TRENDS IN BLOOD ALCOHOL CONCENTRATION LEVELS OF NIGHT DRIVERS

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As part of the Fairfax alcohol safety action project (ASAP), two roadside surveys have been conducted in Fairfax, Virginia. A base-line survey was conducted in January 1972 prior to the start of ASAP operations in February 1972, and a second survey was conducted in October 1972. The ASAP concept recognizes the major role that alcohol plays in fatal and serious highway crashes, and the project consists of countermeasures designed to identify drunken drivers, remove them from the road, and refer them to proper educational or rehabilitation programs. The ultimate objective of the ASAP is to reduce the number of accidents caused by the drinking driver. The purpose of the roadside surveys of randomly selected drivers is to provide a secondary measure of the project's effectiveness in reducing the incidence of driving under the influence of alcohol. This paper compares the blood alcohol concentrations of drivers in the base-line survey with those during the second survey.

•THE FAIRFAX alcohol safety action project (ASAP) was initiated in January 1972 as one of a number of 3-year, federally funded demonstration projects designed to implement and evaluate comprehensive community alcohol countermeasures to the problem of drunken driving. The ultimate objective of the Fairfax ASAP is to reduce the number of crashes that result in fatalities, personal injuries, and property damage by reducing the incidence of drunken driving. Drunken drivers account for a disproportionately large share of serious and fatal accidents. If the ASAP is successful in affecting the normal driving patterns of drunken drivers so that they drive less under the influence, it follows that the number of alcohol-related accidents will be reduced.

The purpose of conducting roadside surveys at night is to provide a secondary measure of the project's effectiveness in reducing the incidence of drunken driving. The base-line roadside survey was conducted before the ASAP countermeasures were implemented. Base-line survey results were established as the base against which changes in drinking habits as indicated in the subsequent yearly surveys could be measured. The second survey was conducted after 9 months of ASAP operations. Because the ASAP countermeasures were operative for only 9 months before the second roadside survey, there may not have been enough time for ASAP to have had a measurable impact. Therefore, any trends identified or conclusions drawn from the comparison of the first two surveys are tentative.

METHODOLOGY

The basic survey procedures were patterned after the procedures outlined in a report by Perrine (1) of the University of Vermont. The two primary functions of the roadside surveys as stated in Perrine's report are "to provide data for describing the basic problem in terms of identification and specification of assumedly relevant parameters, and to provide data for evaluating the results of any changes in circumstances surrounding the basic problem, whether they are the result of unplanned natural events, on the one hand, or controlled premeditated countermeasures, on the other."

Publication of this paper sponsored by Committee on Traffic Law Enforcement.

Sampling Frequency

There will be a total of four roadside surveys during the Fairfax ASAP. The first survey was conducted each night from January 5 through the early morning hours of January 16, 1972. The base-line survey had to be conducted in January because comparative data had to be collected before implementation of the enforcement countermeasure on February 1, 1972, and when the five cooperating police agencies in the area could be of assistance. The second survey was conducted in October 1972, and the two subsequent surveys are scheduled for the month of October. October was selected for the surveys so that the annual changes in BAC levels would reflect fewer seasonal variations in drinking patterns. In addition, the survey results would be available in time for analysis and inclusion in the annual evaluation report. In a more practical vein, the weather in October is more conducive to taking an outdoor survey.

Sample Size and Day of the Week

U.S. Department of Transportation guidelines specify a minimum sample size of 640. The guidelines also suggest that the samples be taken on Friday and Saturday nights. However, ASAP surveys conducted throughout the week in North Carolina and Michigan produced positive readings of 22.2 and 19.0 percent compared with the positive reading of 42.0 percent reported by the Oregon ASAP conducted only on Fridays and Saturdays; therefore, both test periods were considered important. Testing during both periods would reveal those periods that showed the greatest number of drunken drivers so that police patrols could be increased appropriately. Thus, both the base-line and second surveys were conducted on weekends and weeknights. With minimum sample sizes of 640 for both weeknights and weekends (Friday, Saturday), a total of three sets of statistics on the levels of drinking by night drivers can be measured on weekends, on weeknights, and in the aggregate.

Hour of Day

Sampling hours for the drinking driver patterns in Fairfax were 7 p.m. to 3 a.m. This 8-hour period was divided into three 2-hour-20-minute periods in which the interviews were conducted and 1 hour for travel between sites. The time periods were 7:00 to 9:20 p.m. (site 1), 9:50 p.m. to 12:10 a.m. (site 2), and 12:40 to 3:00 a.m. (site 3). Using three time frames instead of the four suggested by the U.S. DOT guidelines allowed us to increase the amount of interview time by reducing the travel time between sites by 33 percent.

Site Selection

The locations for survey sites were roughly proportioned among the five participating police jurisdictions on the basis of their resident populations and the number of police officers. This achieved representative sampling of the various driving conditions in Fairfax and involved all of the police departments from the very beginning of the ASAP. After asking the police departments for a list of sites that conformed to the U.S. DOT guidelines, a staff member of the Virginia Highway Research Council reviewed this list. Sites were selected that seemed to be a representative mixture of rural and urban areas in Fairfax dispersed throughout the county. The final selection of sampling sites was based on keeping travel time between sites under 25 minutes. Thus the driving population was sampled randomly within the constraints of travel time and research design.

Questionnaire and Equipment

The standard U.S. Department of Transportation questionnaire for roadside surveys was used. This questionnaire consisted of questions on the respondent's place of residence, driving habits, drinking habits, drinking attitudes and knowledge, and demographic data and, most importantly, the BAC reading on the breath test.

The breath-testing device for the base-line survey was the Intoximeter-Mark II.

Both the Intoximeter and the HALT breath-testing machine were used on the second survey.

Administrative Procedure

The five participating police departments provided the necessary patrolmen for traffic control. The coordinators were staff members of the Safety Section of the Virginia Highway Research Council. The interviewers and data recorders were provided under a subcontract, and the breath-test operators were ASAP lab technicians provided by Fairfax County.

The coordinators selected the vehicles to be stopped by the policemen, designating the first eligible vehicle whenever a vacancy existed within the mobile vans used for interviews. The policemen simply directed the motorist out of the line of traffic and over to the coordinators. The coordinators requested the motorist's cooperation in the survey. After securing a motorist's cooperation, the coordinator led the driver to one of the two interview vans where he was greeted by a lab technician, who immediately administered the breath test. Then the driver was given the questionnaire, and, by the time the questionnaire was finished, his BAC reading had been calculated and was recorded on the questionnaire. The coordinator thanked the motorist for his cooperation, and he was allowed to proceed on his way if his BAC reading was under 0.10 percent. Those drivers whose BAC was 0.10 percent or greater were given the options of being driven by a sober passenger when available, by a member of the local Jaycees, or by volunteers from the military. Subjects who were only slightly above 0.10 percent were given the option of remaining at the site until their BAC dropped below 0.10 percent upon retesting.

DISCUSSION OF FINDINGS

Summaries of the BAC results are given in Table 1. Comparisons of BACs from the base-line and the second surveys were made from these data.

Total Sample

Comparison of the distribution of BACs for the total sample gave a chi-square value of 18.845. This surpassed the value of 13.277, which is used to establish significance at the 99 percent confidence level for four degrees of freedom. Thus the two distributions were found to be significantly different at the 99 percent confidence level.

After the distributions were found to be significantly different, they were tested to determine in what ways they were different. The percentages of positive BACs were 29.2 for the base-line survey and 35.9 for the second survey. These two percentages were compared and found to be significantly different at the 99 percent confidence level. It can be concluded that there was a greater percentage of positive BAC readings on the second survey than on the base-line survey.

The percentages of BACs above 0.10 percent were 4.2 for the base-line survey and 4.1 for the second survey. These two percentages were not found to be significantly different at even the 20 percent confidence level.

Weeknight Sample

Comparison of BAC distributions for weeknights yielded a chi-square value of 15.822, and the two distributions were found to be significantly different at the 99 percent confidence level.

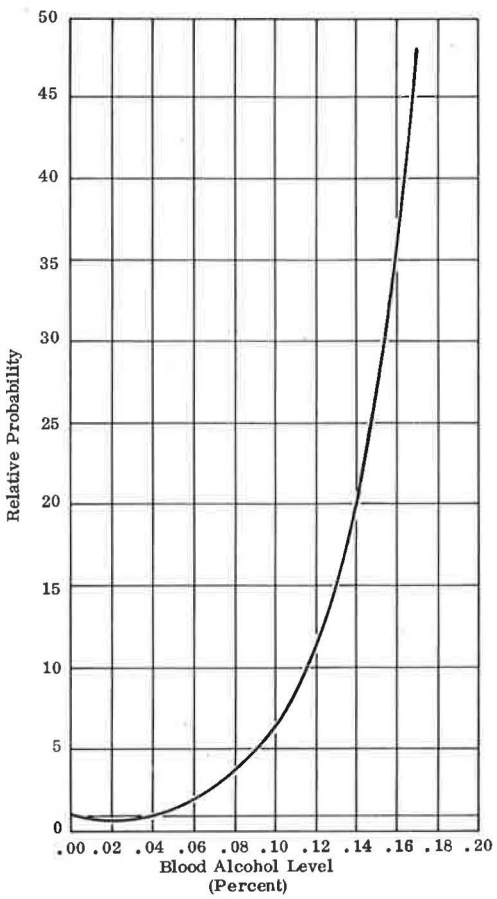
The percentages of positive BACs on weeknights were 25.8 on the base-line survey and 31.6 on the second survey. These two percentages were compared and found to be significantly different at the 99 percent confidence level. It can be concluded that there was a greater percentage of positive BAC readings in the second survey than in the base-line survey.

The percentages of BACs above 0.10 percent were 3.4 for the base-line survey and 4.5 for the second survey. These two percentages were not significantly different at the 95 percent confidence level, so no conclusions can be drawn concerning the difference.

Table 1. BAC levels in roadside surveys.

Sample	BAC Category	Base-Line Survey		Second Survey	
		Number	Percent	Number	Percent
Total	Negative	1,116	70.8	966	64.1
	01 to 04	293	18.6	356	23.6
	05 to 09	101	6.4	123	8.2
	10 to 14	43	2.7	46	3.0
	15 or more	24	1.5	17	1.1
Weeknight	Negative	622	74.2	571	68.4
	01 to 04	139	16.6	169	20.2
	05 to 09	49	5.8	58	6.9
	10 to 14	20	2.4	28	3.4
	15 or more	8	1.0	9	1.1
Weekend	Negative	494	66.9	395	58.7
	01 to 04	154	20.8	187	27.8
	05 to 09	52	7.0	65	9.6
	10 to 14	23	3.1	18	2.7
	15 or more	16	2.2	8	1.2

Figure 1. Relative probability of causing an accident (2).



Weekend Sample

Comparison of the BAC distributions for weekends gave a chi-square value of 7.219. Thus the weekend distributions were not significantly different at the 95 percent confidence level, although they were significant at the 80 percent level.

The percentages of positive BACs were 33.1 for the base-line survey and 42.3 for the second survey. These percentages were found to be significantly different at the 99 percent confidence level. It can be concluded that a greater percentage of drivers had positive BACs on the second survey than on the base-line survey.

The percentages of BACs above 0.10 percent were 5.3 for the base-line survey and 3.9 for the second survey. These percentages were not significantly different at the 95 percent confidence level, so no conclusions can be drawn concerning the difference.

INDEX OF ACCIDENT PROBABILITY

The traditional chi-square method for comparing BAC distributions has been used quite often to compare the drinking patterns in one state with those in another or to compare drinking patterns within a state over a period of time. The analysis presented shows that there was a greater percentage of drinking drivers on the second survey than on the first, but the percentages of drivers who were drunk were not found to be significantly different. However, there is one important fact missing from the previous analysis. Drunken drivers represent only about 4 percent of the driver population, yet they account for 50 percent of all highway fatalities. This disproportionate representation of the drunken driver is not taken into account by a chi-square analysis inasmuch as this analysis assigns an equal value to every category. The method of analysis suggested proposes to include the vital "risk factor" by using the probability of causing an accident (Fig. 1) as developed by Borkenstein in his study of drinking drivers (2). An index of accident probability (IAP) was calculated by multiplying the percentage of drivers in each BAC category by the risk index of that category and then summing the products. In addition to simply comparing the BAC levels, we can compare the relative probabilities of an accident from one survey to another and from one time period to another.

The risks assigned to the BAC levels are as follows:

BAC Category	Risk Index
Negative	1
01 to 04	1
05 to 09	3
10 to 14	12
15 or more	27

Total Sample Comparison

The IAP for the total sample in the base-line survey was 1.815, and that for the second survey was 1.780 (Table 2). This represents a decrease of 1.9 percent in accident probability from the base-line survey even though the previous analysis determined that there were more drivers who had been drinking.

Weeknight Sample Comparison

The IAP for weeknights of the base-line survey was 1.640, whereas that on the second survey was 1.798. This represents an increase of 9.6 percent in the relative accident probability for the weeknight periods.

Weekend Sample Comparison

The IAP for weekends of the base-line survey was 2.053 compared with 1.801 for the second survey. This represents a decrease of 12.3 percent in the relative risk of accidents on weekends from the base-line survey. Although the relative risk of accidents on weekends was reduced by 12.3 percent, it was still higher on weekends than on weeknights as reflected in the IAPs of 1.801 and 1.798 during the second survey.

Table 2. Index of accident probability applied to base-line and second surveys.

Sample	BAC Category	Risk Index	Base-Line Survey		Second Survey	
			Percentage	Value	Percentage	Value
Total	0	1	0.708	0.708	0.641	0.641
	01 to 04	1	0.186	0.186	0.236	0.236
	05 to 09	3	0.064	0.192	0.082	0.246
	10 to 14	12	0.027	0.324	0.030	0.360
	15 or more	27	0.015	0.405	0.011	0.297
		IAP		1.815		1.780
Weeknight	0	1	0.742	0.742	0.684	0.684
	01 to 04	1	0.166	0.166	0.202	0.202
	05 to 09	3	0.058	0.174	0.069	0.207
	10 to 14	12	0.024	0.288	0.034	0.408
	15 or more	27	0.010	0.270	0.011	0.297
		IAP		1.640		1.798
Weekend	0	1	0.669	0.669	0.587	0.587
	01 to 04	1	0.208	0.208	0.278	0.278
	05 to 09	3	0.070	0.210	0.096	0.288
	10 to 14	12	0.031	0.372	0.027	0.324
	15 or more	27	0.022	0.594	0.012	0.324
		IAP		2.053		1.801

Table 3. IAP for total sample by time period.

Time Period	BAC Category	Risk Index	Base-Line Survey		Second Survey	
			Percentage	Value	Percentage	Value
7:00 to 9:20 p.m.	0	1	0.809	0.809	0.694	0.694
	01 to 04	1	0.142	0.142	0.230	0.230
	05 to 09	3	0.033	0.099	0.052	0.156
	10 to 14	12	0.010	0.120	0.018	0.216
	15 or more	27	0.006	0.162	0.006	0.162
		IAP		1.332		1.458
9:50 p.m. to 12:10 a.m.	0	1	0.715	0.715	0.697	0.697
	01 to 04	1	0.194	0.194	0.219	0.219
	05 to 09	3	0.065	0.195	0.059	0.177
	10 to 14	12	0.019	0.228	0.019	0.228
	15 or more	27	0.007	0.189	0.005	0.135
		IAP		1.521		1.456
12:40 to 3:00 a.m.	0	1	0.488	0.488	0.496	0.496
	01 to 04	1	0.262	0.262	0.267	0.267
	05 to 09	3	0.126	0.378	0.148	0.444
	10 to 14	12	0.077	0.924	0.062	0.744
	15 or more	27	0.047	1.269	0.026	0.702
		IAP		3.321		2.653

Table 4. IAP for weeknight sample by time period.

Time Period	BAC Category	Risk Index	Base-Line Survey		Second Survey	
			Percentage	Value	Percentage	Value
7:00 to 9:20 p.m.	0	1	0.817	0.817	0.767	0.767
	01 to 04	1	0.129	0.129	0.178	0.178
	05 to 09	3	0.034	0.102	0.031	0.093
	10 to 14	12	0.010	0.120	0.021	0.252
	15 or more	27	0.010	0.270	0.003	0.081
		IAP		1.438		1.371
9:50 p.m. to 12:10 a.m.	0	1	0.727	0.727	0.700	0.700
	01 to 04	1	0.191	0.191	0.216	0.216
	05 to 09	3	0.063	0.189	0.057	0.171
	10 to 14	12	0.016	0.192	0.021	0.252
	15 or more	27	0.003	0.081	0.006	0.162
		IAP		1.380		1.501
12:40 to 3:00 a.m.	0	1	0.532	0.532	0.543	0.543
	01 to 04	1	0.226	0.226	0.214	0.214
	05 to 09	3	0.129	0.387	0.143	0.429
	10 to 14	12	0.089	1.068	0.071	0.852
	15 or more	27	0.024	0.648	0.029	0.783
		IAP		2.861		2.821

INDEX OF ACCIDENT PROBABILITY BY TIME PERIOD

The distributions of BACs were found to be significantly different from one time period to another, for there were more people drinking and more drunken drivers in the sample at the latest time period, 12:40 to 3:00 a.m. The test periods were examined by assigning them IAPs so that the relative risks of accidents could be compared from one time period to another.

Total Sample Comparison

The IAP for 7:00 to 9:20 p.m. was a very low one of 1.332 during the base-line survey compared with 1.458 for the second survey (Table 3). This represents an increase of 9.5 percent from the base-line survey, but it is still a relatively low IAP.

The IAPs for the time period of 9:50 p.m. to 12:10 a.m. were 1.521 for the base-line survey and 1.456 for the second survey. This represents a 4.3 percent decrease from the base-line survey.

The IAPs for 12:40 to 3:00 a.m. were 3.321 for the base-line survey and 2.653 for the second survey. This represents a decrease of 20.1 percent from the base-line survey, but this time period still ranked as the most dangerous. This decrease could reflect the impact of the ASAP police patrolling during the time period.

Weeknight Sample Comparison

IAPs for 7:00 to 9:20 p.m. on weeknights were 1.438 for the base-line survey and 1.371 for the second survey (Table 4). This represents a 4.7 percent decrease from the base-line survey and is a relatively low IAP.

The IAPs for 9:50 p.m. to 12:10 a.m. on weeknights were 1.380 for the base-line survey and 1.501 for the second survey. This represents an increase of 8.8 percent from the base-line survey.

IAPs for 12:40 to 3:00 a.m. on weeknights were 2.861 for the base-line survey and 2.821 for the second survey. There was very little change from the base-line survey for this time period on weeknights: a decrease of only 1.4 percent. Such a slight reduction might indicate that more ASAP police patrols should be scheduled for this time period on weeknights rather than for earlier hours.

Weekend Sample Comparison

IAPs for 7:00 to 9:20 p.m. on weekends were a very low one of 1.183 for the base-line survey and 1.574 for the second survey (Table 5). This increase of 33.1 percent was large on a percentage basis, but the IAP of 1.574 was still relatively low when compared with those of other time periods.

IAPs for 9:50 p.m. to 12:10 a.m. on weekends were 1.705 for the base-line survey and 1.408 for the second survey. This represents a decrease of 17.4 percent from the base-line survey and might indicate that the ASAP police patrols do affect weekend drinking and driving patterns in Fairfax.

The IAP for 12:40 to 3:00 a.m. on weekends was 3.580 for the base-line survey, and that for the second survey was 2.513. This is a decrease of 29.8 percent from the base-line survey and seems to indicate that the ASAP police patrol has effected modification in weekend drinking and driving patterns in Fairfax.

CONCLUSIONS

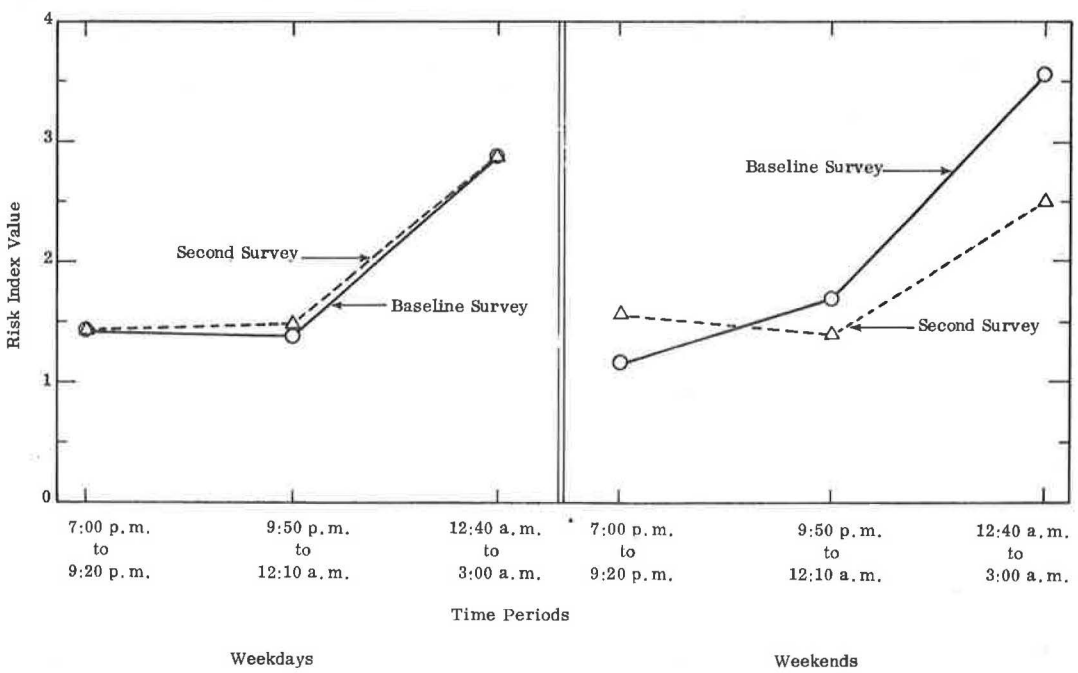
An IAP was calculated for each time period for both weekends and weeknights for both the base-line survey and the second survey. These indexes are shown in Figure 2. The purpose of calculating an index of accident probability was to augment the analysis of BAC levels by comparing the relative risks of accidents associated with the various BAC levels.

From an examination of the graphs in Figure 2, it is apparent that there was very little difference between the surveys in the probabilities of accident occurrence on weeknights. The graphs show that on weeknights the risk of an accident among the drivers

Table 5. IAP for weekend sample by time period.

Time Period	BAC Category	Risk Index	Base-Line Survey		Second Survey	
			Percentage	Value	Percentage	Value
7:00 to 9:20 p.m.	0	1	0.797	0.797	0.594	0.594
	01 to 04	1	0.161	0.161	0.302	0.302
	05 to 09	3	0.031	0.093	0.080	0.240
	10 to 14	12	0.011	0.132	0.014	0.168
	15 or more	27	0.000	0.000	0.010	0.270
		IAP		1.183		1.574
9:50 p.m. to 12:10 a.m.	0	1	0.700	0.700	0.694	0.694
	01 to 04	1	0.198	0.198	0.222	0.222
	05 to 09	3	0.068	0.204	0.064	0.192
	10 to 04	12	0.021	0.252	0.016	0.192
	15 or more	27	0.013	0.351	0.004	0.108
		IAP		1.705		1.408
12:40 to 3:00 a.m.	0	1	0.463	0.463	0.450	0.450
	01 to 04	1	0.282	0.282	0.320	0.320
	05 to 09	3	0.125	0.375	0.153	0.459
	10 to 14	12	0.070	0.840	0.053	0.636
	15 or more	27	0.060	1.620	0.024	0.648
		IAP		3.580		2.513

Figure 2. Index of accident probability.



on the road was about twice as great from 12:40 to 3:00 a.m. as it was for the two earlier time periods. This relative risk measurement did not attempt to take into account differences in traffic volume, but dealt only with the drivers who were operating their vehicles during the given time periods.

The graphs do depict a change in weekend drinking and driving patterns between the two surveys. Both the 9:50 p.m. to 12:10 a.m. and the 12:40 to 3:00 a.m. time periods show a reduction in the IAP from the base-line survey; the more dramatic reduction occurred in the latter time period. This reduction in the IAP on weekends might be a result of the impact of the Fairfax ASAP. In the least, it certainly shows encouraging signs that the late-night ASAP patrols were successfully affecting the normal drinking and driving patterns with the result that the probability of accidents was dramatically reduced.

There is still progress to be made, especially from 12:40 to 3:00 a.m. on weeknights, but it is encouraging to note that, although a significantly greater percentage of drivers were drinking on the second survey, they were drinking in moderation such that the relative risk of accidents actually was reduced. This phenomenon will be carefully monitored throughout the course of the project as a means of determining whether ASAP is successfully reaching the high-risk drivers and removing them from the road to rehabilitate them and reduce their risks to themselves and others.

REFERENCES

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