Cost Analysis of Youth Violence Prevention

WHAT'S KNOWN ON THIS SUBJECT: Violence is a leading cause of death. The emergency department (ED) can prevent violence through proven interventions; however, these interventions are not broadly implemented. There is little evidence to inform decision-makers of the costs associated with preventing violence.

WHAT THIS STUDY ADDS: We report the costs of a brief violence prevention intervention in the ED. We highlight the economic impact of implementation, showing that brief interventions in the ED are an inexpensive way the health care system can prevent violence in adolescents.

abstract

BACKGROUND AND OBJECTIVE: Effective violence interventions are not widely implemented, and there is little information about the cost of violence interventions. Our goal is to report the cost of a brief intervention delivered in the emergency department that reduces violence among 14- to 18-year-olds.

METHODS: Primary outcomes were total costs of implementation and the cost per violent event or violence consequence averted. We used primary and secondary data sources to derive the costs to implement a brief motivational interviewing intervention and to identify the number of self-reported violent events (eg, severe peer aggression, peer victimization) or violence consequences averted. One-way and multi-way sensitivity analyses were performed.

RESULTS: Total fixed and variable annual costs were estimated at $71 784. If implemented, 4208 violent events or consequences could be prevented, costing $17.06 per event or consequence averted. Multi-way sensitivity analysis accounting for variable intervention efficacy and different cost estimates resulted in a range of $3.63 to $54.96 per event or consequence averted.

CONCLUSIONS: Our estimates show that the cost to prevent an episode of youth violence or its consequences is less than the cost of placing an intravenous line and should not present a significant barrier to implementation. *Pediatrics* 2014;133:448–453

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Violence is a leading cause of death among adolescents and is increasingly becoming a public health priority.[1] Interpersonal violence has been estimated to cost 3.3% of the gross domestic product.[2] Although there is evidence to support funding programs for high-risk youth,[3] the implementation of proven interventions are lacking in most health care settings.[4] The established RE-AIM framework (reach, effectiveness, adoption, implementation, and maintenance) highlights the importance of understanding costs in the implementation and maintenance of effective interventions.[5] One strategy to allay perceived cost concerns is through detailed cost analyses describing the funds necessary to implement and maintain an intervention.

The emergency department (ED) can play an important role in violence prevention.[6] Previous data from a randomized controlled trial of a brief intervention that used an indicated prevention approach, the SafERteens study, showed that a brief intervention was effective at decreasing violence.[7,8] Previous research found that, outside of the ED setting, violence prevention programs demonstrate financial benefit.[9–11] The objective of the present article was to report the costs associated with implementing such a program in the ED and the cost to avert violence (ie, peer aggression, peer victimization, violence consequences) among at-risk adolescents (14–18 years old).

METHODS

Intervention Costs

We derived 2012 cost estimates for fixed and variable costs associated with the violence prevention intervention. Fixed costs included development of the software program necessary to direct the intervention, the cost of training personnel to perform the intervention, and the computer hardware. Variable costs included the labor and benefit costs of health care social workers delivering the intervention (which will necessarily vary with the size of the intervention population). Based on experience from the original study, we considered that ~30 minutes of a social worker's time is required to perform the intervention for eligible adolescents. These estimates were used to predict the costs associated with the time required for a social worker to perform the intervention if implemented at a higher volume trauma center. Because adolescent ED volume is the primary driver influencing differences in our variable cost estimates, we modeled the average annual adolescent volume (n = 7884) of pediatric trauma centers involved in the Pediatric Emergency Care Research Network, a large network of pediatric EDs (Rebecca Cunningham, personal communication, unpublished data, 2012). We used current salary and benefits data from the 2011 Bureau of Labor and Statistics and calculated staffing costs based on the amount of time necessary to deliver the intervention.[12,13] The 2011 wage estimates were adjusted to 2012 dollars by using the Consumer Price Index to adjust for inflation from 2011 to 2012.[14] Costs associated with screening for violence were not included in our estimates because universal screening for intimate partner violence already exists, and using this same strategy to ask questions to screen for violence in adolescents should not add a measurable cost burden.[15] We report both fixed and variable costs and performed analyses with each separately and together.[16]

Intervention Effectiveness

The therapist intervention was directed toward at-risk adolescents seeking care at an urban ED who screened positive for past-year aggression (eg, dating violence, weapon carriage/use, peer violence) and alcohol consumption ("In the past year, have you had a drink of beer, wine or liquor more than 2 to 3 times? Do not count just a sip or taste of someone else's drink.").[17] The intervention was delivered by a research social worker trained in motivational interviewing, with the assistance of a tailored computer program; the control group received a brochure. Motivational interviewing develops a discrepancy between future goals and current behavior and increases motivation, self-efficacy, and problem recognition among individuals.[18] The computer program facilitated the intervention by displaying content prompts for the therapists, including tailored feedback for the participant. Compared with the control option, the intervention resulted in less violence at 3 months, defined as the occurrence of severe peer aggression (eg, hit or punched someone, used a knife/gun against someone), peer victimization (eg, hit or punched by someone, had a knife/gun used against them), and violence consequences (ie, trouble at school because of fighting, family or friends suggested you stop fighting, arguments with family or friends because of fighting, felt cannot control fighting, trouble getting along with friends because of your fighting).

We used severe peer aggression, peer victimization, and violence consequences for our primary outcomes in the cost estimate analyses, examining these variables individually and in aggregate. We combined these mutually exclusive variables to assess the total violent events or consequences averted. As reported previously,[7] the intervention demonstrated reductions in occurrence of peer aggression (therapist: −34.3%; control: −16.4%; relative risk [RR]: 0.74 [95% confidence interval (CI): 0.61–0.90]), violence consequences (therapist: −30.4%; control: −13.0%; RR: 0.76 [95% CI: 0.64–0.90]), and peer victimization (therapist: −10.4%; control: 4.7%; RR: 0.70 [95% CI: 0.52–0.95]) at the 3-month follow-up. These previous results were used to

calculate a preventive fraction $(1 - RR)$. Additional details regarding the SafERteens study can be found in previously reported articles.[7,8,19]

Cost-Effectiveness (or Cost per Event Averted)

The cost to avert a violent event or consequence was identified by dividing the costs of the intervention by net events averted.[20] We estimated the net events averted by multiplying the number of adolescents evaluated by the prevalence of violence and the preventive fraction. The time frame for the analysis was 1 year, and a health payer perspective was used.

One-way and Multi-way Sensitivity Analyses

One-way sensitivity analyses were performed to evaluate the impact of varying intervention effectiveness among adolescents, volume, and costs. Multi-way sensitivity analyses were performed to evaluate assumptions by using most favorable and least favorable sets of assumptions to yield best and worst case scenarios. We included both fixed and variable costs in our base analysis because these costs may be relevant to health systems interested in adopting the intervention. However, we also performed analyses by using only variable costs to assess any significant changes to the cost analysis. Results using only variable cost inputs are reported in the multi-way sensitivity analysis.

RESULTS

Intervention Costs

Fixed costs to implement a brief motivational interviewing intervention accounting for the costs to produce software, computer hardware, and to train personnel were estimated to be $48 500 (Table 1). Variable costs were derived by estimating required social worker expenses to perform the intervention and vary based on predicted volume and violence prevalence. The median annual salary for a hospital-based health care social worker,[12] including estimated cost of benefits at 30.8%,[13] was $66 526. The total first-year costs were estimated at $71 784, accounting for the total fixed and variable costs required for implementation.

Cost per Event Averted

Based on the efficacy of the intervention at 3-month follow-up, we predicted that 1540 violence consequences, 1053 episodes of peer victimization, and 1615 episodes of severe peer aggression would be averted if the intervention was fully implemented at an urban ED with an average adolescent volume. This implementation would result in a total of 4208 violent events or consequences averted. It would cost $46.61 per violent consequence averted, $68.20 per peer victimization event averted, $44.44 per event of severe peer aggression averted,

TABLE 1 Costs to Implement a Brief Computer-Guided Therapist Intervention and the Efficacy Results From the SafERteens Trial Used as Inputs for the Analyses

	Costs ($)			Source
	Expected Cost	Low Cost	High Cost	
Fixed Costs				
Cost of software	45 000	40 500	49 500	Personal communication[a]
Cost of hardware	1000	500	1200	Personal communicaton[b]
Cost of training personnel	2500	2250	2750	SafERteens[c]
Total start-up cost	48 500	43 250	53 450	
Variable costs				
Annual salary for a health care social worker	50 861	45 775	55 947	BLS[d]
Mean cost of benefits (30.8% of salary)	15 665	14 099	17 232	BLS[e]
Total annual cost of health care social worker	66 526	59 874	73 179	BLS[f]
Predicted variable year 1 costs	23 284	20 956	25 613	SafERteens[g]
Total fixed and variable year 1 costs	71 784	64 206	79 063	
Intervention Efficacy	RR	95% CI		
		Best RR	Worst RR	
Violence consequence	0.76	0.64	0.90	SafERteens[7]
Peer victimization	0.70	0.52	0.95	SafERteens[7]
Severe peer aggression	0.74	0.61	0.90	SafERteens[7]

[a] Based on a software engineering estimate to reproduce intervention software in 2012 ($\pm$10%).
[b] Estimating $500 cost of a tablet or $1000 to $1200 cost of a laptop.
[c] Based on the costs experienced to train staff in motivational interviewing for the SafERteens intervention ($\pm$10%).
[d] Median 2011 salary from the Bureau of Labor and Statistics (BLS), adjusted to 2012 dollars.[12,14] ($\pm$10%).
[e] Estimated cost of benefits in 2012 from the Bureau of Labor and Statistics[13] ($\pm$10%).
[f] Salary + benefits.
[g] Based on the SafERteens experience, we predicted a 35% increase in daily social worker time to deliver the 30-minute intervention at an ED with a volume of 7884 adolescents per year and 80% screening positive for violence ($\pm$10%).

and $17.06 to avoid a violent event or consequence (Table 2).

Multi-way Sensitivity Analysis

Our multi-way analysis (using worst case cost estimates and intervention efficacy) predicted it could cost up to $54.96 to prevent a violent event or consequence. The best case scenario found it may be as little as $3.63 to avert a violent event or consequence (Table 3).

DISCUSSION

Using data from a randomized clinical trial, we estimated it would cost ~$70 000 to implement this intervention. We estimated that if fully implemented at an average Level 1 pediatric trauma ED, this intervention could avert 4208 violent events or consequences each year among adolescents, costing $17.06 per episode. Our analysis provides necessary information to enhance efforts to translate research into practice as the RE-AIM framework describes. The ED presents an opportunity to reach

high-risk adolescents,[21] the efficacy of SafERteens motivational interviewing has been established, and our analysis now informs the costs associated to adopt and implement a similar intervention.

Our results are critical to assist EDs in evaluating expected costs to identify and advocate for the resources required to reduce violence in their communities. An important consideration of our results is related to the lack of data describing the economic impact of violence. Other cost analyses assessing the impact of prevention programs have used the costs of avoided health care, law enforcement, or property damage costs to show cost savings.[2,9,10,22] The original study of this intervention was not powered to identify improvement in future ED or health care utilization. Currently, data do not exist to relate expected costs to the measured outcomes of fights (severe peer aggression or peer victimization) and consequences of fighting among youth. Therefore, these potential cost savings could not be included in our

cost models. For this reason, it is plausible that our cost analyses may have been too conservative. For example, if preventing severe peer aggression, which could involve weapons, avoids future expenditures related to health care (ie, operating room resources, ICU costs, rehabilitation costs) or law enforcement (eg, juvenile detention) even among 1 youth in this study, then this type of intervention could be substantially less expensive than reported or may even be cost saving. In addition, the avoidance of violence may have other downstream economic benefits not accounted for in this conservative analysis, including the secondary mental health, criminal justice, or subsequent substance use problems and associated costs, that youth may incur if the violence averted had occurred. Although a less conservative approach would yield an even more favorable cost analysis, given the paucity of previous data in this area, we chose to present a more conservative analysis.

Our start-up cost predictions were based on our urban ED in 2012 dollars, and it is important to note that regional and time variations may affect replication of results. The labor costs were based on reported data from the Bureau of Labor and Statistics[12] but will also vary depending on regional differences. Our patient population included those who indicated past year violence and alcohol use; it is possible that applying this intervention more broadly to those with no history of alcohol use may yield different results.

Our outcomes (violence consequences, peer victimization, and severe peer aggression) were mutually exclusive variables representing distinct constructs, providing justification for combining them to analyze in aggregate. It should be noted, however, that the authors of this article have no information on whether all 3 outcomes were a result of 1 fight or separate altercations. Furthermore, we do not have any knowledge

TABLE 2 Projected Number of Violent Events or Violence Consequences Averted and the Associated Costs if an Adolescent Violence Intervention Was Implemented in an Average Volume Level 1 Trauma Center

Variable	Averted Events, $[a]	Cost/Event Averted, $[b]
Violence consequences averted (baseline risk[c]: 81%)	1540	46.61
Peer victimization averted (baseline risk[c]: 45%)	1053	68.20
Severe peer aggression averted (baseline risk[c]: 79%)	1615	44.44
Total violence averted	4208	17.06

[a] Averted events = $(1 - RR) \times$ (baseline risk of event) $\times$ (volume of adolescents). The volume of adolescents used for estimates was 7884 per year.
[b] Cost per averted event includes both fixed and variable costs for 1 year. Details of these costs can be found in Table 1.
[c] Baseline risk was previously reported as part of the SafERteens trial[7] and is the percentage of adolescents reporting an occurrence of the event in the previous 12 months.

TABLE 3 Multi-way Sensitivity Analyses for Cost per Averted Event

Cost	Best Case, $[a]	Worst Case, $[b]
Cost to avert a violent consequence	10.08	123.20
Cost to avert peer victimization	13.83	450.71
Cost to avert severe peer aggression	9.61	127.26
Cost to avert any violence	3.63	54.96

[a] Least expensive estimates only account for variable costs for 1 year. Most effective estimates use the most efficacious reported intervention results to calculate the number of preventable outcomes over 1 year (95% CI).[7]
[b] Most expensive estimates account for fixed and variable costs based on highest estimates for 1 year. Least effective estimates use the least efficacious reported intervention results to calculate the number of preventable outcomes over 1 year (95% CI).[7]

regarding the other person, or persons, involved in the violence; we estimated cost analysis based on savings from youth in our study. By definition, peer violence involves another person; additional cost savings for the other person(s) avoiding involvement with violence were not included in our study and could provide additional cost savings not considered. To address this potential limitation, we present data and costs for each individual outcome, as well as in aggregate.

In the current era of value-driven health care, it is important to give context to the costs incurred to implement violence prevention resources in the ED. Nationally, an average ED visit costs $1349, an average pediatric ED visit for a firearm injury costs $3642, and if admitted to the hospital, the mean charge is $70 164.[23,24] If the violence intervention prevented 1 firearm-related admission per year, it would cover the annual cost of the intervention. Even our worst case cost estimates of $54.96 to

avert violence would be a small portion of an ED visit's costs. For example, when considering the $17.06 expected to prevent violence, this amount is less than the cost of an intravenous line placement. For these reasons, we feel that resources spent to implement violence prevention interventions can add significant value to ED encounters. We suggest policy changes to reimburse for violence prevention counseling in the same way alcohol, tobacco, and other preventive counseling interventions are reimbursed, regardless of the setting in which these services are offered.[25,26] This reimbursement may help diffuse the costs associated with implementation of violence prevention interventions.

Our estimates may be conservative due to the limited evidence available regarding longer term health and economic impacts of adolescent violence. Future research should identify the costs incurred as a result of adolescent violence and its effect on the quality of

life of those involved. We expect that using more detailed data to appropriately account for the economic impact of adolescent violence would likely identify similar violence interventions to be cost saving.

CONCLUSIONS

A brief ED intervention to prevent violence among high-risk youth was estimated to cost a pediatric trauma center $17.06 per violent event or consequence averted. From an economic perspective, this amount is attractive compared with the average costs to the health care system for a single ED visit. Similarly, from a public health perspective, it is an attractive option to prevent a leading cause of death among adolescents.

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