Staying Alive: Assessing CPR Training in King County Schools

Prepared for

Emergency Medical Services Division
Public Health - Seattle & King County

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Abstract

CPR training is a well-established component of the school curriculum in 16 King County school districts. This study aims to determine the training retention rate (from middle to high school), assess memory of CPR techniques, and evaluate confidence in performing CPR. A pre-training questionnaire was administered to 1,073 high school students across King County, Washington, who attended CPR training during the months of March, April and May 2012. Over 68% of students reported having attended at least one CPR training session, and 46% of these had been trained within the last 2 years. Overall, students were most confident when the patient was very familiar (i.e. family member) and least confident when the patient was least familiar (i.e. a stranger) and the difference in confidence was statistically significant at the 0.001 level. The level of confidence was associated with the number of times students had been previously trained, as well as the duration since their last training. Training related fears accounted for the most of the low confidence in untrained students, while psychological fears and fears based on misconceptions accounted for low confidence in trained students. Students' ability to correctly identify components of CPR was statistically significantly different for several factors including previous training, school performance and income status. However, even 2-5 years after training, knowledge of CPR in trained students is much higher than that of untrained students. Together, these results provide strong evidence for maintaining CPR training as part of middle and high school curricula.

Introduction

Across the US only 2-11% of individuals survive after suffering from a sudden cardiac arrest, while the survival rate in King County is at 52%. One reason for this may be the effect of bystander cardiopulmonary resuscitation (CPR) due to a relatively high level of awareness about CPR in the region. Administration of cardiopulmonary resuscitation (CPR) on victims of cardiac arrest is known to increase survival. Studies have shown that individuals who have previously received CPR training are more likely to perform CPR in emergency situations than their untrained counterparts.[1] CPR training improves likelihood of bystander CPR, since individuals are less likely to be afraid or anxious.[2]

CPR training is a well-established component of the school curriculum in 16 King County school districts. The American Heart Association (AHA) updated its guidelines in 2010, and the following year CPR instructors switched from teaching full CPR to compression-only CPR as outlined in AHA's Family and Friends CPR course. CPR training has been a part of the curriculum in King County middle schools for over 20 years, but has also been included in high school curriculum within the last five years. At the high school level, CPR is taught as part of health or physical education classes, and varies greatly in duration and content depending on the school. This study aims to determine the training retention rate (from middle to high school), assess memory of CPR techniques, and evaluate confidence in performing CPR. The research will inform planning of school-based CPR training programs within King County and beyond.

Methods

Survey Design

A number of key informants were interviewed to understand the history of CPR training in King County, as well as get guidance on what would be important research questions to address. Experiences gained from observing a high school CPR training class and riding along with a Medic One unit also provided significant insight for survey development. The final survey was compiled by adapting questions from previous work and getting feedback from several key informants.[1,3] The study methodology was reviewed by the University of Washington Human Subjects Division and granted a certificate of exemption.

Sampling

Targeted sampling was conducted by contacting CPR coordinators for all school districts in King County. According to the information provided, 32 of the 69 public high schools in King County offered CPR training in 2012. Sampling was limited to King County high schools that offered CPR training during the months of March, April and May 2012 (Figure 1). The survey questionnaire was administered to all classes by a single researcher in the first 5-10 minutes of a scheduled CPR training session. After collecting the completed questionnaires, the researcher silently observed the entire CPR training session. The survey sample consisted of 46 classes from 11 schools with class sizes ranging from 12 to 30 students per class.

Demographic data for King County was obtained through the US Census Bureau. Additional information about socioeconomic indicators, such as school's performance on standardized tests or the number of students on reduced price lunches was obtained from Washington's Office of Superintendent of Instruction (OSPI).[4] Collectively, this data was used to ensure that the sample adequately represented the racial, socioeconomic and cultural diversity of King County.

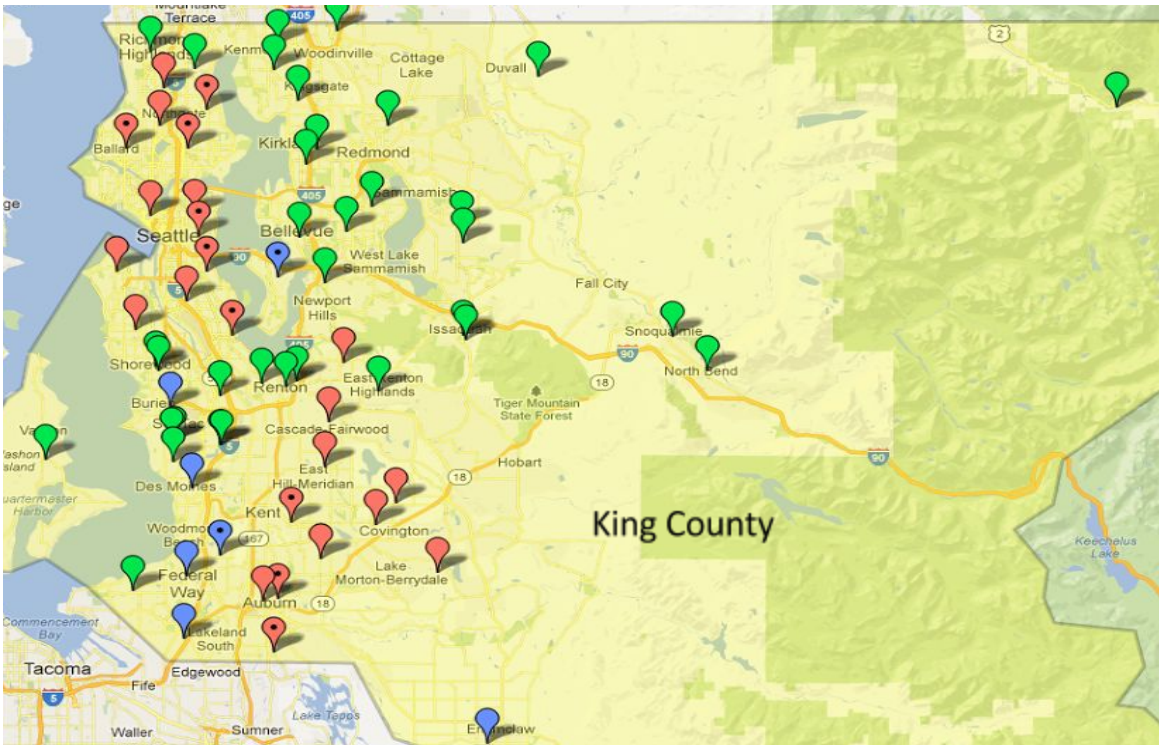

Figure 1. Public high schools in King County where CPR training was (i) not provided (green), (ii) provided by the Fire Department (red), or (iii) provided by school teachers (blue) at the time of the study. Markers with black dots indicate sampling sites (See Appendix C for a full list of schools)

Analysis

Survey data was tabulated, organized and edited for correctness in Microsoft Excel 2010. Responses to open-ended questions (question 5 and question 8 "other", see Appendix A) were reviewed and grouped into similar categories. Categories and grouped responses were reviewed for accuracy by an independent individual (Patricia Atwater) before any analysis was conducted. Numeric values were assigned to the various levels of confidence reported for question 7 to quantify a mean and determine statistical significance (where 1 equals least confident and 3 equals very confident).

Question 9 asked participants to select any of the six statements they considered to be true. A score of +1 was assigned for each correct response, while a score of 0 was assigned for each incorrect response selected (Table 5). Based on this scoring guide, students could get a score ranging from 0 to 6 points. If all boxes were checked, the student got a score of 4. A perfect score of 6 could only be achieved by checking the appropriate boxes AND not checking the incorrect options. If none of the boxes were checked, the student was assumed to have not answered the questions and the entry was assigned a "missing" value.

Table 1. Scoring guide for question 9 regarding components of CPR

	If selected	If not selected
Making sure the scene is safe	1	0
Checking to see if the person is not conscious and not breathing normally	1	0
Pushing gently on the person's chest with your fingers	0	1
Pushing hard on the person's chest with the palm of your hand	1	0
Pushing fast on the person's chest (at least 100 compressions per minute)	1	0
Pushing slowly on the person's chest (30 compressions per minute)	0	1

SPSS Statistical Package (PASW 18 Release 18.0.3) was used to generate frequency distributions, compare variables, perform tests for significance and create regression models.

Results

General findings regarding CPR training

While the sample population represented more individuals from Seattle Public Schools than other schools districts in King County, most of the characteristics of the sample population are representative to those observed in the general King County population (Table 2).

Table 2. Self-reported demographics of survey respondents compared to King County Census 2010 data

Variable	Survey Sample (N = 1073)		King County [1]
	Frequency	Percent (%)	Percent (%)
Sex			
Female	523	48.7	49
Male	526	49.0	51
Missing	24	2.2	
Race/Ethnicity			
Non-Hispanic White	485	45.2	64.8
African American	91	8.5	6.2
American Indian or Alaska Native (AIAN)	11	1.0	0.8
Asian	140	13.0	14.6
Hispanic/Latino	111	10.3	8.9
Native Hawaiian or Other Pacific Islander (NHOPI)	15	1.4	0.8
Other	24	2.2	
Two or more	173	16.1	5.0
Missing	23	2.1	
Language (s) spoken at home			
English	754	70.3	75.7
Spanish	63	5.9	
Chinese (Cantonese/Mandarin)	32	3.0	
Somali/Amharic	18	1.7	
Vietnamese	15	1.4	
Tagalog	10	0.9	
Other	39	3.6	
Two or more	125	11.6	
Missing	17	1.6	
Geographic location			
Seattle Public Schools	551	51.4	18.5
Other King County School Districts	522	48.6	81.5
Socioeconomic Indicators			

[1] Sex, Race/ethnicity and Language data from 2010 US Census; Socioeconomic indicators as reported by the Office of the Superintendent of Public Instruction (OSPI) for the 2011-12 academic year.

Average score on standardized tests (Reading, Writing, Science, Math)		78.0	79.8
Percent of students receiving subsidized lunches		39.2	36.8

Over 68% of students reported having attended at least one CPR training session, as seen in Table 3 below. Thirty-six percent of students admitted to not knowing how to perform CPR even though only 31% admitted to never having attended a CPR training session. This suggests that roughly 5% of the students surveyed did not recall the complete process of performing CPR.

Table 3. Summary of responses for questions 1 through 6 on the survey

Variable	Frequency	Percent (%)
Self-assessed knowledge of CPR (n = 1073)		
Yes	680	63.4
No	386	36.0
Missing	7	0.7
Number of times previously trained (n = 1073)		
None	336	31.3
1	419	39.0
2	185	17.2
3 or more	128	11.9
Missing	5	0.5
Duration since last training (n = 748)		
Within the last year	203	18.9
1-2 years ago	294	27.4
2-5 years ago	201	18.7
Can't remember	50	4.7
Reason for previous training (n = 745)		
School	626	75.5
Work	99	11.9
Volunteer	73	8.8
Other	31	3.7
Reasons for never attending a previous training (n=264)		
Lack of opportunity	71	26.9
No particular reason	47	17.8
Never thought about it	46	17.4
Didn’t deem it necessary	43	16.3
Lack of time	26	9.8
Positive comment	13	4.9
Unaware of how to access training	12	4.5
New to the country	6	2.3
Witnessed or Performed CPR (n = 1073)		
Neither	790	73.6
Performed	38	3.5
Witnessed	184	17.1
Both	33	3.1
Missing	28	2.6

The majority of trained students cited school as the main reason for training, while 12% stated work-related reasons (e.g. babysitting and lifeguarding) and roughly 9% cited getting trained through volunteer associations (e.g. boy scouts, church activities, red cross, etc.). Other reasons included camping, visiting a local fire station or other extracurricular activities.

Approximately one-third of untrained students provided no explanation for why they had never attended a CPR training session. Of those who did respond, the most common reasons included lack of opportunity (27%), never having thought about getting trained (17%) or not considering CPR as an important skill to learn (16%). Table 3 in Appendix B provides some examples of the types of comments for each category. A surprisingly large proportion of students reported witnessing or performing CPR (17.1% and 3.5%, respectively).

In general, students reported feeling the most confident performing CPR on a family member or a good friend, and least confident performing CPR on a stranger (Figure 2).

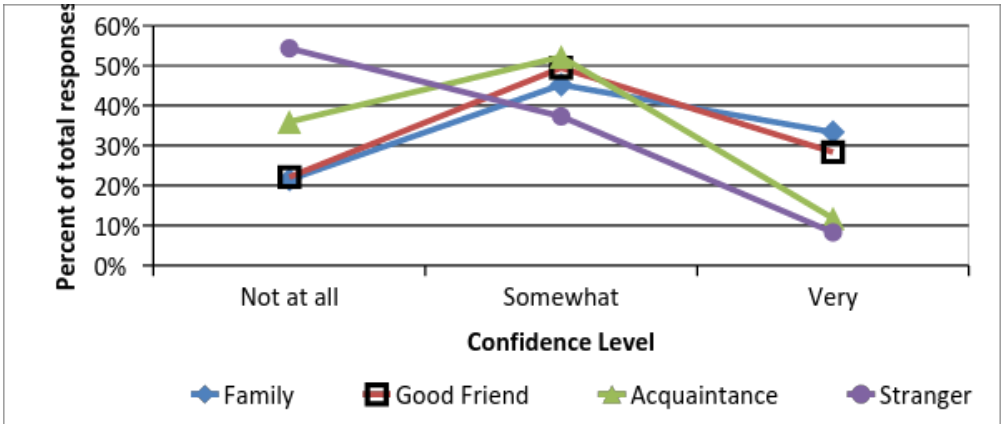

Figure 2. Self-reported level of confidence performing CPR on a family member (N = 1062), a good friend (N = 1058), an acquaintance (N = 1052) and a stranger (N = 1051)

Confidence performing CPR

Students were asked to report how confident they felt performing CPR in an emergency on individuals with varying degrees of familiarity. Overall, students were most confident when the patient was very familiar (i.e. family member) and least confident when the patient was least familiar (i.e. a stranger) (Table 2). The results of paired t-tests indicate that students report higher levels of confidence in performing CPR on a family member, good friend or acquaintance compared to a stranger (Table 4, all differences in mean statistically significant).

Table 4. Results of paired t-tests comparing difference in means for confidence performing CPR on family member, friend and acquaintance relative to stranger. Confidence was rated on a scale from 1 (Not at all confident) to 3 (Very confident).

	Mean Confidence	N	Mean Difference compared to "Stranger"	95% CI for difference		Sig.
				Lower	Upper	
Family member	2.11	1048	0.574	0.527	0.622	<0.00

						1
Good friend	2.06	1049	0.518	0.474	0.562	<0.001
Acquaintance	1.76	1046	0.218	0.189	0.247	<0.001
Stranger	1.54	1046				

A series of ANOVA tests were conducted to determine the significance of the association between training and level of confidence performing CPR on different victims (Table 5). Students who have attended at least one training in the past feel significantly more confident than untrained students in performing on all victim types. Students' level of confidence differs significantly across victim types, regardless of training status. Students' level of confidence also correlates to the time elapsed since previous training. As illustrated in Table 6, level of confidence performing CPR in general decreases as more time elapses from the last time the student was trained. Students who were trained 2-5 years ago were in general still more confident performing CPR than untrained students.

Table 5. Association between training and level of confidence performing CPR on different victims. Confidence was rated on a scale from 1 (Not at all confident) to 3 (Very confident).

Prior Training	Level of Confidence Performing CPR								Sig.
	Family		Friend		Acquaintance		Stranger		
	N	Mean	N	Mean	N	Mean	N	Mean	
Untrained	331	1.91	326	1.83	323	1.54	324	1.37	<0.001
Trained at least once	727	2.21	726	2.16	724	1.85	722	1.61	<0.001
Sig.	<0.001		<0.001		0.001		<0.001		

Table 6. Association between self-reported confidence and duration since last CPR training. Confidence was rated on a scale from 1 (Not at all confident) to 3 (Very confident).

Duration since last training	**Level of Confidence performing CPR**							
	Family Member		Good Friend		Acquaintance		Stranger	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
<1 year	2.37	2.28, 2.46	2.36	2.28, 2.44	2.00	1.91, 2.09	1.71	1.61, 1.81
1-2 years	2.26	2.18, 2.33	2.18	2.11, 2.25	1.86	1.78, 1.93	1.61	1.54, 1.68
2- 5 years	2.01	1.92, 2.11	1.97	1.87, 2.07	1.71	1.62, 1.79	1.53	1.44, 1.61
Untrained	1.88	1.79, 1.97	1.81	1.73, 1.90	1.52	1.46, 1.59	1.36	1.29, 1.42

Table 7 lists the results of one-way analysis of variance (ANOVA) to determine if students' level of confidence performing CPR differs by demographic differences. In each instance, level of confidence is significantly different between the types of victims; confidence increases with the degree of closeness to the victim (i.e. highest for family member). Students who are not white, male, speak languages other than English at home, live south of downtown Seattle and belong to lower socioeconomic groups (as indicated by School performance and lunch subsidies) are more confident performing CPR.

A second set of ANOVA tests compared demographic differences in level of confidence performing CPR on the same victim type (e.g. difference in confidence for white and non-white students performing CPR

on a family member) (Appendix D). Non-white students were significantly more confident than white students performing CPR on a family member or a good friend. Male students were only significantly more confident performing CPR than female students when the victim was a family member. Students who spoke languages other than English at home were significantly more confident performing CPR on all victim types except good friends. Students attending schools located south of downtown, with more than half the students receiving subsidized lunches or with standardized test scores of 79% of lower reported significantly greater confidence performing CPR on nearly all victim types.

Table 7. One way analysis of variance between demographic variables and students' level of confidence. Confidence was rated on a scale from 1 (Not at all confident) to 3 (Very confident).

Independent Variable		Level of Confidence performing CPR								Sig.
		Family		Friend		Acquaintance		Stranger		
		N	Mean	N	Mean	N	Mean	N	Mean	
Race	White	483	2.00	484	1.98	483	1.72	483	1.56	<0.001
	Non-white	561	2.22	555	2.14	550	1.79	549	1.52	<0.001
Sex	Female	519	2.07	518	2.04	514	1.68	517	1.48	<0.001
	Male	523	2.17	520	2.08	518	1.83	514	1.60	<0.001
Primary language spoken at home	English	751	2.07	751	2.03	747	1.76	746	1.55	<0.001
	Non-English	298	2.22	293	2.12	291	1.74	291	1.51	<0.001
Geography proximity to downtown Seattle	South	531	2.20	526	2.12	522	1.80	522	1.56	<0.001
	North	531	2.04	531	2.00	529	1.71	528	1.52	<0.001
School performance	Mean score <79%	599	2.18	594	2.11	589	1.79	588	1.55	<0.001
	Mean score >80%	463	2.04	463	2.00	462	1.71	462	1.52	<0.001
Students on subsidized lunches	*>50%*	357	2.28	353	2.20	349	1.85	350	1.59	<0.001
	<50%	705	2.04	704	1.99	702	1.71	700	1.51	<0.001
School district	Seattle Public Schools	543	2.12	540	2.06	537	1.75	537	1.54	<0.001
	Other School Districts	519	2.11	517	2.06	514	1.77	513	1.54	<0.001

A series of chi-square tests were conducted to determine if demographic variables are associated with the number of training sessions students have attended in the past. Interestingly, students who did not speak English at home, attended schools that were south of downtown, attended schools with a greater proportion of students receiving subsidized lunches or attended schools that performed lower on standardized tests were significantly less likely to have attended any CPR training sessions in the past.

Reasons that students identified for low level of confidence performing CPR fall into 3 major categories: those related to training, fears based on misconceptions and other psychological fears. Refer to Table 1 in Appendix C for sample types of responses for each category. Surprisingly, students who attended at least one training were slightly more likely to have fears based on misconceptions or other psychological fears (Table 9).

Table 8. Results of chi-square tests for associations between demographic variables and the number of times students were trained.

Variable		Previous Training				Total	Sig.
		Untrained		Trained at least once			
		N	%	N	%	N	
Race	*White*	134	27.6%	351	72.4%	485	0.027
	Non-white	191	34.0%	370	66.0%	561	
Sex	*Female*	168	32.2%	354	67.8%	522	0.641
	Male	161	30.8%	362	69.2%	523	
Language spoken at home	*English*	214	28.5%	538	71.5%	752	0.002
	Non-English	115	38.3%	185	61.7%	300	
Geography proximity to downtown Seattle	*South*	235	43.8%	302	56.2%	537	<0.0001
	North	101	19.0%	430	81.0%	531	
School Performance	*Mean score<79%*	265	43.9%	339	56.1%	604	<0.0001
	Mean score>80%	71	15.3%	393	84.7%	464	
Students on subsidized lunches	*>50%*	147	40.6%	215	59.4%	362	<0.0001
	<50%	189	26.8%	517	73.2%	706	
School District	*Seattle*	114	20.8%	434	79.2%	548	<0.0001
	All other districts	222	42.7%	298	57.3%	520	

Table 9. Reasons for low confidence performing CPR in an emergency

	Untrained		Trained		All	
Reason	**N**	**%**	**N**	**%**	**N**	**%**
Training related		**45.4**		**34.0**		**37.6**
Feel inadequately trained	203	29.5	362	23.7	565	25.5
Not sure when CPR is needed	94	13.6	141	9.2	235	10.6
Don't know CPR	16	2.3	1	0.1	17	0.8
Memory/Recall	0	0.0	15	1.0	15	0.7
Fears based on misconceptions		**31.9**		**38.4**		**36.3**
Injuring person	135	19.6	337	22.1	472	21.3
Getting germs	50	7.3	136	8.9	186	8.4
Get into trouble	32	4.6	102	6.7	134	6.0
Fear of death	3	0.4	10	0.7	13	0.6
Psychological fears		**20.6**		**26.2**		**24.5**
Discomfort with physical closeness	79	11.5	197	12.9	276	12.5
Nervous around sick people	58	8.4	157	10.3	215	9.7

Self-doubt	4	0.6	32	2.1	36	1.6
Not knowing the person	1	0.1	14	0.9	15	0.7
Other	**14**	**2.0**	**22**	**1.4**	**36**	**1.6**
Total	689	100.0	1526	100.0	2215	100.0

Recognizing Components of CPR

Responses to Question 9 were scored as described in the Methods section. The average score of the entire sample was found to be 3.86. Mean scores were compared between different groups to see if any differences were observed based on gender, prior training, geographic location, school performance and (average) income status. While the differences were small, they were statistically significant at the 0.05 level for previous training, school performance and income status (Table 10). Figure 2 below illustrates that even 2-5 years after training, knowledge of CPR in trained students is much higher than that of untrained students, especially for checking to make sure the scene is safe.

Table 11 below compares the ability of students to correctly identify the components of CPR relative to their training status. Students that had previously attended at least one training were more likely than untrained students to check for scene safety and recognize the signs of CPR (unresponsive and not breathing). Attending more than one CPR training session appears to reinforce the basic level of knowledge regarding the components of CPR (Figure 3).

Table 10. Differences in scores on Question 9 (components of CPR)

Factor	Comparison Groups	N	Mean	Mean Difference	95%CI		P-value
					Lower	Upper	
Gender	Female	504	3.81	-0.099	-0.245	0.046	0.181
	Male	504	3.91				
Prior training	Never attended a training	308	3.51	-0.500	-0.655	-0.345	<0.001
	Attended at least 1 training	709	4.01				
Prior training	Not trained or trained once	717	3.77	-0.291	-0.449	-0.133	<0.001
	Trained 2 or more times	300	4.06				
Training venue	Trained at non-school venues	112	3.93	-0.081	-0.316	0.153	0.497
	Trained at school	610	4.01				
School District	Seattle Public Schools	529	3.92	0.140	-0.004	0.285	0.057
	Other King County School Districts	491	3.78				
School Performance	Average <79% on test scores	570	3.66	-0.443	-0.586	-0.300	<0.001
	Average >80% on test scores	450	4.10				
Income status	>50% of students on free/reduced priced lunches	334	3.57	-0.428	-0.580	-0.276	<0.001
	<50% of students on free/reduced price lunches	686	4.00				

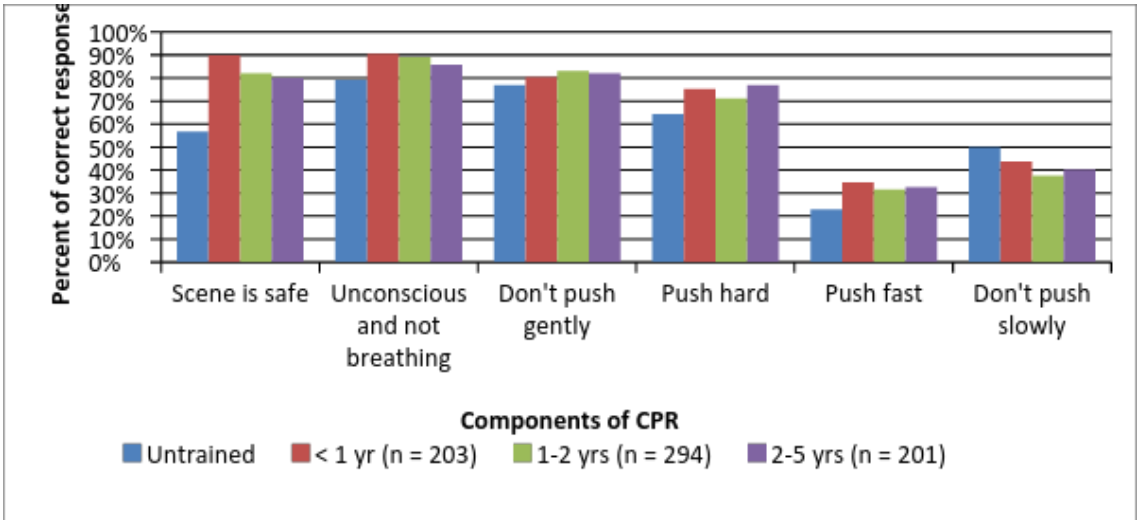

Figure 3. Association between identifying components of CPR and duration since last training

Table 11. Association between training and ability to correctly identify the components of CPR

Correct Response	Never trained (N=336)		Trained at least once (N=732)	
	Freq	Valid %	Freq	Valid %
Making sure the scene is safe	175	57%	594	84%
Checking to see if person is unconscious & not breathing	244	79%	626	88%
Don't push gently with fingers	237	77%	583	82%
Push hard with palm	198	64%	524	74%
Push fast (>100 compressions/min)	71	23%	126	33%
Don’t push slowly (30 compressions per minute)	154	36%	280	39%

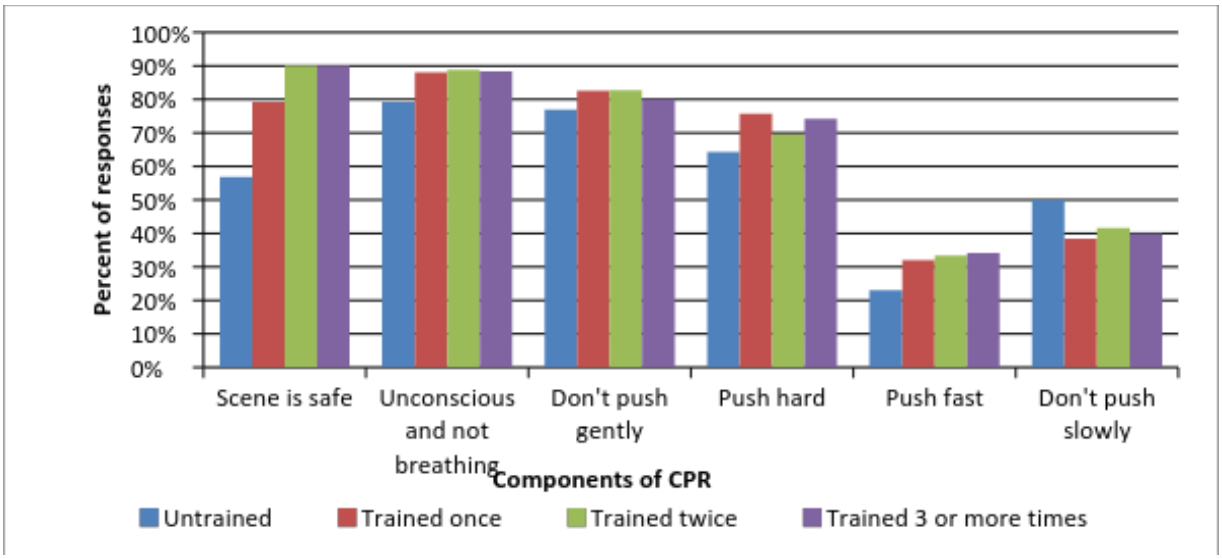

Figure 4. Association between identifying components of CPR and number of times previously trained

Discussion

The percentage of students who reported being trained in CPR (68%) is similar to the percentage of CPR trained King County residents (79%) reported by Sipsma et al.[1] Even though CPR training has been a part of middle school curriculum in King County for over 20 years, 31% of students have never attended a training session. This points to the importance of having a second CPR training session prior to graduation from secondary school. Surprisingly, roughly 12% of students indicated having attended three or more sessions. Their comments revealed that these students were likely enrolled in physical exercise (PE) or health classes, other extracurricular sports or other activities that brought greater exposure to CPR training.

When asked if students had ever witnessed or performed CPR, the proportion of students who said they had either witnessed, performed or done both was much higher than expected (especially when compared to the results of a telephone survey previously conducted in King County in 2008).[1] The way the question is phrased does not clarify if this is in reference to real-life situations and on humans, and it is likely that students may have assumed that witnessing CPR on television or practicing CPR on a mannequin were valid reasons for checking the boxes.

Confidence performing CPR

Level of confidence performing CPR was found to be related to the closeness of the relationship with the patient. A study of high school students in New Zealand found similar results in that students were more willing to perform CPR on family member than a complete stranger[5]. Trained students were significantly more confident than untrained students to perform CPR, which is consistent with the relationship between training and confidence that others have shown.[6] Swor et al showed that CPR provision was more common in bystanders that had received CPR training within five years. Our survey found that even after 2-5 years have elapsed since their training, trained students are more confident than their untrained counterparts. Additionally, even 2-5 years after their training, students are still able to correctly identify the core components of CPR. This points to the importance of students receiving continued CPR training.

The association between having attended at least one training in the past and attending a school north of downtown is likely due to the fact that CPR training in Seattle Public Schools is much more routine and an established program, whereas CPR training is not as consistent throughout the remaining school districts in King County.

Interestingly, lower socioeconomic status (as reflected by lower school performance or higher proportion of students on subsidized lunches) was associated with higher confidence in performing CPR on family, friend and acquaintances. These same parameters were also associated with a lower likelihood of being trained in CPR. Is it possible that ignorance is bliss? Untrained students were less likely to cite psychological fears or fears based on misconceptions as reasons for low confidence. Konstad et al found that fear of disease transmission was higher in Norwegian students with a higher level of knowledge of CPR, and we observed similar results.[3]

Reasons cited for low confidence in performing CPR provide an opportunity to improve existing CPR

training methods. Many of the fears based on misconceptions can be addressed during training. For instance, over 20% of students felt low confidence in performing CPR because they were afraid of injuring the person. This can be addressed during training by explaining that in most cases chest compressions do minimal harm but are extremely beneficial since they enable the circulation of oxygenated blood. Similarly, it is important to explain that compressions-only CPR reduces the chance of a person contracting any illnesses, that persons performing CPR in an emergency are protected by good Samaritan laws, and that failure to perform CPR correctly will not kill a person since theoretically if they are unresponsive and not breathing, they are already dead. As one instructor put it, if you don't do anything, the person is only going to get "deader" by the minute and their odds of being successfully resuscitated worsen.

Recognizing Components of CPR

Trained students were more likely to correctly identify the components of CPR than untrained students. Additionally, students trained two or more times were significantly more likely to correctly identify the core components of CPR than students who were not trained or trained only once. This provides evidence for the need to re-train individuals, and is consistent with the work of others that have shown limited retention of CPR knowledge (from 33 - 52%) only six months after being trained.[7,8]

Our survey showed that 57% of untrained student knew that they should check to make sure the scene is safe and 77% knew that they should make sure the person was unconscious and not breathing. Both trained and untrained students were able to correctly identify how compressions should be performed. While some of this may be attributed to the format of the question (check all that apply), this is likely not the only explanation. One could speculate that much of this observation can be attributed to the coverage of CPR in popular culture, especially as seen on TV or in movies.

A much lower percentage of students were correctly able to identify the rate of compressions. Here, it is important to explain that recent changes in the American Heart Association's training guidelines may be the source of some confusion. Previously, students were taught to perform 30 compressions followed by 2 rescue breaths; as of 2011, mouth-to-mouth resuscitation has been eliminated from the training for lay persons and students are taught to perform chest compressions at a rate of 100 compressions per minute. It is possible that while trained students realized that compressions need to be hard and fast (not slow and gentle), they also recall being told to perform 30 compressions. As a result, many students may have marked either, both or none of the boxes pertaining to the rate of compressions. Since this study is not able to look back retrospectively at the particular components of the training students received previously, it is not possible to determine a source for this confusion. However, in the CPR training session that followed after students filled out the survey questionnaire, one student in nearly every class asked the instructor why they no longer needed to give rescue breaths, or if the 30:2 ratio no longer applied.

Conclusions

This study found that the training retention rate from middle school to high school is 68%, with over 46% of students receiving training within the last two years. Even 2-5 years after training, trained students scored higher in their ability to correctly identify the components of CPR than untrained students. Confidence performing CPR was greater for family members than strangers, and trained

students were generally more confident than their untrained counterparts. Together, this study provides strong evidence for the need to continue CPR training as part of middle and high school curricula.

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Appendix A: Survey Form

Cardiopulmonary Resuscitation (CPR) Training Survey

1) Do you know how to perform CPR? ☐ Yes ☐ No

2) Before today, how many times have you previously completed a CPR training class?
☐ 0 ☐ 1 ☐ 2 ☐ 3 or more

If you answered "0", skip to question 5. If you have attended a CPR training class, answer questions 2, 3 & 4 but skip question 5.

3) When was the most recent time you attended a CPR training class?
☐ Within the last year ☐ 1-2 years ago ☐ 2-5 years ago ☐ Can't remember

4) Did you get CPR training for any of the following reasons?
☐ Through a volunteer association (E.g. Boy and Girl Scouts)
☐ Was a work requirement (E.g. babysitting, lifeguard, camp counselor)
☐ Through school
☐ Other: _____

5) If you have never attended a CPR training session, can you tell us why?

_____

_____

6) Have you ever witnessed and/or performed CPR? *(Check all that apply)*
☐ Have witnessed ☐ Have performed ☐ Have done neither

7) In an emergency, how confident would you feel performing CPR on: *(Check only 1 option per row)*

	Very Confident	Somewhat confident	Not at all
Family member	☐	☐	☐
Good friend	☐	☐	☐
Acquaintance (person is familiar but not close to you)	☐	☐	☐
Stranger	☐	☐	☐

8) If you answered "somewhat confident" or "not at all," why do you feel this way? *(Check all that apply)*
☐ Do not feel adequately trained ☐ Afraid of injuring the person
☐ Afraid of getting into trouble ☐ Do not know when someone needs CPR
☐ Get nervous around sick or injured people ☐ Uncomfortable being too physically close
☐ Afraid of getting germs from the person
☐ Other: _____

9) What are the components of good CPR? *(Check all that apply)*
☐ Making sure the scene is safe
☐ Checking to see if the person is not conscious and not breathing normally
☐ Pushing gently on the person's chest with your fingers
☐ Pushing hard on the person's chest with the palm of your hand
☐ Pushing fast on the person's chest (at least 100 compressions per minute)
☐ Pushing slowly on the person's chest (30 compressions per minute)

10) Race/Ethnicity: *(Check all that apply)*
☐ White/Caucasian ☐ Black/African American ☐ American Indian/Alaska Native
☐ Hispanic/ Latino ☐ Asian ☐ Native Hawaiian /Pacific Islander
☐ Other: _____

11) Sex: ☐ Male ☐ Female 12) Grade: ☐ 9 ☐ 10 ☐ 11 ☐ 12

13) What language is most often spoken in your home?
☐ English ☐ Spanish ☐ Chinese (Cantonese, Mandarin) ☐ Vietnamese
☐ Tagalog ☐ Somali/Amharic ☐ Other: _____

Figure 1. CPR training survey

Appendix B: Additional Information and Coding Guides

Table 1. Sample sites and socioeconomic indicators

School	Sample Size	School District	Geographic Location[2]	Average Test Scores[3]	Students on subsidized lunches[4]
Auburn Riverside High	161	Auburn	South	80.2%	32.6%
Auburn Senior High	182	Auburn	South	71.2%	53.1%
Ballard High	139	Seattle	North	81.6%	22.5%
Franklin High	102	Seattle	South	69.8%	69.0%
Garfield High	68	Seattle	North	76.6%	41.3%
Kent-Meridian High	49	Kent	South	60.9%	69.8%
Mercer Island High	117	Mercer Island	North	93.2%	3.6%
Nathan Hale High	118	Seattle	North	82.9%	31.6%
Rainier Beach High	31	Seattle	South	46.26%	81.9%
Roosevelt High	93	Seattle	North	87.6%	19.7%
Thomas Jefferson High	15	Federal Way	South	71.5%	46.1%

Table 3. Coding template for question 5: reasons for never attending a CPR training sessions

Category	Sample Responses
Lack of time	No time: *"I don't have time"*
Lack of opportunity	No chance: *"Never had the opportunity"; "I hadn't gotten a health class before"* Switched schools: *"moved away during grade 8"* Not offered at school: *"went to a private school where it wasn't mandated"*
Didn't know how to access training	Didn't know where to go: *"…I don't know how or where to go"*
Never thought about it	Never heard of CPR or training: *"I don't understand what is meant by CPR…"* *"Never thought about it"*
Didn't deem it necessary	Didn't think I'd need it: *"Didn't think it was necessary"* Wasn't required to do it: *"I was never required by a former job to know CPR"* Not interested/don't care: *"Never cared to go"; "didn't want to"*
No particular reason	Don't know: *"I don't know I just never did"* No reason: *"No I never did"; "No"* Never got around to it
New to the country	New to US: *"Because I just come to America this year"*

[2] Proximity relative to downtown Seattle

[3] This is an average of grade 10 MSP/HSPE scores for Reading, Writing, Science, Math (year 1) and Math (Year 2) as reported by the OSPI for the 2011-2012 academic year

[4] As reported by the OSPI for the 2011-2012 academic year

Positive comment	Taught informally by family member: *"...my parent taught me, they're a volunteer and a professional firefighter"* Acknowledge importance of knowing CPR: *"Self-defense against death"; "Save a life"*

Table 4. Coding template for question 8: reasons for low confidence performing CPR in an emergency

Reason	Sample Responses
Training related reasons	
Do not feel adequately trained	Offered as an option Other comments: *"Not trained", "Not enough practice"*
Do not know when someone needs CPR	Offered as an option
Memory / Recall	Other comments: "Been too long since last training" "Don't remember", "Afraid of forgetting steps"
Don't know CPR	Never been trained
Fears based on misconceptions	
Afraid of injuring the person	Offered as an option
Afraid of getting into trouble	Offered as an option
Afraid of getting germs from the person	Offered as an option
Fear of death	Feeling guilty if they die because it would be their fault for messing up
Psychological fears	
Get nervous around sick or injured people	Offered as an option
Uncomfortable being physically close	Offered as an option Other comments: "Kissing", "Awkward", any comments about personal contact
Self-doubt	"Afraid of messing up", "Doing it wrong", "Second guess training"; feeling panicked, scared, or pressured
Not knowing the person	Not obliged, don't care, don't know person, not acquainted with stranger, "lack of personal physical knowledge"
Other	
Miscellaneous	Shy, don't like person, expired certificate

Appendix C: List of Public High Schools in King County

Table 1. Status of CPR training in various public high schools in King County

Schools without CPR Training		Schools With CPR Training		
High School	**School District**	**High School** [5]	**District**	**Mode** [6]
Bellevue High	Bellevue	Auburn High	Auburn	FD
Interlake High	Bellevue	Auburn Mountainview High	Auburn	FD
Newport High	Bellevue	Auburn Riverside High	Auburn	FD
Sammamish	Bellevue	West Auburn High	Auburn	FD
Decatur High	Federal Way	Enumclaw High	Enumclaw	TTT
Aviation High	Highline	Federal Way High	Federal Way	TTT
Big Picture	Highline	Thomas Jefferson High	Federal Way	TTT
CHOICE Academy	Highline	Todd Beamer High	Federal Way	TTT
Evergreen Campus	Highline	Highline High	Highline	TTT
Global Connections High	Highline	Mount Rainier High	Highline	TTT
New Start High	Highline	Kentlake High	Kent	FD
Tyee Educational Complex	Highline	Kent-Meridian High	Kent	FD
Issaquah High	Issaquah	Kentridge	Kent	FD
Liberty High	Issaquah	Kentwood	Kent	FD
Skyline High	Issaquah	Mercer Island High	Mercer Island	TTT
Tiger Mountain	Issaquah	Hazen High	Renton	FD
Eastlake High	Lake Washington	Lindbergh High	Renton	FD
International Community	Lake Washington	Ballard	Seattle	FD
Juanita High	Lake Washington	Chief Sealth International	Seattle	FD
Lake Washington High	Lake Washington	Cleveland -STEM	Seattle	FD
Redmond High	Lake Washington	Franklin	Seattle	FD
Bothel High	Northshore	Garfield	Seattle	FD
Inglemoor High	Northshore	Ingraham	Seattle	FD
Woodinville	Northshore	Middle College High	Seattle	FD
Black River High	Renton	Nathan Hale	Seattle	FD
Renton High	Renton	Nova	Seattle	FD
Sartori Education Center	Renton	Rainier Beach	Seattle	FD
Cedarcrest High	Riverview	Roosevelt	Seattle	FD
Shorecrest High	Shoreline	South Lake High	Seattle	FD

[5] Highlighted schools were survey sites

[6] Mode of training refers to whether CPR is taught by the Fire Department (FD) or by a trained school teacher (TTT)

Shorewood High	Shoreline	The Center School	Seattle	FD
Skykomish High	Skykomish	West Seattle	Seattle	FD
Mount Si High	Snoqualmie	Tahoma High	Tahoma	FD
Two Rivers	Snoqualmie			
Foster High	Tukwila			
Vashon Island High	Vashon Island			

Appendix D: Additional Results

Table 1. Results of analysis of variance between demographic variables and students' level of confidence performing CPR

		Level of Confidence performing CPR									
		Family			**Friend**			**Acquaintance**			**Strange**
		N	Mean	Sig.	N	Mean	Sig.	N	Mean	Sig.	N	Mean
of times trained	None	331	1.91	<0.001	326	1.83	<0.001	323	1.54	0.001	324	1.37
	At least 1	727	2.21		726	2.16		724	1.85		722	1.61
	White	483	2.00	<0.001	484	1.98	<0.001	483	1.72	0.081	483	1.56
	Non-white	561	2.22		555	2.14		550	1.79		549	1.52
	Female	519	2.07	0.003	518	2.04	0.088	514	1.68	0.591	517	1.48
	Male	523	2.17		520	2.08		518	1.83		514	1.60
language spoken	English only	751	2.07	0.023	751	2.03	0.382	747	1.76	<0.001	746	1.55
	Other	298	2.22		293	2.12		291	1.74		291	1.51
hy proximity to wn Seattle	South	531	2.20	<0.001	526	2.12	0.005	522	1.80	0.027	522	1.56
	North	531	2.04		531	2.00		529	1.71		528	1.52
erformance	Mean score <79%	599	2.18	0.003	594	2.11	0.017	589	1.79	0.050	588	1.55
	Mean score >80%	463	2.04		463	2.00		462	1.71		462	1.52
s on subsidized	*>50%*	357	2.28	<0.001	353	2.20	<0.001	349	1.85	0.002	350	1.59
	<50%	705	2.04		704	1.99		702	1.71		700	1.51
s. KC	Seattle Public Schools	543	2.12	0.829	540	2.06	0.980	537	1.75	0.619	537	1.54
	Other School Districts	519	2.11		517	2.06		514	1.77		513	1.54