EFFECT OF USING DIFFERENT MODES TO ADMINISTER THE AUDIT-C ON IDENTIFICATION OF HAZARDOUS DRINKING AND ACQUIESCENCE TO TRIAL PARTICIPATION AMONG INJURED PATIENTS

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Abstract — Aims: We compared the effect of three different modes of questionnaire administration on screening for hazardous drinking and acquiescence to trial participation. Methods: A quasi-randomized controlled trial among injured patients seen in acute care clinics compared self-administered paper-and-pencil, self-administered electronic, and orally-administered interview questionnaires. Outcomes included positive AUDIT-C screens for hazardous drinking, willingness to participate in a (hypothetical) lifestyle intervention trial, and recruitment success. Differences were analyzed with nonlinear mixed models, controlling for age, sex, and facility. Structured interviews with staff explored levers and barriers to screening. Results: Of the 370 participants, 22.7% scored ≥4 and 7.8% ≥6 on the AUDIT-C. Electronic questionnaires were more likely than paper questionnaires to identify an AUDIT-C ≥6 (OR = 1.96; 95% CI 1.10–3.48), but not ≥4 (OR = 0.83; 95% CI 0.43–1.62). Oral questionnaires were as likely as paper questionnaires to identify an AUDIT-C ≥4 (OR = 1.00; 95% CI 0.40–2.51) or ≥6 (OR = 1.94; 95% CI 0.83–4.50). Electronic and oral questionnaires were more likely to elicit acquiescence to trial participation (OR = 1.59; 95% CI 1.23–2.07, and OR = 1.66; 95% CI 1.22–2.26, respectively). Oral questionnaires created problems with confidentiality, privacy, and disruption of patient flow, and reduced recruitment success (OR = 0.51; 95% CI 0.42–0.62). Conclusions: Among acutely injured patients in clinics who consented to screening, nearly one-fourth reported hazardous drinking. Compared to paper questionnaires, electronic screening produced less social desirability bias and greater acquiescence to trial participation. Oral questionnaires produced greater acquiescence, but barriers to use adversely affected recruitment. Electronic questionnaires may be preferable for screening for hazardous drinking and recruitment into intervention trials in acute care clinics.

BACKGROUND

Screening in primary and acute care settings can identify patients whose alcohol consumption places them at increased risk for morbidity and mortality (D’Onofrio and Degutis, 2002; Dinh-Zarr et al., 2004; U.S. Preventive Services Task Force, 2004). Brief behavioural counselling for such patients reduces alcohol consumption and may improve health outcomes. The decision to evaluate and treat screen-positive patients is predicated on the assumption that the patient’s responses to the screening test are accurate. However, responses about ‘socially unacceptable’ exposures, such as heavy alcohol consumption or binge drinking, may be influenced by the mode of administration of the screening questionnaire (Dillman, 2000; Czaja and Blair, 2005; Choi and Pak, 2005).

Patients are less likely to report socially undesirable behaviours during a face-to-face interview than when less personal modes of survey administration are used (Richman et al., 1999; Dillman, 2000; Schaeffer and Presser, 2003; Choi and Pak, 2005). Compared with interview-administered surveys, patients report more socially undesirable responses about drinking behaviour (e.g. heavier consumption) with self-administered questionnaires, whether paper-and-pencil or computer-assisted (Hochstim, 1967; Lucas et al., 1977; Waterton and Duffy, 1984; Aquilino and Lo Scuoto, 1990; Aquilino, 1994).

A meta-analysis by Richman et al., (1999), looking at a wide variety of measures, found little evidence of any social desirability distortion from using computer versus paper questionnaires, which might be expected given their similarly impersonal modes of administration. The evidence is less clear for surveys of alcohol use, however. Although one study found no difference in reported rates of alcohol use between paper- and computer-assisted self-interviews (Hallfors et al., 2000), others have found significantly higher levels of reported alcohol use in computerized vs other self-administered modes of delivery (Erdfman et al., 1983; Wright et al., 1998).

The mode of administration may also influence the effect on survey responses of acquiescence, defined by Dillman (2000) as a ‘culturally-based tendency to agree with others’ regardless of the question’s content, although the evidence on this issue is mixed (Dillman, 2000; Schaeffer and Presser, 2003). Acquiescence has been widely studied in relation to subjective queries that appear in opinion surveys (Schaeffer and Presser, 2003). It may also affect subjects’ responses to other types of questions, such as requests that the patient take part in treatment or further research. When a request is made in person, the subject may be more likely to agree than when the request appears in a self-administered survey. This issue is of particular importance in the context of a screening test, since its value ultimately rests on whether screen-positive patients actually receive treatment or follow-up (U.S. Preventive Services Task Force, 2004).

Because data about the effect of mode of administration on responses are relatively limited, and the results are mixed, we aimed to examine the issue using different modes to screen for hazardous drinking among injured patients seen in urgent-care...
clinics. We hypothesized that, compared to a self-administered paper-and-pencil questionnaire,

1. A self-administered electronic questionnaire would reveal higher rates of hazardous drinking (i.e. less social desirability distortion);  
2. A face-to-face interview questionnaire would find lower rates of hazardous drinking (i.e. more social desirability distortion);  
3. A self-administered electronic questionnaire would elicit similar willingness to take part in a future (hypothetical) intervention trial (i.e. similar acquiescence);  
4. A face-to-face interview questionnaire would elicit greater willingness to take part in a future (hypothetical) intervention trial (i.e. greater acquiescence).

METHODS

Study design
As part of a larger feasibility study that examined various methods of screening for hazardous drinking among injured patients seen in acute-care clinics, we conducted a quasi-randomized controlled trial to compare three different modes of questionnaire administration. Self-administered paper-and-pencil, self-administered electronic, and face-to-face interview modes were assigned on a weekly basis at the study clinics, e.g. at Clinic A, Week 1 was oral, Week 2 electronic, Week 3 paper, etc.

Modes of questionnaire administration
1. Electronic: self-administered via a portable ‘black box’ device developed by Point-of-View Questionnaire Systems, which has a keyboard input, LCD screen display, and serial output for data download to remote data storage systems. The device was previously used in some of the study clinics to screen for depression.
2. Oral: a research assistant (RA) read the questionnaire out loud to the patient. To protect patient confidentiality, printed ‘show cards’ with all possible answers were prepared for each question. We asked the patients to point to their answers rather than say them aloud.

Study population, recruitment, data collection and patient management
The study population, recruitment, and patient management procedures have been detailed in a previous study that compared screening by telephone after clinic discharge to screening in the clinic (DiGuiseppi et al., 2006). Briefly, the study was conducted in urban and suburban acute-care clinics in a metropolitan health maintenance organization (HMO) that provides comprehensive prepaid health care coverage to more than 350,000 members.

Between June and September 2003, regular reception staff at each study clinic identified HMO members aged 18 years or older, who presented for initial treatment of an acute injury. Receptionists were oriented to the study and given a brief script, which was also posted at each reception desk. Receptionists asked all acutely injured adult patients if a RA could talk to them about a questionnaire to be done in the waiting area. Receptionists were not asked to screen for eligibility other than age and presenting complaint. Patients who agreed to hear about the study were referred to an RA. The RAs were university graduates with prior research or counseling experience, and training in HMO policies, study procedures, human subject protection, and patient confidentiality. The RAs screened referred patients for eligibility and enrolled all eligible, consenting patients. Patients were excluded if they were institutionalized or unable to communicate in English or Spanish, or presenting with chronic injuries, medical or surgical complications or misadventures, late effects of injuries, or for follow-up visits. RAs tracked patient contacts, results of eligibility screening, and reasons for ineligibility or refusal.

RAs screened patients with the AUDIT-C, an abbreviated Alcohol Use Disorders Identification Test that assesses quantity and frequency of alcohol consumption (Bush et al., 1998; Gordon et al., 2001; Rumpf et al., 2002; Dawson et al., 2005). The three AUDIT-C questions were incorporated into a brief life-style risk assessment questionnaire used routinely by the HMO, with the AUDIT-C replacing two existing questions about drinking. We placed the AUDIT-C toward the end of the questionnaire, embedded among other potentially sensitive questions, to reduce underreporting (Aday and CorNELIUS, 2006). We also asked patients about their readiness to participate in a (hypothetical) future randomized controlled trial of an intervention to prevent injuries through lifestyle changes, and requested injury and demographic information. Patients scoring ≥6 points on the AUDIT-C were given written information that their reported pattern of alcohol use might increase their injury risk and were offered a ‘drinker’s check-up’ medical visit.

To explore levers and barriers to screening, investigators conducted a structured group interview with three of the four RAs to learn their perceptions of and reflections on each mode of administration. Questions were based around a topic guide, with follow-up prompts. The topic guide included all aspects of the process, including recruitment; patient contact and screening for eligibility; obtaining consent; and questionnaire content and administration. Critical incidents (e.g. when a consenting subject did not complete the survey) were explored in more depth. We offered an opportunity for feedback on topics of importance to the RAs that we had not covered. Two facilitators independently recorded and subsequently transcribed detailed interview notes.

Study outcomes
The primary outcome was the identification of hazardous drinking, defined as the proportion of screened patients with AUDIT-C scores ≥4, a cut-off point that yielded the best combined sensitivity (92.6%) and specificity (86.3%) for risk drinking in a U.S. population (Dawson et al., 2005). We also examined a cut-off point of 6, which substantially increases screening specificity (99.7%), at considerable cost to sensitivity (62.2%) (Dawson et al., 2005). The secondary outcome was future trial participation, defined as the proportion of
screened patients who expressed willingness to take part in a hypothetical future lifestyle intervention trial.

We also examined recruitment success, i.e. the proportions of all injured adult patients presenting for care who were successfully recruited into the study, by mode of administration, to evaluate any effect on referral by receptionists or enrolment by RAs, since reception and study staff were not blind to mode of questionnaire administration. To estimate the total number of injured adult patients presenting for care at study facilities during the study period (i.e. the denominator), a de-identified database of all the patients who met study eligibility criteria for age, facility, visit date, and injury diagnosis code was created.

Data analysis
Demographic variables are described for all injured patients seen, all trial participants, and each mode of administration. We separately analyzed the effect of mode on identification of hazardous drinking, future trial participation, and recruitment success with nonlinear mixed models, using generalized estimating equations to handle facility clustering effect, with binomial distribution and a logit link function (Zeger and Liang, 1986). The three modes of questionnaire administration were included as main effects, while controlling for facility and patient age and sex. Tests for interactions between covariates and outcomes were performed; no significant interactions were identified.

Two investigators independently reviewed detailed notes from the structured group interview conducted with the RAs to identify recurring themes and any issues that had implications for methodological feasibility and future practice. Within each mode of questionnaire administration, identified themes and issues were grouped into levers and barriers. Differences in interpretation were resolved through discussion.

Protection of human subjects
The study was approved by the Kaiser Foundation Research Institute Institutional Review Board and the Colorado Multiple Institutional Review Board. A Certificate of Confidentiality was obtained.

RESULTS
The electronic and paper modes were each implemented for a total of three weeks at each study site. Oral administration was implemented for a total of two weeks at each site; the third week was eliminated due to negative feedback from clinic staff and RAs (described under Levers and Barriers to Modes of Questionnaire Administration Reported by RAs, below).

There were 1268 injured adult patients who presented for care at study facilities during the study weeks, of whom 39% were successfully contacted by the RA, 1% were referred by reception staff but not contacted, and 60% were not referred to the RA. The proportion contacted was highest for the paper mode (45.2%) and lowest for the oral mode (30.6%) (Fig. 1).

Overall, 370 patients (29% of all injured patients), i.e. 75% of those contacted, were found to be eligible, consented, and screened for hazardous drinking. The proportion screened was 21.7% for the oral mode, compared to 32.9 and 31.5%, respectively, for the paper and electronic modes (Fig. 1). After adjustment for facility, and patient age and sex, the likelihood of successfully enrolling and screening injured adult

Fig. 1. Flow of patients recruited and screened, by mode of questionnaire administration.
patients was significantly lower during the oral compared to the paper mode weeks (adjusted Odds Ratio = 0.51; 95% C.I. 0.42, 0.62; \( P < 0.0001 \)). Enrolment was somewhat lower for the electronic than the paper mode, a difference possibly due to chance (adjusted Odds Ratio = 0.80; 95% C.I. 0.63, 1.02; \( P = 0.07 \)). Once the RA contacted the patient, the proportions who were found to be ineligible, refused, or did not complete consent procedures (e.g. due to being called for treatment) were similar for all modes.

Most participants, like most injured patients presenting for care, were seen at the suburban facility on weekdays (Table 1). Participants were similar to all injured adult patients in clinic site, time/day seen, sex, and age distribution. The leading causes of injuries among enrolled patients were falls (32.9%) and sports and recreation (27.1%); 99% of injuries were unintentional. Among the participants, 44% reported exercising aerobically at least three times per week, 91% always or almost always used a seatbelt, and 81% were non-smokers.

There were no significant differences among the three study groups in the facility where enrolled, time/day seen, or patient sex or age distribution (Table 1).

### Identification of hazardous drinking

The proportion of enrolled study participants with an AUDIT-C Score \( \geq 4 \) was 22.7% overall, and 23.1% for oral, 24.8% for paper, and 20.5% for electronic administration. Female and suburban patients were less likely to screen positive than male or urban patients, and the likelihood of a positive screen decreased with increasing age. After adjustment for facility, age, and sex, there were no significant differences in identification of hazardous drinking between the electronic or oral modes and the paper mode when using a cut-off point of 4 or higher on the AUDIT-C (Table 2).

The proportion of participants with an AUDIT-C Score \( \geq 6 \) was 7.8%. Oral and electronic administration identified similar proportions of patients with AUDIT-C scores \( \geq 6 \) (9.0 and 9.3%, respectively), while the paper mode identified 5.7%. After adjustment for facility, age, and sex, both oral and electronic questionnaires were nearly twice as likely as paper questionnaires to identify patients with this more specific AUDIT-C cut-off, although the difference between oral and paper modes was not statistically significant (Table 2).

### Future trial participation

The proportions of screened patients who expressed readiness to participate in a future (hypothetical) lifestyle intervention trial varied from 46% for the electronic mode to 54% for the paper and oral modes. After controlling for covariates, those who were given the electronic or oral questionnaire were significantly more likely to express willingness to participate in a future trial than were patients given the paper questionnaire (Table 2).

### Levers and barriers to modes of questionnaire administration reported by RAs

**Paper.** RAs preferred the paper mode because it was simple to administer, could be sent with the patient to the examination room to complete, and afforded privacy for participant responses. Scoring the AUDIT-C was quick and easy, allowing timely feedback to patients. However, it was difficult for participants to complete if they had injured their writing extremity or did not have their glasses. It also did not allow RAs to clarify confusing questions.

**Electronic.** RAs liked the electronic mode because it took the least time to complete, could be sent with patients to the examination room to complete, and was usable by participants who had injured their writing extremity. However, some elderly patients complained that the devices were ‘too technological.’ There were also logistical problems. The devices had to be ‘Docked’ at a printer station to retrieve the AUDIT-C score, so it took more time to provide feedback to patients, who sometimes left before receiving feedback. Potential participants could have been missed when the RA left the waiting room.

### Table 1. Characteristics of all injured adult patients, and of study participants in total and by mode of questionnaire administration

<table>
<thead>
<tr>
<th>Clinic Facility</th>
<th>All injured adults (( N = 1268 ))</th>
<th>Study participants (( N = 370 ))</th>
<th>Paper (( N = 141 ))</th>
<th>Electronic (( N = 151 ))</th>
<th>Oral (( N = 78 ))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suburban</td>
<td>730 (57.6%)</td>
<td>228 (61.6%)</td>
<td>81 (57.4%)</td>
<td>95 (62.9%)</td>
<td>52 (66.7%)</td>
</tr>
<tr>
<td>Urban</td>
<td>538 (42.4%)</td>
<td>142 (38.4%)</td>
<td>60 (42.6%)</td>
<td>56 (37.1%)</td>
<td>26 (33.3%)</td>
</tr>
<tr>
<td>Day/ Hour of Visit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weekday Visit</td>
<td>853 (67.3%)</td>
<td>255 (68.9%)</td>
<td>97 (68.8%)</td>
<td>101 (66.9%)</td>
<td>57 (73.1%)</td>
</tr>
<tr>
<td>After Hours Visitb</td>
<td></td>
<td>115 (31.1%)</td>
<td>44 (31.2%)</td>
<td>50 (33.1%)</td>
<td>21 (26.9%)</td>
</tr>
<tr>
<td>Sexb</td>
<td>687 (54.2%)</td>
<td>190 (53.8%)</td>
<td>70 (50.4%)</td>
<td>80 (55.9%)</td>
<td>40 (56.3%)</td>
</tr>
<tr>
<td>Male</td>
<td>581 (45.8%)</td>
<td>163 (46.2%)</td>
<td>69 (49.6%)</td>
<td>63 (44.1%)</td>
<td>31 (43.7%)</td>
</tr>
<tr>
<td>Age Groupb</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–24</td>
<td>136 (10.7%)</td>
<td>34 (9.6%)</td>
<td>12 (8.6%)</td>
<td>14 (9.8%)</td>
<td>8 (11.1%)</td>
</tr>
<tr>
<td>25–34</td>
<td>250 (19.7%)</td>
<td>90 (25.4%)</td>
<td>31 (22.1%)</td>
<td>41 (26.7%)</td>
<td>18 (25.0%)</td>
</tr>
<tr>
<td>35–44</td>
<td>233 (18.4%)</td>
<td>76 (21.4%)</td>
<td>32 (22.9%)</td>
<td>28 (19.6%)</td>
<td>16 (22.2%)</td>
</tr>
<tr>
<td>45–64</td>
<td>432 (34.1%)</td>
<td>124 (34.9%)</td>
<td>51 (36.4%)</td>
<td>47 (32.9%)</td>
<td>26 (36.1%)</td>
</tr>
<tr>
<td>≥65</td>
<td>217 (17.1%)</td>
<td>31 (8.7%)</td>
<td>14 (10.0%)</td>
<td>13 (9.1%)</td>
<td>4 (5.6%)</td>
</tr>
</tbody>
</table>

*After hours visit’ includes visits made on the weekend or in the evening on a weekday. All other visits were made during the day on weekdays.

b Data on sex and age group were missing for 17 (4.6%) and 15 (4.1%) enrolled subjects, respectively.
EFFECT OF USING DIFFERENT MODES TO ADMINISTER THE AUDIT-C

Table 2. Identification of hazardous drinking, and willingness to participate in a future intervention trial, by mode of questionnaire administration

<table>
<thead>
<tr>
<th>Mode</th>
<th>AUDIT-C ≥ 4 ORa (95% CI)</th>
<th>p-values</th>
<th>AUDIT-C ≥ 6 OR (95% CI)</th>
<th>p-values</th>
<th>Future Trial Participation OR (95% CI)</th>
<th>p-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper</td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Electronic</td>
<td>0.83 (0.43, 1.62)</td>
<td>0.058</td>
<td>1.96 (1.10, 3.48)</td>
<td>0.021</td>
<td>1.59 (1.23, 2.07)</td>
<td>0.001</td>
</tr>
<tr>
<td>Oral</td>
<td>1.00 (0.40, 2.51)</td>
<td>0.096</td>
<td>1.94 (0.83, 4.50)</td>
<td>0.124</td>
<td>1.66 (1.22, 2.26)</td>
<td>0.001</td>
</tr>
<tr>
<td>Facility</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suburban</td>
<td>0.46 (0.32, 0.66)</td>
<td>&lt;0.0001</td>
<td>0.71 (0.50, 0.99)</td>
<td>0.043</td>
<td>0.89 (0.78, 1.01)</td>
<td>0.078</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–24</td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>25–34</td>
<td>0.75 (0.63, 0.90)</td>
<td>0.002</td>
<td>0.45 (0.17, 1.19)</td>
<td>0.109</td>
<td>1.03 (0.76, 1.40)</td>
<td>0.839</td>
</tr>
<tr>
<td>35–44</td>
<td>0.53 (0.28, 1.00)</td>
<td>0.051</td>
<td>0.23 (0.08, 0.66)</td>
<td>0.006</td>
<td>0.79 (0.43, 1.43)</td>
<td>0.430</td>
</tr>
<tr>
<td>45–64</td>
<td>0.27 (0.18, 0.40)</td>
<td>&lt;0.0001</td>
<td>0.05 (0.01, 0.22)</td>
<td>0.0001</td>
<td>1.71 (1.22, 2.41)</td>
<td>0.002</td>
</tr>
<tr>
<td>65+</td>
<td>0.11 (0.04, 0.33)</td>
<td>&lt;0.0001</td>
<td>N/A</td>
<td></td>
<td>1.78 (1.20, 2.63)</td>
<td>0.004</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.33 (0.16, 0.66)</td>
<td>0.002</td>
<td>0.18 (0.10, 0.34)</td>
<td>&lt;0.0001</td>
<td>0.96 (0.72, 1.33)</td>
<td>0.875</td>
</tr>
</tbody>
</table>

Each odds ratio is adjusted for all other variables shown in the Table.

DISCUSSION

An electronically administered questionnaire was twice as likely as a paper questionnaire to identify hazardous drinking, but only when a highly specific AUDIT-C cut-off point of 6 defined a positive screen. An orally administered questionnaire also appeared more likely to identify hazardous drinking at this cut-off point, but the apparent association may have been due to chance. Patients taking either the electronic or oral questionnaire were significantly more likely to express willingness to participate in a future intervention trial than were those taking paper questionnaires, and the magnitude of the benefit was similar for both modes. Although paper questionnaires are commonly used in practice and research, our results suggest that this mode of administration may not be optimal and that alternative modes should be considered.

The results support our hypothesis that patients may be more comfortable reporting socially undesirable behaviours with a computerized questionnaire, at least for the more extreme drinking behaviours indicated by a cut-off point of 6. Electronic questionnaires were also more effective in eliciting willingness to participate in a future lifestyle intervention trial to prevent injuries. This may reflect a positive attitude toward research participation stemming from the ease or ‘fun’ of using the ‘black box’ devices. Prior familiarity with this mode of questionnaire administration among HMO patients may also have contributed, although one would expect patients to be at least as familiar with paper questionnaires. RAs found the electronic questionnaire to be quick and easy to administer, making it a useful mode for busy acute-care clinics. It was less popular among elderly patients, suggesting that an alternative might be required as a back-up in populations involving older adults. In our study, use of the electronic mode occasionally delayed the delivery of screening results to the patient. This would not necessarily be a problem if used clinically, since the box could be docked and the score printed while the patient was being treated.

We expected patients to report less hazardous drinking when interviewed in person, due to its social undesirability (Dillman, 2000; Schaeffer and Presser, 2003). Instead, we found patients to be at least as likely to report hazardous drinking with oral administration as compared to paper administration. Despite staff concerns about spoken answers being
overheard in the busy waiting rooms where the surveys were administered, patients presumably felt sufficiently protected by the use of ‘show cards’ to report these behaviours. As predicted, patients were more likely to agree to take part in a future (hypothetical) intervention trial if they were asked during a face-to-face interview. This is consistent with existing literature regarding the influence of acquiescence on responses to opinion surveys (Dillman, 2000; Schaeffer and Presser, 2003). However, the oral questionnaire was generally disliked by patients and staff, due to concerns about privacy, confidentiality, time, and disruption to patient flow. This may have adversely affected our ability to recruit subjects during oral mode weeks.

Limitations
Study participants were similar to all injured adult patients seen, in terms of the clinic facility visited, the time of day and day of week of the visit, and patient sex and age distribution. This suggests that enrolled subjects were representative of injured adult HMO patients seen for acute-clinic care. The generalizability of these findings to other settings is a matter of judgement. Compared to insured patients who pay for services, prepaid group practice (i.e. HMO) members are less satisfied with their health plans and experience less access to care (Shi, 2000; Miller and Luft, 2002), which may negatively influence their attitudes toward participation. On the other hand, compared to patients without insurance, insured patients such as HMO members are better educated, have higher income and are more likely to be employed (Institute of Medicine, Board on Health Care Services, Committee on the Consequences of Uninsurance, 2001). Such individuals may be more literate and technologically sophisticated, hence more comfortable with electronic devices, and more able to complete both paper and electronic questionnaires, compared to individuals with lower income and educational attainment.

The AUDIT-C was embedded among other sensitive questions toward the end of a brief lifestyle risk assessment instrument routinely used by the HMO. The order and context of the AUDIT-C questions, and the potential familiarity of the instrument to participants, were intended to reduce under-reporting of hazardous drinking. While this may affect the generalizability of our findings to similar efforts using the AUDIT-C alone, it is unlikely to affect the internal validity of our results since the same instrument was used with all three modes.

Logistical constraints (primarily limited availability of the ‘black box’ devices) prevented random assignment of modes of questionnaire administration to individuals. Allocation by alternating weeks did not result in differences among groups in terms of facility, time of day or day of week of visit, or patient sex or age distribution.

Because this study was designed to examine the feasibility of conducting a lifestyle intervention trial among injured patients seen in acute care clinics, we did not test patients’ willingness to consent by actually enrolling patients into an intervention trial. We might have over- or underestimated the beneficial effect of electronic and oral administration on trial participation if the effect of mode on acquiescence is different for hypothetical versus actual trials.

We discontinued oral administration after the second week, which reduced our sample size. It is unlikely that greater power would have enabled us to identify a statistically significant effect of oral administration on the identification of hazardous drinking as defined by an AUDIT-C >4, since our odds ratio was 1.00. However, the smaller sample may have reduced our power to detect a statistically significant difference at a higher, more specific cut-off point (AUDIT-C >6), where the odds ratio approached 2.0 but had wide confidence intervals. The decision to discontinue the oral strategy did not affect our power to detect significant differences between modes of administration in future trial participation.

Although we did control for differences in facility, and patient age and sex, it is possible that some of the apparent differences between oral and paper modes were due to selection bias. Patients presenting during oral administration weeks were only half as likely to be enrolled and screened as patients presenting during paper weeks, a difference largely attributable to failure of the receptionists to refer patients to the RA. Receptionists were not blinded to method, and in the clinic during these weeks. However, the combined rate of ineligibility and refusal among contacted patients was 8.9% with the oral mode, which did not differ from the electronic mode (8.6%) and was only modestly lower than those for the paper mode (12.3%), suggesting against this possible bias. Differences between electronic and paper administration are unlikely to be due to selection bias, as the likelihood of successfully enrolling and screening patients was similar with the two modes of administration.

IMPLICATIONS
Patients completing an electronic questionnaire were more likely to acquiesce to future trial participation than were patients completing a paper questionnaire. Since the electronic questionnaire was also at least as efficacious as the paper questionnaire for identifying patients with hazardous drinking, this mode of administration may be better for screening injured patients in the clinic setting for recruitment into an intervention trial. In such cases, having a docking station on site is essential, since leaving the clinic to obtain screening results can lead to missed recruitment opportunities. Because electronic questionnaires were more effective than paper-and-pencil questionnaires for identifying hazardous drinking when a highly specific AUDIT-C cut-off point of 6 or higher was used, this mode may also be useful in acute-care clinics for identifying patients in need of counselling to reduce their drinking.

Although the orally administered questionnaire appeared to perform as well as or better than the paper questionnaire for both identification of hazardous drinking and eliciting future trial participation, it was more difficult to recruit patients into the study when this method was being used. Some of the apparently beneficial effect of this mode may therefore have been due to selection bias. The oral questionnaire was also least preferred by patients, clinic staff, and researchers. However, there may be some subjects for whom
oral administration remains a potentially useful option. Use of this method would require establishment of procedures to protect patient confidentiality and avoid disruption to clinic flow.

Nearly one in four acutely injured patients who were screened during clinic visits reported hazardous drinking. Approximately half of screen-positive patients indicated readiness to participate in a lifestyle intervention trial. Because the questionnaires were administered by research staff in the context of a trial, it is not known whether similar results would be obtained by clinicians administering the questionnaires in the context of health care. Our results suggest that acute-care clinics are likely to be fruitful sites for identification of injured patients with hazardous drinking patterns for intervention research, and that injured patients in such clinics may also benefit from screening for problem drinking for purposes of brief intervention or referral.

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