Children’s Hospital of Philadelphia

Annual Progress Report: 2009 Formula Grant

Reporting Period

July 1, 2012 – June 30, 2013

Formula Grant Overview

The Children’s Hospital of Philadelphia received $4,034,902 in formula funds for the grant award period January 1, 2010 through December 31, 2013. Accomplishments for the reporting period are described below.

Research Project 1: Project Title and Purpose

_Pediatric Hospital Quality, Safety, and Cost Project_ - The project will inform the research agenda for pediatric hospital medicine and provide answers to key questions about how we can best organize and deliver hospital care to children in order to improve quality, safety, and outcomes, and reduce costs.

Anticipated Duration of Project

1/1/2010 - 12/31/2013

Project Overview

The broad objective of the _Pediatric Hospital Quality, Safety, and Cost Project_ is to perform research aimed at improving the quality and efficiency of care provided to children in the inpatient setting. The project has three separate but related specific research aims, each with their own sub-aims, that together will inform the research agenda for pediatric hospital medicine, and provide answers to key questions about how we can best organize and deliver hospital care to children in order to improve outcomes and reduce costs.

Specific Aim #1 is a prioritization project. Working with existing detailed administrative data from over 600 hospitals, the researchers will identify pediatric hospital conditions that are prevalent, cumulatively expensive to the healthcare system, and exhibit high degrees of regional variation in cost. Extreme variation across hospitals in resource utilization for the same condition often signals an opportunity for standardization of care, improved outcomes and reduced costs. For prevalent and expensive conditions that exhibit a high degree of inter-hospital variation in cost, the researchers will seek explanations for the variation, both in terms of resource categories (e.g. radiology, laboratory, or length of stay costs) driving variation, as well as organizational factors associated with more cost-effective care (e.g. use of and adherence to clinical practice guidelines).
Specific Aim #2 will explore how provider and hospital volume influence the quality and outcomes of care for specific pediatric conditions. Numerous studies in the adult and surgical worlds have shown that for many conditions higher provider and hospital volume is associated with greater compliance with best practices and improved outcomes. However, very little is known about whether this is true for pediatric conditions and the mechanisms through which increased volumes produce better care. Working with the same administrative databases as Aim #1 the researchers will explore volume/quality/outcome relationships for several common pediatric conditions. They will follow these analyses with surveys of clinician leaders of pediatric hospitals to understand how high volume translates into better quality and outcomes, and also how lower volume hospitals are able to achieve high quality and outcomes.

Finally, Specific Aim #3 will use a combination of quantitative and qualitative methods to evaluate and refine a Rapid Response System (RRS) designed to detect deterioration, activate an expert response team, and rapidly assess, stabilize, and transfer (if necessary) patients on general inpatient wards who are exhibiting signs of clinical deterioration, before critical events occur.

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Frances Barg, PhD - employed by University of Pennsylvania  
Lisa M. McLeod, MD - employed by Children’s Hospital Colorado

**Expected Research Outcomes and Benefits**

By identifying pediatric hospital conditions that are prevalent, cumulatively expensive to the healthcare system, and exhibit high degrees of regional variation in cost, and understanding the reasons for that variation, researchers and funders will be able to more rationally channel research dollars towards pediatric hospital conditions for which elucidation of best practices and standardization of care are likely to yield the greatest improvement in outcomes and reduction in total costs.

Knowing whether higher provider and hospital volume is associated with greater compliance with best practices and improved outcomes for pediatric conditions, and understanding the mechanisms through which increased volumes produce better care, will allow healthcare policy
makers to make better decisions about the optimal location (e.g. large academic institution v. small community hospital) for a variety of pediatric conditions. Effective Rapid Response Systems have the potential to save lives, reduce costs, and make the hospital a safer place for children.

Summary of Research Completed

Specific Aim #1: Prioritization Project Subaims:

During the report period, the team continued to ‘drill-down’ to seek explanations for variation in resource utilization for conditions that had been identified as high priority during the earlier phase of the project. Criteria for selecting conditions were prevalence, cost, amount of variation, homogeneity of patient population, availability of evidence and consensus regarding best practices, high morbidity, and quality of data available.

Aim 1b: Drill-down #1: Diabetic Ketoacidosis (DKA). Work on this drill-down was primarily related to manuscript preparation and submission. A paper titled, “Variation in Resource Utilization and Readmission for Diabetic Ketoacidosis in Children’s Hospitals” has been accepted for publication in Pediatrics. The paper reports the project’s finding that readmission for DKA within a year of hospitalization is common, accounting for one-fifth of all DKA admissions and that resource use, hospital length of stay, and readmission rates vary widely across major U.S. children’s hospitals, even after adjusting for differences in patients. The study paper concludes that further research is needed to understand these differences and to identify the most cost effective strategies for managing diabetes.

Aim 1b: Drill-down #2: Hypertrophy of Tonsils and Adenoids. The tonsillectomy drill-down team analyzed: (1) variation in use of antibiotics and dexamethasone; (2) variation in reason-specific revisits across hospitals standardized for patient level factors; (3) patient level factors associated with the reason specific revisit (e.g. bleeding, vomiting and dehydration, all/total reasons); (4) discrete time dependent probabilities of revisits by reason, standardized for patient level factors and for hospital; (5) association between dexamethasone use and revisits for bleeding. Two manuscripts have been developed based on those analyses. The first includes factors 1-4 above and the second focuses on factor 5. Both have been submitted to Pediatrics for consideration.

Aim 1b: Drill-down #3: Appendicitis. Using normalized costing for comparative analysis, the third drill-down focused on a cohort of 37,469 children treated with low-severity appendicitis (non-perforated) at 39 PHIS hospitals. The goal was to characterize the magnitude of cost variation across hospitals and to identify aspects of management that were associated with the greatest relative cost in the treatment of this disease. Cost variation between hospitals, both overall and associated with specific management areas, was analyzed. Solutions were developed for all data quality issues, including a novel method for assigning room-associated costs based on 3 levels of acuity. This approach was devised to address inconsistencies between hospitals in how patients are assigned and charged for facility services (room cost). Key findings from the analysis included a greater than two-fold difference among hospitals in overall median treatment-related cost, as well as significantly different treatment-related cost within the cohort for each of
the individual management areas examined (Figure 1). Operating room costs were found to be the greatest driver of cost variation overall and among most hospitals, while facility costs were a close second for both overall cost and inter-hospital variation (Figure 2). A manuscript is currently in preparation.

**Aim 1b: Drill-down #4: Pneumonia.** The pneumonia drill-down team began work in October 2012, aiming to understand the extent and factors associated with variability in resource use for community acquired pneumonia (PNA), pneumonia + acute asthma (PNAAA) and pneumonia with diagnosis of asthma without acute treatment (PNAUA); to determine the association between adherence to guideline recommendations and resource use in children with PNA, PNAAA and PNAUA; and to determine the relationship between guideline adherence and outcomes. The team has defined the patient cohort, created 3 subgroups and developed a statistical analysis plan. Clinical Transaction Category categories are being finalized. The most relevant metrics of guideline adherence have been identified. Data analysis is beginning, comparing utilization and LOS for the 3 groupers overall and by hospital, and metrics of adherence overall by diagnosis grouper, and by individual hospital.

**Aim 1b: Severe Asthma Pathway Project.** The team is in the early stages of investigating factors causing asthma to be a costly and high variability condition. Records of patients ages 2-18 admitted to the non-ICU inpatient service from 7/1/11-6/30/12 are being analyzed for failure to respond to standard therapy and hospital LOS as well as adverse events.

**Results Dissemination.** The manuscript describing the results of the prioritization project methodology was published in *JAMA Pediatrics* in December 2012. The project team presented a webinar for PHIS hospital executives in January 2013 and for hospital clinicians in March 2013 to report on findings from the tonsillectomy drill-down regarding improved care and lower costs through reduced variation in treatment practices. A paper titled, “Variation in Resource Utilization and Readmission for Diabetic Ketoacidosis in Children’s Hospitals” has been accepted for publication in *Pediatrics*. Two manuscripts related to the tonsillectomy drill down have been submitted to *Pediatrics* for consideration and the results were presented in May, 2013, at a platform session of the Pediatric Academic Societies annual meeting in Washington DC.

**Specific Aim #2: Patient Volumes and Quality of Care for Hospitalized Children**

Researchers continued to investigate process variation and outcomes for pediatric spinal fusion procedures. Given prior results indicating that volume was not associated with outcomes such as readmission, reoperation, or surgical site infection, the team continued to pursue other risk factors that may be contributing to poor outcomes within and/or across hospitals. After exploring prophylactic antibiotic use, focus was turned to a second identified risk factor of blood loss and blood conservation strategies, primarily the use of pharmacologic agents that inhibit clot breakdown (Antifibrinolytic agents, or AF agents). The team designed a retrospective cohort study using administrative data from the PHIS database to analyze the relationship between the use of AF agents (ε-aminocaproic acid (EACA), tranexamic acid (TXA) and aprotinin (APR)) and blood loss. The primary outcome was blood transfusions during the procedural admission. The team selected all children ages 0-18 discharged from PHIS hospitals between 1/1/06-9/30/09, for which a spinal fusion procedure was performed for scoliosis. Patients with diagnoses indicating malignancy or coagulation disorders, as well as cases in which patient blood was
collected and autotransfused during the procedure were excluded. Sub-cohorts of patients with Neuromuscular Scoliosis (NMS) and Adolescent Idiopathic Scoliosis (AIS) were selected, using procedure and diagnosis algorithms previously published by the research group. Analyses comparing the effectiveness of each drug were performed for each sub-cohort separately. To determine the relationship between antifibrinolytic use and blood transfusion procedures, the researchers performed multilevel logistic regression controlling for factors that were significantly associated with antifibrinolytic use or significantly associated with blood transfusions. The team then estimated the average treatment effect of antifibrinolytic use in patients with similar characteristics undergoing similar surgeries, under the assumption that there is no residual confounding by unmeasured factors. In both sub-cohorts, which consisted of 2,722 operations for AIS and 1,517 operations for NMS, the proportion of children in the treated group increased over time (13%-42%), while transfusion rates remained stable. Children with the greatest medical complexity, children undergoing a posterior only procedure, and children with >9 vertebrae fused were more likely to be treated. Of the AF agents, EACA was used most frequently (15%), followed by TXA (7%), and APR (2.2%). The median hospital-specific red cell transfusion rate was 24% (IQR 5-44%) for children with AIS and 43% (IQR 14-63%) for children with NMS. Across hospitals, rates of antifibrinolytic use were not correlated with unadjusted mean transfusion rates. For AIS operations, only EACA use was associated with a significant reduction in odds of transfusion (0.42, p<0.001; Table 1), and the reduction in probability of transfusion for patients in the treated vs. untreated groups was 13% (95% CI, 0.08-0.18), corresponding to a number needed to treat (NNT) of between 8 and 13 children (Figure 3). However, there was no association between red cell transfusions and the use of EACA (OR 1.2, p=0.5), TXA (OR 1.3, p=0.4), or APR (OR 1.2, p=0.7; Table 1). The team concluded that (1) use of these agents was highly variable and increasing over time with no significant changes in transfusion rates, (2) EACA may be an important component of blood conservation in children undergoing spinal fusion surgery for AIS, and (3) use of all of these drugs should be prospectively studied in order to account for factors such as dosing and concurrent practices for blood conservation which may vary by institution.

Results Dissemination. During the current reporting period, results of the prior study on prophylactic antibiotic use were published in the journal Spine. Results of the study completed during the current reporting period were presented as a poster at the Pediatric Academic Societies annual meeting in Washington DC, and as a platform panel presentation at the Pediatric Orthopedic Society of North America annual meeting in Toronto, Canada.

Specific Aim #3: Evaluation of an Early Warning (EW) Scoring System
The first of two aspects of Subaim 3a – the effect of the implementation of a pediatric rapid response system (RRS) on clinical outcomes, has been completed and a manuscript has been submitted for publication. The team evaluated 1,810 unplanned transfers from the general medical and surgical wards to the pediatric and neonatal ICUs during 370,504 non-intensive care patient-days between 7/07-5/12 (Figure 4). The team found that RRS implementation was associated with a 62% reduction in critical deterioration relative to the pre-intervention trend (adjusted incidence rate ratio, 0.38; 95% CI, 0.20-0.75). Cardiac arrest and death were extremely rare at baseline, and their reductions were not significant despite using nearly 5 years of data. The team reported that hospitals seeking to evaluate and optimize pediatric RRS performance should focus on reducing more common proximate adverse outcomes like critical deterioration
rather than exceedingly rare, catastrophic outcomes. The second aspect of Subaim 3a – the effect of RRS implementation on costs, is now underway.

Aim 3c: A video method was developed to study false physiologic monitor alarms and their consequences in children with heart and/or lung failure. Video equipment was acquired and two part-time research assistants were hired. The team recruited 41 nurses and 32 patients from the pediatric ICU and the general medical wards and iteratively developed a research method to study alarms and alarm fatigue. The method is being refined with additional subjects. A manuscript describing study procedures and the technical and logistical challenges encountered has been drafted.

Results Dissemination. Results from the first part of Aim 3a were presented at the Pediatric Academic Societies Annual Meeting and the 8th International Conference on Rapid Response Systems and Medical Emergency Teams in May 2013.

Findings from Aim 3c that were reported in the previous progress report have resulted in three manuscripts: one published in the Journal of Hospital Medicine, another is currently in press with the Joint Commission Journal on Quality and Patient Safety, and a third that is undergoing revision after a favorable journal review.
**Figure 1:** Variation in treatment-related cost in the management of uncomplicated appendicitis at 39 freestanding children’s hospitals.

**Figure 2:** Relative contribution and cost-variation of different management areas in the treatment of uncomplicated appendicitis in children.
Table 1: Odds ratios (OR) and 95% confidence intervals (CI) for the association between red cell transfusion and ε-aminocaproic acid (EACA) or tranexamic acid (TXA) use in AIS and NMS procedures

<table>
<thead>
<tr>
<th></th>
<th>AIS Procedures</th>
<th>NMS Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=2,722</td>
<td>n=1,547</td>
</tr>
<tr>
<td>EACA, OR (95% CI)</td>
<td>0.42 (0.26,0.67)</td>
<td>1.2 (0.73, 1.9)</td>
</tr>
<tr>
<td>TXA, OR (95% CI)</td>
<td>1.0 (0.48,1.9)</td>
<td>1.3 (0.68,2.4)</td>
</tr>
</tbody>
</table>

*p<0.001

Figure 3: Standardized (adjusted) probabilities (point estimates with 95% CI) for receiving a blood transfusion in AIS (Left) and NMS (Right) procedures with and without use of antifibrinolytics, as estimated from multivariable analyses (EACA=ε-aminocaproic acid, TXA=tranexamic Acid, APR=aprotinin).
**Figure 4:** Critical deterioration rates and trajectories over time. The vertical line at month 0 (February 2010) indicates the month of RRS implementation. ICU indicates intensive care unit; RRS, rapid response system.
**Research Project 2: Project Title and Purpose**

*Methods to Evaluate the Content and Dissemination of Internet-Based Interventions to Prevent Injury* - Decades after the National Academies emphasized the importance of injury prevention for our nation’s health, injury prevention science remains an underdeveloped field. As a result, in Pennsylvania, injury remains the leading cause of death for ages 1-44, and 135,334 hospitalizations for injury cost $4.6 billion per year. Children, youths and young adults are the primary victims of injury. With an established highly successful and integrated 50-member multidisciplinary team, the mission of Children’s Hospital’s injury research program is to reduce the burden of injury through evidence-based prevention. This study aims to leverage this expertise to fill the crucial gap for advancing injury prevention by generating new methods to inform injury prevention interventions that are (1) developed systematically and evaluated and (2) disseminated widely and adopted.

**Anticipated Duration of Project**

1/1/2010 - 12/31/2013

**Project Overview**

The objective of this project is to establish rigorous methodologies for the systematic creation, evaluation and dissemination of Internet-based injury prevention interventions with an initial focus on interventions to reduce young-driver crashes and associated injuries. Specific aims are:

**Aim 1: Create and evaluate Internet-based interventions to prevent young-driver crashes**

*Method 1.1:* Review best practices for creating and evaluating theoretically-grounded interventions to promote health and prevent injury, and adapt for Internet-based interventions to prevent young-driver crashes.

*Method 1.2:* Develop and implement a protocol to pretest content for Internet-based interventions and their component modules to assure that the interventions address the intended goals.

*Method 1.3:* Assess the feasibility of using a driving simulator for evaluating the efficacy of Internet-based interventions in changing driving performance.

*Method 1.4:* Test the relative efficacy of an intervention (based on methods developed by the CHOP research team) as compared to that of a currently available intervention.

**Aim 2: Establish a best practices methodology for dissemination of Internet-based interventions to prevent young-driver crashes, and methods to evaluate the impact of dissemination strategies**

*Method 2.1:* Create best practice recommendations for dissemination of Internet-based interventions to prevent young-driver crashes.

*Method 2.2:* Create recommendations and metrics for evaluating dissemination of Internet-based interventions to prevent young-driver crashes (e.g., measuring reach, effectiveness, and unintended consequences).

*Method 2.3:* Measure the change in use patterns of an Internet-based intervention to promote young driver safety before and after an evidence-based marketing strategy or dissemination campaign.
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Expected Research Outcomes and Benefits

This research project will produce evidence-based frameworks, methods and metrics for the creation and dissemination of interventions to reduce young-driver crashes and their related injuries. In particular, the following will be produced:

1. An evidence-based framework for the development and evaluation of theoretically-grounded Internet-based interventions to promote safe behaviors among young drivers and their passengers.
2. An evidence-based protocol for intervention content pre-testing for young driver safety.
4. An evidence-based framework for the development of a plan for dissemination of Internet-based interventions to promote safe behaviors among young drivers and their passengers.
5. An evidence-based framework for the evaluation of the dissemination strategies via the Internet to promote safe behaviors among young drivers and their passengers.

These frameworks will serve as strong scientific foundations for the development and dissemination of interventions to prevent young-driver crashes and their related injuries.

As road traffic injury is the leading cause of a death and acquired disability for Pennsylvania’s young citizens, effective interventions to reduce crashes that are widely disseminated and adopted will improve the health status of Pennsylvania’s youth and young adults.
Summary of Research Completed

Introduction
The Center for Injury Research and Prevention at the Children’s Hospital of Philadelphia has met the three milestones for year four (7/1/2012 – 6/30/2013).

1. Complete the intervention evaluation study (Method 1.4) and analyze results.
2. Conduct the marketing / dissemination study (Method 2.3).
3. Complete a report describing an evidence-based framework for the development and evaluation of strategies to market/disseminate Internet-based interventions to promote safe behaviors among young drivers and their passengers.

1. **Milestone 1: Complete the validation and interventions (Method 1.4) and analyze results**

1.1. Protocol 1 (Further validation of the Simulated Driving Assessment (SDA) and Content Testing of the Risk Awareness and Perception Training (RAPT) program)

For Protocol 1, simulated driving performance was compared between novice teens and experienced adults and simulator-derived and eye tracking metrics were compared with assessments from an experienced driving education instructor.

1.1.1. **Data collection**

All data were collected for the studies comprising Protocol 1. Demographic data of the sample of adult and novice teen drivers in Protocol 1 is presented in Table 1. The teen sample consisted of \( n=20 \) teens who completed the simulated drives. The teens were 65% male \((n=13)\) with mean age =16.8 years. The researchers had \( n=17 \) experienced adults complete the simulated drives. The experienced adults were 59% male \((n=10)\) with mean age = 35.8 years.

1.1.2. **Initial Analyses**

The two studies generated large amounts of data – self-reported survey data, simulator data (collected at 60Hz), video data, and eye tracking data. Several months of analyses were spent reducing simulator data and eye tracking into analyzable metrics – (1) derived variables based on raw acceleration and position data, (2) hand-coding of the eye tracking data, and (3) driving instructor coding of simulator videos of driving performance. A table of more than twelve metrics associated with safe driving was developed with analytical protocols. The key metric was simulated crashes (in which the participant’s vehicle overlapped with other vehicles in the scenario). Over the three experimental drives that comprise the SDA, a total of 33 crashes were observed among novice teen drivers \((n = 19)\) and adult drivers \((n = 14)\).

Two initial analyses were presented in national meetings that began to demonstrate the validity of the simulated driving assessment (SDA). For the Transportation Research Board meeting, we examined any unintended training effects due to the simulated drive (i.e., would a participant’s driving performance improve over the course of the 30-minute drive) among the twenty teen participants. In examining speeding and stopping errors over four time points, each of which
included three standard intersection types, the investigators found no reduction in driving errors over time. At baseline, 45% of teens had one or more errors, and by Time 4 60% of teens had one or more errors. Based on these results, it appears there are no observed learning effects in the SDA.

For the Society for the Advancement of Violence and Injury Research, the researchers presented a poster that revealed significant differences in metrics of driving performance (crashes and headway time – a measure of close following) between novice teen drivers and adult drivers for a common crash scenario (truck pulling out in front of vehicle). At this event, 35% of novice teen drivers \( (n = 7) \) crashed, while zero adults crashed with the braking truck. In comparing headway time at the moment when the brakes lights of the truck turn on, 50% of teens \( (n = 10) \) versus 25% of adults \( (n = 4) \) had a headway time < 3 seconds. Moreover, teens who crashed \( (n = 7) \) had a significantly shorter headway time than participants (including teens and adults) who did not crash. The researchers also examined breaking patterns among participants in various headway time intervals. On average, teens and adults who did not crash showed minimal depression of the throttle.

Another validation analysis involved assessing the congruence of the categorization of safe/unsafe driving based on simulator-derived metrics versus that by an experienced Pennsylvania driving education instructor who reviewed all videos and based his determination on his professional assessment of the participant’s driving performance. Domains of driving performance were also scored by the instructor. Driving instructor evaluation results across the 8 domains of driving are presented in Table 3.

1.1.3. Challenges

A key challenge of driving simulator research is the risk of simulator sickness. Simulator sickness can take the form of nausea, vomiting, headache, and dizziness. Although motion sickness was an exclusion criterion for participants in the study and no subjects reported a history of motion sickness, a total of 21 participants (20 adults, 1 teen) were unable to complete the SDA due to simulator sickness. Based on the literature, the risk of simulator sickness is positively correlated with age, which was consistent with our experience. The most prevalent simulator sickness symptoms experienced during completion of the SDA included eye strain \( (n = 18) \), general discomfort \( (n = 16) \), and fatigue \( (n = 12) \). Despite this challenge, a sufficient sample of subjects with complete data was achieved.

1.2. Protocol 2 (Randomized Trial of the Efficacy of RAPT in Improving Performance on the SDA)

In Protocol 2, simulated driving performance was compared between a treatment group of teens who received RAPT computerized training (with a pre- and a post- test of hazard awareness mastery) versus a control group of teens who received only the pre-test of hazard awareness mastery with no RAPT training.
**Data collection**

All data have been collected for Protocol 2. A total of 39 teens (16-18 years of age) were randomly assigned to either the RAPT computerized training program \( (n = 20) \) or the non-training group \( (n = 19) \). Basic demographic data on teens in the treatment (RAPT trained) and control (non-trained) groups are presented in Table 3.

1.2.1. **Initial analyses**

In examining the pre and post RAPT results, the treatment group showed significant improvement on RAPT after completing the training program. Data reduction similar to that developed for the validation study (Protocol 1) is underway.

1.2.2. **Challenges**

No important challenges to study completion were experienced.

2. **Milestone 2: Conduct the marketing / dissemination study (Method 2.3)**

2.1. Protocol 3 (A health dissemination strategy of pediatric injury prevention information using the social media platform, Twitter).

For Protocol 3, an evaluation study was conducted to better understand the effectiveness of using Twitter as a tool for disseminating pediatric injury prevention information.

2.2. **Data collection**

The researchers are currently collecting data for this protocol. A dataset of nearly 200 Twitter users, including their following base, their total tweet count, their total re-tweet count (re-tweeting messages posted from the Center for Injury Prevention and Research), and actual tweet content has been extracted using Twitter’s REST and Streaming APIs.

2.2.1. **Initial analyses**

An initial analysis presented at the International Society for Research on Internet Interventions (ISRII) 2013 annual meeting, using a Twitter chat as a health information dissemination strategy, revealed that a Twitter chat can be an effective strategy. The Twitter chat was hosted by the Center for Injury Research and Prevention during Teen Driver Safety week in October 2012. A total of 435 tweets were generated from 150 unique Twitter users. These 150 users had a cumulative following base of 658,120 (mean=4,387) and a cumulative history of composing 864,698 tweets (mean=5,765). A total of 137 re-tweets were generated and 10% of the unique users re-tweeted the CIRP facilitator 25 times. This group had a cumulative following base of 61,143 (mean=4,076) and generated a total of 58,796 (mean=3920) historical tweets. Compared to the average number of unique visitors per day for the entire month of October 2012, there was a 41% increase on the day of the Twitter chat.
2.2.2. Challenges

Due to the constraints of Twitter’s APIs, data collection on Twitter can only be conducted in seven-day intervals, and can only provide tweet content information on the fifty latest tweets of any user.

3. Milestone 3: Complete a report describing an evidence-based framework for the development and evaluation of strategies to market/disseminate Internet-based interventions to promote safe behaviors among young drivers and their passengers (Methods 2.2 and 2.3)

The report and framework were presented in the Year 2 progress report.

During Year 4, a Systems Requirements Document was finalized to support the framework for a general purpose platform to support the evaluation of Internet-Based Interventions, which will guide a vendor in the building of this platform as proof of concept.

4. Manuscripts, Presentations, and Additional Awarded Funding

The following is a list of manuscripts, conference papers, presentations, and grant proposals submitted in support of this grant during year 4:

Manuscripts


Conference Presentations / Abstracts


Talks


5. Tables and Figures

<table>
<thead>
<tr>
<th>TABLE 1 Protocol 1 demographic data</th>
<th>Teen Drivers (n=21)</th>
<th>Adult Drivers (n=17)</th>
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<tr>
<td>Variable</td>
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<td>Range</td>
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<tr>
<td>Sex</td>
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<tr>
<td>Male</td>
<td>14 (66.7) - -</td>
<td>10 (58.8) - -</td>
</tr>
<tr>
<td>Female</td>
<td>7 (33.3) - -</td>
<td>7 (41.2) - -</td>
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<td>5 (29.4) - -</td>
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<td>0 (0) - -</td>
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<tr>
<td>Non-Hispanic/Other</td>
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<td>17 (100) - -</td>
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<tr>
<td>Age (years)</td>
<td>16.3 (0.5) 16-17</td>
<td>35.7 (8.3) 25-49</td>
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<tr>
<td>Length of licensure (days)</td>
<td>32 (26.3) 1-88</td>
<td>(&gt;= 5 years)</td>
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<td>Self-reported Driving History</td>
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<td>Crashes</td>
<td>2 (9.52) - -</td>
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<tr>
<td>Moving Violations</td>
<td>0 (0) - -</td>
<td>8 (38.10) -</td>
</tr>
</tbody>
</table>

*a* Self-reported Driving History

*b* With at least 1 crash or moving violation

*b* Occurring > 5 years prior to study visit
TABLE 2 Driving education instructor evaluation of novice teen and adult drivers on 8 domains of driving

<table>
<thead>
<tr>
<th>Domain of Driving</th>
<th>Teen Drivers (n=21)</th>
<th>Adult Drivers (n = 17)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Speed Management</td>
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<td>1.98</td>
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<td>Road Positioning</td>
<td>5.95</td>
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<td>Managing Blind Spot</td>
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<td>Hazard Anticipation and Response</td>
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<td>1.99</td>
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<tr>
<td>Attention</td>
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</tr>
<tr>
<td>Communication and Right of Way</td>
<td>6.24</td>
<td>1.70</td>
</tr>
<tr>
<td>Vehicle Control</td>
<td>5.52</td>
<td>2.18</td>
</tr>
<tr>
<td><strong>Domain Composite Score</strong></td>
<td>46.81</td>
<td>13.74</td>
</tr>
</tbody>
</table>

*Composite Score obtained by adding up scores from all 8 domains

TABLE 3 Protocol 2 demographic data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Trained Group (n = 20)</th>
<th>Non-Trained Group (n =19 )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>10 (50)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>10 (50)</td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White/Caucasian</td>
<td>11 (55.00)</td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>9 (45.00)</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>1 (5.00)</td>
<td></td>
</tr>
<tr>
<td>American Indian</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic</td>
<td>20 (100)</td>
<td></td>
</tr>
<tr>
<td>Unsure</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td>16.75 (.64)</td>
</tr>
<tr>
<td>Length of licensure (days)</td>
<td></td>
<td>70.05 (65.22)</td>
</tr>
</tbody>
</table>