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CLINICAL COMMENTARY

PREPARTICIPATION SCREENING – THE SPORTS PHYSICAL THERAPY PERSPECTIVE

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ABSTRACT

Background and Purpose: The sports physical therapist (SPT) is uniquely qualified to participate in the provision of preparticipation physical examinations (PPE). The PPE is recommended prior to athletic participation and required by many jurisdictions. There is little research to support the process and components; however, a number of professional organizations have recommendations that direct the PPE process.

Description of Topic and Related Evidence: This clinical commentary highlights the role of the sports physical therapist and current evidence related to the preparticipation physical examination process. Data sources were limited to include professional positions and peer reviewed publications from 1988 through January 2013.

Relation to Clinical Practice: Preparticipation physicals should be useful, comprehensive, and cost effective for the athlete and the health care team. Additional research is indicated in many of the areas of the PPE. The SPT is a valuable member of the health care team and can be a primary facilitator of the PPE in concert with the physician, athletic trainer, athletic organization administrators, and others.

Well-designed and inclusive PPEs can be provided to meet the major objectives of identification of athletes at risk. Controversy continues over the extent of the cardiac screening component as well as other sport or athlete specific components.

Keywords: athletes, preparticipation physical examinations, screenings, sports physical therapy

Level of Evidence: 5

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INTRODUCTION

Sports physical therapy is a unique practice area that in 1973 was officially recognized as a Section (special interest group) by the American Physical Therapy Association (APTA) House of Delegates. A group of physical therapists identified a common body of knowledge related to the physical therapy care of the athlete as the impetus for this organization. The intent was to provide opportunities for education, communication, and consultation in the broad practice area known as Sports Medicine. The original name, "The Sports Medicine Section" was changed in the 1980's to "The Sports Physical Therapy Section" in order to more accurately reflect the membership of the group.[1] The Sports Physical Therapy Section (SPTS) defines sports physical therapy as a specialized practice that focuses on prevention, evaluation, treatment, rehabilitation and performance enhancement of the physically-active individual.[2]

In the early 1970's the APTA adopted a position statement in favor of the development of advanced clinical competency testing. As an outcome of this position, sports physical therapy was one of four specialty areas originally approved for development of clinical specialization by APTA in 1981. Led by Tab Blackburn, Terry Malone, and Lynn Wallace, the Sports Council developed and described the competencies that were deemed to be specific to the practice of sports physical therapy. These competencies were validated by a study that identified the level of competency and the level of importance of the competency to the practice of sports physical therapy which served to pave the way for Sports Clinical Specialist (SCS) certification. The first certification examination in sports physical therapy was given in 1988 and 16 physical therapists were certified as Sports Clinical Specialists (SCS's) by the Board for Certification of Advanced Clinical Competencies (BCACC) now known as the American Board of Physical Therapy Specialties (ABPTS).[1] As of 2011, there were 968 individuals possessing the SCS credential.[3]

From the originally identified 16 clinical competencies, after reviews in 1991 and 2001, there are now six areas of requisite clinical competency.[4] These are delineated as follows:

- Rehabilitation/return to activity: The rehabilitation of athletes with impairments, functional limitations, or disabilities focusing on the return of the athletes to their sports.
- Acute injury/illness management: Immediate management of acute injury or illness association with athletic activity.
- Sports science: Maximizing the athlete's sports performance, including training consideration and the effect of such factors as nutrition and environment on performance.
- Medical/surgical considerations: The medical and surgical management of athletes.
- Injury prevention: Injury/disease prevention for athletes.
- Critical Inquiry: Maintenance of current knowledge, applying principles of evidence-based practice in sports physical therapy and contributing to the body of knowledge in sports physical therapy.

The sports physical therapist possesses the education and skills necessary to evaluate the athlete in the musculoskeletal and neuromuscular realms, to make decisions concerning interventions for the injured athlete, and to make recommendations on return to sport.

The responsibility for the PPE can be designated to any number of professionals representing the sports health care team – the certified athletic trainer, the athletic director, the team physician, the sports physical therapist or another designated and knowledgeable person. The sports physical therapist certainly has the expertise to coordinate the PPE process in a variety of settings. A key component of any PPE is the communication process among athletes, coaches, parents and other members of the health care team. Ultimately, the team physician, when available, has the responsibility for the health and well being of the athlete in cooperation with the health care team. This team can include a number of people – coaches, athletic staff, parent volunteers, medical personnel, student trainers, student managers, and others. Once the organizational plan of the PPE is developed, the necessary staff can be determined. It is vital that someone is designated as the coordinator and is identified as the clear authority during the process. This enables a clearly defined role for each individual and permits efficient movement of

athletes throughout the process. All professionals are apprised of the goals, policies and procedures, and processes and how the PPE will be performed. To facilitate the PPE, communication with a map outlining the "flow" and sequencing of the process is developed and shared and a training session can be used if several "new" providers are going to be part of the process.

The purpose of this clinical commentary is to focus on the role of the sports physical therapist in the area of injury prevention and specifically on their role in the planning, coordinating, and/or administration of the PPE. Additionally, the authors discuss the importance of screening for and recognizing medical conditions or injuries that might affect or preclude the athlete's participation.

THE PURPOSE OF THE PPE

Sports participation and athletics can be a positive experience for all age groups – by boosting fitness, enhancing self-esteem, enhancing coordination and providing an opportunity for creative cooperation and competition. Participation in sports and athletic activities has continued to increase at all levels of society from the very young youth sports activities, to high school and college, and finally to the baby boomer generation. More high school students are playing sports than ever before; more than 7.6 million (55.5%) of all high school students participate.[5] For the ninth consecutive year, there has been a marked increase in athletics participation at the collegiate level with more than 444,000 student athletes competing on more than 18,000 teams.[6] Although harder to gather absolute numbers of participants, youth sports and the baby boomer generation both demonstrate an increase in participation – perhaps in response to the message about physical fitness through the life span. With this increase in participation comes the need for specific health care related to the demands of the athlete. The first component of the health care process for athletes starts with the PPE. PPEs, preparticipation screenings, sports screenings, preparticipation medical evaluations, are all synonymous terms used to describe the process that sports participants should complete prior to participation in sports, training, and competition. For the purpose of this clinical commentary, PPE will be used to describe this process. Most organized sports require some sort of preparticipation assessment and many sports-related organizations have position statements on the PPE.[7-11] For example, all 50 states require completion of some type of evaluation prior to participation in high school sports.[12] However, the National Federation of State High School Associations has opted not to adopt or require a standardized PPE. The National Collegiate Athletic Association (NCAA) and the National Association of Intercollegiate Athletics (NAIA) require a preparticipation medical evaluation upon a student-athlete's entrance into an institution's intercollegiate athletics program.[13]

Health care providers also recognize the need for preparticipation evaluations. The Sports Physical Therapy Section of the APTA developed a position paper on preparticipation screening.[14] The American Medical Association (AMA) Committee on Medical Aspects of Sports developed a statement on the Rights of the Athlete; one of these rights is that each athlete is entitled to adequate health supervision.[10] The National Athletic Trainer's Association (NATA) developed "Recommendations and Guidelines for Appropriate Medical Coverage of Intercollegiate Athletics" in 2000 with revisions in 2003 and 2007.[11] The NATA document supports the determination of the athletes' readiness to participate as part of the definition of appropriate medical coverage. In 1997, the publication, the Physician and Sports Medicine issued a consensus statement from five organizations – the American Academy of Family Physicians (AAFP), the American Academy of Pediatrics (AAP), the American Medical Society for Sports Medicine (AMSSM), the American Orthopaedic Society for Sports Medicine (AOSSM), and the American Osteopathic Academy of Sports Medicine (AOASM) that summarized guidelines for screening procedures.[15] These same five organizations joined the American College of Sports Medicine (ACSM) and published the 4th edition of the Preparticipation Physical Evaluation (PPE-4) in 2010.[16] The PPE-4[16] provides the most current comprehensive guidelines for a PPE as well as suggested screening tools and forms.

In a review of the literature on PPE, there is agreement that the PPE is *not* intended to substitute for athletes' regular health care needs but may facilitate opportunities for general health care.[17] Many objectives for the

PPE have been identified; however, the main goal has always been to promote the health and safety of athletes in training and competition, not to exclude them from competition.[18] McKeag[19] identified 11 clearly defined objectives that differentiate the PPE from a traditional health care examination. These are presented in Table 1. McKeag's objectives are recognized and incorporated in the PPE-4 statement of primary and secondary objectives for the PPE. The overall and most important goal of the PPE is to promote the health and safety of athletes.[16]

Primary Objectives

Lombardo[20] recommends that each athlete have a full examination each sports season. A minimum of one examination per year should have an emphasis on the sports-specific activity and body part. Included in the statement is a recommendation that the first PPE be followed by an annual examination concentrating on any reported previous injuries. Others[1, 13, 16] suggest a complete examination at entry into the system followed by an annual evaluation of any intervening illness or injury.

When screening younger children, the assessment allows a determination of their overall health, specific fitness for a particular activity, and their relative level of maturation.[21] At times, the PPE may be the only health care contact for the child in a given year, due to high incidence of uninsured children and limited access to health care services. Consequently, a comprehensive evaluation may be in order when these children do participate in PPEs.

There is little evidence that a screening PPE will identify any potential catastrophic or life threatening medical or musculoskeletal conditions.[22] Wingfield et al[22] conducted a review of the available evidence establishing the validity of the PPE as a method for screening health risk prior to participation in sport and exercise. They reviewed over 639 papers; 310 articles met their selection criteria, and 25 were identified as original research related to the PPE. Only five of the studies assessed the format or effectiveness of the PPE concluding that the PPE was inadequate because of the lack of standardization and inclusion of recommended screening histories and exams. The consensus panel that developed PPE-4 agreed that a comprehensive approach, when uniformly administered, seems to offer the best opportunity to screen health risk prior to sports participation.[16] There continues to be controversy over the inclu-

Table 1. *Objectives of the PPE.*

♦ Determination of the general health of the athlete
♦ Disclosure of defects that may limit participation
♦ Detection of conditions that may predispose the athlete to injury
♦ Determination of optimal level of performance
♦ Classification of the athlete according to individual qualifications
♦ Fulfillment of legal and insurance requirements for organized athletic programs
♦ Evaluation of size and level of maturation of younger athletes
♦ Improvement of fitness and performance
♦ Provision of opportunities for students to compete who have either physiologic or pathologic health conditions that may preclude blanket approval
♦ Provision of the opportunity to counsel youths and answer health and personal questions
♦ Entry of the athlete into the local sports medicine system establishing a doctor-patient relationship that continues

Table 2. *Objectives of the PPE.*

Primary Objectives
♦ Screen for conditions that may be life-threatening or disabling.
♦ Screen for conditions that may predispose to injury or illness.
Secondary Objectives
♦ Determine general health.
♦ Serve as an entry point to the health care system for adolescents.
♦ Provide an opportunity to initiate discussion on health-related topics.

sion of cardiovascular assessments due to the cost and time required to administer such. This issue is primarily related to cost/benefit as very small numbers are identified for additional testing and a very small number of true positives are seen in follow-up. Yet as we all know, cardiovascular conditions are life threatening and thus of a critical nature.

Nett et al[23] found identification of conditions that may predispose an athlete to injury or illness is a worthwhile goal. Identifiable conditions may simply be the athlete with recurrent ankle sprains who needs additional rehabilitation to prevent further injury, or the athlete with exercise induced asthma that can be managed by medication and education. Other acute, recurrent, chronic or untreated illnesses or injuries may be identified as well as those athletes who have not undergone complete rehabilitation of previous injuries.[24]

Secondary Objectives

The AMA Guidelines for Adolescent Preventive Services (GAPS) and the AAP recommend that all adolescents have an annual routine health examination.[25] In this day and age of limited access to health care due to lack of insurance, the PPE may be the only opportunity for some athletes to have access to medical care even though it does not replace a routine health visit. Krowchuk et al[26] found that up to one third of parents said that the PPE is their student-athletes' only contact with the health care system, even when up to 90% had an identified primary care provider and insurance covered yearly health maintenance examinations.[27]

Although there is little evidence that the PPE is cost effective or even effective at excluding athletes from participation, there are distinct advantages for conducting PPEs. The information gained during the PPE provides a basis for the understanding of the fitness level of the athlete and the likelihood of an injury – benefiting not only the athlete but also the coaching and sports health care team. When conducted by the team providers, the athlete has an opportunity to become acquainted with the sports health care team, thus developing a relationship and sense of trust prior to stressful situations, practice, competition, or injury. Specific information from the examination could allow the coaching staff to develop off-season conditioning programs in collaboration with the sports care team, if properly communicated.

Too often, the motivating factors for conducting preparticipation physicals are to fulfill the legal requirement of a state athletic association, league, or school. However, the major factor should be to identify the fitness level of the athlete, the level of preparation or readiness for participation, and any factors that might contribute to injury, as well as a baseline for comparison later. The process is a screening process, which in itself indicates that participants may require a referral for further evaluation, diagnosis or treatment. The process is designed to promote safety and prevent future injuries. Only 0.3-1.3% of athletes with injuries are denied clearance during PPEs.[28,29]

Administration of PPE

There is no single right way to organize a PPE. However, the process should be efficient and effective. Smith[30] and McKeag[19] suggested elements that should be considered in order to ensure a comprehensive and consistent medical examination. These include qualifications of the screener, timing of the examination, method of the examination, frequency of the examination, and routine laboratory screening.

There are no standard protocols for the timing, frequency, or content of evaluations as the governing organizations, institutions, or available resources often guide these decisions.[18] There are many additional factors that can impact the structure and performance of the PPE. There is agreement that the program should be specific to the population being assessed, and as comprehensive as possible with the available resources.[16] PPE programs for athletes provide a unique opportunity for the sports care team to provide information to the player, family, team physician, coaching staff, athletic trainers and others, that may be useful in preventing injury and enhancing performance. PPE examiners can include many members of the health care team – the MD or DO, the nurse practitioner, the physical therapist, the athletic trainer, dentist, exercise physiologist, and/or chiropractor.[31] The ultimate responsibility for recommendations should be that of the "team" physician in consultation with the appropriate special-

ists. State regulations may dictate who should have authority for the final decision-making and may allow health care providers other than physicians to perform evaluations. At the collegiate, professional, national, and international competition levels, the governing bodies will determine who may perform the PPE. Regardless of the participants in the process, standardized forms and formats would benefit the athletes.

Timing

The timing of the PPE should provide adequate time for the treatment or rehabilitation of any identified problem prior to participation and competition; thus the literature suggests that the PPE should be at least six weeks prior to the start of preseason practice.[20] PPE-4 states that the student-athletes should schedule this examination with their personal physician who has relevant medical knowledge of the individual.[16] Whether done by the physician or in a group setting, the ideal timing would be mid-summer or prior to the end of the previous school year. College programs typically coordinate the PPE process prior to the beginning of practice in the respective sport. Most colleges have policies that direct the PPE process with a requirement that each athlete have a comprehensive health examination prior to entry into the collegiate athletic program.[16] The collegiate student-athlete then is required to have follow-up yearly examinations that focus on any injuries or illnesses that have occurred since the entry examination.

At the secondary school level, there are a variety of approaches ranging from a yearly examination to a comprehensive examination every 2-3 years. The PPE-4 recommends that a comprehensive PPE should be performed every two years in younger student-athletes and every 2-3 years in older athletes; a comprehensive PPE at entry into middle school and high school; and annual updates including a comprehensive health questionnaire and problem-focused examinations.[16]

Organization and administration

The organization and administration of the PPE depends on the requirements of the examination, the individuals involved, the amount of time and space, the number of athletes that will be involved, the location, and the available equipment. There are generally two types of examinations: group and office-based, as well as two types of formats: straight-line format and space available format. Both approaches, the group and the office format, can be adequate and have distinct advantages and disadvantages. The office-based examination can be completed by the athlete's own primary care physician that provides the best medical evaluation. These make up a small percentage of all sports evaluations, yet is ideal for continuity of care. Past medical history is well known to the medical provider, and medication history and allergies can be identified. The physician has an established rapport and thus can determine the athlete's motivation for participation. Due to this relationship, continuity of care exists with a possible higher level of confidence and trust level between the athlete and physician. The established rapport between the physician and the athlete provides an opportunity for discussion of confidential issues, such as alcohol and drug abuse, birth control and prevention of sexually transmitted diseases. It also allows for coordination with family resources and referrals or consultations. However, many primary care physicians are less knowledgeable in the demands of a sport and may not understand the implications for the athlete, and therefore the examination may lack specificity or completeness. The major disadvantages of the office-based examination are the lack of consistency and availability of information to the coach and health care team. The cost of this type of evaluation is generally higher. It also requires that the athlete have a primary care provider identified and available.[32]

In contrast, the group examination promotes a spirit of teamwork among the health care team, the athletes, the coaches, and other members of the community who may be involved in the process. The multiple providers can be specialists, for example, a primary care physician may review the history; a cardiologist, the heart; the physical therapist the musculoskeletal system; the athletic trainer; the sport specific requirements. This approach can be more thorough, time efficient, and cost-effective than an office based, single athlete examination. A standardized approach can be developed which will provide for standardized information in order to determine conditioning and training implications. Very

importantly, the PPE requires the athlete to carry their individual "in-process" file with them from station to station. Even with these advantages, there are disadvantages. These include the potential for an environment with noise and confusion, lack of follow through on less than adequate findings, and examinations that are hurried, incomplete and may lack time for privacy and individual counseling.

When using a group examination, two organizational schemes can be used – the straight-line format or the space available format. (Figure 1) In the straight-line format, the athlete checks in, proceeds to the medical examination, then on to each specific station in a pre-determined order. Once the athlete has visited each station, the athlete proceeds to the final check-out. The final check-out station often will include the "team physician" who has the responsibility for final sign-off of completion. In the space available format, the athlete starts with the check-in and then progresses to any of the stations completing all stations prior to checkout. (Table 3) The number of athletes participating in the process and the available space may dictate the format to be used. With a large number of athletes to include in the screening process, a staggered start will be helpful. Athletes can be assigned to specific stations to start the process using sport, last name or an identification number.

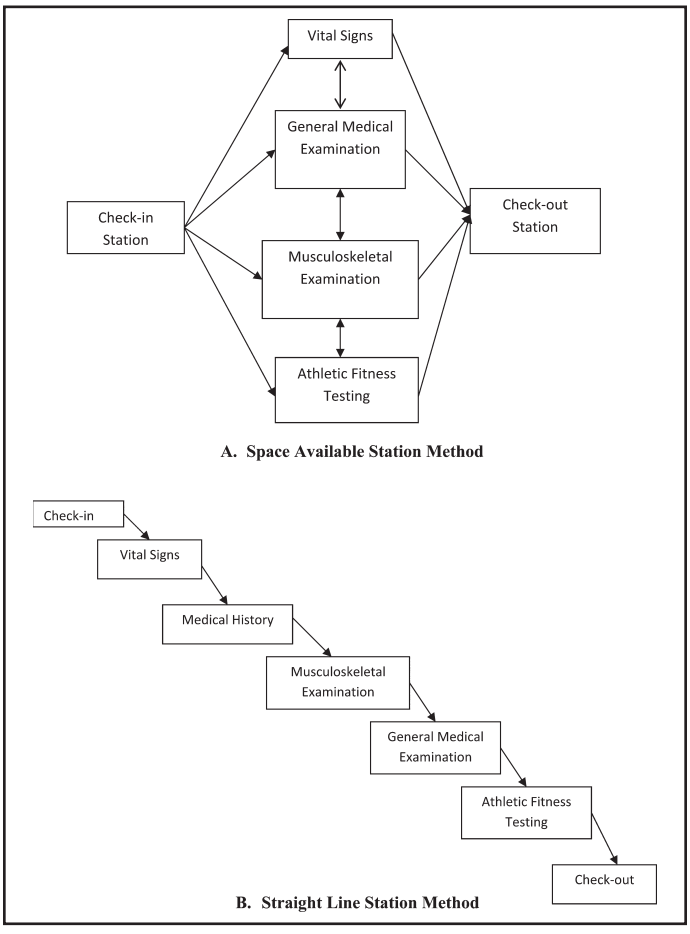

Figure 1. *Examples of traffic patterns for two approaches to PPE.*

Table 3. *Station Examination.*

Stations for the PPE
- Check-in
- History
- Vital Signs
- Medical examination
- Musculoskeletal examination
  - Function specific – flexibility, posture, gait, strength
  - Regional – spine, upper extremity, lower extremity
- Performance testing
  - Speed, agility, power, endurance, balance
- Body composition
- Maturity assessment
- Sport-specific considerations
- Review, assessment, check-out

The check in station is a key first step. At this point, the official or designated forms (required) can be completed by the athlete. If these have been distributed prior to the PPE, the athlete can return the paperwork at this time. These may include the medical history form, insurance information (often multiple forms are required), informed consent, permission to participate in the sport, etc. If fees are being collected, this station should have responsibility for this action. Athletes can be given instructions for the rest of the PPE as well as specific paperwork to be completed throughout the PPE.

The final checkout station is where the data from the entire PPE is combined. When possible, the athlete should meet with the individuals responsible for the PPE – team physician, physical therapist, athletic trainer, coach, for a disposition consultation. At this time, the athlete should be informed of the status of their PPE and provided with any specific follow up information. Data forms should be collected for storage and further analysis with copies distributed as required by policies and procedures.

In general there is agreement on the major components of the examination but there is continued disagreement on specific tests and procedures. Most sources agree on four essential elements – medical

history, general medical examination, musculoskeletal evaluation, and athletic fitness.[33,34] In addition to these major elements, other components can be included, for example, performance testing, body composition, and sport or athlete specific components.

ESSENTIAL ELEMENTS OF THE PPE

Medical History

Many sources confirm that a medical history is a keystone of the examination process.[32,35-37] The literature suggests that as many as 90% of the potential health issues can be identified through the medical history, thus it is considered the most important part of the process.[36] Chun et al[35] state that the medical history alone can lead to the diagnosis of 88% of medical conditions and 67% of musculoskeletal conditions during the PPE. Given the importance, both the athlete and the parent/guardian should complete the medical history in order to obtain the most accurate and complete history.[33,35] The medical history assists the sports care team in determining any present conditions and possible future problems. The history form can be reviewed for completeness at the time of check in and then can be reviewed by members of the sports care team throughout the PPE. Critical information is related to illness, injury or allergy, current medications, and family history for cardiac problems. A very efficient way to clue in the team is to have a column for "key elements or data" that each team member would be able to note quickly as the athlete presents his/her chart. Additional important information includes documentation of inoculations, childhood diseases, and history of concussions or surgery. Questions in the medical history should address common risks of sudden death, exercise –induced bronchospasm (EIB), specific allergies, history of concussions, history of heat injury, sports related injuries and joint trauma, acute illnesses such as mononucleosis, hepatitis A, female maturation (including menstrual history), and eating/dieting patterns to screen for eating disorders.

A complete musculoskeletal history including reporting of any previous fractures, sprains, strains, and contusions is also essential. Some sources state that the musculoskeletal history may be 92% sensitive in the detection of a significant musculoskeletal injury.[38]

Although the medical history has been proven to be valuable, continued effort is needed to refine questionnaires and standardize the format. The PPE-4 provides a recommended standard form.[16]

Medical Examination

The medical examination should be global and complete because any abnormality can affect an athlete's sports performance. A review of the medical history in preparation for the examination should include a review of any ongoing use of medications or the existence of medication allergies. The examination should include blood pressure, pulse, respiration, body weight and height, visual acuity, at a minimum and could include anthropometric measures. The most common abnormalities identified include blood pressure issues and visual acuity. The American Heart Association recommends inclusion of auscultation for heart murmurs, palpation of femoral pulses, examination for the physical stigmata of Marfan syndrome, and a brachial artery blood pressure taken in sitting position. These recommendations for cardiac screening of competitive athletes are suggested in order to identify the cardiovascular risks associated with physical activity and enhance the safety of participants.[40] The PPE-4 describes the cardiovascular screening activities that should be incorporated in the PPE.[16] While screening for cardiac abnormalities is controversial, athletes with heart rate over 120 beats per minute, arrhythmias, systolic or diastolic murmurs should be referred for further evaluation. The lungs should be auscultated for abnormal breath sounds specifically "wheezes". Asthma screening should be completed and any medications should be clearly identified.

Depending on the intent of the PPE and the personnel available, the general medical examination may also include a dental evaluation.[21] The dental evaluation should look for soft tissue lesions and problem teeth. When screening baseball and football athletes, the signs of use of smokeless tobacco should be checked. This station could also be used to fit mouthpieces if indicated. Vision can be included using a standard vision chart with documentation on the use of glasses or contact lenses by the athlete.

The general medical examination for males should include examination of the groin and genitalia in

order to determine the presence of testicles, testicular irregularities, and inguinal hernias or pain. The genitourinary exam in females is not part of the PPE; however, a breast screening examination may be appropriate. Privacy and chaperones should be provided when either component is included. Tanner staging has been used for assessing physical maturity but sources no longer recommend Tanner staging as a routine part of the PPE since there is no data to suggest Tanner staging and recommendations related to this description of maturity (or lack thereof) leads to injury reduction.[25]

There is continued discussion about the use of the body mass index (BMI) during the PPE as a determination of risk, since BMI may not adequately reflect obesity in athletes.[16,39] Further research is needed to confirm inclusion. Most of the elements of the screening examination are included in well child visits or physical examinations of the adult.

Musculoskeletal examination

This component is the area in which the sports physical therapist most obviously utilizes their identified area of expertise. The ultimate goal of this component of the PPE is to identify risks for and to prevent injury, as well as to facilitate optimal musculoskeletal health and optimize performance. Although no specific components are required, frequently included in the musculoskeletal examination are tests/examinations of flexibility, gait, muscle performance, joint laxity, as well as a thorough evaluation of any prior injury. There is some evidence that muscle strength ratios are a risk factor for injury. Therefore inclusion of a neuro-musculoskeletal examination which tests for strength in the form of isometric (hand-held dynamometry), concentric, or eccentric isokinetic testing will contribute to identification of such strength ratios. Right to left differences in strength greater than 15% should be flagged for follow-up as these carry significant risk for injury.[41]

Additional examination should include active and passive range of motion testing, articular testing in the form of joint movement, muscle recruitment testing, static and dynamic postural and balance testing, and appropriate functional tests. Maffey and Emery[42] suggest that sport specific testing should be included based on the available evidence for demands of the sport. Examples might include quadriceps flexibility as a consideration for hamstring injury, balance testing for soccer, or torso and core strength testing for lower quadrant injury prevention in female athletes of many sports. Maffey and Emery[42] present two valid testing methods for torso strength – modified double straight leg lowering test and the flexor endurance test. In addition, functional performance tests such as sit-ups, push-ups, endurance runs, and agility activities should be included.[43,44]

The musculoskeletal exam could be done regionally with specific stations for upper extremity, lower extremity and spine or all elements could be completed at one station. Flexibility testing should assess the movement strategies about the primary joints critical for performance in each sport. It is important to note that general flexibility alone is not the key but rather specific flexibility as dictated by the individual sport. Posture evaluations should be included with observation from all angles. Both static posture and dynamic posture should be observed. Screeners should look for symmetry and any deviations from normal. This is an ideal time for scoliosis screening in the young female athlete. Gait may be evaluated by having the athlete walk or run the length of the hallway or in a space on a flat surface.[45]

If using a regional approach, all of the above elements can be included in each region. Spine evaluations should include evaluation of active and passive movement with overpressure tests to determine pain at end range or inadequate end feels. Major muscle group strength should be evaluated – sit-ups for the trunk or other similar tests.

The lower extremity evaluation should include the hip, knee, ankle and foot. Biomechanical deficiencies may be readily identified. Flexibility, joint stability/laxity, and strength should be included. With a history of any previous injury, proprioception and balance should be evaluated using any variety of tests, ranging from a simple timed standing on one foot with eyes closed to more sophisticated testing, i.e., the clinical test of sensory interaction on balance (CITSIB), the sensory organization test (SOT), or the movement coordination test (MCT).[46]

The upper extremity should include a full movement assessment both in active and passive movement.

Given a history of injury, a more thorough evaluation may be indicated. Flexibility, joint laxity and strength are key components for evaluation. Any screening protocol should be standardized for comparison with norms and for later comparisons.

With limited guidelines available, the sports health care team must rely on expertise and experience in the design of the best approach for the musculoskeletal component of the PPE. Additional research in the area of the musculoskeletal examination is needed and should focus on the specificity and sensitivity of the assessment procedures that could predict injury risk and interventions that can decrease injury risk for athletes.[42]

Performance testing

Although not traditionally included in the PPE, it is the authors' opinion that this is a key element and quite helpful in performance assessment with a goal of performance enhancement. Tests included can be general or sports specific. Testing can be completed by the sports team at the time of the PPE or components can be included in the coach's preseason evaluations.[42] Regardless of when the testing is included, standardized protocols should be used. Areas that may be included in this category are agility, speed, static and dynamic balance, cardiovascular endurance. (See Table 4.) As an example, Cook et al [43,44] Chorba et al[12] and Minick et al[47] describe the use of the Functional movement Screen (FMS™) as a component of the PPE.

Table 4. *Example Performance Assessment Tests.*

Performance Assessment Tests	
Endurance	12 minute run 1.5 mile run Bench step test Submaximal bicycle ergometry test
Speed	40 yard dash 100 yard dash
Sustained speed	440 yard run
Power	Vertical jump Stair climb test
Agility	Shuttle run Cariocas Sidestep test Figure of eights
Balance	One leg standing test (stork test)
Dynamic Balance	Commercial testing devices Beam walking test
Strength	Bench press/leg press Sit-ups Push-ups Pull-ups
Body Composition	BMI calculation Skin folds Hydrostatic weighing Circumferential measures Skin impedance

Laboratory studies

Laboratory studies are generally not included in the PPE since they are rarely of benefit in the non-symptomatic athlete. Currently, there are no routine laboratory tests that have been proven helpful and cost effective as a component of the PPE.[27] Various measures have been proposed, yet are controversial, to determine the use of laboratory tests as a screening or diagnostic tool. Areas that will continue to be investigated include sickle cell testing and iron deficiency testing.

Other considerations

This clinical commentary has referred to sports specific evaluations several times. This is because each sport exhibits unique demands on different parts of the body and it is important that components of PPEs consider this uniqueness.[27] Kibler[21] has provided a system for developing sports-specific profiles based on the demands of sports. He identifies five parameters that are basic to all sports activity – flexibility, strength, power, anaerobic endurance, and aerobic endurance. A battery of tests was developed for use with each of these parameters. The specific test used depends on the specific needs of a sport. (See Table 5.)

Management, decision-making and disposition of athletes

Forms required in addition to the medical history include the informed consent, parental consent, emergency information and medical insurance information. These should be completed and compiled as part of the final checkout of the athlete. The actual PPE form should transmit the decision and should be completed in a private and confidential setting

Table 5. *Tests Often Used to Evaluate the Five Parameters.*

Parameter	Test
Flexibility	Sit and reach – low back
	Goniometric exam:
	Shoulder int/ext rotation
	Shoulder flexion/extension
	Elbow flexion/extension
	Wrist flexion/extension
	Hip flexion/extension
	Knee flexion/extension
	Iliotibial band flexibility
	Gastrocnemius flexibility
Strength	Sit-ups
	Push-ups
	Handgrip dynamometer
	One repetition squat
	Dips
	Isokinetic exam peak torque
Power	Isokinetic exam time to peak torque
	Vertical jump
	Medicine ball throw
Anaerobic endurance	
	Jumping jacks in 1 minute
	20 or 40 yard dash
	Shuttle run
	Hexagon drill
	Sit-ups in 1 minute
Aerobic endurance	
	Step test
	Timed mile run
	Submaximal treadmill or bicycle stress test

with the athlete. Copies of the form should be made available only to those with legal access to the information. The PPE-4 includes forms that may provide guidance in this process.[16] The responsible individual should be a healthcare decision-maker, such as the team physician, athletic trainer, physical therapist, or nurse practitioner, who may consult with any other members of the sports care team. Investigators have reported that less than 2% of athletes are denied clearance following preparticipation examinations and only 3-13% require further evaluation.[31,48,49]

Action that may be taken includes clearance to participate under one of four conditions.

1. Unconditional clearance, cleared for all sports and all levels of participation.
2. Cleared with recommendation for follow-up – including either evaluation or treatment.
3. Not cleared with clearance status to be determined after further evaluation, treatment, or rehabilitation
4. Not cleared in any sport or level of competition.

Questions that guide the determination for clearance include: Does the problem place the athlete at increased risk of injury? Does the problem place any other participant at increased risk of injury? Can the athlete safely participate with treatment? Can limited participation be allowed while treatment is initiated? If clearance is denied for a specific sport, can other athletic activities be substituted? Is consultation with another healthcare provider necessary to answer the above questions?[16]

Examples of conditions that can limit participation include: drug use, acute illness, blood borne pathogens, heart diseases, skin lesions, recurrent heat illness, some eye conditions, eating disorders, hepatomegaly or splenomegaly, kidney abnormalities, neurological disorders such as seizures, and uncontrolled asthma.[24] The AAP Committee on Sports Medicine has compiled a list of disqualifying recommendations for physicians.[29] This list is a good source to determine potential conditions that would limit participation; but one must recognize that these are only recommendations. Results of the PPE should be provided to the physician, parents, and school with consent of the athlete and parents. It is important to note that PPE information is confidential information and subject to HIPAA guidelines. Ideally, at the conclusion of the PPE, the sports care team should look at the data for each team to determine if there are concerns specific to each team. They can then make specific recommendations for the group to address, such as focusing on limited flexibility in key muscle groups, muscular strength imbalances, etc.

Medical Legal Considerations

There are four areas for consideration when the health care provider participates in the provision of PPEs – the athlete's right to participate, Health Information Portability and Accountability Act (HIPAA), Family Educational Rights and Privacy Act (FERPA) and professional liability. The courts have recognized

that the final decision for participation lies with the athlete or with the parents/guardians and not with the health care provider. The physician and other health care providers should not take the decision to prevent clearance lightly and should consult with experts. All reasons for failure to clear should be discussed and a waiver should be obtained releasing the physician, health care provider and organization from liability. Certainly, legal counsel is recommended on this issue.[49]

When dealing with administrative issues, HIPAA regulations may be critical. HIPAA requires the privacy of health information and confidentiality especially in electronic communications; however, also included in the regulatory standards are the privacy of patient records and protected health information. Protected health information is defined as information that could potentially identify a patient/athlete relative to health conditions such as name, diagnosis, address or social security number. Depending on the administration of the PPE, these rules may or may not apply. HIPAA does expressly allow release of medical information without an individual's authorization in some specific situations – "cleared" or "not cleared" is allowed and can be provided to coaches and others with a need to know. Further information would require a signed authorization for release of information.

FERPA is the Federal education act developed in 1974 to protect information that is part of the educational record. FERPA regulations are similar in intent to HIPAA and apply to public schools that receive federal funding. FERPA is excluded from HIPAA and may allow medical information that is part of an educational record to be released to parents, guardians, or school personnel without special consent. These regulations can be extremely complicated and interpreted differently in specific situations and/or jurisdictions. It is always prudent to understand HIPAA, FERPA, and institutional policies to assure that the PPE meet compliance standards.

The legal liability of those who perform PPEs as volunteers is not clearly apparent. Good Samaritan statutes vary from state to state and generally apply only to emergency situations. Under Good Samaritan laws, providers are typically protected from liability except for acts of gross negligence or malpractice. Healthcare providers should be aware of state statutes and legal liability for participation in the PPE process. There are immunity statues that may come into play when healthcare providers are acting on a volunteer basis within their scope of practice. Again, state laws have very different laws and legal precedents.[51]

SUMMARY

The sports physical therapist is uniquely prepared to participate in the PPE process. The actual legal scope of practice of the sports physical therapist is delineated by the state licensure. Many states allow the physical therapist to evaluate without a physician or other healthcare provider referral.[23] Regardless of the specialty or training of the sports health care professionals involved in the PPE, they should not take the responsibility of conducting PPE lightly. The PPE can be performed efficiently and thoroughly when protocols and tools are in place. Regardless of sport setting, the PPE provides the sports care team with an opportunity to complete a thorough examination given available resources. The ability to establish clear communication lines while establishing trust is an invaluable opportunity. The process should allow for quality feedback to all participations with sufficient opportunity for follow-up. The process can be time consuming, resource (human) intensive, but very valuable to the athlete, coach and sports care team. The literature does not identify data to support a specific approach or to establish the best practices for risk factor identification.[42] Questions continue – what is the most efficient process? Who should conduct the evaluations? When and where should they take place? Can we identify risk factors satisfactorily to prevent injury? The PPE can give the sports care team the opportunity to reduce the risks of sports injuries and ensure the health and safety of athletes. Although the vast majority of young athletes are considered healthy, the need to provide screening is important as we attempt to predict injury or potential illness in athletes that may be at risk.[52] The PPE will continue as a requirement and it is our challenge as healthcare providers to continue to improve the process. Best stated that we "still have a long way to go to perfect the PPE – both in content and in who should screen and evaluate the athlete for participation."[17] Prevention of injury and performance enhancement are important, and PPEs can help make an impact on both areas. Well-designed and implemented PPEs

will be welcome by the sports community and benefit everyone. Ensuring an athlete's safety can promote a lifelong health habit of physical activity in which the athlete can learn discipline, teamwork, physical fitness and camaraderie.

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