

Low Cost Safety Improvements Pooled Funds Study Steering Committee Meeting

Meeting Agenda

Tuesday, March 8th, 2005

Turner Fairbanks Highway Research Center

- 7:30 – 8:00 Breakfast
- 8:00 – 8:30 Welcome, Introduction, and Overview of Steering Committee Activities,
Kerry Perrillo and Michael Trentacoste
- 8:30 – 9:00 Overview of Preliminary Survey Findings, Kim Eccles
- 9:00 – 9:30 Presentation on Study Designs, Dr. Bhagwant Persaud
- Meeting attendees will be divided into two groups to discuss each of the potential strategies, share their experiences, and assess the feasibility of evaluating each strategy. Each group will be asked to identify those strategies which should not be considered for the study.*
- 9:30 – 10:30 Breakout Sessions
Group A: Lane Departure (led by Dr. Hugh McGee)
Group B: Unsignalized Intersections and Aggressive Driving (led by Kim Eccles)
- 10:30 – 10:45 Break
- 10:45 – 11:45 Breakout Sessions
Group A: Unsignalized Intersections and Aggressive Driving (led by Kim Eccles)
Group B: Lane Departure (led by Dr. Hugh McGee)
- 11:45 – 12:00 Reconvene and Summary of Morning
- 12:00 – 1:00 Lunch
- 1:00 – 1:15 Explanation of Balloting Procedures
- 1:15 – 2:30 Open Balloting
- 2:30 – 3:00 Summary of Ballots and Discussion of Results
- 3:00 – 3:15 Break
- 3:15 – 4:30 Discussion of Anticipated Implementation of Strategies
- 4:30 – 5:00 Next Steps
- 5:00 Meeting Adjournment

Low Cost Safety Improvements Pooled Funds Study Steering Committee Meeting Notes

Tuesday, March 8th, 2005

Turner Fairbanks Highway Research Center

Introduction, and Overview of Steering Committee Activities

- Mike Trentacoste (FHWA) welcomed the group and discussed housekeeping items
- Kerry Perrillo (FHWA) gave an overview of AASHTO participation and an evolution of the study. She gave an explanation of the strategies eliminated and the high cost strategies included.

Overview of Preliminary Survey Findings

- Kim Eccles (BMI-SG) welcomed the group, and gave an overview of the survey project and the survey findings. She explained that the strategies that were redundant or proven were removed.
 - Kim discussed the survey results of the Lane Departure and Unsignalized Intersection Strategies
 - Tom Welch (IA) asked for an explanation of U30: Enhanced signing and delineation
 - Loren Hill (MN) asked for an explanation of inclusion of strategies listed as additional
 - Patrick Brady (FL) asked for an explanation of “proven”
 - Kim Eccles answered that it must be in the guidebook or from another well designed study with a quantified crash factor
 - Patrick Brady asked if intersection lighting takes into account variations in lighting based on pedestrian vs. automobile use; lighting intensity quantifying?
 - Kim discussed the survey results of Aggressive Driver Strategies. Some strategies were removed because they were either proven, outside the scope, or too difficult to evaluate.
- A discussion followed on strategies to add and remove for all three strategy categories
- Tom Welch asked how to share information with states that are not present at this meeting. Kerry Perrillo answered that notes will be posted on Pooled Funds Study website.
- It was noted that state by state research does not contribute well to the overall research pool. Effectiveness of strategies may vary by state and demographics.
- Michael Trentacoste gave an invitation for suggestions of further research.

Overview of Study Design

- Dr. Bhagwant Persaud (BMI-SG Consultant) discussed the basis of study design and evaluation. He explained experimental vs. observational studies.
- The question was raised regarding the problem of regression to the mean. It was noted that regression to the mean can cause a significant overestimation of the results of a treatment. Examples of treatments that raise traffic volumes are addition of left turn lanes and adding roundabouts. Normalizing doesn't work because the relationship between crashes and traffic volumes is a non-linear relationship.
- A handout was distributed- How Many Treatment Sites are required? –Attachment 2

Breakout Sessions

- Meeting attendees were divided into two groups, lane departure and aggressive driving strategies, and unsignalized intersection strategies. A presentation of each strategy was given and participants were asked to share their experiences, assess the feasibility of evaluating each strategy, and identify which of any strategies should be removed. The following questions and comments were inspired by the presentations.

Breakout Session 1

Group A: Lane Departure and Aggressive Driving (led by Dr. Hugh McGee)

- LD1: Profiled thermoplastic strips for centerlines
 - Brian Stanford (TX) - Inverted profiled thermoplastic strips for centerlines gives retroreflectivity, raised and inverted gives rumble effect. Treatment needs to take into consideration the amount of traffic. Application also influenced by snow plow usage.
 - Robert Hull (UT) – Should strategies that are not applicable across the board be removed? I.e. northern states cannot use certain rumble strips (because of snow plows).
 - Gary Modi (PA) – Consider what is best for your state.
 - Michael Trentacoste – Be objective as far as overall use of strategy, but most will lean toward what is applicable within their state.
 - Loren Hill – Minnesota interested in study of this strategy and the possibility of its modification to suit the needs of each state. Would like wet reflectivity without snow plow prohibition.
 - Harry Taylor (FHWA) - Vote on those that you would like to implement within your state.
- LD2: Wider cross sections on 2-lane roads
 - Cass Napier (KY) – Wider cross-sections have decreased crashes, but increased severity of crashes in KY.

- Gary Modi – Study influence of different variations of cross-section widening (with or without shoulder widening for example).
- John Carey (CT) – Is the experimental design going to account for crash reduction outside of the normal scope (non-fatal accidents, a-type, k-type, fatalities, driveway crash reduction).
- Cass Napier – Agree that type of crash is important in evaluation.
- Faria Emanain (OK) – Concern about cost and maintenance as a part of the evaluation, creates resistance to implementation.
- Mike Griffith (FHWA) – Use of cable guardrails in European countries to aid with alternating passing lanes.
- Mike Trentacoste – Germany uses pavement markings for alternate passing lanes. Also, signage which gives detail of passing lane availability.
- LD6: Median Barriers
 - Cass Napier – Concerns about redundancy of rumble strip studies.
 - Gary Modi – Center-line rumble strips may cause motorcycle issues.
 - How did center-lane rumble strips get a fair rating for suitability for crash based evaluation? Answer: Possibility of evaluation, pending volunteering states for trials.
 - Gary Modi – Looking into safety of raised, snow plowable pavement markings due to the markers being thrown from the roadway and at vehicles.
 - Gary Modi – Tracking of skid resistant pavement. State trying to implement a policy. No reliable data on skid numbers; variability based on different ways to measure this data. Tires and other variables make research difficult.
- LD11: Enhanced Shoulder or in-lane delineation and marking for sharp curves
 - Gary Modi – High speed reductions. Would like to see more data.
- LD12: Delineate poles or trees with reflective tape
 - Gary Modi – Notes that this treatment only works when you have control of the vehicle. The ultimate treatment would be to remove the item.
 - Mike Griffith – Does marking of trees and other objects pull people further off the roadway in low-light areas? Do individuals track on these markings?
 - Roundtable discussion, Gary Modi, Harry Taylor, Loren Hill, etc – consensus, this is a situational strategy that may not be effective when objects are located too far off the roadway.
- LD13: Enhanced Guardrail Delineation
 - Brian Stanford – Standard treatment in TX to help.
 - Gary Modi – PA uses this in some situations.
 - Faria Emamian – Suggests that this reflectivity reduces wear and denting on guardrails. This reduces maintenance costs.

- Gary Modi – This increased delineation can increase traffic speeds because of increased driver comfort.
 - Harry Taylor – Post delineation may help. Reduce redundancy of post delineation and guardrail reflectivity.
 - LD14: Truck Pullovers
 - Gary Modi – Provision of pull-offs vs. traditional stops such as hotels. Variations in opinion by drivers and industry.
 - LD15: Automated Warning Signs for Curves
 - Cass Napier – Cost effectiveness of keep up.
 - John Carey – Issues with teens using this to see how fast they can make it thru a curve and then bragging about speeds on internet.
 - Gary Modi – Implementation resulted in high cost and lots of maintenance issues.
 - A1/A2: Target enforcement for aggressive driving
 - Mike Trentacoste – How to quantify?
 - Linda Cosgrove (NHTSA) – Tie paid media into the levels of education about enforcement.
 - A5: Reduce nonrecurring delays and provide better information about these delays
 - Robert Hull – Salt Lake is broadcasting travel times to certain points via changeable message signs.
 - David Piper (IL) – His state is using limitations on time spent in freeway left lanes (3/4 mile).
 - Brian Stanford – Texas no longer allowed to post “slower vehicles keep right sign,” must post “left lane for passing only.”
 - Loren Hill – Use of aerial video to profile aggressive drivers and aid in their apprehension/conviction.
 - Concern about variability in specificity of discussed strategies.

Group B: Unsignalized Intersections (led by Kim Eccles)

Note taker did not note who made the comments

- U1: Driveway closures/relocations
 - 35% crash data
 - Larger study- is it enough data to use
 - Allowing left turn to just have right-in, right-out; not enough data for analyzing driveway crashes
 - Case by case basis to analyze driveway closures
- U2: Driveway turn restrictions
 - Includes physical factors (signs)
- U3: Longer left turn lanes at intersections
 - Why is it poor? Part of our implementation, have huge safety projects
 - In VA, moderate costs is underestimating it because of road realignment
- U4: Offset left-turn at intersections

- Comment – problem with pedestrian walks
 - City of Minneapolis has this, but has limited left turn on but not left turn offset
- U5: Bypass lanes on shoulders at T-intersections
 - Tested in Minnesota
 - Found effective in low volume, rural in S. Dakota
 - Use shoulder, reinforcing shoulders
 - Kansas
- U6: Left turn acceleration lanes at divided hwy intersections
 - Missouri and Minnesota – has a lot of potential
 - Worry about testing
- U7: Longer right-turn lanes at intersections
 - See crashes – see severe crashes
 - In Arizona, Minnesota, Wisconsin,
- U8: Offset right turn lanes at intersections
 - If its on hwy. put cyclists at risks
- U11: Restrict or eliminate turning maneuvers by signing
 - Shifting problem
 - Signs are not tracks (problem when they were put in)
- U12: Restrict or eliminate turning maneuvers by providing channelization or closing median openings
 - NY – did major studies on closing
- U13: Convert four legged intersections to two T-intersections
 - Offset should be left to right
 - The picture in the presentation shows left to right, but it should be right to left because it is safer than left to right
 - NY – how many states are now converting to roundabouts?
 - Change in volume
- U15: Indirect left turn treatments to minimize conflicts at divided hwy. intersections
 - Example – Michigan/Louisiana/Maryland (just put in unsignalized rural hwy)
- U23: Flashing beacons at stop controlled intersections
 - MN stop using this because of confusing for a four way stop
 - Red/yellow – red (stop) / yellow (through)
- U25: Lane assignment signing or marking
 - Anthony Giancola (NACE) - is it considered low cost? --picture showed a very urban example, which did not appear low cost, but in the guidebook it is listed
- U31: Splitter islands
 - Those found are quantitative
 - Cost is high
- Questions/comments from participants:
 - Look at the severity of right turn lane and unsignalized intersection

- Hope we are look at severity/reduce the overall severity of crash
- Currently analyzing 4 to 3 lanes conversion, just striping a 4 lane to 3 lane
- Intersection Lighting was added to the ballot
 - Possible maintenance problems

Breakout Session 2

Group A: Lane Departure and Aggressive Driving (led by Dr. Hugh McGee)

- LD3: 2-way center left turn lane
 - Sweden – Increase in head on crashes.
 - Patrick Brady – 2-way center left turn lane increases crashes as traffic volumes increase and approach certain levels (exact volumes to be determined).
 - Found to be effective to certain volumes.
- LD5: Alternating passing lanes or four-lane sections at key locations to prevent head-on crashes
 - Pierre Jomini (MT) – creating passing sections on 2-lane roads. Separate, just for the purpose of passing.
 - LD6: Median Barriers for Narrow-Width Medians on Multilane Roads
 - Patrick Brady – clarification of multilane roads meaning 4-lane.
 - Patrick Brady – Uses of Quick Curb.
- LD7: Install edgeline “profile marking,” edgeline rumble strips or modified shoulder rumble strips on section with narrow or no paved shoulders
 - Bhagwant Persaud – Believes this strategy to be evaluated by NCHRP 17-25.
 - Thomas Welch – mention of variations on this strategy.
 - Patrick Brady – Further thoughts on more aggressive rumble strips.
 - Harry Taylor – Some may be snow plowable.
- LD8: Midlane Rumble Strips
 - Patrick Brady – Never heard of this.
 - Shawn Troy (NC) – NC did a quick comparison. Showed no change in crashes. Many variations in offset distances of shoulder rumble strips. NC has discussed midlane rumble strips, but never tested it.
 - Patrick Brady – It would be nice to see someone experiment with this, but it would likely make motorcyclists cringe.

- LD9: Provide Enhanced Pavement Markings
 - Thomas Welch – Missouri, problem with these markers being thrown by snowplows into drivers’ windshields.
 - Patrick Brady – We need to know if it is going to make things worse. Concern about increased speeds and crashes.
 - Bhagwant Persaud – Was a part of NCHRP study on a similar concept. Hugh questions if this study includes enough crash data to reach a conclusion. At this time we can not draw a conclusion from the study as to whether crashes increase because of increased speed
 - Patrick Brady – Increased speed versus increased visibility; usefulness of markings in gauging speed and recognition of curves.
 - Shawn Troy – Concern about the study of crash numbers, severity, and speed as factors in determining the situational use of this strategy.

- LD10: Skid Resistant Pavement Surfaces
 - Barbara O’Rourke (NY) – NY has a lot of data on this.
 - Bhagwant Persaud – NY has had successful applications of this in intersections.
 - Patrick Brady – FL has skid data as well.
 - Maryland also has some data. Look at Colesville Rd. in Silver Spring.

- LD11: Enhanced shoulder or in-lane delineation and marking for sharp curves
 - Clifford Reuer (SD) – Would this be used in addition to other, roadside delineation?
 - Patrick Brady – Would this be in addition to advance warning signs, chevrons, etc.
 - Pierre Jomini – Would an advised speed be better than slow? Slow for one person may be different for another.
 - A good contact for this strategy in Florida, Mendocino County, Gibb Peasley, University of Florida.

- LD12: Delineate utility poles or trees with reflective tape
 - Patrick Brady – Targeting instead of delineation. Is this going to be positive or negative delineation?
 - Clifford Reuer – Concern about uniformity.
 - Group – Utility companies may limit nailing / bolting into utility poles.

- LD13: Enhanced guardrail reflectors
 - Patrick Brady – most reported accidents in FL are no-injury crashes.

- LD14: Pavement Pull-offs for drowsy truck drivers on isolated segments
 - Shawn Troy – NC implementing this for safe pull-offs for truck drivers, emergency etc. NC putting this in Gorge sections.
 - Patrick Brady – FL implementing this with emergency pull-offs in work zones. Also, putting in truck rest areas with showers that allow drivers to sleep in cabs.
 - Neil Boudreau (Ma) – Check with Utah. They have a plan to deal with drowsy drivers.

- LD15: Automated warning signs when driving too fast for curve
 - Patrick Brady – Use of a similar system with accelerating in-pavement lights.
 - Tennessee, using this for trucks.
 - Group – This system used primarily for truckers, some includes weigh on the go technology GA, TN, VA. Concern about rollover data.
 - Patrick Brady – once off roadway, rollover is a result of slope.
 - Harry Taylor – Causation studies are very difficult because of the methodology of police reporting.
 - Group – Causes for leaving the roadway drowsy, drunk, speeding, distraction, deer, offensive drivers.

- A1/A2: Target Enforcement for Aggressive Driving
 - Clifford Reuer – Has seen significant reduction during enforcement, reverses when enforcement stops. This tends to be a temporary fix.
 - Barbara O'Rourke – Enforcement data is generally from the enforcement period only. Seems inaccurate.
 - Use of video imaging helps to establish effect and improve enforcement.
 - Patrick Brady – Random enforcement during enforcement campaign can affect driver behavior patterns by getting they used to police present.
 - Bhagwant Persaud – Crash data may go up because more crashes will be reported.
 - Tom Welch – Effectiveness is limited by volume and police availability.
 - Patrick Brady – Saturation of law enforcement happens in this type of enforcement.
 - Shawn Troy – May reduce percentage of speeders as opposed to significant reduction in average speeds.
 - Barbara O'Rourke – Evaluation of these strategies, data available.

- A3: Educate and impose sanctions against repeat offenders
 - Patrick Brady – How are you going to evaluate that?

- Zero tolerance for speeding is the best way to enforce. Success with this in other countries.
- A4: Change or mitigate the effects of identified elements in the environment
 - Gary Ogletree (TN) - Would that include realistic speed limits?
 - A. Yes.

Group B: Unsignalized Intersections (led by Kim Eccles)

Note taker did not note who made the comments

- U2: Driveway/turn restriction
 - No quantitative data
- U3: Longer left turn lanes at intersections
 - VA – high cost
- U4: Offset left turn lanes at intersections
 - MN – 4-lane freeway
- U5: Bypass lanes on shoulders at T-intersections
 - Decrease in safety
 - FL – doing 4 legged intersections
 - Hundreds of installations
 - 20 t intersection
 - Didn't do a before and after study, did a compare this intersection with this intersection
- U6: Left turn acceleration lanes at divided hwy intersection
 - Jan Hanson – contact to gather more data – information came from Loren Hill
- U7: Longer right-turn lanes at intersections
 - If you use shoulder (existing) as a right turn lane
 - Make a distinction in right turn lane
 - FHWA – study evaluation
 - Mike Griffith – asked how we are defining the term longer
- U8: Offset right turn lanes at intersections
 - Montana – had problem with because of crashes occurring with right turn and incoming traffic
- U11: Restrict or eliminate turning maneuvers by signing
 - At the intersection
 - Effective with physical barriers
- U13: Convert four legged intersections to two T-intersections
 - Picture is transposed
 - Safer – right turn left turn
 - NCHRP 17-25
 - Look at FHWA – comparison/accident studies on four-legged and T-intersection
- U18: Roadside markers or pavement markings for gap assistance
 - Roadside markers or pavement markings for gap assistance

- Gary Ogletree tried. Does the person at the stop sign read the signs?
 - Few numbers/little impact of roadside marker or pavement marking because people do not read the sign
 - Can examine through human factors
 - More of a daytime hours strategy
- U20: Rumble strips on intersection approaches
 - Removed because Janet is studying this topic
- U22: Pavement markings with supplementary messages, such as “stop ahead”
 - Targeted treatment
- U23: Flashing beacons at stop controlled intersections
 - For 2/4 way stop
 - Loren Hill said did not use 2 way stop
 - No study on 2 way stop
- U29: Targeted public information and education on safety problems at specific intersections
 - Area wide campaign
 - Hard asset safety on area wide campaign
- U30: Enhanced signing and delineation
 - Can be multiple studies
- U31: Splitter islands on the minor-road approach to an intersection
 - Loren Hill mentioned the video, Joe Bared’s work on speeds and unsignalized intersections. Developed a video and distributed to some states—new strategies to use novel techniques to reduce speeds—none of the strategies are on the ballot today except U31, splitter island, is on the videotape, and there are rumble strips on the main line
- U34: Improved maintenance of stop signs
 - Peter Kissinger (AAA) -Looking at higher grade reflective material on strategy 34
 - Tim gates (TTI) - looked at stop signs with increased retro and couldn’t find a crash effect. He also looked at retro strips too. Kim Eccles did study of fluorescent yellow –not crashed based, but saw small increases in some with increased retro
 - John Carey used throughout the state so has a large sample size. Group would like to see retro added to the ballot

Balloting and Afternoon Session

- A revised ballot was distributed based on changes made in the morning session
 - Some strategies revised, some strategies were deleted because they were already under study, also based on breakout sessions, some strategies were added, and some were combined

- Discussion of strategies involving left and right turn lane
 - Mike Griffith gave a brief overview of a cost evaluation study for safety effectiveness of intersection left and right turn lanes
 - Tom Welch noted he had an interest in severity for this study instead of a simple quantitative analysis
 - Bhagwant Persaud promised to always include severity in analysis of this strategy
 - Mike Griffith noted the decision to keep this strategy in the ballot is based on limitations of original study
 - Kim Eccles noted that (U7- Longer right-turn lanes at intersections) will be modified to include severity as a condition of evaluation of existing lanes

- Discussion of partial lighting of unsignalized rural intersections
 - Cass Napier has an interest in the provision of partial lighting of unsignalized rural intersections
 - Patrick Brady feels that this is really the issue of the effects of different light intensities on various intersection usages and types

- Discussion of addition of cable barriers to LD5
 - Patrick Brady was concerned about the addition of a cable barrier (LD16) for alternating passing lanes or four-lane sections at key locations to prevent HO crashes (LD5)
 - Hugh McGee stated it would be used as an alternative passing lane strategy
 - Mike Trentacoste clarified that the cable is in place on a very small median
 - Harry Taylor explained the reality vs. the perception of deflection of cable medians in a crash situation. They do not present as much of a problem as some would believe.

- John Nagle (IN) requested review of the midlane rumble strip strategy.

- Kerry Perrillo stated that she will continue to track studies to eliminate those that are already being studied and which are in the top 20 balloting

- Kim Eccles explained the balloting procedure, the open balloting process took place, and the results were reported (see Attachment 2)

Implementation Discussion

- Kim Eccles gave a brief discussion of implementation and installation of strategies
 - Tom Welch asked why would installation benefit this study
 - Kim Eccles replied that it gives the opportunity for prospective vs. retrospective studies. This may allow for random selection of sites. Also

allow for the choice between Empirical Bayesian evaluation or non-Empirical Bayesian evaluation.

- Kim also pointed out that agencies should consider saving data that may normally be purged in order to use comparison for treatment sites vs. untreated. This needs 3-5 years.
- Kim Eccles asked several questions for discussion
 - Has anyone implemented any of these treatments?
 - Does anyone plan on implementing any of these treatments?
 - Is anyone aware of any other states, not represented here today, that are planning to implement any of these treatments?

Arizona

- LD1: Install profiled thermoplastic strips for centerlines
- LD2: Wider cross sections on two-lane roads
- LD3: Center two-way left-turn lanes for four- and two-lane roads
- LD5: Alternating passing lanes or four-lane sections at key locations to prevent HO crashes
- LD7: "Install edgeline "profile marking," edgeline rumble strips or modified shoulder rumble strips on section with narrow or no paved shoulders"
- LD17: New: Combination of lane width versus shoulders
- U5: Bypass lanes on shoulders at T-intersections
- U8: Offset right turn lanes at intersections

Connecticut

- Lane Departure Strategies
- U35: New: Stops signs with increased retroreflectivity

Florida

- LD3: Center two-way left-turn lanes for four- and two-lane roads
 - Removing
- LD7: "Install edgeline "profile marking," edgeline rumble strips or modified shoulder rumble strips on section with narrow or no paved shoulders"
 - Recent and near future installation
- LD10: Provide skid-resistant pavement surfaces
- LD15: Automated warning signs when driver too fast for curve (particularly for trucks)
- LD17: New: Combination of lane width versus shoulders
- U1: Driveway closures/relocations
- U2: Driveway turn restrictions
- U5: Bypass lanes on shoulders at T-intersections
- U12: Channelize or close median openings
- U35: New: Stops signs with increased retroreflectivity

- A1: Revised: Target (manual) enforcement for aggressive driving combined with educational and public information

Illinois

- LD3: Center two-way left-turn lanes for four- and two-lane roads
- LD5: Alternating passing lanes or four-lane sections at key locations to prevent HO crashes
- LD6: Median barriers for narrow-width medians on multilane roads to prevent HO crashes
- LD10: Provide skid-resistant pavement surfaces
- LD13: Enhanced guardrail reflectors
- U4: Offset left-turn lanes at intersections

Indiana

- LD3: Center two-way left-turn lanes for four- and two-lane roads
- LD7: "Install edgeline "profile marking," edgeline rumble strips or modified shoulder rumble strips on section with narrow or no paved shoulders"
- U5: Bypass lanes on shoulders at T-intersections

Iowa

- LD3: Center two-way left-turn lanes for four- and two-lane roads
- LD6: Median barriers for narrow-width medians on multilane roads to prevent HO crashes
- LD7: "Install edgeline "profile marking," edgeline rumble strips or modified shoulder rumble strips on section with narrow or no paved shoulders"
- LD9: Provide enhanced pavement markings
- LD11: Enhanced shoulder or in-lane delineation and marking for sharp curves
- LD12: Delineate utility poles or trees with retroreflective tape
- LD17: New: Combination of lane width versus shoulders
- U3: Longer left turn lanes at intersections
- U6: Left turn acceleration lanes at divided highway intersections
- U7: Longer right-turn lanes at intersections
- U8: Offset right turn lanes at intersections
- U13: Convert four legged intersections to two T-intersections
- U23: Flashing beacons at stop controlled intersections
- U27: Double yellow centerline on the median opening of a divided highway at intersections
- U35: New: Stops signs with increased retroreflectivity

Kansas

- Lane Departure Strategies
-Implementing some strategies, specifics unknown

Kentucky

- Lane Departure Strategies
 - NCHRP 500 Study: Will be implementing some of these strategies, still refining strategies, locations, and criteria
- LD7: "Install edgeline "profile marking," edgeline rumble strips or modified shoulder rumble strips on section with narrow or no paved shoulders"
 - Will be installing
- LD11: Enhanced shoulder or in-lane delineation and marking for sharp curves
 - Will be installing
- LD17: New: Combination of lane width versus shoulders
 - Will be installing
- U5: Bypass lanes on shoulders at T-intersections
- U6: Left turn acceleration lanes at divided highway intersections
- U14: Convert offset T-intersections to four legged intersections
- U17: Change horizontal and/or vertical alignment of approaches
- U19: Large regulatory and warning signs at intersections
- U22: "Pavement markings with supplementary messages, such as "stop ahead""
- U23: Flashing beacons at stop controlled intersections
- U35: New: Stops signs with increased retroreflectivity
- U36: New: Intersection lighting intensity
- U37: New: Use shoulder for right turn lane (variation of U7)

Maryland

- Aggressive Driver Strategies
 - Smooth operator program

Massachusetts

- Lane Departure Strategies
 - Drowsy driver lane departure strategies
- Aggressive Driver Strategies
 - Aggressive Driver program starting this summer
- LD3: Center two-way left-turn lanes for four- and two-lane roads
- LD9: Provide enhanced pavement markings
- U36: New: Intersection lighting intensity

Minnesota

- LD2: Wider cross sections on two-lane roads
- LD3: Center two-way left-turn lanes for four- and two-lane roads
- LD5: Alternating passing lanes or four-lane sections at key locations to prevent HO crashes
- LD6: Median barriers for narrow-width medians on multilane roads to prevent HO crashes

- LD7: "Install edgeline "profile marking," edgeline rumble strips or modified shoulder rumble strips on section with narrow or no paved shoulders"
- U5: Bypass lanes on shoulders at T-intersections
 - Did a study
- U6: Left turn acceleration lanes at divided highway intersections
 - Did a study
- U23: Flashing beacons at stop controlled intersections
 - Removed

Montana

- LD3: Center two-way left-turn lanes for four- and two-lane roads
- LD5: Alternating passing lanes or four-lane sections at key locations to prevent HO crashes

New York

- LD6: Median barriers for narrow-width medians on multilane roads to prevent HO crashes
 - Frequent installation
- A1: Revised: Target (manual) enforcement for aggressive driving combined with educational and public information
 - Lots of data, very active

North Carolina

-Evaluating a lot of work will give Kim info later

- Lane Departure Strategies
 - Engineers placing rumble strips without analyzing crash history
 - Sample size too small, people want answers, often political decision and engineers looks at measures incorrectly
- Unsignalized Intersection Strategies
- Aggressive Driver Strategies

North Dakota

- U23: Flashing beacons at stop controlled intersections

Oklahoma

- Will e-mail information, not sure of items

Pennsylvania

- LD2: Wider cross sections on two-lane roads
- LD7: "Install edgeline "profile marking," edgeline rumble strips or modified shoulder rumble strips on section with narrow or no paved shoulders"
- LD9: Provide enhanced pavement markings

- LD11: Enhanced shoulder or in-lane delineation and marking for sharp curves
- LD12: Delineate utility poles or trees with retroreflective tape
- LD13: Enhanced guardrail reflectors
- LD15: Automated warning signs when driver too fast for curve (particularly for trucks)
- LD17: New: Combination of lane width versus shoulders
- U5: Bypass lanes on shoulders at T-intersections
- U10: Full width paved shoulders in intersection areas
- U11: Restrict or eliminate turning maneuvers by signing
- U17: Change horizontal and/or vertical alignment of approaches
- U18: Roadside markers or pavement markings for gap assistance
- U19: Large regulatory and warning signs at intersections
- U22: "Pavement markings with supplementary messages, such as "stop ahead""
- U23: Flashing beacons at stop controlled intersections
- U25: Lane assignment signing or marking at complex intersections
- U26: Turn path markings
- U28: Targeted enforcement to reduce stop sign violations
- U29: Targeted public information and education on safety problems at specific intersections
- A1: Revised: Target (manual) enforcement for aggressive driving combined with educational and public information
 - Doing study right now

South Carolina

- LD2: Wider cross sections on two-lane roads
 - Hired Consultants
- LD3: Center two-way left-turn lanes for four- and two-lane roads
- LD9: Provide enhanced pavement markings
 - Hired Consultants
- LD12: Delineate utility poles or trees with retroreflective tape
 - Hired Consultants
- U30: Enhanced signing and delineation
- U35: New: Stops signs with increased retroreflectivity
 - Short-term, changing signing with high intensity sheeting
- A1: Revised: Target (manual) enforcement for aggressive driving combined with educational and public information
 - Thru public safety department- awarded by NHTSA

South Dakota

- LD3: Center two-way left-turn lanes for four- and two-lane roads
- LD7: "Install edgeline "profile marking," edgeline rumble strips or modified shoulder rumble strips on section with narrow or no paved shoulders"

- LD15: Automated warning signs when driver too fast for curve (particularly for trucks)

Tennessee

- Lane Departure Strategies
- Aggressive Driver Strategies
- A5: Reduce nonrecurring delays and provide better information about these delays

o Texas

- LD1: Install profiled thermoplastic strips for centerlines
- LD6: Median barriers for narrow-width medians on multilane roads to prevent HO crashes
- LD7: "Install edgeline "profile marking," edgeline rumble strips or modified shoulder rumble strips on section with narrow or no paved shoulders"
- LD11: Enhanced shoulder or in-lane delineation and marking for sharp curves
- LD17: New: Combination of lane width versus shoulders

Utah

- Lane Departure Strategies
- U36: New: Intersection lighting intensity

Virginia

- LD6: Median barriers for narrow-width medians on multilane roads to prevent HO crashes
- LD10: Provide skid-resistant pavement surfaces
- LD15: Automated warning signs when driver too fast for curve (particularly for trucks)
 - Online

Wrap-Up

- Kerry Perrillo led a wrap-up discussion
- A1 was ranked highly; Kerry said she will mention it to NCHRP when they meet on behavioral study. A1 was modified top include educating judges and litigators.
- Kerry thanked meeting attendees for their eager participation
- Kerry noted that there will be a technical advisory committee (TAC) meeting about once a year. The money taken from the Pooled Fund Study was discussed. 23 States joined, 2.43 million from states, money from FHWA, 3.93 million total. Possibility of additional NCHRP funding equating to a total of 4.6 million. Hoped that 20 strategies can be studied with funds. BMI-SG will follow up and

begin evaluations and experimental design. Project will be contracted out at some point this summer.

- Tom Welch asked if it will be contracted out to one or multiple contractors
- Kerry answered preferably one contractor with (possibility of) subcontractors
- Tom Welch noted there may be benefits to using several firms to evaluate data from various states
- Patrick Brady voiced concerns over how to collect the data. States don't have the man power. One contractor would be preferable for this purpose because it is easier to deal with fewer individuals.
- Mike Trentacoste insured that regardless of one or more contractors, assembling a team to perform tasks.
- The group offered options on how to go about selecting a contractor/ assembling a team to perform these tasks.
- It was mentioned that there is a website www.pooledfund.org. Click under proposed studies TPF-5(099). Will update information and will include meeting notes. Eventually there will be an exclusive website for this project. <http://www.pooledfund.org/projectdetails.asp?id=332&status=4>
- Patrick Brady suggested that the contractor may be best to setup and maintain website for project.
- Kim Eccles stated she will follow up on implementation. She invited states to e-mail her regarding any new developments with states represented or not represented here.

Meeting adjourned

Attachment 1: Balloting Results

Strategy ID	Strategy	Score	Ballots
LD7	Install edgeline "profile marking," edgeline rumble strips or modified shoulder rumble strips on section with narrow or no paved shoulders	138	18
LD11	Enhanced shoulder or in-lane delineation and marking for sharp curves	119	16
LD9	Provide enhanced pavement markings	67	12
LD5	Alternating passing lanes or four-lane sections at key locations to prevent HO crashes	61	10

Strategy ID	Strategy	Score	Ballots
U23	Flashing beacons at stop controlled intersections	60	9
LD3	Center two-way left-turn lanes for four- and two-lane roads	54	9
LD6	Median barriers for narrow-width medians on multilane roads to prevent HO crashes	54	9
U5	Bypass lanes on shoulders at T-intersections	51	10
<i>LD17</i>	<i>New: Combination of lane width versus shoulders</i>	48	7
U22	Pavement markings with supplementary messages, such as “stop ahead”	47	8
LD1	Install profiled thermoplastic strips for centerlines	44	7
LD4	Narrow "buffer median" on two-lane roadways	39	6
U18	Roadside markers or pavement markings for gap assistance	34	8
A1	Revised: Target (manual) enforcement for aggressive driving combined with educational and public information	34	8
U4	Offset left-turn lanes at intersections	33	8
<i>U35</i>	<i>New: Stops signs with increased retroreflectivity</i>	32	6
<i>LD15</i>	<i>Automated warning signs when driver too fast for curve (particularly for trucks)</i>	31	6
U6	Left turn acceleration lanes at divided highway intersections	28	5
<i>U36</i>	<i>New: Intersection lighting intensity</i>	28	7
U7	Longer right-turn lanes at intersections	24	3
LD2	Wider cross sections on two-lane roads	24	5
U15	Indirect left-turn treatments to minimize conflicts at divided highway intersections	23	3
<i>U37</i>	<i>New: Use shoulder for right turn lane (variation of U7)</i>	21	3
U25	Lane assignment signing or marking at complex intersections	21	5
<i>LD13</i>	<i>Enhanced guardrail reflectors</i>	18	3
A2	Revised: Target (automated) enforcement for aggressive driving combined with educational and public information	18	4
LD8	Midlane rumble strips	17	3
U8	Offset right turn lanes at intersections	17	3

Strategy ID	Strategy	Score	Ballots
U17	Change horizontal and/or vertical alignment of approaches	17	3
U12	Channelize or close median openings	14	2
U19	Large regulatory and warning signs at intersections	13	4
U30	Enhanced signing and delineation	12	4
A7	<i>Widen painted edgelines to slow and calm aggressive drivers</i>	8	2
U31	Splitter islands on the minor-road approach to an intersection	7	1
LD10	Provide skid-resistant pavement surfaces	7	2
LD14	<i>Widened pavement/pull-offs on isolated segments for emergency situations</i>	6	1
U33	Dashed markings (extended left edgelines) for major-road continuity across the median opening at divided highway intersections	6	1
U1	Driveway closures/relocations	6	2
A5	<i>Reduce nonrecurring delays and provide better information about these delays</i>	6	2
U9	Right turn acceleration lanes at intersections	6	3
LD16	<i>New: Adding cable barrier for LD5</i>	5	2
U14	Convert offset T-intersections to four legged intersections	5	2
A4	Change or mitigate the effects of identified elements in the environment	5	2
A3	Education and sanctions against repeat offenders	4	1
U24	Retime adjacent signals to create gaps at stop-controlled intersections	3	1
U3	Longer left turn lanes at intersections	2	1
U2	Driveway turn restrictions	1	1
U10	Full width paved shoulders in intersection areas	1	1
A6	<i>"Slower Vehicles Keep Right" signs</i>	1	1
LD12	Delineate utility poles or trees with retroreflective tape	0	0
U11	Restrict or eliminate turning maneuvers by signing	0	0
U13	Convert four legged intersections to two T-intersections	0	0
U16	Close or relocate "high-risk" intersections	0	0
U20	REMOVED	0	0

Strategy ID	Strategy	Score	Ballots
U21	Supplementary stop signs mounted over the roadway	0	0
U26	Turn path markings	0	0
U27	Double yellow centerline on the median opening of a divided highway at intersections	0	0
U28	Targeted enforcement to reduce stop sign violations	0	0
U29	Targeted public information and education on safety problems at specific intersections	0	0
U32	Stop bar (or provide a wider stop bar) on minor road approaches	0	0
U34	Improved maintenance of stop signs	0	0

Attachment 2: Bhagwant Persaud’s handout

How many treatment sites are required?

Basics

- When planning a before-after safety evaluation study it is vital to ensure that enough data are included such that the expected change in safety can be statistically detected.
- In the planning stage the expected change in safety is not known, but it is still possible to make a rough determination of how many treatment sites are required based on the best available information about
 - the expected change in safety
 - the average number of crashes per site
- From this, one could estimate, for the number of available sites, the change in safety that can be statistically detected.
- Available sample size estimation methods are (conservatively) based a conventional before-after study with comparison group design
- Statistical accuracy attainable for a given sample size is described by the standard deviations of the estimated percent change in safety.
- One can estimate P-values for various sample sizes and expected change in safety for a given crash history.

- A P-value of 0.10 roughly translates into 90% confidence and is generally regarded as a limiting value.

Case study 1: Red Light Camera Evaluation

- Assume that the number of comparison sites is equal to the number of treatment sites.
- Assume (from published data)
 - 20 crashes/site-year of which
 - 3.5 are right angle crashes and
 - 12.0 are rear-end crashes
- Assume three years of ‘before’ crash counts, one and a half years of ‘after’ period crash counts.

P-values for various sample sizes and expected changes in safety
(based on equal number of comparison sites)

Number of treated sites	20			60			??		
	10%	20%	30%	10%	20%	30%	10%	20%	30%
% change in crashes									
Right angle crashes	0.58	0.23	0.05	0.42	0.08	<0.01	0.33	0.05	<0.01
Rear-end crashes	0.51	0.23	0.10	0.42	0.14	0.04	0.40	0.12	0.03

(Shaded cells indicate where P-values of ≤ 0.10 are attainable)

- Example 1: If the sample contains 20 treated sites, and a 30% reduction in the number of right angle crashes is expected due to RLC installation, we may expect to obtain a statistically significant result at the 10% level (since P actually equals 0.05).
- Example 2: With 60 treated sites, if there is a 20% increase in the number of rear-end crashes, we *do not* expect a statistically significant result at the 10% level (since $P > 0.10$). However, that result would be significant at the 15% level.
- Assessment of available treatment site samples:

Best judgment on possibility of detecting safety effects at the P = 10% level
(Assuming a 25% decrease in right angle crashes and a 30% increase in rear end crashes)

Crash Type	City 1	City 2	City 3	City 4	All
Right angle	U	U	U	W	U
Injury right angle	U	W	U	W	U
Rear end	U	U	U	W	U
Injury rear end	U	W	U	W	U

(U significant results may be obtained

W significant results may not be obtained)

Case study 2: Centre line rumble strips

Minimum required 'before' period mile-years for treated sites
for detecting an expected change in safety ($P \leq 0.10$)
(assumes equal length of before and after periods)

Expected Percent Reduction in Crashes	Equal number of mile-years for treatment and comparison sites		Half as many mile-years for comparison as for treatment sites (Pop Quiz!)	
	2.10 crashes /mile/year	0.54 crashes /mile/year	2.10 crashes /mile/year	0.54 crashes /mile/year
40	13	52		
20	87	339		
10	426	1659		