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Original Research

Cost saving and safety associated with centralised cytotoxic medicine reconstitution at National Hospital Kandy in 2019

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Abstract

Background: Cytotoxic medicines are associated with occupational risks to the operators. Therefore, centralised cytotoxic medicine reconstitution by trained pharmacists was initiated in Sri Lanka in 2009. Centralised parenteral medicine reconstitution has many advantages such as quality assurance, error reduction, wastage reduction and cost saving. However, none of these have been analyzed and reported in Sri Lankan settings before this study. If the cost saving is of a considerable value, Centralised Medicine Reconstitution (CMR) can be applied to other expensive medicines which will help to reduce the cost of medical supplies.

Objectives: To analyse the cost saving and increased safety by reducing the medicine wastage due to the centralised parenteral cytotoxic medicine reconstitution in the National Hospital Kandy (NHK) in 2019.

Methods: The study was conducted using the data recorded in 2019 on the daily medicine balance book maintained at the Cytotoxic Reconstitution Unit (CRU) in NHK. The number of vials used, the quantity of each dose, and the price of the parenteral cytotoxic medicine were used to calculate the total cost and the medicine wastage in the CRU and ward, and compared.

Results: Theoretical medicine cost in wards to dispense 24 medicines was LKR 267.7 million, while the cost in the CRU was LKR 193.9 million. When it was reconstituted by the CRU, there was a wastage of 213,744.60 mg, and in wards, it was 4,353,153.60 mg. It showed a cost savings of LKR 73.8 million and a savings of 4,139,409 mg due to the CMR. The majority of cancer medications are cytotoxic, so reduction of medicine wastage also lowers the occupational risk and the risk to the environment.

Conclusion: CMR of cytotoxic medicine in NHK has shown a 27% cost reduction and increased occupational and environmental safety as determined by 95% reduction in medicine wastage in 2019. CMR of other costly parenteral medicines in addition to the cytotoxics would help to reduce the cost on medicines.

Keywords: cytotoxic, Centralised Medicine Reconstitution, cost saving, increased safety, wastage reduction

Background

The Trade and Development Report 2022 mentions that the current economic recession has overwhelmed the whole world [1]. As a result, many countries have already taken decisions to reduce their expenses including that on healthcare. In addition, the prices of pharmaceutical raw materials and medicines have inflated to an unexpected level all over the world. Indulging in an economic crisis, Sri Lanka is also reaching a difficult situation in providing free healthcare through government health institutions. Decisions for reducing the health budget will not be a surprise. All healthcare institutions, especially public facilities need to search for survival strategies. Identifying the ways for cost reduction is important in this regard. Sri Lanka provides free healthcare in the public sector health institutions which includes free supply of medicines. As anticancer medicines are expensive, high expenditure on anticancer medicines is a major problem associated with chemotherapy [2,3]. The Ministry of Health Sri Lanka allocates nearly 2.8% of its total recurrent expenditure budget to the National Cancer Institute of Sri Lanka (NCISL), the largest cancer hospital in the country.

Anticancer medicines/cytotoxic medicines are highly toxic chemicals. Their toxicity is not limited to cancer cells. Consequences of exposing the normal cells to cytotoxics could range from mild rashes to gene mutations and even to cancers. In addition, exposure to cytotoxics could be teratogenic. Therefore, special precautions are recommended to handle cytotoxic medicines [4]. Parenteral cytotoxic medicines are recommended to be reconstituted in cytotoxic reconstitution units (CRUs) following aseptic techniques by trained healthcare professionals [4]. CRU is a specially made environment with restricted access. Air supply to the environment is controlled and medicines are reconstituted inside a biosafety cabinet or a class IIA laminar air flow cabinet. Use of closed system medicine transfer devices in reconstitution is advised [5]. Adherence to aseptic techniques by the operators who are in personal protective equipment (PPE) like gowns, caps, shoe covers, face shields, etc. is also included in the guidelines for cytotoxic reconstitution. This specially made environment and the practices ensure the sterility of the preparation and the reduced occupational risks to the operators. However, some of the countries with developing economic statuses do not follow these guidelines and recommendations [6-10].

There was a remarkable shift in the method of reconstitution of injectable cytotoxics in 2009 in Sri Lanka. Till 2009, all parenteral cytotoxics were reconstituted in the respective cancer wards with the available facilities by nurses who were not specifically trained for the purpose. However, since 2009, NCISL has started to reconstitute parenteral cytotoxics in a centralised unit with specialized facilities by qualified pharmacists who are specially trained for the purpose. Since 2010, National Hospital Kandy (NHK) and Teaching Hospital (TH)s Kurunegala, Karapitiya and Rathnapura also have started CMR of cytotoxic medicine. CMR is expected to reduce the cost of medicines and the occupational risk associated with the exposure to cytotoxics considerably. Cytotoxic waste generation is another problem associated with chemotherapy. Higher the wastage, higher the risk to the environment and the workers. If the wastage could be reduced, the environmental and occupational safety would be increased and it is important to measure the reduced cost and the increased safety [11].

According to the literature, there were no published reports on studies conducted in Sri Lanka on cost saving, wastage reduction or increased safety due to centralised cytotoxic parenteral medicine reconstitution. Therefore, it was important to systematically analyze the cost savings and the increased safety by measuring the wastage reduction associated with centralised

reconstitution of cytotoxic medicines in Sri Lanka.

Objectives

The objective of the study was to analyze the cost saving and increased safety through medicine wastage reduction associated with the centralised parenteral cytotoxic medicine reconstitution in the NHK in 2019.

Methods

This retrospective study was done using the data of regularly used parenteral cytotoxic medicines reconstituted at the CRU, NHK during 2019. Administrative approval to conduct the study was obtained from the hospital administration prior to the study.

All parenteral cytotoxic medicines reconstituted at the CRU, NHK during 2019 were included while the medicines with no records on the number of vials, strength or the dose were excluded. Details in the daily balance book maintained at the CRU were used to collect the data. The name, dose, strength, the total number of prepared doses and the total number of vials used for reconstitution of the respective medicines in each day were collected. The unit price of each medicine was collected using the 2019 annual estimate of the NHK.

The cost reduction was analyzed obtaining the difference between the cost of reconstitution of medicines at the ward and that at the CRU. As the cytotoxics were entirely reconstituted at the CRU, the cost associated with ward-based reconstitution was calculated theoretically. However, the cost associated with CRU reconstitution was calculated using the actual data.

The cost of each medicine reconstituted at CRU was calculated using the equations 1-5. Then the cost of each cytotoxic medicine reconstituted at the CRU was added up to obtain the cost of all cytotoxic medicines and trastuzumab reconstituted at the CRU (Equation 6).

Before CRU was established at NHK, medicines were reconstituted at wards by nursing officers. There, the practice was to use one medicine vial for one patient ignoring the remaining in the vial. Therefore, the number of vials theoretically used in 2019 were calculated based on one medicine vial for one patient.

Total number of vials were decided based on the equation 8 where any decimal value (part of a vial) was considered a vial as the remaining in the vial was needed to be discarded if not used immediately or within 8 hours.

The cost saving associated with CMR of each cytotoxic medicine was calculated by the difference between the cost of reconstitution of medicines at CRU and that of wards (Equation 10). The total cost saving associated with centralised preparation of all parenteral medicines was calculated by adding the cost savings observed from each medicine (Equation 11).

The total quantity of medicine A that was actually needed was calculated using the data in the daily balance book (Equations 12-14). Total quantity of medicine A used in 2019 at CRU was calculated using the equations 15-17. Total quantity of medicine A used in 2019 at wards was considered as NAZ and Z was the medicine quantity of the vial A. NAZ was considered similar to QA and it was used in calculating the medicine quantity used in wards (Equations 18-20). The wastage of each medicine was calculated by the difference between the total quantity used and the total quantity required. The wastage at the CRU and at wards were calculated using the equations 21 and 22, respectively. Wastage reduction was calculated as the difference between the wastage at wards and that at the CRU (Equation 23) and the total wastage was calculated using the equation 24.

E.g.: Medicine A is reconstituted at the CRU;

Total number of vials of medicine A used in Day 1= n_{A1} ..... (1)

Total number of vials of medicine A used in Day 2= n_{A2} ..... (2)

Total number of vials of medicine A used in 2019 $_{nA}$= $\sum_{i=1}^{365} n_{Ai}$ ..... (3)

Unit price of A = Y_A ..... (4)

Cost of reconstitution of medicine A in 2019 at CRU= $n_A Y_A$ ..... (5)

Cost of cytotoxics if reconstituted at cancer wards, NHK

Total number of vials of medicine A used on Day 1 in all wards =N_{A1} ..... (6)

Total number of vials of medicine A used on Day 2 in all wards = N_{A2} ..... (7)

Total number of vials of medicine A used in 2019 in all wards N_A = $\sum_{i=1}^{365} N_{Ai}$ ..... (8)

Cost of reconstitution of medicine A in 2019 in all wards = $N_A Y_A$ ..... (9)

Cost saving associated with centralised preparation of medicine A = $(N_A - n_A)Y_A$ ..... (10)

Total cost saving due to centralised medicines preparation = $\sum_{j=1}^{k}(N_j - n_j)Y_j$ ..... (11)

Where k = number of parenteral medicines used in 2019

Quantity of medicine A that was needed for the Day 1 = x_{A1} ..... (12)

Quantity of medicine A that was needed for the Day 2 = x_{A2} ..... (13)

Total quantity of medicine A that was needed in 2019 X_A = $\sum_{i=1}^{365} X_{Ai}$ ..... (14)

Total quantity of medicine A used in Day 1 at CRU = R_{A1} ..... (15)

Total quantity of medicine A used in Day 2 at CRU = R_{A2} ..... (16)

Total quantity of medicine A used in 2019 at CRU (R_A)= $\sum_{i=1}^{365} R_{Ai}$ ..... (17)

Total quantity of medicine A used in Day 1 at wards (theoretical) = $N_{A1}Z = Q_{A1}$ ..... (18)

Where Z is the medicine quantity of the vial A

Total quantity of medicine A used in Day 2 at wards (theoretical) = Q_{A2} ..... (19)

Total quantity of medicine A used in wards (theoretical) (Q_A)= $\sum_{i=1}^{365} Q_{Ai}$ ..... (20)

Where k= number of parenteral medicines used in 2019

Wastage of medicine A at CRU = $R_A - X_A$ ..... (21)

Wastage of medicine A at wards (theoretical) = $Q_A - X_A$ ..... (22)

Wastage reduction of medicine A=medicine wastage at ward (theoretical)-Medicine wastage at CRU

= $(Q_A - X_A) - (R_A - X_A) = Q_A - R_A$ ..... (23)

Total wastage reduction, Q-R = $\sum_{j=1}^{k}(Q_j - R_j)$ ..... (24)

Where k = number of parenteral medicines used in 2019

Environmental and occupational safety was determined based on the equations 25 - 27.

Environment and occupational risk = Cytotoxic waste generation.x ..... (25)

Where x = other factors

If x is constant,

Environmental and occupational risk $\propto$ Cytotoxic waste generation ..... (26)

Environmental and occupational safety $\propto$ $\frac{1}{\text{Environmental and occupational risk}}$ ..... (27)

Results

Actual number of vials of each medicine used for reconstitution at CRU were calculated using the equation 3 and given in the table 1 The theoretical number of vials of each medicine used for reconstitution at all wards were calculated using the equation 8 and given in the table 1.

According to the table 1, Paclitaxel injection 30 mg/5ml vial has been highly used (10,099). Next highly used vial was Cyclophosphamide inj. 200 mg (6,391). But, 1,037 number of vials of Cyclophosphamide inj. higher strength (1 g) have also been used. Paclitaxel injection 260 mg vial was less used (742).

Cost of medicines reconstituted at CRU was calculated using the equation 5 and given in the table 2. The theoretical cost of medicines reconstituted at wards were calculated using the equation 9 and given in the table 2. Cost saving by the CRU reconstitution for one medicine was calculated using the equation 10. The total cost saving by the CRU reconstitution was calculated using the equation 11 and given in the table 2.

Table 2 shows that a higher cost saving, 66,551,576.91 Sri Lankan Rupees (LKR), was observed with centralised reconstitution of Trastuzumab Injection 440 mg. However, there was no cost saving observed by centralised reconstitution of some of the medicines such as Actinomycin D inj. 500 mcg, Melphalan injection 50 mg powder and Vinorelbine Injection 10 mg.

The total required quantity, the total quantity used at CRU and the quantity required for reconstitution at wards were calculated using the equations 14, 17 and 20 and values are given in the table 3.

According to the table 3, the total required quantity of all medicines was 13,237,534.56 mg and the total quantity used from all medicines at the CRU was 13,679,888.50 mg. The theoretical quantity requirement for reconstitution at wards was 17,891,749.5 mg. Medicine wastage occurred at CRU, at wards and the wastage reduction due to centralised reconstitution were calculated using the equations 21, 22 and 23, respectively and given in the table 4. According to table 4., negative values could be observed in the wastage of some of the medicines (Vincristine sulphate and Iposphomide) reconstituted at the CRU. Therefore, for analysis of total cost saving and total medicine wastage reduction, calculations had to be done without (adjusted) these two medicines. Final results without these two medicines (adjusted) are shown in the table 5.

Table 5 shows the adjusted total cost saving by CMR done at CRU, NHK in 2019 and was LKR 73,831,207.61. Adjusted total medicine wastage reduction by CMR was 4,139,409.00 mg.

Discussion

Covid pandemic has highly affected the Sri Lankan health sector during 2020 and 2021. It would have made variations to the number of cancer patients visiting and admitting to the hospitals, thus the year 2019 was selected assuming that the latest year with least changes to the number of patient admissions to the hospitals. In 2019, the expenditure on dispensing 24 cancer medicines was LKR 193.9 million, while the cost of dispensing the same medicines in wards would have costed LKR 267.7 million. Therefore, a cost saving of LKR 73.8 million could be observed by CMR at the CRU. It was a 27% cost saving due to centralised reconstitution compared to the ward reconstitution. A total quantity of all medicines 13,237,534.56mg was required for the patients and due to a definite wastage occurrence, a wastage of 213,744.60mg quantity was observed when dispensing through CRU while a wastage of 4,353,153.60mg quantity was seen when dispensing through wards. As cancer medicines are highly toxic, the reduction in medicine wastage reduces the risk to the environment and to the personnel who are handling the waste.

When comparing the results with that of previous research studies, some differences could be observed. Edward et al. (2013) reported that the reduction of medicine wastage was nearly 50% [12]. But in this study it was found that the reduction of medicine wastage was nearly 95%. This research was conducted in 2019 but Edward et at. (2013) have conducted their study in 2013 [12]. The technical improvements resulted from 2013 to 2019 could be a reason for this difference in high amount of wastage reduction. In one of the researches conducted in 2020 in USA, the medicine wastage reduction was 79.5% [13]. In that study, 17 cytotoxic medicines have been considered while in the current study 24 medicines were considered. The differences in the medicines and the number of medicines might lead to differences in the results as the wastages and the costs of different medicines are different [8].

The amount of cost saving in NHK was nearly US$ 414,650 in 2019. But some research cases reported US$ 70,000 [12], US$ 580,000 [13], US$ 530,000 [5] in one year and US$ 700,000 in 2018 [14]. Some researchers found US$ 21,000 cost saving in 6 months [15]. Edward et al. (2013) considered 21 medicines [13] in their study, but its cost saving was higher than that of NHK. Generally, the prices of medicines in the USA are higher compared to the prices of medicines used in Sri Lanka. This might be the reason for higher cost savings resulted in the studies conducted in USA [6,12,13]. In addition, in this research conducted at NHK, the regular medicines and Trastuzumab were considered. Prices of regular medicines are less than the named-patient medicines and if those were considered, a higher cost saving in comparison to the current results could have been observed. In addition, a US$ 21,000 of cost saving has been observed by a study conducted in France [15]. There, the cost saving by centralised medicine preparation was lower than the results of our study, as the number of medicines considered were low compared to the current study. Under this discussion, we can say that numerous factors such as economic status of a country, number of medicines and vials considered, study period and the duration, and the prices of the medicines affect the cost saving.

The volume present in the vial or strength of the vial may be different from one brand to another. Then the wastage will differ which affects the cost saving as well. Training and the experience of the person involved in the process also affect the cost and the wastage of medicines. Less trained or less experienced staff can also be a factor for a high wastage and for high costs. Number of the patients considered in a study and the duration of the research can also be identified as factors that can affect the results.

At the beginning of the research, all parenteral medicines were expected to be analysed, hence the data on 28 medicines reconstituted at the CRU were collected. But, due to poor documentation practices, some of the data could not be retrieved leading to inadequate data availability. Finally, only 24 medicines were included in the study. If all these medicines which were omitted had been included in the study, a higher cost saving could have been obtained.

According to the equation 27, environmental and occupational risks have been greatly reduced as cytotoxic wastage has been reduced by more than 4 kg in weight due to CMR, compared to the ward reconstitution.

Poor documentation observed at the CRU limited the number of medicines considered in the study. Unavailability of number of vials, doses, and prices led to exclusion of some of the medicines from the study. The second limitation in the study was that all the ward related calculations were done theoretically, assuming a similar practice for all the medicine usage for all wards. However, in a hospital, medicine usage is not uniform. Therefore, medicine usage should be handled

case by case. This was not possible as there is no ward-based reconstitution practice currently in NHK for cancer medicines thus, uniform practice was assumed and proceeded.

This study reports a high cost-effectiveness in the CMR of cytotoxics at CRU, NHK. Also, a similar medicine wastage can be seen in other expensive parenteral medicines such as antibiotics. Therefore, we suggest establishing centralised units for all parenteral medicine reconstitutions without limiting to cytotoxics which can reduce the expenditure for parenteral medicines. In addition, it will reduce the risk to the environment as the medicinal wastage is reduced. Further, the quality of the medicine administered to the patients can be ensured with a higher possibility for medication error reductions. The same suggestion can be further extended even to establish medicine pre-preparation units for all medicines. Individualized dose determinations will improve the therapeutic outcome in addition to ensuring the quality and safety. Individualizing the doses will improve the cost effectiveness of the therapy thus, the cost for medicines could be reduced. It is an important measure to reduce the cost of medicine procurement as well. If the prescribers take the lead on individualized prescribing, the pharmacists can support individualized dose dispensing at a centralised unit which is the current practice in many of the developed countries. Another suggestion is to optimize the documentation system maintained at the CRU as poor documentation affects the data retrieval and inventory control procedures in the hospital.

Conclusion

In 2019, centralised cytotoxic medicine reconstitution in NHK has saved LKR 73.8 million by 24 medicines with respect to a theoretical ward reconstitution. Also, 4,139,409 mg of medicine wastage reduction could be observed by centralised cytotoxic medicine reconstitution in NHK in 2019 with respect to 24 cytotoxic medicines, thereby increasing the safety to the environment and the workers. Results revealed that CMR can be applied for other high-cost medicine preparations such as reconstitution of antibiotics.

According to the study, CMR reduces the cost of medicines in large amounts. It also reduces the wastage of medicines. Therefore, patients, workers and environment safety will be improved. By establishing centralized facilitated units, the quality of the end user products can be assured, thereby patient safety can be ensured. By implementing dosage individualization at CMR units, the expected therapeutic outcomes can be successfully achieved. All these will lead to cost minimization at therapeutic interventions.

Author declaration

Author contributions : All authors contributed to the study and manuscript preparation. WTDW involved in planning, data collection, analysis and writing; BDK contributed by planning, editing and supervision; AGSUB involved in planning, editing and supervision; LCPTL contributed in planning, writing, editing and supervision.

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Table 1: Number of vials used at CRU and all wards (theoretical) in NHK in 2019

Description	Actual number of vials used at CRU	Actual number of vials used at wards
Actinomycin D inj. 500 mcg vial	1	1
Asparaginase 10,000 IU vial	29	33
Bleomycin sulphate Inj.15 000 units vial	373	406
Carboplatin inj. 450 mg/45 ml vial	2,276	3,111
Carboplatin inj.150 mg/15 ml vial +diluent	45	48
Cisplatin injection 50 mg vial	3,338	4,154
Cyclophosphamide Inj. 1 g vial	1,037	1,415
Cyclophosphamide inj. 200 mg vial	6,391	6,785
Cytarabine Inj. 100 mg/5 ml vial	497	587
Cytarabine injection1g in 10 ml vial	22	37
Dacarbazine Inj. 200 mg vial	941	1079
Daunorubicin HCl inj.20 mg vial	286	312
Docetaxel injection 20 mg vial	124	130
Docetaxel injection 80 mg vial	1,308	1,734
Doxorubicin HCl inj.10 mg vial	5,072	5,237
Doxorubicin HCl inj.50 mg vial	1,142	1,392
Epirubicin hydrochloride Inj.10 mg vial	22	26
Epirubicin hydrochloride Inj.50 mg vial	1,320	1,416
Etoposide injection 100 mg vial	1,017	1,207
Fluorouracil inj. 1g, 20 ml vial	4,679	6,429
Gemcitabine hydrochloride inj.1g	2,354	2,930
Gemcitabine hydrochloride inj.200 mg	330	342
Iposphomide 1g	622	694
Melphalan injection 50 mg powder with solvent	2	2
Mesna injection 200 mg in 2 ml	1,242	1,324
Methotrexate injection 1 g vial	48	499
Mitomycin injection 2 mg vial	331	417
Oxaliplatin injection 100 mg vial	1,475	2,043
Oxaliplatin injection 50 mg vial	116	130
Paclitaxel injection 260 mg	742	1,047
Paclitaxel injection 30 mg/5 ml vial	10,099	10,784
Paclitaxel Nanoparticle Inj 300 mg	6	8
Trastuzumab Injection 440 mg vial	1,134.4	1,584
Vinblastine Sulphate Inj 10 mg vial	176	212
Vincristine sulphate injection 1mg vial	1,188	1,675
Vinorelbine Injection10 mg Vial	1	1

Table 2: Cost saving of CRU at NHK in 2019

Description	Unit Price (LKR)	Cost of medicines at CRU (LKR)	Cost of medicines at ward (LKR)	Cost deference (Ward-CRU) (LKR)
Actinomycin D inj. 500 mcg vial	643.36	643.36	643.36	0
Asparaginase 10,000 IU vial	4,682.98	135,806.42	154,538.34	18731.92
Bleomycin sulphate Inj.15 000 units vial	945.99	352,854.27	384,071.94	31217.67
Carboplatin inj. 450 mg/45 ml vial	2,610.01	5,940,382.76	8,119,741.11	2,179,358.35
Carboplatin inj.150 mg/15 ml vial + diluent	2,296.52	103,343.4	110,232.96	6,889.56
Cisplatin injection 50 mg vial	461.14	1,539,285.32	1,915,575.56	376,290.24
Cyclophosphamide Inj. 1 g vial	250.00	259,250.00	353,750.00	94,500.00
Cyclophosphamide inj. 200 mg vial	97.92	625,806.72	664,387.2	38,580.48
Cytarabine Inj. 100 mg/5 ml vial	93.69	46,563.93	54,996.03	8,432.1
Cytarabine injection1g in 10 ml vial	92.28	2,030.16	3,414.36	1,384.20
Dacarbazine Inj. 200 mg vial	333.01	313,362.41	359,317.79	45,955.38
Daunorubicin HCl inj.20mg vial	255.48	73,067.28	79,709.76	6,642.48
Docetaxel injection 20 mg vial	570.80	70,779.20	74,204.00	3,424.80
Docetaxel injection 80 mg vial	750.35	981,457.80	1,301,106.90	319,649.10
Doxorubicin HCl inj. 10 mg vial	75.66	383,747.52	396,231.42	12,483.90
Epirubicin hydrochloride Inj.10 mg vial	305.88	6,729.36	7,952.88	1,223.52
Epirubicin hydrochloride Inj.50 mg vial	1,006.12	1,328,078.40	1,424,665.92	96,587.52
Etoposide injection 100 mg vial	172.47	175,401.99	208,171.29	32,769.30
Fluorouracil inj. 1g, 20 ml vial	241.14	1,128,294.06	1,550,289.06	421,995

Description	Unit Price (LKR)	Cost of medicines at CRU (LKR)	Cost of medicines at ward (LKR)	Cost deference (Ward-CRU) (LKR)
Gemcitabine hydrochloride inj.1 g	618.46	1,455,854.84	1,812,087.80	356,232.96
Gemcitabine hydrochloride inj.200 mg	176.98	58,403.40	60,527.16	2,123.76
Iposphomide 1 g	1,733.51	1,078,243.22	1,203,055.94	124,812.72
Melphalan injection 50 mg powder	5,000.00	10,000.00	10,000.00	0.00
Mesna injection 200 mg in 2ml	68.00	78,812.00	84,116.00	5,304.00
Mesna injection 200 mg in 2ml	68	5,644.00	5,916.00	272.00
Methotrexate injection 1 g vial	1,707.85	81,976.80	852,217.15	770,240.35
Mitomycin injection 2 mg vial	1,528.91	506,069.21	637,555.47	131,486.26
Oxaliplatin injection 100 mg vial	913.49	1,347,397.75	1,866,260.07	518,862.32
Oxaliplatin injection 50 mg vial	534.85	62,042.60	69,530.50	7,487.90
Paclitaxel injection 30 mg/5 ml vial	426.78	4,310,051.22	4,602,395.52	292,344.30
Paclitaxel injection 260 mg	5,000.00	3,710,000.00	5,235,000.00	1,525,000.00
Paclitaxel Nanoparticle Inj300 mg	87,921.91	527,531.46	703,375.28	175,843.82
Trastuzumab Injection 440 mg	148,023.97	167,918,391.60	234,469,968.50	66,551,576.91
Vinblastine Sulphate Inj. 10 mg vial	532.61	93,739.36	112,913.32	19,173.96
Vincristine sulphate injection 1 mg vial	84.86	100,813.68	142,140.5	41,326.82
Vinorelbine Injection10 mg Vial	12,000.00	12,000.00	12,000.00	0.00
Total		194,823,855.50	269,042,059.10	74,218,203.60

Table 3: Total required quantity, total quantity used at CRU and quantity required for reconstitution at ward at NHK in 2019

Drug name	Total required quantity (mg)	Total quantity used at CRU (mg)	Quantity required for reconstitution at ward (mg)
Actinomycin D	0.5	0.5	0.5
Asparaginase	264,460	290,000	330,000
Bleomycin sulphate	5,439	5,595	6,090
Carboplatin	1,034,842	1,042,200	1,407,150
Cisplatin injection	162,116	166,900	207,700
Cyclophosphamide	2,271,973	2,315,200	2,772,000
Cytarabine	66,832	71,700	95,700
Dacarbazine	184,825	188,200	215,800
Daunorubicin HCl	5,545.5	5,720	6,240
Docetaxel injection	99,741	107,120	141,320
Doxorubicin HCl	108,868	108,880	122,150
Epirubicin hydrochloride	59,361.5	66,220	71,060
Etoposide	94,784.5	101,700	120,700
Fluorouracil	4,607,214	4679,000	6,429,000
Gemcitabine hydrochloride	2,443,751	2,459,000	2,998,400
Iposphomide	633,395	622,000	694,000
Melphalan	2	100	100
Mesna	24,004,8.45	248,400	264,800
Methotrexate	47,423.8	48,000	499,000
Mitomycin	833	834	834
Oxaliplatin	151,292.3	153,300	210,800
Paclitaxel	492,955.5	497,690	598,140
Trastuzumab	499,136	499,136	696,960
Vinblastine Sulphate	1,474.85	1,760	2,120
Vincristine sulphate	1,567.108	1,223	1,675
Vinorelbine	2	10	10
Total	13,237,534.56	13,679,888.5	17,891,749.5

Table 4: Medicine wastage reduction by centralised reconstitution at NHK in 2019

Name of the medicine	Medicine wastage by centralised reconstitution (mg)	Medicine wastage by ward reconstitution (mg)	Medicine wastage reduction (mg)
Actinomycin D	0	0	0
Asparaginase	25540	65540	40000
Bleomycin sulphate	156	651	495
Carboplatin	7358	372308	364950
Cisplatin	4784	45584	40800
Cyclophosphamide	43227	500027	456800
Cytarabine	4868	28868	24000
Dacarbazine	3375	30975	27600
Daunorubicin HCl	174.5	694.5	520
Docetaxel injection	7379	41579	34200
Doxorubicin HCl	12	13282	13270
Epirubicin hydrochloride	6858.5	11698.5	4840
Etoposide	6915.5	25915.5	19000
Fluorouracil	71786	1821786	1750000
Gemcitabine hydrochloride	15249	554649	539400
Iposphomide	-11395	60605	72000
Melphalan	98	98	0
Mesna	8351.55	24751.55	16400
Methotrexate	576.2	451576.2	451000
Mitomycin	1	1	0
Oxaliplatin	2007.7	59507.7	57500
Paclitaxel	4734.5	105184.5	100450
Trastuzumab	0	197824	197824
Vinblastine Sulphate	285.15	645.15	360
Vincristine sulphate	-344.108	107.892	452
Vinorelbine	8	8	0
Total	202005.492	4413866.49	4211861

Table 5: Adjusted total cost saving and total medicine wastage reduction comparing CRU and wards at NHK in 2019

Total cost of medicines reconstituted at CRU (LKR)	193,865,655.00
Total cost of medicines reconstituted at ward (LKR)	267,696,862.60
Total cost saving by CMR (LKR)	73,831,207.61
Adjusted total medicine wastage at CRU (mg)	213,744.60
Adjusted total medicine wastage at ward (mg)	4,353,153.60
Adjusted total medicine wastage reduction by centralised reconstitution (mg)	4,139,409.00