Reducing nursing needlestick injuries in haemodialysis clinics: a quality improvement program

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Abstract

Background Haemodialysis staff are at high risk of needlestick injuries (NSIs). Hollow-bore needles containing blood are associated with increased risk of acquiring blood-borne viruses (BBVs). A cluster of NSIs reported on our electronic risk management system prompted a closer review of NSIs across our 19 haemodialysis clinics over 18 months.

Actions This project involved: communication between all members of the health care team; a root cause analysis of all reported NSIs; a review of possible preventive measures; and the development of NSI prevention protocols and education of staff.

Results NSIs decreased by 47% with needle stick protrusion accounting for 32% of all NSIs.

Conclusion Implementing a quality improvement and risk management project resulted in a significant reduction in NSIs for both staff and patients.

Keywords

Needlestick injury, haemodialysis, cannulation, nursing, needle tip protrusion.

Background

Haemodialysis staff risk high exposure to blood-borne viruses (BBVs) (Perry *et al.,* 2001). BBVs include hepatitis B virus, hepatitis C virus and human immunodeficiency virus (HIV). The risk of acquisition of hepatitis B virus from exposure to a blood-contaminated hollow-bore needle is 1 in 3, hepatitis C virus acquisition risk is 1 in 30 while acquisition of HIV is 1 in 300 (Wittmann *et al.,* 2007). Risk of exposure and subsequent acquisition of a BBV is higher when handling blood-contaminated hollow-bore needles than any other sharps or from blood or body fluid splashes (NOHSC, 2010).

During one patient care episode the potential use of needles can include: the administration of two local anaesthetics; insertion of two fistula needles; administration of an anticoagulant; administration of one or two IV medications and removal of two fistula needles. This totals nine potential hollow-bore needle contacts per patient. Dialysis staff provide care for an average of four patients per shift, so the potential contact with needles can occur 36 times per dialysis nurse per shift.

Thrum (2000) discussed the degree of exposure risk to BBVs as related to the length of employment in an occupation with frequent blood/needle exposure and the prevalence of BBVs in the client population. While haemodialysis nursing is an occupation with frequent needle exposure, less than 2% of our patient population have BBVs. Therefore, the likelihood of acquisition of a BBV in our organisation is low. However, the consequences of acquisition of a BBV can be catastrophic to the staff, their family and the organisation. Incidence of needlestick injuries (NSIs) should be aimed at zero occurrences.

Our organisation comprises 19 haemodialysis clinics across Australia and New Zealand, averaging 12 haemodialysis stations per clinic. Dialysis staff in the clinics usually consists of a dialysis unit manager, registered nurses, enrolled nurses and dialysis technicians. Support staff are patient service attendants (PSAs) and administrative assistants. The dialysis staff perform the haemodialysis treatments and are most at risk of NSIs. The PSAs have a close support role with the patients and are also at risk of NSIs, though to a lesser extent.

Both the director of nursing and the national quality coordinator review all incidents reported on our electronic risk management system twice weekly. This practice enables an early alert to any new trends or clusters of incidents as in this case

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with NSIs. This system supports in-depth review and follow-up with quality improvement plans involving both corrective and preventive actions.

A cluster of NSIs reported on the electronic incident management system over three months prompted a quality improvement project to review the causes of NSIs, implicating factors, preventive measures and develop NSI prevention protocols to decrease the risk of future occurrences of NSI. The aim was for zero NSIs.

The highest number of NSIs related to needle tip protrusion. A needle tip protrusion occurs when the fistula needle protrudes through the patient's vessel and skin and penetrates the staff member's finger. The fistula needle, which is now contaminated by both the patient's and the staff member's blood, must then be removed by pulling it back through the patient's skin and vessel. This then exposes the patient to the staff member's blood. NSIs from needle tip protrusion results in high exposure risk to both the staff and patient. Needlestick protrusion-related injuries were not a result of non-compliance with protocols. With further investigation when needle tip protrusion occurred our goal was to reduce the likelihood of this happening and becoming a NSI.

Actions

A comparison of NSI incidence rates was made before and after the initiation of the quality improvement and risk management project. This project involved further communication with all health care team members. A memo was immediately sent to all staff alerting them to the number of NSIs reported and reminding them of sharps safe handling and disposal: no recapping and immediate safe disposal of sharps. In addition, root cause analysis of all reported NSIs was undertaken. A root cause analysis method was used to investigate every reported NSI to determine common causes, the reasons for non-compliance with current policies and common practices.

Needle tip protrusion

Needle tip protrusion incidents were the major cause of NSIs, accounting for 32%, eight of the total 25 NSIs. Seven of the eight injuries were caused by the arterial fistula needle, which

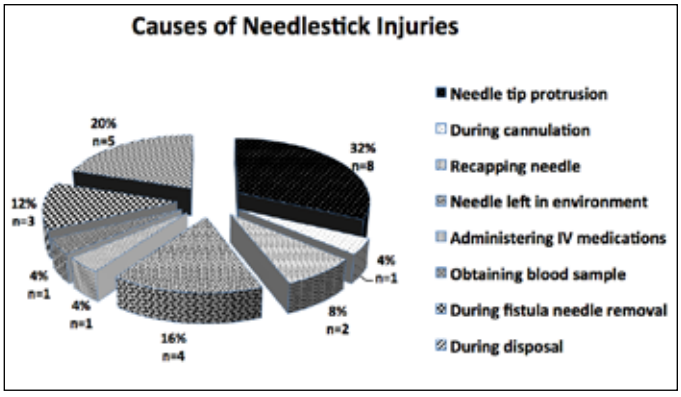


Figure 1. Causes of NSIs.

was in an antegrade position (pointing toward the shoulder in the direction of the blood flow), while inserting or after removal of the venous fistula needle. Antegrade cannulation of arterial needles is the accepted practice for haemodialysis clinics in Australia (Schoch *et al.,* 2012). However, van Loon's (2009) review demonstrated that the direction of the arterial needle makes no difference to haemodialysis efficiency and in fact antegrade cannulation is a predictor for unsuccessful cannulation and related complications. An NSI probably would not have occurred in seven of the eight incidents if the arterial fistula needle had been retrograde (needle point towards the wrist, against the direction of blood flow). This review has identified additional disadvantages of antegrade arterial needle positioning with an increased risk of NSIs and further damage to the patient's fistula.

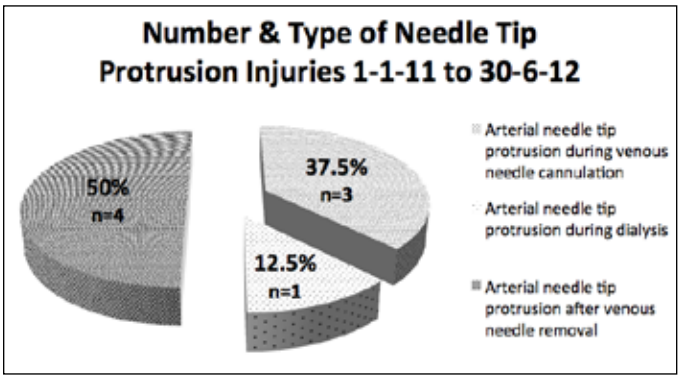


Figure 2. Number and type of needle tip protrusion injuries.

The common practice when removing fistula needles is to remove the venous needle first. Four of the eight (50%), needle tip protrusion incidents occurred after the venous fistula needle was removed first and the antegrade facing arterial fistula needle tip protruded through the patient's vessel and skin. When the two fistula needles are in close proximity and both in the antegrade direction, the arterial fistula needle should be removed first, which is different to the usual practice of removing the venous needle first.

Local anaesthetic use

Root cause analysis of the NSI revealed 24% (n=6) of the incidents involved recapping of needles or used needles left in the environment. Recapping accounted for 8% (n=2) of the incidents. One was a local anaesthetic needle and the other was recapping of a patient's multiple-dose insulin syringe. Sixteen per cent (n=4) of NSI incidents were related to used needles being left in the environment. Three were local anaesthetic syringes and needles and one was an anticoagulant. Four NSIs related to local anaesthetic syringes and needles.

A survey of the 19 clinics into the reason for recapping and needles being left in the environment revealed a common practice of keeping a used local anaesthetic needle and syringe for further use if it was thought additional cannulations could be required in the case of new or difficult fistulas. These needles were either recapped or left on the workbench and

then forgotten when cleaning the area, causing an NSI. These incidents may have been avoided if these syringes had been immediately disposed of after use and a new local anaesthetic syringe and needle obtained for additional cannulations. These incidents would probably not have been prevented through the use of safety needles as this device would not have been engaged if kept for additional cannulations.

One NSI resulted from a pre-filled, pre-packaged anticoagulant. These packaged syringes do not have safety needles, hence increasing the risk of NSIs. The incident involving recapping of a patient's multiple-use insulin syringe may have been avoided if the patient took responsibility of self-administering their insulin and recapping their own syringe.

Removal of fistula needles

Three (12%) of NSIs occurred during removal of fistula needles from the patient. A fistula sheath needle safety device may have prevented these incidents, although the needle needs to be fully removed before the sheath can be engaged.

Needles left in the environment

Another reason for needles being left in the environment was inaccessibility to the sharps disposal container. When the disposal container was not at the site of use, the needle would be left on the bench for later disposal. The needle was then forgotten and an NSI occurred during work area clean-up. One incident occurred because there were a few visitors with the patient during cannulation and the nurse could not reach the sharps container, leaving the needle on the bench for later disposal and a second nurse assisting with clean-up received an NSI.

Disposal

The majority of sharps-related injuries occur after use and before and during sharps disposal (CDC, 2008). NSIs during disposal accounted for 20% (n=5) of the NSIs. Four of the disposal incidents involved fistula needles and one involved a pre-filled, pre-packaged anticoagulant syringe. The pre-packaged anticoagulant did not have a safety device, which increased the risk of an NSI occurring. The fistula needles did not have safety protective sheaths which may have prevented an NSI. Some of these incidents occurred when the sharps container was not at the site of use and the NSI occurred while walking to the sharps container.

Miscellaneous incidents

One incident occurred when a clean needle pierced the blood-covered glove of a staff member. Following correct procedures and changing gloves when bloodied may have prevented this particular incident.

Needleless bloodlines may have prevented NSIs when obtaining a blood sample from the bloodlines and during administration of IV medication into the bloodlines.

Preventive measures

Table 1. Measures which may have prevented NSIs.

	Education of hazard	Compliance with procedures	Needle safety device	Needleless bloodlines
Needle tip protrusion	√			
During cannulation (blood on gloves, clean needle)	√	√		
Recapping needle	√	√	√*	
Needle left in the environment	√	√	√*	
Administering IV medication into bloodlines	√			√
Obtaining blood sample from bloodlines	√		√	√
During fistula needle removal	√			
During disposal	√	√	√	

*Needle safety device would not have been engaged if the needle was being kept for additional cannulations (Chenoweth, 2012).

NSI prevention protocols

After review of causes of reported NSIs, common practices within the dialysis clinics and review of the Australian guidelines on the safe handling and disposal of sharps (NHMRC, 2010), the following NSI prevention protocols were developed. These protocols were communicated to all dialysis clinic managers who then educated their staff.

Table 2. NSI prevention protocols.

NSI prevention protocols	
Needle tip protrusion	Extra caution is required in the following situations: • During insertion of the second fistula needle, pressure can be placed on the first fistula needle and the needle tip can protrude. • While taping needles, ensure not too much pressure is applied • Touching the fistula while fistula needles are in situ can put pressure on them, causing the tips to protrude • During fistula needle removal.
	Change of routine practice may be necessary when needles are close together in the upper arm: • Remove the arterial needle first. Then when site clotted remove the venous needle.

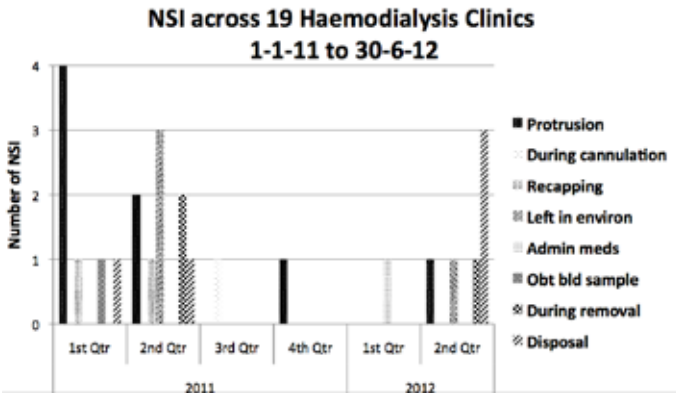
Local anaesthetic	• Discard into sharps container immediately after use, do not keep for future use • If additional local anaesthetic required, use a new needle and syringe
Handling and disposal of needles	Careful and thoughtful disposal of needles is required. • Never recap needles • Never place used needles on workbench; immediate disposal • The person using the needle is responsible for the immediate, safe disposal of the needle into a sharps container • The number of sharps containers should equal the number of staff on a shift • Prior to using and disposing of needles o Sharps container placed at site of use and within easy reach o Sharps container ready to use, i.e. lid open to full extent o Ensure only necessary people in dialysis station area, e.g. visitors asked to wait in waiting room until procedure completed • Thoughtful and careful disposal of needles o Do not change hands o Do not walk while carrying a used needle.

(Chenoweth, 2012)

Results

This quality improvement project began during the 2nd quarter of 2011. During the 2nd quarter of 2011, a root cause analysis was conducted, NSI prevention protocols were developed and staff educated about best practices. Only three NSIs occurred during the next three quarters, with education being the main action implemented. The second quarter of 2012 demonstrated an increase in NSI with the majority occurring during disposal. A further review of disposal methods and additional education was conducted. Overall there was a 47% reduction in NSIs from the first half of 2011 compared with the first half of 2012. Of the 365 staff who have potential exposure to NSIs, 6.8% of staff experienced NSIs over the 18 months.

Figure 3. NSI across 19 haemodialysis clinics.



A previous survey of Australian nurses (NHMRC, 2010) stated 11.2% of staff had experienced a needlestick or sharps injury. Trim and Elliot (2003) reviewed a number of international studies reporting on NSIs in health care. They determined the mean rate of NSIs amongst health care workers was 4.0%

Discussion

Needle tip protrusion injuries have not been identified as a cause of NSIs in this review. Needle tip protrusion injuries has not been identified as a cause of NSIs in haemodialysis staff. Often the forgotten factor during a needle tip protrusion NSI is the patient who is exposed to the staff's blood. Consequently the patient requires the same counselling and exposure management which the staff receive. Needle tip protrusion incidents cannot be prevented through compliance with accepted safe practices or by the use of needle safe devices. The preventive measure implemented was education to increase the staff awareness that these types of NSIs do occur. Cannulation positioning and needle removal procedures were reviewed and alternative procedures recommended. During cannulation, if the fistula needles are close together and the arterial needle is going to be in the antegrade direction, the venous needle

Table 3. Percentage education of NSIs.

	2011		2012	% Reduction of NSIs
	Qtr 1 & 2	Qtr 3 & 4	Qtr 1 & 2	Comparison between 2011 Q 1 & 2 and 2012 Q 1 & 2
Needle tip protrusion	6	1	1	83%
During cannulation		1		
Recapping	2	0	0	100%
Needles left in environment	3	0	1	60%
Medication administration			1	
Obtaining blood sample			1	
During fistula needle removal	2	0	1	50%
During disposal	2		3	–50%
% staff involved	4.1%	0.5%	2.2%	47%
Total NSI	**15**	**2**	**8**	**47%**

should be inserted first. Increasing evidence of the advantages of retrograde positioning of the arterial needle could justify a future review to cannulation of arterial needles in the retrograde direction. Petrosillo *et al.* (1995) lists circumstances of NSIs in haemodialysis. There is no mention of needle tip protrusion as being a cause, yet it accounted for 35% of the NSIs in our review. The author was unable to find any literature which mentions the occurrence of needle tip protrusion as a cause of NSIs. Yet, anecdotally, many haemodialysis nurses are aware that needle tip protrusion can occur and know of someone who has received an NSI from this situation.

A study conducted across nine Italian dialysis units, reported 67 sharps injuries equating to 3.9 per 10,000 dialysis treatments (Petrosillo *et al.*, 1995 p. 280). Our review demonstrated 1.35 NSIs per 10,000 dialysis treatments, which is significantly lower than the Italian review. Benchmarking NSI results against other literature is difficult as the denominator changes between the number of haemodialysis treatments, number of devices, that is, needles (Adams *et al.,* 2006) or the number of health care workers (Trim *et al.,* 2003).

Table 4. Causes of NSI – rate per 10,000 dialysis treatments.

Causes of NSI between Jan 2011 to June 2012 (treatments 185178)	Number	Rate per 10,000 dialysis treatments	As % of total NSI (25)
Needle tip protrusion	8	0.43	32%
During cannulation	1	0.05	4%
Recapping needle	2	0.11	8%
Needle left in environment	4	0.22	16%
Administering IV medications	1	0.05	4%
Obtaining blood sample	1	0.05	4%
During fistula needle removal	3	0.16	12%
During disposal	5	0.27	20%
TOTAL	**25**	**1.35**	**100%**

The financial costs to implement the proposed NSI prevention protocols were minimal. Only two haemodialysis clinics reported having fewer sharps containers than staff on a shift, requiring the purchase of two additional sharps containers. Extra local anaesthetic, syringe and needle were required, which again were small costs. The main focus of preventive measures was on education of staff and compliance with safe needle practices. Bryce *et al.* (1999) noted education was a preventive measure for many causes of NSIs. The cost of additional sharps containers, local anaesthetic equipment and education are minimal when offset by the potential costs of an NSI. These costs could include initial medical support and counselling; laboratory costs for blood sampling; possibly post-exposure prophylactic treatment and, in the worst case scenario, ongoing medical costs after acquisition of a BBV.

Australia currently does not have a mandate for the use of needle safety devices while the US, Canada and the European Union, including England and Germany do (NHMRC, 2010). The benefits of needle-safe devices in the reduction of NSIs are discussed by Trim and Elliott (2003) and Tarantola *et al.* (2005). After analysis of the cause of NSIs in our haemodialysis clinics, needle-safe devices may have prevented 48% (12) NSIs from occurring, though in half of these incidents the needle safety device may not have been engaged if the needle was being kept for further use. Needle-safe devices would not have prevented needle tip protrusion incidents. Needleless bloodlines may have prevented two NSIs. As a result of this review, our organisation has introduced safety needles for local anaesthetic use and are investigating fistula needle sheaths.

Conclusion

Patients, patient service attendants and haemodialysis nurses and technicians are all at an increased risk of exposure to BBVs from NSIs. The need for multidisciplinary education is necessary. Currently most education is directed at nurses only. This review demonstrated that education can make a significant initial impact in the reduction of NSIs. However, this review also showed that an initial education drive alone is not enough. Awareness of NSI and safe work practices needs to become a part of the dialysis culture with ongoing education, auditing of policy compliance followed immediately by more education and introduction of needle-safe devices.

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