Institution: University of Leeds

Unit of Assessment: 2

Title of case study: Development and national implementation of the electronic Frailty Index (eFI): impact on policy, health and care service delivery, and wider society

Period when the underpinning research was undertaken: 2014-2016

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:
Andrew Clegg	Professor of Geriatric Medicine	2012-present
Elizabeth Teale	Clinical Senior Lecturer	2012-present

Period when the claimed impact occurred: 2016-2019

Is this case study continued from a case study submitted in 2014? N

1. Summary of the impact (indicative maximum 100 words)

Older people living with frailty account for around £6 billion of annual NHS expenditure. We led development and national implementation of an electronic frailty index (eFI) that uses routine GP data to identify frailty. The national implementation of the eFI led to major NHS policy impact as it enabled a standardised approach to identifying frailty nationally, providing the platform for the 2017/18 NHS England GP contract and inclusion in the 2019 NHS Long Term Plan. Impact on health and care services is supported through inclusion in NICE guidelines and the development of new models of frailty care, cited in national frailty guidelines. Recognition of impact is through selection as an example of world-class National Institute for Health Research (NIHR) research making a difference to patient care, and the prestigious 2017 Royal College of Physicians' (RCP) Excellence in Patient Care Award.

2. Underpinning research (indicative maximum 500 words)

Frailty is a condition that is common in old age. It develops because as we get older our bodies change, and can lose their inbuilt reserves. These changes mean that older people with frailty can experience sudden dramatic changes in their health when they have an illness. International guidelines recommend frailty should be identified routinely so a more holistic approach to care can be taken, and effective treatments provided. However, the main historical difficulty with identifying frailty routinely is that available clinical tools, such as measuring walking speed or frailty questionnaires, require additional resource, and might be inaccurate.

Professor Clegg and Dr Teale led the underpinning research to develop and validate the eFI in a landmark study funded by the NIHR (**1**). The study used the cumulative deficit model, which identifies frailty on the basis of a range of variables including symptoms, signs, diseases, disabilities and abnormal laboratory values, collectively referred to as deficits. Primary care electronic health record (EHR) systems in the UK use Read Codes to categorise and log multiple patient characteristics including symptoms, signs, laboratory test results, diseases, disabilities and information about social circumstances. Primary care EHR systems therefore provide a potentially simple yet powerful mechanism for identifying cumulative deficits to identify frailty routinely.

Between 2014 and 2016, we followed published guidelines to develop, internally validate and externally validate the eFI in a retrospective cohort study using anonymised primary care EHR data in the ResearchOne and The Health Improvement Network (THIN) databases. The work was led by Clegg and Teale in a collaboration including researchers from the University of Birmingham and the University of Bradford. Following initial development, we constructed eFI categories (fit, mild frailty, moderate frailty, severe frailty). We validated by investigating predictive validity for outcomes of all-cause mortality, unplanned hospitalisation and nursing home admission, using adjusted hazard ratios (HR) at 1, 3 and 5 years, and assessed discrimination and calibration.

We used data from a total of 931,541 patients. The eFI incorporates 36 deficits constructed using 2,171 primary care Read Codes. The eFI calculates a frailty score as a simple proportion of the deficits present in an individual divided by the total possible (e.g. if 9/36 deficits are present, the eFI score = 0.25). One year adjusted HR for mortality was 1.92 (95% confidence interval, CI, 1.81-2.04) for mild frailty, 3.10 (95% CI 2.91-3.31) for moderate frailty and 4.52 (95% CI 4.16-4.91) for severe frailty. Corresponding estimates for hospitalisation were 1.93 (95% CI 1.86-2.01), 3.04 (95% CI 2.90-3.19) and 4.73 (95% CI 4.43-5.06), and for nursing home admission were 1.89 (95% CI 1.63-2.15), 3.19 (95% CI 2.73-3.73) and 4.76 (95% CI 2.73-3.73), with good to moderate discrimination.

These key research insights were globally leading as this work was the first international study to use routinely available, nationally representative data to develop and validate a measure of frailty. Following validation, Professor Clegg and Dr Teale led the national implementation of the eFI into the SystmOne, EMISWeb, Vision and Microtest primary care EHR systems, making it freely available to 100% of general practices in England and 95% of all UK practices. The national implementation work was also globally leading, enabling the UK to become the first country to have a nationally available tool for identifying frailty as part of routine care.

This underpinning research work provided the foundation for the impact described in this case study, and has also become a key reference point for future research, including beyond the original institution and research team. This has included internationally-leading work identifying that:

- Home modifications reduce care home admissions for older people with moderate and severe frailty, in collaboration with researchers at the Universities of Swansea and Liverpool (**2**).
- People with frailty account for an additional £6 billion of NHS expenditure, in collaboration with researchers at the University of York (**3**).
- Frailty is a key predictor of hospitalisation after a diagnosis of heart failure, in collaboration with researchers at Imperial College London (**4**).
- Frailty is an indicator of older people nearing end of life, who may be suitable for advance care planning, in collaboration with researchers from the University of Newcastle (**5**), and
- Hypertension risk is modified in the presence of frailty, indicating need for tailored blood pressure care in frailty, in work led by researchers at King's College London (**6**).

The underpinning eFI work has led directly to considerable competitive grant capture, including:
Associate Director Clegg A, Co-I Teale E
Health Data Research UK North (HDRUK North) (£3,400,000)
HDRUK
05/2020 – 04/2023

PI Clegg A
Development and evaluation of the electronic frailty index+ (eFI+) tool (£548,507)
NIHR
10/2019 – 04/2022

PI Clegg A, Co-I Teale E
Improving care for older people with frailty (£1,500,000)
NIHR ARC
10/2019 – 09/2024

PI Clegg A
Personalised care planning to improve quality of life for older people with frailty (£2,748,666)
NIHR
10/2017 - 02/2023

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

1. **Clegg A**, Bates C, Young J, Ryan R, Nichols L, **Teale E**, Mohammed M, Parry J, Marshall T. Development and validation of an electronic frailty index using routine primary care electronic health record data. *Age and Ageing*. 2016; 45(3): 353-60. doi: 10.1093/ageing/afw039

2. Hollinghurst J, Fry R, Akbari A, Watkins A, Williams N, Hillcoat-Nalletamby S, Lyons RA, **Clegg A**, Rodgers SE. Do home modifications reduce care home admissions for older people? A matched control evaluation of the Care & Repair Cymru service in Wales. *Age and Ageing*. 2020; 49(6): 1056-1061. doi: 10.1093/ageing/afaa158

3. Han L, **Clegg A**, Doran T, Fraser L. The impact of frailty on healthcare resource use: a longitudinal analysis using the Clinical Practice Research Datalink in England. *Age and Ageing.* 2019; 48(5): 665-671. doi: 10.1093/ageing/afz088

4. Bottle A, Kim D, Hayhoe B, Majeed A, Aylin P, **Clegg A**, Cowie MR. Frailty and comorbidity predict first hospitalisation after heart failure diagnosis in primary care: population-based observational study in England. *Age and ageing.* 2019; 48(3): 347-354. doi: 10.1093/ageing/afy194

5. Stow D, Matthews FE, Barclay S, Iliffe S, **Clegg A**, De Biase S, Robinson L, Hanratty B. Evaluating frailty scores to predict mortality in older adults using data from population based electronic health records: case control study. *Age and Ageing.* 2018; 47(4): 564-569. doi: 10.1093/ageing/afy022

6. Ravindrarajah R, Hazra N, Hamada S, Charlton J, Jackson SHD, Dregan A, Gulliford MC. Systolic blood pressure trajectory, frailty and all-cause mortality >80 years of age. Circulation. 2017; 135(24): 2357-68. doi: 10.1161/CIRCULATIONAHA.116.026687

4. Details of the impact (indicative maximum 750 words)

Our eFI project has had direct impact on national health policy, and provision of evidence-based health and care services for older people, alongside wider societal and economic impact, through implementation of new models of evidence-based care to improve outcomes for older people living with frailty. Selection of our eFI project as an example of world class NIHR research making a difference to patient care provides further evidence of impact (**A**).

Impact on national health policy

Our eFI national implementation project enabled major impact on NHS policy change by providing the infrastructure for the 2017/18 GP contract, which includes identification and management of people living with moderate and severe frailty as a key requirement for every general practice in England (**B**). The 2017/18 GP contract supports population-level frailty stratification using the eFI (**C**). To maximise impact and spread, we worked in partnership with NHS England and NHS RightCare to develop supporting resources necessary for GP contract implementation and subsequent development of the NHS RightCare Frailty Toolkit to help optimise a national frailty system using the eFI (**D**).

The success of the eFI national implementation and GP contract changes has had further impact on national policy by directly influencing the 2019 NHS Long Term Plan (**E**). The Plan specifies supporting people to age well as a key objective, with a greater focus on proactive care based on population health management, including use of the eFI.

Following national implementation of the eFI, NHS England data indicate over 2.5 million older people have been assessed for frailty and around 1 million have been identified as living with moderate or severe frailty (**F**). 25,570 people with frailty have been identified as at risk of falling and referred to a falls service, with an estimated prevention of around 2,300 future falls, and 210,687 have received a medication review to optimise medications, reduce tablet burden, and reduce potential side-effects.

Impact on provision of evidence-based health and care services

Use of the eFI is recommended in the 2016 NICE multimorbidity guideline (**G**). Additional examples of work using the eFI have been cited in Royal College of General Practitioners and British Geriatrics Society guidance on integrated care for older people (**H**).

We established a national Healthy Ageing Collaborative (HAC) as part of the Yorkshire & Humber Academic Health Science Network Improvement Academy to maximise impact on provision of evidence-based frailty services. The HAC has engaged with 75 of the 209 CCGs in England to support the use of the eFI to develop new models of care at a practice and population level. Work has extended into Scotland, where the eFI has been implemented in a new model of care to improve quality of life for older people living with frailty across nine general practices spanning three health and social care partnerships, including 75,311 older people aged ≥65 (**I**). As part of our national implementation project, the eFI has also been implemented into bespoke national healthcare intelligence systems (eMBED/Dr Foster; ACG Johns Hopkins; RAIDR) to enable population modelling and improve commissioning decisions.

Examples of the interventions deployed in primary care after identifying people with frailty using the eFI include:

- Targeted medication reviews to reduce problematic prescribing (NHS Vale of York CCG)
- Proactive falls prevention (NHS Leeds South & East CCG)
- Advance care planning and palliative care (NHS Airedale, Wharfdale & Craven CCG)
- Comprehensive geriatric assessment as an evidence-based frailty intervention (NHS South Devon & Torbay CCG)
- Supported self-management for people with mild frailty (NHS Bradford Districts CCG).

In recognition of this major and innovative impact on health and care services, our eFI team were

awarded the prestigious 2017 RCP Excellence in Patient Care Award and 2016 E-Health Insider (EHI) Award for Healthcare Innovation Product of the Year. These prestigious awards have generated considerable national and international interest in the eFI, facilitating spread, uptake and impact.

Wider societal and economic impact

The implementation of evidence-based interventions to improve outcomes using the eFI for proactive case-finding supports sustainability of health and care systems, including reducing demand for services. The eFI is included in a Health Foundation report as an exemplar of how investing in health and care data analytics can support the allocation of finite resources and delivery of high quality care to maximise system sustainability and economic benefit (**J**). Parallel work with NHS England to model health and social care costs associated with frailty, and impact of implementing interventions on projected cost savings, has informed ongoing health policy plans (**K**).

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

A. World class research making a difference: Collaborations for Leadership in Applied Health Research and Care. National Institute for Health Research, 2017. Available at https://tinyurl.com/1kz4lsbn

B. 2017/18 General Medical Services (GMS) contract. NHS Employers, 2017. London. Available at https://tinyurl.com/1bhovhld

C. Testimonial of National Specialty Advisor Older People and Integrated Person Centred Care/ NHS England and Improvement, 13/11/2020

D. NHS RightCare: Frailty Toolkit. Optimising a frailty system. NHS RightCare, 2019. Available at https://tinyurl.com/4vcm66wz

E. The NHS Long Term Plan. 2019. London. Available at https://tinyurl.com/2r82osoo

F. Seymour D. One small step for older people with frailty, one giant leap for frailty care? An analysis of GP Contract Services data for routine frailty identification and frailty care through the GP Contract 2017/2018. Available at https://tinyurl.com/1to0ucpi

G. Multimorbidity: clinical assessment and management (NG56). National Institute for Health and Care Excellence, September 2016. NICE, London. Available at https://tinyurl.com/3u7cqr94

H. Integrated care for older people with frailty: Innovative approaches in practice. Royal College of General Practitioners & British Geriatrics Society 2016. Available at https://tinyurl.com/2coovb96

I. Devereux N, Ellis G, Dobie L, Baughan P, Maonaghan T. Testing a proactive approach to frailty identification: the electronic frailty index. BMJ Open Quality. 2019; 8:e000682. doi: 101136/bmjoq-2019-000682

J. Bardsley M, Steventon A, Fothergill G. Untapped potential: Investing in health and care data analytics. Health Foundation 2019. Available at https://tinyurl.com/ymcmo3de

K. Ageing Well: Quality Healthcare in Later Life. 2018. NHS England. Available at https://tinyurl.com/1qcsz6to