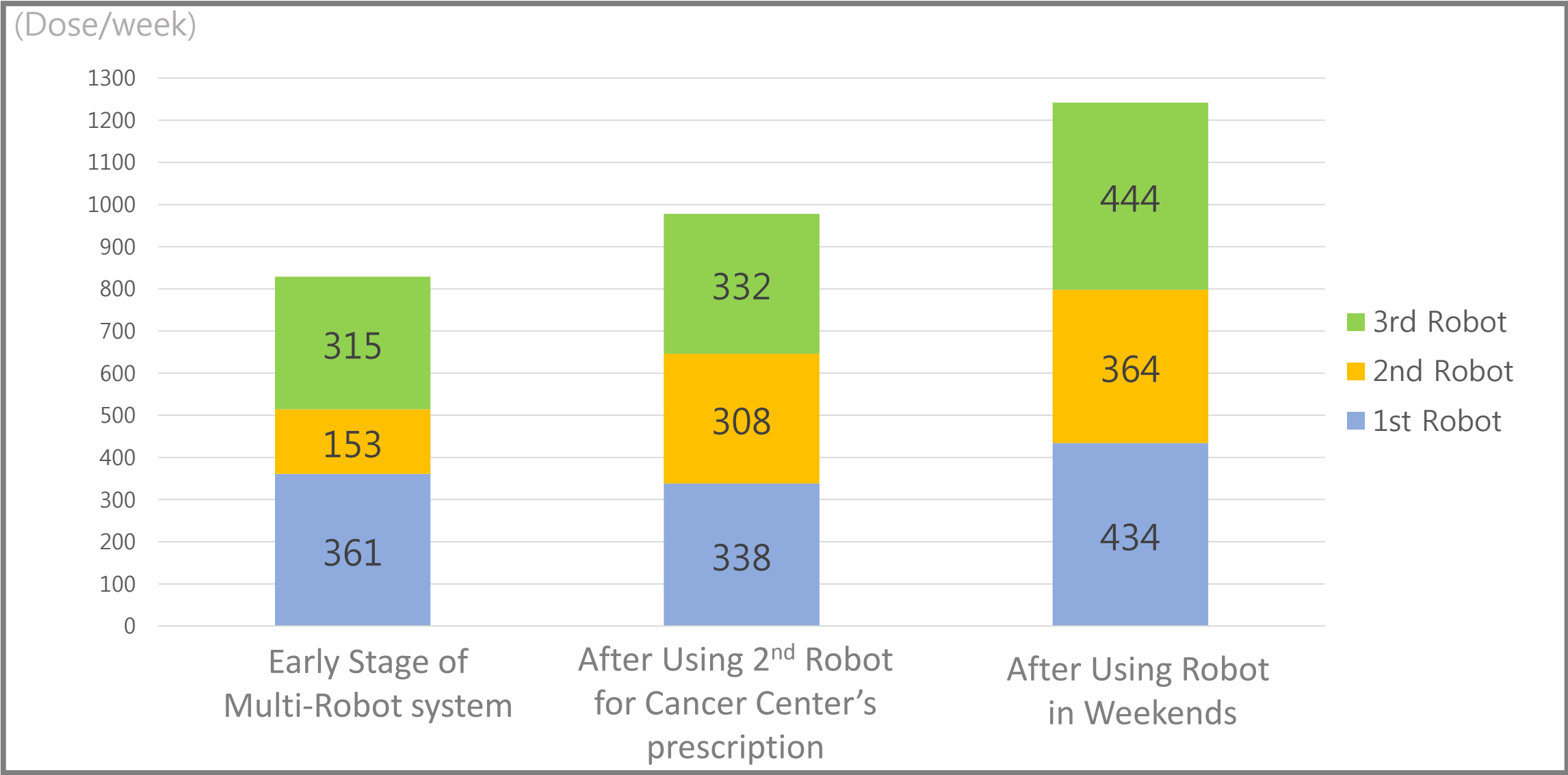
Bring the outpatient's expected prescriptions

1. Using 2nd Robot for “Cancer Center’s” prescription



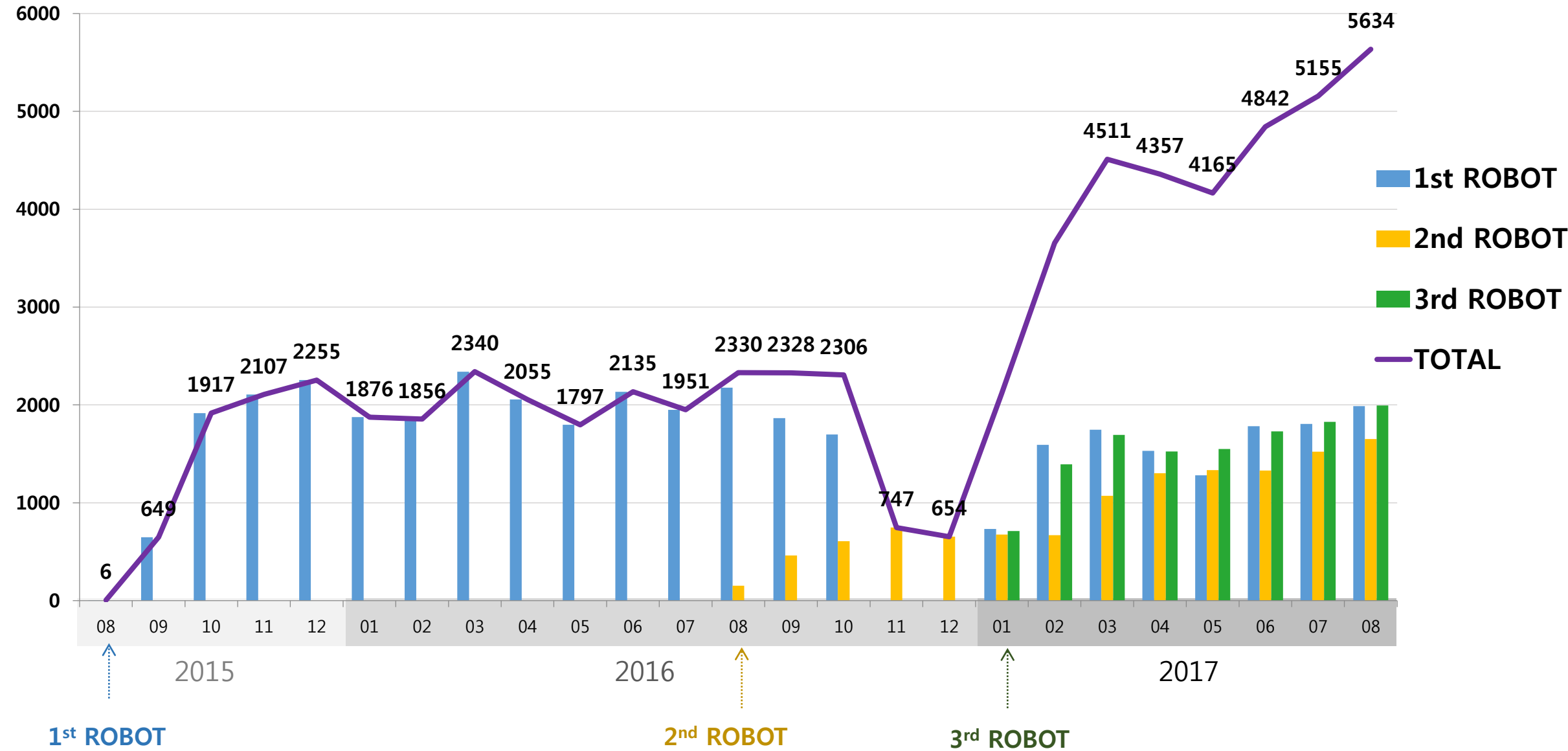
2. Using Robot in Weekends

Total Production Increased!

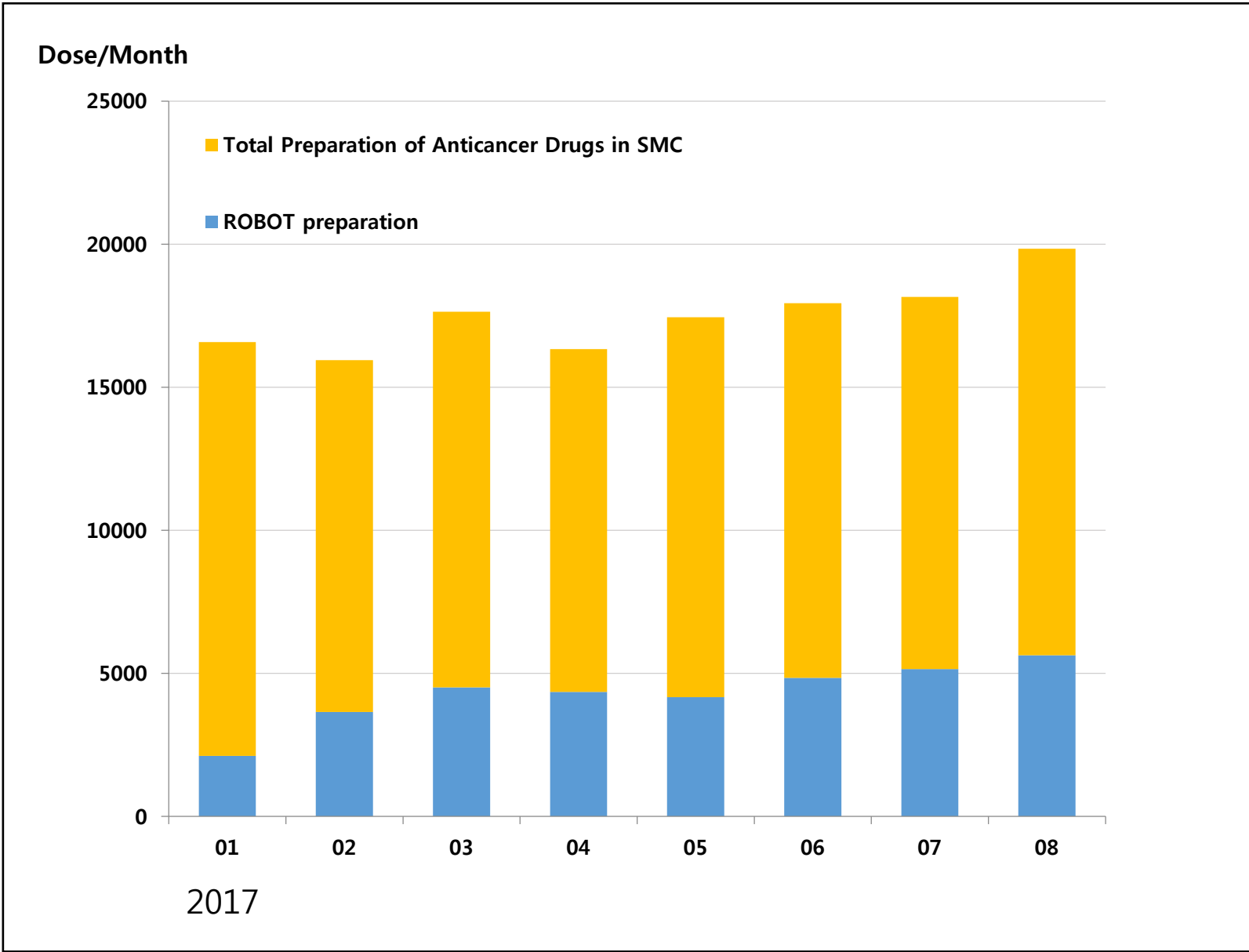


Production Volume of Robot

Dose/Month

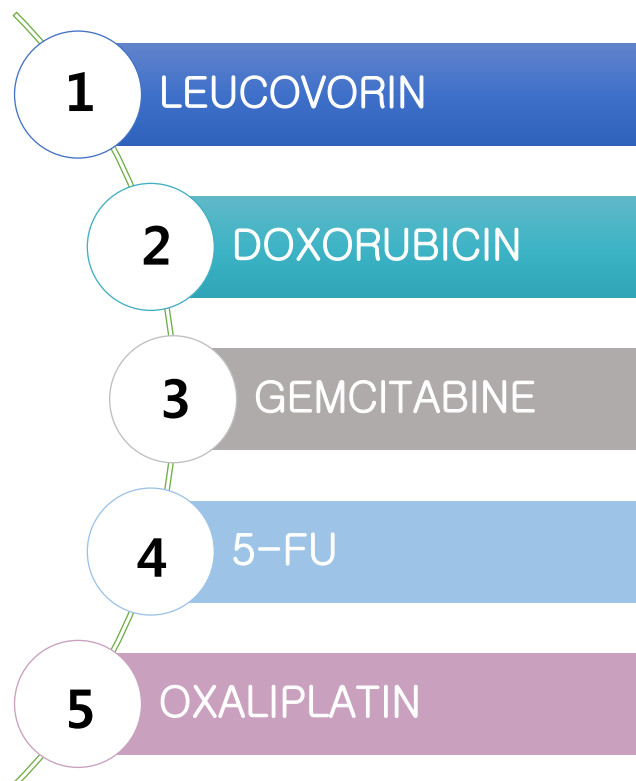


Production Volume of Robot – After Multi-Robot System

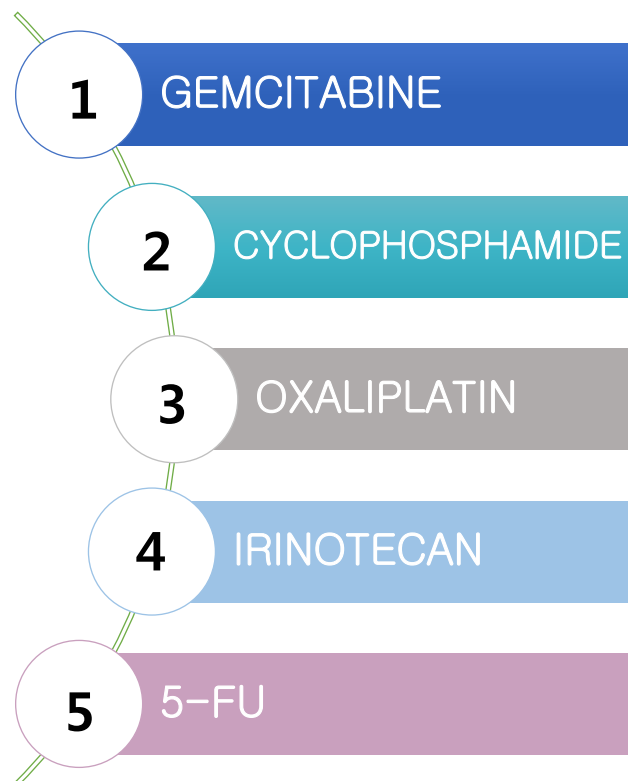


*Robot Covers about 30% of
Total Anticancer Drug Preparation
In SMC*

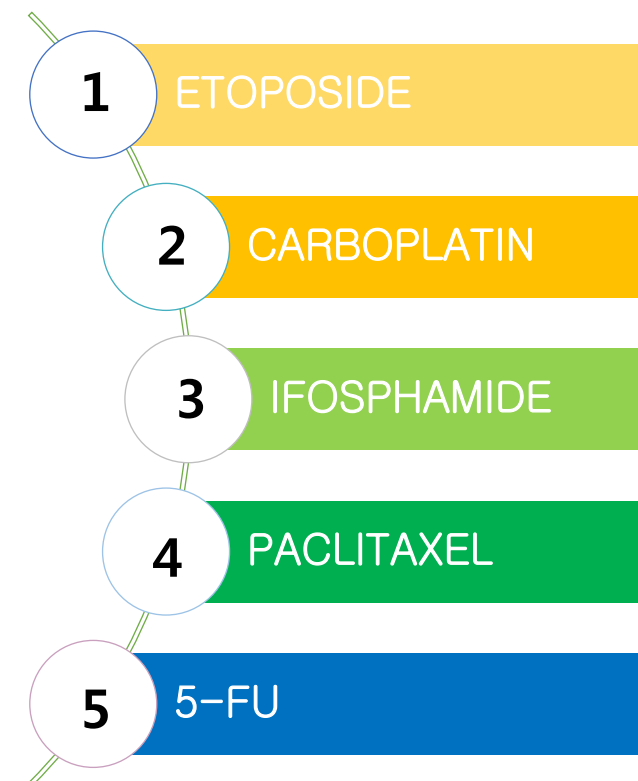
■ Top Five Drugs frequently prepared by Robot



**1st
Robot**



**3rd
Robot**



**2nd
Robot**

■ Average preparation time and dosage error of ROBOT

DRUG	TIME (min)	ERROR (%)
LEUCOVORIN 300mg/30ml	4.5	-1.43
	1.5(syringe)	-0.63
DOXORUBICIN 50mg/25ml	5.3	-0.52
CYCLOPHOSPHAMIDE 500mg/25ml	5.8	-1.06
5-FU 1000mg/20ml	5.6	-0.96
	2.2(syringe)	-0.2
GEMCITABINE 1g/26.32ml	5.2	-1.05
OXALIPLATIN 100mg/20ml	4.8	-0.86
ETOPOSIDE 150mg/7,5ml	4.3	-2.04
IRINOTECAN 100mg/5ml	5.9	-1.94
CARBOPLATIN 450mg/45ml	5.2	-0.14
PACLITAXEL 100mg/16.7ml	5.8	-0.88
IFOSPHAMIDE 1000mg/25ml	5	-0.88
PEMETREXED 500mg/20ml	5.2	-0.81
DOCETAXEL 80mg/4ml	4	-2.44

Preparation time is shorter

When,

- ✓ Small volume of dose
- ✓ Use Syringe as final container
- ✓ Use less vials

Dosage error % is low

When,

- ✓ Large volume of dose

3

Conclusions & Recommendations

- **Conclusions**

: **Benefits and Limitations of Robotized
Compounding System**
- **Recommendations**

Benefits

- Operators' safety
- Process traceability
- Error reporting
- Simple process
- Cost reduction of consumable parts



VS

Limitations

- ✓ Initial installation cost
- ✓ Limitations of preparing certain final containers
- ✓ Preparation time
- ✓ Cleaning procedure



Cancer Center

- Overwhelming major departments
- Simple preparations considering as final containers
- The 5 most-used drugs are in “SMC Drug list for Robot”
- Irregular distribution doses



Main Building

- Mixed with several departments
- Certain final containers cannot be prepared with robot
- Ruled-out drugs from “SMC Drug list for Robot”
- Skewed distribution doses



Since the working environmental conditions are different in every pharmacy, optimizing the use of the robot will be required for efficient pharmacy's workflow.



Thank you
