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Reduction in Needlestick Injuries Using a Novel Package of Interventions

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Reduction in Needlestick Injuries Using a Novel Package of Interventions

by

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of the requirements for the degree of
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DEDICATION

I dedicate my thesis work to my family and friends who have been supportive. I would like to dedicate this to the most important women in my life- my mother and wife. They have make countless sacrifices to ensure that I am able to fulfill my hopes and dreams. Tara Patel, thank you for being the best mother in the world. Megha Patel, thank you for everything that you do for me and our families.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

In 2015 Dr. Pratiksha Vaghela started the “Stop Poking Me” campaign which was aimed at curbing the increase in the number of needlesticks at the James A. Haley Veteran Affairs Hospital (JAHVA). The data for needlesticks was collected by the Occupational Medicine Clinic (OMC) between Oct 2013 and Oct 2016. We then obtained the original data from Dr. Vaghela’s project and compared the data to assess whether the new implementations have truly decreased the number of needlesticks. There was a 23.6% reduction in the number of needlesticks between 2013 and 2016 and even more importantly a 60.1% reduction between 2015 and 2016. Our project shows that the decrease correlates to the implementation of the “Stop Poking Me” campaign.

INTRODUCTION

Healthcare workers (HCW) who are at risk for blood exposure are at an increased risk for acquiring over 20 bloodborne diseases. The major concern is the exposure to hepatitis (B and C virus) and acquired immunodeficiency syndrome (AIDS) from human immunodeficiency virus (HIV) (Calver, 1997). The potential risk for transmission from the source patient to healthcare worker is important and requires interpretation of viral load of the source patient and the amount of blood exposure (Goldman, 2002; Goldberg, Johnston, Cameron, Fletcher, Stewart, McMenamin, Codere, Hutchinson, & Raeside, 2000). The risk of transmission of HBV is between 2 and 19%, especially among the HCW without vaccination or non-responders (Lewis, Enfield, & Sifri, 2015). E-antigen (HBeAg) plays a key role in the range of HBV transmission in that HBeAg-negative blood is less likely to cause transmission than HBeAg-positive blood (Lewis et al, 2015). The transmission rate of HCV is estimate to be 1.8% (Centers for Disease Control and Prevention, 1998). The transmission rate of HIV is <0.3% (Cardo, Culver, Ciesielski, Srivastava, Marcus, Abiteboul, Heptonstall, Ippolito, Lot, McKibben, & Bell, 1997). Besides the risk of infection, there are also possible consequences of anxiety and emotional distress related to needlesticks (Lee, Botteman, Xanthos, & Nicklasson, 2005).

While most of the occupational exposures occur in worldwide, 90% of the reports of occupations infection occur in the US and Europe (Sagoe, Pearson, Perry, & Jagger, 2001). According to the UK National Health Service, needlestick injuries were there second most common reported adverse incidents in work related injuries (National Audit Office, 2003). Occupational Safety and Health Administration estimates that each year 5.6 million healthcare and related employees are at risk for exposure to bloodborne pathogens such as HIV, HBV, and HCV. Each year, the CDC estimates that around 384,000 needlestick injuries occur. Even with these high number of reported injuries, research has shown that there is about 40-75% underreporting of needlesticks (Pugliese & Salahuddin, 1999). The CDC also estimated that up to 83 percent of these sharps injuries can be prevented (Ippolito, Puro, Petrosillo, Pugliese, Wispelway, Tereskers, Bentley, & Jagger, 1997).

A hierarchy of controls is recommended to curb the incidence of needlesticks. According to the American Nurses Association, the hierarchy includes elimination of the hazard, engineering controls, administrative controls, work practice controls, and personal protective equipment (American Nurses Association, 2002). The hierarchy of controls is shown in Figure 1. Elimination of the hazard is the most effective while PPE is the least effective. Each of these factors were considered for the implementation of this project that was conducted at the JAHVA.

METHODS

Three hundred and eighty-three reports of employee exposure to blood or bodily fluid from the JAHVA in Tampa, Florida between October 2012 and September 2016 were reviewed for this study. The data was gathered by the Occupational Health Clinic on an Excel Spreadsheet that was free of patient identifiers. The data includes needlestick injuries not only included needlesticks but all exposure to blood and other potentially infectious material (OPIM) based on OSHA's Bloodborne Pathogens standard (29 CFR 1910.1030). Splash from blood or OPIM, exposure to blood or OPIM from instruments (scalpel, bovie, etc.) and needlesticks were included in the collection of our data. This is slightly different from other research studies because they tend to group needlesticks in their own group. The data that was provided includes both needlestick injuries and exposure to blood or OPIM.

A one-way analysis of variance (ANOVA) was used to determine whether there was any statistically significant difference between three or more unrelated groups. In this analysis there test was used to determine a difference between the means of each of the fiscal years. An ANOVA test was run between each of the groups to identify if there was a significant decrease in the years prior to intervention to the result (Fiscal Year 2016). As shown in Table 1, Fiscal years were compared in groups prior to FY 2016. The first row compared all of the present data (FY 2012, FY 2013, FY 2014, FY 2015, and FY 2016) to each other. Then next row compares one year later (FY 2013, FY 2014, FY 2015, and FY 2016) to each other. The last row compares one year later (FY 2014, FY 2015, and FY 2016) to each other. The ANOVA test cannot show if there are significant difference within the groups but can show that a difference is present. The F-statistic was also calculated to show if the mean between the groups are significantly different. This is different than the usual T-statistic because that is derived from the T-test, which only looks at a single variable. The F-test is used to tell if the difference between the groups (fiscal years) of variables (needlesticks per month), is jointly significant. The p-test was also used to confirm that the overall results were significant. As evident in Table 1, all of the F-statistics would be classified as significant. However, the p-value allows us to examine the bigger picture and assess whether all of the variables (needlesticks per month) are significant. As opposed to looking at just the group via the F-statistics, the p-value allows us to look at all of the variables as well.

The ANOVA test was conducted first to reduce the change of a Type 1 error. This error is typically 5% but in the case of running three t-test on the same data can increased to 14.3% (1-(0.95.*0.95*0.95)). If we were to conduct multiple t-test for all of data (5 t-tests), the Type 1 error would have been 23%. This high error rate would have made our analysis worthless. However, conducting the ANOVA allowed us to determine where the statistically significant data might be presents. Because of this we could analyze the data between only the groups where there was significantly different data, Fiscal Year 2013 to Fiscal Year 2016. Table 2 was developed to show the p-value of the differences between only two fiscal years at a time. The fact that only two groups were compared at a time, we could preserve the 5% Type I error instead of the combined 23%. Table 2 also confirms that there was a significant difference between the Fiscal Year 2016 and Fiscal Year 2014. There was also a significant difference between FY 2016 and Fiscal Year 2015. This table shows that there was 26.3% reduction between FY 2014 and FY 2016. There was also a 60.1% reduction between FY 2015 and FY 2015. This shows that not only did the intervention work but it was significant from a statistical perspective.

RESULTS

The total number of needlesticks per month were compiled in a table starting from Fiscal Year 2012 (October 2011- September 2012) to Fiscal Year 2016 (October 2015 to September 2016). The average needlesticks per fiscal month was calculated by the summation of the total number of needlesticks in the year divided by 12. These averages were then graphed into Figure 2. This figure shows that there was an average of 5.92 needlesticks per month in FY 2012, 6.42 needlesticks per month in FY 2013, 6.42 needlesticks per month in FY 2014, 8.08 needlesticks per month in FY 2015, and 5.08 needlesticks per month in FY 2016. This graph shows there was a steep increase in the number of needlesticks between fiscal year 2014 and fiscal year 2015. This upward trend sparked the need for intervention and was the catalyst to Dr. Vaghela's project. The rise is shown in Figure 3. For the remainder of this section we used April 2015 as the peak of the number of needlesticks. The complete intervention was completed by October 2015, which coincides with the start of Fiscal Year 2016. Fiscal Year 2016 was used to show the result of the intervention. Figure 4 shows the downward trend of needlesticks. Noticeable in Figure 4, is the downward slope (-.21).

Figure 4 shows the different stages of intervention as recommended by the "Stop Poking Me" project. The ★ is the start of the standardization of the needles and reeducation of nursing staff in Ambulatory Care and Acute Care. For her project, Dr. Vaghela interviewed the head of the Sharps Safety Task Force which included the Supervisor of the Medical Supply, the Safety Specialist, and the staff at the occupational health clinic to identify the potential causes for the rise in needlestick injuries. Her investigation showed that the concerns were the variation in the types of safety devices, the lack of familiarity with devices, and improper disposal techniques. Also in

May 2015, needles that were not selected as part of the standardization process were removed from the shelves. The next stage is depicted in Figure 4 as and emphasized education. At this stage the Sharps Safety Task Force, advocated for standardization of devices, use of more passive safety devices, testing of new devices, better packaging of devices, and simplification of multiple process with the elimination of unnecessary steps. The Occupational Health Physician, Dr. Rachel Williams, also encouraged residents to maintain a checklist prior to procedures. She noticed that there was an increase in needlesticks prior to bedside procedures and thus she attempted to encourage a culture of safety amongst Internal Medicine residents. She presented at noon conference regarding safety precautions during high risk procedures (thoracentesis, IV placement, central line placement). She also discussed the importance of elimination of distractions while attempting high risk procedures. These interventions were crucial in educating and retraining the staff to implement an increase emphasis on safety. Education at noon conference and emphasis on safety occurred from July 2015 to September 2015. The depicts the point at which all of the interventions were fully implemented, which was October 2015 and coincided with the start of fiscal year 2016. This allowed for a clean analysis of the effects of the intervention The is when there was an incident when Logistic Service ordered a different set of needles when the usual device was backordered and there was a spike in the number of needlesticks with the substituted device. This exemplifies the need for standardization.

DISCUSSION

Prevention of needlestick injuries has been a topic of concern for several decades. Many of the research conducted in the earlier years have laid the foundation for workplace policies. In 1981, McCormick et al reported that there should be no need to recap needles and that there should be an increase in efficiency of needle disposal systems (McCormick & Maki, 1981). The same research also advised that all hospital employees should be encouraged to report needlesticks to their occupational health provider (McCormick et al, 1981). Unfortunately, the problem of underreporting remains even 27 years after McCormick and Maki's initial report.

In 1982, the Center for Disease Control released recommendations to prevent needlestick injuries (Center for Disease Control, 1982). In their Morbidity and Mortality Weekly Report, the CDC recommended that "needles should not be recapped, purposefully bent or broken by hand, removed from disposable syringes, or manipulated by hand" (CDC, 1982). This report also recommended proper disposal techniques to prevent injury in transport of the needles (CDC, 1982). Both Canada (Laboratory Center for Disease Control, 1987) and the UK (UK Department of Health, 1990), have implemented similar recommendations to reduce needlestick injuries. These recommendations were part of the educational training that was given to the staff at JAHVA. A recent meta-analysis also showed that double-gloving or "no-touch" technique also reduced needlestick injuries (Rogers & Goodno, 2000). Educating staff by using a structured blood borne pathogen training program has shown to reduce self-reported needlestick injuries (Wang, Fennie, Burgess, & Williams, 2003). Other studies have shown improvement through education approaches using educational sessions, interactive sessions, monthly meetings, poster competitions, lecture series, and teaching programs (Zafar, Habib, Hadwani, Ezaj, Khowaja, Kowaja, & Irfan, 2009; Yang, Lio, Chen, Yang, Wang, Chen, & Wu, 2007).

In 1991, Linnemann et al analyzed 1602 needlesticks from 1985 to 1989 at the University of Cincinnati (Linnemann, Cannon, DeRonde, & Lanphear, 1991). They implemented three major interventions during this time period; educational program (1986), rigid sharps disposal containers placed in all hospital rooms (1987), and universal precautions introduced with an intensive service (1988) (Linneman et al, 1991). The group the concluded that there was an increase in the number of reported injuries and they attributed this increase to the new educational programs. They also saw a reduction in recapping injuries from the installation of the rigid sharps containers. The authors also noted that the implementation of all three did not produce a significant reduction in needlestick injuries (Linneman et al, 1991).

In 1995, Weltman et al discovered predictive factors for sharp injuries (Weltman, Short, Mendelson, Lilienfeld, & Rodriquez, 1995). These included sharp containers greater than 4 feet above the ground, lack of attendance to educational training sessions, or being within 5 feet of the nearest disposal container (Weltman et al, 1995). This was not a component of our project but could be helpful to determine other predictive factors in the future.

Multiple research studies have been conducted to show the reduction in sharp injuries because of the use of passive safety mechanism (Goris, Glotzer, Gemeinhart, Wojtak, Zirges, & Babcock, 2014; Tosini, Ciotti, Goyer, Lolom, L'Heriteau, Abiteboul, Pellissier, & Bouvet, 2010). In 2008, Whitby et al, examined needlestick injuries at a major teaching hospital in Australia before and after implementation of safety-engineered devices (Whitby, McLaws, & Slater, 2008). These devices included retractable syringes, needle-free intravenous systems, and safety winged butterfly needles (Whitby et al., 2008). They found that there was a 49% decrease in hollow-bore needlestick injuries (Whitby et al., 2008). This reduction is similar to the one observed in our study.

Grimmond and Good showed in the EXPO-STOP national survey, the importance of percutaneous sharp injuries incidence comparison between other hospitals using occupied beds and full-time equivalent staff as the denominator (Grimmond & Good, 2017). This allows for uniformity of comparable data points within different hospital settings. This ratio was used to calculate the national average of observed needlesticks based on full time employees and daily occupied beds. Grimmond also adjusted the observed data due to the level of underreporting (Grimmond et al, 2017). The full-time employees in JAHVA were listed to be 4,714 employees. The number of residents and students were not added to this denominator. This could have impacted the rate. The number of occupied beds varied between the years but the average was calculated to be 503. The unadjusted data is shown in table 3. Grimmond et al used a 60% adjustment for the true number of sharp injuries to eliminate the concern for underreporting (Grimmond et al, 2017). We adjusted our data in Table 4 to match their data set. Table 4 reveals that using their incidence rate at 30.4, JAHVA was only above the average in fiscal year 2015. Our data supports a decrease that is lower than that expected based on the Grimmond model. Table 5 and 6 show that the relationship between the JAHVA Data compared to the EXPO-STOP by percentages. In table 5, we can see that there was a significant percentage reduction compared to the EXPO-Stop data. We believe that this is likely due to the 60% underreporting that was used in Gimmond's dataset. The same significant reduction is not evident in Table 6, for the needlestick injuries per 100 full-time employees. Table 7 and 8 show the percent reduction after adjustment for underreporting. Table 7 shows the percentage reduction for adjusted data for needles sticks per 100 occupied beds. Table 7 reveals that there was a significant increase in fiscal year 2015 by

21.8%. Table 7 also shows that there was a significant decrease of 16.25% in fiscal year 2016. This reversal shows that the intervention was useful in decreasing the number of needlesticks below that national average. Table 8, however shows that there was only a 88% increase in the number of needlesticks per 100 full time employees versus the EXPO-Stop data, even after adjusting for underreporting.

Limitations

There were several limitations of this study that could have influenced the conclusions. First, there was no demographics of the employees who were being stuck with the needles. Due to HIPPA and IRB requirements, no personal identifiers such as age, gender, or length of work were obtained. This could be important because age, sex, and length of work history could contribute to the initial injury.

Secondly, as discussed before, underreporting is a major issues in the needlestick injuries. There is a level of hierarchy in the medical community that might have negatively skewed certain groups such as residents, head nursing staff, and physicians from reporting needlestick injuries. This level of underreporting can also be an issues when trying to determine if certain interventions are successful.

Lastly, there is concern that the number used for the exact number of full-time employees might be higher than we have quoted. This is because the current number does not reflect the hundreds of medical students, nursing students, residents, and fellows present at the JAHVA. This could cause an artificial elevation in number of sharp injuries per FTE. Although this is the case, we have assumed the number of students, residents, and fellow would not vary drastically across the five years of the study time.

Strengths

The major strength of this study is that there were consecutive years of exposure data at the JAHV and the data collection was followed in a systematic way throughout the years of observation. There were no changes in the way the data was collected and this allowed for an accurate prevalence of needlestick injuries even across different years.

The other major benefit of this project was the use of the Grimmond model to appropriate compare the data to the national averages (Grimmond et al, 2017). Although it was important to show a significant decrease in the number of needlestick injuries within the facility, it was more meaningful to show a fall below the national average.

Another strength of this study is that generalizability of the findings. As noted before, there were many interventions that were packaged into the improvement project. However, from our results we found that standardization of needle was the most important. Figure 4 shows evidence of the importance of standardization. In Figure 4, the symbol, , shows an incident when standardization was not met. In April 2016, needles were ordered that did not were not part of the previously selected needles. This lead to a notable short-term increase in the number of needlesticks. This could have been related to the use of another needle that nursing staff was not previously trained. This could also strengthen the notion that standardization is crucial to prevent needlesticks.

CONCLUSIONS

Overall, this study was useful in showing that the interventions recommended by the 2015 Quality Improvement projection were associated with a significant drop in the number of needlesticks between 2014 and 2016. The Grimmold model allowed this data to be compared to the national averages. We have been able to show that before the intervention, JAHVA's needlesticks were higher than the national average as compiled by EXPO-STOP and after the intervention, JAHVA dropped below the national average in the number of needlesticks.

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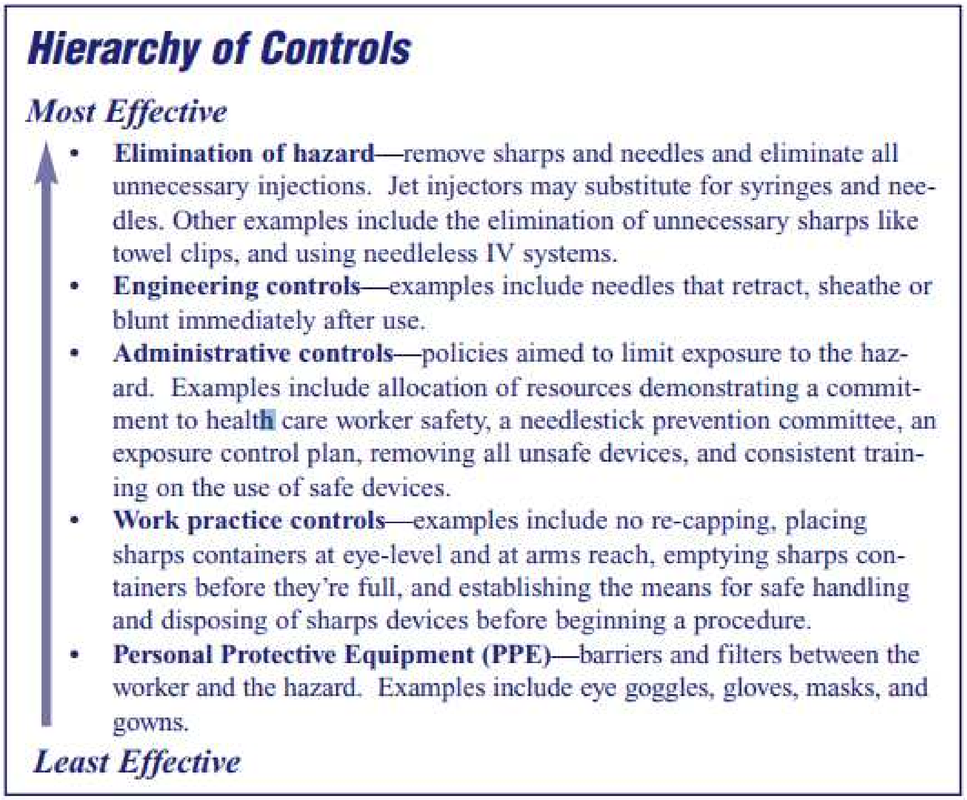
APPENDIX



Hierarchy of Controls

Most Effective

- **Elimination of hazard**—remove sharps and needles and eliminate all unnecessary injections. Jet injectors may substitute for syringes and needles. Other examples include the elimination of unnecessary sharps like towel clips, and using needleless IV systems.
- **Engineering controls**—examples include needles that retract, sheathe or blunt immediately after use.
- **Administrative controls**—policies aimed to limit exposure to the hazard. Examples include allocation of resources demonstrating a commitment to health care worker safety, a needlestick prevention committee, an exposure control plan, removing all unsafe devices, and consistent training on the use of safe devices.
- **Work practice controls**—examples include no re-capping, placing sharps containers at eye-level and at arms reach, emptying sharps containers before they're full, and establishing the means for safe handling and disposing of sharps devices before beginning a procedure.
- **Personal Protective Equipment (PPE)**—barriers and filters between the worker and the hazard. Examples include eye goggles, gloves, masks, and gowns.

Least Effective

Figure 1: Hierarchy of Controls for the Prevention of Needlestick Injuries (American Nurses Association, 2002).

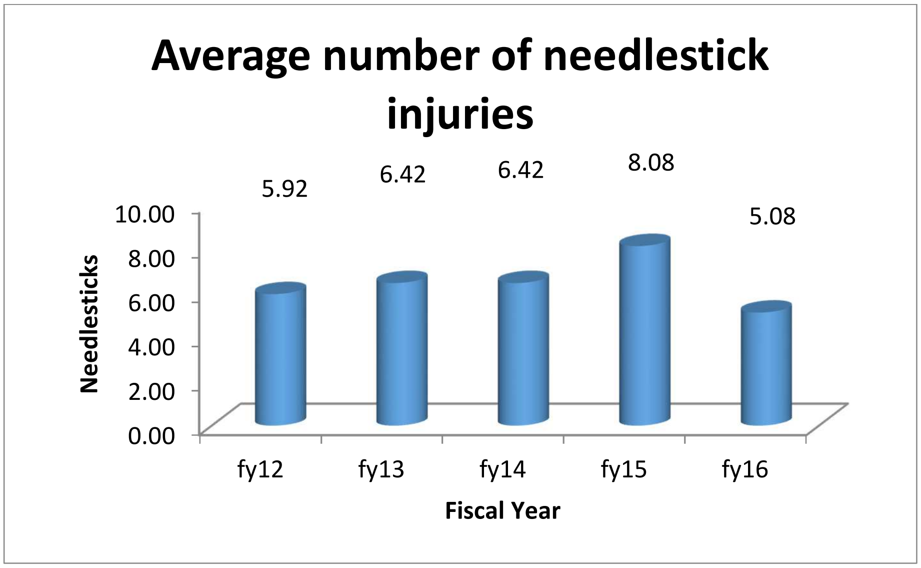


Figure 2: Average needlesticks per month from Fiscal Year 2012- Fiscal Year 2016.

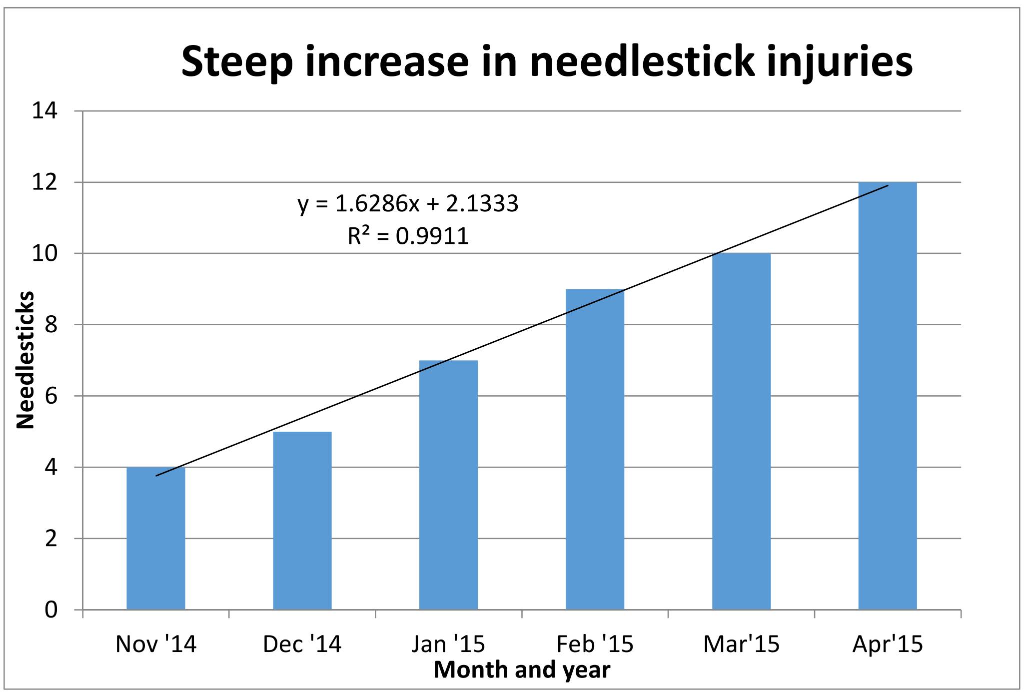


Figure 3: The sharp increase in the number of needlesticks between November 2014 and April 2015.

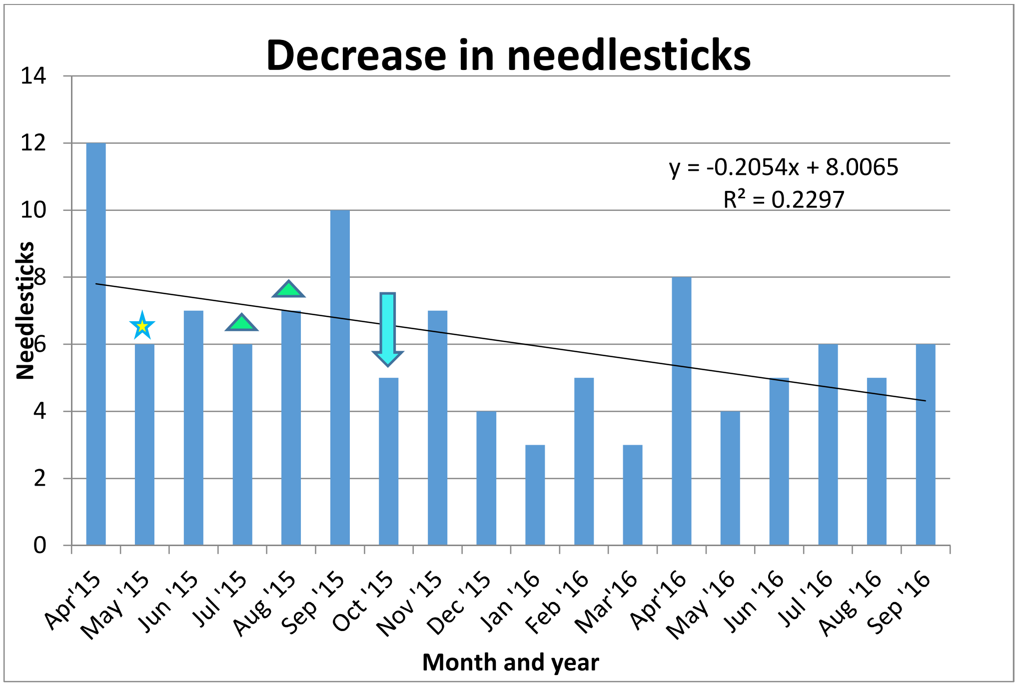


Figure 4: Trend from April 2015 to September 2016

Table 1: ANOVA between the groups

FY	F-statistic	P-Value
12 to 16	2.325	0.068
13 to 16	3.093	0.037
14 to 16	4.642	0.017

Table 2: T-test showing the P-values between each of the groups

FY	**14**		**15**		**16**	
	% difference	**p-value**	**% difference**	**p-value**	**% difference**	**p-value**
13	0	1	20.5	0.142	-26.3	0.144
14			20.5	0.184	-26.3	0.043
15					-60.1	0.007

Table 3: Comparison of JAHVA Data vs. EXPO Stop

	EXPO STOP	FY 12	FY 13	FY 14	FY 15	FY 16
SI/100 Occupied Beds	30.4	16.47	17.86	18.06	22.22	15.28
SI/100 Full-time equivalent staff	2.1	1.76	1.91	1.93	2.38	1.63

Table 4: Comparison of JAHVA Data vs EXPO STOP (using adjustment for under reporting)

	EXPO STOP	FY 12	FY 13	FY 14	FY 15	FY 16
SI/100 Occupied Beds	30.4	27.45	29.76	30.09	37.04	25.46
SI/100 Full-time equivalent staff	2.1	2.93	3.18	3.22	3.96	2.72

Table 5: Comparison of SI/100 Occupied Beds JAHVA Data vs. EXPO Stop by percentage

	FY 12	**FY 13**	**FY 14**	**FY 15**	**FY 16**
Percent Reduction	-45.8	-41.3	-40.6	-26.9	-49.7
p- value	3.88E-16	8.50E-13	2.30E-12	1.25E-05	1.58E-19

Table 6: Comparison of SI/100 FTE JAHVA Data vs. EXPO Stop by percentage

	FY 12	**FY 13**	**FY 14**	**FY 15**	**FY 16**
Percent Reduction	-16.2	-9.0	-8.1	13.3	-22.4
p- value	0.56	0.76	0.78	0.68	0.41

Table 7: Comparison of SI/100 Occupied Beds JAHVA Data vs. EXPO Stop by percentage (using adjustment for underreporting)

	FY 12	**FY 13**	**FY 14**	**FY 15**	**FY 16**
Percent Reduction	-9.70	-2.11	-1.02	21.84	-16.25
p- value	0.14	0.75	0.88	0.002	0.01

Table 8: Comparison of SI/100 FTE JAHVA Data vs. EXPO Stop by percentage (using adjustment for underreporting)

	FY 12	FY 13	FY 14	FY 15	FY 16
Percent Reduction	39.52	51.43	53.33	88.57	29.52
p- value	0.3	0.2	0.2	0.03	0.4