ADOPTION OF AVALANCHE SAFETY BEHAVIORS IN MOTORIZED USERS: A PRECAUTION MODEL-BASED ANALYSIS

Kelly McNeil[1]* and Ian McCammon[2]

[1] *Eastern Oregon University, La Grande, Oregon, USA*
[2] *Salt Lake City, Utah, USA*

ABSTRACT: Motorized winter recreation (snowmobiling and snowbiking) accounts for about a third of avalanche fatalities in the United States. Although avalanche safety education, outreach, and rescue equipment ownership have expanded over the past two decades, gaps remain in the adoption and application of safety practices.

This study applied the Precaution Adoption Process Model (PAPM) to examine relationships among experience, avalanche education, confidence, and precautionary practices across three behavioral domains: avalanche education and adoption of rescue gear and airbag technology.

A total of 1,200 survey responses were collected; 667 were considered valid after removing responses that were outside the scope of precaution adoption. Respondents were predominantly male (82%) and highly experienced, with most reporting more than 10 winters of backcountry riding and more than 20 days per season. Despite this experience, 67% reported no Level 1 or higher avalanche training.

Respondents reported high confidence in their ability to manage avalanche risk, lead groups, and perform rescues regardless of training level. Notably, 31% of respondents without formal training reported high confidence in their ability to assist effectively in a rescue. Precautionary behaviors, however, were more strongly associated with training than experience or confidence. Level 1 respondents reported key practices, including forecast consultation, trailhead checks, group decision-making, and rescue practice, generally 10–20% more frequently than awareness-trained users. PAPM analysis revealed significant differences in adoption across behavioral domains. Rescue gear ownership (mean stage = 6.4) outpaced airbag use (5.9), avalanche education (5.8), and rescue practice ($p < .001$). Together, these findings suggest a mismatch between perceived preparedness and behaviors supporting effective avalanche risk management, with equipment adoption and confidence outpacing formal education and rescue practice.

Improving avalanche safety among motorized users may therefore require shifting emphasis from equipment ownership and experience toward formal education, continued practice, and sustained application of safety behaviors. Stage-based interventions that address barriers specific to each behavior may help translate widespread equipment ownership and confidence into more effective avalanche risk management.

KEYWORDS: Motorized recreation, rescue equipment, rescue errors, avalanche education

1. INTRODUCTION

Motorized users account for approximately one third of avalanche fatalities in the United States over the past decade (Colorado Avalanche Information Center, 2026). Improvements in avalanche safety equipment, forecasting, and education have likely contributed to reductions in avalanche fatalities among winter backcountry users (Birkeland et al., 2017), yet gaps remain between awareness of avalanche risk and adoption of precautionary behaviors (Niemann et al., 2022). Motorized users may acquire avalanche rescue equipment before pursuing formal education, and experience alone may not improve avalanche decision-making (Murphy, 2012; Lundstedt, 2016; Stewart-Patterson & Hanke, 2016).

Avalanche education has been associated with changes in risk perception, increased confidence, and greater use of precautionary measures (Nichols et al., 2018; Greene et al., 2022; McNeil et al., 2023). However, much of this research has focused on skiers and snowboarders. Differences in terrain use, riding culture, social influences, and technology suggest these findings may not transfer directly to motorized users.

Understanding how motorized users adopt avalanche safety behaviors is important for improving education and public safety messaging. Rather than progressing continuously from awareness to action, individuals may be at different stages of readiness for different precautionary

* Corresponding author address:
Kelly McNeil, Health and Human Performance Dept.
Eastern Oregon Univ., La Grande, OR 97850
email: krice@eou.edu

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behaviors. The present study applies the Precaution Adoption Process Model (PAPM) to examine relationships among experience, avalanche education, confidence, and precautionary behaviors across avalanche education, rescue gear ownership, and airbag use. By examining behavioral readiness across these domains, we seek to identify opportunities for interventions aligned with users' stage of adoption.

2. BACKGROUND

2.1 Avalanche Safety Behaviors in Motorized Users

Avalanche educators recognized the need for snowmobile-specific training more than two decades ago (Chabot, 2002). Since then, curricula have been developed to address the unique terrain choices, riding behaviors, and rescue challenges associated with motorized recreation (Wisner et al., 2010; McGhan et al., 2012; Staples et al., 2014; Hanke & Stewart-Patterson, 2016).

Research suggests that avalanche preparedness among motorized users is influenced by equipment, education, social norms, hazard information, terrain, and technology (Murphy, 2012; Baker & McGee, 2016; Hanke & Stewart-Patterson, 2016; Haegeli & Strong-Cvetich, 2020). More recently, Geismar (2023) highlighted the continued need to adapt avalanche education to motorized users. However, much of the existing literature has relied on qualitative methods, small samples, observations or evaluations of educational programming. Few studies have quantitatively examined how motorized users adopt avalanche safety behaviors.

Research on skiers and snowboarders has associated avalanche education with improved risk assessment, increased confidence, and greater use of safety practices (Silverton et al., 2007; Nichols et al., 2018; Landrø et al., 2022; Greene et al., 2022; McNeil et al., 2023). Whether similar relationships exist among snowmobilers and snowbikers remains a critical gap in the literature.

2.2 The Precaution Adoption Process Model

The Precaution Adoption Process Model (PAPM) describes adoption of protective behaviors as a progression through stages rather than a single event (Weinstein, 1988; Weinstein et al., 1998; Weinstein, Sandman, & Blalock, 2008, Glanz et al, 2024). The seven stages are: (1) unaware, (2) unengaged, (3) deciding, (4) decided not to act, (5) decided to act, (6) acting, and (7) maintenance. A key strength of the model is its recognition that barriers and motivations differ across stages, allowing interventions to be tailored to an individual's readiness to adopt a precautionary behavior (Weinstein, 1988).

The PAPM has been applied extensively in public health to identify barriers and guide interventions for protective behaviors (Gielen et al., 2015; Buchanan et al., 2020; Shin et al., 2022). Avalanche preparedness is similarly suited to a stage-based framework because it involves multiple behaviors that may be adopted at different rates, including education, rescue equipment, rescue practice, and risk-management practices.

McCammon, Haegeli, and Gunn (2008) applied the PAPM to out-of-bounds recreationists and found that individuals occupied different stages of awareness and preparedness, suggesting that avalanche safety is better understood as a process of behavioral adoption rather than a simple knowledge deficit. This framework is particularly relevant to motorized users who may own rescue equipment but lack formal education, may complete a course but rarely practice rescue skills, or possess extensive riding experience without consistently adopting recommended risk-management behaviors.

Despite its potential, PAPM has seen limited application in avalanche research, and no known studies have applied it to avalanche safety behaviors among motorized users. This study addresses that gap by examining adoption of avalanche education, rescue gear, and airbags among snowmobilers and snowbikers to identify barriers and opportunities for targeted intervention.

3. METHODS

3.1 Survey Development and Distribution

Data for this study were collected through an online survey of motorized winter recreationists that examined PAPM stage markers including adoption of rescue gear, avalanche education and airbags, confidence and safety practices. Survey questions were developed to assess avalanche-related behaviors, training history, equipment use, riding experience, and perceptions of avalanche risk. Questions were developed using validated PAPM questions and edited for motorized users. The survey was pilot tested and reviewed by experts in the field. It was electronically distributed through avalanche centers, snowmobile organizations, social media platforms, and industry networks targeting motorized users throughout the United States. The survey can be viewed at: https://osf.io/8zd37/.

The survey initially yielded 1,200 responses. For this analysis, we screened out responses that were not relevant to the precaution adoption pro-

cess of motorized recreationists, including professional guides, workers, and those with Level 2 or professional training. We also screened out incomplete responses.

The survey was organized into three sections: 1) demographics, 2) adoption of avalanche safety behaviors, and 3) confidence in avalanche risk management skills. The demographic section included questions related to respondent characteristics, riding experience and type, and level of avalanche education. Experience was assessed using years of backcountry riding and average days ridden per season. Avalanche education was measured by respondents' highest reported level of avalanche training, including awareness presentations, rescue-specific clinic, Level 1, Level 2, and professional courses.

The PAPM adoption section asked specific questions concerning three precautionary behaviors: 1) taking an avalanche course, 2) owning avalanche rescue gear, and 3) owning an avalanche airbag or vest. Responses for each behavior were classified according to the original seven PAPM stages and then condensed to the five stages described below.

The final section of the survey assessed respondents' self-reported confidence in their avalanche risk management skills, including their ability to manage avalanche risk, lead groups in avalanche terrain, and participate effectively in avalanche rescue.

3.2 PAPM Stage Classification

The formal PAPM conceptualizes behavior adoption through seven distinct stages. In applied survey research however, early stages can be difficult to delineate. Consequently, we have modified the original PAPM staging scheme (**Table 1**).

Stages 1 through 3 (Unaware, Unengaged, and Deciding) were combined into a single category labeled No adoption. Although these stages differ conceptually, respondents in each stage had not yet adopted or had practical engagement with the precautionary behaviors.

Stage 4 (Decided not to act) represented respondents who had considered the precautionary behavior and choose not to adopt it. This stage is important for intervention design because adoption barriers may involve perceived costs, low perceived benefits, or skepticism about the value of the behavior.

Stage 5 (Decided to act) was classified as Will adopt. Individuals in this stage accept the value of the precautionary behavior but had not yet implemented it. At this stage, interventions likely involve reducing barriers and facilitating action.

Stage 6 (Acting) denoted those who had adopted the precautionary behaviors (e.g. purchased equipment, attended a class) but had not realized full benefits of the behavior. Interventions typically focus on removing barriers to practicing or fully implementing the safety behavior.

Stage 7 (Maintenance) represents successful implementation of the precautionary behavior. Beyond merely purchasing equipment or attending a class, this stage involved decisively improving personal safety through practice. Interventions for these individuals focus on reinforcement, competence, and continued engagement.

The resulting five-stage framework emphasizes the differences most relevant to avalanche education and intervention design while maintaining the central theoretical principles of the PAPM.

Stage	*PAPM stage(s)*	*Description*
No adoption	1 - 3	No meaningful engagement with precautionary behavior
Decided not to adopt	4	Conscious decision made not to adopt the behavior
Will adopt	5	Intends to adopt but has not yet acted
Acting	6	Behavior has been adopted
Maintenance	7	Behavior is practiced to improve safety

Table 1. Stages used in this study were adapted from the original PAPM classification criteria.

In order to better understand gaps and barriers to education behavior adoption, Stages 6 and 7 were surveyed regarding six additional discriminators (**Table 2**) to provide a more granular picture of adoption behaviors.

Participants' responses were classified independently for avalanche education, rescue gear ownership, and avalanche airbag use. Participants' responses to specific questions would lead them to the correct next section based on their previous answers. Detailed PAPM coding criteria can be found at https://osf.io/8zd37/.

If you have taken an avalanche safety course, how often do you practice the following:
1. Read the public forecast.
2. Check group transceivers before leaving the trailhead.
3. Notice signs of stable or unstable conditions while traveling.
4. Make decisions as a group (human factors/group dynamics).
5. Choose travel techniques to reduce avalanche risk.
6. Practice your rescue skills.

Table 2. Discriminators for stages 6 and 7 provided insights into behavior adoption and reporting consistency.

3.3 Analysis approach

In order to examine differences between adoption stages, respondents' demographics, training, confidence, and behavior were compared using response proportions in each category.

Respondents were staged for avalanche education, rescue gear adoption, and airbag use using the definitions in **Table 1.** Because PAPM stages were repeated ordinal measures, differences were evaluated using the Friedman test and significant effects were identified using Conover's post hoc comparison test. Analysis was performed using *R*-package PMCMRplus (Pohlert, 2024) on the JASP platform (JASP, 2026).

4. RESULTS

4.1 Survey demographics

The survey received 1200 responses, 667 of which were considered valid after removing responses that were outside the scope of precaution adoption: professionals, non-relevant users Level 2 graduates and incomplete forms. The majority of respondents were snowmobilers; only 8% of respondents identified themselves as snowbikers. Our final sample was 82% male and the most common reported riding styles were boondocking (riding in trees and creeks 28%), hill climbing (27%) and trail riding (27%) followed by touring or utility riding (9%) and snowmobile to ski (6%). Rescue gear (transceiver, shovel, probe) ownership was also common, with 92% reporting ownership of at least one of these items for at least one season and 71% reporting ownership of an airbag pack or vest. Regionally, the majority of responses (81%) came from Oregon, Utah, Washington, Alaska, Idaho and Montana.

Most respondents were quite experienced with 63% reporting 10 or more winters snowmobiling in the backcountry. Of these, 25% reported 10-20 winters and 38% reported more than 20 winters. Eighty-two percent reported spending more than 11 days per winter snowmobiling in the backcountry. Of these, 26% reported 21-30 days, 15% reported 30-50 days, and 5% reported more than 50 days.

Some level of avalanche education was common among respondents, with 27% reporting that their highest level of training was an awareness seminar, 17% an avalanche rescue clinic, 33% a Level 1, and 17% reporting no avalanche training. Six percent indicated "other" avalanche training described by respondents as videos, reading books or learning from a mentor.

4.2 PAPM stage differences

The survey results were coded so that a PAPM stage rating for Rescue equipment and Airbag use could be calculated for each respondent. Avalanche education had a more granular staging across the six parameters shown in **Table 2**. The Friedman test showed a significant difference between these education components (χ^2= 307.7 (5); p < 0.001). The concordance effect was small, however (Kendall's W = 0.179) indicating low correspondence (high variance) between responses.

Pairwise comparisons of avalanche education components indicated that PAPM stages among five of the education components were statistically equivalent (Connover's test, p > 0.05). Only component 6 (practice avalanche rescue skills) differed significantly from all others (p < 0.001). While respondents demonstrated relatively high levels of engagement across the first five educational components, significant divergence in 'rescue practice' suggests a distinct barrier to adopting this behavior. This suggests that while riders may be willing to adopt passive safety measures or knowledge-based practices, the active, repetitive maintenance of rescue skills is not progressing at the same rate - a critical point of failure in the adoption process. Consequently, education components one through five in **Table 2** were combined into a single PAPM stage for the foregoing analysis.

Comparing PAPM stages across the four resulting areas of precaution adoption (rescue gear, airbags, avalanche education components 1-5, and component 6) showed significant differences (χ^2= 179.3 (3); p < 0.001). This suggests that these safety behaviors represent distinct domains rather than a single variable of 'safety practices' where users have unique barriers to adoption for each.

The resulting ranking of precaution adoption behaviors appears in **Table 3**. Mean PAPM stages reveal a clear hierarchy: rescue gear adoption (mean stage = 6.4) is the most advanced, followed by airbag use (5.9), avalanche education

				PAPM Stage				
	Mean	*Median*	*N*	*1-3*	*4*	*5*	*6*	*7*
Rescue gear	6.4	7	613	0.03	0.03	0.06	0.30	0.58
Airbags	5.9	7	613	0.14	0.07	0.10	0.10	0.59
Av ed: 1-5	5.8	7	613	0.13	0.04	0.26	0.00	0.56
Av ed: 6	5.6	6	613	0.13	0.04	0.26	0.16	0.41

Table 3. Central tendencies and proportions of each PAPM distribution. Significant differences are notable in stages 6 and 7 across precaution behaviors.

(5.8), and rescue practice (5.6), with significant differences ($p < 0.001$) between the groups. Three features of this result are worth noting. First, respondents frequently reported engaging in behaviors consistent with stage 7 across all precautions - implying a high level of perceived proficiency in these behaviors. Second, rescue gear adoption (30% at stage 6) is the most prominent of the four behaviors, indicating that acquisition of a beacon, shovel and probe precedes other precautionary behaviors. Finally, rescue practice has a noticeably lower proportion (41%) in stage 7 than other behaviors, suggesting that rescue practice lags other precautions. These discrepancies merit a deeper look at rescue equipment and confidence.

4.3 Rescue equipment, education & confidence

Demographically, Stage 4 contained the most female respondents (37%). The most experienced riders were clustered at the highest and lowest PAPM stages. Riding styles increased with PAPM stage, favoring trail riding at the lower stages and boondocking at the higher stages. Unsurprisingly, formal avalanche education was concentrated at the highest PAPM stages.

Only 11% of all respondents reported not owning a complete set of rescue equipment (transceiver, shovel, probe). Of these respondents, 29% did not want or need it for the areas where they rode: 45% intended to buy and 21% were undecided. Respondents who owned complete rescue equipment comprised 89% of the sample. Of these gear owners, 33% reported practicing once or not at all and 68% reported having no formal hands-on training (avalanche rescue clinic or level 1).

Nearly 78% of respondents reported 'agree' or 'strongly agree' that they were confident in their decision-making and rescue skills. **Table 4** shows how this confidence is pervasive across all measured domains, even among those with no formal avalanche training (e.g., 76% of untrained riders reported confidence in making informed avalanche decisions). This consistency suggests that motorized users often enter the backcountry with a high baseline of perceived competence that is not well-calibrated to their training or education.

4.4 Calibration of rescue skills

To more specifically assess how well calibrated rescue confidence levels might be, we compared each respondent's stated confidence in their avalanche rescue skills (item 3 **Table 4**) to their answers regarding their practice frequency:

> *If you have taken an avalanche safety course, how often do you practice your rescue skills?*

A well-calibrated response would show logical consistency between these two answers. In other words, a person who responded "Strongly agree" to item 3 but responds "Rarely" to the question above would appear to be overconfident in assessing their avalanche rescue skills. We compared responses for each level of training. **Table 5(a)** shows the comparison for respondents who reported taking an avalanche rescue clinic as their highest level of training. Comparison of other training levels proceeded similarly.

Calibration proportions across all training levels appear in **Table 5(b).** Generally, about two thirds of respondents at each training level appeared calibrated in their reported rescue effectiveness, while very few were underconfident in their rescue skills. Most notable is that **about a third of respondents appeared to believe they would be effective in an avalanche rescue despite minimal practice**.

4.5 Calibration of informed decisions

Similar to the previous section, we also tested respondents' self-assessments for logical consistency in making informed decisions in avalanche terrain (**Table 4**, item 4). Here, we compared each respondent's reported confidence to

Survey questions asking about confidence in avalanche skills	*None*	*Av. aware*	*Av rescue*	*Level 1*
1. I am confident in my ability to lead a group safely in avalanche terrain.	0.25	0.37	0.73	0.85
2. I contribute valuable skills and knowledge to my riding group.	0.47	0.67	0.91	0.94
3. I am well-prepared to assist effectively in an avalanche rescue.	0.31	0.52	0.74	0.90
4. I make informed and responsible decisions when traveling in the backcountry.	0.76	0.85	0.94	0.94
5. I consistently assess avalanche conditions and adjust my plans accordingly.	0.64	0.84	0.91	0.92
6. I communicate effectively with my group about avalanche risk and safety plans.	0.59	0.81	0.86	0.88
7. I recognize when conditions exceed my skill level and adjust my plans accordingly.	0.83	0.88	0.84	0.92

Table 4. Proportion of respondents reporting "agree" or "strongly agree" with questions regarding confidence in their avalanche skills.

		Frequency of rescue practice				
	Av. Rescue N = 86	*Never*	*Rarely*	*Some-times*	*Often*	*Always*
Prepared for effective rescue?	Strongly agree	**0.00**	**0.06**	**0.09**	0.09	0.02
	Agree	**0.00**	**0.17**	0.28	0.10	0.01
	Neutral	**0.01**	0.12	0.02	0.00	0.00
	Disagree	0.01	0.00	0.00	0.00	0.00
	Strongly Disagree	0.00	0.00	0.00	0.00	0.00

(a)

	Av. Aware	*Av Rescue*	*Level 1*
N	69	86	173
Underconfident	0.03	0.00	0.00
Calibrated	0.64	0.66	0.70
Overconfident	**0.33**	**0.34**	**0.30**

(b)

Table 5. Proportional calibration of self-assessed rescue skills for (a) Respondents who had taken an avalanche rescue clinic, (b) All respondents by self-reported training. Dark gray indicates likely overconfidence.

their answers regarding frequency of reading the avalanche forecast:

If you have taken an avalanche safety course, how often do you read the public forecast?

Logical consistency between these two responses indicates calibration. **Table 6(a)** shows the responses of respondents who reported taking an avalanche rescue clinic as their highest level of training. Note that the threshold for calibration is lower for checking the forecast than for beacon practice since the forecast should be checked before nearly every outing. Comparison of other training levels proceeded in a similar fashion.

Table 6(b) summarizes calibration results across all training levels. Generally, about three quarters of respondents at each training level were potentially calibrated about their ability to make informed decisions, while few were underconfident. Notable is that at least one in five respondents with training below level 1 level **appeared to believe they would make informed decisions in avalanche terrain despite infrequently reading the avalanche forecast.**

4.6 Airbag pack and vest ownership

Respondents' attitudes towards airbag pack or vest ownership appears to be less complicated than with rescue gear. About one-fifth of respondents across all training levels had decided that they did not want or need this technology.

Viewed through the lens of the highest avalanche training completed, airbag ownership increased more or less linearly from 41% (no training) to 83% (level 1). Notable is the high proportion of airbag ownership among riders who reported no avalanche training.

Respondents who did not own airbags reported their adoption barriers were expense (59%), not needed (41%), unsure what to buy (14%) and lack of confidence in their function or safety (5%).

5. DISCUSSION

This study provided a quantitative application of the PAPM to avalanche safety behaviors among motorized winter recreationists. Our results demonstrate that preparedness is not a single behavior, such as owning rescue equipment, completing an avalanche course, or carrying an airbag, but a set of precautionary actions that may progress through different stages of adoption.

Rescue equipment ownership was commonplace among respondents, whereas avalanche education, rescue practice, and airbag ownership represented significantly different stages of adoption. These findings support previous observations that motorized users frequently acquire avalanche equipment before developing the knowledge and skills needed to realize its effectiveness (Murphy, 2012; Hanke & Stewart-Patterson, 2016). More broadly, they support the PAPM premise that individuals occupy different stages of readiness and that interventions should address the barriers associated with those stages.

		Frequency of reading the avalanche forecast				
	Av. Rescue N = 85	*Never*	*Rarely*	*Some-times*	*Often*	*Always*
Make informed decisions?	Strongly agree	**0.01**	**0.00**	**0.04**	**0.05**	0.20
	Agree	**0.00**	**0.04**	**0.11**	0.26	0.25
	Neutral	**0.00**	**0.01**	0.02	0.01	0.01
	Disagree	**0.00**	0.00	0.00	0.00	0.00
	Strongly Disagree	0.00	0.00	0.00	0.00	0.00

(a)

	Av. Aware	*Av Rescue*	*Level 1*
N	70	85	172
Underconfident	0.06	0.01	0.04
Calibrated	0.73	0.74	0.81
Overconfident	**0.21**	**0.25**	**0.15**

(b)

Table 6. Proportional calibration of self-assessed informed decision making for (a) Respondents who had taken an avalanche rescue clinic, (b) All respondents by training. Dark gray indicates likely overconfidence.

A second important finding was that formal avalanche education was consistently associated with precautionary behaviors, whereas riding experience and self-reported confidence were comparatively weak predictors of preparedness. Although respondents were generally experienced riders, more than half reported having no formal avalanche education beyond awareness lectures or rescue clinics. Many respondents expressed confidence in their ability to make safe decisions and contribute effectively during an avalanche rescue. While our calibration measures do not determine actual competence, this mismatch suggest that perceived preparedness may not reliably reflect engagement in behaviors known to support avalanche risk management.

These findings suggest that different precautionary behaviors require different intervention strategies. For example, riders who own rescue equipment but seldom may benefit more from skills refreshers, realistic rescue scenarios, and reinforcement of maintenance behaviors then from messaging focused on equipment ownership. **Table 7** outlines stage-specific intervention strategies for avalanche education, rescue gear, and airbag use based on the 5-stage PAPM framework.

This study had several important limitations The survey relied on voluntary participation and self-reported behaviors, creating potential selection bias, recall, and socially desirable bias. The sample predominantly included experienced male riders from the western United States and may not fully represent motorized users elsewhere. In addition, confidence was inferred from reported precautionary behaviors rather than independently measured competence and should therefore be interpreted cautiously.

Future research should combine stage-based behavioral assessment with objective evaluations of avalanche knowledge, rescue proficiency and field decision-making. Longitudinal studies examining movement between PAPM stages following educational interventions and whether stage-matched messaging improves adoption and long-term maintenance of avalanche safety behaviors.

Collectively, our findings suggest that future gains in motorized avalanche safety may depend less on increasing equipment ownership or awareness and more on moving users toward effective and sustained application of established precautionary behaviors.

6. CONCLUSION

This study demonstrated that avalanche preparedness among motorized users is not a single behavior, but a collection of precautionary behaviors adopted at different rates and stages. Rescue equipment ownership was widespread among respondents, yet formal education, rescue practice, and other behaviors supporting effective risk management lagged behind. Formal avalanche education was more consistently associated with precautionary behaviors than riding experience or self-reported confidence, while the apparent mismatch between confidence and practice suggests that perceived competence may not reliably indicate preparedness.

These findings highlight an important opportunity for avalanche education. For motorized users in avalanche terrain, continued emphasis on equipment acquisition alone is unlikely to produce equivalent gains in rescue proficiency and risk management. The next step is to move beyond

Stage	*Avalanche Education*	*Rescue Gear*	*Airbags*
No Adoption (Stages 1–3)	Increase awareness of avalanche hazard, exposure, and the value of formal education.	Introduce the role of transceivers, probes, and shovels in companion rescue.	Increase awareness of airbag function, benefits, and limitations.
Decided Not to Adopt (Stage 4)	Address misconceptions about formal education and its value for decision-making and terrain management.	Address perceptions that experience reduces the need for rescue equipment; or that you don't need it for your riding area; emphasize complete rescue kits.	Address barriers such as cost, weight, and perceived lack of need.
Will Adopt (Stage 5)	Reduce barriers and provide clear pathways into formal avalanche education.	Facilitate complete rescue-kit adoption and establish group expectations for carrying equipment.	Reduce barriers to acquisition and provide opportunities to evaluate airbag systems.
Acting (Stage 6)	Reinforce application through continued practice, decision-making, and terrain assessment.	Shift emphasis from ownership to hands-on transceiver, probing, and shoveling practice.	Reinforce deployment practice, maintenance, and integration with broader risk management.
Maintenance (Stage 7)	Encourage continuing education and regular application of risk-management practices.	Emphasize recurring rescue practice, efficient companion rescue, and group coordination.	Maintain deployment proficiency and equipment readiness while reinforcing limitations.

Table 7. Intervention strategies for avalanche education, rescue gear, and airbag adoption based on the adapted five-stage PAPM framework.

simply encouraging riders to *own* safety equipment or *know about* avalanche hazards and focus on helping them develop and maintain the skills needed to use those tools effectively. Avalanche educators and organizations should use stage-based approaches to identify where riders are in the adoption process and target interventions accordingly. The PAPM provides a framework for doing so, shifting the focus from increasing adoption alone to advancing riders toward sustained competence and application. If we want to improve avalanche safety among motorized users, we must turn widespread awareness and equipment ownership into practiced, maintained, and effective risk-management behaviors.

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