Institution: Newcastle University

Unit of Assessment: UoA-1

Title of case study: pGALS: a novel and simple approach for musculoskeletal examination of children

1. Summary of the impact

pGALS (paediatric Gait, Arms, Legs, Spine) is a quick, accurate and child-friendly examination technique that identifies children who need to be referred to a paediatric rheumatology specialist. pGALS has been widely disseminated since 2008 and integrated into both undergraduate medical student teaching and the membership examination for the Royal College of Paediatrics and Child Health. pGALS was developed by Newcastle researchers in response to their findings of a self-reported lack of confidence among clinicians when conducting musculoskeletal examinations of children. Research also showed that delays and inappropriate investigations were being conducted before the child was referred to a specialist. pGALS is now taught in at least 15 of the 32 medical schools in the UK and has been described in a number of leading textbooks. It is becoming known and used worldwide, adapted for local cultural and social contexts.

2. Underpinning research

Key researchers.

The Newcastle University researchers involved throughout the period of the research were Professor Helen Foster (project lead), Dr Tim Rapley (social scientist, qualitative methodology) and Dr Sharmila Jandial (education research fellow, now a consultant in paediatric rheumatology).

Background.

Paediatric musculoskeletal problems are extremely common, occurring in up to 30% of young persons and accounting for 3% of hospital day case attendances. The challenge for clinicians is identifying those children who have significant disease and doing so early in its course.

One such disease with significant long term consequences is juvenile idiopathic arthritis. This is defined as inflammation of one or more joints for at least six weeks, in a child under the age of 16 years in whom other known causes of arthritis have been excluded. The inflamed joint is often swollen, warm, has lost normal movement and is stiff in the mornings. Pain is not always a major feature and so it can be difficult for parents and doctors to detect arthritic joints in young children. The UK annual incidence is approximately 1 in 10,000 and at any one time there are about 12,000 affected children in the UK. Juvenile idiopathic arthritis can start at any age from birth to adolescence, but the peak age of onset is six years. It is more common in girls than boys. Joint damage occurs early in the disease progression and the risk of associated blindness (due to associated eye inflammation) is greatest in the first months of arthritis onset. Evidence supports early and aggressive intervention to obtain the optimal outcome.

Research

Research conducted by Foster and colleagues (R1, R2) showed that it was common for many children presenting in primary and secondary care settings with musculoskeletal complaints to experience delay in being referred to paediatric rheumatology services. The researchers found complex referral pathways from their primary care doctor to different secondary care services, via general paediatrics, orthopaedics, and accident and emergency. In addition to delaying the critical referral to a paediatric rheumatologist, such complexity often resulted in children being subjected to inappropriate, costly and unnecessary invasive investigations, such as magnetic resonance imaging (for which many young children need a general anaesthetic) and removal of fluid from the joints (often also requiring anaesthetic). Further Newcastle-led research (R3) identified a general lack of assessment of a child's musculoskeletal system by trainee and consultant general paediatricians, despite other systems, such as cardiovascular or gastrointestinal, being routinely assessed regardless of the complaint with which the child presented. This was linked to a, self-reported, low confidence in their ability to conduct musculoskeletal assessment of children. Foster and colleagues identified (R4) a lack of teaching of musculoskeletal clinical skills in medical schools, a potential explanation for this poor confidence in clinical assessment.

In order to improve the confidence of clinicians conducting musculoskeletal assessment of children and thus alleviate the delay in diagnosis of conditions such as juvenile idiopathic arthritis, Newcastle researchers developed a new method for examination of children's joints. Foster and colleagues reported the development and validation of pGALS (paediatric Gait Arms Legs and Spine) in 2006 (R5). This was tested in the clinic and found to have excellent sensitivity when compared with expert diagnosis and did not lead to false negative results. Further work by the group (R6) showed that the pGALS approach can be useful as a diagnostic tool in the acute (ie non-rheumatological) paediatric setting and can be used by non-specialists.

3. References to the research

R1. Foster HE, Eltringham MS, Kay LJ, Friswell M, Abinun M, Myers A. Delay in access to appropriate care for children presenting with musculoskeletal symptoms and ultimately diagnosed with juvenile idiopathic arthritis. *Arthritis Care and Research* 2007, 57(6), 921-927. DOI: http://dx.doi.org/10.1002/art.2282. **Cited by 19**

R2. Myers A, McDonagh JE, Gupta K, Hull R, Barker D, Kay LJ, Foster HE. More 'cries from the joints': Assessment of the musculoskeletal system is poorly documented in routine paediatric clerking. *Rheumatology* 2004, 43(8), 1045-1049. DOI: http://dx.doi.org/10.1093/rheumatology/keh245. **Cited by 31**

R3. Jandial S, Myers A, Wise E, Foster HE. Doctors Likely to Encounter Children with Musculoskeletal Complaints Have Low Confidence in Their Clinical Skills. *Journal of Pediatrics* 2009, 154(2), 267-271. DOI: http://dx.doi.org/10.1016/j.jpeds.2008.08.013. **Cited by 20**

R4. Jandial S, Rapley T, Foster H. Current teaching of paediatric musculoskeletal medicine within UK medical schools – a need for change. *Rheumatology* 2009, 48(5), 587-590. DOI: http://dx.doi.org/10.1093/rheumatology/kep038. **Cited by 7**

R5. Foster HE, Kay LJ, Friswell M, Coady D, Myers A. Musculoskeletal screening examination (pGALS) for school-age children based on the adult GALS screen. *Arthritis Care and Research* 2006, 55(5), 709-716. DOI: http://dx.doi.org/10.1002/art.22230. **Cited by 31**

R6. Goff I, Bateman B, Myers A, Foster H. Acceptability and practicality of musculoskeletal examination in acute general pediatric assessment. *The Journal of Pediatrics*. 2010 Apr; 156(4):657-62. DOI: http://dx.doi.org/10.1016/j.jpeds.2009.10.047. **Cited by 9**

Key funding

Arthritis Research UK. Foster HE, LJ Kay, TR Rapley, CR May. *A study to develop Regional Musculoskeletal examination for use in school aged children*. 2005-2011, £121,758

Arthritis Research UK. Foster HE (Principal Investigator), Rapley TR, Kay LJ, May CR. *Exploring the barriers to care for children with suspected Juvenile Idiopathic Arthritis*. 2008-2012, £141,874

Arthritis Research UK. Jandial S, Kay LJ, Stewart J, Foster HE. *Improving musculoskeletal clinical skills in medical students*. 2007 – 2011, £128,015

4. Details of the impact

The pGALS (paediatric Gait, Arms, Legs, Spine) examination

Developed by researchers in Newcastle, pGALS is a quick but sensitive screening examination of the musculoskeletal system applicable to the school-aged child, taking less than three minutes to perform. The findings of the examination need to be considered in the context of a history taken at the same time. First, a general assessment looks for joint swelling, any physical asymmetry, flexion deformities or rashes. The child is observed walking (gait); the arms, legs and spine are then sequentially examined through a series of specific movements made by the child and physical examination by the clinician. These tests enable rapid and accurate assessment of the flexibility and symmetry of joint movements and indicate whether or not referral to a specialist is in order.

Having developed and validated the pGALS examination, Foster and colleagues entered into a collaboration with a leading UK charity in order to disseminate knowledge about pGALS to practicing clinicians, parents and, importantly, to those teaching medical students.

Collaborations with Arthritis Research UK

Newcastle researchers collaborated with the UK's leading charity in the field, *Arthritis Research UK,* on the production of teaching aids. Both a video of a pGALS examination of a child and a pdf booklet describing and illustrating the method were developed. *Arthritis Research UK's* Education Manager has confirmed that in 2013 around 100 copies of the DVD are requested per month, with 15,600 copies distributed in total since it was first made. Web-streaming is also popular: with *'5,012 unique views in 2012 and 3,764 unique views in the first 5 months of 2013'* and '*pGALS video clips viewed … on YouTube – upwards of 40,000 views since April 2012.'* (Ev a)

Further collaborations have included surveys (in 2009 and 2013) of current practice in teaching paediatric musculoskeletal examination. The methodology and results of the 2009 survey were reported in R3 and R4. The 2013 survey was led from Newcastle and the design was validated by an independent consultant. Surveys sought the views of lead paediatric teachers (paediatric rheumatology consultants and trainees who teach (100% response rate) and general paediatric consultants (39% response rate)). Additionally, lead adult musculoskeletal teachers were surveyed (62% response rate). The survey received responses representing 23 UK medical schools (Ev b).

Impact on medical school teaching

In 2008, pGALS was introduced as a core clinical skill for paediatric musculoskeletal assessment at Newcastle University Medical School (it is also taught in Newcastle's NuMed course in Malaysia) and other institutions in the UK have followed suit. The impact on teaching beyond Newcastle has been significant and approached through two routes; awareness raising amongst specialists who teach paediatrics and contribution to core medical teaching texts.

Raised awareness impacts on teaching. The 2009 survey received replies from 23 of the 32 UK medical schools (72%) and indicated that only six medical schools were teaching pGALS.

The 2013 survey also received responses from 23 medical schools and indicated that pGALS was being taught in 15 medical schools, with all using the *Arthritis Research UK* pGALS DVD or web streaming service. Importantly, a significant improvement since 2009 is that 14 medical schools allowed students to practice pGALS on children and 13 medical schools gave students the opportunity to examine children with musculoskeletal problems.

Core clinical skills are acquired at medical school. Since pGALS now reaches undergraduate students in at least 15 medical schools in the UK, this begins to address the problem of clinicians' lack of confidence in musculoskeletal examination identified by Newcastle research.

Raised awareness through textbooks. Foster and Jandial were invited in 2008 to contribute a chapter on children's musculoskeletal problems, including a description of pGALS, to one of the most popular paediatrics student textbooks, '*The Illustrated textbook of Paediatrics*', Lissauer and Clayden (eds). *Amazon.co.uk* report that this textbook is its best seller in paediatrics texts (**Ev c**). Evidence from a number of medical school libraries indicated that this text is also generally the most frequently borrowed by students (Ev d).

The pGALS examination has been described in several other textbooks. '*Training in Paediatrics: The Essential Curriculum'* (2009) Gardiner, Eisen and Murphy (eds), '*MRCPCH Clinical: Short Cases, History Taking and Communication Skills*' (2011) Bedwani, Anderson and Beattie, *'Rheumatology in Primary Care'* (2012) Wagh (ed) and the '*Pocket Tutor Paediatric Clinical Examination'* (2012) Brugha, Marlais and Abrahamson (eds). In February 2012 *Oxford University Press* requested permission to use photographs of the pGALS examination produced by *Arthritis Research UK* in their '*Oxford Specialist Handbooks on Paediatric Rheumatology'.*

Impact on paediatrician training

Foster is Chair of the Royal College of Paediatrics and Child Health (RCPCH) College Advisory Committee for higher specialist training in paediatric rheumatology in the UK. She was able to use her position to lobby the Board of Examiners, backed by the evidence-base provided by the Newcastle research, to address the lack of confidence and competence in the paediatric musculoskeletal examination skills reported by paediatricians in the UK. In 2009, Foster was successful in persuading the RCPCH to include paediatric musculoskeletal assessment in the

competency framework for training and also, most importantly, included in the clinical part of the MRCPCH examination (a mandatory examination for all paediatricians in the UK) and pGALS was included as a minimum basic skill (Ev e). Consequently, all paediatricians trained in the UK are now aware of pGALS. Supplementary resources for trainees and examiners have also been developed by Foster and Jandial at the request of the RCPCH and are available on the RCPCH website (Ev f).

International impact

In May 2013 the Intellectual Property coordinator for the American Academy of Family Physicians sought copyright permission to use the pGALS materials and the *Arthritis Research UK* Education Manager has confirmed that, *'Examples of recent requests to reproduce the description of how to perform the screening examination* [pGALS] *include: … "The Pediatric Clinics of North America" (Canadian request, November 2011)* [and] *"General Practice at a Glance" textbook (request from Wiley-Blackwell, July 2011).'* (Ev a)

The Director of Paediatrics of a major hospital in Mumbai, India, has confirmed the use of pGALS in practice there, stating, *'*[pGALS] *is routinely used in clinical practice in our country … Hands On - a document prepared by the authors* [Foster and Jandial] *and the video demonstrating pGALS are popular teaching tools and are routinely used by my colleagues and me in our training and teaching sessions.'* (Ev g). An Emeritus Professor of Pediatric Rheumatology in Canada has also noted that pGALS *'has filled a significant gap in medical education and has been widely adopted world-wide'* (Ev h).

5. Sources to corroborate the impact

Ev a. Information supplied by the Education Manager of Arthritis Research UK, whose contact details are available on request. The video is available at http://www.arthritisresearchuk.org/health-professionals-and-students/video-resources/pgals.aspx

Ev b. The survey was undertaken in June/July 2013 using Survey Monkey and the methodology was similar to the previous study by Newcastle researchers. The response rate was acceptable for a questionnaire of this type and the instrument was validated and optimized by established strategies. Contact details for the independent consultant are available on request.

Ev c. Data from Amazon.co.uk shows '*The Illustrated textbook of Paediatrics*', Lissauer and Clayden (eds), published by Mosby, to be the bestseller in the category *Books > Scientific, Technical & Medical > Medicine & Nursing > Medical Sciences A-Z > Paediatrics* http://www.amazon.co.uk/ILLS-TXTBK-PAEDIATRICS-4ESTUDENTCONSULT/dp/0723435650

Ev d. Lending data provided by Newcastle University library staff who conducted a survey amongst colleagues. Data from five English medical school libraries was obtained indicating that only a 'Crash course' paediatrics text was more frequently borrowed.

Ev e. The Royal College of Paediatrics and Child Health have produced a guide for candidates and examiners that references pGALS on page 33. It is available at the RCPCH website or a pdf copy can be provided on request. http://www.rcpch.ac.uk/training-examinations-professional-development/assessment-and-examinations/examinations/clinical-e-3

Ev f. Supplementary resources are available at http://www.rcpch.ac.uk/training-examinations-professional-development/postgraduate-training/sub-specialty-training/paediatr

Ev g. Correspondence is available from the Director of Paediatrics Jaslok Hospital and Research Centre, Mumbai, India. Contact details are available on request.

Ev h. Correspondence is available from the Professor Emeritus, Division of Rheumatology, Department of Pediatrics, University of British Columbia, and British Columbia's Children's Hospital, Vancouver, Canada. Contact details are available on request.