

Injection practices among clinicians in U.S. health care settings

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Background: Improper use of syringes, needles, and medication vials has resulted in patient-to-patient transmission of bloodborne pathogens, including hepatitis C virus. This study examined the injection practices of health care providers to identify trends and target opportunities for education on safe practices.

Methods: An on-line survey was conducted in May and June 2010 of clinicians in US health care settings that prepare and/or administer parenteral medications.

Results: The majority of the 5446 eligible respondents reported injection practices consistent with current recommendations. However, the following unsafe practices were identified: 6.0% “sometimes or always” use single-dose/single-use vials for more than 1 patient; 0.9% “sometimes or always” reuse a syringe but change the needle for use on a second patient; 15.1% reuse a syringe to enter a multidose vial and then 6.5% save that vial for use on another patient (1.1% overall).

Conclusion: Unsafe injection practices represent an ongoing threat to patient safety. Ensuring safe injection practices in all health care settings will require a multifaceted approach that focuses on surveillance, oversight, enforcement, and continuing education.

Key Words: Injection safety; bloodborne pathogens; survey needlestick injuries; safety practices; reuse syringes; reuse vials; propofol.

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Increasing reports of outbreaks in health care settings in the United States involving transmission of hepatitis B virus (HBV) and hepatitis C virus (HCV) to patients associated with unsafe injection practices and breakdowns in basic infection control have uncovered an alarming trend. Recent reviews of HBV and HCV outbreaks showed that from 1998 to 2009, there were 51 outbreaks involving the notification of more than 75,000 potentially exposed patients and identification of 620 who became infected with HBV or HCV.^{1,2} These outbreaks occurred in a variety of health care settings including 9 hospitals; 9 hemodialysis facilities; 16 outpatient clinics and ambulatory surgery centers; and 17 long term care facilities. The majority resulted from unsafe injection practices and lapses in basic infection control practices, including failure to maintain aseptic technique when preparing or administering parenteral

medications (eg, overt syringe reuse or contamination of shared parenteral medications by reused syringes); contamination of equipment and supplies (eg, preparing medications in contaminated area); or improper use and handling of blood glucose monitoring equipment, (eg, single patient use fingerstick devices used on multiple patients or blood glucose meters not cleaned between patients). These identified outbreaks may represent a wider problem. For example, 67% of recently surveyed ambulatory surgical centers in 3 states were found to have at least 1 lapse in basic infection control, including unsafe injection and medication practices³. It is also believed that identified outbreaks represent only a portion of the true burden of infection. Many outbreaks and sporadic transmission of health care-associated viral hepatitis go

unrecognized because most patients with acute HBV or HCV infection are asymptomatic or have mild nonspecific symptoms.^{4,5}

Studies in the mid 1990s indicated that 20-39% of anesthesia personnel were reusing syringes for multiple patients⁶; by 2002 this rate had dropped to 1-3% according to a telephone survey of 500 randomly selected providers, including anesthesiologists, other physicians, certified registered nurse anesthetists (CRNAs), other nurses, and oral surgeons.⁷ Limited data in 2008 from an Anesthesia Patient Safety Foundation poll indicated that up to 27% of clinicians could be reusing propofol infusion syringes while changing only the tubing between patients.⁸ To gain a full understanding about current injection practice patterns to assist with targeting outreach and education, the Premier Safety Institute conducted a Web-based survey of clinicians that prepare and/or administer parenteral medications across a wide variety of US health care settings.

METHODS

During May and June, 2010, we conducted an on-line survey of clinicians practicing in a variety of health care settings using a convenience sample. The survey was posted on the Safety Institute Web site and an email invitation with a link to the survey was sent to the 39,100 subscribers of Premier's *Safety Share* public newsletter that include clinicians and health care providers from hospital and non-hospital settings. The survey link was also shared via an email invitation and in the newsletters of 10 collaborating organizations. These organizations included the American Academy of Anesthesiologist Assistants; Accreditation Association for Ambulatory Health Care; American Association of Critical-Care Nurses; American Society of Health-System Pharmacists; Association for Professionals in Infection Control and Epidemiology; Infusion Nurses' Society; Pittsburgh Regional Health Initiative; Society for Healthcare Epidemiology of America; Society of Gastroenterology Nurses and Associates, and Innovatix (non-acute health care providers).

The survey contained questions about awareness of injection safety and respondents' primary source and method of receiving information on this topic and frequency of performing various injection practices. These practices included those generally considered acceptable if performed with aseptic technique according to current guidelines, as well as those not recommended, having been demonstrated to result in transmission of bloodborne pathogens.⁹ The items in the survey that assessed specific injection practices were grouped according to the *type* of practice (e.g., syringe use, single-dose vial use, or multi-dose vial use) and *not* according to recommended or unacceptable practices. Respondents were also asked to indicate their professional training, the type of health care organization, and the department where they practice the majority of the time. Respondents had the ability to provide comments for each item in the survey. Examples of both the most frequently occurring and revealing comments on current practices are summarized in the results.

The exact number of individuals receiving the link to the survey provided by the Safety Institute and 10 collaborating organizations is not known; however, the combined membership of these organizations represents a wide variety of professions and practice settings.

There were a total of 8,035 responses to the survey. All respondents were asked 3 general questions about their knowledge of injection safety and the source and format of this information. This information was analyzed separately.

We eliminated 492 respondents who identified themselves as pharmacists after learning from the open ended responses that the majority of the pharmacists were working under a sterile pharmacy hood and not preparing or administering parenteral medications at the point of administration. An additional 2,097 responses were eliminated that answered "no" (1,678) or did not respond (419) to the question, "in your current practice do you prepare or administer parenteral medications," at which time the survey automatically closed and participants were thanked for their participation. Thus, a total of 5,446 respondents were included in the final analysis.

RESULTS

The total number of individuals that actually received the link to the survey (eg, both opened and read the invitation) was not known, thus an overall response rate could not be determined.

In the preliminary analysis of the 8,035 respondents, 79.6% answered "yes" to the first item in the survey "prior to receiving the survey, have you ever heard of injection safety?" The next 2 items asked

about the source and format of this information. The professional organization was selected as the most frequent source (60.1%) and guidelines as the most common format (59.6%) (Table 1).

The fourth item asked them to indicate “yes or no” to the question, “in your current practice do you prepare or administer parenteral medications?” A total of 5,446 respondents answering yes to this question were included in the final analysis and represented a wide range of health care organizations (both hospital and non-hospital) and departments (Table 2). Of the 5,199 that indicated their health care organization, 66.0% (3,432) were from hospitals and 34.0% (1,767) were from non-hospital settings. The majority of respondents identified themselves as registered nurses (89.5%). Responses on specific injection practices are summarized in Table 3 and below.

Acceptable practices if performed with aseptic technique

Administering a medication in a syringe prepared by someone else. The majority of respondents (71.0%) indicated that they never administered a medication in a syringe that was prepared by someone else. Only 29.0% indicated that they “sometimes or always” administered medications prepared by someone else. The most frequent comments provided by this group described when they engaged in this practice, such as, “*only during a code or emergency, only in vaccine and flu clinics*” and many pointed out that “*the syringe was always labeled*” or that they “*watched the person preparing the syringe.*”

Enter a single-dose vial more than once for the same patient. A total of 30.2% (1,599 respondents), reported that they “always or sometimes” enter a single-dose/single-use vial more than once for the same patient. However, we did not assess whether the respondents were using the same or a new sterile syringe to obtain the additional doses for that same patient. Comments included reasons such as, “*if it is done within 24 hours; only if a short time has passed; when giving heparin in dialysis lines; as a cost cutting measure; we don’t want to waste the drug; and during a code.*” Many of the respondents indicated that this was a practice for specific drugs, providing examples, such as: “*IV Dilaudid, insulin, lidocaine, Narcan, phenylephrine, Ativan, terbutaline, and fentanyl.*”

Use a multi-dose vial for more than 1 patient. A third of respondents (34.4%) never use a multi-dose vial on more than 1 patient, with the frequent comment: “*we don’t use multi-dose vials at our organization.*” However, the majority (65.6%) are using multi-dose vials for more than 1 patient. About half of the comments indicated they were using multi-dose vials for specific medications and the most frequent examples were vaccines, tuberculin skin testing, Vitamin B 12, lidocaine, and insulin. The other half of the comments were about the techniques used, such as: “*I use a new syringe for each entry and we date the vials after opening.*”

Practices not considered appropriate or consistent with current guidelines.

Use of single-dose vial for more than 1 patient. A total of 318 respondents indicated that they “sometimes or always” use single-dose/single-use vials for more than 1 patient representing 6.0% of all respondents. Examples of frequent comments to explain this practice were: “*as a cost saving measure, done only when obtaining all of the doses at the same time, always using a new syringe, it depends on the size of the vial, only with sterile technique, when giving specific drugs (e.g., vaccines or insulin), and when giving propofol during the shortage.*”

Reuse a syringe but change the needle for use on a second patient. Forty-five respondents representing 1.0% reported that they “sometimes or always” administer medication to more than 1 patient using the same syringe but a new sterile needle for each patient. Comments were provided by only 4 of the respondents and 3 indicated they do this with insulin and 1 with propofol. Of the 37 individuals who provided information on the organization where they work, 24 (64.9%) work in hospital settings and 13 (35.1%) worked in non- hospital settings. Twelve of the 13 worked in ambulatory surgery centers and the 1 remaining person worked in a long term care facility.

Reuse syringe for additional doses from the same multi-dose vial. A total of 797 respondents (15.1%) indicated that they are “sometimes or always” reusing a syringe for additional doses from the same multi-dose vial for the same patient. Frequent comments made by those who reported this practice included: “*when giving insulin, for moderate sedation, for conscious sedation, for emergency situation, for critical care patients, for multiple IV medication doses, we use the vial as the cap for the needle if using the syringe more than once.*” For those respondents who reported “always or sometimes” engaging

in this practice, the survey prompted them to answer an additional question about what they did with the vial after re-entry with same syringe. The majority of those answering the follow-up question, 738 of 789 (93.5%), indicated that they discarded the vial. However, an alarming 51 of the 789 (6.5%) indicated that they “*saved that vial for use on another patient.*” Four of the 51 clinicians provided comments; 2 indicated they did this with insulin, 1 stated “*only if there was medication left in the vial*”, and 1 explained “*only if the vial remained sterile.*” A number of respondents—who indicated they “*always discard the vial*” after re-entry for the same patient—pointed out that they did observe this practice among other clinicians.

Of the 51 professionals who reported reusing a syringe to obtain an additional dose from a multi-dose vial and then leaving it for use on another patient, approximately half (52.0%) were from the hospital setting and the other half (48.0%) were from the non-hospital setting.

Of the 47 who reported their department, 13 (27.7%) indicated they worked in surgery or anesthesia; 9 (19.0%) in general patient care; 3 (6.4%) in endoscopy, 3 (6.4%) in oncology, 3 (6.4%) in a physician office, 3 (6.4%) in emergency care, and the remaining 13 (27.7%) worked in a variety of other departments/locations, such as cardiac catheterization lab, employee health, dermatology, pain management clinic, and a travel clinic.

Use a bag or bottle of intravenous (IV) solution as a source of supply or medication diluent for more than 1 patient. A total of 448 respondents (9.0%) indicated that they “always or sometimes” use a bag or bottle of intravenous solution as a source of supply or medication diluent for more than 1 patient. The most frequent comments included the following: “*always use alcohol pad first; with one hour expiration; always a new needle and syringe; draw flushes with a spike; only for 24 hours; only in the med room; use a 500 mL bag of saline with stop-cock to dilute IV meds; only when we are out of single bottles of diluents.*”

DISCUSSION

Our 2010 study aimed to identify the current injection practices of clinicians in US health care settings in order to assess the extent of acceptable and improper use of syringes, needles and medication vials during preparation and administration of parenteral medications across multiple professions in both the hospital and non-hospital settings. Although the majority of respondents indicated they were following recommended safe injection practices, even the small percentage of health care providers that were identified as not complying with recommended practices is alarming. Anything less than 100% compliance with infection control guidelines and aseptic technique contributes to risk of transmission of bloodborne viruses resulting in infections; both individual cases and outbreaks may go undetected for some time. In addition to increasing the potential for patient infections, unsafe injection practices put providers themselves at risk of needlestick injuries and potential infections, as well as licensing board actions and malpractice suits.⁴

Mistaken beliefs

There are a number of mistaken beliefs about the risks associated with syringe reuse and aseptic technique when handling injectable medications during preparation and administration that likely contribute to many of the outbreaks of health care-associated viral infections such as HBV and HCV infections.^{4, 6, 7-13} For example, there is the belief that contamination is limited to the needle portion when a syringe and needle are used together as a unit. There is also an incorrect belief that the syringe does not become contaminated if the plunger is only “pushed” to inject medications and not “pulled” to aspirate or withdraw. However, decades old experimental studies have shown that contamination does in fact extend to the barrel of the syringe during intramuscular, subcutaneous, intradermal, and intravenous (IV) injections.^{4, 10-12} There is an additional risk of syringe contamination resulting from the negative pressure that occurs if a contaminated needle is removed from the syringe.

Another mistaken belief, in the case of IV administration, is that there is no risk of syringe contamination if the injection is given into the fluid path of IV tubing that is not visibly contaminated with blood.⁴ To the contrary, the risk for syringe contamination is not eliminated by the length of IV tubing or the presence of heparin locks or valves.¹³ When a contaminated needle or syringe is used to

draw medication from a vial, the contamination can then be transferred to the vial. Professionals unfortunately often cite a need to reduce waste and costs as their rationale for reuse.

Aseptic technique is absolutely essential when handling, preparing, and administering parenteral medications (ie, injection or infusion) to prevent microbial contamination, protect the patient from infection, and prevent the spread of pathogens. Fig 1 summarizes the current recommendation for injection practices for patient safety.

Acceptable practices if performed with aseptic technique

There are a number of injection practices that are considered acceptable only if aseptic technique is strictly maintained. If these practices are not performed aseptically, they can lead to contamination of the injection equipment and supplies and disease transmission.

Administer a medication in a syringe prepared by someone else. Whereas this practice of administering a medication in a syringe prepared by someone else is not addressed in any guidelines, the person administering the injection must assume that aseptic technique was used to draw up the medication. We were glad to see that a common theme of the 1,557 respondents that indicated they always or sometimes engage in this practice, was that they “*always watched the person preparing the syringe and ensured it was labeled*” suggesting that they understood the importance of aseptic technique.

Re-entry of single-dose vial for same patient. Approximately a third of our respondents indicated that they enter a *single-dose/single-use vial* more than once for an additional dose for the same patient; however we did not assess whether they used the same syringe or a new sterile syringe for re-entry. The Centers for Disease Control and Prevention (CDC) guidelines emphasize that needles and syringes are single use items and that any vial should *not* be entered with a used syringe or needle (Fig 1). First, re-entering a single-dose vial with the same needle is a risky practice because if strict aseptic technique is not followed, there is a potential for contaminating the needle through inadvertent touch contamination from contact with organisms on the patient’s skin, the IV tubing/access device if one is used (eg, heparin lock) that may be contaminated with the patient’s blood, or during re-entry into the used vial. The risk of bacterial contamination is especially important for patients that may be immunocompromised. The use of a new sterile syringe and needle for re-entry into the vial does not eliminate the risk of compromising the sterility of single-dose vials of medications *if* strict aseptic technique is not used and the vial becomes contaminated. Once contaminated, the opportunities for bacterial growth are increased the longer the time elapsing between uses and the lack of bacteriostatic or preservative agents in many single-dose vials to inhibit bacterial growth (eg, vaccines). It is also important to note that single-dose vials are intended for a single procedure or injection and should always be discarded at the end of the procedure/injection. They should never be stored for later use or subsequent procedures, even if for the same patient.

Reuse of multi-dose vials. The majority of respondents (65.6%) reported using multi-dose vials for more than 1 patient. Although multi-dose vials contain more than 1 dose of medication because they contain a bacteriostatic agent, there is still a risk that a multi-dose vial may become contaminated. It is also important to note that bacteriostatic agents are not effective against viruses, such as HBV and HCV. It is for these reasons, that the CDC recommends single-dose vials be used whenever possible and that medications packaged as multi-dose vials be assigned to a single patient whenever possible (Fig 1).

Practices not considered appropriate or consistent with current guidelines

There are certain inappropriate injection practices that have been associated with disease transmission and are dangerous and unacceptable.

Reuse of single-dose vials for multiple patients. The CDC explicitly recommends that single-dose vials or ampoules not be used for multiple patients (Fig 1). However, we found that 318 professionals, 6.0% of the respondents, reported this was their practice, and comments indicated this was often done with vaccines, insulin, and propofol. Another frequent comment was that reuse of the single-dose vial depended on the size of the vial. This comment reflects the confusion that many providers have about large volume vials that are labeled as single use (ie, single-dose) believing that the large volume in the container makes it suitable for multiple patients and not to use it would be wasteful. A number of unsafe practices such as reuse of single-dose vials on multiple patients are done with the notion that they reduce costs without an appreciation of the risks involved. For example, in a Nevada endoscopy center outbreak investigated in 2008, it was discovered that syringes were routinely reused, after changing needles, to

obtain additional doses of propofol from single-dose vials for patients who required additional sedation.^{14,15} Although the syringe was discarded at the end of the procedure, any remaining medication in the single-dose propofol vial was used for subsequent patients. Over 63,000 patients who had undergone procedures were exposed to this long-standing practice and at risk of bloodborne pathogen transmission. Overall, 106 cases of Hepatitis C were linked to this outbreak, costing the health department nearly \$21 million for outbreak investigation, response, and testing of potentially exposed patients.¹⁶

Because propofol is formulated in a lipid emulsion that supports rapid bacterial growth even with inclusion of a bacteriostatic agent, there have also been numerous outbreaks from bacterial pathogens linked to reuse of single-dose vials of propofol.¹⁷ The recent propofol shortage has prompted a number of providers to reuse single-dose vials of propofol, even though this is a very risky practice and has been implicated in numerous outbreaks of both viral and bacterial pathogens.^{4,17}

Overt syringe reuse. Any form of syringe reuse is a dangerous practice. An alarming finding was that nearly 1.0% (45 out of 5,472 clinicians) responding to the question indicated that they use the *same* syringe for multiple patients but *change the needle* for each patient. Even 1% of clinicians performing this unacceptable practice could translate into thousands of patients at risk and contribute to the burden of bloodborne pathogen transmission.

In an outbreak in Oklahoma, direct syringe reuse resulted in over 100 cases of HBV and HCV infections over a 3-year period.¹⁶ Here, a professional in a pain remediation clinic routinely prepared a single needle and syringe at the beginning of each clinic session for 3 different medications. The 3 needles and syringes were used to administer the 3 medications sequentially to all patients treated in the individual clinic session through a peripheral IV catheter.

We were pleased to see that the majority (99.2%) of respondents indicated they never engaged in this practice and provided comments that reflected their awareness of this practice as egregious. These comments characterized the practice as “*appalling, horrifying, or gross.*”

Contamination of shared medications from reuse of syringes

Another deficient practice that has resulted in HBV and HCV transmission involves the reuse of a syringe to withdraw medications or solutions from containers of medication or solution that might be shared. This type of error does not typically involve overt reuse of a syringe for multiple patients. Instead, a syringe is reused to draw up additional medication for a single patient, thereby contaminating the medication vial or IV bag of solution that is subsequently used for multiple patients.⁴

For example, this practice led to the outbreak of HCV in the Nevada endoscopy center described above that involved routine reuse of syringes, after changing the needle, to obtain *additional doses of medication from a single-dose vial of propofol that was used for subsequent patients.*¹⁵

The current CDC guidelines specifically recommend that syringes, cannulas and needles be used only once, and if multi-dose vials are used, both the needle or cannula and syringe used to access the multi-dose vial must be sterile (Fig 1).⁹ The CDC guidelines also recommend that needles and syringes should not be reused to access a medication or solution that might be used for a subsequent patient. Additionally, the CDC recommends limiting the use of multi-dose vials of medication to single patients, whenever possible, as an extra barrier of protection against unrecognized syringe reuse or other means of vial contamination.

In our study, the 797 respondents (15.1%) that indicated that they “sometimes or always” reuse a syringe for additional doses from the same multi-dose vial for the same patient were asked to indicate the disposition of the multi-dose vial. A total of 51 of the 789 (6.5%) that answered the question on disposition of the vial indicated that “*they saved the vial for reuse on another patient.*” Although only 4 of the 51 provided comments, they do provide some insight into the mistaken belief by some health care professionals that this practice is safe as long as good technique is used, for example, explaining this practice is done “*only if the vial remained sterile.*” A number of respondents who indicated they never engage in this practice did provide a comment that they have observed others doing this, suggesting that this practice may be more common than our data indicate.

Use a bag or bottle of IV solution for more than 1 patient. In another large outbreak, 99 patients treated at a hematology-oncology clinic in Nebraska were infected with HCV when a nurse reused syringes, after drawing blood from central venous catheters, to withdraw saline solution from 500 mL bags for flush procedures. Each bag of saline was routinely used as a common source of flush for 25-50 patients.¹⁸ Our survey found that at least 448 health care professionals are using a bag or bottle of IV

solution as a source of supply or medication diluent for more than 1 patient. There is little doubt that re-entering IV bags to obtain diluents for medications has the potential for outbreaks of significant size if large volume bags are used and aseptic technique is not followed as happened in the Nebraska outbreak. Some comments suggest that there is some awareness of potential risk and certain controls were being put into place that are believed to reduce the risk, for example: “*we limit use to 24 hours*” or “*we only do this in the medication room.*” However, even with limiting the use of IV bags as a common supply to 24 hours, this is still not an acceptable practice. Although it may shorten the duration of potential exposure, it will not prevent potential disease transmission if the IV bag becomes contaminated.

Insulin administration. “During insulin administration” was a common theme among the comments for many of the practices that are considered unsafe, for example, using single-dose vials for more than 1 patient, reusing a syringe on another patient after changing the needle, and reusing a syringe for the same multi-dose vial and then saving the vial for use on another patient. This finding is disturbing given the frequency of outbreaks of HBV infections from improper use and handling of blood glucose monitoring equipment, such as reusing fingerstick devices for multiple patients and sharing blood glucose meters between patients without disinfecting after each use.¹⁹ Although many of the 15 reported outbreaks in the past decade have affected long-term care residents, the same conditions that facilitate transmission can be present in a wide variety of settings. A recent survey of infection control practices at 68 ambulatory surgical centers in 3 states found lapses in blood glucose monitoring in 46.3% of the centers.³ Our survey data in combination with these reports suggest that lapses in infection control and aseptic technique for both glucose monitoring and insulin administration may be an under-recognized issue across other health care settings and worthy of increased attention.

Hospital versus non-hospital settings

Much of the recent focus has been on unsafe injection practices in the non-hospital setting^{1,3} where it is thought that attention to infection prevention and control is lacking relative to hospital settings. However, our data trends indicate that unsafe injection practices are happening in both hospital and non-hospital settings. Of those that report reusing a syringe to obtain an additional dose from a multi-dose vial and then leaving it for use on another patient, approximately half were from the hospital setting and the other half were from the non-hospital setting. We also found that for those who indicated they reused syringes and only changed the needle between patients, the majority (64.9%) of those providing information on their organization worked in hospital settings and 35.1% (13 of 37) worked in non-hospital settings. Although the proportions of respondents varied by setting, our data suggest that unsafe injection practices likely resulting from mistaken beliefs may be occurring in the hospital setting more frequently than previously thought.

Limitations

Our study has several limitations. First, because our sample was only a convenience sample and not randomized, it may not be representative of all types of health care organizations and departments. Although the respondents represented many different health care professions, the majority were registered nurses. Second, respondents may be over-represented by those who were more interested in safe practices. Third, because it was not an observational study, it relied on self-reported practices that may not fully represent actual practice. We also did not assess the respondents’ number of years in practice or the geographic location of their health care setting, which would have provided additional information on where to target outreach and education. As a result, our findings provide only conservative estimates of current injection practices.

Summary: Lessons learned

Our findings provide evidence that health care professionals continue to engage in unsafe injection practices, which represent an ongoing threat to patient safety in the United States and are devastating to all those patients who are impacted. A common theme among all the outbreaks was the failure of health care providers to adhere to the most basic concepts of infection control and injection safety.⁹ Despite the availability of guidance on best practices from CDC and other groups, there remains a lack of awareness and implementation of these recommendations by many.

Although non-hospital settings have come under intense scrutiny in the past few years because of the frequency of reported outbreaks and breaches in infection control,^{1,3} our data indicate that some of the most flagrant infractions (syringe reuse on multiple patients with only a needle change and re-entry into multi-dose vial leaving it for reuse on another patient) are being reported at least half of the time by professionals in hospital settings.

Preventing the spread of bloodborne pathogens like HBV, HCV, and HIV is a basic expectation anywhere health care is provided.²⁻⁵ This applies to protection of both the patient and the health care provider. Significant progress has been made in reducing risk of occupational infection with bloodborne pathogens such as HBV following widespread adoption of safer devices, safe work practices, and hepatitis B vaccination. We need to apply the same energy for reducing risks to patients from unsafe injection practices. This will require a multi-faceted approach that focuses on surveillance, oversight, enforcement, and continuing educational efforts aimed at ensuring safe injection practices in all practice settings. It will also be important to get additional insight and address some of the incorrect beliefs about injection practices during educational programs. The source and format for receipt of information about injection safety (Table 1) should help guide educational efforts. The trends identified in this survey, including the range of locations and departments where unsafe practices are occurring indicate the need for education in all settings where health care is provided. There is also a need for targeted educational initiatives, including curricula in nursing, medical and other health care professional training and vocational programs. In addition to the CDC, a number of organizations and groups have educational resources, videos, guidelines and position papers to assist in education and training.²⁰⁻²³ Although there is clear need for more education, this may not necessarily eliminate all unsafe practices. Adopting principles from human factors engineering, we must consider redesigning devices, equipment, and processes to reduce or eliminate risk of bloodborne pathogen transmission. Just as we have seen sharps safety devices reduce risk of occupational needlesticks, we also need to look at engineering changes to reduce risks of unsafe injection practices, for example redesigns of syringes that make it easy to comply with injection safety and consistent and clear labeling of medications vials to encourage intended usage.

Finally, each and every health care provider has a duty to carefully review their infection prevention and control practices and the practices of any staff peers as well as those they supervise, ensuring they are all following the recommended practices (Fig 1). We must create a safety culture whereby every provider is empowered to take responsibility to stop any colleague from engaging in unsafe practices and help ensure that safe practices are understood and followed by all. Patients must also be educated on safe practices and be empowered to question the practices of any health care provider that may impact the safety of a patient.

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Table 1 Knowledge-awareness of injection safety

Source	n (%)
<i>How did you hear about injection safety?</i>	
Professional organizations	3,568 (60.1)
Co-Workers	2,750 (45.9)
Centers for Disease Control (CDC)	1,854 (31.0)
Supervisor	1,354 (22.6)
Media	898 (15.0)
Health Department	780 (13.0)
Other	1,108 (18.5)
<i>How was information received?</i>	
Guidelines	3,536 (59.6)
Educational session - seminar	3,278 (55.2)
Bulletins	2,065 (34.8)
Brochures	1,137 (19.2)
Textbook	1,059 (17.8)
Other	727 (12.3)

Note: Total frequencies vary; multiple responses were possible; some respondents did not answer all questions.

Table 2. Characteristics of respondents on survey of injection practices

Category	n (%)
Professional Training	
Anesthesiologist Assistant (AA-C)	120 (2.4)
Anesthetist (CRNA)	49 (1.0)
Dentist (DDS)	9 (0.2)
Licensed Nurse (LPN, LVN)	145 (2.8)
Laboratory Technologist	13 (0.3)
Operating Room Technician (ORT)	10 (0.2)
Patient Care Technician (PCT)	35 (0.7)
Pharmacist	23 (0.5)
Physician (MD, DO, DPM)	120 (2.4)
Registered Nurse (RN)	4,570 (89.5)
Respiratory Therapist	10 (0.2)
Healthcare Organization	
Hospital setting (n=3,432)	
Hospital (< 100 beds)	675 (13.0)
Hospital (100 – 250 beds)	1,005 (19.3)
Hospital (251 – 500 beds)	1,145 (22.0)
Hospital (> 500 beds)	607 (11.7)
Non-hospital setting (n=1,767)	
Ambulatory Surgery Center	513 (9.9)
Ambulatory care center (1) (Hospital-based/ affiliated)	244 (4.7)
Ambulatory care center (1) (Stand alone)	456 (8.8)
Dialysis	10 (0.2)
Home Care (2)	133 (2.6)
Long term care (3)	110 (2.1)
Physician's office	243 (4.7)
Urgent care center (4) (stand-alone)	22 (0.4)
Other (5)	36 (0.7)
Primary Practice Area / Department	
Ambulatory (6)	185 (3.6)
Cardiac Catheterization/Electrophysiology (EP)	56 (1.1)
Emergency care	342 (6.6)
Endoscopy	321 (6.2)
General patient clinical care (7)	1,276 (24.6)
Geriatrics / Home Care (8)	84 (1.6)
Infection Control / Employee Health	233 (4.5)
Infusion therapy	214 (4.1)
Intensive (critical) care (9)	835 (16.1)
Maternal-Child (10)	279 (5.4)
Oncology	147 (2.8)
Pain management	52 (1.00)
Radiology-Radiation	90 (1.7)
Surgery or Anesthesia services	927 (17.9)
Other (11)	146 (2.8)

Note: Total frequencies vary - some respondents did not answer all questions. (1) Clinics, public health, ambulatory infusion, behavioral health; (2) Home health, home infusion, hospice; (3) Assisted living, nursing homes; (4) ER, trauma centers; (5) Dental, laboratories, Outpatient pharmacies, institutional settings; (6) Clinics, offices, dialysis; (7) Medical/surgical, telemetry, general care units; (8) Long-term care, sub-acute, assisted living; (9) Intensive care unit (ICU), Coronary care unit (CCU), Surgical intensive care unit (SICU); (10) Labor & delivery, mother baby, pediatrics, Pediatric intensive care unit (PICU), Neonatal intensive care unit (NICU); (11) Administration, education, mental health

Table 3 Injection practices

	Never, n (%)	Combined <i>always + sometimes,</i> n (%)	Sometimes, n (%)	Always, n(%)	Total, n*
Acceptable practices if performed with aseptic technique					
How often do you administer a medication in a syringe that was prepared by someone else?	3,813 (71.0)	1,557 (29.0)	1,482 (27.6)	75 (1.4)	5,370
How often do you enter a single-dose/single-use vial more than once to obtain additional doses for the same patient?	3,703 (69.8)	1,599 (30.2)	1,497 (28.2)	102 (1.9)	5,302
How often do you use multi-dose vials for more than one patient?	1,827 (34.4)	3,484 (65.6)	2,296 (43.2)	1,188 (22.4)	5,311
Practices not considered appropriate or consistent with current guidelines					
How often do you use single-dose/single-use vials for more than one patient?	4,985 (94.0)	318 (6.0)	296 (5.6)	22 (0.4)	5,303
How often do you administer medication to more than one patient using the <i>same syringe</i> but a <i>new sterile needle for each patient</i> ?	5,247 (99.2)	45 (0.9)	25 (0.5)	20 (0.4)	5,292
How often do you use a bag or bottle of intravenous solution as a source of supply or medication diluent for more than one patient?	4,817 (91.5)	448 (9.0)	403 (7.7)	45 (0.9)	5,265
How often do you reuse a syringe to obtain additional doses from the <i>same multi-dose vial</i> for the <i>same patient</i> ?	4,492 (84.9)	797 (15.1)	714 (13.5)	83 (1.6)	5,289
The disposition of the vial for 789 of the 797 who “always or sometimes” reuse a syringe to obtain additional doses from the <i>same multi-dose vial</i> for the <i>same patient</i>	Discard vial? 738 (93.5)	Leave for use on another patient? 51 (6.5)			789

*Total n = number of responses to each question. Frequencies vary; some respondents did not answer all questions.

Figure 1 Recommended injection practices for patient safety

Recommended Injection Practices for Patient Safety		
<p>Injection safety is a set of measures taken to perform injections in an optimally safe manner for patients, health care personnel, and others.</p> <p>Aseptic technique refers to the manner of handling medications and injection equipment to prevent microbial contamination; it applies to the handling, preparation, and storage of medications as well as the handling of all supplies used for injections and infusions, including syringes, needles, and IV tubing.</p>		
Recommendations	Practices You Must Know	CDC Category*
Use aseptic technique.	<ul style="list-style-type: none"> • Avoid contamination of sterile injection equipment. • Do not administer medications from a syringe to multiple patients, even if the needle or cannula on the syringe is changed. 	1A 1A
Use syringes, needles and cannulae only once.	<ul style="list-style-type: none"> • Needles, cannulae and syringes are sterile, single-use items; they should not be reused for another patient nor to access a medication or solution that might be used for a subsequent patient. 	1A
Use single-dose vials for parenteral medications <i>whenever possible</i> .	<ul style="list-style-type: none"> • Do not administer medications from single-dose vials or ampules to multiple patients or combine leftover contents for later use. 	1A
If multi-dose vials are used, assign to a single patient <i>whenever possible</i> .	<ul style="list-style-type: none"> • If multi-dose vials must be used, both the needle or cannula and syringe used to access the multi-dose vial must be sterile. • Do not keep multi-dose vials in the immediate patient treatment area and store in accordance with the manufacturer's recommendations; discard if sterility is compromised or questionable. 	1A 1A
Use fluid infusion and administration sets (i.e., intravenous bags, tubing and connectors) for one patient only and dispose appropriately after use.	<ul style="list-style-type: none"> • Do not use bags or bottles of intravenous solution as a common source of supply for more than one patient. • Consider a syringe or needle/cannula contaminated once it has been used to enter or connect to a patient's intravenous infusion bag or administration set. 	1B 1B
<p>*Category IA: Strongly recommended and supported by well-designed experimental, clinical or epidemiologic studies. Category IB: Strongly recommended and supported by some experimental, clinical or epidemiologic studies and a strong theoretical rationale. From: Centers for Disease Control and Prevention. Guideline for isolation precautions: preventing transmission of infectious agents in healthcare settings 2007. Atlanta (GA): U.S. Department of Health and Human Services, CDC; 2007. Available at: http://www.cdc.gov/ncidod/dhqp/gl_isolation.html.</p>		