

# Developing a Comprehensive, Interdisciplinary Concussion Program

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**ABSTRACT:** There has been a growing trend of local and national coverage of and interest in concussion injuries over the past 2 decades. Increasing public concern over potential catastrophic and unknown long-term effects of sports-related concussion injuries has led to an acknowledgment of the strong public health need for addressing all concussion injuries, regardless of mechanism of injury. In efforts to address this need for concussion prevention and management, both in sports and nonsports, The University of Kansas Health System initiated the interdisciplinary Center for Concussion Management program in 2012. The program was created as a virtual clinic concept and includes voluntary participation from various providers across the institution, limited budget, and space obstacles. Since its inception, the program has continued to operate as its initial design of a multidisciplinary team model outside the sole ownership of 1 department, and has expanded to include education and outreach to local and regional schools and groups.

**KEYWORDS:** Concussion, mild traumatic brain injury, management, program development, interdisciplinary, administration, health care, virtual clinic, public health, collaboration

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## Introduction

Over the past decade, sports-related concussions have become a national conversation in the United States, launched into the mainstream as an epidemic following a notable lawsuit against the NFL and the presumed link between repetitive concussions, a form of mild traumatic brain injury (mTBI), and the pathologic diagnosis of long-term traumatic encephalopathy.\* Due to the increased awareness surrounding concussion injuries and recognition of the need for improved vigilance, prevention, and treatment, many organizations began to take steps toward implementing and incorporating concussion programs. It is accepted that development of concussion-related care programs and expansion of concussion education efforts are important regarding prevention and management of concussions,<sup>1</sup> yet best practices and guidelines for establishing new concussion programs have primarily taken a mechanism-delineated sports or nonsports approach, instead of a comprehensive one.<sup>2-5</sup> Various groups across the globe identified the need for clinical practice guidelines regarding concussions, yet at the time of program development discussions at The University of Kansas Health System (TUKHS), there was a lack of evidence-based guidelines for a comprehensive concussion program, treating injuries from

a variety of causes, across a spectrum of ages, as well as timelines from dates of injury.<sup>6</sup> Without preset benchmarks for design and implementation of a comprehensive, not mechanism of injury or age-specific, multidisciplinary program, TUKHS attempted to address this growing concussion need and establish a concussion management program. This article aims to provide insight into building a successful and comprehensive multidisciplinary concussion management program, not one that is solely sports focused, and address how and why that was done at TUKHS. Furthermore, this article will explore the virtual collaboration of care design set out by TUKHS Center for Concussion Management (CCM) and why it is effective. Finally, this article will describe the CCM's outreach and education efforts to change misconceptions and redefine concussion culture.

\*For the purposes of clarification, the CCM acknowledges the connection between a concussion injury and an mTBI. The terms “concussion” and “mTBI” are used interchangeably throughout this article, as a concussion is a form of mTBI.

## The Beginning—Why and When

In 2006, Washington state high school athlete, Zackery Lystedt, suffered a concussion during a football game. Without what is



currently considered to be appropriate medical clearance, he returned to play while experiencing significant head pain. Before the game was over, Lystedt collapsed and was taken to the hospital where he was treated for severe brain injuries received as a result from prematurely returning to play. Despite his massive brain trauma, he survived, but went on to face numerous permanent physical disabilities as a direct result of his sequential mTBIs. His injuries sparked a response from the state of Washington, enacting the Zackery Lystedt Law, aimed at protecting young athletes, and setting parameters for return to play following a concussion.<sup>7,8</sup> This was a precursor to a climate of need for a more standardized nationwide recognition of concussion.

A similar scenario to that of the Lystedt case described above took place at a local high school in Kansas; however, unlike Lystedt, the Kansas student athlete's injuries proved fatal. At the time of this student's death, Kansas had not yet adopted any Lystedt law-type of concussion regulations. Concussion legislation was not passed in Kansas until the following year in 2011.

Around the same time, on the college and professional athletic scene, several high-profile injuries and concussion-related situations brought attention to concussions and highlighted the beginnings of a culture shift regarding protection of athletes and caring for their injured brains. For example, in January 2011, Pittsburgh Penguins All-Star hockey player Sidney Crosby received a hit to the head from an opposing player, knocking him to the ground. Dazed, he left the ice, but then returned to play after the game's intermission, and even went on to play another game several nights later. During that next game, he took another hard hit and was diagnosed with a concussion the following day. Subsequently, Crosby then sat out for the majority of the 2010 to 2011 season, including the playoffs, with concussion symptoms. He returned to play the following season, only to remove himself once again from play, citing ongoing concussion-related symptoms ([https://www.espn.com/nhl/story/\\_/id/7459581/sidney-crosby-concussion](https://www.espn.com/nhl/story/_/id/7459581/sidney-crosby-concussion)). His injuries have been attributed to prompting an National Hockey League-wide response to head injury and player protection.<sup>9</sup> In 2011, Cleveland Browns football quarterback Colt McCoy sustained a concussion after a helmet-to-helmet hit. Sideline medical personnel were occupied and did not witness the incident. Unaware of the severity of the hit, the medical team did not perform any sideline concussion testing and sent McCoy back into the game after determining he was fit to return to play. He was not officially diagnosed with a concussion until the following day (<https://www.nytimes.com/2011/12/15/sports/football/browns-didnt-give-mccoy-concussion-test-because-they-didnt-see-hit.html>). As an immediate response, the NFL added certified athletic trainer (ATC) spotters to the team of medical professionals watching football games for potential injuries.<sup>10</sup> In Kansas, University of Kansas college basketball player Zach Peters, a freshman, withdrew from basketball and academics

completely after only playing part of the fall 2012 semester, reporting that he had decided to leave to give full attention to his recovery from injuries including postconcussion symptoms. The decision for a young star athlete at the start of his college sporting career to withdraw from sports and academics due to concussion issues was notable and garnered media attention ([http://www.kansan.com/sports/injuries-force-freshman-forward-zach-peters-to-leave-kansas/article\\_baac5c5c-951f-5241-8d42-94aaaa0feb9.html](http://www.kansan.com/sports/injuries-force-freshman-forward-zach-peters-to-leave-kansas/article_baac5c5c-951f-5241-8d42-94aaaa0feb9.html)).

With sports thrusting concussion injuries and postconcussion symptoms into local and national spotlights, viewers, fans, players, and lawmakers began to take note of the potential for catastrophic effects of unregulated play and practice. Literature published by concussion experts during this era of media attention on sports-related brain injuries shows the mechanism-sided approach given to concussion in the health care setting. Sports-based concussion programs championed proper management and treatment of injured athletes,<sup>11,12</sup> while a myriad of others addressed the variety of nonsports injuries.<sup>13</sup> As the Kansas high school player's family and community mourned the student athlete's tragic death, and with the newly enacted sports-related concussion legislation passing in Kansas, TUKHS team recognized that, if there were proper education and management regarding mTBI treatment and recovery, they could possibly prevent others from following a similar path. The University of Kansas Health System is an academic medical center situated within a region covering patient needs within both metropolitan and rural communities. Kansas is home to many sport teams, military bases, and more. Given the range of patients seeking care and support from TUKHS, TUKHS concussion leaders united to find a cost-effective and timely way to navigate the growing need for expert concussion care, encompassing all concussion injuries, not just sports. The executive leadership, in turn, listened and agreed. In July of 2012 TUKHS established the CCM, a comprehensive concussion program.

### Starting the Conversation

When TUKHS concussion program conversations began, there were no nationally recognized concussion programs in Kansas or the greater Midwest. What programs were available were targeted to either athletes receiving care from sports medicine providers or the nonathlete population receiving treatment from neurologists, not an inclusive combination of both providers and patients.<sup>11,12</sup> Concussion injuries evaluated and treated at TUKHS were from both sports and nonsports mechanisms, echoing continuing national concussion statistic trends (Table 1). In addition, with national attention and education efforts focused on the impact of sports-related concussions, groups were noting the increased numbers of concussion-related hospital visits, suggesting a need for usage review and standardization of resources, including community-based education efforts.<sup>14</sup> While sports-related concussions were often at the forefront of concussion discussions, the

**Table 1.** 2019 CDC report: surveillance report of traumatic brain injury–related emergency department visits, hospitalizations, and deaths.<sup>16</sup>How big is the problem?<sup>16</sup>

- In 2014, about 2.87 million TBI-related emergency department (ED) visits, hospitalizations, and deaths occurred in the United States, including more than 837 000 of these health events among children.
  - TBI was diagnosed in approximately 288 000 hospitalizations, including more than 23 000 among children. These consisted of TBI alone or TBI in combination with other injuries.
- In 2014, an estimated 812 000 children (age 17 years or younger) were treated in US EDs for concussion or TBI, alone or in combination with other injuries.

What are the leading causes of TBI?<sup>16</sup>

- In 2014, falls were the leading cause of TBI. Falls accounted for almost half (48%) of all TBI-related ED visits. Falls disproportionately affect children and older adults:
  - Almost half (49%) of TBI-related ED visits among children 0 to 17 years were caused by falls.
  - Four in 5 (81%) TBI-related ED visits in older adults aged 65 years and older were caused by falls
- Being struck by or against an object was the second leading cause of TBI-related ED visits, accounting for about 17% of all TBI-related ED visits in the United States in 2014.
- Over 1 in 4 (28%) TBI-related ED visits in children less than 17 years of age or less were caused by being struck by or against an object.
- Falls and motor vehicle crashes were the first and second leading causes of all TBI-related hospitalizations (52% and 20%, respectively).

Abbreviation: CDC, Centers for Disease Control and Prevention; TBI, traumatic brain injury.

national trends indicated that the rates of other nonsports mTBI injuries were significant.<sup>15</sup> Therefore, during the initial program development conversations, the group focused on what it takes to treat and manage all concussions, by establishing current concussion patient processes and flow through TUKHS system, and then identifying stakeholders for potential program participation based on the mapped-out process.

### Mapping Out the Process and Defining the Stakeholders

#### *Identifying avenues for concussion care—an interdisciplinary approach*

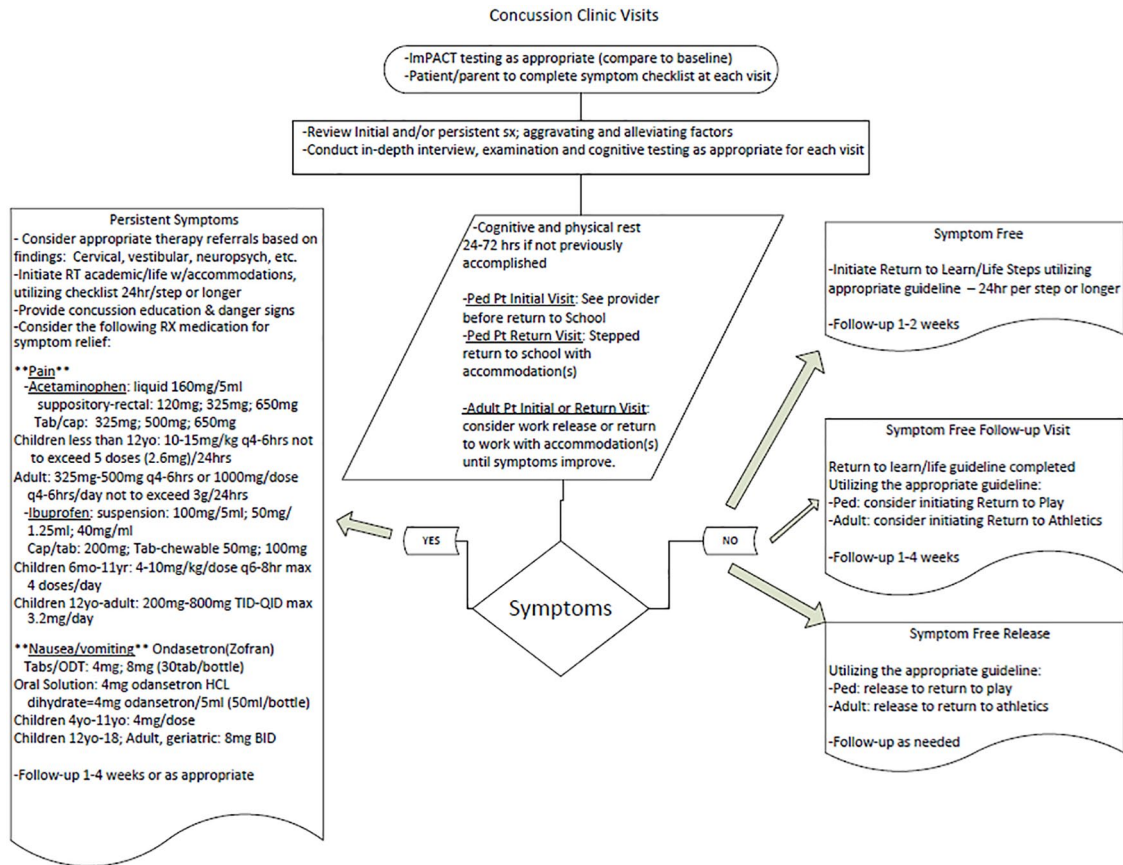
Mapping out the process and identifying potential concussion providers meant pinpointing all potential access points patients with concussion could enter TUKHS system. Opportunities for seeking care changes as the injury timeline progresses, starting with the initial injury, 24 to 72 hours following injury, treatment, and prolonged treatment. Due to the wide range of care needs and requirements for a patient with concussion, and the multitude of possibilities of entering into TUKHS system for concussion care, the CCM providers needed to reflect those potentially involved in a patient's journey. Areas covered would need to include inpatient and emergency department teams, as well as a spectrum of ambulatory care clinics. Ultimately, the initial CCM planning meeting included members from the following areas: neurosurgery, trauma, neurology, sports medicine/orthopedics, rehabilitation medicine, and pediatrics.

#### *Virtual clinic*

With the goal of incorporating a wide breadth of providers under 1 CCM umbrella without requiring years of funding, space, and employment discussions, the group developed a virtual interdisciplinary model of care. A virtual model of care meant that, through voluntary participation by the CCM providers, the patients with concussion could be seen as before in the already established clinics, but would allow for a method of unification of these providers to incorporate standardized

methods, tools, and care practices. Using a virtual clinic approach, the CCM could move out of the auspices of ownership and housing by any 1 department. Mirroring other successful TUKHS interdisciplinary centers, including TUKHS' Vascular Services center, the group's providers would maintain their original employment appointments, clinics and schedules, as well as billing practices in their respective departments. Through the virtual care connection, CCM providers would develop and follow up-to-date treatment guidelines and standards, as well as patient referrals and processes. As these providers were already participating in the care and management of patients with concussion, there were no additional patient loads or alteration or addition of clinic schedules required.

Many providers treat and manage concussions every day throughout TUKHS. At the time when conversations began about starting the CCM, among these providers were several that had expressed interest and expertise in advancing concussion education and management as well as community engagement. Identifying these core leaders helped provide the foundation for the virtual clinic collaboration model. After establishing buy-in from these core providers (and the providers then communicating and receiving approvals from their respective departments), they then became liaisons to their departments and the concussion program. Although in the 2020 era, the use of the term "virtual" may give an impression of a telehealth-based clinic, "virtual" in this setting was more of a process implementation to use and exploit existing resources for standardized multidisciplinary collaborations and referrals. Just as any health care program might require standard operating procedures, billing systems, referral pathways, and clinical practice guidelines, so did a concussion program. With the virtual concept, the core leaders identified the key components where a patient's journey into TUKHS with a concussion may lead and what components could be maximized to provide efficient and optimal care, including specialty referrals and standardized treatment guidelines. While the CCM included a key group of TUKHS concussion experts, part of the concept for the group was to provide education internally and externally to



**Figure 1.** Sample algorithm developed by CCM for concussion management. CCM indicates Center for Concussion Management.

teach providers how to properly manage concussions with up-to-date practice guidelines, including incorporating ancillary treatments, and when and how to refer patients to CCM providers. This model of care allows for specialists to continue to provide their specialty care, while promoting consistent concussion care, regardless of provider.

### *Referrals and practices—standardization*

With the core concussion providers on board, the next step was for the group to lay out parameters for the day-to-day processes, primarily addressing referral pathways and establishing and updating standards for clinical practices. These practices included initial patient triage, concussion treatments and treatment plans, provider referral methods and standards, and objective measurement tools. This also included referrals between CCM providers. Vital to the success of the CCM program is the standardization and availability of concussion care tools and resources. All CCM members have access to the same assessment tools and examination resources, return-to-activity protocols, and treatment protocols. Development and updates of new and existing treatment tools and programs are discussed and agreed on by core CCM members. This includes development of medical record flowsheets, symptom checklists, and a headache treatment protocol, all of which are shared and implemented by all practitioners (Figure 1). The group also

discusses what timepoints to use these tools, updates in research which may impact these items, and any issues impacting use of the tools, including internal system changes, injury trends, and more. In addition, members of the CCM established an official internal referral system, including an established name of the program, and contact information for the program. New appointment referrals are made internally within the electronic medical record system by selecting the CCM, which is listed among the preset departmental referral options; referrals are not made directly to the individual providers or their departments. The CCM regularly communicates with schedulers, billing representatives, and internal and external referral representatives to address updates to the various processes, including development of decision tree flowcharts for when and how to refer to the CCM, accepted or modifications to insurance standards, and exceptions or outliers to the normal processes. Having communication with the various core provider departments helps promote consistent use of these standards and processes.

### *Establishing a new role—a virtual gatekeeper*

With the involvement of multiple providers spanning many different departments within a very large, tertiary academic medical center, it became apparent to the planning group that a unified gatekeeper would be essential to the program's

**Table 2.** Overview of questions and education offered during the CCM triage process.

<p>Questions addressed during the triage process:</p> <ul style="list-style-type: none"> <li>□ Date of injury</li> <li>□ Mechanism of injury</li> <li>□ Symptoms (initial, persistent, aggravating)</li> <li>□ Symptom improvement methods (if any)</li> <li>□ Patient's pertinent medical history</li> <li>□ Concussion history</li> <li>□ Migraine history</li> <li>□ ADHD history</li> </ul> <p>Education offered during the triage process:</p> <ul style="list-style-type: none"> <li>□ Affirmation of symptoms</li> <li>□ Initiating and importance of cognitive rest, including duration</li> <li>□ Use of over-the-counter pharmaceutical and other aids for symptom management</li> <li>□ Overview of concussion injuries and typical symptom presentation timeline</li> <li>□ Setting recovery expectations</li> </ul>	<ul style="list-style-type: none"> <li>□ Dyslexia history</li> <li>□ Learning disability history</li> <li>□ Mood disorder history</li> <li>□ Seizure history</li> <li>□ Motion sickness history</li> <li>□ Chronic pain history</li> <li>□ Previous treatments for current concussion</li> <li>□ Imaging performed for current concussion</li> </ul>
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Abbreviation: ADHD, attention deficit hyperactivity disorder; CCM, Center for Concussion Management.

success. This role was envisioned by the concussion leadership as one that would bind the CCM together and help patients navigate the complicated TUKHS medical system. As created, the position remains outside of the individual CCM provider departments, so not to fall under the ownership of a single group, beholden to serving the needs and interests of a single department over another. Ultimately, this role was placed within its own virtual Concussion department—a department in name and on record, but not in the traditional sense with space and other departmental features. As with all newly created positions within a health care system, much consideration was made regarding the position's funding and reporting structure. To align with the nature of the role and the program, the position was ultimately hospital supported and would provide initial intake and triage of patient referrals. In most cases, this coordinator would be the first point of contact with the patient. This role would help navigate the initial appropriate referral placement, scheduling, and information gathering, and provide recommendations to patients prior to them being seen by a provider. Due to the specialized training required to allow for initial clinical contact and providing basic clinical recommendations, the role required a registered nurse level of medical knowledge and understanding.

Since its inception, this position has grown beyond its original vision and has extended to also include the important and necessary task of community outreach and education, including internal TUKHS education and outreach, addressing concussion standards and practices, as well as CCM referral processes.

### *Initial intake*

As outlined above, the triage role is critical for reviewing concussion referrals and navigating them to the correct TUKHS concussion provider or declining the referral, as appropriate. If a patient is seen outside of TUKHS by a provider who then refers treatment to TUKHS, a referral is sent to TUKHS. This referral is either sent directly by the outside

provider to the CCM coordinator or is routed to the coordinator via a centralized TUKHS referral intake. The CCM has established themselves as a resource for TUKHS departments, so when a referral from an outside provider is sent directly to one of the provider clinics, the CCM has educated the departments on how to handle the referral and route it to the CCM coordinator for review. Referrals are also placed internally by TUKHS providers, referring their patients to the CCM. The key is that, regardless of the initiator, all referrals follow the same navigation and triage process. Collectively, the group identified several key issues to review and address during this CCM coordinator triage process, including a set of standard questions to ask the patient or caregiver as well as basic concussion treatment recommendations for patients to follow until they are seen by a provider (Table 2). By offering basic concussion education and initial treatment recommendations prior to their first CCM visit, the patients can begin their treatment and recovery processes sooner. This also allows for patients who may recover on their own to do so with the education and reassurance from the CCM coordinator.

### *Timelines and rapid access to care*

While a concussion may need urgent or emergency room-level treatment initially, follow-up with CCM treatment and management typically happens after the first few weeks following the injury. Improving access to a CCM provider and beginning concussion treatment within these first few weeks could prove difficult if patients were to follow typical new patient scheduling procedures. Clinic schedules, especially with the specialty providers, fill up quickly. To address this point, CCM providers allow scheduling preference for all CCM patients. Instead of the normal access to new patient specialty care schedules, the CCM streamlined the process to allow for the CCM coordinator to schedule within those core specialty clinics directly, or refer to other schedulers with the understanding that the patient has already undergone initial intake

triage and a level of scheduling priority is given based off of the information gained during the triage process. While each patient, injury, and situation are different, there are some general triage points which help guide the scheduling of new patients. The CCM coordinator reviews items such as age (eg, minors are scheduled with a pediatric provider), mechanism of injury (eg, the coordinator will strive to place them with a provider that sees similarly situated patients, such as sports-derived injuries or athletes are schedule with a sports medicine or sports neurologist provider), work-related injuries (eg, schedule with a provider that accepts worker's compensation patients), time from injury (the CCM sees patients from all timepoints, including those acutely injured to long-term post-concussion follow-up care), previous injuries and treatments, and more. Other considerations may include adhering to agreed-on terms for scheduling and visits for those patients who are part of a group that falls under a partnership or contract with TUKHS. In addition, clinic schedules are also sometimes a factor for consideration. For example, if a particular provider does not have availability to see the injured patient within a reasonable amount of time, the CCM coordinator can navigate that patient to another provider, as appropriate. Similar to the scheduling priority given during the initial intake process, once the initial CCM visit is completed and the patient is referred for concussion-related therapies, the same scheduling standards and priorities apply when scheduling these patients within the CCM ancillary clinics. Using the CCM referral process, the patients with concussion obtain quicker access to care for subsequent and referred visits. Internal delays in the scheduling and referral process are largely due to improper or incomplete referrals. It is also key to note that, while the CCM sets standards for various aspects of concussions, including management and treatment, referrals, and scheduling, each individual department maintains its own scheduling and billing practices. The CCM does not direct any billing standards by way of collecting fees or payments during or after patient visits. This is because the CCM is a virtual care collaboration and does not function as a department that bills for or receives direct revenue from patient visits. What is reviewed and discussed by the CCM core group, however, are billing practice items such as proper International Classification of Diseases coding of concussion patient visits and flow of worker's compensation patient cases.

## Who We Are

### *Providers and concussion-dedicated staff*

The core of the CCM has a foundation of doctors and providers, including leaders from various medical areas within TUKHS, spanning across multiple local TUKHS locations. These core members provide concussion consultation and follow-up concussion management care, including acute concussion injuries, postconcussion syndrome, as well as managing return-to-play and return-to-activity protocols:

**Neurology**—Focuses on long-term issues handled outside of a primary care setting, including symptom management, such as headache.

**Neurosurgery**—Focuses on patients who have concomitant structural injuries to the brain.

**Pediatrics**—Treats and manages patients with concussion who are minors.

**Physical and Rehabilitative Medicine**—Treats patients with persistent physical limitations who need trained rehabilitative care, including inpatient care.

**Sports medicine**—Focuses on student athletes and athletic injuries.

**Trauma**—Works with initial presentations and concomitant trauma injuries as well as outpatient follow-up.

**Ancillary teams**—Other CCM team members provide specialty care, including various therapeutic specialties:

**Cervical therapy**—(physical therapists with extensive training) A highly specialized form of therapy addresses changes in the upper neck anatomy, focusing on movements which realign skeletal structures, relieve nerve pain, and resolve pain from hypermobility or hypomobility.

**Exertional training**—This training is used to help gauge and guide care for those patients who need physical therapy to manage their concussions and who want to resume physical activity, such as sports, athletic training, or exercise.

**Neuropsychology**—Assess cognitive dysfunction, including preexisting and acute presentations of deficits.

**Occupational therapy**—Trained therapists help patients return to work, addressing specific work-situational needs and help identify if a patient is ready to return to work.

**Physical therapy**—Work with pediatric and adult patients and specialize in gait function.

**Psychology**—Assess and treat emotional and behavioral issues, including preexisting and acute presentations, but limited to development of issues or exacerbation of preexisting issues relating to concussion injury.

**Psychiatry**—Assess and treat mental disorders, including preexisting and acute presentations, but limited to development of issues or exacerbation of preexisting issues relating to concussion injury.

**Speech therapy**—Provides ongoing therapy for cognitive and speech deficits.

**Vestibular audiologists**—Concussion injuries may exacerbate or bring about other hearing issues which may need specific attention outside of the therapies listed above, including hearing loss and tinnitus.

**Vestibular therapy**—(physical therapists with specialized training) A critical component of standard concussion treatment; these physical therapists are trained and have expertise in treating vestibular dysfunction.

**Vision therapy**—Patients with convergence, accommodation, eye movement disorders, or other vision issues due to their concussions may need the help of vision therapy, including

special glasses. This can be directed by optometrists who have specialized training in vision care and visual symptoms following concussion.

### **Center for Concussion Management Meetings: Program Goals, Updates, Research, and New Treatment Guidelines**

The core CCM members routinely meet to discuss program goals, issues, and current practices. The CCM also hosts regular interdisciplinary meetings and research meetings, which include players from all participating disciplinary groups, researchers, providers, and administrators. Integral to its process, the group discusses research projects, including new concepts, objective measurement tools, and ideas, as well as updates in published research. Outreach projects are also addressed. The peer review process is critical to the integrity of the clinic, to ensure that the patients are being treated with the most current, up-to-date methods, and that standard treatment processes are being followed among the various departments. As discussion points or issues arise, the CCM team communicates with each other via email or other technology and will meet ad hoc.

### **Other Pieces to the Puzzle**

#### *Partnerships and outreach*

Essential to changing concussion culture and addressing the continued need for concussion awareness, the CCM focuses a lot of its efforts on outreach, community presence, and education. Members of the CCM routinely interact with local and regional nonprofit groups, parent organizations, student athletes, health care providers, school administrators and staff, and others. Some of our other local partnerships and events include working with professional sports teams to provide education and outreach during games, sporting, and charity events, ImPACT testing (ImPACT Applications, Inc, San Diego, CA) for student athletes, and related education for coaches and parents, as well as promoting concussion awareness at school and health events.

More recently, the CCM partnered with several school districts to use TUKHS sports medicine athletic trainers within the school facilities. These ATCs are employed by TUKHS but are physically stationed within these partner schools, creating a direct bridge from the hospital to the community. Athletic trainers monitor student play and aid in recognizing, treating, and diagnosing concussions at the time of injury or when symptoms are reported.<sup>17,18</sup> The CCM also works with these schools and meets regularly to establish and review return-to-play and return-to-learn criteria, as well as development of head injury protocols.<sup>19,20</sup> The CCM also directs and provides educational training opportunities for school staff, including teachers, administrators, and nurses, as well as for parents to learn more about concussions and symptom recognition.<sup>21,22</sup> On a larger scale, TUKHS also has partnerships with college and professional athlete groups, using the expertise of the

CCM team. These community partnerships enhance the CCM's continuity of care, offer a streamlined connection for this care within TUKHS clinics, and promote safe practices, especially with groups where concussions typically go unreported or underreported.<sup>23</sup> Having community members understand symptom recognition and encouraging athletes to report and receive concussion treatment appears to reduce concussion recovery time.<sup>24</sup>

### **Expanded Outreach**

#### *Telemedicine*

The state of Kansas is largely rural and extending the CCM's outreach efforts beyond the Kansas City metro area presents many challenges. One solution crafted by the CCM to address this geographical limitation was telemedicine. As an attempt to give rural access to care, the group has partnered with local telemedicine providers, establishing virtual provider connections. Given the current global pandemic situation, the opportunity for TUKHS to provide telehealth visits for this patient population has grown significantly, allowing for safe social distancing practices, meanwhile also alleviating any travel-related symptom exacerbation or restrictions.

#### *Community education*

Beyond patient encounters, the CCM also works with Kansas communities to coordinate and participate in concussion-related educational conferences. Some conferences are provider focused, offering a chance for local and regional concussion providers to come together in one place to highlight and discuss current concussion treatment practices and challenges facing such providers. Tools are given for learning up-to-date best practices for concussion diagnosis and treatment, and filling in any gaps that may exist in handling complex cases. Other conferences are community based, such as school or school athletic department focused, attended by parents of student athletes and school staff, including coaches. Conferences have been conducted in person, but also occur virtually via the Internet or other livestream-type tools. Not requiring CCM members to physically travel to various locations across the state or throughout the region not only reduces time and travel costs but also allows the CCM to access and bridge its efforts into distant or rural communities. To date, the CCM has provided outreach and education to more than 100 000 people.

Some of our educational events include the following:

- Current Concepts in Concussion Management local conference
- State and local school nurse symposiums
- Family medicine seminars
- Local TUKHS resident didactics
- Bicycle helmet fittings at various bicycle rodeos (organizations involved include Safe Kids; Headstrong for Jake)
- Poster presentations at local and national meetings

- Lectures given at local and national meetings
- Concussion education conference for nursing providers
- Regional hospital education presentations with partnering Kansas hospitals

## Legislation

### *Establishing parameters*

The CCM is also a key leader in developing, advocating for, and modifying Kansas state legislation which governs concussion-related regulations, especially those concerning student athletes. The CCM works with various organizations throughout the state, including other concussion experts via the Kansas Sports Concussion Partnership and the Brain Injury Association, focusing on ensuring that appropriately trained concussion experts and medical providers are working with a standardized set of criteria, critically aimed at keeping kids safe and preventing future harm, including from secondary impact syndrome.

### *Statewide impact*

With vested interest in all aspects of concussion (prevention, education, treatment, and management), the CCM also focuses efforts on a broader, statewide scale. Also, because our organization geographically covers both Kansas and Missouri, the CCM aims to serve this bistate population. Several CCM members sit on various statewide committees which focus on setting statewide concussion standards and initiatives. Similarly, the CCM focuses efforts on legislative happenings, including providing input or support for or against new laws or concussion-related interests. The CCM is actively involved in advocating for Kansas legislation related to return-to-play and other concussion concerns. In 2011, Kansas and Missouri successfully passed laws that required medical clearance from a medical doctor for student athletes returning to play. In 2016, however, legislation was introduced in the state of Kansas that expanded this return-to-play authorization to anyone who was a licensee of the healing arts. The CCM championed against this bill because of its too-broadly defined list of authorized providers, and instead the CCM advocated for students to be assessed and released by concussion experts.<sup>25</sup> This legislation was approved by the Kansas House of Representatives but failed to pass through the Senate.

## Future Directions

### *Funding*

Also vital to the group's historical and future successes is securing philanthropic gifts. Funding of this nature provides opportunities for more community and health care involvement, as well as additional CCM-focused staff and providers. The CCM has partnered with various local and national agencies to secure funding. Through the generosity of these CCM supporters, the CCM has established an endowment fund, which provides continued funding for the CCM's efforts, including continued and increased outreach, as well as research and education endeavors.

### *Technology*

While the CCM has used telehealth for some established, follow-up patient visits, it has not been, prior to 2020, routinely and widely integrated into practice, although using this type of service has shown some benefits in the concussion population.<sup>26</sup> Now, as stated above, with the current pandemic climate and need for social distancing, services like telehealth for outpatient visits are more in favor than in-person visits or canceling visits.<sup>27</sup> Other concussion-related testing and services are available via handheld devices which can aid in providing objective measurements to gauge concussion recovery.<sup>28</sup> While there currently is no evidence-based gold standard for remote care for patients with concussion, there is a wide variety of existing and new developments of tools and programs from which concussion providers can use or recommend to their patients.

### *Research*

Being part of an academic medical center, research is a key driver for successful patient care, community engagement, and education. The CCM's focus to achieve regional and national recognition includes building a strong research program. Collaborations with other groups outside of the core interdisciplinary team as well as outside of TUKHS, studying injury trends, improvements to patient care with a focus on providing useable standards of care to others, and other potential treatment options and subjective measurement tools are all components of the CCM's research focus. To aid in the development and growth of the CCM research program, the CCM hired a full-time research manager. This role is solely dedicated to overseeing, facilitating, and running the group's research projects and operations.

### *Collaboration*

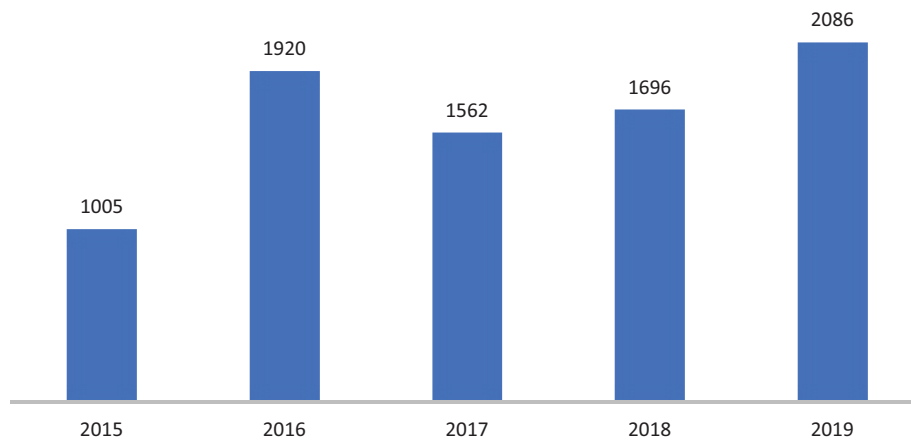
Efforts are underway to collaborate with other concussion centers around the country. These include joining consortiums allowing for discrete data collection via electronic medical record. These data can be used internally to better track outcomes and set benchmarks. It can also be shared throughout the consortium to provide benchmarks for all entities involved, allow for large-scale data research, and improve overall outcome measurements for the treatment of patients treated for concussion. The CCM is also coordinating with other sites across the country to conduct multicenter research.

## What Sets Us Apart

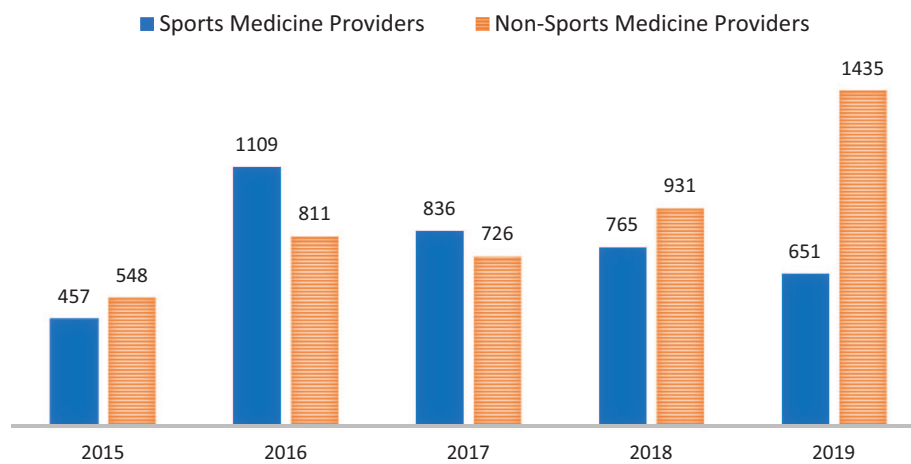
### *Not just sports*

While sports-related concussions brought, and continue to bring, much needed attention to concussions, these are not the only types of concussion injuries seen by many institutions, including TUKHS. Initial high-level overview program data of unique CCM patient encounters suggest that the ratio of the sports-related concussions to the nonsports injuries is fairly balanced





**Figure 2.** Number of individual CCM patient encounters by year—overall. CCM indicates Center for Concussion Management.



**Figure 3.** Individual CCM patient encounters by provider type and year—overall. CCM indicates Center for Concussion Management.

(Figures 2 and 3). Further review and investigation of CCM patient data will provide more specific information as to patient and injury trends, including demographic and injury-specific trends, but the initial data presented in these figures provide insight into the need for continued comprehensive concussion efforts. Addressing all injuries means recognizing that specialty concussion care for sports-related injuries is important, but equally critical are the nonsports injuries. To care for this spectrum of concussion patients with treatment sought at various timepoints from dates of injury and various referral entryways into TUKHS, the CCM uses a coordinated, multidisciplinary approach. As highlighted by Rytter et al,<sup>29</sup> the multidisciplinary approach for care aligns treatment strategies and attitudes across a spectrum of expert providers, resulting in coordinated interventions and disseminated information. Allowing for streamlined utility of multidisciplinary, individualized treatment promotes opportunities to reduce concussion symptoms.

#### *Removing the stigma and increased awareness*

Raising awareness for the importance of concussion recognition and treatment includes tackling this issue and disseminating accurate information. This promotes inclusive conversations, reaching

across sports/nonsports lines and addressing all concussion injuries, regardless of their cause or the age or sex of the patients.

#### **Conclusions**

When the CCM was started in 2012, its efforts focused on a broad, multidisciplinary approach for treating and managing concussions. The program was established in response to a national and local need for concussion medical expertise and community education. Key foundations of the program included creating a system whereby space and commitment could be easily attained, and without the need for developing a new department and clinic. Support from the institution and TUKHS leadership was also necessary for the program's success. This is truly a partnership between the Health System, and the many departments involved in concussion care. Over the past 7 years, the CCM has set itself apart from other programs based on its strong collaborative multidisciplinary approach as well as its extensive outreach and education efforts.

#### **Public Health Concern—Need for More**

The increased awareness regarding sports-related concussion injuries due to media coverage has brought long-overdue

attention to this public health issue. As a direct result of such attention, changes to better protect players and student athletes have been made to athletic rules and play, and in other areas such as academic accommodations for concussed athletes and restrictions on athletic practice.<sup>30,31</sup> More efforts are being made to inform, and tackling how best to inform, players and coaches about concussion symptoms and reporting. Parents are more vigilant with their children's athletic activities.<sup>32</sup> Sports, not only on a professional level, but collegiate and youth athletic programs as well, have been directly impacted by this shift in concussion culture. Along with these changes, new research support has been made available to support development of new concussion tools and standards, including development of new concussion protocols, risk reduction programs, and diagnosis and treatment-related research, as well as promotion of the continuing review of concussion standards and medical practice that can also be applied to nonsports injuries.<sup>33,34</sup>

More interest in and funding to address concussions in sport has led the field of concussion management and research in a positive direction, advancing mTBI knowledge that pervades beyond the parameters of sports. New fields are becoming part of the concussion treatment conversation, including neuro-ophthalmology<sup>35</sup> and audiology.<sup>36</sup> Mild traumatic brain injury research dollar availability is growing, with government, sport, and private interest in military-related projects for impact and blast injuries, consortiums promoting long-term data collection and data sharing, and advanced biomarker, imaging, driving, and other technologies.

The global concern over sports-related concussions, especially about adolescents and other young players, is appropriate. Yet, concussions remain a public health issue that requires much education and study. Concussion conversations have become part of the sports stratosphere, but the same does not yet apply to other populations of concussion sufferers, including the elderly population,<sup>37,38</sup> as well as within sex and gender contexts, workplace contexts, domestic violence and abuse cases,<sup>39</sup> potential issues with race-ethnicity-related factors and implications,<sup>40</sup> and more.<sup>41</sup> Furthermore, given the misconceptions surrounding the required roles of a single traumatic event or loss of consciousness, there is still a clear need to destigmatize and educate the public regarding concussions. Even with availability and promotion of concussion education and initiatives, such as the Centers for Disease Control and Prevention Heads Up initiative, there are still misperceptions surrounding concussion symptoms, when to report an injury, illness profiles, and coping mechanisms or strategies (or lack thereof). Perceptions of the negative consequences of injury disclosure are targets for future studies and public health initiatives.<sup>42</sup> Similarly, prevention, across the spectrum, is insufficient.<sup>43</sup> With attention focused on building comprehensive concussion programs, such as the CCM, education, outreach, and research will continue to further promote concussion awareness and management.

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## Author Contributions

The first draft was completed by first author, Jamie Chen, and then subsequent drafts and edits were made by all co-authors. All authors contributed to the content, text, tables, and references as well as the writing and editing of the manuscript. All authors agreed with the text and conclusions of the article, and reviewed and approved the final version of the manuscript.

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