

THE EFFECTIVENESS OF ‘PRACTICE WHILE WATCHING’ TECHNIQUE FOR THE FIRST AID TRAINING OF THE CHEMICAL INDUSTRY EMPLOYEES

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ABSTRACT

INTRODUCTION: Industrial accidents constitute about 20% of all causes of accidents. They are often sudden, unexpected and may lead to tragic consequences, which however can be partially reduced if first aid and emergency treatment are given as soon as possible. The most important part of a chain of survival is the bystanders' response. In practice, it is highly dependent on the ability of co-workers to perform basic first-aid tasks. The aim of this paper was to present the effectiveness of ‘practice while watching’ training method for the first aid training of the chemical industry employees. The authors focused on the most important elements of the training, which have an impact on the acquisition of knowledge and skills of first aid.

MATERIAL AND METHODS: The training involved 69 employees of the chemical industry. The test sheets were used for the assessment, where each of the action steps was assigned points 0 for incorrect and 1 for a properly performed activity.

RESULTS: Each step was completed by at least 76% of workers. When providing both adult and infant CPR, the main difficulty was calling for help. Younger employees obtained better results than older colleagues.

CONCLUSIONS: The study demonstrated the high effectiveness of the ‘practice while watching’ method. In addition, workers' age turned out to be a significant variable which affected their performance.

KEY WORDS: audio-visual aids; cardiopulmonary resuscitation; employee training; first aid training; ‘practice while watching’ technique

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INTRODUCTION

Chemical industry constitutes nowadays a major part of the modern world economy producing more than 400 million tons of different chemicals per year [1] and creating numerous job places worldwide. In 2015 world chemicals turnover was valued at € 3,534 billion and was majorly dominated by China, followed by the United States of America, Germany,

Japan and South Korea [2]. However, the mishandling of chemical substances may impose significant consequences for the environment as well as for humans resulting in injury, disabilities or even death of one or more individuals. It is therefore important to promote safety and prevention among employees of the chemical sector and increase awareness of the potential risks and the methods of reducing them.

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Industrial accidents constitute about 20% of all causes of accidents [3]. Their frequent occurrence was shown to be in 80–90% of cases caused by human errors whereas environmental conditions are responsible for 10–20% of them [3]. Significance of human errors is also emphasized by the observation that the industrial accidents happen more often within first half of the morning shift and at fifth or sixth hour in the night shift as a result of growing fatigue [4].

Industrial accidents are often sudden, unexpected and their consequences may be tragic, including severe body trauma and disablement or in the worst-case scenario even fatal, causing distress and economic problems to their victims and their families and generating costs for national economies estimated as 3% to 5% of the gross national product [5]. retrospective analysis, However, often shows that they could have been prevented by adequate training of workers and introducing safer working conditions [6, 7]. Nevertheless, if the industrial accident happens, its tragic consequences can be at least partially reduced if first aid (immediate help given to the victim, before treatment may be provided by qualified health personnel) and emergency treatment are given immediately [5]. They may improve the chances for survival, diminish the costs of treatment and rehabilitation and reduce the time of hospitalization [8]. Medicine has advanced significantly over past few decades and is now able to save people even in very serious conditions, given they receive proper help prior to the arrival of specialized medical care, as often the first few minutes after an accident may be crucial for survival. In practice, whether the victim receives first aid is highly dependent on the ability of witnesses (in case of industrial accidents often co-workers) to perform basic first-aid tasks [9]. Hatzakis et al. showed that the majority of industry workers do not possess sufficient knowledge regarding first aid [5]. The study presented a large number of workers unable to give correct answers even to simple questions such as pulse rate or ratio of ventilations to chest compressions in CPR. Simultaneously a high percentage of employees declared willingness to give help in case of an accident.

Effectiveness of first aid training has been a subject of many studies and it was found that experimental groups who had undergone it, generally received a higher number of correct answers than the control groups [3]. In a study carried out by Lingard, it was also observed that introducing the first

aid training in a workplace had a positive preventive effect on the occupational safety of employees and improvement of their risk control behaviour making them more aware of potential hazards and enhancing their motivation to avoid them. It seems therefore even more beneficial to introduce first aid training to all employees rather than only to selected members of staff [10].

Adequate training should basically consist of two parts: theoretical and practical. theory behind it, However, should only give general notion and understanding why specific action is implemented. The greater emphasis ought to be put on the practical aspect of training which should correspond with the amount of time dedicated to it. Simulation-based training methods have been proven effective in healthcare workers education in case of both theory and practice [11, 12]. Still, training should correspond with circumstances potential rescuers work in [13]. Taking all of the above into consideration, the aim of this article is to present 'practice while watching' method of teaching first aid developed by American Heart Association to employees of the chemical industry and to verify its effectiveness with attention especially to the most vital elements of first aid training that influence assimilation of knowledge and gaining practical skills.

MATERIAL AND METHODS

Sample

The examined group consisted of 69 employees of the heavy chemical industry (49 males and 20 females) aged 26 to 55 who were trained with 'practice while watching' method. The median age was equal to 35 so for further analysis the examinees were divided into two age groups. The detailed characterization of the examined group is presented in Table 1.

Educational intervention

A standardized Heartsaver CPR and AED educational intervention were used in the study. Preparing for teaching begins approximately 30 days before the day of the course. Examinees were divided into 6 training groups (5 groups of 12 people and 1 of 9) and every group completed six hours of training course. American Heart Association does not impose the number of participants taking part in the training since the optimal student-instructor ratio has not yet been determined. In the project, 3 AHA instructors were present every day of the training and

Table 1. Respondents' characteristics (n; %)

Gender	
Male	49; 71.02
Female	20; 28.98
Total	69; 100.00
Age	
≤ 35	37; 53.62
> 35	32; 46.38
Working position	
Assembly line operator	44; 63.77
Transport operator	9; 13.04
Administrative worker	9; 13.04
Production area leader	4; 5.80
Laboratory worker	3; 4.35
Formal Education Level	
Primary or vocational	15; 21.74
Secondary	36; 52.17
Higher	18; 26.09

every one of them was evaluating simultaneously 3 training stations. In our study the ratio of participants to training stations was equal to 2:1. AHA emphasizes to ensure the highest possible number of phantoms. In our study we used 6 adult phantoms (Little Anne by Laerdal, Norway), 6 infant phantoms (Baby Anne by Laerdal, Norway) and 4 training AED defibrillators (AED Trainer XFT-120 C+). Additional equipment involved elements necessary to display instructional video — multimedia projector, loudspeakers and DVD player. The classroom was set up to ensure that participants can comfortably observe the instructional video while kneeling next to the phantom. The Heartsaver course is divided into 2 basic modules which are presented in Table 2.

Evaluation settings and the research tool

After the completion of every part, the participants underwent practical skills evaluations: adult CPR with AED and infant CPR. The research tool used in this study was evaluation forms consisting of 12- and 11-points checklists for the assessment of respectively adult and infant CPR (Fig. 1 and 2). Due to the fact that evaluation of CPR skills in adults differs from the assessment criteria of practical training on infants, the numbers had to be rescaled to a neutral 0–100-point scale which allows comparison of performance to reflect a similarity. Each evaluation was conducted simultaneously by 3 instructors and the

Table 2. Heartsaver course scheme

Module 1	Module 2
Training with 'practice while watching' method	
<ul style="list-style-type: none"> • Proper and safe removal of disposable gloves contaminated with body fluids of the victim • Level of consciousness and breathing assessment 	<ul style="list-style-type: none"> • Delivering chest compressions to adults/infants • Delivering mouth-to-mouth ventilation to adults/infants • Delivering rescue breaths with a mask to adults/infants • Delivering CPR to adults/infants
Training without instructional videos, under the supervision of the instructor	
<ul style="list-style-type: none"> • Administration of adrenaline prefilled syringes • Stoppage of bleeding • Immobilisation of the injured extremity 	<ul style="list-style-type: none"> • Using AED defibrillator • Delivering CPR with AED to adults/infants • Full infant CPR algorithm

results were written down on evaluation forms. Having successfully finished and passed the training course, every participant is rewarded with a certificate issued by an authorized course organizer. It has been proven that the level of practical skills gained during a CPR course decreases sharply within a few months or even days after the first training [14]. However, no data are available on how often the course should be repeated and as a sort of compromise AHA has decided to grant certificates only for 2 years. After this period in order to renew it one has to take part in a recertification course.

Statistical analysis

Normal distribution of evaluation of skills in adult CPR and infant CPR, among participants, Shapiro-Wilk test was performed. To compare skills in adult CPR and skills in the field of infant CPR the non-parametric Wilcoxon test was used. To check the significance of differences in the level of skills in adult CPR vs. infant CPR, non-parametric tests were used: Kruskal-Wallis test (for comparison of three groups) and the Mann-Whitney test (for comparison of two groups). Correlations between quantitative variables were assessed using a non-parametric significance test: Spearman rank correlation coefficient. Statistically significant p-value < 0.05 was utilized. Statistical calculations were performed using the Statistica 10 (Statsoft) software.



Heartsaver® CPR AED Skills Sheet

American Heart Association
Heartsaver CPR AED
Adult and Child CPR AED
Side 1 of 2

Student Name: _____

Test Date: _____

Step	Critical Performance Steps	Adult CPR AED ✓ if done correctly	Child CPR AED ✓ if done correctly
1	Verbalizes that the scene is safe		
2	Checks for response—tap and shout		
3	Yells for help		
4	Tells someone to phone the emergency response number (or 911) and get an AED (for adult only)		
5	Checks for no breathing or only gasping <i>Minimum 5 seconds; maximum 10 seconds</i>		
6	Locates hand placement for compressions <i>Moves clothes out of the way of the chest Lower half of the breastbone; 1 or 2 hands for child</i>		
7	Delivers first set of compressions <i>Gives 30 compressions in 18 seconds or less</i>		
8	ADULT: Gives 2 breaths with a mask CHILD: Gives 2 breaths without a mask <i>At least 1 breath results in visible chest rise Breaths given and compressions started within 10 seconds</i>		
9	Delivers second set of compressions <i>Gives at least 23 of 30 compressions in the correct chest location</i>		
10	ADULT: Gives 2 breaths with a mask CHILD: Gives 2 breaths without a mask <i>At least 1 breath results in visible chest rise Breaths given and compressions started within 10 seconds</i>		
11	Instructor says, “You have just completed 5 sets of compressions and breaths.” Leaves to phone 911 and get an AED (for child only)		
12	Turns on the AED immediately after it arrives		
<p><i>The next step is done only with a manikin with a feedback device designed to indicate when compressions are 2 inches deep (child) or more (adult) and/or indicate that chest recoil is complete. If no feedback device, STOP THE TEST.</i></p>			
13	Delivers third set of compressions of adequate depth <i>Acceptable if at least 23 of 30 compressions indicate a depth of at least 2 inches (adult) or about 2 inches (child)</i>		
		STOP THE TEST	STOP THE TEST

© 2011 American Heart Association

Record test results on bottom of side 2

FIGURE 1. Evaluation form — Adult CPR



Heartsaver® CPR AED Skills Sheet

American Heart Association
 Heartsaver CPR AED
 Infant CPR
 Side 2 of 2

Student Name: _____
 Test Date: _____

Step	Critical Performance Steps	Infant CPR ✓ if done correctly
1	Verbalizes that the scene is safe	
2	Checks for response—tap and shout	
3	Yells for help	
4	Checks for no breathing or only gasping <i>Minimum 5 seconds; maximum 10 seconds</i>	
5	Locates hand placement for compressions <i>Two fingers just below the nipple line on the breastbone</i>	
6	Delivers first set of compressions <i>Gives 30 compressions in 18 seconds or less</i>	
7	Gives 2 breaths without a mask <i>At least 1 breath results in visible chest rise</i> <i>Breaths given and compressions started within 10 seconds</i>	
8	Delivers second set of compressions <i>Gives at least 23 of 30 compressions in the correct chest location</i>	
9	Gives 2 breaths without a mask <i>At least 1 breath results in visible chest rise</i> <i>Breaths given and compressions started within 10 seconds</i>	
10	Instructor says, “You have just completed 5 sets of compressions and breaths.” Verbalizes the need to leave to phone 911	
<i>The next step is done only with a manikin with a feedback device designed to indicate when compressions are about 1½ inches deep or indicate that chest recoil is complete. If no feedback device, STOP THE TEST.</i>		
11	Delivers third set of compressions of adequate depth <i>Acceptable if at least 23 of 30 compressions indicate a depth of about 1½ inches</i>	
		STOP THE TEST

Test age groups taught in this course. Record all test results here. Sign where indicated.							
Test Summary	PASS = above steps all done correctly NR = needs remediation Circle PASS or NR for each age group tested	Adult CPR AED		Child CPR AED		Infant CPR	
		PASS	NR	PASS	NR	PASS	NR
Instructor signature affirms that skills tests were done according to AHA Guidelines. <i>Save this sheet with the course records.</i>		Instructor Signature: _____ Print Instructor Name: _____ Date: _____					

© 2011 American Heart Association

FIGURE 2. Evaluation form — Infant CPR

RESULTS

Each step of both infant and adult CPR was completed by at least 76% of workers. The most striking result to emerge from the data is that the 'Yelling for help' stage of adult and infant CPR was incorrectly finished by a staggering 23.19% and 20.29% of workers, respectively.

When providing the adult CPR (Tab. 3), another 7.25% of learners failed at asking someone to phone the emergency response number and bring AED. Occasional errors were also observed when evaluates a victim's reaction or breathing. In contrast, above-mentioned tasks were finished incorrectly by 10.14% and 13.04% of workers when providing infant CPR (Tab. 4). Compared with results from adult CPR, learners more often skipped the first step (Verbalizing that the scene is safe) when providing infant CPR.

Statistically significant negative average correlations were observed between age and practical skills of the employees in CPR on adults ($R = 0.65$; $p < 0.01$) and infants ($R = 0.57$; $p < 0.01$). Results obtained by different age subgroups were presented in Table 5. Gender and level of education did not have a statistically significant effect on workers performance ($p > 0.05$).

In the trial, employees in the age of 35 or younger were more likely than their older colleagues to

perform well. While providing adults CPR, members of the younger group had problems with the proper application of only one phase of the procedure which was 'Yelling for help' — 3 workers made mistakes in this phase. When providing the infant CPR, only one learner failed when 'Checking for response' and other two when 'Yelling for help'. Other stages were performed correctly by all the participants in the younger group whereas the total number of errors observed in the older group reached 34.

DISCUSSION

The results obtained in this study indicate that the 'practice while watching' method may be successfully used during first aid training courses,

Table 3. Practical skills evaluation of the workers in adult CPR

Critical performance steps	Results*	
	n	%
1. Verbalizes that the scene is safe	69	100.00
2. Checks for response – tap and shout	67	97.10
3. Yells for help	53	76.81
4. Tells someone to phone the emergency response number and get an AED	64	92.75
5. Checks for no breathing or only gasping	66	95.65
6. Locates hand placement for compressions	69	100.00
7. Delivers first set of compressions	69	100.00
8. Gives 2 breaths with a mask	69	100.00
9. Delivers the second set of compressions	69	100.00
10. Gives 2 breaths with a mask	69	100.00
12. Turns on the AED immediately after it arrives	68	98.55
13. Deliver the third set of compressions of adequate depth	69	100.00

*Number of workers who finished each step correctly

Table 4. Practical skills evaluation of the workers in infant CPR

Critical performance steps	Results	
	n	%
1. Verbalizes that the scene is safe	65	94.20
2. Checks for response — tap and shout	62	89.86
3. Yells for help	55	79.71
4. Checks for no breathing or only gasping	60	86.96
5. Locates hand placement for compressions	67	97.10
6. Delivers first set of compressions	68	98.55
7. Gives 2 breaths without a mask	69	100.00
8. Delivers the second set of compressions	69	100.00
9. Gives 2 breaths without a mask	69	100.00
10. Verbalizes the need to leave to phone the emergency response number	69	100.00
11. Deliver the third set of compressions of adequate depth	69	100.00

*Number of workers who finished each step correctly

Table 5. Practical skills evaluation according to the age of workers

	n	mean
Adults CPR		
≤ 35 years	37	99.4
> 35 years	32	94.2
Infants CPR		
≤ 35 years	37	99.3
> 35 years	32	90.4

*Results were considered as statistically significant when $p < 0.05$

especially among industry workers. Its effectiveness in regard to both theoretical and practical knowledge gained by the participants was high with the average skill-set in adult and infantile CPR equal to respectively 96.9 ± 5.2 points and 95.2 ± 8.8 points out of maximum 100 points in each case. Meanwhile, estimations show that only 2.6–3.5% of the general population is able to perform adequate first aid [5]. The national survey conducted by Rasmus and Czekajlo [15] showed that although around 75% of Polish population has participated in a first aid course before, the CPR knowledge in Poland is still low and a standardized, improved curriculum is required. State of CPR knowledge displayed by younger generation is also unsatisfying, especially among individuals unrelated to medicine and healthcare [16]. Similar results were obtained also in an analogous survey performed in Norway, where theoretical CPR knowledge was surprisingly low compared with 90% of the interviewees who declared receiving first aid training in the past [17]. However, the number of CPR trained citizens varies greatly by country with 30–45% of Swedes [18] and only 12% of Hong Kong population [19]. Lower percentages of people who underwent CPR courses were observed among the elderly, foreigners and those not included in the workforce [18].

Data analysis allows observing that some points on the checklists were implemented perfectly by the whole examined group, while other stages proved to be more problematic. Both in adult and infantile CPR most mistakes were observed in step 3 (Yells for help), which was performed incorrectly respectively by 23.2% and 20.3% of examinees. In case of adult CPR evaluation the second most frequent source of mistakes was step 4 (Tells someone to phone the emergency response number and get an AED'), followed by, in decreasing order, step 5 (Checks for no breathing or only gasping), step 2 (Checks for response — tap and shout) and step 12 (Turns on the AED immediately after it arrives). The second leading cause of errors in infantile CPR was step 4 (Checks for no breathing or only gasping), followed by step 2 (Checks for response — tap and shout), step 1 (Verbalizes that the scene is safe), step 5 (Locates hand placement for compressions) and step 6 (Delivers first set of compressions). A possible application of these data is to provide slight differences in the teaching method and pay more attention to more

problematic stages of the CPR performance, for instance repeating crucial parts and pointing out most frequent errors.

The results of our study showed no significant difference ($p > 0.05$) in regard to the gender on the skills in performing CPR on both adults and infants, which is consistent with results of some other studies [20, 21]. Peberdy et al. stipulated, however, that men may, in fact, perform CPR better and noted that the depth of the chest compressions was greater for males [22]. This is mirrored by results of Sim et al. who showed that men accomplished a significantly better median adequate depth (82.0% vs 56.0%, $p = 0.01$) [23]. Sayee and McCluskey concluded that both gender and body mass index (BMI) may influence the effectiveness of CPR performance [24], as males and individuals with BMI greater than 24 tend to perform CPR more effectively when using 30:2 ratio. Interestingly, no statistical difference with regards to BMI was found when a ratio 15:2 was used and the effect of gender was also less visible. Since 30:2 ratio was viewed to be more exhausting, the physical fitness, exercise habits and fatigue of the individual seem to play significant role in the CPR performance and their role was observed also in other studies [25–27]. Russo et al. confirmed that the chest compressions performed by female participants are too shallow, however, they also showed that good physical fitness and BMI were found to increase the quality of CPR performance independently of gender [25]. This observation may in fact partially explain the reason why our study does not demonstrate any correlation between examinee's gender and the effectiveness of their CPR performance, as industry workers possess in general more physical strength.

We found a statistically significant negative average correlation between age and practical skills of the employees in CPR on adults and infants (in both cases $p < 0.01$), which is confirmed by most of the other researchers. Sim et al. showed that median adequate rate of chest compressions decreased significantly with age ($p = 0.02$) [23] and Peberdy et al. found that younger participants provided better depth and this effect seems to be caused by age-related decrease in physical strength and functional fitness [22]. No differences in depth and rate of compressions with age were observed in research performed by Trowbridge et al. [28]. However, authors did observe differential decline in chest compression force with older group.

No significant difference ($p > 0.05$) was found in regard to the formal education level of the participants on the skills in performing CPR on both adult and infants after participating in the first aid training course and to our knowledge no other research of this kind has been conducted so far. Instead, the research conducted hitherto have focused mainly on influence of socioeconomic status on likelihood of first aid training in the past and rates of bystander-initiated CPR when required [29–33]. Blewer et al. found that lower education level and household income were correlated with decreased likelihood of receiving proper CPR and other studies showed that lower rates of CPR initiations by bystanders were observed in neighbourhoods of low-income, poor education and inhabited by minorities [31]. The authors' research seems to be the first to examine the connection between formal education level and post-training CPR performance and even though no correlation was found, there is a clear need for further evaluation of this phenomenon in order to provide the society with most reliable and customized CPR training tool.

We acknowledge that this study had several limitations, especially with convenient and limited in size sample and as a result it should not be generalized to represent general population of industry workers, but it can be assumed that data we obtained may be used to provide better understanding in similar cases.

CONCLUSIONS

This research shows that 'practice while watching' method of first aid training may serve as a valuable tool in provision of CPR knowledge among chemical industry employees and its high effectiveness may arise from systematic repetition of skills both individual and incorporated into full CPR algorithm for a sufficient period of time. The authors did not observe any statistically significant differences regarding gender and formal education level on CPR performance, however, age seems to affect the quality of skills of the employees in CPR on both adults and infants.

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