The challenge of head injuries in mountain biking:

An approach to sports concussion implemented at Crankworx Rotorua

Dr Tom Reynolds & Dr Ben McHale, ACEM Winter Symposium 2019

ASCENT medical support

TBI

Concentration

Balance

Head Injury

Fatigue

Vision

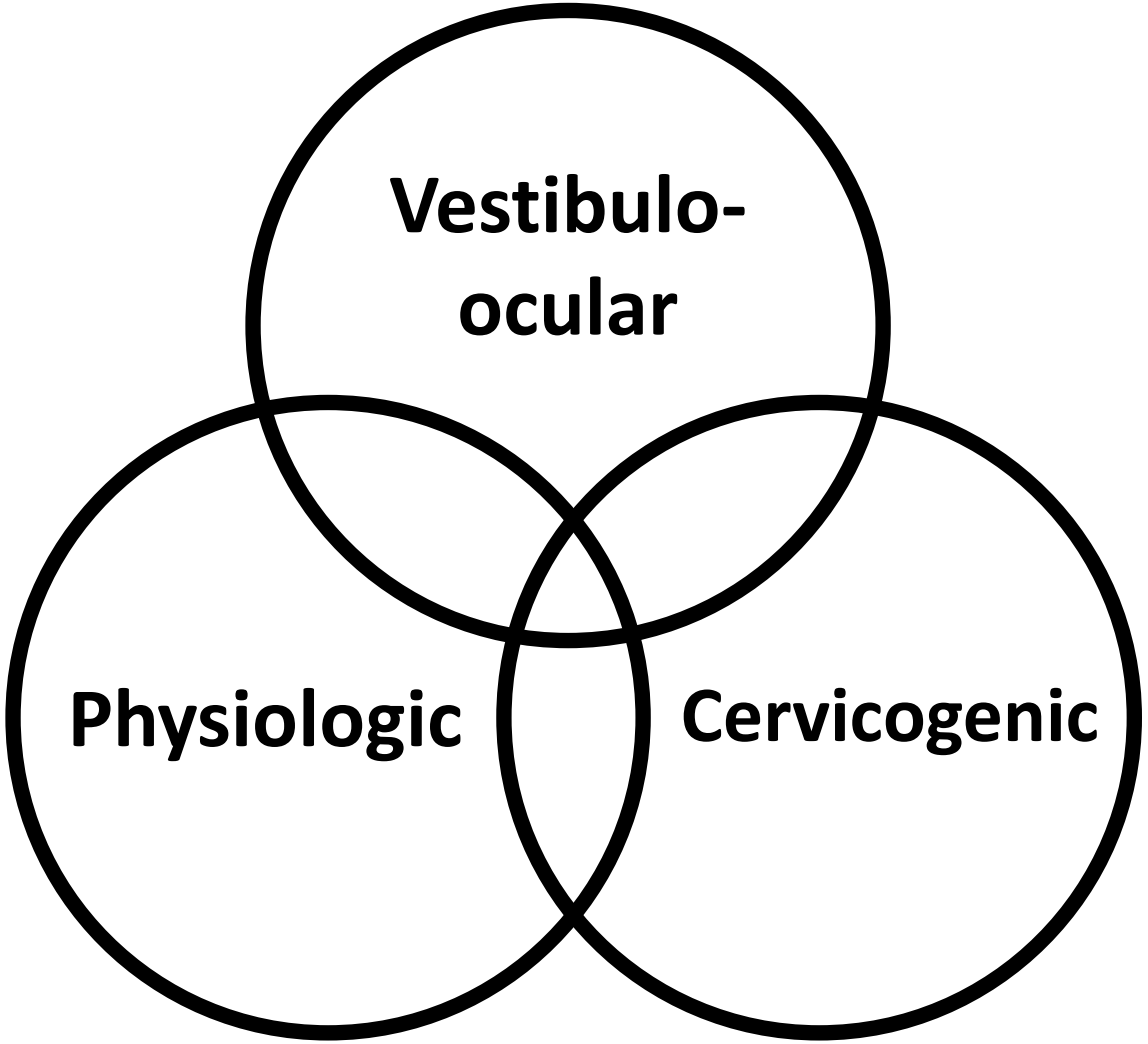
Concussion

Executive functions

Memory

"Head knock"

Concussion syndromes / phenotypes



- ❑PT
- ❑OT
- ❑GP
- ❑Concussion clinic

TRAUMATIC BRAIN INJURY
Adult acute flowchart

ACC process completed by DHB | ACC process completed by ACC | Discharge points | DHB clinical processes

ACUTE TBI – ED PHASE

EMERGENCY DEPARTMENT (ED) PRESENTATION
Clinical Exam and Secondary Survey

SEVERE TBI

MODERATE TBI

SUSPICION OF MILD TBI (with negative radiology)

Admit to ICU *

Admit to ward. Full Westmead and Rivermead post concussion symptom questionnaire by RN or OT; and full MDT assessment if required **

Abbreviated Westmead PTA and consider Rivermead post concussion symptom questionnaire

POSITIVE SCREEN

NEGATIVE SCREEN

Trauma Coordinator (or delegate) or Neuro Ward completes ACC Early Cover process where an ACC Case Manager is required before discharge

ACC Registration Centre receives and processes (acknowledges receipt) and contacts DHB if more information required to determine ACC cover

ACC Case Manager allocation. ACC Case Manager contacts DHB ward to contribute to discharge planning

MDT, Trauma Coordinator (or delegate) identifies patients with TBI requiring TBI rehabilitation

Trauma Coordinator (or delegate) or ward notifies TBI rehabilitation provider (48-72 hours post admission)

Discharge destination considered

DISCHARGE HOME ?

ACC45 completed and submitted to ACC. Consider referral to Concussion Service (ACC883) for follow-up

DISCHARGE with ACC4154, "Knowing about your mild TBI" pamphlet and follow-up instructions

NO

YES

TBI rehabilitation provider visits patient and contributes to weekly discharge planning whilst MDT assessment and intervention continues

TBI rehabilitation provider and ACC Case Manager actively engaged prior to discharge

Discharge summary and MDT handover with ongoing management plan

DISCHARGE TO TBI REHABILITATION PROVIDER

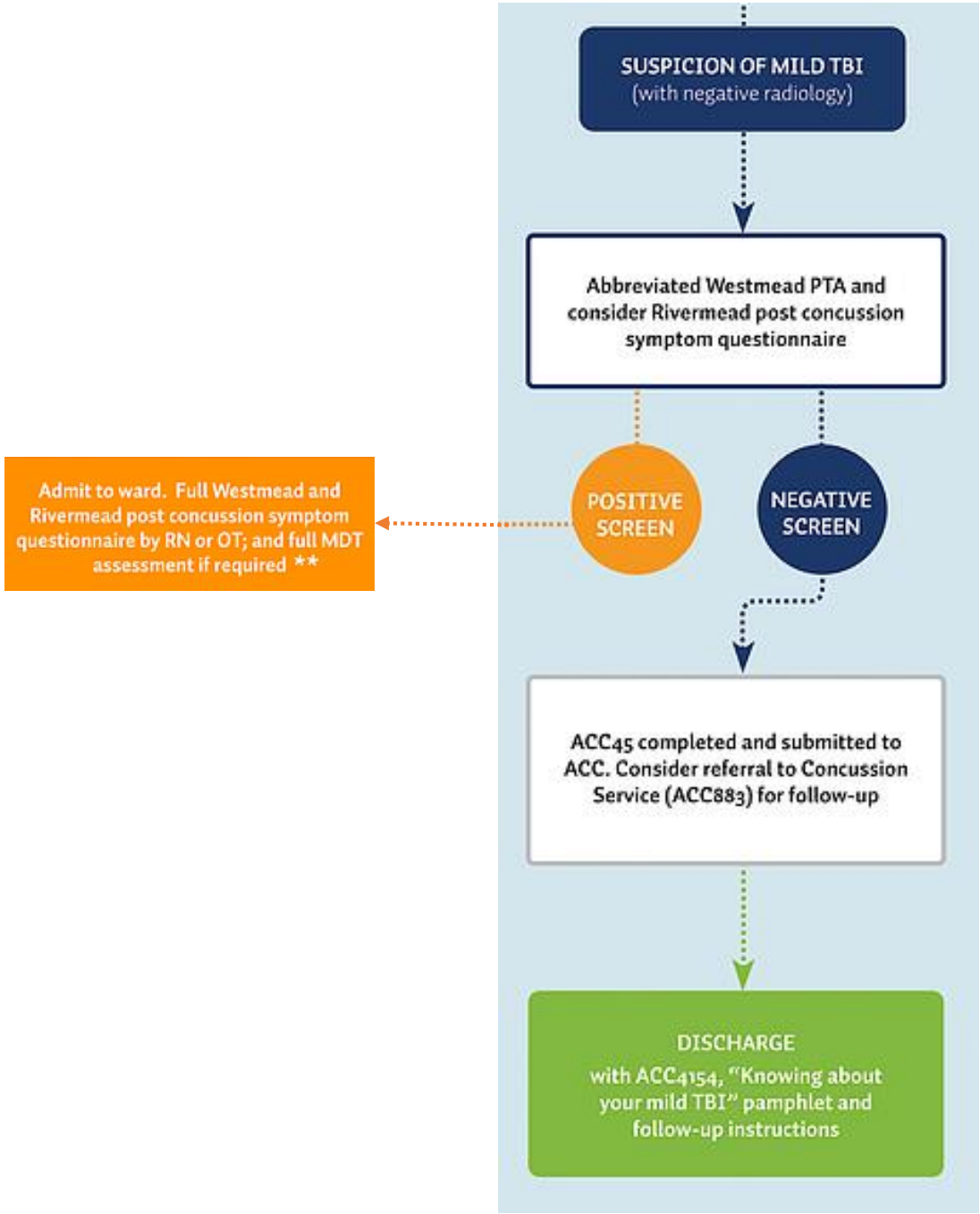
PATIENT SELF-DISCHARGES without services in place. Notify ACC provider on 0800 222 070. Refer to Concussion Service (ACC883)

MDT assessment and intervention continues

Referral for onward services (e.g. Concussion Service, Training for Independence, Home Care)

ACC confirms services for discharge

DISCHARGE HOME WITH DISCHARGE SUMMARY AND EDUCATION



CONCUSSION TOOLS?

The Rivermead Post-Concussion Symptoms Questionnaire*

After a head injury or accident some people experience symptoms which can cause worry or nuisance. We would like to know if you now suffer from any of the symptoms given below. As many of these symptoms occur normally, we would like you to compare yourself now with before the accident. For each one, please circle the number closest to your answer.

0 = Not experienced at all
1 = No more of a problem
2 = A mild problem
3 = A moderate problem
4 = A severe problem

Compared with before the accident, do you now (i.e., over the last 24 hours) suffer from:

Headaches	0	1	2	3	4
Feelings of Dizziness	0	1	2	3	4
Nausea and/or Vomiting	0	1	2	3	4
Noise Sensitivity, easily upset by loud noise	0	1	2	3	4
Sleep Disturbance	0	1	2	3	4
Fatigue, tiring more easily	0	1	2	3	4
Being Irritable, easily angered	0	1	2	3	4
Feeling Depressed or Tearful	0	1	2	3	4
Feeling Frustrated or Impatient	0	1	2	3	4
Forgetfulness, poor memory	0	1	2	3	4
Poor Concentration	0	1	2	3	4

ABBREVIATED WESTMEAD PTA SCALE (A-WPTAS)
GCS & PTA testing of patients with MTBI following mild head injury

Abbreviated Westmead PTA Scale (A-WPTAS) incorporating Glasgow Coma Scale (GCS)

MRN sticker here

Date: / Time		T1	T2	T3	T4	T5
Motor	Obeys commands	6	6	6	6	6
	Localises	5	5	5	5	5
	Withdraws	4	4	4	4	4
	Abnormal flexion	3	3	3	3	3
	Extension	2	2	2	2	2
	None	1	1	1	1	1
Eye Opening	Spontaneously	4	4	4	4	4
	To speech	3	3	3	3	3
	To pain	2	2	2	2	2
	None	1	1	1	1	1
Verbal	Oriented ** (tick if correct)	5	5	5	5	5
	Name	☐	☐	☐	☐	☐
	Place	☐	☐	☐	☐	☐
	Why are you here	☐	☐	☐	☐	☐
	Month	☐	☐	☐	☐	☐
	Year	☐	☐	☐	☐	☐
	Confused	4	4	4	4	4
	Inappropriate words	3	3	3	3	3
	Incomprehensible sounds	2	2	2	2	2
	None	1	1	1	1	1
GCS	**Score out of 15**	**/15**	**/15**	**/15**	**/15**	**/15**
	Picture 1	Show pictures (see over)				
	Picture 2					
	Picture 3					
A-WPTAS	**Score out of 18**		**/18**	**/18**	**/18**	**/18**

** must have all 5 orientation questions correct to score 5 on verbal score for GCS, otherwise the score is 4 (or less).

Use of A-WPTAS and GCS for patients with MTBI

The A-WPTAS combined with a standardised GCS assessment is an objective measure of post traumatic amnesia (PTA).
Only for patients with current GCS of 13-15 (<24hrs post injury) with impact to the head resulting in confusion, disorientation, anterograde or retrograde amnesia, or brief LOC. **Administer both tests at hourly intervals** to gauge patient's capacity for full orientation and ability to retain new information. Also, **note the following**: poor motivation, depression, pre-morbid intellectual handicap or possible medication, drug or alcohol effects. ***NB:*** *This is a screening device, so exercise clinical judgement. In cases where doubt exists, more thorough assessment may be necessary.*

Admission and Discharge Criteria:

A patient is considered to be out of PTA when they score 18/18.

Both the GCS and A-WPTAS should be used in conjunction with clinical judgement.

Patients scoring 18/18 can be considered for discharge.

For patients who do not obtain 18/18 re-assess after a further hour.

Patients with persistent score <18/18 at 4 hours post time of injury should be considered for admission.

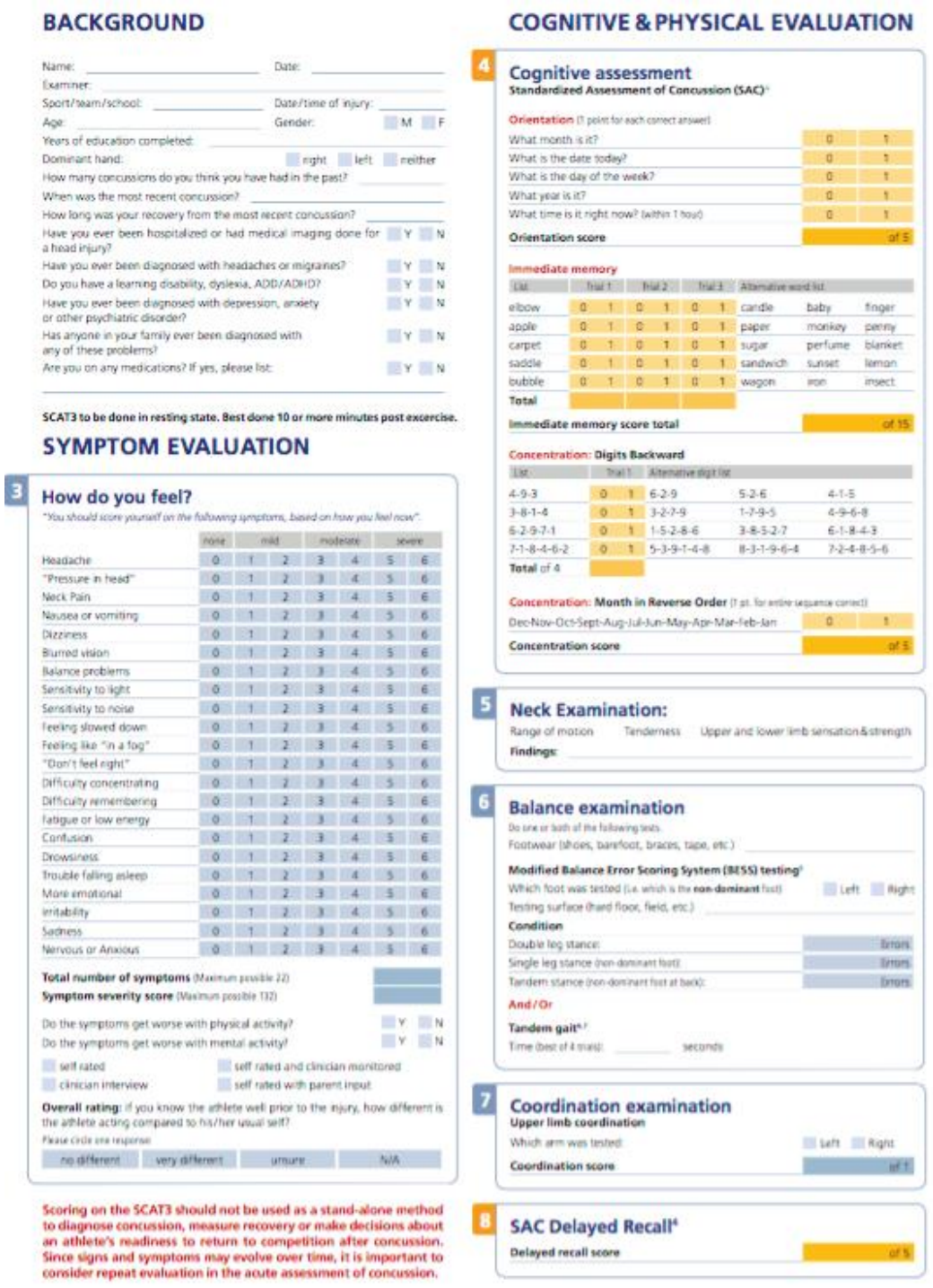
Clinical judgement and consideration of pre-existing conditions should be used where the memory component of A-WPTAS is abnormal but the GCS is normal (15/15).

Referral to GP on discharge if abnormal PTA was present, provide patient advice sheet.

Target set of picture cards

PUPIL ASSESSMENT	T1	T2	T3	T4	T5	+	=	REACTS BRISKLY

Sport Concussion Assessment Tool (SCAT5)



BACKGROUND

Name: _____ Date: _____

Examiner: _____

Sport/team/school: _____ Date/time of injury: _____

Age: _____ Gender: M F

Years of education completed: _____

Dominant hand: right left neither

How many concussions do you think you have had in the past? _____

When was the most recent concussion? _____

How long was your recovery from the most recent concussion? _____

Have you ever been hospitalized or had medical imaging done for a head injury? Y N

Have you ever been diagnosed with headaches or migraines? Y N

Do you have a learning disability, dyslexia, ADD/ADHD? Y N

Have you ever been diagnosed with depression, anxiety or other psychiatric disorder? Y N

Has anyone in your family ever been diagnosed with any of these problems? Y N

Are you on any medications? If yes, please list: Y N

SCAT3 to be done in resting state. Best done 10 or more minutes post excercise.

SYMPTOM EVALUATION

3 How do you feel?

"You should score yourself on the following symptoms, based on how you feel now"

	none	mild		moderate		severe	
Headache	0	1	2	3	4	5	6
"Pressure in head"	0	1	2	3	4	5	6
Neck Pain	0	1	2	3	4	5	6
Nausea or vomiting	0	1	2	3	4	5	6
Dizziness	0	1	2	3	4	5	6
Blurred vision	0	1	2	3	4	5	6
Balance problems	0	1	2	3	4	5	6
Sensitivity to light	0	1	2	3	4	5	6
Sensitivity to noise	0	1	2	3	4	5	6
Feeling slowed down	0	1	2	3	4	5	6
Feeling like "in a fog"	0	1	2	3	4	5	6
"Don't feel right"	0	1	2	3	4	5	6
Difficulty concentrating	0	1	2	3	4	5	6
Difficulty remembering	0	1	2	3	4	5	6
Fatigue or low energy	0	1	2	3	4	5	6
Confusion	0	1	2	3	4	5	6
Drowsiness	0	1	2	3	4	5	6
Trouble falling asleep	0	1	2	3	4	5	6
More emotional	0	1	2	3	4	5	6
Irritability	0	1	2	3	4	5	6
Sadness	0	1	2	3	4	5	6
Nervous or Anxious	0	1	2	3	4	5	6

Total number of symptoms (Maximum possible 22)

Symptom severity score (Maximum possible 132)

Do the symptoms get worse with physical activity? Y N

Do the symptoms get worse with mental activity? Y N

self rated self rated and clinician monitored

clinician interview self rated with parent input

Overall rating: if you know the athlete well prior to the injury, how different is the athlete acting compared to his/her usual self?

Please circle one response

no different | very different | unsure | N/A

Scoring on the SCAT3 should not be used as a stand-alone method to diagnose concussion, measure recovery or make decisions about an athlete's readiness to return to competition after concussion. Since signs and symptoms may evolve over time, it is important to consider repeat evaluation in the acute assessment of concussion.

COGNITIVE & PHYSICAL EVALUATION

4 Cognitive assessment

Standardized Assessment of Concussion (SAC)[1]

Orientation (1 point for each correct answer)

What month is it?	0	1
What is the date today?	0	1
What is the day of the week?	0	1
What year is it?	0	1
What time is it right now? (within 1 hour)	0	1
Orientation score		of 5

Immediate memory

List	Trial 1		Trial 2		Trial 3		Alternative word list		
elbow	0	1	0	1	0	1	candle	baby	finger
apple	0	1	0	1	0	1	paper	monkey	penny
carpet	0	1	0	1	0	1	sugar	perfume	blanket
saddle	0	1	0	1	0	1	sandwich	sunset	lemon
bubble	0	1	0	1	0	1	wagon	iron	insect
Total									

Immediate memory score total of 15

Concentration: Digits Backward

List	Trial 1		Alternative digit list		
4-9-3	0	1	6-2-9	5-2-6	4-1-5
3-8-1-4	0	1	3-2-7-9	1-7-9-5	4-9-6-8
6-2-9-7-1	0	1	1-5-2-8-6	3-8-5-2-7	6-1-8-4-3
7-1-8-4-6-2	0	1	5-3-9-1-4-8	8-3-1-9-6-4	7-2-4-8-5-6
Total of 4					

Concentration: Month in Reverse Order (1 pt. for entire sequence correct)

Dec-Nov-Oct-Sept-Aug-Jul-Jun-May-Apr-Mar-Feb-Jan	0	1
Concentration score		of 5

5 Neck Examination:

Range of motion Tenderness Upper and lower limb sensation & strength

Findings: _____

6 Balance examination

Do one or both of the following tests

Footwear (shoes, barefoot, braces, tape, etc.) _____

Modified Balance Error Scoring System (BESS) testing[1]

Which foot was tested (i.e. which is the **non-dominant** foot) Left Right

Testing surface (hard floor, field, etc.) _____

Condition

Double leg stance:	Errors
Single leg stance (non-dominant foot):	Errors
Tandem stance (non-dominant foot at back):	Errors

And / Or

Tandem gait[1,7]

Time (best of 4 trials): _____ seconds

7 Coordination examination

Upper limb coordination

Which arm was tested: Left Right

Coordination score of 1

8 SAC Delayed Recall[4]

Delayed recall score of 5

ASCENT medical support

Symptom score <4 symptoms (<6)

Cognitive score (SAC) >25/30

Balance Score* >25/30

Hanninen T, et al. Sport Concussion Assessment Tool: Interpreting day-of-injury scores in professional ice hockey players. 2018. *Journal of Science and Medicine in Sport, 21(8),* 794-9.
Zimmer A, Marcinak J, Hibyan S, Webbe F. Normative values of major SCAT2 and SCAT3 components for a college athlete population. 2014. *Applied Neuropsychology, 22(2).*


15

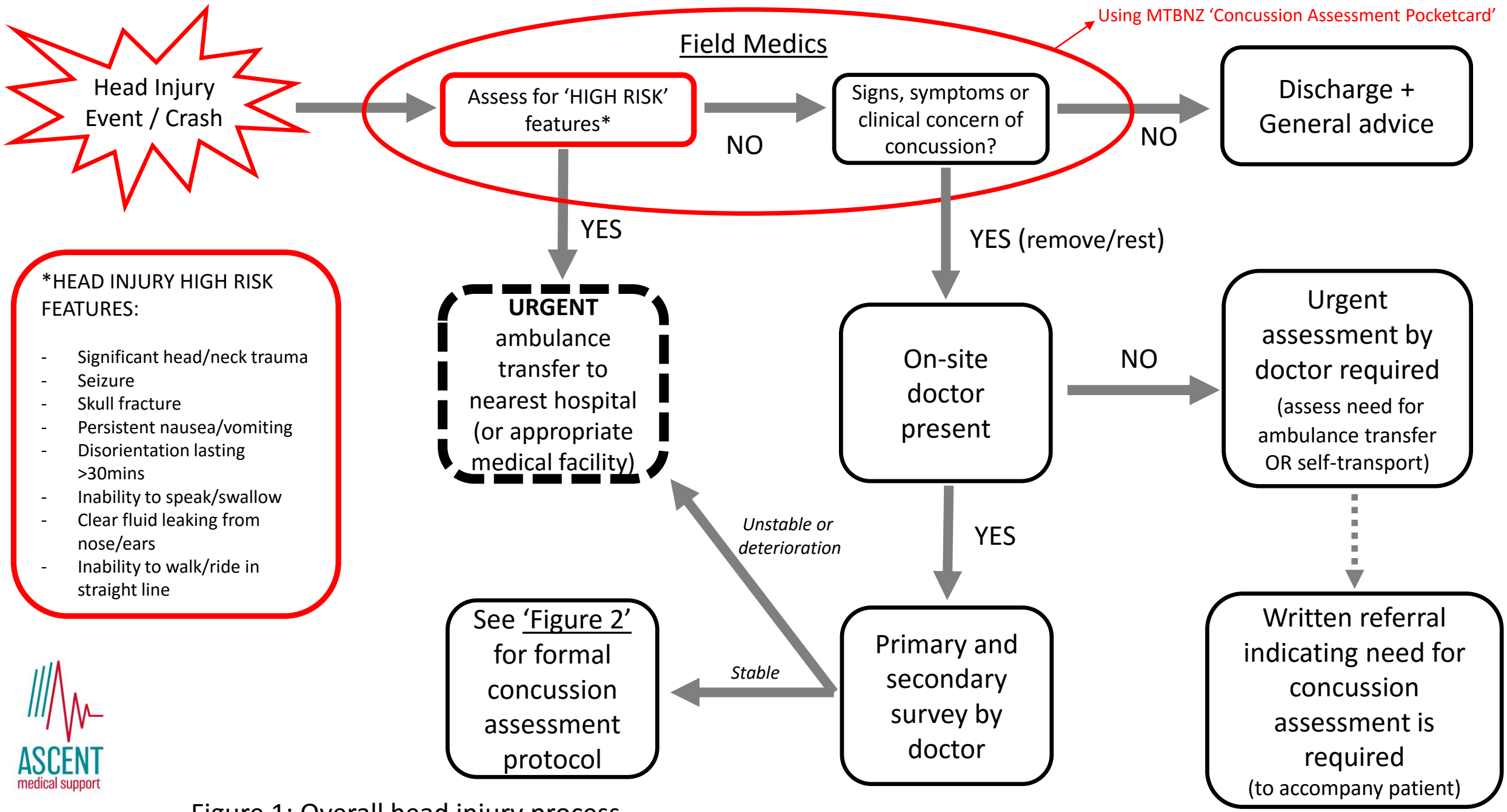


Figure 1: Overall head injury process

Concussion Awareness Pocketcard

for Mountain Bikers

CYCLING NEW ZEALAND MOUNTAIN BIKE

HIGH RISK features

Significant head/neck trauma
Seizure
Skull fracture
Persistent nausea/vomiting
Disorientation lasting >30 mins
Inability to speak/swallow
Clear fluid leaking from nose/ears
Inability to walk/ride in straight line

ORIENTATING Q's

-Can you tell me how you crashed?
-What city/trail network is this?
-What is the name of the trail you were riding?
-How far are you from the trailhead (or finishline in a race)?
-Who are you riding (or racing) with?
-What's in your jersey pockets (or pack)?
-Can you name the months of the year backwards, starting with December?

Following a CRASH assess for the following:

Any **HIGH RISK** features? **YES** → **Call 111** for emergency medical transport. Spinal precautions

NO

Rider **UNRESPONSIVE** at any time? **YES** → **STOP** – Needs medical evaluation

NO

Answers less than 5 **ORIENTATING QUESTIONS** correctly **YES** → **STOP** – Needs medical evaluation

NO

Monitor rider/assess for signs & symptoms of **CONCUSSION** (see other side)

In case of emergency call 111. The information on this card is not a replacement for medical assessment. Please refer to MTBNZ's Concussion Awareness Policy for more information.

Concussion in MTBers: SIGNS and SYMPTOMS

CYCLING NEW ZEALAND MOUNTAIN BIKE

Regardless of the rider's ability to continue to ride, race or train, any rider suspected of concussion should be observed for signs and symptoms of concussion. Riders with symptoms of concussion and/or other concerning changes in their health should stop riding and seek prompt medical attention.

SIGNS of concussion (what you see)

- Appears **DAZED** or **STUNNED**
- Appears **CONFUSED** or **DISOREINTATED**
- **LOSES** consciousness
- Shows **BEHAVIOUR** or **PERSONALITY** changes
- **CAN'T RECALL** events prior to or after crashing
- **DAMAGE** to face or head or **HELMET**

SYMPTOMS of concussion (what they feel)

- **HEADACHE** or **PRESSURE** in the head
- Nausea or **VOMITING**
- **BALANCE** problems or **DIZZINESS**
- **DOUBLE** or **BLURRY** vision
- **SENSITIVITY** to light or noise
- Concentration or **MEMORY** problems
- Feeling **SLUGGISH**, **HAZY** or **GROGGY**

In case of emergency call 111. The information on this card is not a replacement for medical assessment. Please refer to MTBNZ's Concussion Awareness Policy for more information.

Dr Kim Hurst, MTBNZ, 2016

ASCENT medical support

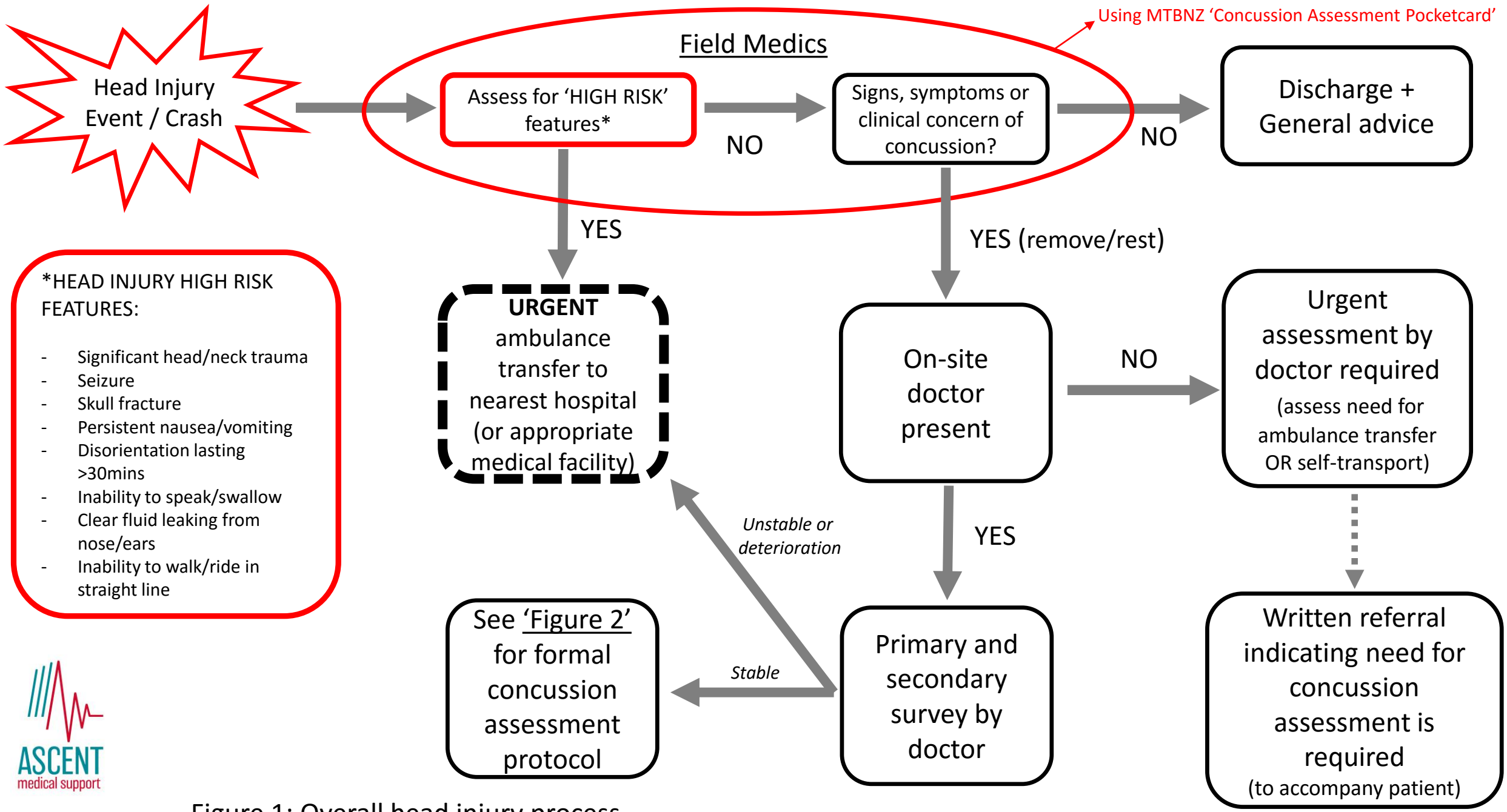
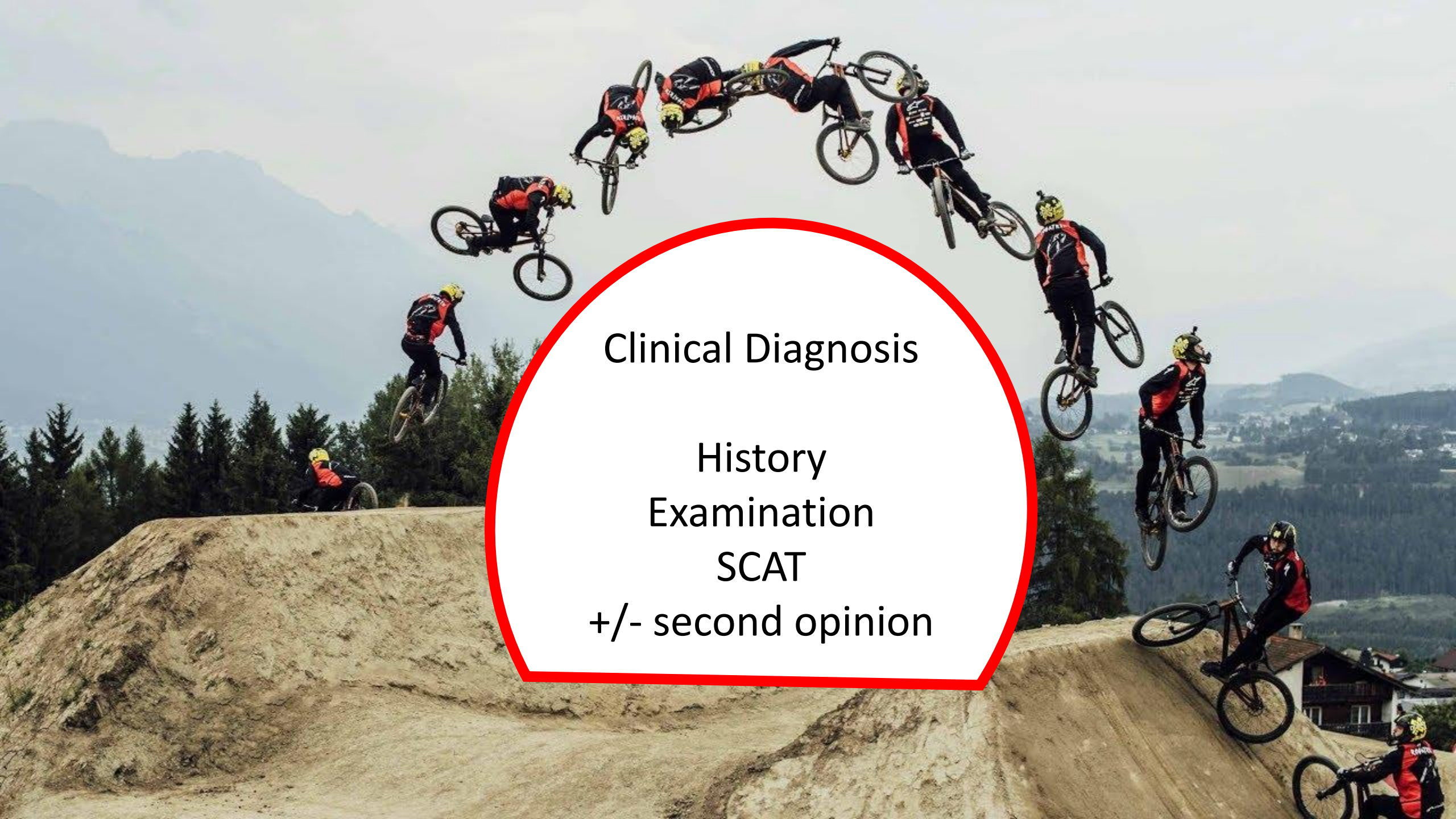
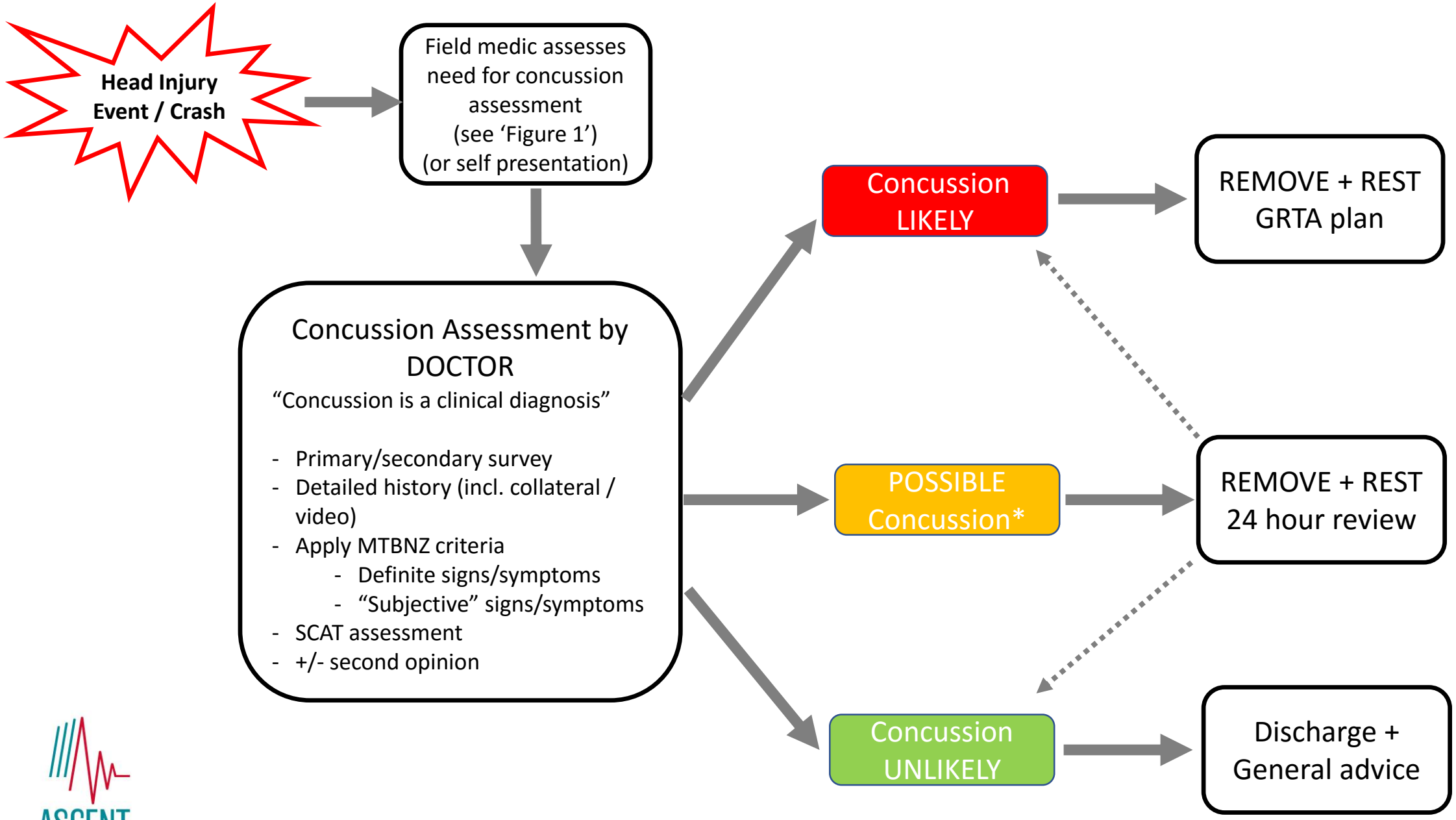


Figure 1: Overall head injury process


Clinical Diagnosis
History
Examination
SCAT
+/- second opinion



ASCENT medical support

Figure 2: Head injury assessment by doctor with outcomes


But doc, when
can I ride again?

Return to Activity Advice

- Simple
- Step by step
- When to seek further assistance
- Written (patient +1)

ASCENT medical support

Concussion - Graduated Return to Activity (GRTA) Plan

Athletes cannot return to activity or competition on the day of injury.

In the days following a concussion athletes follow a step by step return to activity plan. This plan is the same for all athletes. Progression depends on symptoms. In order to allow time for adequate recovery the minimum period of stand down from racing is 6 days.

This recovery period is important to reduce the risk of another concussion, avoid injury to another part of the body (potential 60% increase), and to prevent long term complications. These can all result in much longer enforced breaks from competition. Sports performance is also affected by a concussion – athletes cannot perform at their normal level while concussed.

Each stage of the GRTA is at least 24 hours long. An athlete should only progress once they can complete a given stage and have been symptom free for 24 hours. If symptoms re-occur, then athletes should rest until they resolve and resume the program at the previous asymptomatic stage. *E.g. Develop headache when attempting stage 4, rest until symptoms stop, return to stage 3 for a further 24 hours before attempting stage 4 again.*

Stage	Return to Activity Stage	Functional Exercise	Objective
1	No activity	Complete physical and mental rest. No exertion, including prolonged use of technology. Avoid phones, computers, TV.	Recovery
2	Indoor (stationary trainer) riding	Light exercise riding at less than 70% of maximum heart rate for a short duration. Avoid rollers as balance may be impaired.	Increase heart rate
3	Riding on road/non technical trails	Avoid riding that poses a risk of increased head injury.	Add movement
4	Riding on road/non technical trails incorporating hills and/or higher intensity riding	Progression to add more intensity/increase heart rate.	Add intensity of exercise
5	Riding on more technical terrain	Progression to adding more mentally and physically challenging riding.	Movement, co-ordination, cognitive load. Restore confidence.
6	Return to full riding/racing	Normal pre-injury riding	Full return to riding

Fig 1. GRTA plan from MTBNZ Concussion Awareness Policy, 2016

A doctor or physio can help guide the return to play process. If symptoms are ongoing after 10 days athletes should seek a review with a doctor, ideally with experience in sports concussion management.

Further information:

Guidance based on 4th International Consensus Statement on Concussion in Sport (2012) and associated SCAT3 protocols

Benefits of standardised approach

- ✓Aids a tricky diagnosis
  (Provides more useful information e.g. modifiers, different phenotypes)
- ✓Consistent and repeatable
  (Using an evidenced based process – SCAT5)
- ✓Directs patient to appropriate care
- ✓Potentially enhances compliance


CRANKWORX
ROTORUA
MARCH
19-24

WHIP OFF

DOWNHILL

ENDURO (EWS)

DUAL SPEED/STYLE

ASCENT
medical support

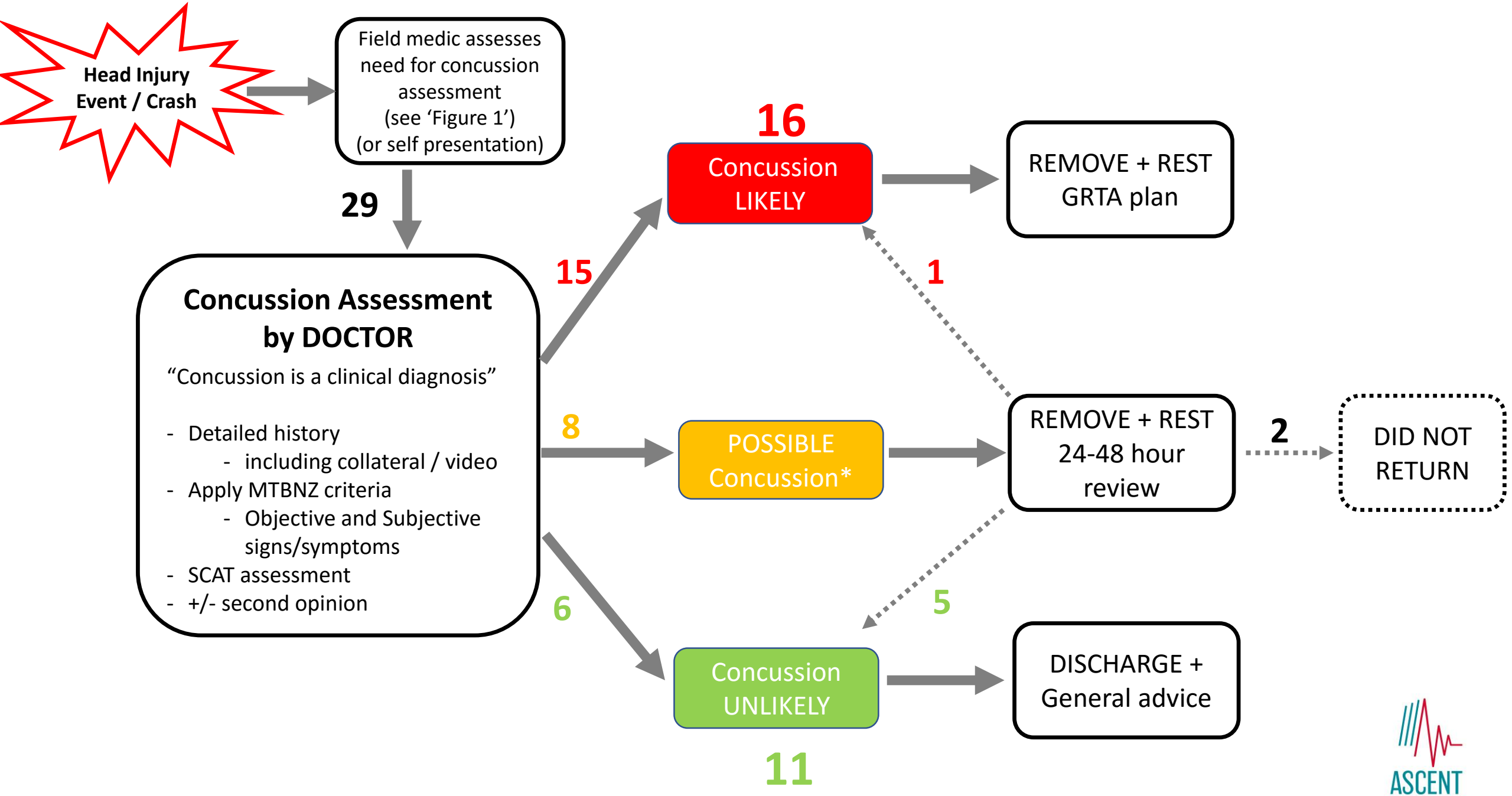
INJURY/ILLNESS	2019	2018
Suspected fracture (excluding spine)	30	23
Abrasion requiring dressing	29	32
Sprain	14	17
Contusion/bruising	12	25
Concussion	**10**	**16**
Minor head injury – no concussion	9	11
Suspected spinal fracture	6	2
Laceration requiring closure (sutures or steri-strips)	5	8
Suspected significant chest or abdominal injury	2	4
Allergic reaction	2	0
Dislocation	1	2
Serious traumatic brain injury	1	1
Eye injury	1	0
Headache (non-traumatic)	1	0
Palpitations	1	0
TOTAL injuries/illnesses seen	**124**	**141**

ASCENT
medical support

CONCUSSION ASSESSMENTS

- 29 of 940 athletes were assessed for concussion at an on-site medical tent by a doctor
    - 16/29 (56%) diagnosed with likely concussion (1.7% of competitors).

ASCENT medical support


Head Injury Event / Crash
Field medic assesses need for concussion assessment (see 'Figure 1') (or self presentation)
29
Concussion Assessment by DOCTOR
"Concussion is a clinical diagnosis"
- Detailed history
- including collateral / video
- Apply MTBNZ criteria
- Objective and Subjective signs/symptoms
- SCAT assessment
- +/- second opinion
15
16
Concussion LIKELY
REMOVE + REST GRTA plan
1
8
POSSIBLE Concussion*
REMOVE + REST 24-48 hour review
2
DID NOT RETURN
6
5
Concussion UNLIKELY
DISCHARGE + General advice
11

CASE 1: EXHAUSTION + ENVIRONMENTAL FACTORS

- 28yo female, Enduro race – 7 hours riding with 7 timed stages

<u>SCAT 5:</u> Exhausted!

- Symptom score 15 →
- Cognition (SAC) 23/30 →
- Balance (BESS) 5 errors →

<u>48 hour review</u>: 'Asymptomatic'

All normal

- Outcome: **Concussion UNLIKELY** - Cleared to race other events

ASCENT medical support

SYMPTOM EVALUATION

3 How do you feel?

"You should score yourself on the following symptoms, based on how you feel now".

	none	mild		moderate		severe	
Headache	0	1	2	3	4	5	6
"Pressure in head"	0	1	2	3	4	5	6
Neck Pain	0	1	2	3	4	5	6
Nausea or vomiting	0	1	2	3	4	5	6
Dizziness	0	1	2	3	4	5	6
Blurred vision	0	1	2	3	4	5	6
Balance problems	0	1	2	3	4	5	6
Sensitivity to light	0	1	2	3	4	5	6
Sensitivity to noise	0	1	2	3	4	5	6
Feeling slowed down	0	1	2	3	4	5	6
Feeling like "in a fog"	0	1	2	3	4	5	6
"Don't feel right"	0	1	2	3	4	5	6
Difficulty concentrating	0	1	2	3	4	5	6
Difficulty remembering	0	1	2	3	4	5	6
Fatigue or low energy	0	1	2	3	4	5	6
Confusion	0	1	2	3	4	5	6
Drowsiness	0	1	2	3	4	5	6
Trouble falling asleep	0	1	2	3	4	5	6
More emotional	0	1	2	3	4	5	6
Irritability	0	1	2	3	4	5	6
Sadness	0	1	2	3	4	5	6
Nervous or Anxious	0	1	2	3	4	5	6

Total number of symptoms (Maximum possible 22)

Symptom severity score (Maximum possible 132)

OTHER FACTORS CAN AFFECT SYMPTOMS

ASCENT medical support

CASE 1: EXHAUSTION + ENVIRONMENTAL FACTORS

- 28yo female, Enduro race – 7 hours riding with 7 timed stages

<u>SCAT 5:</u> Exhausted!

- Symptom score 15 →
- Cognition (SAC) 23/30 →
- Balance (BESS) 5 errors →

<u>48 hour review</u>: 'Asymptomatic'

All normal

- Outcome: **Concussion UNLIKELY** - Cleared to race other events

ASCENT medical support

CASE 2: ADDITIONAL SIGNIFICANT INJURIES

- 16 yo male, Downhill practice
  - Significant crash with sore shoulder ++ and multiple abrasions
    (Later diagnosed as having clavicle fracture)

- <u>SCAT 5:</u> Pain++
  - Symptom score 11 →
  - Cognition (SAC) 27/30 →
  - Balance (BESS) N/A due to injury →

<u>48 hour review</u>: Asymptomatic

All normal

- Outcome: **Concussion UNLIKELY** – unable to continue due to clavicle fracture

ASCENT medical support

TAKE HOME MESSAGES…

- Concussion assessments can be enhanced with a standardised approach, it makes the process consistent/reproducible/reliable

- Taking the patient ‘on a journey’ through assessment can help understanding and acceptance of a diagnosis

- A 24 – 48 hour review helped in difficult diagnoses (?GP review)

- SCAT is a tool validated in athlete populations and can be applied without a baseline result

- Could New Zealand ED’s benefit from an ED-CAT?

ASCENT
medical support

Further reading:

Consensus statement on concussion in sport
https://bjsm.bmj.com/content/bjsports/early/2017/04/26/bjsports-2017-097699.full.pdf

SCAT5 form (downloadable)
https://bjsm.bmj.com/content/bjsports/early/2017/04/26/bjsports-2017-097506SCAT5.full.pdf

Concussion syndromes
http://concussioncorps.org/wp-content/uploads/2013/11/Ellis-Brain-Injury-2015.pdf

Concussion phenotypes
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5615260/pdf/brainsci-07-00119.pdf


Questions?
Comments?
tom@ascentmedical.co.nz
ben@ascentmedical.co.nz
ASCENT
medical support