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Community-acquired, non-occupational needlestick injuries treated in US Emergency Departments

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ABSTRACT

Background The escalating number of persons self-injecting medications, predominantly insulin, has generated concerns that the public is at risk of acquiring blood-borne infections from discarded needles/syringes. Communities have developed disposal guidelines but a debate continues over the need for further legislation and/or at-home safety devices. This study examines the number, characteristics, treatment and costs of community-acquired needlestick injuries (CANSIs).

Methods US-representative CANSI rates and characteristics were derived from 2001–08 National Electronic Injury Surveillance System All Injury Program data on product-related injuries treated at US emergency departments (EDs). CANSI-related medical care was examined using 2003–09 National Hospital Ambulatory Medical Care Surveys, representing all US ED visits. Cost analyses used 2010 Current Procedural Terminology Coding and Medicare rates.

Results In 2001–08, an estimated 16 677 CANSIs were treated in US EDs, with an associated annual rate of 0.7 per 100 000 US citizens (95% CI 0.6–0.8) and no observable temporal trend. The estimated maximum annual medical cost of ED-treated CANSIs was $9.8 million, or $0.03 per citizen, $1.66 per insulin-injecting person and $0.0018 per insulin injection.

Conclusions US ED-treated CANSI rates are extremely low. Stricter disposal programs and the at-home use of safety devices do not appear to be needed at this time.

Keywords blood-borne infections, diabetes, injection, needlestick injuries, prevention, cost assessment

Introduction

A number of medications are now available for therapeutic self-injection, including epinephrine, in prefilled, auto-injector syringes, for prevention of anaphylaxis. The 2007 US National Home and Hospice Care Survey found that 5 of 10 000 home healthcare patients used these devices.[1] This figure is dwarfed by the number of individuals who self-inject insulin. In 2010, an estimated 6.4% of the world's adult population—285 million people—had diabetes mellitus. By 2030, that will grow to 7.8%.[2] Between 1980 and 2010, the number of civilian, non-institutionalized Americans with diabetes mellitus rose from 5.6 to 20.9 million.[3] In 2010, an estimated 5.7 million US adults with diagnosed diabetes were taking insulin.[4,5] These and similar data have generated concerns that syringes/needles discarded in residential and public settings may place the general public at increasing risk of blood-borne infections—in particular, hepatitis B virus (HBV), hepatitis C virus (HCV) and human immunodeficiency virus (HIV).[6–8]

The relationships among diabetes mellitus, HBV, HCV and HIV are multidirectional and do not necessarily translate into greater prevalence of these infections in all diabetic populations. HCV infection, HIV infection and associated protease inhibitor therapy can lead to hyperglycemia and insulin-requiring type 2 diabetes.[9,10] HBV vaccine coverage is inadequate in US adults, and the risk of acute HBV infection is higher in adults with type 2 diabetes.[11] HBV and HCV outbreaks associated with shared glucose-monitoring

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equipment and breaks in glucose-monitoring-associated infection-control practices have occurred in long-term-care communities.[12] Outbreaks have not been reported in association with EpiPens or insulin syringes/pens.

Local communities, organizations and various government bodies have instituted guidelines and recommendations for safe needle/sharp disposal, with the goal of preventing community-acquired needlestick injuries (CANSIs). In the USA, there is an ongoing debate about whether further legislation is needed[13–15] and various companies are marketing safety and 'needless' devices for at-home use. Similar devices helped decrease healthcare workers' risk of needlestick injuries,[16,17] but at considerable cost.

This study examines CANSIs treated at US hospital emergency departments (EDs) to assess: (i) their characteristics and incidence, (ii) whether their rate is increasing, (iii) the associated medical care and (iv) the estimated maximum cost of that care.

Methods

National Electronic Injury Surveillance System All Injury Program (NEISS-AIP), operated by the Office of Statistics and Programming (OSP), National Center for Injury Prevention and Control, US Centers for Disease Control and Prevention (CDC) and the US Consumer Product Safety Commission (CPSC)

NEISS-AIP provides nationally representative incidence estimates of non-fatal injuries treated in US hospital EDs, based on injury-related visits at 66 of 100 NEISS hospitals, a national stratified probability sample of hospitals with six or more beds and a 24-h ED. Strata include children's hospitals and four general hospital size strata defined by annual number of ED visits.[18] Each case is assigned a sample weight; these are summed to provide national estimates. Miscodings are minimized by: weekly reviews of random samples of written narratives abstracted verbatim from the medical record, five trained coders visually reviewing narratives and coded data elements for every NEISS-AIP case, CPSC supervisors visiting each hospital once or twice yearly and blindly abstracting from the records of a random sample of ED cases and extensive batch edits on the final dataset. NEISS-AIP personnel estimate that $<1\%$ of records, on average, are miscoded (personal communication, J. L. Annest, 17 July 2012).

NEISS-AIP analyses herein include all 2001–08 records with NEISS product code 1716 ('hypodermic needles and syringes') and/or comments with the letter strings: 'hypodermic', 'needle', 'needlestick', 'needle-stick', 'needle stick', 'percutaneous injur', 'sharp injur', 'sharps injur' or 'syringe' and without comments, indicating that the injury was related to occupational activities, receipt or provision of professional healthcare, medical training, drug use, lancets or non-medical needles. Of note, inadvertent inclusion of records related to these activities would bias toward an overestimation of CANSI rates. NEISS-AIP data and associated medical records cannot be accessed by non-NEISS researchers. OSP personnel performed my specified record selections and SAS runs.

US National Hospital Ambulatory Medical Care Surveys (NHAMCS), directed by the National Center for Health Statistics (NCHS), CDC

The elements and levels of CANSI-associated ED medical service, procedures, treatment and medication were determined using publicly available 2003–09 NHAMCS files.[19,20] NHAMCS include a four-stage systematic random sample of all injury- and non-injury-related patient visits to non-Federal hospitals, during randomly assigned 4-week reporting periods. Trained hospital personnel complete patient record forms, which are reviewed and validated by NCHS staff and include data on the patient's complaint(s), cause of the injury, diagnostic/screening services, medical procedures, medications, types of providers seen, discharge diagnoses, follow-up disposition (if any) and expected source(s) of payment.[19,20] NCHS field representatives review the logs used for visit sampling to determine whether any cases were missed and edit completed forms for missing data, which is sought through consultation with hospital staff and medical record review. Quality control for the medical and drug coding operation, as well as straight-key items, includes a two-way, 10% independent verification procedure. All forms with coding variations or illegible entries related to the reason for a visit, diagnostic and therapeutic procedures, diagnosis, International Classification of Diseases (ICD) diagnosis E codes, or medication items are reviewed and adjudicated at NCHS.

I could not access medical records, but I used the following four-step process to select and internally validate the cases used in the NHAMCS analyses herein: (i) I examined each 2003–09 NHAMCS ED case with ICD-9-CM diagnosis E codes even vaguely consistent with the possibility of a needlestick/sharp injury (E920.5, E920.8, E920.9, E928.8, E928.9, E986, E988.8, E988.9 and E989). (ii) NHAMCS's descriptive variable ('*vcause*') can be used to provide event details. I examined *vcause* in each selected record and, if it indicated the injury involved healthcare or intentional action,

I excluded it from the analyses. (iii) If the '*payment source*' variable was coded as 'Worker's Compensation', I excluded the record from analyses. (iv) If the 'work-related' ('*workrel*') variable was marked 'yes' and this was consistent with the *vcause* and *payment source* coding, I excluded the record from analyses. For 16 records, *workrel* was coded 'yes', payment was not through worker's compensation and *vcause* did not suggest that the injury was work-related. Those 16 records were included in the NHAMCS CANSI analyses. Since NHAMCS data were used solely to characterize CANSI-related medical treatment and costs, this did not affect the CANSI incidence estimate. Fifty-one NHAMCS records met the criteria for the CANSI analyses.

In 2004 and 2005, NHAMCS and the NCHS's National Ambulatory Medical Care Surveys (NAMCSs) collected needlestick injury data from outpatient departments and physicians' offices. I examined those data and determined that, at most, three records from outpatient departments and two from physicians' offices might have been associated with CANSIs. These are not included herein because (i) those numbers of needlestick injuries were inadequate for analysis and (ii) the data were not collected in other years.[19–22]

Cost estimates

I estimated costs associated with various elements/levels of service using Current Procedural Terminology Coding (CPT)[23,24] and 2010 Medicare rates, with the assistance/advice of physicians, CPT coding experts and hospital billing officers. I based medication costs on a standard course of therapy with generic medications, unless a particular brand name was specified in the NHAMCS record. For each record, cost calculations took into account the specified healthcare providers, time spent receiving care, procedures/treatments, laboratory tests and medications.

In order to maximize the estimated cost of ED-associated medical care, I made the following assumptions:

(i) NHAMCS forms have separate (yes/no) variables for the following blood tests: complete blood cell count, blood urea nitrogen, creatinine, cardiac enzymes, electrolytes, glucose, liver function tests, arterial blood gases, blood alcohol, '*HIV serology*' (antibody status) and '*other blood test(s)*'. If *other blood test(s)* was marked 'yes' and specified blood tests did not add up to the specified '*total number of laboratory studies done*', I assumed that HBV and HCV serology were done.

(ii) If *HIV serology* was blank and not marked 'no' and *other blood test* was marked 'yes', I assumed that HIV antibody testing was done.

(iii) If a patient's disposition was 'refer to [another] physician/clinic for follow-up' or 'refer to other physician', I assumed that the referral was to an infectious disease specialist and he/she provided an initial evaluation and the maximum prophylaxis and follow-up recommended for healthcare-associated NSIs, including HBV immunoglobulin; HBV vaccine; HBV, HCV and HIV serology; HIV prophylaxis (nelfinavir 1250 mg b.i.d. × 28 days and zidovidine 300 mg/lamivudine 150 mg b.i.d. × 28 days); follow-up evaluation at 2–4 weeks with full serology; follow-up evaluation at 4–6 months with full serology and follow-up evaluation at 1 year with HIV serology.[25] Of note, CANSIs rarely require this full constellation of treatment and follow-up (reference 25 and Appendix).

Other data sources

I obtained US population figures from census reports.[26] Since most medical self-injections are of insulin, I used these as a surrogate for all self-injections. Of note, this overestimates the per-person/per-injection cost of CANSIs. The numbers of insulin-injecting US diabetes patients ≥18 years old and insulin injections received per year were obtained from the 2011 US Roper Diabetes Patient Market Study Roper survey of non-military, non-institutionalized US adults with diabetes, which estimated the annual numbers of adults with diabetes by applying regressions of CDC's National Health Interview Survey and Behavioral Risk Factor Surveillance System estimates to Roper survey data (Data provided by and cited with the permission of GfK Custom Research LLC, www.gfk.com.)

Data analyses

All analyses retained NEISS-AIP's and NHAMCS's weighting, strata and primary sampling unit design variables and used SAS SAS/STAT® Version 9.2's survey module (SAS Institute, Cary, NC). NEISS-AIP's sampling design permits statistically reliable estimation if the estimate is based on ≥20 records and the associated coefficient of variation is ≤30%; NHAMCS's design requires ≥30 records and an associated standard error of the estimate of ≤30%.

Results

NEISS-AIP data

In 2001–08, an estimated 16 677 CANSIs required ED treatment, for a median of 1937 per year, with no consistent observed temporal trend in annual numbers (Table 1). Persons <10 and 20–39 years of age had the highest

Table 1 Number and rate of community-acquired needlestick/sharp injuries treated in US emergency departments, 2001–08, NEISS-AIP[a]

Year	*Case count*	*National estimate*	*95% CI for estimate*	*CV*	*Rate*[b]	*95% CI for rate*	*US population*
2001	43	2118	1035–3201	26.1	0.7	0.4–1.1	285 039 803
2002	38	2019	1168–2870	21.5	0.7	0.4–1.0	287 726 647
2003	41	2738	1633–3843	20.6	0.9	0.6–1.3	290 210 914
2004	42	1612	983–2241	19.9	0.6	0.3–0.8	292 892 127
2005	44	1828	907–2749	25.7	0.6	0.3–0.9	295 560 549
2006	26	1604	812–2396	25.2	0.5	0.3–0.8	298 362 973
2007	34	1855	NP[c]	32.8	NP	NP	301 290 332
2008	59	2903	NP	43.1	NP	NP	304 059 724
Total, 2001–08:							
	327	16 677	13 899–19 455	8.5	0.7	0.6–0.8	2 355 143 069

CI, confidence interval; CV, coefficient of variation

[a]The US National Electronic Injury Surveillance System All Injury Program (NEISS-AIP) data herein include needlestick and sharp (but not lancet) injuries occurring outside of healthcare and work settings ($n = 327$). See the Methods section for survey details.

[b]Rate per 100 000 population. Rates assume that no individual had more than one needlestick/sharp injury during this time period.

[c]Not presented (NP) because estimates may be unstable (CV > 30%).

CANSI rates (1.3 and 0.9 per 100 000, respectively, versus 0.6 for 10- to 19-year-olds and 0.4 for those >39 years old). Fifty-six percent of recorded CANSIs were to women. The type of needle was mentioned in 21% of records: EpiPens, in 4%, and insulin syringes, in 17%.

NHAMCS data

Based on the *vcause* variable, 10 records with needlestick injury-ICD codes involved an intentional injection (e.g. therapeutic receipt of epinephrine) and 18 involved a complication of illegal drug use (e.g. a drug overdose or infection at an injection site). At least 75 of these injuries were received while the individual was providing healthcare, working in a medical setting, or as a complication of receiving healthcare (e.g. 'infiltration at the site of blood drawing'). At least 17 others were work-related. These ($n = 120$) were all excluded from NHAMCS analyses, leaving 51 CANSI-related records. If record inclusion had been based solely on ICD coding, the CANSI number would have been erroneously inflated over 3-fold (i.e. 171 versus 51).

For 26 of the 51 records, the *vcause* variable provided no information other than 'needle stick'. In 14 records, *vcause* indicated the site of injury: finger ($n = 6$), foot or 'stepped on a needle' ($n = 4$), thumb ($n = 2$), hand ($n = 1$) and forearm ($n = 1$). In three records, *vcause* noted the injury occurred while emptying garbage or handling a plastic bag; one, walking barefoot in a hotel room; two, on a beach; one, playing in a park and one, in an alley. In one record, *vcause* noted that the source was unknown and in one, the needle was a neighbor's. In three records, *vcause* referred to the needle as 'dirty' and in one, *vcause* noted that the patient was concerned 'it might be a drug needle and for HIV'. In two records, v*cause* mentioned an EpiPen and in one, a 'syringe'.

All 51 CANSI-related NHAMCS records represented initial visits. One patient was admitted for several hours of observation. Three received intravenous fluids; two received bronchodilator inhalation therapy. Two patients arrived by ambulance. No information was available concerning the reasons for these treatments, other than the injury code. Forty-eight patients were treated by a physician. One received a follow-up appointment to an associated clinic; 20 were referred to another physician. While in the ED, nine received tetanus toxoid; two, HIV prophylaxis; two, HBV vaccine and one, anti-HBV immunoglobulin.

Estimation of healthcare-associated costs

The median estimated cost of ED evaluation, diagnostic studies and treatment was $575 (Table 2); the range was $415 (for a patient who was not seen by a physician and received no tests or medications) to $3371. When the potential costs associated with referral to infectious diseases physicians were included in the calculations, the median estimated cost of CANSI-associated medical treatment was $5078, range $415–$6288.

Based on these median cost figures, the estimated annual national medical costs of ED-treated CANSIs were $1.1 million for ED care alone and $9.8 million for both ED

Table 2 Estimated per-patient and US national health care costs associated with community-acquired, non-occupational needlestick injuries treated in US EDs

	Median (mean)
Per-patient cost[a,b]	
Emergency room	$ 575 ($ 669)
Emergency room and referral care	$5078 ($3423)
Annual US emergency room costs associated with these injuries[a,b,c]	
Total medical cost	$1 113 775 ($1 394 865)
Cost per US citizen[d]	$0.0038 ($0.0047)
Cost per insulin-injecting person[e]	$0.1876 ($0.2349)
Cost per insulin injection[e]	$0.00020 ($0.00026)
Annual US emergency room and maximum projected referral costs associated with these injuries[a,b,c]	
Total medical cost	$9 836 086 ($7 136 955)
Cost per US citizen[d]	$0.0334 ($0.0242)
Cost per insulin-injecting person[e]	$1.6565 ($1.2019)
Cost per insulin injection[e]	$0.00181 ($0.00131)

[a]The per-patient cost estimate was based on data extracted from 51 ED records in the 2003–09 National Hospital Ambulatory Medical Care Surveys (NHAMCS). See the Methods section for details.

[b]Individual patient costs were calculated using 2010 Medicare rates and include all treatments, testing, radiographic studies and blood work done in the ED. Referral costs include the projected costs associated with the maximal care that would be provided by infectious disease specialists (see the Methods section for details). Medical costs that would be incurred if any patient developed HBV, HCV, HIV or other infections, as a result of the needlestick injury, were not included in these calculations. These costs also do not include expenses associated with non-ambulance transportation, time lost from work, child care needed while a patient was receiving medical care, etc.

[c]The estimated median and mean total costs were calculated by applying NHAMCS median and mean per-patient costs to the median or mean annual number of injuries estimated from the 2001–08 National Electronic Injury Surveillance System All Injury Program (NEISS-AIP). See the Methods section for NEISS-AIP details.

[d]The rate's denominator is the average annual US population for 2001–08.

[e]The number of US adult diabetes patients receiving insulin and the number of insulin injections received in a year were estimated from 2011 Roper survey data concerning non-military, non-institutionalized US adults (≥18 years old) with diabetes, i.e. 561 000 adults with type 1 diabetes received insulin, with an average of 3.5 injections a day and 5 377 000 adults with type 2 diabetes received insulin, with an average of 2.4 injections a day, for a total of 5.94 million insulin-injecting adults with diabetes receiving insulin and 5.43 billion injections by diabetic adults/year.

and maximum follow-up medical care (Table 2). Including both ED and maximum follow-up care, the estimated maximum annual cost would be 3.34 cents per US citizen, $1.66 per insulin-injecting person and 0.181 cents per insulin injection.

Discussion

Main findings of this study

This study provides US-representative maximum incidence and cost estimates for ED-treated CANSIs and has three main findings. First, CANSI estimates should not be based solely on ICD coding. Based on NHAMCS's descriptive variables, doing so might overestimate actual rates by over 3-fold. Second, CANSIs requiring ED care are rare events and require relatively minimal medical care. These findings are consistent with and expand on those of several studies done in local communities or health facilities in the UK, the Netherlands and Canada.[27–29] Third, although self-administration of medications has escalated in the USA, there has not been a concomitant increase in ED-treated CANSIs.

What is already known on this topic

For any needlestick injury, the most critical medical question is its likelihood of transmitting a blood-borne pathogen—particularly HIV, HBV or HCV. Empirical data, scientific evidence and theoretical considerations all support that pathogen transmission from a CANSI is extraordinarily unlikely (Appendix). The risk factors for transmission include the involvement of a larger gauge hollow-bore needle (as used in phlebotomy or blood sampling from a vascular line), deep injury and/or a procedure involving a needle that was in the artery or vein.[30,31] Insulin devices and EpiPens have small gauge needles. NHAMCS data herein support that CANSIs are to extremities, not blood vessels. Worldwide, there have been only three reported cases each of HBV[32–34] and HCV[35,36] and no documented case of HIV transmission from non-healthcare-associated needlestick injuries.[25] Two of the HCV infections were from occupational exposure; all three HBV transmissions were to persons without adequate vaccination and/or post-exposure prophylaxis.

Despite this evidence, there are concerns that members of the general public may be at increasing risk of infections from injuries caused by: (i) used needles/syringes discarded by persons legally self-injecting medication and (ii) disposed needles/syringes that have been found, reused and rediscarded by persons illegally self-injecting addictive substances (IDUs). These concerns have led to guidelines for safe needle/sharp disposal[6–8,13,14] but further legislation, regulations and programs are being advocated, including 'take-back programs' and 'Extended Producer Responsibility' laws

requiring that syringe manufacturers be responsible for post-use disposal.[15,37,38] In addition, some manufacturers are marketing safety and 'needleless' syringes for at-home use.

What this study adds

This study provides the first nationally representative data on CANSIs, to help inform related policies and prevention activities. These analyses indicate that, despite the ballooning number of US persons self-injecting medications, ED-treated CANSI rates have not increased and the associated medical costs are relatively low.

Limitations of this study

This study is limited in the following respects. First, it includes only US incidents. However, its results are consistent with those of localized studies from other countries.[27–29] Second, it examines only ED-treated injuries. I could not locate any accurate data concerning the number or medical significance of untreated CANSIs or concerning CANSIs treated at non-ED facilities. Of note, the 2003–04 NCHS surveys included needlestick injuries treated at outpatient departments and physicians' offices; only five might have been unrelated to healthcare or occupation. This suggests that medical treatment is predominantly provided at EDs. Third, these cost calculations do not include mental healthcare/counseling or non-medical expenses (e.g. child care costs, travel expenses and/or income losses incurred while obtaining medical care). Fourth, I could not externally validate these data or review the medical records of any of the cases involved in this study. However, NEISS-AIP and NCHS extensively validate their data[18–20] and, in this study, my selection process included internal validation checks. Fifth, I could not determine the indications for the medical care provided to these patients, other than what was represented by a diagnostic code. Some procedures (e.g. ambulance transport, inhalation therapy and hospital observation) were likely related to the patient's emotional reaction to their injury, not the injury itself, but this could not be confirmed. Sixth, these analyses support that ED-treated CANSIs are rare events but, because of that rarity, these estimates are imprecise. Seventh, it must be emphasized that the calculations herein purposefully provide maximum estimates, to deter complaints by legislation and safety device advocates that these data underrepresent the number and financial impact of CANSIs.

These limitations should be considered when interpreting these estimates, but they do not negate the key finding of this study: although the number of persons self-administering insulin has ballooned in the past decade, there has not been an observable increase in the incidence of CANSIs requiring US ED treatment. Indeed, the incidence of ED-treated CANSI was so low that statistically valid US estimates could be derived only from NEISS-AIP, an ongoing survey devoted to injuries. Based on these data, it would be difficult to justify additional legislation or the expense of using needle-free or safe-injection devices in a community setting. Prevention of blood-borne infections might be better served by funding HBV vaccination and IDU syringe/needle exchange programs.

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Appendix

Evidence supporting the low risk of HBV, HCV and/or HIV transmission from a community-acquired, non-healthcare-associated, non-occupational, needlestick injury (CANSI)

Worldwide, there have been only three documented reports of HBV transmission from a non-healthcare-associated needlestick injury. One case was reported in 1997, from Spain, and involved a needlestick injury from a known HIV-positive/HBV-positive source to a HBV-unvaccinated child who did not receive post-exposure prophylaxis (PEP)[32] (of note, the child did not become infected with HIV). The second HBV infection occurred in Tbilisi, Georgia, in a woman with unknown immunization status, caring for a mother with chronic HBV infection. It was not known if the daughter received PEP.[33] The third HBV infection occurred in Australia, with seroconversion documented 2 months after a community-acquired accidental needlestick injury, in a person with incomplete HBV vaccination and who did not receive anti-HBV immunoglobulin.[34] Three cases of HCV transmission have been reported; two were occupationally acquired. One occurred in Spain to a woman cleaning a mausoleum.[35] Two were reported from Australia, one to a man doing the daily emptying of rubbish bins in a caravan park and one to a woman walking through an inner city car park.[36] There has never been a documented case of HIV infection occurring in a person injured by a needle discarded in a public setting.[25]

The rarity of these case reports is not unexpected, when one compares the characteristics of CANSIs to the known risk determinants for HBV, HCV and HIV transmission via a needlestick injury. These determinants are interrelated and include: (i) the likelihood that the needle was previously used to inject a person who was actively infectious for one of these organisms; (ii) whether the injured person is susceptible, previously infected or vaccinated; (iii) the relative transmissibility of the three organisms via blood, (iv) the amount and viability of the organism transmitted, (v) the invasiveness and severity of the injury and (vi) whether PEP, if indicated, is provided at the time of the injury. These determinants are reviewed in the following paragraphs.

Risk of exposure and susceptibility

The infection status of the source individual is rarely known and often is also not known for the injured party. However, the probabilities can be estimated using population statistics, beginning with the national level. In the USA, all three viruses are endemic; however, the prevalence rates in the general population are low. HBV prevalence has declined over the past decade,[39] in large part because of the development of an effective HBV vaccine and extensive post-natal vaccination. HBV vaccine is recommended for the general population but strongly encouraged for persons with diabetes.[11] Ninety-one percent of people in the USA have reportedly received at least one dose of HBV vaccine but many adults have not received the full series.[11,39]

HCV is the most common chronic blood-borne infection in the USA, with a prevalence of ~1.3%.[40] Infected persons are often clinically asymptomatic and can clear the infection. In chronic infection, blood viral levels can be low or non-detectable. Thus, a person receiving a CANSI could already have been infected with HCV and be unaware of it.

Only a minority of persons infected with HBV or HCV via any route develop symptomatic or chronic infection. At this time, there is not an effective HCV vaccine; however, there are therapies for the treatment of clinically significant disease and screening for infection is currently being encouraged.

The US CDC estimates that >1.1 million people in the USA are living with HIV infection, and almost 1 in 5 (18.1%) are unaware of their infection, for a prevalence rate of 447.8 per 100 000 population.[41] The overall prevalence of HIV infection in the USA varies by geographic area (from 0.03% in North Dakota to 2.06% in Washington, DC).[40,42] Prevalence rates also vary greatly among subpopulations within any given community (e.g. residents of a nursing home would be far less likely to be infected with HIV than would residents of transitional housing associated with a drug treatment program). The principal means of HIV transmission in the USA is through sexual contact or sharing drug abuse equipment with an infected person. Given this situation, a syringe/needle discarded in a location frequented by persons illegally self-injecting addictive substances (IDUs) is more likely to be contaminated than one contacted in a residential or general community setting.

Transmissibility through blood

In studies of healthcare personnel who sustained injuries from needles contaminated with blood containing HBV, the risk of developing clinical hepatitis if the blood was both hepatitis B surface antigen (HBsAg)- and HBeAg-positive was 22–31%; the risk of developing serologic evidence of HBV infection was 37–62%.[43] In comparison, the risk of developing clinical hepatitis from a needle contaminated with HBsAg-positive and HBeAg-negative blood was 1–6%, and the risk of developing serologic evidence of HBV infection, 23–37%.[43] Effective HBV vaccination obviates this risk and appropriate PEP of unvaccinated, exposed persons effectively prevents infection (see below). HCV is not transmitted efficiently through blood exposures. The average incidence of anti-HCV seroconversion following accidental percutaneous exposure from an HCV-positive source is 1.8% (range: 0–7%).[43] For both HBV and HCV, only a minority of persons infected via any route develop chronic infection. For HIV, based on published healthcare-associated HIV studies, the average risk of transmission from a single exposure to known infected blood would be, overall, ~0.3%.[40,44] However, this risk varies with the nature of the exposure (see below) and, as with HBV, prompt and appropriate HIV PEP reduces the risk of transmission.

Viability of organisms

HBV, HCV and HIV can all survive outside the body for hours to days, even in a dry state.[40,45–49] However, survival is extremely poor and it has been shown that HCV survival is relatively poorest in insulin syringes, which have a low residual volume, compared with tuberculin and other syringes with detachable needles.[49]

Nature of the injury

As noted above, based on published studies concerning HIV infection and healthcare-associated needlestick injuries, the average risk of HIV transmission from a single exposure to known infected blood would be, overall, ~0.3%.[40,44] However, this figure is specifically for blood known to be HIV contaminated and includes the full spectrum of possible injuries, from mildest to most severe. The following factors were associated with a higher risk of HIV transmission (and also are likely associated with higher risk of HBV and HCV transmission): deep injury (13-fold increase in risk), visible blood on device (4.5-fold increase) and an injury associated with a needle accessing an artery or vein (3.6-fold increase).[30] The risk associated with injuries lacking these characteristics is <0.3%. Epinephrine self-injector syringes/needles and insulin syringes/needles have lower gauge needles and are not likely to cause a deep injury. When used correctly and for medically indicated purposes, these needles do not enter an artery or vein. A CANSI rarely involves an artery or vein.

Prophylaxis

A final determinant of infection risk is whether transmission can be prevented, in the event of an exposure to infectious organisms. At this time, there is not an HCV vaccine and PEP protocols do not appear to be effective in preventing HCV transmission. Post-exposure anti-HBV immunoglobulin and HBV vaccination are available and effective if initiated quickly. There is no HIV vaccine but evidence suggests that HIV PEP is sometimes effective if taken early. However, toxicities cause some individuals to stop therapy before completion of a full 28-day course. HIV PEP is recommended for non-healthcare setting exposures if the source is known to be infected. Decisions about HIV PEP for unknown-source exposures is made on a case-by-case basis, taking into consideration the available information concerning type of exposure, whatever is known about the risk characteristics of the source and the HIV prevalence in the exposure setting.[25,40] It is not recommended routinely in a case of CANSI.[25,40]