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Repeated reuse of insulin injection syringes and incidence of bacterial contamination among diabetic patients in Jimma University Specialized Hospital, Jimma, Ethiopia

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ABSTRACT

Objective: To determine the level of bacterial contamination of reused insulin syringes among diabetic patients.

Methods: A facility based cross sectional study was conducted among diabetic patients. Data on socio-demographic variables, history of injection syringe reuse, and frequency of reuse of syringes were collected using predesigned questionnaire. Finally, the samples from the syringes were cultured according to standard microbiological techniques.

Results: Eighteen diabetic patients at Jimma University Hospital participated. A total of 83.3% of participants reused a single injection syringe for >30 consecutive injections, while 16.7%, reused for ≤30 injections. Our results showed 22.2% of syringes were contaminated with methicillin resistant *Staphylococcus aureus*.

Conclusions: We conclude reuse of syringes is associated with microbial contamination. The findings that 4/18 syringes being contaminated with bacteria is an alarming situation. A mechanism should be designed for patient's to get injection syringes with affordable price. If reusing is not avoidable, reducing number of injections per a single syringe and avoiding needle touching with hand or other non-sterile material may be an alternative to reduce the risk of contamination.

1. Introduction

Diabetes mellitus (DM) is diverse group of hyperglycemic disorders with different etiologies and clinical pictures. The hyperglycemia observed in DM is caused by either a lack of insulin or insulin insensitivity by the tissue[1].

The health impact of DM is considerable and as assessed overtime, the morbidity and mortality associated with it was related to both short and long term complications[2]. Globally (as of 2000), an estimated 285 million people had

diabetes, with type 2 making up about 90% of the cases. Its incidence is increasing rapidly, and by 2030 this number is estimated likely to double[3], while type 1 diabetes, causes an estimated 5%–10% (11–22 million) of all diabetes cases[4,5].

The management concentrates on keeping blood sugar levels as close to normal as possible, without causing hypoglycemia. This can usually be accomplished with diet, exercise, and use of appropriate medications[6]. Type 2 diabetes is treated with metformin, while type 1 diabetes with a combination of regular and neutral protamine hagedorn insulin, or synthetic insulin analogs[7,8].

Insulin is most commonly administered by injection at periodic intervals several times per day, though other options, such as insulin pumps exist. Insulin is usually

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given as a shot into the skin, a subcutaneous injection[7,8]. Diabetic patients are traditionally taught to discard plastic syringe/needle units after a single use and to employ aseptic technique for administering insulin injections. Moreover, recent advice from insulin needle manufacturers states that insulin needles should only be used on one occasion[9,10]. Use of a new, single-use syringe and needle is thought to provide the highest level of safety to the recipients[9].

However, repeated use of insulin needles by DM patients is not rare, rather it is the common practice in many countries, particularly in resource limited countries. Mainly unreliable and insufficient supplies and cost might lead to the syringe/needles being reused[11]. There are a number of controversial body of evidence on the repeated reuse of the syringe/needles. Some evidences suggest that repeated use of insulin needles increases the risk of infection[11–13]. Once the syringe gets contaminated, reusing it opens the way for microorganisms to cause infection at the repeated injection site. Others argued that most patients using disposable syringes, reuse them until the needle is blunt, could be a practice which is safe and economical[14,15].

However, there is currently inadequate data regarding the frequency and type of micro-flora contamination seen on syringes/needles after repeated use. This is especially true in our study area (Jimma) in particular and our country (Ethiopia) in general, where DM is one of the major causes of hospitalization in different health institutions[16].

By the time this study was conducted, diabetic patients at Jimma University Specialized Hospital (JUSH) were received only two injection syringes from the diabetic clinic until they returned for the next follow up mostly for a month. Patients think how effectively they should use the two syringes until they receive the other two during their next visit to the diabetic clinic. Some patients only discard the syringe only if the needle shows visible bends, and makes injection painful. There was and still is an awareness by health care professionals that patients reuse disposable syringes. Despite syringe labels that advise single-use only, this perception appears to have resulted in health care professionals developing occasional “unofficial” guidelines ranging from “use each syringe for no more than one or two days” to “use a syringe until it is no longer comfortable”[17].

Thus, the purpose of this study is to determine the level of bacterial contamination of reused syringes by DM patients on regular follow-up at diabetic clinic of JUSH.

2. Materials and methods

2.1. Study area and period

The study was conducted in JUSH, diabetes clinic, one of the chronic diseases clinics of the hospital, rendering service twice weekly on Monday and Tuesday. JUSH is a

teaching and referral hospital found in Jimma town, and located at south west of Ethiopia, about 352 km from Addis Ababa, the capital of Ethiopia. The town has a characteristic of tropical highland climate condition, heavy rain fall, warm temperature, and long wet period[18]. The hospital serves a total of five million populations in southwest Ethiopia.

2.2. Study design and subjects

A facility based cross sectional study was conducted from February–June, 2008 among diabetic patients. A total of 18 diabetic patients who have been active in follow-up for their diabetes for more than one year at JUSH diabetic clinic, willing to participate in this study, and who uses insulin injection medication were included in this study. Data on socio-demographic variables (like age, sex, occupation, marital status), history of injection syringe reuse, and frequency of reuse of insulin injection syringes were collected using predesigned questionnaire by trained nurse. Printed forms were supplied to the nurse to record the following retrospective data’s: duration of previous insulin therapy, number of injections, location of the injection sites, frequency of needle reuse and complications associated with the injection procedure and injection sites. Generally, three approaches were used to collect the required data: (i) interview/questionnaire, (ii) examination of injection sites, and (iii) culturing of samples from insulin syringes (Table 1).

Table 1

Distribution of demographic characteristics and methicillin resistant *Staphylococcus aureus* (MRSA) study participants.

Variables		Number (n)	Frequency (%)	MRSA		
				Positive	Negative	Percentage (%)
Gender	Female	7	38.9	2	5	28.6
	Male	11	61.1	2	9	18.2
Age group (years)	15–30	4	22.2	0	4	0.0
	31–45	6	33.3	3	3	50.0
	46–65	8	44.4	1	1	12.5
Occupation	Farmer	8	44.4	2	6	25.0
	Housewife	7	38.9	2	5	28.6
	Merchant	1	5.6	0	1	0.0
	Student	2	11.1	0	2	0.0
Marital status	Married	15	83.4	4	11	26.7
	Single	2	11.1	0	2	0.0
	Divorced	1	5.6	0	1	0.0
Frequency of reusing a single syringe	<30 times	3	16.7	0	3	0.0
	>30 times	15	83.3	4	11	26.7
Habit of recapping the needle	Yes	18	100.0	4	14	22.2
	No	0	0.0	0	0	0.0
Awareness on the risk of reusing injection syringe	Yes	5	27.8	1	4	20.0
	No	13	72.2	3	10	23.1
Skin lesion on injection site	Yes	4	22.2	3	1	75.0
	No	14	77.8	1	13	0.8
Total		18	100.0	4	14	22.2

2.3. Sample collection and analysis

Reused injection syringes from each study subject were separately collected with sterile plastic container. Samples were labeled properly and as soon as possible (within 2 h of collection) transferred to the medical microbiology laboratory for processing and analysis.

2.4. Laboratory investigation

After the samples (reused injection syringe) was brought to JUSH microbiology laboratory, it was put in refrigerator until it was processed. Culture medias (MacConkey agar, blood agar, mannitol salt agar and nutrient broth) were prepared and incubated over night to check for media sterility. The recapped syringe was detached aseptically, leaving the needle free for washing. The needle of each reused injection syringe was washed by sterile swab using distilled water, and the sample suspension was placed in sterile test tubes labeled accordingly. Each sample was inoculated to four different culture medias. Negative control sample (new, unused injection syringe) was processed the same way as patient syringe. Additionally, one from each type of culture media was left not inoculated. Both inoculated and control medias were incubated over night to appreciate the presence of growth. Colony characteristic was read after 24 h of incubation. Following colony characterization, culture medias for biochemical test and antibiotic sensitivity testing (triple sugar iron, sulfide–indole–motility medium, Simmons citrate agar and Muller Hinton agar) were prepared. Sample suspension from each colony was prepared using normal physiologic saline, and the sample was inoculated to culture medias which were ready for biochemical test and antibiotic sensitivity testing according to standard microbiological test methods. All the work was performed under a laminar air flow–cabinet using aseptic procedures. All results of biochemical test including catalase, coagulase and indole tests were recorded (Table 2). Colonies from culture medias were also Gram stained to characterize bacteria based on their Gram reaction, microscopically. The data obtained from the questionnaire and laboratory investigation were carefully documented and analyzed. Descriptive statistics

was used to characterize the socio–demographic variables and the microbiological test results. Finally, outcomes were presented using tables.

2.5. Ethical consideration

Ethical clearance was obtained from Ethical Clearance Committee of Jimma University. The study participants participated in the study after informed verbal consent was obtained. Study participants were reimbursed and/or got replacement for the syringe they provided for the study. Findings of the study was communicated to JUSH diabetic clinic for proper intervention (in order to provide health information on the risk of reusing injection syringe to all study participants and other diabetic patients).

3. Results

Eighteen out–patients from the diabetes clinic at JUSH, Jimma, with insulin dependent diabetes, aged 15–65 years, consented to take part in this study. With respect to socio–demographic characteristics, most of study subjects were males 61.1% (11/18), >45 years old 44.4% (8/18), married 83.4% (15/18), and farmers 44.4% (8/18). All of them had been taking subcutaneous insulin injection for at least one year at the time of the study, and they had a history of reusing their insulin injection syringes. Most of the study participants (83.3%, 15/18) had been reusing their syringe for 15 or more days injecting themselves twice a day, which indicated that a single injection syringe had been reused for more than 30 consecutive injections. Whereas, the rest (16.7%, 3/18) reused the insulin injection syringe for 30 injections or less. However, all study subjects experienced to recap the needle after every single injection (Table 1).

Assessing the repeatedly reused insulin injection syringes obtained from study participants (self injection practice at home) for the presence of contaminant bacteria, the laboratory results showed that 4/18 (22.2%) injection syringes were found to be contaminated with MRSA. Colony characterization and biochemical test results of this study confirmed that the bacteria was Gram–positive, non–motile,

Table 2

Laboratory test results of cultures, biochemical and antibiotic sensitivity tests of the samples from insulin injection syringes, JUSH, Jimma, Ethiopia.

Culture media used	Colony characteristics	Biochemical test		Drug sensitivity test	
		Tests done	Result	Drugs tested	Result
MacConkey agar	Small, pink colony	Catalase	Positive	Penicillin G	Sensitive
Manitol salt agar	White–yellow colony	Coagulase	Positive	Gentamycin	Sensitive
Blood agar	White, non–hemolytic	Lactose	Fermenter	Amikacin	Sensitive
Nutrient broth	Turbid	Glucose	Fermenter	Vancomycin	Sensitive
Gram reaction	Gram–positive	Motility	Non–motile	Ampicilin	Sensitive
				Methicilin	Resistance

coagulase positive and resistant to methicillin (Table 2).

Moreover, 50.0% (3/6) of adults who were 31–45 years old, 25.0% (2/8) of farmers and 28.6% (2/7) of housewives were reusing insulin injection syringes which were contaminated with MRSA (Table 1). Skin lesion at the repeated injection site was observed on 4 diabetic patients, of whom for 3 of them their respective injection syringes were found to be positive for MRSA.

4. Discussion

The findings of the present study demonstrate that the reuse of disposable syringes is associated with microbial contamination. Four of the 18 (22.2%) insulin injection syringes were contaminated. As DM is a major public health problem throughout the world especially in many parts of Asia and East Africa^[3], it is anticipated that a lot of diabetic patients would be using continuous subcutaneous insulin injection to monitor their glucose level. Even if the syringe used is recommended to be disposed off after a single injection, it has been practiced to reuse it due to many reasons. It was reported, mainly, because patients couldn't afford the expense of injection syringe for their daily need. However, there are controversial reports concerning the reuse of insulin syringes with respect to risk of microbial contamination and cost–benefit analysis.

The MRSA detected in this study are known to colonize the skin and cause wound infection. It was similarly reported from Bassetti and Battagay that MRSA contaminated repeated insulin injection syringe used by drug injection users^[12]. Likewise, Jarosz–chobot *et al.* report showed that both *Staphylococcus epidermidis* and *Staphylococcus aureus* were found to be contaminant bacteria for the reused syringe in children taking continuous subcutaneous insulin injection^[13]. Regardless of the type of bacteria, the above reports commonly share the fact that reused injection syringes are liable for contamination which may possibly end with complication of the infected area. On the contrary, Schuler *et al.* reported no sign of local infection despite needle reuse of more than 33000 injections among 20 diabetic patients underlining that the reuse of pen needles as a simple, safe and cost–beneficial procedure^[14]. In the same way, Thomas *et al.*, Islam and Ali, Fleming, Collins *et al.* all supported reuse of insulin injection syringe and reported no adverse events^[15,19–21]. The disagreement between our finding and the aforementioned reports could be attributed to the difference in the study population, the way patients handle and store the syringes/needles, their personal and environmental hygiene, the aseptic technique followed during injection, and the level of awareness of risk of contamination and practicing appropriate guidelines and

precautions. It is our sincere believe that reusing insulin injection needles by itself may not be the only reason for needle contamination as there are a number of factors as mentioned above could play crucial roles. Yet, it needs further in–depth investigation at different localities of the world. In this study, skin lesion at the repeated injection site was observed on 3/4 diabetic patients, whose respective injection syringes were positive for MRSA. Hence, the skin lesion at the repeated injection site could be attributed to MRSA. However, it couldn't exclude other contaminant microorganisms and infections which may also result in skin complication including the effect of distorted needle structure^[10,22]. It has been well elucidated that skin lesions and skin irritation are usually associated with bacterial contamination^[15,23]. In this study, injection needles reused 30 times or less, showed no bacterial contamination and skin lesions at repeated injection sites. This would be supported by Borders *et al.* who suggested that limited reuse of plastic syringes is safe^[11]. However, this study failed to recommend the view that reusing a syringe for 30 injections or less is safe to insulin users against infection or bacterial growth on injection syringes. This may be attributed to the small patients cohort included in this study. Nevertheless, although small sample sizes, the results are rather as expected, hence we believe the results are rather as expected, the results can contribute to an improved awareness among Ethiopian diabetes patients of the negative consequences of reusing syringes and how the risk could be reduced if reuse cannot be avoided.

Repeated use of insulin syringes (needles) by diabetic patients is not rare; rather it is the rule in many part of the world specially in developing countries. This study confirms the same scenario in JUSH diabetic clinic follow–up diabetic patients (all participated subjects were reusing their syringes). Although we admit the sample size of this study was rather small, the findings that 4/18 syringes being contaminated with MRSA is an alarming situation that MRSA was one of the contaminant microorganisms and it might be the major responsible factor for the skin lesion at the repeated injection site. Beside, the question of affordability (price) issue of syringe for their daily use, we suggest that needle reuse should not be optimal practice. Thus, the risk must be weighed against the convenience of needle reuse and the effect on health care budgets of providing a new needle for each injection. Therefore, we support the provision of sufficient number of injection syringes for patient's daily need or there should be a way for patient's to get injection syringes with affordable price. If reusing is unavoidable, reducing the number of injections per a single syringe and avoiding needle touching with hand or other non–sterile material may be an alternative to reduce the risk of contamination. Finally, the presence of MRSA only on 4/18 reused syringes does not rule out the absence of other

microbial contaminants. Hence, we invite other researchers to further elucidate the risk of reusing insulin injection syringes and project the possible solutions.

Conflict of interest statement

We declare that we have no conflict of interest.

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