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HEALTH CARE

CPR Memory and Skill Degradation Among Non-Allied Healthcare Professionals

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Abstract

Cardiopulmonary Resuscitation is defined by the Mayo Clinic as a lifesaving technique that is useful in many emergencies, such as a heart attack, stroke, choking, or drowning, in which someone's breathing and heartbeat have stopped. Under the guidelines put forth by the International Liaison Committee on Resuscitation (ILCOR) and the Emergency Cardiovascular Care Organization (ECC), the American Red Cross and American Heart Association currently require that an individual's CPR certification be renewed every two years. However, data has suggested that non-allied healthcare providers, such as

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school-based personnel, may require more regular training to maintain required CPR proficiency levels. Four hundred non-allied healthcare professionals from a school district in central Georgia were CPR-certified under the American Heart Association (AHA) Heart-Saver curriculum. Participants included 153 males and 247 females from elementary, middle, and high school settings. Participants included administrators, teachers, coaches, and staff. Two tenured college professors from the School of Health and Human Performance were responsible for teaching and certifying study participants. Each of these professors possessed a minimum of five years of CPR certification experience with the American Heart Association. Course sizes were limited to 12-15 participants. All CPR certification courses were implemented under standardized, controlled circumstances. Following the initial certification, twenty-five percent of participants were randomly selected to be reassessed at either three, six, nine, or twelve months, respectively, to determine memory and skill degradation rates and patterns. Degradation of declarative and procedural knowledge was observed during subsequent retest sessions at each of the three-, six-, nine-, and twelve-month marks. Scores depreciated approximately 10% each three-month retesting period, to 88%, 79%, 69%, and 57%, respectively. Data suggest that after six months, participants failed to meet the AHA standards for demonstrating acceptable declarative and procedural knowledge related to CPR implementation. Due to the observed degradation in both declarative and procedural knowledge, it is apparent that a more periodic training and recertification process in CPR is required for school-based personnel. A more consistent and periodic approach to preparing school-based first responders may prove beneficial in maintaining CPR proficiency rates, which very well could save lives.

Introduction

CPR Certification Protocols

Cardiopulmonary Resuscitation, or CPR, is defined by the Mayo Clinic as a lifesaving technique that is useful in many emergencies, such as a heart attack, stroke, choking, and/or drowning, in which someone's breathing and heartbeat have stopped (Mayo Clinic, 2022). The aforementioned circumstances fall into a category of incidences known as Cardiorespiratory Distress, or CRDs, in which the cardiac or respiratory system experiences severe dis-

tress. Currently, the CDC acknowledges that nine out of every ten cardiac arrest situations end in death without immediate treatment (Centers for Disease Control and Prevention, 2022). However, in cases where CPR is administered within the first few minutes, CPR can double or even triple a person's chance of survival (American Heart Association, 2022; American Red Cross, 2022; Centers for Disease Control and Prevention, 2022; Larsen et al., 1993; National Academies of Science, Schultz & McCoy, 2016). Hence, regarding an event of CRD, CPR becomes increasingly critical to the survival of the individual involved. However, CPR must be properly executed to be an effective life-saving measure.

Regarding CPR standardized practices, two major organizations are recognized for advancing recommendations and upholding guidelines. These committees are the International Liaison Committee on Resuscitation (ILCOR) and the Emergency Cardiovascular Care Organization (ECC). They are the authorities by which new CPR recommendations and guidelines are decided and communicated to the public. Currently, the most recent guidelines for CPR are thirty chest compressions to two rescue breaths (American Heart Association, 2022; American Red Cross, 2022; CPR Steps, 2022). According to Blewer et al., "Prompt delivery of bystander CPR (B-CPR) can increase the probability of survival by two-fold" (2017). Yet less than one-third of Sudden Cardiac Arrest (SCA) patients receive prompt B-CPR in the United States, to the detriment of many individuals (Hung et al., 2017). This lack of access to timely CPR continues to prove to be problematic in saving lives under time-sensitive CRD situations. Moreover, this begs the question of why CPR is not being provided in a timely manner. Is there a lack of bystander knowledge and preparation regarding CPR-associated skills? Are current CPR training practices and certification practices across the United States insufficient?

MyCPRcertificationonline.com claims that "For a person who is not in regular practice, the skills and knowledge learned at the first training depreciate drastically in the first year (2022). For this reason, CPR certifications are only valid for two years, after which there is need for renewal" (American Heart Association, 2022; American Red Cross, 2022). Numerous studies (Andresen et al., 2007; Riegel et al.,2005; Spooner et al., 2007) have tended to agree with this prin-

ciple, suggesting that over the course of one calendar year, there is considerable degradation in CPR implementation ability without continued practice, rehearsal, instruction, and/or training. This notion raises the debate as to what the ideal latency period is between training and recertifications. When does depreciation set in and to what degree? How long should a certification last and how should/could continuing education be applied most appropriately?

CPR in the School Setting

When considering emergency, healthcare, and safety personnel in the school setting, three positions often come to mind: the school nurse for general student healthcare, the athletic trainer for all-purpose sports-related healthcare, and the school resource officer for providing safety and a direct line of communication for emergencies on school grounds.

According to the recommendation of the National Association of School Nurses (NASN), each school should have a ratio of one nurse to every one thousand students, or at least one nurse per school on staff (Mangena & Maughan, 2015). How does the U.S. as a whole measure up to these expectations? According to the NASN's national survey in 2018, 81.9% of public schools and 34.6% of private schools reported having a full or part-time school nurse on staff (Willgerodt et al., 2018). With this national baseline for comparison, it appears that the state of Georgia falls short of national expectations. By compounding evidence from statements from the Georgia Department of Public Health and the Georgia Association of School Nurses (GASN), the state of Georgia has 1600 employees providing full-time school nursing services to 1.7 million students; with only 39% of all public schools in Georgia having a full-time nurse in their personnel (Georgia Association of School Nurses, 2022; Georgia Department of Public Health, 2022).

When ensuring that a school's athletes are safe and receive adequate healthcare, having an Athletic Trainer (AT) is necessary. The number of schools employing ATs has significantly increased nationwide over the past decades. In 1994, 35% of secondary schools employed an AT, while the present-day numbers have increased to 70% of public schools and 58% of private secondary schools employing at least one certified AT (Pike et al., 2019). Evaluating schools in Georgia with employed ATs indicates that the culture of athletic

safety is held to a high standard. Through aggregating the data from various surveys, Georgia schools appear to average relatively high AT employment rates; with 73% of public and 56% of private secondary schools having an employed AT on school grounds (Huggins et al., 2019; Pike et al., 2019; Pryor et al., 2015). Furthermore, it is worth noting that AT employment data, which is directly associated with secondary school settings, extends to elementary settings. It is important to understand that most private schools in Georgia are K-12, and a large percentage of public secondary schools reside on the same campus or in close proximity to elementary schools. Hence, ATs employed in secondary settings often serve multiple populations.

Concurrently, to facilitate emergency care and safety within the school population, the deployment of law enforcement officers in school systems has become paramount. The number of school resource officers has risen exponentially throughout the nation, and concerns are predicated on the safety of students. In the 1970s, only a small portion of schools utilized resource officers on campus, with the nation reporting less than 1% of schools employing such personnel (Gottfredson et al., 2020). Presently, approximately 48% of all schools and 65% of secondary schools nationwide employ full-time resource officers to capitalize on the safety of students (Gottfredson et al., 2020). In Georgia, 42% of public schools and 52% of private schools employ at least one resource officer (Georgia Department of Education, 2022).

The synergy of the task force of school nurses, ATs, and resource officers has become the gold standard for healthcare and the attenuation of precarious scenarios in the school setting (Embrey & Rosiack, 2019). However, due to constraints such as funding and staffing, these individuals cannot always be relied upon to be the sole emergency first responders. In many CRD events on school grounds, that responsibility falls to administrators, teachers, coaches, and staff members.

Emergency Medical Service Response Time

The data is relatively conclusive that CRD events tend to result in high fatality rates when immediate, proper, CPR is not administered (American Heart Association, 2022; American Red Cross, 2022; Ibrahim, 2007). Hence the importance of early CPR intervention

from those in close proximity to the patient to increase the chance of survival. Bystander response is an essential element in this chain of survival until Emergency Medical Service (EMS) personnel arrive. Unfortunately, despite the fact that EMS can provide critical prehospital care, response times to such time-sensitive CRD scenarios (choking, anaphylactic shock, stroke, cardiac arrest, drowning, and others) vary significantly based on location (Hsia et al., 2018). A recent study of EMS response times throughout the United States was conducted based on income areas. Results suggested that in high-income areas within the United States, EMS response rates averaged 13.6 minutes. In contrast, EMS response rates in low-income areas averaged 18.8 minutes (Hsia et al., 2018). Response times appeared to be primarily related to the scene's proximity to the location of the EMS provider. On average, response scenes in high-income areas were reported at a mean distance of 6.08 miles from the EMS base of operations, whereas in low-income areas, response scenes were reported at a mean distance of 8.77 miles (Hsia et al., 2018). This same study used National Emergency Medical Service Information System (NEMSIS) data and found that the expected time for EMS arrival to school settings nationwide was between eight and 15 minutes (Hsia et al., 2018). Therefore, based on expected EMS response times, school-based personnel should anticipate being responsible for providing eight to 15 minutes of high-quality CPR prior to EMS arrival, making bystander knowledge of CPR critically important in reducing the risk of death in CRD events on school grounds.

Georgia CPR Requirements for School Personnel

The Georgia State Department of Education does not require teachers to maintain a CPR certification for licensure. However, individual school districts in the state may require employees to have a current Adult, Child, and Infant CPR, AED, and First Aid certification as a condition of employment. (CPR certification for Teachers in Georgia, 2022).

The Georgia High School Association (GHSA) is a National Federation of State High School Associations member. It serves as the preeminent governing body for Georgia High School Athletics. The GHSA's purpose is the "promotion of education in Georgia from a mental, physical, and moral viewpoint, to standardize and encourage participation in athletics, to promote sportsmanship and an ap-

preciation for and study of music, speech and other fine arts through Region and State competitions." As the preeminent governing body, the GHSA sets all guidelines and by-laws by which high school coaches, athletes, trainers, parents, and volunteers must abide in the state, including requirements for CPR and First Aid certifications.

As of April 2019, the GHSA approved a rule change in their constitution, which requires all coaches to receive CPR and AED training (Georgia High School Association Constitution and By-Laws, 2022; Heck, 2019). The exact by-law states, "Every faculty coach, community coach, and student-teaching intern at a GHSA member school must complete: (b) CPR (minimum compressions only) and AED training prior to any team activity or within a maximum of 30 days from the start of a team activity and it must be renewed at a minimum of every two years. NOTE: A fine for every coach who does not complete a rules clinic, or who does not complete the required CPR and AED training, before the assigned deadline will be assessed to the school" (Georgia High School Association, 2022).

Conclusion

Due to a variety of factors, public school and private school settings nationwide have observed an increase in on-site Cardiorespiratory Distress prevalence rates over the past decades (American Heart Association, 2022; American Red Cross, 2022; Elfein, 2021; Roth et al., 2015). This observed increase in CRD events appears to affect students, staff, administration, parents, and campus visitors alike. With the average response time for EMS anticipated at approximately eight to 15 minutes, on-site first responders need to be prepared to provide timely, high-quality CPR until those emergency medical professionals arrive on the scene. It is essential that school-based employees be properly trained in CPR and First Aid to enhance their chances of survival during cardiorespiratory distress events. This study was designed to evaluate how prepared school-based employees are to respond to worst-case scenario CRD events by evaluating CPR memory and skill degradation rates post initial certification.

Methods

Participants

To evaluate the efficacy of the criteria set for the length of time, non-allied healthcare professionals can maintain CPR certification status with credibility, a convenience sample of 400 public-school employees from elementary, middle, and high schools in central Georgia was utilized for this study. Subjects included 153 males and 247 females. The professional positions of participants were noted as follows: Teachers, 257; Administrators, 56; Teachers/Coaches, 47; Staff, 32; and Coaches, 8. Participants represented school settings as follows: High School, 165; Middle School, 137; and Elementary School, 98. Schools were represented as follows: High Schools, 2; Middle Schools, 4; and Elementary Schools, 8.

All CPR certification courses provided to participants were implemented under standardized, controlled circumstances in order to increase validity and reliability. This included utilizing the same location for certifications, identical scripted conditions for implementation, identical instructors, and identical equipment calibrated to AHA specifications. Furthermore, class sizes were kept to 12-15 participants, with a maximum 4:1 instructor-to-student ratio per class, to allow for ideal learning environments for all participants.

CPR Instructors & Content

Two tenured college professors from the School of Health and Human Performance at a medium-sized public liberal arts college in central Georgia were responsible for teaching and certifying study participants. Each of these professors possessed at least five years of CPR certification experience with the American Heart Association (AHA) {CPR, First Aid, and AED}. Moreover, both instructors had certified over 2,000 participants at the time of the study. Each professor also had their AHA instructor certifications renewed in 2021, immediately before the intervention. The professors were supported by three graduate assistants from the School of Health and Human Performance during certifications; each of which had accumulated one year of AHA CPR, First Aid, and AED instructor certification experience.

The study participants' certification courses followed the AHA Heart Saver K-12 program. The course included Adult/Child and Infant CPR, Adult/Child and Infant Choking, Adult/Child and Infant AED, First Aid, and a Written Content exam. The AHA Heart Saver 2020 Skills Forms and Exams were implemented in accordance with all AHA guidelines for assessment during the practical skills portion of the certification course.

Participant Recruitment

The acquisition of participants was carried out via a contact letter sent to school district's boards of education, offering free CPR certification to any employee willing to partake in the study. This recruitment process cultivated all 400 school employees who participated in the study.

Equipment

Prestan CPR equipment was used to complete this study. Prestan 2000-series adult/child and infant CPR manikins were used for all testing sessions for chest compression evaluation. These models provided electronic feedback control on compression rate and compression depth to practitioners. Prestan AED trainers were also implemented for all testing sessions, as well as Prestan CPR safety face shields with oxygen bags for rescue breathing evaluation. Further testing equipment included: WorldPoint, First-On-Scene first-aid kits with stop-the-bleed materials, EpiPen trainers, tourniquets, and SAM splints. The CPR manikins and AEDs were all calibrated prior to testing and sanitized before use. For training and testing purposes, a 2:1 ratio of participants to equipment was implemented for the study.

Baseline and Follow-Up Assessment

A three-hour AHA Heart Saver certification course was implemented immediately before the initial certification assessment. The AHA Heart Saver certification is valid for a two-year period, pending the successful completion of all course assessments. The AHA 2020 Rubrics for Adult/Child and Infant CPR & AED and First Aid were implemented for assessment purposes, along with the 2020 Heart Saver Content Examination. All initial baseline certifications were conducted in a one-week time period. Following the initial certifica-

tion, twenty-five percent of participants were randomly selected to be reassessed at either three, six, nine, or twelve months, respectively, to determine memory and skill degradation rates and patterns.

Data Analysis

For this study, instructors recruited participants who were school employees from counties around the PI's institution. There were 400 total employees who participated in the study. Subjects included 153 males and 247 females. Subjects included 257 teachers, 56 administrators, 47 teachers/coaches, 32 staff members, and 8 coaches. Subjects were employed at 14 separate schools, including two high schools, four middle schools, and eight elementary schools.

The 28th version of the SPSS software was used to complete data analyses. To determine if baseline testing depended on gender, school setting, or professional position, Independent Sample T-Tests and One-Way ANOVAs were applied. To determine how participants performed on the initial testing immediately after training and then again at intervals of three months up to a full year after training (months 3, 6, 9, and 12), to determine degradation patterns in performance, Dependent Sample T-Tests were applied. Repeated Measures ANOVAs were applied to determine if declarative and procedural knowledge degradation occurred over the course of the year and to determine at what respective intervals throughout the year degradation in declarative and procedural knowledge impaired participants' ability to respond appropriately to emergency situations. Within testing, all assessments were two-tailed, with alpha levels set at 0.05 for statistical significance and all CI levels set to 95%.

Results

An Independent Sample T-Test comparing the mean scores between males and females on each of the eight assessed areas of CPR was run to determine if baseline tests were dependent upon gender. (See Table 1) Data indicates that gender did not play a significant role in baseline test performance. A One-Way ANOVA was conducted to determine if the school setting or professional position had a significant influence on each of the eight assessed areas of CPR during baseline testing. (See Tables 2 and 3) Data indicates that neither school setting nor professional position had a significant impact on baseline exam scores.

Table 1
Initial CPR Certification Assessment Scores by Genders

Assessment	Gender	N	Mean	Std. Deviation
Written Test	Male	153	90.8627	3.74000
	Female	247	90.9069	4.13436
Adult CPR	Male	153	95.0850	3.42389
	Female	247	94.3846	3.33280
Child CPR	Male	153	95.2614	3.17633
	Female	247	94.5344	3.17476
Infant CPR	Male	153	95.6340	3.01259
	Female	247	94.9838	2.72890
Adult Choking	Male	153	94.8954	1.45169
	Female	247	94.8623	1.51325
Infant Choking	Male	153	93.1373	2.44965
	Female	247	93.2267	2.44226
First Aid	Male	153	93.9673	2.97007
	Female	247	94.0162	2.95353
AED	Male	153	93.1307	3.69333
	Female	247	93.2227	3.61611

The passing proficiency score for the American Heart Association's CPR certification exam is 84%. During baseline testing, after the initial training, participants performed exceptionally well on the written exam averaging a 94 percent pass rating. However, memory degradation of declarative knowledge was observed during subsequent retest sessions at each of the three-, six-, nine-, and 12-month marks. Scores depreciated approximately 10% at each three-month retesting period to 88%, 79%, 69%, and 57%, respectively. Data suggest that after six months, participants failed to meet the AHA standards for demonstrating acceptable declarative knowledge related to CPR implementation.

Independent Sample T-tests signified statistically significant degradation rates from baseline assessments across all assessed areas at each subsequent three-month retest, except for the three-month to six-month period for Adult and Infant Choking and the baseline to three-month and nine-month to 12-month period for AED implementation. Adult CPR baseline skill proficiency scores averaged 95%. Scores degraded to 88% at three months, 78% at six months, 68% at nine months, and 52% at 12 months. Child CPR baseline skill proficiency scores averaged 95%. Scores degraded to 89% at three months, 79% at six months, 68% at nine months, and

Table 2
Initial CPR Certification Assessment Scores by Professional Positions

Assessment	Position	N	Mean	Std. Deviation
Written Test	Administrator	56	91.7500	4.23084
	Teacher	257	90.7315	4.08813
	Teacher/Coach	47	91.4468	3.08438
	Coach	8	91.2500	4.65219
	Staff	32	89.7500	3.47340
Adult CPR	Administrator	56	94.0893	3.60947
	Teacher	257	94.5759	3.49596
	Teacher/Coach	47	94.8511	2.86644
	Coach	8	95.2500	1.66905
	Staff	32	95.8125	2.84477
	Total	400	94.6525	3.38088
Child CPR	Administrator	56	94.3929	3.14312
	Teacher	257	94.6654	3.34198
	Teacher/Coach	47	95.4255	2.74055
	Coach	8	95.2500	1.66905
	Staff	32	95.7188	2.75018
	Total	400	94.8125	3.19105
Infant CPR	Administrator	56	95.4643	2.62134
	Teacher	257	95.0584	3.03889
	Teacher/Coach	47	95.4468	2.57757
	Coach	8	95.2500	1.66905
	Staff	32	95.9063	2.24843
	Total	400	95.2325	2.85461
Adult Choking	Administrator	56	94.7500	1.37840
	Teacher	257	94.9650	1.42342
	Teacher Coach	47	94.7021	1.82870
	Coach	8	95.0000	.00000
	Staff	32	94.5938	1.79353
	Total	400	94.8750	1.48826
Infant Choking	Administrator	56	93.5357	2.48607
	Teacher	257	93.1751	2.35113
	Teacher/Coach	47	92.7234	2.70026
	Coach	8	92.5000	2.39046
	Staff	32	93.5938	2.68640
	Total	400	93.1925	2.44241
First Aid	Administrator	56	94.2857	2.85220
	Teacher	257	93.7471	2.92254
	Teacher/Coach	47	94.3191	2.93485
	Coach	8	96.8750	2.53194
	Staff	32	94.3125	3.19715
	Total	400	93.9975	2.95624
AED	Administrator	56	93.9643	2.77629
	Teacher	257	93.0078	3.84260
	Teacher Coach	47	93.0851	3.54983
	Coach	8	95.0000	.00000
	Staff	32	92.9688	3.75443
	Total	400	93.1875	3.64150

51% at 12 months. Infant CPR baseline skill proficiency scores averaged 95%. Scores degraded to 88% at three months, 78% at six months, 70% at nine months, and 57% at 12 months. Adult Choking baseline skill proficiency scores averaged 94%. Scores degraded to 89% at three months, 86% at six months, 77% at nine months, and 71% at 12 months. Infant Choking baseline skill proficiency scores averaged 93%. Scores degraded to 86% at three months, 80% at six

Table 3
Initial CPR Certification Assessment Scores by Professional Positions

Assessment	Position	N	Mean	Std. Deviation
Written Test	Elementary	98	91.1224	4.27957
	Middle	137	90.8029	4.02536
	High	165	90.8242	3.78049
Adult CPR	Elementary	98	94.7857	3.63332
	Middle	137	95.7664	3.19066
	High	165	93.6485	3.08182
	Total	400	94.6525	3.38088
Child CPR	Elementary	98	94.8980	3.51577
	Middle	137	95.6861	3.06247
	High	165	94.0364	2.90477
	Total	400	94.8125	3.19105
Infant CPR	Elementary	98	95.1020	2.99308
	Middle	137	95.7883	2.94166
	High	165	94.8485	2.63329
	Total	400	95.2325	2.85461
Adult Choking	Elementary	98	94.9898	1.34314
	Middle	137	94.8613	1.53959
	High	165	94.8182	1.53127
	Total	400	94.8750	1.48826
Infant Choking	Elementary	98	93.2755	2.40609
	Middle	137	93.1898	2.54816
	High	165	93.1455	2.38710
	Total	400	93.1925	2.44241
First Aid	Elementary	98	93.8878	2.92829
	Middle	137	93.9489	2.99588
	High	165	94.1030	2.95417
	Total	400	93.9975	2.95624
AED	Elementary	98	92.8878	3.92686
	Middle	137	93.2701	3.57381
	High	165	93.2970	3.53247
	Total	400	93.1875	3.64150

months, 70% at nine months, and 60% at 12 months. First Aid baseline skill proficiency scores averaged 94%. Scores degraded to 88% at three months, 81% at six months, 65% at nine months, and 43% at 12 months. AED baseline skill proficiency scores averaged 93%. Scores degraded to 91% at three months, 77% at six months, 70% at nine months, and 66% at 12 months. Hence, according to the AHA benchmark of 84% proficiency in declarative and procedural knowledge, results suggest that participants were no longer proficient in CPR at approximately six months post-initial training and certification.

A One-Way Repeated Measures ANOVA was calculated to determine if declarative knowledge, based on Written Exam scores, decreased significantly over time. A significant effect was found ($F(4,396) = 441.37$, $p < .001$). Written Exam scores decreased every three months over the course of the year. A One-Way Repeated Measures ANOVA was calculated to determine if Adult CPR procedural knowledge decreased significantly over time. A significant effect was found ($F(4,396) = 561.82$, $p < .001$). Adult CPR proficiency decreased every three months. A One-Way Repeated Measures ANOVA was calculated to determine if Child CPR procedural knowledge decreased significantly over time. A significant effect was found ($F(4,396) = 701.51$, $p < .001$). Child CPR proficiency decreased every three months. A One-Way Repeated Measures ANOVA was calculated to determine if Infant CPR procedural knowledge decreased significantly over time. A significant effect was found ($F(4,396) = 1165.82$, $p < .001$). Infant CPR proficiency decreased every three months. A One-Way Repeated Measures ANOVA was calculated to determine if Adult Choking Response procedural knowledge decreased significantly over time. A significant effect was found ($F(4,396) = 821.50$, $p < .001$). Adult Choking Response proficiency decreased every three months. A One-Way Repeated Measures ANOVA was calculated to determine if Infant Choking Response procedural knowledge decreased significantly over time. A significant effect was found ($F(4,396) = 1682.79$, $p < .001$). Infant Choking Response proficiency decreased every three months. A One-Way Repeated Measures ANOVA was calculated to determine if First Aid Response procedural knowledge decreased significantly over time. A significant effect was found ($F(4,396) = 2204.563$, $p < .001$). First Aid Response proficiency decreased every three months. A One-Way Repeated Measures ANOVA was calculated to determine if AED Implementation procedural knowledge decreased significantly over time. A significant effect was found ($F(4,396) = 1592.37$, $p < .001$). AED Implementation proficiency decreased every three months.

Discussion

Within this study, the observed degradation rates in both declarative and procedural CPR skills in these non-allied healthcare professionals occurred in a near-constant progression over the course of a calendar year. The significant decline in retest scores observed dur-

ing the six-month period after the initial CPR certification appears to be the most disconcerting finding in this study. These results suggest that participants were not capable of performing high-quality CPR six months post-initial certification. This observation is likely because the participants in this study, as non-allied healthcare professionals, engaged in little to no authentic rehearsal of CPR skills in their regular workplace functions following the initial certification. This finding aligns with standard Motor Behavior research, suggesting that if a skill is not rehearsed regularly, knowledge of how to perform that skill will gradually deteriorate over time, similar to the principle of diminishing returns (Ives, 2019). Hence, whereas allied healthcare professionals (such as doctors, hospital nurses, emergency medical technicians, and other medical professionals), who continuously rehearse CPR skills in authentic pragmatic situations associated with regular work-based functions, appear suited to a two-year CPR recertification cycle, non-allied healthcare professionals (such as school-based administrators, teachers, coaches, and staff), do not appear to be in such a position. Without a more regular CPR training cycle, it is unlikely such school-based non-allied healthcare professionals will be capable of performing necessary high-quality CPR in response to a worst-case scenario CRD situation on school grounds.

The presence of such unqualified practitioners in a school-based setting can obviously be extremely dangerous. If a school-based practitioner is unprepared to respond appropriately to a CRD event, both response time and response accuracy are likely to be diminished, placing a potential victim at significant risk. Early and accurate response rates are essential elements in the chain of survival for a victim of any CRD. Research has consistently shown that the success rate of resuscitation following the timely and accurate administration of an electric shock via an AED to an individual experiencing CRD is approximately 90% (Zed et al., 2008). However, for every minute that passes without administering a defibrillator, the success rate for resuscitation drops from 7% to 10% (Zed et al., 2008; Larsen et al., 1993). As such, the qualifications of first responders in school-based settings trained in CPR can quite literally dictate whether a victim of CRD lives or dies.

In light of the results from this study, it is recommended that CPR training for non-allied health professionals, such as school-

based practitioners, become more regular. Due to the observed dramatic degradation in both declarative and procedural knowledge, it is apparent that more periodic training and recertification in CPR is required for school-based personnel. A more consistent and periodic approach to preparing school-based first responders may prove beneficial in maintaining CPR proficiency rates, which could save lives.

Follow-Up

Replicated versions of this study with other non-allied healthcare professions may reinforce the notion that such practitioners require a shorter latency period between recertifications to maintain proficiency in CPR application. Such additional data could support the argument for more regular recertification requirements.

Limitations

Participants were not monitored between initial and post-testing sessions. Hence, where participants were asked not to "prepare" prior to retest scenarios, there was no way for the investigators to control for participant compliance. However, if participants did "prepare" for the retest sessions, the findings would be even more alarming based on the degradation rates observed. Furthermore, participants' inclusionary status in the study as "initial certification" practitioners was based on self-report data, which showed that none were previously certified in CPR/AED implementation. However, it is possible that some participants may have had CPR training prior to engaging in the study protocols.

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