Medication Wastage in a University Hospital in Japan

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Medication wastage is a global issue; however, there are few reports in Japanese hospitals. The purpose of this study was to clarify the situation of medication wastage at our university hospital. We investigated the numbers, costs, reasons, occurrence departments, and involvement of high-priced medications of medication wastage for two years. We analyzed 6730 cases and the total cost was 22782027 Japanese yen (JPY). The most common reasons for medication wastage were change or discontinuation of medication after preparation and breakage or contamination due to dropping. The highest cost was expired medications. The department with the highest number of cases was the hospital wards; however, the hospital pharmacy department accounted for the majority of the costs and most of the reasons were expired medications. Medication wastage of 50000 JPY or more per case was only 1.3% of the total but accounted for 58.6% of the cost. These findings indicate that expired medications in the hospital pharmacy department have the largest impact on medication wastage from the viewpoint of economic loss, and suggest the need for efforts on medication management focusing on high-priced medications. The challenge of minimizing medication wastage should be addressed from the perspectives of both hospital management and the effective use of resources.

Key words medication wastage; expired medication; high-priced medication; hospital pharmacy department

INTRODUCTION

In Japan, national medical expenses are steadily increasing,1) and the annual expenses exceed 43 trillion Japanese yen (JPY).2) Prescription medication costs are estimated to be about 10 trillion JPY.3) In hospitals, medication costs account for a large proportion of the total medical costs, which is a burden on hospital management.4) Furthermore, the price of new medications is rising.5,6) High medical costs have a critical impact on the sustainability of the health insurance system; thus, reducing waste in medical care is essential.

Medication wastage is a global issue.7–16) The definition of medication wastage was given in a report that used the Delphi technique as follows: “Medication wastage refers to any medication which expires or remains unused throughout the whole medicines supply chain. Also refers to the unnecessary or inappropriate consumption of medications by patients, or the unjustified non-adherence to treatment guidelines by healthcare professionals. Medication wastage poses a financial burden on patients themselves and the state’s economy and requires adequate education of all people concerned.”7) In previous studies, the most common reasons for medication wastage were ‘medication changed,’ ‘patient death,’ ‘resolution of patient’s condition,’ and ‘expired medications.’12) However, these reasons were based on self-reports by patients or someone on their behalf and lacked the perspective of healthcare professionals. Moreover, many studies focused on the medications administered to patients, with limited reports of medication wastage situations in hospitals where healthcare professionals manage medications.13–16)

In the present study, we investigated the situation of medication wastage in our university hospital, and analyzed the reasons, numbers, and costs.

MATERIALS AND METHODS

Setting The present study was conducted at the hospital of the University of Occupational and Environmental Health, Japan (Kitakyushu, Japan), which is an advanced treatment hospital with 678 beds. Ethical approval by the Ethics Committee of Medical Research of our university was not applicable because this study did not contain any human subjects.

Data Source As part of routine work in our hospital, information on the medications that could not be used or completely administered (excluding re-dispensable and/or reusable medications) was described by the healthcare professionals in each department on a “Medication Disposal Report,” and these reports were submitted to the hospital pharmacy department. The contents of the “Medication Disposal Report” included the reason for the wastage, the occurrence department, and the type and number of medications. In this study, submitted reports during the period between April 2019 and March 2021 were used for analysis.

Data Analysis The submitted reports for two years were evaluated and aggregated by hospital pharmacists. The occurrence departments of medication wastage were classified into 11 types of hospital wards: intensive care unit, hospital pharmacy department, outpatient department, emergency room,
general perinatal medical center (neonatal intensive care unit, maternal fetal intensive care unit, or growing care unit), endoscopy department, central operation unit, kidney center, outpatient chemotherapy unit, and others. The reasons of medication wastage were classified into nine types of change or discontinuation of medication after preparation: breakage or contamination due to dropping, preparation error, expired medications, damage due to mishandling, lost medications, failure to take medications due to nausea or refusal, discontinuation due to adverse reactions such as allergic reactions, and others. The “Medication Disposal Report” was aggregated for each medication type by the quantity of each report. For example, if one report described that a mixture injection of three medication vials and one infusion solution bottle were wasted, these were each aggregated into one case. The costs of wasted medications were calculated based on the purchase prices at our hospital. The definition of medication wastage of high-priced medications was 50000 JPY or more per case, which is the original setting in our hospital.

The numbers and costs were counted according to the classification of the reasons for medication wastage, and the proportion of each reason to the total medication wastage was calculated. In addition, the numbers and costs were counted according to the classification of the occurrence departments, and the proportion of each department to the total was calculated. The numbers and costs were also counted for medication wastage of 50000 JPY or more per case and that exceeded 100000 JPY or more, and the proportion to the total medication wastage was calculated. Medication wastage of 100000 JPY or more per case was investigated in further detail.

### RESULTS

#### Total Number and Total Cost of Medication Wastage for Two Years

For the two-year period, the total number of medication wastage cases was 6730, and the total cost was 22782027 JPY. The proportion of the total cost of medication wastage to the total purchase amount of medications (10912997463 JPY) was 0.21%.

#### Numbers and Costs of Medication Wastage for Each Reason

The numbers and costs of medication wastage for each reason, and the proportion of each reason to the total are shown in Table 1. The most common reasons of medication wastage were change or discontinuation of medication after preparation and breakage or contamination due to dropping, which together accounted for about two-thirds of the total. On the other hand, the highest cost was expired medications, which accounted for more than half of the total, even though the number was not high at 7.5%.

#### Numbers and Costs of Medication Wastage for Each Occurrence Department

The numbers and costs of medication wastage for each occurrence department, and the proportion of each department to the total medication wastage are shown in Table 2. The department with the highest number of medication wastage was the hospital wards, which accounted for about two-thirds of the total. The department with the highest cost was the hospital pharmacy department, which accounted for more than half of the total, even though the number was not high at 8.1%. The distributions of the numbers and costs based on the reasons in each department are shown in Fig. 1. The most common reason in the hospital pharmacy depart-

| Reason                                                                 | Number | Proportion to the total number | Cost     | Proportion to the total cost |
|------------------------------------------------------------------------|--------|--------------------------------|----------|------------------------------|
| Change or discontinuation of medication after preparation               | 2358   | 35.0%                          | ¥7434761 | 32.6%                        |
| Breakage or contamination due to dropping                              | 1957   | 29.1%                          | ¥623504  | 2.7%                         |
| Preparation error                                                      | 1147   | 17.0%                          | ¥1838420 | 8.1%                         |
| Expired medications                                                    | 502    | 7.5%                           | ¥1151366 | 50.5%                        |
| Damage due to mishandling                                              | 195    | 2.9%                           | ¥206936  | 0.9%                         |
| Lost medications                                                       | 119    | 1.8%                           | ¥25108   | 0.1%                         |
| Failure to take medications due to nausea or refusal                   | 70     | 1.0%                           | ¥15453   | 0.1%                         |
| Discontinuation due to adverse reactions such as allergic reactions     | 88     | 1.3%                           | ¥515797  | 2.3%                         |
| Other                                                                  | 294    | 4.4%                           | ¥606862  | 2.7%                         |
| **Total**                                                              | **6730** |                                | **¥22782027** |                      |

| Department                                      | Number | Proportion to the total number | Cost     | Proportion to the total cost |
|------------------------------------------------|--------|--------------------------------|----------|------------------------------|
| Hospital wards                                  | 4437   | 65.9%                          | ¥6826782 | 30.0%                        |
| Intensive care unit                            | 812    | 12.1%                          | ¥709390  | 3.1%                         |
| Hospital pharmacy department                   | 542    | 8.1%                           | ¥11624834| 51.0%                        |
| Outpatient department                          | 335    | 5.0%                           | ¥1818065 | 8.0%                         |
| Emergency room                                 | 134    | 2.0%                           | ¥194842  | 0.9%                         |
| General perinatal medical center               | 161    | 2.4%                           | ¥38895   | 0.2%                         |
| Endoscopy department                           | 109    | 1.6%                           | ¥30971   | 0.1%                         |
| Central operation unit                         | 72     | 1.1%                           | ¥62013   | 0.3%                         |
| Kidney center                                  | 60     | 0.9%                           | ¥356295  | 1.6%                         |
| Outpatient chemotherapy unit                   | 39     | 0.6%                           | ¥557932  | 2.4%                         |
| Other                                          | 29     | 0.4%                           | ¥562008  | 2.5%                         |
| **Total**                                      | **6730** |                                | **¥22782027** |                          |
ment was expired medication.

**Numbers and Costs of Medication Wastage in High-Priced Medications** The numbers and costs of medication wastage of 50000 JPY or more per case and of 100000 JPY or more per case, and the proportions to the total are shown in Table 3. The number of medication wastage of 50000 JPY or more per case was 1.3% of the total number; however, this accounted for 70.7% of the total cost. Furthermore, the number of medication wastage of 100000 JPY or more per case was 0.7% of the total number, but this accounted for 58.6% of the total cost. There were 48 cases of medication wastage of 100000 JPY or more per case, and the types and numbers of medications, reasons, and occurrence departments are shown in Table 4. The most common category of the wasted high-priced medications was anti-cancer agents such as immune checkpoint inhibitors, anti-vascular endothelial growth factor antibodies, and anti-epidermal growth factor receptor monoclonal antibodies.

**DISCUSSION**

The purpose of this study was to clarify the situation of medication wastage in our hospital. Our results showed that the total number was 6730 cases and the total cost was 22782027 JPY for two years. The most common reasons for medication wastage were change or discontinuation of medication after preparation and breakage or contamination due to dropping; however, in terms of costs, expired medications were the most important. The department with the highest number of cases was the hospital wards; however, in terms of costs, the hospital pharmacy department accounted for the majority and the most common reason was expired medications.

Thus far, only one report had been found on medication wastage in Japanese hospitals. Honda et al.\(^{13}\) reported that the numbers and costs of medication wastage in their national hospital with 574 beds were 193 to 288 cases and 114203 to 225418 JPY per year, respectively (period between 2002
| Medication name                              | Medication category | Number of waste | Reason                                      | Occurrence department |
|---------------------------------------------|--------------------|-----------------|---------------------------------------------|-----------------------|
| Ipitinumab injection                        | Anti-cancer agent (ICI) | 4V              | Change or discontinuation of medication after preparation | Hospital wards        |
| Freeze-dried activated human blood coagulation factor VII concentrate containing factor X | Anti-hemophilic agent | 3V              | Expired medication                          | Hospital pharmacy     |
| Thiopeta injection                          | Anti-cancer agent (alkylating agent) | 4V          | Expired medication                          | Hospital pharmacy     |
| Agalsidase beta injection                   | Fabry disease treatment agent | 1V            | Expired medication                          | Hospital pharmacy     |
| Abacavir/lamivudine combination tablet      | Anti-HIV agent      | 171T            | Expired medication                          | Hospital pharmacy     |
| Avelumab injection                          | Anti-cancer agent (ICI) | 3V              | Change or discontinuation of medication after preparation | Hospital wards        |
| Freeze-dried live attenuated measles and rubella combined vaccine | Anti-cancer agent (proteasome inhibitor) | 3C            | Expired medication                          | Hospital pharmacy     |
| Ixazomib capsule                            | Anti-cancer agent (proteasome inhibitor) | 3V            | Expired medication                          | Hospital pharmacy     |
| Nivolumab injection                         | Anti-cancer agent (ICI) | 1V              | Change or discontinuation of medication after preparation | Outpatient chemotherapy unit |
| Ceritinib capsule                           | Anti-cancer agent (ALK inhibitor) | 58C            | Expired medication                          | Hospital pharmacy     |
| Pembrolizumab injection                     | Anti-cancer agent (ICI) | 1V              | Preparation error                           | Hospital pharmacy     |
| Anti-inhibitor coagulant complex injection  | Anti-hemophilic agent | 2V              | Preparation error                           | Kidney center         |
| Lenvatinib capsule                          | Anti-cancer agent (multi-tyrosine kinase inhibitor) | 37C       | Expired medication                          | Hospital pharmacy     |
| Abacavir/lamivudine combination tablet      | Anti-HIV agent      | 90T             | Expired medication                          | Hospital pharmacy     |
| Freeze-dried activated human blood coagulation factor VII concentrate containing factor X | Anti-hemophilic agent | 1V            | Expired medication                          | Hospital pharmacy     |
| Bevacizumab injection                       | Anti-cancer agent (anti-VEGF antibody) | 2V            | Discontinuation due to adverse reactions (allergic reactions) | Hospital wards        |
| Trametinib tablet                           | Anti-cancer agent (MEK inhibitor) | 8T            | Expired medication                          | Hospital pharmacy     |
| Panitumumab injection                       | Anti-cancer agent (anti-EGFR monoclonal antibody) | 3V          | Change or discontinuation of medication after preparation | Outpatient department |
| Panitumumab injection                       | Anti-cancer agent (anti-EGFR monoclonal antibody) | 3V          | Change or discontinuation of medication after preparation | Outpatient department |
| Panitumumab injection                       | Anti-cancer agent (anti-EGFR monoclonal antibody) | 3V          | Change or discontinuation of medication after preparation | Hospital wards        |
| Ruxitumab injection                         | Anti-hemophilic agent | 3V              | Expired medication                          | Hospital pharmacy     |
| Bevacizumab injection                       | Selective immunosuppressant | 5V            | Change or discontinuation of medication after preparation | Hospital wards        |
| Ruxitumab injection                         | Anti-hemophilic agent | 1K              | Change or discontinuation of medication after preparation | Outpatient department |
| Panitumumab injection                       | Anti-thrombotic agent (AT III) | 9V            | Expired medication                          | Hospital pharmacy     |
| Eribulin injection                          | Anti-cancer agent (anti-tubulin cytotoxic agent) | 3V          | Change or discontinuation of medication after preparation | Hospital wards        |
| Dexamethasone injection                     | Detoxifying agent for anti-neoplastic treatment | 4V            | Expired medication                          | Hospital pharmacy     |
| Pomalidomide capsule                        | Anti-cancer agent (immunomodulatory agent) | 3C            | Expired medication                          | Hospital pharmacy     |
| Cetuximab injection                         | Anti-cancer agent (anti-EGFR monoclonal antibody) | 5V            | Change or discontinuation of medication after preparation | Hospital wards        |
| Alemtapine injection                        | Anti-thrombotic agent (t-PA) | 1V            | Change or discontinuation of medication after preparation | Emergency room        |
| Crizotinib capsule                          | Anti-cancer agent (ALK inhibitor) | 14C           | Expired medication                          | Hospital pharmacy     |
| Eltrombopag/hydroxychloroquine combination tablet | Anti-HIV agent | 25T            | Expired medication                          | Hospital pharmacy     |
| Voriconazole dry syrup                      | Anti-yeast agent | 2V              | Expired medication                          | Hospital pharmacy     |
| Amsacalcidol tablet                         | Anti-cancer agent (CDK 4/6 inhibitor) | 48T           | Expired medication                          | Hospital pharmacy     |
| Bevacizumab injection                       | Anti-cancer agent (anti-VEGF antibody) | 1V            | Change or discontinuation of medication after preparation | Outpatient department |
| Trametinib tablet                           | Anti-cancer agent (MEK inhibitor) | 19T           | Expired medication                          | Hospital pharmacy     |
| Nivolumab injection                         | Anti-cancer agent (ICI) | 4V              | Change or discontinuation of medication after preparation | Hospital wards        |
| Emtricitabine/tenofovir combination tablet  | Anti-HIV agent      | 53T             | Expired medication                          | Hospital pharmacy     |
| Rituximab injection                         | Anti-cancer agent (anti-CD20 monoclonal antibody) | 1V            | Change or discontinuation of medication after preparation | Hospital wards        |
| Aflibercept intravitreal injection          | Anti-neovascularisation agent (anti-VEGF antibody) | 1V            | Change or discontinuation of medication after preparation | Outpatient department |
| Rituximab injection                         | Anti-cancer agent (anti-CD20 monoclonal antibody) | 1V            | Change or discontinuation of medication after preparation | Hospital wards        |
| Lorlatinib tablet                           | Anti-cancer agent (ALK inhibitor) | 5T            | Expired medication                          | Hospital pharmacy     |
| Aflibercept intravitreal injection          | Anti-neovascularisation agent (anti-VEGF antibody) | 1V            | Breakage or contamination due to dropping | Outpatient department |
| Eribulin injection                          | Anti-cancer agent (anti-tubulin cytotoxic agent) | 2V            | Breakage or contamination due to dropping | Outpatient department |
| Rabbit anti-human thymocyte immunoglobulin | Selective immunosuppressant | 3V            | Discontinuation due to adverse reactions (allergic reactions) | Hospital wards        |
| Bevacizumab injection                       | Anti-cancer agent (anti-VEGF antibody) | 3V            | Change or discontinuation of medication after preparation | Outpatient department |
| Methylthioninium injection                  | Methemoglobinemia treatment agent | 1A            | Expired medication                          | Hospital pharmacy     |

**Abbreviations:** V, vial(s); T, table(s); C, capsule(s); S, syringe(s); K, kit(s); A, ampoule(s); ICI, immune checkpoint inhibitor; HIV, human immunodeficiency virus; mTOR, mammalian target of rapamycin; ALK, anaplastic lymphoma kinase; VEGF, vascular endothelial growth factor; MEK, mitogen-activated protein kinase kinase; EGFR, epidermal growth factor receptor; AT, antithrombin; t-PA, tissue plasminogen activator; CDK, cyclin-dependent kinase.
and 2004). They also reported that 58.1% were in hospital wards and 41.5% were in the hospital pharmacy department. However, their report did not include reasons such as expired medications and did not classify the costs into the occurrence departments. A comparison of their report with the present study shows a large difference in the numbers and costs of medication wastage. At our hospital, the submission of the “Medication Disposal Report” was thoroughly carried out by healthcare professionals in each department, our hospital provides advanced treatment as a university hospital, and our investigations were conducted during the recent period when high-priced medications were widely used. These factors may explain the high number and cost of medication wastage in our study.

Studies of medication wastage from hospitals in other countries were reported in Saudi Arabia and Ethiopia. Al-Dhawaiilie reported the types and reasons of wasted intravenous medication at a university hospital in Saudi Arabia; Alsamanhodi et al. reported the types, reasons, and costs of wasted intravenous medication at a tertiary care hospital in Saudi Arabia; and Ebrahim et al. reported the types and costs of wasted medication, including oral, at primary and general hospitals in Ethiopia. Despite these studies being conducted in different settings and methods, the most wasted medication type in all these studies was anti-microbial agents. On the other hand, the most important type of wasted medication indicated in our study was anti-cancer agents. Thus, it is difficult to compare these reports with our results due to the different systems and qualities of medical care in different countries.

Our study found that expired medications was the most serious concern for medication wastage. The main measure to minimize expired medications is to optimize ordering and inventory at the hospital pharmacy department. In particular, high-priced medications account for the majority of the medication wastage costs and should be carefully managed by hospital pharmacists and other healthcare professionals. It will be necessary to establish an innovative management system for medications in the future. Another major concern was the medication wastage due to change or discontinuation of medication after preparation. In order to minimize this medication wastage, physicians and hospital pharmacists should carefully ensure that the medications are suitable for administration to the patient before preparation, especially high-priced medications such as anti-cancer agents.

Our study had some limitations. First, this study was conducted in a single center; therefore, our results may not be transferable to other hospitals in Japan. Second, this study did not investigate the process leading up to medication wastage; thus, in the case of expired medications, it was unclear which process had the larger impact. Third, the impact of medication wastage on comprehensive hospital management, such as profit margins, could not be evaluated. Fourth, specific plans to minimize medication wastage were not examined in this study. Further research is needed to establish an effective strategy.

In conclusion, our study indicated the high number and cost of medication wastage at our hospital. The most important reason for medication wastage was expired medications, suggesting the need for efforts on medication management focusing on high-priced medications by the hospital pharmacy department. The challenge of minimizing medication wastage should be addressed from the perspectives of both hospital management and the effective use of resources.

Conflict of Interest The authors declare no conflict of interest.

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