*Accepted article: British Journal of Sports Medicine*


# BRINGING COMPLEXITY TO SPORTS INJURY PREVENTION RESEARCH: FROM SIMPLIFICATION TO EXPLANATION

Sheree Bekker[1]

Alexander M Clark[2]

1. Australian Collaboration for Research into Injury in Sport and its Prevention (ACRISP); School of Health Sciences, Federation University Australia, Ballarat, Australia
2. Faculty of Nursing, University of Alberta, Edmonton, Alberta, Canada

Correspondence to: Sheree Bekker, School of Health Sciences, Federation University Australia, P.O. Box 663, Ballarat, VIC 3353, Australia; s.bekker@federation.edu.au

Sports injury prevention research takes being formulaic to the extreme. Countless papers begin by reminding that sports injuries remain a significant public health burden,[1] and we are reassured that the proven efficacy of numerous interventions shows that sports injuries can be prevented.[2] Despite this optimistic picture, and amidst the proliferation of consensus statements and guidelines, the effectiveness of sports injury prevention interventions remains disappointingly inconsistent. We trace these discrepancies to two approaches that have guided past work—simple and complicated—and then move to propose a potentially useful way forward, that of complexity.

## The simple approach

The 'simple' perspective advocates that injury incidence can be reduced via a recipe-type approach. Simplicity casts sports injuries as straightforward occurrences for which an optimal intervention is sought, where interventions either 'work' or 'do not work'. The Sequence of Prevention model,[3] for example, consists of four steps: (1) establish the extent of the problem, (2) establish the aetiology and extent of the injury, (3) introduce preventative measures and (4) assess intervention effectiveness by repeating stage 1. Under this simplified approach, research is conducted solely into the efficacy of interventions.

Interventions thus remain remarkably poorly described, hampering exploration of reasons for variations in outcomes—researched as a 'whole' rather than as multifaceted entities. Moreover, it is debatable whether the simple approach can even accommodate variations in intervention effects because the focus of this view is on identifying 'what works' rather than seeking to understand such variations. This does little to further the understanding of the large volume of both positive and negative findings in this field.

## The complicated approach

More recent approaches recognise the limitations of this simple view, and the need for more sophisticated 'complicated' approaches to intervention.[4] As in other disciplines, the complicated approach uses formulae, past experience and historical precedence to specify what to include or address in interventions aimed to maximise their likelihood of effectiveness.[5] In contrast to the simple approach, the complicated perspective acknowledges the multifaceted nature of interventions, seeking to understand the influence of context, evidence-based content, dissemination and implementation on effectiveness.[4] This approach is often deemed more 'ecological', more 'integrated' and more 'real-world' than the simple approach.

The attempt to more fully capture what influences intervention outcomes is welcome. Yet research continually shows that many other factors influence intervention effectiveness, including such components as compliance, attitudes and beliefs, and fidelity. Although such components are ubiquitous across sports settings, these factors remain vaguely described and unaccounted for. Consequently, there is no adequate means of explaining the inconsistent outcomes of supposedly promising interventions designed under the complicated approach. As such, variations in effects are dismissed, avoided or cast as an array of implementation

issues. The assumption appears to be that interventions are 'proven' efficacious but unidentified and unanticipated barriers act to ameliorate or mask effectiveness.

This complicated view is widely understood and used as the means to 'bridge the gap' between efficacy and effectiveness. Accordingly, in practice, the complicated approach translates into a lengthy pipeline process which assumes that we can bridge this gap if only 'missing' implementation factors are better understood.[6]

## The complex alternative

In contrast to simple and complicated approaches, a complex approach recognises that formulae, experience and precedence have limited applicability across situations, times and settings.5 Under this approach, interventions cannot be inherently effective because outcomes are influenced by interactions of people, places and programmes.[7] Single factors are unlikely to account for large variations in effect size because interventions have multiple components, which interact in unpredictable ways and may be moderated by context. The question as to whether a specific type of intervention works or not, or what its key 'magic bullet' components are cannot, therefore, be addressed.

This shift reflects the complexity of sport itself. In sport, both results and injuries are influenced by interactions between people, the physical environment and the social environment. Interactions across and/or between individual components (eg, the actions or changes made by a coach), subcomponents (eg, actions of particular players), context (eg, elite v community; competitive v friendly), as well as a range of other intervention-related factors (eg, fidelity), affect outcomes. Given sports injury prevention outcomes are influenced by intrapersonal, interpersonal, organisational, community, and societal factors, it is puzzling that research into sports injuries remains firmly anchored in approaches that view injury events as simple or complicated. Rather, interventions should be researched in terms of their complexity.[8]

Future interventions using a complexity lens should take account of the complex nature of interventions (Figure 1). Research should focus on 'what works for whom, when, where and why'—taking account of not only whether interventions work, but also how they interact, influence and interplay within individuals as well as different populations.[7]

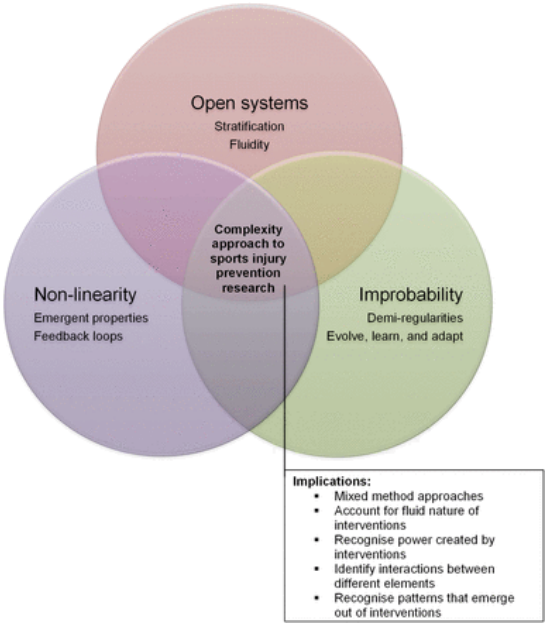


**Figure 1** The implications of a complexity approach to sports injury prevention research.

## References

1. Finch CF , Cassell E . The public health impact of injury during sport and active recreation. J Sci Med Sport 2006;9:490–7. doi:10.1016/j.jsams.2006.03.002
2. Lauersen JB , Bertelsen DM , Andersen LB . The effectiveness of exercise interventions to prevent sports injuries: a systematic review and meta-analysis of randomised controlled trials. Br J Sports Med 2014;48:871–7. doi:10.1136/bjsports-2013-092538
3. van Mechelen W , Hlobil H , Kemper HC . Incidence, severity, aetiology and prevention of sports injuries. A review of concepts. Sports Med 1992;14:82–99. doi:10.2165/00007256-199214020-00002
4. Finch C . A new framework for research leading to sports injury prevention. J Sci Med Sport 2006;9:3–9. doi:10.1016/j.jsams.2006.02.009
5. Glouberman S , Zimmerman B . Complicated and complex systems: what would successful reform of Medicare look like? Toronto: Commission on the Future of Healthcare in Canada, 2002. http://www.publications.gc.ca/site/eng/235920/publication.html (accessed 16 Mar 2016).
6. Hawe P . Lessons from complex interventions to improve health. Public Health 2015;36:307. doi:10.1146/annurev-publhealth-031912-114421
7. Pawson R , Tilley N . Realistic evaluation. Sage, 1997.
8. Clark AM . What are the components of complex interventions in healthcare? Theorizing approaches to parts, powers and the whole intervention. Soc Sci Med 2013;93:185–93. doi:10.1016/j.socscimed.2012.03.035