CLINICAL PREDICTION RULES IN PHYSIOTHERAPY CLINICAL EDUCATION

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STATEMENT OF ORIGINALITY

I hereby certify that the work embodied in the thesis is my own work, conducted under normal supervision. The thesis contains no material which has been accepted, or is being examined, for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made. I give consent to the final version of my thesis being made available worldwide when deposited in the University's Digital Repository, subject to the provisions of the Copyright Act 1968 and any approved embargo.

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I hereby certify that this thesis is in the form of a series of papers. I have included as part of the thesis a written declaration from each co-author, endorsed in writing by the Faculty Assistant Dean (Research Training), attesting to my contribution to any jointly authored papers (Appendix 1).

DEDICATION

My thesis is dedicated to the memory of my sister

Katherine Louise (Katie)

who passed away while I was writing this thesis

on 18 August 2018

after battling an aggressive cancer.

Taken too soon, always missed.

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PUBLICATIONS AND PRESENTATIONS

The following publications and presentations were a direct result of the work completed in this thesis:

Published papers

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- Knox GM, Snodgrass SJ, Stanton TR, Kelly DH, Vicenzino B, Wand BM & Rivett DA. (2017) Physiotherapy students' perceptions and experiences of clinical prediction rules. *Physiotherapy*.103(3):296-303, http://dx.doi.org/10.1016/j.physio.2016.04.001

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- Knox GM, Snodgrass SJ, Southgate E & Rivett DA. (2019b) A Delphi study to establish consensus on an educational package of musculoskeletal clinical prediction rules for physiotherapy clinical educators. *Musculoskelet Sci Pract*. https://doi.org/10.1016/j.msksp.2019.102053

Poster presentations

- Knox GM, Snodgrass SJ, Rivett DA. (2015) Clinical educators' experiences and perceptions of clinical prediction rules. *World Confederation for Physical Therapy Congress*, May 2015, Singapore. *Physiotherapy,* 101(Supp 1): e767.

- Knox GM, Snodgrass SJ, Stanton TR, Kelly DH, Vicenzino B, Wand BM, Rivett DA. (2015) Students' experiences and perceptions of clinical prediction rules. *World Confederation for Physical Therapy Congress*, May 2015, Singapore. *Physiotherapy,* 101(Supp 1): e768.

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Conference and other invited presentations

- Knox GM. (2013) The use of clinical prediction rules by clinical educators with physiotherapy students: clinical educators' survey. Oral presentation. *University of Newcastle Physiotherapy Seminar.* Newcastle, Australia. December 2013.

- Knox GM. (2014) Physiotherapy students' perceptions and experiences of clinical prediction rules. Oral presentation. *University of Newcastle Physiotherapy Seminar.* Newcastle, Australia. November 2014.

- Knox GM, Snodgrass SJ, Southgate E, Rivett DA. (2017) Clinical educators' preferences regarding a package to aid in the teaching of clinical prediction rules to students on clinical placement. Oral presentation. *Momentum 2017, Australian Physiotherapy Association National Conference*, Sydney, Australia, October 2017.

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ABBREVIATIONS AND ACRONYMS

APA	Australian Physiotherapy Association
APP	Assessment of Physiotherapy Practice
AS	Ankylosing Spondylitis
AWR	Amsterdam Wrist Rules
CATCH	Canadian Assessment of Tomography for CHildhood injury
CCHR	Canadian CT Head Rule
CCSR	Canadian Cervical Spine Rule
CHALICE	Children's Head injury ALgorithm for the prediction of Important Clinical Events
CPR	Clinical Prediction Rule
CSM	Cervical Spine Myelopathy
CT	Computerised Tomography
	Carpal Tunnel Syndrome
DVT	Deep Vein Thrombosis
EBP	Evidence-Based Practice
ED	Emergency Department
EuroSCORE	European System for Cardiac Operative Risk Evaluation
FABQWS	Fear Avoidance Beliefs Questionnaire Work Subscale
HETI	Health Education and Training Institute
IBP	Inflammatory Back Pain
ICU	Intensive Care Unit
IES	Impact of Event Scale
IQR	Inter-Quartile Range
LBP	Low Back Pain
LR	Likelihood Ratio
+LR	Positive Likelihood Ratio
-LR	Negative Likelihood Ratio
LRCE	Low Risk Clinical Examination
MCL	Medial Collateral Ligament
MORES	Male Osteoporosis Risk Estimation Score
MRI	Magnetic Resonance Imaging
MWM(s)	Mobilisation(s) With Movement
NDI	Neck Disability Index
NEXUS	National Emergency X-radiography Utilization Study

NHMRC	(Australian) National Health and Medical Research Council
NOC	New Orleans Criteria
OA	OsteoArthritis
OADRS	Ottawa Acceptability of Decision Rules Scale
OAR	Ottawa Ankle Rule
ODI	Oswestry Disability Index
OKR	Ottawa Knee Rule
ORAI	Osteoporosis Risk Assessment Instrument
OST	Osteoporosis Self-Assessment Tool
PDR	Pittsburgh Decision Rule
PDS	Posttraumatic Diagnostic Scale
PE	Pulmonary Embolism
PECARN	Pediatric Emergency Care Applied Research Network
PERC	Pulmonary Embolism Rule-out Criteria
SAE	Self-Addressed Envelope
SCI	Spinal Cord Injury(ies)
SCORE	Simple Calculated Osteoporosis Risk Estimation
SD	Standard Deviation
SIJ	Sacro-Iliac Joint
UK	United Kingdom
US	United States
VAS	Visual Analogue (pain) Scale
WAD	Whiplash-Associated Disorders

ABSTRACT

Clinical reasoning is an important skill for physiotherapy students to master, though it can be challenging given their limited clinical experience. Tools exist to aid clinical decision-making, and one that is evidence-based is the clinical prediction rule (CPR). CPRs are algorithms that combine patient characteristics and clinical features into numerical indices to predict the probability of a clinical condition or outcome. Physiotherapy clinical educators play a key role in facilitating clinical reasoning skills in students; however it is unknown whether students learn about CPRs in the clinical setting.

A series of four linked studies, using a variety of research methodologies, was conducted to determine the awareness and use of CPRs by physiotherapy students and clinical educators, and then to propose key components for an educational package.

Physiotherapy clinical educators and final year pre-professional students were separately surveyed to ascertain their awareness and use of CPRs, including the teaching of CPRs on clinical placement, the relationship with clinical decision-making, and relationship with evidence-based practice. Clinical educators were subsequently interviewed for their views on educational strategies on CPRs for clinical educators. Finally an international panel of experts were consulted in a modified Delphi study to finalise the essential content and optimal methods of delivery for an educational package for clinical educators.

Clinical educators reported a poor awareness, understanding and use of CPRs, and few taught them to students. Students similarly reported little awareness and minimal use of CPRs. However those students who were more familiar with CPRs found them useful in promoting their clinical decision-making skills. Clinical educators agreed that an educational package on CPRs for educators would be desirable for improving their clinical use of CPRs and teaching of CPRs. Building on the views of the clinical educators, physiotherapy experts in CPRs recommended the content of this educational package should cover why, when and how to use CPRs clinically, and their limitations. Information on the different types of CPRs, with specific examples, was also identified as important. Online delivery was endorsed via self-directed learning and webinars, along with access to electronic versions of actual CPRs. Self-assessment of learning was also supported.

In summary, physiotherapy students and clinical educators have a poor understanding and limited or no clinical experience in using CPRs, but this could possibly be addressed by the development of an evidence-based educational package for clinical educators. Improving physiotherapy clinical educators’ knowledge of CPRs may lead to physiotherapy students gaining a greater understanding and ability to use CPRs while on clinical placement.

CHAPTER 1

INTRODUCTION

1.1 Clinical Prediction Rules

Clinical prediction rules (CPRs) are research-based tools designed to assist the decision-making of clinicians by quantifying the relative contributions of various characteristics to provide numeric indices and so a probability of an outcome (Beattie & Nelson 2006, Laupacis et al 1997). Their purpose is to help clinicians in interpreting clinical information (Wasson et al 1985). As such they can reduce uncertainty in patient care by specifying how to make predictions using the clinical findings (Stiell et al 1996, Wasson et al 1985) and may give clinicians more confidence in their own decisions (Smith & Cleland 2004).

As an example, Diabetes Australia tells us “The size of your waist is an indicator of your risk of Type II Diabetes … Measure yourself, reduce your waist, reduce your risk”. This advice is based on a CPR developed by the National Health and Medical Research Council (NHMRC 2003), which showed waist circumference is a predictor for the development of diabetes.

The basic principle behind CPRs is not new; they have a long, and at times somewhat controversial, history. The term evolved over time following the increased use of multivariate models to predict patient outcomes.

1.1.1 Terminology

CPRs are known by a number of different terms, and so it is important to recognise the variations in terminology in order to understand that they are in fact different names for the same entity. Terms such as clinical decision rules, clinical prediction guidelines, and clinical prediction criteria are all synonymous with clinical prediction rules.

The term used in this thesis will be Clinical Prediction Rules as this appears to be the most commonly used in the physiotherapy literature. However it should be understood that there are limitations inherent within the name – they are not always predictive, and should almost never be taken as a strict 'rule'. That is, CPRs are almost always used as a guide to assist the clinician in their decision-making, rather than as a rule dictating the decision and associated actions.

1.1.2 The Evolution of CPRs

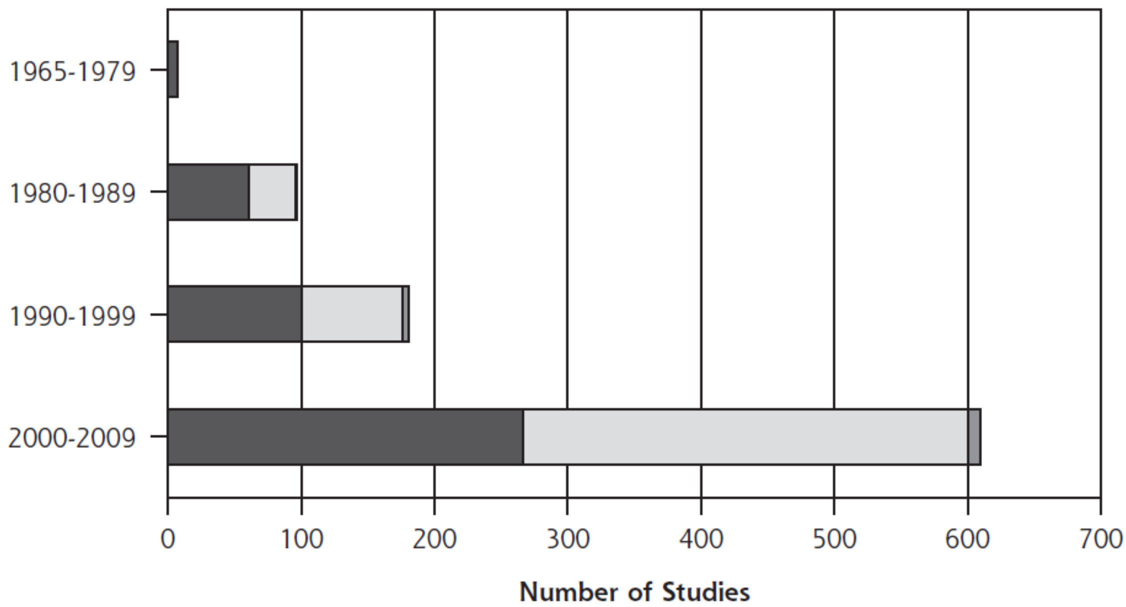
Clinicians have always made predictions – diagnostic predictions of the presence of a condition, prognostic predictions of the course of a condition, and even predictions on the anticipated response to a chosen treatment approach – these predictions being based on assessment outcomes, response to interventions, and demographic considerations (Braitman & Davidoff 1996). For a long time these predictions have been qualitative and informal, or arguably an "informed guess" (Beattie & Nelson 2006), based on previous experience with patients with similar characteristics; whereas now clinical prediction using the quantitative nature of probability models has become a science in its own right.

The first branch of science that employed probability models to make predictions was meteorology. This is a science that was originally fundamentally based upon pattern recognition and rational plausibility arguments, which then evolved with the introduction of numerical weather prediction, involving statistical prediction models that help inform the likelihood of meteorological events. The idea of numerical weather prediction was first proposed by Vilhelm Bjerknes (1904), a Norwegian physicist who was professor of applied mechanics and mathematical physics at the University of Stockholm. Bjerknes suggested that weather forecasting (prognosis) could be achieved by solving a system of nonlinear partial differential equations.

Psychologists have also been utilising similar ideas about predictions for patient outcomes since early in the 20th century, beginning with the use of actuarial tables to develop early prediction models, which were found to demonstrate their superiority over unassisted human judgement (when based on the same evidence). Ongoing reviews have confirmed the supremacy of mechanical prediction over clinical judgement in psychology (Grove et al 2000, Meehl 1954, Sawyer 1966). Such prediction models are still in use in the form of Decision Trees for the differential diagnosis of disorders (American Psychiatric Association 1994, DSM-IV).

This clinical prediction model was eventually adopted by medicine. The concept first appeared in the medical literature in the 1960s (Deandrade & Casagrande 1965, Norris et al 1969, Ritchie et al 1968) and became sufficiently widespread that it was recognised as being worthy of examination in the mid-1980s (Wasson et al 1985). Initially, CPRs were developed to aid clinical decisions where there was a higher associated risk involved, such as trauma-related injuries. The scope and applicability of CPRs to predict outcomes gradually expanded in healthcare in the 1990s. This period also marked when physiotherapists started using some medical CPRs that had been developed and that were relevant to their scope of practice, as well as developing CPRs specifically for physiotherapy practice.

A review of original studies on CPRs published up to 2009 (Keogh et al 2014) identified 895 studies commencing in the 1960s. It was found that the number of CPR studies has steadily increased over time (Figure 1.1), with only seven studies (less than 1%) published prior to 1980, 97 studies (nearly 11%) in the 1980s, 181 studies (about 20%) in the 90s, and with the vast majority (610 studies, 68%) published in the following decade.



Note: Few studies were reported before 1980; therefore, we grouped these studies into a broader time period (1965-1979).

Figure 1.1 CPR studies, split by decade reported (N=895)
(from Keogh et al 2014, and further explained in Figure 2.7)

1.1.3 The Purpose of CPRs

Clinical reasoning is the decision-making process occurring during a clinical encounter, undertaken by the clinician in collaboration with the patient, that considers all the available information to determine goals of treatment and strategies for health management (Edwards et al 2004). It is an ongoing process throughout the consultation (or series of consultations) with a patient, as more data is gathered (Baker et al 2017). Clinicians may utilise a number of factors to progress their clinical reasoning skills (Wainwright et al 2011). Initially, pre-professional entry-level education may influence their reasoning in certain ways, depending on the clinical methods and therapeutic approaches learnt as students (Jones & Rivett 2019). Personal clinical experience and, after a while, a degree of pattern-recognition based on memorable and repeated experiences, play a major role in the practitioner developing a 'memory bank' of patient interactions which can be drawn on when confronted with a similar clinical presentation. The experience of clinicians can also be incorporated into their own practice and reasoning, assimilated from attending presentations at conferences, courses, and lectures, and through reading journal articles and text books. However, with the increasing output of scientific research in health in general, and specifically in physiotherapy, it is challenging for the clinician to appropriately incorporate new-found knowledge into their practice for the benefit of their patients. One method of integrating research into practice for specific patient presentations is through the use of CPRs (Beattie & Nelson 2006).

Clinicians use CPRs to assist in making a diagnosis, establishing a prognosis, and/or determining ideal methods of intervention (Childs & Cleland 2006), by means of formalising assessments in order to streamline the process and improve clinical precision (McGinn et al 2000). However, Beattie & Nelson (2006) caution that CPRs should augment rather than be used as a substitute for clinical judgement. A clear understanding of the relative strengths and weaknesses of any CPR is necessary before it should be employed, and the broader clinical context should be considered. Indeed, a study by Learman and colleagues (2012) confirmed that physiotherapists in the United States did not follow the intervention recommended by a CPR if 'red flags' (potential indicators of sinister pathology) become apparent during the examination which might indicate the intervention was inappropriate.

Another consideration for physiotherapists is that in recent decades there has been an emphasis on Evidence-Based Practice (EBP) in physiotherapy education. Accordingly, some physiotherapy educators have eschewed physical tests or treatment interventions that are not supported by compelling evidence based on empirical research. However there are arguments against taking such an extreme view (Smith & Pell 2003), and indeed some authors counsel that EBP should simply be used to augment and enhance traditional clinical skills (Guyatt 2008). The development of CPRs, formulated and validated by evidence-based research, may similarly be considered to facilitate the use of scientific evidence in conjunction with experiential-based clinical judgements and within the overall context of a balanced approach to patient care.

One advantage of employing CPRs is that clinicians can more effectively utilise the information gained during a comprehensive assessment and examination of a patient to make a decision about diagnosis, prognosis or intervention. This may reduce the need for further time-consuming testing procedures and the associated use of expensive equipment (for example, imaging studies). Despite these potential benefits, the understanding and use of CPRs by physiotherapy students and early-career physiotherapists has not been investigated. The use of such a tool, encapsulating current scientific evidence to aid clinical decision-making, would be well suited to advancing the practice of physiotherapy clinicians with minimal experience in both an evidence-based and efficient manner.

1.2 Design and Structure of the Thesis

The programme of research contained in this thesis comprises four studies. The first two examine the current situation with respect to the awareness, understanding and use of CPRs amongst physiotherapy students and their clinical educators, and in so doing uncover a number of issues. The final two studies propose an educational solution and explore the means of providing this.

Chapter 2 presents the literature review undergone to examine CPRs, including their stages of development, requirements and methodological standards. It explores the purpose and availability of a wide variety of CPRs, including their benefits and limitations. Finally there is a review of CPRs available in all areas of healthcare, and their use and applicability in physiotherapy, followed by a precis of physiotherapy clinical education, and a reflection on the education of CPRs to physiotherapy students.

Chapters 3 and 4 detail the first two studies, which are surveys of physiotherapy clinical educators (Chapter 3) and students (Chapter 4) regarding their understanding and use of CPRs. A survey instrument was developed based on a comprehensive examination of the literature describing the use of CPRs in physiotherapy practice and education, as well as considerations required to obtain the optimum response from potential participants (such as the benefits of paper-based over online surveys). Study 1 was a descriptive exploratory survey of clinical educators to determine their knowledge of, attitudes towards and use of CPRs, both clinically and in clinical education. The clinical educators surveyed in this study were affiliated with the University of Newcastle in Australia, with most working in the state of New South Wales but with some also in Tasmania, the Australian Capital Territory and the Northern Territory. Study 1 has been published in a peer-reviewed journal (Knox et al 2015).

Study 2 was a descriptive exploratory survey of final year physiotherapy students from one university in each of the mainland Australian states to ascertain their awareness, use and understanding of CPRs. The aim was to ascertain whether students would report experiences with CPRs consistent with the responses received from clinical educators in Study 1. In this way Study 2 complements Study 1 by validating the findings while at the same time providing a different perspective. Although the clinical educators in Study 1 were mostly from New South Wales, the students surveyed in Study 2 were from across wider Australia, and so this provides a broader perspective. Study 2 has been published in a peer-reviewed journal (Knox et al 2017).

These first two studies found that improved comprehension of CPRs was needed by both physiotherapy clinical educators and students. It became clear that clinical educators might be well positioned to promote a better understanding of CPRs and facilitate their clinical use by physiotherapy students on placements, but would require specific educational support on CPRs to be able to do so. It was proposed that an educational package for distribution to physiotherapy clinical educators – to introduce them to CPRs, explain the rationale behind their development and use, and outline the advantages and limitations of using CPRs in clinical practice – could be useful in achieving this outcome. The exact content and delivery of such a package would require careful consideration to ensure it meets the needs of physiotherapy clinical educators. It was therefore decided to consult with end-users to determine their views on what would be required in such an educational package. These considerations and the associated findings from the first two studies were used to help inform the development of the aims and questions for Studies 3 and 4.

Thus, Study 3 (Chapter 5) consisted of semi-structured group and individual interviews with physiotherapy clinical educators to determine what they considered should be included in a learning package on CPRs designed for clinical educators, and their preferences as to how this information should be presented and delivered. A qualitative descriptive approach was used to analyse the responses. Study 3 has been published in a peer-reviewed journal (Knox et al 2019a).

For the final study, it was decided to consult with physiotherapy international experts in CPRs to finalise the core elements of the learning package and its dissemination. Therefore, the findings of Studies 1 and 2 were considered together with the outcomes of Study 3, and the ensuing conclusions were used to draft statements for Round 1 of a modified Delphi study (Study 4, Chapter 6). The Delphi study recruited international physiotherapy experts in CPRs to ascertain their views on the key elements and recommended mode of delivery of a learning package for clinical educators, building on the results of Study 3. This study enabled final recommendations to be made regarding the content and delivery of an educational package on CPRs designed for physiotherapy clinical educators. Study 4 has been submitted for publication in a peer-reviewed journal (Knox et al 2019b).

Chapter 7 summarises the literature review and highlights the gaps found in the scientific research at the commencement of the thesis, followed by a summary of the findings of each of the four studies and how individually and collectively they address the gaps in the literature. Chapter 8, the final chapter of the thesis, draws together and connects the findings of the four studies comprising the thesis, with a discussion of the overall conclusions and limitations of the body of work. Implications for the physiotherapy profession in general, and clinical educators and students in particular, are considered and examined. Finally, possibilities and recommendations for future research in this field are presented.

1.3 Scope of the Thesis

Clinical reasoning or decision-making is a key skill that physiotherapy students must master in order to become effective health professionals, although it is perhaps one of the more difficult to grasp due to its inherent cognitive nature. While there are various tools to aid the process of clinical decision-making, the scope of this thesis is restricted to only one such tool, the CPR, which is based on empirical evidence. Other methods to facilitate clinical reasoning skill are beyond the scope of this thesis.

Perceptions, understanding and use of CPRs among practising physiotherapists have only been investigated in those acting as clinical educators, and not in clinicians in general. Furthermore, these views and experiences were limited to physiotherapy clinical educators in Australia.

This thesis explores only one means of informing clinical educators about CPRs, and there may be other considerations and methods for educators to learn about CPRs. Similarly, the thesis is restricted to physiotherapy students learning about CPRs as part of their clinical education. Methods of educating them in the use of CPRs as part of the broader university curricula have not been considered, and would involve considerably more consultation with physiotherapists, students, and university academics.

1.4 Thesis Research Aims and Significance

The genesis of this thesis arose from the relatively recent growth in prominence in CPRs in physiotherapy practice in Australia and elsewhere, and the ongoing dilemma of facilitating the development of clinical reasoning skills in physiotherapy students. This then coalesced into the fundamental overarching aim for the body of work:

What is the current state of the use of CPRs in physiotherapy clinical education?

This was to be achieved by examining the understanding and use of CPRs by physiotherapy clinical educators, both in their clinical work and in clinical teaching situations with students; investigating how prepared clinical educators are to incorporate the teaching of CPRs into their practice, and what they might need for this to happen; and also by exploring the exposure to and understanding of CPRs by physiotherapy students.

The results of this thesis provide an enhanced understanding of the use of CPRs to assist in decision-making in physiotherapy clinical education, and have the potential to promote the learning of clinical reasoning by physiotherapy students in Australia. The findings may influence how students are taught clinical decision-making, and about the role of CPRs in the clinical setting, by providing clear recommendations on the content and delivery of an educational package on CPRs for clinical educators. This was achieved through a series of four studies.

CHAPTER 2

LITERATURE REVIEW

This chapter will describe in detail a review of the literature related to CPRs. It begins with some background on the physiotherapy profession, and how the need for sound clinical reasoning strategies became paramount. There follows an explanation of the stages of development CPRs go through, an appraisal of where in this process most CPRs tend to be at the moment, and a brief review of the levels of evidence supporting particular CPRs.

This is followed by a description of the types of CPRs that have been derived, the purposes for which they can be used, and a consideration of the benefits of using CPRs compared to other clinical reasoning strategies, along with discussion about the barriers to their adoption. Finally, there is a review of the CPRs available for use in various areas of medicine, and those that are particularly useful in and relevant to physiotherapy, concluding with an introduction to clinical education in physiotherapy and an observation on the value of CPRs to health professional students.

At the time of commencement of this thesis in 2009, little was known about the use and acceptability of CPRs among physiotherapy practitioners, educators or researchers, nor was it known whether physiotherapy students were being exposed to CPRs during their training, either on campus or on clinical placement. An editorial at the time (Fritz 2009) provided basic information to physiotherapists about CPRs, in an apparent early attempt to advocate for their applicability to physiotherapy clinical practice.

2.1 Background

CPRs are a relatively recent inclusion in physiotherapy practice that may improve practitioner clinical reasoning by augmenting their decision-making process with a structured approach and with mathematical prediction modelling. In order for clinicians to have confidence in utilising them, CPRs need to be researched and critiqued for their validity, relevance and suitability for practice. This thesis focusses on physiotherapy clinical educators and their students, and their use of CPRs as evidence-based tools. Therefore this chapter will provide background information on the historical context of the profession, the need for sound clinical decision-making, and the applicability of CPRs for this purpose.

2.1.1 Historical Context

Physiotherapy as a profession has grown and evolved considerably since its inception, especially in terms of scope of practice and in the evidence basis underpinning consultations and interventions. The first appearance of physiotherapy practice was perhaps with the 'Father of Modern Medicine' himself, Hippocrates (c.460 - c.370 BC), and later with Galenus (or Galen) (129 – c.200 AD), both of whom advocated physical therapy techniques such as massage, hydrotherapy, and manual therapy (Wharton 1991). In fact hydrotherapy may date back even further than this, with the Ancient Greeks building public bath houses in the 6th century BC and utilising natural hot springs well before this for therapeutic purposes (Ancient World Alive 2015).

Figure 2.1 Shoulder massage relief at museum in Cyrene, Libya, thought to be 2000 years old (Physio-pedia 2010)

Physiotherapy as a professional group started in Sweden with Per Henrik Ling who in 1813 founded the Royal Central Institute of Gymnastics (the Swedish term for physiotherapist is *sjukgymnast*, a literal translation of which is 'someone involved in gymnastics for the sick'), teaching manipulation, massage and exercise, with official registration finally being granted in 1887 by the National Board of Health and Welfare (Brodin 2008). In Australia, physiotherapy as a profession commenced in 1906 when massage therapists (as they were known at the time) from New South Wales, Victoria, South Australia, and Western Australia joined together to form an association, with the aim of protecting the public from untrained practitioners. The development of educational standards as part of the association's membership aided in their goal of guaranteeing high standards of therapy for patients. In these early days, massage therapists worked in public hospitals under the direction of medical practitioners, practising with only a small measure of independence (Australian Physiotherapy Association 2016).

In the beginning of the profession in Australia, a program of study was developed through universities with practical training occurring in hospitals. Graduates initially earned a Diploma of Massage, which later became a Diploma of Physiotherapy in most states in the 1940s. Bachelor degree courses in Physiotherapy emerged in most states in the 1970s. With the growth of the profession and the improvement in standards of education, physiotherapists in 1976 earned the right to be first-contact practitioners, thus no longer requiring a referral from medical practitioners (Chipchase et al 2006).

Along with this professional autonomy came a greater responsibility; while physiotherapists were working under the direction of medical officers, it was the latter who made the diagnosis and decided the appropriate intervention. As first-contact practitioners, physiotherapists were now making clinical decisions independently and unsupervised, and consequently there was an educational need to ensure learned procedures for patient assessment and examination enabled appropriate diagnostic decisions and treatment choices to be made. It also became necessary for the profession to develop, and for practitioners to learn, sound and effective strategies for clinical decision-making to advance the physiotherapeutic process towards safe and appropriate patient management (Gilliland 2014).

2.1.2 Clinical Reasoning

Clinical decision-making is an ongoing challenge for clinicians, and is particularly so for students. University coursework teaches physiotherapy students methods and strategies to assess a patient who might require physiotherapy intervention. They are traditionally taught a structured approach to assessment so that all potentially relevant information is comprehensively gathered, in order to consider all the clinical problem(s) with which the patient presents. This information is collected via searching of relevant historical information such as medical records and tests or investigations, a patient interview consisting of carefully directed questioning, and a physical examination whereby further clinical data is sought and confirmed or refined (Banning 2008). The students also learn and practice an extensive variety of treatment techniques, again aimed at a wide range of clinical presentations. For treatment to be most effective, it must be directed at the problem(s) identified within the assessment process.

Clinical reasoning refers to the thinking and decision-making processes undertaken by the practitioner in collaboration with the patient (Smith et al 2009), to ensure that the treatment optimally addresses the issues identified in the assessment, and is actually relevant and directly related to the assessment findings; rather than blindly treating all patients who present with apparently-similar symptoms in the same way. In this respect it defines the difference between a professional, who thinks and reasons about what to do, and a technician, whose behaviour is dictated by external factors/persons. Clinical reasoning is a continuous process, occurring in each treatment session and throughout the course of treatment, with constant reflection on changes in signs and symptoms and particularly consideration of response to intervention, with the overall aim of consistent progress being made in the patient's condition.

Thus clinical reasoning is a very important skill to develop for any clinician, yet it is one of the harder concepts to teach to student physiotherapists who do not yet have sufficient clinical experience to facilitate the process of clinical reasoning. Experienced clinicians can often recognise patterns in a clinical presentation (Jones & Rivett 2004) that can indicate a specific diagnosis, or at least suggest a particular direction to be investigated; this pattern recognition process efficiently and accurately progresses clinical decision-making. Inexperienced clinicians and students do not have the benefit of seeing patterns in past practice, so any method or process that assists them to progress their clinical reasoning could be beneficial for both the clinician/student and their patients. In this way, learning a more formalised and mechanical structure for clinical decision-making may make it easier for students to achieve competency in clinical reasoning (Edwards et al 2004, Jones & Rivett 2004). Indeed if clinical decision-making is well-structured, this improves efficacy in the process because important information is less likely to be missed (Petty & Moore 2001). However, in learning mechanical models students should never lose sight of the human aspect of the clinical interaction (Grove et al 2000), and that they are working with human beings, not mechanical objects.

Any intervention aimed at addressing a patient's presenting problem will likely be ineffective without careful consideration of factors that contributed to, and/or continue to affect, the problem. As many of these factors as possible need to be identified in order to propose a diagnosis, consider a prognosis, and develop an approach to intervention. In addition to pattern recognition, there are other methods of embarking on the process of clinical reasoning which consider these factors. One of the simplest, for example, is the hypothetico-deductive (problem-based) approach (Banning 2008):

Step 1: Assessment of the patient.
Step 2: From the assessment, what problems have been identified?
Step 3: Therefore, from this problem list, what are the aims of treatment?
Step 4: Therefore, according to these aims, what methods of treatment are available to address the problems?

Several other authors have proposed problem-solving models along these lines. May and Newman (1980) listed seven steps: problem recognition, problem definition, problem analysis, data management, solution development, solution implementation, and outcome evaluation. Olsen (1983) also suggested seven considerations: cause, problem, method, solution, product, modality, and goal. Models of clinical reasoning such as these can aid students or new clinicians by giving direction to their consultations.

Taken further, Rothstein and Echternach (1986) proposed eight steps in the hypothetico-deductive reasoning model (Table 2.1).

Table 2.1 Steps involved in the hypothetico-deductive clinical reasoning process (reproduced from Rothstein & Echternach 1986)

1	Collect initial data (interview, history)
2	Generate a problem statement (chief complaint) and establish goals (measurable & functional)
3	Physical examination
4	Generate working hypothesis (related to goals)
5	Plan re-evaluation methodology
6	Plan treatment strategy based on hypotheses
7	Plan specifics of treatment
8	Implement treatment

More experienced clinicians may use a similar step-by-step approach, but the steps become more fluid, with an intermingling of the information-gathering, hypothesis-generation and intervention-planning. These steps might be recycled, with preliminary theories and plans refined, expanded or discarded, prior to finalisation of the process (Barrows & Tamblyn 1980, Elstein et al 1978, Payton 1985).

More complex methods also exist. There is a school of thought that physiotherapy intervention can be more effective if patients are classified into sub-groups to assist with selection of optimal treatment strategies (Hancock et al 2009a). This is particularly the case with low back pain (LBP), where it is not possible to identify a patho-anatomical cause in the vast majority of presentations (Deyo & Phillips 1996, Deyo & Weinstein 2001), yet most clinicians accept that non-specific LBP is not one single condition but consists of smaller homogeneous sub-groups (Brennan et al 2006, Kent & Keating 2004). Treatment determined as a result of subdividing patients into groups in this way leads to better outcomes compared to standardising interventions for all LBP patients (Fritz et al 2003). To date, several classification systems have been proposed to enable subdivision of the non-specific LBP population (Bernard & Kirkaldy-Willis 1987, Delitto et al 1995, McKenzie 1981, Petersen et al 2003, Petersen et al 2004, Rose 1989, Spitzer 1987, Waddell 2005, Werneke & Hart 2004).

A similar approach to treatment of the cervical spine was proposed in a recent paper (Dewitte et al 2014) in which the authors developed a ‘clinical algorithm’ that was aimed at guiding clinical decision-making by novice physiotherapists. A flow chart was presented to junior practitioners to assist in ascertaining whether neck pain was primarily mechanical in nature and would consequently respond to manual techniques such as joint mobilisation or manipulation, and further, recommended what specific type of technique would be most appropriate depending on the clinical presentation.

Given the importance of successful clinical reasoning, the challenges involved in reassessing a patient and appropriately progressing interventions, and the difficulty in learning effective clinical reasoning as a novice clinician, various tools and strategies have been developed to assist with clinical reasoning. An increasingly prominent example of one such strategy in the physiotherapy literature is the CPR (Haskins et al 2014, Learman et al 2012), whereby clinical decision-making is guided by a relevant predictive tool designed to quantitatively indicate probabilistic outcomes.

2.2 Stages of Development of CPRs

To appreciate CPRs, the first important distinction to understand is that there are two different ways of describing a CPR; firstly by its purpose (whether it is to aid diagnosis, prognosis or determining the ideal method of intervention), and secondly by its stage of development. To be fully developed, a CPR should successfully go through three stages of development (Figure 2.2), with the progression through these stages improving its validity and its acceptability.

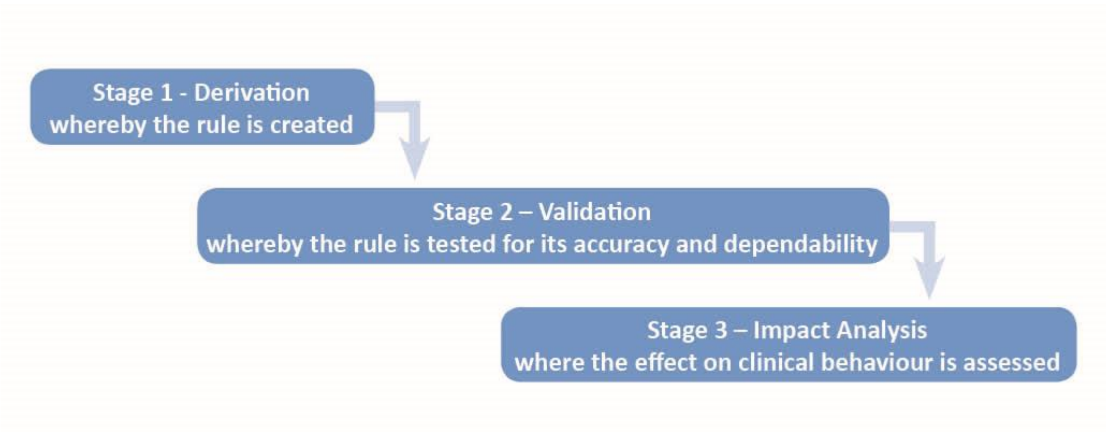


Figure 2.2 The three stages of development of a CPR (Glynn & Weisbach 2011)

These three stages will be discussed in detail below, although there are often preliminary stages: firstly the identification of an issue for which a CPR may be perceived as being useful, and secondly there may be a preliminary study which aims to uncover potential predictors. Wallace and colleagues (2011) describe the process more expansively (Figure 2.3), acknowledging that as the CPR goes through the stages, the level of evidence increases and the CPR becomes valid, trustworthy and acceptable for clinical use.

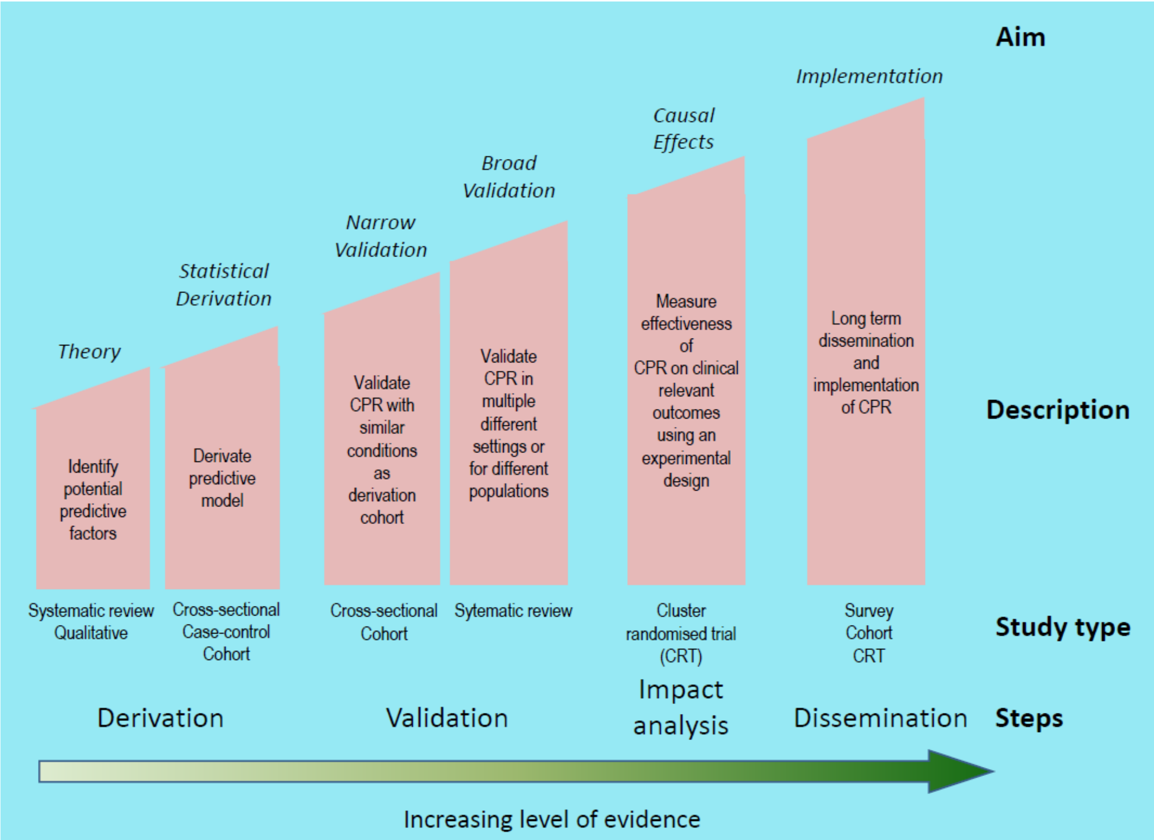


Figure 2.3 Theoretical framework for study designs from theory to implementation of CPRs (Wallace et al 2011)

Considering the aims of these stages, the attributes that define a useful CPR were described by Blackmore and colleagues (2005) (Table 2.2).

Ideally, the outcome being predicted should be physical rather than mental, spiritual, behavioural or sociological (Wasson et al 1985), as the more objective a CPR is, the more likely it will apply to diverse populations in various settings.

Table 2.2 Attributes that define a useful CPR (reproduced from Blackmore et al 2005)

Is clinically important	Addresses a clinical question of sufficient importance to justify resources to develop the rule, and to justify time by practitioners to learn and implement the rule
Has face validity	Users must accept the logic as well as the science to enable adoption and acceptance
Is reproducible	Must yield consistent results when used in clinical practice by all practitioners
Is easy to use	Complexity of the rule must be tailored to the level of the practitioner who will actually apply the rule in practice
Is clinically relevant	Results from the rule must provide information of use to practitioners
Suggests a course of action	Use of the rule must have potential to change patient care
Is validated	The rule must be effective in groups other than that in the initial study to demonstrate generalisability

2.2.1 Derivation

2.2.1.1 The Process of Deriving a CPR

An alphabet of studies have reported the derivation of CPRs relevant to physiotherapy (Altman et al 1986, Bauer et al 1995, Currier et al 2007, Dionne et al 2005a, Enthoven et al 2003, Feuerstein et al 2000, Gross & Battie 2005, Hicks et al 2005, Iverson et al 2008, Jull & Stanton 2005, Kuipers et al 2006a, Lesher et al 2006, Mintken et al 2010, Nouri & Lincoln 1993, Osmond et al 2010, Park et al 2005, Quayle et al 1997, Raney et al 2009, Stiell et al 1992, Tseng et al 2006, Vicenzino et al 2009, Wainner et al 2005, Zarchy & Ershoff 1991). Indeed it would appear that the majority of studies on CPRs related to physiotherapy practice are derivative in nature.

The process of deriving a CPR has become well defined. In generating a CPR, the most important factor to consider is that the outcome to be predicted should have clinical significance. Considerations might include the actual need for a clinical guideline of this nature;

in other words, is existing practice unproductive or perhaps too variable, such that a defined and standardised approach would improve patient care (Stiell & Wells 1999)?

The structure of the derivation study is determined by the purpose for which the CPR is intended (Beattie & Nelson 2006). For a diagnostic CPR, designed to predict the probability of the presence of a condition, a prospective cross-sectional study compares findings from the CPR with a 'gold standard' that is indicative of the presence or absence of the condition. The CPR should demonstrate a very strong correlation to this standard, with positive or negative responses on the CPR being closely related to positive or negative results on the 'gold standard' test procedure.

For a prognostic CPR, designed to predict the probability of a particular outcome, a prospective longitudinal study aims to compare findings from the CPR with measures of changes in patient status over time, with positive scores on the CPR being strongly associated with the observed changes.

For an interventional CPR, designed to predict the probability of outcome when a specific treatment method is applied, the study should be a prospective longitudinal randomised controlled trial design that compares outcomes following different interventions on participants with the same score on the CPR. Randomly allocated treatment groups should demonstrate significant differences according to the intervention they receive, with the chosen intervention predominant over the others. Maher (2005) cautions that a control group is particularly critical for intervention CPRs, so that the intervention of interest is compared to another intervention in another group (or no intervention).

The predictive data should always be collected prospectively; if data is collected retrospectively, potential variables are more likely to be missed, because one would only be able to consider those predictors that were assessed and collected at the outset. Also, with retrospective data collection, as the outcome is already known, this may lead to bias in determining predictors.

Researchers start by making a list of variables that are possible predictors – from the participant history, clinical assessment and examination, and from test procedures. Many of these potential predictors do not become part of the CPR, so at this early stage all possibilities can be considered, although increasing the number of predictor variables to be examined requires an increased sample size (Childs & Cleland 2006). By considering their own clinical experience as well as previous research in the area, researchers can hypothesise those predictors perhaps more likely to be involved, but these should be practicable and relevant. Variables should only be included if information is going to be readily available to clinicians at the time of consultation, otherwise the CPR will not be able to be used by clinicians for clinical decision-making.

Ultimately the actual creation of a CPR requires several outcome predictors; Laupacis and colleagues (1997) recommend at least three, although too many predictors will make the rule more difficult to remember and apply. The CPR derived and validated by Eagle and colleagues (2004) for prognosis of acute coronary syndrome is somewhat unwieldy with nine predictors, making it less likely to be used unless an app is available to aid in the calculation, even though it may be quite valid.

Cook (2008) expresses some concerns about the choice of outcome events that may be used in some CPRs. Any that rely on patient recall, such as Global Rating of Change score, may suffer from recall bias in any long-term analysis, thus adversely affecting their reliability as a measure of outcome. Also, some outcome events will not be transferable to other populations, such as those that use scores affected by socio-demographic factors (e.g. admission to hospital), administrative factors (e.g. length of stay in hospital), or internal behavioural characteristics (such as changes in attitude, e.g. fear avoidance behaviour), and so should be avoided as predictors.

Care should also be taken with predictors that have a subjective element or are open to varied interpretation, such as tests that rely on feel such as palpation of spinal movement, or other joint stiffness/laxity tests. Interrater reliability of potential predictors must be considered and tested, and only those that score highly can be included in the final CPR (May et al 2006, Robinson et al 2007).

Another consideration with potential predictors is the inherent reliability of some tests and investigations. CPRs for deep vein thrombosis (DVT) have been derived that include the D-Dimer test as one of the predictors (Oudega et al 2005, Wells et al 2003), but there are various methods for this test to be performed, which could affect the accuracy of the calculated CPR.

Also, any CPR that relies on imaging techniques such as Magnetic Resonance Imaging (MRI) or Computerised Tomography (CT) may be affected by changes in technology.

The study population used to derive the CPR should be clearly stated, specifying inclusion and exclusion criteria, how they were selected, clinical and demographic features, and study setting. This assists clinicians to understand the generalisability of the CPR when considering its use.

Sample size may be affected by the risks associated with false negative results. A study that derives a CPR to recognize a risk of significant consequence, such as death or serious injury following head or neck trauma, requires more participants than, say, one that diagnoses sinusitis or calculates the risk of developing urinary tract infection. In general, Cook (2008) recommends 10-15 participants for each predictor variable.

Having determined the potential predictor variables for a CPR, the participants in the study are examined at the outset for the presence or absence of each variable. There must be blinding between two groups of researchers: those examining the variables at baseline, and those who determine the prognosis or diagnosis according to accepted methods (the 'gold standard') or who apply the intervention technique. Selecting appropriate and relevant reference criteria are critical in giving the newly-developed CPR integrity and reliability. After the appropriate time has elapsed (dependent upon whether the CPR is for diagnosis, prognosis or intervention), the next step is to examine the participants – in which patients were the predictors present at the outset, and which patients exhibit the outcome being investigated at the conclusion? One then considers which predictors are most effective at predicting the outcome. Those with lower statistical probability are discarded; a predictor may exhibit no predictive value on its own, it may be predictive on its own but add no predictive value to the CPR that is not provided by other predictors, or assessment of the predictor may be likely to have poor reproducibility amongst clinicians.

It is then possible to commence applying the predictors and analysing their validity, revising their predictability on an ongoing basis, to see if the CPR appears to hold true. Brehaut and colleagues (2007) have developed the Ottawa Acceptability of Decision Rules Scale (OADRS), which can also be used by authors of CPRs to assess whether their CPR will be accepted and utilised by clinicians.

A CPR must be practical and straightforward enough to remember in a clinical setting for ease of application (Laupacis et al 1997, McGinn et al 2000). It should involve predictors of outcomes such that misclassification does not seriously jeopardise patient care. It must be clearly explained with predictors plainly defined so that clinicians may apply and utilise the CPR and further validate it (Wasson et al 1985). Furthermore, it will only be useful, and therefore will only be used, if it has good predictive power (Cook et al 2010a). It has also been suggested (Graham et al 2001, Laupacis et al 1997) that a CPR is more likely to be used if it actually recommends what to do (e.g. take an X-ray) rather than just giving the probability of a condition (e.g. fracture).

2.2.1.2 Methodological Standards for Derivation Studies

Studies deriving CPRs should rigidly adhere to certain standards in order for clinicians to have confidence that the resultant CPR is compellingly convincing, and therefore reliable for use in the clinical setting. Many authors have considered and discussed the need for methodological quality in the derivation of CPRs. Among these there are some basic standards that recur, but there is some disagreement about what else is important.

Wasson and colleagues (1985) recommended that both those who derive CPRs, and those who intend to use them, should closely consider the design of the studies in which the CPRs are derived. They identified certain flaws in study design that can affect the validity of the derived CPRs –

1. defining outcomes poorly
2. defining predictors poorly
3. failing to blind those assessing outcomes from those assessing predictors.

These researchers defined methodological standards to ensure study design is optimal and proposed the recommendations outlined in Table 2.3.

Table 2.3 Methodological standards for CPR derivation studies (reproduced from Wasson et al 1985)

	Standard	Description
1	Clear definition of the outcome being predicted	Blinded assessment when appropriate
2	Precise definition of all predictor variables considered	Blinded if a retrospective study (though preferably should be collected prospectively)
3	Study population described	Age, sex, important clinical characteristics, so that comparisons can be made with other populations
4	Study site described	Type of institution, setting, size of catchment area, how patients were referred
5	Misclassification rate tested (the error rate at which patients are classified into incorrect risk groups)	Using cross-validation techniques
6	Effects of clinical use prospectively measured	
7	Mathematical method used to create the CPR is described	

Other authors in the years since have subsequently considered and recommended changes to these standards, depending on what they saw as being critical, and also what they felt was missing in derivation studies (Laupacis et al 1997).

Subsequent to this, McGinn and colleagues (2000) recommended clinicians assess CPRs they are considering using based on –

1. the method of the derivation study
2. the validation of the CPR and whether its repeated use obtains the same results
3. its predictive power.

It is unclear whether these authors were aware of or considered earlier recommendations, but they presented a simplified list of six methodological standards required for the derivation of a CPR (Table 2.4).

Table 2.4 Methodological standards for CPR derivation studies (reproduced from McGinn et al 2000)

1	All important predictors must be included in the derivation process
2	All important predictors must be present in a significant proportion of the study population
3	All outcome events and predictors must be clearly defined
4	Those assessing the outcome event must be blinded to the presence of the predictors, and those assessing the presence of predictors must be blinded to the outcome event
5	Sample size must be adequate (including adequate number of outcome events)
6	The rule must make clinical sense

Taken further, Kuijpers and colleagues (2004) were particularly concerned about the standards of studies deriving prognostic CPRs. They suggested that the consideration of psychosocial aspects (such as depression, catastrophising, kinesiophobia, and pain behaviour) was a critical factor in prognostic studies, based on the proposal by Van der Heijden (1999) that such factors suggest a poor prognosis for painful musculoskeletal problems. More specifically, some degree of depression is often found in patients suffering LBP (Main et al 1992) and is associated with increased pain and disability, and a poorer prognosis (Sullivan et al 1992). Notably, Haggman and colleagues (2004) found that physiotherapists were poor at identifying depression in their LBP patients, and recommended the use of a simple screening tool. Thus Kuijpers and colleagues (2004) developed a list of 18 criteria, adopted and adapted from a number of authors and representing seven broad categories, to assess the methodological quality specifically for *prognostic* studies (Table 2.5) which includes the important criterion of 'Standardised assessment of potential psychosocial prognostic factors'.

Table 2.5 Criteria to assess the methodological quality of prognostic studies (reproduced from Kuijpers et al 2004)

1. Study population	A. Inclusion of an inception cohort
	B. Description of inclusion and exclusion criteria
	C. Description of study population
2. Response information	D. Response rate ≥ 75%
	E. Description of non-responders vs. responders
3. Extent & length of follow-up	F. Prospective data collection
	G. Follow-up of at least 6 months
	H. Dropouts/loss to follow-up ≤ 20%
	I. Information on subjects completing study vs. dropouts/loss to follow-up
4. Treatment	J. Treatment fully described or standardised
5. Outcome	K. Standardised assessment of relevant outcome criteria
6. Prognostic factors	L. Standardised assessment of subject characteristics and potential clinical prognostic factors
	M. Standardised assessment of potential psychosocial prognostic factors
7. Data presentation	N. Frequencies of most important outcome measures
	O. Frequencies of most important prognostic factors
	P. Appropriate analysis techniques
	Q. Prognostic model presented
	R. Sufficient numbers of subjects

Another review of methodological standards was undertaken in 2009 by Beneciuk and colleagues who noted that there was still no consensus on what constituted a 'methodologically sound' CPR, particularly one in the early stage of derivation. They also noted that many CPRs relevant for physiotherapists had not passed on to the stages of validation and impact analysis, so consideration of the quality of the derivation study was critical if a clinician wanted to consider incorporating a particular CPR into their clinical practice. Specifically, they wanted to assess studies deriving CPRs for physiotherapy *intervention*. They felt that Kuijpers's list for prognostic studies could be utilised for intervention studies with only minor alteration. They restored the standard of masking (blinding) of outcome assessor and treating clinician (a factor appearing on previous lists), and removed the criterion relating to response rates on the basis that this was rarely reported in physiotherapy literature (Table 2.6).

Table 2.6 Criteria to assess the methodological quality of studies deriving CPRs for physiotherapy intervention (reproduced from Beneciuk et al 2009)

Item	Description
A	Inception cohort
B	Inclusion and exclusion criteria
C	Study population
D	Non-responders vs. responders
E	Prospective data collection
F	Follow-up of at least 6 months
G	Dropouts/loss to follow-up ≤ 20%
H	Information on subjects completing study vs. dropouts/loss to follow-up
I	Intervention fully described or standardised
J	Standardised assessment of relevant outcome criteria
K	Masking of outcome assessor and treating clinician
L	Standardised assessment of subject characteristics and potential clinical prognostic factors
M	Standardised assessment of potential psychosocial prognostic factors
N	Frequencies of most important outcome measures
O	Frequencies of most important prognostic factors
P	Appropriate analysis techniques
Q	Prognostic model presented
R	Sufficient numbers of subjects

They then applied these new criteria to review studies that derived CPRs for physiotherapy intervention (Table 2.6) and found that commonly a number of these criteria were not satisfied (Table 2.7), particularly those relating to sufficient detail of inclusion and exclusion criteria, use of an inception cohort and adequate follow-up.

Table 2.7 Methodological criteria commonly receiving low ratings in studies deriving CPRs for physiotherapy intervention (reproduced from Beneciuk et al 2009)

Item*	Criterion	% of studies satisfying the criterion	Problems occurring if this criterion is not met
B	Inclusion and exclusion criteria	3	Creates difficulties with validating the CPR
A	Inception cohort	10	Affects the generalisability of the outcomes
F	Follow-up of at least 6 months	10	Therefore may not truly measure treatment response
K	Masking of outcome assessor and treating clinician	27	Potentially creates bias
R	Sufficient numbers of subjects	40	Affects the generalisability of the outcomes
M	Standardised assessment of potential psychosocial prognostic factors	47	May affect prognosis of conditions

* Items in this column relate directly to Items in Table 2.6

The methodological standards of derivation studies are critical – a poorly-designed and conducted study is less likely to derive a CPR that will be adopted for practice or validated. The papers discussed above propose important considerations relating to the reliability of derived CPRs, yet there is no evidence that clinicians are considering, or even aware of, these recommendations. Of particular concern is Item 'B' in Table 2.8, showing that few studies deriving CPRs for physiotherapy intervention adequately describe inclusion and exclusion criteria; CPRs thus derived will be difficult to validate, so may never proceed further than the derivation stage (Tseng et al 2006). Certainly these criteria will closely relate to a CPR's maturing through the stages of development from derivation to validation to impact analysis, and its progression through the levels of evidence outlined in Figure 2.3 and discussed further below. These methodological considerations will be considered when discussing and critiquing CPR studies in the sections below.

2.2.1.3 Statistical Considerations

A CPR, like any clinical test, is never going to be 100% accurate, so false positives or negatives are going to occur (Davidson 2002). However, the closer to 100% achieved in accuracy, the fewer false results. The precision of a CPR is best expressed with the statistical terms of sensitivity, specificity, and positive and negative likelihood ratios.

Sensitivity refers to the proportion of patients demonstrating the diagnosis or outcome of interest who are also positive on the CPR; it reflects the efficacy of the CPR in recognising a condition or outcome when present (i.e. how sensitive it is). A very sensitive CPR is more likely to pick up the presence of the diagnosis or outcome, so a negative result is likely to be a true reflection of its absence; thus high sensitivity reduces the likelihood of false negatives.

Specificity is the proportion of patients who do not demonstrate the diagnosis or outcome of interest and who are negative on the CPR, reflecting the efficacy of the CPR in identifying the lack of a condition or outcome when it is in fact absent (i.e. how specific it is). Therefore if positive, a very specific CPR will confirm the presence of the diagnosis or outcome, so high specificity means fewer false positives.

The purpose of a CPR will determine which of these, sensitivity or specificity, is going to be a more important consideration. In many clinical situations health practitioners will want to reduce the likelihood of false negatives, as this means a condition or problem is present but missed, so a high sensitivity is usually preferable. Unfortunately, increasing the sensitivity usually decreases the specificity (and vice versa) (Davidson 2002).

Likelihood ratios pool the information contained in the characteristics of sensitivity and specificity (Dujardin et al 1994). A positive likelihood ratio (+LR) represents the chance a diagnosis or outcome is present when a patient scores positively on the CPR, that is, confirming the diagnosis or outcome – the higher the +LR the greater the likelihood it is present. Conversely, a negative likelihood ratio (-LR) represents the chance a diagnosis or outcome is absent when a patient scores negatively on the CPR, that is, excluding the diagnosis or outcome – the lower the -LR the less likely its presence.

An accurate CPR should therefore have either a high +LR to rule the diagnosis in, or a low -LR to rule it out. A +LR greater than 5.0 or a -LR less than 0.2 is considered reasonably accurate, while a +LR score greater than 10.0 or -LR less than 0.1 is considered significant (Jaeschke et al 1994).

In this way, diagnostic CPRs can be useful not only in determining the presence but also the absence of a diagnosis, via a low -LR. Similarly, a low -LR on an interventional CPR would indicate that a chosen treatment approach might not be the best option, suggesting that clinicians should try other methods with a greater chance of success.

Of course with any study, a larger number of participants are needed to give stronger statistical predictive power. The drawback of some derivative studies is that they are underpowered, leading to a risk that the CPR does not hold true when tested in a different population or setting. One example of this is the CPR identifying patients with ankylosing spondylitis (AS) who may respond to an exercise programme (Alonso-Blanco et al 2009). This study involved only 35 participants and without further reproduction, testing and validation it may not be relied upon.

Derivation studies when published should include all necessary details to enable the CPR to be applied and tested, and the study itself to be rigorously reproduced and validated. McGinn and colleagues (2000) state that CPRs that have been derived but not validated "should not be considered ready for clinical application" (p.81).

2.2.2 Validation

2.2.2.1 The Process of Validating a CPR

The next step after derivation is to validate the CPR. In validating a previously-derived CPR, one needs to examine the quality of the study that developed the CPR before deciding whether it is worth utilising or testing. It is generally recommended that CPRs must be validated before being considered reliable or acceptable for widespread clinical use (Cook et al 2010a, Reilly & Evans 2006). This stage is important because many CPRs demonstrate reduced accuracy in validation studies (Toll et al 2008). There are a number of reasons for this. Firstly, the apparent associations between predictors and outcomes could be purely by chance, existing only in the study group, such that other predictors would materialise in a different group of subjects, even if from the same population. Secondly, the predictors may be peculiar to aspects of the study design, such as the study population or the clinicians involved in deriving the CPR, in which case it will not hold true in a different population or with different clinicians. Thirdly, perhaps due to lack of understanding or poor practice, clinicians may not apply the CPR correctly, so that it works only in theory (McGinn et al 2000).

There are several methods of cross-validation available to the researcher, whereby the results of the original study are re-used to test the CPR derived (Heckerling et al 1992). One such method involves removing the results of one of the participants from the study, deriving the CPR without that individual, then applying the CPR to that participant to see if it holds true. This can be repeated for each participant, to determine the success of the CPR (McGinn et al 2000).

However, cross-validation is the weakest method of validating a CPR as it still involves the same population of patients and the same group of clinicians. It is therefore recommended that derivation and validation should occur separately and independently, on a different study population in a different setting (and ideally with a different research group) to improve accuracy and efficacy (McGinn et al 2000), although there are some studies which have derived a CPR and validated it as part of the same study (Dionne et al 2005a, Eagle et al 2004, Haydel et al 2000, Heymans et al 2009, Konno et al 2007a). Validation should involve the incorporation of a number of studies to test the CPR's accuracy more completely by testing it at multiple clinical sites (McGinn et al 2000). The idea of independently validating a CPR is that by testing it on different populations and in different settings, researchers are seeking to show that the CPR holds true across a range of societal variables, considering the possibility that predictor variables appearing in the derivation stage may have occurred by chance. Also, it must show that clinicians are able to interpret and apply the CPR accurately, and be comfortable with its use (Stiell et al 1996). It is important that a validation study aims to investigate if the CPR works in a clinical setting when actually being applied by clinicians, not just as a purely statistical exercise (McGinn et al 2000).

Changes may occur during validation as a result of a new testing procedure becoming available that adds to the predictive value of the CPR. The validation process may also result in changes to the CPR, if it is found to be unreliable or inaccurate when applied to a different population. If the CPR is updated in such a way it will subsequently require further validation in its new form (Toll et al 2008).

An interesting example of the need for widespread (and ongoing) validation is the case of the European System for Cardiac Operative Risk Evaluation (EuroSCORE), a prognostic CPR that was designed to predict the risk of death within 30 days post-operatively for patients undergoing cardiac surgery, and which was derived in large collaborative studies all over Europe, including 13,000 patients in Britain (Nashef et al 1999) and 19,000 patients in France (Roques et al 1999). It was initially validated in numerous studies all over the globe, particularly in a very large study involving 590,000 patients in the United States (US) (Nashef et al 2002) following smaller validation studies in Europe (504 patients in Germany, Geissler et al 2000) and in Asia (803 patients in Japan, Kawachi et al 2001). However, another study with 444 patients in Lithuania (Vanagas et al 2003) found it less reliable than other similar scoring systems for patients at high risk, highlighting the fact that there may be various CPRs that aim to predict outcomes for the same condition, where scores are perhaps affected by local factors, and clinicians should find the CPR(s) that works best in their population.

Meanwhile, the original authors worked on refining the tool with nearly 15,000 patients across Europe (Michel et al 2003, Roques et al 2003) to improve its performance in high-risk patients. This refinement was validated with another 14,500 patients in further studies in Britain (Gogbashian et al 2004, Karthik et al 2004), Switzerland (Barmettler et al 2004), Italy (Zingone et al 2004), Sweden (Nilsson et al 2004), the US (Toumpoulis et al 2005), and Japan (Nishida et al 2006). It seemed the CPR was working well, at least in the Northern Hemisphere.

However, a large study on over 8,000 patients in Australia (Yap et al 2006) found that neither the original nor the refined EuroSCORE worked at all with Australian patients; this could have been due to differences in population, comorbidities, the health system, or surgical approach. Further validation has continued worldwide, and although some studies have supported the validity of the CPR in Italy (D'Errigo et al 2008) and the US (Kobayashi et al 2009), many more are now finding the CPR unreliable in Britain (Bhatti et al 2006), the Netherlands (van Gameren et al 2008, Siregar et al 2012), Italy (Ranucci et al 2009), China (Zheng et al 2009, Wang et al 2010), Turkey (Akar et al 2011), and Canada (Tran et al 2012), with most authors recommending recalibration of the EuroSCORE due to its tendency to overestimate risk. This deficiency may be a reflection of improved surgical techniques, which would have evolved considerably since the CPR was first derived, whereby risk has actually been reduced compared to fifteen years ago.

Perhaps as a result of this feedback, the original authors noted mortality post-cardiac surgery had significantly reduced and conducted another large study to recalibrate the CPR, calling it the EuroSCORE II, involving 22,381 patients undergoing major cardiac surgery in 154 hospitals in 43 countries (Nashef 2012). Further validation has occurred on this recalibrated version, but with mixed results. One study conducted in the Netherlands on 11,788 patients at a single centre found EuroSCORE II better than the original EuroSCORE at calculating post-operative risk, and recommending the EuroSCORE II for consideration for post-operative patients (Ad et al 2016). However another recent multi-centre study on 1125 patients in Germany (Kieser et al 2016) found neither version to be well-calibrated, with the original EuroSCORE overestimating risk and the EuroSCORE II underestimating it.

This example highlights the need that before using a CPR, even one that has been validated on multiple occasions, clinicians should first ascertain whether it may be out of date – how long is it since its derivation, and has the relevant clinical situation changed since then? As another example, a CPR that includes a specific clinical test may be out of date if the application or reliability of the clinical test has changed in any way.

During validation, researchers are aiming to reproduce and confirm the precision of the CPR: does it really work? There is a need to apply strict criteria to ensure appropriate application of the CPR; not only will a poor understanding or poor application fail to validate it, there may actually be dire consequences in some areas of medicine, such as those for neck fracture (Stiell et al 2001a) or head injury (Stiell et al 2001b). Alternatively, a perfectly sound and useful CPR may fail to be validated simply due to poor application.

A CPR derived by Flynn and colleagues (2002), using manipulation of the spine for low back pain, has been found to reliably improve clinical decision-making by at least three other studies (Childs et al 2004, Cleland et al 2006, Fritz et al 2005a). However another two studies (Hallegraef et al 2009, Hancock et al 2008) investigated the validity of this CPR and reported it to be ineffective in predicting response to treatment. On closer inspection, these studies highlight one of the problems with validating a CPR; the study must reproduce the CPR exactly as published, not with variations the authors wish to make.

Hancock and colleagues (2008) did not perform the manipulation as described in the derivation study, a fact they acknowledge in their discussion, instead choosing to use low-velocity mobilisation techniques for most patients rather than high-velocity thrust. This could be a significant distinction that might affect the effectiveness of the CPR, and likely led to their results differing from the original studies.

Hallegraef and colleagues (2009) only considered two of the five predictors described in the original CPR for manipulation of the spine for low back pain: duration of symptoms less than 16 days and no symptoms distal to the knee. There is no mention of the other three predictors: at least one hip with internal rotation range of motion greater than 35°; lumbar hypomobility; and a score on the Fear Avoidance Beliefs Questionnaire Work Subscale lower than 19. A study cannot said to be testing or validating a derived CPR without including all the predictors.

Validation also aims to confirm the CPR's generalisability to various populations. Several studies have tested the Ottawa Ankle Rule (Stiell et al 1992), a CPR designed to determine the need for radiography in acute ankle and foot injuries (described in detail below). These follow-up studies aimed to validate this CPR not only in general terms (Anis et al 1995) but more particularly whether it can be used in children (Libetta et al 1999, Plint et al 1999), as the original study derived the CPR only on patients 18 years or over.

However, there may be a risk of invalidating a perfectly useful CPR by attempting to validate it in populations for which it is not required. Wells and colleagues (1997, 1998, 2000a) derived and repeatedly tested a CPR for the detection of DVT. Childs and Cleland (2006) suggested that researchers aiming to validate this CPR by testing for DVT amongst a broad range of patients with a multiplicity of primary diagnoses (and not necessarily those at risk of DVT) may weaken clinicians' confidence in using the CPR with patients really at risk. On the other hand, Riddle and colleagues (2005) validated the CPR in a study investigating patients with orthopaedic conditions, a population at higher risk of DVT and as such, more likely to need the application of the CPR.

2.2.2.2 Methodological Standards for Validation Studies

As with derivation, validation studies also need to maintain methodological quality. McGinn and colleagues (2000, 2008) suggest four methodological standards should be adhered to, in order to validate a CPR (Table 2.8).

Table 2.8 Methodological standards for CPR validation studies (reproduced from McGinn et al 2000, McGinn et al 2008)

1	Patients should be chosen randomly and represent a broad spectrum within the range of clinical presentation
2	For each criterion standard, assessors should be blinded to the patient's actual status
3	Inter-pretation of the predictor variables and of the rule itself should be blinded from the outcome
4	Follow-up should be possible on all subjects

Validation studies should occur prospectively, and increased validity occurs with all the usual parameters that improve the power of a study – increased sample size, randomised allocation of participants, and blinding of clinicians such that those that perform the predictor test do not evaluate the outcome and vice versa. If at all possible, the presence or absence of any outcome should be established without knowledge of the level of predictor variables, depending particularly on the extent to which assessment of the outcome measure is open to interpretation (Laupacis et al 1997). It is also important that the clinicians in the study are carefully trained in the accurate application of the CPR, including the correct methods of testing for predictor variables, otherwise a sound and effective CPR may fail to be validated.

The aim of validation is to expand usage of the CPR. Validation aims to show that repeated application of a CPR provides the same result consistently, by testing it in multiple centres, in diverse populations that vary in incidence and outcome of the tested entity, with a range of clinicians and an assortment of institutions. The question is, does it work when clinicians are actively applying it in a practice setting using the derived CPR for decision-making and not just their own experience?

Ultimately, the greater the number and variety of settings in which the CPR is tested, applied and found valid, the more confidence there is that it will be applicable in an untested setting. Justice and colleagues (1999) proposed a hierarchy of external validity (Figure 2.4), with each level reflecting the degree of precision and generalisability.

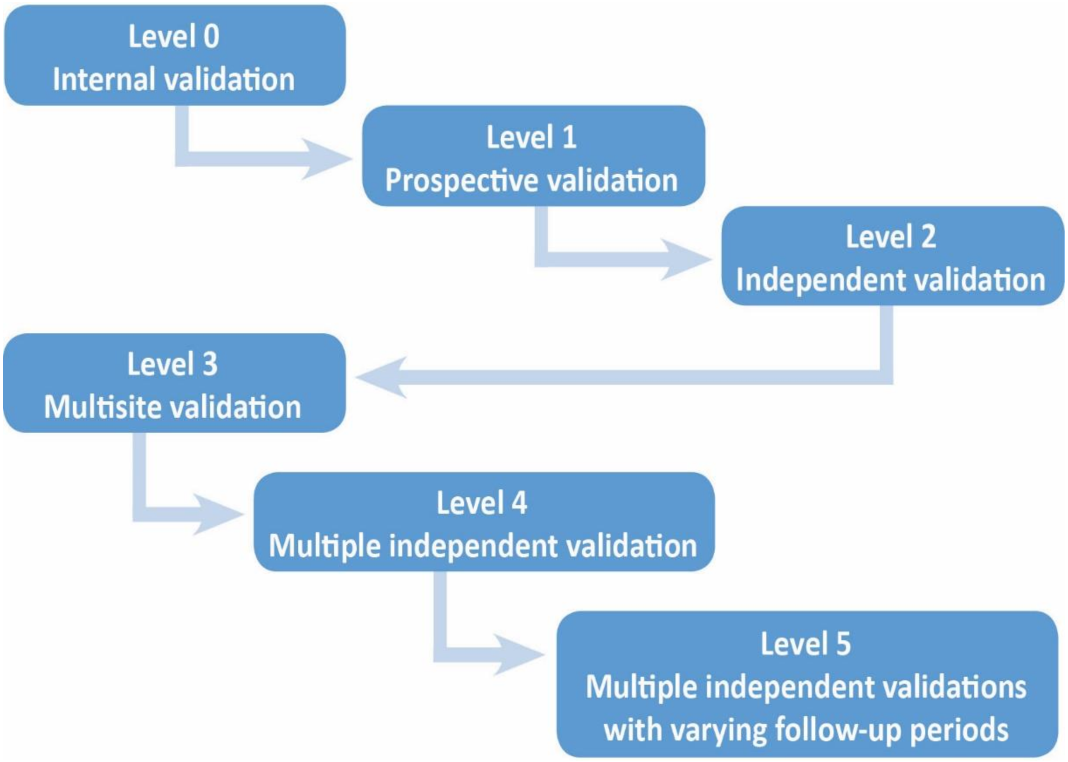


Figure 2.4 Hierarchy of validation (Justice et al 1999)

In general, validation studies are much less common than derivation studies such that, if corroborated at all, a CPR may be only substantiated by one or two studies (Cleland et al 2006, Cleland et al 2010, Hanson et al 2000, Kuipers et al 2007, Laslett et al 2005, Teyhen et al 2007, Werneke & Hart 2004).

Once validated, a CPR may be assessed for its clinical impact.

2.2.3 Impact Analysis

This stage of the CPR's development is to seek evidence of the fact that, and the extent to which, the CPR actually changes clinicians' behaviour, improves care, and has benefits in patient clinical outcomes and/or financial savings. This is the ultimate challenge and goal of using CPRs effectively in clinical practice. A CPR that has been validated and found to be dependable may still not be employed due to a lack of acceptance by clinicians and/or patients. An impact analysis is the best way to determine whether incorporating a CPR into clinical decision-making actually leads to an improvement in patient outcomes. For an effective impact analysis, there are several phases recommended (Figure 2.5 and Table 2.9) (Wallace et al 2011).

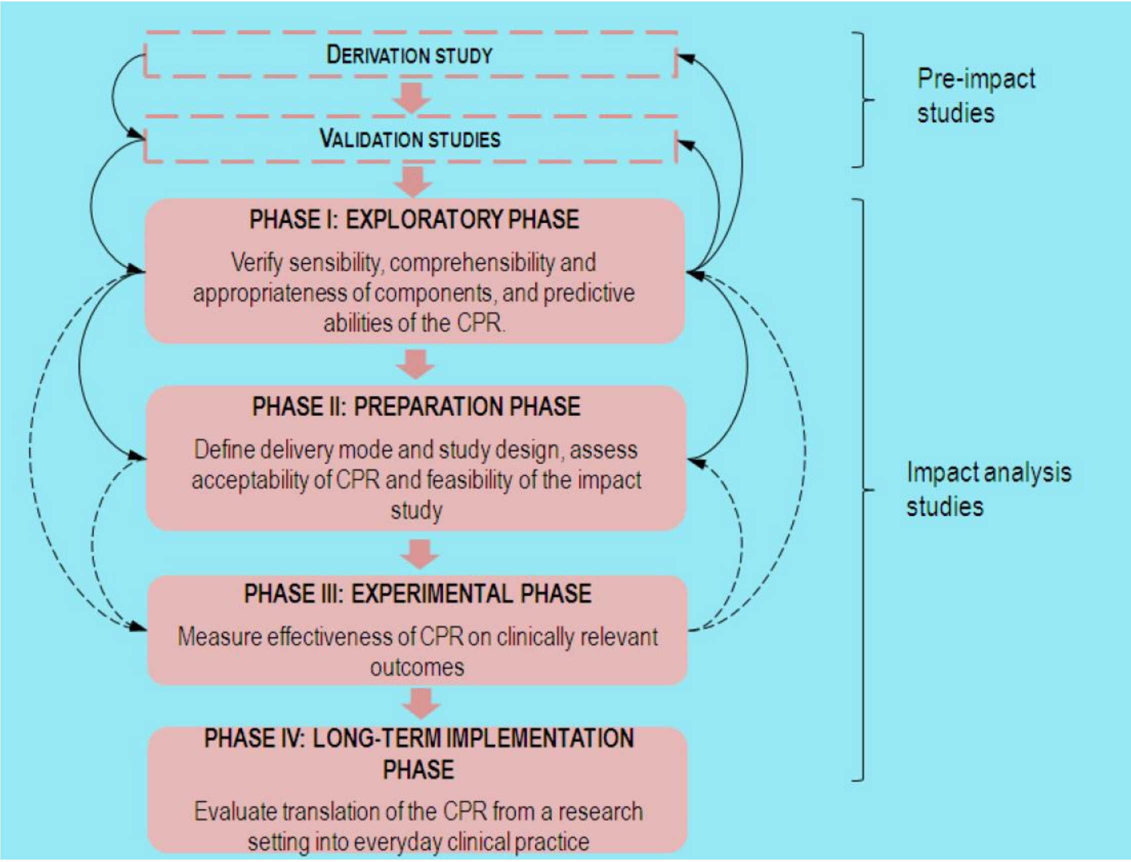


Figure 2.5 Phases for impact analysis of CPRs (Wallace et al 2011)

Table 2.9 Phases for impact analysis of CPRs (reproduced from Wallace et al 2011)

Phase I: Preliminary analysis	**Is the CPR ready for this stage?** For it to be ready, it must have been derived and validated according to stringent methodological criteria, such as described above. A systematic review is recommended for finding and analysing all studies that validate the CPR.
Phase II: Preparation	**Laying the foundations for the study.** Define the study setting, assess the CPR's acceptability, identify possible barriers to its use, decide how it will be incorporated as part of clinical consultations, and possibly also offer ongoing feedback to practitioners while the trial is ongoing.
Phase III: Study	**Assess the impact.** Using carefully considered and clearly specified outcome measures, such as practitioner behaviour or improved care, although patient satisfaction and quality of life are also to be considered.
Phase IV: Dissemination	**Spread the word.** If impact analysis demonstrates the CPR is effective it is ready for widespread implementation.

The impact study should aim to compare two groups, one where the CPR is applied and the other control group where the CPR is not, with the investigation looking for *significant* differences in outcomes. It might also be worth considering dividing those applying the CPR into several groups, with varying levels of support for the CPR (such as mandatory policies requiring the use of the CPR, or where use of the CPR is optional). Of course, as with any study involving human subjects there may be ethical considerations precluding these approaches, but there are a number of variations possible. The same group of clinicians could be studied prior to their knowledge (and therefore application) of the CPR, and compared to their clinical behaviour after they are instructed in the CPR's application and use.

Alternatively, two groups of clinicians could be studied at the same time, one group giving care based on application of the CPR, and the other applying their usual clinical guidelines or standard practice. This latter arrangement would be preferable given the facility to randomise clinicians and patients into the two groups. However, randomisation should not be undertaken by simply asking the same clinician to 'randomly' apply either the CPR or their usual care. Furthermore, randomisation could be achieved by utilising multiple centres (cluster randomisation), with the clinicians at some centres applying usual care, and those at other centres the CPR. This aids in preventing cross-contamination between groups who might otherwise exchange experiences and views.

Reilly and Evans (2006) made recommendations about the methods of an impact study (Table 2.10).

Table 2.10 Methodological standards for studies on impact analysis of CPRs (reproduced from Reilly & Evans 2006)

1	**Study design**	Randomised controlled trial
2	**Inclusion criteria**	Population must be specified if different from derivation or validation studies, indicating generalisability
3	**Outcome measures**	Must be investigated, not just the predictive value or accuracy of the CPR
4	**Blinding**	Between the group that applies the CPR, and the group that measures outcomes
5	**Sample size**	Needs to be larger if sensitivity, rather than specificity, is being measured

Given the importance of this final stage, it is unfortunate that there are relatively few studies devoted to examining how CPRs affect clinicians' behaviour. However many of those that have been undertaken do illustrate the advantages of CPRs in improving clinical practice. There has been a consistent and ongoing effort at analysing the effects of the CPRs derived in Canada and validated in many countries, consisting of the Ottawa Ankle Rule (OAR), Ottawa Knee Rule (OKR), Canadian C-Spine Rule (CCSR), and Canadian CT Head Rule (CCHR), including a large survey of 2,100 emergency department physicians in Australia, Canada, the United Kingdom (UK) and the US on their use of the CCSR and CCHR (Eagles et al 2008). Briefly, the first three CPRs recommend whether X-rays are necessary in ankle/foot, knee, and neck injuries, and the fourth whether a CT scan is indicated in head injury. Implementation and utilisation of these CPRs has been shown to lead to less radiography, reduced waiting times for patients in the Emergency Department (ED), and less cost to patients and health services, without compromising patient care with missed injury diagnoses (Auleley et al 1997, Beutel et al 2012, Brehaut et al 2006, Brehaut et al 2010, Graham et al 1998, Graham et al 2001, Heyworth 2003, Nichol et al 1999, Perry & Stiell 2006, Stiell et al 1994, Stiell et al 1997a, Stiell & Bennett 2007).

An impact study should also look at not only *whether* the CPR is being used, but also *how* it is being used. A clinician may report using a CPR, but does so inconsistently; another may use the CPR only as part of the decision-making process; yet another may even use it incorrectly through faulty recall or learning. A survey of 262 Canadian emergency physicians (Brehaut et al 2005) found that while 99% were familiar with the OAR and 89% reported applying it, only 42% relied on it solely to determine their course of action with the remainder considering other factors in their clinical decision-making. This suggests that it was not being used as a 'rule', but as an aid to clinical judgement.

More significantly, only 31% were able to accurately remember the CPR by identifying the correct indicators. The authors felt that this was a concern, given that this particular CPR is relatively simple and also well known; more complex CPRs are likely to be even more difficult to apply correctly. The use of memory aids to assist in correct application was recommended. Thus impact studies have an important role to play, not only in exploring the usage of the CPR but also in advising ways to improve its performance in practice.

CPRs do not have to be used in isolation, but can also have an impact when used as part of a more comprehensive clinical approach. A CPR derived by Fine and colleagues (1997) for prognosis of community acquired pneumonia aimed to determine whether patients in hospital EDs should be admitted. Marrie and colleagues (2000) studied 19 teaching and community hospitals in Canada using this CPR as part of a clinical pathway, and found that for a total of 1,743 patients the CPR reduced rate of admissions in low-risk patients by 18%, but with no reduction in admission rates for high-risk patients, thus saving resources without risking patient health.

An impact analysis should consider four questions:

1. Did implementing the CPR achieve its purpose in impacting on patient care?
2. How did its actual impact compare with its potential impact?
3. Was the accuracy of the CPR maintained?
4. Did any changes to the CPR affect its accuracy?

Essentially, impact can be measured in terms of safety (proportion of false negatives) and efficiency (proportion of false positives). Reilly and Evans (2006) suggest that efficiency improves if clinicians follow a CPR at all times; however, safety increases when the CPR is overruled by using clinical judgement.

As part of this final stage of development, May and Rosedale (2009) suggest several steps (Figure 2.6), starting with analysing the effect the CPR has on the use of resources, along with follow up studies on the accuracy of the CPR. Practitioners and patients should be surveyed to determine the CPR’s acceptability, and finally an economic analysis should be performed to determine the cost-effectiveness of the CPR. When all these steps have been satisfied, the CPR can be considered ready for dissemination and widespread implementation.

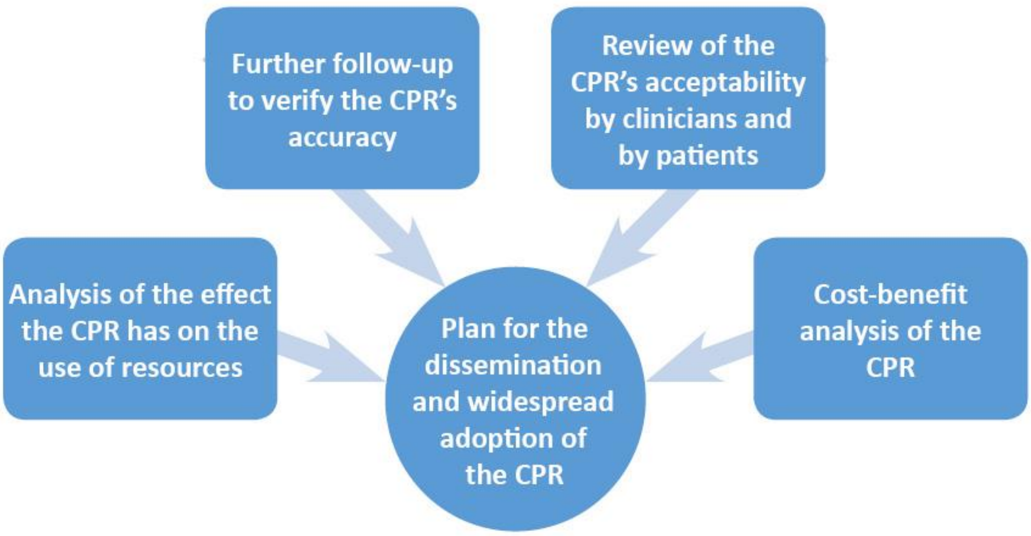


Figure 2.6 Steps leading to the dissemination and adoption of a CPR (adapted from May & Rosedale 2009)

2.2.4 At What Stage Are Most CPRs?

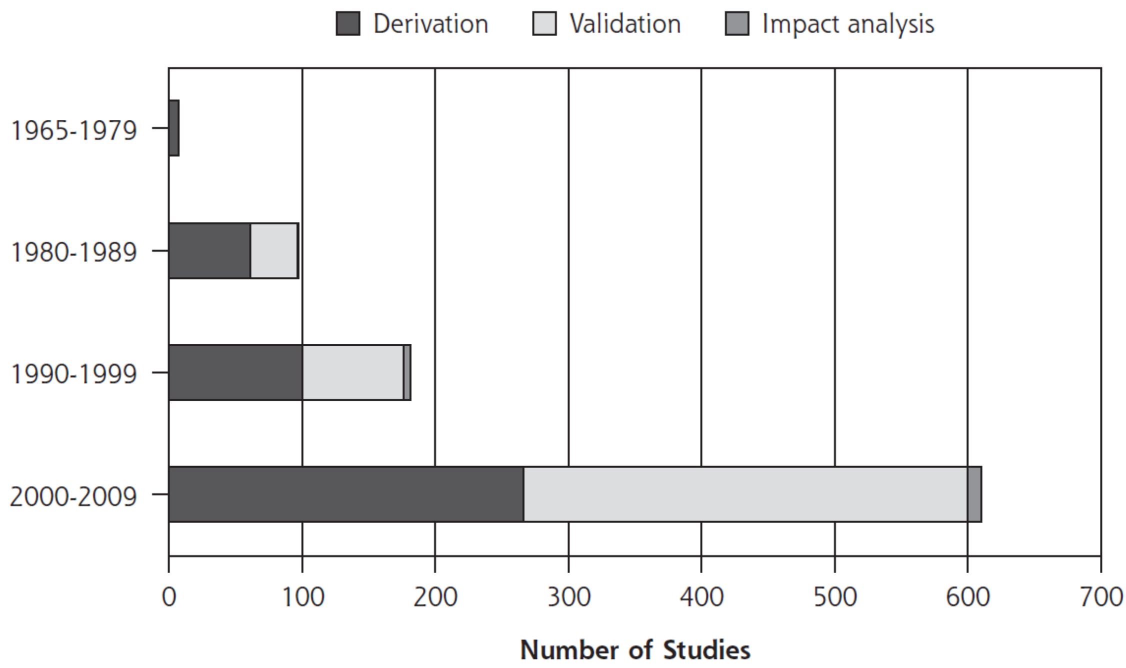
A number of authors have considered the question as to where in the development process one might find CPRs, given the stated importance of validation before they should be utilised, and the ultimate goal of having an impact on clinical performance. A consistent theme in these reviews is that there are always a relatively large number of CPRs that have been derived, with a smaller number having been validated, and very few being assessed for impact (Glynn & Weisbach 2011, Keogh et al 2014, Laupacis et al 1997, Toll et al 2008).

An early analysis of 30 medical studies covering the period 1991-1994 found that 15 derived a CPR and ten derived and simultaneously validated a rule. Only four validated a previously derived rule, while only one described the impact of a CPR (Laupacis et al 1997).

Toll and colleagues (2008) found that the number of scientific papers discussing CPRs had increased from 6,744 in 1995 to 15,662 in 2005, yet still the vast majority were about the derivation stage, with the authors reporting a “relatively small number” validating previous CPRs, and “hardly any” investigating their impact (Toll et al 2008, p1085) – although the exact numbers were not reported. Beneciuk and colleagues (2009) reported that most publications on CPRs for physiotherapy intervention are derivation studies, and suggested that, given the paucity of studies published that validate a CPR or investigate its impact, clinicians should attempt to ensure the CPRs they use were at least derived from higher-quality studies.

Glynn and Weisbach (2011) extensively reviewed those CPRs available for physiotherapists, evaluating 53 CPRs for diagnosis, prognosis or intervention. Of these 23 (43%) had been validated, although some had only been validated internally; just 30% had been externally validated by different researchers in different populations. Only two of the 53 had had their impact studied, although in both cases the impact was positive, with clinicians’ behaviour altered to the benefit of patients. A systematic review of studies on CPRs (including diagnostic, prognostic and intervention) for physiotherapy management of LBP for the period 1990-2009 found that of 25 CPRs that were derived, only two had been validated, and there were none that had progressed to an impact analysis (Haskins et al 2012).

More recently, a review of CPRs in all areas of medicine by Keogh and colleagues in 2014 found 434 derived CPRs, of which 238 (54.8%) had undergone validation in at least one study, but still only 12 (2.8%) had had their impact analysed. Although still insufficient in number, it does appear that the rate of validation has increased over the decades, as can be seen in the graph below (Figure 2.7), but impact analysis remains very slow to occur.



Note: Few studies were reported before 1980; therefore, we grouped these studies into a broader time period (1965-1979).

Figure 2.7 CPR studies, split by decade reported and stage of development of the rule (N=895) (Keogh et al 2014)

2.2.5 Levels of Evidence

McGinn and colleagues (2000) recommended a hierarchy of evidence for CPRs which is worthwhile examining for several purposes; it can be used to judge whether a CPR is worthy of consideration, to help to decide whether to use it, to ascertain how far along in the process of development it has progressed, and to determine how much evidence it has linked to it. This was elaborated upon by Beattie and Nelson (2006) (Table 2.11).

Table 2.11 Hierarchy of evidence for CPRs (reproduced from Beattie & Nelson 2006)

Stage of development	Rationale	Research Strategy	Clinical utility
Need	Concern over inadequate early detection of condition; use of ineffective treatments; excessive cost of care; poor outcomes		
Initial development	Identify all relevant predictors and relevant outcome measures	Clinical observations, review of literature, patient focus groups, expert clinician panel. Determine reliability of measures	
Derivation	Determine variables that are the most powerful predictors	Sampling strategy, obtain measures, ensure complete follow-up	Proposed model only
Level 4 validation	Provide preliminary information regarding the stability of the proposed CPR for limited, well-defined population	Not validated, or validated with split-half original data set, or retrospective data	Needs further validation before clinical usage
Level 3 validation	Determine if the proposed model is stable for different but similar sample	Prospective validation, similar sample set and examiners	May be used with caution, only for patients similar to those in the study
Level 2 validation	Determine if the proposed model yields similar results for a variety of patients	Prospective validation with a wide variety of patients and clinicians. One large study, or several small studies that differ from one another, with demonstrated accuracy	May be used in a variety of settings with confidence in their accuracy
Level 1 validation	Determine if the proposed model improves overall clinical practice and changes clinical behaviour. Determine if the use of the CPR improves patient outcomes	Prospective studies with a wide variety of subjects and clinicians. At least one impact study that describes improvement in clinical practice	May be used in a variety of settings with confidence that it can change clinician behaviour and improve patient outcomes

Thus CPRs that have not been validated, or have only been validated in populations similar to the derivation study (including those that were internally validated) should be used only with caution. CPRs that have been validated in a wider variety of patients and settings can be used with more confidence.

Studies with a higher level of evidence are more likely to have an impact on clinical behaviour. Given that many CPRs have not yet been validated, those derived from high-quality studies could perhaps be considered for application in a clinical setting (Beneciuk et al 2009).

Due to low numbers of participants within studies or relatively low numbers of relevant studies, the use of meta-analyses and systematic reviews are valid methods of increasing the reliability of study outcomes, assessing the predictive value and level of evidence of a particular CPR. Their value lies in the consideration of multiple studies conducted in different populations and settings, improving the accuracy of the sensitivity and specificity of the tests.

2.3 Types of CPRs

Generally speaking there are three broad categories of CPRs (Figure 2.8), depending upon the purpose for which they are intended. These will be discussed in turn.

Diagnostic CPRs

- CPRs that use clinical variables to focus on a specific diagnosis

Prognostic CPRs

- CPRs that aim to predict an outcome (positive or negative)

Prescriptive or intervention CPRs

- CPRs designed to determine the most effective mode of treatment

Figure 2.8 Types of CPRs

2.3.1 Diagnostic

Some CPRs are designed to increase the probability of detection of the presence of a certain condition. In the same way a CPR could also reveal that a condition is unlikely to be present, thereby saving time and resources by avoiding further unnecessary testing. Diagnostic CPRs may also be referred to as screening CPRs.

To ensure any diagnostic test, such as a CPR, is valid, Demirdjian (2010) recommends taking it through four phases of assessment (Table 2.12).

Table 2.12 Phases of assessment for a diagnostic test (reproduced from Demirdjian 2010)

Phase	Questions for analysis	How a CPR can be considered
I	Is the test result different for healthy subjects and those with the condition? If it cannot even do this, the test is worthless and not worth taking further.	Does the CPR differentiate between the healthy and sufferers?
II	Is a patient who scores positive on the test, more likely to have the condition?	Is the CPR sensitive enough to accurately detect the presence of the condition?
III	Does the test accurately distinguish between those with the condition and those without?	Does the CPR correctly identify sufferers?
IV	Does applying the test lead to better patient outcomes?	Does using the CPR improve the patient's prognosis?

In radiology, diagnostic (or screening) CPRs can be very useful, particularly in EDs, due to the high cost of imaging and the risks associated with exposure to radiation. They are valuable not only in deciding which patients require investigation to rule in or rule out diagnoses, but also in determining which imaging method is the best option, given that applications such as CT and MRI have a high degree of sensitivity and specificity, but plain X-rays are substantially cheaper (Blackmore 2005). Physiotherapists should be aware of relevant CPRs that are being used in any ED they may be working in, learning to apply them correctly and thereby improving the efficacy of the ED and aiding the prompt processing of patients through the department.

Examples of this are some well-known CPRs developed by Stiell and colleagues. The first two, the OAR and OKR, were derived to allow a more selective approach to the use of radiography in acute ankle and foot injuries (OAR, Stiell et al 1992) and in acute knee injuries (OKR, Stiell et al 1995) presenting to the ED. The idea if this type of screening was first raised in some earlier studies (Brand et al 1982, Dunlop et al 1986). Both CPRs are designed to *rule out* fractures, so a high sensitivity is desired. The OAR demonstrated a sensitivity of 100% and a specificity of 40% in the derivation study of 900 adults, while the OKR demonstrated a sensitivity of 100% and a specificity of 54% in the derivation study of 1047 adults.

Put simply, these CPRs stipulate that an X-ray of the affected part is <u>only</u> required in the presence of a defined number of specific and easily-assessed signs and symptoms, most of which relate to sites of pain and palpation tenderness and the inability to weight-bear. If these conditions are not met then a fracture is unlikely, and unnecessary radiology can be avoided, whereas prior to the development of these CPRs there was routine X-ray imaging of all ankle, foot and knee injuries. Thus the introduction of the CPRs enabled the saving of patient time and hospital resources.

The OAR has been prospectively validated in a wide selection of studies, not only by the authors (Stiell et al 1993) and others in Canada (McBride 1997), but also on approximately 6000 patients in a wide variety of settings including urban, district and community general and specialist orthopaedic hospitals, trauma centres, and sports medicine centres, all over the globe. Validations have occurred in the US (Leddy et al 1998, Pigman et al 1994, Verma et al 1997), England (Salt & Clancy 1997), Scotland (Keogh et al 1998), France (Auleley et al 1998), Spain (Aginaga et al 1999, Garces et al 2001), Germany (Chandra & Schafmayer 2001), Greece (Papacostas et al 2001), the Netherlands (Pijnenburg et al 2002), Iran (Yazdani et al 2006), Hong Kong (Yuen et al 2001), and Australia (Broomhead & Stuart 2003), although an early multicentre trial on 350 patients in New Zealand (Kelly et al 1994) found an unacceptable rate (14%) of false negatives. A systematic review of 32 studies with meta-analysis of 15,581 patients in 27 studies by Bachmann and colleagues (2003) found a pooled sensitivity of 97.6% and specificity of 31.5%, and suggested that the rate of unnecessary X-rays would be reduced by 30-40% with the use of the OAR.

Furthermore, it has been shown that the OAR does not require assessment by physicians, but can be just as appropriately and effectively applied by physiotherapists (Springer et al 2000) and by nursing staff (Mann et al 1998, Salomone et al 1997), thus further conserving hospital resources. On the other hand, another study (Blackham et al 2008) found that the general public was unable to apply the rule effectively, suggesting that allowing patients to assess their own ankle may actually increase demand for X-rays.

As the OAR was derived in and developed for adults (18 years and over), there has been some considerable discussion concerning its direct applicability and transferability to younger patients with ankle and foot injuries. Two smaller studies (fewer than 200 participants) have validated its use in children aged 5-19 years (Chande 1995, Karpas et al 2002), although Clark and Tanner (2003) did not recommend it as being sensitive enough for children under 18 years of age, suggesting that the possibility of Salter-Harris fractures raised concerns for its efficacy in this age group.

Boutis and colleagues (2001) proposed a Low Risk Clinical Examination (LRCE) that was able to identify high-risk ankle fractures in children (aged 3-16 years) and at the same time reduce the use of radiography by more than the OAR. Dayan and colleagues (2004) reviewed two studies validating the OAR in children under 18 years (Libetta et al 1999, Plint et al 1999) and found that its application might lead to too much or too little radiography than was clinically advisable. They therefore independently derived a CPR for ankle and foot injuries in children (the Malleolar Zone Algorithm), with similar enough predictors to both the OAR and the LRCE, but with slight variations. Gravel and colleagues (2009) performed a prospective validation of these three CPRs on a sample of 272 children, and concluded that the OAR had higher sensitivity than the LRCE or the Malleolar Zone Algorithm. The debate continues.

The OKR has undergone similar testing and positive validation on several thousand patients in North America and Europe (Diercks et al 1997, Emparanza et al 2001, Jenny et al 2005, Ketelslegers et al 2002, Stiell et al 1996, Tigges et al 1999), although it appears to be less reliably applied by nursing staff (Szucs et al 2001). Another systematic review and meta-analysis by Bachmann and colleagues (2004) found a pooled sensitivity of 98.5% and specificity of 48.6% for this CPR. At around the same time as the OKR was being derived, other researchers were also deriving CPRs to assist in deciding the necessity of X-rays for knee injuries; one by Bauer and colleagues (1995) and another known as the Pittsburgh Decision Rule (PDR) by Seaberg and colleagues (1994). Comparisons of the efficacy of the OKR and PDR have been done: Richman and colleagues (1997) tested their application on 351 patients and found only 84.6% sensitivity with both CPRs and recommended refinement; another study on 745 patients by the original authors of the PDR (Seaberg et al 1998) found that both CPRs had the desirable sensitivity at nearly 100%, but that the PDR had much greater specificity than the OKR (60% compared to 27%). More recently, Konan and colleagues (2013) found that the OKR was better validated across a wider adult population but recommended the PDR was more sensitive with children.

Further consideration has been given as to the OKR's applicability to children. A prospective multicentre validation trial (Bulloch et al 2003) found a sensitivity of 100% and a specificity of 42.8% with 750 children aged 2-16 years, while another small study (Khine et al 2001) reported one missed fracture out of 13 patients (sensitivity 92%). A more recent validation reported similar results to Bulloch and colleagues', but also recommended the CPR not be used on children under 5 years (Vijayasankar et al 2009). Another study (Moore et al 2005) suggested that a much simplified CPR for children, just the inability to weight bear, would give 100% sensitivity but would still reduce X-rays by 53%.

The National Emergency X-Radiography Utilization Study, or NEXUS (Hoffman et al 2000), and the CCSR (Stiell et al 2001a) both aim to determine whether X-ray would be useful to ascertain the risk of fracture in the cervical spine. Validation studies have compared the two. In a large study on over 8000 patients Stiell and colleagues (2003) found the CCSR to have better sensitivity (99.4% vs. 90.7%) and specificity (45.1% vs. 36.8%), which would have resulted in fewer X-rays (55.9% compared to 66.6%). Dickinson and colleagues (2004) retrospectively validated the NEXUS on nearly 9000 patients who were assessed by the clinical guidelines, and determined the CPR to have a sensitivity of 92.7% and a specificity of 37.8%, concluding that application of the CPR would have reduced the use of radiography from 68.9% to 62.8%. Bandiera and colleagues (2003) compared the CCSR with emergency physicians' unstructured clinical judgement on over 6000 patients, finding the CCSR to have better sensitivity (100% vs. 92.2%) but lower specificity (44% vs. 53.9%). A more recent systematic review of 15 studies by Michaleff and colleagues (2012) concluded the CCSR had better diagnostic accuracy, with more often higher sensitivity and specificity.

Viccellio and colleagues (2001) found the NEXUS rule was accurate in identifying cervical spine fractures in children, and Touger and colleagues (2002) found it could be applied safely to the elderly, although Barry and McNamara (2005) report a case of an elderly man whose cervical fracture was identified when the CCSR was applied but would have been missed under the NEXUS criteria. They recommended the use of the CCSR with patients over 65 years. Another CPR was derived specifically for patients over 65 years of age (Bub et al 2005), while for high-risk cervical spine injuries, another was developed to identify patients for whom helical CT is indicated (Blackmore et al 1999) via retrospective review of 472 medical records, the latter having been validated independently on 600 patients (Hanson et al 2000). Although the CCSR was derived for application by emergency physicians, several studies have found that ED nurses and paramedics are able to apply it safely and effectively (Clement et al 2007, Clement et al 2011, Miller et al 2006, Stiell et al 2007, Vaillancourt et al 2009).

Many CPRs have been derived for the more selective use of CT in minor head injury, including the New Orleans Criteria (NOC) (Haydel et al 2000), the CCHR (Stiell et al 2001b), and the NEXUS II (Mower et al 2005). Subsequent studies have validated all three as having high sensitivities of 99-100%, but the CCHR and the NEXUS II were found by a number of studies to have better specificity than the NOC (CCHR 37-51%, NEXUS II 44-47% vs. NOC 3-33%) and would result in fewer CT scans (52% compared to 88%), which is arguably the object of the exercise (Papa et al 2007, Papa et al 2012, Smits et al 2005, Stein et al 2009, Stiell et al 2005). In a systematic review, Harnan and colleagues (2011) found the CCHR had been more widely validated, and suggested it had better specificity than all other CPRs including the NEXUS II, although they also felt the exclusion criteria (such as unstable vital signs, history of seizure, bleeding disorder, use of anticoagulants, returned for reassessment of the same head injury, no clear history of trauma) were perhaps too vague and made it difficult to implement.

For paediatric head injuries, the NOC was validated in a small study on 175 children over five years of age (Haydel & Shembekar 2003) while the NEXUS II has been validated in a much larger study of 1666 children of all ages (0-18 years) (Oman et al 2006). Alternatively, many groups have derived head injury CPRs specifically for children and infants, such as the University of California-Davis (Palchak et al 2003), the Canadian Assessment of Tomography for CHildhood injury (CATCH) (Osmond et al 2010), the Children's Head injury ALgorithm for the prediction of Important Clinical Events (CHALICE) (Dunning et al 2006), the Pediatric Emergency Care Applied Research Network (PECARN) (Kuppermann et al 2009), and others (Atabaki et al 2008, Buchanich 2007, Da Dalt et al 2006, Dietrich et al 1993, Greenes & Schutzman 2001, Güzel et al 2009, Quayle et al 1997). In a recent comprehensive systematic review of all of the above paediatric CPRs plus the NEXUS II and the NOC, most were found to have high sensitivities of 96-100%, with the PECARN having the highest specificity at 58-60% (Pickering et al 2011). A further review compared CATCH, CHALICE and PECARN, finding them all to have high sensitivity and low specificity but noting that only PECARN had undergone validation (Lyttle et al 2012). This review also noted that these three CPRs had been derived in different populations, so needed to be validated within a single population to enable clinicians to compare and contrast in order to decide which is worthy of implementation.

Impact studies have looked into the implementation of the Canadian-derived CPRs. Several studies on the OAR (Anis et al 1995, Auleley et al 1997, Stiell et al 1994, Verbeek et al 1997), the OKR (Nichol et al 1999, Stiell et al 1997a), and the CCSR (Perry & Stiell 2006, Stiell & Bennett 2007) reported that application resulted in significant reduction in X-ray requests, with consequent reduction in costs, without adversely affecting patient care. However, although there has been good acceptance of the OAR and OKR in Canada and the UK (Graham et al 1998, Graham et al 2001), there is less inclination to adopt their use in the US, France and Spain (Beutel et al 2012, Graham et al 2001). Also, Brehaut and colleagues (2006) reported that the CCSR was slower than the OAR/OKR to gain acceptance given the higher risk associated with false negatives.

In an implementation trial of the CCHR, Stiell and Bennett (2007) found the rule was not being applied, even though validated and known amongst emergency physicians, perhaps due to physician views that CT scans are standard clinical practice for head injury. However, another study (Eagles et al 2007) reported high usage in Canada (83%) and moderate use in Australasia (55%) and the UK (44%), but less use in the US (29%) where there was simply less awareness of the rule.

Given the success of CPRs in the management of ankle and knee injuries, it seemed logical to develop a similar CPR to predict the need for X-rays in wrist injuries given that trauma to the wrist represents about 20% of musculoskeletal injuries presenting to EDs (Walenkamp et al 2015), and is the second most common musculoskeletal presentation (Australian Institute of Health and Welfare 2016). Also, similar to the ankle and knee, X-rays are routinely performed for wrist trauma although only 41.6% are positive for fracture (van den Brand 2013). A pilot study on 179 patients (Calvo-Lorenzo et al 2008) derived a CPR specifying an X-ray if just one of the four predictors is present (Table 2.13); although they reported a sensitivity of 100% and specificity of 37.7%, no validation has occurred and its adoption in practice is unknown. More recently, Brants and Ijsseldijk (2015) also conducted a small study (95 patients) and derived a CPR with the predictors for X-ray (Table 2.13), also with 100% sensitivity and better specificity at 50%, though this too is yet to be validated. The predictors are similar in both of these CPRs, with common presenting signs and symptoms that make clinical sense as indicating the possible presence of a wrist fracture.

Table 2.13 Comparing unvalidated wrist CPRs (reproduced from Calvo-Lorenzo et al 2008, Brants & Ijsseldijk 2015)

	Calvo-Lorenzo et al 2008	Brants and Ijsseldijk 2015
Predictors – any one of the following:	Age at least 35 years	Age at least 55 years
	Dorsal wrist oedema	Immediate post-injury swelling
	Inability to perform radial deviation or supination	Unable to carry weight with the injured limb
	Instability or pain with the distal radio-ulnar drawer test	Supporting the injured limb with the other hand for pain relief
Sensitivity	100%	100%
Specificity	37.7%	50%

Recently Walenkamp and colleagues (2015) derived two CPRs, called the Amsterdam Wrist Rules (AWR), in a cohort of 487 patients at an academic hospital, which was subsequently externally validated in 395 patients at a group of regional hospitals – one for all wrist fractures and one just for distal radius fractures (Table 2.14). Again, the emphasis with these wrist rules, as with the ankle and knee, is to aim for a high sensitivity so as not to miss fractures, while a lower specificity is less of a concern.

Table 2.14 Comparing predictors in the validated AWR and Amsterdam Pediatric Wrist Rules (reproduced from Walenkamp et al 2015, Slaar et al 2016)

	All Wrist Fractures	Distal Radius Fractures	Paediatric
Predictors	• Age • Sex • Swelling of wrist • Swelling in anatomical snuffbox • Visible deformation • Distal radius tender to palpation • Pain with radial deviation • Pain with axial compression of the thumb	• Age • Swelling of wrist • Visible deformation • Distal radius tender to palpation • Pain on palmar flexion • Pain on supination • Pain on ulnar deviation • Pain on radioulnar ballottement test	• Age • Swelling of the distal radius • Visible deformation • Distal radius tender to palpation • Anatomical snuffbox tender on palpation • Pain with supination
Sensitivity	98.2%	98.4%	95.9%
Specificity	21.0%	25.1%	37.3%

A feature of the AWR is the age predictor, whereby risk increases with age, so the same group of researchers simultaneously worked to develop a paediatric version for those aged 3-18 years (Slaar et al 2016) – which they naturally called the Amsterdam Pediatric Wrist Rules. The derivation arm of the study assessed 408 children at a university hospital, producing similar criteria to the original AWR but with slight differences (Table 2.14), such as where risk *reduces* with age, again achieving a high sensitivity and moderate specificity. The multicentre design of the study allowed the new CPR to be externally validated on 379 children in a group of three other teaching hospitals. Very recently the paediatric CPR underwent impact analysis (Mulders et al 2018) and in a sample of 408 patients the rule correctly identified 98% of fractures and resulted in 19% fewer X-rays, reducing costs as well as patient time spent in the ED (from 94 to 68 minutes).

All these screening CPRs would be useful and applicable for physiotherapists working in an ED setting. Other CPRs have been derived and validated to assist with diagnosis in a wide variety of conditions, including asthma (Gershel et al 1983), chest pain (Goldman et al 1982), pulmonary embolism (PE) and DVT (Wells et al 1997, Wells et al 2000a, Wells et al 2000b), stroke (Celani et al 1994), colon cancer (Zarchy & Ershoff 1991), neck pain (Wainner et al 2003), rotator cuff tear (Park et al 2005), carpal tunnel syndrome (CTS) (Wainner et al 2005), and osteoarthritis (OA) of the knee (Altman et al 1986).

2.3.2 Prognostic

For patients with specific clinical findings, CPRs can be used to predict the probability and extent to which they might recover from a condition, and in this respect can prove useful in determining therapist and patient goals, and perhaps even in directing intervention appropriately. Also, by flagging patients who may take longer to recover, support mechanisms (such as financial or social support) can be activated at an earlier stage than might otherwise have happened, and closer monitoring of progress can be undertaken to facilitate return-to-work strategies.

Whiplash-associated disorders (WAD) can be considerably debilitating, but also have a wide range in the length of time symptoms may persist. For this reason, any tool that assists in the prognosis is potentially valuable. Although earlier studies started identifying predictors for a poor prognosis (Norris & Watt 1983), several studies have progressed the development of a CPR with prognostic validity for this collection of symptoms. The idea of a CPR in this instance is to see if factors identifiable immediately after a motor vehicle accident could be used as predictors of rate of recovery. The advantage of identifying prognostic indicators is that this can lead to better management by assisting with decisions about intervention options (Georgopoulos & Taylor 2017).

Suissa and colleagues (2001) found that a slower recovery could be expected in patients presenting with neck pain on palpation, muscle pain, pain or numbness radiating distally, and headache, especially if the patient were female and aged over 60. Other symptoms such as muscle stiffness or spasm, decreased neck range of movement and dizziness were found to have no predictive value. Older women with the specified symptoms exhibited a median recovery period of 262 days, compared to young men without this particular set of symptoms who recovered in 17 days – so the predictor variables appear to be a good indicator of at least the *relative* length of convalescent time.

Alternatively, Hartling and colleagues (2002) came to a more specific conclusion: that patients who were hit from behind at a location other than a city intersection (and therefore perhaps at a higher speed?), and who complained of pain in the neck, upper back or shoulder at two weeks post-injury (in the absence of fractures or head injury) were more likely to still suffer from pain six months later.

In a third study, Kongsted and colleagues (2008) investigated just one predictor – the score on the Impact of Event Scale (IES) as rated at ten days post-injury. The IES is a self-reported measure designed to quantify the stress response by asking questions about feelings towards a stressful event. Higher scores on this scale were found to be suggestive of ongoing symptoms (such as pain, headache, an inability to work) at twelve months post-injury. The authors therefore recommended that treatment directed towards a stress reaction could benefit long-term prognosis.

More recently it was suggested that the best indicator of recovery from WAD was the score on the Neck Disability Index (NDI); a score of 40 or more (out of 100) was the best predictor of chronic disability, while a score of 32 or less was the best predictor of recovery (Ritchie et al 2013). This study also suggested that the Posttraumatic Diagnostic Scale (PDS) was more accurate as a secondary predictor than the IES, as the PDS also considers the impact of posttraumatic stress. The CPR thus derived in this study depends on the three predictors of NDI score, PDS score, and age. External validation of the CPR was subsequently undertaken in a study that reported a sensitivity of 54.9%, specificity 86.0%, +LR 3.9 and –LR 0.5 (Ritchie et al 2015). The study also included a survey of physiotherapy practitioners who reported that the CPR was easy to use, made clinical sense, and was a viable tool to aid with prognosis.

Another CPR has been derived to assess prognosis in cervical pain, specifically in the presence of cervical radiculopathy (Cleland et al 2007a). This is a simple CPR consisting of just four variables: age under 54; dominant arm not affected; looking down does not exacerbate symptoms; and patients receive a combination of interventions (including manual therapy, traction and strengthening exercises). The authors found that a successful recovery should ensue if at least three of the variables are present, with a +LR of 5.2. Although only a Level 4 validation (as per Beattie & Nelson 2006), the study of 96 participants demonstrated good methodological quality according to the criteria suggested by Kuijpers and colleagues (2004).

A prognostic CPR has also been developed for recovery from non-specific LBP (Hancock et al 2009b), derived in a study of 239 subjects. The CPR consists of three simple variables – pain no more than 7/10 on the Visual Analogue Scale (VAS), no more than one previous episode of LBP, and the duration of the presenting episode no more than five days. If all three variables are present and the patient is treated with manual therapy and given the drug diclofenac, the authors found that 60% of patients would recover in just one week, and 95% in 12 weeks. Internal validation found that the CPR was better at predicting recovery than predictions made by treating physiotherapists.

A further CPR of interest to musculoskeletal physiotherapists is one derived by Kuijpers and colleagues (2006a) for calculating the risk of persistent shoulder pain. Although it comprises a complex scoring system for the calculation, it can be used to predict the percentage risk of the patient having pain persist at six weeks and at six months. The first variable is the duration of the complaint on presentation, depending on whether the pain has already been present less than six weeks, 6-12 weeks, or more than 12 weeks. Also assessed is whether the onset of pain was gradual rather than sudden, and pain scores on the VAS for shoulder pain and neck pain. Other variables for the 6-week prognosis are psychosocial issues and pain on repetitive movements; while the other predictor variable for the 6-month prognosis is whether the patient also has LBP. The authors suggest a sliding scale with increased risk of persisting symptoms as the score increases according to the variables. The CPR was internally validated within the derivation study, and was subsequently prospectively validated in a follow-up study on 212 participants (Kuijpers et al 2007) which showed good performance for 6-week prediction but less accuracy for the 6-month prediction.

ODI

In a different clinical area, those physiotherapists working with patients with spinal cord injuries (SCI) may be interested in utilising a CPR to predict the probability of independent walking one year after traumatic SCI (van Middendorp et al 2011). This large study of 1442 patients in 19 European centres found good predictability based on five variables: age, strength of quadriceps femoris and of gastrocnemius/soleus, and sensation to light touch in the L3 and S1 dermatomes.

Prognostic CPRs are aimed at flagging patients who may require more directed care, though clinicians' judgement may still be superior. A systematic review by Sinuff and colleagues (2006) found that physicians in Intensive Care Units (ICUs) were better than CPRs, or other similar scoring systems, at predicting mortality amongst critically-ill patients in the first 24 hours of ICU admission. It might therefore be better to include or at least consider physicians' predictions when developing a CPR for this type of application, if not during derivation then at least during validation.

Further studies have aimed at developing and testing CPRs on the prognosis of other musculoskeletal conditions commonly encountered by physiotherapists, such as neck pain (Werneke & Hart 2003), low back pain (Enthoven et al 2003, George et al 2005), and upper limb disorders (Feuerstein et al 2000); or other medical conditions such as pneumonia (Auble et al 1998, Farr et al 1991), acute coronary syndrome (Eagle et al 2004), melanoma (Clark et al 1989) and venous leg ulcers (Skene et al 1992).

Prognostic CPRs such as those above can be used by physiotherapists as a means of assisting their consultations with patients, enabling forecasts to be made on the likely or expected recovery rates. It can be reassuring for patients to be given, in this way, some awareness of the expected timeline associated with their recovery, if they can see that they are improving at the expected rate.

2.3.3 Intervention

CPRs can also be used to predict the probability, given certain clinical findings, that patients will respond favourably to a selected method of treatment. Thus they can be very useful and effective in taking patients from a larger heterogeneous diagnostic group, into a discrete homogenous subgroup that is more likely to respond to a particular intervention approach (Fritz 2009). Not only is this course of action practical, it has the added advantage of making the process evidence-based. Intervention CPRs can also be helpful to determine which treatment approaches may not be beneficial, if predictor variables are found to be absent in a patient, and so directing intervention towards other methods which may be more favourable.

One of the best examples of the advantages of interventional CPRs is for LBP. Given the high prevalence (estimated up to 80% of the population will suffer at least once in their life, Rubin 2007), the multitude of presentations and problems that occur with this condition, and the resultant considerable economic and societal costs, CPRs could have a significant impact on clinical outcomes if they can successfully predict the optimum method of treatment. This is especially relevant to physiotherapy given that physiotherapists are one of the health professions most often involved in intervention for LBP (Chenot et al 2008). Jellema and colleagues (2006) found that different factors acted as predictors of LBP outcome depending on whether the patients received a combination of activity, exercise and physiotherapy, or minimal intervention which addressed psychosocial factors only.

Manipulation of the spine is an approach commonly used for LBP, yet there is conflicting evidence as to its efficacy. Flynn and colleagues (2002) sought to identify patients with LBP who would be more likely to benefit from this mode of intervention. The study identified five predictors: duration of symptoms less than 16 days; at least one hip with internal rotation range of motion greater than 35°; lumbar hypomobility; no symptoms distal to the knee; and a score on the Fear Avoidance Beliefs Questionnaire Work Subscale (FABQWS) lower than 19. The authors showed that if three of these predictors were present, the probability of successful treatment using spinal manipulation increased from 45% to 68%, and if four were present the positive response rate jumped to 95%.

Several studies have reviewed these results, with the CPR being positively validated in multicentre trials (Childs et al 2004, Cleland et al 2006, Fritz et al 2005a). The CPR was also indirectly validated by Fritz and colleagues (2004), who identified six factors associated with an inability to benefit from spinal manipulation, four of which were the opposite of the predictors for the CPR. Unfortunately, as Huijbregts (2007) notes, the predictors are quite specific and most clinicians will see a proportion of patients who do not fit the CPR criteria, which may limit its usefulness.

A number of CPRs have been developed in Level 4 validation studies that identify patients with LBP likely to benefit from other interventions. One study with 129 subjects derived a CPR recommending mechanical traction in supine lying if the patient is over 30 years of age, has no neurological deficit, does no manual labour at work, and scores less than 21 on the FABQWS (Cai et al 2009). If all variables are present there is a +LR of 9.4 that three weeks of intervention will result in a 50% reduction in disability on the modified Oswestry Disability Index (ODI).

Another study on 64 patients by Fritz and colleagues (2007) identified that the presence of one or both of two predictor variables (symptoms peripheralise with repeated lumbar spine extension, and/or are reproduced with straight leg raise of the contralateral leg) helps to identify patients with signs of nerve root compression. Intervention applied to these patients with mechanical traction in prone lying, when combined with manual therapy, extension exercises and education can lead to a 50% reduction in disability over a period of six weeks when measured on the modified ODI; the likelihood of recovery is reduced from 84% to 45% if traction is not used.

Other predictors have been identified that indicate a lumbar stabilisation exercise programme may be beneficial (Hicks et al 2005). If at least three of four variables are present there is a +LR of 4.0 that there will be a 50% improvement in function on the ODI after eight weeks of exercises. If none of the variables are present there is a –LR of 0.2 that exercises will not be helpful. An exercise programme may also be beneficial for patients with AS (Alonso-Blanco et al 2009). This small study on 35 subjects found a +LR of 11.2 that exercises over a 15-week programme would significantly improve function if at least two of three variables are identified.

A number of Level 4 validation studies have also aimed to determine ideal methods of intervention for patients with neck pain. CPRs have been derived that identify indicators for response to cervical manipulation (Tseng et al 2006), thoracic manipulation (Cleland et al

2007b), stretching and exercises (Hanney et al 2013), and mechanical traction (Raney et al 2009).

There is also a CPR for the treatment of chronic tension headaches with trigger point therapy (Fernandez-de-las-Penas et al 2008). Eight variables were identified in a study of 122 subjects, including age, presence of trigger points at various sites, neck range of movement into rotation, score on the NDI, and what was termed a Total Tenderness Score (whereby palpation tenderness is scored at eight pairs of muscles and tendon insertions). The probability of a successful response to trigger point therapy increases as more variables are identified as positive: 74% probability with four variables, 86% with five variables, and 100% with six or more variables.

Temporomandibular joint pain may be successfully treated with an occlusal splint, according to a study on 119 subjects (Emshoff & Rudisch 2008). The variables identified were time since onset of pain, VAS pain score at initial assessment, change in VAS pain score at 2-month follow-up, and clinical diagnosis of disc displacement with and without reduction. Prediction of success had a + LR of 10.8, and failure a –LR of 0.05.

Other musculoskeletal conditions for which interventional CPRs exist are knee pain (Currier et al 2007), patello-femoral pain syndrome (Iverson et al 2008, Lesher et al 2006) and ankle sprain (Whitman et al 2009). Unfortunately a recent review (Gross et al 2016) which identified 21 CPRs available for interventions for musculoskeletal conditions such as LBP, neck pain, patellofemoral pain, ankle sprain and lateral epicondylalgia found that most of them had not been validated externally.

Should researchers wish to derive an interventional CPR, Cook and colleagues (2010a) utilised a Delphi method to devise a quality checklist to ensure a minimum standard is achieved in study design and reporting. They developed this after noting that there had been a proliferation in the development of CPRs but without any guidelines having been developed for the reporting of such studies. They suggest their checklist, which covers 23 considerations in four broad areas (Table 2.15), allows researchers to improve the study design and method of reporting studies deriving interventional CPRs.

Table 2.15 Quality checklist for studies deriving interventional CPRs (reproduced from Cook et al 2010a)

Area	Items	Criteria to meet
Study sample	1-4	Setting and location described Study sample described and representative of a patient group receiving the intervention
Outcome measure	5-8	Outcome measures are defined, are reliable and valid, and administration is blinded
Quality of testing	9-17	Tests described in detail, are logical and reliable, and performed prospectively Blinding between outcome measures and intervention
Statistical considerations	18-23	10-15 subjects per predictor variable Statistical significance and confidence intervals reported

2.4 Benefits and Limitations of CPRs

A CPR is a simple algorithm focussing on a few highly significant indicators. It provides information in an abridged format on the smallest number of factors statistically indicative of a particular outcome, and imparting that information in such a way that application follows in a practical manner. However, these same factors that make CPRs so useful also make it all the more important that they be understood and used exactly as planned, being calculated and applied correctly, in order to fulfil their true value.

In a survey of 263 physicians in the US asked to rate the CPRs that were most familiar and most useful, participants confirmed CPRs were easy to use, fit well into clinicians' thought process and workflow, helped with decision-making and saved time (Richardson et al 2015). The authors recommended that CPRs that had reached a higher level of evidence were appropriate for integration into electronic medical records. Used appropriately, CPRs have the potential to save time (the clinician's, the patient's) and money (the patient's, insurers', government's) by directing a course of action more effectively and efficiently. In one study on 221 patients (Davis et al 1997) it was found that if the risk of ankle fracture were calculated to be 5% or less, a third of patients were prepared to not have an X-ray given the option to return in 2-3 days if pain persisted; furthermore, the proportion of patients prepared to wait for an X-ray increased to more than half if they had to pay $100 for the test. For knee injuries, the tolerance was found to be even higher (Baig & Davis 1997), with up to 40% of 252 patients preferring not to have an X-ray if the risk of fracture were only 10%. On the other hand, another much smaller (only 29 subjects) but more recent study (Smith et al 2011) found that most patients asked for an X-ray even if a CPR suggested it was unnecessary.

In a qualitative study (Haskins et al 2014), Australian physiotherapists spoke positively of CPRs, acknowledging that they represented EBP. Participants further indicated that CPRs formalised existent processes for clinical reasoning, helping inform decision-making and giving greater confidence in making predictions, which made them particularly useful for novice practitioners. As they become more widely known, understood, accepted and applied, it may become essential for clinicians to explain CPRs to patients in order to rationalise the course of action being taken, such as explaining the OAR to support a decision not to X-ray a sprained ankle. This will require a greater understanding by the clinician, but should result in better communication with the patient and improved patient compliance. Building trust between clinician and patient is necessary for patient compliance since most procedures require prior consent.

Beattie and Nelson (2006) maintain that CPRs are more significant and useful, or even required, in critical areas where there is clinical uncertainty, such as where incorrect analysis results in an adverse event, or significantly increases cost for no benefit. Thus CPRs may assist in screening for under-diagnosed conditions with potentially serious consequences, such as DVT (Wells et al 1997). Alternatively they can be useful in ascertaining a prognosis or determining an ideal method of intervention where there are multiple and conflicting opinions, such as in multifactorial presentations like non-specific LBP.

Papers where CPRs are derived should be read and examined closely to fully comprehend what they actually advocate, as what may appear at first glance to be a useful CPR may not prove to be so. One study developed a CPR for patients who presented with neck pain, to identify those who might respond to intervention with an appropriate exercise programme (Hanney et al 2013). The study found five predictors of patients likely to respond to this approach, reporting a specificity of 81% with +LR 2.97 for four positive variables, and a specificity of 99% with +LR of 14.94 if all five variables were present. However the authors conceded that a beneficial response to this intervention may only be short-term, as at six-month follow-up patients reported no significant differences in outcomes.

Another consideration is that clinical decision-making is not quite the same as clinical prediction, so that CPRs can give *probabilities* of a diagnosis or prognosis or response to treatment intervention, but do not necessarily advocate decisions (Reilly & Evans 2006). Thus CPRs can potentially contribute to decision-making but should not be used solely to direct it (Barry & McNamara 2005, Brehaut et al 2005); for example, ignoring the psychosocial context of a patient may adversely affect the true measure of risk of a condition and so lead to social inequalities (Lang 2005).

The challenge faced by clinicians is in appraising the quality of a CPR and its potential for improving clinical outcomes, and in finding methods to seamlessly integrate the CPR into clinical practice (McGinn et al 2008). The use of laminated posters or pocket cards, describing the CPR with a succinct explanation of variables, might be helpful. Passive methods of dissemination, such as publication of original research in journals and by presentation at conferences, may be useful in raising awareness in the early stage after CPR derivation but is not well targeted at assisting clinicians. For improved adoption of CPRs more active methods are needed, aimed at those who are more likely to be able to use them, such as publication of systematic reviews and meta-analyses, targeted mailings of practice guidelines, and visiting speakers who can address concerns and overcome barriers (Stiell and Bennett 2007).

For, even if a CPR is valid, there may still be barriers that prevent or hinder its use (Abboud & Cabana 2001, Cabana et al 1999, Haskins et al 2014, McGinn et al 2008, Stiell et al 2006). There may simply be a lack of awareness or understanding of it, or the details are just forgotten. Clinicians may disagree with the concept of using a decision rule, rather than using developed clinical reasoning skills, considering it is too simplistic when faced with the complexities of a clinical presentation, or perhaps too rigid. There is also the view that CPRs are too complicated, and that they lack universality, applying to only a small number of patients. Practitioners may also simply be resistant to change, preferring to stick to tried-and-true methods than 'risking' a new approach, or perceive there is no real advantage in using such tools. Moreover, an experienced clinician may intuitively recognise and respond appropriately to a set of circumstances without the need to apply a CPR.

The clinician may be familiar with a CPR but disagree with the way it was generated, disbelieve the evidence, doubt its effect on outcomes, or even believe it is unsafe for the patient. Some even just dislike the term 'rule' (Haskins et al 2014). They may lack the self-assurance to apply the CPR correctly, or they may feel that the mechanics of applying a CPR is unwieldy and time-consuming, and therefore not worth the effort. They may also be unable to follow the steps involved in the CPR precisely, resulting in miscalculations that mean the CPR is not followed correctly.

Poor understanding and therefore use of a CPR may lead to lack of confidence in it. Alternatively, there may be other simple, practical considerations that prevent following the direction the CPR suggests, such as the concern for litigation, which is a particular consideration in the US (Graham et al 2001). Another particular barrier identified (Plüddemann et al 2014) is the general tendency to continue to derive additional CPRs for the same clinical entity, instead of validating the ones available.

Researchers deriving a new CPR may find it useful to consider the above barriers, and try to address these issues in advocating the adoption of their new rule. Reilly and Evans (2006) describe a list of strategies to consider for overcoming barriers to using CPRs effectively (Table 2.16).

Table 2.16 Barriers to the use of CPRs (reproduced from Reilly & Evans 2006)

Barrier	Approach
Before introduction	
Scepticism of guidelines & of 'cookbook' medicine; feeling of diminished autonomy	Emphasise & enable discretionary use of CPR
Belief that clinical judgement is superior	Compare clinical judgement with CPR via simulated impact analysis
Distrust accuracy of predictors of CPR	Review derivation & validation of CPR, discuss logic of CPR with clinicians
Medico-legal concerns	Establish CPR as standard of care
Disinterest in addressing inefficiencies	Investigate how CPR could facilitate clinicians' tasks
During use (impact analysis)	
Weak incentives for using CPR consistently & accurately	Track usage & provide feedback about impact on patient outcomes
Conviction that overruling CPR is often justified	Track & assess whether clinical judgement improves with CPR use
Concern that important factors are not addressed by CPR, e.g. comorbidities	Review derivation; track whether excluded factors affect predictions or outcomes
Concern that improving efficiency threatens patient safety	Solicit local consensus about tradeoffs
After impact analysis establishes benefit	
CPR 'instrument' is not easy to use	Solicit clinicians' input & redesign format
Absence of supportive infrastructure to sustain use of CPR	Redesign procedures
Natural regression to previous behaviours	Institute continuous performance management procedures
Fear of unintended consequences	Solicit concerns & measure outcomes

A recent Australian qualitative study using focus groups involving 19 physiotherapists, six chiropractors and three osteopaths discussing CPRs for WAD (Kelly et al 2017a) found similar barriers to those reported by Reilly and Evans in regards to acceptance, and identified three factors that participants felt would improve implementation of a CPR:

1. Allowing administrative flexibility in how the CPR could be applied in practice.
2. Providing guidance on how to communicate the use and application of the CPR to patients, such as a written dialogue to act as a guide when talking to patients.
3. The existence of an 'external driver' such as a compensation body or practitioner regulatory authority, specifying mandatory application of a CPR to ensure adherence to best-practice guidelines.

It has been suggested that to move from awareness to acceptance of a clinical guideline such as a CPR, there is a seven-stage pathway (Table 2.17) (Glasziou & Haynes 2005). Steps 1-3 relate to whether the test is appropriate and desirable for use with patients, steps 3-5 consider whether the test is able to be used with a clinician's patient group, and steps 6 and 7 finalise its implementation and include patient education (Gaddis et al 2007).

Table 2.17 Steps from awareness of, to adherence to, a CPR (reproduced from Glasziou & Haynes 2005)

Step	Description
1. Awareness	Clinicians must be aware of it. With the overabundance of information available to clinicians it is not surprising that simply being aware of a relevant CPR is a challenge in itself.
2. Acceptance	They have to accept that it improves their practice. Having heard of a new procedure or test such as a CPR, clinicians may not be persuaded to change their practice from what they believe works for them.
3. Applicability	They must consider whether it is appropriate for their patient group. Clinicians have to understand the CPR and what it represents, to be able to apply it correctly to the right patients.
4. Available and able	They have to know enough to be able to employ it correctly. To utilise a CPR requires access to it, and knowledge and understanding of how to apply it, including any testing procedures that are an integral part of the CPR.
5. Acted on	They have to remember to use it. Even knowing of a CPR, a clinician may forget to apply it but continue with previous practice methods.
6. Agreed to	They have to convince the patient that it is best for them. A patient's beliefs and values may affect their consent to the use of a CPR. It may even be necessary to go through all the above steps with the patient in order to convince them that it is the best course of action.
7. Adhered to	The CPR must be applied correctly, and completely. This may require adherence by the patient, such as with an exercise programme to enhance an intervention.

However it would seem that this list is incomplete. For a CPR to be utilised, especially on an ongoing basis, there would need to be an education component for clinicians – and this would be useful at every step (Table 2.18). Ongoing education is an integral part of the adoption and use of CPRs in clinical practice.

Table 2.18 Steps from awareness of, to adherence to, a CPR, and how education aids the process (building on Glasziou & Haynes 2005)

Step	Description	The role of education
1. Awareness	Clinicians must be aware of it.	Education raises awareness by informing clinicians of a CPR's existence.
2. Acceptance	They have to accept that it improves their practice.	Clinicians should be educated on how the CPR improves practice.
3. Applicability	They must consider whether it is appropriate for their patient group.	Education is required to show how the CPR is applicable and appropriate.
4. Available and able	They have to know enough to be able to employ it correctly.	Education is required to show how the CPR should be employed.
5. Acted on	They have to remember to use it.	Ongoing education, in a readily accessible form such as cards or phone apps, will assist memory.
6. Agreed to	They have to convince the patient that it is best for them.	Here the clinician uses education to explain the use and application of the CPR to the patient.
7. Adhered to	The CPR must be applied correctly, and completely.	This is particularly where education is necessary on an ongoing basis, to ensure its effectiveness.

2.5 CPRs Available for Use in Medicine

CPRs have been derived or developed in medicine for decades. A survey of studies reveals a wide variety of medical CPRs covering most areas of practice or specialty. They are used to predict as diverse outcomes as death from malnutrition (Dramaix et al 1993), the probability of developing delirium in hospital (Inouye et al 1993), the likelihood of fractures in osteoporosis (Nguyen et al 1993), diagnosis of carotid stenosis (Sauve et al 1994), prognosis of venous leg ulcers (Skene et al 1992) and the likelihood of traffic accidents in elderly drivers (Marottoli et al 1994).

The recent review by Keogh and colleagues (2014) found CPRs in most areas of medicine, most commonly in cardiovascular and respiratory, followed by musculoskeletal (see Figure 2.9). However it was noted that although there were studies on CPRs in 17 broad clinical domains, in only five of these (digestive, cardiovascular, respiratory, musculoskeletal and neurological) had there been any impact analysis conducted. A survey of 401 medical practitioners in the UK by the same authors in the same year (Plüddemann et al 2014) found the most commonly used CPRs were for the management of cardiovascular disease and depression.

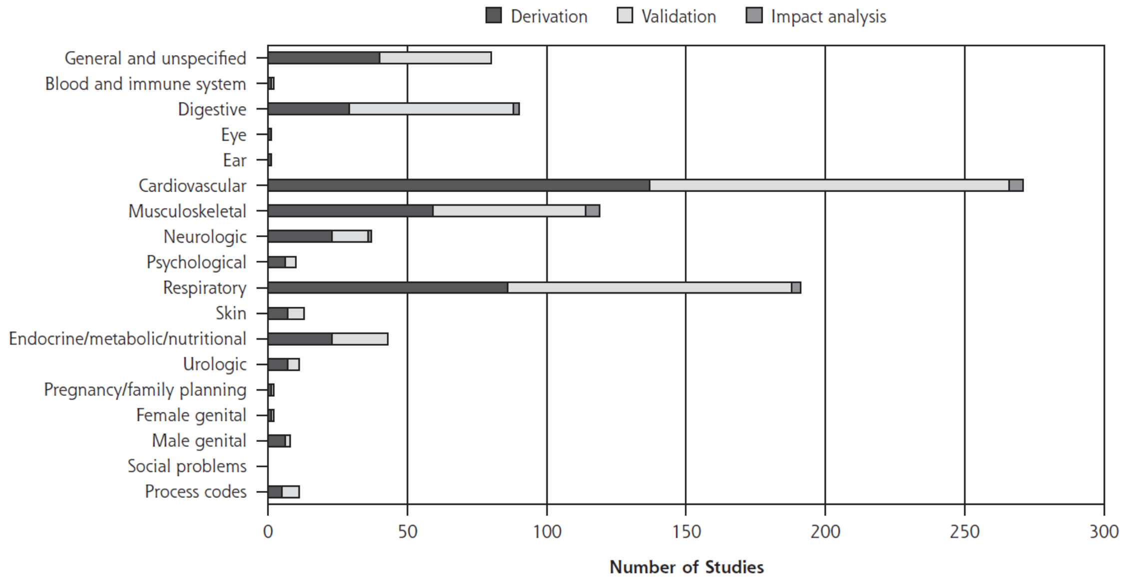


Figure 2.9 Broad clinical domains for CPR studies (N=895) (Keogh et al 2014)

PE is a major problem given that it has a high fatality rate if untreated (Anderson et al 1991) yet is difficult to diagnose as the same signs and symptoms are usually indicative of other less-serious conditions (Moser 1990). As a result, there have been a number of CPRs derived, tested and validated to aid in the diagnosis of PE (Calisir et al 2009, Lucassen et al 2011). One can choose from the Wells Rule (Wells et al 2000b) which was subsequently simplified (Gibson et al 2008); the Geneva Rule (Wicki et al 2001) which has been revised (Le Gal et al 2006), and further simplified (Klok et al 2008); the Pisa Rule (Miniati et al 2003) which has also been simplified (Miniati et al 2008); the Charlotte Rule (Kline et al 2002); or the Pulmonary Embolism Rule-out Criteria (PERC Rule) (Kline et al 2008).

DVT is a concern too, with 52-79% leading to PEs (Mostbeck 1999), yet again the signs and symptoms are not specific to the diagnosis (Haeger 1969). Thus, a number of CPRs have also been derived and validated for the diagnosis of DVT in the lower limb (Iorio 2011, Landefeld et al 1990, Nypaver et al 1993, Oudega et al 2005, Perrier et al 1999, Riddle & Wells 2004, Wells et al 1997, Wells et al 1998, Wells et al 2000a, Wells et al 2003), in the upper limb (Constans et al 2008), and more specifically for patients who are pregnant (Chan et al 2009) or with cancer (Carrier et al 2008, Louzada et al 2012). For physicians treating patients with thromboembolism, there are also CPRs to assess the risk of bleeding while on anticoagulants (Gage et al 2006, Kuijer et al 1999, Landefeld & Goldman 1989).

A review of the literature reveals a multitude of CPRs available for use in many areas of medicine and for many purposes (Table 2.19).

Table 2.19 CPRs available for use in medicine

Condition or problem	Purpose of CPR	Reference(s)
Respiratory		
Tuberculosis	Diagnosis	Bock et al 1996, Cohen et al 1996, Gaeta et al 1997, Tattevin et al 1999
Adult Respiratory Distress Syndrome	Assessment of risk	Fowler et al 1982
Respiratory Syncytial Virus Infection in children	Assessment of risk	Wyer 2006
Pneumonia	Prognosis	Auble et al 1998, Bont et al 2007, Farr et al 1991, Fine et al 1997, Man et al 2007
Asthma	Diagnosis	Gershel et al 1983
	Assessment of severity	Arnold et al 2008
	Risk of relapse and need for hospitalization	Fischl et al 1981
Ear, Nose and Throat		
Sinusitis	Diagnosis	Van Duijn et al 1992, Williams et al 1992
Pharyngitis (strep throat)	Diagnosis	Centor et al 1981, Dobbs 1996, Ebell et al 2000, Komaroff et al 1986, Walsh et al 1975
Persistent middle ear effusions	Assessment of risk	Kraemer et al 1983
Cardiology		
Acute chest pain	Diagnosis	Goldman et al 1982, Goldman et al 1996, Pozen et al 1984, Selker et al 1998
Acute coronary syndrome	Prognosis	Eagle et al 2004, Hess et al 2008
Heart failure	Prognosis	Auble et al 2007
Syncope	Indications for intervention	Kessler et al 2010
	Prognosis and prediction of serious outcomes	Martin et al 1997
Cardiac disease testing	Risk of death during	Morrow et al 1993
Cardiac stress tests	How to perform safely	Sox 1985
Myocardial infarction	Diagnosis	Lee et al 1991
	Short-term prognosis	Eisenberg et al 1981, Longstreth et al 1983, Parsons et al 1994
	Long-term prognosis	Merrilees et al 1984
Left ventricular function post myocardial infarction	Predict	Krumholz et al 1997, Silver et al 1994, Tobin et al 1999
	Assess	Palmeri et al 1982
Return to work after cardiac surgery	Predict the likelihood	Stanton et al 1983
Vascular		
Pulmonary embolism	Assessment of risk	Pryor et al. 1993, Ramsdale et al 1982
	Diagnosis	Morise et al 1997
	Prognosis	Mark et al 1991, Van Walraven et al 1999

Neurological		
Stroke	Assessment of risk as a result of atrial fibrillation	The Stroke Prevention in Arial Fibrillation Investigators 1992a, 1992b
	Differential diagnosis	Celani et al 1994, Poungvarin et al 1991
	Determine safety in driving afterwards	Nouri & Lincoln 1993
Bacterial meningitis	Prognosis	Oostenbrink et al 2002
Epilepsy	Prognosis	Medical Research Council Antiepileptic Drug Withdrawal Study Group 1993, Thurston et al 1982
Nontraumatic coma	Prognosis	Levy et al 1981
Dementia	Diagnosis (identify patients who should undergo CT scan)	Bradshaw et al 1983, Chui & Zhang 1997, Dietch 1983, Freter et al 1998, Larson et al 1984
Orthopaedics		
Hip fracture	Prognosis (identify patients predisposed to permanent institutionalization)	Keene and Anderson 1982
Osteoporosis	Indications for bone densitometry in women	Osteoporosis Risk Assessment Instrument (ORAI) – Cadarette et al 2000; the Simple Calculated Osteoporosis Risk Estimation (SCORE) – Lydick et al 1998
	Indications for bone densitometry in non-Caucasian women	Osteoporosis Self-Assessment Tool (OST) – Koh et al 2001
	Indications for bone densitometry in men	Male Osteoporosis Risk Estimation Score (MORES) – Shepherd et al 2007
Abdominal		
Abdominal pain	Diagnosis – criteria for endoscopy	Mann et al 1983
	Diagnosis – criteria for abdominal X-ray	Eisenberg et al 1982
Appendicitis	Diagnosis	Kharbanda et al 2005
Blunt trauma		
Intra-abdominal injuries in adults	Risk of injury	Holmes et al 2009a
Intra-abdominal injuries in children	Risk of injury	Holmes et al 1999, Holmes et al 2009b
Thoracic injuries in children	Risk of injury	Holmes et al 2002
Penetrating abdominal trauma	Risk of infection	Nichols et al 1984
Opthamology		
Conjunctivitis in children	Diagnosis	Meltzer et al 2010
Renal		
Renal disease	Assessment of risk	Moore et al 1984
	Prognosis	Hutchinson et al 1982
Genitourinary		
Genitourinary symptoms	Diagnosis	Berg et al 1984
Children developing a urinary tract infection	Assessment of risk	Gorelick & Shaw 2000
General medical		
Involuntary weight loss	Diagnosis and prognosis	Marton et al 1981
Bacteraemia	Diagnosis	Bates & Lee 1992
Hypercalcemia	Differential diagnosis of cause	Wong & Freier 1982
Enlarged peripheral lymph nodes	Indication to biopsy	Slap et al 1984
General surgical		
Nausea and vomiting	Assessment of post-operative risk	Sinclair et al 1999
Delirium	Assessment of post-operative risk	Marcantonio et al 1994
Myocardial ischemia	Assessment of post-operative risk	Hollenberg et al 1992
Myocardial infarction	Assessment of post-operative risk	Ashton et al 1993
Death	Assessment of post-operative risk	Browner et al 1992

Emergency department		
Drug overdose	Prognosis	McCarron et al 1982
Head injury	When to admit patient to hospital	Mendelow 1982
Cardiac arrest	When to cease cardiopulmonary resuscitation	Morrison et al 2007, Van Walraven et al 1999
Chest pain	Assessment of risk of cardiac event	Emergency Department Assessment of Chest pain Score (EDACS) – Than et al 2014
Mental health		
Depression	Diagnosis	Whooley et al 1997
Suicidal ideation	Identify	Cooper-Patrick et al 1994
Alcohol abuse	Identify and screen for	Buchsbaum et al 1981, Skinner et al 1984
Liver disease	Assessment of risk in alcoholism	Ryback et al 1982
Oncology		
Breast cancer	Assessment of risk	Gail et al 1989
	Assessment of subsequent risk of lymph node involvement	Cserni et al 2007, Chagpar 2008
Cancer of the colon	Diagnosis	Zarchy & Ershoff 1991
Melanoma	Prognosis	Clark et al 1989, Schuchter et al 1996
Cancer of the prostate	Prognosis	Chodak et al 1991
Non-Hodgkins lymphoma	Prognosis	International Non-Hodgkins Lymphoma Prognostic Factors Project 1993

There are certain challenges in paediatric practice, given the concerns and expectations of parents, the difficulties of obtaining a comprehensive and valid history, and a potentially abbreviated examination from an uncooperative child. Paediatric CPRs could be valuable but their development may be restricted by the limited patient pool available with the condition – trying to find the many hundreds of patients required for derivation and subsequent validation to the necessary degree of precision may simply be too much.

One systematic review identified CPRs that had been derived specifically for children (Maguire et al 2011) and came up with a long list covering a wide variety of clinical specialty areas (Table 2.20).

Table 2.20 Conditions for which CPRs have been developed for children (reproduced from Maguire et al 2011)

Outcome	Population of children	No. of studies (N=137)
Occult serious bacterial infection	Febrile infants	21
	Febrile neutropenia	4
Streptococcal pharyngitis	Sore throat	13
Bacterial meningitis	Children at risk of meningitis	12
Appendicitis	Abdominal pain	11
Intracranial injury	Head trauma	11
Extremity fracture	Blunt ankle injury	11
Malaria	Fever in malaria-endemic region	6
Chest radiograph infiltrate	Suspected pneumonia	4
Septic joint	Irritable joint	4
Vesicoureteric reflux	Urinary tract infection	3
Intra-abdominal injury	Blunt abdominal trauma	3
Lyme meningitis	Meningitis	2
Urinary tract infection	Young girls with fever	2
Normal chest radiograph	Respiratory syncytial virus infection	2
Influenza	Influenza-like illness	3
Safe discharge from the emergency department	Bronchiolitis	2
Dehydration	Vomiting or diarrhea	2
Uneventful course	Idiopathic thrombocytopenia	1
Pathologic diagnosis	Back pain	1
Pneumocystis pneumonia	HIV infection and pneumonia	1
Persistent disease	Graves disease	1
Undervaccination	Emergency department patients	1
False-positive blood culture	Children in the emergency department with blood culture taken	1
Emergency operative management	Trauma	1
Intrathoracic injury	Blunt torso trauma	1
Cervical spine injury	Trauma	1
Difficult intravenous access	Children who require an intravenous line	1
Cervical infection	Adolescents who require pelvic exam	1
Active rickets	Third-world children with leg deformity	1
Tumor lysis syndrome	Leukemia	1
Cervical infection	Suspected pelvic inflammatory disease	1
HIV infection	Suspected HIV infection	1
Pulmonary embolism	Suspected pulmonary embolism	1
Tuberculosis	Suspected tuberculosis	1
Pyloric stenosis	Suspected pyloric stenosis	1
Esophageal varices	Chronic liver disease	1

In all, they found 137 studies describing 101 CPRs targeting 36 childhood conditions, particularly acute infections and trauma. The authors felt that these conditions would be ideal candidates for the application of CPRs because they are widespread, often have poor outcomes, diagnoses are often difficult to substantiate, and as a result patients often undergo unnecessary tests and interventions. Unfortunately they again found the issue of few CPRs being validated (only 8% with broad validation) and none with impact analysis. They suggested that research be aimed at not only CPRs to aid clinicians with decision-making, but also developing 'decision aids' to help parents make decisions regarding care of their children. In addition, they recommended paediatric CPRs should assist rather than direct decision-making, providing practitioners with information to enhance their clinical judgement and enable them to include consideration of the parents' preferences and values.

2.6 CPRs Available for Use in Physiotherapy

Although not a new concept in general (and particularly emergency) medicine, CPRs are a relatively innovative idea in physiotherapy practice. While CPRs have been developed that may be useful for physiotherapists there is no clear evidence that they are widely used, possibly because they are unknown to many clinicians, or their value is not appreciated. Recent studies have identified multiple barriers that inhibit physiotherapists' use of CPRs, particularly relating to lack of understanding and poor perception of CPRs (Haskins et al 2014).

However more recently there has been a growth in CPRs applicable to physiotherapy (Fritz 2009), with an escalation of articles discussing CPRs, their use and relevance, as well as studies deriving them. In fact, Beattie and Nelson (2006) recommend that the development of CPRs should be a high priority in physiotherapy research, particularly those that screen for potentially serious conditions or consequences, and those that aid in classification of patients into subgroups to assist with selection of optimal treatment strategies.

It should also be a requirement that the CPRs derived must be useful in meaningfully adding to clinical management. Kastelein and colleagues (2009) 'derived' two CPRs: one for knee effusion, consisting of knee swelling noticed by the patient, plus a positive Ballottement test; and another for medial collateral ligament (MCL) tear, consisting of a history of external force or rotational trauma, plus pain and laxity with the valgus stress test at 30°. This study arguably adds little except to validate the accuracy of the Ballottement test and the valgus stress test. Any competent physiotherapist would likely be able to diagnose knee effusion and an MCL tear just as easily from the history and examination using the same tests, without the need to employ a CPR.

Indeed, Fritz (2009) felt that the emphasis in the derivation of CPRs for physiotherapy has been on a methodologically sound construct, but losing sight of the importance of actually improving clinical outcomes. Noting that almost all studies on CPRs for physiotherapy were derivative, it was recommended that future research should focus on critically examining and validating existing CPRs, so that clinicians can have confidence in utilising them, and thus improve patient care. Another recent qualitative study using focus groups consisting of 26 Australian physiotherapists, identified the following desirable characteristics of CPRs (Haskins et al 2015a), and although the study investigated CPRs for LBP these could equally apply to CPRs for any condition or outcome (Table 2.21).

Table 2.21 Physiotherapists' requirements for CPRs (reproduced from Haskins et al 2015a)

General area	Requirements of CPRs
Application	Simple, practical, easy to apply
	Be for specific and well-defined presentations
	Compatible with traditional clinical decision-making
Believability and significance	Make sense, with a clear relationship between predictor variables and outcome
	Relevant and meaningful
Performance	Inspire confidence that its use will lead to better patient outcomes
	Must be accurate in order to be useful

Similarly, in deciding whether to apply a CPR in the clinical setting, several considerations should be taken into account (Table 2.22).

Table 2.22 Considerations in applying a CPR (reproduced from Beattie & Nelson 2006)

1	**What was the process used to derive and validate the CPR?**	Was the data collected prospectively? Did the researchers consider all potential predictor variables at the outset? Was there a 'gold standard' available with which to test and compare positive/negative outcomes? Was the sample size sufficient to give power to the statistical result? Has the CPR been validated, and if so, how well was this done?
2	**How accurate is the CPR?**	By how much does a positive score on the CPR increase the likelihood of the desired outcome?
3	**How relevant and applicable is the CPR to the population at hand?**	Was the CPR derived or validated on a similar population? Are there differences in age, incidence of condition, or even social factors?

There is certainly a wide selection of CPRs relevant to physiotherapy practice. A large number are for LBP, but then this would be appropriate given that LBP is the most common reason for consulting physiotherapists, representing up to 50% of musculoskeletal presentations (Di Fabio & Boissonnault 1998, Jette & Delitto 1997) (see Table 2.25).

A large Japanese study involving over a hundred orthopaedic specialists at 50 hospitals and 22 clinics evaluated a total of 468 patients who had been diagnosed with spinal stenosis, based on expert opinion in considering the patient's clinical history and physical examination, along with radiographic findings from X-ray and MRI investigations (Konno et al 2007b). The resultant CPR derived for the diagnosis of spinal stenosis reported a sensitivity of 92.8%, specificity of 72.0%, +LR 3.31 and –LR 0.1 (unfortunately if a bit clumsy with 10 predictors). This was subsequently independently validated in a study involving 118 patients at 10 hospitals, which found a sensitivity of 94.8% and a specificity of 40.0% (Kato et al 2009). The original authors note that there is no 'gold standard' for the diagnosis of spinal stenosis, such as CT or MRI which involve interpretation to reach the diagnosis, but they suggest that their CPR can act as a 'diagnostic support tool', that is, lending support to a clinical diagnosis.

Another condition for which CPRs are available is in the presence of AS, also termed Inflammatory Back Pain (IBP); there are a number of different classification systems available to clinicians (Table 2.24). The 'gold standard' for a diagnosis of IBP was a blood test for the antigen HLA-B27 but this has its limitations - testing can be expensive, and 6% of white people carry the antigen idiosyncratically and consequently may be false-positives, so it seemed prudent to develop other accurate methods to identify the condition. An early study on 138 patients (42 with known IBP, 21 with mechanical LBP, and 75 control patients) suggested that clinical history on its own is sufficient for a differential diagnosis (Calin et al 1977) reporting a sensitivity of 95% and a specificity of 85% if four out of five criteria were present (Table 2.24). This is as sensitive as HLA-B27 testing but with a much better specificity (with the blood test at only 20%). In a second study, Rudwaleit and colleagues (2006) developed the Berlin criteria (Tables 2.23 & 2.24). The derivation study assessed 213 patients (101 with IBP, 112 with mechanical LBP) to develop a set of criteria, to be used for both diagnosis and classification of IBP.

Table 2.23 Proposed new criteria for inflammatory back pain in young to middle-aged adults (50 years old) with chronic back pain, and application as classification and diagnostic criteria (reproduced from Rudwaleit et al 2006)

Individual parameters of the inflammatory back pain criteria	
1. Morning stiffness of >30 minutes' duration 2. Improvement in back pain with exercise but not with rest 3. Awakening because of back pain during the second half of the night only 4. Alternating buttock pain	
Application as *classification* criteria	
The criteria are fulfilled if at least 2 of the 4 parameters are present	Sensitivity 70.3% Specificity 81.2% Positive LR 3.7
Application as *diagnostic* criteria	
If **none** of the 4 parameters are present	Sensitivity 10.9% (95% CI 6.2–18.5) Specificity 57.1% (95% CI 47.9–65.9) Positive LR 0.25 (95% CI 0.14–0.46) Posttest probability 1.3%
If **1** of the 4 parameters is present	Sensitivity 18.8% (95% CI 12.4–27.5) Specificity 61.6% (95% CI 52.4–70.1) Positive LR 0.5 (95% CI 0.3–0.8) Posttest probability 2.6%
If **2** of the 4 parameters are present	Sensitivity 36.6% (95% CI 27.9–46.4) Specificity 83.9% (95% CI 76.0–89.6) Positive LR 2.3 (95% CI 1.4–3.7) Posttest probability 10.8%
If **≥3** of the 4 parameters are present	Sensitivity 33.6% (95% CI 25.1–43.3) Specificity 97.3% (95% CI 92.4–99.1) Positive LR 12.4 (95% CI 4.0–39.7) Posttest probability 39.4%

In a follow-up study (Sieper et al 2009), a separate set of criteria were derived in an international workshop of 13 expert rheumatologists (Table 2.24), reporting a sensitivity of 77.0% and a specificity of 91.7% when four of the five criteria are present. The same study went on to conduct a review and validation on 648 patients with chronic undiagnosed back pain, comparing the Calin criteria, Berlin criteria and experts' criteria. The study found the Calin criteria demonstrated higher sensitivity but lower specificity, the Berlin criteria lower sensitivity but better specificity, and concluded the experts' criteria demonstrated a balance between sensitivity and specificity. The Berlin criteria underwent further external validation in another study of 141 patients (Chan et al 2012) and was found to be an accurate indicator of IBP.

Table 2.24 IBP according to various criteria (reproduced from Calin et al 1977, Rudwaleit et al 2006, Sieper et al 2009)

Calin Criteria (Calin et al 1977)	**Berlin Criteria (Rudwaleit et al 2006a)**	**IBP experts (Sieper et al 2009)**
• Age at onset < 40 years • Duration of back pain more than 3 months • Insidious onset • Morning stiffness • Improvement with exercise	• Morning stiffness of >30 minutes' duration • Improvement with exercise but not with rest • Awakening during the second half of the night because of pain • Alternating buttock pain	• Age at onset < 40 years • Insidious onset • Improvement with exercise • No improvement with rest • Pain at night (with improvement on getting up)
IBP if 4/5 present	IBP if 2/4 present	IBP if 4/5 present
Sensitivity 95% Specificity 85%	Sensitivity 70% Specificity 81%	Sensitivity 77% Specificity 92%

One large study enrolled 1213 patients in the North-Western US to derive a CPR predicting long-term limitations in function for those with chronic LBP, which was then internally validated in the same study (Dionne et al 1997). One- and two-year follow up was obtained with 1024 patients. Measurement of functional limitations was achieved through a modified Roland-Morris questionnaire, with the outcome predictors for the CPR being somatization and depression, with a reported sensitivity of 86% and specificity of 57%. The CPR was successfully validated in a different population of 860 patients in French-speaking Canada (Dionne 2005), with a reported sensitivity of 91% and a specificity of 29%; in this study, the measure of functional disability was determined through a 17-question symptom checklist (ten on depression, seven on somatisation).

A further validation occurred in a 2-year prospective study that was also investigating improving the predictive validity of the CPR by determining if the symptom checklist could be streamlined without the CPR losing accuracy (Dionne et al 2011). Another 1262 patients were enrolled with 1090 available for the two-year follow-up. The authors were able to manage to effectively screen patients with a simple 5-question screening tool – only one for depression, three for somatization, and a new one on 'pain in the heart or chest'. The authors did not seek to explain this last predictor.

A CPR has also been derived for diagnosis of cervical spine myelopathy (CSM), identifying five predictors that work both to rule in and rule out the diagnosis. The derivation study reports a specificity of 99% and +LR of 30.9 that CSM is present if three of the five predictors are present, while if only one of five predictor tests are positive the condition is unlikely with a sensitivity of 94% and a –LR of 0.18 (Cook et al 2010b). This CPR has been internally and externally validated in a large prospective multicentre study comprising 743 patients in North America, South America, Europe and Asia (Tetreault et al 2015).

There are several CPRs that can indicate the prognosis in WAD (Hartling et al 2002, Kongsted et al 2008, Norris & Watt 1983, Ritchie et al 2013, Suissa et al 2001, Williamson et al 2015) and more that can be used to direct intervention (Cai et al 2011, Hanney et al 2013). A recent systematic review of CPRs available for this cluster of symptoms (Kelly et al 2017b) found that although many had not been validated, the CPRs contained common predictor variables, such as the NDI score, along with behavioural and psychological factors, and recommended that these could be considered individually by clinicians to aid in prognosis.

Further examples of CPRs relevant for use in physiotherapy practice are listed in Table 2.25.

Table 2.25 CPRs available for use in physiotherapy

Region or problem	Purpose of CPR	Reference(s)
Persistent pain		
Persistent musculoskeletal pain	Prognosis	Hewitt et al 2007
Neuropathy		
Peripheral neuropathy in older persons	Diagnosis	Richardson 2002
Low Back Pain		
Vertebral fracture	Diagnosis	Henschke et al 2009
Malignancy	Diagnosis	Henschke et al 2007
Radiographic instability	Diagnosis	Fritz et al 2005b
Pain originating in the disc	Diagnosis	Laslett et al 2006a
Pain originating in the sacroiliac joint	Diagnosis	Laslett et al 2003, Laslett et al 2005, van der Wurff et al 2006
Pain originating in the facet (zygapophyseal) joint	Diagnosis	Laslett et al 2006b
6-week pain outcome	Prognosis	Jellema et al 2006
6-month pain outcome	Prognosis	George et al 2005
Successful return-to-work outcome	Prognosis	Dionne et al 2005a
General predictors for rate of recovery	Prognosis	Enthoven et al 2003, Gross & Battie 2005, Hancock et al 2009b, Heymans et al 2009
Development of chronic pain and disability	Prognosis	Werneke & Hart 2001
Likely to respond to spinal manipulation	Interventional	Childs et al 2004, Cleland et al 2006, Fritz et al 2004, Flynn et al 2002, Fritz et al 2005a
Likely to respond to lumbar traction in supine	Interventional	Cai et al 2009
Likely to respond to lumbar traction in prone	Interventional	Fritz et al 2007
Likely to respond to the McKenzie approach	Interventional	McKenzie 1981, May et al 2008
Likely to respond to exercises according to directional preference	Interventional	Long et al 2004
Likely to respond to stabilisation exercises	Interventional	Hicks et al 2005, Teyhen et al 2007
Likely to respond to Pilates exercises	Interventional	Stolze et al 2012
Exercises specifically for AS (IBP)	Interventional	Alonso-Blanco et al 2009

Neck Pain		
Cervical facet joint pain	Diagnosis	Schneider et al 2014
Cervical radiculopathy	Diagnosis	Wainner et al 2003
	Predictors of response to treatment	Cleland et al 2007b
Likely to respond to cervical manipulation	Interventional	Tseng et al 2006
Likely to respond to cervical traction and exercise	Interventional	Raney et al 2009
Likely to respond to a combination of thoracic spine manipulation, exercise, and patient education	Interventional	Cleland et al 2007a
Development of chronic pain and disability	Prognosis	Werneke & Hart 2003
Headache		
General predictors of response to treatment	Interventional	Jull & Stanton 2005
Likely to respond to treatment with muscle trigger point therapy alone	Interventional	Fernandez-de-las-Penas et al 2008
Likely to respond to treatment with muscle trigger point therapy combined with joint mobilisation	Interventional	Fernandez-de-las-Penas et al 2011
Temporomandibular joint		
Temporomandibular joint pain likely to respond to treatment with an occlusal splint	Interventional	Emshoff & Rudisch 2008
Upper limb		
Work-related upper limb disorders	Prognosis	Feuerstein et al 2000
Shoulder pain	Prognosis	Kuijpers et al 2006a
Likelihood of sick leave as a result of shoulder pain	Assessment of risk	Kuijpers et al 2006b
Shoulder soft tissue disorders likely to respond to physiotherapy treatment	Interventional	Kennedy et al 2006
Rotator cuff tear	Diagnosis	Litaker et al 2000
Degree of subacromial impingement and rotator cuff tear	Differential diagnosis	Park et al 2005
Shoulder pain likely to respond to cervicothoracic manipulation	Interventional	Mintken et al 2010
Lateral epicondylalgia likely to respond to exercise and mobilisations-with-movement	Interventional	Vicenzino et al 2009
CTS	Diagnosis	Wainner et al 2005
OA in the hand	Diagnosis	Altman et al 1990
Lower limb		
OA hip	Diagnosis	Altman et al 1991, Sutlive et al 2008
OA knee	Prognosis	Wolfe & Lane 2002
	Diagnosis	Altman et al 1986
Knee pain likely to respond to mobilisation of the hip	Interventional	Currier et al 2007
Patellofemoral pain likely to respond to treatment with lumbopelvic manipulation	Interventional	Iverson et al 2008
Patellofemoral pain likely to respond to treatment with taping	Interventional	Lesher et al 2006
Patellofemoral pain likely to respond to treatment with foot orthoses	Interventional	Vicenzino et al 2010
Patellofemoral pain likely to respond to treatment with a combination of foot orthoses and modified activity	Interventional	Sutlive et al 2004
Ankle sprain likely to respond to treatment with manual therapy and general mobility exercise	Interventional	Whitman et al 2009
Pelvic floor		
Urinary incontinence	Assessment	Hilton & Stanton 1981

A very recent study reported the derivation of a CPR for the treatment of patients with plantar heel pain (Wu et al 2018). In the presence of five of six variables, the authors found anti-pronation taping effective in providing significant pain reduction within a seven-day period, with a specificity of 96% and +LR of 6.7. Although only a small study (28 patients) and clearly too recent to have been validated, it is an interesting example of a CPR that 'makes sense' clinically. Given that it involves an intervention that is very simple, non-invasive, appears to work quickly, and could already be under consideration by a clinician for this condition, it might be a worthwhile exercise to calculate the CPR and if applicable, try this taping as a first-visit treatment, perhaps as a 'mini-trial'.

2.7 Clinical Education of Physiotherapy Students

Having considered CPRs in some detail, and explored those available in medicine in general, and in physiotherapy in particular, it is pertinent to consider how clinical learning occurs in physiotherapy education. This is because the setting for clinical education, involving as it does consultations with actual patients with conditions that require intervention, is ideal for the introduction of the application of CPRs. It is important that students be able to understand how to apply the CPR in a clinical environment, and where it could aid with their clinical decision-making.

In any field of health, including physiotherapy, the progression of learning from an academic, theoretical context to a clinical environment is a critical element in advancing to competence as a beginning practitioner (Patton et al 2013). This is because the clinic is such a rich learning environment that even experienced clinicians never stop learning – every interaction or consultation with a patient is a potential source of learning, expanding the knowledge base in often-subtle ways (Christensen et al 2019).

Education of theory occurs from commencement of a university course, and occurs at various steps as the student progresses through the years of study. In Australia, physiotherapy students commonly spend their first year or two learning essential background theory in such areas as physics, chemistry, anatomy, biomechanics, physiology, sociology and psychology, but most of these involve abstract concepts or rote-learned facts to be stored in their knowledge-base until they can see how to utilise the information they have learned managing clinical problems. As they progress through the years of study students learn more theory based on the theory already learned, such as on disease processes/medical conditions and examination/treatment processes, but this is still largely an abstract period of learning.

Students often then apply this factual underpinning knowledge to aid their understanding as they progress to learn physiotherapy professional skills, such as clinical assessment procedures and treatment techniques, but even then they usually learn these physiotherapy skill focussed topics as abstract concepts and motor skills to be mastered. They can learn much by practicing these skills on each other, but it is only when they can apply and consolidate all they have learned in a clinical setting with real (or simulated) patients with real-world problems that they can begin to grasp the complexities of dealing with people and their illnesses and injuries, including collaborative decision-making about diagnosis, prognosis and intervention. In this way clinical education is fundamental in preparing physiotherapy students for their professional practice (Patton et al 2013).

Learning is a dynamic process, and in the context of a clinical placement, students utilise strategies to adapt and reorganise the theoretical basis of university-based knowledge into practical clinical application and decision-making (Delany & Bragg 2009). In an academic example of a consultation, patients will typically tend to be presented with a 'standard' set of symptoms/signs and respond in a standard way to a similarly standard intervention, whereas the clinical environment teaches students that no patient is 'standard' and they must apply a much greater range of strategies to help the patient (Hollenbery 1994). This can aid the development of skills in lateral thinking and creativity, in working through a problem to generate solutions where management decisions or interventions already tried have proven ineffective (Christensen et al 2019). Through clinical education, students experience the opportunity to analyse and verify information and theories learnt in academic subjects, thereby better appreciating the link between theory and practice (Patton et al 2013, Roskell et al 1998).

Clinical education refers to practice-based learning; that is practical experience with real patients in a clinical setting, offering unique encounters without peer (Baldry Currens & Bithell 2000). As students participate in more clinical experience they undergo transformative learning, a process that utilises prior understanding to form new ideas that guide their actions into the future (Christensen et al 2019). In particular, they have the opportunity of reflection, thinking about their experiences to give meaning to their clinical encounters. Clinical education is thus a form of experiential learning that provides the opportunity for students to apply knowledge, and to acquire or practise skills such as problem-solving and critical reasoning, communication skills (including active listening) and manual skills, as well as giving them direct experience in various clinical settings such as working in a multi-disciplinary team, something they would be unlikely to gain exposure to on campus. While not a new concept, with Dewey advocating it as far back as 80 years ago (Dewey 1938), experiential learning allows the student to practise their role, preparing them for the workplace by facilitating the development of professional behaviours and attitudes and, under the guidance of and by observing the example set by a practising physiotherapist, they can begin to form a professional identity. It is for these reasons that there is much support and advocacy for clinical education to be integrated throughout the curriculum of physiotherapy education, rather than leaving all clinical education to the end of the course after all theory has been studied. The list of advantages of integrating clinical education in this manner is long (Table 2.26) (Hakim et al 2014).

Table 2.26 The educational value of integrated clinical education (reproduced from Hakim et al 2014)

Benefit	Description
1. Link theory with practice	Facilitates the relationship between academic theory and practical reality
2. Improve satisfaction with academic studies	Improves understanding of the need and applicability of theory, thereby facilitating learning
3. Provide visual imagery	Encounters with patients provide context for subsequent academic theory
4. A different type of learning	Provides a break from the intensity of the academic curriculum
5. Increase confidence dealing with patients	Improves self-assurance and self-confidence in the application of theory
6. Improve interviewing skills	Provides the opportunity to practise interviewing and history-taking
7. Practice procedures	Provides the opportunity to practise tests and procedures in an authentic environment
8. Understand the complexities of people	Presents the student with the social, psychological and emotional context of real patient care
9. Understand ethical considerations	Fosters an awareness and understanding of ethics as an intrinsic element of service delivery
10. Understand the importance of empathy	Reinforces the importance for practitioners to show empathy as part of relating to patients
11. Understand the impact of ill health	Fosters an appreciation of how ill health affects lifestyle, and the importance of ready access to health services
12. Motivation	Early contact with patients motivates students to continue their studies
13. Role models	Working with practising clinicians provides students with role models in their chosen profession
14. Validation	Helps to validate their chosen profession

There are several models of clinical education in use by health disciplines both in Australia and internationally. None is identified as being superior to others, they all have their advantages and disadvantages, and all are appropriate for all clinical areas and all curriculum stages; the most common used in physiotherapy are listed in Table 2.27 (Baldry Currens 2003, Baldry Currens & Bithell 2003, Lekkas et al 2007, Stiller et al 2004).

Table 2.27 Models of clinical education (reproduced from Baldry Currens 2003, Baldry Currens & Bithell 2003, Lekkas et al 2007, Stiller et al 2004)

Model	Advantages	Disadvantages
One educator to one student – the 1:1 model	Student gets individual attention Less demanding for clinical educator	Student is dependent on just one educator for all their learning Risk of passive dependence No opportunity for peer-assisted or collaborative learning
One educator to multiple students – the 1:2 model	More placements able to be offered Educator more likely to be a dedicated position Active learning facilitated Encourages student's clinical independence Encourages collaborative learning and development of teamwork	Supervision of individual student may be inadequate Potential for each student to get fewer patients or less variety Potential problems between students if they are incompatible or too competitive
Multiple educators to one student – the 2:1 model	Educators share responsibility Can include part-time clinicians as educators Students benefit from multiple educators with different experience Absence of any staff member is covered	Student may feel disconnected Reduced consistency in supervision and assessment Requires staff to collaborate closely
Multiple educators to multiple students	Shared responsibility among educators Students benefit from multiple educators Part-time clinicians included as educators Staff member absence is covered	Student may feel disconnected Reduced consistency in supervision and assessment Close collaboration of staff required

The importance placed on clinical education is reflected in the time dedicated to it (commonly about 1000 hours in Australian physiotherapy pre-professional courses) and in the proportion of the curriculum it occupies (up to 40% of the time in Australian physiotherapy pre-professional courses, and up to 48% in the US) (Crosbie et al 2002, Recker Hughes et al 2014). With this in mind, it is critical that quality is maintained, to ensure that students are able to make the most of their clinical experience time, and there has been considerable thought and effort applied by the universities offering physiotherapy courses to ensure that clinical education maintains the high standards expected of students, especially those soon to graduate and enter the workforce. Despite this, there was little cooperation and coordination between most Australian universities as to how students should be assessed on their clinical performance, until Megan Dalton's seminal work in 2009 that culminated in the Assessment of Physiotherapy Practice (APP, Dalton 2009). The APP is a standardised and validated document for assessing physiotherapy student performance on clinical placement, which has now been adopted by all physiotherapy courses at Australian universities.

The APP can be utilised at each stage of a student's clinical education, encapsulating every essential element of a student's performance succinctly but at the same time comprehensively. There are seven major areas, which in total comprise 20 elements for assessment (Table 2.28). Each element is assessed on a scale from 0-4, giving a maximum score of 80. Each item must be passed, and a score of 0 or 1 on any item is insufficient to pass on that item, and consequently results in a failure of the practical placement assessment. Thus the student must demonstrate not only competence in assessing and treating a patient, they must also demonstrate a professional attitude, an appreciation of ethical behaviour, safe practice, and, critically, the use of EBP. The APP comes with a comprehensive list of descriptors for each individual element (e.g. 16 examples just on verbal communication, starting with 'greets others appropriately') for the clinical educator to consider in order to mark the students appropriately. In follow-up studies, the APP has been found to be a valid indicator of a student's competence in clinical practice (Dalton et al 2011) and demonstrates a high degree of inter-rater reliability (Dalton et al 2012).

Table 2.28 Elements assessed in the APP (reproduced from Dalton 2009)

Areas of assessment	Elements
Professional behaviour	1. Patient rights and consent 2. Commitment to learning 3. Ethics 4. Teamwork
Communication	5. Verbal and non-verbal 6. Documentation
Assessment	7. Patient interview 8. Selection of outcome measures 9. Physical examination

Analysis and planning	10.	Assessment findings interpreted appropriately
	11.	Patient's problems identified and prioritised
	12.	Goals identified (both short and long-term)
	13.	Appropriate intervention selected
Intervention	14.	Intervention performed effectively
	15.	Education of the patient
	16.	Interventions are continually monitored for effect
	17.	Interventions are modified or progressed as necessary
	18.	Discharge planning is considered
Evidence based practice	19.	EBP is recognised and applied
Risk management	20.	A safe workplace is provided for therapist and patient

2.8 Use of CPRs in Clinical Education

It is to be noted that of the 20 elements of the APP, several are difficult if not impossible to learn and appreciate in the more theoretical learning environment of a university classroom. Here is the value of clinical education, to put theoretical concepts into actual real-world practice. For example, professional behaviour can be taught theoretically in the classroom, but in the clinical situation it begins to coalesce into part of the student clinician's overall practice, fostered and encouraged by the role modelling of, and on reflective discussion with, the clinical educator. This also particularly applies to clinical decision-making, as clinical education is recognised as being the ideal method for students to develop expertise in clinical reasoning (Delany & Bragg 2009, Ryan & Higgs 2008). The student can work through a real clinical problem, deliberating and analysing a patient's clinical data in consultation with their educator, the outcome of which is not only a plan of treatment for the patient at hand, but also a valuable learning experience in the process of effective clinical decision-making. Similarly, students on campus can be theoretically taught the potential benefits and value of EBP, but it is only in the clinical setting that they actually experience how to apply evidence-based knowledge in making clinical decisions.

Kember (1997) notes that clinical educators' approach to transmission of knowledge uses a structured technique, and the inclusion of CPRs is a consummate model of this. Due to their low level of experience novice clinicians are more protocol-driven and mechanical in their approach, and thus more likely to utilise structure as this helps them avoid errors in reasoning such as disregarding pertinent information and jumping to conclusions (Christensen et al 2019, Jensen et al 1990, Jensen et al 1992). The CPR is an ideal example of the application of scientific or empirical evidence into clinical practice, and it is potentially a useful tool to aid clinical decision-making for students and novice physiotherapists. Although there are studies that have investigated the teaching of clinical decision-making to medical (Frize & Frasson 2000, Michalowski et al 1993, O'Donnell & Baron 1991, Petrini et al 1987), nursing (Cholowski & Chan 1992), and physiotherapy (Harris & Dyrek 1989) students, there are no studies investigating the teaching of CPRs to health students, or the knowledge or use of CPRs by students in physiotherapy or any other health-related courses. Similarly, no studies have been published investigating how the teaching of CPRs to physiotherapy students might benefit those students in their clinical interactions and reasoning. There has also been no exploration of what might be needed to occur to enable the teaching of CPRs to physiotherapy students on clinical placement. Extensive searches have revealed gaps in the literature in this respect. This supports the need for the studies undertaken as part of this thesis, in at least starting to fill these gaps in our understanding.

CHAPTER 3

PHYSIOTHERAPY CLINICAL EDUCATORS' PERCEPTIONS AND EXPERIENCES OF CLINICAL PREDICTION RULES

This chapter has been published in a peer-reviewed scientific journal as follows:

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3.1 Overview

This chapter describes the first of four studies that comprise the thesis. Although it was found in Chapter 2 that there are many CPRs available and appropriate for use in physiotherapy practice, there was no evidence that Australian physiotherapy students were learning about them, nor was it known the extent to which physiotherapy clinical educators in Australia were using them in practice or teaching them to students. It was therefore decided to ascertain the awareness and knowledge of CPRs among physiotherapy clinical educators of pre-professional students, determine the extent to which CPRs are clinically used by these clinical educators, and explore which specific CPRs are known and used by them. It was also important to bring to light whether they were teaching physiotherapy students about CPRs on placements, and if so, what was the nature and extent of this instruction. Additionally, the study aimed to establish whether or not clinical educators find CPRs helpful in progressing their own clinical reasoning skills, and their views regarding the advantages and disadvantages of using CPRs in facilitating students' clinical reasoning skills. Finally, the study aimed to explore the link between CPRs and the broader scope of EBP as understood by clinical educators.

3.2 Abstract

3.2.1 Objectives

Clinical prediction rules (CPRs) are widely used in medicine, but their application to physiotherapy practice is more recent and less widespread, and their implementation in physiotherapy clinical education has not been investigated. This study aimed to determine the experiences and perceptions of physiotherapy clinical educators regarding CPRs, and whether they are teaching CPRs to students on clinical placement.

3.2.2 Design

Cross-sectional observational survey using a modified Dillman method.

3.2.3 Participants

Clinical educators (n=211, response rate 81%) supervising physiotherapy students from 10 universities across 5 states and territories in Australia.

3.2.4 Results

Half (48%) of respondents had never heard of CPRs, and a further 25% had never used CPRs. Only 27% reported using CPRs, and of these half (51%) were rarely if ever teaching CPRs to students in the clinical setting. However most respondents (81%) believed CPRs assisted in the development of clinical reasoning skills and few (9%) were opposed to teaching CPRs to students. Users of CPRs were more likely to be male ($p<0.001$), have post-professional qualifications ($p=0.020$), work in private practice ($p<0.001$), and work in the area of musculoskeletal physiotherapy ($p<0.001$) compared with non-users. The CPRs most commonly known, used and taught were the Ottawa Ankle Rule, the Ottawa Knee Rule, and Wells' Rule for Deep Vein Thrombosis.

3.2.5 Conclusions

Students are unlikely to be learning about CPRs on clinical placement, as few clinical educators use them. Clinical educators will require training in CPRs and assistance in teaching them if students are to better learn about implementing CPRs in physiotherapy clinical practice.

3.3 Introduction

Clinical prediction rules (CPRs) are research-based tools designed to assist the clinician in their decision-making. These tools quantify the relative contributions of various clinical features and patient characteristics to provide numeric indices and therefore the probability of an outcome (Beattie & Nelson 2006, Laupacis et al 1997). They can be used to assist in making a diagnosis, establishing a prognosis, or determining the best intervention (Childs & Cleland 2006). CPRs can streamline the assessment process and improve clinical precision (McGinn et al 2000). As such, they may reduce uncertainty in patient care (Stiell et al 1996) and give clinicians more confidence in their decisions (Smith & Cleland 2004).

Although long utilised in medicine, CPRs are a relatively new concept in physiotherapy. Whilst CPRs have been developed that are relevant to physiotherapy practice, there is little evidence to indicate that physiotherapists know about them or use them (Haskins et al 2012, Haskins et al 2014). Moreover, although the impact of CPRs on clinical decision-making in medicine has been investigated (Eagles et al 2008, Hess et al 2008, Perry & Stiell 2006), their impact on decision-making by physiotherapists is largely unknown (Learman et al 2012).

The extent to which physiotherapy students are learning about CPRs is similarly unexplored. Physiotherapy clinicians and educators may be unaware of CPRs, or may not appreciate their clinical utility. Consequently, physiotherapy students may not be learning about CPRs from their clinical educators who are unfamiliar with the tool. This could be a problem for students as they enter the workforce, where under contemporary demands of evidence-based practice (EBP) they may be expected to know about CPRs and be able to utilise them in their clinical practice.

The aims of this study therefore are to 1) ascertain the awareness and knowledge of CPRs among clinical educators for pre-professional students; 2) determine the extent to which CPRs are clinically used by clinical educators and the extent to which they are taught to students in the clinical setting; and 3) establish whether or not clinical educators find them helpful in progressing their own and their students' clinical reasoning skills.

3.4 Methodology

The study design is a cross-sectional observational survey of physiotherapy clinical educators.

3.4.1 Survey Instrument

The ten-page questionnaire comprised mainly closed-ended questions. Any open-ended questions asked for specific information that facilitated categorisation and quantitative analysis of data. The first section (8 questions) asked about clinical educators' knowledge and use of CPRs as clinicians, why they use them, why they don't use them more often, and whether they deviate from the clinical direction indicated by a CPR. The second section (8 questions) included questions about clinical educators' use of CPRs with students in the clinical setting, what they teach students about CPRs and why they teach them, why they don't teach them more often, whether they believe CPRs should be taught to students, and their views on the relationship between CPRs and the development of clinical reasoning skills. This second section included a table of 30 CPRs (14 diagnostic, 3 prognostic and 13 interventional), chosen as being more commonly known and also more relevant to physiotherapy practice (Glynn & Weisbach 2011), that were listed by their intended purpose; clinical educators were asked to indicate which of these they recognised, which they used in clinical practice, and which they taught to students. Participants were also asked to name any CPRs they knew, such as by citing their author(s) or geographical origin. The final section (12 questions) addressed respondent demographic information, including pre-professional and any post-professional qualifications, the clinical setting in which they worked, and the academic level of students they taught.

The questionnaire was initially developed based on the published literature on CPRs. It was further developed with input from five academic experts, each of whom had published in international peer-reviewed scientific journals on the use of CPRs in physiotherapy. Each expert was specifically asked to provide comment on the content and face validity of the questionnaire. Feedback was received from all five experts and the questionnaire was modified accordingly.

The survey was piloted with a sample of convenience of six former physiotherapy clinical educators in the main areas of clinical practice (musculoskeletal, cardiorespiratory and neurological). Each was invited to complete the draft questionnaire individually, and asked to provide feedback on clarity and ease of completion, as well as indicating the time taken to complete it.

3.4.2 Sampling and Recruitment

Clinical educators supervising physiotherapy students in Australia were surveyed. Participants were sourced through the database of physiotherapy clinical educators maintained by the University of Newcastle, Australia. This included educators working in hospitals, community facilities and private practices.

An explanatory letter and reply-paid self-addressed envelope (SAE) was sent to the contact person at each clinical placement site requesting the names of all physiotherapists acting as clinical educators at their site. From these responses, and from the original database of clinical educators, a list was created of potential participants. Therefore, questionnaires were mailed directly to named clinical educators, allowing a response rate to be accurately calculated, and enabling follow-up of non-respondents.

The protocol for the administration of the questionnaire followed Dillman's Tailored Design Method (Dillman et al 2009), with minor modifications in the follow-up steps allowing more time for potential participants to respond before each reminder; previous studies have found that such minor deviations from Dillman's original Total Design Method (Dillman 1978) do not adversely affect response rates (Hoddinott & Bass 1986). The Dillman protocol is used widely in published survey research, and incorporates a number of effective methods to maximise the number of respondents (Edwards et al 2002).

The procedure began with a pre-notification letter to all identified potential participants, alerting them to the imminent arrival of the questionnaire. A survey package containing a letter of invitation, information statement, questionnaire and reply-paid SAE was then posted to potential participants within one week of pre-notification. Removable codes on the front page of questionnaires were used to track non-respondents. Once completed questionnaires were received they were immediately separated from the coding number to protect confidentiality.

Two weeks following the mailing of the questionnaire, a follow-up postcard was sent to participants thanking them for completing the questionnaire and prompting them to return it if they had not already done so. Four weeks later, non-respondents were sent a second copy of the questionnaire with a cover letter and a reply-paid SAE. Four to six weeks after this, a scripted follow-up telephone call was made to those who had still not responded. This not only reminded non-respondents to complete the survey, but also allowed the researchers to uncover reasons for non-response. Consent to participate was inferred by the completion and return of the questionnaire.

3.4.3 Data Analysis

Analysis involved descriptive statistics expressed as proportions of respondents, with mean (standard deviation) values calculated for some parameters. Associations were explored using the Chi-squared test. The statistical analysis package STATA v11.0 was used (StataCorp, USA 2009).

3.5 Results

From the university clinical educator database and returned lists from clinical site contacts, 292 clinical educators were identified, with each being sent a copy of the questionnaire. Three were returned undelivered, and during telephone follow-up a further eleven were identified as undeliverable due to the educator being on maternity leave (n=4) or undefined long-term leave (n=2), retired (n=1), or having left employment at the site (n=4). Fifteen additional potential participants were excluded as they did not currently act as clinical educators. One educator had been identified twice as she worked part-time at two sites. This resulted in a final list of 262 potential participants. A total of 211 completed questionnaires were returned, yielding a response rate of 81% (211/262).

Respondents were clinical educators primarily based in the state of New South Wales but also located in three other states and territories in Australia, including metropolitan, regional, rural and remote settings. They supervised students from more than 10 universities from 5 of the 6 Australian states and territories in which pre-professional courses are offered. Demographic information for all respondents is shown in Tables 3.1 and 3.2. The majority of respondents were female (146/211, 69%), and had no post-professional qualifications (167/211, 79%). Eighty percent (169/211) worked in hospitals, 12% (26/211) in the community, 10% (21/211) in private practice, and 5% (10/211) in aged care facilities. Eighty-five percent (180/211) of respondents supervised students from other universities in addition to the University of Newcastle (range 1-10 other universities, mean [SD] 2.6 [1.32]).

Table 3.1 Demographic and educational characteristics of survey respondents. All data are expressed as a number (percentage) unless otherwise indicated.

	Study participants (n=211)	CPR users (n=57)	CPR non-users (n=154)	Profession demographics*
Gender				
Male	65 (31)	30 (53)	35 (23)	6937 (30)
Female	16 (8)	0 (0)	16 (10)	16198 (70)
Age (years)				
25 & under	6 (3)	3 (5)	3 (2)	2566 (10)
26-30	54 (26)	16 (28)	38 (25)	4954 (20)
31-40	72 (34)	18 (32)	54 (35)	7082 (29)
41+	78 (37)	19 (33)	59 (38)	9891 (40)
Missing data	1 (0)	1 (2)	0 (0)	
Pre-professional physiotherapy qualification				
Diploma	16 (8)	4 (7)	12 (8)	
Post-graduate diploma	6 (3)	2 (4)	4 (3)	
Bachelor degree	179 (85)	49 (86)	130 (84)	
Masters degree	9 (4)	1 (2)	8 (5)	
Missing data	1 (0)	1 (2)	0 (0)	
State or country of pre-professional qualification				
New South Wales	145 (69)	42 (74)	103 (67)	
Australian Capital Territory	3 (1)	0 (0)	3 (2)	
Victoria	12 (6)	2 (4)	10 (6)	
Queensland	10 (5)	2 (4)	8 (5)	
South Australia	7 (3)	2 (4)	5 (3)	
Western Australia	3 (1)	1 (2)	2 (1)	
New Zealand	4 (2)	3 (5)	1 (1)	
United Kingdom	18 (9)	2 (4)	16 (10)	
Other country	8 (4)	2 (4)	6 (4)	
Missing data	1 (0)	1 (2)	0 (0)	
Post-professional qualification				
Post-professional qualification	44 (21)	18 (32)	26 (17)	
No post-professional qualification	167 (79)	2 (4)	128 (83)	
Years of Practice				
< 2	0 (0)	0 (0)	0 (0)	
2-5	28 (13)	9 (16)	19 (12)	
6-10	69 (33)	18 (32)	51 (33)	
11-15	39 (18)	9 (16)	30 (19)	
16-20	23 (11)	5 (9)	18 (12)	
> 20	50 (24)	15 (26)	35 (23)	
Missing data	2 (1)	1 (2)	1 (1)	
Mean number of years (standard deviation)	14.4 (7.5)	14.0 (8.9)	14.5 (9.1)	

* Physiotherapy Board of Australia (2013)

Table 3.2 Employment and clinical education characteristics of survey respondents. All data are expressed as a number (percentage) unless otherwise indicated.

	Study participants (n=211)	CPR users (n=57)	CPR non-users (n=154)	Profession demographics
State or territory of work				
New South Wales	189 (90)	54 (95)	135 (88)	7131 (29)**
Australian Capital Territory	16 (8)	0 (0)	16 (10)	460 (2)**
Tasmania	5 (2)	2 (4)	3 (2)	398 (2)**
Northern Territory	1 (0)	1 (2)	0 (0)	153 (1)**
Type of facility*				
Tertiary teaching hospital	89 (42)	25 (44)	64 (42)	
Secondary referral hospital	52 (25)	11 (19)	41 (27)	
Primary health facility, community hospital	28 (13)	5 (9)	23 (15)	
Community centre and/or home visits	26 (12)	6 (11)	20 (13)	
Private practice – 1-3 physiotherapists	12 (6)	8 (14)	4 (3)	
Private practice – 4 or more physiotherapists	9 (4)	5 (9)	4 (3)	
Aged care facility	10 (5)	2 (4)	8 (5)	
Not-for-profit organisation	1 (0)	1 (2)	0 (0)	
Area of practice*				
Musculoskeletal	70 (33)	31 (54)	39 (25)	
Orthopaedics	45 (21)	13 (23)	32 (21)	
Acute/cardiorespiratory	45 (21)	11 (19)	34 (22)	
General inpatient	40 (19)	8 (14)	32 (21)	
Neurological	34 (16)	8 (14)	26 (17)	
Rehabilitation	55 (26)	7 (12)	48 (31)	
Community	40 (19)	9 (16)	31 (20)	
Paediatrics	19 (9)	5 (9)	14 (9)	
Aged care	12 (6)	0 (0)	12 (8)	
Women's health	4 (2)	1 (2)	3 (2)	
Hand therapy	2 (1)	1 (2)	1 (1)	
Lymphoedema	2 (1)	0 (0)	2 (1)	
Burns	1 (0)	1 (2)	0 (0)	
Chronic pain	1 (0)	0 (0)	1 (1)	
Mental health	1 (0)	0 (0)	1 (1)	
Intellectual disability	1 (0)	1 (2)	0 (0)	
Clinical educator experience (years)				
< 2	32 (15)	11 (19)	21 (14)	45 (13)***
2-5	79 (37)	19 (33)	60 (39)	134 (39)***
> 5	93 (44)	26 (46)	67 (44)	163 (48)***
Missing data	7 (3)	1 (2)	6 (4)	1 (0)***
Mean (standard deviation)	6.4 (5.4)	6.2 (5.1)	6.5 (5.5)	
Other universities supervised				
0	27 (13)	10 (18)	17 (11)	
1	38 (18)	6 (11)	31 (20)	
2	63 (30)	13 (23)	50 (32)	
3	45 (21)	14 (25)	31 (20)	
4	21 (10)	10 (18)	10 (6)	
5	10 (5)	3 (5)	7 (5)	
6 or more	3 (1)	0 (0)	3 (2)	
Missing data	4 (2)	1 (2)	5 (3)	
Number of students supervised per year				
Mean (standard deviation)	6.8 (5.4)	7.7 (7.7)	6.5 (8.1)	

* Multiple answers possible so may add up to more than 100% ** Physiotherapy Board of Australia (2013) *** Stiller et al. (2004)

3.5.1 Awareness and Knowledge of CPRs

Forty-eight percent (102/211) of respondents had never heard of CPRs and a further 25% (52/211) had never used CPRs (together comprising 'non-users'), leaving 27% (57/211) as 'users' of CPRs. The non-users answered no further questions about CPRs.

Users of CPRs were significantly more likely to be male (χ^2= 17.45, p<0.001), have post-professional qualifications (χ^2=5.44, p=0.020), work in private practice (χ^2= 14.40, p<0.001), and work in musculoskeletal physiotherapy (χ^2=15.85, p<0.001) (Tables 3.1 and 3.2). There were no significant differences between users and non-users of CPRs in age, years of practice, level of pre-professional qualification, state or country of pre-professional qualification, or state/territory of work.

From the table of 30 CPRs listed (Table 3.3), all CPRs were known by at least two users, with 21 of the 30 known by at least 23% (13/57) of the users. Ninety-five percent (54/57) of users recognised at least one of the CPRs listed, 63% (36/57) recognised at least five, and 42% (24/57) recognised at least 10 on the list. One educator was familiar with all 30 CPRs and another recognised all but one (Emshoff & Rudisch 2008). The most commonly known CPRs were for identification of injuries to the ankle and foot and the need for an X-ray (37/57, 65%) (Stiell et al 1992), identification of deep venous thrombosis (DVT) (33/57, 58%) (Wells et al 1998), and for identification of injuries to the knee and the need for an X-ray (29/57, 51%) (Stiell et al 1995). Fourteen percent (8/57) of users were able to nominate a total of a further 11 CPRs not on the list.

When asked to name any CPRs they knew, by citing their author(s) or geographical origin, only 49% (28/57) of users could do so, the most common being the Ottawa Ankle Rule (21/57, 37%) (Stiell et al 1992), the Ottawa Knee Rule (11/57, 19%) (Stiell et al 1995), and Wells' Rule for DVT (6/57, 11%) (Wells et al 1998). A total of 21 CPRs were named, though most users could only name one or two. Only 14% (8/57) could name three or more, with one able to name ten CPRs.

Table 3.3 Knowledge, use and teaching of Clinical Prediction Rules (CPR) by purpose (n=57). All data are expressed as a number (percentage) unless otherwise indicated.

Purpose of Clinical Prediction Rule	Know of	Use in practice	Teach to students
Identification of injuries to ankle and foot (need for X-ray) (Stiell et al 1992)	37 (65)	29 (51)	23 (40)
Identification of deep venous thrombosis (Wells et al 1998)	33 (58)	23 (40)	18 (32)
Identification of injuries to knee (need for X-ray) (Stiell et al 1995)	29 (51)	24 (42)	17 (30)
Low back pain, diagnosis of sacroiliac joint problem (Laslett et al 1995)	27 (47)	20 (35)	16 (28)
Assessment of seriousness of injury to cervical spine (need for X-ray) (Stiell et al 2001a)	25 (44)	17 (30)	11 (19)
Whiplash-associated disorders, and at risk of developing chronic symptoms (Hartling et al 2002)	24 (42)	12 (21)	7 (12)
Diagnosis of rotator cuff tear (Litaker et al 2000, Park et al 2005)	23 (40)	14 (25)	10 (18)
Patellofemoral pain, and likely to benefit from patellar taping (Lesher et al 2006)	22 (39)	16 (28)	10 (18)
Risk of osteoporosis (Cadarette et al 2000, Koh et al 2001, Lydick et al 1998, Shepherd et al 2007)	22 (39)	12 (21)	10 (18)
Low back pain, diagnosis of spinal stenosis (Sugioka et al 2008)	21 (37)	14 (25)	10 (18)
Low back pain, and likely to benefit from lumbar stabilisation exercises (Hicks et al 2005)	20 (35)	14 (25)	11 (19)
Diagnosis of carpal tunnel syndrome (Wainner et al 2005)	19 (33)	12 (21)	9 (16)
Diagnosis of subacromial impingement (Park et al 2005)	18 (32)	13 (23)	9 (16)
Low back pain, and likely to respond to spinal manipulation (Flynn et al 2002, Fritz et al 2004)	18 (32)	8 (14)	4 (7)
Neck pain likely to be cervical radiculopathy (Wainner et al 2003)	17 (30)	11 (19)	8 (14)
Assessment of seriousness of head injury (need for CT scan) (Haydel et al 2000, Mower et al 2005, Stiell et al 2001b)	16 (28)	9 (16)	6 (11)
Patellofemoral pain, and likely to benefit from orthotics (Sutlive et al 2004, Vicenzino et al 2010)	14 (25)	11 (19)	6 (11)
Diagnosis of osteoarthritis of the hip (Altman et al 1991, Sutlive et al 2008)	14 (25)	9 (16)	6 (11)
Diagnosis of osteoarthritis of the knee (Altman et al 1986)	14 (25)	8 (14)	5 (9)
Diagnosis of pulmonary embolism (Le Gal et al 2006, Wells et al 2000b)	14 (25)	6 (11)	5 (9)
Treatment of lateral epicondylalgia with MWMs (Mobilisations With Movement) and exercise (Vicenzino et al 2009)	13 (23)	6 (11)	4 (7)
Low back pain, and likely to respond to mechanical traction (Cai et al 2009, Fritz et al 2007)	11 (19)	5 (9)	4 (7)
Neck pain, and likely to benefit from thoracic spine manipulation (Cleland et al 2007b)	10 (18)	5 (9)	3 (5)
Shoulder pain, and likely to benefit from cervico-thoracic manipulation (Mintken et al 2010)	8 (14)	4 (7)	2 (4)
Headache, likely to respond to trigger point therapy (Fernandez-de-las-Penas et al 2008)	6 (11)	5 (9)	5 (9)
Risk of peripheral neuropathy (Richardson 2002)	6 (11)	4 (7)	4 (7)
Neck pain, and likely to benefit from cervical traction (Raney et al 2009)	6 (11)	3 (5)	2 (4)
Neck pain, and likely to benefit from cervical spine manipulation (Tseng et al 2006)	5 (9)	2 (4)	2 (4)
Patellofemoral pain, and likely to benefit from lumbar spine manipulation (Iverson et al 2008)	5 (9)	2 (4)	1 (2)
Treatment of temporomandibular joint pain with splint (Emshoff & Rudisch 2008)	2 (4)	0 (0)	0 (0)
Other CPRs for any condition except low back pain	7 (12)	5 (9)	4 (7)
Other CPRs for low back pain.	5 (9)	5 (9)	5 (9)
None of the above	3 (5)	3 (5)	3 (5)
Mean (SD) number of CPRs per user	9.0 (7.6)	5.8 (5.9)	4.2 (5.5)

SD = standard deviation

3.5.2 Clinical Use and Teaching of CPRs

Eighty-four percent (48/57) of CPR users applied at least one CPR of those listed in their clinical practice, 42% (24/57) used at least five, and 26% (15/57) used at least ten on the list. Two educators (4%) used 20 or more. Sixty-seven percent (38/57) of CPR users taught at least one of the listed CPRs to students, 28% (16/57) taught at least five, and 16% (9/57) taught at least ten on the list, with one clinical educator teaching 22 of them. Of the CPRs most commonly known, used and taught, the three most common, and seven of the ten most common had been validated, while the ten least known, used and taught had not been validated.

The most common reasons for using CPRs were to assist with diagnosis (31/57, 54%), prognosis (24/57, 42%), or intervention (18/57, 32%); 67% (38/57) of users stated one or more of these reasons. Another common reason for using CPRs was to streamline the assessment procedure (18/57, 32%), while 19% (11/57) used CPRs because they are seen as being reflective of current best practice. The most common reasons for not using CPRs more often were a preference for using standard clinical reasoning processes rather than a 'formula' (24/57, 42%), lack of knowledge about CPRs generally (14/57, 25%), and a lack of awareness of CPRs available in their area of clinical practice (13/57, 23%); 70% (40/57) reported one or more of these reasons.

Twenty-one percent (12/57) of CPR users never mentioned them to students, and a further 30% (17/57) rarely told students about CPRs; only 12% (7/57) were 'often' encouraging students to use CPRs. The most common reasons for not teaching CPRs more often were a lack of familiarity with or knowledge of CPRs – 63% (36/57) reported one or both of these – followed by a desire to encourage students to practice their clinical reasoning rather than using a 'formula' (24/57, 42%). The most common reasons for teaching CPRs were to assist with diagnosis (21/57, 37%), prognosis (18/57, 32%), or intervention (18/57, 32%), with 53% (30/57) teaching them for one or more of these purposes. CPRs were also taught to improve the students' EBP (19/57, 33%), and because they were perceived as reflective of current best practice (14/57, 25%).

3.5.3 Relationship Between CPRs And Clinical Reasoning

Of the clinical educators that used CPRs, 53% (30/57) reported they used them to aid with their own clinical reasoning. Additionally, 39% (22/57) of CPR users also reported teaching CPRs to students in order to help with the development of students' clinical reasoning skills, and 32% (18/57) taught students how CPRs may help with decision-making in the clinical setting. In addition, 60% (34/57) of users believed CPRs assisted the development of clinical reasoning skills, while only 12% (7/57) believed CPRs hindered skill development in clinical reasoning. When asked if they favoured or opposed the teaching of CPRs to students, 51% (29/57) were in support and 40% (23/57) had no preference. Only 9% (5/57) were opposed to the teaching of CPRs.

Participants were also asked if they had ever employed a CPR, but then consciously proceeded contrary to the clinical decision indicated by the CPR, i.e., by deciding on an alternate diagnosis, prognosis or intervention. Two-thirds (38/57, 67%) of users had deviated from the clinical direction indicated by a CPR.

3.6 Discussion

This survey explored the experiences and perceptions of physiotherapy clinical educators regarding the use of CPRs, and reveals that few are using the tools in their practice and even fewer are teaching them to the students they supervise.

The high response rate (81%) (Dillman et al 2009) captures a substantial proportion of clinical educators affiliated with the University of Newcastle. Based on registrant data from the Physiotherapy Board of Australia (2013), respondents were representative of physiotherapists registered to practice in Australia, although proportions in age are lower in the under-26 years, as might be expected amongst a population of clinical educators compared to physiotherapists in general. Years of experience as clinical educators showed similar proportions to those found in a study of perceptions of clinical education models in Australia (Stiller et al 2004). Moreover, with 85% of respondents supervising students from other universities (as well as the University of Newcastle), the sample is arguably broadly representative of clinical educators in Australia.

Clinical educators most likely to be using and teaching CPRs were male, have post-professional qualifications, and/or were in private practice, yet more than half of all surveyed educators (53%) did not fit these demographics. Furthermore, the 12% of users who reported 'often' encouraging the use of CPRs by students represented only 3% of all respondents. Given these figures, most students are unlikely to be learning about CPRs whilst on clinical placement.

3.6.1 Awareness and Knowledge of CPRs

The results demonstrate that knowledge of CPRs amongst physiotherapy clinical educators is relatively poor, with nearly half (48%) of respondents having never heard of them. There was also some confusion expressed in returned questionnaires about what constituted a CPR, with some respondents indicating they use various methods of clinical decision-making and suggesting they might be using CPRs without knowing the term. Amongst those reporting using CPRs, 37% had only heard of a handful (less than five) of derived CPRs, and half (51%) could not name a CPR.

3.6.2 Clinical Use and Teaching of CPRs

Usage of CPRs amongst physiotherapy clinical educators is also very modest, with about half (48%) of those who had heard of CPRs not using them. A majority of users of CPRs were only using a few CPRs, with 58% using fewer than five. Some expressed the view that there were few available for their area of practice, but this may be due to a lack of awareness rather than availability: 57% of CPR users ventured a lack of knowledge or awareness as a reason for not using CPRs more often. Users of CPRs were significantly more likely to work in musculoskeletal physiotherapy, which may be a reflection of there being more CPRs available in this field relevant to physiotherapy practice (Glynn & Weisbach 2011), but is likely also a result of physiotherapists having a more diagnostic role in this than in other fields of practice.

Even amongst those who used CPRs, half (51%) were rarely if ever teaching them to students, and 78% were teaching fewer than five CPRs. Comments by respondents reflected a negative perception or perhaps erroneous understanding about CPRs, such as not wanting students to follow a 'recipe', or that the use of CPRs would 'foster technician-based practice'. However there were also positive comments about their value in enhancing clinical accuracy. A balanced view was expressed by one respondent; CPRs "should be an adjunct to clinical reasoning, not replace it".

Those clinical educators teaching CPRs to students did so not only for aiding decisions regarding diagnosis, prognosis and intervention, but also for the wider aims of improving students' awareness and use of EBP and because CPRs represent current best practice. The primary reason many clinical educators were not teaching CPRs to students was a lack of awareness or knowledge. The CPRs most commonly known, used and taught were found to be more likely to be those that had been validated, suggesting that clinical educators were aware of the stages of development of CPRs and had more confidence in utilising those that had been validated.

3.6.3 Relationship Between CPRs and Clinical Reasoning

Two-thirds of users indicated they had at times deviated from the clinical decision indicated by a CPR, with varying reasons cited such as preferring to "depend on clinical reasoning" and the complexity of "patients with multiple comorbidities". Thus a majority of CPR users were utilising them as an adjunct to assessment and management, perhaps to guide, but not direct, their own clinical reasoning. CPRs were often taught to assist with the development of students' clinical reasoning skills, with most user clinical educators (81%) believing CPRs aided the improvement of clinical decision-making skills. The greater use of CPRs by musculoskeletal physiotherapists possibly relates to the need for clinicians in this field to commonly apply a hypothetico-deductive approach to clinical reasoning (Jones 2014), and requiring tools to aid in the decision-making process that reduce risk of error by being evidence-based.

3.6.4 Limitations

Although the overall response rate was high, 73% (154/211) of respondents were non-users of CPRs: consequently only 57 respondents answered subsequent questions about the use and teaching of CPRs. The recruitment process restricted participants to one university database, however this still resulted in recruitment of clinical educators from across half (four) of Australian states and territories. These clinical educators supervised students from 53%

(10/19) of universities in most (five of the six) states and territories offering physiotherapy courses in Australia.

3.6.5 Future Research

Future surveys could explore clinical educator views and experiences internationally to determine possible variations in clinical educator responses in different countries. Future studies might also survey physiotherapy students to ascertain their exposure to CPRs whilst on clinical placement and associated perceptions in order to determine their knowledge and understanding of the use of CPRs. Another potential line of research could investigate clinicians who know about CPRs but choose not to utilise them, and exploring their reasons for doing so.

3.7 Conclusion

This study found that many clinical educators were unaware of CPRs, and many others were not using them. Clinical educators using CPRs generally utilised them as a tool to assist their clinical practice and decision-making and that of their students, although many only used a few specific CPRs. As a result, pre-professional students are being exposed to few, if any, CPRs in the clinical setting.

Ethical Approval: Ethical approval for the study was granted by the University of Newcastle Human Research Ethics Committee (approval number H-2012-0192).

CHAPTER 4

PHYSIOTHERAPY STUDENTS' PERCEPTIONS AND EXPERIENCES OF CLINICAL PREDICTION RULES

This chapter has been published in a peer-reviewed scientific journal as follows:

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4.1 Overview

This chapter describes the second of the four studies comprising the thesis. The first study (Chapter 3) found a low level of awareness and usage of CPRs amongst physiotherapy clinical educators and, as a consequence, physiotherapy students on clinical placement were likely receiving little exposure to CPRs. However it was still unknown whether students were aware of or using CPRs. In this follow-up study, students across Australia were surveyed to ascertain their understanding and clinical experiences with CPRs, and whether these were consistent with the responses previously received from clinical educators in Study 1 regarding their teaching of CPRs to students.

Consequently, this study was designed to primarily explore the awareness and knowledge of CPRs among final year pre-professional physiotherapy students, and establish the extent to which these students were being exposed to CPRs on clinical placement. Specifically, it explored whether physiotherapy students were actually learning about CPRs on clinical placement, and if so, what exactly were they being taught, and which CPRs did they know of and use clinically. The study also aimed to investigate what students felt about the advantages and disadvantages of using CPRs, ascertain whether students found CPRs useful in learning and developing their clinical reasoning skills, and explore any relationship between CPRs and EBP that might be recognised by students.

4.2 Abstract

4.2.1 Objectives

Clinical reasoning can be difficult to teach to pre-professional physiotherapy students due to their lack of clinical experience. It may be that tools such as clinical prediction rules (CPRs) could aid the process, but there has been little investigation into their use in physiotherapy clinical education. This study aimed to determine the perceptions and experiences of physiotherapy students regarding CPRs, and whether they are learning about CPRs on clinical placement.

4.2.2 Design

Cross-sectional survey using a paper-based questionnaire.

4.2.3 Participants

Final year pre-professional physiotherapy students (*n*=371, response rate 77%) from five universities across five states of Australia.

4.2.4 Results

Sixty percent of respondents had not heard of CPRs, and a further 19% had not clinically used CPRs. Only 21% reported using CPRs, and of these nearly three-quarters were rarely, if ever, learning about CPRs in the clinical setting. However most of those who used CPRs (78%) believed CPRs assisted in the development of clinical reasoning skills and none (0%) was opposed to the teaching of CPRs to students. The CPRs most commonly recognised and used by students were those for determining the need for an X-ray following injuries to the ankle and foot (67%), and for identifying deep venous thrombosis (63%).

4.2.5 Conclusions

The large majority of students in this sample knew little, if anything, about CPRs and few had learned about, experienced or practiced them on clinical placement. However, students who were aware of CPRs found them helpful for their clinical reasoning and were in favour of learning more about them.

4.3 Introduction

Clinical reasoning refers to the thinking and decision-making processes undertaken by the practitioner in collaboration with their patients (Smith et al 2009). Goals and health management strategies are jointly decided based on clinical data, patient choices, practitioner judgment and knowledge (Higgs & Jones 2000). It is a fundamental skill that underpins physiotherapy assessment and management, yet it is challenging to teach to pre-professional physiotherapy students who have minimal clinical experience. It can be difficult for students to learn and develop clinical reasoning skills, so teaching a more formalised and mechanical structure for clinical decision-making may make it easier for students to achieve competency in clinical reasoning (Edwards et al 2004, Jones & Rivett 2004). Various tools and strategies have been developed to assist with clinical reasoning: one example of this gaining prominence in the physiotherapy literature is the clinical prediction rule (CPR) (Haskins et al 2014, Learman et al 2012).

A CPR is a tool derived to facilitate clinical decision-making, being used to either establish a diagnosis, formulate a prognosis, or propose an optimal treatment approach (Childs & Cleland 2006). CPRs do this by combining relevant clinical variables to give a numeric probability of a condition or an outcome (Beattie & Nelson 2006, Laupacis et al 1997). Although there are many CPRs that can be applied in physiotherapy clinical practice, preliminary evidence is emerging that CPRs are underutilised by physiotherapists, who are either unaware of them (Knox et al 2015) or reluctant to use them (Haskins et al 2012, Haskins et al 2014).

The extent to which physiotherapists are exposed to CPRs as pre-professional students is unknown. Of the five universities involved in this study, one does not formally teach anything about CPRs in its curriculum, while the other four introduce only a few basic concepts with specific examples of CPRs. A study by our research team found that most physiotherapy clinical educators in Australia were not teaching CPRs (Knox et al 2015), so a comprehensive evaluation of physiotherapy students across Australia would be valuable in order to ascertain how much they know about CPRs. It may be beneficial to teach students a general understanding of CPRs as an aid to learning clinical reasoning, and exposing students to the application of CPRs in the clinic is consistent with an evidence-based approach to physiotherapy learning and practice. Furthermore, if students can be better educated about CPR usage it may help alleviate the fears of some clinical educators that CPRs promote a recipe-based approach to clinical practice (Knox et al 2015).

Accordingly the aims of this study were to (1) investigate the understanding, extent and nature of the clinical use of CPRs among final year pre-professional physiotherapy students across Australia; and (2) explore the influence of CPRs on students' learning of clinical reasoning and associated implications in the context of evidence-based practice (EBP).

4.4 Methodology

The study involved a cross-sectional survey of final year pre-professional physiotherapy students in Australia using a paper-based questionnaire.

4.4.1 Survey Instrument

Development of the questionnaire began with a review of the literature related to CPRs, including those available and relevant to physiotherapy practice. The draft questionnaire was then provided to five academic experts who had published in peer-reviewed international scientific journals on the use of CPRs in physiotherapy. Each expert was asked to comment on the content and face validity of the questionnaire. All five experts provided feedback on the appropriateness, clarity, comprehensiveness and validity of the questionnaire.

The draft questionnaire was next piloted with a sample of convenience of eight recent physiotherapy graduates within 12 months of finishing their pre-professional qualification. They were asked to complete the draft questionnaire individually, and to provide feedback on clarity of questions and ease of completion, as well as indicating the approximate time taken to complete the survey. Following incorporation of their feedback, the questionnaire was finalised.

The 8-page questionnaire was comprised predominantly of closed-ended questions; any open-ended questions requested specific information that enabled categorisation and quantitative analysis of data. There were three sections. The first section (8 questions) examined students' knowledge and use of CPRs in the clinical setting, why they use them, why they do not use them more frequently, whether they may deviate from the clinical path indicated by a CPR if used, and how they accessed information on CPRs. The second section (8 questions) asked about students' exposure to CPRs with their clinical educators in the clinical setting. Students were asked whether they learned about CPRs from clinical educators and what they learned, their views on being taught CPRs by clinical educators, and whether they considered using CPRs affected the growth of their clinical reasoning skills. The second section also included a table of 30 CPRs (3 prognostic, 14 diagnostic and 13 interventional), chosen as being relevant to physiotherapy practice (Glynn & Weisbach 2011), and listed by their intended purpose: students were asked to indicate which of these they were familiar with, and which they had actually used on clinical placement. Respondents were also asked to nominate any CPRs they knew by name, such as by citing the geographical origin or author. The third and final section (5 questions) asked for simple demographic information, including the type of clinical settings attended for placements.

4.4.2 Sampling and Recruitment

Final-year physiotherapy students were surveyed from four undergraduate and three graduate pre-professional programs, with cohort sizes ranging from 21 to 151 students, across five universities in five Australian states. All university programs were accredited, and required students to meet a national set of educational standards mandated by the Australian Physiotherapy Council (2015).

Specific methods of recruitment varied at the different universities, but included any or all of the following: flyers placed on physical and/or electronic noticeboards notifying students of the study, and emails sent to final year physiotherapy students via their student email accounts with a copy of the flyer and an Information Statement for Participants. Subsequently, at each university one of the researchers attended a lecture where all or most final-year students were expected to attend, and questionnaires were distributed along with a copy of the Information Statement for Participants. The purpose of the study was explained, and students were invited to either complete the survey then or take it with them to complete later. All completed questionnaires were collected in a drop-off box at each university. No identification was attached to the questionnaires so student anonymity was maintained.

4.4.3 Data Analysis

Using the statistical analysis package STATA v11.0 (StataCorp, USA 2009), analysis was comprised of descriptive statistics presented as proportions of respondents, with mean (standard deviation) and range values determined for some parameters. Associations between responses to selected questions were investigated using the Chi-squared test. Data were checked for normality and non-parametric statistics were used when appropriate.

4.5 Results

Across the five universities there were 484 students in final-year programs. A total of 371 completed questionnaires were returned, resulting in a response rate of 77% (371/484). Respondent demographic information is shown in Table 4.1. The majority of respondents were female (234/371, 63%), and were aged 20-23 years (253/371, 68%). All but one student had attended a clinical placement in a hospital and 56% (209/371) had attended a private practice placement. Nearly two-thirds (238/371, 64%) had completed placements in all three major clinical areas (musculoskeletal/orthopaedics, cardiorespiratory, and neurological) (Australian Physiotherapy Council 2015) while almost all respondents (338/371, 91%) had attended placements in at least two of these areas. Nearly half (173/371, 47%) had also completed placements in more specialised areas such as paediatrics and women’s health.

Table 4.1 Demographic and educational characteristics of survey respondents. All data are expressed as a number (percentage) unless otherwise indicated.

	Study participants (n=371)	CPR users (n=79)	CPR non-users (n=292)
Gender			
Male	136 (37)	30 (38)	106 (36)
Female	234 (63)	48 (61)	186 (64)
Missing data	1 (0)	1 (1)	0 (0)
Age (years)			
Mean (Standard Deviation)	23.2 (3.1)	23.5 (2.9)	23.1 (3.2)
Range	20-45	20-33	20-45
Type of facility attended for clinical placements *			
Tertiary teaching hospital	277 (75)	61 (77)	216 (74)
Secondary referral hospital	141 (38)	33 (42)	108 (37)
Primary health facility, community hospital	212 (57)	34 (43)	178 (61)
Community centre and/or home visits	172 (46)	30 (38)	142 (49)
Private practice – 1-3 physiotherapists	117 (32)	18 (23)	99 (34)
Private practice – 4 or more physiotherapists	115 (31)	24 (30)	91 (31)
Special school/Paediatric centre	13 (4)	1 (1)	12 (4)
University clinic	6 (2)	1 (1)	5 (2)
Aged care facility	5 (1)	0 (0)	5 (2)
Area of practice experienced on clinical placements *			
Musculoskeletal	339 (91)	66 (84)	273 (93)
Orthopaedics	241 (65)	44 (56)	197 (67)
Acute/cardiorespiratory	325 (88)	66 (84)	259 (89)
General inpatient	185 (50)	35 (44)	150 (51)
Neurological	266 (72)	50 (63)	216 (74)
Rehabilitation	263 (71)	42 (53)	221 (76)
Community	158 (43)	28 (35)	130 (45)
Paediatrics	124 (33)	14 (18)	110 (38)
Women's health	30 (8)	3 (4)	27 (9)
Aged care	7 (2)	1 (1)	6 (2)
Amputees	6 (2)	2 (3)	4 (1)
Cancer/palliative care	5 (1)	0 (0)	5 (2)
Mental health	4 (1)	1 (1)	3 (1)
Lymphoedema	3 (1)	0 (0)	3 (1)
Hand therapy	2 (1)	1 (1)	1 (0)
Spinal cord injuries	2 (1)	0 (0)	2 (1)
Burns	1 (0)	0 (0)	1 (0)
Chronic pain	1 (0)	1 (1)	0 (0)
Sports injuries	1 (0)	0 (0)	1 (0)
Animal	1 (0)	0 (0)	1 (0)

* Multiple answers possible so may add up to more than 100%

4.5.1 Awareness and Knowledge of CPRs

Sixty percent (222/371) of respondents had not heard of CPRs, with a further 19% (70/371) having never used CPRs (together constituting the 'non-users'), resulting in 21% (79/371) as CPR 'users'. The non-users were not required to answer any further questions about CPRs. No significant differences were found between users and non-users of CPRs in age, gender, type of facility attended or area of practice experienced on clinical placement.

Of the 30 CPRs listed in Table 4.2, all were known by at least four users, with 20 of the CPRs recognised by more than a quarter (20/79) of the users. Ninety-two percent (73/79) of users knew at least one CPR on the list, 66% (52/79) knew at least five, and 38% (30/79) knew at least 10 of the CPRs listed. One student recognised all 30 and another three students were familiar with all but two of the CPRs. The median number of CPRs known to student users was 6, with an inter-quartile range (IQR) of 3-12. The CPRs most commonly known by student users were those for determining the need for an X-ray following injuries to the ankle and foot (53/79, 67%) (Stiell et al 1992), and for identifying deep venous thrombosis (DVT) (50/79, 63%) (Wells et al 1998). Two users were familiar with an additional two CPRs for other purposes not on the list. Thirty-eight percent (30/79) of users were able to name CPRs they knew, mostly the Ottawa Ankle Rule (28/79, 35%) (Stiell et al 1992) and the Ottawa Knee Rule (16/79, 20%) (Stiell et al 1995), with only two students able to specifically name another CPR.

Table 4.2 Knowledge and use by student users (n=79) of CPRs listed by purpose and in order of best known to least known. All data are expressed as a number (percentage) unless otherwise indicated.

Purpose of Clinical Prediction Rule	Know of	Used on placement	Stage of Development (Glynn & Weisbach 2011, Haskins et al 2015b, Keogh et al 2014)
Identification of injuries to ankle & foot (need for X-Ray) (Stiell et al 1992)	53 (67)	30 (38)	Impact analysis
Identification of deep venous thrombosis (Wells et al 1998)	50 (63)	32 (41)	Impact analysis
Diagnosis of subacromial impingement (Park et al 2005)	38 (48)	16 (20)	Derivation
Risk of osteoporosis (Cadarette et al 2000, Koh et al 2001, Lydick et al 1998, Shepherd et al 2007)	38 (48)	11 (14)	Validation
Identification of injuries to knee (need for X-Ray) (Stiell et al 1995)	37 (47)	18 (23)	Impact analysis
Patellofemoral pain, and likely to benefit from patellar taping (Lesher et al 2006)	34 (43)	19 (24)	Derivation
Diagnosis of rotator cuff tear (Litaker et al 2000, Park et al 2005)	30 (38)	16 (20)	Validation
Low back pain, diagnosis of sacroiliac joint problem (Laslett et al 1995)	29 (37)	15 (19)	Validation
Treatment of lateral epicondylalgia with MWMs (Mobilisations with Movement) and exercise (Vicenzino et al 2009)	29 (37)	12 (15)	Derivation
Low back pain, and likely to respond to mechanical traction (Cai et al 2009, Fritz et al 2007)	26 (33)	5 (6)	Derivation
Diagnosis of carpal tunnel syndrome (Wainner et al 2005)	25 (32)	10 (13)	Derivation
Whiplash-associated disorders, and at risk of developing chronic symptoms (Hartling et al 2002)	25 (32)	4 (5)	Derivation
Low back pain, and likely to respond to spinal manipulation (Flynn et al 2002, Fritz et al 2004)	24 (30)	6 (8)	Validation
Assessment of seriousness of injury to Cervical Spine (need for X-Ray) (Stiell et al 2001a)	24 (30)	2 (3)	Impact analysis
Patellofemoral pain, and likely to benefit from orthotics (Sutlive et al 2004, Vicenzino et al 2010)	23 (29)	10 (13)	Derivation
Diagnosis of osteoarthritis of the knee (Altman et al 1986)	23 (29)	9 (11)	Validation
Low back pain, diagnosis of spinal stenosis (Sugioka et al 2008)	23 (29)	8 (10)	Validation
Neck pain likely to be cervical radiculopathy (Wainner et al 2003)	23 (29)	6 (8)	Derivation
Low back pain, and likely to benefit from lumbar stabilisation exercises (Hicks et al 2005)	22 (28)	12 (15)	Validation
Diagnosis of pulmonary embolism (Le Gal et al 2006, Wells et al 2000b)	20 (25)	4 (5)	Impact analysis
Risk of peripheral neuropathy (Richardson 2002)	15 (19)	7 (9)	Derivation
Diagnosis of osteoarthritis of the hip (Altman et al 1991, Sutlive et al 2008)	15 (19)	4 (5)	Validation
Assessment of seriousness of Head Injury (need for CT Scan) (Haydel et al 2000, Mower et al 2005, Stiell et al 2001b)	15 (19)	2 (3)	Impact analysis
Neck pain, and likely to benefit from cervical traction (Raney et al 2009)	14 (18)	3 (4)	Derivation
Headache, likely to respond to trigger point therapy (Fernandez-de-las-Penas et al 2008)	12 (15)	3 (4)	Derivation
Patellofemoral pain, and likely to benefit from lumbar spine manipulation (Iverson et al 2008)	12 (15)	3 (4)	Derivation
Neck pain, and likely to benefit from cervical spine manipulation (Tseng et al 2006)	12 (15)	2 (3)	Derivation
Shoulder pain, and likely to benefit from cervico-thoracic manipulation (Mintken et al 2010)	11 (14)	2 (3)	Derivation
Neck pain, and likely to benefit from thoracic spine manipulation (Cleland et al 2007b)	11 (14)	1 (1)	Validation
Treatment of temperomandibular joint pain with splint (Emshoff & Rudisch 2008)	4 (5)	0 (0)	Derivation
Other CPRs for any condition except low back pain	2 (3)	1 (1)	
Other CPRs for low back pain	0 (0)	0 (0)	
Nil	6 (8)	25 (31)	
Median (IQR) number of CPRs per user	6 (3-12)	2 (0-6)	

IQR = inter-quartile range

4.5.2 Use of and Learning About CPRs on Clinical Placement

Sixty-eight percent (54/79) of users had employed at least one CPR from the list of 30 while on clinical placement, 30% (24/79) had used at least five, and 13% (10/79) had applied at least ten of those listed. The greatest number used by any student was 19 and the median number used by students was two (IQR 0-6). The most commonly used CPRs were for identification of DVT (32/79, 41%) (Wells et al 1998), and for determining the need for an X-ray following injuries to the ankle and foot (30/79, 38%) (Stiell et al 1992).

The most common reasons reported by students for using CPRs, and for not using them more often, are listed in Table 4.3, along with reasons for wanting to learn about them and perceptions about why students don't learn about CPRs more often. Even though 72% (57/79) of users of CPRs said they considered their clinical educators as a source of information on CPRs whilst on clinical placement, 80% (63/79) reported that educators were either not using CPRs or not teaching them, suggesting that a relatively small proportion of all clinical educators are actually teaching CPRs. Figure 4.1 shows how often students reported learning about CPRs whilst on clinical placement. Participants were also asked if they advocated the teaching of CPRs to students, with 80% (63/79) in favour and 20% (16/79) expressing no preference; none was opposed to the teaching of CPRs.

Table 4.3 Most common reasons reported by student users of CPRs (n=79) for using and learning about CPRs. All data are expressed as a number (percentage)

Why do you use CPRs?	
Assist with making a diagnosis	52 (66)
Assist with making a prognosis	26 (33)
Assist with choosing an intervention	33 (42)
Make interventions more effective	13 (16)
One or more of the above four reasons	66 (84)
Assist with clinical reasoning	59 (75)
Streamline assessment procedures	28 (35)
Because they are reflective of current best practice	14 (18)
Why don't you use CPRs more often?	
Lack of practice with their use	47 (59)
Lack of knowledge about their use	45 (57)
One or both of these reasons	64 (81)

Why do you think you haven't learnt about CPRs more often while on clinical placement?	
Educators don't seem to use them	54 (68)
Educators don't know enough about them to be able to teach them to students	24 (30)
One or both of the above two reasons	63 (80)
Educators prefer that students practice standard clinical reasoning rather than using a formula	34 (43)
Why do you think students should learn about CPRs on clinical placement?	
Assist with making a diagnosis	55 (70)
Assist with making a prognosis	38 (48)
Assist with choosing an intervention	46 (58)
Make interventions more effective	20 (25)
One or more of the above four reasons	67 (85)
Help with developing clinical reasoning	48 (61)
Streamline assessment procedures	31 (39)
Improve use of evidence-based practice	23 (29)
Because they are reflective of current best practice	21 (27)
Assist student learning	16 (20)

4.5.3 Relationship Between CPRs and Clinical Reasoning

The most common single reason stated by students for using CPRs was to assist with their clinical reasoning (59/79, 75%) (Table 4.3). In addition, 61% (48/79) of student users said they wanted to learn about CPRs to help with the development of clinical reasoning skills (Table 4.3), and 27% (21/79) had learned on clinical placement how CPRs can help with clinical reasoning. The majority of users (62/79, 78%) believed CPRs aided skill development in clinical reasoning, while less than 4% (3/79) believed CPRs impeded the learning of clinical reasoning. When asked if they had ever considered a CPR but had proceeded contrary to the clinical direction indicated, that is by deciding on an alternate diagnosis, prognosis or intervention, 46% (36/79) of users responded they had deviated from the clinical decision suggested by the CPR.

4.6 Discussion

This survey investigated the perceptions and experiences of pre-professional physiotherapy students in Australia regarding their use of CPRs, and reveals that many have never heard of CPRs and many more are not using them. Those students who had used them reported that they were learning little about CPRs from their clinical educators. The 27% of student users who reported they were ‘sometimes’ or ‘always’ learning about CPRs whilst on clinical placement (Figure 4.1) represent less than 6% of total respondents, and so most students are unlikely to be taught CPRs in the clinical setting, supporting the findings of our survey of physiotherapy clinical educators (Knox et al 2015). Arguably if students have such a poor understanding of CPRs or are using them inappropriately, it highlights the need for better education regarding EBP (including CPRs) in the classroom and in the clinic.

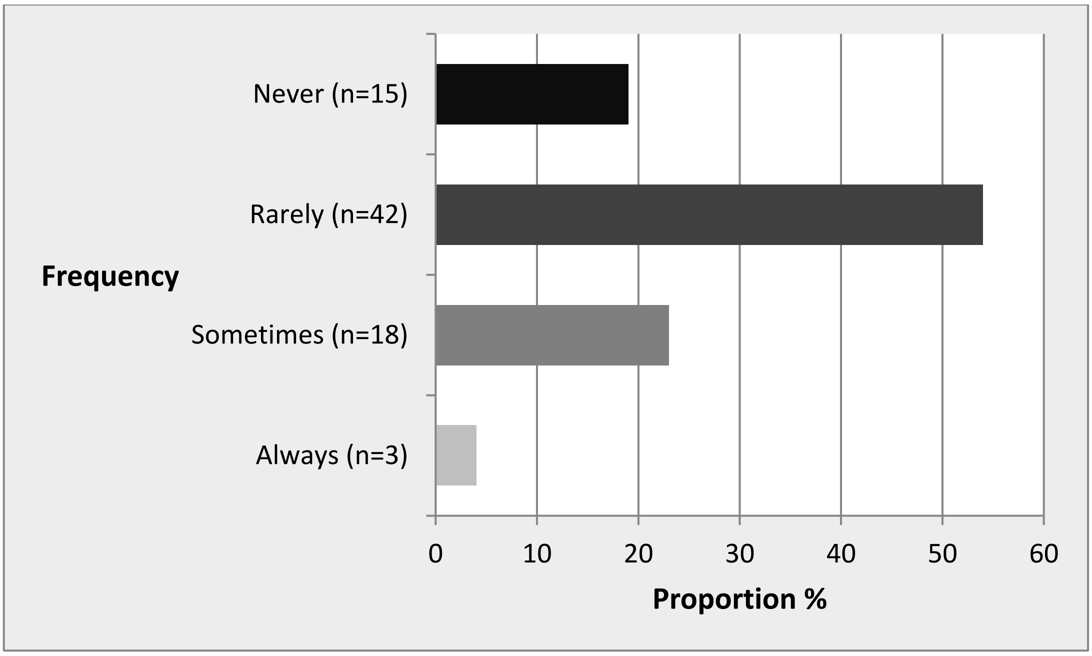

Figure 4.1 Proportions of student users who reported learning about CPRs whilst on clinical placement.

The response rate of 77% captures a substantial proportion of final-year students at the universities surveyed. These are broadly representative of physiotherapy programs in Australia as the sample included respondents from both undergraduate and graduate pre-professional programs, a range of cohort sizes, universities located in municipalities of different sizes and across all major states in Australia offering physiotherapy education.

4.6.1 Student Understanding of CPRs

The results indicate that physiotherapy students’ knowledge of CPRs is surprisingly limited, with 60% of respondents having never heard of them. Comments indicated confusion about the term ‘Clinical Prediction Rules’, with some students unable to differentiate between them and standard clinical reasoning or outcome measures, with two respondents saying “I don’t exactly know how Clinical Prediction Rules differ to (sic) clinical reasoning" and "I feel that they might be outcome measures". Overall, knowledge of CPRs was limited, with few students recognising or able to name a CPR. Indeed, only a handful of students reported a wide exposure to many CPRs, and only two students could name a CPR other than the Ottawa Ankle and Knee Rules. This might be concerning given several studies (Cabana et al 1999, Eagles et al 2008, Graham et al 2001) have suggested that lack of awareness or understanding of a CPR is a major barrier to its utilisation.

Even though the term 'Clinical Prediction Rule' was defined at the start of the survey, including variations of the terminology used, several student respondents indicated they had not used CPRs and then made comments suggesting they actually may have been exposed to CPRs but had a limited understanding. For example, one respondent stated: "I have had experience with some of the statements in the 'Purpose of clinical prediction rule' table but have never heard it called Clinical Prediction Rule". Thus some respondents categorised as being non-users may in fact have been users, albeit unknowingly.

4.6.2 Student Experience with CPRs on Clinical Placement

Use of CPRs by physiotherapy students on placement was also low (only 21% of respondents); even amongst those who had heard of CPRs nearly half (47%) had never used them. Most CPR users were only using a few, with 70% using fewer than five. The most common reasons for this were students not knowing enough about CPRs or not using them often enough (81%) and a perceived lack of use or knowledge about CPRs by clinical educators (80%). This is consistent with a recent survey of physiotherapy clinical educators (Knox et al 2015), which found that a large proportion of educators knew little about CPRs and so were unlikely to be teaching them to students on clinical placement.

A CPR should undergo three stages of development (derivation, validation, impact analysis) (Beattie & Nelson 2006, McGinn et al 2000), with progression through each of these stages leading to growing confidence in the clinical utility of the tool (see Table 4.2). The two CPRs that students were most familiar with had progressed to the impact analysis (final) stage of development. Six of the eight CPRs most commonly known and used by students had been validated (second stage) The finding that students were more likely to know of and use CPRs that had undergone impact analysis, or at least been validated, possibly suggests they may have learned about the stages of development of CPRs and perhaps had more confidence in employing those that had progressed beyond the derivation stage. It may also indicate that their clinical educators were more likely to teach and encourage the use of validated CPRs, or that CPRs that had been validated were more likely to have been incorporated into clinical practice and teaching.

Students used CPRs, and wanted to learn about them, for multiple reasons. Each CPR is designed and developed to aid with determining either a diagnosis, an outcome, or an ideal intervention (Childs & Cleland 2006), and a large proportion (84%) of student users were employing CPRs for one or more of these purposes (Table 4.3). One student said that CPRs were a “useful guide” that helped overcome their lack of experience. The large majority (80%) favoured the teaching of CPRs to students and not one user respondent was opposed, suggesting that the barriers to student use of CPRs relates more to a lack of knowledge rather than a lack of confidence in these tools (Graham et al 2001, Haskins et al 2014, Stiell et al 2006).

4.6.3 Student Perceptions About CPRs And Clinical Reasoning

While studies may indicate that physiotherapists rely less on research-based evidence than on other sources of information for treatment selection (Turner & Whitfield 1997), practitioners do in the main have a positive attitude towards learning and clinically implementing EBP (Jette et al 2003, Iles & Davidson 2006). EBP can play a significant role in all aspects of broader patient management – consisting of Examination, Evaluation (including clinical reasoning), Diagnosis, Prognosis, Intervention and Outcomes – by evaluating procedures utilising the analytical tests of sensitivity, specificity and likelihood ratios (Fritz & Wainner 2001), and which inform the development of CPRs (Glynn & Weisbach 2011). Students generally felt positive about the relationship between CPRs and clinical reasoning, with three-quarters using CPRs specifically to assist with their clinical reasoning, and more than half believing CPRs aided the development of clinical reasoning skills. Interestingly, comments such as CPRs were “an option, not to replace clinical reasoning” indicated that CPRs were indeed recognised as simply an aid and not a prescription. Consistent with this interpretation, nearly half of the users stated they had proceeded in a differing direction to the clinical decision suggested by a CPR, citing reasons such as “more complex issues” and “other clinical indicators which contraindicated the findings of the CPR”. This suggests that students often use them to guide, rather than direct, their clinical reasoning.

4.6.4 Limitations

Although the response rate was high amongst potential respondents, 79% (292/371) of respondents were non-users of CPRs; thus only 79 respondents were able to answer subsequent questions about the use and learning of CPRs. Furthermore, it is possible that some non-users had actually used a CPR but were unfamiliar with the term.

The study was limited to five universities in Australia, although these were across five states. The majority of respondents were in undergraduate programs, which is the most common professional pathway in Australia. Professional pathways differ internationally, and it is unknown whether the knowledge or use of CPRs would be different for students completing their pre-professional physiotherapy qualification through varied pathways in other countries.

4.6.5 Future Research

Students reported that many clinical educators were not teaching them about CPRs in the clinic and that exposure to CPRs in the classroom by academics was also limited. Future research could therefore potentially develop and evaluate an educational package aimed at assisting physiotherapy clinical educators and possibly academics in using and teaching these tools in the context of evidence-based practice.

4.7 Conclusion

This study found that the minority of physiotherapy students who knew about CPRs recognised them as useful for many reasons including as an aid to their clinical reasoning, and expressed that they wished to learn more about them. However the majority of students were unaware of CPRs or were not getting the opportunity to use them or learn about them on clinical placement.

Ethical Approval: Ethical approval for the study was granted by the Human Research Ethics Committees at The University of Newcastle (No. H-2012-0192), The University of South Australia (No. 0000031945), The University of Queensland (No. 2013001154), The University of Melbourne (No. 1341376) and The University of Notre Dame Australia (No. 014035F).

CHAPTER 5

THE PREFERENCES OF PHYSIOTHERAPY CLINICAL EDUCATORS ON A LEARNING PACKAGE FOR TEACHING MUSCULOSKELETAL CLINICAL PREDICTION RULES – A QUALITATIVE STUDY

This chapter has been published in a peer-reviewed scientific journal as follows:

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https://doi.org/10.1016/j.msksp.2018.10.005

5.1 Overview

This chapter describes the third of the four studies that comprise the thesis. The key findings from the first two studies were that few clinical educators knew much about or used CPRs, and as a result very few clinical educators were teaching CPRs to students on clinical placement. Students also reported in Study 2 (Chapter 4) that they were unlikely to be learning about, experiencing or practising CPRs on clinical placement. In order for students to consolidate the knowledge and practice they need with this potentially valuable and useful evidence-based tool that may assist them in their clinical decision-making, many clinical educators would need to receive specific training in CPRs.

An educational package for distribution to physiotherapy clinical educators, to introduce them to CPRs, explain the rationale behind the use and applicability of CPRs, as well as the advantages/disadvantages of using CPRs in their clinical practice, could be useful in increasing awareness and knowledge among clinical educators. It could consequently increase the likelihood of students learning to apply CPRs in practice while on clinical placement. The exact content of such a package requires careful consideration to ensure it meets the needs of clinical educators: it was therefore decided to consult with end-users to determine what they considered was required in the educational package.

Thus this study aimed to establish whether an educational package on CPRs would be welcomed and utilised by clinical educators, explore what information clinical educators required in a learning package on the clinical use of CPRs, and finally ascertain what methods of presentation and delivery of the package were preferred by educators.

5.2 Abstract

5.2.1 Background

There is a growing number of clinical prediction rules (CPRs) relevant to physiotherapy, particularly in the musculoskeletal area, but many students are not learning about them due to lack of awareness or understanding by clinical educators. An educational package specifically designed for physiotherapy clinical educators would aid their understanding of CPRs and ability to utilise them clinically, and also to be able to teach them to students.

5.2.2 Objectives

To determine the desired content and preferred methods of delivery of an educational package for clinical educators on musculoskeletal CPRs.

5.2.3 Design

A qualitative descriptive approach using semi-structured group and individual interviews with clinical educators.

5.2.4 Method

Educators working in the clinical area of musculoskeletal physiotherapy who had an awareness of or interest in CPRs were recruited and interviewed on their views regarding the content and delivery of an educational package on musculoskeletal CPRs. Audio files were transcribed and analysed using framework analysis to explore and develop themes and subthemes.

5.2.5 Findings

Content of an educational package should include general information on CPRs to improve familiarity and understanding, including a brief description, purpose, stages of development, application, limitations, and Information to dispel common myths and misunderstandings, as well as some specific examples of commonly-used CPRs. The package should be available in multiple formats to allow for different learning styles, both online via video, webinars, and podcasts, and face-to-face in practical sessions.

5.2.6 Conclusions

Clinical educators would find an educational package useful in assisting them to learn about musculoskeletal CPRs and to teach them to students.

5.3 Introduction

It is incumbent on health professionals in practice today to be able to demonstrate that their clinical interactions are based upon the principles of 'best practice', a code that dictates that those interactions are founded on scientific evidence and as a consequence are the most efficient and effective available. This evidence-based best practice can be used to guide investigations, assessment procedures, clinical decision-making and interventions. Clinical prediction rules (CPRs) are evidence-based mathematical tools designed to assist clinical decision-making (Beattie & Nelson 2006, Glynn & Weisbach 2010, Laupacis et al 1997, Learman et al 2012). They aid in developing a diagnosis, formulating a prognosis, or determining an appropriate intervention (Childs & Cleland, 2006), by formalising clinical assessment in order to streamline the process and improve clinical precision (McGinn et al 2000). While certainly not the only tool available to aid clinicians in patient consultations, CPRs have been reported to be a useful adjunct in guiding clinical decision-making (Brehaut et al 2006, Eagles et al 2008, Graham et al 1998, Haskins et al 2014). There is a growing number of CPRs relevant to physiotherapy, particularly in the musculoskeletal area (Glynn & Weisbach 2010, Knox et al 2015, Knox et al 2017), but studies have found barriers to their implementation in clinical practice (Abboud & Cabana 2001, Cabana et al 1999, Haskins et al 2014, McGinn et al 2008, Stiell et al 2006), including awareness of their availability and familiarity with their use. Education on their purpose is recommended to improve the acceptability of CPRs by clinicians (Kelly et al 2017a).

Because CPRs are especially useful with complex conditions or where there is "clinical uncertainty" (Beattie & Nelson 2006, p158) they may be particularly helpful for physiotherapy students, who lack experience and thus may struggle with analysing challenging clinical presentations. There is evidence that physiotherapy clinical educators believe CPRs can aid the development of clinical reasoning skills in physiotherapy students, and that there are few educators opposed to the teaching of CPRs to students (Knox et al 2015). Physiotherapy students report CPRs as being helpful in developing skills in clinical decision-making (Knox et al 2017). However, these same two studies also revealed that few clinical educators know about or use CPRs, and as a result very few are teaching CPRs to students on clinical placement. Consequently, students are unlikely to be learning about or practising CPRs in a clinical setting.

In order for students to consolidate the knowledge and practice they need with this potentially valuable and useful evidence-based tool, many clinical educators will need to receive training in CPRs. Studies have found that appropriately-designed educational packages are effective in introducing educational material on a specific topic (Au et al 2016, Gartshore et al 2017, McKenzie & Mellis 2017, Moule et al 2014). An educational package for distribution to physiotherapy clinical educators, to introduce them to CPRs, explain the rationale behind the use and applicability of CPRs, as well as the advantages of using CPRs in their clinical practice would be useful in fulfilling this goal.

The necessary content and best method(s) of delivery of such a package require careful consideration to ensure it meets the needs of clinical educators. The aim of the present study was to explore what clinical educators want in such an educational package including the preferred breadth and depth of content, mode of presentation (how it appears) and method of delivery (how it is distributed).

5.4 Methodology

5.4.1 Study Design

A qualitative descriptive approach was chosen for the study as the objective was to explore the perspectives of clinical educators on the use and usefulness of CPRs in their own clinical practice, what students should be taught about CPRs and how, and the way an educational package should be presented and delivered. With qualitative description, the aim is not a study of the culture (as in ethnography), development of theory (grounded theory) or interpretation of experience (phenomenology) but "a rich, straight description of an experience" (Neergaard et al 2009, p2). Thus the data analysis is typically less interpretive than in other forms of qualitative research designs, with the end result being a description of participants' experiences expressed in a language similar to that used by the participants (Jiggins Colorafi & Evans 2016, Kim et al 2016, Neergaard et al 2009, Sandelowski, 2000). The lower level of interpretation that occurs means that multiple researchers looking at the same data are more likely to agree on the analysis (Jiggins Colorafi & Evans 2016), which improves the validity of the study outcomes. Qualitative description was therefore an appropriate approach as the aim of the study was to explore the perceptions and experiences of clinical educators with CPRs, and to record those experiences and perceptions directly with the words and phrases used by the educators.

A series of semi-structured group and individual interviews was conducted, guided by a schedule of open questions and prompts designed to explore the participants' experiences and views. Participants were asked to share their knowledge and use of CPRs, their ideas and preferences for the content of an educational package on the teaching of CPRs to physiotherapy students in the clinical education setting (including what they thought educators should know about CPRs, and what they thought students should know about them), and their thoughts and preferences on the presentation and delivery method of such an educational package.

Open questions were used as they allowed participants to frame their own answers, whereas closed questions tend to be “loaded questions” that fit answers to the researcher’s ideas by “forcing responses into narrow categories” (Charmaz 2014, p32). As with other qualitative methodologies, the aim of the interviews was not to produce generalisable findings in a statistical sense, but rather to elicit rich information, capturing and describing the range of views, issues and suggestions to obtain generalisability in an analytical sense. Studying people’s responses and experiences of phenomena in certain situations gives us an idea of how others might experience similar circumstances (French et al 2001).

5.4.2 Participants

Purposive sampling involves selective recruitment of participants with the knowledge and experience to have the best insight into the research question(s) (Greenwood & Parsons 2000). This sampling technique was used to recruit physiotherapy clinical educators working in both public and private facilities, in metropolitan, regional and rural locations. Such an approach was required to represent the differing learning needs and challenges faced in a variety of clinical and geographical settings, and by educators with different levels of experience.

The clinical educators recruited were required to have some awareness of or interest in CPRs so that they would have an understanding of the subject matter, and so be able to comment on the use of CPRs in the clinical setting and in clinical teaching, although the level of knowledge and usage varied, in order to obtain a more representative discussion. Only educators working in the clinical area of musculoskeletal physiotherapy (including orthopaedics and emergency departments) were recruited, as previous studies revealed that these are the clinical areas where most CPRs relevant to physiotherapy are used (Glynn & Weisbach 2011, Knox et al 2015, Knox et al 2017).

5.4.3 Recruitment

Potential participants were sourced from the database of physiotherapy clinical educators affiliated with the University of Newcastle. An initial contact email, with an information statement attached, was sent to potential participants inviting them to participate in the research, and following this one of the research team contacted the potential participant by telephone. This contact proceeded according to a standardised protocol and covered the following areas: voluntary nature of participation and the right to refuse participation; reiteration of study aims; confirmation of eligibility; interview method including time and dissemination of findings; anonymity and confidentiality; de-identification of data for publication; and option of more time for consideration. Those indicating a willingness to participate were invited to nominate a convenient time and contact telephone number for the interview. They were also asked to return a completed consent form and demographic questionnaire before their interview.

5.4.4 Procedure

Interviews were conducted between October 2016 and October 2017. One group interview (83 minutes in duration) and twelve individual interviews (11-31 minutes in duration) were conducted with a total of 14 participants. The first author (GK) conducted the individual interviews. He was trained by an experienced qualitative researcher in interviewing techniques (ES) who conducted the first (group) interview with the lead author present in order to observe interviewing technique. The group interview was conducted face-to-face, while the individual interviews were conducted by telephone: telephone interviews were employed in order to enable the views of participants in regional and rural areas to be included.

5.4.5 Data Analysis

Audio files from each interview were transcribed and analysed using the framework method. Framework analysis was chosen as the technique to examine and interpret the data as it is very effective in analysing data from interviews where the object is to construct themes by comparing within and between datasets (Gale et al 2013). It is also better suited for research which has specific questions to be asked of a pre-determined sample (Green & Thorogood 2009, Srivastava & Thomson 2009).

Cross-checking (Charmaz 2014, Domholdt 2005, Petty et al 2012) between members of the research team was done, whereby two members of the research team analysed and identified themes individually from the transcripts, before meeting to compare and contrast themes identified. Member checking (Creswell & Miller 2000, Domholdt 2005, Petty et al 2012, Thomas & Magilvy 2011) was also performed to improve validity, whereby participants were offered transcripts to read and confirm their comments and views were correctly represented, with about half the participants accepting the offer.

5.5 Findings

5.5.1 Participants

Demographic data of the 14 participants are summarised in Table 5.1. There was no significant gender bias (8 male, 6 female) and ages ranged from 27-64 years (mean 40, SD 10.6). Participants worked in both public and private facilities, ranging in size from large teaching hospitals to small community-based health centres and clinics, situated in metropolitan (three participants), regional (six participants) and rural (five participants) centres, with three participants teaching students in a university setting as well as working clinically. Years of professional experience ranged from 5-31 years (mean 16.5, SD 9.0), and as clinical educators from 1-30 years (mean 9.4, SD 8.4). Two participants had post-graduate entry-level qualifications, six more had post-professional qualifications at Masters or Doctorate level, and two were clinical specialists accredited by the Australian College of Physiotherapists. The number of students supervised per year by individual participants ranged from 1-30.

The experience that participants had with CPRs is provided in Table 5.2, indicating the degree of variation amongst participants with respect to: 1) their awareness of the existence of CPRs and the scope of conditions and problems for which CPRs are available; 2) their familiarity with the application and applicability of CPRs in various clinical settings; 3) the extent to which they used CPRs in their clinical practice; and 4) the confidence they expressed in using CPRs appropriately and effectively. This reveals that awareness did not necessarily lead to familiarity, and familiarity did not guarantee usage, nor was confidence always an indicator of usage. The wide variation in these parameters among the participants demonstrates that the themes expressed by the participants are likely reflective of clinical educators in general, in terms of their experiences with CPRs.

Table 5.1 Demographic and educational characteristics of participants

Pseudonym	Gender	Age	Work setting	Location *	Working full time (F/T) or part time (P/T)	Years working as a physiotherapist	Years working as a clinical educator	Students supervised per year	Students supervised at any one time	Entry level degree	Post-professional qualifications	Clinical specialist qualification (awarded by Australian College of Physiotherapists)
Alan	Male	64	Private practice	Metropolitan	F/T	29	15	18	2	Bachelor	Post-Graduate Certificate	Sports
Belinda	Female	43	Private practice & university	Metropolitan	P/T	22	21	6-10	2	Bachelor	Nil	Nil
Carolyn	Female	32	Public hospital	Regional	F/T	9	4	6-10	1-2	Masters	Nil	Nil
Donald	Male	41	Public community	Rural	F/T	18	1	2	1	Bachelor	Masters	Nil
Ellen	Female	30	Private practice	Rural	F/T	8	1	1	1	Bachelor	Nil	Nil
Frank	Male	56	Public & private hospital inpatients & outpatients	Rural	F/T	31	30	12-14	2	Bachelor	Masters	Nil
Gabby	Female	34	Public hospital & community	Rural	F/T	10	9	10	2	Masters	Masters	Nil
Harry	Male	50	Private practice	Regional	F/T	29	10	2-4	2	Bachelor	Masters	Nil
Ian	Male	36	Public hospital	Metropolitan	F/T	15	5	16-30	2-4	Bachelor	PhD	Nil
Joe	Male	43	Public hospital	Regional	F/T	20	6	4-20	2-4	Bachelor	Nil	Nil
Karen	Female	27	Public hospital	Regional	F/T	5	4	2-3	1-2	Bachelor	Nil	Nil
Lee	Male	34	Public hospital	Rural	F/T	7	3	2	1	Bachelor	Nil	Nil
Meg	Female	31	Public hospital & university	Regional	P/T	10	6	Variable	2-4	Bachelor	Nil	Nil
Noel	Male	39	Private practice & university	Regional	F/T	18	16	Variable	1-4	Bachelor	Masters	Paediatrics

* Metropolitan (population over 100,000), regional (25,000 – 100,000) and rural (under 25,000)
(Departments of Primary Industries and Energy & Human Services and Health, 1994; Roufeil & Battye, 2008)

Table 5.2 Experience of participants with CPRs

Pseudonym	Work setting	Awareness of CPRs *	Familiarity with CPRs *	Usage of CPRs *	Confidence with use of CPRs *
Alan	Private practice	4	4	3	4
Belinda	Private practice & university	4	4	3	4
Carolyn	Public hospital	4	3	2	2
Donald	Public community	1	1	1	1
Ellen	Private practice	3	3	2	2
Frank	Public & private hospital inpatients & outpatients	3	2	1	1
Gabby	Public hospital & community	2	2	1	1
Harry	Private practice	2	1	0	0
Ian	Public hospital	5	5	5	5
Joe	Public hospital	5	5	4	5
Karen	Public hospital	5	5	4	5
Lee	Public hospital	4	3	2	3
Meg	Public hospital & university	4	4	3	4
Noel	Private practice & university	3	3	2	2

* 0 = Not at all 1 = To a small extent 2 = To some extent 3 = To a moderate extent 4 = To a great extent 5 = To a very great extent

5.5.2 Framework Themes

The framework analysis identified three main themes – the content of an educational package, the presentation and delivery of the package, and methods to raise awareness of the package (Figure 5.1). Content refers to the breadth and depth of information clinical educators thought should be included in a CPR learning package for clinical educators. Presentation and delivery refer to how the information is packaged and circulated to clinical educators. Methods refers to ways of raising awareness of the package and promoting it to clinical educators.

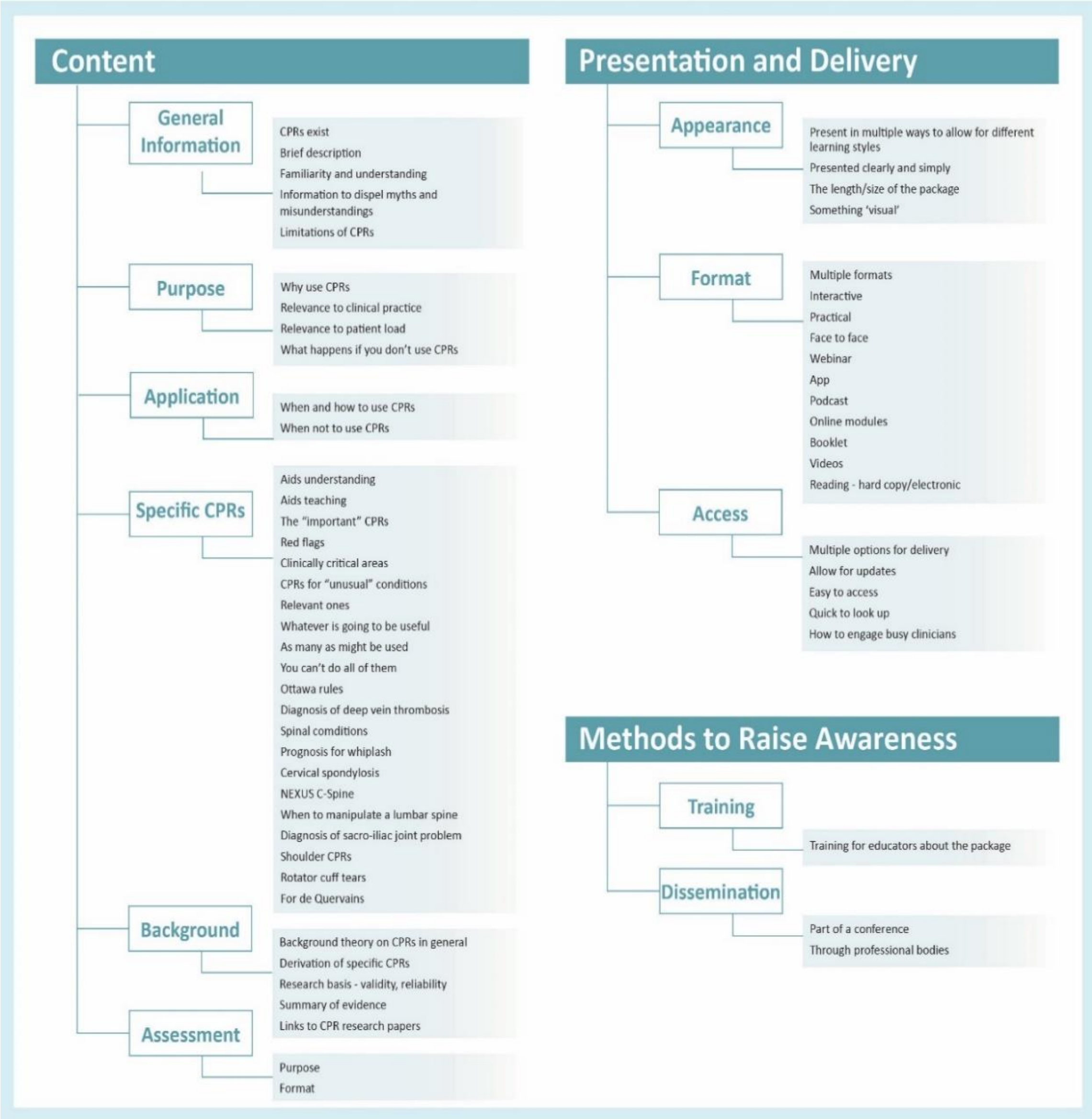

Figure 5.1 Themes that emerged regarding clinical educators' preferences for an educational package

5.5.3 Content of the Package

Participants shared what they thought clinical educators should know about CPRs in general, and which specific CPRs they should know about in order to effectively teach students. The majority of participants (8/14) indicated a package should contain some background information on CPRs, specifically on the research that underpins specific CPRs. Participants all agreed (14/14) that there should be some general information about CPRs starting with basics such as an explanation of what a CPR is and a description of their practical application:

> "Maybe just a page or something on what clinical prediction rules are and why they are important" (Ellen).

Some participants wanted copies of CPR research papers, or at least links to these, as this would enable educators to research individual CPRs that might be useful and pertinent to their clinical load. They would then be able to see the current stage of development for a CPR, how it was derived and whether the derivation population related to the clinician's patient population, thus giving greater confidence in the use of a particular CPR and how to teach it:

> "We probably need to know everything about them … what they are, how to use them" (Gabby).
> "What's actually available for what part of the body … and what test is involved for each clinical prediction rule, and also how actually you do the test" (Lee).
> "When to use them and when not to use them" (Meg).
> "If you understand the research that's gone into them and how they came about then I think then you get a better understanding of how to apply them" (Noel).

Most participants (12/14) were also in favour of a learning package containing specific examples of CPRs. Comments were made that examples can help in the understanding of theory, and would therefore be valuable in comprehending the principles of CPRs, and would also aid in their teaching to students:

> "If I'm learning something I like to have examples … they could have examples as well as like a case study to help them be able to then apply the rules" (Karen).
> "I think giving examples is probably a really good way of teaching" (Ian).

Participants also noted that there were specific CPRs that educators and students should be aware of due to their being more widely known and used in practice. There was considerable variation in opinions as to which specific CPRs should be included, and whether there should even be a limit. Many participants (9/14) mentioned specific CPRs for inclusion in an educational package, the most common being the various Ottawa Rules (8/14):

> "If they are going into an orthopaedic prac then say the Ottawa ankle one" (Carolyn).

> "There's the Nexus C-Spine rules and there's the Canadian C-Spine rules and they're both different and they're both useful and I think in clinical practice you use a combination of the two" (Noel).
> "You'll be trying to make sure you don't miss DVTs (deep vein thrombosis)" (Alan).
> "I still go through the SIJ (sacroiliac joint) testing (with students); I still think that's a useful set of tests" (Joe).

Participants recommended that it was important for any educational package to clearly specify the limitations of CPRs. Haskins and colleagues (2014) suggest that a barrier to the clinical adoption and implementation of CPRs is the fear that they are a challenge to a clinician's autonomy, from the false belief that their proponents advocated them as replacing clinical judgement rather than augmenting it. Some participants reflected on this barrier by suggesting that the package should include information to dispel common misunderstandings about CPRs:

> "That it's emphasised, these can be used as a guideline, but you still need to always have that degree of suspicion" (Belinda).
> "They inform a clinical decision and not form that clinical decision. So it's not replacing, in any way, traditional clinical reasoning approaches but rather it's an additional tool that can be used to supplement clinical reasoning" (Ian).

All participants commented on the need to have some form of assessment or 'competency check' in the package so that clinical educators could evaluate their own and their students' level of understanding. Suggestions ranged from a brief 'tick box' checklist to a scenario-based assessment. Several commented that incorporating assessment both motivated student and educator to more closely engage with the learning material:

> "I guess that's a good motivator for actually learning stuff isn't it really" (Harry).
> "It probably does work because it does probably make you actually pay a little bit more attention; you can't just skip through the pages and you're aware that … you are going to be assessed on it; at least have to show competency at the end of the program, so I would definitely welcome that" (Ian).

5.5.4 Presentation and Delivery of the Package

Once the desired content was established, participants contributed their thoughts on how the learning package should be presented and delivered to clinical educators, expressing views on the length, the layout and visual appearance, as well as how it could be accessed. Opinions varied on the length of the package, with some participants warning you could 'lose people' (Carolyn) if it were too long, while others wanted it long enough for sufficient detail to be included:

> "As short as possible" (Belinda).
>
> "For each of the clinical prediction rules you probably need like 5 minutes" (Ellen).
>
> "Anywhere between like an hour to a couple of hours might be about where your limit is" (Ian).

Nevertheless participants generally supported a package that was succinct and clearly presented:

> "I think the simplicity needs to stay there ... if you had some really clear clinical prediction rules" (Alan).

Similarly, all participants expressed an opinion on the style of delivery for a learning package, with most favouring multiple options. This was because it would cater for different learning styles and preferences, and might also be desirable for those clinical educators who learn in a combination of ways:

> "I think that's part of learning, you've got to cater to all those different styles" (Belinda).
>
> "Like a lecture and probably handouts and probably some journal articles with maybe some examples, to support it" (Ian).

There was substantial support (11/14 participants) for face-to-face instruction in CPRs combined with 'hands-on' practice of applying the CPR:

> "The actual application, answering the questions to clarify exactly what things mean and why they're important, that'd have to be done face to face" (Harry).
>
> "Talk about them and explain them in more depth than you can fit in a flyer or on a handout, and then demonstrate them, for example the SIJ one, demonstrate how to do the test and then get them to perform the test" (Ellen).

As well as this, 11/14 participants wanted something that they could read, electronically and/or in hard copy:

> "Some tests I'd be quite happy to do after reading it described so long as it's well described" (Donald).
>
> "Word documents ... saved so ... we could access them on our shared drive or something like that" (Gabby).

Whatever form of presentation it may take, participants indicated that a learning package should be easy to access, with 10/14 favouring the package being accessible online, including webinars and podcasts:

> "An online learning package for me, that would tick all my boxes... it makes it really accessible, interactive hopefully as well … you could have perhaps different modules in the program, so you target it to where someone's development is up to" (Ian).
>
> "Video of them performing the test … I guess that would be just as good for more remote areas" (Carolyn).
>
> "Pre-recorded podcasts ... because the participants can just suck in the information in their own time" (Noel).

It was further suggested that various organisations already have online access portals which could be utilised, such as the Australian Physiotherapy Association (APA) online learning platform or the state-based online learning portal for public New South Wales Health employees via the Health Education and Training Institute (HETI).

> "Just thinking of getting it out to everyone, the webinars that the APA run" (Belinda).
>
> "If there was an online training through HETI then that's where people could learn about in their own time" (Gabby).

It was also noted that the package would require regular updating as new CPRs were derived or existing CPRs were further validated. In this instance clinical educators would need to be alerted to the changes, such as via regular email updates:

> "An email when there's any updates to that information … I was thinking in terms of longevity, you can't just have a package can you because it's going to be updated … and then can, I guess, download whatever the current update of this information is" (Joe).

5.5.5 Methods to Raise Awareness of the Package

Finally, participants discussed methods of introducing the package to clinical educators, and training them to utilise the package effectively, both in their own clinical work and in a clinical teaching setting with students:

> "Maybe something in conjunction with the APA … and Department of Health, a combined thing for supervisors" (Frank).
>
> "The other way you might be able to do it is to tie it into a conference setting" (Alan).
>
> "An education day or something … if there's enough information there for it to be a half day or a full day or something that's probably one of the better ways and target it at clinical educators" (Gabby).

5.6 Discussion

Previous studies have found that physiotherapists lack awareness and familiarity with CPRs (Haskins et al 2014, Kelly et al 2017a), as do more specifically physiotherapy clinical educators (Knox et al 2015) and students (Knox et al 2017). This study proposes a solution to this problem could be in the form of an educational package designed for clinical educators to learn about CPRs, and to enable them to clinically teach their students about CPRs, so that as these students enter the workforce they do so with an appreciation of the potential benefits of utilising CPRs. The form and content of a learning package has been explored in this study. With a large range in interview length (11-83 minutes) reflecting the varying degrees of knowledge and experience with CPRs, participants expressed a variety of views and opinions on what should be in the package and how it should be delivered, though there was a measure of agreement on the basic components.

Firstly, there should be some general information on CPRs. As many educators are largely ignorant of these tools this information needs to include a basic definition and explanation; how they are developed and the stages of development; their relevance to clinical practice including how and when to apply them and why they should be used; information to dispel myths and misunderstandings; and the limitations of CPRs. In particular it should be emphasised that they are a guide to *aid* rather than replace autonomous clinical reasoning – clear explanation of this would help dispel one of the major misconceptions relating to CPRs.

Secondly, there should be some specific examples of CPRs. This would facilitate a deeper understanding of CPRs by demonstrating how they work in a clinical setting. There was some disagreement as to whether this should be an exhaustive list of 'all the CPRs you might use' (as expressed by Ellen), or just those most commonly used, or perhaps those which have been validated and shown to have a positive impact on health outcomes and healthcare resources. Nonetheless, there was considerable support for the various Ottawa rules, which have been well-validated in multiple studies (Bachman et al 2004, Bulloch et al 2003, Emparanza et al 2001, Gravel et al 2009, Libetta et al 1999, Moore et al 2005, Plint et al 1999, Richman et al 1997, Stiell et al 1993, Stiell et al 1996, Vijayasankar et al 2009) and are the best known CPRs amongst physiotherapy clinical educators and students (Knox et al 2015, Knox et al 2017).

The inclusion of background information on CPRs was considered valuable, and there was support for copies of, or at least links to, study papers that describe the development of some specific CPRs. By understanding the evidence-base behind individual CPRs, clinical educators may have more confidence in their effectiveness and so potentially be more likely to use them clinically, as well as to teach them to students. An assessment module was proposed as being useful in a number of ways, by encouraging educators to study and comprehend the learning materials and by giving them the opportunity to check that they have understood the package content, as well as providing a form of appraisal of the students under their supervision.

This study found that there was a wide variety of opinions on the way a learning package should be presented and delivered, and it would seem sensible to offer the package in a number of ways to cater for different learning styles and preferences. There was support for specific training sessions for clinical educators, to help understand CPRs and to understand the package itself. There could be an initial introduction via webinars, with accompanying videos of the tests involved and how to implement specific CPRs. It could also be offered as face-to-face practical sessions, perhaps tied in to existing conferences, for educators who prefer this mode of learning.

The variety of delivery options suggested by participants arguably reflects the need to enable clinical educators to access the educational material irrespective of their geographical location. Face-to-face lectures and practical sessions are more likely to be available only to metropolitan and perhaps regional-centre educators, but other regional and rural educators would still be able to access potential online options including e-modules, videos, webinars, podcasts, apps and electronic copies of documents describing CPRs.

Finally, consideration should be given to the package being offered in different lengths, with varying levels of detail, to cater both for those who are more interested and for those who only want a quick summary, and who may be discouraged from engaging if there is too much information. Accordingly, there could be a 'core package' containing brief and basic information, with perhaps various modules to add to this for those clinical educators who desire greater depth and detail. To facilitate accessibility the package should be available online, perhaps via existing learning platforms/portals with hard copy print options. Updates of the package material are needed regularly as research advances, and could be distributed via email with links to relevant study papers.

5.7 Limitations

Data in this study were collected from a relatively small group of physiotherapy clinical educators, although they were purposefully recruited to provide a broad representation of the various key clinical and geographical settings where musculoskeletal physiotherapists work, they had markedly varied awareness and familiarity with CPRs, and they were able to offer a large number and variety of comments and suggestions relating to the proposed educational package. Most of the interviews were conducted by telephone, which may have limited some participants' expression, such as with their non-verbal means of communication. Participants were limited to one university database, which restricted participation to clinical educators in the state of New South Wales in Australia, and as such the findings may not generalise to other populations of physiotherapy clinical educators; however the study population was broadly representative in terms of age (Physiotherapy Board of Australia 2018) and experience in clinical education (Knox et al 2015, Stiller et al 2004).

5.8 Conclusions and Recommendations

The results of this study suggest that physiotherapy clinical educators would welcome an educational package to assist them to learn about CPRs and to enable them to clinically teach the use of CPRs to students. The introduction of such a package may lead to students having a greater understanding and appreciation of CPRs, thereby facilitating their learning and preparedness for contemporary practice in an evidence-based healthcare setting. This study has prepared the groundwork for a package with recommendations on scope of content and methods of delivery, and future research would be needed to further develop, implement and assess the effectiveness of such a package. The key findings of the study are that an educational package should contain a basic description of CPRs and how to apply them clinically (as many clinical educators are unfamiliar with them), an acknowledgement of their limitations, and information to dispel associated misunderstandings (which is a major barrier to their use). Such a package should be available both face-to-face and online to enable clinical educators access irrespective of their geographical location.

Ethical Approval: Ethical approval for the study was granted by the University of Newcastle Human Research Ethics Committee (approval number H-2016-0110).

CHAPTER 6

A DELPHI STUDY TO ESTABLISH CONSENSUS ON AN EDUCATIONAL PACKAGE OF MUSCULOSKELETAL CLINICAL PREDICTION RULES FOR PHYSIOTHERAPY CLINICAL EDUCATORS

This chapter has been published in a peer-reviewed scientific journal as follows:

Knox GM, Snodgrass SJ, Southgate E & Rivett DA. (2019b) A Delphi study to establish consensus on an educational package of musculoskeletal clinical prediction rules for physiotherapy clinical educators. *Musculoskelet Sci Pract.*
https://doi.org/10.1016/j.msksp.2019.102053

6.1 Overview

This chapter describes the fourth and final study of the thesis. Having determined what clinical educators desired in an educational package in the last study (Chapter 5), it was proposed to consult with international physiotherapy experts in CPRs to finalise the core elements of the learning package and its preferred method of dissemination. The views of physiotherapy experts from across the world were therefore sought primarily on the key elements to be included in an educational package on understanding and using CPRs for physiotherapy clinical educators, and secondly to determine their opinions on the ideal modes of presentation and delivery of this package to clinical educators.

6.2 Abstract

6.2.1 Background

Clinical prediction rules (CPRs) are evidence-based tools to aid clinical decision-making, and there are many that are relevant for physiotherapists, especially in the musculoskeletal field. However, a lack of awareness and understanding by physiotherapy clinical educators could limit students' exposure to these potentially valuable tools. An educational package tailored for clinical educators could help them recognise the value of CPRs and implement them in clinical practice with students.

6.2.2 Objectives

To determine consensus on the essential content and optimal delivery of an educational package on musculoskeletal CPRs for physiotherapy clinical educators.

6.2.3 Design

An online survey of physiotherapy experts who have published on CPRs, using a Delphi approach.

6.2.4 Method

Sixteen experts were recruited for a two-round reactive Delphi study in which they rated previously identified elements, as well as suggesting new items for an educational package.

6.2.5 Findings

A pre-defined consensus of ≥ 70% identified that the content of an educational package should cover fundamental aspects of CPRs including why, when and how to use them clinically, and

their limitations. Information on the evidence-base of different types of CPRs, with specific examples, was also identified as important. Online delivery was recommended via self-directed learning and webinars, along with electronic versions of actual CPRs. A self-assessment component was also supported.

6.2.6 Conclusions

An educational package on musculoskeletal CPRs for clinical educators was supported with key elements outlined by an international panel of experts.

6.2.7 Implications

Improving clinical educators' knowledge of CPRs may lead to physiotherapy students having a greater understanding and ability to use CPRs.

6.3 Introduction

Physiotherapists have a professional responsibility, primarily to their patients but also to third parties such as employers and funding bodies, to ensure that their clinical consultations include procedures and interventions that are consistent with best practice and are evidence-based (Glasziou & Haynes 2005). Skills in clinical reasoning or decision-making underpin the clinical consultation process, as the clinician is required to make ongoing decisions about diagnosis, treatment and prognosis based both on the scientific evidence and clinical findings related to the presenting patient. However, effective clinical decision-making is not a skill that is easy to acquire or to teach to others (Jones & Rivett 2019).

A tool that is increasingly available to assist the physiotherapist with their decision-making is the clinical prediction rule (CPR) (Brehaut et al 2006, Eagles et al 2008, Graham et al 1998). CPRs are evidence-based tools that can assist the clinician with formulating a diagnosis, advancing a prognosis, or guiding the selection of ideal methods of intervention (Childs & Cleland 2006). A CPR is a statistical algorithm that quantifies the relative contribution of patient characteristics and clinical features into numerical indices to predict the probability of a clinical condition or outcome (Beattie & Nelson 2006). A CPR is developed in three stages: first derivation, in which it is initially created, usually in a small homogeneous population; second validation, involving testing in other populations for consistency, accuracy and reliability; and finally impact analysis, in which its influence is evaluated for its effect on clinician behaviour and acceptability, with consequent improvements in patient outcomes and/or financial savings while still maintaining standards of clinical care (Cook 2008, McGinn et al 2000).

Although CPRs have been available in medicine since the 1960s (Deandrade & Casagrande 1965, Keogh et al 2014), their adoption in clinical practice by physiotherapists has been relatively slow due to a lack of awareness and understanding (Knox et al 2015), along with a certain scepticism about their value in the clinical encounter (Haskins et al 2014, Kelly et al 2017a). As physiotherapists who use CPRs report finding them helpful in decision-making (Knox et al 2015, Knox et al 2019a) and as they are evidence-based, it may be beneficial for students to learn about them from their clinical educators during their formative clinical experiences.

Previous research has suggested physiotherapy clinical educators in Australia do not have much awareness of CPRs and thus are unlikely to use them when educating students, consistent with the reported experiences of Australian physiotherapy students (Knox et al 2015, Knox et al 2017). In the same studies, both physiotherapy clinical educators and students expressed a desire to learn more about CPRs in physiotherapy practice. Physiotherapy clinical educators may therefore benefit from being offered a tailored educational package on CPRs (Au et al 2016, Gartshore et al 2017, Moule et al 2014), which could enable them to use and teach CPRs to students in clinical practice. Given that nearly all CPRs relevant to physiotherapy practice are in the broader musculoskeletal field (including emergency department and orthopaedic) (Glynn & Weisbach 2011, Knox et al 2015, Knox et al 2017) arguably the focus of an educational package should be in this clinical area.

A recent study has identified potential elements of an educational package on musculoskeletal CPRs by interviewing physiotherapy clinical educators, including their suggestions for depth and scope of content as well as preferred options for availability and delivery (Knox et al 2019a). The present study aimed to refine and add to these preliminary ideas by consulting a panel of experts on CPRs for their recommendations on both content and delivery of such an educational package. The purpose of the proposed package would be to facilitate content expertise for clinical educators learning about CPRs, rather than actually provide a resource for teaching the use of CPRs to students – although the package could be the first step towards educators having the necessary understanding of CPRs to enable the teaching to occur. The Delphi approach was chosen as it is an established and reliable method of obtaining and utilising the considered opinion of experts, ascertaining the level of agreement, and determining the measure of consensus (Fink et al 1984, Hasson et al 2000, Hsu & Sandford 2007, Powell 2003). It is a structured and staged process consisting of iterative rounds designed to converge individual opinion into general agreement using summarised information and feedback.

6.4 Method

6.4.1 Design

A modified Delphi study was conducted using an online platform, consisting of two rounds. Although a Delphi study usually consists of three rounds, the main purpose of the first round is to generate factors for consideration, with the latter rounds rating and refining these factors. This generative type of first round was unnecessary in the present study as we used factors already identified by clinical educators in an earlier study (Knox et al 2019a), thereby attempting to link these factors with the experts' opinions, and also reduce the burden of participation for the experts. This modification to the approach is termed a reactive Delphi and is a useful means to avoid a first round which frequently generates an abundance of responses that are inter-related. These inter-related responses can be a problem whereby in condensing data for the second round, items may be omitted with the possibility of researcher bias (McKenna 1994, Walker & Selfe 1996). A Delphi study relies on the continued involvement of participants through to its completion, so another advantage is that by minimising the number of rounds there is less chance of participant fatigue and attrition (Fink et al 1984, Giannarou & Zervas 2014, Hasson et al 2000, Powell 2003).

6.4.2 Participants

Participants were selected purposefully on the basis of their experience and knowledge of CPRs (Akins et al 2005, Hasson et al 2000, Hsu & Sandford 2007). Target participants were physiotherapy clinicians and academics with experience in post-professional education, and who were experts in CPRs, identified as those with recent (within the years 2007-2017) publications on CPRs in peer-reviewed journals, drawn internationally and recognised in their area of expertise.

6.4.3 Procedure

A list of potential participants was drawn up from peer-reviewed articles published on CPRs in the target time period (Figure 6.1), with particular consideration given to first, second and last authors. From this, physiotherapists were identified and affiliations were scrutinised to confirm their involvement in post-professional education. Then a search for email addresses commenced, from the papers on CPRs, from other papers by the same authors, and from professional networks. This resulted in a list of 82 expert physiotherapists, recently published on the topic of CPRs, although email addresses were unavailable for six of these and many other email addresses could not be confirmed as being current. Initial contact was made by emailed letter of invitation, which described the study aim and included a copy of the participant Information Statement. Sixteen of the 68 potential participants completed both rounds of the Delphi study. Informed consent was implied by the completion of Questionnaire 1.

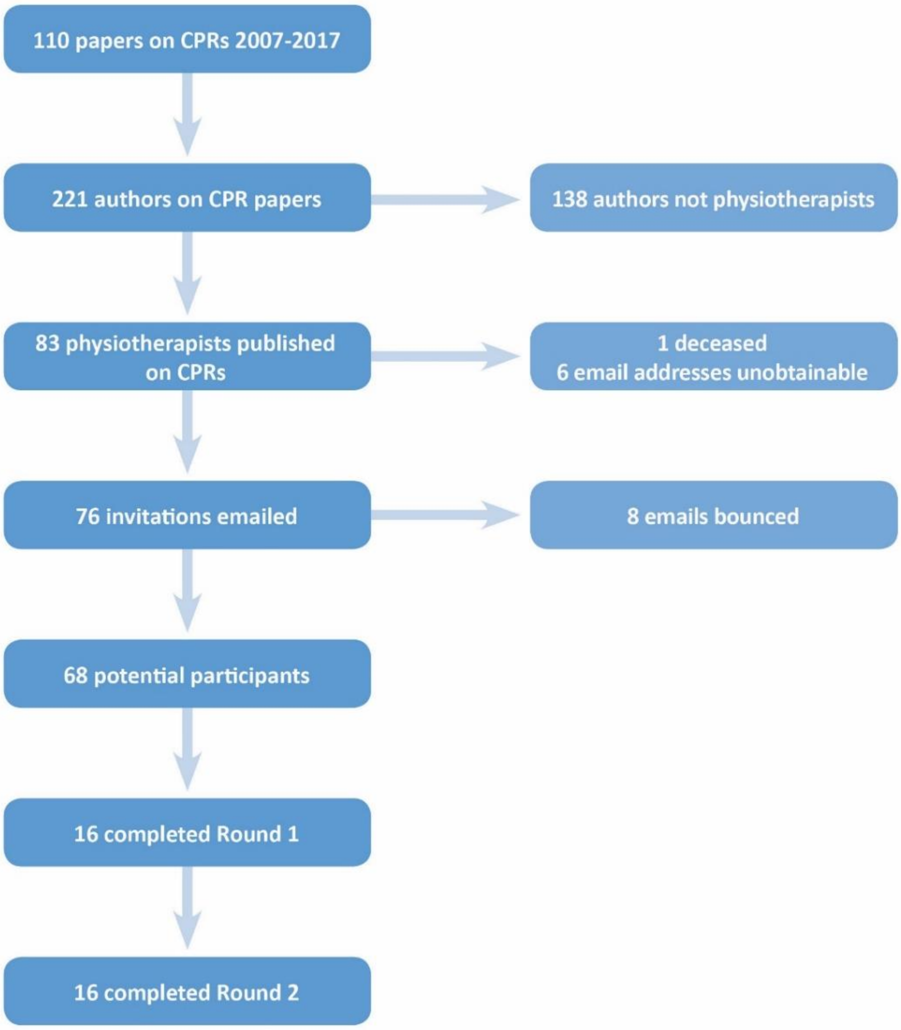

Figure 6.1 Flow chart outlining the identification and recruitment of participants

<u>Question formats</u>

The questions were in two formats. Firstly, participants were provided with a list of suggestions, from which they could select as many or as few as they felt relevant. Secondly there were questions with a five-point Likert scale, with participants being asked to rate factors as follows:

1. *Essential* – the selected item is an extremely important part of a learning package.
2. *Important* – the selected item is an important part of a learning package.
3. *Undecided* – uncertain of the importance of the selected item as part of a learning package.
4. *Not important* – the selected item is not an important part of a learning package.
5. *Insignificant* – there is absolutely no importance whatsoever of the selected item as part of a learning package.

Round 1 The questionnaire for Round 1 was developed from items derived from data obtained in a previous qualitative study (Knox et al 2019a) consisting of interviews with physiotherapy clinical educators, which used thematic analysis to develop themes and sub-themes (Gale et al 2013). These items were listed as the clinical educators suggested, with no editing by the researchers, and consisted of three sections:

1) Suggestions for content of the educational package, comprising 11 questions with a Likert scale, followed by 12 examples of CPRs for selection;
2) One question on presentation and delivery, with 11 options for selection, along with a question on the length of the package; and
3) A final section on self-assessment, consisting firstly of a Likert scale on whether an assessment should be included, followed by three assessment formats for consideration.

Participants were also given the opportunity to make further suggestions for content, presentation and delivery, and self-assessment, as well as being encouraged to make general comments, such as to explain their choices.

Upon the completion of Round 1, items were analysed for the level of consensus (Likert questions) and the degree of support (optional selections). Suggestions from participants were analysed for similarity to items already in the questionnaire, and to suggestions from others, and any new items were added to the questionnaire for Round 2. This resulted in five extra items within the questions about content to be included in a CPR educational package, and four additional examples of specific CPRs to be included in a package. There were no further suggestions relating to presentation, delivery or self-assessment. Some items were reworded for clarity and for inclusion of new suggestions that were related. Irrespective of the level of support indicated in Round 1, no items were deleted by the authors and all were included in Round 2, in order to avoid any researcher bias.

Round 2 provided participants with a summary of the proportion of responses for each answer to each question from Round 1, and asked the participants to once again rate the factors but with consideration of the relative importance given to the factors by the Delphi group ratings in Round 1. It has been suggested that people may modify their views based on the opinions of others (Mead & Moseley 2001) and so the feedback process used here gave the participants the opportunity to reconsider their original responses and perhaps change their opinion based on that of the whole group. This opportunity to revise opinions is a critical element in the progression towards consensus (Powell 2003). The feedback provided did not identify individual participants' opinions or comments and preserved group anonymity, so participants were able to retract, revise or add to their opinions without losing face, and thus the views expressed were likely to be more honest and representative (Sumsion 1998, Walker & Selfe 1996, Williams & Webb 1994).

Each round was conducted over a period of three weeks, with reminders sent at the end of the first and second weeks.

6.4.4 Data analysis

A critical consideration in any Delphi study is the issue of consensus. The purpose of a multiple-round survey, with feedback to participants as to previous responses, is to achieve consensus by advising participants what others are thinking. A systematic review of Delphi studies found that definitions of consensus varied considerably (Diamond et al 2014), but several are available and workable (Fink et al 1984). Consensus in this study was defined as 70% or more agreement within two points on the five-point Likert scale, or as a 70% or more level of support of listed items, as used or recommended by many previous studies (Akins et al 2005, Brown et al 2005, de Villiers et al 2005, French et al 2017, Hasson et al 2000, McMahon et al 2014, Rushton et al 2014, Sumsion 1998).

Statistical analysis was performed on the Likert scale questions, with mean and median indicating overall support and central tendency, and with standard deviation (SD) reflecting the amount of dispersion between responses, and variance for determining homogeneity (Giannarou & Zervas 2014, Hasson et al 2000, Hsu & Sandford 2007). This process ensured that the opinions of each participant were represented in the final analysis.

6.5 Findings

6.5.1 Participants

Sixteen experts were recruited for Round 1, with all 16 completing Round 2 for a 100% continuation rate (Figure 6.1). A summary of participant demographics is shown in Table 6.1. The majority had considerable experience as physiotherapists and as academics, and all had been aware of CPRs for at least 9 years. Most participants were from the United States (44%, n=7) or Australia (44%, n=7); 69% were male. The 16 participants were broadly representative of the 76 experts identified for invitation, of whom 49% were from the US, 24% from Australia, and 67% were male. The higher relative proportion of Australian participants was likely due to professional networks, with most of the Australian respondents known personally to the authors.

Table 6.1 Demographic and academic characteristics of participants

	n (%)	Range	Mean (SD)
Gender	male 11 (69) female 5 (31)		
Age		32-68	49.7 (9.5)
Years as a physiotherapist		7-45	25.0 (9.9)
Years as a clinical educator		3-36	17.9 (9.3)
Years in conducting research		4-36	19.0 (7.7)
Years teaching and/or researching CPRs		3-18	11.0 (4.1)
Years aware of CPRs		9-20	14.4 (3.3)
Location	Australia 7 (44) United States 7 (44) Canada 1 (6) United Kingdom 1 (6)		

CPR – clinical prediction rule; SD - standard deviation

Table 6.2 Consensus from survey of experts in CPRs (n=16) on content of an educational package (general information) – n (%)

	1. Essential	2. Important	3. Undecided	4. Not important	5. Insignificant	Mean (SD)	Median	Variance
1. Brief definition/description of CPRs	14 (88)	2 (13)	0 (0)	0 (0)	0 (0)	1.1 (0.3)	1.5	0.1
2. Why use CPRs – their purpose, and relevance to clinical practice	13 (81)	2 (13)	1 (6)	0 (0)	0 (0)	1.3 (0.6)	2.0	0.3
3. When & how to use CPRs – the benefits, and integration with other forms of reasoning and with other assessment processes	12 (75)	4 (25)	0 (0)	0 (0)	0 (0)	1.3 (0.5)	1.5	0.2
4. When not to use CPRs – limitations and disadvantages, the ability to "override the rule", and alternatives to using CPRs	12 (75)	4 (25)	0 (0)	0 (0)	0 (0)	1.2 (0.4)	1.5	0.2
5. Information to improve familiarity with & understanding of CPRs	8 (50)	8 (50)	0 (0)	0 (0)	0 (0)	1.5 (0.5)	1.5	0.3
6. Information on the evidence basis of specific CPRs	8 (50)	8 (50)	0 (0)	0 (0)	0 (0)	1.5 (0.5)	1.5	0.3
7. Information to dispel myths & misunderstandings about CPRs	4 (25)	11 (69)	1 (6)	0 (0)	0 (0)	1.8 (0.5)	2.0	0.3
8. Case scenarios demonstrating the use of specific CPRs	4 (25)	11 (69)	1 (6)	0 (0)	0 (0)	1.8 (0.5)	2.0	0.3
9. Background information on CPRs in general, such as their stages of development	3 (19)	13 (81)	0 (0)	0 (0)	0 (0)	1.8 (0.4)	1.5	0.2
10. Examples of CPRs for different purposes and how they need to be developed differently, i.e. interventional, prognostic, diagnostic	3 (19)	11 (69)	1 (6)	1 (6)	0 (0)	2.0 (0.7)	2.5	0.5
11. A list of what CPRs exist	3 (19)	10 (63)	2 (13)	1 (6)	0 (0)	2.1 (0.7)	2..5	0.5
12. Access to further information – research papers where specific CPRs underwent impact analysis	4 (25)	9 (56)	2 (13)	1 (6)	0 (0)	2.0 (0.8)	2.5	0.6
13. Access to further information – research papers where specific CPRs were validated	2 (13)	11 (69)	3 (19)	0 (0)	0 (0)	2.1 (0.5)	2.0	0.3
14. Access to further information – research papers where specific CPRs were derived	1 (6)	14 (88)	1 (6)	0 (0)	0 (0)	2.0 (0.4)	2.0	0.1
15. What happens if you don't use CPRs – such as consistency in clinical decision-making	2 (13)	12 (75)	1 (6)	1 (6)	0 (0)	2.1 (0.7)	2.5	0.4
16. How to explain the use of CPRs to patients	5 (31)	3 (19)	4 (25)	4 (25)	0 (0)	2.4 (1.1)	2.5	1.3
Inclusion of a self-assessment component	9 (56)	5 (31)	2 (13)	0 (0)	0 (0)	1.6 (0.7)	2.0	0.5

CPR – clinical prediction rule; SD – standard deviation

Table 6.3 Consensus from survey of experts in CPRs (n=16) on content of an educational package (specific CPRs to be included)

CPR	Level of support - n (%)	Stage of development of CPR
1. Ottawa ankle rule	16 (100)	Impact analysis
2. Ottawa knee rule	16 (100)	Impact analysis
3. Canadian C-spine rule	15 (94)	Impact analysis
4. Diagnosis of deep vein thrombosis	13 (81)	Impact analysis
5. Intervention for low back pain	10 (63)	Validation
6. Prognosis for whiplash associated disorder	9 (56)	Validation
7. When to manipulate a lumbar spine	5 (31)	Validation
8. Diagnosis of a sacroiliac joint problem	5 (31)	Validation
9. Diagnosis of rotator cuff tears	4 (25)	Validation
10. Diagnosis of subacromial impingement	4 (25)	Derivation
11. Diagnosis of cervical spine myelopathy	4 (25)	Validation
12. Diagnosis of cervical spine radiculopathy	4 (25)	Derivation
13. Ottawa subarachnoid haemorrhage (S&H) rule for headache evaluation	3 (19)	Validation
14. Intervention for chronic plantar heel pain	2 (13)	Derivation
15. NEXUS C-spine rule	1 (6)	Validation
16. Diagnosis of cervical spondylosis	1 (6)	Derivation

CPR – clinical prediction rule

Table 6.4 Consensus from survey of experts in CPRs (n=16) on format options for presentation and delivery of an educational package

Format	Level of support - n (%)
Online modules – i.e. self-directed learning	16 (100)
Written information – electronic versions that can be saved	14 (88)
Webinars	12 (75)
Face-to-face lectures involving instruction in CPRs	7 (44)
Face-to-face practical sessions – practising the application of CPRs in the clinic	7 (44)
Apps	7 (44)
Podcasts	5 (31)
Written information – handouts in hard copy	4 (25)
A course or education day specifically on CPRs	3 (19)
As part of education/training days on other subjects as well	2 (13)
Videos	1 (6)
How long should an educational package take to complete?	**Level of support - n (%)**
15-20 minutes	1 (6)
2-3 hours	3 (19)
4-6 hours	3 (19)
8 hours / 1 day	5 (31)
20 hours	1 (6)
Time not specified / missing data	3 (19)
Format of a self-assessment component:	**Level of support - n (%)**
Scenario-based questions	16 (100)
Multiple choice questions – where just one option is chosen	7 (44)
Tick box questions – where multiple options can be chosen	1 (6)

CPR – clinical prediction rule

6.5.2 Content of an Educational Package

Results are summarised in Tables 6.2-6.4. There was strong support from the panel to include almost all of the proposed general information items, including all of the suggestions from the clinical educators and all but one of the new suggestions by participants (Table 6.2). Except for item 16, “How to explain the use of CPRs to patients”, most participants rated items as being either essential or at least important for inclusion; not one item was rated as insignificant and no more than one respondent rated any of these as not important.

Although 16 CPRs were listed as possible examples for inclusion in an educational package, only four gained consensual support above the 70% requirement (Table 6.3), with most of the rest only gaining support from less than one-third of participants. Table 6.3 also includes the achieved stages of development for the 16 CPRs, for relative comparison.

6.5.3 Presentation and Delivery of an Educational Package

Table 6.4 shows the level of support for various options for presentation and delivery of an educational package. Even though participants could have supported all of these options had they wished, they varied in their selection and consensus could only be reached on three options, with two of these online (self-directed learning and webinars). There was also considerable support and consensus for clinical educators being able to save electronic versions of actual CPRs. After this, there was moderate support for face-to-face options of instruction and practice. There was no consensus reached on how long an educational package should take to complete with most responses within a range of 2-8 hours.

There was strong support and consensus on including a self-assessment component, with no panel member against the idea and only two undecided (Table 6.2). However the only format that reached consensus was scenario-based questions, which in fact had unanimous support (Table 6.4), although there was also some support for multiple choice questions.

6.6 Discussion

This Delphi survey of expert physiotherapy clinicians and academics was conducted to gain consensus on the content and delivery of an educational package on CPRs for physiotherapy clinical educators. The scope of the study was limited to experts commenting on a proposed package to provide educators with a resource to enable them to improve their own awareness and understanding of the use of CPRs in a clinical setting. The Delphi approach is a widely used and recognised method for obtaining expert opinion on a topic. The use of a panel of respondents with relevant knowledge and experience in the subject improves the content validity of the outcome, and the use of consecutive rounds of questionnaires improves concurrent validity (Hasson et al 2000, Walker & Selfe 1996, Williams & Webb 1994). Although each Delphi study is unique, our defined level of consensus at 70% is a commonly chosen mark that reflects a greater measure of support in this group of experts than just a simple majority.

Delphi studies have been undertaken with panels of various sizes ranging from 4-3000 (Cantrill et al 1996) although larger panels become difficult to administer and often have poor response rates (de Villiers et al 2005). One recent systematic review of Delphi studies found that many had 11-25 participants by the final round (Diamond et al 2014), and other studies agree that reliable results can be achieved by a homogeneous group of 10-20 experts (Akins et al 2005, Cook et al 2006, Giannarou & Zervas 2014, Henry et al 1987, Jeffery et al 2000). Our panel of 16 experts is therefore consistent with these findings. Powell (2003) further suggests that it is the qualities of the panel rather than the number of experts that determine whether it is representative. Even though they are all experts in the given field they are likely to have a variety of viewpoints and opinions, and it is this diversity that results in a valid outcome. Consistency of participation through the rounds is also a significant factor, and enlisting the help of those who are willing to devote the time required is possibly more important than the number recruited (Sumsion 1998). In this regard it is pleasing all 16 experts in the present study completed all rounds.

The panel of 16 participants selected by consensus a large amount of material to be contained in an educational package on CPRs. A lower SD and variance indicate that scores are closer to the mean and demonstrate a strong consensus (Williams & Webb 1994): the SD for the first 15 items in Table 6.2 was no more than 0.8 and variance consistently less than 0.6, indicating strong consensus from our panel. On examining these 15 items, all of which were recommended for inclusion, there is a depth and breadth of information on CPRs that suggests the expert panel considered clinical educators should be well versed in the use of musculoskeletal CPRs and understand the basis of their development. Notably, the evidence base of specific CPRs, and access to further related information including the research papers describing their derivation, validation, and impact analysis, has strong support. An understanding of the scientific evidence for specific CPRs may arguably improve their acceptability to clinical educators. Further, an understanding of the limitations of CPRs in general and also specific to particular CPRs (e.g. stage of development attained), might assist educators in their judicious application in clinical practice and education.

One particular item, “How to explain the use of CPRs to patients”, did not realise a similar level of agreement, with a wider spread of expert ratings from ‘essential’ to ‘not important’. The descriptive statistics confirm the panel had a lack of consensus about this item, with SD and variance both greater than 1. Interestingly, all the other items relate to information directly for clinicians themselves, with this being the only item relating to patients, so it would seem that although there were no comments from the panel clarifying their opinion, there were differing views on the advisability of explaining CPRs to patients.

The spread of opinion regarding specific CPRs for inclusion likely reflects the backgrounds and personal interests of the panel members, and the four new suggestions by participants (Items 11-14, Table 6.3) received only minor support. Significantly, the four CPRs with the most support (Items 1-4, Table 6.3) are well-known, widely-used, and have all gone through the final stage of impact analysis and been found to have a favourable impact on both patient outcomes and healthcare resources. Notably respondents were, by consensus, strongly in favour of the item which recommends including “Examples of CPRs for different purposes and how they need to be developed differently, i.e. interventional, prognostic, diagnostic” (Item 10, Table 6.2). So although consensus was reached at the predetermined level of 70% on only four specific CPRs (Ottawa ankle rule, Ottawa knee rule, Canadian C-spine rule, and diagnosis of deep vein thrombosis – all of which are screening/diagnostic) it might be worth considering the inclusion of the next two CPRs (Items 5 & 6, Table 6.3) in an educational package for which there was majority (56% consensus) support and which would satisfy the criterion of examples for each purpose (intervention for low back pain, and prognosis for whiplash associated disorders).

In considering the formats for presentation and delivery, participants recommended the modular, flexible options offered by online self-directed learning and webinars. This is consistent with adult learning theory, whereby adults exhibit characteristics of being ready to learn, being orientated towards learning, and being motivated to learn (Knowles 1984). Once clinical educators have adopted these characteristics of adult learning, an online educational package may enable them to utilise these characteristics to learn about CPRs. Similarly the other delivery option on which there was consensus, providing electronic versions of CPRs that could be saved, would also enable clinical educators to learn or revise any CPR as the need arose and time permitted. Despite this consensus, some participants supported face-to-face and practical learning modes, commenting “Practical sessions are really critical for administering and interpreting”, and a “Mix of independent learning and face to face might work well for this content”. So although the face-to-face delivery options did not individually gain sufficient support (Items 4 & 5, Table 6.4), there was combined approval for one or both of these face-to-face options from ten respondents (63%).

The participants were undecided on the length of any educational package, and this may reflect the challenge of balancing the comprehensiveness of the material with a pragmatic consideration of time available for busy clinical educators. This interpretation is supported by the flexible delivery options chosen by expert consensus which allow clinical educators to learn at their own pace with bite-sized pieces of information. Given the volume of material supported for inclusion, it is not surprising that a majority of those experts that specified a total time period required for learning, recommended between half a day and a full day (8/13, 62%).

There was consensus amongst the panel for some form of self-directed assessment, designed so that the learner (clinical educator) could evaluate their own knowledge acquisition (Eva & Regehr 2008). The recommendation of scenario-based questions in any self-assessment reflects the importance given by participants to the practical application of CPRs as part of clinical decision-making. This may involve applying clinical reasoning skills, deciding which CPR to use, recognising the criteria in a patient presentation, and using the rule in a real sense. There was some support for multiple choice questions as well, and in preparing an educational package it may be worth scattering some multiple choice questions throughout the material for immediate, instant feedback, while also situating scenario-based questions at key junctures after clinical educators have gained a deeper level of understanding.

An educational package, as proposed and supported by clinical educators (Knox et al 2019a) and endorsed by the expert panel in this Delphi study, could assist physiotherapy clinical educators by promoting their understanding and clinical use of CPRs. The package should be designed such that clinical educators could learn about the extent and purpose of CPRs, and to improve their awareness and understanding of their clinical application. However the scope of the proposed package, and the scope of this study, is limited to developing resources to aid clinical educators as learners about CPRs. It was not intended to additionally develop resources for clinical educators to improve their teaching skills related to CPRs, as this would involve a much greater depth of study to determine and recommend strategies and resources for teaching in a clinical setting. Nevertheless, having learned about CPRs and gained a better understanding, clinical educators may be better prepared to enable physiotherapy students to apply CPRs in their clinical learning and practice.

6.7 Limitations

Findings in a Delphi study are limited to the panel's experiences, opinions and willingness to share (Cook et al 2005), and there are no standardised guidelines for the definition or selection of experts (Dewitte et al 2018, Hsu & Sandford 2007). The findings describe expert opinion rather than fact, and the development of consensus, even by a panel of experts, does not guarantee that the 'correct' answer has been found. The relatively modest number of participants in the present study, while arguably still being an acceptable number (Diamond et al 2014), may have somewhat limited the range of views. The original response rate (16 respondents from 68 potential participants, 24%) is also relatively low, although the true rate may actually be higher as some email addresses may not have been current. It is unfortunate that few experts from Europe participated as it would have been interesting to see if their views were reflective of the opinions expressed by North American and Australian participants. On the other hand, the zero attrition rate is a strength of this study.

6.8 Future Research

Further research may seek to validate our findings. Alternatively, it may be viewed that this study's findings form an adequate basis for developing a CPR educational package for physiotherapy clinical educators as learners of CPRs, with due consideration given to educational theory and how it applies to adult learning. Following development, the package would need to be piloted in a study prior to widespread implementation, with ongoing evaluation of its acceptance and effectiveness. Attention would need to be given to ongoing updates as further CPRs are derived and current ones are validated or analysed for impact. Following the implementation of the package, subsequent studies could then explore what clinical educators would need in terms of information, strategies and resources to enable them to teach similar content to students in the clinical setting, and how this might be formulated.

6.9 Conclusions

This Delphi study has conducted an international consensus survey of physiotherapy experts in CPRs and resulted in recommendations for content of an educational package on CPRs designed for physiotherapy clinical educators, along with recommended methods for presentation and delivery. The key findings from this investigation indicate such a package should contain comprehensive information on all relevant aspects of CPRs, including when, how, and why to use the three types. The provision of background information on the evidence-base of CPRs may improve their clinical acceptance, and the inclusion of a self-assessment component might aid the learning of clinical educators. Specific examples of musculoskeletal CPRs should be included, particularly the better developed ones such as the Ottawa rules. Online availability of the package would ensure access by clinical educators irrespective of geographical location and work hours, and the ability to save electronic versions of individual CPRs would facilitate review and implementation as required.

6.10 Acknowledgements

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Ethical Approval: Ethical approval for the study was granted by the University of Newcastle Human Research Ethics Committee (approval number H-2018-0154).

CHAPTER 7

DISCUSSION: SUMMARY OF KEY FINDINGS

7.1 Overview of Literature Review

As primary contact practitioners, Australian physiotherapists have a responsibility to adhere to 'best practice' guidelines, ensuring that patient consultations consist of procedures and decisions that are performed according to the current evidence-base. CPRs are evidence-based, and as such are an important tool to incorporate EBP into all stages of the patient consultation, from assisting with the diagnosis, aiding with prognosis, and to guiding the selection of the ideal type of intervention.

There are a large number of CPRs available for use in physiotherapy to aid clinical judgements in patient interactions. Practitioners utilising these tools to assist their clinical decision-making should be aware of the limitations of CPRs; particularly that they are an aid to, not a replacement for, collaborative patient-centred clinical reasoning. All CPRs should be used in conjunction with other forms of evidence, and together with the clinician's expertise and the patient's values and preferences lead to an appropriate course of action.

When using any particular CPR the clinician should be cognisant of its particular stage of development, and thus the level of evidence reached, in order to decide whether it is appropriate for clinical use; less developed CPRs with lower levels of evidence, particularly those that have not been validated, should be applied with caution (indeed, if at all). However, there are CPRs that have been widely validated and found to have a positive impact on clinician behaviour and patient outcomes, and these should be considered for appropriate use by physiotherapists in clinical practice.

Although the literature was in general agreement on these points, there was little evidence at the outset of the thesis that physiotherapists were actually utilising CPRs, nor were there any studies exploring the reasons for CPRs not being used more in physiotherapy practice. In particular, there was no evidence at all relating to physiotherapy pre-professional students being exposed to or being taught CPRs in the clinical education setting. Overall, there had been little research undertaken on the use of CPRs as tools to assist clinical decision-making in physiotherapy clinical practice, and also their appropriateness for teaching to physiotherapy students to aid the development of their clinical reasoning skills.

7.2 Overview of Study Results

The research described in this thesis was aimed at addressing and exploring the gaps in the literature outlined above, particularly as they relate to physiotherapy student clinical education. This exploration began with Study 1 (Chapter 3) in which a cross-section of Australian physiotherapy clinical educators were surveyed. The survey questionnaire asked these clinical educators what they knew and understood about CPRs, including which CPRs they used in clinical practice (if any) and for what purpose they were employed. Educators were also asked what they taught physiotherapy students on clinical placement about CPRs, and if so, which specific CPRs they used in clinical education. A large number of clinical educators (n=262) were approached to participate, and the high response rate of 81% (n=211) supports the validity of the results as being reflective of their actual experiences with and perceptions of CPRs.

The first notable finding of Study 1 was the lack of knowledge and understanding of CPRs amongst the great majority of clinical educators. In fact, nearly half of the respondents were completely unaware of CPRs. Without such knowledge, many clinical educators clearly cannot be effectively incorporating CPRs into their teaching of physiotherapy students on clinical placement. Furthermore, nearly half of the remainder of respondents did not use CPRs in their own clinical practice. Thus only 27% (n=57) of those clinical educators responding to the survey both knew of and used CPRs. These findings suggest that if only about a quarter of clinical educators know about and use CPRs, then students are unlikely to learn about CPRs while on clinical placement, even though this is the ideal setting for consolidating learning about the clinical role and application of CPRs (Baldry Currens & Bithell 2000, Dewey 1938).

The clinical educators using CPRs provided much information on the reasons they used CPRs, which specific CPRs they chose to utilise clinically, and what they taught students about CPRs in the clinical setting. The prevailing reason these educators used CPRs was to aid their clinical decision-making, in assisting with diagnosis, prognosis or intervention, while the most common reasons for not using them more often were a lack of understanding, knowledge or awareness.

Similarly, the primary reason clinical educators were teaching CPRs to students on placement was to aid their clinical reasoning skills regarding a diagnosis, prognosis or intervention, as well as to improve the students' use of EBP and better understand its application in a clinical setting. Clinical educators indicated a general belief that CPRs can aid the development of skills in clinical decision-making among physiotherapy students, and few respondents opposed the teaching of CPRs to students. The primary reason clinical educators were not teaching CPRs to students more often was a lack of knowledge or familiarity with CPRs, rather than an opinion that they should not be taught.

There was a range of CPRs known of and clinically utilised by respondents, the more common being those that were at least validated (Cadarette et al 2000, Hicks et al 2005, Koh et al 2000, Laslett et al 2005, Litaker et al 2000, Lydick et al 1998, Park et al 2005, Shepherd et al 2007, Sugioka et al 2008), and the most favoured being those that had had their impact assessed (Stiell et al 1992, Stiell et al 1995, Stiell et al 2001a, Wells et al 1998). This further supports at least some level of understanding and awareness of EBP by some clinical educators, including the relationship between CPRs and EBP. These specific CPRs, with higher levels of underpinning evidence, were also more likely to be those that were taught to and practised by students on placement.

Taken together, the findings of this first study suggested that physiotherapy students were unlikely to be learning about CPRs on clinical placement. The implications of this are that as these students commence clinical practice they would not be utilising a potentially valuable tool, and that consequently their clinical interactions with patients may be adversely affected.

The survey of Australian final-year pre-professional physiotherapy students in Study 2 (Chapter 4) confirmed many of the findings from the first study. The survey questionnaire asked the students about their awareness and understanding of CPRs, and the nature and extent of their use of CPRs on clinical placements. They were specifically asked about their exposure to CPRs from their clinical educators, and if there was any perceived relationship between their use of CPRs and the development of their clinical reasoning skills. Once again a high response rate (77%) and large study sample size (n=371) provide a high degree of confidence in the validity of the findings. It should be noted that a response rate as low as 10-15% is the average for surveys (Fryrear 2015), with 50% deemed an acceptable response rate (Nulty 2008) and 60% ideal (Fincham 2008).

The lack of exposure to and clinical use of CPRs by the majority of respondents, with a large number of students being completely unacquainted with the term CPR, essentially reflected the findings of Study 1. There was some confusion expressed about how they differ from outcome measures or other methods of clinical reasoning. Only 21% (n=79) of respondents had some experience with CPRs, but even among those students aware of CPRs, few (n=21, less than 6% of respondents) indicated they were 'always' or 'sometimes' learning about CPRs when on clinical placement. This supported the findings of Study 1, suggesting that student exposure to CPRs was rare.

It was notable that the small number of students who were familiar with CPRs were clearly using them to assist their clinical decision-making, aiding with diagnosis, prognosis and intervention, and were also using them as part of striving for 'best practice'. Moreover, the student respondents who were using CPRs were generally very positive in wanting to learn more about them, with a large majority (78%) indicating that familiarity with CPRs aided the development of skills in clinical reasoning. Importantly, those students using CPRs did so as an adjunct to, rather than a replacement for, their own clinical decision-making, as indicated by a willingness to deviate from the clinical direction suggested by the CPR when other factors such as a complex clinical picture presented.

Echoing the findings of Study 1, the CPRs most commonly known and used by students were likely to have been at least validated (Cadarette et al 2000, Koh et al 2000, Laslett et al 2005, Litaker et al 2000, Lydick et al 1998, Park et al 2005, Shepherd et al 2007), with the two best known having had extensive impact analysis performed (Stiell et al 1992, Wells et al 1998). This suggests that the stage of development and level of evidence was potentially being considered by clinical educators when teaching CPRs to students on clinical placement, reinforcing the relationship of CPRs with EBP. However, the students aware of and using CPRs generally reported using few CPRs, and indicated that this was due to a lack of knowledge or practice, along with an observed lack of knowledge and use of CPRs by their clinical educators.

Thus Studies 1 and 2 together revealed that physiotherapy students were unlikely to be learning about CPRs while on clinical placement due to their clinical educators mostly not using CPRs, with the majority of educators lacking knowledge and understanding of such potentially valuable tools. As a result, this thesis next explored whether an educational package on CPRs, designed for clinical educators, could be useful in filling this gap in their knowledge. An incidental finding from the first two studies was that the vast majority (about 98%) of CPRs relevant to physiotherapy clinical practice are in the musculoskeletal field of practice, so this became a focus for the final two studies.

Study 3 (Chapter 5) was a qualitative study involving a series of interviews with Australian clinical educators to determine their thoughts about an educational package on CPRs; in particular, to explore whether it would be potentially desirable and useful, ascertain their preferences regarding the content, and to establish the preferred methods for its presentation and delivery. Participants in the study were found to have wide ranging familiarity, usage and confidence with using CPRs, consistent with the findings of Study 1 and Study 2.

Key findings to arise from this study included the strong message that an educational package on CPRs would be generally embraced by clinical educators, who would likely find it a useful resource for enhancing their own knowledge base and confidence in using CPRs. It would therefore help equip clinical educators with the specific knowledge and understanding of CPRs to be able to introduce them to students on clinical placement, thereby addressing the gap in awareness and understanding of CPRs for both educators and students.

A further important outcome of the study was the finding that there was only a weak relationship between awareness of CPRs and clinical usage of the tools, and that confidence in using CPRs did not necessarily reflect actual usage. This was a further indication of the need for an educational package to improve not only consciousness of CPRs, but also confidence and understanding of how to use them. It also revealed that perhaps practice with the application of CPRs was required as well.

Additional findings arose with study participants describing a wide range of material that would be desirable for the content in an educational package to improve familiarity and understanding, starting with basics such as the three types of CPRs; the three stages of development; how, when and why to use CPRs clinically; and their limitations. Of particular concern was the inclusion of material that clarified and corrected the misunderstandings expressed by some practitioners, particularly to substantiate that CPRs were to be used to assist rather than replace autonomous practitioner clinical decision-making, and that they were not a simple, rigid formula to be blindly followed regardless of the patient's presenting clinical picture.

It was expressed by participants that the inclusion of some specific examples of CPRs would be helpful to aid learning and to demonstrate how CPRs can be used in practice, particularly those that were more commonly used and which had reached further stages of development. This should include copies of or links to papers where specific CPRs were not only derived but validated and had their impact assessed, thereby consolidating the place of CPRs within the EBP paradigm. A self-assessment module was also supported by participants as being potentially beneficial in enabling clinical educators to undertake a 'competency check' on their understanding of the material.

Further findings from Study 3 included that an educational package should be available in a variety of lengths and formats to cater for differing clinical educator preferences and learning styles. However online delivery was viewed as being suitable for all educators irrespective of their geographical locale, but also with the option of practical sessions being available face-to-face, involving 'hands-on' practice such as in a simulated clinical encounter. Participants also expressed that there would need to be some form of campaign to raise awareness of an educational package, otherwise clinical educators may not be aware of the resource and miss out on its benefits. The time and effort required to develop an educational package and prepare it for distribution would be futile and would not improve outcomes if clinical educators were not adequately informed of its availability and able to easily access it.

In order to refine and validate the suggested content of an educational package and its preferred modes of delivery as expressed by clinical educators in Study 3, the key findings of Study 3 were brought forward as the starting point of the modified Delphi study comprising Study 4. That is, these findings were translated into a series of statements about the components of an educational package. Physiotherapy experts in CPRs were then consulted in order to gain consensus on which components should be included in an educational package, and how they should be presented and distributed. This international panel of experts had all researched and published on CPRs and as such could be expected to have an ideal grasp of the material necessary for an effective educational package on CPRs. Their additional experience as tertiary educators would also mean they would be well-placed to determine the optimum methods for its presentation and distribution to clinical educators.

The panel of experts were provided with the thoughts and opinions expressed by the clinical educators in the interviews of the previous study (Study 3), and were asked to rate these recommendations/statements, provide feedback on them, and make any further suggestions relating to content and delivery. The most noteworthy finding from the expert panel consultation was their support for the inclusion in the package of a breadth and depth of information covering all aspects of CPRs. This should incorporate their purpose, benefits, limitations, background information, relationship with EBP, and integration with practitioner clinical decision-making to help dispel the myths and misunderstandings relating to CPRs. There was also consensus that links should be provided to the research papers where specific CPRs were derived, validated, and had their impact assessed. The panel not only agreed with and supported the material suggested by the clinical educators interviewed in Study 3, but went further in suggesting that even more information was desirable so that clinical educators could improve their familiarity with and understanding of CPRs, in order to understand them more fully and be able to confidently use them clinically.

Specifically, the panel supported the educational package containing specific examples of CPRs, notably the inclusion of four well-known and extensively-used diagnostic/screening CPRs, all of which have been widely validated and evaluated for impact (Stiell et al 1992, Stiell et al 1995, Stiell et al 2001a, Wells et al 1998). Panel members were also supportive of including another two CPRs which have also been validated, particularly as these would give examples of one of each of the other types of CPRs – prognostic (Ritchie et al 2013) and interventional (Flynn et al 2002, Hicks et al 2005).

An additional noteworthy finding in Study 4 was that the experts were almost unanimous in supporting the inclusion of a self-assessment component in the educational package. Furthermore, they were wholly in favour of this being in the format of scenario-based questions, which would allow clinical educators to work through a presented clinical problem using a CPR. The clinical educator would thus learn how CPRs are utilised in clinical situations, aiding their understanding and learning at a deeper level. It would also enable the clinical educator to gauge their level of mastery of the package material.

Similar to the clinical educators in Study 3, the expert panel in Study 4 also preferred delivery of an educational package via online options, which would allow a more flexible learning environment for clinical educators to engage with in their own time and at their own pace; this too would be available irrespective of geographical location and hence more universally accessible. Additionally, the panel supported the availability of electronic data on CPRs which could be saved and hence also available whenever time permitted for study purposes or for when an appropriate patient presented.

The combined outcomes of Studies 3 and 4 determined the recommended content and means of delivery of an educational package on CPRs for clinical educators. The clinical implications of this are that by raising the awareness and understanding of CPRs by clinical educators, they might be more likely to use them in their clinical practice. As a consequence of this, physiotherapy students might become more exposed to and familiar with CPRs in clinical placements, thereby aiding the development of their own clinical reasoning skills, improving their understanding of EBP, and enhancing the effectiveness of their clinical consultations as beginning practitioners.

Having considered the specific findings of the four studies individually, they will now be considered as a collective body of work in the next chapter.

CHAPTER 8

DISCUSSION: CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

The aim of this thesis was to identify the current state of the understanding and use of CPRs in physiotherapy clinical education. Prior to the four studies comprising this thesis, no such investigations had been conducted and so the following gaps existed in the literature:

1. It was unknown whether physiotherapy students were aware of or had an understanding of CPRs, and what their level of exposure to or use of CPRs was on clinical placement.

2. It was unknown what physiotherapy clinical educators knew or understood about CPRs, whether they were using CPRs clinically and if so which, and whether they were teaching students about CPRs on clinical placements.

3. It was unknown whether it was desirable to provide professional development on CPRs to clinical educators to overcome any deficit identified in (1) or (2) above, and what content and form any ensuing such educational package should encompass.

The review of the literature in Chapter 2 found that many existing CPRs are relevant and potentially useful to contemporary evidence-based physiotherapy clinical practice. The first two studies (Chapters 3 and 4) undertaken in this thesis have explored the above first two gaps identified in the literature review, and revealed the lack of awareness and use of CPRs among both physiotherapy clinical educators and final year physiotherapy students in Australia. The final two studies (Chapters 5 and 6) undertaken in this thesis then addressed the third identified gap above, and proposed the optimal content and delivery of an educational package on CPRs for physiotherapy clinical educators.

While CPRs are an evidence-based and potentially useful tool, most physiotherapy students are not learning about them on clinical placements, nor even appear aware of them. To correct this gap in student knowledge and skill, a learning package on CPRs for physiotherapy clinical educators could be useful, as indicated by both physiotherapy clinical educators and by a panel of international physiotherapy experts in CPRs. It would help educate clinical educators about CPRs, enabling them to utilise CPRs in the clinical setting, and thus provide them with the knowledge and confidence to teach CPRs to their students on clinical placement. Indeed, it has been found that an educational package would likely be accepted and used by clinical educators, with the key elements of its content identified, as well as the preferred methods of its access and delivery. This thesis therefore proposes the content elements and preferred modes of delivery for an educational package on CPRs for clinical educators, as the first step in addressing the identified deficiencies in clinical education and for the first time in the literature.

8.1 Discussion of Key Findings and Their Implications

As a collective body of work, the studies in this thesis have uncovered a large and widespread gap in knowledge among most physiotherapy clinical educators relating to CPRs, specifically a lack of awareness, understanding and use. As a consequence, physiotherapy students on clinical placement are rarely learning about these tools or using them with actual patients. However those clinical educators and students who were using CPRs reported finding them useful, not only clinically in improving their patient outcomes, but also in aiding the development of their own clinical reasoning skills.

Therefore if clinical educators are not aware of or are reluctant to use CPRs, many physiotherapy students will continue to be denied the opportunity to learn from their supervised clinical practice the potential value of CPRs. This may firstly impact the quality of their patient interactions and ability to strive for the provision of 'best practice'. Secondly, it may also affect their acquisition of more advanced clinical reasoning skills and related knowledge. It might even be argued that it is negligent of clinical educators to not be aware of and use CPRs given their growing evidence-base, especially if as a result they are unable to teach the tools to students in the clinical setting.

Guyatt (2008) advocates that EBP be used as a method to extend and strengthen clinical skills, and CPRs have been recommended as an ideal method of applying EBP in a clinical setting (Beattie & Nelson 2006). Structuring clinical decision-making, such as by using CPRs, has been proposed to result in greater accuracy in information-gathering (Petty & Moore 2001). CPRs can aid in the analysis and understanding of clinical information, and can improve patient care by using clinical findings to make predictions about likely clinical outcomes (Stiell et al 1996, Wasson et al 1985). The studies in this thesis have built on this proposition by suggesting that the education of physiotherapy students in the use of CPRs in the clinical setting would likely be beneficial to the facilitation of development of their clinical decision-making skills, and therefore the outcomes they achieve with their patients upon graduation.

An educational package as proposed for clinical educators in this thesis, would explain all relevant aspects of CPR development and use, and be ideal in improving not only the educators' awareness but also their understanding and confidence in employing CPRs. As a consequence, students would be more likely to learn about and use CPRs while on clinical placement, thus likely improving their skills in clinical reasoning as well as their ability to apply current best EBP to individual patients.

Ideally an increased capacity and prominence of the learning of CPRs in clinical education would be carefully articulated with classroom teaching of CPRs in university curricula. As students exposed to CPRs enter the workforce, this may gradually affect the awareness and use of CPRs by the broader physiotherapy profession in general. Indeed, it is possible that the educational package that has been proposed for physiotherapy clinical educators in this thesis could be used as a starting point for upskilling all physiotherapy clinicians, particularly in the musculoskeletal field, to learn more about the availability and use of CPRs.

8.2 Limitations of the Thesis

Each of the chapters presenting the four studies in this thesis have outlined the limitations associated with each study and their impact on the study's conclusions. In summary, the key limitations of each study impacting the overall conclusions and scope of this thesis are as follows:

- The first two studies (Chapters 3 and 4) surveyed a large number of clinical educators and students. However as many respondents were unaware of or at least not using CPRs, there only remained small samples in each study (n=57 in Study 1, n=79 in Study 2) that could comment on the use of CPRs, including their perceived benefits and limitations. It may be that different samples would realise different responses and opinions.

- Clinical educators surveyed in Study 1 (Chapter 3) and those interviewed in Study 3 (Chapter 5) were only those affiliated with the University of Newcastle, Australia and it may be that educators with other universities in other states of Australia, or internationally, may report different experiences, perceptions and use of CPRs.

- The physiotherapy students surveyed in Study 2 (Chapter 4) were broadly representative of those studying across Australia. However students studying physiotherapy in other countries may have different perceptions, awareness and usage of CPRs.

- The final two studies (Chapters 5 and 6) involved modest samples; however this is typical for studies using qualitative methodology, and both studies used purposive selection for recruitment. Nonetheless, other study populations within Australia or internationally may have responded differently and yielded alternate findings.

- Continued rounds in the modified Delphi study (Study 4, Chapter 6) may have resulted in consensus being reached on more options, such as clarification on whether the item “How to explain the use of CPRs to patients” should in fact be included in an educational package. It may also have shed more light on the specific CPRs for inclusion, such as the examples of prognostic and interventional CPRs, and alternate methods of presentation and delivery may have been agreed upon as options. However, further rounds beyond the two undertaken may have resulted in greater attrition of participants and therefore impacted the validity of the results.

There were also some overall limitations to this body of work, with some commonalities arising among the four studies:

- Most of the studies were conducted within Australia, and so international awareness and use of CPRs by physiotherapy students and clinical educators in other countries has not been investigated.

- Clinical educator participants were mostly in the state of New South Wales, possibly further limiting the findings. It may be that clinical educators in other states may have been differently exposed to and educated in CPRs through universities based in their states.

- Initially the investigation of CPRs in physiotherapy clinical education in this thesis had a broader clinical scope, but as it was found that the vast majority of CPRs relevant to physiotherapy were in the musculoskeletal field, this became a focus for the educational package. An educational package for physiotherapy clinical educators in other clinical fields (such as cardiorespiratory) may have other requirements.

- The studies were limited to the physiotherapy profession, so the findings may have less relevance to other allied health disciplines or other healthcare professions which may have alternate requirements.

- The studies focussed on clinical education and the knowledge and use of CPRs among clinical educators, so awareness and use among the broader practising physiotherapy profession may differ from that found.

Due to the lack of research in the area of CPR awareness and use in physiotherapy clinical education, it was necessary to start from the beginning without the advantage of any prior knowledge, and explore the views and experiences of physiotherapy students and clinical educators. There was also a lack of evidence in the literature regarding the optimal content and mechanism for educating clinical educators on CPRs. By addressing these shortcomings in the literature over the four studies, it was beyond the scope of this thesis to actually fully develop the educational package and evaluate its acceptability and effectiveness.

8.3 Recommendations for Future Research

There are many avenues for further investigation following on from the research contained in this thesis, as proposed below.

Further studies may look at validating the findings of Studies 1-3, by studying different populations of physiotherapy clinical educators or students in other countries, where there may be differing experiences with and awareness of CPRs, and consequently alternate requirements in terms of an educational package. This could provide evidence of the accuracy, validity, reliability and generalisability (or otherwise) of the results contained in this thesis, and lead to a better understanding of the use of CPRs in physiotherapy education.

Future research may also explore the views and experiences of academics in pre-professional physiotherapy courses/programs in Australia and internationally, to investigate whether CPRs are an appropriate part of current university curricula; and, if not, whether they could be considered for greater emphasis, especially with the teaching of these tools in the broader context of EBP. This could lead to a more consistent and integrated approach to the teaching of CPRs to physiotherapy students, whereby the necessary theory behind CPRs could be taught to students in the classroom, and the practical application could be learned and experienced in clinical education while on placement.

Ultimately, the primary recommendation from this thesis for future research is the completion of the development, piloting, implementation and evaluation of an educational package on CPRs for clinical educators. This may require the appropriate involvement of experts in educational theory and its application to adult learning. Following widespread implementation of an educational package, there would need to be ongoing appraisal of its acceptance and use by clinical educators, as well as its effectiveness as a learning tool. Once implemented, an educational package would require ongoing updates to ensure its content is current, which would necessitate consistent monitoring of newly published literature on CPRs. Although this thesis has recommended and planned for an educational package on CPRs aimed at physiotherapy clinical educators, the package may also be appropriate for dissemination to physiotherapy clinicians in general, or for incorporation into pre-professional physiotherapy courses/programs; however further investigation would be advisable to determine its appropriateness to either of these groups.

The desirable end-result of an educational package on CPRs would be the improved awareness, understanding and use of CPRs by clinical educators, with the potential consequence that physiotherapy students would more consistently learn about CPRs on clinical placement, improving their awareness and use of the tools. This could lead to enhanced clinical decision-making and better patient outcomes as the students graduate and enter the workforce.

8.4 Conclusions

This program of research, consisting of four studies, has exposed a lack of knowledge and understanding of CPRs by physiotherapy clinical educators, and as a result a lack of exposure to CPRs by physiotherapy students. It is to be noted that since the commencement of this thesis, other authors have investigated the awareness and use of CPRs by physiotherapy clinicians (Haskins et al 2014, Kelly et al 2017a) and uncovered similar attitudes among practitioners in general, with a lack of use and understanding evident. These studies also reported a reluctance by physiotherapy clinicians to use CPRs due to false beliefs and misunderstandings, such as that CPRs are too simplistic and encourage a ‘cookbook’ approach, reduce clinician autonomy, or conversely that they are too complicated and difficult to remember and apply. It is therefore recommended that education on CPRs be considered on a profession-wide basis, and not just for clinical educators, if they are to be utilised to their full potential and appropriately.

Although the final development of an educational package is beyond the scope of this thesis, it has been found that such a package would likely be beneficial for clinical educators (and therefore for their students), and would generally be welcomed and utilised. Given the demonstrated lack of awareness and understanding of CPRs, the completion of the development of an educational package for clinical educators is strongly advocated. It would likely lead to the greater implementation of EBP by clinical educators with a consequent benefit for the education of physiotherapy students on placement, as well as the enhancement of the ongoing development of clinical reasoning skills for both educator and student.

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APPENDIX 1

STATEMENTS OF COLLABORATION FROM

CO-AUTHORS

By signing below I confirm that Grahame Knox contributed to the study conception and design, data acquisition, data analysis and interpretation, and manuscript preparation and revision for publication to the paper/publication entitled:

Knox GM, Snodgrass SJ, Rivett DA. (2015) Physiotherapy clinical educators' perceptions and experiences of clinical prediction rules. *Physiotherapy.* 101(4):364-72, http://dx.doi.org/10.1016/j.physio.2015.03.001

Professor Darren A. Rivett **Date: 26.04.2019**

Associate Professor Suzanne J. Snodgrass **Date: 29.04.2019**

Professor Liz Sullivan **Date: 30.04.2019**

Deputy Head of Faculty - Health and Medicine

By signing below I confirm that Grahame Knox contributed to the study conception and design, data acquisition, data analysis and interpretation, and manuscript preparation and revision for publication to the paper/publication entitled:

> Knox GM, Snodgrass SJ, Stanton TR, Kelly DH, Vicenzino B, Wand BM, Rivett DA. (2017) Physiotherapy students' perceptions and experiences of clinical prediction rules. *Physiotherapy*.103(3):296-303, http://dx.doi.org/10.1016/j.physio.2016.04.001

Professor Darren A. Rivett **Date: 26.04.2019**

Associate Professor Suzanne J. Snodgrass **Date: 29.04.2019**

Associate Professor Tasha R. Stanton **Date: 28.04.2019**

Dr David H. Kelly **Date: 29.04.2019**

Professor Bill Vicenzino **Date: 29.04.2019**

Associate Professor Benedict M. Wand **Date: 29.04.2019**

Professor Liz Sullivan **Date: 30.04.2019**

Deputy Head of Faculty - Health and Medicine

By signing below I confirm that Grahame Knox contributed to the study conception and design, data acquisition, data analysis and interpretation, and manuscript preparation and revision for publication to the paper/publication entitled:

Knox GM, Snodgrass SJ, Southgate E & Rivett DA. (2019) The preferences of physiotherapy clinical educators on a learning package for teaching musculoskeletal clinical prediction rules – a qualitative study. *Musculoskelet Sci Pract,* 39(1): 16-23. https://doi.org/10.1016/j.msksp.2018.10.005

Professor Darren A. Rivett **Date: 26.04.2019**

Associate Professor Suzanne J. Snodgrass **Date: 29.04.2019**

Associate Professor Erica Southgate **Date: 26.04.2019**

Professor Liz Sullivan **Date: 30.04.2019**

Deputy Head of Faculty - Health and Medicine

By signing below I confirm that Grahame Knox contributed to the study conception and design, data acquisition, data analysis and interpretation, and manuscript preparation and revision for publication to the paper/publication entitled:

> Knox GM, Snodgrass SJ, Southgate E & Rivett DA. (2019) A Delphi study to establish consensus on an educational package of musculoskeletal clinical prediction rules for physiotherapy clinical educators. *Musculoskelet Sci Pract* (submitted for publication).

Professor Darren A. Rivett **Date: 26.04.2019**

Associate Professor Suzanne J. Snodgrass **Date: 29.04.2019**

Associate Professor Erica Southgate **Date: 26.04.2019**

Professor Liz Sullivan **Date: 30.04.2019**

Deputy Head of Faculty - Health and Medicine

APPENDIX 2

ETHICAL APPROVAL FOR STUDIES PRESENTED IN CHAPTERS 3-6

HUMAN RESEARCH ETHICS COMMITTEE

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

Notification of Expedited Approval

To Chief Investigator or Project Supervisor:	**Professor Darren Rivett**
Cc Co-investigators / Research Students:	**Doctor Suzanne Snodgrass** **Mr Grahame Knox**
Re Protocol:	**The use of clinical prediction rules by clinical educators with physiotherapy student**
Date:	**28-Aug-2012**
Reference No:	**H-2012-0192**
Date of Initial Approval:	**28-Aug-2012**

Thank you for your **Response to Conditional Approval** submission to the Human Research Ethics Committee (HREC) seeking approval in relation to the above protocol.

Your submission was considered under **Expedited** review by the Chair/Deputy Chair.

I am pleased to advise that the decision on your submission is **Approved** effective **28-Aug-2012**.

In approving this protocol, the Human Research Ethics Committee (HREC) is of the opinion that the project complies with the provisions contained in the National Statement on Ethical Conduct in Human Research, 2007, and the requirements within this University relating to human research.

Approval will remain valid subject to the submission, and satisfactory assessment, of annual progress reports. *If the approval of an External HREC has been "noted" the approval period is as determined by that HREC.*

The full Committee will be asked to ratify this decision at its next scheduled meeting. A formal *Certificate of Approval* will be available upon request. Your approval number is **H-2012-0192**.

If the research requires the use of an Information Statement, ensure this number is inserted at the relevant point in the Complaints paragraph prior to distribution to potential participants You may then proceed with the research.

Conditions of Approval

This approval has been granted subject to you complying with the requirements for *Monitoring of Progress*, *Reporting of Adverse Events*, and *Variations to the Approved Protocol* as detailed below.

PLEASE NOTE:
In the case where the HREC has "noted" the approval of an External HREC, progress reports and reports of adverse events are to be submitted to the External HREC only. In the case of Variations to the approved protocol, or a Renewal of approval, you will apply to the External HREC for approval in the first instance and then Register that approval with the University's HREC.

- ***Monitoring of Progress***

Other than above, the University is obliged to monitor the progress of research projects involving human participants to ensure that they are conducted according to the protocol as approved by the HREC. A progress report is required on an annual basis. Continuation of your HREC approval for this project is conditional upon receipt, and satisfactory assessment, of annual progress reports. You will be advised when a report is due.

- ***Reporting of Adverse Events***

1. It is the responsibility of the person **first named on this Approval Advice** to report adverse events.
2. Adverse events, however minor, must be recorded by the investigator as observed by the investigator or as volunteered by a participant in the research. Full details are to be documented, whether or not the investigator, or his/her deputies, consider the event to be related to the research substance or procedure.
3. Serious or unforeseen adverse events that occur during the research or within six (6) months of completion of the research, must be reported by the person first named on the Approval Advice to the (HREC) by way of the Adverse Event Report form within 72 hours of the occurrence of the event or the investigator receiving advice of the event.
4. Serious adverse events are defined as:
    - Causing death, life threatening or serious disability.
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    - Overdoses, cancers, congenital abnormalities, tissue damage, whether or not they are judged to be caused by the investigational agent or procedure.
    - Causing psycho-social and/or financial harm. This covers everything from perceived invasion of privacy, breach of confidentiality, or the diminution of social reputation, to the creation of psychological fears and trauma.
    - Any other event which might affect the continued ethical acceptability of the project.

5. Reports of adverse events must include:
    - Participant's study identification number;
    - date of birth;
    - date of entry into the study;
    - treatment arm (if applicable);
    - date of event;
    - details of event;
    - the investigator's opinion as to whether the event is related to the research procedures; and
    - action taken in response to the event.

6. Adverse events which do not fall within the definition of serious or unexpected, including those reported from other sites involved in the research, are to be reported in detail at the time of the annual progress report to the HREC.

- ***Variations to approved protocol***

If you wish to change, or deviate from, the approved protocol, you will need to submit an *Application for Variation to Approved Human Research*. Variations may include, but are not limited to, changes or additions to investigators, study design, study population, number of participants, methods of recruitment, or participant information/consent documentation. **Variations must be approved by the (HREC) before they are implemented** except when Registering an approval of a variation from an external HREC which has been designated the lead HREC, in which case you may proceed as soon as you receive an acknowledgement of your Registration.

Linkage of ethics approval to a new Grant

HREC approvals cannot be assigned to a new grant or award (ie those that were not identified on the application for ethics approval) without confirmation of the approval from the Human Research Ethics Officer on behalf of the HREC.

Best wishes for a successful project.

Professor Allyson Holbrook
Chair, Human Research Ethics Committee

For communications and enquiries:
Human Research Ethics Administration

Research Services

Research Integrity Unit
HA148, Hunter Building
The University of Newcastle
Callaghan NSW 2308
T +61 2 492 18999
F +61 2 492 17164
Human-Ethics@newcastle.edu.au

Linked University of Newcastle administered funding:

Funding body	Funding project title	First named inves

HUMAN RESEARCH ETHICS COMMITTEE

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

Notification of Expedited Approval

To Chief Investigator or Project Supervisor:	**Professor Darren Rivett**
Cc Co-investigators / Research Students:	**Mr Grahame Knox** **Associate Professor Suzanne Snodgrass** **Doctor Erica Southgate**
Re Protocol:	**Physiotherapy clinical educators' preferences regarding an educational package to aid in the teaching of clinical prediction rules to physiotherapy students on clinical placement.**
Date:	**08-Jun-2016**
Reference No:	**H-2016-0110**
Date of Initial Approval:	**08-Jun-2016**

Thank you for your **Response to Conditional Approval (minor amendments)** submission to the Human Research Ethics Committee (HREC) seeking approval in relation to the above protocol.

Your submission was considered under **Expedited** review by the Ethics Administrator.

I am pleased to advise that the decision on your submission is **Approved** effective **08-Jun-2016**.

In approving this protocol, the Human Research Ethics Committee (HREC) is of the opinion that the project complies with the provisions contained in the National Statement on Ethical Conduct in Human Research, 2007, and the requirements within this University relating to human research.

Approval will remain valid subject to the submission, and satisfactory assessment, of annual progress reports. *If the approval of an External HREC has been "noted" the approval period is as determined by that HREC.*

The full Committee will be asked to ratify this decision at its next scheduled meeting. A formal *Certificate of Approval* will be available upon request. Your approval number is **H-2016-0110**.

If the research requires the use of an Information Statement, ensure this number is inserted at the relevant point in the Complaints paragraph prior to distribution to potential participants You may then proceed with the research.

Conditions of Approval

This approval has been granted subject to you complying with the requirements for *Monitoring of Progress*, *Reporting of Adverse Events*, and *Variations to the Approved Protocol* as detailed below.

PLEASE NOTE:
In the case where the HREC has "noted" the approval of an External HREC, progress reports and reports of adverse events are to be submitted to the External HREC only. In the case of Variations to the approved protocol, or a Renewal of approval, you will apply to the External HREC for approval in the first instance and then Register that approval with the University's HREC.

- ***Monitoring of Progress***

Other than above, the University is obliged to monitor the progress of research projects involving human participants to ensure that they are conducted according to the protocol as approved by the HREC. A progress report is required on an annual basis. Continuation of your HREC approval for this project is conditional upon receipt, and satisfactory assessment, of annual progress reports. You will be advised when a report is due.

- ***Reporting of Adverse Events***

1. It is the responsibility of the person **first named on this Approval Advice** to report adverse events.
2. Adverse events, however minor, must be recorded by the investigator as observed by the investigator or as volunteered by a participant in the research. Full details are to be documented, whether or not the investigator, or his/her deputies, consider the event to be related to the research substance or procedure.
3. Serious or unforeseen adverse events that occur during the research or within six (6) months of completion of the research, must be reported by the person first named on the Approval Advice to the (HREC) by way of the Adverse Event Report form (via RIMS at https://rims.newcastle.edu.au/login.asp) within 72 hours of the occurrence of the event or the investigator receiving advice of the event.
4. Serious adverse events are defined as:
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    - Causing or prolonging hospitalisation.
    - Overdoses, cancers, congenital abnormalities, tissue damage, whether or not they are judged to be caused by the investigational agent or procedure.
    - Causing psycho-social and/or financial harm. This covers everything from perceived invasion of privacy, breach of confidentiality, or the diminution of social reputation, to the creation of psychological fears and trauma.
    - Any other event which might affect the continued ethical acceptability of the project.

5. Reports of adverse events must include:
    - Participant's study identification number;
    - date of birth;
    - date of entry into the study;
    - treatment arm (if applicable);
    - date of event;
    - details of event;
    - the investigator's opinion as to whether the event is related to the research procedures; and
    - action taken in response to the event.

6. Adverse events which do not fall within the definition of serious or unexpected, including those reported from other sites involved in the research, are to be reported in detail at the time of the annual progress report to the HREC.

- ***Variations to approved protocol***

If you wish to change, or deviate from, the approved protocol, you will need to submit an *Application for Variation to Approved Human Research* (via RIMS at https://rims.newcastle.edu.au/login.asp). Variations may include, but are not limited to, changes or additions to investigators, study design, study population, number of participants, methods of recruitment, or participant information/consent documentation. **Variations must be approved by the (HREC) before they are implemented** except when Registering an approval of a variation from an external HREC which has been designated the lead HREC, in which case you may proceed as soon as you receive an acknowledgement of your Registration.

Linkage of ethics approval to a new Grant

HREC approvals cannot be assigned to a new grant or award (ie those that were not identified on the application for ethics approval) without confirmation of the approval from the Human Research Ethics Officer on behalf of the HREC.

Best wishes for a successful project.

Professor Allyson Holbrook
Chair, Human Research Ethics Committee

For communications and enquiries:
Human Research Ethics Administration

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NIER, Block C
The University of Newcastle
Callaghan NSW 2308
T +61 2 492 17894
Human-Ethics@newcastle.edu.au

RIMS website - https://RIMS.newcastle.edu.au/login.asp

Linked University of Newcastle administered funding:

Funding body	Funding project title	First named investigator	Grant Ref

HUMAN RESEARCH ETHICS COMMITTEE

Notification of Expedited Approval

To Chief Investigator or Project Supervisor:	**Professor Darren Rivett**
Cc Co-investigators / Research Students:	**Mr Grahame Knox** **Associate Professor Suzanne Snodgrass** **Doctor Erica Southgate**
Re Protocol:	**Physiotherapy clinical educators' preferences regarding an educational package to aid in the teaching of clinical prediction rules to physiotherapy students on clinical placement.**
Date:	**27-Sep-2016**
Reference No:	**H-2016-0110**

Thank you for your **Variation** submission to the Human Research Ethics Committee (HREC) seeking approval in relation to a variation to the above protocol.

Variation to:

1. Send out the Participant Information Statement via email, rather than by post.

2. Conduct the participant screening only with those participants who have already confirmed their request to participate in the study via email.

- Participant Information Statement, version 3 dated 25.8.2016
- Recruitment email, version 2 dated 25.8.2016

Your submission was considered under **Expedited** review by the Chair/Deputy Chair.

I am pleased to advise that the decision on your submission is **Approved** effective **26-Sep-2016**.

The full Committee will be asked to ratify this decision at its next scheduled meeting. A formal *Certificate of Approval* will be available upon request.

Professor Allyson Holbrook
Chair, Human Research Ethics Committee

For communications and enquiries:
Human Research Ethics Administration

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Callaghan NSW 2308
T +61 2 492 17894

Human-Ethics@newcastle.edu.au

RIMS website - https://RIMS.newcastle.edu.au/login.asp

Linked University of Newcastle administered funding:

Funding body	Funding project title	First named investigator	Grant Ref

From: Ruth Gibbins <ruth.gibbins@newcastle.edu.au>
Sent: Friday, 6 January 2017 10:09 AM
Subject: Variation: H-2016-0110

Re: Physiotherapy clinical educators' preferences regarding an educational package to aid in the teaching of clinical prediction rules to physiotherapy students on clinical placement.
HREC Reference: H-2016-0110

Thank you for your **Variation** submission to the Human Research Ethics Committee (HREC) seeking approval for a variation to the above project.

Variation to:

1. Issue a second email invitation to clinical educators inviting them to participate in focus groups.
2. Offer one-on-one semi-structured interviews as an option for participation.
3. Add the Ourimbah campus as a focus group venue for the convenience of Central Coast participants.
4. Extend recruitment to include employees of the Physiotherapy Department of Kempsey District Hospital as there is no longer the potential for an unequal relationship with the Student Researcher Grahame Knox (due to a change in employment circumstances).

- Email Invitation (v3, dated 22/11/2016)
- Information Statement (v4, dated 22/11/2016)

Your submission was considered under **Expedited** review by the **Chair/Deputy Chair**.

I am pleased to advise that the decision on your submission is **Approved effective 15 December 2016**.

The full Committee will be asked to ratify this decision at its next scheduled meeting. A formal *Certificate of Approval* will be available upon request.

Kind regards
Ruth

MS RUTH GIBBINS
Human Ethics Officer
Research and Innovation Services
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T: +61 2 49216333
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The University of Newcastle (UON)
University Drive
Callaghan NSW 2308
Australia

CRICOS Provider 00109J

HUMAN RESEARCH ETHICS COMMITTEE

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

Notification of Expedited Approval

To Chief Investigator or Project Supervisor:	**Professor Darren Rivett**
Cc Co-investigators / Research Students:	**Mr Grahame Knox** **Associate Professor Suzanne Snodgrass** **Associate Professor Erica Southgate**
Re Protocol:	**Physiotherapy clinical educators' preferences regarding an educational package to aid in the teaching of clinical prediction rules to physiotherapy students on clinical placement.**
Date:	**25-Jul-2017**
Reference No:	**H-2016-0110**

Thank you for your **Variation** submission to the Human Research Ethics Committee (HREC) seeking approval in relation to a variation to the above protocol.

Variation to:

1. Remove the exclusion criterion of 'current UON employee' as the chief investigator is no longer the Head of School, School of Health Sciences, and therefore does not have the same managerial/supervisory relationship with staff.

2. Remove the requirement that participants be from NSW as the introduction of individual interviews (previously approved) means that face-to-face engagement is no longer required. Participation will be open to all UON physiotherapy clinical educators Australia-wide.

- Information Statement (v5, dated 30/04/2017)

Your submission was considered under **Expedited** review by the Ethics Administrator.

I am pleased to advise that the decision on your submission is **Approved** effective **25-Jul-2017**.

The full Committee will be asked to ratify this decision at its next scheduled meeting. A formal *Certificate of Approval* will be available upon request.

Associate Professor Helen Warren-Forward
Chair, Human Research Ethics Committee

For communications and enquiries:
Human Research Ethics Administration

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Linked University of Newcastle administered funding:

Funding body	Funding project title	First named investigator	Grant Ref

HUMAN RESEARCH ETHICS COMMITTEE

Notification of Expedited Approval

To Chief Investigator or Project Supervisor:	**Professor Darren Rivett**
Cc Co-investigators / Research Students:	**Associate Professor Suzanne Snodgrass** **Mr Grahame Knox** **Associate Professor Erica Southgate**
Re Protocol:	**A learning package for physiotherapy clinical educators on clinical prediction rules: establishing consensus on content and delivery using the Delphi technique.**
Date:	**20-Aug-2018**
Reference No:	**H-2018-0154**
Date of Initial Approval:	**20-Aug-2018**

Thank you for your **Response to Conditional Approval (minor amendments)** submission to the Human Research Ethics Committee (HREC) seeking approval in relation to the above protocol.

Your submission was considered under **Expedited** review by the Ethics Administrator.

I am pleased to advise that the decision on your submission is **Approved** effective **20-Aug-2018**.

In approving this protocol, the Human Research Ethics Committee (HREC) is of the opinion that the project complies with the provisions contained in the National Statement on Ethical Conduct in Human Research, 2007, and the requirements within this University relating to human research.

Approval will remain valid subject to the submission, and satisfactory assessment, of annual progress reports. *If the approval of an External HREC has been "noted" the approval period is as determined by that HREC.*

The full Committee will be asked to ratify this decision at its next scheduled meeting. A formal *Certificate of Approval* will be available upon request. Your approval number is **H-2018-0154**.

If the research requires the use of an Information Statement, ensure this number is inserted at the relevant point in the Complaints paragraph prior to distribution to potential participants You may then proceed with the research.

Conditions of Approval

This approval has been granted subject to you complying with the requirements for *Monitoring of Progress*, *Reporting of Adverse Events*, and *Variations to the Approved Protocol* as detailed below.

PLEASE NOTE:
In the case where the HREC has "noted" the approval of an External HREC, progress reports and reports of adverse events are to be submitted to the External HREC only. In the case of Variations to the approved protocol, or a Renewal of approval, you will apply to the External HREC for approval in the first instance and then Register that approval with the University's HREC.

- ***Monitoring of Progress***

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- ***Variations to approved protocol***

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Linkage of ethics approval to a new Grant

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Best wishes for a successful project.

Associate Professor Helen Warren-Forward
Chair, Human Research Ethics Committee

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RIMS website - https://RIMS.newcastle.edu.au/login.asp

Linked University of Newcastle administered funding:

Funding body	Funding project title	First named investigator	Grant Ref

APPENDIX 3

QUESTIONNAIRES TO SURVEY CLINICAL EDUCATORS AND STUDENTS FOR STUDIES PRESENTED IN CHAPTERS 3 AND 4

The Use Of Clinical Prediction Rules By Clinical Educators With Physiotherapy Students

Clinical Educators' Survey

The following survey forms part of a Research Higher Degree through The University of Newcastle by Grahame Knox, under the supervision of Professor Darren Rivett and Dr Suzanne Snodgrass.

The research aims to investigate the use of Clinical Prediction Rules and their relationship to clinical reasoning, and to explore whether they may be useful in the teaching of clinical reasoning to physiotherapy students.

For the purpose of the research the term "Clinical Prediction Rules" is used, though you may also know them as "Clinical Decision Rules", "Clinical Decision Guidelines", "Clinical Prediction Tools" or any other similar wording. These refer to the tools designed to assist decision-making of clinicians by quantifying the relative contributions of various characteristics to provide numeric indices which are then used to assist in making a diagnosis, establishing a prognosis, and/or determining ideal methods of intervention.

As the survey is aimed at determining the extent to which Clinical Prediction Rules are used, your assistance is sought <u>even if you do not use such tools</u>, and even if you have never heard of them or know little about them. For you it will be a very quick survey, but equally valuable for the research outcome.

The survey is a maximum of 28 questions, mostly check-the-box, and should take about <u>15 minutes</u> depending on your responses. Please insert an X in the appropriate boxes or comments where indicated.

Grahame Knox
M.Phil. Candidate

Supervised by:
Professor Darren Rivett, Head of School
Dr Suzanne Snodgrass, Senior Lecturer

Discipline of Physiotherapy
School of Health Sciences
Faculty of Health
The University of Newcastle
University Drive, Callaghan
NSW 2308, AUSTRALIA
Tel: 02 6562 0294
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THE UNIVERSITY OF NEWCASTLE AUSTRALIA

www.newcastle.edu.au

Part 1 Awareness and Use of Clinical Prediction Rules

Question 1:

At the present time, which statement best describes your knowledge of Clinical Prediction Rules? *Check one only*.

☐ I have never previously heard of Clinical Prediction Rules and know nothing about them.
↳ GO TO QUESTION 17

☐ I have heard of Clinical Prediction Rules but know little or nothing about them (e.g. colleagues may have mentioned them). → GO TO QUESTION 2

☐ I know something of Clinical Prediction Rules (e.g. I have read about them, discussed them with colleagues). → GO TO QUESTION 2

☐ I know a lot about Clinical Prediction Rules (e.g. I am interested in them, I understand their basis, use, application). → GO TO QUESTION 2

Question 2:

At the present time, which statement best describes your use of Clinical Prediction Rules? *Check one only.*

☐ I have never used Clinical Prediction Rules. → GO TO QUESTION 17

☐ I have used Clinical Prediction Rules in the past but I no longer use them. → GO TO QUESTION 3

☐ I rarely use Clinical Prediction Rules (e.g. on the odd occasion, perhaps when a colleague suggests it). → GO TO QUESTION 3

☐ I use Clinical Prediction Rules sometimes (e.g. I use them whenever it occurs to me, or there are a few that I use regularly with certain conditions). → GO TO QUESTION 3

☐ I use Clinical Prediction Rules often (e.g. I am always thinking how they might apply with any patient). → GO TO QUESTION 4

Question 3:

Why don't you use Clinical Prediction Rules more often? *Check all that apply.*

☐ I do not know enough about them to be able to use them.

☐ I do not know of any in my area of clinical practice.

☐ I do not know how they apply in my area of clinical practice.

☐ They are rarely indicated in my area of clinical practice.

☐ I prefer to use my own clinical reasoning rather than a "formula".

☐ I think they are too time-consuming to apply.

☐ I do not think the research supports their use.

☐ Most of them have not been validated.

☐ Other. *Please specify*: ____________________

Question 4:

Why do you use Clinical Prediction Rules? *Check all that apply.*

- ☐ I do not use them.
- ☐ To assist with my clinical reasoning.
- ☐ To replace my clinical reasoning when it seems indicated.
- ☐ To streamline assessment procedures.
- ☐ To assist with diagnosis, e.g. so I can be more confident about what I'm dealing with.
- ☐ To assist with prognosis, e.g. so I can give patients an indication of their likely clinical outcome.
- ☐ To assist with choosing an intervention.
- ☐ To make interventions more effective.
- ☐ I think they are an efficient use of my time.
- ☐ They are reflective of current best practice.
- ☐ Others. *Please specify*: ______________________________

____

____

Question 5:

How do you feel about Clinical Prediction Rules? *Check all that apply.*

- ☐ I think they are easy to learn.
- ☐ I think they are easy to remember.
- ☐ I think they are easy to use.
- ☐ I do not believe they are useful.
- ☐ I think their value is exaggerated.
- ☐ I think they are difficult to learn.
- ☐ I think they are difficult to remember.
- ☐ I think they are difficult to use.
- ☐ Others. *Please specify*: ______________________________

____

____

____

Question 6:

Do you ever calculate a Clinical Prediction Rule, and then proceed contrary to the Rule's direction, i.e. decide on an alternate diagnosis, prognosis or intervention? ***Check one box with each type of rule.***

Type of Rule	Often	Occasionally	Rarely	Never
Diagnostic				
Prognostic				
Intervention				

If so, why do you not consistently follow the Clinical Prediction Rule? ___________________

____

____

Question 7:

What are your sources of information about Clinical Prediction Rules? ***Check all that apply.***

- ☐ From lecturers/tutors while studying.
- ☐ Post-graduate or independent study.
- ☐ Journal articles.
- ☐ Books.
- ☐ Indirectly when researching a topic (e.g. online).
- ☐ From colleagues who recommend or mention them.
- ☐ Onsite working with other professions (e.g. in Emergency Departments).
- ☐ Professional development courses/conferences/events.
- ☐ Others. *Please specify*: ____

Question 8:

How do you access Clinical Prediction Rules in the clinical setting? ***Check all that apply.***

- ☐ From memory.
- ☐ From applications downloaded onto electronic devices (iPhone, Blackberry, etc.).
- ☐ Journals/articles on hand.
- ☐ Journals/articles online.
- ☐ Books at hand.

- [ ] Laminated cards detailing one or more CPRs.
- [ ] Self-formulated tables, references, etc. printed out.
- [ ] Self-formulated tables, references, etc. saved on computer.
- [ ] Others. *Please specify*: ____

Part 2 Use of Clinical Prediction Rules with Students

Question 9:

At the present time, which statement best describes your teaching about the usage of Clinical Prediction Rules by students treating patients in a clinical setting under your supervision? *Check one only*.

- [ ] I never mention Clinical Prediction Rules to students.
- [ ] I rarely tell students about Clinical Prediction Rules (e.g. maybe if a student asks about them).
- [ ] I sometimes assist or teach students the use of Clinical Prediction Rules (e.g. I use them when it occurs to me, and there are a few that I use regularly with students when certain conditions present).
- [ ] I often suggest to my students that they use Clinical Prediction Rules (e.g. I regularly teach students about how they might apply them). → QUESTION 10 OPTIONAL, OTHERWISE GO TO QUESTION 11

Question 10:

What are your reasons for not teaching or using Clinical Prediction Rules with students more often? *Check all that apply.*

- [ ] I don't use them enough myself.
- [ ] I think they are too difficult to use.
- [ ] I think they are too difficult to teach.
- [ ] I think they are too time-consuming to teach.
- [ ] I think they are too time-consuming to apply.
- [ ] The research does not support their use.
- [ ] I do not think they improve clinical practice.
- [ ] I don't know enough about them to be able to teach them to students.
- [ ] I generally find that the students know nothing about them.
- [ ] I prefer the students to practice their clinical reasoning rather than using a "formula".
- [ ] They do not assist student learning.
- [ ] Other. *Please specify*: ____

Question 11:

Why do you teach Clinical Prediction Rules to students? *Check all that apply.*

☐ I don't teach them.

☐ As an educational tool.

☐ They are reflective of current best practice.

☐ To help students with developing their clinical reasoning.

☐ To streamline assessment procedures.

☐ To assist them with diagnosis.

☐ To assist them with prognosis.

☐ To assist them with choosing an intervention.

☐ To make their interventions more effective.

☐ To improve their evidence-based practice.

☐ I think they are easy to teach.

☐ I think they are easy to apply.

☐ They assist student learning.

☐ I find that students catch on to them quickly.

☐ I find that students are able to apply them effectively.

☐ Others. *Please specify*: ______________________________

Question 12:

What do you teach students about Clinical Prediction Rules? *Check all that apply.*

☐ I do not teach students anything about Clinical Prediction Rules.

☐ I teach how they may apply Clinical Prediction Rules, in a general sense.

☐ I tell them about specific Clinical Prediction Rules.

☐ I teach how to use specific Clinical Prediction Rules with patients.

☐ I teach the development of Clinical Prediction Rules, e.g. with relevant journal articles.

☐ I teach them how to decide when and when not to use Clinical Prediction Rules.

☐ I teach how Clinical Prediction Rules can help with clinical reasoning.

☐ Others. *Please specify*: ______________________________

____

Question 13:

Do you favour or oppose the teaching of Clinical Prediction Rules to students? *Check one only*.

Strongly favour	Slightly favour	No preference	Slightly oppose	Strongly oppose
☐	☐	☐	☐	☐

Comments: ____

Question 14:

How do you feel about Clinical Prediction Rules with respect to students' learning of clinical reasoning? *Check one only*.

☐ Clinical Prediction Rules can help the learning of clinical reasoning.

☐ Clinical Prediction Rules have no effect on learning clinical reasoning.

☐ Clinical Prediction Rules hinder the learning and/or development of clinical reasoning.

☐ I don't know whether Clinical Prediction Rules affect the learning of clinical reasoning.

Comments: ____

____

Question 15:

Please indicate which Clinical Prediction Rules you know of, actually use in your own clinical practice, and teach to students (either in tutorial or clinic), for the following purposes? *Check all that apply, otherwise leave blank.*

Purpose of Clinical Prediction Rule	Know of	Use in practice	Teach to students
Identification of deep venous thrombosis			
Diagnosis of pulmonary embolism.			
Risk of osteoporosis.			
Risk of peripheral neuropathy.			
Low back pain, diagnosis of spinal stenosis.			
Low back pain, diagnosis of sacroiliac joint problem.			
Low back pain, and likely to respond to spinal manipulation.			
Low back pain, and likely to respond to mechanical traction.			
Low back pain, and likely to benefit from lumbar stabilisation exercises.			
Other for low back pain. Please specify:			
Assessment of seriousness of Head Injury Spine (need for CT Scan).			
Assessment of seriousness of injury to Cervical Spine (need for X-Ray).			
Neck pain likely to be cervical radiculopathy.			
Neck pain, and likely to benefit from cervical traction.			
Neck pain, and likely to benefit from cervical spine manipulation.			

Purpose of Clinical Prediction Rule	Know of	Use in practice	Teach to students
Neck pain, and likely to benefit from thoracic spine manipulation.			
Whiplash-associated disorders, and at risk of developing chronic symptoms.			
Headache, likely to respond to trigger point therapy.			
Treatment of temperomandibular joint pain with splint.			
Diagnosis of subacromial impingement.			
Diagnosis of rotator cuff tear.			
Shoulder pain, and likely to benefit from cervico-thoracic manipulation.			
Treatment of lateral epicondylalgia with MWMs (Mobilisations with Movement) and exercise.			
Diagnosis of carpal tunnel syndrome.			
Diagnosis of osteoarthritis of the hip.			
Diagnosis of osteoarthritis of the knee.			
Patellofemoral pain, and likely to benefit from lumbar spine manipulation.			
Patellofemoral pain, and likely to benefit from patellar taping.			
Patellofemoral pain, and likely to benefit from orthotics.			
Identification of injuries to knee (need for X-Ray).			
Identification of injuries to ankle & foot (need for X-Ray).			
Others. *Please list and/or describe by intent, effect, etc.*:			

Question 16:

Do you know any Clinical Prediction Rules by name? If so please list e.g. by author, origin:

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Part 3 Some Information About You

Question 17:

Your gender?

☐ Male ☐ Female

Question 18:

Your age range?

☐ 25 and under ☐ 26-30

☐ 31-40 ☐ 41 and over

Question 19:

What is your initial (entry-level) physiotherapy qualification? *Check one only*.

☐ Diploma ☐ Graduate Diploma

☐ Bachelor's Degree ☐ Master's Degree

☐ Doctorate ☐ Other. *Please specify*: ______________

Question 20:

Where did you complete your initial (entry-level) physiotherapy qualifications? *Check one only*.

☐ New South Wales Specify university ______________________________

☐ ACT

☐ Victoria Specify university ______________________________

☐ Queensland Specify university ______________________________

☐ South Australia Specify university ______________________________

☐ Western Australia Specify university ______________________________

☐ New Zealand

☐ USA ☐ Canada

☐ UK ☐ South Africa

☐ Other *Please specify*: ____

Question 21:

Do you have any other qualifications relevant to physiotherapy? *Please list:*

____

____

Question 22:

How long have you been practising physiotherapy (not counting breaks from work, e.g. for extended travel, parental leave, etc., but including post-graduate study, academic work, research)?

________ years

Question 23:

Where are you currently working?

- ☐ New South Wales
- ☐ ACT
- ☐ Queensland
- ☐ Victoria
- ☐ Tasmania
- ☐ South Australia
- ☐ Northern Territory
- ☐ Western Australia

Question 24:

In what type of facility do you work? *Check all that apply.*

- ☐ Tertiary teaching hospital
- ☐ Secondary referral hospital
- ☐ Primary health facility, community hospital
- ☐ Community centre and/or home visits
- ☐ Private practice – small, 1-3 physiotherapists
- ☐ Private practice – large, 4 or more physiotherapists, with or without multiple sites
- ☐ Other. *Please specify*: ____

Question 25:

How long have you been supervising physiotherapy students on clinical placement?

________ years ________ months

And how many students do you supervise per year on average? ____________________

Question 26:

If you teach Clinical Prediction Rules to the students you supervise, in what year of their course are these students? *Check all that apply.*

- ☐ 1st year undergraduate
- ☐ 2nd year undergraduate
- ☐ 3rd year undergraduate
- ☐ 4th year undergraduate
- ☐ 5th year (e.g. combined degree)
- ☐ 1st year post-graduate (e.g. Masters Degree)
- ☐ 2nd year post-graduate (e.g. Masters Degree)

Question 27:

In what area(s) do you supervise students? *Check all that apply.*

☐ Musculoskeletal (e.g. outpatients, private practice)

☐ Orthopaedics (e.g. wards, outpatients, emergency department)

☐ Acute/Cardio-respiratory

☐ General inpatient

☐ Neurological

☐ Rehabilitation

☐ Community

☐ Specialist (e.g. Paediatrics, Women's health, Hand Therapy) *Please specify*: ________________

____

☐ Other. *Please specify*: ____

Question 28:

Have you acted as a clinical educator for students from universities other than the University of Newcastle?

☐ Yes ☐ No

If so, how many other universities? ____________________

Please feel free to write below any further comments or thoughts you may have on Clinical Prediction Rules, your use of them, or their applicability to students:

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THANK YOU FOR YOUR TIME IN COMPLETING THIS SURVEY

The Use Of Clinical Prediction Rules By Clinical Educators With Physiotherapy Students

Students' Survey

The following survey forms part of a Research Higher Degree through The University of Newcastle by Grahame Knox, under the supervision of Professor Darren Rivett and Dr Suzanne Snodgrass.

The research aims to investigate the use of Clinical Prediction Rules and their relationship to clinical reasoning, and to explore whether they may be useful in the teaching of clinical reasoning to physiotherapy students.

For the purpose of the research, the term "Clinical Prediction Rules" is used, though you may also have heard of them as "Clinical Decision Rules", "Clinical Decision Guidelines", "Clinical Prediction Tools" or any other similar wording. These refer to the tools designed to assist decision-making of clinicians by quantifying the relative contributions of various characteristics to provide numeric indices which are then used to assist in making a diagnosis, establishing a prognosis, and/or determining ideal methods of intervention.

As the survey is aimed at determining the extent to which Clinical Prediction Rules are used, your assistance is sought <u>even if you do not use such tools</u>, and even if you have never heard of them or know little about them. For you it will be a very quick survey, but equally valuable for the research outcome.

The survey is a maximum of 21 questions, mostly check-the-box, and should only take about <u>10-15 minutes</u> depending on your responses. Please insert an X in the appropriate boxes or comments where indicated.

Grahame Knox
M.Phil. Candidate

Supervised by:
Professor Darren Rivett, Head of School
Dr Suzanne Snodgrass, Senior Lecturer

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Part 1 Awareness and Use of Clinical Prediction Rules

Question 1:

At the present time, which statement best describes your knowledge of Clinical Prediction Rules? *Check one only.*

☐ I have never previously heard of Clinical Prediction Rules and know nothing about them.
↪ GO TO QUESTION 17

☐ I have heard of Clinical Prediction Rules but know little or nothing about them (e.g. educators, other hospital or university staff, or other students may have mentioned them).
↪ GO TO QUESTION 2

☐ I know something of Clinical Prediction Rules (e.g. I have read about them, discussed them with educators). → GO TO QUESTION 2

☐ I know a lot about Clinical Prediction Rules (e.g. I am interested in them, I have some understanding of their basis, use, application). → GO TO QUESTION 2

Question 2:

At the present time, which statement best describes your use of Clinical Prediction Rules? *Check one only.*

☐ I have never used Clinical Prediction Rules. → GO TO QUESTION 17

☐ I rarely use Clinical Prediction Rules (e.g. perhaps only when the educator suggests it).
↪ GO TO QUESTION 3

☐ I use Clinical Prediction Rules sometimes (e.g. I use them whenever it occurs to me, or there are a few that I use regularly with certain conditions). → GO TO QUESTION 3

☐ I use Clinical Prediction Rules often (e.g. I am always thinking how they might apply with any patient). → GO TO QUESTION 4

Question 3:

Why don't you use Clinical Prediction Rules more often? *Check all that apply.*

☐ I do not know enough about them to be able to use them.

☐ I have not had enough practice with their use to be able to apply them.

☐ I do not know how they apply to the patients I have treated on clinical placement.

☐ I prefer to practise my own clinical reasoning rather than a "formula".

☐ They are rarely indicated in clinical practice.

☐ I think they are too time-consuming to apply.

☐ I do not think the research supports their use.

☐ Most of them have not been validated.

☐ Others. *Please specify*: ____

Question 4:

Why do you use Clinical Prediction Rules? *Check all that apply.*

- ☐ To assist with my clinical reasoning.
- ☐ To replace my clinical reasoning when it seems indicated.
- ☐ To streamline assessment procedures.
- ☐ To assist with diagnosis, e.g. so I can be more confident about what I'm dealing with.
- ☐ To assist with prognosis, e.g. so I can give patients an indication of their likely clinical outcome.
- ☐ To assist with choosing an intervention.
- ☐ To make interventions more effective.
- ☐ I think they are an efficient use of my time.
- ☐ They are reflective of current best practice.
- ☐ Others. *Please specify*: ______________________________

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____

Question 5:

How do you feel about Clinical Prediction Rules? *Check all that apply.*

- ☐ I think they are easy to learn.
- ☐ I think they are easy to remember.
- ☐ I think they are easy to use.
- ☐ I do not believe they are useful.
- ☐ I think their value is exaggerated.
- ☐ I think they are difficult to learn.
- ☐ I think they are difficult to remember.
- ☐ I think they are difficult to use.
- ☐ Others. *Please specify*: ______________________________

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____

____

Question 6:

Have you ever calculated a Clinical Prediction Rule, and then proceeded contrary to the Rule's direction, i.e. decided on an alternate diagnosis, prognosis or intervention? *Check one box with each type of rule.*

Type of Rule	Often	Occasionally	Rarely	Never
Diagnostic				
Prognostic				
Intervention				

If so, why did you not consistently follow the Clinical Prediction Rule? ________________

____

____

Question 7:

What are your sources of information about Clinical Prediction Rules? *Check all that apply.*

- ☐ From educators while on clinical placement.
- ☐ From lecturers/tutors at university.
- ☐ Independent study.
- ☐ Journal articles.
- ☐ Books.
- ☐ Indirectly when researching a topic (e.g. online).
- ☐ From other students who recommend or mention them.
- ☐ Others. *Please specify*: ____

____

Question 8:

How do you access Clinical Prediction Rules in the clinical setting? *Check all that apply.*

- ☐ From memory.
- ☐ From educators.
- ☐ From applications downloaded onto electronic devices (iPhone, Blackberry, etc.).
- ☐ Journals/articles on hand.
- ☐ Journals/articles online.

☐ Books at hand.

☐ Laminated cards detailing one or more CPRs.

☐ Tables etc., printed out by the educator or other staff & available at the clinical placement.

☐ Self-formulated tables, references, etc., printed out by myself.

☐ Tables, references, etc. available on computer at the clinical placement.

☐ Self-formulated tables, references, etc. saved on personal computer.

☐ Others. *Please specify*: ____

Part 2 Use of Clinical Prediction Rules with Educators

Question 9:

At the present time, which statement best describes your learning of Clinical Prediction Rules while treating patients in a clinical setting under the supervision of educators? *Check one only*.

☐ I have never learnt about Clinical Prediction Rules on clinical placement.

☐ I rarely learn about Clinical Prediction Rules on clinical placement (e.g. occasionally, maybe if the educator uses it).

☐ I sometimes learn about Clinical Prediction Rules (e.g. some educators seem to use them more often than others).

☐ I am always learning from educators about Clinical Prediction Rules and how I might apply them. → QUESTION 10 OPTIONAL, OTHERWISE GO TO QUESTION 11

Question 10:

Why do you think you haven't learnt about Clinical Prediction Rules more often while on clinical placement? *Check all that apply.*

☐ The educators don't seem to use them.

☐ I think they are too time-consuming to learn.

☐ I think they are too time-consuming to apply.

☐ The research does not support their use.

☐ Educators don't know enough about them to be able to teach them to students.

☐ Educators prefer that we practice our clinical reasoning rather than using a formula.

☐ I don't think they assist student learning.

☐ Others. *Please specify*: ____

____

Question 11:

Why do you think students should learn about Clinical Prediction Rules on clinical placement? *Check all that apply.*

- ☐ I don't think we should.
- ☐ They are reflective of current best practice.
- ☐ To help with developing my clinical reasoning.
- ☐ To streamline assessment procedures.
- ☐ To assist me with making a diagnosis.
- ☐ To assist me with making a prognosis.
- ☐ To assist me with choosing an intervention.
- ☐ To make my interventions more effective.
- ☐ To improve my evidence-based practice.
- ☐ They assist student learning.
- ☐ I find that I am able to apply them effectively.
- ☐ Others. *Please specify*: ______________________________

Question 12:

What do you learn about Clinical Prediction Rules from educators? *Check all that apply.*

- ☐ I do not learn about Clinical Prediction Rules.
- ☐ I learn specific Clinical Prediction Rules.
- ☐ I learn how I might apply Clinical Prediction Rules, in a general sense.
- ☐ I learn about the development of Clinical Prediction Rules, e.g. with relevant journal articles.
- ☐ I learn how to decide when and when not to use Clinical Prediction Rules.
- ☐ I learn how Clinical Prediction Rules can help with clinical reasoning.
- ☐ Others. *Please specify*: ______________________________

Question 13:

Do you favour or oppose the teaching of Clinical Prediction Rules to students? *Check one only.*

Strongly favour	Slightly favour	No preference	Slightly oppose	Strongly oppose
☐	☐	☐	☐	☐

Comments: ______________________________

Question 14:

How do you feel about Clinical Prediction Rules with respect to your learning of clinical reasoning? *Check one only.*

☐ Clinical Prediction Rules can help the learning of clinical reasoning.

☐ Clinical Prediction Rules have no effect on learning clinical reasoning.

☐ Clinical Prediction Rules hinder the learning and/or development of clinical reasoning.

☐ I don't know whether Clinical Prediction Rules affect the learning of clinical reasoning.

Comments: ____

Question 15:

Please indicate which Clinical Prediction Rules you know of, and which you have actually used on your own clinical placements, for the following purposes? *Check all that apply, otherwise leave blank.*

Purpose of Clinical Prediction Rule	Know of	Used on placement
Identification of deep venous thrombosis		
Diagnosis of pulmonary embolism.		
Risk of osteoporosis.		
Risk of peripheral neuropathy.		
Low back pain, diagnosis of spinal stenosis.		
Low back pain, diagnosis of sacroiliac joint problem.		
Low back pain, and likely to respond to spinal manipulation.		
Low back pain, and likely to respond to mechanical traction.		
Low back pain, and likely to benefit from lumbar stabilisation exercises.		
Other for low back pain. Please specify:		
Assessment of seriousness of Head Injury Spine (need for CT Scan).		
Assessment of seriousness of injury to Cervical Spine (need for X-Ray).		
Neck pain likely to be cervical radiculopathy.		
Neck pain, and likely to benefit from cervical traction.		
Neck pain, and likely to benefit from cervical spine manipulation.		
Neck pain, and likely to benefit from thoracic spine manipulation.		
Whiplash-associated disorders, and at risk of developing chronic symptoms.		
Headache, likely to respond to trigger point therapy.		
Treatment of temperomandibular joint pain with splint.		
Diagnosis of subacromial impingement.		
Diagnosis of rotator cuff tear.		
Shoulder pain, and likely to benefit from cervico-thoracic manipulation.		
Treatment of lateral epicondylalgia with MWMs (Mobilisations with Movement) and exercise.		
Diagnosis of carpal tunnel syndrome.		
Diagnosis of osteoarthritis of the hip.		
Diagnosis of osteoarthritis of the knee.		

Purpose of Clinical Prediction Rule	Know of	Used on placement
Patellofemoral pain, and likely to benefit from lumbar spine manipulation.		
Patellofemoral pain, and likely to benefit from patellar taping.		
Patellofemoral pain, and likely to benefit from orthotics.		
Identification of injuries to knee (need for X-Ray).		
Identification of injuries to ankle & foot (need for X-Ray).		
Others. *Please list and/or describe by intent, effect, etc.*:		

Question 16:

Do you know any Clinical Prediction Rules by name? If so please list e.g. by author, origin:

____

____

____

____

Part 3 Some Information About You

Question 17:

Your gender?

☐ Male

☐ Female

Question 18:

Your age? __________________

Question 19:

In what type of facility have you had clinical placements? *Check all that apply.*

☐ Tertiary teaching hospital

☐ Secondary referral hospital

☐ Primary health facility, community hospital

☐ Community centre and/or home visits

☐ Private practice – small, 1-3 physiotherapists

☐ Private practice – large, 4 or more physiotherapists, with or without multiple sites

☐ Other. *Please specify*: ______________________________

Question 20:

In what areas have you had clinical placements? *Check all that apply.*

- ☐ Musculoskeletal (e.g. outpatients, private practice)
- ☐ Orthopaedics (e.g. wards, outpatients, emergency department)
- ☐ Acute/Cardio-respiratory
- ☐ General inpatient
- ☐ Neurological
- ☐ Rehabilitation
- ☐ Community
- ☐ Specialist (e.g. Paediatrics, Women's health, Hand Therapy) *Please specify*: ________________

____

- ☐ Other. *Please specify*: ____

Question 21:

Have you had any clinical placements other than in New South Wales?

- ☐ Interstate *Please specify*: ____

____

____

- ☐ Overseas *Please specify*: ____

____

Please feel free to write below any further comments or thoughts you may have on Clinical Prediction Rules, your use of them, or their applicability to clinical reasoning:

____

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____

THANK YOU FOR YOUR TIME IN COMPLETING THIS SURVEY

The Use Of Clinical Prediction Rules By Clinical Educators With Physiotherapy Students

Students' Survey

The following survey forms part of a Research Higher Degree through The University of Newcastle by Grahame Knox, under the supervision of Professor Darren Rivett and Dr Suzanne Snodgrass, in collaboration with Dr Tasha Stanton at the University of South Australia.

The research aims to investigate the use of Clinical Prediction Rules and their relationship to clinical reasoning, and to explore whether they may be useful in the teaching of clinical reasoning to physiotherapy students.

For the purpose of the research, the term "Clinical Prediction Rules" is used, though you may also have heard of them as "Clinical Decision Rules", "Clinical Decision Guidelines", "Clinical Prediction Tools" or any other similar wording. These refer to the tools designed to assist decision-making of clinicians by quantifying the relative contributions of various characteristics to provide numeric indices which are then used to assist in making a diagnosis, establishing a prognosis, and/or determining ideal methods of intervention.

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The survey is a maximum of 21 questions, mostly check-the-box, and should only take about <u>10-15 minutes</u> depending on your responses. Please insert an X in the appropriate boxes or comments where indicated.

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UniSA | Sansom Institute for Health Research

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Part 1   Awareness and Use of Clinical Prediction Rules

Question 1:

At the present time, which statement best describes your knowledge of Clinical Prediction Rules? *Check one only.*

- ☐ I have never previously heard of Clinical Prediction Rules and know nothing about them.
  ↳ GO TO QUESTION 17

- ☐ I have heard of Clinical Prediction Rules but know little or nothing about them (e.g. educators, other hospital or university staff, or other students may have mentioned them).
  ↳ GO TO QUESTION 2

- ☐ I know something of Clinical Prediction Rules (e.g. I have read about them, discussed them with educators). → GO TO QUESTION 2

- ☐ I know a lot about Clinical Prediction Rules (e.g. I am interested in them, I have some understanding of their basis, use, application). → GO TO QUESTION 2

Question 2:

At the present time, which statement best describes your use of Clinical Prediction Rules? *Check one only.*

- ☐ I have never used Clinical Prediction Rules. → GO TO QUESTION 17

- ☐ I rarely use Clinical Prediction Rules (e.g. perhaps only when the educator suggests it).
  ↳ GO TO QUESTION 3

- ☐ I use Clinical Prediction Rules sometimes (e.g. I use them whenever it occurs to me, or there are a few that I use regularly with certain conditions). → GO TO QUESTION 3

- ☐ I use Clinical Prediction Rules often (e.g. I am always thinking how they might apply with any patient). → GO TO QUESTION 4

Question 3:

Why don't you use Clinical Prediction Rules more often? *Check all that apply.*

- ☐ I do not know enough about them to be able to use them.
- ☐ I have not had enough practice with their use to be able to apply them.
- ☐ I do not know how they apply to the patients I have treated on clinical placement.
- ☐ I prefer to practise my own clinical reasoning rather than a "formula".
- ☐ They are rarely indicated in clinical practice.
- ☐ I think they are too time-consuming to apply.
- ☐ I do not think the research supports their use.
- ☐ Most of them have not been validated.
- ☐ Others. *Please specify*: ____

Question 4:

Why do you use Clinical Prediction Rules? *Check all that apply.*

- ☐ To assist with my clinical reasoning.
- ☐ To replace my clinical reasoning when it seems indicated.
- ☐ To streamline assessment procedures.
- ☐ To assist with diagnosis, e.g. so I can be more confident about what I'm dealing with.
- ☐ To assist with prognosis, e.g. so I can give patients an indication of their likely clinical outcome.
- ☐ To assist with choosing an intervention.
- ☐ To make interventions more effective.
- ☐ I think they are an efficient use of my time.
- ☐ They are reflective of current best practice.
- ☐ Others. *Please specify*: ______________________________

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____

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Question 5:

How do you feel about Clinical Prediction Rules? *Check all that apply.*

- ☐ I think they are easy to learn.
- ☐ I think they are easy to remember.
- ☐ I think they are easy to use.
- ☐ I do not believe they are useful.
- ☐ I think their value is exaggerated.
- ☐ I think they are difficult to learn.
- ☐ I think they are difficult to remember.
- ☐ I think they are difficult to use.
- ☐ Others. *Please specify*: ______________________________

____

____

____

Question 6:

Have you ever calculated a Clinical Prediction Rule, and then proceeded contrary to the Rule's direction, i.e. decided on an alternate diagnosis, prognosis or intervention? ***Check one box with each type of rule.***

Type of Rule	Often	Occasionally	Rarely	Never
Diagnostic				
Prognostic				
Intervention				

If so, why did you not consistently follow the Clinical Prediction Rule? ________________

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Question 7:

What are your sources of information about Clinical Prediction Rules? ***Check all that apply.***

- [ ] From educators while on clinical placement.
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- [ ] Independent study.
- [ ] Journal articles.
- [ ] Books.
- [ ] Indirectly when researching a topic (e.g. online).
- [ ] From other students who recommend or mention them.
- [ ] Others. *Please specify*: ________________________________

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Question 8:

How do you access Clinical Prediction Rules in the clinical setting? ***Check all that apply.***

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- [ ] From educators.
- [ ] From applications downloaded onto electronic devices (iPhone, Blackberry, etc.).
- [ ] Journals/articles on hand.
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- [ ] Books at hand.
- [ ] Laminated cards detailing one or more CPRs.
- [ ] Tables etc., printed out by the educator or other staff & available at the clinical placement.
- [ ] Self-formulated tables, references, etc., printed out by myself.
- [ ] Tables, references, etc. available on computer at the clinical placement.
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- [ ] Others. *Please specify*: ______________________________

Part 2 Use of Clinical Prediction Rules with Educators

Question 9:

At the present time, which statement best describes your learning of Clinical Prediction Rules while treating patients in a clinical setting under the supervision of educators? *Check one only.*

- [ ] I have never learnt about Clinical Prediction Rules on clinical placement.
- [ ] I rarely learn about Clinical Prediction Rules on clinical placement (e.g. occasionally, maybe if the educator uses it).
- [ ] I sometimes learn about Clinical Prediction Rules (e.g. some educators seem to use them more often than others).
- [ ] I am always learning from educators about Clinical Prediction Rules and how I might apply them. → QUESTION 10 OPTIONAL, OTHERWISE GO TO QUESTION 11

Question 10:

Why do you think you haven't learnt about Clinical Prediction Rules more often while on clinical placement? *Check all that apply.*

- [ ] The educators don't seem to use them.
- [ ] I think they are too time-consuming to learn.
- [ ] I think they are too time-consuming to apply.
- [ ] The research does not support their use.
- [ ] Educators don't know enough about them to be able to teach them to students.
- [ ] Educators prefer that we practice our clinical reasoning rather than using a formula.
- [ ] I don't think they assist student learning.
- [ ] Others. *Please specify*: ______________________________

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Question 11:

Why do you think students should learn about Clinical Prediction Rules on clinical placement? *Check all that apply.*

- [ ] I don't think we should.
- [ ] They are reflective of current best practice.
- [ ] To help with developing my clinical reasoning.
- [ ] To streamline assessment procedures.
- [ ] To assist me with making a diagnosis.
- [ ] To assist me with making a prognosis.
- [ ] To assist me with choosing an intervention.
- [ ] To make my interventions more effective.
- [ ] To improve my evidence-based practice.
- [ ] They assist student learning.
- [ ] I find that I am able to apply them effectively.
- [ ] Others. *Please specify*: ______________________________

Question 12:

What do you learn about Clinical Prediction Rules from educators? *Check all that apply.*

- [ ] I do not learn about Clinical Prediction Rules.
- [ ] I learn specific Clinical Prediction Rules.
- [ ] I learn how I might apply Clinical Prediction Rules, in a general sense.
- [ ] I learn about the development of Clinical Prediction Rules, e.g. with relevant journal articles.
- [ ] I learn how to decide when and when not to use Clinical Prediction Rules.
- [ ] I learn how Clinical Prediction Rules can help with clinical reasoning.
- [ ] Others. *Please specify*: ______________________________

Question 13:

Do you favour or oppose the teaching of Clinical Prediction Rules to students? *Check one only.*

Strongly favour	Slightly favour	No preference	Slightly oppose	Strongly oppose
☐	☐	☐	☐	☐

Comments: ______________________________

Question 14:

How do you feel about Clinical Prediction Rules with respect to your learning of clinical reasoning? *Check one only*.

☐ Clinical Prediction Rules can help the learning of clinical reasoning.

☐ Clinical Prediction Rules have no effect on learning clinical reasoning.

☐ Clinical Prediction Rules hinder the learning and/or development of clinical reasoning.

☐ I don't know whether Clinical Prediction Rules affect the learning of clinical reasoning.

Comments: ____

Question 15:

Please indicate which Clinical Prediction Rules you know of, and which you have actually used on your own clinical placements, for the following purposes? *Check all that apply, otherwise leave blank.*

Purpose of Clinical Prediction Rule	Know of	Used on placement
Identification of deep venous thrombosis		
Diagnosis of pulmonary embolism.		
Risk of osteoporosis.		
Risk of peripheral neuropathy.		
Low back pain, diagnosis of spinal stenosis.		
Low back pain, diagnosis of sacroiliac joint problem.		
Low back pain, and likely to respond to spinal manipulation.		
Low back pain, and likely to respond to mechanical traction.		
Low back pain, and likely to benefit from lumbar stabilisation exercises.		
Other for low back pain. Please specify:		
Assessment of seriousness of Head Injury (need for CT Scan).		
Assessment of seriousness of injury to Cervical Spine (need for X-Ray).		
Neck pain likely to be cervical radiculopathy.		
Neck pain, and likely to benefit from cervical traction.		
Neck pain, and likely to benefit from cervical spine manipulation.		
Neck pain, and likely to benefit from thoracic spine manipulation.		
Whiplash-associated disorders, and at risk of developing chronic symptoms.		
Headache, likely to respond to trigger point therapy.		
Treatment of temperomandibular joint pain with splint.		
Diagnosis of subacromial impingement.		
Diagnosis of rotator cuff tear.		
Shoulder pain, and likely to benefit from cervico-thoracic manipulation.		
Treatment of lateral epicondylalgia with MWMs (Mobilisations with Movement) and exercise.		
Diagnosis of carpal tunnel syndrome.		
Diagnosis of osteoarthritis of the hip.		
Diagnosis of osteoarthritis of the knee.		

Purpose of Clinical Prediction Rule	Know of	Used on placement
Patellofemoral pain, and likely to benefit from lumbar spine manipulation.		
Patellofemoral pain, and likely to benefit from patellar taping.		
Patellofemoral pain, and likely to benefit from orthotics.		
Identification of injuries to knee (need for X-Ray).		
Identification of injuries to ankle & foot (need for X-Ray).		
Others. *Please list and/or describe by intent, effect, etc.*:		

Question 16:

Do you know any Clinical Prediction Rules by name? If so please list e.g. by author, origin:

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Part 3 Some Information About You

Question 17:

Your gender?

☐ Male ☐ Female

Question 18:

Your age? __________________

Question 19:

In what type of facility have you had clinical placements? *Check all that apply.*

☐ Tertiary teaching hospital

☐ Secondary referral hospital

☐ Primary health facility, community hospital

☐ Community centre and/or home visits

☐ Private practice – small, 1-3 physiotherapists

☐ Private practice – large, 4 or more physiotherapists, with or without multiple sites

☐ Other. *Please specify*: ____

Question 20:

In what areas have you had clinical placements? *Check all that apply.*

☐ Musculoskeletal (e.g. outpatients, private practice)

☐ Orthopaedics (e.g. wards, outpatients, emergency department)

☐ Acute/Cardio-respiratory

☐ General inpatient

☐ Neurological

☐ Rehabilitation

☐ Community

☐ Specialist (e.g. Paediatrics, Women's health, Hand Therapy) *Please specify*: ________________

____

☐ Other. *Please specify*: ____

Question 21:

Have you had any clinical placements other than in South Australia?

☐ Interstate *Please specify*: ____

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☐ Overseas *Please specify*: ____

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Please feel free to write below any further comments or thoughts you may have on Clinical Prediction Rules, your use of them, or their applicability to clinical reasoning:

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THANK YOU FOR YOUR TIME IN COMPLETING THIS SURVEY

The Use Of Clinical Prediction Rules By Clinical Educators With Physiotherapy Students

Students' Survey

The following survey forms part of a Research Higher Degree through The University of Newcastle by Grahame Knox, under the supervision of Professor Darren Rivett and Dr Suzanne Snodgrass, in collaboration with Dr Louisa Remedios and Dr David Kelly at the University of Melbourne.

The research aims to investigate the use of Clinical Prediction Rules and their relationship to clinical reasoning, and to explore whether they may be useful in the teaching of clinical reasoning to physiotherapy students.

For the purpose of the research, the term "Clinical Prediction Rules" is used, though you may also have heard of them as "Clinical Decision Rules", "Clinical Decision Guidelines", "Clinical Prediction Tools" or any other similar wording. These refer to the tools designed to assist decision-making of clinicians by quantifying the relative contributions of various characteristics to provide numeric indices which are then used to assist in making a diagnosis, establishing a prognosis, and/or determining ideal methods of intervention.

As the survey is aimed at determining the extent to which Clinical Prediction Rules are used, your assistance is sought <u>even if you do not use such tools</u>, and even if you have never heard of them or know little about them. For you it will be a very quick survey, but equally valuable for the research outcome.

The survey is a maximum of 21 questions, mostly check-the-box, and should only take about <u>10-15 minutes</u> depending on your responses. Please insert an X in the appropriate boxes or comments where indicated.

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www.newcastle.edu.au

Part 1 Awareness and Use of Clinical Prediction Rules

Question 1:

At the present time, which statement best describes your knowledge of Clinical Prediction Rules? *Check one only.*

- ☐ I have never previously heard of Clinical Prediction Rules and know nothing about them. ↳ GO TO QUESTION 17
- ☐ I have heard of Clinical Prediction Rules but know little or nothing about them (e.g. educators, other hospital or university staff, or other students may have mentioned them). ↳ GO TO QUESTION 2
- ☐ I know something of Clinical Prediction Rules (e.g. I have read about them, discussed them with educators). → GO TO QUESTION 2
- ☐ I know a lot about Clinical Prediction Rules (e.g. I am interested in them, I have some understanding of their basis, use, application). → GO TO QUESTION 2

Question 2:

At the present time, which statement best describes your use of Clinical Prediction Rules? *Check one only.*

- ☐ I have never used Clinical Prediction Rules. → GO TO QUESTION 17
- ☐ I rarely use Clinical Prediction Rules (e.g. perhaps only when the educator suggests it). ↳ GO TO QUESTION 3
- ☐ I use Clinical Prediction Rules sometimes (e.g. I use them whenever it occurs to me, or there are a few that I use regularly with certain conditions). → GO TO QUESTION 3
- ☐ I use Clinical Prediction Rules often (e.g. I am always thinking how they might apply with any patient). → GO TO QUESTION 4

Question 3:

Why don't you use Clinical Prediction Rules more often? *Check all that apply.*

- ☐ I do not know enough about them to be able to use them.
- ☐ I have not had enough practice with their use to be able to apply them.
- ☐ I do not know how they apply to the patients I have treated on clinical placement.
- ☐ I prefer to practise my own clinical reasoning rather than a "formula".
- ☐ They are rarely indicated in clinical practice.
- ☐ I think they are too time-consuming to apply.
- ☐ I do not think the research supports their use.
- ☐ Most of them have not been validated.
- ☐ Others. *Please specify*: ____________________

Question 4:

Why do you use Clinical Prediction Rules? *Check all that apply.*

- [ ] To assist with my clinical reasoning.
- [ ] To replace my clinical reasoning when it seems indicated.
- [ ] To streamline assessment procedures.
- [ ] To assist with diagnosis, e.g. so I can be more confident about what I'm dealing with.
- [ ] To assist with prognosis, e.g. so I can give patients an indication of their likely clinical outcome.
- [ ] To assist with choosing an intervention.
- [ ] To make interventions more effective.
- [ ] I think they are an efficient use of my time.
- [ ] They are reflective of current best practice.
- [ ] Others. *Please specify*: ______________________________

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Question 5:

How do you feel about Clinical Prediction Rules? *Check all that apply.*

- [ ] I think they are easy to learn.
- [ ] I think they are easy to remember.
- [ ] I think they are easy to use.
- [ ] I do not believe they are useful.
- [ ] I think their value is exaggerated.
- [ ] I think they are difficult to learn.
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- [ ] Others. *Please specify*: ______________________________

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Question 6:

Have you ever calculated a Clinical Prediction Rule, and then proceeded contrary to the Rule's direction, i.e. decided on an alternate diagnosis, prognosis or intervention? *Check one box with each type of rule.*

Type of Rule	Often	Occasionally	Rarely	Never
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If so, why did you not consistently follow the Clinical Prediction Rule? ________________

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Question 7:

What are your sources of information about Clinical Prediction Rules? *Check all that apply.*

- ☐ From educators while on clinical placement.
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Question 8:

How do you access Clinical Prediction Rules in the clinical setting? *Check all that apply.*

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Question 9:

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Question 16:

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☐ Other. *Please specify*: ____

Question 21:

Have you had any clinical placements other than in Victoria?

☐ Interstate *Please specify*: ____

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☐ Overseas *Please specify*: ____

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The Use Of Clinical Prediction Rules By Clinical Educators With Physiotherapy Students

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The research aims to investigate the use of Clinical Prediction Rules and their relationship to clinical reasoning, and to explore whether they may be useful in the teaching of clinical reasoning to physiotherapy students.

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Prof Bill Vicenzino
Chair in Sports Physiotherapy
UQ Physiotherapy
School of Health and Rehabilitation Sciences
Phone: 3365 2781
Email: b.vicenzino@uq.edu.au

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

Grahame Knox
M.Phil. Candidate

Supervised by:
Professor Darren Rivett, Head of School
Dr Suzanne Snodgrass, Senior Lecturer

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School of Health Sciences
Faculty of Health
The University of Newcastle
University Drive, Callaghan
NSW 2308, AUSTRALIA
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Email: Grahame.Knox@newcastle.edu.au

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Part 1 Awareness and Use of Clinical Prediction Rules

Question 1:

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Question 5:

How do you feel about Clinical Prediction Rules? *Check all that apply.*

- ☐ I think they are easy to learn.
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- ☐ I do not believe they are useful.
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Question 6:

Have you ever calculated a Clinical Prediction Rule, and then proceeded contrary to the Rule's direction, i.e. decided on an alternate diagnosis, prognosis or intervention? ***Check one box with each type of rule.***

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If so, why did you not consistently follow the Clinical Prediction Rule? ________________

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Question 7:

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- ☐ Others. *Please specify*: ____

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Part 2 Use of Clinical Prediction Rules with Educators

Question 9:

At the present time, which statement best describes your learning of Clinical Prediction Rules while treating patients in a clinical setting under the supervision of educators? *Check one only*.

- [ ] I have never learnt about Clinical Prediction Rules on clinical placement.
- [ ] I rarely learn about Clinical Prediction Rules on clinical placement (e.g. occasionally, maybe if the educator uses it).
- [ ] I sometimes learn about Clinical Prediction Rules (e.g. some educators seem to use them more often than others).
- [ ] I am always learning from educators about Clinical Prediction Rules and how I might apply them. → QUESTION 10 OPTIONAL, OTHERWISE GO TO QUESTION 11

Question 10:

Why do you think you haven't learnt about Clinical Prediction Rules more often while on clinical placement? *Check all that apply.*

- [ ] The educators don't seem to use them.
- [ ] I think they are too time-consuming to learn.
- [ ] I think they are too time-consuming to apply.
- [ ] The research does not support their use.
- [ ] Educators don't know enough about them to be able to teach them to students.
- [ ] Educators prefer that we practice our clinical reasoning rather than using a formula.
- [ ] I don't think they assist student learning.
- [ ] Others. *Please specify*: ______________________________

____

Question 11:

Why do you think students should learn about Clinical Prediction Rules on clinical placement? ***Check all that apply.***

- ☐ I don't think we should.
- ☐ They are reflective of current best practice.
- ☐ To help with developing my clinical reasoning.
- ☐ To streamline assessment procedures.
- ☐ To assist me with making a diagnosis.
- ☐ To assist me with making a prognosis.
- ☐ To assist me with choosing an intervention.
- ☐ To make my interventions more effective.
- ☐ To improve my evidence-based practice.
- ☐ They assist student learning.
- ☐ I find that I am able to apply them effectively.
- ☐ Others. *Please specify*: ____________________

Question 12:

What do you learn about Clinical Prediction Rules from educators? ***Check all that apply.***

- ☐ I do not learn about Clinical Prediction Rules.
- ☐ I learn specific Clinical Prediction Rules.
- ☐ I learn how I might apply Clinical Prediction Rules, in a general sense.
- ☐ I learn about the development of Clinical Prediction Rules, e.g. with relevant journal articles.
- ☐ I learn how to decide when and when not to use Clinical Prediction Rules.
- ☐ I learn how Clinical Prediction Rules can help with clinical reasoning.
- ☐ Others. *Please specify*: ____________________

Question 13:

Do you favour or oppose the teaching of Clinical Prediction Rules to students? ***Check one only.***

Strongly favour	Slightly favour	No preference	Slightly oppose	Strongly oppose
☐	☐	☐	☐	☐

Comments: ____________________

Question 14:

How do you feel about Clinical Prediction Rules with respect to your learning of clinical reasoning? *Check one only.*

- ☐ Clinical Prediction Rules can help the learning of clinical reasoning.
- ☐ Clinical Prediction Rules have no effect on learning clinical reasoning.
- ☐ Clinical Prediction Rules hinder the learning and/or development of clinical reasoning.
- ☐ I don't know whether Clinical Prediction Rules affect the learning of clinical reasoning.

Comments: ____

Question 15:

Please indicate which Clinical Prediction Rules you know of, and which you have actually used on your own clinical placements, for the following purposes? *Check all that apply, otherwise leave blank.*

Purpose of Clinical Prediction Rule	Know of	Used on placement
Identification of deep venous thrombosis		
Diagnosis of pulmonary embolism.		
Risk of osteoporosis.		
Risk of peripheral neuropathy.		
Low back pain, diagnosis of spinal stenosis.		
Low back pain, diagnosis of sacroiliac joint problem.		
Low back pain, and likely to respond to spinal manipulation.		
Low back pain, and likely to respond to mechanical traction.		
Low back pain, and likely to benefit from lumbar stabilisation exercises.		
Other for low back pain. Please specify:		
Assessment of seriousness of Head Injury Spine (need for CT Scan).		
Assessment of seriousness of injury to Cervical Spine (need for X-Ray).		
Neck pain likely to be cervical radiculopathy.		
Neck pain, and likely to benefit from cervical traction.		
Neck pain, and likely to benefit from cervical spine manipulation.		
Neck pain, and likely to benefit from thoracic spine manipulation.		
Whiplash-associated disorders, and at risk of developing chronic symptoms.		
Headache, likely to respond to trigger point therapy.		
Treatment of temperomandibular joint pain with splint.		
Diagnosis of subacromial impingement.		
Diagnosis of rotator cuff tear.		
Shoulder pain, and likely to benefit from cervico-thoracic manipulation.		
Treatment of lateral epicondylalgia with MWMs (Mobilisations with Movement) and exercise.		
Diagnosis of carpal tunnel syndrome.		
Diagnosis of osteoarthritis of the hip.		
Diagnosis of osteoarthritis of the knee.		

Purpose of Clinical Prediction Rule	Know of	Used on placement
Patellofemoral pain, and likely to benefit from lumbar spine manipulation.		
Patellofemoral pain, and likely to benefit from patellar taping.		
Patellofemoral pain, and likely to benefit from orthotics.		
Identification of injuries to knee (need for X-Ray).		
Identification of injuries to ankle & foot (need for X-Ray).		
Others. *Please list and/or describe by intent, effect, etc.*:		

Question 16:

Do you know any Clinical Prediction Rules by name? If so please list e.g. by author, origin:

____

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____

Part 3 Some Information About You

Question 17:

Your gender?

☐ Male ☐ Female

Question 18:

Your age? ________________

Question 19:

In what type of facility have you had clinical placements? *Check all that apply.*

☐ Tertiary teaching hospital

☐ Secondary referral hospital

☐ Primary health facility, community hospital

☐ Community centre and/or home visits

☐ Private practice – small, 1-3 physiotherapists

☐ Private practice – large, 4 or more physiotherapists, with or without multiple sites

☐ Other. *Please specify*: __________________________________

Question 20:

In what areas have you had clinical placements? *Check all that apply.*

☐ Musculoskeletal (e.g. outpatients, private practice)

☐ Orthopaedics (e.g. wards, outpatients, emergency department)

☐ Acute/Cardio-respiratory

☐ General inpatient

☐ Neurological

☐ Rehabilitation

☐ Community

☐ Specialist (e.g. Paediatrics, Women's health, Hand Therapy) *Please specify*: ________________

____

☐ Other. *Please specify*: ____

Question 21:

Have you had any clinical placements other than in Queensland?

☐ Interstate *Please specify*: ____

____

____

☐ Overseas *Please specify*: ____

____

Please feel free to write below any further comments or thoughts you may have on Clinical Prediction Rules, your use of them, or their applicability to clinical reasoning:

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THANK YOU FOR YOUR TIME IN COMPLETING THIS SURVEY

The Use of Clinical Prediction Rules By Physiotherapy Students

Students' Survey

The following survey forms part of a Research Higher Degree through The University of Newcastle by Grahame Knox, under the supervision of Professor Darren Rivett and Dr Suzanne Snodgrass, in collaboration with Dr Benedict Wand at the University of Notre Dame Australia.

The research aims to investigate the use of Clinical Prediction Rules and their relationship to clinical reasoning, and to explore whether they may be useful in the teaching of clinical reasoning to physiotherapy students.

For the purpose of the research, the term "Clinical Prediction Rules" is used, though you may also have heard of them as "Clinical Decision Rules", "Clinical Decision Guidelines", "Clinical Prediction Tools" or any other similar wording. These refer to the tools designed to assist decision-making of clinicians by quantifying the relative contributions of various characteristics to provide numeric indices which are then used to assist in making a diagnosis, establishing a prognosis, and/or determining ideal methods of intervention.

As the survey is aimed at determining the extent to which Clinical Prediction Rules are used, your assistance is sought <u>even if you do not use such tools</u>, and even if you have never heard of them or know little about them. For you it will be a very quick survey, but equally valuable for the research outcome.

The survey is a maximum of 21 questions, mostly check-the-box, and should only take about <u>10-15 minutes</u> depending on your responses. Please insert an X in the appropriate boxes or comments where indicated.

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<u>Part 1 Awareness and Use of Clinical Prediction Rules</u>

Question 1:

At the present time, which statement best describes your <u>knowledge</u> of Clinical Prediction Rules? *Check one only.*

☐ I have never previously heard of Clinical Prediction Rules and know nothing about them.
↳ GO TO QUESTION 17

☐ I have heard of Clinical Prediction Rules but know little or nothing about them (e.g. educators, other hospital or university staff, or other students may have mentioned them).
↳ GO TO QUESTION 2

☐ I know something of Clinical Prediction Rules (e.g. I have read about them, discussed them with educators). → GO TO QUESTION 2

☐ I know a lot about Clinical Prediction Rules (e.g. I am interested in them, I have some understanding of their basis, use, application). → GO TO QUESTION 2

Question 2:

At the present time, which statement best describes your <u>use</u> of Clinical Prediction Rules? *Check one only.*

☐ I have never used Clinical Prediction Rules. → GO TO QUESTION 17

☐ I rarely use Clinical Prediction Rules (e.g. perhaps only when the educator suggests it).
↳ GO TO QUESTION 3

☐ I use Clinical Prediction Rules sometimes (e.g. I use them whenever it occurs to me, or there are a few that I use regularly with certain conditions). → GO TO QUESTION 3

☐ I use Clinical Prediction Rules often (e.g. I am always thinking how they might apply with any patient). → GO TO QUESTION 4

Question 3:

Why don't you use Clinical Prediction Rules more often? *Check all that apply.*

☐ I do not know enough about them to be able to use them.

☐ I have not had enough practice with their use to be able to apply them.

☐ I do not know how they apply to the patients I have treated on clinical placement.

☐ I prefer to practise my own clinical reasoning rather than a "formula".

☐ They are rarely indicated in clinical practice.

☐ I think they are too time-consuming to apply.

☐ I do not think the research supports their use.

☐ Most of them have not been validated.

☐ Others. *Please specify*: ______________________________

Question 4:

Why do you use Clinical Prediction Rules? *Check all that apply.*

- ☐ To assist with my clinical reasoning.
- ☐ To replace my clinical reasoning when it seems indicated.
- ☐ To streamline assessment procedures.
- ☐ To assist with diagnosis, e.g. so I can be more confident about what I'm dealing with.
- ☐ To assist with prognosis, e.g. so I can give patients an indication of their likely clinical outcome.
- ☐ To assist with choosing an intervention.
- ☐ To make interventions more effective.
- ☐ I think they are an efficient use of my time.
- ☐ They are reflective of current best practice.
- ☐ Others. *Please specify*: ______________________________

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____

Question 5:

How do you feel about Clinical Prediction Rules? *Check all that apply.*

- ☐ I think they are easy to learn.
- ☐ I think they are easy to remember.
- ☐ I think they are easy to use.
- ☐ I do not believe they are useful.
- ☐ I think their value is exaggerated.
- ☐ I think they are difficult to learn.
- ☐ I think they are difficult to remember.
- ☐ I think they are difficult to use.
- ☐ Others. *Please specify*: ______________________________

____

____

____

Question 6:

Have you ever calculated a Clinical Prediction Rule, and then proceeded contrary to the Rule's direction, i.e. decided on an alternate diagnosis, prognosis or intervention? ***Check one box with each type of rule.***

Type of Rule	Often	Occasionally	Rarely	Never
Diagnostic				
Prognostic				
Intervention				

If so, why did you not consistently follow the Clinical Prediction Rule? _________________

____

____

Question 7:

What are your sources of information about Clinical Prediction Rules? ***Check all that apply.***

- ☐ From educators while on clinical placement.
- ☐ From lecturers/tutors at university.
- ☐ Independent study.
- ☐ Journal articles.
- ☐ Books.
- ☐ Indirectly when researching a topic (e.g. online).
- ☐ From other students who recommend or mention them.
- ☐ Others. *Please specify*: ______________________________________

____

Question 8:

How do you access Clinical Prediction Rules in the clinical setting? ***Check all that apply.***

- ☐ From memory.
- ☐ From educators.
- ☐ From applications downloaded onto electronic devices (iPhone, Blackberry, etc.).
- ☐ Journals/articles on hand.
- ☐ Journals/articles online.

☐ Books at hand.

☐ Laminated cards detailing one or more CPRs.

☐ Tables etc., printed out by the educator or other staff & available at the clinical placement.

☐ Self-formulated tables, references, etc., printed out by myself.

☐ Tables, references, etc. available on computer at the clinical placement.

☐ Self-formulated tables, references, etc. saved on personal computer.

☐ Others. *Please specify*: ______________________________

Part 2 Use of Clinical Prediction Rules with Educators

Question 9:

At the present time, which statement best describes your learning of Clinical Prediction Rules while treating patients in a clinical setting under the supervision of educators? *Check one only*.

☐ I have never learnt about Clinical Prediction Rules on clinical placement.

☐ I rarely learn about Clinical Prediction Rules on clinical placement (e.g. occasionally, maybe if the educator uses it).

☐ I sometimes learn about Clinical Prediction Rules (e.g. some educators seem to use them more often than others).

☐ I am always learning from educators about Clinical Prediction Rules and how I might apply them. → QUESTION 10 OPTIONAL, OTHERWISE GO TO QUESTION 11

Question 10:

Why do you think you haven't learnt about Clinical Prediction Rules more often while on clinical placement? *Check all that apply.*

☐ The educators don't seem to use them.

☐ I think they are too time-consuming to learn.

☐ I think they are too time-consuming to apply.

☐ The research does not support their use.

☐ Educators don't know enough about them to be able to teach them to students.

☐ Educators prefer that we practice our clinical reasoning rather than using a formula.

☐ I don't think they assist student learning.

☐ Others. *Please specify*: ______________________________

____

Question 11:

Why do you think students should learn about Clinical Prediction Rules on clinical placement? *Check all that apply.*

- ☐ I don't think we should.
- ☐ They are reflective of current best practice.
- ☐ To help with developing my clinical reasoning.
- ☐ To streamline assessment procedures.
- ☐ To assist me with making a diagnosis.
- ☐ To assist me with making a prognosis.
- ☐ To assist me with choosing an intervention.
- ☐ To make my interventions more effective.
- ☐ To improve my evidence-based practice.
- ☐ They assist student learning.
- ☐ I find that I am able to apply them effectively.
- ☐ Others. *Please specify*: ______________________________

Question 12:

What do you learn about Clinical Prediction Rules from educators? *Check all that apply.*

- ☐ I do not learn about Clinical Prediction Rules.
- ☐ I learn specific Clinical Prediction Rules.
- ☐ I learn how I might apply Clinical Prediction Rules, in a general sense.
- ☐ I learn about the development of Clinical Prediction Rules, e.g. with relevant journal articles.
- ☐ I learn how to decide when and when not to use Clinical Prediction Rules.
- ☐ I learn how Clinical Prediction Rules can help with clinical reasoning.
- ☐ Others. *Please specify*: ______________________________

Question 13:

Do you favour or oppose the teaching of Clinical Prediction Rules to students? *Check one only.*

Strongly favour	Slightly favour	No preference	Slightly oppose	Strongly oppose
☐	☐	☐	☐	☐

Comments: ______________________________

Question 14:

How do you feel about Clinical Prediction Rules with respect to your learning of clinical reasoning? *Check one only*.

☐ Clinical Prediction Rules can help the learning of clinical reasoning.

☐ Clinical Prediction Rules have no effect on learning clinical reasoning.

☐ Clinical Prediction Rules hinder the learning and/or development of clinical reasoning.

☐ I don't know whether Clinical Prediction Rules affect the learning of clinical reasoning.

Comments: ____

Question 15:

Please indicate which Clinical Prediction Rules you know of, and which you have actually used on your own clinical placements, for the following purposes? *Check all that apply, otherwise leave blank.*

Purpose of Clinical Prediction Rule	Know of	Used on placement
Identification of deep venous thrombosis		
Diagnosis of pulmonary embolism.		
Risk of osteoporosis.		
Risk of peripheral neuropathy.		
Low back pain, diagnosis of spinal stenosis.		
Low back pain, diagnosis of sacroiliac joint problem.		
Low back pain, and likely to respond to spinal manipulation.		
Low back pain, and likely to respond to mechanical traction.		
Low back pain, and likely to benefit from lumbar stabilisation exercises.		
Other for low back pain. Please specify:		
Assessment of seriousness of Head Injury (need for CT Scan).		
Assessment of seriousness of injury to Cervical Spine (need for X-Ray).		
Neck pain likely to be cervical radiculopathy.		
Neck pain, and likely to benefit from cervical traction.		
Neck pain, and likely to benefit from cervical spine manipulation.		
Neck pain, and likely to benefit from thoracic spine manipulation.		
Whiplash-associated disorders, and at risk of developing chronic symptoms.		
Headache, likely to respond to trigger point therapy.		
Treatment of temperomandibular joint pain with splint.		
Diagnosis of subacromial impingement.		
Diagnosis of rotator cuff tear.		
Shoulder pain, and likely to benefit from cervico-thoracic manipulation.		
Treatment of lateral epicondylalgia with MWMs (Mobilisations with Movement) and exercise.		
Diagnosis of carpal tunnel syndrome.		
Diagnosis of osteoarthritis of the hip.		
Diagnosis of osteoarthritis of the knee.		

Purpose of Clinical Prediction Rule	Know of	Used on placement
Patellofemoral pain, and likely to benefit from lumbar spine manipulation.		
Patellofemoral pain, and likely to benefit from patellar taping.		
Patellofemoral pain, and likely to benefit from orthotics.		
Identification of injuries to knee (need for X-Ray).		
Identification of injuries to ankle & foot (need for X-Ray).		
Others. *Please list and/or describe by intent, effect, etc.*:		

Question 16:

Do you know any Clinical Prediction Rules by name? If so please list e.g. by author, origin:

____

____

____

____

Part 3 Some Information About You

Question 17:

Your gender?

☐ Male ☐ Female

Question 18:

Your age? ________________

Question 19:

In what type of facility have you had clinical placements? *Check all that apply.*

☐ Tertiary teaching hospital

☐ Secondary referral hospital

☐ Primary health facility, community hospital

☐ Community centre and/or home visits

☐ Private practice – small, 1-3 physiotherapists

☐ Private practice – large, 4 or more physiotherapists, with or without multiple sites

☐ Other. *Please specify*: ____

Question 20:

In what areas have you had clinical placements? *Check all that apply.*

☐ Musculoskeletal (e.g. outpatients, private practice)

☐ Orthopaedics (e.g. wards, outpatients, emergency department)

☐ Acute/Cardio-respiratory

☐ General inpatient

☐ Neurological

☐ Rehabilitation

☐ Community

☐ Specialist (e.g. Paediatrics, Women's health, Hand Therapy) *Please specify*: ________________

____

☐ Other. *Please specify*: ____

Question 21:

Have you had any clinical placements other than in Western Australia?

☐ Interstate *Please specify*: ____

____

____

☐ Overseas *Please specify*: ____

____

Please feel free to write below any further comments or thoughts you may have on Clinical Prediction Rules, your use of them, or their applicability to clinical reasoning:

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THANK YOU FOR YOUR TIME IN COMPLETING THIS SURVEY

APPENDIX 4

FOCUS GROUP AND INTERVIEW SCHEDULES FOR STUDY PRESENTED IN CHAPTER 5

Research Project:

Physiotherapy clinical educators' preferences regarding an educational package to aid in the teaching of clinical prediction rules to physiotherapy students on clinical placement

<u>Focus Group Schedule</u>

<u>An Educational Package On Clinical Prediction Rules</u>

Prefacing informed consent questions

Have you been given sufficient time to read through the Information Sheet and Consent Form?

Have you had your questions answered satisfactorily?

Do you consent to participating in this focus group?

Introduction. (5-10 minutes including informed consent questions above)

Welcome

Good evening and thank you very much for taking the time to join our focus group on clinical prediction rules and their teaching to students in the clinical setting. My name is Grahame Knox and I am a PhD student at the University of Newcastle, and Senior Clinician in Musculoskeletal Physiotherapy at Orange Health Service.

Overview

My research team and I are very interested in knowing what clinical educators would like to be included in an educational package on clinical prediction rules to be designed for clinical educators, to facilitate their teaching of clinical prediction rules to physiotherapy students on clinical placement. You have been invited because you are all physiotherapists who have worked as clinical educators, and have some knowledge of clinical prediction rules in the area of musculoskeletal physiotherapy. We want to tap into your experiences, opinions and ideas on what should be included in an educational package for clinical educators and what your preferences are for how the educational package should be presented and delivered.

Ground Rules

It is important that I remind the group that there are no right or wrong answers. I expect that we will hear differing opinions and points of view. Please feel free to share your view even if it differs from what may have already been said.

I am recording the session because I do not want to miss any of your comments. No names will be included in any reports and your comments are confidential. Please don't feel you have to respond to every question. If you wish to follow up on something that someone else has said, please feel free to do so. Feel free to have a conversation with one another about these questions. I am here to ask questions, listen and make sure that everyone gets an opportunity to share their thoughts.

If you have a mobile phone please put it on silent mode, and if you need to answer can I ask you to please step out of the room.

Questioning Route (10-15 minutes)

Part 1: Introduction

Please tell the group your name and a little bit about yourself: where you work, how long you've been a physiotherapist, how long you've been a clinical educator, what students you take on placement.

Part 2: Group knowledge of Clinical Prediction Rules (20 minutes)

- What do you understand by the term 'clinical prediction rules'?
- Which clinical prediction rules do you know about?
- How did you hear about them?
- Why/when do you use them?
- How useful do you think they are?
- Are there some you are aware of that you don't use; why not?

Part 3: Content of educational package on Clinical Prediction Rules (20-30 minutes)

- What do you think clinical educators should know about clinical prediction rules?
- Which clinical prediction rules do you think clinical educators should know about?
- How do you think clinical educators should learn about clinical prediction rules?
- What do you think students should know about clinical prediction rules?
- Which clinical prediction rules do you think students should know about?
- How do you think students should be taught about clinical prediction rules?
- What would help you in teaching clinical prediction rules to students?

Part 4: Presentation and delivery of package (20-30 minutes)

If an educational package were developed for clinical educators to help them teach clinical prediction rules to students on clinical placement, how do you think such a package should be presented and delivered?

- Prompts:
    - What forms of presentation and delivery have you preferred in the past for your professional development?
    - How much/how long should the package be, how many hours of study?
    - Inservice, weekend course, online?
    - Assessed at the end?
    - Paper-based e.g. booklet, by ordinary mail
    - Electronic, e.g. by email, website

Ending

Thank participants for attending.

Participants are reminded that they can receive a summary of the results once the study is completed if they wish.

Research Project:

Physiotherapy clinical educators' preferences regarding an educational package to aid in the teaching of clinical prediction rules to physiotherapy students on clinical placement

Interview Schedule

An Educational Package On Clinical Prediction Rules

Prefacing informed consent questions

Have you been given sufficient time to read through the Information Sheet and Consent Form?

Have you had your questions answered satisfactorily?

Do you consent to participating in this interview?

Introduction. (5-10 minutes including informed consent questions above)

Welcome

Hello and thank you very much for taking the time to be interviewed on clinical prediction rules and their teaching to students in the clinical setting. My name is Grahame Knox and I am a PhD student at the University of Newcastle, and Senior Clinician in Musculoskeletal Physiotherapy at Orange Health Service.

Overview

My research team and I are very interested in knowing what clinical educators would like to be included in an educational package on clinical prediction rules to be designed for clinical educators, to facilitate their teaching of clinical prediction rules to physiotherapy students on clinical placement. You have been invited because you are a physiotherapist who has worked as a clinical educator, and have some knowledge of clinical prediction rules in the area of musculoskeletal physiotherapy. We want to tap into your experiences, opinions and ideas on what should be included in an educational package for clinical educators and what your preferences are for how the educational package should be presented and delivered.

Ground Rules

It is important that I remind you that there are no right or wrong answers.

I am recording the session because I do not want to miss any of your comments. No names will be included in any reports and your comments are confidential. Please don't feel you have to respond to every question.

Questioning Route (10-15 minutes)

Part 1: Introduction

Please tell me your name and a little bit about yourself: where you work, how long you've been a physiotherapist, how long you've been a clinical educator, what students you take on placement.

Part 2: Knowledge of Clinical Prediction Rules (20 minutes)

- What do you understand by the term 'clinical prediction rules'?
- Which clinical prediction rules do you know about?
- How did you hear about them?
- Why/when do you use them?
- How useful do you think they are?
- Are there some you are aware of that you don't use; why not?

Part 3: Content of educational package on Clinical Prediction Rules (20-30 minutes)

- What do you think clinical educators should know about clinical prediction rules?
- Which clinical prediction rules do you think clinical educators should know about?
- How do you think clinical educators should learn about clinical prediction rules?
- What do you think students should know about clinical prediction rules?
- Which clinical prediction rules do you think students should know about?
- How do you think students should be taught about clinical prediction rules?

- What would help you in teaching clinical prediction rules to students?

Part 4: Presentation and delivery of package (20-30 minutes)

If an educational package were developed for clinical educators to help them teach clinical prediction rules to students on clinical placement, how do you think such a package should be presented and delivered?

- Prompts:
  - What forms of presentation and delivery have you preferred in the past for your professional development?
  - How much/how long should the package be, how many hours of study?
  - Inservice, weekend course, online?
  - Assessed at the end?
  - Paper-based e.g. booklet, by ordinary mail
  - Electronic, e.g. by email, website

Ending

Thank participants for agreeing to be interviewed.

Participants are reminded that they can receive a summary of the results once the study is completed if they wish.

APPENDIX 5

QUESTIONNAIRES FOR DELPHI STUDY PRESENTED

IN CHAPTER 6

ESTABLISHING CONSENSUS FOR A SELF-LEARNING PACKAGE ON MUSCULOSKELETAL CLINICAL PREDICTION RULES FOR PHYSIOTHERAPY CLINICAL EDUCATORS.

Questionnaire 1

The aim of the study is to determine the ideal content and delivery method of an educational package for physiotherapy clinical educators working in a musculoskeletal (MSK) setting to improve their understanding of clinical prediction rules (CPRs). This first questionnaire asks you to rate items according to what content you believe should be in such a learning package, and preferences for presentation and delivery. Please indicate your level of agreement with the items suggested. After rating these, you have the opportunity to *make any suggestions for items not already listed* that you feel are necessary, useful or relevant.

Some of the questions ask you to choose items from a list. For other questions please score the importance of the item's inclusion in a learning package, using the following scale:

1. ***Essential;*** the selected item is an extremely important part of a learning package.
2. ***Important;*** the selected item is an important part of a learning package.
3. ***Undecided;*** uncertainty of the importance of the selected item as part of a learning package.
4. ***Not important;*** the selected item is not an important part of a learning package.
5. ***Insignificant;*** there is absolutely no importance whatsoever of the selected item as part of a learning package.

Please indicate the response that best represents your opinion.

A Few Questions About You

Please answer the following demographic questions:

1) Your gender? ______________________

2) Your age? ______________________

3) How long have you been in practice as a physiotherapist? ______________________

4) How long have you been involved in clinical education? ______________________

5) How long have you been involved in conducting research? ______________________

6) How long have you been involved in teaching and/or researching CPRs? ______________________

7) How long have you been aware of CPRs? ______________________

Content of the Package

In terms of what physiotherapy clinical educators should know about MSK CPRs, what are the most important areas of content to be included?

8) Brief definition/description of CPRs

1 ______________ 2 ______________ 3 ______________ 4 ________________ 5

Essential Important Undecided Not important Insignificant

9) Information to improve familiarity with & understanding of CPRs

1 ______________ 2 ______________ 3 ______________ 4 ________________ 5

Essential Important Undecided Not important Insignificant

10) Information to dispel myths & misunderstandings about CPRs

1 ______________ 2 ______________ 3 ______________ 4 ________________ 5

Essential Important Undecided Not important Insignificant

11) Why use CPRs – their purpose, and relevance to clinical practice

1 ______________ 2 ______________ 3 ______________ 4 ________________ 5

Essential Important Undecided Not important Insignificant

12) What happens if you don't use CPRs – such as consistency in clinical decision-making

1 ______________ 2 ______________ 3 ______________ 4 ________________ 5

Essential Important Undecided Not important Insignificant

13) When & how to use CPRs – the benefits

1 ______________ 2 ______________ 3 ______________ 4 ________________ 5

Essential Important Undecided Not important Insignificant

14) When not to use CPRs – limitations and disadvantages

1 ______________ 2 ______________ 3 ______________ 4 ________________ 5

Essential Important Undecided Not important Insignificant

15) Background information on CPRs in general, such as their stages of development

1 ______________ 2 ______________ 3 _______________ 4 ________________ 5

Essential Important Undecided Not important Insignificant

16) Information on the evidence basis of specific CPRs

1 ______________ 2 ______________ 3 _______________ 4 ________________ 5

Essential Important Undecided Not important Insignificant

17) Links to research papers where specific CPRs were derived

1 ______________ 2 ______________ 3 _______________ 4 ________________ 5

Essential Important Undecided Not important Insignificant

18) Case scenarios demonstrating the use of specific CPRs

1 ______________ 2 ______________ 3 _______________ 4 ________________ 5

Essential Important Undecided Not important Insignificant

Other – please specify:

1 ______________ 2 ______________ 3 _______________ 4 ________________ 5

Essential Important Undecided Not important Insignificant

Other – please specify:

1 ______________ 2 ______________ 3 _______________ 4 ________________ 5

Essential Important Undecided Not important Insignificant

Other – please specify:

1 ______________ 2 ______________ 3 _______________ 4 ________________ 5

Essential Important Undecided Not important Insignificant

19) Please indicate which specific CPRs, including a description of how to use them clinically, should be included in the package:

- Ottawa ankle rule

- Ottawa knee rule
- Diagnosis of DVT
- Prognosis for whiplash associated disorder
- Diagnosis of cervical spondylosis
- NEXUS C-Spine Rule
- Canadian C-Spine Rule
- Intervention for low back pain
- When to manipulate a lumbar spine
- Diagnosis of an SIJ problem
- Diagnosis of rotator cuff tears
- Diagnosis of subacromial impingement
- Others – please specify ______________________________

____

____

Further suggestions for content:

Presentation and Delivery of the Package

In terms of how the information might be packaged and disseminated to clinical educators, what do you consider are the most effective methods of presentation and delivery?

20) Indicate which format options should be offered for presentation and delivery of the content:

- Face-to-face lectures involving instruction in CPRs
- Face-to-face practical sessions – practising the application of CPRs in the clinic
- A course or education day specifically on CPRs
- As part of education/training days on other subjects as well
- Webinars
- Online modules – i.e. self-directed learning

- Podcasts
- Videos
- Apps
- Written information – handouts in hard copy
- Written information – electronic versions that can be saved
- Others – please specify ____

  ____

  ____

21) In total, how long should the package take to complete? ______________________

Further suggestions for presentation and delivery:

Self-Assessment

22) How important is it that there be a self-assessment component for clinical educators, to gauge their level of understanding?

1	2	3	4	5
Essential	Important	Undecided	Not important	Insignificant

Tick the format(s) that assessment should take:

- Tick box questions – where multiple options can be chosen
- Multiple choice questions – where just one option is chosen
- Scenario-based questions
- Other – please specify ____

  ____

  ____

Thank you for your time and participation.

Professor Darren A. Rivett
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Mr Grahame Knox
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ESTABLISHING CONSENSUS FOR A SELF-LEARNING PACKAGE ON MUSCULOSKELETAL CLINICAL PREDICTION RULES FOR PHYSIOTHERAPY CLINICAL EDUCATORS.

Questionnaire 2

The aim of the study is to determine the ideal content and delivery method of an educational package for physiotherapy clinical educators working in a musculoskeletal (MSK) setting to improve their understanding of clinical prediction rules (CPRs). This second and final questionnaire asks you to rate items according to what content you believe should be in such a learning package, and preferences for presentation and delivery. Please indicate your level of agreement with the items suggested.

Thank you for your responses to Questionnaire 1. On listed items, the percentage of all participants' responses from Questionnaire 1 selecting that item is indicated next to it. On questions with a Likert scale, the percentage is indicated below the question, with each level of importance. There are some additional items based on responses.

As a reminder, some of the questions ask you to choose items from a list. For other questions please score the importance of the item's inclusion in a learning package, using the following scale:

1. ***Essential;*** the selected item is an extremely important part of a learning package.
2. ***Important;*** the selected item is an important part of a learning package.
3. ***Undecided;*** uncertainty of the importance of the selected item as part of a learning package.
4. ***Not important;*** the selected item is not an important part of a learning package.
5. ***Insignificant;*** there is absolutely no importance whatsoever of the selected item as part of a learning package.

Please indicate the response that best represents your opinion in the light of the responses from the other expert participants.

Content of the Package

In terms of what physiotherapy clinical educators should know about MSK CPRs, what are the most important areas of content to be included?

1) Brief definition/description of CPRs

1 ____________ 2 ____________ 3 ____________ 4 ______________ 5

Essential	Important	Undecided	Not important	Insignificant
(76%)	(18%)	(6%)	(-)	(-)

2) Information to improve familiarity with & understanding of CPRs

1 ____________ 2 ____________ 3 ____________ 4 ______________ 5

Essential	Important	Undecided	Not important	Insignificant
(59%)	(41%)	(-)	(-)	(-)

3) Information to dispel myths & misunderstandings about CPRs

1	2	3	4	5
Essential	Important	Undecided	Not important	Insignificant
(41%)	(59%)	(-)	(-)	(-)

4) Why use CPRs – their purpose, and relevance to clinical practice

1	2	3	4	5
Essential	Important	Undecided	Not important	Insignificant
(59%)	(29%)	(12%)	(-)	(-)

5) What happens if you don't use CPRs – such as consistency in clinical decision-making

1	2	3	4	5
Essential	Important	Undecided	Not important	Insignificant
(24%)	(53%)	(12%)	(12%)	(-)

6) When & how to use CPRs – the benefits, and integration with other forms of reasoning and with other assessment processes

1	2	3	4	5
Essential	Important	Undecided	Not important	Insignificant
(59%)	(41%)	(-)	(-)	(-)

7) When not to use CPRs – limitations and disadvantages, the ability to "override the rule", and alternatives to using CPRs

1	2	3	4	5
Essential	Important	Undecided	Not important	Insignificant
(59%)	(41%)	(-)	(-)	(-)

8) Background information on CPRs in general, such as their stages of development

1	2	3	4	5
Essential	Important	Undecided	Not important	Insignificant
(29%)	(53%)	(18%)	(-)	(-)

9) Information on the evidence basis of specific CPRs

1	2	3	4	5
Essential	Important	Undecided	Not important	Insignificant

(41%)	(53%)	(6%)	(-)	(-)

10) Access to further information – research papers where specific CPRs were derived

1	2	3	4	5
Essential	Important	Undecided	Not important	Insignificant
(35%)	(53%)	(-)	(12%)	(-)

11) Case scenarios demonstrating the use of specific CPRs

1	2	3	4	5
Essential	Important	Undecided	Not important	Insignificant
(35%)	(41%)	(25%)	(-)	(-)

New suggestions from participants:

12) A list of what CPRs exist

1	2	3	4	5
Essential	Important	Undecided	Not important	Insignificant
(-)	(6%)	(-)	(-)	(-)

13) How to explain the use of CPRs to patients

1	2	3	4	5
Essential	Important	Undecided	Not important	Insignificant
(6%)	(-)	(-)	(-)	(-)

14) Access to further information – research papers where specific CPRs were validated

1	2	3	4	5
Essential	Important	Undecided	Not important	Insignificant
(6%)	(-)	(-)	(-)	(-)

15) Access to further information – research papers where specific CPRs underwent impact analysis

1	2	3	4	5
Essential	Important	Undecided	Not important	Insignificant
(6%)	(-)	(-)	(-)	(-)

16) Examples of CPRs for different purposes and how they need to be developed differently, i.e. interventional, prognostic, diagnostic

1	2	3	4	5
Essential	Important	Undecided	Not important	Insignificant
(6%)	(-)	(-)	(-)	(-)

17) Please indicate which specific CPRs, including a description of how to use them clinically, should be included in the package:

- Ottawa ankle rule (100%)
- Canadian C-Spine Rule (94%)
- Diagnosis of DVT (88%)
- Ottawa knee rule (88%)
- Prognosis for whiplash associated disorder (63%)
- Intervention for low back pain (56%)
- When to manipulate a lumbar spine (50%)
- Diagnosis of an SIJ problem (44%)
- Diagnosis of subacromial impingement (44%)
- Diagnosis of rotator cuff tears (38%)
- NEXUS C-Spine Rule (31%)
- Diagnosis of cervical spondylosis (25%)

New suggestions from participants:

- Diagnosis of cervical spine radiculopathy (6%)
- Diagnosis of cervical spine myelopathy (6%)
- Intervention for chronic plantar heel pain (6%)
- Ottawa subarachnoid haemorrhage (SAH) rule for headache evaluation (6%)

Presentation and Delivery of the Package

In terms of how the information might be packaged and disseminated to clinical educators, what do you consider are the most effective methods of presentation and delivery?

18) Indicate which format options should be offered for presentation and delivery of the content:

- Online modules – i.e. self-directed learning (67%)
- Written information – electronic versions that can be saved (67%)
- Face-to-face practical sessions – practising the application of CPRs in the clinic (53%)
- Webinars (53%)
- Face-to-face lectures involving instruction in CPRs (47%)
- Apps (47%)
- A course or education day specifically on CPRs (40%)
- As part of education/training days on other subjects as well (33%)
- Videos (33%)
- Podcasts (27%)
- Written information – handouts in hard copy (27%)

19) In total, how long should the package take to complete? ______________________

Suggestions from participants

15-20 minutes	(7%)
1 hour	(14%)
2 hours	(7%)
2-3 hours	(7%)
3 hours	(7%)
4 hours	(7%)
2 hours to 1 day	(7%)
1 day / 8 hours	(21%)
20 hours	(7%)
Several sessions	(14%)

Self-Assessment

20) How important is it that there be a self-assessment component for clinical educators, to gauge their level of understanding?

1 _____________ 2 _____________ 3 _____________ 4 _____________ 5

Essential	Important	Undecided	Not important	Insignificant
(50%)	(31%)	(19%)	(-)	(-)

Tick the format(s) that assessment should take:

- Scenario-based questions (100%)
- Multiple choice questions – where just one option is chosen (63%)
- Tick box questions – where multiple options can be chosen (25%)

Thank you for your time and participation.

Professor Darren A. Rivett
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Mr Grahame Knox
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Associate Professor Suzanne Snodgrass
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APPENDIX 6

POSTER PRESENTATIONS OF STUDIES PRESENTED

IN CHAPTERS 3-5

Clinical Educators' Experiences and Perceptions of Clinical Prediction Rules

Knox GM,[1,2] Snodgrass SJ,[1] Rivett DA[1]

[1]School of Health Sciences, The University of Newcastle, Australia
[2]Kempsey District Hospital, Kempsey, Australia

Introduction

Although clinical prediction rules (CPRs) have long been used in medicine, their implementation in physiotherapy practice is more recent and less widespread, and their application in physiotherapy clinical education has not been investigated.

Purpose

This study aimed to determine the knowledge and use of CPRs by physiotherapy clinical educators, and whether they are teaching CPRs to students on clinical placement.

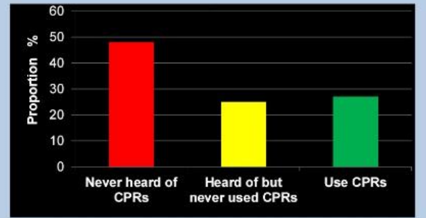

Figure 1: Familiarity of clinical educators with CPRs.

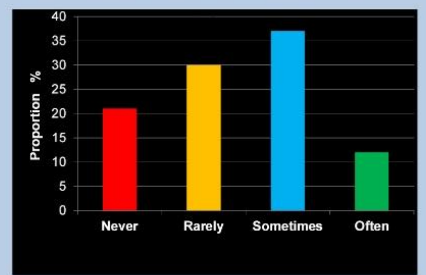

Figure 2: Frequency of clinical educators who use CPRs teaching students about CPRs on clinical placement.

Participants

Clinical educators who supervised physiotherapy students from more than 10 universities across 5 states and territories in Australia were surveyed.

Data were collected during 2013. Two hundred and eleven responses were received for a response rate of 81%.

Method

A cross-sectional observational survey of physiotherapy clinical educators was undertaken using a modified Dillman method.[1]

Results

Forty-eight percent of respondents (n=102) had not heard of CPRs, and a further 25% (n=52) had never used CPRs (Figure 1).

Only 27% (n=57) used CPRs, and of these about half (51%, n=29) rarely, if ever, taught CPRs to students in the clinical setting (Figure 2), although 60% (n=34) of users believed CPRs assisted skill development in student clinical reasoning, while only 12% (n=7) believed CPRs hindered the development of clinical reasoning skills.

Of the clinical educators that used CPRs, 53% (n=30) employed them to assist their own clinical reasoning, and 39% (n=22) taught CPRs to students to help with the development of clinical reasoning skills (Table 1).

Those using CPRs were more likely to be male (53%, n=30, p<0.001), have post-professional qualifications (32%, n=18, p=0.020), work in private practice (23%, n=13, p<0.001), and work in the area of musculoskeletal physiotherapy (54%, n=31, p<0.001) compared with non-users (23%, n=35; 17%, n=26; 5%, n=8; and 25%, n=39, respectively).

The Ottawa Ankle Rule[2], Ottawa Knee Rule[3], and Wells' Rule for Deep Vein Thrombosis[4] were the CPRs most commonly known, used and taught (Table 2).

Why do you teach CPRs?	% (n)
Assist with making a diagnosis	37 (21)
Assist with making a prognosis	32 (18)
Assist with choosing an intervention	32 (18)
One or more of the above 3 reasons	53 (30)
Assist with developing clinical reasoning skills	39 (22)
Improve student s' evidence-based practice	33 (19)
Reflective of current best practice	25 (14)
Why don't you teach CPRs more often?	
Lack of practice with their use	60 (34)
Lack of knowledge about their use	30 (17)
Prefer the students to practice their standard clinical reasoning methods	42 (24)

Table 1: Most common reasons reported by clinical educators who employed CPRs (n=57) for teaching and not teaching CPRs.

Conclusions

Clinical educators who utilise CPRs are employing them for many clinical conditions, and are generally positive about CPRs assisting student clinical reasoning skill development. However, many clinical educators are unaware of CPRs, and many more are not using them, so students are unlikely to be learning about CPRs on clinical placement.

Purpose of CPR	Know % (n)	Use % (n)	Teach % (n)
Identification of injuries to ankle & foot (need for X-Ray)[2]	65 (37)	51 (29)	40 (23)
Identification of deep venous thrombosis[4]	58 (33)	40 (23)	32 (18)
Identification of injuries to knee (need for X-Ray)[3]	51 (29)	42 (24)	30 (17)
Low back pain, diagnosis of sacroiliac joint problem[5]	47 (27)	35 (20)	28 (16)
Assessment of seriousness of injury to cervical spine (need for X-ray)[6]	44 (25)	30 (17)	19 (11)

Table 2: Knowledge, use and teaching of CPRs by clinical educators (n=57).

Implications

Most clinical educators will need to be trained in using CPRs and assisted in teaching them if students are to better learn about implementing CPRs in physiotherapy clinical practice.

Ethical approval for the study was granted by the Human Research Ethics Committee at The University of Newcastle.

References
1. Dillman DA. Mail and Telephone Surveys: The Total Design Method. New York: John Wiley & Sons, Inc. 1978.
2. Stiell IG, Greenberg GH, McKnight RD, Nair RC, McDowell I, Worthington JR. A study to develop clinical decision rules for the use of radiography in acute ankle injuries. Ann Emerg Med. 1992;21:384-90.
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Students' Experiences and Perceptions of Clinical Prediction Rules

Knox GM,[1,2] Snodgrass SJ,[1] Stanton TR,[3] Kelly DH,[4] Vicenzino B,[5] Wand BM,[6] Rivett DA[1]

[1]School of Health Sciences, The University of Newcastle, Australia; [2]Kempsey District Hospital, Kempsey, Australia; [3]The Sansom Institute for Health Research, The University of South Australia, Adelaide, and Neuroscience Research Australia, Sydney, Australia; [4]School of Health Sciences, The University of Melbourne, Australia; [5]School of Health and Rehabilitation Sciences, The University of Queensland, Brisbane, Australia; [6]School of Physiotherapy, The University of Notre Dame Australia, Fremantle, Australia

Introduction

Learning clinical reasoning can be difficult for physiotherapy students because they lack the clinical experience necessary to aid the process. Clinical prediction rules (CPRs) could potentially facilitate the development of clinical reasoning skills, but there has been little research into the use of CPRs in physiotherapy clinical education.

Purpose

This study aimed to determine the awareness, knowledge and use of CPRs by physiotherapy students to ascertain whether they are learning about CPRs on clinical placement, and to explore whether students found CPRs useful in facilitating the development of clinical reasoning skills.

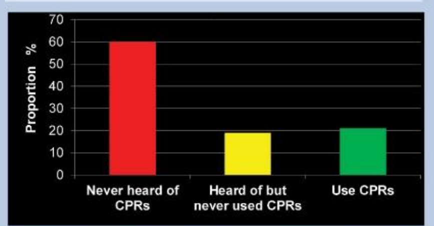

Figure 1: Familiarity of physiotherapy students with CPRs.

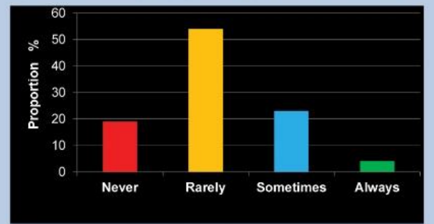

Figure 2: Proportions of student users who reported learning about CPRs whilst on clinical placement.

Participants

Final year physiotherapy students were surveyed from four undergraduate and three graduate programs at five universities across five states of Australia.

Data were collected during 2013 and 2014. Three hundred and seventy-one responses were received for a response rate of 77%.

Method

A cross-sectional observational survey was undertaken via direct distribution of questionnaires in student lectures.

Results

Sixty percent (n=222) of respondents had never heard of CPRs, and an additional 19% (n=70) had never used CPRs (Figure 1).

Only 21% (n=79) described using CPRs. Of these 72% (n=57) rarely, if ever, learned about CPRs on clinical placement (Figure 2), although most (78%, n=62) believed CPRs aided the development of clinical reasoning skills and none opposed the teaching of CPRs to students.

Students reported using CPRs for various reasons (Table 1), however, the main reasons for not using them more often were a lack of knowledge or practice.

Even though 72% (n=57) of students who used CPRs nominated clinical educators as their primary source of information about CPRs, 80% (n=63) reported that clinical educators were not using CPRs and not teaching them, supporting findings of a survey of clinical educators.[1]

CPRs for determining the need for an X-ray following injuries to the ankle and foot (67%, n=53), and for identification of deep venous thrombosis (63%, n=50), were those most commonly recognised and used by students (Table 2).

Responses and comments suggested that students were using CPRs to aid rather than replace their clinical reasoning.

Why do you use CPRs?	% (n)
Assist with making a diagnosis	66 (52)
Assist with making a prognosis	33 (26)
Assist with choosing an intervention	42 (33)
Make interventions more effective	16 (13)
One or more of the above four reasons	84 (66)
Assist with clinical reasoning	75 (59)
Streamline assessment procedures	35 (28)
Reflective of current best practice	18 (14)
Why don't you use CPRs more often?	
Lack of practice with their use	59 (47)
Lack of knowledge about their use	57 (45)
One or both of these reasons	81 (64)

Table 1: Most common reasons reported by students who employed CPRs (n=79) for using and not using CPRs.

Purpose of CPR	Know % (n)	Used % (n)
Identification of injuries to ankle & foot (need for X-Ray)[2]	67 (53)	38 (30)
Identification of deep venous thrombosis[3]	63 (50)	41 (32)
Diagnosis of subacromial impingement[4]	48 (38)	20 (16)
Risk of osteoporosis[5]	48 (38)	14 (11)
Identification of injuries to knee (need for X-Ray)[6]	47 (37)	23 (18)

Table 2: Knowledge and use of CPRs by student users (n=79).

Conclusions

Although students stated that clinical educators were their main source of information on CPRs, clinical educators were reported to be rarely, if ever, using or teaching CPRs. The great majority of students knew little, if anything, about CPRs and few learned about or employed them in the clinical setting. However, those students who were aware of CPRs found them helpful in their clinical reasoning and were in favour of learning more about them.

Implications

If students are to learn about CPRs and their implementation in physiotherapy clinical practice, clinical educators will need training in the use of CPRs and assistance in teaching them. CPRs may be of potential benefit in aiding students in the development of their clinical reasoning skills.

Ethical approval for the study was granted by the Human Research Ethics Committees at The University of Newcastle, The University of South Australia, The University of Queensland, The University of Melbourne and The University of Notre Dame Australia.

References

1. Knox GM, Snodgrass SJ, Rivett DA. Physiotherapy clinical educators' perceptions and experiences of clinical prediction rules. Physiotherapy. 2015. doi:10.1016/j.physio.2015.03.001

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Clinical Educators’ Preferences Regarding an Educational Package to Aid Teaching Clinical Prediction Rules to Students on Clinical Placement: Preliminary Findings

Knox GM,[1,2] Snodgrass SJ,[1] Southgate E,[3] Rivett DA[1]

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Background:

Clinical Prediction Rules (CPRs) are evidence-based mathematical tools designed to aid in clinical decision making (see Fig. 1 for example)[1]. Recent studies have revealed that few physiotherapy clinical educators use CPRs, and that very few educators are teaching CPRs to students on clinical placement[1,2]. Consequently, students are unlikely to be learning about or employing CPRs on clinical placement. If students are to learn and practice using CPRs in the clinical setting, many educators will need to receive training in CPRs. An educational package may help achieve this; however, the elements of a package that would best facilitate educators’ learning and teaching of CPRs are unknown.

Purpose:

To investigate the elements clinical educators consider should be included in a learning package on CPRs designed for them, and their preferences as to how this information should be presented and delivered.

The Ottawa Ankle Rule

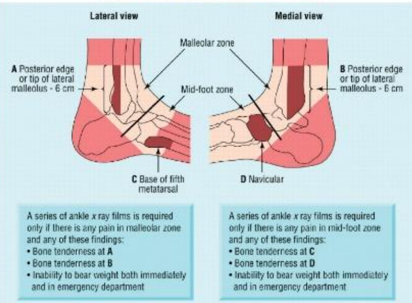

Fig 1. The most commonly known CPR - the Ottawa Ankle Rule[3]

Methods:

The study design employs a series of semi-structured interviews of Australian clinical educators (n=3) affiliated with the University of Newcastle, to explore their preferences for an educational package on CPRs, including content, curriculum and mode of delivery, and barriers (real or perceived) to implementation of CPRs in clinical practice and in teaching in the clinical setting. Purposive sampling was used to recruit educators working in the musculoskeletal field with varying degrees of experience as educators. Both hospital-based and private practitioner educators were invited to participate, in urban, regional and rural locations, to help capture the differing learning needs and challenges faced. Eligibility to participate required some awareness of CPRs and experience in using CPRs in clinical practice. Digitally recorded audio files from interviews were transcribed and analysed using framework analysis.

Results:

Preliminary findings are reported as the study is still underway (Fig. 2). The CPRs that educators considered as most important for students to learn are those that are used in identifying ‘red flags’ such as fractures, infections or other serious pathological conditions. Educators indicated that an educational package should include background information so that they (and therefore the students they teach) could understand the validity and reliability of each CPR, including any limitations, and why CPRs are relevant to contemporary physiotherapy practice. They suggested that delivery of the educational package should accommodate various learning preferences and styles; this may involve online tutorials and webinars, paper-based information and face-to-face tutorials.

Clinical Educators’ Preferences

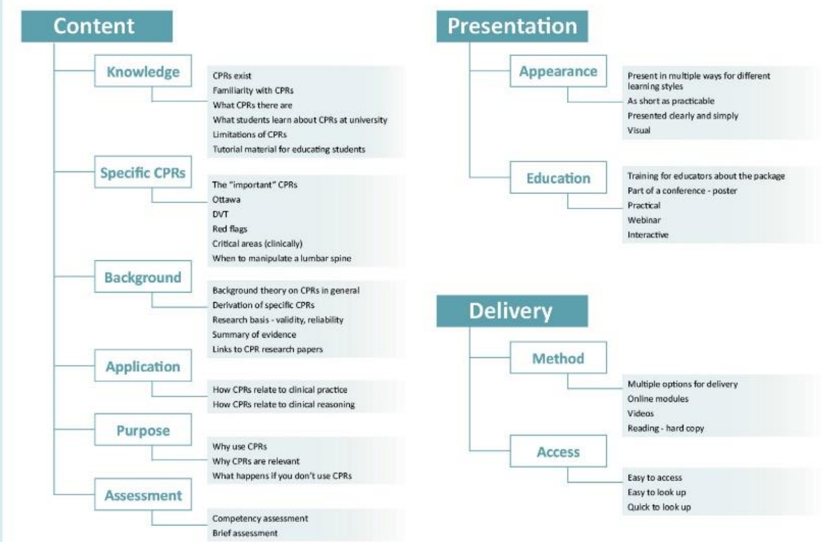

Fig. 2 Educators’ preferences for an educational package.

Conclusions:

Preliminary findings suggest clinical educators believe that an educational package designed for educators to help them teach CPRs to students would be beneficial. Further interviews with educators are being conducted to ascertain a wider range of opinions on preferences for content, presentation and delivery of the package.

Implications:

The implementation of an educational package may lead to students being exposed to CPRs to a greater degree during their clinical training, thereby helping students better prepare for contemporary practice in an evidence-based environment.

Ethics approval:
Ethics approval was granted by the Human Research Ethics Committee of The University of Newcastle Approval No. H-2016-0110

References:
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