

Medication Injection Safety Knowledge and Practices among Health Service Providers in Korea

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Purpose: Outbreaks resulting from medication injections have recently been on the rise in Korea despite various established guidelines. The objective of this study was to assess the degree to which healthcare professionals are aware of safe injection practice guidelines and to account for the adherence to and the deviation from safe injection guidelines formulated by healthcare providers.

Methods: In November 2016, a cross-sectional anonymous questionnaire covering general characteristics of injections, patient safety culture, awareness of safe injection practices, and adherence to and barriers to safe injection guidelines was issued to healthcare providers who administer medication injections or manage and supervise these injections (N=550). Multivariate logistic regression analysis via enter method was performed to define the influencing factors of adherence of safe injection practices.

Results: On average, respondents adhere to 17 of the 24 guidelines. Multivariate logistic regression found that those who were more likely to adhere to safe injection guidelines either underwent a patient safety training experience within the last year, provided care in a setting characterized by a highly developed patient safety culture, or were employed as physicians or nurses, as opposed to some other type of care provider. Barriers to safe injection guidelines were attributable to; thoughts of waste to discard leftover medicine, provisions that made adherence cumbersome, a weak culture of compliance, and insufficient amounts of injectable medicine, products, and education.

Conclusions: The results of this study indicate that controllable factors like training experience of healthcare providers and patient safety culture were positively associated with adherence to safe injection practices. It was suggested that the training of healthcare providers on safe injection practices be a continuous process to promote patient safety. Additionally, there should be an increased focus on developing and implementing policies to improve patient safety culture from a prevention rather than post-management perspective.

Key words: Injections, Safety management, Guideline adherence

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I. Introduction

Over the last two decades, outbreaks and patient concerns about unsafe injection practices reports have been on the rise even in developed countries [1-5]. Though a total of 61 healthcare-associated hepatitis B and C outbreaks were recorded by the Centers for Disease Control and Prevention during 2008~2017 in the U.S., the numbers reported here may have been greatly underestimated because of the long incubation period (up to 6 months) and typically asymptomatic course of acute hepatitis B and C infections [6]. In January 2005, a few malignant cases of recurrent subcutaneous abscesses in the gluteal region were reported in Icheon City [7]. In October 2012, 27 patients were hospitalized due to septic arthritis caused by a presumed NTM infection, after having been given triamcinolone injections at a single clinic [8].

Medication injection-associated infection can be prevented when healthcare providers adhere to infection control guidelines [9]. However, despite various established guidelines, including the Association for Professionals in Infection Control and Epidemiology position paper [10] and World Health Organization [11], unsafe practices have continued, including use of a single dose vial for more than one patient, reuse of syringes [12], and leaving a needle or spike device for later reuse in the same medication vial [13]. It is therefore important to assess the awareness, practices, and adherence of service providers and identify the barriers to adherence to infection control guidelines, to promote patient safety in medication injections. The three common barriers to dedicating medication vials to individual patients are medication shortages,

a desire to reduce medication waste, and the high cost of medications [13]. The barriers to safe injection practice could be affected by economic status, social aspects, or organizational patient safety culture [14-15].

Recently, there was a report on the reuse of needles and syringes in conjunction with an increase in cases of HCV at a clinic in Korea [16]. Thus, the objective of this study was to assess the awareness of safe injection practices of service providers, and the adherence and barriers to guidelines of safe injection practice in various settings to promote injection safety.

II. Methods

1. Survey subjects and methods

A cross sectional study using a structured questionnaire survey was conducted from November 24 to 28, 2016, to understand the level of knowledge, adherence, and barriers to safe injection practice of health service providers. In consideration of the convenience of respondents, both online and offline methods were used to collect data. The respondents were 1,000 professionals providing healthcare at various clinical settings, including members of the Korean Academy of Family Medicine, Korean Nurses Association, Korean Licensed Practical Nurses Association, and Korean Society for Quality in Health Care. They were asked if they were working on medication injection or were managing and supervising medication injections the last one year to screen respondents. Out of the 1,000 respondents, the data of 550 respondents

were analyzed after excluding 450 respondents whose responses were “No” to both the screening questions.

The questionnaire covered the following five areas: 1) general characteristics, 2) awareness of safe injection practice, 3) adherence to guidelines of injection practice, 4) barriers to adhering to the guidelines of injection practice, and 5) patient safety culture. The questions regarding awareness of safe injection practice, adherence, and barriers were developed through literature reviews and in consultation with experts involved with patient safety. The questions went through a pilot test and thereafter revised before this study was carried out. Patient safety culture was assessed using the Korean version of the self-reported Agency for Healthcare Research and Quality (AHRQ) patient safety questionnaire measured on a 5-point Likert scale [17]. IRB approval from the National Evidence-Based Healthcare Collaborating Agency (IRB No. NECAIRB16-004) was obtained before carrying out this study.

2. Measurement

1) Awareness of safe injection practice

Awareness of safe injection practice was assessed with 12 questions to which the survey participants responded “Yes” or “No.” Each question with the answer “yes”-received one point, and the total score ranged from 0 to 12 points.

2) Adherence to the guidelines of safe injection practice

24 questions were used to assess adherence to the guidelines regarding medication injection [9-

13]. This included practices related to injections, syringes, and injection needles for the last one year. Items were measured on a 5-point Likert scale (never, rarely, occasionally, frequently, very frequently) (Cronbach’s $\alpha = .784$).

3) Barriers to the adherence of guidelines of safe injection practice

Barriers to the adherence of guidelines of safe injection practice were identified using 14 questions to which the survey participants responded “Yes” or “No”, developed by researchers based on a literature review. Respondents were asked if they agreed to the barriers mentioned (Cronbach’s $\alpha = .786$).

4) Patient safety culture

Validated Korean version of “Hospital Survey on Patient Safety Culture” (HSPSC) questionnaire developed by Agency for Healthcare Research and Quality (AHRQ) was used to assess the patient safety culture [17]. The HSPSC consists of 44 questions that are divided into the following sections: A. Work environment of each department (18 questions). B. Immediate superior/manager (4 questions). C. Communication and procedures (6 questions). D. Frequency of reported accidents (3 questions). E. Hospital (11 questions). F. Patients’ safety level (1 question). G. Number of accidents related to patient safety reported (1 question). The sections A through E were assessed on a 5-point scale of “Not at all,” “No,” “Average,” “Yes,” or “Absolutely yes” for each question while sections F and G, which concern the safety culture score of patients, were assessed on scores ranging from 42 to 210 points (Cronbach’s $\alpha = .782$).

5) General characteristics

General characteristics were assessed using 12 questions regarding the medical institution type, type of occupation, work experience, status of participation in training held by the institution for the past one year, status of participation in training held by an external institution for the past one year, and status of possession of injection safety-related guidelines/regulations in the working institution.

3. Statistical analysis

The data collected in this study were presented as frequencies, means, and standard deviations. To identify potential factors influencing adherence to safe injection practices, the variables of general characteristics, awareness of safe injection practices, and patient safety culture were dichotomized by the mean to facilitate interpretation of data, and preliminary univariate analyses were conducted using chi-square or ANOVA ($p < .05$). Then, the final determinants of adherence to safe injection practice

guidelines were identified using multivariate logistic regression analysis via enter variable selection method. The reliability of questionnaire was verified using Cronbach's α . The significance level was set at $p < .05$ (two-tailed), and all data analyses were conducted using SPSS 19.0 (Chicago, IL) for Windows.

III. Results

1. General characteristics of respondents and level of patient safety culture

Table 1 shows the general characteristics and patient safety culture of respondents. Of the respondents, 303 (55.1%) were working for a tertiary or general hospital, 66 (12.0%) were physicians, 258 (46.9%) were nurses, and 258 (41.1%) were nursing assistants. 51.1% of the respondents had been working for less than five years. 355 (64.5%) of the respondents had training experience during the last one year. The mean score of patient safety culture was 144.47 ± 19.4 .

Table 1. General characteristics and level of safety culture of patients

		(n = 550)
	Classification	n (%) ¹⁾
Institution type	Tertiary or general hospital	303 (55.1)
	Clinics, specialized hospital, nursing home, public health center	247 (44.9)
Type of occupation	Physician	66 (12.0)
	Nurse	258 (46.9)
	Nursing assistants and others	226 (41.1)
Work experience	5 years or less	281 (51.1)
	More than 5 years	269 (48.9)
Training experiences (for the last one year)	Yes	355 (64.5)
	No	191 (34.7)
Awareness of safe injection practice	Mean \pm standard deviation	9.7 \pm 1.5
Guidelines/regulations on drug storage and management	Yes	500 (90.9)
	No	46 (8.4)
Patient safety culture	Mean \pm standard deviation	144.5 \pm 19.4

¹⁾ The total is not 100% in some cases due to missing variables

2. Awareness of safe injection practice

The mean score for the awareness of safe injection practices was 9.8 out of 12 points (Table 2). 42.7% of the respondents gave incorrect answers to

questions regarding “Disinfecting the injection area is performed for 30 seconds” and “Alcohol-soaked cotton in a container is not prepared in advance”. This was the highest number of incorrect answers.

Table 2. Awareness of safe injection practice

		(n = 550)		
	Question	Correct (n, %)	Incorrect (n, %)	Missing (n, %)
1.	In medication injection, only injection needles are contaminated.	519 (94.3)	29 (5.3)	2 (0.4)
2.	Contaminated syringes or injection needles can be fully identified by the naked eye.	506 (92.0)	44 (8.0)	0 (0.0)
3.	Once injection needles are replaced, syringes can be reused.	543 (98.7)	7 (1.3)	0 (0.0)
4.	If medication must be dissolved for injection, a large amount of solvent fluid or bottle can be used in combination.	490 (89.1)	59 (10.7)	1 (0.2)
5.	For skin disinfection prior to injection, the skin is disinfected with an alcohol swab by wiping from left to right horizontally.	392 (71.3)	155 (28.2)	3 (0.5)
6.	Disinfecting the injection area is performed for 30 seconds.	313 (56.9)	235 (42.7)	2 (0.4)
7.	Once the skin surface has dried after skin disinfection, the effect of disinfection disappears.	478 (86.9)	70 (12.7)	2 (0.4)
8.	Alcohol-soaked cotton in a container is not prepared in advance.	313 (56.9)	235 (42.7)	2 (0.4)
9.	Confirmation is to be made whether multiple patient use is written in the drug manual containing prescription cautions etc., included in the injection package.	465 (84.5)	83 (15.1)	2 (0.4)
10.	TPN solution must be discarded 48 hours after opening.	466 (84.8)	81 (14.7)	3 (0.5)
11.	You are aware of injection-related infection incidents that occurred in South Korea.	480 (87.3)	69 (12.5)	1 (0.2)
12.	You are familiar with injection safety use guidelines published in South Korea.	378 (68.7)	171 (31.1)	1 (0.2)
Mean ± standard deviation		9.7 ± 1.5		

3. Adherence to safe injection practice guidelines

The results of adherence to safe injection practice guidelines were as shown in Table 3. Of the 550 respondents, 384 (69.8%) answered that they do not follow the guideline “Syringes and injection needles that were used by patients at home are collected by the institution”; 272 (49.5%) answered that they do not follow the guideline “Syringes and injection

needles are opened in the patients’ vicinity.”; 238 (43.3%) answered that they do not follow the guideline “When opening an injectable drug that can be used for a long term, the disposal date must be written on the bottle”. Finally, 7 respondents (1.3%) answered that “Once injection needles are replaced, the syringe can be reused” is correct. In general, respondents followed 17-18 guideline practices out of the 24-guideline practices outlined.

Table 3. Adherence to guideline of safe injection practice

		(n = 550)	
How much have you performed the following for the last one year?		Non-compliant (n,%)	Compliant (n,%)
1.	Syringes and injection needles that were used by patients at home are collected by the institution.	384 (69.8)	166 (30.2)
2.	Syringes and injection needles are opened in the patients’ vicinity.	272 (49.5)	278 (50.5)
3.	When opening an injectable drug that can be used long term, the disposal date must be written on the bottle.	238 (43.3)	312 (56.7)
4.	A fluid set is replaced with a new one every 48 hours.	192 (34.9)	358 (65.1)
5.	When opening an injectable drug, the expiration date must be confirmed.	191 (34.7)	359 (65.3)
6.	When total parenteral nutrition (TPN) is given, a fluid set is replaced with a new one every 24 hours.	188 (34.2)	362 (65.8)
7.	When opening an injectable drug that can be used long term, the opening date must be written on the bottle.	176 (32.0)	374 (68.0)
8.	The injection area is replaced with a new one every 48-72 hours.	161 (29.3)	389 (70.7)
9.	When inserting a peripheral vein catheter, the insertion date must be written.	160 (29.1)	390 (70.9)
10.	Blood, blood products, or lipid drugs are replaced with new ones as well as a fluid set whenever a new bottle is used.	160 (29.1)	390 (70.9)
11.	When preparing for injection, the drug name and dose in the injection bottle must be read and confirmed.	158 (28.7)	392 (71.3)
12.	When injecting a different drug in the identical patient, a new injection needle and syringe were used.	149 (27.1)	401 (72.9)
13.	One or more patients were injected with one bottle of injectable drug.	146 (26.5)	404 (73.5)
14.	In an emergency case, both previously opened injectable drugs and syringes are discarded.	143 (26.0)	407 (74.0)
15.	Whether there is flare or pain in the peripheral vein catheter insertion area is confirmed.	129 (23.5)	421 (76.5)
16.	Whenever injecting drugs for multiple use to multiple patients, new needles and syringes were used.	127 (23.1)	423 (76.9)
17.	You used an opened injectable drug that you did not open yourself.	127 (23.1)	423 (76.9)
18.	Injection was done without disinfecting the rubber plug of a vial.	109 (19.8)	441 (80.2)
19.	Previously used syringes/injection needles were placed with new syringes/injection needles in the same tray.	102 (18.5)	448 (81.5)
20.	Regardless of your intention, you have reused an injectable drug.	98 (17.8)	452 (82.2)
21.	You have disinfected a syringe or an injection needle.	96 (17.5)	454 (82.5)
22.	Injectable drugs that remained after use with one patient were placed at one location to use them for other patients.	96 (17.5)	454 (82.5)
23.	For reuse of vials for multiple use, injection needles, cannulas etc., were put in the rubber part of vials.	91 (16.5)	459 (83.5)
24.	For doing tasks quickly, you have put vials for multiple use in your uniform pocket.	83 (15.1)	467 (84.9)
Mean ± standard deviation		17.13 ± 7.26	

4. Differences among adherences to safe injection practice guidelines

The results of the univariate analyses showing the differences in adherence to safe injection practices were as provided in Table 4. Institution

type ($p < .001$), occupation type ($p < .001$), work experience ($p < .05$), training experience ($p < .001$), guidelines/regulations on drug storage and management ($p < .001$), patient safety culture ($p < .001$) differed significantly between the compliant and non-compliant group.

Table 4. Differences between guideline compliant and non-compliant group

		Adherence(n, %) ¹⁾		$\chi^2(p\text{-value})$
Variable		Compliant	Non-compliant	
Institution type	Tertiary or general hospital	184 (60.7)	119 (39.3)	12.38 ($p < .000$)
	Clinics, specialized hospital, nursing home, public health center	185 (74.9)	62 (25.1)	
Type of occupation	Physician	44 (66.7)	22 (33.3)	42.85 ($p < .000$)
	Nurse	207 (80.2)	51 (19.8)	
	Nursing assistant and others	118 (52.2)	108 (47.8)	
Work experience	5 years or less	173 (61.6)	108 (38.4)	7.94 (.005)
	More than 5 years	196 (72.9)	73 (27.1)	
Training experience (for the last one year)	Yes	265 (74.6)	90 (25.4)	23.12 ($p < .000$)
	No	104 (54.5)	87 (45.5)	
Awareness of safe injection practice	Greater than mean	240 (71.6)	95 (28.4)	8.04 (.005)
	Less than mean	129 (60.0)	86 (40.0)	
Guidelines/regulations on drug storage and management	Yes	349 (69.8)	151 (30.2)	13.32 ($p < .000$)
	No	20 (43.5)	26 (56.5)	
Patient safety culture	Greater than mean	209 (75.7)	67 (24.3)	19.87 ($p < .000$)
	Less than mean	151 (57.6)	111 (42.4)	

¹⁾ The total is not 550 in some cases due to missing variables

5. Factors related to adherence to safe injection practice guidelines: results of multivariate logistic regression

Results showed that safe injection practices were influenced by the status of training experience related to safe injection practices, patient safety culture, and type of occupation. Multivariate logistic regression identified three factors in those who were more likely to adhere to safe injection practice guidelines: (1) having training experience about patient safety in the last one year (OR, 2.24; 95% CI, 1.47, 3.40). (2) Having a higher patient

safety culture score (OR 2.12; 95% CI, 1.43, 3.14). (3) Being a physician (OR 2.23; 95% CI, 1.18, 4.22) or a nurse (OR, 4.17; 95% CI, 2.32, 7.50) compared to being nursing assistants and other professionals. The factors - institution type, having a work experience of more than 5 years, having awareness of safe injection practices, and having guidelines or regulations on drug storage and management in working institutions were found insignificant (Table 5). In step 3, Cox & Snell R^2 was found to be 0.135 and Nagelkerke R^2 was 0.188. The result of Hosmer and Lemeshow test was 0.903.

Table 5. Influencing factors in adherence to guideline of safe injection practice

Characteristics	Adherence of safe injection practice ¹⁾		
	OR	95% CI	<i>p</i>
Having training experiences	2.24	1.47 - 3.40	.000
High safety culture of patient	2.12	1.43 - 3.14	.001
Occupation: Physician	2.23	1.18 - 4.22	.014
Occupation: Nurse	4.17	2.32 - 7.50	.000
Institution type	.81	.47 - 1.39	.440
Work experience over 5 years	.84	.53 - 1.33	.450
Awareness of safe injection practice	1.24	.83 - 1.86	.300
Guidelines/regulations on drug storage and management	1.86	.94 - 3.71	.076
(Constant)	.27	-	.000

OR odds ratio; 95% CI confidence interval

¹⁾ The dependent variable had two categories: Greater and lower than mean of injection practice adherence

6. Barriers to adherence to safe injection practice guidelines

Barriers to adherence to safe injection practice guidelines were as shown in Table 6. Of the 550 respondents, 244 (44.4%) answered that “It is unfortunate to discard injectable drugs only after using some”; 196 (35.6%) answered “It is cumbersome to comply with sterilization method at every injection”; and 195 (35.5%) answered “There

is no enough space to store new drugs or products”; 178 (32.4%) and 154 (28.0%) answered that stored drugs and stored products, including syringes, needles, fluid sets, were insufficient, respectively; 153 (27.8%) answered that there was not enough opportunity to learn about sterilization methods; 148 (26.9%) answered that there is no culture that promotes adherence to sterilization methods; and 147 (26.7%) answered that there is not enough time to practice sterilization methods.

Table 6. Barriers to adherence of safe injection guideline

(n = 550)

Question	Yes (n, %)	No (n, %)
1. It is unfortunate to discard injectable drugs only after using some.	244 (44.4)	304 (55.3)
2. It is cumbersome to comply with sterilization methods at every injection.	196 (35.6)	354 (64.4)
3. There is not enough space to store new drugs or products.	195 (35.5)	355 (64.5)
4. The amount of stored drugs is insufficient.	178 (32.4)	371 (67.5)
5. The amount of products such as stored syringes, injection needles, fluid sets etc., are insufficient.	154 (28.0)	395 (71.8)
6. There is not enough opportunity to learn about sterilization methods.	153 (27.8)	396 (72.0)
7. There is no atmosphere of adherence to sterilization methods.	148 (26.9)	402 (73.1)
8. There is not enough time to practice sterilization methods.	147 (26.7)	403 (73.3)
9. The contents of the sterilization methods specified in the guidelines are confusing or not accurate.	92 (16.7)	458 (83.3)
10. Caution is always taken to prevent the amount of injection-related waste products from becoming excessive.	67 (12.2)	483 (87.8)
11. After acquiring a license, it is easy to forget about the sterilization methods because of a lack of repeated education or training.	59 (10.7)	491 (89.3)
12. No payment is made for the remaining drugs after use.	55 (10.0)	495 (90.0)
13. The cost of drugs is too expensive.	49 (8.9)	501 (91.1)
14. There are no disadvantages or consequences even if one does not adhere to the sterilization methods.	26 (4.7)	523 (95.1)

* The total is not 550 in some cases due to missing variables

IV. Discussion

The objective of this study was to assess the awareness regarding safe injection practices, adherence to guidelines for safe injection practices for healthcare providers, and barriers in promotion of patient safety. Awareness regarding safe injection practices scored an average of 9.8 out of 12 points. The most number of incorrect answers were to the questions related to alcohol-soaked cotton and adequate disinfecting time. 10% and 15% of the respondents gave incorrect answers to questions related to confirmation about multiple patient use and usage of large amounts of solvent fluid to resolve injection, respectively. In addition, "Once injection needles are replaced, syringes can be reused" was 1.3%, so there has been a concurrent risk of reusing syringes even though outbreaks recently occurred in Korea.

In terms of adherence to guidelines for safe injection practices, the highest number of respondents who did not adhere to safety regulations was seen in the responses to "Syringes and injection needles that were used by patients at home are collected by the institution." With respect to the increase in chronic diseases that require self-injections, including diabetes mellitus and rheumatoid arthritis, it is necessary to consider developing a policy for prevention of secondary infection. Sudesh Gyawali et al. emphasized the need for provision of safety boxes for the disposal of used syringes and a continuous and repeated training process for medical staff on waste product management [18]. Further, 30% of all the respondents answered that they did not note the opening date/disposal date or did

not confirm the expiration date when opening injectable drugs. About 20% reported cases related to the reuse of injection-related products, such as opening syringes or injection needles in advance, not using new needles and syringes for multiple-use medication injections, using injectable drugs that they themselves had not opened, or placing previously used syringes/injection needles on a tray. Therefore, it was confirmed that the safety precautions of healthcare providers regarding injection safety were not adequate.

Results showed that safe injection practices were affected by status of training related to injection safety practices for the previous year, patient safety culture, and type of occupation. The probability of practicing safe injection-related activities was more than twice greater in the group that underwent training related to injection safety practices than the group that did not undergo training; the same was true for the physician and nurse groups. With regard to patient safety culture, positive workplace and organizational culture was significantly associated with medication errors and hospital acquired infection [19]. Several studies have attempted to find the relationship between safety culture and safety behavior, though these have tended to focus more on hand hygiene [2-5]. The disconnection between intent and action appears to be influenced by organizational structure as well as cultural beliefs [20]. Marzieh Javadi et al. mentioned that normative beliefs and control beliefs related to safety culture also have to be improved to inspire the provider's intention to implement patient safety behavior simultaneously [21-22]. Organizational structure [20] and social cohesiveness [24] of among team members also

influence the success of interventions for improving compliance.

With respect to occupation, respondents who were neither doctors nor nurses were thought to have lacked the opportunity to receive training on safe injection practices and to have a sufficient recognition of patient safety culture. A study reported the negative relationship between the number of hours per resident day of licensed practical nurses and food enjoyment in nursing homes, but relatively few studies have been devoted to differences in adherence and barriers to safe practices by type of occupation.

Further research is required to determine these factors comprehensively. Cresswell and Monrouxe found that awareness varied across the medical junior doctors and medical students [23]. There was a strong belief that evidence for the effectiveness of good hygiene behaviors is lacking, and doctors and medical students had a predominant view that hygiene was an additional rather than integral part of the process. The authors emphasized ownership of patient safety behavior and understanding the doctor's role in developing the hygiene culture. The Speaking Up for Safety Program focused on how leadership support, HCW awareness, supply availability, and culture change increased compliance to hand hygiene [24].

Regarding barriers to medication injections, 44.4% of the respondents answered with "It is unfortunate to have to discard injectable drugs without using them entirely". To resolve this, it is necessary to have a close consultation between insurance companies and manufacturing companies. The Korean health insurance system is a unique hybrid single payer system where all

people residing in South Korea are eligible for coverage under the National Health Insurance Program. Regarding injectable drugs whose unit prices are determined by packaging unit, the current insurance payment structure leaves some room for ambiguity regarding the reuse of drugs in cases where some of the injectable drugs are left over after use [25]. Manufacturing companies need to make product units with smaller amounts; also, subdividing insurance payments into units with smaller amounts will help lower the risk of reuse. Most respondents also found it cumbersome to comply with the sterilization procedures for every injection; the improvement of recognition using continuous and repeated education or modification of existing safety processes or campaigns can make patient safety culture among the providers the most effective method of counteracting this [26].

Approximately 80% of the respondents confirmed that their institutions had guidelines and regulations on drug storage and management. However, approximately 50% of them responded that they had not undergone any training related to injection safety held by their institutions or external agencies, which indicates a lack of a continuous training process on injection practices. Also, regarding barriers safe injection practices, the high number of responses on "After acquiring a license, it is easy to forget about sterilization methods because of a lack of repeated education or training" and "There are not enough opportunities to learn about sterilization methods" suggests the importance of systematic and continual training in each area. Kossover-Smith et al. emphasized that training in basic prevention must be repeated continuous and repeated process right from the

early years of service of public healthcare service providers [27].

Naveed Zafar Janjua et al. argued that the introduction of syringes combined with reuse prevention devices should be considered at the national level [28]. Insufficient injectable medicine and related products and no reimbursements for the remaining drug after use were mentioned as barriers in adherence to safe injection guidelines. This means that the government should make reuse-prevention syringes available at lower prices and that it should gradually phase out the sale of the existing syringes and incentivize manufacturers that make reuse-prevention injections. However, to achieve this, close consultation among the government, hospitals, and manufacturers is required, and there is a limit to mandating the exclusive use of reuse-prevention syringes.

This study had several limitations. Participants (healthcare providers) were selected as a convenience sample and both online and offline methods; thus, the findings may not be entirely representative of healthcare providers in Korea. Second, despite asking the participants if they were working on medication injection or were managing and supervising medication injections the last one year to screen respondents, the job on medication injection including storage, preparation, and administration was not specified. It might vary among healthcare providers and would be useful to know more about the specific job related to injection and awareness level. Third, the measure for adherence to guidelines was based on self-report; thus, there might be the possibility of social desirability bias. Nevertheless, this study revealed factors associated with adherence to

guidelines in healthcare providers. Further study could be conducted to identify effective strategies for prevention of outbreak

V. Conclusions

This study's results indicate that controllable factors like training experience of healthcare providers and patient safety culture were positively associated with adherence to safe injection practices. The study concluded that healthcare providers be continually and repeatedly trained in safe injection practices to promote patient safety. Additionally, there should be an increased focus on developing and implementing policies to improve patient safety.

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