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# Investigating the sterile surgical supply waste in laparotomy surgery

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## Abstract

**Background** Operating rooms contribute to over 40% of hospital expenses, with a portion attributed to waste from single-use, sterile surgical supplies (SUSSS). This research aimed to determine the amount of cost wastage due to not using SUSSS during laparotomy procedures.

**Methods** A descriptive-analytical investigation was conducted in two prominent teaching hospitals in Mashhad, Iran 2018. Seventy-seven laparotomy surgeries were scrutinized, documenting both used and unused disposable devices, with their respective costs being assessed. Data analysis was performed using SPSS version 16 software.

**Results** The study revealed that during surgery in the operating rooms, waste of SUSSS averaged 5.9%. Betadine solution and sterile Gauze types were the top two contributors to resource wastage. Sterile Gauze types incurred the highest cost loss. The study found a significant correlation between cost wastage and surgeon experience ( $r=0.296$ ,  $P<0.001$ ) as well as surgery duration ( $r=0.439$ ,  $P<0.001$ ).

**Conclusion** Inadequate management of available and commonly used disposable supplies leads to increased hospital expenses. Enhancing the surgical team's knowledge of sterile surgical supplies usage and making thoughtful selections can play a vital role in curbing health costs by minimizing waste of SUSSS in the operating rooms.

**Keywords** Cost saving, Hospital Supply, Operating room, Laparotomy

## Introduction

In 2018, health costs accounted for over 9.6% of the global economy, reflecting an increasing share of health in Gross Domestic Product (GDP) across all countries [1]. The health sector's economic share varies by country. Among the world's countries, the United States allocates the highest percentage of its GDP to healthcare, approximately 18% [2]. Iran allocates around 6.7% of its GDP to health [3]. Over 12 years, Iran has witnessed a fourteen-time increase in per capita healthcare expenditures [4]. Hospitals stand out as the largest and costliest components within the healthcare system [5], significantly contributing to overall healthcare expenses, with operating rooms playing a pivotal role in this regard [6, 7]. The operating room is a major cost and revenue center for the hospital, representing at least 40% of its expenses

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[8]. Evidence indicates that a significant portion of operating room expenses is attributed to the unnecessary wastage of resources, particularly disposable items [7, 9, 10]. A significant cause of resource wastage in the operating room is single-use sterile surgical supplies (SUSSS), including personal protective equipment, sutures, and disposable instruments. These items are opened before and during surgery and placed on the sterile scrub table. Once opened, disposable sterile instruments cannot be reused and are discarded, even if unused [11]. While the advantages of using disposable supplies are well-known, the substantial expenses incurred from their indiscriminate use in operating rooms are evident [12, 13]. Studies indicate significant wastage of consumables in operating rooms. A multicenter survey estimated that 26% of SUSSS opened during surgery went unused [14]. Zygourakis et al. (2017) found that cost waste of unused consumables in neurosurgery averaged \$653, constituting 13.1% of total surgical costs [15]. Rose et al. reported that opened but unused supplies in general surgery cost \$4,528.18, with costs and waste increasing for more complex procedures [8].

Given that SUSSS comprises a substantial portion of operating room expenses [15], reducing their waste saves costs and conserves resources [9, 13, 16]. This requires identifying unused SUSSS that are not used and discarded at the end of surgeries. In Iran, the increasing use of single-use consumables in operating rooms highlights the importance of assessing the types and amounts of waste generated, along with the associated cost losses, to aid in effective planning and cost reduction. Thus, this study aimed to quantify the cost wastage from unused SUSSS during laparotomy surgeries at two major government teaching hospitals in Mashhad, northeast Iran.

## Methods

This descriptive-analytical study was conducted in 2018 at two large government teaching hospitals affiliated with Mashhad University of Medical Sciences: Imam Reza Hospital (918 beds) and Ghaem Hospital (924 beds) in Northeast Iran. Imam Reza Hospital has 18 equipped surgical beds, while Ghaem Hospital has 11, with both performing the majority of laparotomy surgeries in the

region. The study focused on laparotomy surgeries conducted at these hospitals, selecting two surgeries randomly from the daily list through a lottery method. It was confirmed by the Ethics Council of Mashhad University of Medical Sciences (ethics code: IR.MUMS.NURSE.REC. 1397.080). Following the guidelines outlined in Zygourakis et al.'s study [15], the study's minimum sample size was set at 73 surgeries.

$$n = \frac{z^2 p(1-p)}{d^2} = \frac{1.96^2 \times .95 \times .05}{0.05^2} = 73$$

For every surgery, patient demographic data, surgery type, and duration (in minutes) were gathered. During the procedure, both used and unused SUSSS were noted. Unused SUSSS were those opened but not utilized by the surgical team, requiring disposal as they couldn't be resterilized. Two surgical technologist observed and recorded the disposable sterile surgical instruments opened during laparotomy surgery, assessing their use until the end of the surgery based on a checklist. The sampling period lasted 12 weeks.

The checklist included all disposable sterile devices opened by the circulator and scrub nurses. Its content validity was confirmed by eight individuals, including research team members, faculty, and experienced operating room staff. The inter-rater reliability coefficient for recording consumables was 0.96. Cost analysis was done based on three steps of identifying, Measuring and valuing unused SUSSS. In the identification phase, unused and non-reusable disposable supplies were determined for each laparotomy surgery. After identifying and measuring the number unused SUSSS, its costs was valued and calculated according to the cost purchased by hospital supplies. Finally, the total waste cost was calculated for each laparotomy surgery separately. Data analysis utilized descriptive statistics (frequency, mean, standard deviation) and inferential tests (Pearson's correlation coefficient, one-way ANOVA) with SPSS version 16 software.

## Results

In this study, 77 surgeries were examined. The mean and standard deviation of surgery duration were  $147.40 \pm 54.53$  min, with the shortest being 45 min and the longest 260 min. Surgeon experience averaged  $12.11 \pm 7.86$  years, ranging from 2 to 27 years.

Tables 1 and 2 display patient demographics and type of laparotomy procedures. Patients undergoing laparotomy had an average age of  $47.31 \pm 14.3$ , with hydatid cysts being the most common surgery (11.7% frequency).

Table 3 presents the inventory of opened SUSSS in laparotomy procedures throughout the research. This table details the quantity, price, and cost of disposable

**Table 1** Demographic frequency of patients who underwent laparotomy in the study

variable		Frequency (Percent)
Age (years)	20–39	28 (36.3)
	40–59	33 (42.9)
	> 60	16 (20.8)
Gender	Male	54 (70.1)
	Female	23 (29.9)
Marital status	Single	15 (19.5)
	Married	62 (80.5)

**Table 2** Frequency of patients undergoing laparotomy according to the type of laparotomy

Surgery Type	Frequency (Percent)
Hydatid Cyst	9 (11.7)
Inguinal Hernia	8 (10.4)
Colon Cancer	7 (9)
Liver Tumor	6 (7.8)
Cardiac Cancer	6 (7.8)
Exploratory Laparotomy	6 (7.8)
Stomach Cancer	5 (6.5)
Abdominal Abscess	4 (5.2)
Sigmoidectomy	3 (3.9)
Colon Polyps	3 (3.9)
Others	20 (26)

supplies, alongside the amount of wastage and the percentage of cost wastage of unused opened SUSSS during surgery. As per the findings, the top 10 most wasted supplies consist of betadine solution (13.85%), sterile Gauze types (10.39%), Nelaton catheters (8.1%), syringes (8.1%), serum set (7.69%), peripheral venous catheter (7.69%), disposable gloves (6.89%), sterile gloves (6.43%), scalpel (6.32%), and non-absorbable Suture (5.54%). The mean cost wastage of disposable supplies were 5.9% during laparotomy surgery, with the highest cost wastage linked to sterile Gauze (28.25%), sterile gloves (13.9%), and non-absorbable sutures (13.2%), betadine solution (12.5%), and disposable gun (6.77%). These items accounted for roughly 75% of the cost wastage of SUSSS during surgical procedures.

Pearson's correlation coefficient indicated a significant relationship between the amount of cost wastage during surgery and the surgeon's experience ( $r=-0.296, P<0.001$ ) and surgery duration ( $r=0.439, P<0.001$ ). The analysis of variance did not reveal a significant difference in average cost wastage based on the type of laparotomy surgery ( $F=1.77, P=0.053$ ).

**Discussion**

The research focused on the cost wastage resulting from unused disposable supplies in laparotomy surgeries. The study revealed a 5.9% wastage rate due to unused SUSSS during 77 laparotomy surgeries. Prior studies have presented varied findings on consumable wastage in operating rooms. The results of the Meyer et al. study (2022) identified a 26% wastage rate for unused disposable sterile instruments in surgeries [14]. Zygourakis et al. (2017) found that the average cost of unused consumables in 58 neurosurgical procedures was \$653, accounting for 13.1% of the total surgical consumables cost [15]. Likewise, de Castro (2013) documented a 9.34% wastage rate across 105 consumable items in 275 general surgeries [17]. The lower wastage rate in this study implies effective consumable resource utilization in the examined settings. However, challenges like equipment supply constraints and hospital economic sanctions could potentially reduce resource wastage, highlighting the necessity to enhance resource efficiency. The hospital's financial constraints hindered the purchase of expensive disposable equipment, raising concerns among the operating room staff.

**Table 3** The type and number of consumables supplies, the amount of wastage, and the percentage of cost wastage during laparotomy surgery

Consumables	Opened Consumables	Unused, opened consumables	Price of a unit (Rials*)	Total consumption cost (Rials*)	waste of money (Rials*)	waste (Percent)	Waste of cost (percent)
Betadine (Green And Scrub) (Liter)	13.86	1.92	400,000	5,544,000	768,000	13.85	12.5
Sterile Gauze (Number)	3579	372	4673	16,724,667	1,738,356	10.39	28.25
Types Of Syringes (Number)	37	3	13,440	497,280	40,320	8.1	0.66
Nelaton (Number)	37	3	12,000	444,000	36,000	8.1	0.59
Serum Set (Number)	13	1	12,000	156,000	12,000	7.69	0.20
IV Line (Number)	13	1	11,000	143,000	11,000	7.69	0.18
Sterile disposable Drapes (Quantity)	29	2	38,000	1,102,000	76,000	6.89	1.24
Sterile Gloves (Quantity)	482	31	27,500	13,255,000	852,500	6.43	13.90
Scalpel Blade (Number)	174	11	4500	783,000	49,500	6.32	0.80
Non-Absorbable Suture (Number)	361	20	40,550	14,638,550	811,000	5.54	13.20
Suction Tube (Number)	84	4	50,000	4,200,000	200,000	4.76	3.26
Hemovac Drain (Number)	65	3	134,000	8,710,000	402,000	4.61	6.55
Disposable Gun (Number)	202	8	52,000	10,504,000	416,000	3.96	6.77
Absorbable Suture (Number)	125	4	64,684	8,085,500	258,736	3.2	4.21
Washing Serum (Liter)	45.95	1.45	50,000	2,297,500	72,500	3.15	1.18
Cauter Pencil (Number)	85	2	200,000	17,000,000	400,000	2.35	6.51
Total				104,084,497	6,143,912		100
Average Overall Cost Loss (Percentage)							5.9 (percent)

\* In 2018, one dollar was worth 130,000 Rials on average

Considering the benefits of using disposable supplies in the operating room, reducing the wastage of disposable devices and enhancing the efficiency of surgical units has become crucial. Preventing the unnecessary opening of supplies can help minimize waste and conserve resources in operating rooms [18]. Exploring effective strategies has been a focus of various studies. Making changes in operating room practices can lead to reduced hospital expenses [14]. Training and feedback can encourage proper resource utilization by the surgical team [19]. Revealing surgery costs to medical professionals could aid in controlling operating room expenses [20–23]. Educational interventions have successfully lowered the waste and costs of various items in the operating rooms [19]. Establishing a committee to investigate resource utilization in the ENT operating rooms has proven effective [24]. Additionally, using reusable devices in surgical settings has been suggested to decrease resource wastage [24–26]. The results of the present study showed that the majority of cost wastage was linked to low-cost equipment such as betadine solution, sterile gauze, sterile gloves, non-absorbable sutures, Hemovac drains, and disposable gauze. This aligns with other studies that also report low-cost supplies, like gauze, gloves, and sutures, as significant contributors to cost wastage [15, 17, 27]. Heydari et al. noted that in hospital departments, low-priced equipment that were overstocked were often mismanaged, leading to increased wastage [27]. Price and inventory levels influence supply, demand and resource utilization. This pattern is evident in societal consumption habits, where the highest proportion of wastage occurs with low-cost, high-inventory items [28]. Using low-priced consumables in large volumes can significantly impact the hospital's budget, contributing to high waste costs. Offering items like betadine, bandages, and sterile gauze in smaller packages can help reduce consumption and save cost.

Another finding of the current study was the direct and significant correlation between the cost wastage during surgery and the surgeon's experience level. Surgeons with less experience may have a limited understanding of consumables costs, leading to more device openings [14]. Deshpande et al. (2021) revealed that surgeons familiar with scrubs had reduced wastage in the operating room [29], while Zygourakis et al. (2017) did not find a significant link between cost wastage and neurosurgeons' experience, possibly due to variations in surgeries [15].

The current study also identified a notable association between surgery duration and cost wastage, indicating that longer surgeries resulted in increased consumable wastage and related costs. Jabbar et al. (2021) corroborated these results, highlighting the strong connection between surgery duration and consumable wastage [9].

One of the main limitations of the present study was the small sample size, requiring careful interpretation of statistical results. Due to the lack of electronic registration for unused consumables supplies during surgery, direct observation and checklist completion by two individuals were necessary. Increasing sampling would escalate manpower costs and data collection time. Additionally, the study solely focused on cost wastage from the unused disposable supplies in laparotomy surgeries, not reflecting wastage in all surgical procedures. Future research should explore cost wastage in other surgeries like neurosurgery or orthopedic surgeries.

## Conclusion

This study was the initial report on the cost wastage from unused SUSSS in laparotomy surgery at Mashhad University of Medical Sciences. Findings revealed financial loss in the operating room due to unused opened disposable supplies, albeit it is lower than previously reported in other studies. To reduce this cost waste, exploring effective strategies and altering current operating room practices to minimize hospital financial resource wastage is recommended.

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## Author contributions

M. B., S. M., M. A., R. S, M. P., and Z. E, contributed to editing this manuscript and endorsed the final version for publication. They devised and organized the study M. B, M. P, M. A., and identified and enrolled potential participants. M. B., M. A., and R. S significantly contributed to the conceptualization, data acquisition, analysis, and interpretation. M. B., M. P., and M. A. played important roles in the conceptualization and design. All authors participated in drafting or revising the manuscript critically, ensuring its intellectual integrity. They all reviewed and approved the final version.

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## Data availability

No datasets were generated or analysed during the current study.

## Declarations

### Ethics approval and consent to participate

Written informed consent was obtained from each participant. This study has been approved by the Ethics Committee of the Mashhad University of Medical Sciences, Mashhad, Iran (code number: IR.MUMS.REC. 1397.080). All methods were carried out following relevant guidelines and regulations in the Declaration of Helsinki. The researcher invited eligible and willing individuals to participate in the study after obtaining written and informed consent from all subjects and/or their legal guardian(s).

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

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