Institution: York St John University

Unit of Assessment: 3 (Allied Health Professions, Dentistry, Nursing and Pharmacy)

Title of case study: Safe and effective exercise for patients with heart disease

1. Summary of the impact

Prof Doherty's research is themed around 'safe and effective exercise for patients with complex cardiac disease' where, until his leading research had been carried out, thousands of patients were denied access to such services. Prof Doherty implemented the first prospective randomised control trial (RCT) in this population which has: benefitted patients directly by enabling more programmes to offer rehabilitation to this group of patients; impacted on clinical guidance nationally and internationally; contributed to Department of Health policy; and influenced the public and clinical populations through the NHS, British Heart Foundation, Arrhythmia Alliance and professional clinical groups.

2. Underpinning research

In 1999 exercise-based cardiac rehabilitation (CR) was proven to reduce premature death by 13%, reduce cardiac death by 23% and improve quality of life. At the time, patients with heart failure and those who had survived a cardiac arrest (severe arrhythmia), and been fitted with an implantable cardioverter defibrillator (ICD), were denied access to rehabilitation exercise in the belief that exercise might trigger inappropriate shocks from the ICD. Those who wanted to exercise were medically supervised with the ICD deactivated, electrocardiography applied and onsite external defibrillation.

Doherty, as part of the Manchester Heart Centre (University of Manchester) research team (1999 to 2003), questioned the over medicalization of this approach as it went against the ethos of rehabilitation and made patients unsure about taking part in exercise. After securing £20,802 funding from a BHF Innovative Practice Fund [1] and a further £8,000 from the Northwest Regional Health Action Zone [2] the research team designed an exercise-based CR programme that aimed to avoid inappropriate shocks yet achieve effective exercise. Doherty led the NHS ethics application which was controversial because routine clinical practice at the time was to deactivate the ICD prior to supervised exercise. In 1999 no prospective trials had tried to exercise patients with the ICD switched on. NHS ethical approval was secured for heart failure patients fitted with an ICD to undertake exercise with the ICD activated. In order to overcome patient and clinician anxieties about exercise Doherty designed both a specific exercise test to assess fitness and a new exercise training programme involving twice-weekly exercise training, over twelve weeks, incorporating a warm-up, moderate intensity main exercise component and cool-down.

The study was a success as there were no inappropriate ICD shocks during 500 hours of exercise. The effect of the exercise programme was significant in improving fitness, anxiety and depression, and quality of life. The trail was published in *Heart* in 2003 [3].

Doherty has inspired and supported new researchers through nine successful PhD completions, three of which were PhD studentships in CR since 2008. One was funded by the Malaysian Education Ministry (£27,000) and two were secured through York St John University (£45,000 each). The International PhD student, Nor Razaob, has worked under Professor Doherty's supervision to evaluate the impact of arm versus leg exercise testing in 30 patients with heart failure. The research has led to substantial findings that question existing approaches to exercise testing and training in patients with heart failure [4]. This research has led to post-doctoral research with the Universiti Kebangsaan Malaysia where Doherty and Razaob are investigating the implementation of their UK exercise interventions in a Malaysian population with cardiac disease.

Doherty continued this research collaboratively with Prof Lewin (University of York since 2005) and Prof Taylor (Exeter University since 2010) where they developed additional safe exercise

interventions for home use as part of a patient self-management approach in heart failure. Doherty is a co-researcher and leads on the exercise intervention for this five-year, £2 million, NIHR programme (REACH-HF) which commenced in 2013 [5].

3. References to the research

[1] Grant awarded by the British Heart Foundation as an innovative practice award (1999-2001). Cardiac rehabilitation in patients with implantable defibrillators. Manchester Heart Centre and the University of Manchester. £20,802.

[2] Grant awarded by the Northwest Regional Health Action Zone (2000). Review of clinical exercise testing protocols. Manchester Heart Centre. £8,000.

[3] Fitchet A, Doherty P, Bundy C, Bell W, Fitzpatrick AP, Garratt CJ. Comprehensive cardiac rehabilitation programme for implantable cardioverter-defibrillator patients: a randomised controlled trial**.** *Heart*. 2003:89:(2):155-60.

[4] Razaob N, and Doherty P. Using arm and leg exercise testing results to inform the exercise prescription in patients with heart failure: time for a rethink! *British Journal of Cardiology*. Submitted June 2012 (ref number PS1171).

[5] Doherty is a co-investigator on the REACH-HF research team. REACH-HF is an independent research programme funded by the National Institute for Health Research (NIHR) (Reference Number RP-PG-1210-12004). The REACH-HF research team is led by Dr Hayes Dalal, from the Royal Cornwall Hospital, and Professor Rod Taylor, from the University of Exeter Medical School, and aims to develop a home-based self-management programme for patients with heart failure. This is part of a five year programme grant, for £2 million, which started in Dec. 2012. http://www.rcht.nhs.uk/RoyalCornwallHospitalsTrust/WorkingWithUs/TeachingAndResearch/ReachHF/ResearchTeamMembers/Co-Investigators.aspx

4. Details of the impact

Impact on national policy

The research was instrumental in gaining Professor Doherty an invitation to the writing group for the National Service Framework for Coronary Heart Disease Chapter Eight: Arrhythmias and Sudden Cardiac Death in 2005 [5.1]. Doherty's contribution was the recommendation that patients with an ICD should be offered CR.

Impact on safety and inclusivity

Prof Doherty's research facilitated an invitation to lead on two position statements with the Resuscitation Council (UK) to resolve concerns from clinicians and patients about the risks of exercise following a cardiac arrest or after having an ICD fitted [5.2]. This guidance, cited by the British Association for Cardiovascular Prevention and Rehabilitation (BACPR), is the fundamental reference for all UK CR programmes and many international programmes. http://www.bacpr.com/pages/page_box_contents.asp?pageid=751&navcatid=137

The confidence of clinicians to include ICD patients in CR programmes is strongly associated with these position statements which are based on Professor Doherty's research and the expertise derived from his research. There are over 340 CR programmes in the UK with an average annual throughput of 500 cardiac patients per programme. The number of patients with a cardiac arrest, ventricular arrhythmia, heart failure or ICD who can now access CR due to these findings is estimated to be 10% of all eligible patients (17,000 per year). This means that over 100,000 high-risk patients have potentially benefitted from this research over the last ten years.

The percentage of CR programmes that actively excluded patients with ICD and cardiac arrest has improved from 99% exclusion in 2003 to only 14% in the most recent national audit report (NACR 2012 table 2, page 6) [5.3]. The impact is likely to be much larger if other international CR programmes were to be taken into account.

Impact on the public. This has two components:

1. Professor Doherty was a co-author with the Arrhythmia Alliance on exercise advice for patients with an ICD [5.4] and was invited annually to share his research and give practical tips to patients and carers on how to exercise safely [5.5]. He was also invited by the BHF to publish an online guide for patients and carers on how to exercise safely at home [5.6].
2. The exercise programme in Doherty's RCT has continued to be used at Manchester Heart Centre and York Hospital since 2002 and 2004 respectively. The proven benefits from completing exercise-based CR coupled with an average completion rate of 500 patients per year, per site, is estimated to have impacted on around 11,000 cardiac patients [5.7].

Impact on clinical guidance (national)

Doherty's research informed clinical practice in the 'exercise guidance' of the Association of Chartered Physiotherapists in Cardiac Rehabilitation [5.8]. In 2007 and in 2012 Prof Doherty's research informed the BACPR Standards and Core Components for Cardiovascular Disease Prevention and Rehabilitation which promotes CR for patients fitted with an ICD [5.9].

Impact on clinical practice (international)

Prof Doherty's research informed the European Association for Cardiovascular Prevention and Rehabilitation guidelines for exercise in cardiovascular disease. His research was directly cited with reference to ICD patients and exercise [5.10]. Doherty has developed post-doctoral research with one of his former PhD students (Nor Razaob) with the Universiti Kebangsaan Malaysia where they are investigating exercise interventions in patients with cardiac disease.

Research does not automatically translate into practice but requires hard work to convince clinicians and patient groups that change is needed and that more CR programmes should include high-risk patients. Professor Doherty has committed significant time and effort to presenting his research in keynote and invited national and international presentations:

- 'Risk and beneficial effects of strength training on the cardiovascular system', European Society of Cardiology. EuroPrevent Conference, Rome, Italy, April 2013
- 'Evidence base for exercise based cardiac rehabilitation', Cardiology Review Course: Mayo Clinic, Royal College of Physicians, London, March 2009 to 2012
- 'Exercise testing: arm and leg exercise in heart failure', European Association for Cardiovascular Prevention and Rehabilitation, Berne, Switzerland, Sept 2012
- 'Exercise testing and prescription in cardiac rehabilitation', Clinical evidence based workshop. 6th Cardiovascular Congress, Dammam, Saudi Arabia, Dec. 2010
- 'La dolce vita: What every cardiologist needs to know about physical activity', European Society of Cardiology, Barcelona, August 2009
- 'Exercise and Arrhythmia: Safe and effective exercise for patients with heart disease', Keynote, Physiotherapy Congress, Manchester, 2008
- 'Reducing the risk of a cardiac event in community based exercise programmes', Keynote, Irish Association of Cardiac Rehabilitation, Dublin, 2007
- 'Exercise and Arrhythmia: a safe and pragmatic approach', British Association for Cardiovascular Prevention and Rehabilitation (BACPR). Belfast, 2006.

5. Sources to corroborate the impact

5.1 Doherty's recommendation for ICD patients to be offered CR. Section 7, page 8. NSF for Coronary Heart Disease (2005) Chapter Eight: Arrhythmias and Sudden Cardiac Death. Expert Writing Group Member. Department of Health (www.dh.gov.uk)

5.2 Resuscitation Council (UK) statements 2008 and 2009
http://www.resus.org.uk/pages/crepbacr.htm
Contact: Chairman, Resuscitation Council (UK), 5th Floor, Tavistock House North, Tavistock Square, London, WC1H 9HR

5.3 National Audit for Cardiac Rehabilitation (NACR) Report (2012). BHF Cardiac Care and Education Research Group. http://www.cardiacrehabilitation.org.uk/nacr/docs/2012.pdf
Contact: Director of the NACR. University of York

5.4 Co-author with the Arrhythmia Alliance: The Heart Rhythm Charity. Physical activity and exercise advice for patients with an Implantable Cardioverter Defibrillator (ICD) April 2010. http://www.heartrhythmcharity.org.uk/www/media/files/For_Patients/100414-FINAL-Physical_activity_and_exercise_advice_for_patients_with_an_ICD.pdf
Trustee and Executive Committee
info@heartrhythmcharity.org.uk

5.5 Invited speaker Heart Rhythm Congress 'Is exercise bad for your heart'
Arrhythmia Alliance Patient Session, Birmingham, 2007-2009
http://www.heartrhythmcongress.com/archive-folder/2008-programme.html

5.6 Exercise guidelines 'Get active - from the comfort of your chair'
http://www.bhf.org.uk/heart-matters-online/june-july-2012/activity/chair-based-exercise.aspx Lead for Prevention & Care, BHF

5.7 CR programmes using Prof Doherty's research exercise programme:

Cardiac Rehabilitation Coordinator, Manchester Heart Centre, Manchester Royal Infirmary, Oxford Road, Manchester, M13 9WL

5.8 Page 20: Exercise Training in ICD and reference number 51 on page 31 cites Doherty's research: Association of Chartered Physiotherapists in Cardiac Rehabilitation (ACPICR). Also see appendix G: Extra Considerations.
http://acpicr.com/sites/default/files/Acpicr%20standards_1.pdf

5.9 Page 22, reference 69 cites Doherty's research: BACPR Standards and Core Components for Cardiovascular Disease Prevention and Rehabilitation, 2007 and 2012.
Contact: President of the Association
www.cardiacrehabilitation.org.uk/nacr/docs/BACPR_Standards_2012.pdf

5.10 Page 1355, reference 188 cites Doherty's research: Vanhees L, et al Importance of characteristics and modalities of physical activity and exercise in the management of cardiovascular health in individuals with cardiovascular disease (Part III). EJPC 2012
http://cpr.sagepub.com/content/early/2012/01/23/2047487312437063