Alcohol Screening and Changes in Problem Drinking Behaviors in Medical Care Settings: A Longitudinal Perspective*

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ABSTRACT. Objective: Although the effect of alcohol assessment in medical settings has received attention, the longitudinal study of such efforts has been restricted to studying a single assessment/intervention dose. Such interventions can be recurrent and have effects on subsequent problem drinking. **Method:** A sample of problem drinkers in the general population ($n = 672$) and with admissions to chemical-dependency programs ($n = 926$) was interviewed at baseline and 1, 3, 5, and 7 years later. At each wave, respondents were asked about their drinking, their medical visits, and the intensity of the medical contact (whether during the visit they were asked about their drinking and, if so, whether they received or were referred to alcohol treatment). **Results:** Rates of problem drinking declined over time, from 48% at the 1-year follow up to 38% at the 7-year follow-up. Problem drinkers were more likely at each

wave to receive or be referred to treatment. Alcohol and drug severity increased with more intensive medical-contact types over time. Predicting subsequent problem drinking status from prior intensity of medical contact, odds of problem drinking at subsequent waves decreased with time, age, and prior drug severity while increasing with volume and alcohol severity. Odds of problem drinking were lower among prior problem drinkers receiving assessment and treatment/referral, compared with the assessed-only group. Examined separately, this effect was found only for those drinkers with lower volumes (average < 0.5 drinks/day). **Conclusions:** Alcohol assessment may be effective in reducing problem drinking but may be most effective among the non-heaviest drinkers. (*J. Stud. Alcohol Drugs*, 72, 471–479, 2011)

THERE ARE A NUMBER OF REASONS for screening for problem drinking in medical care settings and, in particular, primary care settings (Mezey, 1995). In many cases, problem drinking is not detected in the medical setting until classic signs, including both long-term health effects such as liver cirrhosis or pancreatitis and short-term effects such as delirium tremens, are present (Elvy et al., 1988). Prior reports (U.S. Department of Health and Human Services and National Institute on Alcohol Abuse and Alcoholism, 1993) have estimated that from 9 to 22 years of life are lost for an individual from alcoholic liver disease, compared with 2 years for cancer and 4 years for heart disease. Heavy drinkers also have been found to be both more frequent and more costly consumers of health care services, using substantially more emergency room, inpatient, and other expensive health care services (Cherpitel, 1991; Mertens et al., 2005; Parthasarathy et al., 2001). Therefore, testing of effective prevention strategies has become an important national research priority. In doing so, primary care settings have been identified as an appropriate place for the

identification, intervention, and referral of problem drinkers (Zimberg, 1983). One method that has been commonly used in clinical settings in an attempt to reduce consumption of alcohol is that of screening, brief intervention, and referral to treatment (Babor et al., 2007).

A previous study of the sample of problem drinkers used here (Weisner and Matzger, 2003) examined the association between a number of demographic, insurance, treatment, and severity variables and whether there was any contact with medical or mental health providers in the following year and, if so, whether drinking was addressed during the contact. A number of important individual factors were found to differentiate those with and without contact as well as whether drinking was addressed during the contact, including age, gender, and insurance status. In addition, those with contact with medical providers had higher alcohol, medical, and psychiatric Addiction Severity Index (ASI) scores than those without contact. Those whose drinking was addressed in the contact had higher severity as well (including drug severity). Such results suggest that, on average, those with more severe problems and, in particular, alcohol problems were more likely to have their drinking assessed. Although it could be argued that each respondent was a problem drinker at baseline and therefore should be screened for problem drinking during a medical or mental health contact occurring at any time in the following year, some of these respondents (in fact, more than half) no longer met problem drinking criteria 1 year later. This prior study also did not examine the effect of these interventions on subsequent drinking problems. In

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addition, when respondents were asked whether any of the providers brought up the subject of their drinking, they also were asked whether they received treatment directly or were referred to treatment. The effect of this potentially important distinction also was not investigated.

Although some studies have examined the long-term efficacy of brief physician advice for problem drinking (Fleming et al., 2002), such studies have typically assumed that the intervention occurred at a single point in time. The present study attempted to examine problem drinking behaviors over time and the influence of contact with medical venues. In addition to any medical-venue contact, the substantive content of the contact with regard to alcohol use also was considered. Taken together, the influence of the qualitative type of contact with medical venues on the likelihood of problem drinking at a later time was studied, taking into account whether respondents actually reported being problem drinkers during the period in which the medical contact took place.

Drinking trajectories of the sample used in the present analyses have been examined in several prior studies. Examining volume consumed in the past 12 months, Delucchi et al. (2004) found five distinct drinking trajectories, described as early nondrinkers (reports of very low or no consumption across the four interviews, 8% of the sample), quitters (drinking 12 months prior to baseline but very low or no consumption afterward, 7%), gradual improvers (gradually decreasing volume over time, 12%), moderate drinkers (fairly constant and moderate consumption over time, 21%), and heavy drinkers (constant and higher consumption over time, 52%). Trajectories of problem drinking were explored in Delucchi and Weisner (2010), where five trajectories were again found and were described as non-problem drinkers over time (42% of the sample), late problem drinkers (2%), early remitters (13%), later remitters (5%), and consistent problem drinkers (38%). Here in this study, an alternative method was used to capture heterogeneity in drinking behaviors found from previous analyses: namely, conditioning on the respondent's prior problem drinking state and examining the role of contact with medical settings in assessing the likelihood of problem drinking at the subsequent follow-up.

The prior work on subtypes of drinking over time indicates that there is a group that continues to drink heavily over the study period, and, should they have contact with medical settings, it is likely that these drinkers are the most likely to have their drinking addressed by a physician. However, it is unknown what their response to a given intensity of contact will be, and it may depend on their level of drinking. Therefore, based on these findings from prior studies, several hypotheses were put forth in the present analyses: (a) among those who have contact with medical settings, heavier drinkers will be more likely to have their drinking addressed in the visit and will be more likely to receive or be referred to treatment; (b) among problem drinkers who have a medical-setting contact, there will be heterogeneity in

terms of the response to a given intensity of contact, depending on the respondents' overall drinking level; and (c) these findings will generally be stronger for men than for women.

Method

Sample

Data collection for the present study was conducted in a northern California county with a population of approximately 900,000. Interviews were conducted at baseline in 1995 and 1996, as well as 1, 3, 5, and 7 years later. Two sampling groups were used: individuals admitted to chemical-dependency treatment programs and a group of dependent and problem drinkers in the general population who had not been in treatment during the previous year.

The treatment sample ($n = 926$) included consecutive admissions of men and women ages 18 and older within all public and private chemical-dependency treatment programs in the county that met the following criteria (Kaskutas et al., 1997): (a) at least one new intake occurred per week, (b) drugs other than alcohol were not the primary focus of the agency (e.g., methadone maintenance programs were not included), and (c) first-line treatment entry (i.e., programs limited to aftercare) were excluded. The public programs included two detoxification programs, two residential programs, and two outpatient programs. The private programs included detoxification, inpatient, and outpatient programs: They were four managed care and fee-for-service programs, which served the entire county and were the only ones to meet the study size criteria (Kaskutas et al., 1997). Data collection was conducted by trained interviewers who were independent of the treatment agencies. They administered structured in-person questionnaires to all participants by the end of the third day of residential treatment or the third outpatient visit. Informed consent was obtained, and participation was independent of receiving agency services. Across treatment agencies, the recruitment rate was 80%.

The general population sample of dependent and problem drinkers not entering treatment ($n = 672$) was collected in the same county. Sampling was first carried out using random-digit dialing to obtain a probability sample of 13,394 men and women ages 18 years and older. Of this sample, 7.6% met problem drinking criteria (described below), had not received alcohol or drug treatment during the prior 12 months, and were recruited for an in-person interview. In the following analyses, this general population sample is referred to as the *untreated sample*. Only 9.5% of the preliminary sample of 13,394 had received treatment before the previous year. Treatment was defined as detoxification or inpatient or outpatient alcohol and drug treatment programs. In-person interviews were conducted with this untreated sample in a private location by the same interviewers who interviewed the treatment sample, using a similar instrument. The general population recruitment rate was 71% (Tam, 1997).

To account for differences in the fieldwork duration across agencies as well as for nonresponse differences (age, sex, and ethnicity) within agencies, the data were weighted. Although weights were constructed for all five waves, only Wave 2 (the first follow-up) weights were used in the longitudinal analyses that follow. This was done because Wave 2 was used as the first time point for longitudinal analyses (because everyone at baseline was a problem drinker, there would be no variability in the problem drinking covariate at baseline). As is done in cross-sectional analyses, only a single case weight per respondent was allowed in longitudinal analyses. Sample and weighting procedures are described in prior publications (Weisner and Matzger, 2003). In the analyses that follow, the treatment and general population samples were combined.

Measures

Demographic characteristics included gender, age, education (less than or equivalent to high school graduate, and more than high school), income (<\$20,000 and ≥\$20,000), and ethnicity (White, African American, Hispanic, and other). To meet the problem drinking criteria for inclusion in the baseline sample, individuals had to report at least two of the following three criteria for the previous 12 months: (a) drinking 5+ drinks in a single day at least once a month for men (3+ drinks weekly for women), (b) one or more alcohol-related social consequences (from a list of eight), and (c) one or more alcohol-dependence symptoms (from a list of nine). This measure of problem drinking is consistent with those used in alcohol epidemiological research, and similar measures have been used in a wide variety of published studies (Hilton, 1987; Institute of Medicine, 1990; Schmidt et al., 1998; Weisner, 2002; Weisner and Schmidt, 1995).

An abbreviated form of the ASI was used to assess drug, alcohol, medical, and psychiatric problem severity (Weisner et al., 2001). The ASI is a valid and reliable instrument (McLellan et al., 1992) that assesses the severity of alcohol, drug, medical, psychiatric, and employment problems; family/social relations; and legal problems. In each of the domains, questions are asked that measure the number, frequency, and duration of problem symptoms in the patient's lifetime and in the past 30 days. The resulting score is a continuous measure from 0 to 1.0. Measurement of dependence (nine drug types) used questions from the Diagnostic Interview Schedule for Psychoactive Substance Dependence from the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* (DSM-IV-TR; American Psychiatric Association, 2000), to provide a diagnosis of alcohol dependence (Humphreys and Weisner, 2000; Weisner et al., 2001). The presence or absence of each symptom was asked for the previous 30 days. The number of treatment episodes in the subject's lifetime and in the 12 months before each interview also was assessed, with *treatment* defined as

detoxification and inpatient and outpatient alcohol and drug treatment. In addition, the number of Alcoholics Anonymous meetings attended in the past 12 months was assessed.

The instrument included a multidimensional measure of insurance status, including the type of insurance (Schmidt, 1997; Weisner, 2002). For these analyses, the public insurance category included individuals with Medicaid, the county health plan, Medicare, Veterans Administration or military insurance, and CHAMPUS. The measure of private insurance included both managed care and fee-for-service health plans. Total alcohol volume of consumption and frequency of drinking 5+ drinks over the past 12 months were estimated, using the graduated frequencies measure (Greenfield, 2000).

Having a medical visit. At each of the three waves following baseline, an individual had to report staying overnight in a medical hospital, going to the emergency department, or having a medical-office visit in the 12-month period before each interview to meet the medical-visit criterion for a given wave.

Having drinking addressed in the medical visit. Again, at each of the three interviews after the baseline interview, the following three questions were asked if the respondent reported having had a medical visit in the past 12 months: "You [also] mentioned that you [stayed overnight in a medical hospital (and)/had a medical office visit] in the past year. (1) Thinking of that time/those times, did anyone who provided you with medical services bring up the subject of your drinking? (2) Did they refer you to services somewhere for your drinking? (3) Did they themselves provide you with any other counseling or services for your drinking while you were there?"

A set of four medical-setting intensity-of-contact variables were then defined for each individual and for each of the follow-up waves 2-4: no medical setting contact, a medical-setting contact but no assessment of drinking, a medical-setting contact with assessment of drinking but no offer of referral or direct counseling, and a medical-setting contact with assessment of drinking and either referral of the subject to treatment or an offer of direct counseling.

The outcome variable of interest is the respondent's problem drinking status at Waves 3, 4, and 5. Our primary goal was to predict the dichotomous problem drinking status variable, as defined above, for a given interview Wave (3, 4, and 5) as a function of the medical-setting contact type at the prior interview (Waves 2, 3, and 4). Because all respondents were problem drinkers at baseline, the Wave 1 predictor (medical-setting contact type) and the Wave 2 outcome (problem drinking status) were not used in the analyses.

Analysis

Demographic characteristics of the combined treatment and general-population problem drinker participants at the first follow-up ($N = 1,338$) were examined, both overall as

well as for the various contact types. The first follow-up was used as the first point of analysis, as nearly everyone would be considered a problem drinker at baseline. Therefore, only data from Waves 2–5 were used in the analyses. To inform the relationship between problem drinker status and measures of alcohol consumption over time, the distribution of individuals across the four possible categories of setting-contact type was first estimated separately for problem drinkers and non-problem drinkers at each wave. To establish that key drinking measure outcomes were related to what occurred in the setting across time, the following generalized estimating equations (GEE) model (Diggle et al., 2002), denoted as Model 1, was estimated:

$$y_{i,t} = \alpha + \beta \times t + \lambda_0 \times \text{PD}_{i,t} + \lambda_1 \times \text{SCT}_{i,t} + \lambda_2 \times \text{PD}_{i,t} \times \text{SCT}_{i,t} + e_{i,t}$$

where $y_{i,t}$ is an outcome (e.g., the volume of consumption over the past 12 months and ASI alcohol) of interest and $\text{PD}_{i,t}$ and $\text{SCT}_{i,t}$ are the corresponding problem drinker status and four-category setting-contact type (none, contact not asked, contact asked about alcohol only, and contact asked about alcohol + treatment/referral) for respondent i at Wave t (for $t = 2, 3, 4, 5$). A time trend also was included to account for temporal variation in the outcomes not accounted for by problem drinker status, setting-contact type, and their interaction. Given a time point, for each combination of problem drinker status and setting-contact type, the marginal mean value of the response was estimated. Note that in the GEE model here, the error in prediction $e_{i,t}$ was defined as an exchangeable correlation structure, which is constant within an individual and independent between individuals.

For Model 1, tests of equality for the marginally estimated mean outcomes were performed within problem drinker status (yes/no) for three specific ordered contrasts, which compared each level of screening to the next most intense level defined as (a) between those with a setting contact but who were not asked about their drinking and those with a setting contact who were asked but not referred or treated; (b) between those with a setting contact who were asked about their drinking and referred or treated and those with a setting contact who were not asked about their drinking; and (c) between those with a setting contact who were asked about their drinking and not referred or treated, compared with their counterparts who were referred or treated. Evidence in favor of effective screening for problem drinking would be indicated by increasing severity of the outcome across screening intensity.

In an attempt to gauge the possible effectiveness of the screening for alcohol problems in the medical setting, the following longitudinal transition model (Diggle et al., 2002), denoted as Model 2, was estimated:

$$\log(p_{i,t+1} / (1 - p_{i,t+1})) = \alpha + u_{0,i} + \beta \times t + \theta_0 \times \text{PD}_{i,t} + \theta_1 \times \text{SCT}_{i,t} + \theta_2 \times \text{PD}_{i,t} \times \text{SCT}_{i,t} + \sum_k \phi_k x_{i,t,k}$$

where $p_{i,t+1}$ is the probability that the respondent i is a problem drinker at Wave $t + 1$ (for $t = 2, 3, 4$), PD and SCT are as described above and are measured at Wave t , and x includes time invariant (baseline age, gender, ethnicity [White, Black, Hispanic, other]) and time varying (capped yearly volume from the graduated frequencies measure, ASI alcohol, ASI drug, ASI medical, and ASI psychiatric, whether the respondent had any specialty or nonspecialty treatment, as well as the number of Alcoholics Anonymous meetings he or she attended in the past 12 months) covariates. Here the random effect $u_{0,i}$ is assumed to be distributed normally with a mean of 0 and a variance of σ^2 . This model is similar to that proposed in Diggle et al. (2002), with the advantage that it allows the transitions from problem drinking states for an individual to be correlated over time. Similar to Model 1, the three contrasts described above (a–c) were the focus of testing within this model.

Note that, for both Models 1 and 2, respondents can move in and out of problem drinking status over the follow-up periods, and therefore *problem drinkers* and *non-problem drinkers* refer not to a fixed set of respondents but to a changing set who are problem (or not problem) drinkers at the various follow-up waves. However, Delucchi and Weisner (2010) provide evidence of relative stability over time. The longitudinal models estimated provide, in a sense, an averaged relationship over time, while simultaneously accounting for within-individual correlation in error of prediction. For Models 1 and 2, the three λ and three θ parameters are of primary interest, and comparisons between medical-setting contact-type groups for problem and non-problem drinkers are based on tests of linear contrasts of these parameters. Stata Version 10 (StataCorp LP, College Station, TX) was used to estimate each of the longitudinal models.

Results

Table 1 shows demographic characteristics of the full sample under study weighted to account for the sampling design. Shown are distributions, both overall at Wave 2 as well as broken down by setting-contact type. Overall, the majority of the sample came from the treatment sample (53%, compared with 47% from the general-population sample), and the sample was predominantly male (63%) and White (61%, compared with 22% Black and 9% Hispanic). The mean age was 37 years. A little more than half the sample (53%) had family incomes of \$20,000 per year or more. A majority achieved a high school diploma or less (63%), and about half the sample reported having private insurance (56%), compared with only public insurance (27%).

There were more males among those with no contact compared with those who had contact but no drinking assessment. Those with more intensive types of contact were older, had lower incomes, were more likely to be from the treatment sample, and were more likely to have public insur-

TABLE 1. Distributions of demographic and drinking variables at the first follow-up ($N = 1,338$)

Variable	Contact type at first follow-up				Total ($N = 1,338$)
	No contact ($n = 459$)	Contact, drinking not assessed ($n = 688$)	Contact, asked about drinking ($n = 94$)	Contact, asked about drinking and treated/ referred ($n = 97$)	
Gender***					
Male	71.7	56.6	61.1	62.9	62.7
Female	28.3	43.4	38.9	37.1	37.3
Age***	35.1	37.3	39.7	40.6	36.8
Ethnicity*					
White	55.7	63.5	64.7	55.8	61.3
Black	22.7	19.7	23.3	27.7	21.6
Hispanic	7.6	7.2	4.4	4.9	9.0
Other	9.9	6.6	3.6	9.6	8.1
Income***					
<\$20,000	46.3	41.8	63.5	68.5	47.0
≥\$20,000	53.7	58.2	36.5	31.5	53.0
Education					
≤High school	63.8	61.6	66.0	64.3	62.9
>High school	36.2	38.4	34.0	35.7	37.1
Sample***					
General population	49.4	52.8	31.8	9.1	46.8
Treatment	50.6	47.2	68.2	90.9	53.2
Insurance***					
None	22.6	13.0	26.0	13.2	17.4
Public	23.8	25.0	33.8	49.8	27.1
Private	53.6	62.0	40.2	37.0	55.5
Alcohol consumption, ASI variables, treatment, and AA attendance					
Volume***	620	573	1,088	1,841	722
GF 5+***	48.4	43.2	112.2	166.5	59.3
ASI alcohol***	.10	.10	.14	.28	.12
ASI drug***	.03	.04	.04	.10	.04
ASI medical***	.06	.20	.31	.31	.17
ASI psych***	.12	.15	.31	.20	.16
Any treatment	.17	.22	.52	.60	.25
No. of AA meetings***	29.2	31.5	65.8	96.2	36.2

Notes: ASI = Addiction Severity Index; AA = Alcoholics Anonymous; GF5+ = frequency of drinking five or more drinks in a day in the past 12 months and is derived from the graduated frequencies measure.

* $p < .05$; *** $p < .001$. These footnotes indicate a significant difference in rates or averages across contact types.

ance (and less likely to have private insurance). In addition, drinking measures, severity on each ASI measure, likelihood of alcohol treatment with Alcoholics Anonymous, and attendance at Alcoholics Anonymous all increased with intensity of contact type, as would be expected.

When examining the relationship between problem drinker status and the nature of the medical-contact type, the sample sizes available for estimating the longitudinal models also are of interest. Table 2 shows the sample distribution, measured at each wave as well as overall, of medical-setting contact type separately within problem drinkers, compared with non-problem drinkers. Note that the proportion of problem drinkers hovers around half ($638 / [638 + 700] = 48\%$

are problem drinkers) at Wave 2 and slowly declines from Wave 3 to Wave 5 (44%, 41%, and 38%). It is expected that, for non-problem drinkers, the proportion having a medical contact in which the respondents were asked about their drinking only or asked as well as referred or treated will be less prevalent than the corresponding conditional distribution for problem drinkers. This result is confirmed in Table 2, where the proportions asked about their drinking are 8.6%, 3.5%, 6.0%, and 3.6% for interviews 2–5, substantially less than the corresponding proportions 20.4%, 16.6%, 14.6%, and 16.0%. Although such sample sizes are lower, comparisons for these groups are of less interest than those for problem drinkers with medical contacts who are asked about

TABLE 2. Distribution of sample sizes for medical-setting contact within problem drinker (PD) status

Variable	PD status at $t = 2$		PD status at $t = 3$		PD status at $t = 4$		PD status at $t = 5$		Overall PD status	
	Not PD	PD	Not PD	PD	Not PD	PD	Not PD	PD	Not PD	PD
Contact type at Wave t , n	700	638	730	576	748	513	746	451	2,924	2,190
No contact, %	36.2	32.2	40.8	37.8	36.8	34.3	30.1	29.3	35.9	33.6
Contact, drinking not assessed, %	55.2	47.4**	55.7	45.6***	57.2	51.1*	66.3	54.7***	58.7	49.3
Contact, asked about drinking, %	5.6	8.6*	3.0	8.8***	4.3	7.6*	2.7	8.2***	3.9	8.3
Contact, asked about drinking and treated/referred, %	3.0	11.8***	0.5	7.8***	1.7	7.0***	0.9	7.8***	1.5	8.8

* $p < .05$; ** $p < .01$; *** $p < .001$. These footnotes indicate a significant difference between PDs and non-PDs within contact types.

their drinking (minimum percentages of 7% at each wave for the group that was asked about their drinking only as well as the group that was asked as well as treated or referred).

Results for Model 1, the longitudinal GEE model predicting time-varying outcomes, are briefly described here (results not shown). Although analyses were performed for yearly volume of consumption, frequency of drinking 5+ and 8+ drinks per day, and ASI drug severity, results are discussed only for ASI alcohol severity, because findings were similar across these outcomes. Among problem drinkers, those with medical contacts who were asked about their drinking reported significantly higher ASI alcohol severity than those with a contact who were not asked ($p < .01$). In addition, those with a contact who were asked about their drinking and who received or were referred to treatment had significantly higher ASI alcohol-severity scores than those with a contact who were only asked about their drinking (but not treated or referred), as well as those with a contact who were not asked about their drinking ($p < .001$). Hence, it appears that, on average, the settings routed the more severe (and those with higher volumes, more 5+ and 8+ drinks/day and higher ASI drug severity) into more intensive screening or treatment. Among non-problem drinkers, no differences between types of contact were found.

With ASI medical severity considered as the outcome variable, problem drinkers with a medical visit who received or were referred to chemical-dependency treatment reported significantly lower ASI medical scores than those with a contact who were not asked about their drinking ($p < .01$). Among non-problem drinkers, those who were only asked about their drinking reported significantly higher ASI medical scores than both those with contacts who were not asked about their drinking and those who were asked about their drinking and treated or referred. Each of the above tests incorporated a Bonferroni adjustment for the three post hoc pairwise tests performed. Note that within-individual correlations of errors in the prediction of the outcome variables

were substantial, ranging from .19 to .37, indicating a propensity for individuals to be consistently above or below the average predicted relationship.

Of particular interest here is the association between problem drinking status and screening and referral, both assessed during the same period, in predicting problem drinking status at the following wave (Model 2). Similar to Model 1, the focus is on testing linear combinations of the θ parameters in order to test the three contrasts specified in the Analysis section separately for problem and non-problem drinkers. An initial form of Model 2 was estimated, including each of the time invariant (age, gender, ethnicity) and time varying (time, ASI measures, volume of consumption, any alcohol treatment, and number of Alcoholics Anonymous meetings attended) covariates along with the time-varying problem drinking status and medical-contact type at the prior wave (results not shown). In this model, those with higher ASI alcohol scores and volumes of consumption were more likely to be problem drinkers at the following wave, whereas those who were older at the 1-year follow-up and those with higher ASI drug scores were less likely to be problem drinkers at the following wave. In addition, among problem drinkers, those who were asked about their drinking and treated or referred were less likely to report problem drinking at the prior wave than those who were only asked about their drinking. Interestingly, among non-problem drinkers, those who were asked about their drinking and received or were referred to treatment were more likely than those who were only asked about their drinking to be problem drinkers at the following interview. This multivariate model also was estimated separately for men and women (removing the gender variable from each model), with similar findings for men among problem drinkers. For women, no differences in likelihood of problem drinking status were found across the medical-setting contact types.

In the interest of exploring whether there was a differential effect of the intervention on different types of drinkers,

TABLE 3. Multivariate logistic transition generalized estimating equations model predicting problem drinking status at Wave $t + 1$ with a 12-month volume partition

Predictor variable	β coefficient (SE)
Time	-1.01 (0.24)***
Age	-0.015 (0.005)**
Male	-0.02 (0.08)
White	0.15 (0.12)
Black	-0.10 (0.17)
Hispanic	-0.24 (0.18)
ASI alcohol	3.15 (0.39)***
ASI drug	-1.52 (0.68)**
ASI medical	-0.09 (0.12)
ASI psychiatric	0.22 (0.22)
Any treatment	0.07 (0.10)
No. AA meetings	0.003 (0.002)
Volume	0.0003 (0.0001)***

Notes: Wave t medical-contact type by Wave t problem drinking status (see Table 4). Mean (variance) estimate of $\sigma^2 = .38 (.16)$, $p = .011$. ASI = Addiction Severity Index; AA = Alcoholics Anonymous.

** $p < .01$; *** $p < .001$. These footnotes indicate a significant beta coefficient.

a Wave 2 median split on volume was performed for the problem drinking group at 180 drinks per year (the median volume level of problem drinkers across time) in an attempt to yield usable sample sizes in each corresponding cell for comparisons. Including this variable in Model 2 and its interactions with both medical-contact types among problem drinkers at a given wave yields the coefficients in Tables 3 and 4. Table 3 shows coefficients for time-invariant and time-varying covariates, with results similar to those described above for Model 2 without the volume partition.

As seen in Table 4, for problem drinkers with Wave 2 volumes below the 180 drinks-per-year threshold, the predicted probability of problem drinker status at the following wave period was significantly lower for the referred or treated group than both those with contact who were asked about their alcohol use and those with contact who were not asked. However, for the group above the Wave 2 threshold of 180 drinks per year, no differences between any of the groups were found. This suggests that the effect of increasing intensity of contact on the likelihood of problem drinking status over time is seen primarily in those with lower consumption levels.

Discussion

The relatively high rate of any contact with medical settings among problem drinkers over time (66% on average across the four follow-up interviews) presents a unique opportunity for the assessment of problem drinking, as well as for the treatment and referral to treatment of these respondents. However, not acting on such opportunities or continuing to monitor drinking behaviors comes with its cost, as it has been found that "brief advice and counseling

TABLE 4. Beta coefficients (SE) predicting problem drinking status at Wave $t + 1$ for Model 2

Variable	Medical-contact type at Wave t		
	Contact, not assessed	Contact, asked only	Contact, asked +
Not problem drinkers at Wave t			
Contact, not assessed	—	—	—
Contact, asked only	0.09 (0.11)	—	—
Contact, asked +	0.25* (0.12)	-0.07 (0.09)	—
Problem drinkers, LV at Wave t			
Contact, not assessed	—	—	—
Contact, asked only	0.25 (0.21)	—	—
Contact, asked +	-0.36* (0.18)	-0.41** (0.16)	—
Problem drinkers, HV at Wave t			
Contact, not assessed	—	—	—
Contact, asked only	-0.17 (0.20)	—	—
Contact, asked +	0.23 (0.22)	0.27 (0.22)	—

Notes: An en dash (—) indicates a contrast not tested or redundant with a contrast on the lower diagonal of each subtable. *Contact, asked +* refers to respondents with a medical-setting contact who were asked about their drinking and who received or were referred to treatment. LV, HV = low vs. high split on T2 Volume = 180 drinks per year.

* $p < .05$; ** $p < .01$. These footnotes indicate a significant beta coefficient.

without regular follow-up appears insufficient to sustain significant long-term reductions in drinking behaviour" (Wutzke et al., 2002, p. 672). Only 26% of problem drinkers across the four waves with a medical contact, averaged over time, were assessed for their drinking, and, among those who were assessed, about half either received or were referred to alcohol treatment. In fact, of those problem drinkers who were asked about their drinking during a medical contact, 40% of those who were problem drinkers at some subsequent follow-up period and who had a medical contact during that period reported not being asked about their drinking (results not shown). Such a finding might be a product of a number of different factors, including the discomfort of the physician, the lack of preparedness of the physician to deal with alcohol-related problems, or the lack of knowledge of whether a given level of drinking or symptoms necessitates broaching the subject or providing or referring the patient to alcohol treatment (Israel et al., 1996).

Regarding the hypotheses posited in the introduction, evidence was found in favor of the first hypothesis. Conditional on contact with a medical setting, Tables 1 and 3 suggest that heavier drinkers were indeed more likely to have their drinking addressed and to receive or be referred to treatment in medical settings.

The second hypothesis also was supported whereby lighter drinkers were found to be responsive to receiving or being referred to treatment, compared with either having their drinking addressed (but not being treated or referred to treatment) or not having their drinking addressed at all. Therefore, for these lighter drinkers, the more intensive type of contact appears to be more effective. However, this effect

also may be strengthened by selective recall, in that those who received the more intensive assessment from medical practitioners may have been more likely to remember the contact than those who were merely asked if they drank alcohol. Unlike lighter drinkers, there was no effect observed in Model 2 for heavier drinkers: Namely, there was no differential likelihood of being a problem drinker at the following time point for the three groups defined as those who were not asked about their drinking, those who were only asked about their drinking, and those who were referred or treated. These heavier drinkers are likely those that require more than a brief intervention to influence their drinking behaviors.

Evidence in favor of the third hypothesis was somewhat mixed. Although findings for Model 1 were generally replicated for both men and women, results for the longitudinal models presented in Tables 3 and 4 predicting problem drinking status at the subsequent wave from problem drinking and type of medical contact during the prior period remained significant only for men, both for the combined sample and for the 180-drinks-per-year volume split for men. Examining Table 2 separately by gender indicated somewhat smaller available relative sample sizes for women, compared with men, especially in the group that received or were referred to treatment. Therefore, this null finding may be simply the result of a lack of available power, as prior studies of brief intervention have found similar, if not larger, reductions among women than among men (Fleming et al., 1997).

Although dependence status at the following wave also was examined as an outcome alternative to problem drinking status, no results were found for the contact by prior dependence-status interaction, either overall or for subgroups (results not shown). Such an outcome points to one possible source of the observed effect. Because problem drinking status is typically triggered by a less intensive drinking pattern than is dependence, it may be that those with lower drinking volumes at Wave 2 (the low-volume subgroup) are closer to the problem drinking threshold, and therefore less behavior change is needed to cross this threshold than for the heaviest of drinkers. Dependent drinkers also may require more intensive, specialized treatment (Fleming et al., 1997), and the extent of the actual treatment provided or whether the individuals actually went to the treatment to which they were referred is not available.

Note that the present study is challenged by several limitations. The first lies with examination of the broader medical care setting, compared with the more focused primary care setting. The literature examining the effect of problem drinking has most often been confined to the primary care setting. Although analyzing primary care settings would have been ideal, the present analyses do not allow for restrictions to those reporting only medical office (i.e., primary care) visits because of constraints on sample size, and this restriction is required, because an assessment of drinking was done

combining all three medical-setting subtypes. Although it is difficult to tell which medical subtype may elicit the highest likelihood of assessment of problem drinking among the three subtypes, the most frequently reported setting was medical-office visits, so that respondents at least reported more potential exposure in which the assessment could occur.

Second, although the analytic method here allows the use of available data for respondents, approximately 13% of the sample dropped out of the study after baseline and hence could not be used in the analyses here (i.e., all data for the first through fourth follow-ups were missing). These respondents had higher volumes of consumption, higher counts of DSM-IV dependence symptoms, and greater alcohol-related problems (all $p < .01$), compared with those present for at least one follow-up. Therefore, the sample analyzed does not reflect the full spectrum of the severity gradient of the population to which we wish to generalize.

Finally, there may be important issues related to selection into medical settings that may influence the study findings here. Although those with any medical-setting contacts across the four follow-up waves were not more severe (in terms of volume, dependence, or alcohol-related problems, number of lifetime treatment episodes) than those without any contact (results not shown), other variables did predict a higher likelihood of having a medical visit, including whether the respondents were taking medication for a chronic physical problem and whether they had experienced a medical problem in the past 30 days, as well as how troubled they were by these problems. For this reason, ASI medical was included as a control factor in the model. However, the counter-factual of how respondents would have responded to a medical visit in terms of their likelihood of being a problem drinker at the following interview, had they had one, is not known and could influence the direction of findings.

Regardless of these limitations, this study has provided evidence for an effect of continual screening and brief intervention in medical settings on reducing problem drinking over time. Clearly, there appear to be missed opportunities for intervention among individuals previously identified as problem drinkers, and a more comprehensive approach to identifying such individuals and continuing to monitor their drinking behaviors would appear to be potentially beneficial in reducing problem drinking. Although this effect was found to be most pronounced among those who are not the heaviest drinkers, more targeted and intensive efforts aimed at treatment and referral may be more effective for the heavier drinkers.

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