BRIEF REPORTS

Evaluation of the Potential for Bloodborne Pathogen Transmission Associated with Diabetes Care Practices in Nursing Homes and Assisted Living Facilities, Pinellas County

Nicola D. Thompson, PhD,† Vaughn Barry, MPH,† Karen Alelis, MPH,‡§ Dongming Cui, MD, DrPH,§ and Joseph F. Perz, DrPH‖*

OBJECTIVES: To evaluate and characterize routine blood glucose monitoring practices in nursing homes and assisted living facilities (ALFs).

DESIGN: Cross-sectional, self administered survey and facility site visit.

SETTING: Two hundred eighty-nine licensed long-term care facilities in Pinellas County, Florida.

PARTICIPANTS: Stratified random sample of 48 long-term care facilities (17% overall sample).

MEASUREMENTS: Data on facility characteristics, infection control policies, staff practices, and equipment used for blood glucose monitoring. Differences between facilities in each stratum were compared and evaluated using the Pearson chi-square or Fisher exact test.

RESULTS: Fifteen nursing homes and 17 small and 16 large ALFs participated; 53 declined (48% participation rate). Bloodborne pathogen training ($P=.02$), hepatitis B vaccination ($P=.003$), and blood glucose monitoring ($P<.001$) policies were reported less often at ALFs. Staff glove use during blood glucose monitoring was lowest (50%) at small ALFs ($P=.02$). Reusable fingerstick devices intended for personal use were most often in use at ALFs ($P<.001$); four of 18 facilities (including 1 nursing home) were inappropriately using them for multiple residents. At 22 facilities (including all nursing homes), multiple residents shared blood glucose meters; only six (27%) reported cleaning them after each use.

CONCLUSION: Despite existing recommendations, practices that facilitate bloodborne pathogen transmission during blood glucose monitoring were identified at nursing homes and ALFs. Infection control practices and polices were most often lacking at ALFs. Better training and oversight of blood glucose monitoring in long-term care is needed to prevent transmission of bloodborne pathogens. **J Am Geriatr Soc 2010.**

Key words: long-term care; hepatitis B virus; blood glucose monitoring; diabetes; infection control

Monitoring of blood glucose levels is an increasingly frequent practice in persons with type 1 and type 2 diabetes mellitus.[1,2] An underappreciated risk is the opportunity for exposure to another person's blood through contaminated equipment and supplies if devices used for measuring blood glucose levels are shared.[3]

Numerous outbreaks of hepatitis B virus (HBV) infection—a serious and potentially life-threatening infection[4,5]—have been attributed to sharing of blood glucose monitoring equipment.[6–9] Outbreaks have been most frequently reported in residents of nursing homes and assisted living facilities (ALFs).[3] In 1990, because of the recognized risk of transmission of bloodborne pathogens through reusable spring-loaded finger stick devices, the Food and Drug Administration and the Centers for Disease Control and Prevention (CDC) recommended that this blood sampling equipment be restricted to individual use.[10,11] More-comprehensive infection control guidance from the CDC targeted specifically to the long-term care setting was published in 2005.[12]

Despite these recommendations, outbreaks related to care for diabetes mellitus have continued and may be increasing in frequency.[3,13] Recently reported HBV infection outbreak activity in long-term care settings in Florida prompted the survey described here and involved collaboration with an established Nursing Home and Assisted Living Program in the Disease Control Division of Pinellas County Health Department. A survey was conducted in

From the *Epidemic Intelligence Service, †Division of Viral Hepatitis, Epidemiology and Surveillance Branch, and ‖Division of Healthcare Quality Promotion, Prevention and Response Branch, Centers for Disease Control and Prevention, Atlanta, Georgia; ‡Florida Epidemic Intelligence Service, Florida Department of Health, Tallahassee, Florida; and §Epidemiology Program, Pinellas County Health Department, St. Petersburg, Florida.

Address correspondence to Nicola D. Thompson, 1600 Clifton Road, MS G-37, Atlanta, GA 30333. E-mail: ndthompson@cdc.gov

DOI: 10.1111/j.1532-5415.2010.02802.x

© 2010, Copyright the Authors
Journal compilation © 2010, The American Geriatrics Society
0002-8614/10/$15.00

long-term care facilities within Pinellas County to evaluate and characterize routine blood glucose monitoring practices in non-outbreak settings and to identify training and policy needs.

METHODS

Study Population, Sample Selection, and Facility Enrollment

A sampling frame of all licensed long-term care facilities (N = 289) in Pinellas County in 2007 was obtained from the Florida Agency for Health Care Administration (AHCA). The 289 facilities were assigned to one of three mutually exclusive strata based on facility type and size (as determined according to number of beds): nursing homes (n = 72) and small (<50 beds) (n = 50) and large (≥50 beds) (n = 167) ALFs. Using a random number table, facilities were selected using a stratified sampling strategy with equal allocation to enable evaluation and characterization of practices of facilities within each stratum.

Members of the investigation team contacted randomly selected facilities by telephone. The facility director or other appropriate staff member was informed of the objectives and purpose of the study, time involved, and risks and benefits of participation and asked to complete a facility survey and participate in a facility site visit. For those that agreed to participate, a copy of the survey was mailed or e-mailed, most often to the facility director or nursing director, for self-administration. Completed surveys were returned to the county health department before the site visit. Facilities that declined participation or did not return calls were removed from the sample and replaced by another randomly selected facility. This process continued until a 20% sample (n = 58) of the county's 289 facilities were enrolled.

Survey and Site Visit

The survey, based on one previously developed and used to assess practices in ALFs,[14] included questions on facility characteristics, number of residents and staff, prevalence of diabetes mellitus among residents, and practices and policies for care of diabetes mellitus and infection control. Only aggregate, facility-level data were collected; no individual or patient level data were requested. During the facility site visit, equipment used for blood glucose monitoring and staff practices were observed, and short interviews were conducted with staff. Two investigation teams comprising investigators from the CDC and the Pinellas County Health Department conducted all site visits during a 2-week period in late 2007.

No reimbursement for time or participation was offered. This study was determined to be "non-human subject research" and was approved by the CDC, National Center for HIV/AIDS, Viral Hepatitis, Sexually Transmitted Diseases, and Tuberculosis Prevention, Office of the Associate Director for Science.

Data Analysis

Data collected from the survey and site visit were stored in an ACCESS database (Microsoft, Redmond, WA) and analyzed using SAS version 9.1 (SAS Institute, Inc., Cary, NC) and STATA (StataCorp, College Station, TX). The frequencies of selected characteristics, infection control policies, and blood glucose monitoring practices were calculated among participating facilities for the three strata. Statistical significance of differences between the three strata were evaluated using the Pearson chi-square or Fisher exact test; $P<.05$ was considered statistically significant.

RESULTS

Facility Enrollment and Participation

To enroll 58 facilities, the investigation team called 101 to solicit participation; 24 declined to participate, and 19 did not return telephone calls to the health department regarding survey participation. Of the 58 facilities enrolled, 10 subsequently did not complete or return the survey and elected to withdraw their participation. The final sample included 48 facilities (48% participation rate), representing 17% of the 289 in Pinellas County, and contained 15 nursing homes and 16 large and 17 small ALFs. Combined, the 48 participating facilities had a total population of 3,562 residents. The median facility size was 120 beds for nursing homes, 93 beds for large ALFs, and 10 beds for small ALFs. A description of participating facilities is shown in Table 1. No statistically significant difference with respect to facility size (number of beds), facility ownership, facility license type, or for-profit status were identified between the facilities that participated and those that declined to participate or dropped out of the survey (data not shown).

Facility Infection Control Policies

Respondents from small ALFs were less likely than those from nursing homes and large ALFs (Table 2) to report that their facility had a copy of the Occupational Safety and Health Administration (OSHA) Bloodborne Pathogen Standard[15] ($P<.001$), provided staff with infection control ($P=.20$) or bloodborne pathogen training ($P=.02$), or had a system for reporting sharps injuries or blood and blood fluid exposures ($P=.02$). In addition, small ALFs were reportedly less likely to offer hepatitis B vaccine to their staff ($P=.003$). Most (80%) nursing homes reportedly had a facility policy for blood glucose monitoring, compared with only 33% of large and 0% of small ALFs ($P<.001$).

Residents with Diabetes Mellitus and Blood Glucose Monitoring Practices

At the time of the survey, 38 of 48 (79%) facilities reported having at least one resident with diabetes mellitus, including all nursing homes and 15 of 16 large ALFs but only eight of 17 (47%) small ALFs. In total, 429 (12%) of 3,562 residents had diabetes mellitus; the average prevalence of diabetes mellitus in nursing home residents (439 of 1,966 residents, 22%) was more than twice that of ALF residents (large: 132/1,429 residents (9%); small: 15/167 residents (9%), $P<.001$). Survey respondents from nursing homes reported that nearly all (95%) residents with diabetes mellitus required regular (≥1 per week) blood glucose monitoring, compared with 87% and 66% of residents with diabetes mellitus in small and large ALFs, respectively. The percentage of residents reported to perform their own blood glucose monitoring varied according to facility type ($P<.001$), ranging from 0% in nursing homes to 20% in large and 60% in small ALFs.

Table 1. Characteristics of Participating Nursing Homes and Assisted Living Facilities, Pinellas County, 2007

Characteristic	Nursing Home n = 15	Assisted Living Facility: Large (>50 Beds) n = 16	Assisted Living Facility: Small (≤50 Beds) n = 17
Licensed beds, n (median, range per facility)	2,102, (120, 39–299)	1,573, (93, 52–225)	194, (10, 4–24)
Residents, n (% occupancy)	1,966 (94)	1,429 (91)	167 (86)
License type, n (%)			
Standard license	15 (100)	5 (31)	10 (59)
Standard plus ≥1 other types*	—	11 (69)	7 (41)
Corporate ownership	10 (67)	9 (56)	7 (41)
Freestanding	11 (73)	7 (44)	17 (100)
For-profit status	10 (67)	15 (94)	17 (100)

* Other license types at assisted living facilities: limited nursing service, limited mental health, extended continuing care.

At the 38 facilities with one or more residents with diabetes mellitus, it was found that glove use by staff during blood glucose monitoring was lowest (50%) at small ALFs ($P = .02$; Table 3). Single-use safety lancets were used in most nursing homes (93%) but only 33% of large ALFs and none of the small ALFs ($P < .001$). In addition, reusable finger-stick devices (designed for personal use) were found most often in large (67%) and small (100%) ALFs, compared with just one of 15 (7%) nursing homes ($P < .001$). Of the 18 facilities where reusable fingerstick lancing devices were used, interviews with staff identified that four (22%) facilities (including 1 nursing home) used them inappropriately for multiple residents. In one instance visible blood was observed on the end cap that makes contact with the skin during lancing. At all facilities where sharing of these devices was identified, the investigation team immediately instructed staff to end this practice and recommended a change to single-use safety lancets. During site visits, interviews with staff indicated that 22 (58%) of the 38 facilities with one or more residents with diabetes mellitus routinely shared blood glucose testing meters between residents; this occurred most often in nursing homes ($P < .001$); six facilities (27%) reported that these shared meters were cleaned between each resident use.

DISCUSSION

Continuing reports of HBV infection outbreaks in residents with diabetes mellitus in long-term care settings,[3,13] stimulated concern that practices associated with transmission were not unique to facilities where outbreaks were reported. Through this survey, routine blood glucose monitoring practices in non-outbreak settings were evaluated, and a number of practices were identified that have been associated with the spread of HBV infection. Deficient practices were identified at nursing homes and ALFs, although the results indicate that practices and policies for preventing bloodborne pathogen transmission were most poorly implemented at ALFs. The differences reported may reflect, in part, the different philosophies under which these care settings operate.[14,16] Lack of federal oversight and standardized training programs for assisted living providers; differences in state-based regulation, licensing, and inspection; and the greater heterogeneity in facility size and resident populations in ALFs may also contribute to these differences. Better implementation of existing recommendations for providing safe care for diabetes mellitus is needed throughout the long-term care spectrum, although it appears that more-urgent needs may exist in the area of assisted living.

Table 2. Infection Control Polices at Participating Long-Term Care Facilities, Pinellas County, 2007

Policy	n (%): Nursing Home n = 15	n (%): Assisted Living Facility: Large (>50 Beds) n = 16	n (%): Assisted Living Facility: Small (≤50 Beds) n = 17	*P*-Value
Have copy of Occupational Safety and Health Administration guidelines	14 (93)	16 (100)	6 (35)	<.001
Provide infection control training to staff	14 (93)	16 (100)	14 (82)	.20
Provide bloodborne pathogen training to staff	15 (100)	14 (88)	11 (65)	.02
Reporting of sharps injuries, blood exposures	15 (100)	14 (88)	11 (65)	.02
Offer hepatitis B vaccine to staff with blood, body fluids, or sharps contact	15 (100)	13 (81)	5 (29)	.003
Policy for blood glucose monitoring	12 (80)	5 (33)	0 (0)	<.001*

* *P*-value for nursing home vs small and large assisted living facility combined.

Table 3. Summary of Blood Glucose Monitoring Practices at 38 Facilities with One or More Resident with Diabetes Mellitus, Pinellas County, 2007

Practice	Nursing Home n = 15	Assisted Living Facility: Large (>50 Beds) n = 15	Assisted Living Facility: Small (≤50 Beds) n = 8	*P*-Value
Staff always perform blood glucose monitoring with gloves on	12 (80)	12 (100)*	4 (50)	.02
Lancing devices use at facility				
Single-use safety lancets	14 (93)	5 (33)	0 (0)	<.001†
Personal-use fingerstick device	1 (7)	10 (67)	7 (100)‡	<.001†
Used on multiple residents	1 (100)	2 (20)	1 (14)	§
Blood glucose testing meters shared	15 (100)	5 (33)	2 (25)	<.001
Blood glucose testing meters cleaned between each resident use	4 (27)	2 (40)	0 (0)	§

* Three facilities missing data.
† *P*-value for nursing home vs small and large assisted living facility combined.
‡ One facility missing data.
§ *P*-value not calculated.

Despite long-standing recommendations from federal agencies,[10,11] it was found that a number of the facilities were using personal-use fingerstick lancing devices on multiple residents. Because of the documented risks for bloodborne pathogen transmission when finger stick lancing devices are shared, safety lancets (auto-disable, single use) should be used whenever staff assist residents with blood glucose monitoring in congregate care settings.

The use of blood glucose testing meters for multiple residents was common, especially in the nursing homes surveyed, but few reported that they were routinely cleaned between each resident use. HBV is highly infectious and can remain viable in occult blood on environmental surfaces at room temperature for at least 7 days,[11,17] and contamination of blood glucose testing meters has been implicated as a cause of HBV transmission.[3,12,13,18] For this reason, cleaning and disinfection of the blood glucose testing meters between each use is recommended when they are used for more than one person.[12]

Glove use by staff during blood glucose monitoring was particularly low among staff at small ALFs. Failure to wear gloves and perform hand hygiene during diabetes care contributes to the spread of HBV,[12,13] and glove use is also needed to protect staff from exposure to bloodborne pathogens.[19] The nature and frequency of procedures that may result in blood and body fluid exposures may differ in long-term care and acute care hospitals, but the potential for staff exposure and subsequent infection should be recognized.[20–22] In addition, failure to comply with the OSHA Bloodborne Pathogens Standard which requires[15] bloodborne pathogen training and the reporting of blood and body fluid exposure suggest that risks are underestimated in ALFs.[14] Finally, the lack of compliance with OSHA regulations for offering hepatitis B vaccine to staff at occupational risk for exposure to blood and body fluids identified at ALFs indicate that vaccine coverage rates may not be comparable with those reported in hospital settings.[23,24]

Despite the use of a stratified random sampling approach to avoid a convenience sample, the main limitation of this survey was that the overall participation rate was only 48%. Although no statistically significant differences were detected between participants and nonparticipants with respect to facility characteristics such as size, ownership, license type, and for-profit status, nonresponse bias may have affected the generalizability of the results. Another limitation was that the primary method of data collection was self-report, because direct observation of staff practices and equipment used could not be performed at all facilities visited (e.g., the 10 facilities without residents with diabetes mellitus). Even with evaluation of practices by direct observation, bias may not be eliminated because of the temporary positive effect of observation on behavior.[25] Considering these two limitations together, it is likely that the frequency of deficient practices during diabetes care was greater than what was reported here, although the results are comparable with those from a similar survey of 50 ALFs in central Virginia.[14] In that survey, 16% of facilities shared fingerstick devices between residents, and of eight facilities sharing glucose testing meters, half did not clean them after each use.

Continued efforts to eliminate bloodborne pathogen transmission risks during diabetes mellitus care and ensure adoption of basic infection control standards remain much needed in the long-term care setting. Needs are particularly acute in ALFs, where oversight and regulation are relatively limited and licensing and inspection practices are variable. Across the long-term care continuum, better implementation of existing infection control recommendations for safe blood glucose monitoring and diabetes mellitus care is needed to protect this growing and vulnerable population.

ACKNOWLEDGMENTS

We would like to acknowledge Dr. Stephanie Bialek at the CDC for her assistance with the study protocol development and the staff at the Pinellas County Health Department who helped to facilitate this study, especially Dr. Patricia Ryder of the Disease Control Division, Roger Rugletic, RN, and Linda Miller, RN. In addition, we would like to thank the long-term care facilities and their staff who generously participated in the survey.

The findings and conclusions of this article are those of the authors and do not necessarily represent the official position of the CDC.

Conflict of Interest: The editor in chief has reviewed the conflict of interest checklist provided by the authors and has determined that the authors have no financial or any other kind of personal conflicts with this paper.

Author Contributions: Study concept and design: Thompson, Barry, Cui, and Perz. Acquisition of subjects and/or data: Thompson, Barry, Alelis, and Perz. Analysis and interpretation of data: Thompson, Barry, and Perz. Preparation and final approval of manuscript: Thompson, Barry, Alelis, Cui, and Perz.

Sponsor's Role: None.

REFERENCES

1. Centers for Disease Control and Prevention. Self-monitoring of blood glucose among adults with diabetes–United States, 1997–2006. MMWR Morbid Mortal Weekly Rep 2007;56:1133–1137.
2. Saaddine JB, Cadwell B, Gregg EW et al. Improvements in diabetes processes of care and intermediate outcomes: United States, 1988–2002. Ann Intern Med 2006;144:465–474.
3. Thompson ND, Perz JF. Eliminating the blood: Ongoing outbreaks of hepatitis B virus infection and the need for innovative glucose monitoring technologies. J Diabetes Sci Technol 2009;3:283–238.
4. Shepard CW, Simard EP, Finelli L et al. Hepatitis B virus infection: Epidemiology and vaccination. Epidemiol Rev 2006;28:112–125.
5. Centers for Disease Control and Prevention. Surveillance for acute viral hepatitis – United States, 2007. MMWR Morbid Mortal Weekly Rep 2009;58(no. SS-3):1–27.
6. Polish LB, Shapiro CN, Bauer F et al. Nonsocomial transmission of hepatitis B virus associated with the use of a spring-loaded fingerstick device. N Engl J Med 1992;326:721–725.
7. Quale JM, Landerman D, Wallance B et al. Deja Vu: Nosocomial hepatitis B virus transmission and fingerstick monitoring. Am J Med 1998;105:296–301.
8. Centers for Disease Control and Prevention. Nosocomial hepatitis B virus infection associated with reusable fingerstick blood sampling devices – Ohio and New York City. MMWR Morbid Mortal Weekly Rep 1997;46:217–221.
9. Khan AJ, Cotter SM, Schultz B et al. Nosocomial transmission of hepatitis B virus infection among residents with diabetes in a skilled nursing facility. Infect Control Hosp Epidemol 2002;23:313–318.
10. Food and Drug Administration. Safety Alert: Hepatitis B Transmission Via Spring-Loaded Lancet Devices. Rockville, MD: Department of Health and Human Services, Public Health Service, Food and Drug Administration, 1990.
11. Centers for Disease Control and Prevention. Nosocomial transmission of hepatitis B virus associated with spring-loaded fingerstick device – California. MMWR Morbid Mortal Weekly Rep 1990;39:610–613.
12. Centers for Disease Control and Prevention. Transmission of hepatitis B virus among persons undergoing blood glucose monitoring in long-term-care facilities–Mississippi, North Carolina, and Los Angeles County, California, 2003–2004. MMWR Morbid Mortal Weekly Rep 2005;54:220–223.
13. Thompson ND, Perz JF, Moorman AC et al. Nonhospital health care–associated hepatitis B and C virus transmission: United States, 1998–2008. Ann Intern Med 2009;150:33–39.
14. Patel AS, White-Comstock MB, Woolard CD et al. Infection control practices in assisted living facilities: A response to hepatitis B outbreaks. Infect Control Hosp Epidemiol 2009;30:209–214.
15. United States Department of Labor. Occupational Safety and Health Administration. Regulations (Standards—29CFR). Bloodborne pathogens. 1910.1030 [on-line]. Available at http://www.osha.gov Accessed August 10, 2009.
16. Utz RL. Assisted living: The philosophical challenges of everyday practice. J Appl Gerontol 2003;22:379–404.
17. Bond WW, Favero MS, Peterson NJ et al. Survival of hepatitis B virus and drying and storage for one week. Lancet 1981;i:550–551.
18. Louie RF, Lau MJ, Lee JH et al. Multicenter study of the prevalence of blood contamination on point-of-care glucose meters and recommendations for controlling contamination. Point Care 2005;4:158–163.
19. Siegel J, Rhinehart E, Healthcare Infection Control Practices Advisory Committee. et al. Guidelines 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 www.cdc.gov/ncidod/dhqp/gl_isolation.html Accessed on May 24, 2009.
20. American Association of Diabetes Educators. Position statement – Educating providers and persons with diabetes to prevent the transmission of bloodborne infection and avoid injuries from sharps. Diabetes Educ 1997;23:401–403.
21. Beltrami EM, Kozak A, Williams I et al. Transmission of HIV and hepatitis C virus from a nursing home patient to a healthcare worker. Am J Infect Control 2003;31:168–175.
22. Beltrami EM, McAurthur MA, McGeer A et al. The nature and frequency of blood contacts among home healthcare workers. Infect Control Hosp Epidemiol 2000;21:765–770.
23. Vos D, Gotz HM, Richardus JH. Needlestick injury and accidental exposure to blood: The need for improving the hepatitis B vaccination grade among health care workers outside the hospital. Am J Infect Control 2006;34:610–612.
24. Simard EP, Miller JT, George PA et al. Hepatitis B vaccination coverage levels among healthcare workers in the United States, 2002–2003. Infect Control Hosp Epidemiol 2007;28:783–790.
25. Kazandjian VA, Lied T. Healthcare Performance Measurement: Systems Design and Evaluation. Milwaukee, WI: ASQC Quality Press, 1999.