Why should anyone discard the needle after a mandibular block injection?

During the economic downturns, dental professionals are forced to cut costs. Some dentists save the needle after an inferior alveolar nerve block injection in case the injection was not successful. The success rate for the inferior alveolar nerve block, commonly referred as mandibular nerve block, is around 80% to 85%. Because of the slow onset of paresthesia and a substantial failure rate, there are temptations to recap the needle and give another mandibular block using the same needle later if necessary.

However, disposal of the needles immediately after completion of injections is recommended, especially after multiple injections. If the patient requires another mandibular block injection a few minutes later, then a new needle should be used. Recapping and saving the contaminated needle on the dental tray for future use is not justified because the risk of the needle stick injury outweighs the cost of a dental needle.

Also, once a needle hits the bony surface, the very tip of the needle becomes blunt. A dull or bent tip would cause unnecessary tissue trauma and discomfort for patients. And the patients will remember the painful injections and may seek any future dental treatments elsewhere.

Cost analysis of missing mandibular block:

The average cost of 50 lidocaine w/ epi — $24.50	The cost of one cartridge — $0.49
The cost of 50 articaine cartridges ——— $38.00	The cost of one cartridge — $0.76
2 employees with combined wage of $30/hour (wages)	The cost of waiting additional 5 minutes — $2.50
Rent and utilities of $3000/month and working 40 hr/week	The cost of waiting additional 5 minutes — $3.95

The cost of dental needle ——————————————————————— $0.11

The cost of giving the patient another mandibular block injection and waiting an additional 5 minutes for the onset of paresthesia from the second injection **is $6.94 when you consider the wages, rent and another cartridge**. After giving a mandibular block, immediate disposal of the used needle is prudent and wise. Rather than trying to recap the used needle, more attention should be given to the proper mandibular block in the first place. **The practitioners should not risk needle stick injuries on themselves or their staffs because of one contaminated needle**.

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Can you protect yourself and your staff from preventable needle stick injuries for $5.00 a month?

Q. How much does it cost to implement the LeEject dental safety needle and syringe system in your office?

A. Under $5.00 per month.

Assumption: In a typical dental office of one dentist and one hygienist, they have 20 existing metal syringes and plan to replace them with the LeEject syringes. The price of each LeEject syringe is assumed to be $20.

How many dental needles does a dentist use in a year? In the Journal of Canadian Dent. Assoc. (2009), 75(9), 649, Andrew Gaffen and Daniel Haas had estimated the use of local anesthetics by all Ontario dentists during 2007 which was 1,613 cartridges per dentist per year. Since it is possible to use multiple cartridges with one needle, it is estimated that a practitioner uses about 1,500 needles a year.

It is our company's policy to reduce needle stick injuries and to offer our products at an affordable price range. The recommended retail prices of the LeEject needles and syringes would be offered at the same price ranges as others. Also, through proper maintenance a LeEject dental syringe will last twenty years.

The cost of syringes: A dental office buys 20 LeEject syringes to replace the existing syringes and uses them for 20 years. Then, the amortized cost of the 20 syringes is $1.67 per month.

The cost of needles: Since the dental needles are disposable, it is necessary to buy new needles. The cost difference between a box of LeEject safety needles and a box of traditional needles is assumed to be $1.00. The combined usage of 3000 needles (between a dentist and a hygienist) in a year is 30 boxes per year or 2.5 boxes per month. The cost difference is actually $2.50/month.

The total cost of using LeEject needles and syringes:

$2.50/month + $1.67/month = **$4.17 per month**

The actual cost of implementing the LeEject dental safety needle and syringe system in your dental office is less than $5.00 per month.

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Cost of Needle Stick Injuries

1. The Centers for Disease Control and Prevention (CDC) estimate that the rates of sero-conversion are:

Hepatitis B (HBV) – 6% to 30% after needle stick injuries

Hepatitis C (HCV) – average of 1.8% after needle stick injuries

HIV – 0.3% after needle stick injuries

2. Frequencies of needle stick injuries in Healthcare.

Panlilio, et al. (2004) estimated that 384,325 needle stick and sharps-related injuries occur every year to healthcare workers (HCW) in hospital settings in the US.

The National Institute of Occupational Safety and Health (NIOSH) estimated that up to 800,000 needle stick injuries occurred in 2004 in the US for both hospital and non-hospital healthcare workers (HCW) in the US. Miller, et al. (1999) from the World Health Organization (WHO) estimated that the cause of more than 1.3 million deaths and the cost of US$535 million for treatment are due to unsafe injection practices (using contaminated needles and syringes) in the world.

Hauri, et al. (2004) from WHO estimated that contaminated injections caused an estimated 21 million HBV infections, two million HCV infections and 260,000 HIV infections in the year of 2000.

Experts agree that many needle stick injuries are underreported.

3. Frequencies of Needle Stick Injuries in *Dentistry*

Shah, et al. (2006) reviewed workers' compensation claims submitted to the Department of Labor and Industries State Fund during a 7-year period (1995 through 2001) in Washington State in the US. Of a total of 4,695 accepted State Fund percutaneous injury claims, **924 (20%)** were submitted by dental professionals, including **dental assistants (667, 75%)**, **dental hygienists (161, 18%)** and **dentists (66, 7%)**. The absolute number of injuries reported increased progressively each year, from 78 in 1995 to 216 in 2001. The majority of those reporting were **females (638,71%)** and **the mean age was 30 years (95% CI: 29-31)**. Dental assistants sustained most of the injuries while cleaning instruments and trays (n = 160, 24%), followed by changing a local anesthetic carpule (n = 125, 19%) and recapping a needle (n = 118, 18%). Of the 894 dental health care workers with percutaneous injuries, there was evidence of **HBV in 6 persons**, **HCV in 30 persons**, **HIV in 3 persons** and both HBV and HCV (n = 2) exposures.

McCarthy, et al. (2000) investigated non-sterile occupational injuries and infection control practices reported by final-year dental, medical and nursing undergraduates at the University of Western Ontario, Canada. Non-sterile occupational injuries in the previous year were reported by **82% of dental students**. Leggat, et al. (2006) surveyed a random sample of 400 dentists in Queensland, Australia. A total of 285 surveys (73.1%) were completed and returned. More than three-quarters (78.5%) reported damaging their gloves at least once during a clinical procedure in the previous 12-months period. The most common devices to cause 'sharps' injury in the previous 12 months were needles (14.4%) and burs (10.2%).

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4. Costs associated with needle stick injuries.

A. CDC (2004) estimated that the direct costs, associated with an initial follow-up and treatment of healthcare workers (HCW) who have sustained a needle stick injury, range from $500 to $3,000 depending on the type of treatments.

B. Leigh, et al. (2007) estimated 644,963 needle sticks in the HCW for 2004 of which 49% generated costs. Testing revealed 96% had prophylaxis and the remaining 4% were suffering from long term infections (34 persons with chronic HBV, 143 with chronic HCV, and 1 with HIV). The medical expenses totaled up to $107.3 million. Lost-work productivity generated $81.2 million, for which 59% involved testing and prophylaxis and 41% involved long-term infections. The total sum of combined medical and work productivity costs was $188.5 million in the US.

5. Psychological trauma associated with needle stick injuries.

Exposures to blood-borne pathogens via needle stick injuries cause a significant emotional and psychological toll on victims, the cost of which is difficult, if not impossible, to quantify. Healthcare workers who are injured by needle stick injuries face the uncertainty of their infection status in the immediate period following the injury, and, once the news is known, face whatever life-changing, long-term consequences are associated with the disease they may have contracted.

Psychological trauma affects them not only at work; trauma goes beyond the work place to such an extent that they fear to tell their partners that they had needle stick injury and they are exposed to HBV, HCV, HIV infection. Explaining to their families that they are taking antiretroviral (ARV) drugs for possible HIV from a needle sick injury is causing additional trauma. The side effects of ARV drugs are significant. Trauma also impacts their families since they have to abstain from sexual activities for a few months until that they know they did not contract HIV.

In their study of the economic impact of needle stick injuries, Lee, et al. (2005) found that 29 out of 110 nurses sought emotional counseling in the year following the injury.

In a more detailed case study, Worthington, et al. (2006) described two nurses who received needle stick injuries from an HIV-infected patient. Despite testing negative for HIV antibodies for more than 22 months after their injuries, both nurses displayed symptoms consistent with posttraumatic stress disorder (PTSD): insomnia, ongoing depression and anxiety, nightmares, and panic attacks upon returning to the work environment where the injuries were received. The authors maintained that the long-term emotional consequences of needle stick injuries are likely unappreciated.

6. Ignorance and/or apathy among HCW

AORN (2005) reported that some HCW's abide by an "it-won't-happen-to-me attitude" and resist making changes to their daily routines simply because old habits are hard to let go.

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Self-Aspirating Syringes with Consideration of Epinephrine Level

Self-aspirating syringes have been gaining popularity recently. The self-aspirating mechanism works by a little bump at the end of the syringe compressing the diaphragm of the anesthetic cartridge during injection. When the pressure of injection is released (Figure 1), there is the relaxation of the diaphragm, thus creating negative pressure. In general, these self-aspirating syringes do not offer harpoons and their plungers end with pistons (Figure 2).

In self-aspirating needles and syringe system, **aspiration can occur only after injection has been started**. The most local anesthetics used in dentistry contain epinephrine. In the inadvertent cases of injection into the bloodstream, there are concerns of epinephrine level before self-aspiration can take place. The main purpose of this paper is to review the safety of the patients regarding the self-aspirating syringes regarding the epinephrine level. Depending on the volume of the anesthetic, the amount of epinephrine could trigger the unexpected cardiovascular events in the compromised patients.

Dr. John A. Yagiela published a paper titled *Local Anesthetics* in Anesth. Prog. 38:128-141, 1991. In his paper he compiled the results by different authors and plotted the changes in the plasma epinephrine concentration level absorbed from the injection sites as the different amounts of epinephrine were injected.

The rule of thumb is that 2 cartridges (1.8 ml) of 2% lidocaine with epinephrine 1:100,000 (36 microgram of epinephrine) are considered safe in most cardiac patients. According to Dr. Yagiela's graph, from the resting level of 39 pg/ml, **infiltration of 36 mcg of epinephrine** would produce **additional increase in blood level of 150 pg/ml** thus to **the new total of 189 pg/ml**, which is assumed to be safe.

In the self-aspirating syringe, a few droplets of the anesthetic solution have to be expressed prior to self- aspiration. The minimum amount is calculated to be between 0.1 to 0.15 ml. The amount of epinephrine in the 0.15 ml of 2% lidocaine with epinephrine 1:100,000 is calculated to be **1.5 mcg**. The resultant level of the epinephrine has to be safe after inadvertent injection of 1.5 mcg of epinephrine into the bloodstream to conclude that the self-aspirating syringe is safe.

According to Dr. Yagiela, the resting level of 39 pg/ml of epinephrine is calculated to be 0.1365 mcg of epinephrine is circulating (endogenous) in an average female body. The inadvertent injection of 1.5 mcg epinephrine (exogenous) plus 0.14 mcg of resting level (endogenous) add up to total of **1.64 mcg of the new circulating epinephrine**. In an average female body, the addition of **1.5 mcg of injected epinephrine intravenously** (according to the calculations in the opposite page) gives to **the new serum level of 470 pg/ml**, which is **dangerous** to the patients with significant cardiovascular compromises.

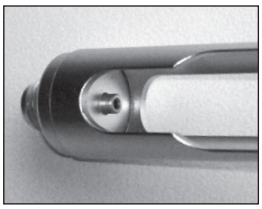

Figure 1

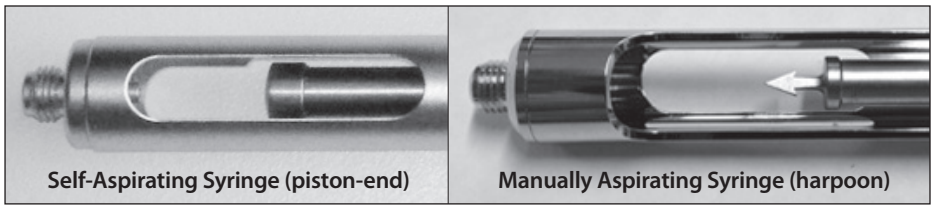

Figure 2

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For reference:

$$150\ pg/ml = 150\ ng/l = 0.15\ mcg/l$$

$$1\ pg = 10^{-12} \quad 1\ ng = 10^{-9} \quad 1\ mcg = 10^{-6}$$

1). An average adult male is 70 kg (154 lb) and adult female is 50 kg (110 lb).

2). The volume of blood in a healthy person is calculated to be 7% of body weight.

3). In average the volume of blood is 4.9 liter and 3.5 liter in male and female respectively. For our calculation, we will use female's body weight for additional safety.

4). The resting level of epinephrine is 39 pg/ml prior to injection of local anesthetics.

$$0.039\ mcg/l \times 3.5\ l\ (blood\ volume\ of\ female) = 0.1365\ mcg$$

0.1365 mcg of circulating epinephrine (endogenous) will be used as a baseline

5). 1.5 mcg of epinephrine was injected into the bloodstream prior to testing self-aspiration which is the amount of epinephrine in the 0.15 ml of anesthetic (exogenous).

$$1.5\ mcg\ (exogenous) + 0.1365\ mcg\ (endogenous) \approx 1.64\ mcg\ (total)$$

$$\frac{1.64\ mcg\ (total\ circulating\ epinephrine)}{3.5\ l\ (blood\ volume\ of\ adult\ female)} \approx 0.47\frac{mcg}{l} = 470\frac{pg}{ml}$$

Although it can be argued that for patients with significant cardiovascular diseases, the operator should choose the local anesthetic without epinephrine and it is a poor choice of the medication, not a failure of the medical device; however, the design and usage of a medical device should have the compensatory mechanism built in to accommodate the frequent usage of the medical device.

Therefore, **self-aspirating syringes should not be used with local anesthetics containing vasoconstrictors like epinephrine**. Furthermore, **self-aspirating syringes should not be used on children under the age of 12 and weighing less than 100 lbs (45kg) for consideration of systemic overdose of the local anesthetics themselves**.

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One Hand Scoop Technique and Other Safety Devices to Assist in Recapping of Dental Needles

The current methods of recapping used dental needles are outdated and flawed. **The CDC and OSHA recommend the "one hand scoop technique" to recap used needles in dentistry, but not in medicine**. In medicine, the "one hand scoop technique" is no longer used; either safety needles are used or needles are thrown away attached to the plastic syringes without recapping. Many dental schools are still teaching the "one hand scoop technique." Unfortunately, the "one hand technique" is **against our human nature** and this recommendation of the "one hand scoop technique" is going to be **ignored** over and over again. It is human nature to do it faster and more precisely with two hands than use the slower and insecure "one hand scoop technique." Especially during busy times, we really cannot expect poorly trained, new dental assistants to use the "one hand scoop technique."

Many **safety devices** were developed to avoid needle stick injuries during recapping of the used needles. These safety devices are made of metal, rubber or cardboard and they basically hold the cap of the needle so the operator can recap the used needles, sometimes using both hands. Many dental schools recommend and utilize these devices. But when such devices are missing for some reason, then these young professionals are at a **greater risk** of needle stick injuries.

The combination of these inadequacies can have life changing repercussions for young dental professionals as seen in the studies below:

G. McCarthy and J. Britton reviewed occupational injuries of final-year dental, medical and nursing students at The University of Western Ontario and published the results in the J Canadian Dent Assoc, Nov. 2000. Vol. 66, No.10. Nonsterile occupational injuries in the previous year were reported by **82% of dental**, 57% of medical and 27% of nursing respondents, including one HBV and one HIV exposure. Students who reported 2-handed recapping of needles had twice the number of percutaneous injuries (mean = 1.9/year) than those who avoided recapping or recapped with one hand using a device or scoop technique. Approximately one-third of all dental students reported recapping needles with both hands. Student health care workers are at increased risk of occupational injury because of inexperience in performing invasive procedures.

Shah, S., et al. in BMC Public Health 2006, 6:269 have reviewed workers' compensation claims submitted to the Dept. of Labor and Industries State Fund during a 7-year period (1995 through 2001) in the State of Washington, USA. Of a total of 4,965 accepted State Fund percutaneous injury claims, 924 (20%) were submitted by dental professionals, **including dental assistants (667, 75%)**, dental hygienists (161, 18%) and dentists (66, 7%). The absolute number of **injuries reported increased progressively each year**, from 78 in 1995 to 216 in 2001. The majority of those reporting were **females (638, 71%)** and **the mean age was 30 years** (95% CI:29-31). **Dental assistants sustained most of the injuries** while cleaning instruments and trays (n=160, 24%), followed by changing a local anesthetic carpule (n=125, 19%), and recapping a needle (n=118, 18%). Of the 894 dental health care workers with percutaneous injuries, there was evidence of **HBV** (hepatitis B virus) **in 6 persons, HCV** (hepatitis C virus) **in 30 persons, and HIV in 3 persons and both HBV and HCV (n=2) exposures**.

There are numerous clinical studies reporting needle stick injuries among dentists, **but the studies reporting needle stick injuries among dental assistants or hygienists are nonexistent**. It is generally held that needle stick injuries are rare among experienced dentists, but most injuries occur among the new dental healthcare professionals and dental assistants.

The healthcare agencies, dental schools, teaching hospitals, and dental employers should be acutely aware of potential needle stick injuries and be willing to actively implement dental safety needles. Needle stick injuries are a public health hazard that should be taken seriously. Every effort should be made in utilizing the safety devices whenever possible.

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Aspiration Problems in Current Aspirating Syringes

Although the current aspirating dental syringes offer valuable aspiration features, there are other reasons which can give a false negative aspiration result. It has been argued that using a smaller needle than the 25 gauge needle may not give positive aspirations consistently. Some recommend aspirations in at least two planes before injection. If the bevel of the needle presses against the wall of a blood vessel, aspiration in that plane may not work. Or when too much force is exerted during aspiration, the blood vessel wall may collapse, and it may result in a false negative aspiration.

Because of constant uses, the harpoon may get dull and does not engage the rubber backing of the cartridge firmly. During injection, there can be an accidental separation of the harpoon from the cartridge during aspiration, the operator may not be able to aspirate prior to injection.

For many patients, intraoral injection is widely perceived as the single most stressful procedure encountered in routine dentistry. Psychogenic reactions to intraoral injection include pallor, sweating, nausea, headache, palpitations, hyperventilation and syncope. With such, **severe emotional responses from the patients, it is often difficult for the operators to stay calm. The most common reason for the accidental injection of the anesthetics into the bloodstream is that the operators simply forget to aspirate**. Having a safety back-up system, like the self-aspiration feature, will reduce the rate of accidental injection into the bloodstream and reduce catastrophic results.

The self-aspiration feature should not be used as a substitute for manual aspiration but as an adjunct feature. The self-aspiration feature can remind the operators to aspirate by noticing bouncing plunger or reveal blood in the cartridges. The self-aspiration is an additional safety back-up mechanism when the manual aspiration fails in certain circumstances.

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