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Mild Traumatic Brain Injury and Post Concussion Symptoms

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SUMMER 2001

ALBERTA OCCUPATIONAL MEDICINE NEWSLETTER

EDITORIAL COMMENTS

As the new editor of this newsletter, I would like to take this opportunity to introduce myself to our readers. I completed my fellowship in Community Medicine in 2000 at the University of Calgary where I spent most of my elective time in the study of Occupational Health. I obtained my MD from the University of Manitoba in 1995. Prior to that I worked in private industry in marketing and accounting positions after obtaining my Bachelor of Commerce in 1984 at the University of Manitoba.

My educational and occupational activities prior to entering into medicine have influenced my choice of practice area. I am currently working in several settings including a clinic providing occupational services to employees and employers, a physical rehabilitation facility, and providing some consulting services to Calgary area dental health care workers.

Occupational Medicine is the area of medicine that "deals with the effects of the work environment on human health and the risks and limitations that medical conditions can pose in the course of work." The work environment poses hazards to human health in the form of physical, chemical, biological, psychological, and ergonomic hazards. On the flip

side, a person's medical conditions have the potential to impact their ability to work, and can put their health, and others' health at risk, be it a truck driver with a recent myocardial infarction, or a surgeon with a history of poorly controlled epilepsy. Work-related illnesses and injuries have the potential to impact the employee, their family, co-workers, the employer, and the community at large.

As editor I hope to include articles that are of general interest and usefulness to as wide a range of health care practitioners as possible. Previous information has covered areas such as:

- clinical articles pertaining to the prevention, diagnosis, treatment, and rehabilitation of occupational illness or injuries;
- educational opportunities and resources that are available;
- articles on the teaching and research activities of Alberta post-secondary educational institutions relevant to occupational health and medicine;
- policies and programs relating to occupational health and safety;
- announcements of provincial, national, and international conferences and meetings.

I invite all readers to submit articles or any other information of relevance to the practice of occupational health to myself for consideration for publication. Keynote articles should be no more than 3000 words and contain no more than two tables or diagrams, and as many as six key references. There are no strict formatting or style guidelines that must be followed. Please submit a 3.5inch IBM compatible disk and/or an email attachment to myself. Authors of all keynote articles approved for publication will receive an honorarium of \$250.00. Disks can be mailed to me at:

Dr. Ken Fryatt
 9 Silverdale Place N.W.
 Calgary, Alberta
 T3B 4C4

Emails can be forwarded to me at ken.fryatt@home.com

I would like to thank the Workers' Compensation Board Alberta for funding the newsletter through a grant for continuing medical education. I would also like to thank Kim Blaikie for her ongoing help in the production of the newsletter.

The Summer 2001 edition's main article has been submitted by Jerry Rose PhD, CPsych and John Slessor, MB, ChB from the Workers' Compensation Board Alberta. The

Prepared in the Department of Community Health Sciences, Faculty of Medicine
 The University of Calgary, through funding provided by The Workers' Compensation Board Alberta
 and the Section of Occupational Medicine, Alberta Medical Association

article discusses the continuum of care model (CCM) being developed for people who have suffered from a mild traumatic brain injury (MTBI).

The development of a CCM is an important issue since head injuries can be difficult to treat - due to the infrequency that they are seen; the wide variety of clinical presentations; the variable degree of severity and the prolonged recovery period. The potential for devastating disability makes it important to treat MTBI's appropriately. Hopefully the model currently being developed by the WCB will be a resource to physicians and others, when trying to help patients and their families through this injury.

If you have any questions regarding the implementation of the continuum of care model please contact the Workers' Compensation Board of Alberta.

Ken Fryatt, MD, FRCPC
Editor

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MILD TRAUMATIC BRAIN INJURY AND POST CONCUSSION SYMPTOMS: THE DEVELOPMENT PROCESS FOR WORKER'S COMPENSATION BOARD - ALBERTA CONTINUUM OF CARE MODEL (CCM) AND CURRENT ISSUES IN DEFINITION, ETIOLOGY AND TREATMENT

Jerry Rose, PhD, CPsych*, John Slessor, MB, ChB**

(The authors would like to acknowledge the contribution of the internal working committee in the development of the background paper for this continuum of care.)

Introduction

A key objective for the WCB – Alberta is to 'manage superior health care and vocational outcomes'. The development of continuum of care models is one of the activities undertaken to achieve this objective. WCB-Alberta (WCB-AB) is developing Continuum of Care Models (CCM) for Traumatic Brain Injuries (ranging from mild to severe/catastrophic) and psychological injuries resulting from a single, traumatic workplace incident or injury (e.g., Post Traumatic Stress Disorder). These models are expected to improve disability management processes, health care outcomes, and cost-effectiveness and decrease human suffering. This article describes how WCB-AB has developed a continuum of care model for Mild Traumatic Brain Injury (MTBI) and the information they have accumulated to define key elements of the model. The continuum of care model is still in draft form at the time of writing this article, and has initially been implemented through their Calgary office starting with work-related injuries occurring after April 01, 2001. Interested readers are invited to contact the authors to obtain more information, and provide input into the ongoing development of the model.

1. Continuum of Care Models (CCM)

1.1 What is a Continuum of Care Model (CCM)?

A Continuum of Care Model (CCM) is a high level, evidence-based, disability management tool designed to assist in the health care management of a specific injury category (e.g., brain injuries). Such a model promotes a consistent, fair, evidence-based approach to the health care management of a given health condition. For case managers, the CCM acts as a 'road map' which identifies typical recovery patterns, and builds in guidelines for milestones where decisions for assessment and treatment can be made (i.e., the right service at the right time). The CCM can also assist health care providers by identifying 'best practices' for a given injury category, and is designed to augment rather than replace clinical treatment guidelines or sound clinical judgement

(Nikolaj & Boon, 1998). These models can help prevent extended, inappropriate, and/or ineffective treatment by building in checkpoints where treatment progress can be judged, and alternative approaches can be provided if progress is not being made. Such models can also serve as an educational tool for health care and case management professionals who often struggle with how to manage these complex conditions.

The CCM can also be used to predict costs, service utilization, outcomes, and assist in cost-benefit analyses. A key part of the development process is to provide information to patients, care givers and professionals interacting with patients to ensure that the required 'best practices' are available in a timely manner. Ultimately the continuum of care model is expected to result in more consistent and cost-effective services, with improved outcomes and client satisfaction.

1.2 How effective are Continuum of Care Models (CCMs)?

Currently the WCB-AB is utilizing a CCM for soft tissue injuries which has resulted in (a) more timely services to injured workers, (b) appropriate assessment and intervention if the injured worker has not returned to work after the normally expected healing period, and (c) an earlier average return to work. A CCM for progressive injuries (e.g., Repetitive Strain Injuries) is also in the final stages of development following the implementation of a successful pilot treatment program at the Millard Centre in Edmonton.

1.3 How has WCB-Alberta's Continuum of Care Model for MTBI been developed?

The development process of the CCM for Mild Traumatic Brain Injury (MTBI) involves the following steps:

1. Establishing a steering committee with representation from the clinical and case management areas.
2. Reviewing the literature, surveying best practices, and visiting treatment facilities.

3. Developing a draft background paper and continuum of care model.
4. Soliciting validation of the paper and model by internal and external experts and seeking input from the medical community.
5. Identifying and eliminating service gaps.
6. Initially implementing the model through the WCB-AB office in Calgary.
7. Evaluating the model (Fall 2001/Spring 2002).
8. Adapting the model based upon the results of the pilot.
9. 'Rolling out' the model to the health care community at large.

Having described continuum of care models and their development we will now discuss some of the issues which emerged from our literature review related to Mild Traumatic Brain Injury, and its sequelae which are often referred to as Post Concussion Syndrome (PCS). These issues form the foundation for understanding the assessment and treatment needs of this specific population.

2. Mild Traumatic Brain Injury (MTBI) and Post Concussion Syndrome (PCS)

2.1 Definitions

2.1.1 Mild Traumatic Brain Injury. A variety of terms such as mild traumatic brain injury, mild head injury, and concussion are often used interchangeably although they each might have different criteria (e.g., whether patient was hospitalized or not, or duration of post traumatic amnesia). Indeed, some of the variability in this area's research findings have been attributed to the inconsistency of definitions used. The Mild Traumatic Brain Injury Committee of the Head Injury Interdisciplinary Special Interest Group of the American Congress of Rehabilitation Medicine (ACRM) (1993) attempted to standardize definitions in this area. The ACRM (1993) definition of MTBI is as follows:

"A patient with mild traumatic brain injury is a person who has had a traumatically induced physiological disruption of brain function, as

manifested by at least one of the following:

1. any period of loss of consciousness,
2. any loss of memory for events immediately before or after the accident,
3. any alteration in mental state at the time of the accident (e.g., feeling dazed, disoriented, or confused); and
4. focal neurological deficit(s) that may or may not be transient; but where the severity of the injury does not exceed the following:
 - loss of consciousness (LOC) of approximately 30 minutes or less,
 - after 30 minutes, an initial Glasgow Coma Scale (GCS) score of 13-15, and
 - post-traumatic amnesia (PTA) not greater than 24 hours" (ACRM, 1993, p. 86).

This definition includes: the head being struck, the head striking an object, and the brain undergoing an acceleration/deceleration movement (i.e., whiplash) without direct external trauma to the head. Radiological findings may be normal with this class of injuries.

One criticism of this definition is that it is too heterogeneous as 'mild' injuries can range from feeling dazed for a few seconds to a 'complicated' mild brain injury resulting in 30 minutes of loss of consciousness, up to 24 hours of post traumatic amnesia, and abnormal radiological findings. These are two very different injuries.

At this point WCB-AB chose to use the ACRM (1993) definition as it appears to be well established, and as developing new definitions at this juncture will only add to the diagnostic confusion. As part of our pilot we hope to break down this heterogeneous classification into sub-groups on a post-hoc basis to ascertain if differences in initial injury severity can predict long-term outcomes.

2.1.2 Post Concussion Syndrome (PCS).

The term Post Concussion Syndrome (PCS) refers to the variety of physical, cognitive and behavioral symptoms that up to 50% of people complain of following a mild head injury (Evans, 1992). These symptoms generally fall

into the following three clusters:

1. Physical. Nausea, vomiting, dizziness, headache, blurred vision, sleep disturbance, quickness to fatigue, lethargy, or other sensory loss that cannot be accounted for by peripheral injury or other causes,

2. Cognitive deficits. Deficits in attention, memory, concentration, perception, speech/language or executive functions, that cannot be completely accounted for by emotional state or other causes, and

3. Behavioral change(s) and/or alterations in degree of emotional responsivity (e.g., irritability, quickness to anger, disinhibition, or emotional lability) that cannot be accounted for by a psychological reaction to physical or emotional stress or other causes" (Source: ACRM, 1993, pps. 86/87).

The term Persistent Post Concussion Syndrome (PPCS) has been used when these symptoms endure for a long time. The usefulness of the term 'post-concussion syndrome' has been questioned as some people have argued that it is neither a sensitive nor a specific diagnosis, since many people report these symptoms in the absence of a head injury. The number and severity of symptoms needed for such a diagnosis have also been questioned. The Diagnostic and Statistical Manual of Mental Disorders – 4th. Ed. (DSM-IV) (American Psychiatric Association, 1994) contains research criteria for a condition termed 'postconcussional disorder'. The designation of this condition as a research criteria reflects the current uncertainty as whether it is a clinically sensitive or specific diagnosis. Given the lack of agreement in the usefulness of the term post concussion syndrome (PCS), WCB-AB is considering adopting the term 'Post Concussion Symptoms' when referring to symptoms that can be identified as having specifically followed a mild traumatic brain injury.

2.2 Time Course of symptoms following MTBI

The time course and frequency of symptoms following MTBI differs depending on which research is cited. Typically, most authors agree that about

85% of people recover within three to six months following the injury, and a significant minority of people (i.e., 5-20%) appear to develop persistent symptoms or measurable neuropsychological deficits. However, in a recent study, Thornhill et al. (2000) reported that 47% of respondents described moderate or severe disability one year after a mild head injury. Such disparate results may be due to the measures used, and the difference between objectively measured deficits and subjectively reported symptoms. Other factors that can often confound research results include the effects of substance abuse, differential diagnoses such as somatization disorder or depression, varying definitions of mild brain injury, and the impact of response bias in the context of litigation or compensation claims.

2.3 The Etiology of Post Concussion Symptoms following MTBI

A biopsychosocial model which suggests that post concussion symptoms arise from a complex interaction of biological, psychological and social variables is currently favored in the literature. Such a model is shown in Figure 1. Due to limitations of space this model cannot be explained in detail. However, it is generally accepted that the initial symptoms following a MTBI will reflect physiological processes. The primary physiological process associated with MTBI is thought to be diffuse axonal injury (DAI), with associated secondary physiological changes occurring at the metabolic and cellular levels. However, there is still some debate as to whether the forces involved in MTBI are sufficient to cause mild diffuse axonal injury, or permanent axonal damage. A more current hypothesis is that metabolic changes such as depressed cerebral glucose metabolism, or mitochondrial pathology may be responsible for some of the problems seen after MTBI (Dr. Gregory O'Shanick, personal communication, January 26, 2001). However, these latter theories need further research. As time goes on physically based symptoms typically clear, and psychosocial factors appear to become influential in perpetuating symptoms. Such factors include the individual's personality, coping style, life stressors, and their

premorbid health and functional status. An important point here is that some patients can focus on normally occurring phenomena (e.g., forgetting) and misattribute them to a brain injury. If they are anxiety-prone some people can 'catastrophize' that they have a serious brain injury which can cause anxiety and depression which in turn produces further symptoms, or exacerbates existing ones. This process can lead to a vicious cycle and eventual psychological decompensation. In summary, one author once wrote, "It is not only the type of injury that matters, but the type of head" (Symonds (1937, cited in Binder, 1997, p. 443).

2.4 Limitations in the MTBI and PCS research.

The research in this area has a number of limitations. These include small sample sizes, a lack of randomized controlled studies, a variety of research tools which often lack reliability and validity, and various operational definitions of mild brain injury. As a result, few definitive 'truths' appear to exist in this area, and the research tends to leave more questions than answers. Having said this, the following treatment recommendations appear to be reasonable.

2.5 Treatment of MTBI.

There is no one specific treatment for MTBI and its sequelae. Currently a best practice model would include:

- **Early identification of MTBI** by emergency medical technicians,

hospital emergency wards, and physician's and other health professionals. At this point risk factors for life threatening injuries such as hematomas need to be assessed.

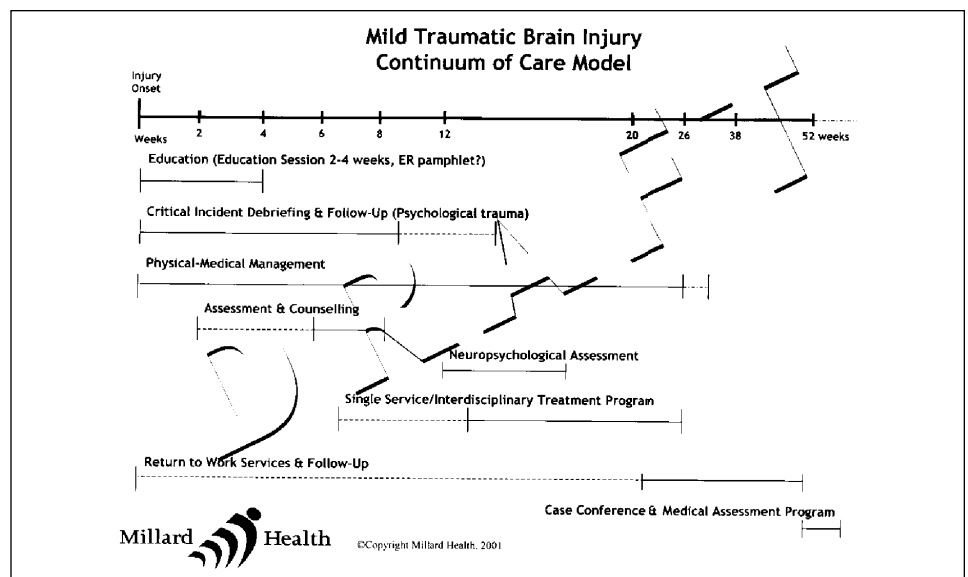
- **Education:** Once serious life threatening injuries have been ruled out, the patient and a significant other should be provided with education. Education typically includes:

- Typical symptoms that can follow a MTBI as part of a natural recovery process.
- Reassurance of a good recovery in most cases.
- Recommendations for gradual resumption of activities (including work).
- Cautions about incurring another head injury.
- Further resources to contact if problems worsen.

The pamphlet "Facts about concussion and brain injury. Where to get help." by the Centers for Disease Control and Prevention is a useful resource for patients. It can be downloaded from:

<http://www.cdc.gov/ncipc/tbi/tbibook.pdf>.

- **Early treatment** should be provided for of physical-medical problems such as dizziness and balance problems, pain, and sleep disturbance. Psychological assessment and counseling may be required if the injury event triggers an acute stress reaction (e.g., a



A Biopsychosocial Model of Mild Traumatic Brain Injury and Post Concussion Symptoms

PRE-INJURY VARIABLES

- ◆ Personality-Self Perception
- ◆ Life Stressors & Coping Skills
- ◆ Lifestyle (e.g., substance abuse)
- ◆ Physical/Mental Health -- abilities/disabilities
- ◆ Demographics (age, gender, SES, occupation)
- ◆ Previous Head Injuries

MILD TRAUMATIC BRAIN INJURY

PERI-INJURY VARIABLES

- ◆ Other Injuries (e.g., musculoskeletal injury)
- ◆ Severity of Injury (e.g., brain damage)
- ◆ Nature of Injury Event (e.g., stressful)
- ◆ Reaction of Patient or Family

(A) Patient's Responses
Include:

- PTSD/Phobias -Adjustment disorders
- Depression -Misattribution of symptoms
- Catastrophising - Alcohol/Substance Abuse
- Response Bias -Avoidance/Social Isolation

(B) Reaction of Family/Support System
Include:

- Roles/expectations -Solicitous responses
- Anger/frustration -Lack of information

POST-INJURY VARIABLES

(C) Situational Variables
Include:

- Litigation/Compensation issues
- Work Situation - Type of work
- Life stressors
- Financial Concerns

(D) Health Issues/Differential Diagnosis(es)
Include:

- Chronic pain -PTSD
- Major depression -Somatization disorder
- Migraines -Musculoskeletal/Cervical injury
- Introgenesis

Outcome - Post Concussion Symptoms
(e.g. number, duration, & severity of symptoms, length of disability, return to work or not)

Sources: Blader (1997), CCSRT (2000), Jacobson (1995), Kay (1993), Kibby & Long (1996), King (1997);

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motor vehicle crash involving a fatality)

- **Out-patient follow-up.** Patients should be referred for assessments and treatments as appropriate. Within the CCM this will typically involve a screening assessment at around two to four weeks following their MTBI for those people who are still off work, or are having problems remaining at work or increasing their work hours. Treatment recommendations are provided after this assessment and could include: education, further assessments and treatment, and/or a gradual/modified return to work plan.
- **A more in-depth assessment** may be required for patients who have not returned to work, or are having problems at work due to their MTBI after six to eight weeks post-injury. This assessment will normally include a medical status exam (MSE), and psychosocial and

neuropsychological screen. The client will be referred for further single or interdisciplinary services as appropriate.

- **Interdisciplinary assessment and treatment** will be provided to those clients who have not returned to work, are still symptomatic at three to four months post injury, and are not currently receiving the services noted above. This assessment should include a full neuropsychological assessment which includes testing of response bias (e.g., exaggeration or minimization of symptoms), and personality disorders. Treatment recommendations would be based on the assessment findings, and may include an interdisciplinary treatment program. Such a program could typically last between one and three months.
- **Return to work services** would also be part of a treatment program, and this could continue after program

discharge (e.g., job coaching). These interventions typically involve negotiating modified and/or gradual return to work with the employer if the patient is still job-attached. An on-site assessment may be required to assist with return to work planning. Vocational assessment and counseling, and supported employment may be needed for those people who do not maintain attachment with their employer, and who are required to change their employment.

- **Education of the patient's employer, and significant other** is a key issue for all of these interventions.
- If a person has not returned to work due to their post traumatic symptoms at one year post-injury further in-depth assessment(s) should occur in order to determine the possible reasons for the symptoms (e.g., differential diagnoses).

3. Initial Implementation of the CCM

The CCM is initially being implemented through the WCB-AB office in Calgary, for clients residing in Southern Alberta. WCB-AB is partnering with Columbia Rehabilitation Centre Concussion Clinic, and Community NeuroRehab Services (CNS), who will provide services to this patient population in Calgary. Physicians will be notified about the model through various publications, and they will receive a letter about the program if their patients are thought to meet the

inclusion criteria. After a period of evaluation the model will be adapted if necessary and then implemented across the Province.

Questions and Feedback

WCB-AB wishes to work in partnership with health professionals and their patients. If you have questions, concerns or any other feedback or information you would like to share in relation to this program, please contact Jerry Rose, PhD, C Psych, Senior Research and Development Consultant, WCB Health

Care Services (Tel: (780) 498-3238, e-mail jerry.rose@wcb.ab.ca).

References available upon request.

*Senior Research and Development Consultant, WCB-Health Care Services, Millard Centre

**Medical Consultant, Medical Services, WCB-Alberta

UPCOMING CONFERENCES

CANADA:

- **The Fifth International Symposium on Biological Monitoring in Occupational and Environmental Health**

The Fifth International Symposium on Biological Monitoring in Occupational and Environmental Health will provide a forum for the exchange of ideas among colleagues in such high impact areas as analytical chemistry, epidemiology, molecular biology, occupational health and public health.

September 19 - 21, 2001
Banff, Alberta, Canada

Contact: Office of Continuing Medical Education
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3330 Hospital Drive N.W.
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Canada T2N 4N1
Phone: 403-220-7032 FAX: 403-270-2330
E-mail: isbm@ucalgary.ca
Web: <http://www.cme.ucalgary.ca/isbm/>

- **OEMAC 2001: The Art and Science of Assessment in the New Millennium**

The Occupational and Environmental Medical Association of Canada (OEMAC) will be holding its Annual Scientific Conference and General Meeting at the Sheraton Hotel in Halifax, Nova Scotia from

September 29th to October 2nd 2001, followed by a course provided by the American Board of Independent Medical Examiners (ABIME) from October 2nd - 4th, 2001

September 29 - October 4, 2001
Halifax, Nova Scotia, Canada

Contact:
Phone: 902-456-3554
Web: <http://members.tripod.com/altergo0/index.htm>

INTERNATIONAL:

- **ACOEM State-of-the-Art Conference (SOTAC) What's New in Occupational Medicine - Recent Advances in Research and Practice.**

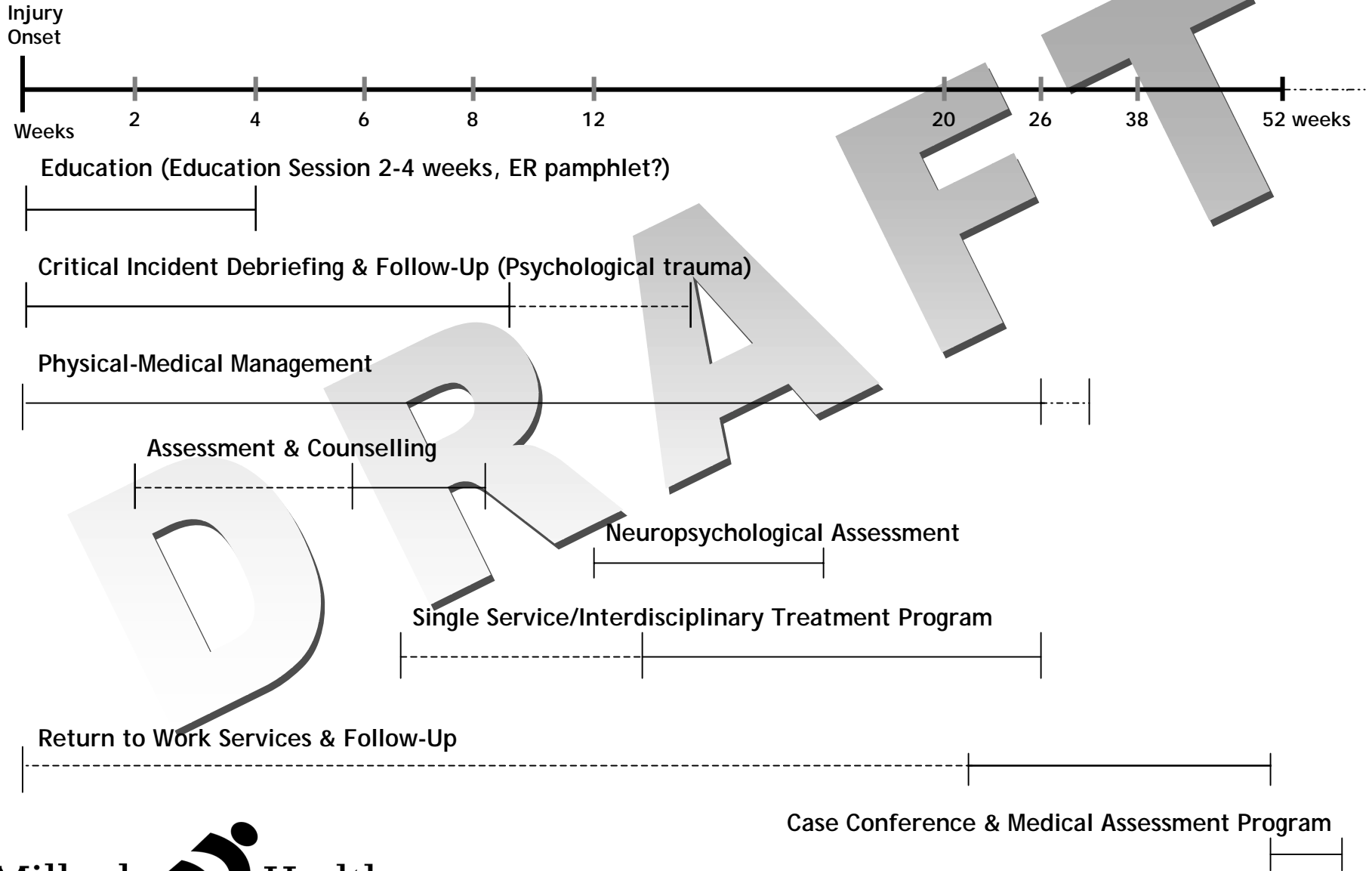
The conference will focus on presenting state-of-the-art research in ergonomics, pulmonary disease, causation, chronic pain, and genomics, as well as practical application of the newest findings in occupational medicine.

October 28 - November 1, 2001
Seattle Washington

Contact: ACOEM Education Department
1114 N. Arlington Heights Road
Arlington Heights, IL 60004
Phone: 847-818-1800 Fax: 847-818-9286
Web: <http://www.acoem.org>

For a more complete listing of conferences and courses, check out our website at:
www.med.ucalgary.ca/oemweb

Mild Traumatic Brain Injury Continuum of Care Model



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MILD TRAUMATIC BRAIN INJURY

**A Biopsychosocial Model
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