The Confounding Variables Impeding High-Quality CPR

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Disclosures

No Conflict of Interest

Objectives

1. Analyze parameters for CPR administration
2. Identify the factors impeding CPR performance
3. Compare differences in CPR performance between different types of athletic equipment

Background Information

Incidence of SCA, Survival, & CPR Guidelines

Cardiac Arrest in the Athletic Population

- July 1, 2014 – June 30, 2016
- 132 total cases
  - Overall Survival = 48%
  - Mean age = 16 years
  - Middle School = 21%
  - High School = 59%
  - College = 11%

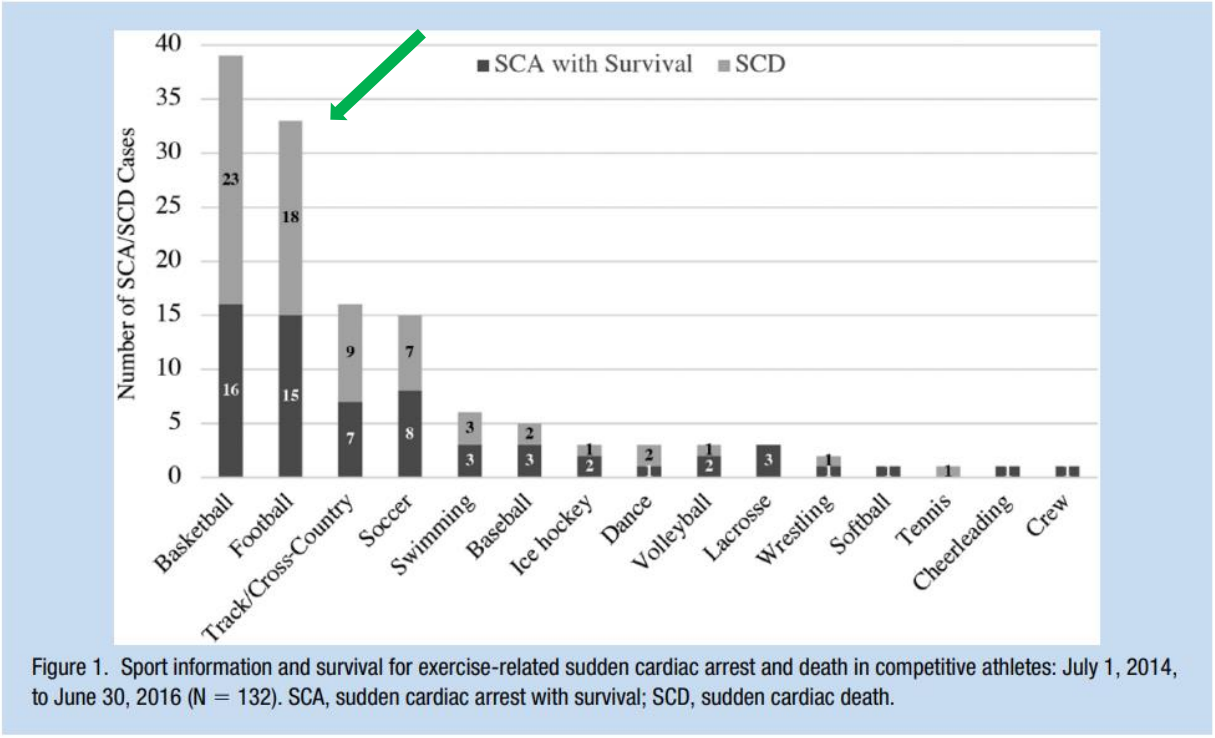
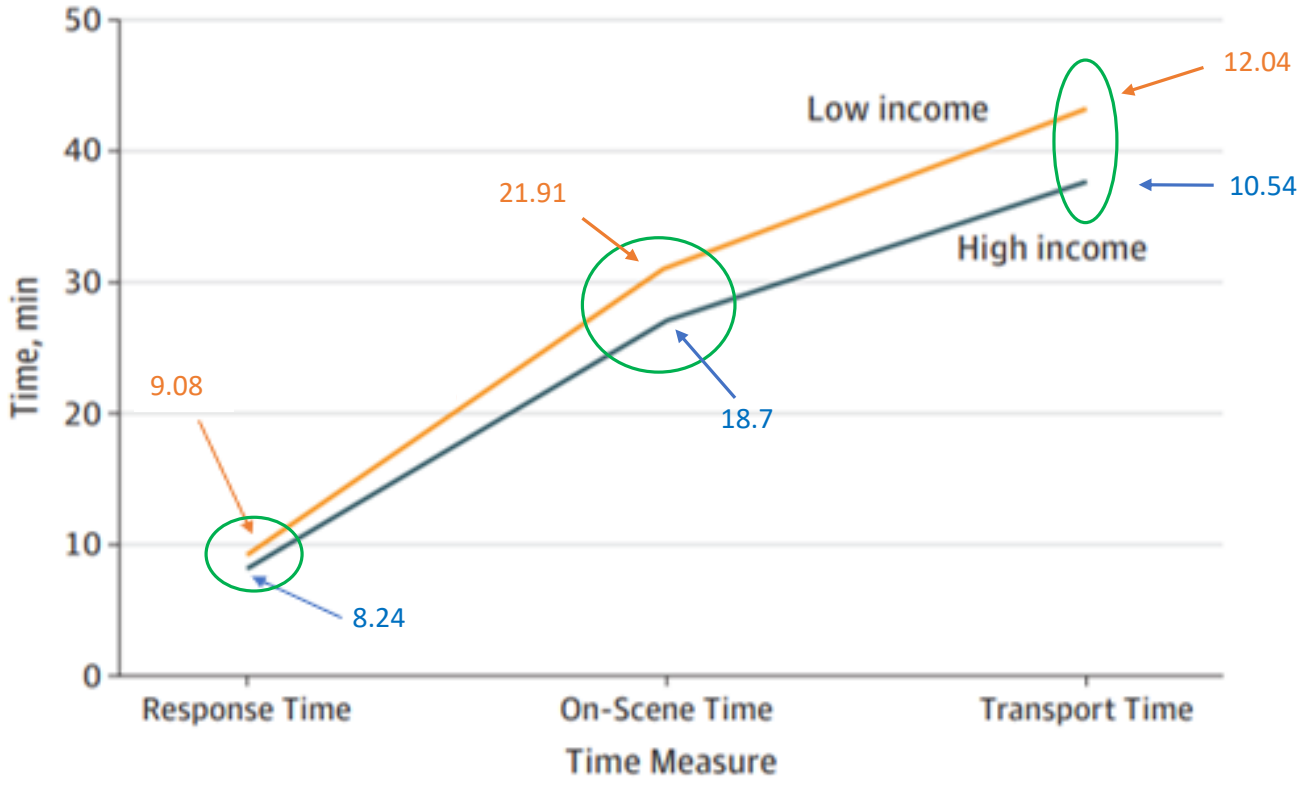


Figure 1. Sport information and survival for exercise-related sudden cardiac arrest and death in competitive athletes: July 1, 2014, to June 30, 2016 (N = 132). SCA, sudden cardiac arrest with survival; SCD, sudden cardiac death.

Retrieved from Drezner et al., *Sports Health* (2019)[1]

Figure 1. Income and Cumulative Emergency Medical Services Time

Retrieved From Hsia et al., *JAMA* (2018)[2]



EMS Response Time

Importance of Prehospital Care

Survival rate = 67% with immediate care delivered

- 2.3% per minute to CPR
- 1.1% per minute to defibrillation
- 2.1% per minute to ACLS

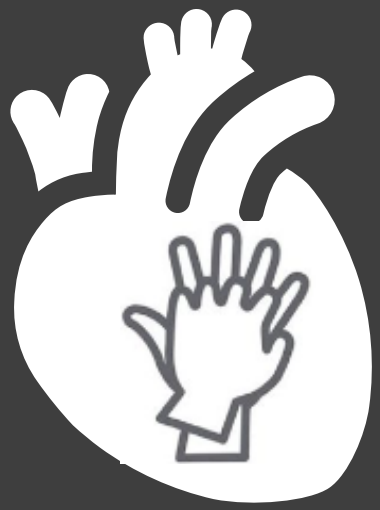
Survival decreases 5.5% per minute without care

Larsen et al., *Ann Emerg Med* (1993)[3]

2020 AHA Guidelines

Chest Compressions

- Rate
  - 100-120 cpm
- Depth
  - 2-2.4 inches (5-6 cm)
- Full chest recoil



Ventilations

- Volume
  - 500-600 mL
- Compression: Ventilation Ratio
  - 30:2
- Chest Compression Fraction
  - ≥60%

Panchal et al., *Circulation* (2020)[4]

CPR and the ATC

Quality of CPR Performed by the Certified Athletic Trainer

ATs Chest Compression Performance

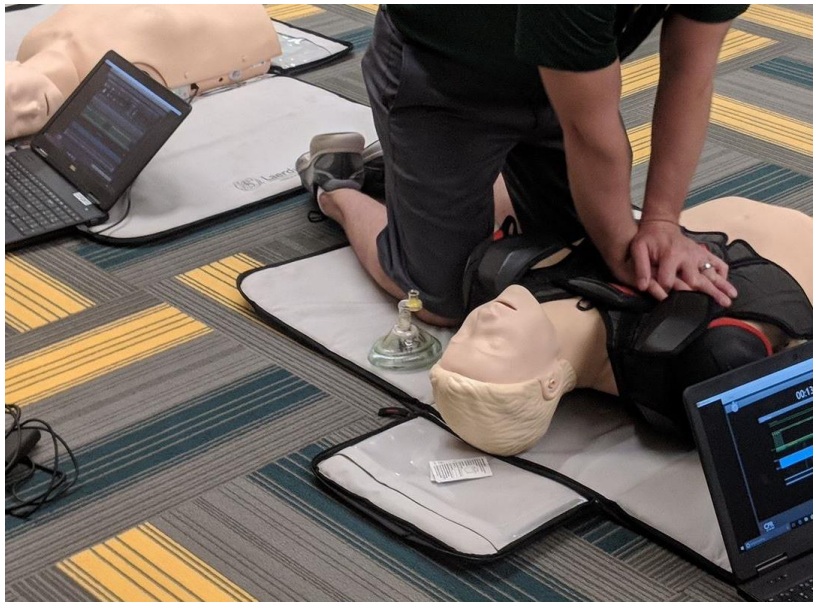
Author	n	Rate (cpm)	Recoil (%)	Depth (mm)	Depth (%)	Duration
Mihalik et al. (2016) [5]	32	114.1	**77.7**	**49.1**	**63.9**	--
Waninger et al. (2014) [6]	36	113	100	**37**	--	2 min
Boergers et al. (2018) [7]	36	115	--	56.8	--	2 min
Clark et al. (2018) [8]	26	110.3	83	51.5	**65.4**	2 min
Del Rossi et al. (2011) [9]	34	**126**	**76.1**	--	**29.3**	4 min

ATs Ventilation Performance

Author	n	Pocket Mask	Bag-Mask
Mihalik et al. (2016) [5]	32	**37.8%**	**61.2%**
Clark et al. (2018) [8]	26	**61.6%**	83.5%
Longo et al. [10]	50	**35.64%**	--
Konkol et al. (2022) [11]	20	**61.3%**	--
Skaro et al. (2020) [12]	41	**58.66%**	--

Barriers to Quality CPR

1. Protective Athletic Equipment
2. Body Composition
3. Training/Education



1. Protective Athletic Equipment

Current Guidance for ATs

National Athletic Trainers' Association Position Statement: Preventing Sudden Death in Sports

Douglas J. Casa, PhD, ATC, FNATA, FACSM* (co-chair); Kevin M. Guskiewicz, PhD, ATC, FNATA, FACSM† (co-chair); Scott A. Anderson, ATC‡; Ronald W. Courson, ATC, PT, NREMT-I, CSCS§; Jonathan F. Heck, MS, ATC‖; Carolyn C. Jimenez, PhD, ATC¶; Brendon P. McDermott, PhD, ATC#; Michael G. Miller, PhD, EdD, ATC, CSCS**; Rebecca L. Stearns, MA, ATC*; Erik E. Swartz, PhD, ATC, FNATA††; Katie M. Walsh, EdD, ATC‡‡

Retrieved from Casa et al., *Journal of Athletic Training* (2012) [13]

The Inter-Association Task Force for Preventing Sudden Death in Secondary School Athletics Programs: Best-Practices Recommendations

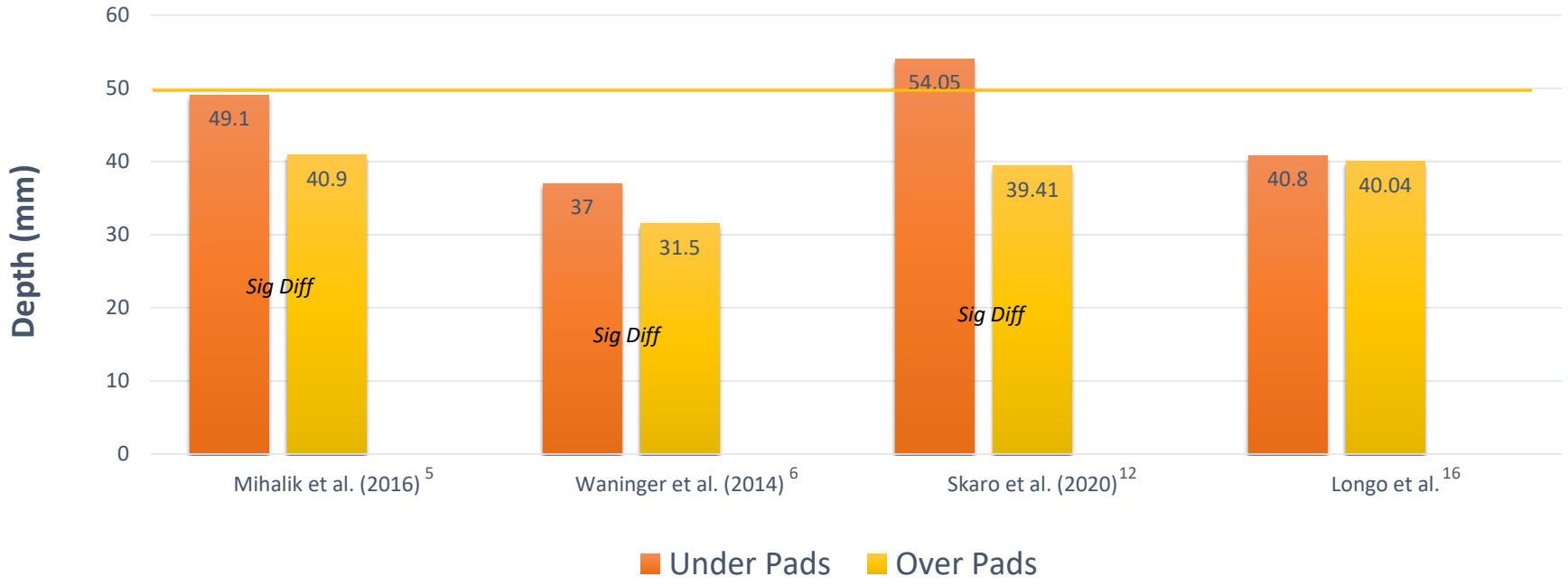
Douglas J. Casa, PhD, ATC, FNATA, FACSM (Chair)*†; Jon Almquist, VATL, ATC*; Scott A. Anderson, ATC*; Lindsay Baker, PhD‡; Michael F. Bergeron, PhD, FACSM§; Brian Biagioli, EdD‖; Barry Boden, MD¶; Joel S. Brenner, MD, MPH, FAAP#; Michael Carroll, MEd, LAT, ATC*; Bob Colgate**; Larry Cooper, MS, LAT, ATC*; Ron Courson, PT, ATC, NREMT-I, CSCS*; David Csillan, MS, LAT, ATC*; Julie K. DeMartini, MA, ATC†; Jonathan A. Drezner, MD††; Tim Erickson, CAA‡‡; Michael S. Ferrara, PhD, ATC, FNATA*; Steven J. Fleck, PhD, CSCS, FNSCA, FACSM§§; Rob Franks, DO, FAOASM‖‖; Kevin M. Guskiewicz, PhD, ATC, FNATA, FACSM*; William R. Holcomb, PhD, LAT, ATC, CSCS*D, FNATA, FNSCA§§; Robert A. Huggins, MEd, ATC†; Rebecca M. Lopez, PhD, ATC, CSCS†; Thom Mayer, MD, FACEP¶¶; Patrick McHenry, MA, CSCS*D, RSCC§§; Jason P. Mihalik, PhD, CAT(C), ATC##; Francis G. O'Connor, MD, MPH, FACSM††; Kelly D. Pagnotta, MA, ATC, PES†; Riana R. Pryor, MS, ATC†; John Reynolds, MS, VATL, ATC*; Rebecca L. Stearns, PhD, ATC†; Verle Valentine, MD††

Retrieved from Casa et al., *Journal of Athletic Training* (2013) [14]

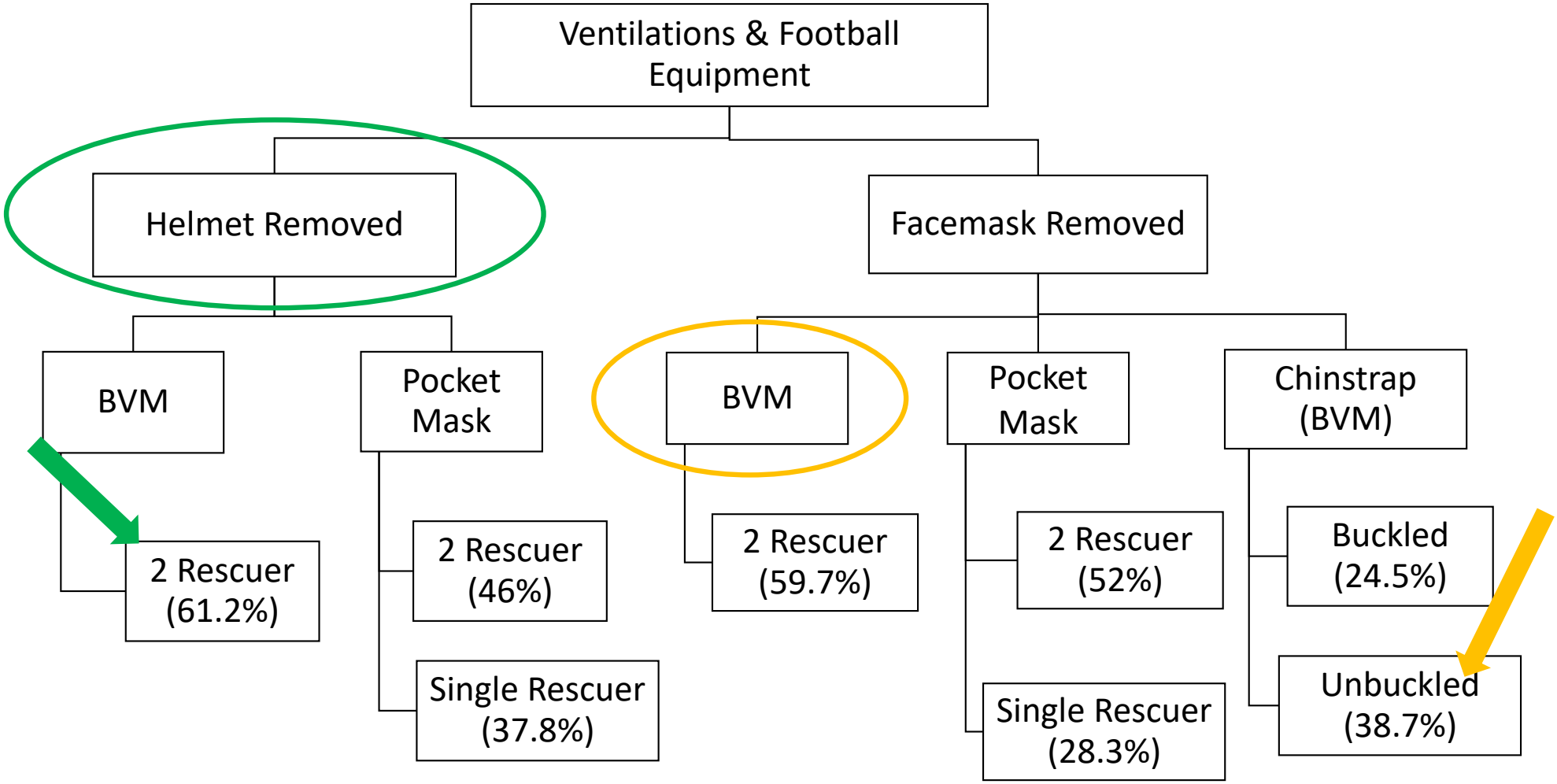
Inter-Association Task Force Recommendations on Emergency Preparedness and Management of Sudden Cardiac Arrest in High School and College Athletic Programs: A Consensus Statement

Jonathan A. Drezner, MD*; Ron W. Courson, ATC, PT, NREMT-I†; William O. Roberts, MD, FACSM‡; Vincent N. Mosesso, Jr, MD§; Mark S. Link, MD, FACC¶; Barry J. Maron, MD, FACC‖

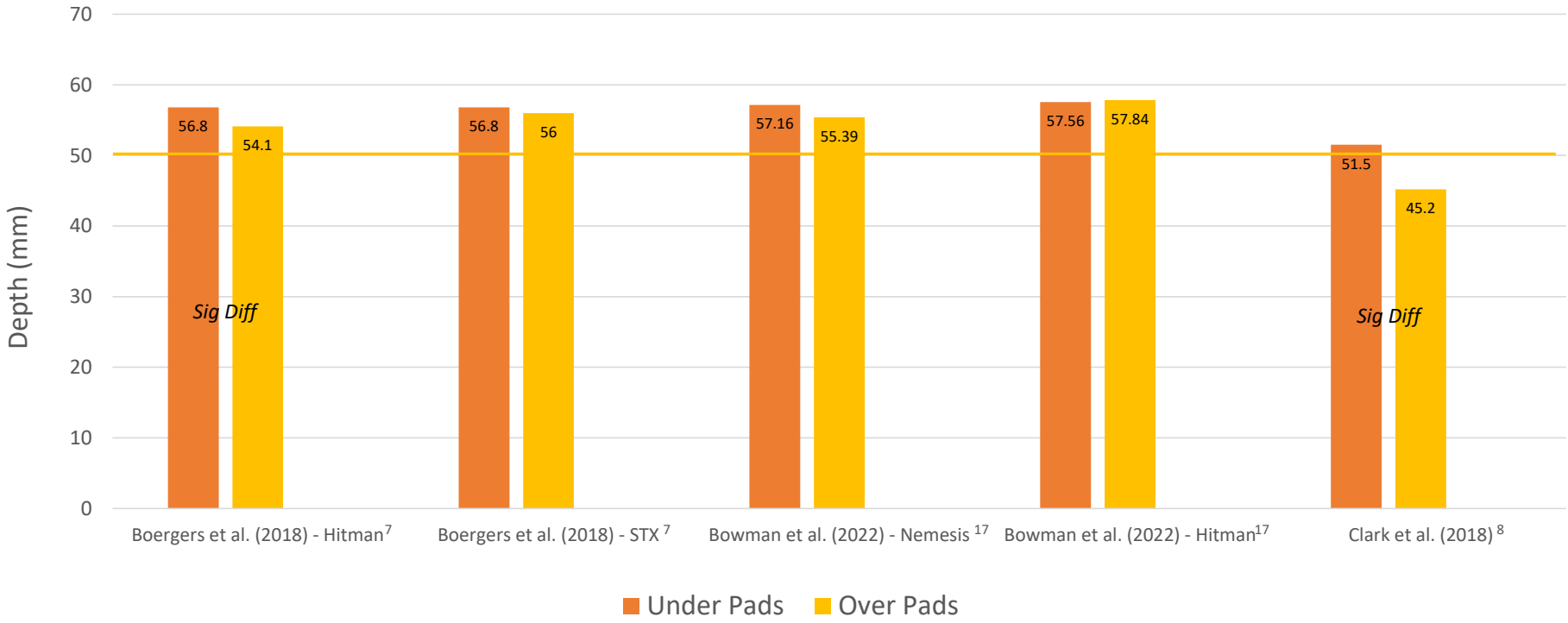
Retrieved from Drezner et al., *Journal of Athletic Training* (2007)[15]



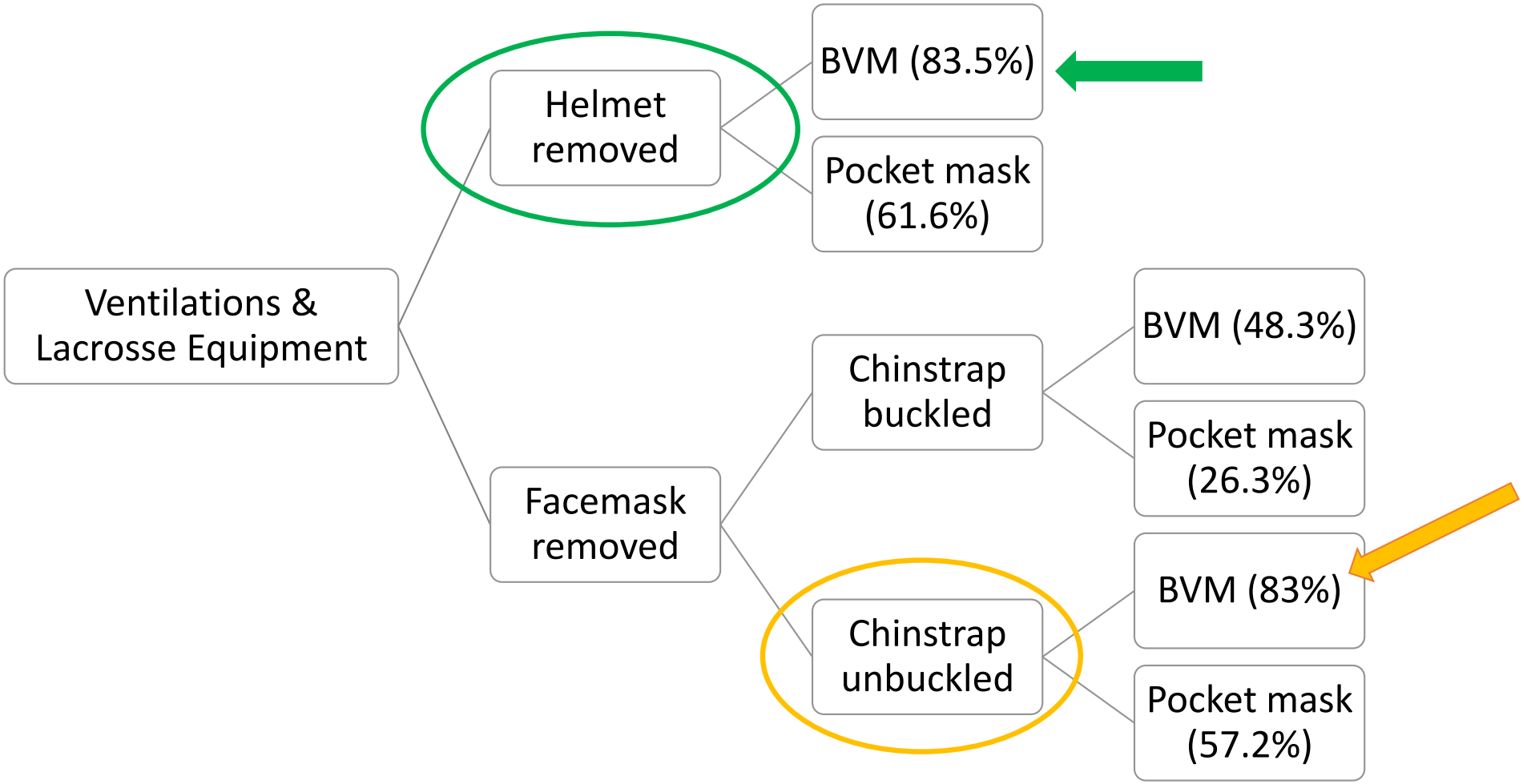
Chest Compressions & Football Equipment



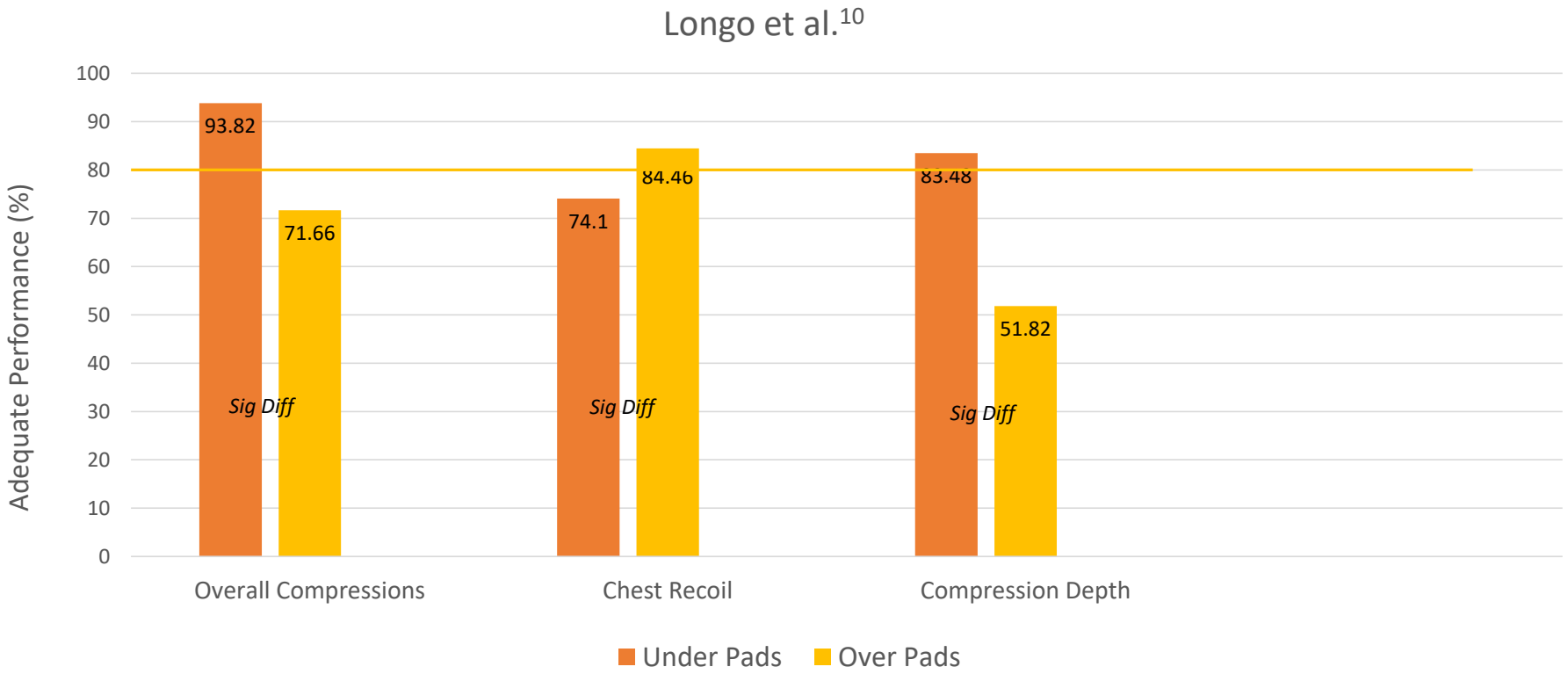
Mihalik et al., *Prehospital Emergency Care* (2016)[5]



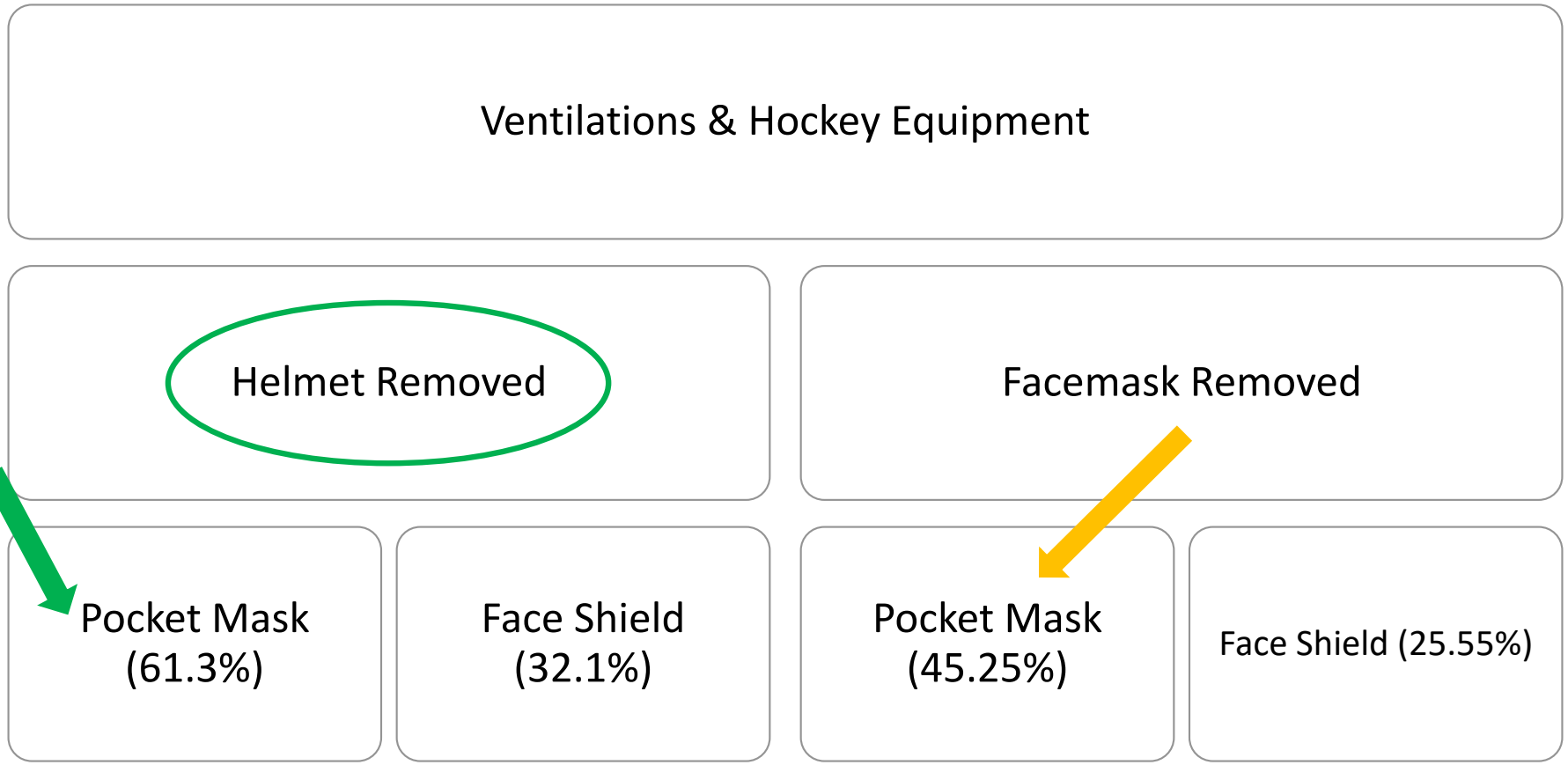
Chest Compressions & Lacrosse Equipment



Clark et al., *Journal of Athletic Training* (2018)[8]



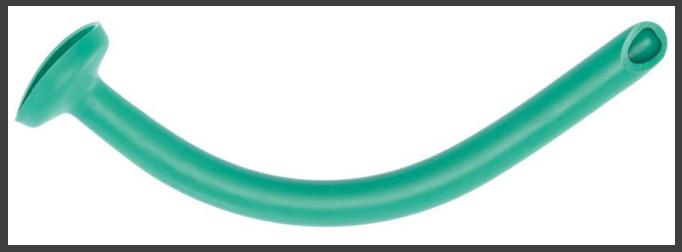
Chest Compressions & Hockey Equipment



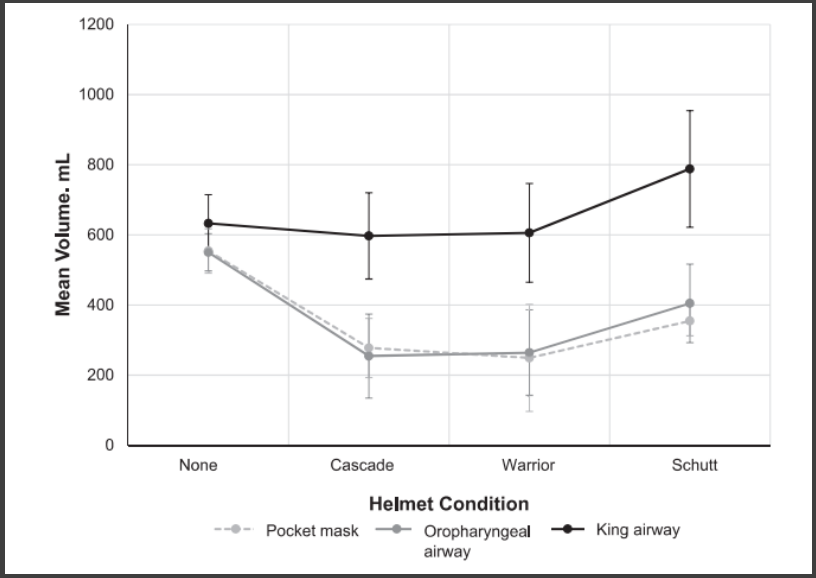
Konkol et al. (2022)[11]

What About Airway Adjuncts?

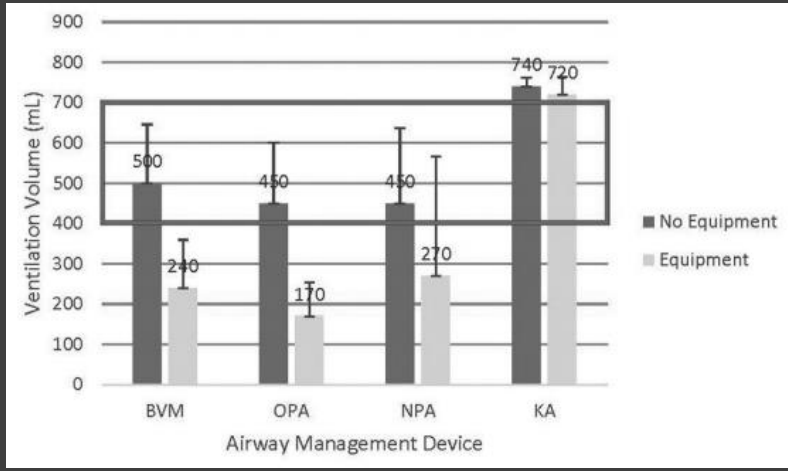
- Research in AT limited to lacrosse equipment
  - Boergers et al., *Athletic Training & Sports Health Care* (2017)[18]
  - Bowman et al., *Journal of Athletic Training* (2018)[19]
- Clinician comfort with airway management may be a factor



Airway Management Devices & Lacrosse Equipment



Retrieved from Bowman et al., *Journal of Athletic Training* (2018) [19]



Retrieved from Boergers et al., *Athletic Training & Sports Health Care* (2017)[18]

Football Equipment Removal

Longo et al.[16]

- EMTs & Paramedics + Shoulder Pad Removal Only
  - 22.6 ± 8.53

Del Rossi et al. (2011)[9]

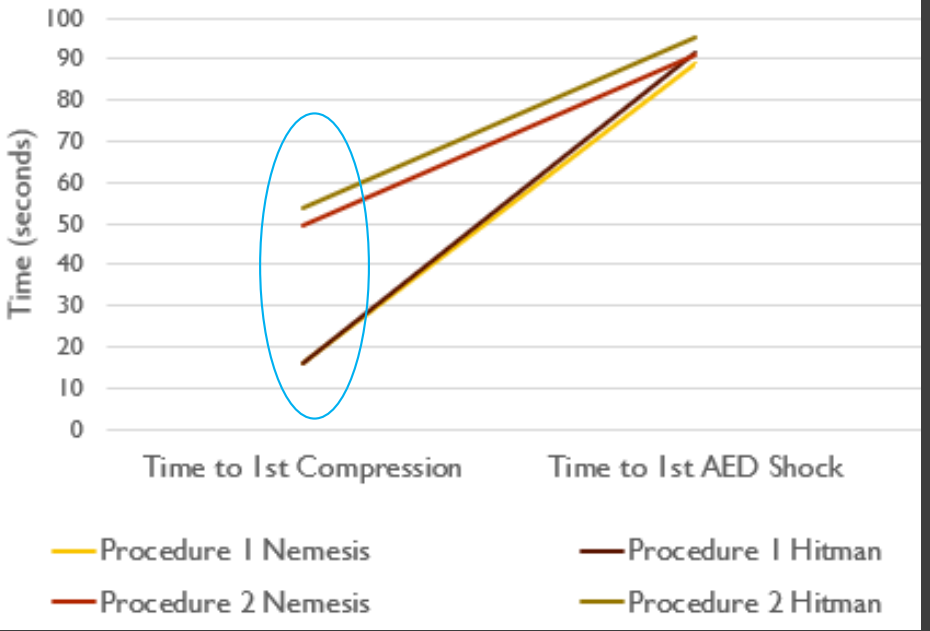
- Remove facemask + chest protector left on
  - Time to remove facemask: 72.7 s
  - Time to 1st breath: 93.7 s
  - Time to expose chest: n/a
  - Time to 1st compression: 105.8 s
- Facemask removal & chest protector
  - Time to remove facemask: 70.5 s
  - Time to 1st breath: 91.5 s
  - Time to expose chest: 24.4 s
  - Time to 1st compression: 126.1 s

Retrieved from Del Rossi et al., *Resuscitation* (2011)[9]

Lacrosse equipment removal

- **Procedure 1:** Removal of helmet & initiate CPR over pads → pad retraction and AED application
- **Procedure 2:** Removal of helmet and pads → CPR and AED application
- **CPR Quality:** Difference between chest-exposure procedure or pad type for depth & recoil was NS

Bowman et al., *Journal of Athletic Training* (2022)[18]



2. Body Composition

Obesity

- Smith & Smith, *Prim Care Clin Office Pract* (2016)[20]
  - People who are overweight or obese outnumber normal-weight individuals by 2:1
  - Projection → 85% of American adults will be either overweight or obese by the year 2030

Table 3. Percentage of Male High School Athletes Classified Into BMI Categories, by Sport.

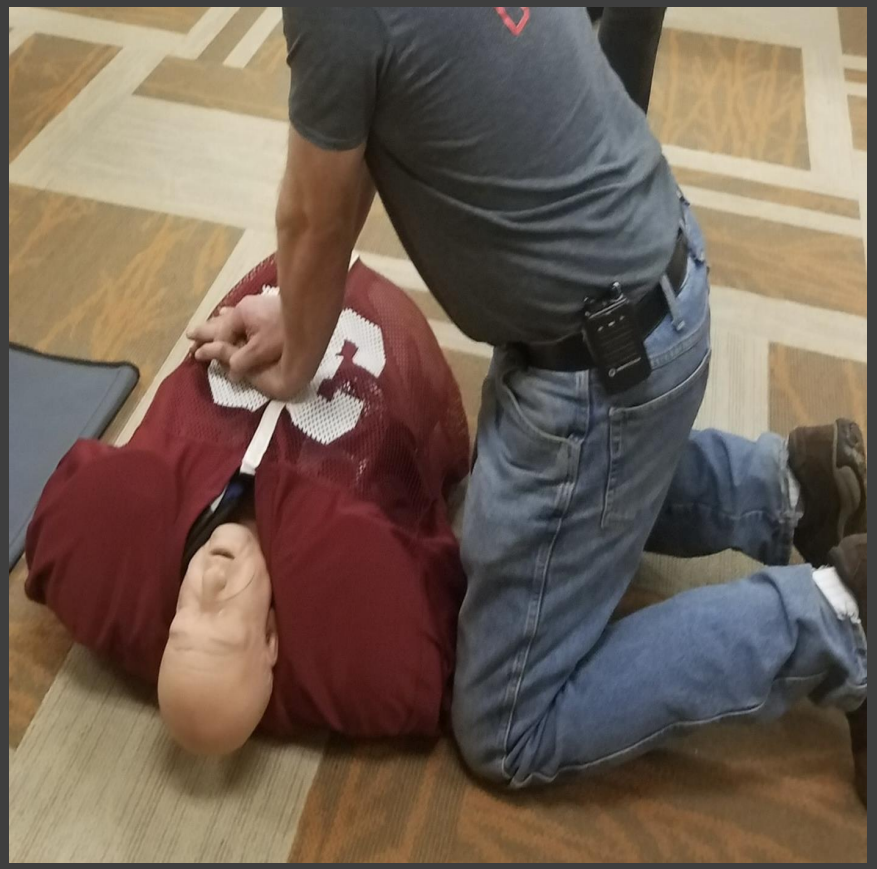
	Football, n = 305 339	Baseball, n = 38 559	Basketball, n = 38 968	Lacrosse, n = 3654	Soccer, n = 4692
Underweight (BMI <18.5)	0.9	1.4	1.8	1.2	3.9
Healthy weight (BMI = 18.5-24.9)	47.4	68.7	78.5	68.9	82.4
Overweight (BMI = 25-29.9)	33.8	25.9	17.1	25.6	12.3
Obesity (BMI = 30-34.9)	12.4	3.4	2.1	3.7	1.3
Class 2 obesity (BMI >34.9)	5.6	0.6	0.5	0.5	0.2

Abbreviation: BMI, body mass index (in kg/m^2).

Retrieved from Berkowitz et al., *Clinical Pediatrics* (2019)[21]

CPR & Obesity

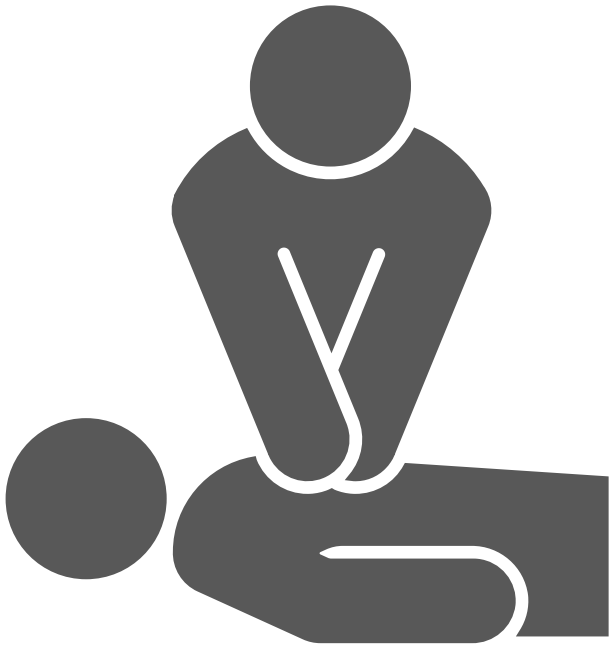
- Tellson et al., *Proc (Bayl Univ Med Cent)*(2017)[22]
  - Control: **23/30** successful compressions
  - Obese: **0/30** successful compressions
- Secombe et al., *Anaesth Intensive Care* (2018) [23]
  - Control: **81.2%** adequate depth
  - Obese: **7.9%** adequate depth
- Longo et al.[16]
  - Control: **40.8 mm** depth (w/ FB pads 40.4 mm)
  - Obese: **38.2 mm** depth (w/ FB pads 32.84 mm)



CPR Guidelines and BMI

- CT scan to calculate Internal AP diameter and External AP diameter
- Significant difference in EAPD and IAPD for each BMI group
- Residual internal chest depth measurements available for compression increased with BMI
- Conclusion
  - Current CC depth of ≥ 50 mm is not appropriate for all adults
  - Targeting between 1/3 – 1/4 EAPD might be appropriate

Lee et al., *Am J Emerg Med* (2015) [24]

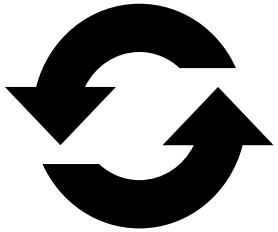


3. Training/Education

CPR Education and the Athletic Trainer

- ECC updates every 2 years
- CPR/AED for Professional Rescuer
  - Chest Compressions
  - Ventilations
    - Pocket Mask
    - BVM
  - AED

Best Practices for CPR Training



Monthly training is recommended

Anderson et al., *Resuscitation (*2019)[25]

Deliberate feedback improves CPR quality

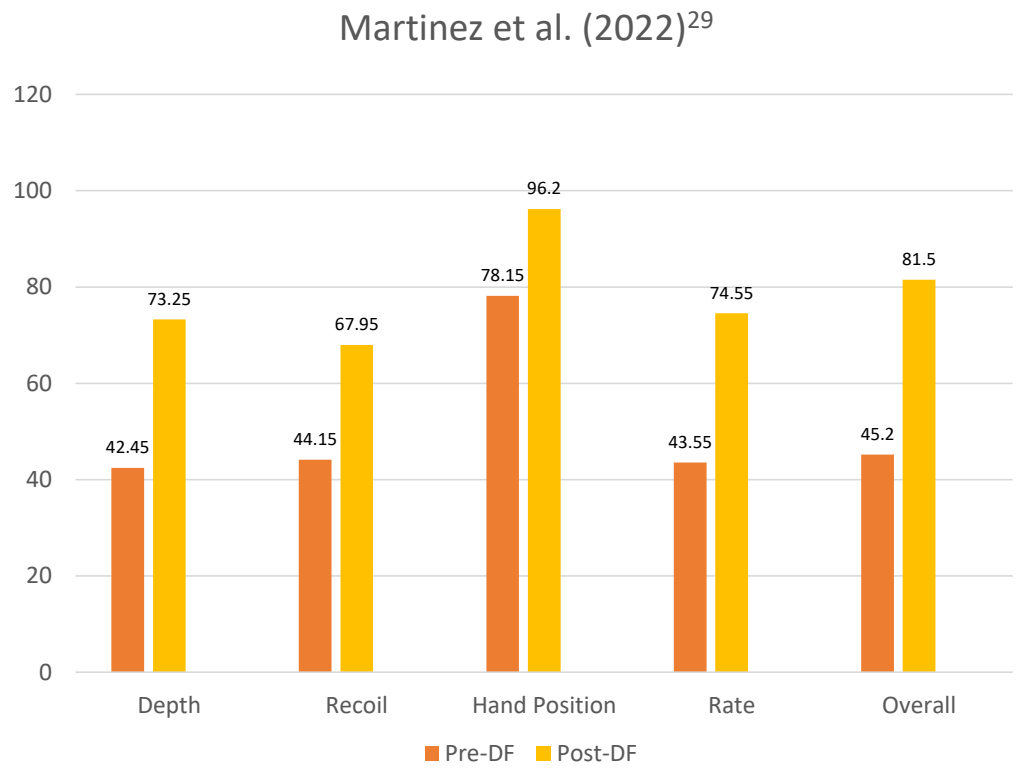
Akizuki et al., *PLoS ONE* (2019)[26]

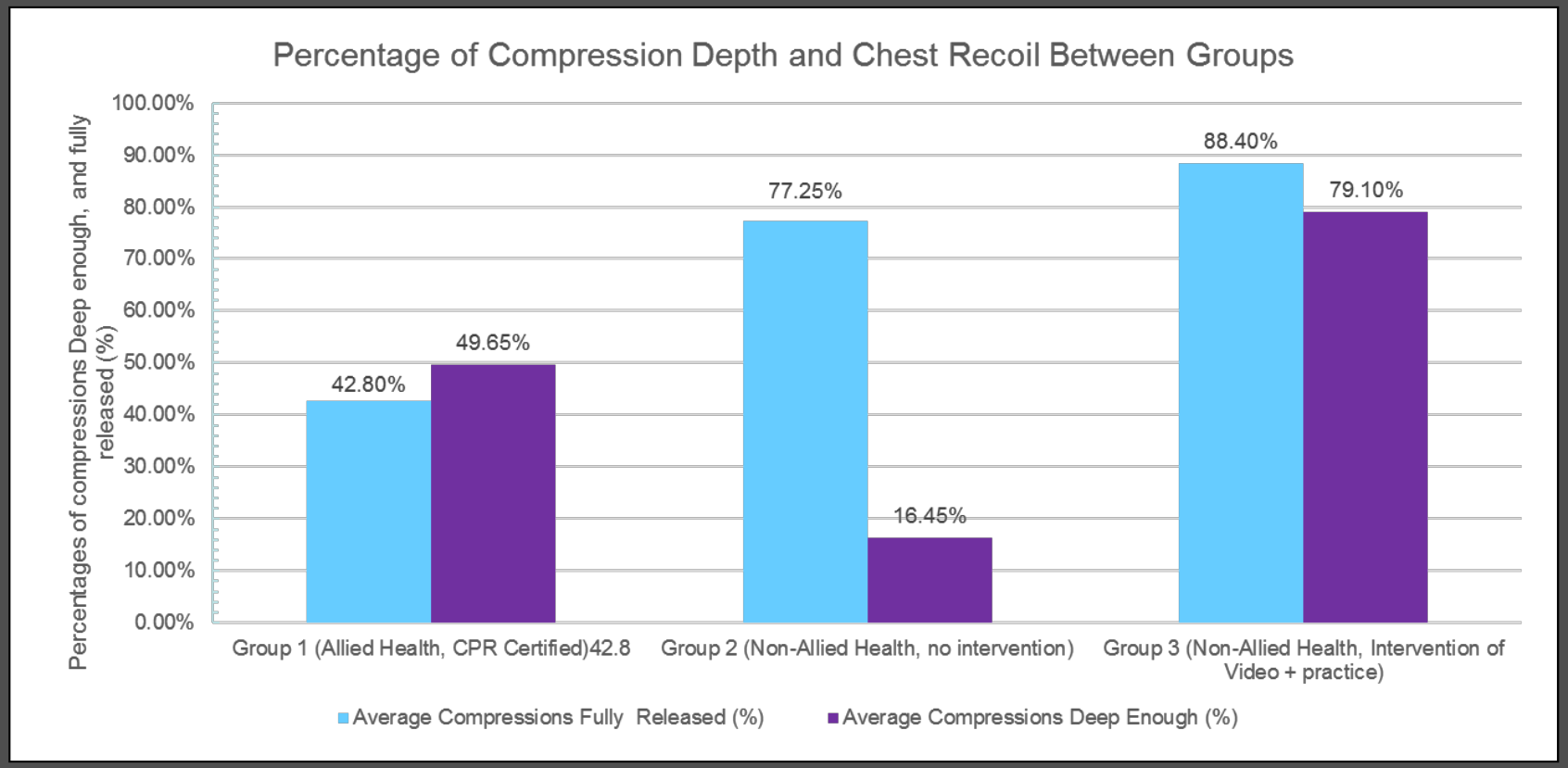
Baldi et al., *CJEM* (2017)[27]

Instructor feedback is inaccurate with a high rate of false positives

Brennan et al., *CJEM* (2016)[28]

Deliberate feedback

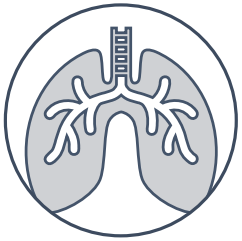




Lyman et al. (2017)[30]

Take Home Messages

Time to remove equipment is important



Be mindful of the ventilation method you use

Practice/training is essential!

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