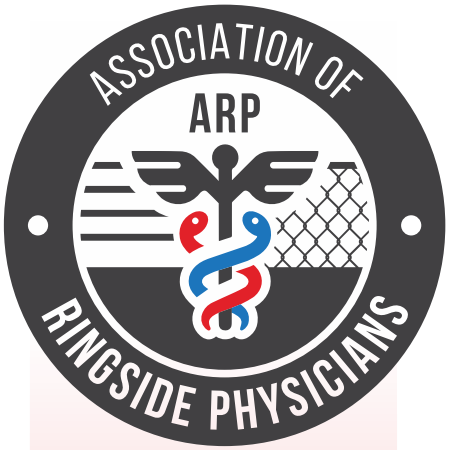


Association of Ringside Physicians

Journal of Combat Sports Medicine

Volume 5, Issue 2
July 2023

Editor-in-Chief, Editorial Board

Nitin K. Sethi, MD, MBBS, FAAN, is a board certified neurologist with interests in Clinical Neurology, Epilepsy and Sleep Medicine. After completing his medical school from Maulana Azad Medical College (MAMC), University of Delhi, he did his residency in Internal Medicine (Diplomate of National Board, Internal Medicine) in India. He completed his neurology residency from Saint Vincent's Medical Center, New York and fellowship in epilepsy and clinical neurophysiology from Weill Cornell Medical Center, New York. Dr. Sethi is a Diplomate of the American Board of Psychiatry and Neurology (ABPN), Diplomate of American Board of Clinical Neurophysiology (ABCN) with added competency in Central Clinical Neurophysiology, Epilepsy Monitoring and Intraoperative Monitoring, Diplomate of American Board of Psychiatry and Neurology (ABPN) with added competency in Epilepsy, Diplomate of American Board of Psychiatry and Neurology (ABPN) with added competency in Sleep Medicine and also a Diplomate American College of Sports Medicine (ACSM)/Association of Ringside Physicians (ARP) and a Certified Ringside Physician. He is a fellow of the American Academy of Neurology (FAAN) and serves on the Board of the Association of Ringside Physicians. He currently serves as Associate Professor of Neurology, New York-Presbyterian Hospital, Weill Cornell Medical Center and Chief Medical Officer of the New York State Athletic Commission.

Editorial Staff

Susan Rees, Senior Managing Editor
Email: srees@reesgroupinc.com

Susan Rees, The Rees Group President and CEO, has over 30 years of association experience. Currently the Executive Director of the American Osteopathic Academy of Sports Medicine, American Society for Veterinary Clinical Pathology, and the Society for Psychophysiological Research, Susan spent 12 years with the Credit Union National Association (CUNA & Affiliates) as the director of their educational publishing division. Susan has an extensive background in association management, marketing and regulatory affairs, as well as print and electronic publishing. She is also an award-winning video producer, having produced educational videos and films for the financial training market. Susan spent two years with Forbes Inc., publisher of Forbes magazine as an international acquisitions editor in the book publishing division. At Forbes, Susan worked with businesses and associations to produce books, manuals, web sites and online learning tools for general retail sales distribution, or distribution through the business or association. Susan holds a Bachelor of Arts Degree in Communications and a Master of Science Degree in Education from the University of Wisconsin-Madison. She has been President and CEO of TRG since 2000.

Lisa M. Nelson, Senior Managing Editor
Email: lnelson@reesgroupinc.com

Lisa Nelson has worked in association management for over 35 years; the past 32 years with The Rees Group. She is currently the Managing Director of the Society for Clinical and Medical Hair Removal, but spent much the last 30 years working with association publications. She is the former Managing Editor for the *Journal of Cardiopulmonary Rehabilitation* and the *Annals of Behavioral Medicine*, and continues to edit for several association newsletters.

Table of Contents

From the Editor's Desk

Dear Colleagues,

I trust this issue finds you all in good health. In Volume 5 Issue 2 of the *ARP Journal of Combat Sports Medicine,* Twohey and Neidecker present the results of their survey on ringside physician laceration repair compensation for state sanctioned events across the United States. The authors found that most state commissions allow ringside physicians to suture. Just over half of physicians allowed to suture receive extra compensation for these services, and the majority of those who do charge negotiate the price with the event promoter. The amount charged varied widely from state to state, but generally remained constant within a given state. Sethi, in his commentary, discusses clinical presentation and management of acute concussive injuries and moderate to severe traumatic brain injury in the boxing ring. Dr. Bhagratie and colleagues in their interesting commentary present the similarities and differences between ringside/cageside coverage and sideline coverage at a football/soccer game. Sethi presents a case report on traumatic peroneal neuropathy in an MMA athlete and reviews the associated literature. Sandoval et al. in their important study examine the varying medical requirements for combat sports licensure across various United States Commissions identifying consistencies and discrepancies that exist across different commissions.

I take this opportunity to wish you and your families Happy Holidays. May 2023 be filled with good health and happiness. Our two Senior Editorial Managers, Lisa Nelson and Susan Rees, continue to work tirelessly to improve the journal and make it a valuable resource for the combat sports community. The ***ARP Journal of Combat Sports Medicine*** is actively soliciting case reports, case series, review articles, and original studies related to the field of combat sports medicine. Please consider the journal for publication of your valuable work.

Sincerely,

Nitin K Sethi, MD, MBBS, FAAN
Editor-In Chief

LACERATION REPAIR COMPENSATION OF RINGSIDE PHYSICIANS ACROSS THE UNITED STATES

Eric Twohey, MD, Department of Physical Medicine and Rehabilitation, Mayo Clinic, Rochester, Minnesota, USA (Corresponding Author: twohey.eric@mayo.edu)

John Neidecker, DO, ATC, FAOASM, Association of Ringside Physicians President, OrthoNC, Raleigh, North Carolina, USA, Campbell University School of Osteopathic Medicine, Buies Creek, North Carolina, USA

KEYWORDS: Combat sports, ringside physician, compensation, laceration repair

STUDY FUNDING: No targeted funding reported.

DISCLOSURES: The author JN serves on the medical advisory board of the North Carolina Boxing and Combat Sports Commission (NCBCSC) and is a ringside physician of the New York State Athletic Commission (NYSAC). The views expressed by the authors are their own and do not necessarily reflect the views of the institutions and organizations which the authors serve.

Introduction

The responsibilities of a ringside physician vary widely across the United States depending on the commission sanctioning the event, promoter, and physician experience. Soft tissue lacerations happen frequently in combat sport events, accounting for up to 50-60% of injuries sustained.[1,2] It is not uncommon for a ringside physician to suture a laceration in between fights or after the event to help provide prompt medical care and potentially saving the athlete a trip to the emergency room.

While the practice of suturing during a combat sport event is common, many things remain unclear about the practice of suturing at events including: how many states allow a ringside physician to suture? If and how much compensation a ringside physician receives for these services? And how ringside physicians are compensated for their services? The purpose of this survey was to evaluate these uncertainties for state-commissioned fights across the United States.

Methods

Association of Ringside Physicians (ARP) members were asked via email and/or text message between August and September 2022 to complete a survey regarding laceration compensation for state commission sanctioned events.

1. Does the commission allow you to suture lacerations post-bout if you are functioning as the ringside physician for the event?
2. If so, do you receive extra compensation for suturing post-bout?
3. If so, do you negotiate with the promoter about how much you receive?
4. On average, how much do you receive per athlete that you suture post-bout?
5. Any other helpful information that you think would be helpful for our study?

If there was no response or ARP member from an area, state commissions were reached out to di-

rectly. Those who practice in multiple states were asked to complete one survey for each state.

Results

A total of 63 responses were received from 94 physicians who were sent the survey, for a response rate of 67%. Two commissions responded as well, making a total of 37 states that were represented in the survey (Figure 1). Of the states that responded, 29/37 (78%) were allowed to suture (Figure 2). As state commissions were not able to answer if physicians received extra compensation for suturing, a total of 27 states were represented among a total of 48 responses pertaining to question 2 of the survey. Response numbers by state ranged from 1 to a maximum of 6 responses from the

Figure 1. Responses Received from States

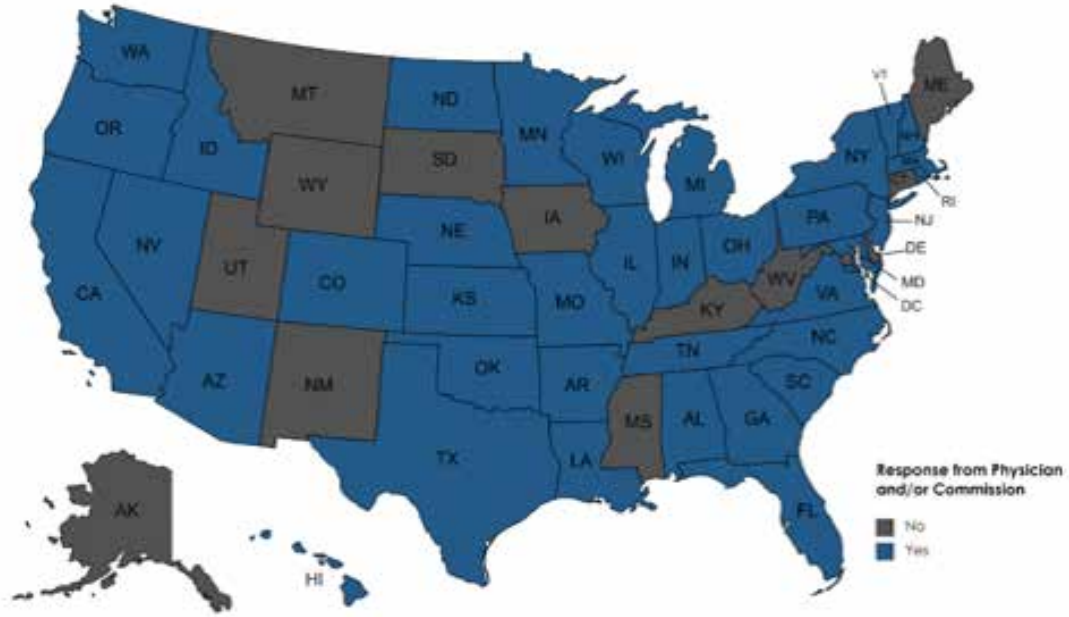


Figure 2. States Allowing Suturing by Ringside Physician

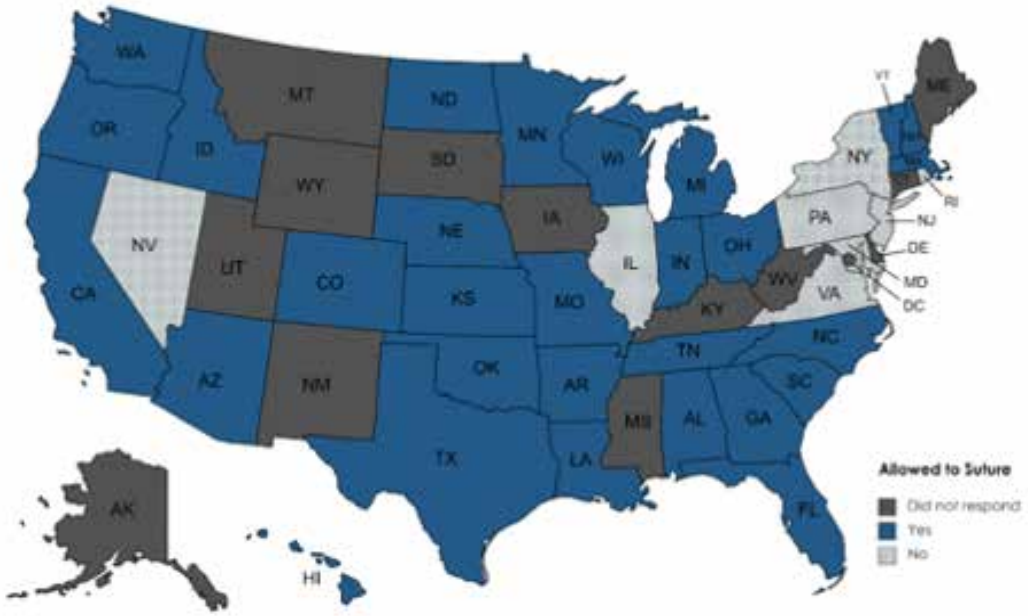
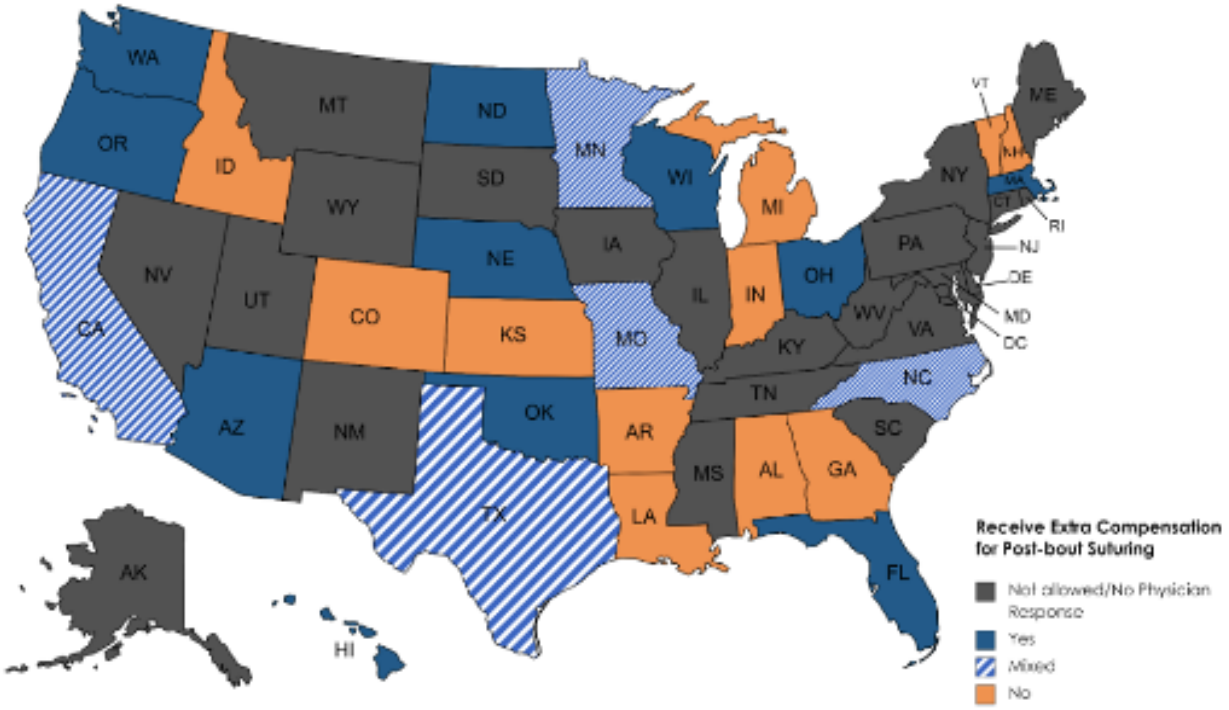


Figure 3. Number of Responses to "Do You Receive Extra Compensation For Suturing"

Figure 4. Do You Receive Extra Compensation for Suturing



state of Alabama (Figure 3). Twenty-five of the 48 physicians (52%), representing 16 out of 27 states (59%), received extra compensation for post-bout suturing (Figure 4). Of those that did receive extra compensation, 19/25 (76%) negotiated with the promoter on the price charged. Average compensation per athlete ranged from the cost of a suturing kit (approximately $45) to $400 (Figure 5).

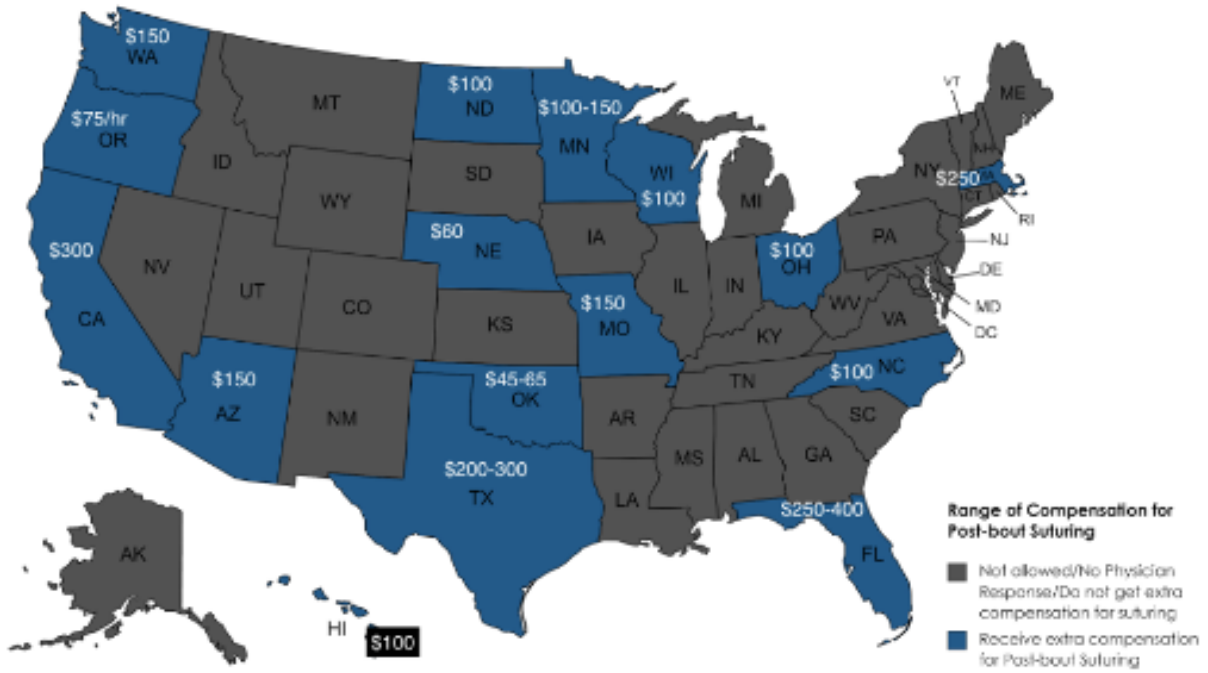
Discussion

This laceration compensation survey represents 67% of the 94 ARP physicians that were contacted. While the majority of responses come from a handful of states, overall 37 states were represented. Nearly all of the states that did not provide a response did not have an ARP physician that provided coverage for fights in that state.

Most states (78%) did allow the ringside physician to suture. States that did not allow the ringside physician to suture did have other set-ups to take care of the fighter such as a separate physician (employed by the promotion, not by the commission) whose sole role was for suturing, or having all lacerations seen in a local emergency department.

Just over half (52%) of physicians allowed to suture received extra compensation for suturing. The amount of payment for suturing varied widely from state to state. This ranged from $45, or about the cost of a suturing kit in Oklahoma, to a maximum of $400 per athlete sutured in Florida. There are almost certainly factors that contribute to this that were not able to be highlighted in our study such as physician experience, specialty training, the level of the fight, etc. A few physicians commented that they did not charge what they typically would for their services because of their love for the sport and concern that the promotion would not be able to afford them otherwise. While most ringside physicians charged per

Figure 5. Compensation Range for Suturing



athlete sutured, there were a few unique scenarios for payment such as in Oregon in which a physician charged by the hour.

Future studies could consider looking into other factors that may play a role in laceration repair compensation such as: physician experience, specialty training, amateur versus professional, or type of combat sport.

Conclusion

Our survey shows that the majority of states allow ringside physicians to suture. Just over half of physicians allowed to suture receive extra compensation for these services, and the majority of those that do charge negotiate the price with the event promoter. The amount charged varies widely from state to state, but generally is pretty similar within a given state.

References

1. Lystad, Reidar P., Kobi Gregory, and Juno Wilson. "The epidemiology of injuries in mixed martial arts: a systematic review and meta-analysis." ***Orthop J Sports Med*** 2.1 (2014): 2325967113518492.

2. Bledsoe GH, Li G, Levy F. Injury risk in professional boxing. ***South Med J.*** 2005 Oct;98(10):994-8. doi: 10.1097/01.smj.0000182498.19288.e2. PMID: 16295814.

COMMENTARY

Clinical presentation and management of acute concussive injuries and moderate to severe traumatic brain injury in the boxing ring

Nitin K Sethi, MD, MBBS, FAAN
Department of Neurology, New York-Presbyterian Hospital, Weill Cornell Medical Center
New York, NY, USA
(Email: sethinitinmd@hotmail.com)

KEYWORDS: Boxing; concussion; traumatic brain injury

DISCLOSURES: The author serves as the Chief Medical Officer (CMO) of the New York State Athletic Commission (NYSAC). The views expressed by the author are his own and do not necessarily reflect the views of the institutions and organizations which the author serves.

Background

Professional boxing is a popular combat sport worldwide. In boxing every punch thrown to the head is thrown with the intention of winning by causing a knockout (KO). As a result of the frequent head impact exposures concussions are common. Traumatic subdural hematoma (SDH) is the most common cause of boxing related mortality.[1] Timely identification and management of concussions in the boxing ring helps protects the combatant's neurological health.

Concussion definition and clinical presentation

Concussion is defined as a clinical syndrome characterized by immediate and transient alteration in brain function, including alteration of mental status and level of consciousness, resulting from mechanical force or trauma.[2] Mild grade of concussive injuries are usually not accompanied by loss of consciousness. Head impact exposures associated with prolonged loss of consciousness and post traumatic amnesia are indicative of more severe grade of traumatic brain injury (TBI). The symptoms of concussion are predominantly subjective with the patient reporting headache, subjective feeling of dizziness or feeling off-balance, light sensitivity (photophobia), sound sensitivity (phonophobia), nausea, poor sleep, labile mood, and cognitive dysfunction. On examination the neurological examination is usually non-focal. The patient may exhibit impaired coordination, poor balance, and stance (as documented by the Balance Error Scoring System), impaired attention and concentration, executive dysfunction, and difficulty multitasking.

Clinical presentation of acute concussion inside the boxing ring or cage

A KO usually leads to an acute concussive injury inside the boxing ring or cage. The presentation is rather dramatic with the boxer exhibiting sudden loss of body tone resulting in a hard fall on to the canvas after a blow to the head or temple. Varying degrees of both linear and rotational (angular) acceleration is transferred from the punch and absorbed through the intracranial cavity. Impact deceleration causes a second head impact exposure to occur when the boxer falls and the head bounces off the canvas. The boxer displays unresponsiveness leading to a stoppage to the action by either

the referee or the ringside physician. Immediately following the fall, the boxer may exhibit decerebrate posturing and low amplitude clonic jerks of the legs lasting on an average less than 20 seconds. It is unclear whether this reflects a brainstem release phenomenon or a short-duration post-traumatic seizure (impact seizure). Neurological examination inside the ring immediately following the stoppage usually reveals a conscious but unresponsive boxer. The eyes may be open or closed. Pupils are midsize, equal in size with sluggish response to light. At times slow roving eye movements are seen. The boxer does not respond to verbal commands and this conscious unresponsive state may persist for a few minutes. The boxer then enters an acute confusional state and attempts to get up. He does not follow commands and becomes combative when restrained by the medical staff.[3] The fact that the fight is over does not register. After a minute or two, the boxer calms down with return of orientation to person, place (venue), and circumstance (the fight is over).

Management of acute concussive injury inside the ring or cage

Inside the ring the acute concussive injury is unnerving to witness as a physician because of its dramatic presentation and rapid evolution of clinical semiology. Management inside the ring or cage should focus on stabilization of the downed fighter and follow the A (airway), B (breathing) and C (circulation) sequence of events in Basic Life Support (BLS). The downed fighter's airway should be opened using a head-tilt chin-lift or jaw-thrust maneuver while maintaining immobilization of a potentially compromised cervical spine.[4] Removing the mouthpiece ensures a patent airway. The downed fighter usually has a rapid respiratory rate and rescue breathing is not needed. The acute concussive injury is not accompanied by circulatory rest and cardiopulmonary resuscitation (CPR) is not needed. The neurological syndrome is self-limited with the boxer returning to baseline neurological function usually in the ring itself. The boxer should be gently restrained until fully conscious, alert, and responding appropriately to commands. At this point, the boxer should be asked about the presence or absence of headache, dizziness, blurring of vision, double vision, neck pain, and weakness in the arms or legs. Pupils should be assessed for size, symmetry, and reactivity. Extraocular movements should be checked, and the boxer asked to follow a two-step command ("touch your left ear with your right glove"). The downed fighter who denies any neurological symptoms and has a non-focal neurological examination is assisted off the canvas and made to sit on a stool. After a few minutes of rest, the boxer should be asked to stand up. Finger to nose test, stance with legs together and eyes closed, and tandem gait is then assessed. The boxer should then be assisted out of the ring by the ringside physician/inspector and taken to the medical room backstage for more thorough assessment and definitive management.

In the event the downed fighter is not breathing, mouth-to-mouth ventilation, bag-mask ventilation (preferably with oxygen), or mouth-to-mask ventilation can be instituted until an advanced airway is in place.[5] At this point the emergency medical personnel stationed ringside with resuscitation equipment should be summoned inside the ring/cage by the ringside physician. CPR should be started immediately in the downed unconscious fighter who is not breathing. An automated defibrillator (AED) is critical in reviving the heart of a fighter in cardiac arrest. It should be used in the ring as soon as it is available. After initial stabilization in the ring (establishment of airway and circulation) and placement of C-collar, the fighter should be transferred to the spine board using log-roll (LR) maneuver or the lift-and-slide technique for immediate transport via onsite ambulance to the nearest Level I trauma center for more thorough assessment with neuroimaging and definitive management by neurology and neurosurgery physicians.

Management of concussive injury in the aftermath of the fight in the neurologically stable fighter

The concussed fighter is examined in the post-fight medical room. Since there are currently no validated ringside imaging or biofluid (blood or saliva) biomarkers for concussion, the diagnosis of concussion is made clinically based on history of head impact exposure followed by characteristic symptoms and signs. In the medical room a more detailed neurological examination is carried out. A concussed fighter with no history of loss of consciousness, short period of post-traumatic amnesia, Glasgow Coma Scale (GCS) score of 15/15 and with a normal (non-focal) neurological examination should not be immediately discharged from the venue. Traumatic subdural hematoma (SDH) is the most common cause of boxing related mortality and can present with a lucid interval. Hence it is prudent to "red-flag" the fighter. The red-flagged fighter is not immediately discharged from the venue, is observed, and undergoes serial neurological examination for a period ranging from 15-30 minutes. A stable fighter can be discharged from the venue with advice to the coach/family to observe closely for the next 24 hours, call 911, and go to the nearest hospital if the boxer complains of neurological symptoms such as headache, exhibits change/depression of sensorium or starts to vomit. Prior to discharge, the athlete is administered a period of medical suspension (usually 90 days) and is advised a period of cognitive and physical rest. The rationale for this is that a concussed brain is in a state of energy crisis and fares better when the cognitive and physical demands on it are less. Cognitive rest entails pulling back from cognitive activities such as college work, screen time (amount of time spent using devices with screens such as a smartphone, computer, television, or video game console). Physical rest entails pulling back from normal physical activities such as running, jogging, and sparring. Complete cocooning is ill-advised with recent research work showing that it may in fact be detrimental and lead to prolongation of post-concussion symptoms. The concussed athlete should be evaluated by a physician skilled in concussion management and, once cleared, a graded and gradual return to boxing (RTB) can begin. Several RTB protocols exist.[6,7] Despite individual variations, the basic tenant remains the same and involves the combatant progressing from light aerobic activity (walking or stationary bike for 10 minutes, no resistance training) to boxing/MMA-specific activity/drills to non-contact training drills to contact sparring and if asymptomatic return to combat sports after a release has been signed by the treating physician.

In most cases neuroimaging with computed tomography (CT) or magnetic resonance imaging (MRI) is not warranted in the immediate aftermath of a bout in a neurologically intact fighter. If conducted, it usually comes back negative. Concern for moderate to severe TBI is raised in any fighter with GCS <15, suspected open, depressed, or basal skull fracture, post-traumatic seizure (impact seizure), pupillary abnormality, concern for CSF rhinorrhea or otorrhea, >1 episode of vomiting since the head injury, focal neurological deficit on examination, progressive increase of post-concussion symptoms, and deterioration of mental status should be transferred to the nearest Level I trauma center for urgent CT scan head.[8,9,10]

Conclusion

Concussion is the most common type of head injury in combat sports. Timely identification of the concussed fighter, good medical stoppage (a medical stoppage for the right medical indication which is neither too early but certainly never too late), appropriate management of the downed fighter in the ring and in the aftermath of the bout usually results in a good outcome.

References

1. Guterman A, Smith RW. Neurological sequelae of boxing. *Sports Med.* 1987; 4:194-210.
2. Kazl C, Torres A. Definition, Classification, and Epidemiology of Concussion. *Semin Pediatr Neurol.* 2019; 30:9-13.

3. Sethi NK. The Stunned Brain: Neuroanatomical Correlates of an Acute Concussion in Boxing. *Concepts in Neurol and Red.* 2020; 1(1): 1005.

4. Arai YC, Ueda W, Fukunaga K, Kimura T, Komatsu T. Jaw thrust maneuver. *Acta Anaesthesiol Scand.* 2006; 50:126.

5. Davies JD, Costa BK, Asciutto AJ. Approaches to manual ventilation. *Respir Care.* 2014; 59:810-22; discussion 822-4.

6. Neidecker J, Sethi NK, Taylor R, Monsell R, Muzzi D, Spizler B, Lovelace L, Ayoub E, Weinstein R, Estwanik J, Reyes P, Cantu RC, Jordan B, Goodman M, Stiller JW, Gelber J, Boltuch R, Coletta D, Gagliardi A, Gelfman S, Golden P, Rizzo N, Wallace P, Fields A, Inalsingh C. Concussion management in combat sports: consensus statement from the Association of Ringside Physicians. *Br J Sports Med.* 2019; 53:328-333.

7. Sethi NK. Post-concussion return to boxing protocol. *S **Afr J Sports Med.*** 2016; 28:61-62.

8. National Clinical Guideline Centre (UK). Head injury: triage, assessment, investigation and early management of head injury in children, young people and adults. London: National Institute for Health and Care Excellence (UK); 2014 Jan. PMID: 25340248.

9. Davis T, Ings A; National Institute of Health and Care Excellence. Head injury: triage, assessment, investigation and early management of head injury in children, young people and adults (NICE guideline CG 176). *Arch Dis Child Educ Pract Ed.* 2015; 100:97–100.

10. Hodgkinson S, Pollit V, Sharpin C, et al. Early management of head injury: summary of updated NICE guidance. *BMJ.* 2014;348: g104.

COMMENTARY

Where does the sideline meet the ringside? Commentary on medicine in unpredictable settings

Joe Bhagratie DO
Ascension St. Vincent's Sports Medicine Fellowship
Jacksonville, FL USA
(Corresponding author: jbhagratie1@gmail.com)

George Michael Johnson DO
Ascension St. Vincent's Sports Medicine Fellowship.
United States Navy
Jacksonville, FL USA

Bashyam Iyengar MD
Ascension St. Vincent's Sports Medicine Fellowship and Primary Care Residency.
Jacksonville, FL USA

DISCLOSURE: The views expressed in this poster are those of the author and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense or the U.S. Government.

Sidelines are the parallel, white or colored lines that delineate the outer limits of a sports field and are perpendicular to the goal lines.[1] Ringside refers to a location closer to the ring's ropes or the cage's outer border than the first row of spectator seats.[2] Both sideline medicine and ringside medicine involve providing medical care in a fast-paced and high-stress environment, often with limited resources. Both types of medicine also involve making quick decisions about the care and treatment of patients, as the health and safety of the athletes or boxers is of the utmost importance. Both sideline and ringside medicine require practitioners to have a strong understanding of sports medicine and be able to respond to a wide range of medical emergencies.

Many of the guidelines that the Association of Ringside Physicians (ARP) has proposed run concurrently with what the American Medical Society of Sports Medicine (AMSSM) has recommended for training sport medicine physicians. This commentary aims to highlight the similarities and differences the sports medicine community has with ringside coverage. We aim to address preparticipation physicals, sideline preparedness, and in-game responsibilities.

Preparticipation physicals are a commonality for both types of athletic events. The general goals of a preparticipation physical exam (PPE) are determining the athlete's general physical; evaluating for life-threatening or disabling conditions, including the risk of sudden cardiac arrest and other conditions that may predispose the athlete to illness or injury.[3] While the spirit of the preparticipation exam is to ensure the safety of the participants during their particular event, there is another aspect that is an important and often overlooked feature of the preparticipation physical examination. That it is a gateway into medical services especially for those participants who are uninsured, underinsured or who do not have a medical home.

There are some differences in the demographic makeup of the participants in each of the athletic categories and these differences in demographic characteristics may impact certain aspects of the preparticipation physical exam. There is a wide range of age categories for those covering the sideline from middle school/high school to collegiate to professional level athletes. Usually, sideline athletes especially in the adolescent and young adult age categories tend to be grouped in relationship to their level of schooling. Correspondingly, martial arts athletes are categorized less on their level of schooling but more on their ranking. Thus combat sports athletes are ranked whether they are amateur fighters, collegiate fighters, newly minted professions and seasoned professional athletes.

Regardless of the setting, it is important to have a proper cardiovascular exam that includes blood pressure monitoring. A consistent recommendation is to monitor for the presence of pathological heart murmur, since these can be the harbingers of serious disability and even death.[3] While a good cardiovascular physical exam is advocated, there is considerable debate regarding the use of EKG as a screening tool in preparticipation physical exams. Currently in the United States these are not required for middles school and high school aged athletes. There are some collegiate sports that require EKGs before participating.

When it comes to ring side sports coverage and the cardiac exam, it is less governed by age or schooling but more based on where the actual event is taking place. Since different locales have different recommendations. For example, if the event were to be in New York any age participant needs an EKG, while in Florida participants over the age of 40 must have a normal EKG with the last year.[4,5,6] Contrasted with those competing in Nevada there is no EKG requirement for any age.[7]

Another area of concern is elevated blood pressure. In this regard timing plays a critical role in management and the ability to clear a participant. Per ARP, a participant in combat sports will be disqualified for severe pre-bout hypertension.[5] Typically, these preparticipation evaluations are performed the day before the event, thus there is considerably less time to rectify the blood pressure and allow the athlete to participate. While in other sideline sports, there is typically ample time between the PPE and the event that an intervention can take place and the participant has a greater chance of participating in their sport. In this aspect there is less maneuverability the ringside physician has with regard to clearance for those individuals with hypertension.

Ubiquitous are the blood labs within ringside, which is not so on the sideline. Because of the incidences of lacerations within combat sports, it is required annually for hepatitis B, hepatitis C, and HIV serology. This is a time commitment that normally a sideline doctor does not encounter, reviewing every player's labs and possible EKGs and MRIs, the weeks leading to a fight, and making sure they are within normal and up to date.

Another interesting difference between sideline and combat sports is the difference in neurologic testing. Most sports require some form of baseline neurocognitive testing. In school-aged athletes, the athletic trainer can often collect baseline data using one of the various services that collect data on paper or computer-based tests that measure memory, reaction time, and cognition. Athletic trainers can administer some, and some require the interpretation of a neuropsychologist.[9] Who administers and what testing is performed depends on the resources and level of sport covered. Some tests boast not needing a player's baseline, compared to a database of information of what is within normal and not. The reason for this is concussions. NFL does not require a preparticipation MRI or any neuroimaging.[10] Neurocognitive testing to collect a baseline is not standard within combat sports, nor is neurocognitive testing required after a ringside physician has determined a concussion. Because combat sports have direct trauma to the head and athletes deal with repetitive trauma, some state commissions require Neurologic imaging.[6] Some states, like New York, require neuroimaging for all athletes every three years. Florida requires neuroimaging annually if over the age of 40 years old. Furthermore, some states, like Nevada, do not require any neuroimaging.

As a physician, the burden and the risk are heavy on both the sideline and ringside and incur substantial responsibility. Combat medicine would seem to be the more violent of sports. However, American football and its unpredictability have more than its fair share of trauma. Trauma is common in other sports, and the physician's job is preparation. As a sport becomes more physically demanding, medical bag considerations change, becoming more like to those of a ringside doctor. On-site medical supplies for general use include a blood pressure cuff and stethoscope.[11] Splints and cervical collars are essential in all contact sports. Recommended as well are IV fluids and cricothyrotomy kits within the guidelines. Again, the on-site medical bag and sideline medical supplies should take into account the various sports, levels of competition, and medical resources that are accessible.[11] In combat sports, a suture set, skin staple applicator, and flashlight for neurologic exams are important and vary on comfort level.

Both share the commonality that they are a departure from the controlled confines of a typical outpatient physician practice and are thus a more unpredictable environment. While both the ringside physician and sideline physician, occupy a location adjacent to the action of the sport. There are some considerable differences between the matrix of individuals and ancillary support staff these different setting provide for the physician. Both sideline and ringside sports require the covering physician to be a part of a team and navigate the balance. For the purposes of generality and to make some important distinctions, we will outline the typical personnel types that are available on most American football sidelines from high school to professional level. Typically, there is a full coaching staff, with an athletic trainer and athletic director, that usually assists and communicates with the physician. Contrast this to a typical ringside personnel, which consists of a ringside coach and/or sparring partner, who typically have minimal medical background as well limited or no medical equipment. Ringside benefits in that states require two or more physicians for professional coverage and having colleagues of that level, and varying knowledge and experience is immeasurable. Both events typically have access to EMS, who will have spine boards, splints, and further ATLS resources and training.

Interestingly with ringside sports are the promotors. Depending on the level of the event, promotions will have specific resources available, able to set up a medical exam area for the physicians to work. Additionally, the promotor may have transport services for urgent injuries that need to be evaluated in an urgent care or emergency department, but are stable, not necessitating an EMS transport.

Depending on the sideline sport, a training room may be nearby to examine an injured player. If not, then a sideline exam with at least a portable exam table will suffice. Ringside, the same dilemma occurs. Some venues will have resources for a cage-side exam area with a medical exam table away and covered from those not immediately involved in the fighter's care. If not, the promotion must have an athlete locker room for each corner.

Important to point out how a physician interacts in a game with the referee. The stoppage of play and when the medical team can examine a player depends on the sport. In football, the athletic trainer and physician can walk onto the field to evaluate a player when a play is at a stoppage. The referee at that time will call a medical timeout if not signaled prior.[12] Soccer requires the referee to stop the game as it is continuous, then medical staff can attend to a player. In boxing and MMA, the action during a round is continuous. The referee is the sole arbitrator in stopping a fight and allowing the physician into the ring to evaluate the athlete. A fighter can be examined closer by the physician between rounds, and the referee can provide additional time for this evaluation before the beginning of the next round.

In combat sports, the player's corner of coaches is held back during the physician's in-ring exam. Coaches are allowed to interact with the player after the physical exam. In sideline sports, a coach can interact with a player anytime during an exam. Physicians ringside can have a coach enter the ring

if additional help is needed, i.e., language translation. In both, general consensus to minimize the potential for a catastrophic event or development of a disabling condition, coaches must not be allowed to impose demands inconsistent with guidelines and recommendations established by sports medicine and athletic training professional organizations.[13]

In that respect, getting to a player is different per sport as well. Football and soccer are open fields. A physician standing sideline has direct access to a player. Boxing is similar in that physicians can enter the field of play at any opening. However, they must traverse the ropes to enter the ring. In cage fights, it is crucial to know the entry points and for the physician to introduce themself to the staff in charge of opening the cage, so they know the physician ahead of time. Variety within combat sports and different promotions will have different shapes and access points to the fighters.

Here we have addressed a snippet of comparing sideline and ringside coverage. Much more can be examined, including comparing injuries from contact and combat sports, the treatment of concussions that are recommended, further into in-game management, and other topics. Looking into how other sports interact with different aspects of medicine will help continue ringside medicine progress. Both types of medicine involve making quick decisions about the care and treatment of patients, as the health and safety of the athletes or fighters is of the utmost importance. Both sideline and ringside medicine require practitioners to have a strong understanding of sports medicine and be able to respond to a wide range of medical emergencies. Overall, the goal of both sideline and ringside medicine is to ensure the health and safety of athletes during sporting events, and to help them perform at their best.

References:

1. Sidelines. Wikipedia. Published November 23, 2022. Accessed January 2, 2023. https://en.wikipedia.org/wiki/Sidelines#cite_note-1.
2. Ringside Definition. Law Insider. Accessed January 2, 2023. https://www.lawinsider.com/dictionary/ringside.
3. MacDonald J, Schaefer M, Stumph J. The Preparticipation Physical Evaluation. *Am Fam Physician.* 2021;103(9):539-546.
4. Slorida State Boxing Commission Frequently Asked Questions and Answers. Accessed January 2, 2023. http://www.myfloridalicense.com/dbpr/pro/sbc/documents/box_faq.pdf.
5. Medical Resources. Department of State. Accessed January 2, 2023. https://dos.ny.gov/medical-resources.
6. Medical Requirements by Commission – Association of Boxing Commissions. Abcboxing.com. Published 2019. https://www.abcboxing.com/medical-requirements-by-commission/.
7. Professional Contestant. boxing.nv.gov. Accessed January 2, 2023. https://boxing.nv.gov/Licensing/Professional_Contestant/.
8. deWeber K, Ota KS, Dye C. Pre-bout hypertension in the combat sports athlete: clearance recommendations [published online ahead of print, 2022 Jan 12]. *Phys Sportsmed.* 2022;1-7. doi:10.1080/00913847.2022.2025468.
9. Armstrong C. Evaluation and Management of Concussion in Athletes: Recommendations from the AAN. American Family Physician. 2014;89(7):585-587. Accessed January 2, 2023. https://www.aafp.org/pubs/afp/issues/2014/0401/p585.html.
10. NFL Head, Neck and Spine Committee's Concussion Diagnosis and Management Protocol. 8:2022. https://static.www.nfl.com/image/upload/v1665264248/league/moexjmdzy2kvjtqsdpbx.pdf.
11. Sideline preparedness for the team physician: consensus statement. *Med Sci Sports Exerc.* 2001;33(5):846-849. doi:10.1097/00005768-200105000-00027.
12. 2022 NFL Rulebook | NFL Football Operations. operations.nfl.com. Accessed January 2, 2023. https://operations.nfl.com/the-rules/2022-nfl-rulebook/#rule13.
13. Courson R, Goldenberg M, Adams KG, et al. Inter-association consensus statement on best practices for sports medicine management for secondary schools and colleges. *J Athl Train.* 2014;49(1):128-137. doi:10.4085/1062-6050-49.1.06.

CASE REPORT

Traumatic peroneal neuropathy in an MMA athlete: case report and review of literature

Nitin K Sethi, MD, MBBS, FAAN
Department of Neurology, New York-Presbyterian Hospital, Weill Cornell Medical Center
New York, NY, USA
(Email: sethinitinmd@hotmail.com)

KEYWORDS: MMA; peroneal neuropathy; combat sports

DISCLOSURES: The author serves as the Chief Medical Officer (CMO) of the New York State Athletic Commission (NYSAC). The views expressed by the author are his own and do not necessarily reflect the views of the institutions and organizations which the author serves.

Abstract

Peroneal nerve (PN) innervates the lower extremity and, due to its location, is prone to injury. Numerous traumatic and non-traumatic causes of PN injury have been elucidated. In sports such as soccer, knee dislocation results in PN injury. Traumatic peroneal neuropathy (TPN) is also commonly encountered in mixed martial arts (MMA). In this combat sport, the cause of TPN is direct impact on the fibular neck by the opponent's leg. The blunt force trauma causes acute TPN manifesting in the cage itself with foot drop impairing the combatant's ability to attack and defend.

Case Report

A 25-year-old male combatant lost his MMA bout by submission via rear naked choke in the fourth round. The combatant was noted to have a "slapping gait" as he walked back unaided from the cage to the post-fight medical examination room. He complained of decreased sensation and numbness on dorsum of right foot and lateral aspect of right lower leg. Examination revealed weakness of ankle dorsiflexion with resultant foot drop causing catching of toes during ambulation. He was unable to stand unsupported on his right leg. There was no evidence of traumatic knee injury including dislocation. Right thigh and calf were swollen and tender from repeated leg kicks. Distal pulses (femoral, popliteal, posterior tibial, and dorsalis pedis) were palpable. The combatant was educated about foot drop, prescribed an ankle-foot orthotic (AFO) and advised to follow up with an orthopedic physician. A 45-day medical suspension was administered.

Discussion

The common peroneal nerve (CPN), a branch of the sciatic nerve winds around the fibular neck and divides into the superficial (S) and deep (D) PNs. While the CPN lacks any motor innervation prior to dividing, the SPN innervates the lateral compartment of the leg and the DPN innervates the anterior compartment of the leg and dorsum of the foot.[1] Mixed martial arts, sometimes referred to as cage fighting, is a popular, full-contact combat sport which incorporates techniques from various combat sports such as boxing, kick boxing, wrestling, judo, Brazilian jiu-jitsu, and karate among others. Leg kicks (also referred to as a low kick), an essential part of the MMA striking game, involve kicks to the opponent's thigh and calf with the shinbone or foot.[2] Attacking and damaging the opponent's leg causes a loss of dexterity, stability, and mobility and helps set up other moves such as

strikes and takedowns. Due to its location, the sciatic nerve and its branches are prone to traumatic neuropathy by leg kicks. In the author's experience working cage side, TPN usually presents acutely during the fight and is the result of either a single low kick to the area over the fibular neck or the culmination of multiple low kicks to that area leading to tissue swelling causing compression neurapraxia. The combatant develops foot drop acutely and struggles to continue. The injury usually does not result in an immediate medical stoppage in the cage. Combatants realizing their limitation choose to stand with their back resting on the cage for support and continue to trade punches with the opponent. On conclusion of the bout, examination inside the cage documents a prominent foot drop. The combatant is usually able to "limp out" of the cage with assistance from camp members. Post-fight medical examination reveals weakness of ankle dorsiflexion and resultant foot drop (catching the toes while ambulating). The weakness is accompanied by numbness (paresthesia) along the lateral leg and dorsum of foot.

Peroneal nerve injury is commonly associated with sports-related knee injury. Cho et al. in their study analyzed surgical outcome and management of 84 cases of PN injury associated with sports-related knee injury. These occurred in sports such as skiing (42 cases), football (23 cases), soccer (8 cases), basketball (6 cases), ice hockey (2 cases), track (2 cases) and volleyball (1 case). Out of the 84 cases, 36 cases were identified with fracture/dislocation. The authors found that TPN injuries in these cases were usually associated with stretch/contusion requiring graft repair. Graft length of <6 cm was associated with good prognosis of nerve repair.[3] Giuseffi et al. in their review of surgical treatment of peroneal nerve palsy after knee dislocation, found that the results of neurolysis and nerve grafting were dependent on nerve graft length with low recovery rates (44%) for nerve grafts >6 cm. Posterior tibial tendon transfer helped improve function and ambulation in some patients.[4]

In the post-fight medical evaluation, the ringside physician should check strength of foot/toe dorsiflexion and foot eversion. The physician should assess for knee dislocation and fracture of the fibular neck. These two injuries can potentially comprise integrity of the neurovascular bundle and must be treated as an orthopedic emergency. The combatant should be transported via on-site ambulance to the nearest Level I trauma center for imaging and specialized care. A combatant with intact distal pulses and in whom no concern for knee dislocation, fracture or compartment syndrome is present can be managed conservatively. A medical suspension ranging from 30 to 45 days should be administered. The combatant should be prescribed an AFO and instructed to follow up with an orthopedic physician and physical therapist. In most young combatants without comorbidities such as diabetes, PN neuropathy resolves spontaneously with conservative management.

Conclusion

Peroneal nerve neuropathy is a common injury in MMA usually because of a low kick to the area over the fibular neck. Knee dislocation and fracture should be ruled out. In most combatants, the injury can be managed with nonsurgical measures. Prognosis is good with spontaneous full recovery in most cases.

References

1. Lezak B, Massel DH, Varacallo M. Peroneal Nerve Injury. [Updated 2022 Sep 4]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK549859/

2. Low kick. Wikipedia. https://en.wikipedia.org/wiki/Low_kick#:~:text=A%20low%20kick%20(also%20known,with%20the%20shinbone%20or%20foot. (Last accessed on December 9th, 2022)

3. Cho D, Saetia K, Lee S, Kline DG, Kim DH. Peroneal nerve injury associated with sports-related knee injury. *Neurosurg Focus*. 2011;31: E11.

4. Giuseffi SA, Bishop AT, Shin AY, Dahm DL, Stuart MJ, Levy BA. Surgical treatment of peroneal nerve palsy after knee dislocation. *Knee Surg Sports Traumatol Arthrosc.* 2010; 18:1583-6.

COMBAT SPORTS LICENSE MEDICAL REQUIREMENTS: SIMILARITIES AND DIFFERENCES AMONGST COMMISSIONS

Carlos G. Sandoval, BS
Medical Student
New York University Grossman School of Medicine, New York, NY

Taylor Paskey, MD
Orthopedic Surgery Resident
Department of Orthopedics, Columbia University Irving Medical Center, New York, NY.

John Neidecker, DO, ATC, FAOASM
President of the Association of Ringside Physicians
OrthoNC, North Carolina, USA
Campbell University School of Osteopathic Medicine, North Carolina, USA
North Carolina Boxing and Combat Sports Commission
New York State Athletic Commission (Corresponding Author: neidecker@ringsidearp.org)

Elan Goldwaser, DO, FAOASM
Columbia University Irving Medical Center, Department of Orthopedics, New York, New York, USA
Columbia University Vagelos College of Physicians and Surgeons, New York, New York, USA
New York State Athletic Commission

KEYWORDS: Combat sports, athletic commissions

DISCLOSURES: The author JN serves on the medical advisory board of the North Carolina Boxing and Combat Sports Commission (NCBCSC). JN and EG are ringside physicians for the New York State Athletic Commission (NYSAC). The views expressed by the authors are their own and do not necessarily reflect the views of the institutions and organizations which the authors serve.

Introduction

Combat sports oversight can vary significantly from commission to commission. One area of regulation which can differ considerably is in medical requirements that are needed for combat sports licensure. Although not undertaken, uniformity in licensing requirements across all commissions has been proposed in the past.[1,2]

The Association of Boxing Commissions (ABC) is a non-profit organization in which one of its missions is to "promote the uniformity of health and safety standards and other requirements pertaining to the conduct of combat sports events."[3] The ABC has made available a handbook regarding ringside medicine, outlining the recommendations of medical requirements needed for combat sports licensure.[4]

The ABC is not a regulatory body and has no authority over athletic commissions. Ultimately, it is up to the individual commission to adopt or exclude recommendations made by the ABC. Few

United States commissions have accepted the ABC recommendations in full. Most United States commissions have partially included or have modified the ABC recommendations. Reasons for not fully endorsing the ABC recommendations include but are not limited to: resources, expense, availability, and input/differing opinion from the individual commissions medical advisors.

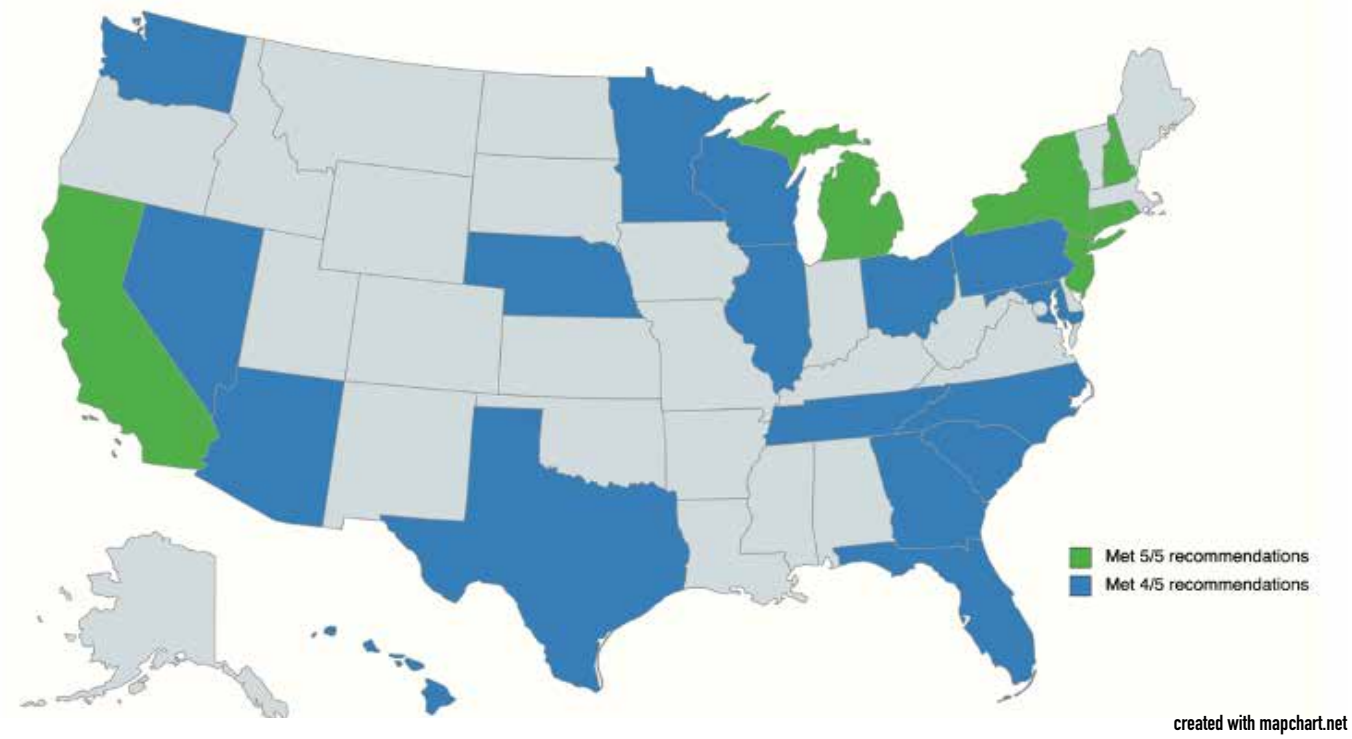
The purpose of this study is to examine more thoroughly the varying medical requirements for combat sports licensure across the United States commissions. This study intends to identify consistencies and discrepancies across all the commissions and can be used as a foundation for the development of new recommendations in the name of combat sports athlete safety.

Methods

Medical requirements for combat sports licensure across the United States commissions were collected from the ABC website.[5] The medical requirements for all 50 states were included in our data, with the exclusion of the Native American tribes. Of the 50 states, 7 of them (Alaska, Louisiana, Massachusetts, South Dakota, Utah, West Virginia, and Wyoming) were excluded as there was either no commission or no confirmed data on the ABC website. Of the remaining 43 states, 3 of the states (Hawaii, Michigan, and North Dakota) had two separate commissions for MMA and boxing which were included in our data analysis as their own independent commissions.

The data collected from the ABC website consisted of the medical clearance requirements the 46 commissions had for physical exam, eye exam, hepatitis B, hepatitis C, HIV, ECG, neurological exam, neurological imaging, urinalysis, and pregnancy test for all fighters, as well as any additional older athlete or high-risk athlete criteria. These data were then analyzed to identify the raw numbers and percentage of commissions requiring each test, in addition to the timing of said requirement. Upon collecting all the data, each commission's requirements were compared to the recommendations set forth by ABC in their handbook, which include a physical exam, eye exam, hepatitis B/C test, HIV test, and an ECG.

Figure 1



Results

Overall, seven of the 46 state commissions met all five recommended requirements set forth by the ABC (California, Connecticut, Michigan, New Hampshire, New Jersey, New York, Rhode Island) and 17 state commissions met four of the five recommended requirements (Arizona, Florida, Georgia, Hawaii, Illinois, Maryland, Minnesota, Nebraska, Nevada, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Texas, Washington, Wisconsin). *(Figure 1)*

Physical exam

Out of the 46 state commissions, 42 commissions required a physical exam (91%); three commissions didn't require any physical exam (7%); and one commission listed it as a conditional requirement (2%).

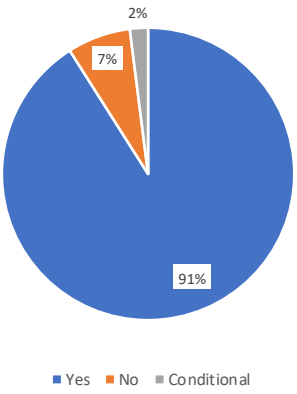
Out of the 42 commissions that required a physical exam, 18 commissions required an annual physical (42%); 13 commissions required a pre-fight physical (30%); 5 commissions required a physical within 6 months (12%); 2 commissions required a physical within 90 days (5%); 2 commissions required a physical within 30 days (5%); 1 commission required a physical within two years (2%); 1 commission required an initial physical in addition to a pre-fight physical (2%); and 1 commission did not specify a timing requirement for their physical exam (2%). *(Figure 2)*

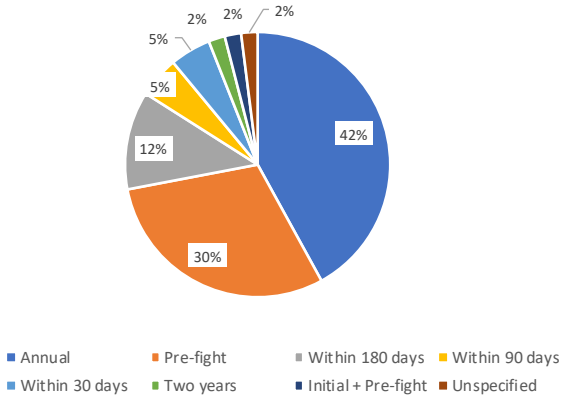
Eye exam

Out of the 46 state commissions, 3 commissions did not have any data on requirements for an eye exam. Of the remaining 43 commissions, 26 commissions required an eye exam (60%); 14 commissions didn't require any eye exam (33%); and 3 commissions listed it as a conditional requirement (7%).

Out of the 26 commissions that required an eye exam, 14 commissions required an annual eye exam (54%); 3 commissions required an exam within 180 days (11%); 1 commission required an exam within 90 days (4%); 1 commission required an exam within 30 days (4%); 1 commission required an exam within two years (4%); 1 commission required only an initial eye exam (4%); and 5 commissions did not specify a timing requirement for their eye exam (19%). *(Figure 3)*

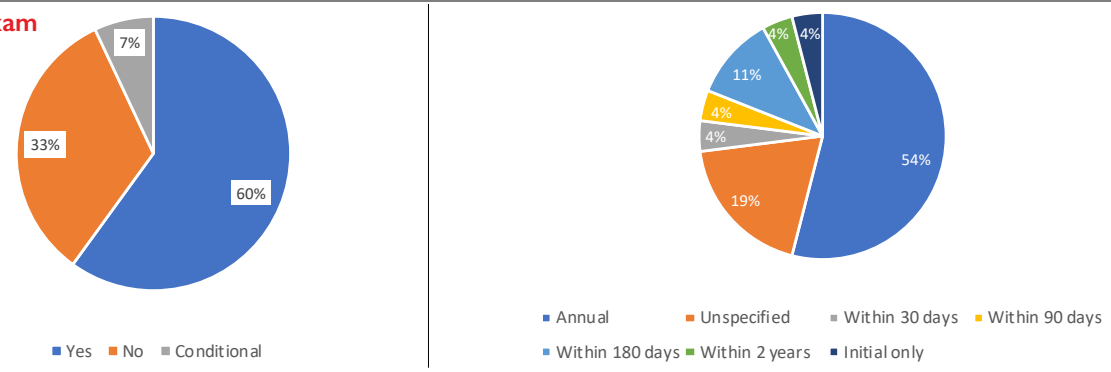
Figure 2: Physical Exam





a) Chart displays the percentage of commissions that required a physical exam, did not require a physical exam, or had a physical exam listed as a conditional requirement. b) Chart displays the percentage of commissions with a specific timing required for their physical exam requirement.

Figure 3: Eye Exam



a) Chart displays the percentage of commissions that required an eye exam, did not require an eye exam, or had an eye exam listed as a conditional requirement. b) Chart displays the percentage of commissions with a specific timing required for their eye exam requirement.

Hepatitis B & Hepatitis C

Out of the 46 state commissions, 42 commissions required hepatitis B and hepatitis C testing (91%); 3 commissions didn't require any test (7%); and one commission listed it as a conditional requirement (2%).

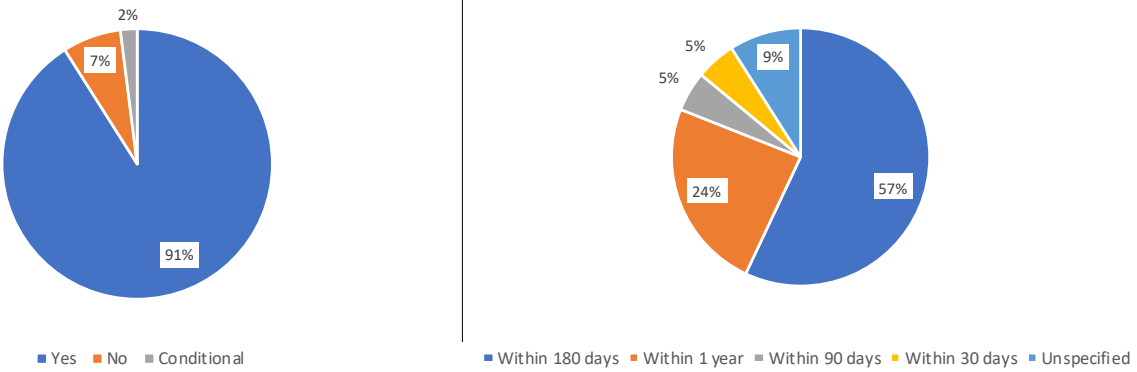
Out of the 42 commissions that required hepatitis B and C testing, 24 commissions required testing within 180 days (57%); 10 commissions required testing within 1 year (24%); 2 commissions required testing within 90 days (5%); 2 commissions required testing within 1 month (5%); and 4 commissions did not specify a timing requirement for their hepatitis B and C tests (9%). *(Figure 4)*

HIV

Out of the 46 state commissions, 43 commissions required HIV testing (94%); 2 commissions didn't require any test (4%); and one commission listed it as a conditional requirement (2%).

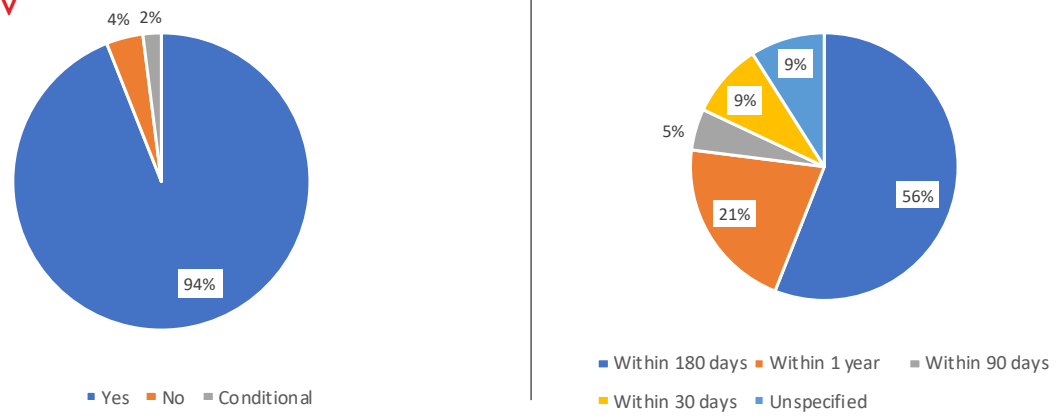
Out of the 43 commissions that required HIV testing, 24 commissions required testing within 180 days (56%); 9 commissions required testing within 1 year (21%); 4 commissions required testing within 1 month (9%); 2 commissions required testing within 90 days (5%); and 4 commissions did not specify a timing requirement for their HIV tests (9%). *(Figure 5)*

Figure 4: Hepatitis B/C



a) Chart displays the percentage of commissions that required a hepatitis B/C test, did not require a hepatitis B/C test, or had a hepatitis B/C test listed as a conditional requirement. b) Chart displays the percentage of commissions with a specific timing required for their hepatitis B/C test requirement.

Figure 5: HIV



a) Chart displays the percentage of commissions that required a HIV test, did not require a HIV test, or had a HIV test listed as a conditional requirement. b) Chart displays the percentage of commissions with a specific timing required for their HIV test requirement.

Figure 6: ECG

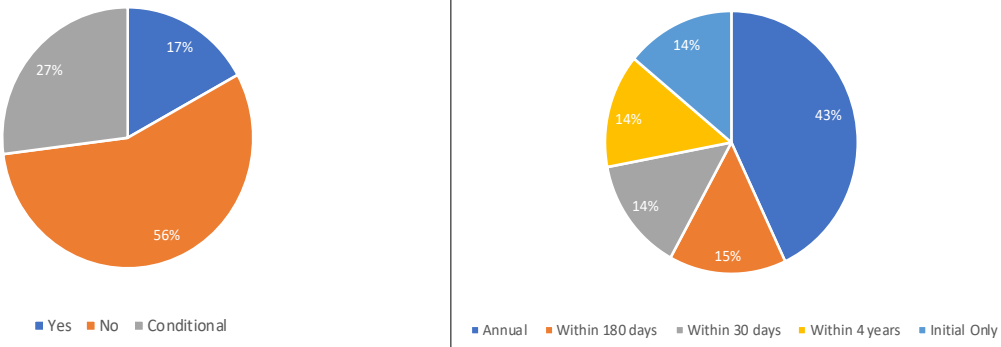


Chart displays the percentage of commissions that required an ECG, did not require an ECG, or had an ECG listed as a conditional requirement. b) Chart displays the percentage of commissions with a specific timing required for their ECG requirement.

ECG

Out of the 46 state commissions, 5 commissions did not have any data on requirements for an ECG. Of the remaining 41 commissions, 7 commissions required an ECG (17%); 23 commissions didn't require any ECG (56%); and 11 commissions listed it as a conditional requirement evaluated on a case-by-case basis (27%).

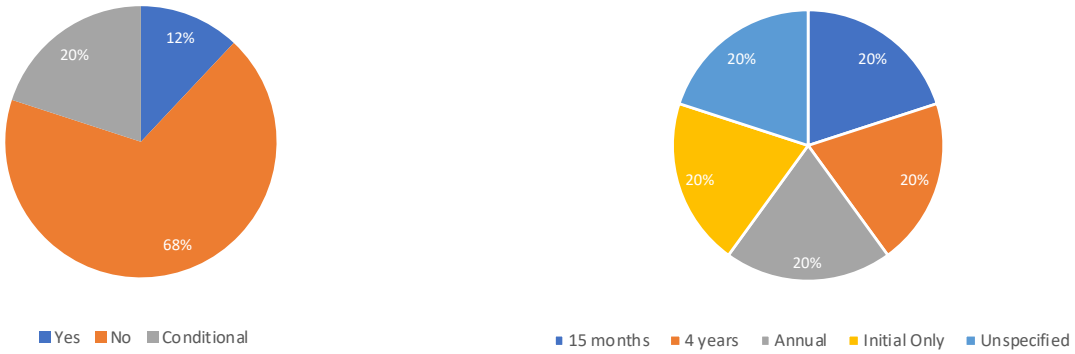
Out of the 7 commissions that required an ECG, 3 commissions required an ECG within 1 year (43%); one commission required an ECG within 180 days (14.25%); one commission required an ECG within 30 days (14.25%); one commission required an ECG within 4 years (14.25%); and one commission required only an initial ECG (14.25%). *(Figure 6)*

Neurological exam

Out of the 46 state commissions, 5 commissions did not have any data on requirements for a neurological exam. Of the remaining 41 commissions, 5 commissions required a neurological exam (12%); 28 commissions didn't require any neurological exam (68%); and 8 commissions listed it as a conditional requirement (20%).

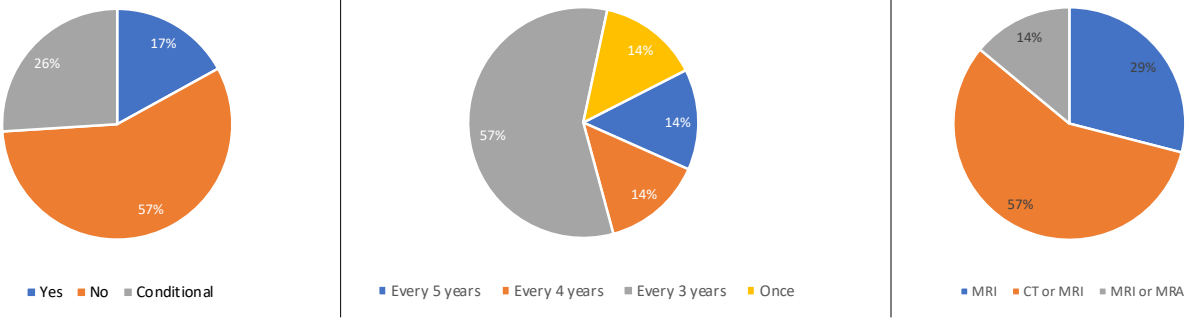
Out of the five commissions that required a neurological exam, one commission required an annual exam (20%); one commission required an exam within 4 years (20%); one commission required an exam within 15 months (20%); one commission required only an initial neurological exam (20%); and one commission did not specify a timing requirement for a neurological exam (20%). *(Figure 7)*

Figure 7: Neurological Exam



a) Chart displays the percentage of commissions that required a neurological exam, did not require a neurological exam, or had a neurological exam listed as a conditional requirement. b) Chart displays the percentage of commissions with a specific timing required for their neurological exam requirement.

Figure 8: Neurological Imaging



a) Chart displays the percentage of commissions that required neurological imaging, did not require neurological imaging, or had neurological imaging listed as a conditional requirement. b) Chart displays the percentage of commissions with a specific timing required for their neurological imaging requirement. c) Chart displays the percentage of commissions with a specific imaging modality required for their neurological imaging.

Neurological Imaging

Out of the 46 state commissions, four commissions did not have any data on imaging requirements. Of the remaining 42 commissions, 7 commissions required neurological imaging (17%); 24 commissions didn't require any imaging (57%); and 11 commissions listed it as a conditional requirement (26%).

Out of the seven commissions that required neurological imaging, four commissions required imaging within 3 years (57%); one commission required imaging within 4 years (14.3%); one commission required imaging within 5 years (14.3%); and one commission required imaging only upon initial presentation (14.3%).

Out of the seven commissions that required neurological imaging, two commissions required the imaging modality to be an MRI (29%); four commissions accepted either a CT scan or an MRI as the modality (57%); and one commission accepted either an MRI or an MRA as the modality (14%).

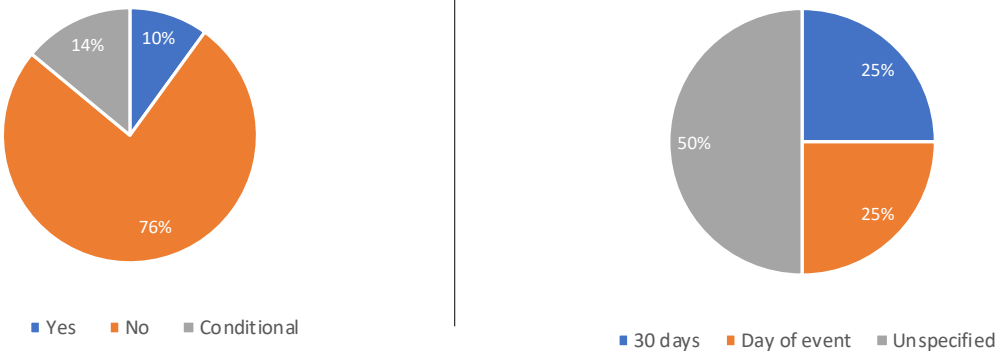
Out of the two commissions that required specifically an MRI as the imaging modality, one commission required an MRI within 4 years and one commission required an MRI within 5 years. Out of the four commissions that accepted either CT or MRI as the imaging modalities, three commissions required a CT or MRI within 3 years and one commission required a CT or MRI within 4 years. The one commission that accepted either MRI or MRA as the imaging modality required an MRI or MRA as only a one-time requirement. *(Figure 8)*

Urinalysis

Out of the 46 state commissions, 4 commissions did not have any data on urinalysis requirements. Of the remaining 42 commissions, 4 commissions required a urinalysis (10%); 32 commissions didn't require a urinalysis (76%); and 6 commissions listed it as a conditional requirement evaluated on a case-by-case basis (14%).

Out of the four commissions that required a urinalysis, one commission required a urinalysis within 30 days (25%); one commission required a urinalysis the day of the fight (25%); and 2 commissions did not specify a timing requirement for their urinalysis (50%). *(Figure 9)*

Figure 9: Urinalysis



a) Chart displays the percentage of commissions that required a urinalysis, did not require a urinalysis, or had a urinalysis listed as a conditional requirement. b) Chart displays the percentage of commissions with a specific timing required for their urinalysis requirement.

Pregnancy Test

Out of the 46 state commissions, 6 commissions did not have any data on requirements for pregnancy testing. Of the remaining 40 commissions, 33 commissions required pregnancy testing (82%) and 7 commissions didn't require any pregnancy testing (18%).

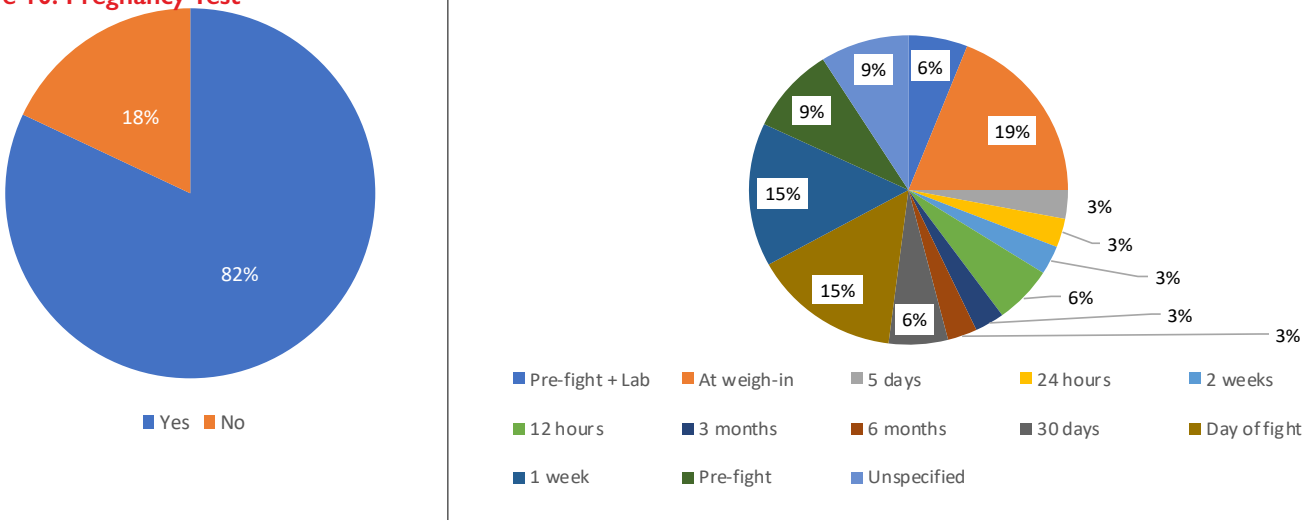
Out of the 40 commissions that required pregnancy testing, 6 commissions required testing at the weigh-in (19%); 5 commissions required testing the day of the fight (15%); 5 commissions required testing within one week (15%); 3 commissions required testing at the pre-fight (9%); 2 commissions required testing done at a lab in addition to the pre-fight (6%); 2 commissions required testing within 12 hours (6%); 2 commissions required testing within 30 days (6%); 1 commission required testing within 24 hours (3%); 1 commission required testing within 5 days (3%); 1 commission required testing within two weeks (3%); 1 commission required testing within three months (3%); 1 commission required testing within 6 months (3%); and 3 commissions did not specify a timing requirement for their pregnancy testing (9%). *(Figure 10)*

Older Athlete Criteria

Out of the 46 state commissions, 31 commissions had older athlete criteria (67%) and 15 commissions did not have any older athlete criteria (33%).

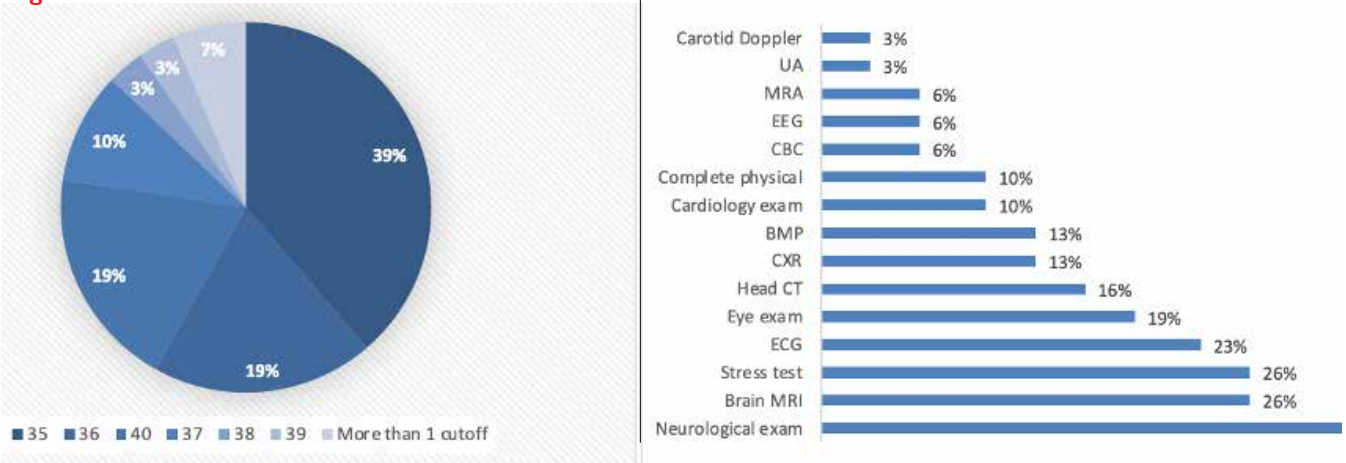
Out of the 31 commissions that had older athlete criteria, 35 years was the age to meet criteria for 12 commissions (39%); 36 years was the age to meet criteria for 6 commissions (19%); 37 years was the age to meet criteria for 3 commissions (10%); 38 years was the age to meet criteria for 1 commission (3%); 39 years was the age to meet criteria for 1 commission (3%); 40 years was the age to meet cri-

Figure 10: Pregnancy Test



a) Chart displays the percentage of commissions that required a pregnancy test, did not require a pregnancy test, or had a pregnancy test listed as a conditional requirement. b) Chart displays the percentage of commissions with a specific timing required for their pregnancy test requirement.

Figure 11: Older Athlete Criteria



a) Chart displays the percentage of commissions with a specific age cutoff for their older athlete criteria. b) Chart displays the percentage of commissions that included a specific requirement in their older athlete criteria.

teria for 6 commissions (19%); and 2 commissions had two different sets of older athlete criteria with different age cutoffs (7%).

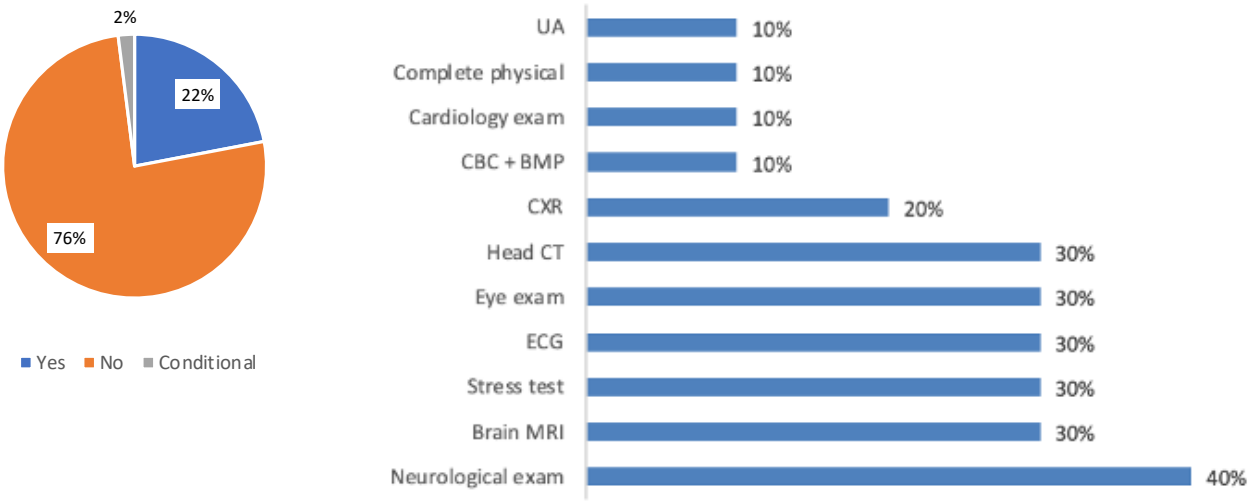
The most common additional requirements older athletes needed to meet were neurological exam (32%); brain MRI (26%); stress test (26%); ECG (23%); eye exam (19%); head CT scan (16%); metabolic blood profile (13%); chest X-ray (13%); cardiology examination (10%); complete physical exam (10%); CBC (6%); EEG (6%); MRA (6%); urinalysis (3%); and carotid artery doppler exam (3%). *(Figure 11)*

High-risk athlete criteria

Out of the 46 state commissions, 10 commissions had high-risk athlete criteria (22%); 35 commissions did not have any high-risk athlete criteria (76%); and 1 commission assessed high-risk athlete criteria on a case-by-case basis (2%).

The most popular additional requirements high-risk athlete needed to meet were neurological exam (40%); brain MRI (30%); stress test (30%); ECG (30%); eye exam (30%); head CT scan (30%); chest X-ray (20%); CBC and metabolic blood profile (10%); cardiology examination (10%); complete physical exam (10%); and urinalysis (10%). *(Figure 12)*

Figure 12: High-Risk Athlete Criteria



a) Chart displays the percentage of commissions that had high-risk athlete criteria, did not have high-risk athlete criteria, or had high-risk athlete criteria as a conditional requirement. b) Chart displays the percentage of commissions that included a specific requirement in their high-risk athlete criteria.

Discussion

Combat sports require a high level of physical fitness and endurance to participate. In order to maintain this level of physical acumen and meet the growing demands of the sport, an athlete must dedicate time to train and prepare. Included in this preparation and to prepare a combat sports athlete for the arena, many state commissions have included pre-fight medical requirements as part of their regulations for participation as recommended by the ABC.

The five main recommendations made by the ABC for pre-fight testing are a physical exam, eye exam, hepatitis B/C and HIV testing and an ECG. Many important health-related concerns can be highlighted from these pre-fight medical exams. The results of the testing provide an opportunity for combat sports athlet to address any health disparities before putting themselves at risk in the arena. As demonstrated in our results, only 7 out of 46 state commissions meet all 5 of these recommendations as set forth by the ABC. Ten percent of the state commissions did not require a physical exam prior to participating in the sport.

Eye exams were another medical recommendation highlighted with large variability in compliance, with only 60% of state commissions requiring eye exams. If the ABC recommendations are proposed to protect fighters, then the question is raised, why are not more state commissions enacting them?

We propose the discrepancies are a result of varying resources, expense, availability and as a result of differing opinions among the medical advisory boards. Ultimately it is up to the individual commissions to adopt or exclude recommendations by

the ABC and, as discussed previously, despite an effort made in the past to adopt uniformity in licensing requirements, this has not been enacted.

For females, it is of note that of the 40 commissions who had published information about pregnancy testing, 33 (82%) of the commissions required it. It is also of note that of those commissions who required pregnancy testing, 78% needed testing within 1 week of the bout, whereas 22% of commissions accepted testing outside the 1-week bout window.

Another portion of the medical recommendations from the ABC are those specific to the older athletes, which are largely defined as athletes at least 35 years of age. The medical requirements for older athletes ranged from obtaining additional specialty focused exams (e.g., cardiology, neurology, etc.) to completing additional laboratory testing, to potentially obtaining additional brain imaging (MRI or CT head). Given a significant amount of this additional testing is determined on a case-by-case basis for fighters, it could be helpful to determine if the number or severity of fights an athlete has participated in weighs into the commission's final recommendations for the older athletes.

Ultimately, determining the recommended type of pre-fight testing and the frequency of testing is an important but onerous responsibility that the ABC is tasked with. Some have speculated that too many medical requirements could discourage or potentially limit the number of combat sports athletes. However, one could argue the safety of the athletes should always be prioritized even if it comes with an additional expense to the athlete/promotor or potentially requires additional resources from the healthcare system.

Limitations

There are many limitations to this summary and analysis. First and foremost, not all states have their recommendations officially published, and many have incomplete requirements published or accessible. Furthermore, the *ABC Handbook of Ringside Medicine* was published in July 2011 and the ABC medical requirements listed on the website have not been updated since March 2017. Additionally, multiple commissions have conditional or case-by-case requirements for which we do not know their individual stringency.

Conclusion

This study investigated the consistencies and discrepancies between state commissions' medical clearance requirements and compared them to the ABC's recommendations of a physical exam, eye exam, ECG, hepatitis B/C test, and HIV test. Only 7 out of 46 state commissions met all five recommendations set forth by the ABC. Notable discrepancies were noted between state commissions, especially in requirements for eye exams, neurological exams/imaging, and timing of pregnancy tests.

The ultimate root cause analysis would be to better understand how state commissions finalize their regulations. The compliance between the individual type of testing is extremely variable, so how does each state commission decide which test(s) they require based on the ABC's recommendations? What, if any, of the finalized recommendations are centered around evidenced-based medicine? Ultimately, this information should be used to guide future medical clearance requirements across all state commissions, ensuring athlete safety, proper medical resource management, and the implementation of evidence-based medicine.

References

1) Bershad L, Ensor R. Boxing in the United States: Reform, Abolition or Federal Control? A New Jersey Case Study. *Seton Hall Law Review.* 1989;19:865-912.

2) McElroy J. Current and Proposed Federal Regulation of Professional Boxing. *Seton Hall Journal of Sport Law.* 1999;9:46-51.

3) Association of Boxing Commissions, "Consitution", https://www.abcboxing.com/abc-constitution/ Accessed 15th of December, 2022.

4) Wulkan S, Bailes JE, Curreri A, et al., The ABC Handbook of Ringside Medicine. August 2011, Association of Boxing Commissions, Accessed 15th of December, 2022.

5) Association of Boxing Commissions, "Medical Requirements", https://www.abcboxing.com/medical-requirements-by-commission/ Accessed 15th of December, 2022.

Information and Submission Instructions for Authors

General and Formatting Guidelines:

All manuscripts must be in written in English, using UK or American English spellings. All materials must be submitted electronically to Nitin Sethi, Editor-in-Chief, at sethinitinmd@hotmail.com.

Submissions must:

- Be submitted in Microsoft Word format (.doc or .docx);
- Be double-spaced with 1" margins;
- Be typed in a commonly-used font (Times Roman, Helvetica, Arial, or similar), no smaller than 11 points.
- Include page numbers

Abbreviations and Acronyms

The use of abbreviations and acronyms, except for those that are quite common in combat sports medicine is strongly discouraged. Authors should be careful to ensure that idiosyncratic acronyms are not included in the submitted version, as this will improve readability for the editors and the reviewers. In addition, authors will be asked to remove idiosyncratic acronyms in any accepted materials.

Photos, Figures and Tables

ARP encourages the submission of photos, slides, graphs, charts, etc. that serve to complement or reinforce the information provided. At initial submission, all tables and figures may be embedded in the main document file. Materials accepted for publication must have the associated figures submitted individually and appended to the main document at final submission (see below for formatting instructions). Manuscript preparation should follow the guidelines provided in the AMA Manual of Style (10th edition or later). If a figure has been published previously, authors must cite the original source and submit written permission from the copyright holder to use it. This permission must be submitted at the time of manuscript submission.

Letters to the Editor

Letters will be published as space permits and at the discretion of the editors.

Title Page

An article's title page must include the following information:

- Title
- Names of all authors and institution where work was done (if applicable)
- Word count
- Key words
- Acknowledgment of grant support (if applicable)
- The contact email for the primary author.

References

References should be listed in the order in which they appear in the article and should be formatted using the *AMA Manual of Style.*

Examples:

Print Journal (1-6 authors)

Nathan JP, Grossman S. Professional reading habits of pharmacists attending 2 educational seminars in New York City. *J Pharm Practice.* 2012;25(6):600-605.

Print Journal (more than six authors)

Geller AC, Venna S, Prout M, et al. Should the skin cancer examination be taught in medical school? *Arch Dermatol.* 2002;138(9):1201-1203.

Electronic Journal Article

Without a Digital Object Identifier (DOI)

Aggleton JP. Understanding anterograde amnesia: disconnections and hidden lesions. *Q J Exp Psychol.* 2008;61(10):1441-1471. http://search.ebscohost.com/login.aspx?direct=true&db=pbh&AN=34168185&site=ehost-live Accessed March 18, 2010.

With DOI:

Gage BF, Fihn SD, White RH. Management and dosing of warfarin therapy. *The American Journal of Medicine.* 2000;109(6):481-488. doi:10.1016/S0002-9343(00)00545-3.

Journal Article with No Named Author or Group Name:

Centers for Disease Control and Prevention (CDC). Licensure of a meningococcal conjugate vaccine (Menveo) and guidance for use--Advisory Committee on Immunization Practices (ACIP), 2010. *MMWR Morb Mortal Wkly Rep.* 2010;59(9):273.

Entire Book

Rantucci MJ. Pharmacists Talking With Patients: A Guide to Patient Counseling. 2nd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2007.

Book Chapter

Solensky R. Drug allergy: desensitization and treatment of reactions to antibiotics and aspirin. In: Lockey P, ed. Allergens and Allergen Immunotherapy. 3rd ed. New York, NY: Marcel Dekker; 2004:585-606.

Website

Canadian Press. Generic drugs to be bought in bulk by provinces. CBC News. http://www.cbc.ca/news/canada/saskatchewan/ story/2013/01/18/drug-costs-provinces.html. Published January 18, 2013. Updated January 18, 2013. Accessed February 4, 2013.

Types of Submissions:

Basic Science and Research Articles

Our suggested maximum article length is 30 typewritten pages (including references), and shorter manuscripts are welcome. It is also suggested that the introductory and discussion sections be limited to approximately 1500 words each. Please consult with the editorial office if your manuscript departs significantly from these guidelines.

Basic science and research articles should include the following subcategories, clearly labeled in the manuscript:

1. Abstract of no more than 300 words in length, which summarizes the main points of the article. Please include 3-5 keywords that facilitate search engine optimization (SEO) and that are consistent with the title, headers, and abstract.
2. Introduction
3. Body
4. Results
5. Discussion
6. Conclusion/Summary
7. References

Case Studies

Case studies should include four distinct and labeled sections:

1. Introduction
2. Statement of Purpose
3. Findings
4. Conclusion
5. References

Commentaries

Commentaries on recently published works may be considered for publication. As commentaries are generally based on insights and opinions of the author, no strict guidelines are required. Authors may consider:

1. Abstract (not to exceed 150 words)
2. Introduction
3. Discussion
4. Summary and Conclusion
5. References

If applicable, authors must provide grant funding sources, acknowledgments, a conflict of interest statement, and the name and email address for comments. Grant funding sources should be also provided at submission and will be reported in the published paper.

Figures. Authors should construct figures with notations and data points of sufficient size to permit legible reduction to one column of a two-column page. As a guide, no character should be smaller than 1 mm wide after reduction. Standard errors of the mean should be depicted whenever possible. Rules should be at least 1/2 point. Use of shading should be limited. There are two preferred formats for electronic figures, photographs, or other artwork that accompany the final manuscript: Encapsulated PostScript (EPS) and Portable Document Format (PDF).

Copy-editing and page proofs. The editor reserves the right to copy-edit manuscripts. The corresponding author will receive page proofs for final proofreading. These should be checked and returned within two days of receipt.

Copyrights: The Association of Ringside Physicians will publish a work only upon the authors' signing and submitting copyright transfer agreements. These agreements should be completed, signed, and submitted by the authors upon acceptance of the manuscript.

All manuscripts considered for publication are screened for plagiarism using several plagiarism detection websites. These websites include (but not limited to) Dupli Checker, quetext, Copyleaks, PaperRater, and Plagiarisma.