Prevention of Injury and Protection of the Health of the Athlete

The sequence of prevention

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Universitair Medische Centra

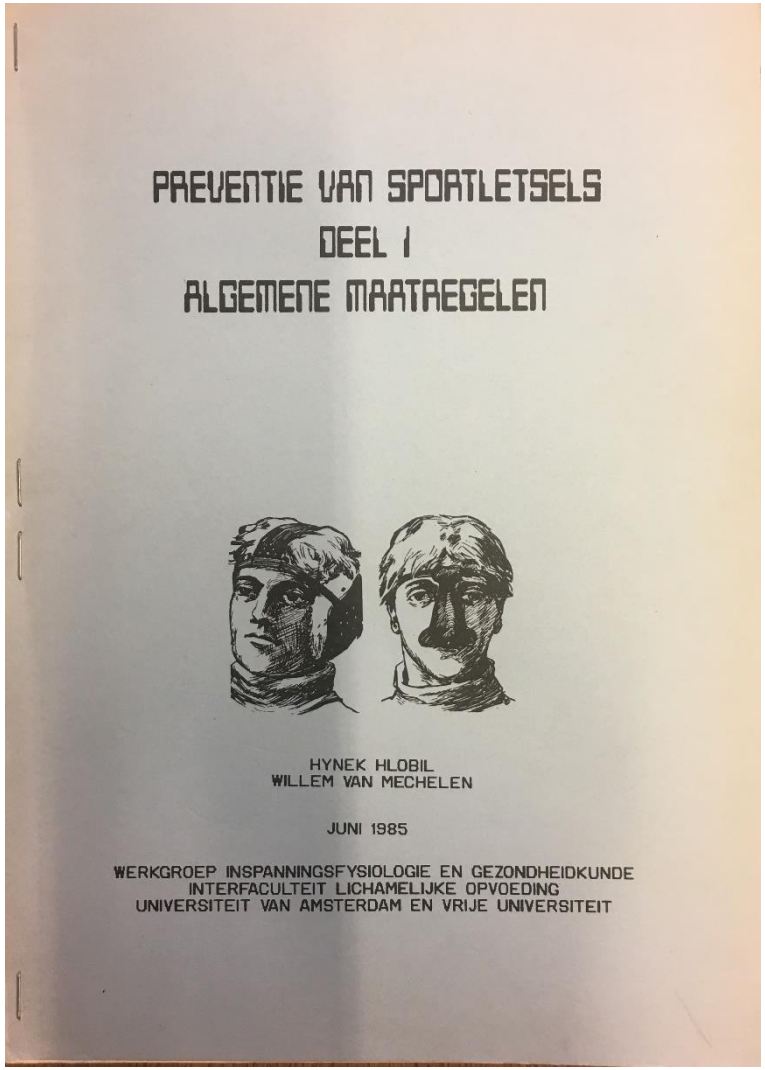
Disclosure

- Research money (direct-indirect): UWV, TNO, NIVEL, ZonMw, Dutch Government, Dutch Heart Foundation, Delta Lloyd, UVIT, Monuta, KLM, RIVM, ArboNed, Heineken, Dutch Dairy Industry, KNMG, WCRF, KWF, AMD VU/VUmc, Astra Zeneca, Ergotron, Stichting Arbouw, IOC, …….
- Miscellaneous: TCCC, Masterfood, Donjoy, WHO, EC, CDC, GR, MRC, Finish Academy Sci., EHFA, Pfizer, Eli Lilly, Nike, …….
- Paid positions: director EVALUA Nederland B.V., shareholder Evalua international Ltd., non-executive board member ArboUnie B.V., UMCG, UWV

Outline

- The sequence of prevention
- A comparison
- The sequence applied
- What's next?

'The sequence' 1984 - 1986



'The sequence' 1984 - 1986

PREVENTIE VAN SPORTLETSELS

DEEL I

AL

HYNEK HLOBIL
WILLEM VAN MECHELEN

JUNI 1985

WERKGROEP INSPANNINGSFYSIOLOGIE EN GEZONDHEIDKUNDE
INTERFACULTEIT LICHAMELIJKE OPVOEDING
UNIVERSITEIT VAN AMSTERDAM EN VRIJE UNIVERSITEIT

3.2 Preventiesequentie.

het ontstaan van een scheenbeenblessure voorkomen (primaire preventie), maar ook de ernst van een eventueel optredend letsel verminderen (secundaire preventie). Als voorbeeld van tertiaire preventie ten slotte, geldt een programma van spierverstekende oefeningen in geval van een, ten gevolge van een sportongeval ontstane, gewrichtsinstabiliteit. Door zo'[illegible] men de kans op het ontstaan van een chronische gewrichtsafw[illegible]king kunnen verminderen.

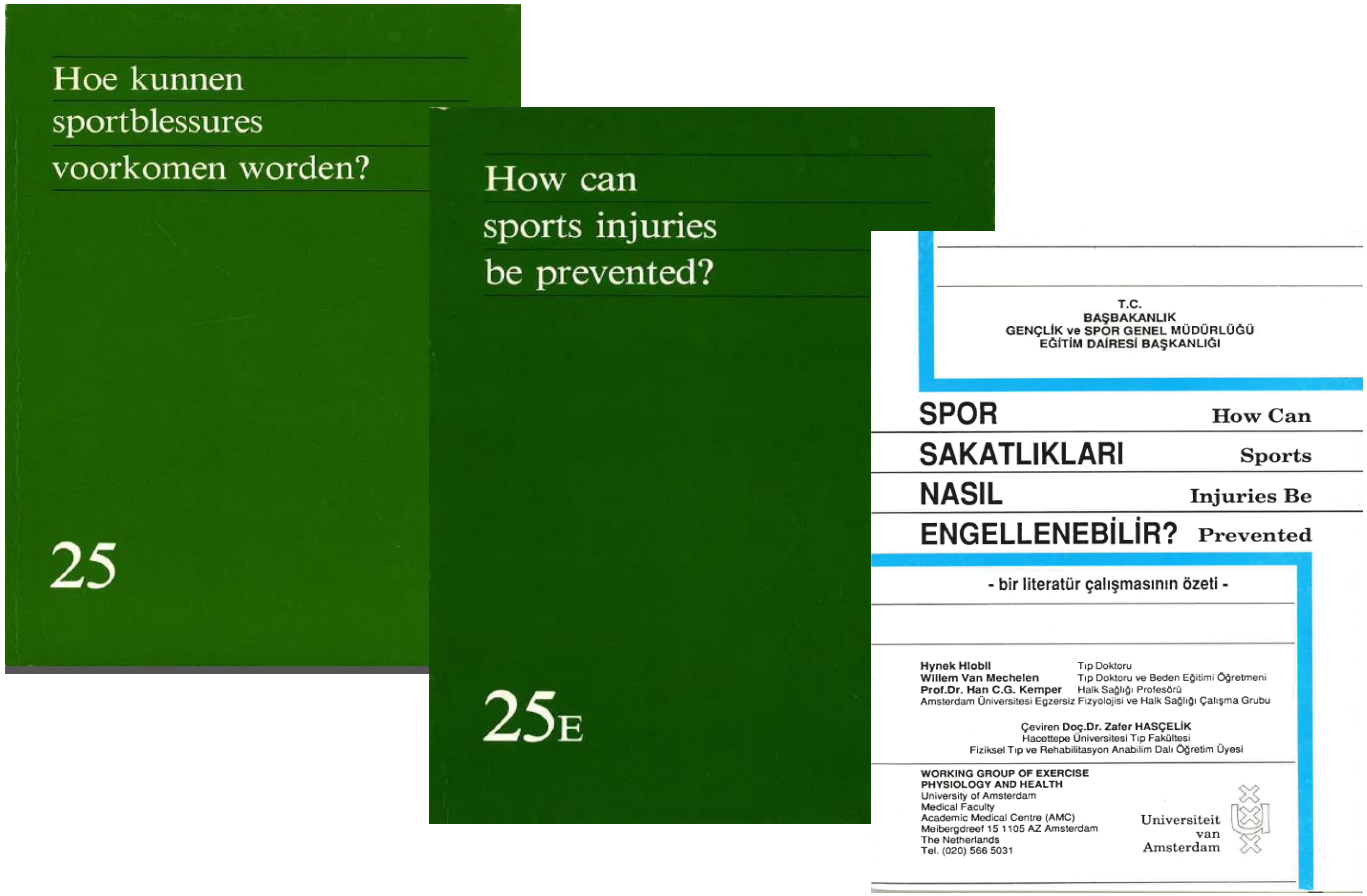
[illegible] van
eau's
van een
blessure
uit van
, welke

worden
bleem, op
de

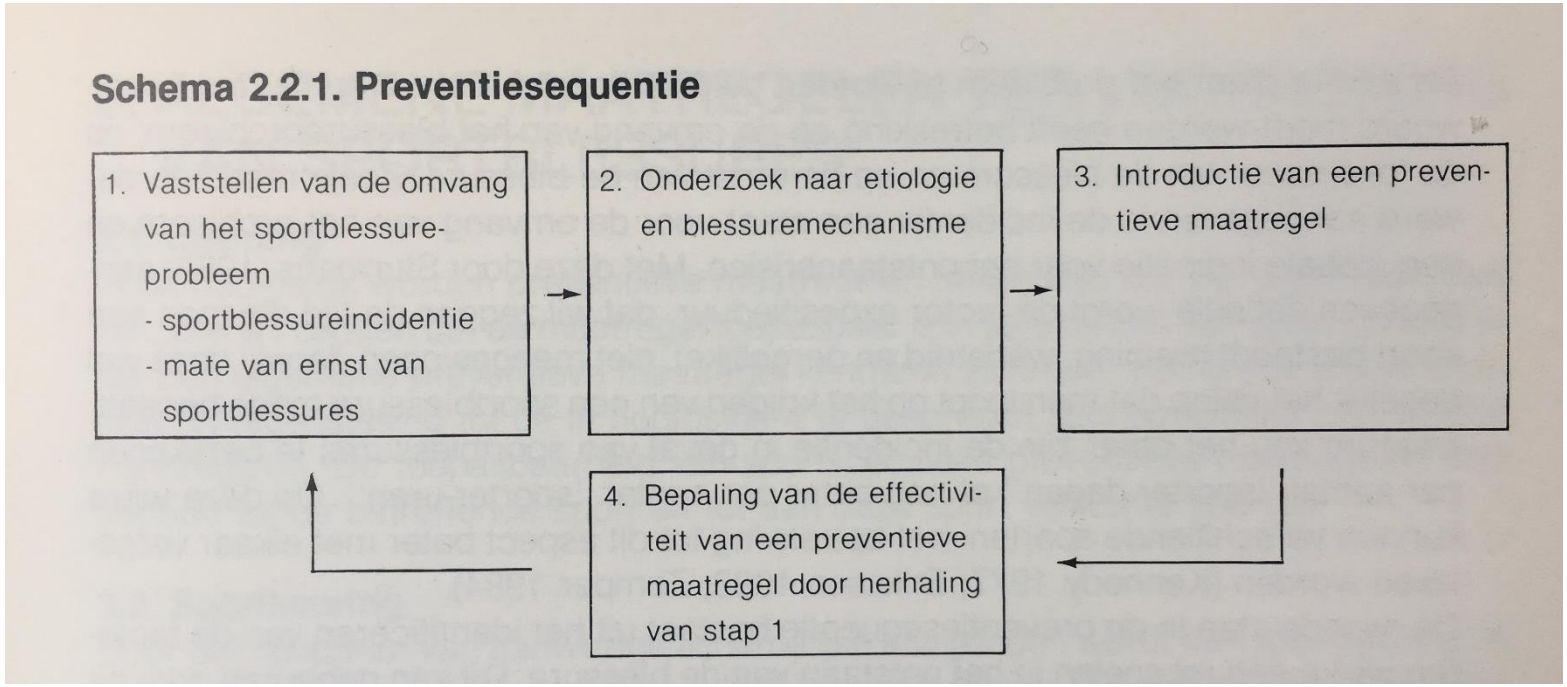
robleem.
ter met

deze door Sturmans (1983) aangegeven definitie wordt de factor expositieduur, dat wil zeggen de tijd die men aan sport besteedt (training, wedstrijd en dergelijke), niet meegewogen, terwijl deze wel degelijk het risico dat men loopt op het krijgen van een sportblessure mede bepaalt. Daarom zou het beter zijn de incidentie in geval van sportblessures te berekenen per aantal 'sporter-dagen' of nog beter per aantal 'sporter-uren'. Op deze wijze heeft men een goede maat in handen ten einde omvang van het sportblessureprobleem te kunnen meten en om verschillende sporten met betrekking tot dit aspekt met elkaar te vergelijken (Kennedy, 1977; Eriksson, 1983; Zemper, 1984). De lokalisatie van de blessures laat zich eenvoudig vaststellen. Maten van ernst van de opgelopen blessure werden reeds eerder omschreven. Indien op deze wijze het probleem is geidentificeerd, dient men af te wegen of de kans die men door sportbeoefening loopt op het oplopen van een sportblessure en de gevolgen hiervan, acceptabel is of niet (Hayes, 1974). De vraag wie deze afweging op grond van welke kriteria moet maken, laten wij hier onbeantwoord. Als men dan vervolgens besluit dat het risiko op het oplopen van een bepaalde sportblessure niet acceptabel is dan zal men maatregelen moeten gaan treffen. Aan de hand van de tot nu toe verkregen informatie, d[illegible] zeggen incidentiecijfers, lokalisatie van de blessur[illegible] en een [illegible]mschrijving van de mate van ernst van de blessure[illegible] is dit ni[illegible]t mogelijk. Immers

'The sequence' - 1987



'The sequence' - 1987



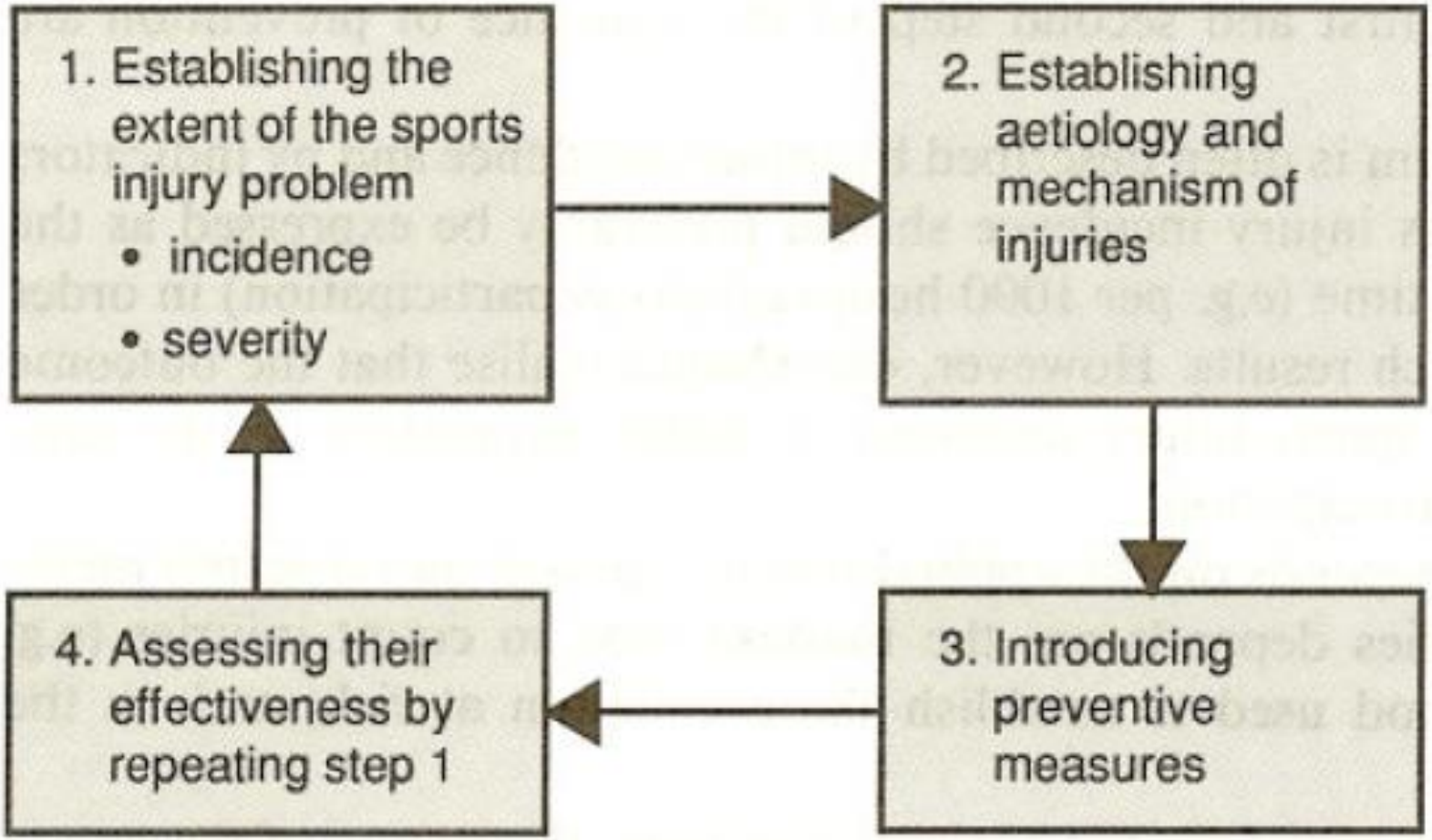


Fig. 1. The 'sequence of prevention' of sports injuries (van Mechelen et al. 1987).

1992 publication

REVIEW ARTICLE

Sports Medicine 14 (2): 82-99, 1992
0112-1642/92/0008-0082/$09.00/0

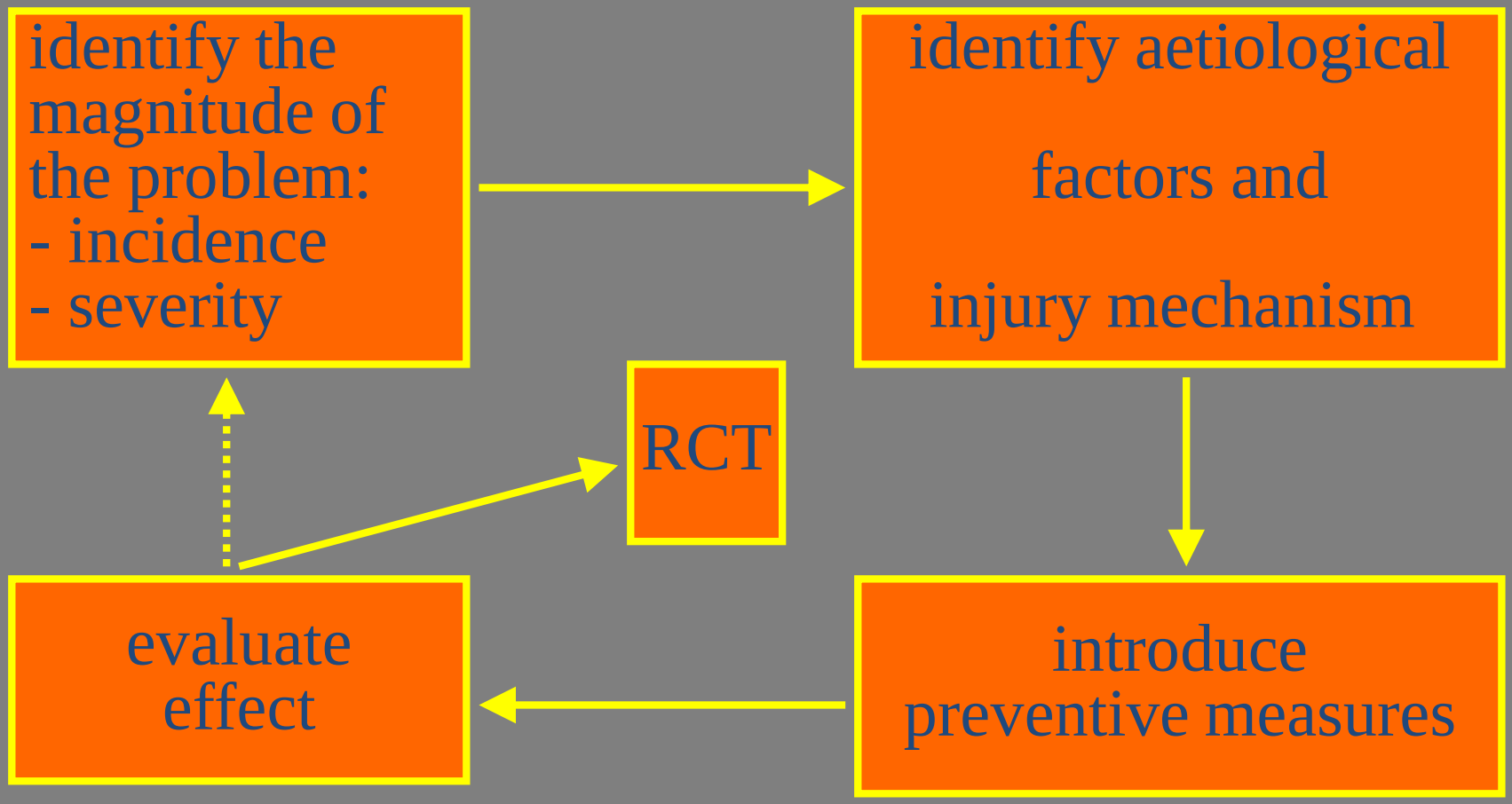
SPO1 158

Incidence, Severity, Aetiology and Prevention of Sports Injuries
A Review of Concepts

Willem van Mechelen, Hynek Hlobil and *Han C.G. Kemper*
Department of Health Science, Faculty of Human Movement Sciences, Vrije Universiteit en University of Amsterdam, Amsterdam, The Netherlands

Contents

Sequence of prevention



Winne Meeuwisse - 1994

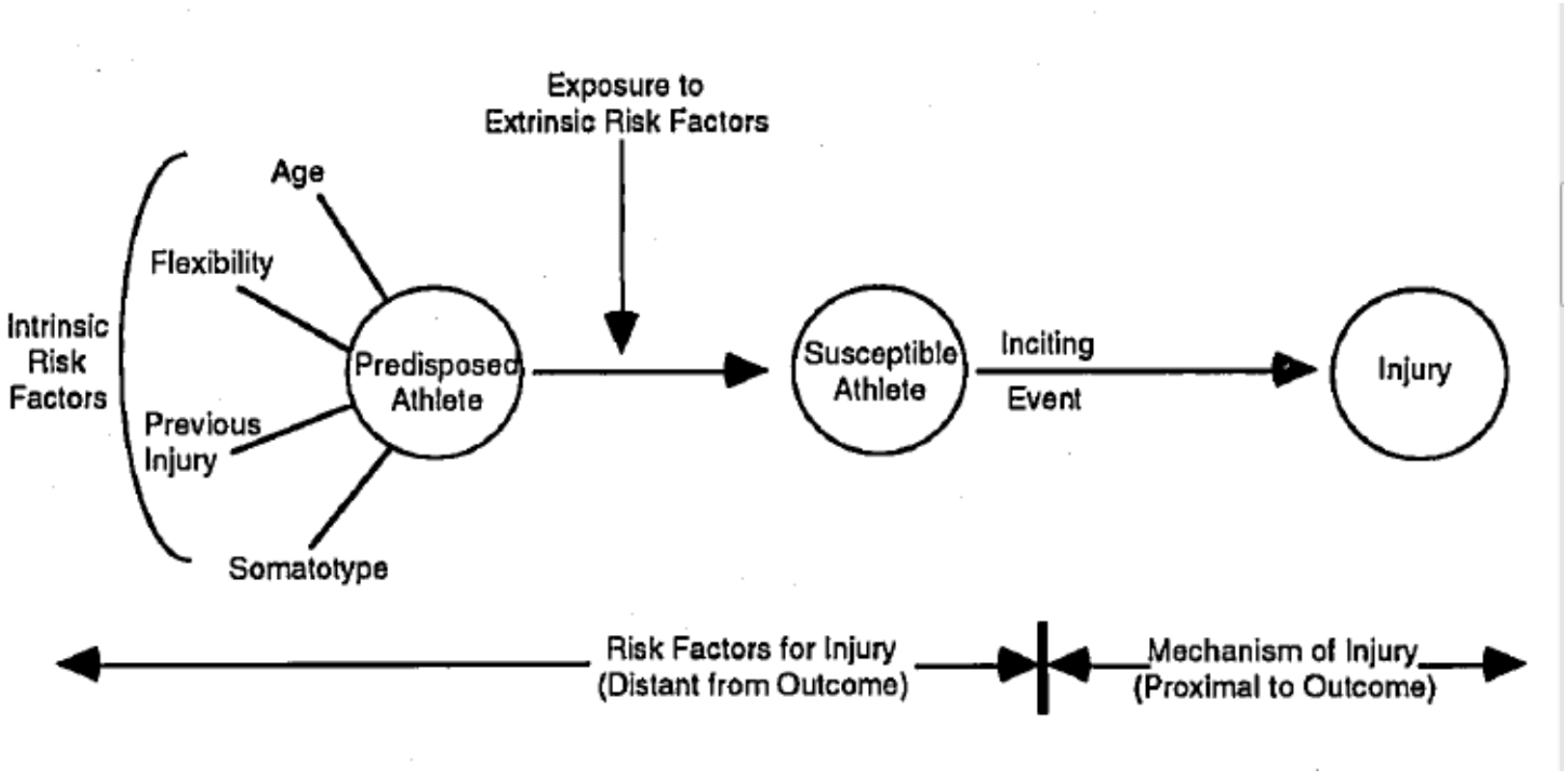
Assessing Causation in Sport Injury: A Multifactorial Model

Willem H. Meeuwisse, M.D.

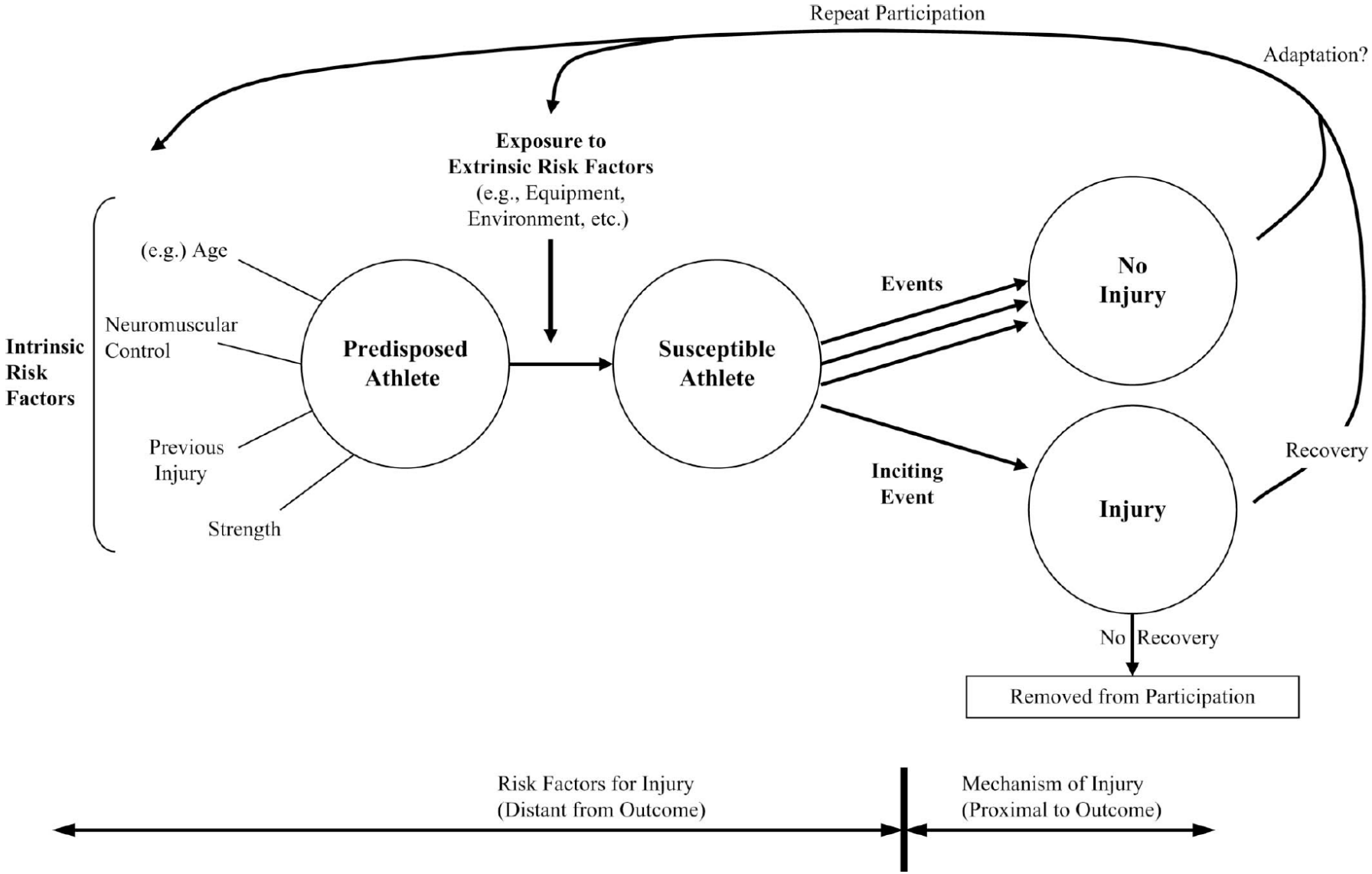
University of Calgary Sport Medicine Centre, Calgary, Alberta, Canada

Clinical Journal of Sport Medicine
4:166–170 © 1994 Raven Press, Ltd., New York

Winne Meeuwisse



Clinical Journal of Sport Medicine
4:166–170 © 1994 Raven Press, Ltd., New York


Repeat Participation
Adaptation?
Exposure to
Extrinsic Risk Factors
(e.g., Equipment,
Environment, etc.)
(e.g.) Age
Neuromuscular
Control
Previous
Injury
Strength
Intrinsic
Risk
Factors
Predisposed
Athlete
Susceptible
Athlete
Events
No
Injury
Inciting
Event
Injury
Recovery
No Recovery
Removed from Participation
Risk Factors for Injury
(Distant from Outcome)
Mechanism of Injury
(Proximal to Outcome)

Sequence of prevention – a comparison

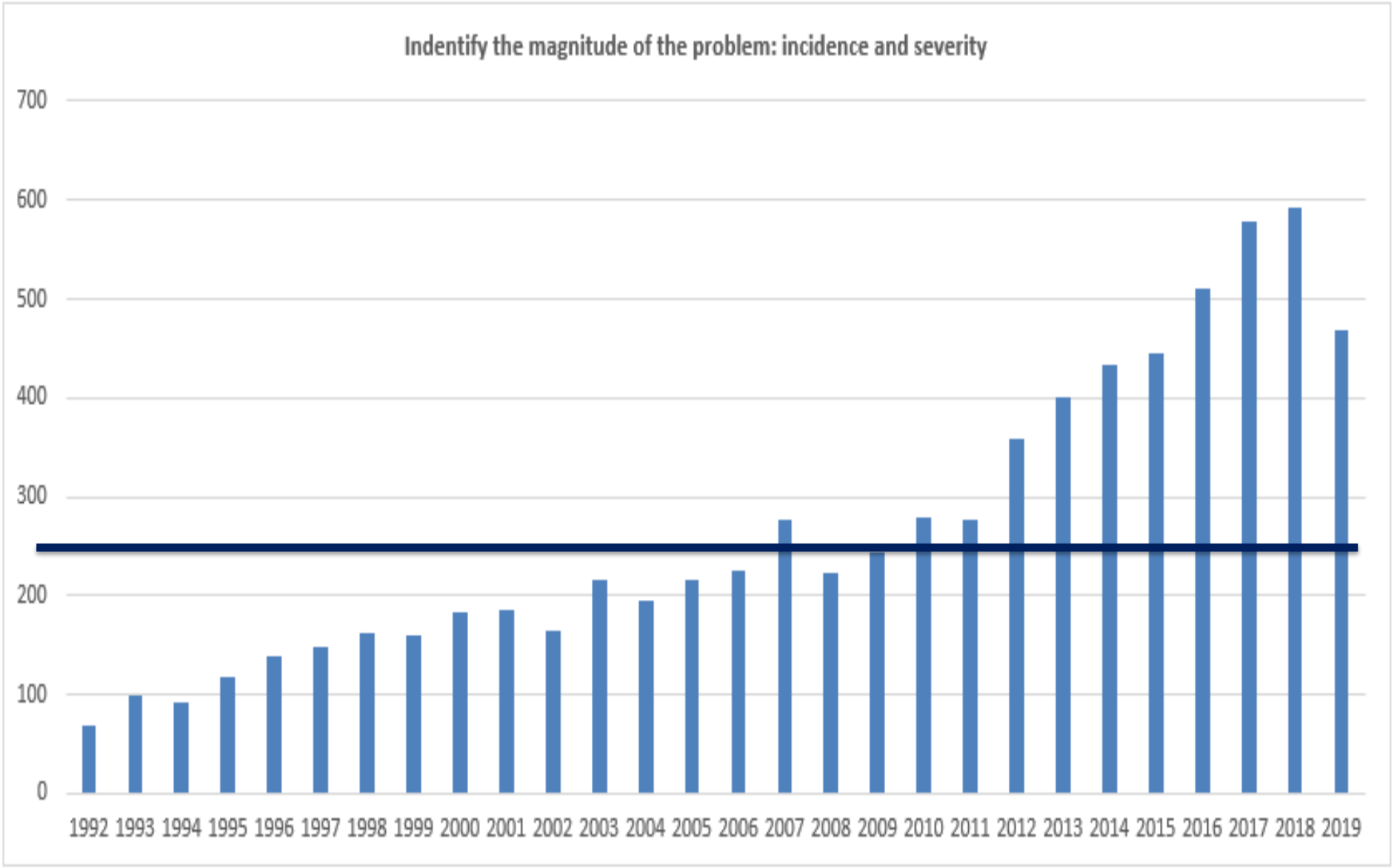
Step 1

Step 2

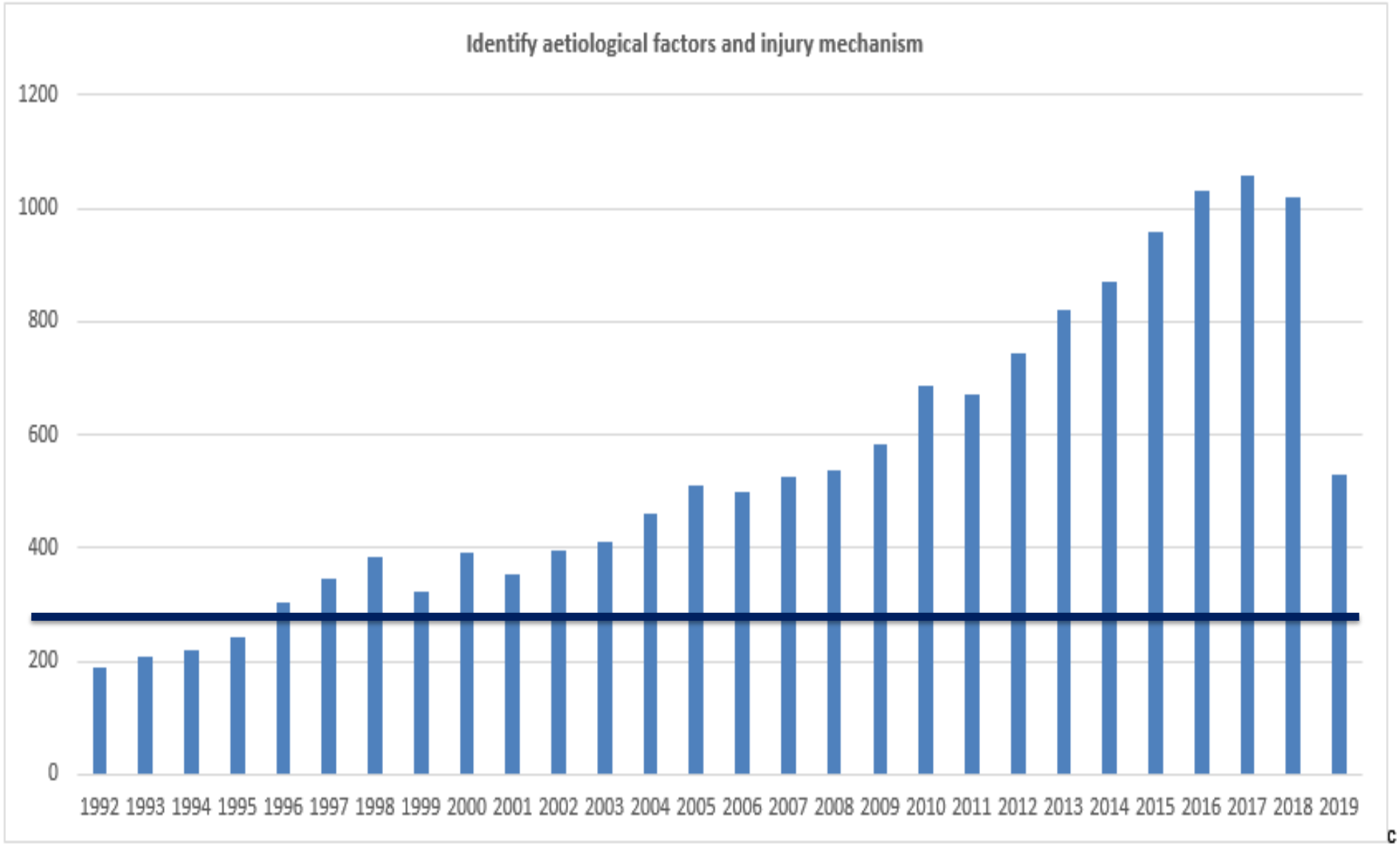
Step 4

Step 3

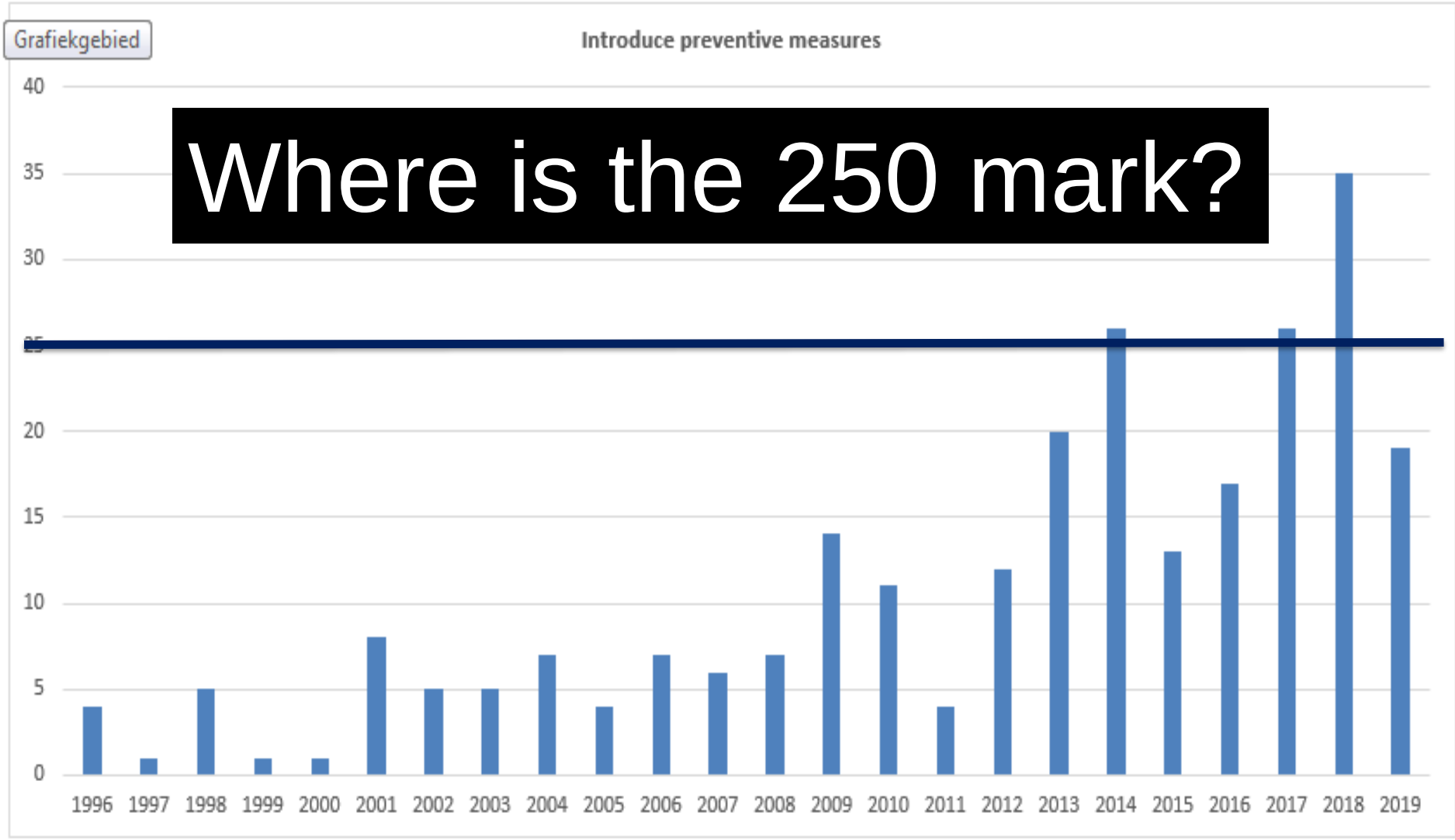
Step 1


Indentify the magnitude of the problem: incidence and severity
700
600
500
400
300
200
100
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019

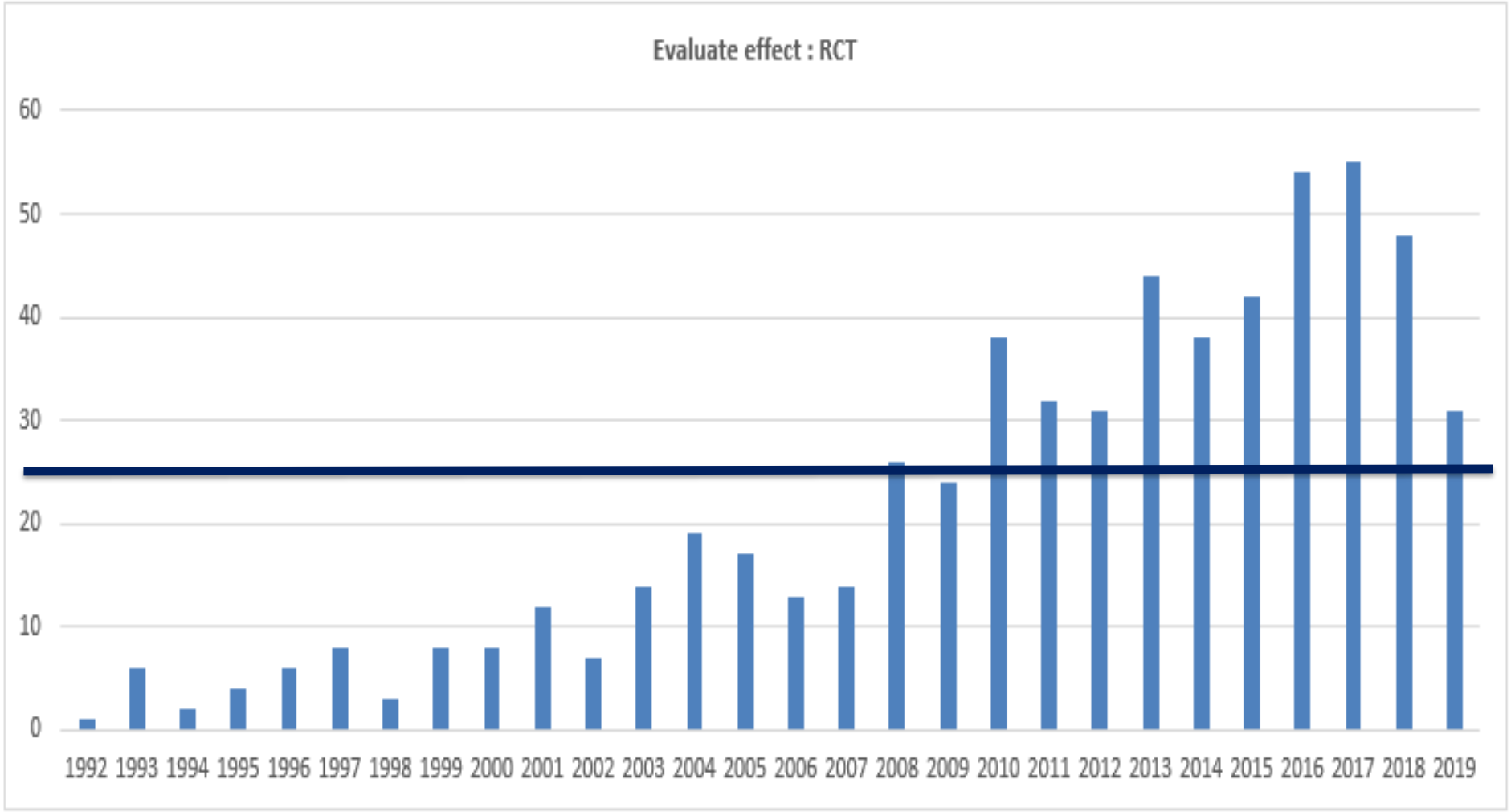
Step 2


Identify aetiological factors and injury mechanism
1200
1000
800
600
400
200
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019

Step 3


Grafiekgebied
Introduce preventive measures
Where is the 250 mark?
40
35
30
25
20
15
10
5
0
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019

Step 4


Evaluate effect : RCT
60
50
40
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019

Translating Research into Injury Prevention Practice

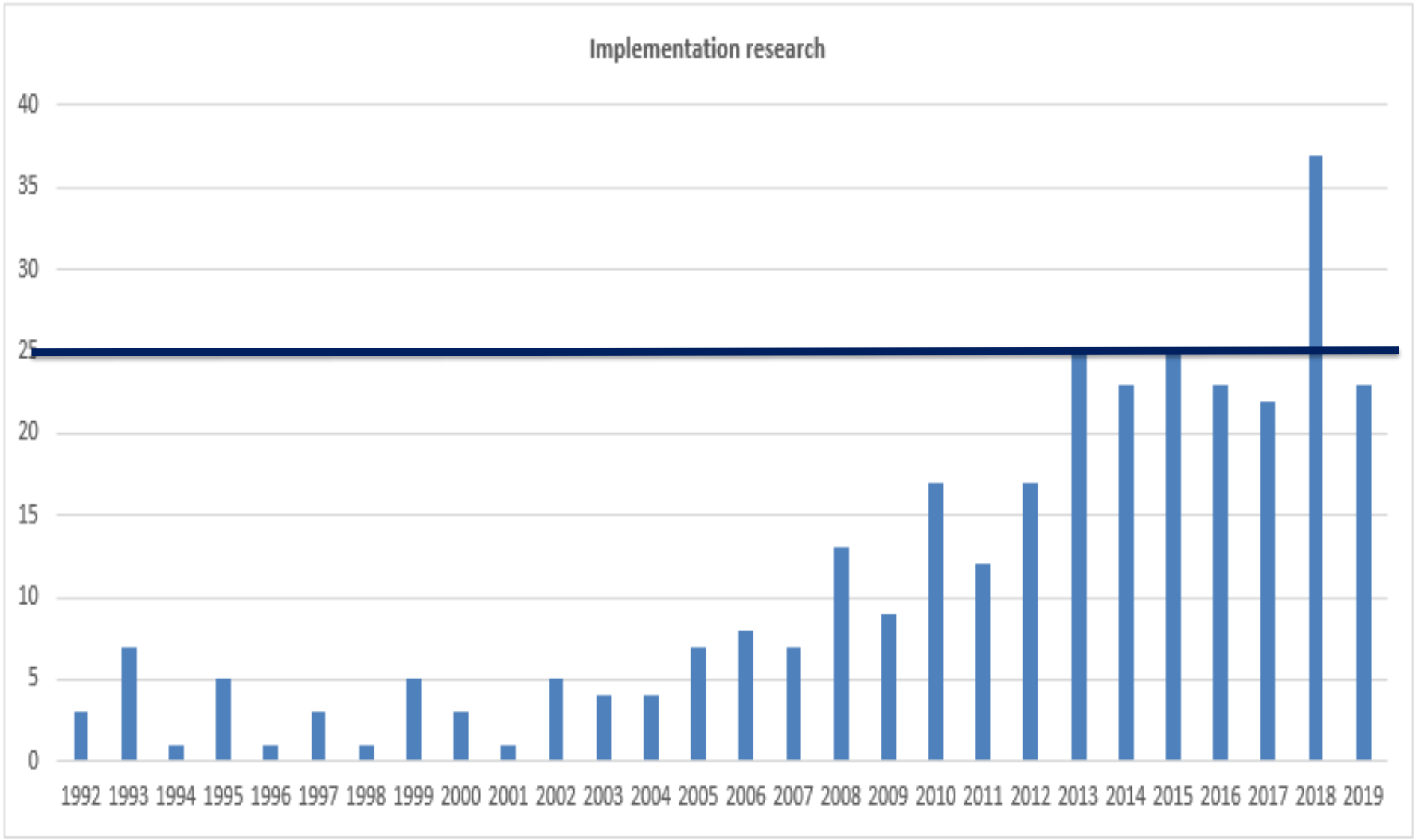
stage		approach [1]
1	Injury surveillance	Establish extent of the problem
2	Establish aetiology and mechanisms of injury	Establish aetiology and mechanisms of injury
3	Develop preventive measures	Introduce preventive measures
4	"Ideal conditions"/scientific evaluation	Assess their effectiveness by repeating stage 1
5	Describe intervention context to inform implementation strategies	
6	Evaluate effectiveness of preventive measures in implementation context	

A new framework for research leading to sports injury prevention

Caroline Finch *

Journal of Science and Medicine in Sport (2006) 9, 3–9

Step 5+6


Implementation research
40
35
30
25
20
15
10
5
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019

Step 1 & 2

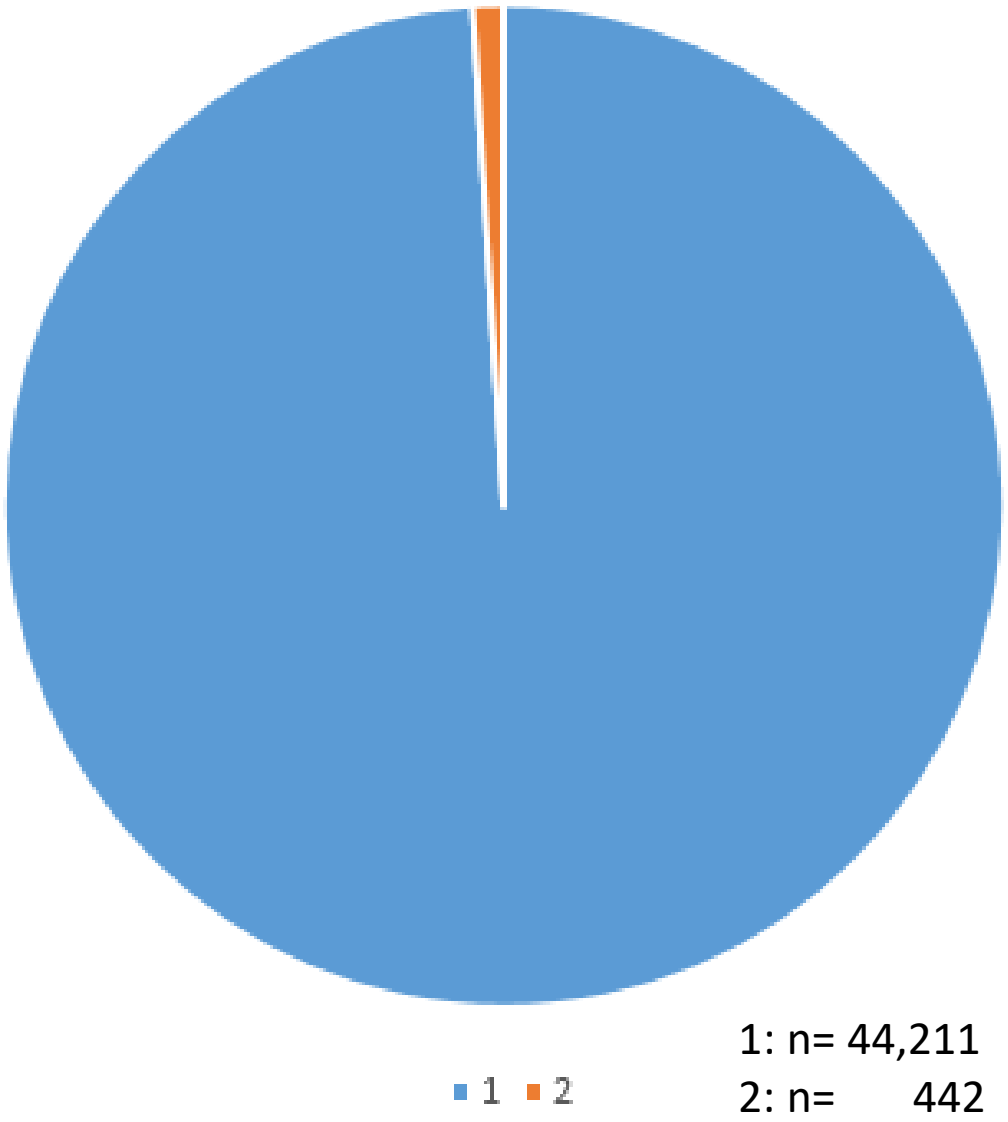
Step 3 & 4

Effective widespread implementation?

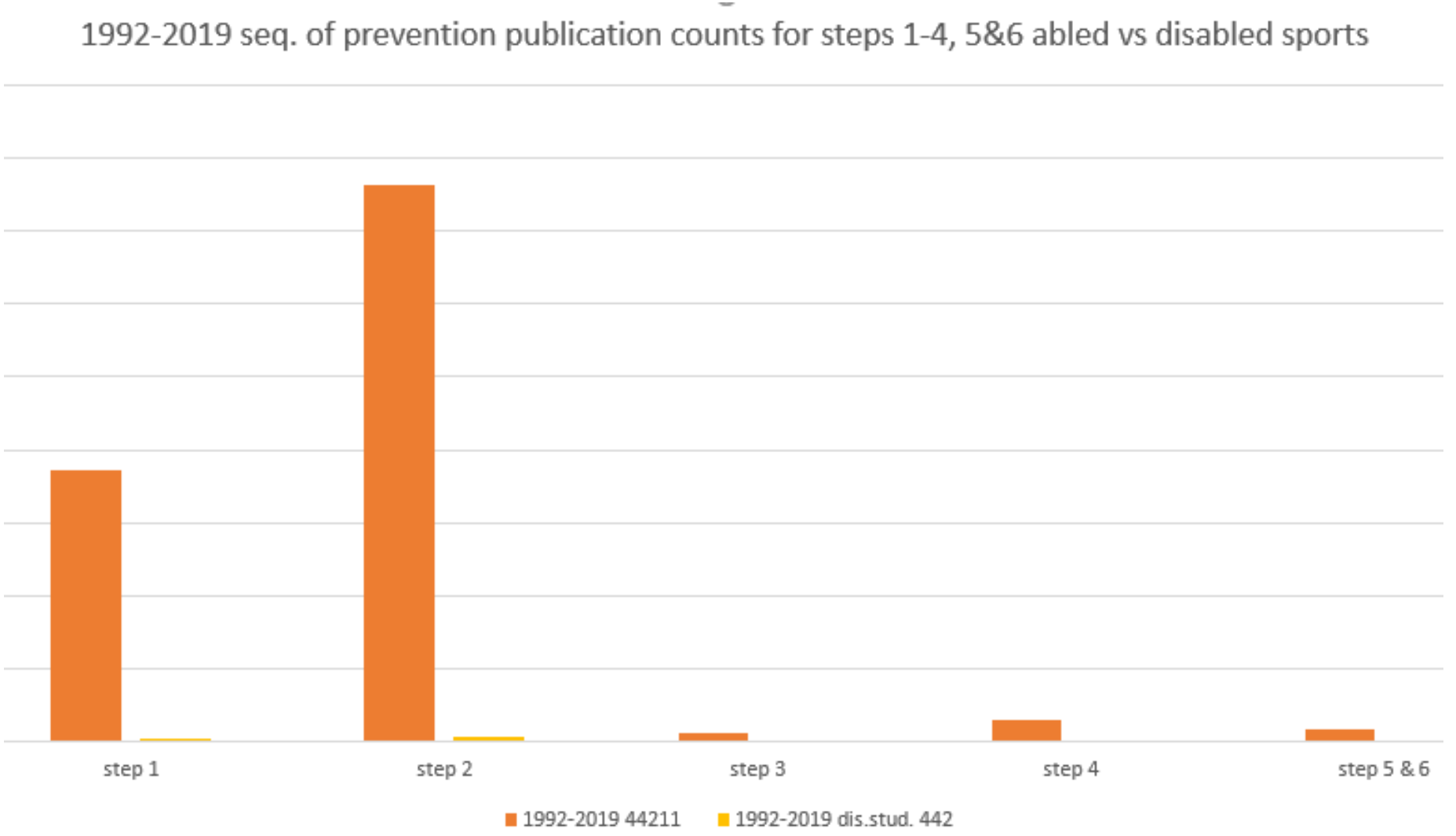
What's it like for disability sports?

HARD TO TELL

athletic injuries abled (=1) vs disabled (=2) sports 1992-2019: 99% vs. 1%



1: n= 44,211
2: n= 442


1992-2019 seq. of prevention publication counts for steps 1-4, 5&6 abled vs disabled sports
step 1
step 2
step 3
step 4
step 5 & 6
1992-2019 44211
1992-2019 dis.stud. 442

Step 1 & 2

Step 3 & 4

Effective widespread implementation?


Step 1 & 2

step 1 re-visited

identify the magnitude of the problem:
- incidence
- severity

Challenges,
next to definitional issues:

- overuse versus acute

- real time data collection

Data collection

To cite: Clarsen B, Myklebust G, Bahr R. *Br J Sports Med* 2013;**47**:495–502.

Development and validation of a new method for the registration of overuse injuries in sports injury epidemiology: the Oslo Sports Trauma Research Centre (OSTRC) Overuse Injury Questionnaire

Benjamin Clarsen, Grethe Myklebust, Roald Bahr

To cite: Clarsen B, Rønsen O, Myklebust G, *et al. Br J Sports Med* 2014;**48**:754–760.

The Oslo Sports Trauma Research Center questionnaire on health problems: a new approach to prospective monitoring of illness and injury in elite athletes

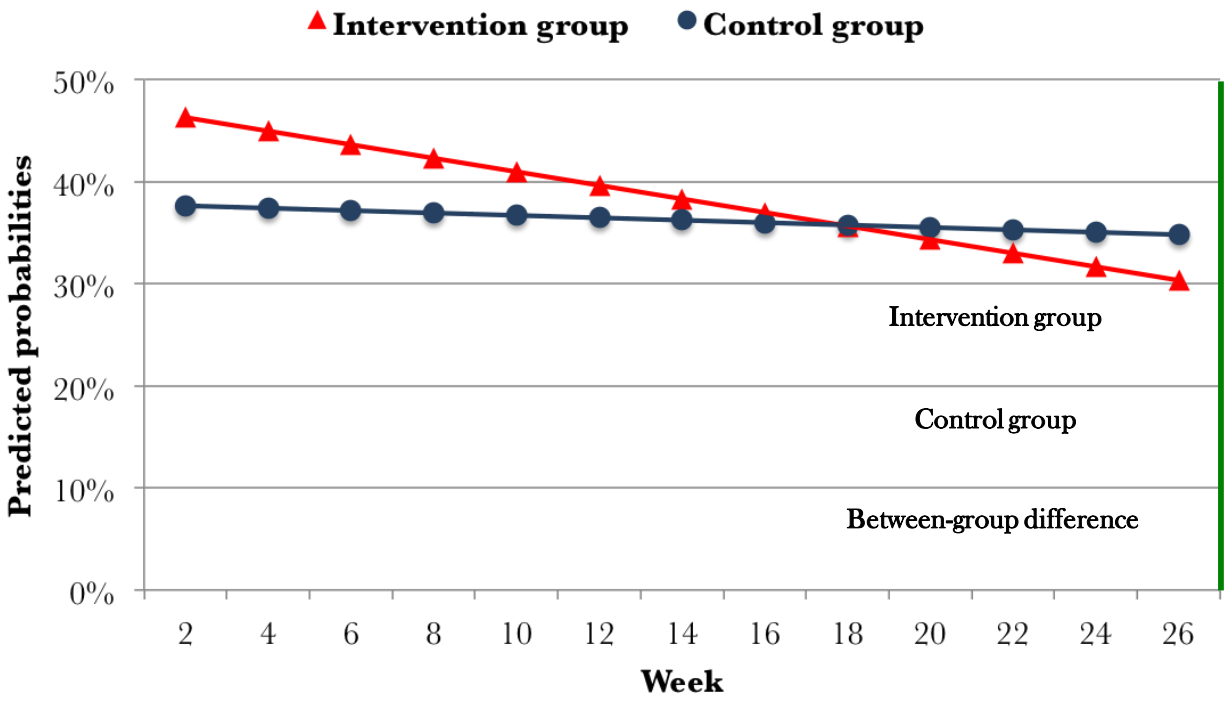
Benjamin Clarsen,[1] Ola Rønsen,[2] Grethe Myklebust,[1] Tonje Wåle Florenes,[1] Roald Bahr[1]

BJSM Online First, published on August 30, 2017 as 10.1136/bjsports-2016-097025

Effectiveness of online tailored advice to prevent running-related injuries and promote preventive behaviour in Dutch trail runners: a pragmatic randomised controlled trial

Luiz Carlos Hespanhol,[1,2] Willem van Mechelen,[1,3,4,5] Evert Verhagen[1,4,6]

Intervention effect on running injuries (linear probability mixed model)



After 6 months

-16%
95% CI -23 to -9*

-3%
95% CI -10 to 4

Abs. diff: -13%
95% CI -23 to -3*

Step 2 re-visited

identify aetiological

factors and

injury mechanism

Line of reasoning

NMT → postural control → injury status

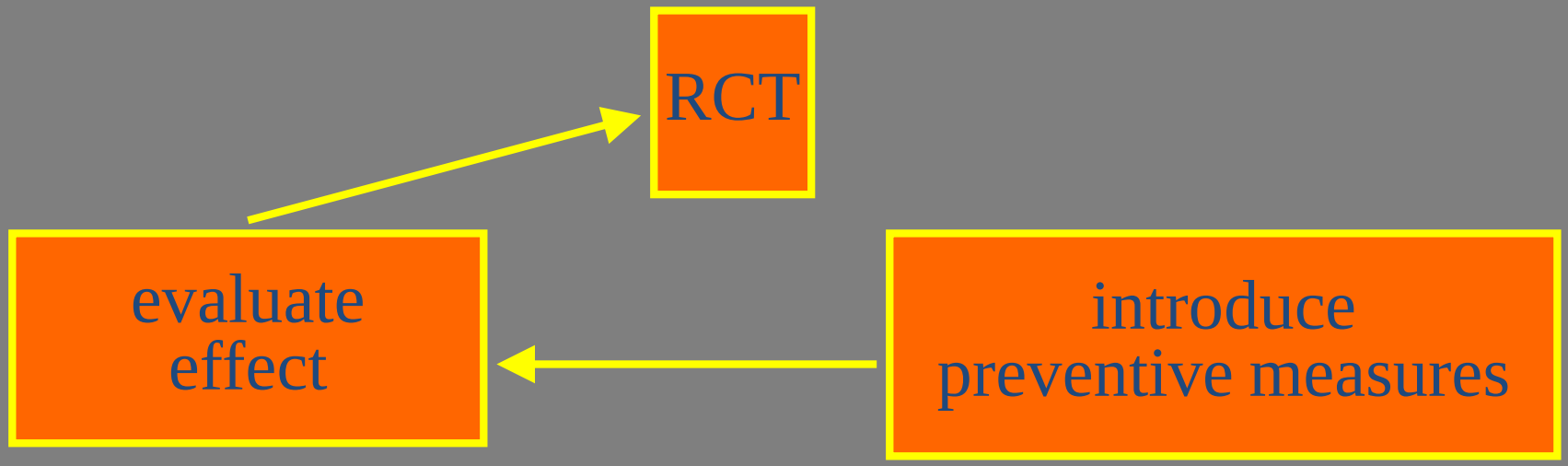
Step 2 re-visited

Challenge:

identify aetiological factors and injury mechanism

- Postural control
  - *How does it work?*
  - Need:
    - to differentiate between morphological, physiological and functional changes
    - to search for measures other than postural sway, etc.
    - link this ‘other measure’ to outcome in epi studies

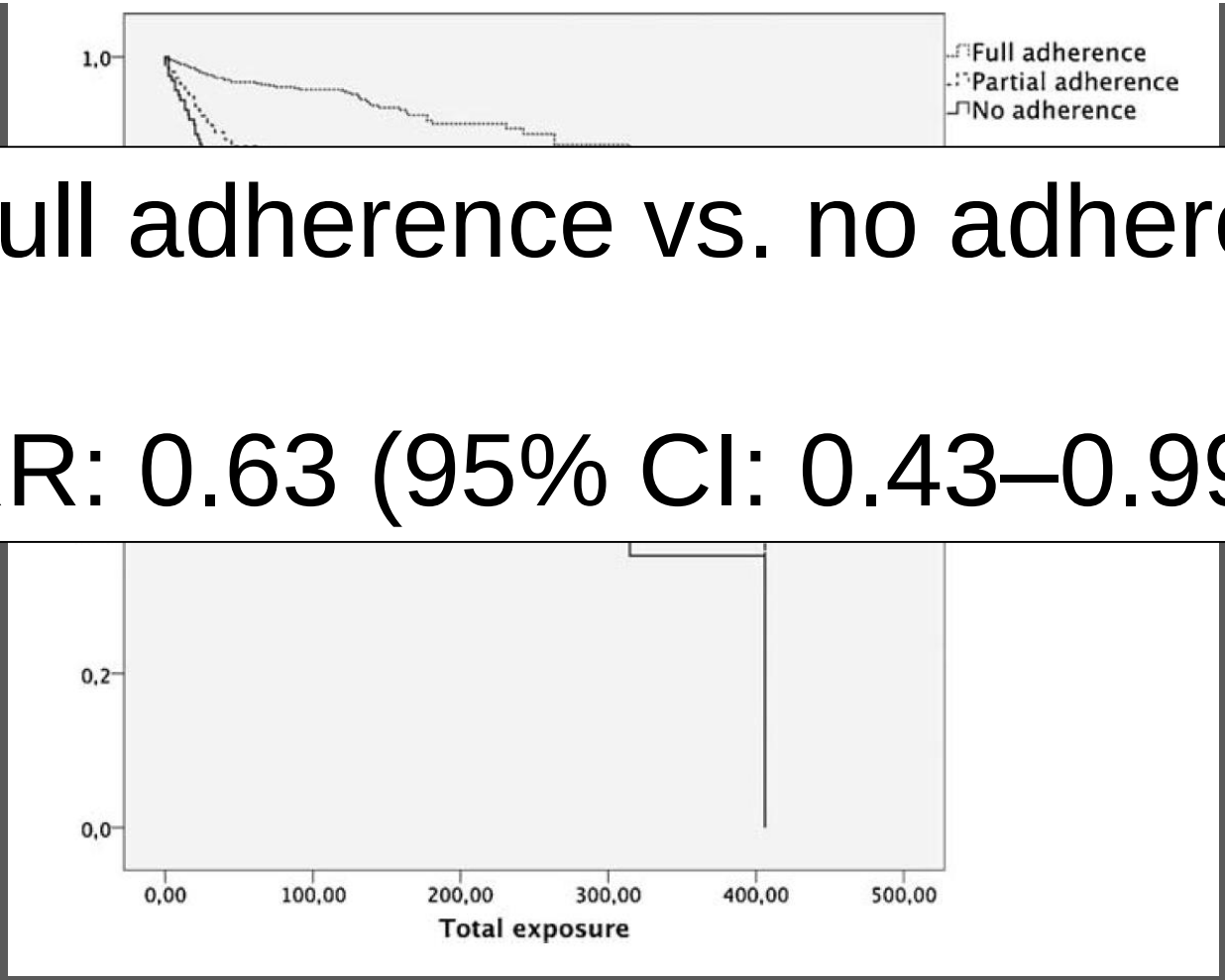
Step 3 and 4 re-visited



The impact of adherence on sports injury prevention effect estimates in randomised controlled trials: Looking beyond the CONSORT statement

Evert A.L.M. Verhagen [a,*], Maarten D.W. Hupperets [a,b], Caroline F. Finch [b], Willem van Mechelen [a]

Journal of Science and Medicine in Sport 14 (2011) 287–292



RR full adherence vs. no adherence

RR: 0.63 (95% CI: 0.43–0.99)

Conclusions

- Highly effective NMT intervention

- However,
  adherence strongly affects outcome

Translating Research into Injury Prevention Practice

stage		approach [1]
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A new framework for research leading to sports injury prevention

Caroline Finch *

Journal of Science and Medicine in Sport (2006) 9, 3–9

The Implementation of Musculoskeletal Injury-Prevention Exercise Programmes in Team Ball Sports: A Systematic Review Employing the RE-AIM Framework

James O'Brien · Caroline F. Finch

Sports Med (2014) 44:1305–1318

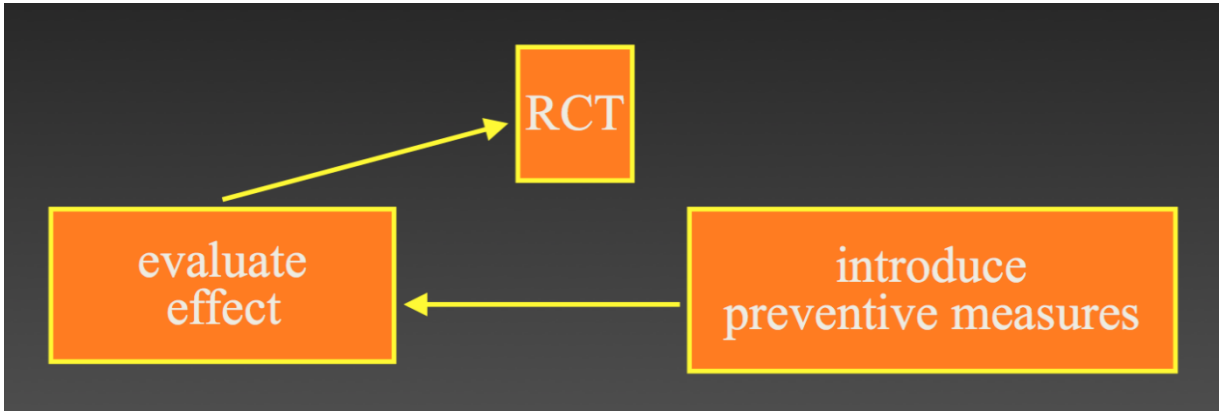
- RE-AIM:
  - Reach, Efficacy, Adoption, Implementation, Maintenance
- assessed the reporting of RE-AIM components

- scarce information specific RE-AIM components
- major reporting gaps program adoption & maintenance

Step 3 & 4 + TRIPP 5 & 6 re-visited

Challenges:

- Design interventions that are actually executed
  - report on implementation process (qualitatively)
  - alternative delivery modes
- We need to deliver proof societal relevance
  - cost-benefit
  - cost-effectiveness
  - PROMs



The sequence applied in disability sports

an example step 1 & 2

5-in-5

Risk of Injuries in Paralympic Track and Field Differs by Impairment and Event Discipline

The American Journal of Sports Medicine, Vol. 44, No. 6
DOI: 10.1177/0363546516629949

A Prospective Cohort Study at the London 2012 Paralympic Games

Cheri A. Blauwet,[*†‡] MD, Daniel Cushman,[§] MD, Carolyn Emery,[‖¶] MSc, PhD, Stuart E. Willick,[§] MD, Nick Webborn,[†#] MBBS, MSc, Wayne Derman,[†**††] MBChB, PhD, Martin Schwellnus,[†††‡§§] MD, PhD, Jaap Stomphorst,[†‖‖‖] MD, and Peter Van de Vliet,[¶¶] PhD
Investigation performed at the London 2012 Paralympic Games

- 10 day event
- 977 athletes competing in athletics
- databases (2) driven injury data collection
- athlete impairment & event discipline: IPC-athlete database
- IRs (injuries per 1000 athlete-days) by: impairment, event discipline, sex & age

Results

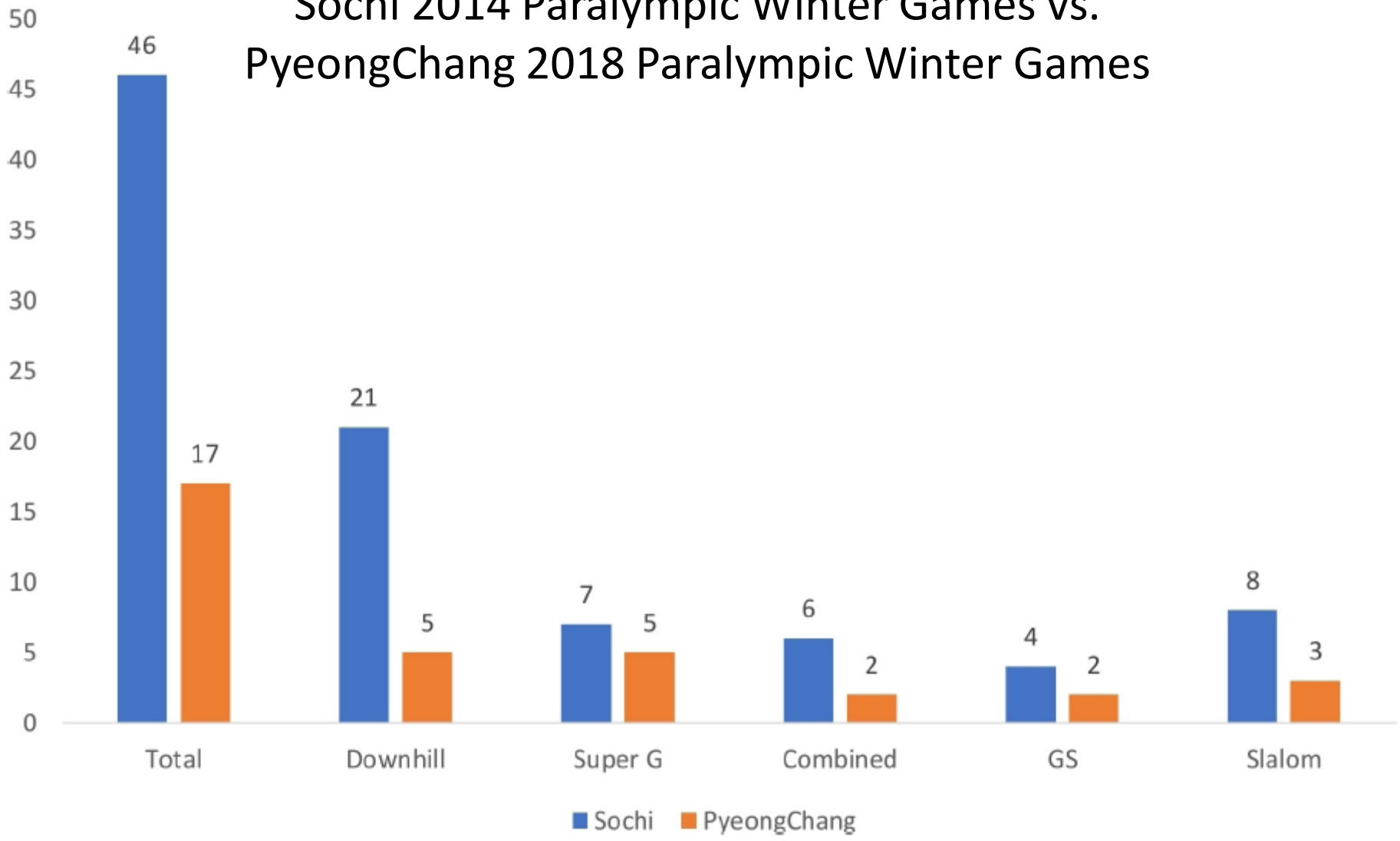
- overall IR: 22.1 injuries per 1000 athlete-days (95% CI, 19.5-24.7)
- track disciplines: ambulant athletes vs. other impairment categories
  - ambulant athletes with cerebral palsy lower incidence of injuries: (IR, 10.2; 95% CI, 4.2-16.2)
- Athletes seated throwing vs. athletes in wheelchair racing: higher incidence of injuries (IR, 23.7; 95% CI, 17.5-30.0 vs. 10.6; 95% CI, 5.5-15.6)
- In both track and field disciplines the majority of injuries did not result in time loss from competition or training
- Ambulant athletes: greatest proportion of injuries to the thigh (16.4% of all injuries; IR, 4.0), predominantly in track athletes
- Wheelchair or seated athletes: greatest proportion of injuries to the shoulder/clavicle (19.3% of all injuries; IR, 3.4), predominantly in field athletes

When van Mechelen's sequence of injury prevention model requires pragmatic and accelerated action: the case of para alpine skiing in Pyeong Chang 2018

Cheri Blauwet,[1,2] Nick Webborn,[3] James Kissick,[4] Jan Lexell,[5] Jaap Stomphorst,[6] Peter van de Vliet,[7] Dimitrije Lazarovski,[8] Wayne Derman[9,10]

Blauwet C, *et al*. *Br J Sports Med* Month 2019 Vol 0 No 0

total acute para alpine ski event injuries Sochi 2014 Paralympic Winter Games vs. PyeongChang 2018 Paralympic Winter Games



Pragmatic approach

- course setting: less aggressive lines & ‘waves’ instead of jumps
- snow preparation phase:
  - development snow contingency plan
  - continuous course grooming
  - implementing new methods of snow preparation
- translation of ‘lessons learnt’ from Olympic Winter Games to Paralympic Winter Games
- crafting pre-competition schedules: more practice days prior to competition start
- pre-Games technical & medical briefings
- earlier start times: advantage of excellent snow conditions

Longer follow-up study (1 year)

Fagher *et al. BMC Sports Science, Medicine and Rehabilitation* (2016) 8:28
DOI 10.1186/s13102-016-0053-x

BMC Sports Science, Medicine and Rehabilitation

STUDY PROTOCOL Open Access

The Sports-Related Injuries and Illnesses in Paralympic Sport Study (SRIIPSS): a study protocol for a prospective longitudinal study

Kristina Fagher[1*], Jenny Jacobsson[2], Toomas Timpka[2], Örjan Dahlström[2,3] and Jan Lexell[1,4,5]

JMIR Publications
JMIR Human Factors ISSN 2292-9495
Making health care interventions and technologies usable, safe, and effective
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JMIR Hum Factors. 2017 Oct-Dec; 4(4): e30.
Published online 2017 Nov 29. doi: 10.2196/humanfactors.8117: 10.2196/humanfactors.8117
PMCID: PMC5729228
PMID: 29187343

An eHealth Application of Self-Reported Sports-Related Injuries and Illnesses in Paralympic Sport: Pilot Feasibility and Usability Study

Monitoring Editor: Gunther Eysenbach

Reviewed by Evert Verhagen and Binaya Sapkota

Kristina Fagher, BSc, MSc,[#1] Jenny Jacobsson, BSc, MSc, PhD,[#2] Örjan Dahlström, MSc, PhD,[#2] Toomas Timpka, MD, PhD,[#2] and Jan Lexell, MD, PhD[#1,3,4]

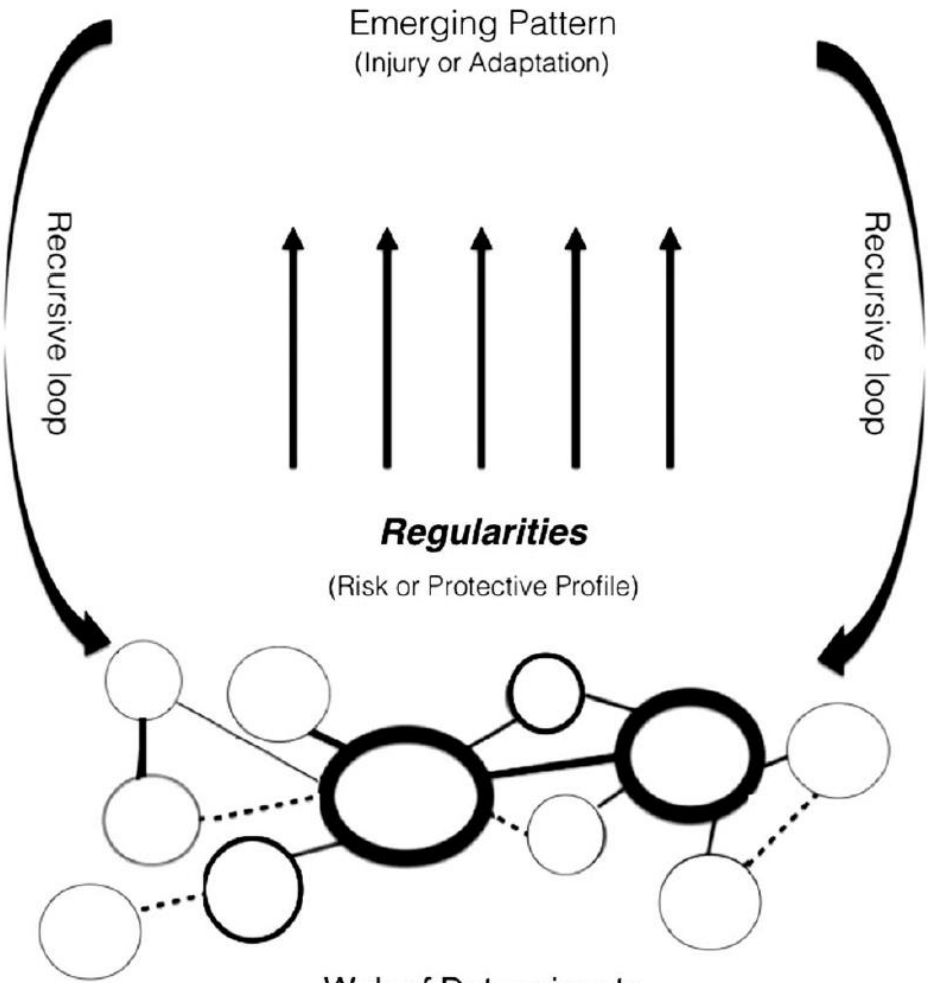
What's next?

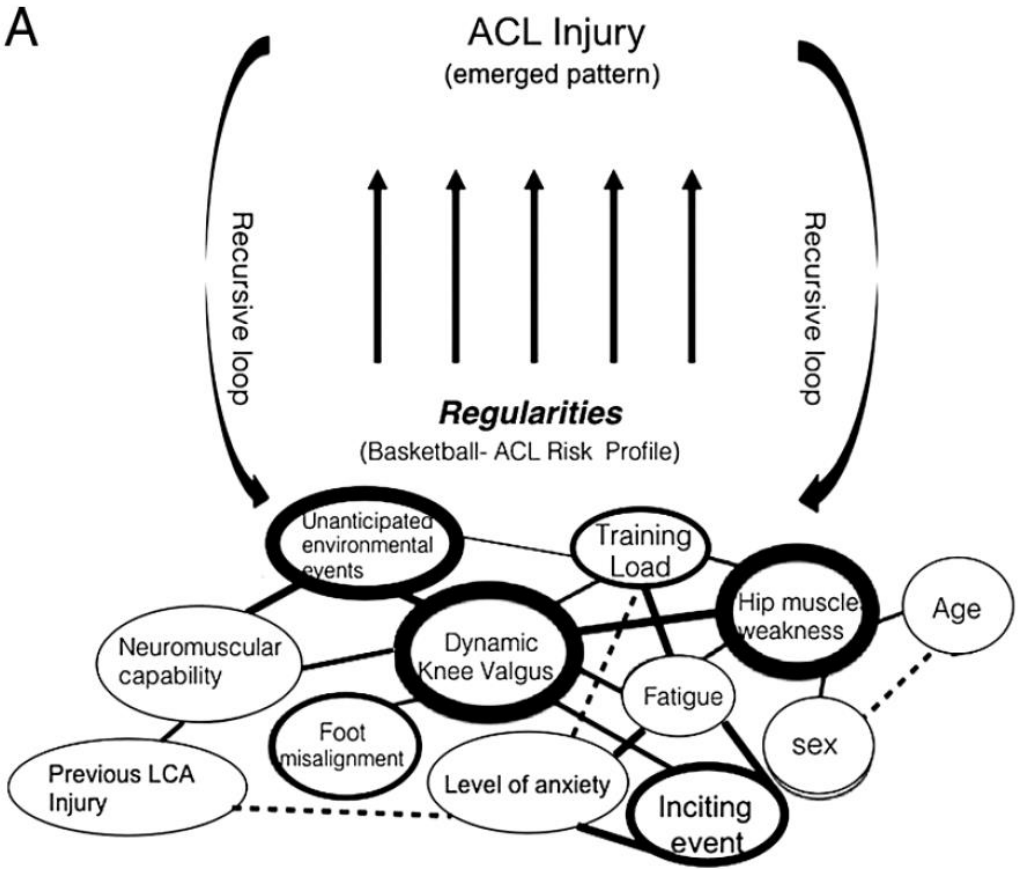
Complex systems approach for sports injuries: moving from risk factor identification to injury pattern recognition—narrative review and new concept

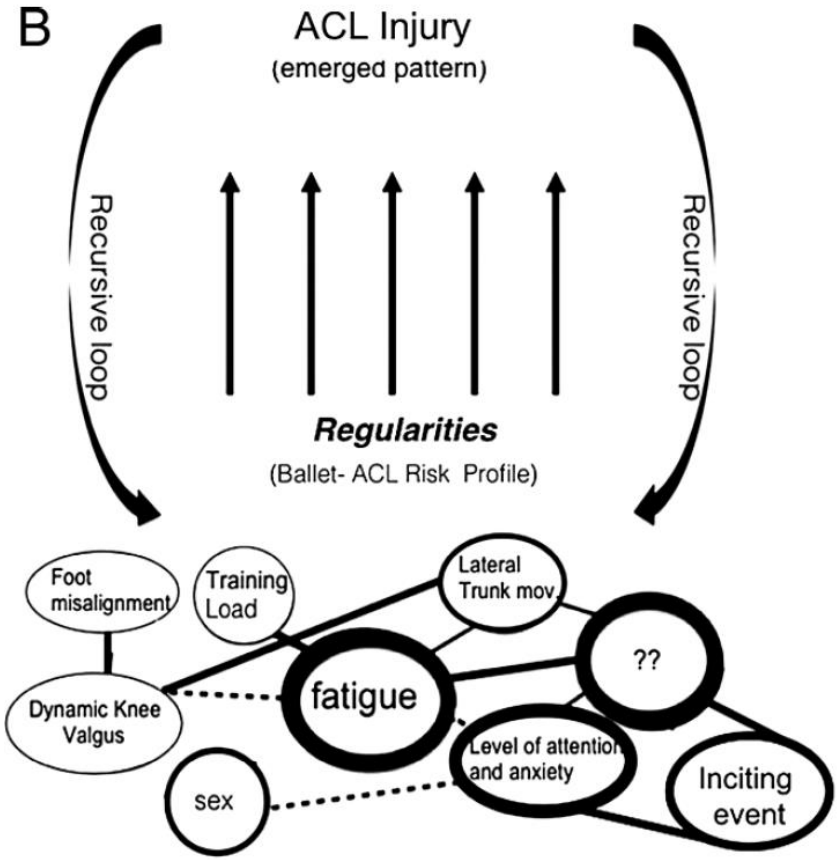
N F N Bittencourt,[1] W H Meeuwisse,[2] L D Mendonça,[3] A Nettel-Aguirre,[4] J M Ocarino,[5] S T Fonseca[5]

To cite: Bittencourt NFN, Meeuwisse WH, Mendonça LD, *et al*. *Br J Sports Med* Published Online First: [*please include* Day Month Year] doi:10.1136/bjsports-2015-095850

Web of determinants




A
ACL Injury
(emerged pattern)
Recursive loop
Recursive loop
Regularities
(Basketball- ACL Risk Profile)
Unanticipated environmental events
Training Load
Hip muscle weakness
Age
Neuromuscular capability
Dynamic Knee Valgus
Fatigue
Foot misalignment
sex
Previous LCA Injury
Level of anxiety
Inciting event

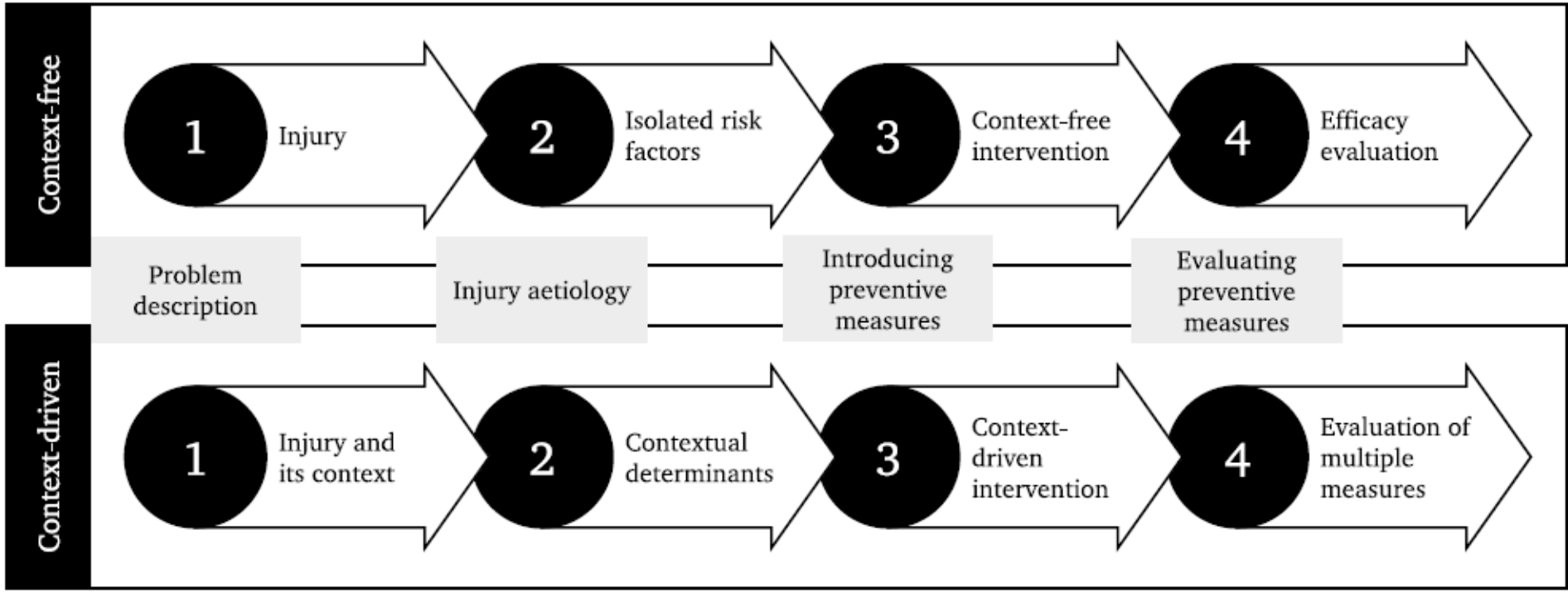

B
ACL Injury
(emerged pattern)
Recursive loop
Recursive loop
Regularities
(Ballet- ACL Risk Profile)
Foot misalignment
Training Load
Lateral Trunk mov.
??
Dynamic Knee Valgus
fatigue
Level of attention and anxiety
sex
Inciting event

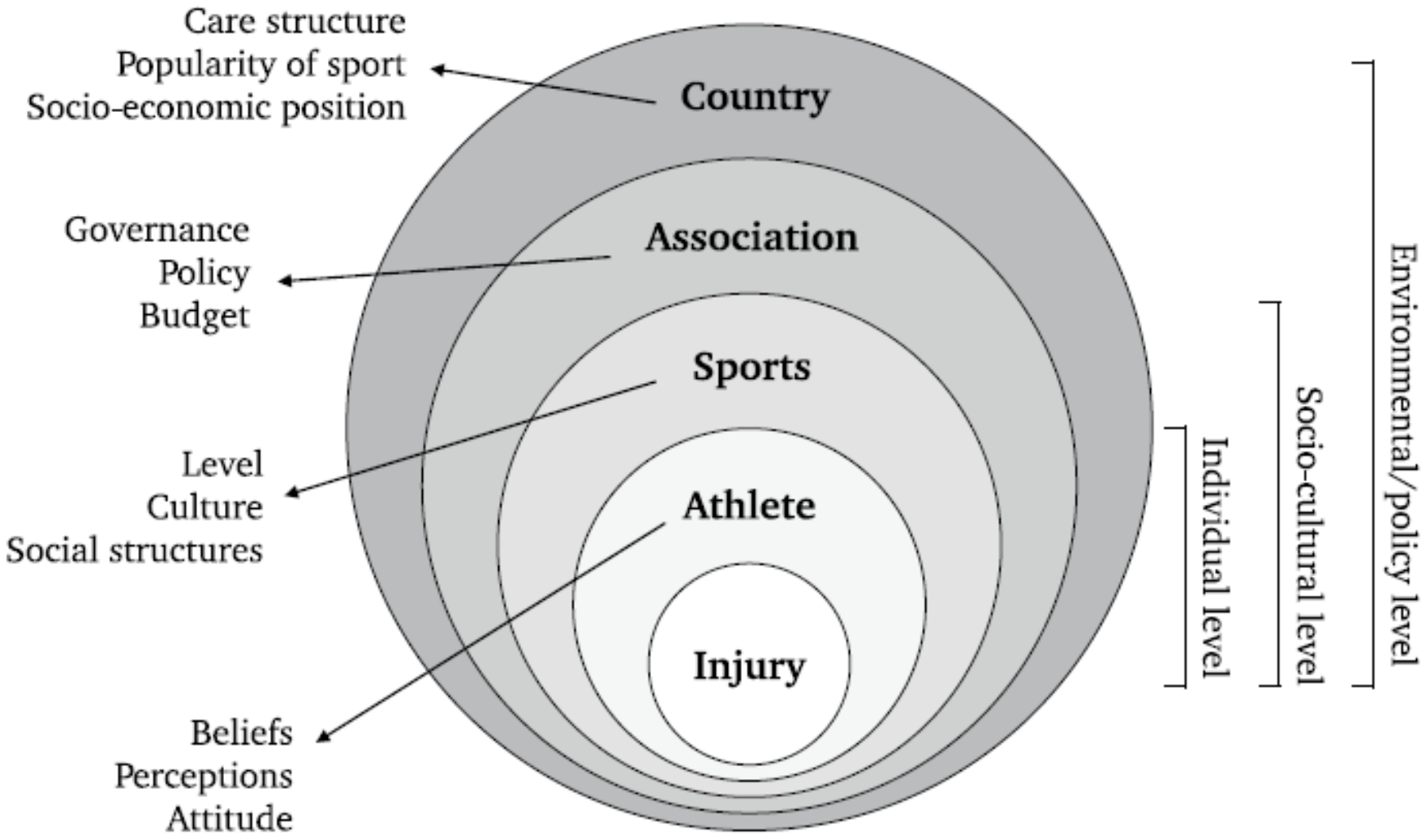
Context Matters!

Context Matters: Revisiting the First Step of the 'Sequence of Prevention' of Sports Injuries

Sports Medicine (2018) 48:2227–2234
https://doi.org/10.1007/s40279-018-0953-x

Caroline Bolling[1] · Willem van Mechelen[1,2,3,4] · H. Roeline Pasman[1] · Evert Verhagen[1,2]




Care structure
Popularity of sport
Socio-economic position
Country
Governance
Policy
Budget
Association
Sports
Level
Culture
Social structures
Athlete
Injury
Beliefs
Perceptions
Attitude
Environmental/policy level
Socio-cultural level
Individual level

To sum up

- ‘the sequence’ provides a useful framework for the prevention of sports injuries
- Paralympic Sports is lagging behind
- Implementation: ‘the difficult one’
- Context matters

https://www.exerciseismedicine.eu/conferences/8th-eieim-conference-in-amsterdam-2019.html