

Institution: University of York		
Unit of Assessment: 2 - Public Health, Health Services and Primary Care		
Title of case study: Improving service quality, uptake and health outcomes for patients with heart disease attending cardiac rehabilitation.		
Period when the underpinning research was undertaken: 2014 - 2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Patrick Doherty	Professor	Jan 2014 - present
Alex Harrison	Research Fellow	Nov 2014 - present
Laura Bojke	Reader	Oct 1999 - present
Sebastian Hinde	Research Fellow	Oct 2010 - present
Period when the claimed impact occurred: 2014 - 2020		
Is this case study continued from a case study submitted in 2014? N		
1. Summary of the impact (indicative maximum 100 words) University of York research achieved positive impact on health policy, service quality and delivery benefitting patient health as part of cardiac rehabilitation (CR):		
<ol style="list-style-type: none"> i. Developed key performance indicators and a new analytic approach leading to a National Certification Programme for CR demonstrating a 30% improvement in service quality; ii. Played a key role in reducing national CR wait times by more than 50% with an associated (economically-modelled) increase in uptake of 15% and improved long-term patient health evidenced by a favourable cost per quality-adjusted life-year of GBP3,286; iii. Improved CR provision for patients with heart failure through an award winning self-management intervention, incorporating our chair based exercise programme, leading to implementation and roll-out within the National Health Service (NHS); iv. Strategy, policy and clinical guidance: Influenced British Heart Foundation Strategy, The NHS Long-term Plan and international clinical guidance. 		
2. Underpinning research (indicative maximum 500 words)		
<ul style="list-style-type: none"> • University of York (UoY) research by Doherty, Harrison, Bojke and Hinde: Through a series of robust observational studies utilising national registry data Doherty and colleagues evaluated cardiac rehabilitation (CR) service quality and also determined the extent to which waiting times influenced patient outcomes. Statistical analyses accounted for confounders and used transparent reporting methods: <u>Study one</u> applied a new analytical approach utilising national registry data from routine clinical practice to evaluate the extent to which CR programmes met minimum standards and key performance indicators of service quality. This research concluded that in the period 2013 to 2014 only 27 CR programmes (12%) met all CR quality criteria and that 5% of programmes failed to meet any of the quality criteria (3.1). This approach helped establish the first UK CR service performance categories and directly informed the creation of the National Certification Programme in 2016. <u>Study two</u> used logistic and multinomial regression to investigate the influence of CR timing on psychological outcomes in 39,588 post heart attack patients. This was the first study to conclude that longer wait times were associated with less than optimal mental health outcomes (3.2). This complemented a previous study published in 2016 (by Doherty) confirming the benefits of timely CR on physical fitness and physical activity status. • Doherty was co-investigator on a National Institute for Health Research (NIHR) programme grant 'Rehabilitation Enablement in Chronic Heart Failure (REACH-HF)' that developed and evaluated, through a clinical trial, a new self-managed home-based intervention for patients with heart failure. The intervention was developed with patient and carer involvement and was proven to be safe, clinically effective and cost effective. Doherty developed the chair-based exercise intervention incorporating seven exercise intensity levels quantifying the metabolic costs for each of the exercise levels. He also led the exercise prescription component of REACH-HF which created a new tailored exercise approach for patients with heart failure. Doherty was principal investigator for the York NHS Hospital trial, one of four sites across the UK that delivered REACH-HF (3.3). 		

- Doherty was one of three co-leads on a European-wide project (Cardiac Rehabilitation Outcome Study-CROS) with the Cochrane Group, Heidelberg University. This was the first study to exclude pre-1995 CR studies as part of their systematic review and meta-analysis investigating the prognostic effects of CR in the modern era of cardiology. This research, based on a sample size of 232,295 patients, established CR effectiveness but raised serious concerns about the quality of CR interventions included in clinical trials. Through its analysis of registry (clinically based) studies, it also highlighted poor quality in CR services as part of routine clinical practice across Europe (3.4).
- Doherty was co-investigator on an NIHR programme grant evaluating the effectiveness of psychological interventions through a rigorous clinical trial in patients with depression and anxiety which are conditions known to act as barriers to CR uptake. Doherty was involved in the design, implementation, analysis and dissemination of this research, which proved that CR plus behaviour activation therapy was clinically effective. The group also carried out a novel cost effectiveness systematic review of CR in the modern era of cardiology (influenced by Doherty's CROS research) which informed the first value for money case for CR (3.5).
- Bojke, Hinde, Doherty and Harrison, supported by NIHR and British Heart Foundation (BHF) carried out a de novo approach to health economic modelling using and adapting systematic review evidence combined with National Audit of Cardiac Rehabilitation (NACR) data resulting in the development of a tailored health economic model evaluating increased uptake and health gains by socioeconomic status in cardiac patients attending CR. This research has directly informed the NHS England Long-term Plan targets and BHF Strategy (3.6).

3. References to the research (indicative maximum of six references)

(Quality indicator = QI)

- 3.1. Doherty, PJ**, Salman, A, Furze, G & Dalal, HM, **AS Harrison**. 2017, 'Does cardiac rehabilitation meet minimum standards: An observational study using UK national audit?' Open Heart, vol 4, e000519, pp. 1-5. doi.org/10.1136/openhrt-2016-000519
QI = peer reviewed funding and paper from BHF research grant (2014-17)
- 3.2.** Sumner, J, Böhnke, JR & **Doherty, P**. 2017 'Does service timing matter for psychological outcomes in cardiac rehabilitation? Insights from the National Audit of Cardiac Rehabilitation' Eur J Prev Cardiol. 2017. doi.org/10.1177/2047487317740951
QI = peer reviewed funding and paper from BHF research grant (2017-19).
- 3.3.** Dalal, HM, Taylor, RS, Jolly, K, Davis, RC, **Doherty, P**, et al. 2018. 'The effects and costs of home-based rehabilitation for heart failure with reduced ejection fraction: REACH-HF Trial. Eur J Prev Cardiol. 2019. pp. 1-11. doi.org/10.1177/2047487318806358
QI = peer reviewed funding and paper from an NIHR programme grant (2014-18). Our roll-out of this research into the NHS won a BMJ Services Award in 2020
- 3.4.** Rauch, B, Davos, CH, **Doherty, P**, et al. 'The prognostic effect of cardiac rehabilitation in the era of acute revascularisation and statin therapy: A systematic review and meta-analysis of randomized and non-randomized studies - The Cardiac Rehabilitation Outcome Study (CROS)'. Eur J Prev Cardiol. 2016. doi.org/10.1177/2047487316671181
QI = peer reviewed paper and approved project of the European Association of Preventative Cardiology (2014-17)
- 3.5.** Shields, GE, Wells, A, **Doherty, P** et al. 'Cost-effectiveness of cardiac rehabilitation: a systematic review' Heart 2018;104:1403-1410. doi.org/10.1136/heartjnl-2017-312809
QI = peer reviewed funding and paper from an NIHR programme grant (2015-19)
- 3.6. Hinde S, Harrison A, Bojke L & Doherty P**. 'Improving Cardiac Rehabilitation Uptake: Potential health gains by socioeconomic status', Eur J Prev Cardiol. 2019 Nov;26(17):1816-1823. doi.org/10.1177/2047487319848533

QI = peer reviewed funding and paper from NIHR-CLAHRC (2014-19) and BHF grant: Transformation and innovation of cardiac rehabilitation services' (2019-22).

QI summary: all papers peer reviewed, five based on peer reviewed grants, one approved European project, three submitted in REF 2021 and one received a BMJ Service Award.

4. Details of the impact (indicative maximum 750 words)**[Impact I] Developed clinical standards and National Certification Programme**

- a. Research by Doherty developed key performance indicators and an analytic approach leading to the foundation of a National Certification Programme for CR (NCP_CR). This is run jointly by the British Association for Cardiovascular Prevention and Rehabilitation (BACPR) and national audit team (**3.1 & 3.2**). The National Certification Programme monitors and reports on the quality of CR delivery against published clinical minimum standards. Longitudinal national audit data shows that CR quality has improved significantly from only 27 programmes (12%) in 2014 to 93 programmes (42%) achieving full certification status in 2020 representing a 30% improvement. British Journal of Cardiology (2016) (**5.1a**).
- b. The same research informed clinical standards and core components used by over 230 clinical programmes across the UK. (**3.1** is reference 81 in the quotation below):
“The ultimate goal is for all CR programmes to deliver services in line with the Standards and Core Components in this document, however at present most programmes are working towards the minimum standards as outlined in the NCP_CR.⁸¹” Page 19 BACPR Standards and Core Components (2017) (**5.1b**).
- c. National reporting of key performance indicators as part of the NCP_CR showing that the quality of CR has increased since this research was conducted. BHF Quality and Outcomes Report 2020 page 23 (5.1c).
- d. UoY research on the development and success of a national certification programme and minimum standards was viewed, by the European Association for Preventive Cardiology, as the first to implement and evaluate minimum standards which were then used to inform the development and implementation of European standardization and quality improvement of secondary prevention:
“The use of minimum standards for the evaluation of the quality of CR has been tested elsewhere²¹” Page 2 Standardization and quality improvement of secondary prevention through cardiovascular rehabilitation programmes in Europe: Eur J Prev Cardiol. 2020. Reference 21 in the quote is **3.1**, (**5.1d**).

[Impact II] Improving national CR wait times and patient outcomes

- a. Research presented at national and international conferences in 2015 and 2016 showed that timely CR led to improved mental health and physical health outcomes (**3.2**). The BACPR standards writing group reviewed Doherty’s research on waiting times and CR delay and used it to support timely CR as part of their standards. Using published data collected as part of NHS Digital audits the quotation below highlights more than a 50% reduction in waiting times driven by UoY research:
“In 2020, UK median CR wait times have reduced to 33 and 21 days for surgical and non-surgical patients, respectively. This represents a reduction in waiting time of 21 days for surgical patients and of 19 days for non-surgical patients compared with 2014 surpassing national targets and yielding significant improvements in service delivery and patient benefit by avoiding delay (Hinde et al 2020). This change in clinical practice owes much to sustained BHF-funded studies at the University of York on wait times. Before these studies, average wait times had only decreased by 2.5 days between 2011 and 2014.” Page 20 BHF Quality and Outcomes Report 2020 (**5.2a**).
- b. UoY research on waiting times has continued to inform new versions of clinical standards evidenced by the following quotation where reference 28 in the quotation is our research on the benefits of early CR: “There is continued emphasis on the importance of early CR which is both safe and feasible, and improves patient uptake and adherence.^{21–28}” Page 511 BACPR, Standards and Core Components. Heart 2019;105:510-515 (**5.2b**).
- c. The quotation below cites two UoY studies, on the impact of early rehabilitation on psychological outcomes and physical outcomes, as the only references used to inform the decision to include early CR as a minimum standard for CR services across Europe: *“The timing of CR has a significant impact on fitness⁵³ and psychological outcomes⁵⁴”* page 3 of Standardization and quality improvement of secondary prevention through cardiovascular rehabilitation programmes in Europe: Eur J Prev Cardiol. 2020 (**5.2c**).

- d. Beyond the recognised improvement in physical and mental health outcomes for patients, evidenced through UoY research on timely CR, there is also a service level benefit achieved through enhanced uptake. Timely CR increases the likelihood of patients starting whereas delayed CR decreases the likelihood. Health economic modelling of timely CR has quantified a 15.3% benefit in CR uptake (i.e. ~ 20,786 more patients based on 2019 national audit data) and improved long-term health with a cost per quality-adjusted life-year of GBP3,286 (5.2d).

[Impact III] Development and implementation of a new self-management intervention to address a known gap in CR delivery for patients with heart failure (HF).

- a. The REACH-HF programme of research including Doherty's chair based exercise intervention was developed with extensive patient and carer involvement. Clinical and cost effectiveness was established (3.3) after which REACH-HF was rolled out through four NHS Beacon sites and four Scottish Health Boards. Roll-out was supported by NIHR, NHS England/Scotland. NHS Digital also introduced REACH-HF as a new mode of delivery option in Jan 2019 allowing clinicians to routinely record this intervention as part of an NHS provision. The REACH-HF service implementation approach, outlined above, won the BMJ Services Award for Stroke and Cardiovascular Services in 2020. The BMJ award recognised REACH-HF for its excellence in healthcare provision and for successfully implementing leading research into NHS clinical practice (5.3a).
- b. REACH-HF was adopted by the South West Academic Health Sciences Network (5.3b).
- c. The REACH-HF intervention was adopted nationally by the BHF and BACPR as part of the Covid-19 initiative to enable older patients with heart failure to exercise safely at home. In response to Covid-19 NHS service changes and an urgent need for online training of NHS staff, Doherty and REACH-HF colleagues changed their face-to-face facilitator course to online training. In doing so they successfully delivered training to 100 staff leading to an increase in home-based CR services in the UK. Doherty also adapted his chair based exercise programme making it freely available to NHS staff and patients online. National audit data pre-Covid (2019) vs Covid era (2020) confirms that the proportion of patients with heart failure taking up hospital-based CR dropped by 47% whereas home-based CR increased by 52%. Based on the success of our Covid-19 response along with development and implementation of online training for NHS staff, NICE endorsed REACH-HF as a quality assured shared learning example under the theme of Covid-19-ready-rehabilitation-for-heart-failure (5.3c).

[Impact IV] Policy and practice: NHS Long-term Plan; British Heart Foundation Strategy and international clinical guidance.

- a. In 2019 UoY researchers (Doherty, Harrison, Hinde, Bojke) were asked by NHS England and BHF executives to investigate, as part of NHS Long-term Plan preparations, the cost benefit of increasing CR uptake. Our findings and calculations (3.6 also incorporating 3.5 in the cost analysis), were used to aid decision making and set targets as part of the NHS Long-term Plan and BHF Strategy:

“Scaling up and improving marketing of cardiac rehabilitation to be amongst the best in Europe will prevent up to 23,000 premature deaths and 50,000 acute admissions over 10 years” (Page 63 section 3.72 of the Long Term Plan) (5.4a).

BHF strategy document (The Big Picture 2018) used our research findings and UoY based National Audit of Cardiac Rehabilitation data to set its 65% and 85% targets: *“Achieving an uptake rate of 65% would result in 8,500 fewer deaths and 21,000 fewer hospital readmissions over 10 years. And reaching 85% uptake could save a remarkable 20,000 lives and avoid nearly 50,000 admissions over the next decade, as well as saving the NHS tens of millions of pounds. Source: Hinde S, Bojke L, Harrison A, Doherty P. (2018) Modelling of potential CR uptake scenarios for the BHF vs 2015/16 NACR data” Page 3 (5.4a).*

- b. Our joint European collaborative research project entitled Cardiac Rehabilitation Outcome Study (CROS) was used to inform Scottish National Clinical Guidance SIGN 150:

“While CR meets the definition of a complex intervention, with studies including some or all of the elements described in the BACPR pathway, systematic reviews have concluded that the reduction in cardiovascular mortality associated with attending CR can be attributed to the exercise component.^{5,6}” Page 1, Reference 6 is **3.4, (5.4b)**.

The CROS project systematic review and meta-analysis also informed European standards on the ability of CR to benefit patients by reducing premature death:

“Previous data, including recent meta-analysis have shown the efficacy of CR^{3,5-7} to reduce mortality” Page 2, reference 5 is **3.4, (5.4b)**.

5. Sources to corroborate the impact (indicative maximum of 10 references)

The sources to corroborate impact are presented below as combination of coherent forms of evidence for each of the impact areas detailed in section 4. These have been bundled into four evidence files uploaded as part of our REF 2021 UOA 2 submission.

5.1. Clinical standards and National Certification Programme:

- a) Peer reviewed paper on the *Development of the National Certification Programme* in the British Journal of Cardiology (2016)
- b) *BACPR Standards and Core Components* (2017)
- c) Analysis of CR quality from 2014 to 2020. BHF Quality and Outcomes Report (2020)
- d) Peer reviewed paper on *Standardization and quality improvement of secondary prevention through cardiovascular rehabilitation programmes in Europe* published in the European Journal of Preventive Cardiology 2020.

5.2. Improving national CR wait times and patient outcomes:

- a) BHF Quality and Outcomes Report 2020
- b) Peer reviewed paper on *UK clinical standards* published in BMJ Heart 2019
- c) Peer reviewed paper on *Standardization and quality improvement of secondary prevention through cardiovascular rehabilitation programmes in Europe* published in European Journal of Preventive Cardiology 2020
- d) Peer reviewed paper on *Health economic modelling of timely CR uptake and quality of life outcomes* published in European Journal of Preventive Cardiology 2020.

5.3. Development and implementation of a new self-management intervention for patients with heart failure:

- a) BMJ 2020 Health Services award for Stroke and Cardiovascular Services
- b) South West Academic Health Science Network adoption of REACH-HF
- c) NICE and NHS online resources showing how the REACH-HF intervention and Doherty's chair based exercise programme were adopted as part of the Covid-19 national initiative.

5.4. Strategy, policy and international clinical guidance:

- a) BHF Strategy; NHS England Long-term Plan
- b) Scottish clinical guidance and European standards.