ORIGINAL ARTICLE

Barriers and Facilitators to Injection Safety in Ambulatory Care Settings

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OBJECTIVE. Identify factors referred to as barriers and facilitators that can prevent or assist safe injection practices in ambulatory care settings to guide quality improvement.

DESIGN. In this mixed-methods study, we utilized observations and interviews.

SETTING. This study was conducted at ambulatory clinics at a midwestern academic medical center from May through August 2017. Sites included a variety of clinical settings that performed intramuscular, intradermal, intravenous, or intra-articular injections.

PARTICIPANTS AND INTERVENTIONS. Direct observations of injections and interviews of ambulatory care staff were conducted. An observation checklist was created, including standards of injection safety from nationally recognized guidelines. Interview questions were developed using the System Engineering Initiative for Patient Safety (SEIPS) model. Interviews were recorded, transcribed, and then coded by 2 investigators.

RESULTS. In total, 106 observations and 36 interviews were completed at 21 clinics. Injection safety standards with the lowest adherence included using needleless access devices to prepare injections (33%) and the proper use of multidose vials (<80%). Of 819 coded interview segments, 461 (56.3%) were considered facilitators of safe injection practices. The most commonly identified barriers were patient movement during administration, feeling rushed, and inadequate staffing. The most commonly identified facilitators were availability of supplies, experience in the practice area, and availability of safety needles and prefilled syringes.

CONCLUSIONS. Perceived barriers and facilitators to infection control elements of injection safety are interconnected with SEIPS elements of persons, organizations, technologies, tasks, and environment. Direct observations demonstrated that knowledge of safety injection standards does not necessarily translate to best practices and may not match self-reported data.

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Unsafe injection practices place both patients and healthcare workers (HCWs) at risk for infection transmission. For patients, the vast majority of recent infectious outbreaks in healthcare have occurred in the outpatient setting as the result of unsafe injection practices.[1] More than half of these outbreaks involved bloodborne viral or bacterial infections and have not been restricted to a single type of clinic or specialty.[1–4] During a 2007 outbreak in Nevada, the reuse of syringes and the use of single-dose vials (SDVs) for multiple patients resulted in up to 106 cases of healthcare-acquired hepatitis C and the notification of 63,000 patients for possible exposure of hepatitis C and other bloodborne pathogens.[5,6] Since 2001, >150,000 people have been notified of exposure to bloodborne infections in similar outbreak investigations. These incidents prompted The Joint Commission (TJC) to release a Sentinel Event Alert calling for the improvement of injection practices.[7]

Safe injection practices also protect HCWs from exposure to bloodborne pathogens. The Centers for Disease Control and Prevention (CDC) defines a sharp injury as "a penetrating stab wound from a needle, scalpel, or other sharp object that may result in exposure to blood or other body fluid." The CDC estimates that 385,000 sharps-related injuries occur annually in hospital settings; however, it is also estimated that 50% of sharp injuries go unreported.[8] Most needlestick injuries occur in the inpatient setting, but almost 10% occur in ambulatory settings.[9] Among the 150 ambulatory clinics in the current study, the incidence of sharps injuries has increased since 2015, and more than half have been from needle sticks (unpublished internal communication).

Safe medication administration is a national patient safety goal for ambulatory healthcare.[10] To promote safe medical injection practices, the CDC launched "The One & Only

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Campaign," which emphasizes the use of 1 needle and 1 syringe for each patient and the correct usage of multidose (MDV) and single-dose (SDV) vials.[1] The CDC also recommends implementing training programs to reinforce safe injection practices and monitoring adherence to the recommendations.[1]

The Institute of Medicine (IOM) promotes viewing safety from a systems perspective[11] and asserts that healthcare outcomes do not result from the action of a single individual but depend on the interaction of many factors, including environment of practice, organizational culture and structure, and human factors.[12] Focusing on just 1 of these factors does not necessarily produce the desired improvements in healthcare outcomes.[13] The continued occurrence of unsafe medication-vial usage suggests that the knowledge of safe practices alone is not enough to ensure adherence.[14,15] The Systems Engineering Initiative for Patient Safety (SEIPS) model, which emphasizes persons, organization, technologies and tools, tasks, and environment[12] is one framework used to evaluate healthcare systems.

Understanding the SEIPS barriers and facilitators that prevent or assist safe injection practices can help guide clinical interventions to reduce disease risk exposure. In a recent study by Anderson et al,[15] HCWs self-reported a high knowledge of injection safety and no barriers to safe usage of medication vials; however, observation data collected in the same study revealed significant nonadherence to safe usage of medication vials. In addition, 2 other studies that collected anonymous survey data from clinicians reported that reuse of syringes for multiple patients still occurs in practice.[16,17] At the time of this project, few other published studies had described the extent of nonadherence to available injection safety standards, and no published studies have described contributing factors to these practices. The goal of this study is to identify barriers and facilitators to safe injection practices in the ambulatory setting to guide quality improvement interventions.

METHODS

An invitation for voluntary study participation was sent to the manager or director at clinic sites that were known to perform intramuscular, intradermal, intravenous, or intra-articular injections. Observations and interviews were conducted in person by investigators familiar with site-visit observation and standardized interviewing techniques. Clinics that accommodate high volumes of patients, defined as 1 patient every 15–45 minutes, as well as those that provide urgent care or same-day services or perform invasive procedures, were given priority. Participating clinics were categorized by type and included adult primary care, pediatric primary care, family medicine, urgent care, medical specialty services, procedural centers, dialysis centers, and imaging departments. To maintain confidentiality, the names of participating staff were not recorded.

Observations

The investigator observed the preparation and administration of 10 injections or all injections within 2 hours, whichever came first. We defined 1 injection as the administration of medication or contrast through 1 syringe to 1 patient. If the observed staff member also participated in the interview, observation was completed first. For each injection observed, the investigator recorded whether staff performed the elements of safe injection using a checklist of safe injection standards guided by the CDC, the National Institute for Occupational Safety and Health, and the American Nurses' Association standards on safe injection and the prevention of needle stick injuries (Table 1).[18–20]

For all standards, the investigator recorded "yes" if the standard was performed or "no" if it was not performed (Table 1). The observer offered guidance to the staff at the time of observing a practice not meeting standards. Totals for each standard were calculated using Microsoft Excel. In some clinics, interviews were conducted even though no injections were observed.

Interviews

Semistructured interviews consisted of 5 open-ended questions that addressed each of the SEIPS domains: persons, organization, technologies and tools, tasks, and environment (Table 2). Following observations, the investigator interviewed at least 1 staff member who performed injections at the clinic site and a supervisor. Interviews were digitally recorded and transcribed when possible. Information was transcribed, and data were entered into the QDA Miner Lite software program (Provalis Research, Montreal, Quebec, Canada) to assist with the coding of themes according to SEIPS domains of persons, organization, technologies and tools, tasks, and environment. Each coded segment was classified as a barrier or facilitator and whether it was reported by supervisory staff. It was then assigned a category and grouped according to common theme or multiple themes if applicable. The frequency of each theme and their attribution as a facilitator or barrier to injection safety were calculated (Figures 1 and 2). Finally, the observed data and interview data were compared to identify associations between the elements performed and the SEIPS themes reported (Table 1). This project was considered a quality improvement study and was exempt from review by our institutional review board.

RESULTS

Of the 32 clinics contacted between May and August 2017, 21 clinics participated in this study. Of the 11 nonparticipating clinics, the most common reasons for declining participation were (1) staff turnover issues, (2) giving injections so infrequently that none would be observed, (3) providers giving the injections did not have time to accommodate the visit, or

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TABLE 1. Injection Safety Observation Checklist[a] Reported by Number of Injections Adherence to Elements from May to August 2017 (n = 106)

	Adherence to Injection Safety Elements by Clinic Area with Predominant SEIPS Theme Reported During Interviews, Adherent, No./Total[b] (%)					
Observation Elements/Predominant SEIPS Themes after Coding	Adult Primary Care	Pediatrics, Urgent Care, and Family Medicine	Medical Specialty	Procedural	Dialysis	Imaging
1. Medication is drawn or prepared in a clean, designated area.	10/10 (100)	33/36 (92)	10/13 (77)	17/19 (89)	14/14 (100)	7/7 (100)
Environment	Common themes reported: • Suboptimal condition of the medication room and location • Unavailability of separate medication room away from patient care area • Inadequate size and lighting					
2. Medication is drawn up and administered using needleless access device, if applicable.	0/8 (0)	2/19 (11)	0/9 (0)	7/10 (70)	12/12 (100)	1/7 (14)
Tools/technology	Common themes reported: • Unavailability of safety needleless devices for medication preparation • Type of needle used					
3. Rubber septum of medication vial is cleansed with alcohol prior to access.	8/9 (88)	21/26 (81)	8/8 (100)	8/11 (73)	14/14 (100)	6/7 (86)
Organization, tools/technology	Common themes reported: • Need ongoing training and refresher courses • Scheduled time allowed for training is needed • Need easy access to training materials and reminder tools • Need clear and easy access to policies					
4. Needles, syringes, IV solution bags, and IV tubing and connectors are used for only one patient.	7/7 (100)	36/36 (100)	13/13 (100)	20/20 (100)	14/14 (100)	9/9 (100)
Organization, tools/technology	Common themes reported: • Clear labels and organization of medication storage • Adequate staffing and training • Availability of continued training courses • Clear and easy accessible policies and protocols • Leadership qualities and financial availability • Availability of stocks • On-line or computers resources for easy ordering					
5. If using a multidose vial, expiration date is checked prior to administration.	5/5 (100)	3/5 (100)	4/5 (80)	NA	NA	NA
Workflow, persons, organization	Common themes reported: • High patient turnover resulting in reduced time • Increase multitask due to high volume • Daily routine protocol for checking before preparing injections • Staff behavior and ability to pay attention to details • Ongoing education and training for safe injections • Clear labeling protocol is needed					
6. If using a multidose vial, medication is kept in a centralized location.	2/2 (100)	5/5 (100)	3/6 (50)	NA	NA	NA
Environment, organization	Common themes reported: • Condition of medication and location • Adequate size of clinic • Organized medication room and sufficient medication storage • Leadership qualities and financial availability					
7. If using a single use vial, not used for >1 dose or >1 patient.	6/6 (100)	31/31 (100)	7/7 (100)	20/20 (100)	14/14 (100)	9/9 (100)
Organization, tools/technology	Common themes reported: • Clear labels and organization of medication storage • Adequate staffing and training • Availability of continued training courses • Clear and easy accessible policies and protocols • Availability of stocks • On-line or computers resources for easy ordering					
8. If patient needs to be physically stabilized for injection, additional help is available and utilized.	4/4 (100)	15/18 (83)	NA	10/10 (100)	NA	NA
Workflow, persons	Common themes reported: • Be prepared and plan for the day • Pre-visit and injection planning • Team work and available staff • Patient cooperation, physical condition, and responsive to instruction					

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TABLE 1. *Continued*

	Adherence to Injection Safety Elements by Clinic Area with Predominant SEIPS Theme Reported During Interviews, Adherent, No./Total[b] (%)					
9. Needles are not exposed until the moment of use.	6/6 (100)	34/34 (100)	13/13 (100)	12/12 (100)	NA	6/6 (100)
Workflow, persons, organization	Common themes reported: • Clear daily routine workflow • Prepare for high patient volume and multi-task • Pre-visit and injection planning each day • Staff training and team work • Clear and easy policies to follow					
10. Contaminated needles are not recapped.	11/11 (100)	34/34 (100)	13/13 (100)	7/7 (100)	NA	6/6 (100)
Workflow, persons, organization	Common themes reported: • Clear daily routine workflow • Staff training and teamwork • Clear and easy policies to follow					
11. Needles are not passed by hand; instead, a designated tray or location is used for placement and retrieval.	NA	NA	NA	10/10	NA	6/6
Environment, workflow, persons, organization	Common themes reported: • Condition and adequate size of the medication room • Organize medication room with clear labels and storage • Pre-visit and injection planning for the day • Staff behavior and team work • Adequate supplies and provisions • Clear and easy access to policies • Leadership qualities					
12. When appropriate, all needle safety devices are activated promptly with one hand after use.	11/11 (100)	31/34 (91)	11/11 (100)	NA	2/2 (100)	NA
Workflow, organization, tools/technology	Common themes reported: • Postinjection workflow • Staff education and training • Clear and easy access to policies • Available safety devices					
13. All needles and syringes are immediately discarded into sharps container after use.	10/11 (91)	36/36 (100)	13/13 (100)	20/20 (100)	14/14 (100)	9/9 (100)
Environment, workflow, organization	Common themes reported: • Condition of medication and patient-care area • Easy access and location of sharp containers • Post-injection workflow protocol and training • Patient behavior that can cause distraction • Adequate staffing and training • Adequate financial means to maintain supplies • Leadership qualities • Clear and easy access to policies					

NOTE. SEIPS, System Engineering Initiative for Patient Safety; NA, not applicable.

[a]Adapted from standards from the Centers for Disease Prevention and Control, National Institute for Occupational Health and Safety, and the American Nurses' Association.

[b]Total reported number of adherence and nonadherence; does not include not applicable or not observed.

(4) they did not feel that injection safety was an issue. Of the 21 clinics, 16 participated in both the interviews and observations, 2 participated in observations only, and 3 had interviews only. For 3 clinics, only interviews were performed because no injections were given during the observation period. One staff member and one manager were interviewed in all clinics except for pediatrics where only one staff was available for interview. Participating clinics included 4 adult internal medicine departments, 6 pediatric or family medicine departments, 1 provided urgent-care services, 3 adult specialty medicine services (dermatology, allergy, and immunology), 3 ambulatory procedures (digestive health, radiation oncology, and ambulatory surgery), 2 provided imaging services, and 2 provided outpatient dialysis services (Table 1). Most of the clinics were located within the city of Madison, and 3 were in outlying communities.

In total, 106 injections were observed at the 21 clinics (average 5 injections per clinic, range, 0–10 injections). Most injections (82.1%) involved SDVs compared to MDVs (17.9%). Of the 13 standards, 5 were followed 100% of the time, including the standard of not using SDVs for >1 dose or >1 patient (Table 1). The standard with the lowest compliance rate was preparing and administering injections using needleless access devices. Primary care and urgent care clinics were more likely to not meet this standard (Table 1) because

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TABLE 2. Injection Safety Interview Questions

SEIPS Element	Questions Proposed
Workflow	• Can you describe your usual workflow for giving injections? • Are there any elements in this workflow that make giving safe injections harder? • Are there any elements in this workflow that make giving safe injections easier?
Persons	• Can you think of a time when an individual (whether a staff member or a patient) has made it easier for you to give injections safely? • Can you think of a time when an individual (whether a staff member or a patient) has made it harder for you to give injections safely?
Organization	• Can you think of a time in which the organization (the clinic or the entire organization) has made it easier for you give injections safely? • Can you think of a time in which the organization (the clinic or the entire organization) has made it harder for you give injections safely?
Environment	• Can you think of and describe factors in your work environment that make it easier to give injections safely? • Can you think of and describe factors in your work environment that make it harder to give injections safely?
Tools and technology	• How has technology helped your ability to give safe injections? • How has technology hurt your ability to give safe injections?

NOTE. SEIPS, System Engineering Initiative for Patient Safety.

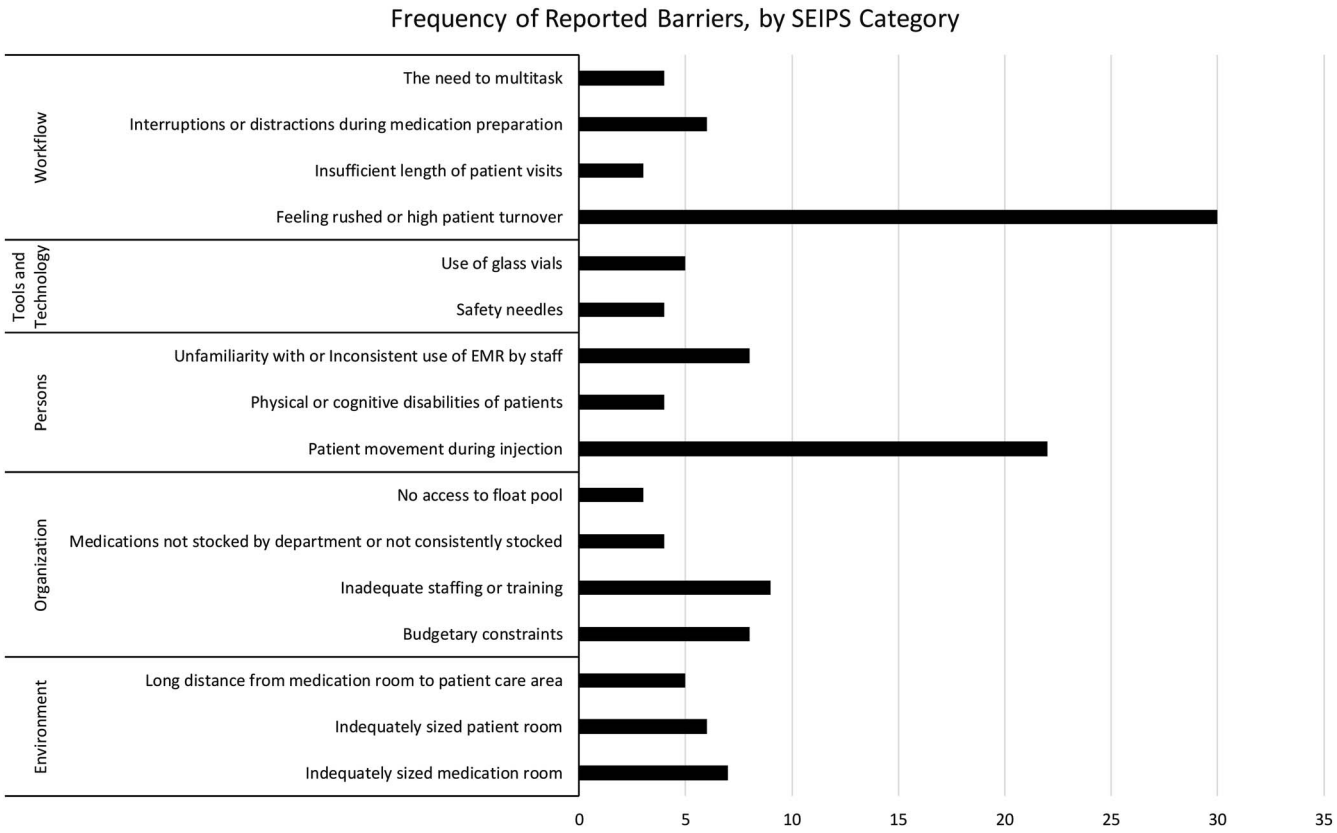

FIGURE 1. Frequency (%) of reported barriers, arranged by System Engineering Initiative for Patient Safety (SEIPS) category.

needleless devices were unavailable for the preparation of injectables. Other elements with low adherence included checking the expiration date of MDVs prior to use (20%–40% nonadherence) and keeping MDVs out of patient care areas (Table 1). For these standards, primary and urgent care locations were more likely than other clinic types to be nonadherent due to the frequency of MDV use and the relative nonuse of MDVs in procedural, dialysis, and imaging clinics.

Of the 36 completed interviews, 819 segments were coded across the 5 SEIPS elements. Of those, 358 (43.7%) segments were considered barriers and 461 (56.3%) were considered facilitators. Interview segments infrequently directly addressed

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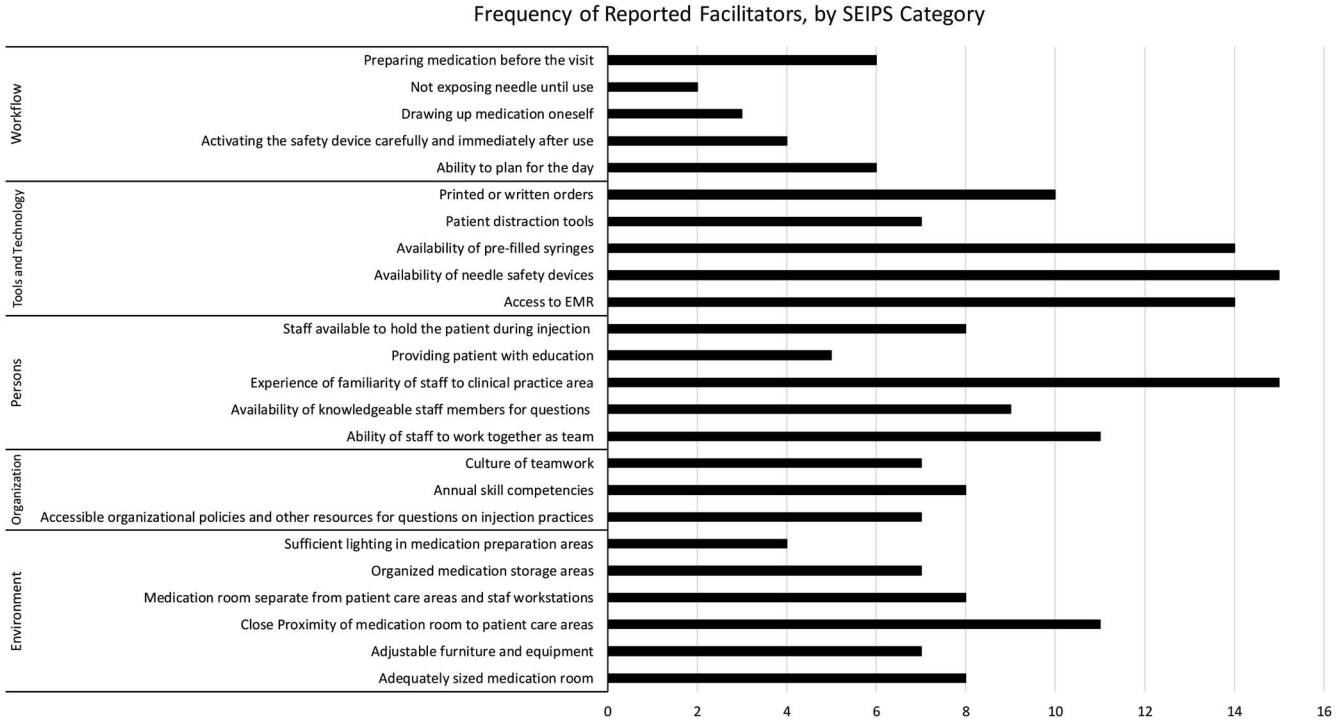

FIGURE 2. Frequency (%) of reported facilitators, arranged by System Engineering Initiative for Patient Safety (SEIPS) category.

the checklist standards. For instance, none of the participants noted barriers to cleansing the rubber hub of the vial prior to accessing, despite that element only being followed 86% of the time. The only standards explicitly mentioned in interview responses were the availability and correct use of safety devices and the availability of needleless devices for preparation of injectables. No pattern was noted between responses and type of clinic or between staff within clinics. Themes indirectly relating to checklist standards along with SEIPS categories are reported in Table 1 with the frequencies of adherence by clinic type.

Workflow

A wide variety of responses were recorded for the workflow category, reflecting the diversity of practice across participating clinics. In total, 72 different themes were assigned to 154 coded segments, 87 (55%) of which were described as barriers. The most frequently described barrier was the perception of feeling rushed and a high patient turnover (Figure 1). One participant commented that being in a hurry increases the risk for missing steps in the injection process. For reported facilitators, themes that included planning ahead for the injections emerged. Some technical aspects of injection administration were also noted to be facilitators (Figure 2).

Persons

Of the 202 segments coded to persons, 101 (50%) were described as barriers. The most frequently described barrier theme was patient movement during the injection (Figure 1), such as jumping or attempting to swat the hands of the HCW. One participant described having to hold a child during an immunization due to concerns of the child jumping and causing a needlestick injury. In pediatric populations, HCWs reported this type of patient reaction most often. For facilitators, a primary theme involved attempts to ameliorate a negative patient reaction. However, facilitators most frequently described were positive characteristics of staff giving the injection and available resources (Figure 2).

Environment

Of the 129 segments coded to environment, 51 (40%) were considered barriers to safe injection practice, including lack of space, smaller patient care areas, and limited storage supply space. The most common facilitator reported by both staff and managers was having injection supplies near work areas. Other common themes characterized the room in which medications are prepared and the availability of adjustable equipment (Figure 2).

Organization

Of the 136 segments coded to organization, 67 (49%) were classified as barriers. Most of the barrier themes involved inadequate staffing and training (Figure 1). Financial barriers were reported exclusively by managers. Managers were more likely than staff members to report annual skill competencies as helpful (Figure 2). One manager explained that regular competencies

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served as reminders for skills and safety concerns and provided assurance that staff adhered to safe injection practices. Both managers and staff reported that a culture of teamwork and accessible resources were important to injection safety.

Tools and Technology

Of the 198 segments coded to tools and technology, only 54 (27%) were classified as barriers. The most frequently reported facilitator was the availability of supplies near the work area (Figure 2). Although most participants reported the availability of safety needles and other types of safety devices as a facilitator, some reported safety needles as barriers because they obstructed visualization of the injection site or required the user to push up the shield over the needle with one or both hands. Characteristics of types of syringe were also important to participants. Another frequently reported facilitator was access to an electronic medical record (EMR) to assist with preparing medication and access to other online resources. Finally, although patient movement was the most frequently reported barrier in the "Persons" section of the study, tools used for needle pain management were reported less frequently as facilitators.

DISCUSSION

Concurrent use of observations followed by interviews allowed investigators to better identify gaps in injection safety practice. Interestingly, the safe practice elements that investigators observed were not frequently discussed in the interviews. Preference for using SDVs over MDVs was reported rarely in interviews, despite the recommended practices involving MDV use being suboptimal in observations. Thus, the self-reported data may not sufficiently gauge actual practice in the clinics. This finding is consistent with the study by Anderson et al, [11] which highlighted deficits in safe practice despite survey responses reporting no barriers.

Instead of directly discussing safe injection practices, many interview participants focused on elements that may indirectly impact the medication administration process or the overall daily clinic workflow. This type of response is supported by the most frequently reported barrier, the perception of being rushed. The interviews revealed that infection control aspects of safe injection practices are perceived to be closely connected with other clinic processes. Therefore, addressing practice concerns from only an infection control perspective may not achieve improved adherence to safe injection practices.

The strengths of this study include that observations and interviews were performed at a variety of outpatient settings offering different medical services as well as settings that give injections at different frequencies (Table 1). Semistructured interviews allowed investigators to gather diverse responses from both clinical staff directly involved in patient care as well as participants in managerial or supervisory roles. Observations also captured a wide variety of patient care staff, including medical assistants, licensed practical nurses, and physicians.

This study has several limitations. The possibility of reporting bias in interviews could not be excluded due to the inherent pressure to give a socially desirable response. Staff may have known the correct practice for injections but have been hesitant to report factors in which their practice deviates from the accepted one for fear of penalty. The greater number of reported facilitators over barriers may indicate the presence of this bias. Participants may have changed injection practices due to the presence of the observer. Because of time limitations in the study, investigators were only able to observe a small number of injections given in a period, and sometimes investigators observed the same staff for multiple injections. Thus, it is impossible to generalize results to all injections performed across all clinics. Finally, because of the limitations in the scope of the study, only a small number of the total reported barriers and facilitators could be discussed here.

Given the limitations of self-reporting, organizations may incorporate this model of observation to identify areas of nonadherence to practice standards and policies. The infection prevention department at the organization in this study routinely performs site visits to assess adherence to regulatory standards of safe injection, much like the elements assessed in this study. Most of the information gathered during these site visits is obtained through the self-report from the clinic manager. Because the observations of this study revealed more deficits in safe practice than the site visits reports, the study suggests that it may be necessary to monitor for adherence of regulatory standards with additional observations.

Future studies should aim to collect a larger amount of observation data from different staff members across the clinics. Inadequate staffing and staff unfamiliar with the clinic workflow were identified as barriers; thus, clinics that declined participation in the study due to staffing or training issues may have more unrecognized safe injection performance challenges. Because of the design, this study could not explore causative factors of nonadherence to safe injection practices. Additional studies on the effect of interventions focusing on the identified barriers and facilitators are needed.

In conclusion, perceived barriers and facilitators to infection control elements of injection safety are interconnected with the SEIPS elements of persons, organizations, technologies, tasks, and environment affecting injection administration and clinic processes. Frequently identified barriers included patient reactions during injection administration and challenging staff workflows. Frequently identified facilitators were supplies availability and appropriate safety devices. Direct observations may not align with self-reported data and may be necessary to accurately assess adherence to injection best practices.

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