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Impact of healthcare waste management training intervention on the knowledge and practices of healthcare professionals: a quasi-experimental study in a Surgical University Hospital in Southern Tunisia

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ABSTRACT

Introduction. Healthcare professionals (HCPs) play a crucial role in healthcare waste management (HWM). Insufficient knowledge and inadequate management practices are the most important issues in the HWM process.
The purpose of the study — the objective was to assess an educational program's impact on HCP's knowledge and practices regarding HWM.
Materials and Methods. This quasi-experimental study consisted of a pretest evaluation, an intervention, and a post-test re-evaluation conducted in Habib Bourguiba University Hospital during the period of January 2nd to April 30th, 2022.
Results. Overall, 134 HCPs provided complete responses. The median age was 40 years (Interquartile range = [32.00–48.75] years) and the sex ratio was 0.44. We found a significant rise in the knowledge score (KS) of participants regarding global HWM knowledge (86.8 ± 6.7 vs 58.5 ± 6.8; $p < 0.001$) and also in the KS for each waste category: non-infectious waste (89.6 ± 8.7 vs 68.9 ± 15.4; $p = 0.005$), infectious waste (90.7 ± 4.2 vs 74.3 ± 9.7; $p = 0.001$), sharps (89 ± 7,3 vs 72.9 ± 7.0; $p < 0.001$) and cytotoxic waste (80.0 ± 21.7 vs 17.2 ± 5.7; $p < 0.001$). We noted a significant rise in PS of participants regarding global HWM practices (93 ± 6 vs 73 ± 10; $p < 0.001$) and also for each item: availability of equipment in the medical treatment cart (100 ± 1 vs 71 ± 23; $p < 0.001$), healthcare waste segregation (78 ± 20 vs 54 ± 27; $p = 0.002$), information and training about HWM (100 ± 10 vs 71 ± 46; $p = 0.003$), and healthcare waste disposal (91 ± 14 vs 45 ± 34; $p = 0.001$). The KS change was significantly more important for HCPs who had no previous training in HWM during the last 3 years than other HCPs with previous training (29.8 vs 25; $p = 0.042$).
Research limitations. It was a single-center study that could impact the generalization of the results on a national scale. Secondly, as previously noted, the participation rate was low but this fact was not an obstacle to having a positive impact on HCP's knowledge and practices in the whole hospital.
Conclusions. HWM training sessions are a promising and effective intervention to improve knowledge and practices of HCPs. It should not be a one-time activity but it should be a continuous and regular process to ensure a safe care environment and deliver quality care.

Keywords: *knowledge; healthcare professionals; healthcare waste management; impact; practices; training session*

Compliance with ethical standards. The study does not require submission of the opinion of the biomedical ethics committee or other documents.

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Health care organization

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Влияние обучения обращению с медицинскими отходами на знания и практику медицинских работников: квазиэкспериментальное исследование в хирургической университетской больнице на юге Туниса

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РЕЗЮМЕ

Введение. Медицинские работники (МР) играют важную роль в обращении с медицинскими отходами (МО). Недостаточные знания и неадекватные методы контроля являются наиболее важными проблемами в обращении с МО.

Цель исследования — оценить влияние образовательной программы на знания и методы обращения с МО у МР.

Материалы и методы. Данное квазиэкспериментальное исследование состояло из предварительной оценки, проведения образовательной программы и повторной оценки с тестированием в Университетской больнице Хабиба Бургибы в период с 2 января по 30 апреля 2022 г.

Результаты. Все 134 МР предоставили полные ответы. Средний возраст МР составил 40 лет (межквартильный размах 32,00–48,75 года), соотношение полов составило 0,44. Мы обнаружили значительный рост оценки компетенций (ОК) участников относительно глобальных знаний об обращении с МО (86,8 ± 6,7 против 58,5 ± 6,8; $p < 0,001$), а также оценки знаний для каждой категории отходов: неинфекционные отходы (89,6 ± 8,7 против 68,9 ± 15,4; $p = 0,005$), инфекционные отходы (90,7 ± 4,2 против 74,3 ± 9,7; $p = 0,001$), острые предметы (89 ± 7,3 против 72,9 ± 7; $p < 0,001$) и цитотоксические отходы (80 ± 21,7 против 17,2 ± 5,7; $p < 0,001$). Мы отметили значительный рост оценки реализации (ОР) у участников по сравнению с общими практиками обращения с МО (93 ± 6 против 73 ± 10; $p < 0,001$), а также по каждому пункту: наличие медицинских тележек в оснащении отделений (100 ± 1 против 71 ± 23; $p < 0,001$), сортировка медицинских отходов (78 ± 20 против 54 ± 27; $p = 0,002$), информация и обучение по обращению с МО (100 ± 10 против 71 ± 46; $p = 0,003$) и утилизация медицинских отходов (91 ± 14 против 45 ± 34; $p = 0,001$). Для МР, не прошедших предварительное обучение по обращению с МО в течение последних 3 лет, изменение оценки знаний было значительно более существенным по обращению с МО, чем для других МР, прошедших ранее обучение (29,8 против 25; $p = 0,042$).

Ограничения исследования. Исследование было одноцентровым, что могло повлиять на обобщение результатов в национальном масштабе. Во-вторых, уровень участия был низким, но этот факт не стал препятствием для оказания положительного влияния на знания и практику МР во всей больнице.

Выводы. Учебные курсы по обращению с МО являются многообещающим и эффективным мероприятием для улучшения знаний и практики у МР. Это не должно быть разовым мероприятием, а должно стать непрерывным и регулярным процессом для обеспечения безопасной среды ухода и предоставления качественной помощи.

Ключевые слова: *знания; специалисты здравоохранения; управление отходами здравоохранения; влияние; практики; учебный курс*

Соблюдение этических стандартов. Исследование не требует предоставления мнения комитета по биомедицинской этике или других документов.

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Introduction

Across the world, fighting healthcare-associated infections (HAI) and ensuring a secure healthcare environment for patients is still the major objective of hospital institutions [1]. HAI are responsible for an important growth in morbidity and mortality rates and high costs for hospitals worldwide notably in developing countries [2]. Despite their gravity, the main part of HAI is preventable, especially by respecting simple standard healthcare precautions [3]. Healthcare waste management (HWM) is one of those pillars of the HAI prevention strategy. Poor HWM could expose health care professionals (HCPs), waste handlers, patients, and even the community to infections, injuries, and toxic pollutants [4]. Not only could humans be affected by inadequate waste management, but the entire environment could be polluted [5]. Healthcare waste was generated continuously during the process of medical care. Healthcare waste is widely considered a growing and continuous concern for health authorities. Moreover, it was named the second most hazardous waste globally after radiation waste [6].

Recently, and particularly during the global COVID-19 pandemic, thousands of tons of additional medical waste were generated, according to a new WHO report [7]. This rise could be linked to the increasing use of disposable devices in healthcare facilities and also the use of disposable personal protective equipment such as masks, coveralls and gloves. The increase in the number of patients and hospitalizations for COVID-19 could also play a role in the increase in the amount of waste generated [8]. All this information lets us think about the importance of having a correct HWM strategy in healthcare settings which become an urgent need.

HCPs play a crucial role in HWM. In fact, HCPs are responsible for the initial segregation and storage activities which represent the main step to have a correct HWM. However, insufficient knowledge and inadequate management practices among the HCPs are the most important issues in the HWM process. Indeed, if the infectious component were not separated from the non-infected waste, the entire mass become considered potentially infectious [9]. For this reason, HCPs should be trained continuously to refresh and update their knowledge of waste segregation and disposal of healthcare waste. In fact, previous research indicated that the lack of HWM-related training could affect HCPs' knowledge and practices on HWM and, therefore, may negatively impact HWM in hospitals [10]. This lack of knowledge about HWM is particularly more noted in developing countries where the consciousness about the necessity of adequate HWM to prevent HAI is still deprived [11]. In Tunisia, a waste management unit must imperatively be created in each health establishment with staff training on the HWM according to the decree of application No. 2008-2745 of July 28, 2008 [12].

From this perspective, the **objective** of this study was to evaluate the impact of the implementation of a healthcare waste management training intervention on the knowledge and practices of HCPs in a Tunisian surgical university hospital.

Materials and Methods

Study Design and Settings. This was a quasi-experimental study consisting of a pretest evaluation, an intervention, and a post-test re-evaluation during the period of January, 2nd to April, 30th, 2022. We conducted this study in the Habib Bourguiba University Hospital (HBUH), which is the Surgical University Hospital of Sfax in Southern Tunisia. We conducted the survey in this hospital because of its particularity as one of the principal surgical hospitals in the country. In the HBUH, patients from Sfax and also from all over the south of the country are operated. Moreover, it is an establishment comprising an emergency service, intensive care units, and analysis laboratories. The governorate of Sfax, the capital of southern Tunisia, is Tunisia's second most important economic city. It is situated in the southeast of the country and covers 4.6% of the country area and has nearly 1,013,021 inhabitants [13, 14].

Study Population. All professional categories of HCPs in HBUH were eligible for this survey. Knowledge concerning HWM was assessed among medical, paramedical, administrative, and even worker staff. Excluded cases were those who gave incomplete responses. To obtain a representative sample participants were selected proportionally to the number of HCPs in each department.

The minimum sample size was calculated based on an expected good knowledge prevalence published previously of 9,5% [15], a 5% margin of error, and 10% loss or incomplete responses. The minimum required sample size was at least 132 cases.

Knowledge assessment. After reviewing the appropriate literature, a self-administered questionnaire was developed as a knowledge assessment instrument and used in a pilot study to test its clarity and relevance.

The questionnaire contained two parts. The first part included participants' age, gender, affiliated department, working seniority and occupation. The second part was divided into four sections according to the type of waste: non-infectious waste (2 items), infectious waste (12 items), sharps (4 items) and cytotoxic waste (3 items). There were four choices for each item with only one correct answer. The questionnaire was distributed to the participants and it was used for data collection before and after the training session.

Each correct item regarding HCPs' knowledge of HWM was scored "1" or "0" if it was not.

The average knowledge score (KS) was calculated for each section by adding the corresponding items. Then, we adjusted out of 100 the KS for each section and the global average KS.

According to the evaluation criteria of M.J. Essi et al. [16], HCPs were classified to have bad (KS < 25), insufficient (KS [25–49]), mean (KS = 50–75), or good knowledge (KS ≥ 75) about HWM.

Practices assessment. We used an audit grid developed to assess the current HWM practices of HCPs at each department of HBUH. A baseline was conducted one month before the intervention. The follow-up was done two months after the educational intervention program.

This audit grid was composed of 15 items distributed in four sections: availability of equipment in the medical treatment cart (4 items), healthcare waste segregation (3 items), displayed HWM procedure and disposal program (2 items), and healthcare waste disposal (5 items).

To calculate the practice score (PS), each item compliant with the guidelines was scored 1 and each non-compliant item was scored 0. The average PS was calculated for each section by adding the corresponding items. Then, we adjusted out of 100 the PS for each section and the global average PS ranging from 0 to 15 points.

According to the evaluation criteria of M.J. Essi et al. [16], HCPs were classified to have harmful (PS < 25), inadequate (PS = 25–49), and adequate practices (PS ≥ 50).

Intervention procedure. We informed all HCPs about the training session, 2 weeks before the start of the study.

According to the number of HCPs, training sessions were delivered at the rate of one, two, and even three sessions per department.

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Table 1. Description of the study population
Таблица 1. Характеристика обследованных

Variables | Характеристики	Abs. | Абс.	%
Gender: | Пол:		
females | женщины	93	69.2
males | мужчины	41	30.8
Occupation department: | Отделение:		
medical | терапевтическое	23	17.7
surgical | хирургическое	101	75.1
intensive care units | интенсивной терапии	10	7.2
Working seniority (years): Рабочий стаж (лет):		
< 10	62	46.4
≥10	72	53.6
Occupation: | Должность:		
nurses | медсёстры	85	63.6
workers | работники	21	16.2
physicians | врачи	5	4.4
administrative | администраторы	16	12.1
others categories | другие	7	3.7
Previous training in healthcare waste management during the last 3 years Предшествующее обучение по обращению с медицинскими отходами	24	19

During each training session, we detailed the risks incurred by poor HWM, the different types of healthcare waste, and the stages of HWM, with an emphasis on sorting waste at the point of generation. The training material has been educationally prepared and pre-tested. At each department, we screened a detailed PowerPoint presentation, posters, and continued visits to sensitize workplace HCPs to best ensure that key messages are extremely clear and memorable.

Statistical analysis. Statistical analysis was achieved using IBM SPSS.26 Software. According to the normality of the variables, verified by Shapiro–Wilk and Kolmogrov–Smirnov tests, continuous variables were represented as mean ± standard deviation or minimum and maximum range if they were normally distributed or as median and interquartile ranges (IQR) if not. The categorical variables were expressed in numbers and percentages.

We used the student-paired T-test to compare the mean scores of HCPs' knowledge and practices in HWM before and after training. We used the Mann–Whitney test, Kruskall–Wallis test, or ANOVA test according to the normality of and to the number of modalities of each variable to determine the association between knowledge and practice scores change and different factors tested. A *p*-value less than 0.05 was considered statistically significant.

Ethical Considerations. Participation was entirely voluntary and anonymity and confidentiality were guaranteed and maintained.

Results

Description of the Study Population. Overall, 134 HCPs provided complete responses giving a response rate of 37%. The median age was 40 years (IQR = 32.0–48.7 years). There were 93 women (69.2%) with a sex ratio of 0.44. According to the professional category, nurses and workers staff represented respectively 63.6% (n = 85) and 16.2% (n = 21) of all HCPs. One hundred and one HCPs were working in surgical departments (75.1%) and 10 (7.2%) in intensive care units. According to work experience, the median working seniority was about 12 years (IQR = 5–22 years) and 72 participants (53.6%) had a working seniority > 10 years. Twenty-four HCPs (19%) reported that they attended training sessions about HWM previously (**Table 1**).

Impact of the training sessions on the knowledge of Healthcare Professionals about Healthcare Waste Management. For global KS, the mean rose from 58.5 ± 6.8 to 86.8 ± 6.7 after the training session ($p < 0.001$). According to the evaluation criteria of M.J. Essi et al. [16], the prevalence of HCPs with good knowledge rose from 18.6% (n = 25) to 73.1% (n = 98) (**Table 2**).

By detailing each waste category, we found a significant rise in the KS of non-infectious waste (89.6 ± 8.7 vs 68.9 ± 15.4; $p = 0.005$), the KS of infectious waste (90.7 ± 4.2 vs 74.3 ± 9.7; $p = 0.001$), the KS of sharps (89 ± 7.3 vs 72.9 ± 7; $p < 0.001$) and the KS of cytotoxic waste (80 ± 21.7 vs 17.2 ± 5.7; $p < 0.001$) (**Table 3**).

Impact of the training sessions on the practices of Healthcare Professionals about Healthcare Waste Management. For global PS, the mean rose from 73 ± 10 to 93 ± 6 after the training session ($p < 0.001$). According to the evaluation criteria of M.J. Essi et al. [16], the prevalence of adequate practices observed in HBUH units rose from 17.8% (n = 5) to 93.7% (n = 26) (Table 2).

Table 2. Levels of knowledge and practices of healthcare professionals according to the evaluation criteria of M.J. Essi et al. [16]
Таблица 2. Уровни знаний и практических навыков у медицинских работников в соответствии с критериями оценки Эсси и др. [16]

Показатель Index	Score Оценка	Level Уровень	Before the intervention До программы		After the intervention После программы	
			abs. | абс.	%	abs. | абс.	%
Knowledge Знания	< 25/100	Bad | Плохой	8	5.9	6	4.4
	25–49/100	Insufficient | Неудовлетворительный	26	19.4	7	5.2
	50–74/100	Mean | Средний	75	55.9	23	17.1
	75–100/100	Good | Хороший	25	18.6	98	73.1
Practices Практические навыки	< 25/100	Harmful | Опасный	1	3.6	0	0
	25–49/100	Inadequate | Неадекватный	22	78.6	2	6.3
	50–100/100	Adequate Адекватный	5	17.8	26	93.7

Table 3. Comparison of pre-training and post-training mean knowledge and practices scores regarding healthcare waste management among healthcare professionals ($M \pm SD$)

Таблица 3. Сравнение средних показателей знаний и практических навыков в области обращения с медицинскими отходами среди медицинских работников до и после обучения ($M \pm SD$)

Показатель Index	Criterion Критерий	Pre-training До обучения	Post-training После обучения	*p*
Knowledge items Компетенции	Global KS | Общая оценка компетенций (ОК)	58.5 ± 6.8	86.8 ± 6.7	< 0.001
	KS of non-infectious waste | ОК в отношении неинфекционных отходов	68.9 ± 15.4	89.6 ± 8.7	0.005
	KS of infectious waste | ОК в отношении инфекционных отходов	74.3 ± 9.7	90,7 ± 4.2	0.001
	KS of sharps | ОК в отношении острых предметов	72.9 ± 7	89 ± 7.3	< 0.001
	KS of cytotoxic waste | ОК в отношении цитотоксических отходов	17.2 ± 5.7	80 ± 21.7	< 0.001
Practices items Практические навыки	Global PS | Общая оценка практических навыков	73 ± 10	93 ± 6	< 0.001
	Availability of equipment in the medical treatment cart Наличие медицинских тележек в оснащении	71 ± 23	100 ± 1	< 0.001
	Healthcare waste segregation | Разделение медицинских отходов	54 ± 27	78 ± 20	0.002
	Displayed HWM procedure and disposal program Трансляция процедуры обращения с медицинскими отходами и программа их утилизации	71 ± 46	100 ± 10	0.003
	Healthcare waste disposal | Утилизация медицинских отходов	45 ± 34	91 ± 14	0.001

N o t e. KS — Knowledge score, PS — practices score, SD — standard deviation, HWM — healthcare waste management.

П р и м е ч а н и е. KS — оценка знаний, PS — оценка практических навыков, SD — стандартное отклонение, HWM — обращение с медицинскими отходами.

Depending on the items, we noted a statistically significant improvement in the availability of equipment in the medical treatment cart score (100 ± 1 vs 71 ± 23; $p < 0.001$). Similarly, this improvement was noted for the healthcare waste segregation (78 ± 20 vs 54 ± 27; $p = 0.002$), for information and training about HWM (100 ± 10 vs 71 ± 46; $p = 0.003$) and for healthcare waste disposal (91 ± 14 vs 45 ± 34; $p = 0.001$) (Table 3).

Factors associated with changes in knowledge and practice scores regarding healthcare waste management by healthcare professionals. The KS change was significantly more important for HCPs who had no previous training in HWM during the last three years than other HCPs with previous training (29.8 vs 25; $p = 0.042$). As for practices, PS change was not statistically associated with the occupation department (**Table 4**).

Table 4. Factors associated with knowledge and practices changes concerning healthcare waste management among healthcare professionals

Таблица 4. Факторы, связанные с изменениями компетенций знаний и практических навыков у медицинских работников в обращении с медицинскими отходами

Показатель | Index	Variables | Переменные	Median | Медиана	IQR	*p*
Knowledge Компетенции	Gender: | Пол:			
	females | женщины	29.4	24.5–32.1	0.497[a]
	males | мужчины	29.6	19.4–31.3	0.497[a]
	Occupation department: | Отделение:			
	medical | терапевтическое	30	27.4–31.5	0.586[b]
	surgical | хирургическое	30	21.00–32.14	0.586[b]
	intensive care units | интенсивной терапии	27.8	20.3–31.1	0.586[b]
	Working seniority, years: | Рабочий стаж, лет:			
	< 10	29.5	25.2–31.5	0.864[a]
	≥ 10	30	21.7–32.1	0.864[a]
	Occupation: Должность:			
	nurses | сестры	30	25.0–32.1	0.356[a]
	others categories | другие категории	28.9	20.2–31.2	0.356[a]
	Previous training in healthcare waste management during the last 3 years: Предшествующее обучение обращению с медицинскими отходами в последние 3 года:			
	yes | было	25	4.2–31.2	0.042[a]
	no | не было	29.8	20.8–31.6	0.042[a]
Practices Практические навыки	Occupation department: | Отделение:			
	medical | терапевтическое	4.1	0–12.3	0.206[c]
	surgical | хирургическое	17.2	0–41	0.206[c]
	intensive care units | интенсивной терапии	14.1	9.8–17.0	0.206[c]

N o t e. [a] — Mann–Witney test, [b] — Kruskall–Wallis test, [c] — ANOVA test.

П р и м е ч а н и е. IQR — межквартильный диапазон. [a] — Критерий Манна–Уитни, [b] — критерий Крускалла –Уоллиса, [c] — ANOVA тест.

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Discussion

This study delivered valuable information about knowledge as well as practices regarding HWM among HCPs in HBUH in Southern Tunisia. It was conducted to determine the impact of HCPs training on HWM at a university surgical hospital in Southern Tunisia.

It should be pointed out first of all that we had a low participation rate in this survey. The lack of presence of HCPs in training has already been reported by a recent preceding systematic review in 2020 [17]. This could be explained by the overload of HCPs at work especially in surgical establishments and also by the resistance to change and the fear of judgment.

As has already been reported in the literature [18], the basic knowledge of the HCPs about the HWM was not very good before our intervention. This fact could be related primarily to insufficient professional training on this important theme. In fact, knowledge is an essential resource in health sciences. Inadequate knowledge may lead to improper applications and practices that may be detrimental to any healthcare establishment [19]. Continuous training is a key point in improving HCP's knowledge about HWM [17]. Moreover, a meta-analysis revealed that improving the knowledge of HCPs requires ongoing knowledge assessment studies [17].

Despite the low participation rate, our study showed that the training session led to a statistically significant improvement in knowledge among HCPs regarding all healthcare waste types. In fact, the global KS about HWM and the KS of each waste category increased significantly after the intervention. The same findings have been noted in other previous studies [1, 6, 20, 21]. The significant improvement in KS demonstrated that the training intervention was successful in achieving its intended objectives. This might be ascribed to several factors, such as the training program's thorough content, the HCPs' enthusiasm and want to learn and change, the encouraging questions, interactive discussions using multimedia, and the repetition of the message through a variety of mediums. More than a few studies reported the helpfulness of continuous training to develop the HCPs' knowledge [18, 22, 23].

For the intervention methodology, as previously said, we used PowerPoint detailed presentations, posters, and visits. It has been demonstrated that the degree of knowledge can be directly influenced by employing the "information education and communication" package in the form of workshops, PowerPoint presentations, video films, and graphic representation [24]. Moreover, in the same context, a study from a tertiary healthcare establishment in India showed that a training manual could be also a useful tool to raise HCPs' HWM knowledge [25].

Our knowledge evaluation covered all types of HWM and showed that HCPs improved their knowledge in the different waste management categories. Another quasi-experimental study from Pakistan reported the same positive significant results [21]. This demonstrated that teaching sessions were effective in improving the overall knowledge about HWM among HCPs.

The positive change in HCP's knowledge regarding HWM was converted to good practices two months after the intervention. Indeed, we noted a statistically significant improvement in practices among HCPs after the training session with a statistical increase in PS between baseline and follow-up.

For the evaluation, we used an audit grid which was a useful tool characterized by objectivity, clarity, and feasibility and it was largely used in literature to assess HWM practices [6, 26]. Several studies in the literature demonstrated similar positive results in terms of practices after training sessions in Tunisia [6], Panipat [27], Bangladesh [28] and Pakistan [1].

This fact could be explained by the training session's capacity to positively impact HCP's willingness to change, behaviors and habits in terms of HWM. It gave the impression that training session advantages go beyond the simple improvement of knowledge towards changing habits and practices, which remains the challenge and the ultimate goal of any training or educational program in terms of hospital hygiene.

We noted a statistically significant improvement in the availability of equipment in the medical treatment cart score. This fact was previously reported by a Tunisian study [6]. The original contribution of our study was that an improvement was noted in the healthcare waste segregation among HCPs after the training session. Previous data from different countries did not reveal a significant change in this item after the intervention such as Tunisia [6], Tanzania [29], and Pakistan [30]. This result could be explained by the lack of equipment needed for sorting waste, the resistance to changing practices from HCPs in those studies, and finally the lack of supervision and continuous control of HCPs practices towards healthcare waste segregation at hospital departments.

Similarly, significant improvements were noted for information and training about HWM and for healthcare waste disposal. This fact was proof of our training quality and capacity to touch and correct all HWM practices aspects.

Moreover, this study showed that the KS change was significantly more important for HCPs who had no previous training in HWM during the last three years than other HCPs with previous training. This was also illustrated in previous studies [31, 32].

Indeed, HCPs with previous training had more basic knowledge about HWM compared to their colleagues who did not have previous training in the last three years. Therefore, the change in their KS will not be so significant as their colleagues who were trained for the first time. As a result, the KS will be noticeably and significantly increased after the HCPs intervention without previous HWM training.

To the best of our knowledge, this study was the first one to enlighten the impact of HWM training intervention on the knowledge and practices of HCPs in the surgical university hospital in southern Tunisia. The subject was really interesting given the enormous increase in the amount of waste following the COVID-19 pandemic and the economic impact of good HWM in hospitals. There were some limitations of our study. First of all, it was a single-center study that could impact the generalization of the results on a national scale. However, making this intervention in a surgical establishment could have great importance and contribution in terms of HAI and blood exposure accident prevention because of the nature of invasive acts of care delivered. Secondly, as previously noted, the participation rate was low but this fact was not an obstacle to having a positive impact on HCP's knowledge and practices in the whole hospital.

In terms of this survey, we recommend the generalization of training sessions as an effective method to improve HWM and all other standard precautions at all hospital types.

Likewise, training sessions should be exhaustive and addressed to all HCPs categories and they should be continuously reminded according to a frequency adapted to the human resources.

Conclusions

In conclusion, our results showed that the HWM training session is a promising and effective intervention to improve the knowledge and practices of HCPs.

This type of intervention is exceedingly needed and its importance cannot be overemphasized. Certainly, HCPs are the strongest link and the first managers of healthcare waste at hospitals, however, they are not the only ones concerned. HWM has to be a shared responsibility between all stakeholders: patients, visitors, and administration. Training sessions about HWM should not be a one-time activity but it should be a continuous and regular process to ensure a safe care environment and deliver quality care.

REFERENCES / ЛИТЕРАТУРА

1. Kumar R., Somrongthong R., Ahmed J. Impact of waste management training intervention on knowledge, attitude and practices of teaching hospital workers in Pakistan. *Pak. J. Med. Sci.* 2016; 32(3): 705–10. https://doi.org/10.12669/pjms.323.9903
2. Askarian M., Shiraly R., Aramesh K., McLaws M.L. Knowledge, attitude, and practices regarding contact precautions among Iranian physicians. *Infect. Control Hosp. Epidemiol.* 2006; 27(8): 868–72. https://doi.org/10.1086/506411
3. Haut Autorité de Santé (HAS). Évaluation De La Prévention Des Infections Associées Aux Soins; 2022.
4. Hosny G., Samir S., El-Sharkawy R. An intervention significantly improve medical waste handling and management: A consequence of raising knowledge and practical skills of health care workers. *Int. J. Health Sci. (Qassim).* 2018; 12(4): 56–66.
5. Chartier Y., Emmanuel J., Pieper U., Prüss A., Rushbrook P., Stringer R. Standards for improving quality of maternal and newborn care in health facilities. *WHO Publ.* 2014; 329: 1–84.
6. Ben Jmaa M., Ben Ayed H., Ben Hmida M., Maamri H., Limam M., Trigui M., et al. Effectiveness of a training intervention about healthcare waste management on the knowledge and practical skills of healthcare professionals in a teaching hospital of Southern Tunisia. *Hosp. Top.* 2023; 101(2): 55–64. https://doi.org/10.1080/00185868.2021.1969307
7. WHO. Tonnes of COVID-19 health care waste expose urgent need to improve waste management systems. Available at: https://who.int/news/item/01-02-2022-tonnes-of-covid-19-health-care-waste-expose-urgent-need-to-improve-waste-management-systems
8. Ndiaye O., Fall F.T., Faye P.M., Thiongane A., Fall A.L. Department of pediatrics at the Albert Royer National Children's Hospital: Preliminary study comparing the first quarter of 2019 and 2020. *Pan. Afr. Med. J.* 2020; 36: 162. https://doi.org/10.11604/pamj.2020.36.162.23629 (in French)
9. Patel S.S., Sukhovii O., Zvinchuk O., Neylan J.H., Erickson T.B. Converging impact of the ongoing conflict and COVID-19 pandemic on mental health and substance use disorders in Ukraine. *J. Emerg. Manag.* 2021; 19(9): 63–8. https://doi.org/10.5055/jem.0603
10. Makhura R.R., Matlala S.F., Kekana M.P. Medical waste disposal at a hospital in Mpumalanga Province, South Africa: Implications for training of healthcare professionals. *S. Afr. Med. J.* 2016; 106(11): 1096–102. https://doi.org/10.7196/samj.2016.v106i11.10689
11. Krishnan K.U., Devamani T.S.D., Jayalakshmi G. On the path of continual improvement: An evaluation of biomedical waste management training. *Indian J. Med. Microbiol.* 2015; 33(Suppl.): S119–21. https://doi.org/10.4103/0255-0857.150911
12. Maaroufi K., Tudor T., Vaccari M., Siala A., Mahmoudi E. An evaluation of staff engagement with infectious healthcare waste management policies: a case study of Tunisia. *Int. J. Environ. Res. Public Health.* 2020; 17(5): 1704. https://doi.org/10.3390/ijerph17051704
13. The Foreign Investment Promotion Agency. Sfax Governorate, presentation and statistics. Tunisia; 2021. Available at: https://investintunisia.tn/En/sfax-in-a-nutshell_114_428
14. National Institute of Statistics. National Population Census. Tunisia; 2021. Available at: https://ins.tn/en
15. Askarian M., McLaws M.L., Meylan M. Knowledge, attitude, and practices related to standard precautions of surgeons and physicians in university-affiliated hospitals of Shiraz, Iran. *Int. J. Infect. Dis.* 2007; 11(3): 213–9. https://doi.org/10.1016/j.ijid.2006.01.006
16. José E.M., Oudou N. L'Enquête CAP (Connaissances, Attitudes, Pratiques) en Recherche Médicale. Health Sciences and Diseases; 2013.
17. Mannocci A., di Bella O., Barbato D., Castellani F., La Torre G., De Giusti M., et al. Assessing knowledge, attitude, and practice of healthcare personnel regarding biomedical waste management: a systematic review of available tools. *Waste Manag. Res.* 2020; 38(7): 717–25. https://doi.org/10.1177/0734242x20922590
18. Shivalli S., Sanklapur V. Healthcare waste management: qualitative and quantitative appraisal of nurses in a tertiary care hospital of India. *ScientificWorldJournal.* 2014; 2014: 935101. https://doi.org/10.1155/2014/935101
19. Thirunavukkarasu A., Al-Hazmi A.H., Dar U.F., Alruwaili A.M., Alsharari S.D., Alazmi F.A., et al. Knowledge, attitude and practice towards bio-medical waste management among healthcare workers: a northern Saudi study. *PeerJ.* 2022; 10: e13773. https://doi.org/10.7717/peerj.13773
20. Kaur A., Kaur P. A study to assess the effectiveness of self instructional module on biomedical waste management among the staff nurses of the selected hospitals of Ludhiana, Punjab. *Int. J. Adv. Nurs. Manag.* 2018; 6(1): 62. https://doi.org/10.5958/2454-2652.2018.00014.8
21. Shaheen T., Ghani M., Kausar S. Gauging the effectiveness of training sessions among nurses regarding biomedical waste management: a quasi-experimental study from a developing country. *Cureus.* 2020; 12(12): e12196. https://doi.org/10.7759/cureus.12196
22. Akbolat M., Dede C., Isik O., Saglam H. Medical waste management practices in Turkey: A case study in Sakarya. *Pak. J. Med. Sci.* 2011; 27(4): 892–5.
23. Enwere O.O., Diwe K.C. Knowledge, perception and practice of injection safety and healthcare waste management among teaching hospital staff in south east Nigeria: an intervention study. *Pan. Afr. Med. J.* 2014; 17: 218. https://doi.org/10.11604/pamj.2014.17.218.3084
24. Acharya S., Laupsien P., Wenzl C., Yan S., Großhans J. Function and dynamics of slam in furrow formation in early Drosophila embryo. *Dev. Biol.* 2014; 386(2): 371–84. https://doi.org/10.1016/j.ydbio.2013.12.022
25. Verma L.K., Mani S., Sinha N., Rana S. Biomedical waste management in nursing homes and smaller hospitals in Delhi. *Waste Manag.* 2008; 28(12): 2723–34. https://doi.org/10.1016/j.wasman.2007.12.013
26. Hames K. Healthcare waste disposal: An analysis of the effect of education on improving waste disposal. *Healthc. Infect.* 2013; 18(3): 110–4. https://doi.org/10.1071/HI12050
27. Meshram S., Javed S. A study to assess the effectiveness of structured teaching programme on knowledge regarding occupational health hazards among factory workers in selected factory of Indore, M. P., India. *Int. J. Healthc. Educ. Med. Informatics.* 2020; 7(1&2): 1–9.
28. Pollák V., Romanov A. Study of elastic and thermoelastic properties of ethylene-propylene and ethylene–vinyl acetate copolymers. II. Thermoelastic properties. *J. Appl. Polym. Sci.* 1979; 23(4): 995–1002. https://doi.org/10.1002/app.1979.070230404
29. Manyele S., Anicetus H., Habtu M., Massa K., Said M., Saria J., et al. Readiness of healthcare facilities to implement onsite healthcare waste management protocols and incineration guidelines in Tanzania. *J. Environ. Prot. (Irvine, Calif).* 2022; 13(11): 913–40. https://doi.org/10.4236/jep.2022.1311058
30. Kumar R., Somrongthong R., Shaikh B.T. Effectiveness of intensive healthcare waste management training model among health professionals at teaching hospitals of Pakistan: A quasi-experimental study. *BMC Health Serv. Res.* 2015; 15: 81. https://doi.org/10.1186/s12913-015-0758-7
31. Deress T., Hassen F., Adane K., Tsegaye A. Assessment of knowledge, attitude, and practice about biomedical waste management and associated factors among the healthcare professionals at Debre Markos town healthcare facilities, northwest Ethiopia. *J. Environ. Public Health.* 2018; 2018: 7672981. https://doi.org/10.1155/2018/7672981
32. Nwankwo C. Knowledge and practice of waste management among hospital cleaners. *Occup. Med. (Lond.).* 2018; 68(6): 360–3. https://doi.org/10.1093/occmed/kqy078

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