

# Automated preparation of oncology drugs in an Italian cancer center: Evaluation of productivity, errors interception, and waste reduction achieved by managing vials overfill

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## WHAT WAS DONE?

- Automated preparation with two robots APOTECachemo and one gravimetric-assisted workflow system APOTECAs was introduced to improve productivity and working efficiency, while reducing the risk of human errors [1, 2].
- To optimize resources utilization and reduce waste, a new procedure was implemented to enable the management of overfilled drug vials. Indeed, manufacturers fill injectable drug vials with a volume that slightly exceeds the nominal volume (overfill) to ensure proper withdrawing and patient dosing.

## WHY WAS DONE?

To analyze the performances of the automated preparation process in the oncology pharmacy by assessing the productivity and workload distribution, the potential human errors intercepted during the automated preparation, and the waste reduction achieved by managing vials overfill.

## HOW WAS DONE?

To perform the analysis, all data were retrieved from the production management software APOTECAManager and examined over a period of two years (2019-2020).

### Productivity and workload distribution

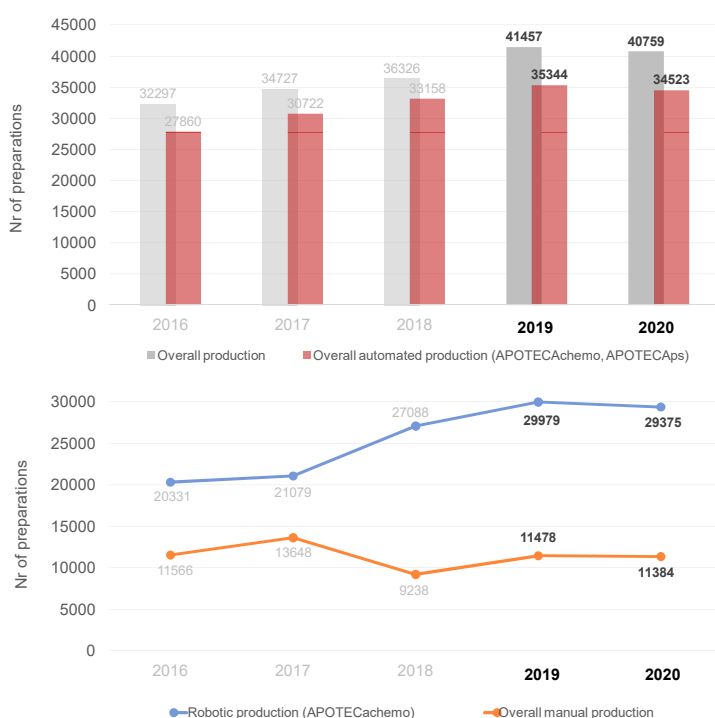
The annual throughput in terms of oncology preparation was calculated for the automated and the manual preparation process.

### Errors interception

Human errors intercepted during automated process were clustered into four groups: (1) loading of wrong component in APOTECachemo robot (final container, solvent, drug vial) in the robot, (2) multiple barcodes reading, (3) failed manual reconstitution with APOTECAs, (4) set a wrong expiration date during the preparation confirmation.

### Waste reduction (after overfill management)

The overfill amounts were measured for 17 high-cost drug vials by volumetric verifications manually performed by experienced pharmacy technicians. The annual number of vials used and the corresponding waste reduction due to the overfill management were determined.



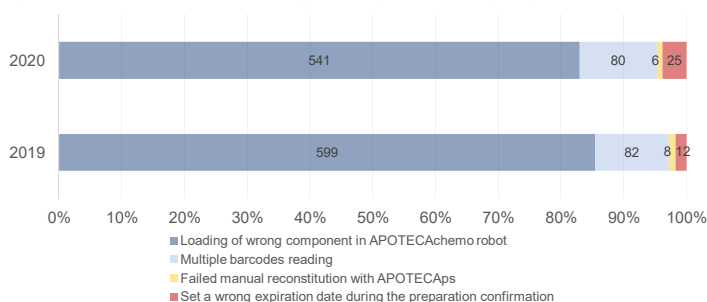
## WHAT HAS BEEN ACHIEVED?

### Productivity and working efficiency

82,216 preparations were compounded over two years, 72% of which with robotic systems and 28% manually prepared, either with gravimetric-assisted workflow (13%) or conventional volumetric technique (15%). Overall, automated preparation with APOTECA covers 85% of the total production.

### Errors interception

The total number of human errors intercepted by the automation systems amounted to 701 in 2019 and 662 in 2020. Most errors were intercepted by robotic systems and were related to loading of wrong component (83%).



### Waste reduction

Vials overfill ranged from 0.2mL (ramucirumab, eribulin, trastuzumab-emtansine, pembrolizumab, nivolumab) to 2.5mL (ipilimumab). The total waste reduction due to overfill management resulted in 789 vials saved, corresponding to 855,013€.

Drug product	Overfill amount (mL)	Annual quantity prescribed (mg)		Nr of vials used (theoretical)		Nr of vials used (actual)		Net gain (nr of vials)	
		2019	2020	2019	2020	2019	2020	2019	2020
Cyramza 100mg/10ml (LILLY)	0.2	6,000	10,800	60	108	59	106	1	2
Cyramza 500mg/50ml (LILLY)	1.0	88,500	46,500	177	93	174	91	3	2
Avastin 400mg/16ml (ROCHE)	0.6	-	339,200	-	848	-	817	0	31
Eribitux 100mg/20ml (MERCK)	0.8	-	215,200	-	2,152	-	2,069	0	83
Darzalex 400mg/20ml (JANSSEN)	0.8	-	375,600	-	939	-	903	0	36
Empliciti 300mg (BMS)	1.0	26,100	7,500	87	25	80	23	7	2
Empliciti 400mg (BMS)	1.0	15,200	13,600	51	45	36	32	15	13
Halaven 0,88mg/2ml (EISAI)	0.2	526,24	415	598	472	543	429	55	43
Kadcyla 100mg (ROCHE)	0.1	3,000	5,800	30	58	29	56	1	2
Kadcyla 160mg (ROCHE)	0.3	26,880	24,800	168	155	162	149	6	6
Keytruda 100mg/4ml	0.2	-	197,800	-	1,978	-	1,884	0	94
Kypriolis 60mg (AMGEN)	0.9	18,960	19,140	316	319	307	310	9	9
Opdivo 240mg/24ml (BMS)	0.5	-	236,880	-	987	-	967	0	20
Opdivo 100mg/10ml (BMS)	0.6	354,400	188,800	3,544	1,888	3,343	1,781	201	107
Opdivo 40mg/4ml (BMS)	0.2	7,400	3,240	185	81	176	77	9	4
Rixathon 500mg/50ml	0.8	-	475,000	-	950	-	935	0	15
Yervoy 200mg/40ml (BMS)	2.5	20,800	22,800	104	114	98	107	6	7
<b>Total</b>				<b>5,320</b>	<b>11,212</b>	<b>5,006</b>	<b>10,736</b>	<b>789</b>	

## WHAT NEXT?

The study confirmed that automated preparation represents a well-established practice in terms of productivity and reduces potential medication errors as well as waste of drugs. Overfill management will be implemented for additional drug products.

[1] C. Donati et al. Impact of fully automated chemotherapy preparation on safety, performances, and workflow in an Italian multisite cancer center. ISOPP 2019, London.  
[2] P. Sllimbani et al. Optimisation of compounding organization after implementing a robotic system for automated preparation of oncologic drugs. EAHP 2019, Barcelona.