Hepatitis C Virus Infection Among Public Safety Workers

To the Editor: In an interesting and timely article, Upfal and colleagues conducted a cross-sectional study of hepatitis C virus (HCV) infection among three categories of public safety workers (PSW): police, firefighters, and emergency medical service (EMS) personnel.[1] Using the enzyme immunoassay (EIA-2) test to define HCV seropositivity, the authors found a seroprevalence of 0.6% among police officers, 2.3% among firefighters, and 2.8% among EMS personnel. Multivariate analysis revealed significant associations between HCV seropositivity and EMS personnel (odds ratio [OR], 9.5), firefighters (OR, 5.2), "guilty about drinking" (OR, 4.4), surgery before 1990 (OR, 2.7), age (OR, 1.9), and "life dissatisfaction/misfortunes" (OR, 1.6). The analysis found no significant associations with (1) reported frequency of encounters with blood on the job, (2) actual percutaneous or mucosal exposure incidents, or (3) employees currently working in the "field" versus the "office." The authors concluded that "the overall prevalence was lower than that typical of urban populations" and that "no significant occupational exposure risk" was observed, but they cautioned readers from drawing firm conclusions, given the study limitations. We would like to comment on these limitations and discuss their impact on the study's results.

The use of the general population as a comparison group in this study is problematic for two reasons. First, the method to determine HCV seropositivity differed between the two groups. The Upfal et al study used a single positive EIA-2 test, whereas the general population study required all EIA-2 positive tests to have confirmatory testing (HCV MATRIX).[2] The Centers for Disease Control and Prevention estimates that in populations with an HCV-infection prevalence of 0% to 10%, between 20% and 50% of EIA repeatedly reactive results are false-positive.[3–5] This limitation overestimates the HCV seropositivity among PSW in this study.

The second problem with using the general population as a comparison group relates to selection and survivor bias. As job applicants, PSW are typically screened for illicit drug use. Applicants with positive drug tests are excluded from entering the workforce. Applicant drug screening policies were in effect at the Detroit Fire, Police, and EMS Departments (personal communication with the Detroit Fire and Police Departments, July 2001). Although a preemployment drug screen does not rule out past or prevent future illicit drug use, its use attracts employees less likely to use illicit drugs. In fact, studies found between 0 and 0.8% of emergency first responders reported ever using injection drugs,[6–8] whereas a national survey found that 1.7% of men in the general population reported ever using injection drugs.[9] Because illicit/injection drug use is the major risk factor for HCV infection,[2,10,11] studies of PSW should find a lower prevalence of HCV infection, absent an occupational source, than the general population. In addition, because of the heavy physical demands placed on firefighters, those with advanced liver disease (coagulopathy, cirrhosis, or chronic active hepatitis) are probably precluded from entering the workforce or may be required to exit the workforce.[12]

Another selection bias problem is the relatively low participation rates among the PSW. The study reported participation rates for police, firefighters, and EMS personnel of 61%, 48%, and 70%, respectively. (Our calculation of police participation was 39% [1560 of 4000]). Although this limitation is discussed in the article, it needs more emphasis because those with known HCV infection are unlikely to participate (eg, they already know they are seropositive), and participation was less convenient for those most likely to be occupationally exposed to blood (field vs office workers in each of the occupational groups). These limitations would underestimate the HCV seropositivity among PSW in this study.

The regression analysis of this study produced some interesting yet perplexing results. It found that the strongest predictors for HCV seroprevalence were the occupations of EMS personnel and firefighter (OR, 9.5 and 5.2, respectively) compared with police officers. Because all these occupations undergo illicit drug testing and have similar demographics, it seems intuitive that this finding would be attributable to increased frequency of occupational blood contact, particularly needlestick injuries, among these occupations.[13] However, the three variables used to assess occupational blood exposure in this study were not significantly associated with HCV seropositivity. To interpret these data, it would have been helpful to know the details on how occupational exposures to blood were assessed. This would include not just the frequency of encountering blood and bodily fluids but also the frequency of each type of exposure (needlestick injury, mucous membrane, and skin [intact and non-intact]) over an individual's working *career*. In the absence of detailed exposure information, job title (eg, EMS personnel and firefighters) may be a useful surrogate for occupational exposure.

Finally, it is important to mention injection drug use as a potential study confounder. Because the study did not mention injection drug use, we assume this issue was not included in the survey instrument. As mentioned by the authors, "guilty about drinking" and "misfortunes and dissatisfaction with life" may well be proxies of substance abuse, particularly injection drug use.

We agree with the authors that behavioral risk factors, particularly injection drug use, are the most important risk factors for HCV infection. However, by the nature of the adverse conditions under which they

work (in moving vehicles, in confined spaces, with disoriented and/or combative patients) and the documented risk of occupational exposure to blood, PSW are at some risk for occupationally acquired HCV infection. In light of this ongoing risk, we encourage local municipalities employing PSW to maintain an HCV prevention program that includes (1) HCV testing for postexposure management after a percutaneous or permucosal exposure of HCV-positive blood; (2) consideration of HCV testing for postexposure management after a percutaneous or permucosal exposure to blood of unknown HCV status; and (3) education about the transmission of bloodborne pathogens, training in proper safety measures, appropriate personal protective equipment and safety devices, and vaccinations against hepatitis B virus.[5]

Thomas Hales, MD, MPH
Winifred L. Boal, MPH
Clara Sue Ross, MD, JD
National Institute for Occupational Safety and Health
Cincinnati, Ohio

References

1. Upfal MJ, Naylor P, Mutchnick MM. Hepatitis C screening and prevalence among urban public safety workers. *J Occup Environ Med.* 2001;43:402–411.
2. Alter MJ, Kruszon-Moran D, Nainan OV, et al. The prevalence of hepatitis C virus infection in the United States, 1988 through 1994. *N Eng J Med.* 1999;341:556–562.
3. Centers for Disease Control. Recommendations for prevention and control of hepatitis C virus (HCV) infection and HCV-related chronic disease. *MMWR Morb Mortal Wkly Rep.* 1998;47:10. No. RR-19.
4. Gretch DR. Diagnostic tests for hepatitis C. *Hepatology.* 1997;26(suppl 1):43S-47S.
5. Centers for Disease Control. Hepatitis C virus infection among firefighters, emergency medical technicians, and paramedics—selected locations, United States, 1991–2000. *MMWR Morb Mortal Wkly Rep.* 2000;29:660–665.
6. Woodruff BA, Moyer LA, O'Rourke KM, Margolis HS. Blood exposure and the risk of hepatitis B virus infection in firefighters. *J Occup Environ Med.* 1993;35:1048–1054.
7. Valenzuela TD. Hook EW III, Copass MK, Corey L. Occupational exposure to hepatitis B in paramedics. *Arch Intern Med.* 1985;145:1976–77.
8. Werman HA, Gwinn R. Seroprevalence of hepatitis B and hepatitis C among rural emergency medical care personnel. *Am J Emerg Med.* 1997;15:248–251.
9. SAMHSA. National Household Survey on Drug Abuse: Main Findings 1998. Available at: [http://www.samhsa.gov/oas/NHSDA/98MF.pdf]. Accessed Dec 2000.
10. Murphy EL, Bryzman S, Williams AE. Prevalence of hepatitis C virus infection in the United States (Letter). *N Eng J Med.* 1999;341:2093.
11. Dore GJ, Law MG, Kaldor JM. Prevalence of hepatitis C virus infection in the United States (Letter). *N Eng J Med.* 1999;341:2093–2094.
12. National Fire Protection Association. *NFPA 1582, Standard on Medical Requirements for Fire Fighters and Information for Fire Department Physicians.* Quincy MA: NFPA; 2000.
13. Hochreiter MC, Barton LL. Epidemiology of needlestick injury in emergency medical service personnel. *J Emerg Med.* 1988;6:9–12.

Reply

We are grateful to our colleagues at the National Institute for Occupational Safety and Health for sharing their perspectives on HCV risk and infection, for helping to reinforce our original conclusions, and for the opportunity to respond to potential misinterpretations of our findings. We are in agreement that "PSW are at some risk for occupationally acquired HCV infection." This statement is true of all workers who have the potential for exposure to human blood, and it is consistent with the discussion in our article. Our article provides actual examples of public safety worker HCV seroconversions following occupational exposure. We also agree that PSW, like any other workers, should be educated about bloodborne pathogens, should be offered HBV vaccination, and should undergo appropriate postexposure management when exposures occur. This indeed is the practice in Detroit and many other municipalities.

Although there is no doubt about statistical differences in seroprevalence between police, fire, and EMS workers in our data set, our findings do not support occupational exposure as the reason for this observation. Those individuals with positive tests differed significantly from others in the cohort on behavioral indices, but not in their reporting of frequency of blood contact, history of an actual exposure incident, or primary work location (field vs office). To suggest that occupational exposure is more important than behavioral risk, as proposed by Hales et al, merely because of an association between HCV and occupation, would misrepresent our findings.

Similar to health care workers, seroconversions caused by blood exposures are likely to occur in some cases, but as we pointed out, our observations do not quantify the magnitude of that risk because occupational risk appears to be overshadowed by other risk factors. Also similar to health care workers (except those in certain areas such as dialysis and liver transplantation), the seroprevalence in our population is no higher than that of the general population. Our article did point out the limitations, however, of comparison with the general population.

Hales et al comment that our testing methods (EIA-2, without HCV MATRIX confirmatory testing) may have overestimated the actual seroprevalence of HCV. This effect would strengthen, rather than weaken, the conclusion of a PSW prevalence no higher than that of the general population. Further, although this might cause a modest degree of data dilution, there is no reason to believe that a bias would result, because the effect should be evenly distributed.

Hales et al suggest that drug abuse might be lower among PSWs compared with the general population. Indeed, this effect may help explain the anomalous low seroprevalence among Detroit police officers, who are subject to up to three random

drug tests annually. Firefighters and EMS personnel, on the other hand, are not subject to random drug tests. Applicant drug testing merely discourages those who are unable to present a clean urine specimen *at the time of the test*, whereas random testing is likely to truly screen out those with drug abuse problems. The extent to which preplacement drug testing of firefighters and EMS personnel would reduce applications from those with histories of injection drug use is unknown. It is important to recognize that individuals who choose to be firefighters or EMS personnel in large urban centers are not particularly risk-averse compared with most other citizens. Thus, perhaps these individuals might be susceptible to other risk-taking behaviors. On the other hand, it may be that randomly tested law enforcers are less likely to use illegal substances. Thus, if the screening effect proposed by Hales et al were operative, it would serve only to reinforce the hypothesis of a behavioral explanation for the lower seroprevalence rate among police officers and to further argue against an occupational exposure mechanism to explain rate differences. In addition, Hales et al note that PSWs admit to less injection drug use on surveys than the general population. This may be because they are at greater career jeopardy (vs the average citizen) if a history of injection drug use were to be discovered.

Hales et al propose that attrition from the workforce due to advanced liver disease could create a bias. However, because of the very long latency of HCV, liver disease tends to be a late finding, and individuals with advanced liver disease represents a relatively small minority of those who currently test positive for HCV.

On the issue of the 63.8% versus 39%, we encourage Hales et al to reread our results section and redo the math. Police officers comprise 1560 of 2447 (63.8%) of the participants, as reported. Incomplete participation (eg, 1560 of 4000 police officers) was appropriately reported as a limitation of our study.

Of note, an investigation similar to ours, with findings similar to those we described, was recently completed in Oregon by Rischitelli et al is discussed below and will be reported in an upcoming issue of the *Journal*.

Mark Upfal, MD
Detroit Medical Center
Occupational Health Services

Paul Naylor, PhD
Milton Mutchnick, MD
Division of Gastroenterology
Department of Internal Medicine
Wayne State University

Hepatitis C Screening and Prevalence Among Urban and Rural Public Safety Workers in Oregon

To the Editor: There has been considerable interest and debate regarding the distribution and determinants of HCV infection among public safety workers, particularly firefighters.[1,2] We read with interest the recent contribution of Upfal and colleagues reporting the prevalence of anti-HCV antibody among urban public safety workers in Detroit, Michigan.[3] They reported a seroprevalence of 1.1% in their total sample (n = 2447) and observed differences between police, emergency medical service workers, and firefighters (0.6%, 2.8%, and 2.3%, respectively). Working in field versus office settings and frequency of exposure to blood did not seem to explain these differences, suggesting that other individual medical and behavioral factors were most important.

Our experience with HCV-antibody surveillance in Oregon generally confirms the findings of Upfal and colleagues. Until its closure in July 2000, the Occupational Infectious Disease Service of the Occupational Health Program at Oregon Health & Science University provided occupational infectious disease training, immunization, postexposure evaluation, and treatment to public safety and health care workers in Oregon and southwest Washington. During 1991 through 1999, we performed 2251 initial HCV-antibody screening tests. Some of these tests were performed routinely to document the baseline serostatus of workers; others were performed immediately after an exposure to establish a baseline for follow-up. Tested individuals included firefighters, paramedics, police officers, public works employees, school district employees, and employees of private organizations. Interest in baseline HCV testing increased steadily during this period (Table 1).

From 1991 to 1999, 73 professional emergency medical technicians and paramedics employed by a private ambulance service were tested, with one positive result (1.4%) (Table 1). Sixty-three special education and first aid providers of local school districts were tested with no positive results (0.0%). Ninety sewage and wastewater treatment workers were tested with no positive results (0.0%). Twenty additional personnel from dental offices, emergency response teams, and other private companies were tested with no positive results (0.0%).

Among fire and law enforcement personnel, 1179 firefighters and 826 police officers were tested. There were nine positive tests among the firefighters (0.8%) and three positive tests in the police officers (0.4%). All positive tests occurred among personnel employed in the metropolitan areas of Portland and Salem, Oregon. There were no positive tests (0 of 100 and 0 of 103, respectively) among rural firefighters and police (Table 1). Rural areas in the Northwest probably have a lower seroprevalence of hepatitis B and C compared with urban areas because of the distribution of demographic and behavioral risk factors. One study of health care workers in rural Wash-

TABLE 1
Results of HCV Screening (Positive Tests/Total tests) in the OHSU Occupational Health Program (1991 to 1999)*

	EMS	Fire	Police	Public Works	School	Other
Year						
1991	0/0	0/4	0/0	0/0	0/0	0/0
1992	0/0	0/0	0/0	0/0	0/0	0/0
1993	0/0	0/7	0/2	0/0	0/2	0/0
1994	0/0	0/34	0/1	0/0	0/1	0/0
1995	0/0	0/54	0/1	0/0	0/0	0/0
1996	1/1	3/52	0/1	0/2	0/0	0/0
1997	0/19	0/119	0/99	0/54	0/56	0/7
1998	0/26	4/587	0/75	0/19	0/2	0/11
1999	0/27	2/322	3/648	0/14	0/2	0/2
Total	1/73	9/1179	3/827	0/89	0/63	0/20
Seroprevalence	1.37%	0.76%	0.36%	0%	0%	0%
95% exact CI	0.03–7.4%	0.35–1.4%	0.07–1.1%	NA	NA	NA

* HCV, hepatitis C virus; OHSU, Oregon Health & Science University; EMS, emergency medical services; CI, confidence interval; NA, not applicable.

ington State confirmed a lower distribution for markers of hepatitis B infection.[4]

The seroprevalence data obtained in Oregon are similar to or lower than those reported in other populations of public safety workers, including Upfal's sample in Detroit.[1–7] The prevalence in our Oregon sample is also lower than estimates for the general US population, particularly when adjusted for age, gender, and race.[8–11]

In February 2000, HCV prevalence estimates of 4.5% were initially reported among firefighters in Philadelphia, Pennsylvania. These data included positive antibody tests (EIA-3) that were indeterminate by recombinant immunoblot assay testing or were not subjected to confirmatory testing. Reanalysis of the sample by the Centers for Disease Control and Prevention demonstrated a confirmed seroprevalence of 3.0%.[2] The actual HCV seroprevalence in Detroit public safety workers may be even lower than reflected in Upfals et al's study, given the false-positives associated with the EIA method. In populations with a HCV seroprevalence of less than 10%, 20% to 50% of repeatedly reactive tests by EIA may be false-positive.[2] Our group is currently completing a cross-sectional survey of 719 police, fire, and corrections officers. Preliminary analyses indicate that 2 of 9 positive antibody tests failed to be confirmed by recombinant immunoblot assay.

Our experience with public safety workers in Oregon is consistent with that of Upfal and colleagues in Michigan, indicating that HCV-antibody prevalence is low in public safety workers. In our ongoing study, we have collected information on employment history, frequency of contact with blood on the job, and history of transfusions, injectable drug use, and male-male sexual activity. These data may improve the understanding of the relative contribution of occupational and nonoccupational risk factors in HCV infection in this group of workers.

Gary Rischitelli, MD, JD, MPH
Linda McCauley, RN, MSN, PhD
William C. Lambert, PhD
Detroit Medical Center
Occupational Health Services
Center for Research on
Occup and Environ Toxicol
Oregon Health & Science
University

References

1. Rischitelli DG, McCauley L, Harris J, Gershon R, Guidotti T. The risk of acquiring hepatitis B or C among public safety workers: a systematic review. *Am J Prev Med.* 2001;20:299–306.
2. Anonymous. Hepatitis C virus infection among firefighters, emergency medical technicians, and paramedics—selected locations, United States, 1991–2000. *MMWR Morb Mortal Wkly Rep.* 2000;49:660–665.
3. Upfal MJ, Naylor P, Mutchnick MM. Hepatitis C screening and prevalence among urban public safety workers. *J Occup Environ Med.* 2001;43:402–411.
4. Harris JR, Finger RF, Kobayashi JM, et al. The low risk of hepatitis B in rural hospitals. Results of a seroepidemiologic survey. *JAMA.* 1984;252:3270–3272.
5. Spitters C, Zenilman J, Yeargain J, Pardoe K. Prevalence of antibodies to hepatitis B and C among fire department personnel prior to implementation of a hepatitis B vaccination program (Letter, see Comments). *J Occup Environ Med.* 1995;37:663–664.
6. Pardoe KL. Prevalence of antibodies to hepatitis B and C among fire department personnel prior to implementation of a hepatitis B vaccination program (Letter; Comment). *J Occup Environ Med.* 1996;38:124–125; discussion 127–128.
7. Pardoe KL. Slaying the hepatitis dragon. A study of fire department vaccinations for hepatitis B and C. *JEMS.* 1994;19(5):59–66.
8. Alter MJ. Epidemiology of hepatitis C. *Hepatology.* 1997;26(3 suppl 1):62S-65S.
9. Alter MJ. Epidemiology of hepatitis C in the West. *Sem Liver Dis.* 1995;15(1):5–14.
10. Alter MJ. Occupational exposure to hepatitis C virus: a dilemma (Editorial; Comment). *Infect Control Hosp Epidemiol.* 1994;15:742–744.
11. Alter MJ. Community acquired viral hepatitis B and C in the United States. *Gut.* 1993;34(2 suppl):S17–19.