Institution: Newcastle University		
Unit of Assessment: UoA2		
Title of case study: LifeCurve™ software for assessing functional decline		
Period when the underpinning research was undertaken: 2011-2018		
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:**
Prof Carol Jagger	AXA Professor of Epidemiology of Ageing	1/9/08 to present
Prof Peter Gore	Professor of Practice	1/10/07 to present
Dr Andrew Kingston	Lecturer	15/9/08 to present
Dr Joanna Collerton	Principal Clinical Research Associate	19/3/01 to 31/10/19
Dr Karen Davies	Senior Research Nurse	6/1/03 to 30/4/19
Prof Dame Louise Robinson	Regius Professor of Ageing	1/12/98 to present
Emeritus Prof Martin Eccles	Professor of Primary Care Research	1/1/89 to present
Prof Thomas Von Zglinicki	Professor of Cellular Gerontology	1/3/00 to present
Dr Carmen Martin-Ruiz	Senior Research Associate	17/8/01 to present
Emeritus Prof Oliver James	Senior Research Investigator	1/10/85 to 30/11/12
Emeritus Prof John Bond	Prof of Social Gerontology & Health Services Research	1/2/79 to present
Emeritus Prof Tom Kirkwood	Professor of Medicine/ Strategic Research Advisor	1/10/99 to present
Prof Garth Johnson	Professor of Rehabilitation Engineering	1/9/81 to 30/9/08
Period when the claimed impact occurred: 2015–present		
Is this case study continued from a case study submitted in 2014? No		

1. Summary of the impact

Newcastle research identified that the ability to complete activities of daily living independently is lost in a specific order with ageing, thus reducing an individual's quality of life. Newcastle research underpinned development of LifeCurve™, a tool assessing an individual's current functional ability. Healthcare providers can use LifeCurve™ to match safe, specific interventions to an individual, to prevent functional decline, and maintain independence for longer. LifeCurve™ has been deployed in 10 Local Authorities in England and Scotland, resulting in over 10,000 assessments, improving the independence of individuals. In 2020, provision of LifeCurve™ was expanded internationally to Australia and New Zealand.

2. Underpinning research

Ageing population and Activities of Daily Living (ADL)

Increased life expectancy and constantly improving later life healthcare have resulted in the over 80s becoming the fastest growing demographic. Projections suggest that by 2050 there will be 392 million people worldwide over the age of 80, three times as many as in 2013[1]. An increasing concern is that an ageing population will lead to an increased proportion of people living with disability or becoming dependant on relatives and healthcare facilities, potentially for a long period of time. This in turn will place greater financial burden on long-term healthcare providers (R1, R2).

One measure of the severity of disability in older age is a reduced ability to perform simple tasks, termed activities of daily living (ADL). As an individual loses the ability to perform ADLs, they require increasing support re-enabling or compensating for disability, often subsequently resulting in entering care. Premature entry into care results in increased loss of independence, as an individual's ADLs are performed for them, in turn negatively affecting quality of life. Therefore timely intervention to preserve ADL ability would maintain an individual's independence for longer,

[1] www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2013.pdf

reducing their need for care. Accurately tracking an individual's ADL ability as they age and identifying when loss begins is therefore vitally important.

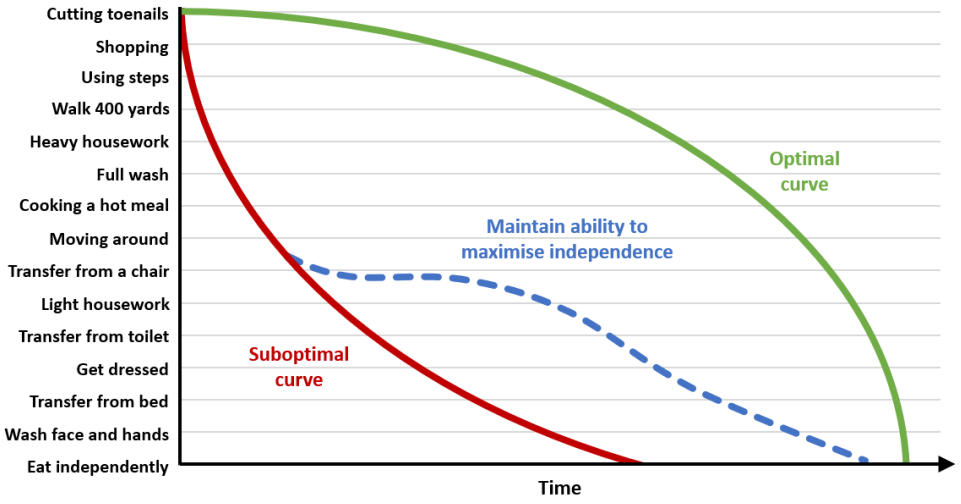
Predictable decline of function

Although previous research suggested that ADLs are lost in a consistent order, these studies did not include large cohorts of the very old, where functional decline is greatest, or large numbers of ADLs. To address this, Newcastle research conducted detailed health assessments of 841 Newcastle individuals born in 1921 (aged 85 at the time of the study). The study (R3) asked them about their ability to complete 17 ADLs such as "cutting toenails" and "feeding yourself". Analysis of the responses confirmed a hierarchy of loss for ADLs in the very old, with activities involving dexterity being lost before those involving the lower body.

Further Newcastle research into 6,841 individuals aged over 65 found that both self-reporting and metric-driven objective measures successfully captured the functional ability of older people and the loss of ADLs (R4). A combination of both self-reporting and objective measures can therefore effectively assess an individual's ADL ability. This allows for the implementation of appropriate interventions which take the unique circumstances of an individual's environment into account.

Compression of functional decline (CFD)

Knowing that ADLs are lost in a specific and predictable order, an individual's current ADL status could now be used to place them on a curve to identify their likely next stages of functional loss. Consequently, appropriate and effective interventions can be implemented for that person. This results in ADLs being retained for longer, compressing the decline in ability into a smaller window much later in life. Newcastle research developed this into a framework called "compression of functional decline" (CFD, R5). CFD is exemplified by the hypothetical trajectories for an ageing individual in the graph below, where an individual moves away from the early steep drop of the "Sub-optimal curve", indicating early loss of ADL ability, and towards the "Optimal curve" through appropriate interventions. The ideal CFD would be an individual retaining independence through most of their later life, and only losing ADL ability very late in their lives.



3. References to the research

SciVal field-weighted citation impact (FWCI) as of December 2020. Newcastle researchers in **bold.**

R1. **Jagger C**, **Collerton JC**, **Davies K**, **Kingston A**, **Robinson LA**, **Eccles MP**, **von Zglinicki T**, **Martin-Ruiz C**, **James OFW**, **Kirkwood TBL.** (2011) Capability and dependency in the Newcastle 85+ cohort study. Projections of future care needs. *BMC Geriatrics*. 11(21) DOI: https://doi.org/10.1186/1471-2318-11-21. FWCI: 0.86.

R2. **Kingston A**, Comas-Herrera A, **Jagger C**. (2018) Forecasting the care needs of the older population in England over the next 20 years: estimates from the Population Ageing and Care Simulation (PACSim) modelling study. *Lancet Public Health*. 3(9):E447-E455. DOI: https://doi.org/10.1016/S2468-2667(18)30118-X. FWCI: 10.23.

R3. **Kingston A**, **Collerton J**, **Davies K**, **Bond J**, **Robinson L**, **Jagger C.** (2012) Losing the ability in activities of daily living in the oldest old: a hierarchic disability scale from the Newcastle 85+ study. *PloS One*. 7(2):e31665. DOI:10.1371/journal.pone.0031665. FWCI: 0.98.
R4. Seidel D, Brayne C, **Jagger C**. (2011) Limitations in physical functioning among older people as a predictor of subsequent disability in instrumental activities of daily living. *Age and Ageing*. 40(40):463-469. DOI: 10.1093/ageing/afr054. FWCI: 1.14.
R5. **Gore PG**, **Kingston A**, **Johnson GR**, **Kirkwood TBL**, **Jagger C**. (2018) New horizons in the compression of functional decline. *Age and Ageing*. 47(6):764–768 DOI: 10.1093/ageing/afy145. FWCI: 0.57.

4. Details of the impact

Development of LifeCurve™ and impacts on ADL SmartCare

Newcastle University collaborated with occupational therapists and the healthy ageing company ADL Smartcare[2], directed by Professor Gore, to develop LifeCurve™. LifeCurve™ is an "*ageing assessment tool and App that tracks an individual's ability to complete 15 ADLs and 4 fitness and strength markers, to understand how they are ageing*" (EV1). It is available as both a basic free version and a paid version providing in-depth assessment, tailored support and insights to customers. An individual's likely pathway is then plotted to allow implementation of safe, specific interventions to mitigate an individual's further loss of function. LifeCurve™ has directly impacted ADL SmartCare, becoming "*a critical part of our own portfolio of services*" (EV1).

Impacts on UK Local Authorities

ADL Smartcare have been providing LifeCurve™ to Local Authorities (LAs) since June 2015 (EV1). Between 2016 and July 31st 2020, LifeCurve™ was used in 10,098 assessments with 9,055 individuals in 10 Scottish and English LAs (Table 1, EV1, EV2). The focus of subsequent interventions varies with each council. For example, North Lanarkshire uses the principles of LifeCurve™ in their website, "Making Life Easier", which helped 8,700 people in 2019 (EV3). They run various intervention workshops and training sessions based on LifeCurve™ assessments which "*has led to [their] staff in health helping people to think more about improving their abilities than relying on care and equipment. … The implementation of these interventions, with monitoring through LifeCurve™, has led to users retaining their independence for longer/having a high quality of life as they age*" (EV3).

Table 1 – Table of the number of assessments using LifeCurve™ in local authorities, as of 11th June 2020.

Local authority	Individuals	Assessments
Angus Health and Social Care Partnership	1,026	1,055
Bradford Metropolitan District Council	788	800
Cumbria County Council	290	293
East Lothian Health and Social Care Partnership	669	697
Falkirk Health and Social Care Partnership	1,159	1,322
Fife Health and Social Care Partnership	1,069	1,176
Kirklees Council (launched 2020)	177	204
North Lanarkshire Health and Social Care Partnership	2,736	2,820
Rotherham Council	1,435	1,490
Eclipse HomeCare	201	241
Total	9,550	10,098

[2] www.adlsmartcare.com

Smaller organisations, like Eclipse Home Care, take a focused approach. In 2017 they ran the "Ageing Redefined" pilot study, in partnership with Worcestershire County Council (EV4), using LifeCurve™ to track the care hours required for 7 individuals (EV5). All individuals reported increased confidence and independence leading to an average 15% decrease in required care hours over 6 weeks. As a direct result, Eclipse Home Care use "*LifeCurve™ assessments with a wider range of clients and were recently judged as outstanding by the CQC in the areas where [they] are using LifeCurve™*" (EV5). Eclipse Care Home confirms that "*The use of ADL LifeCurve™ assessment has led to improved independence of many of our clients*" and "*implementation of … interventions, with monitoring through LifeCurve™, has led to users retaining their independence for longer/having a high quality of life as they age*". Furthermore, they state that "*care workers have reported a higher satisfaction with their jobs, as they can help people to improve their independence*" (EV5).

Impacts on international institutions

LifeCurve™ use has recently expanded internationally. In June 2020, the Australian Government Department of Health incorporated LifeCurve™ into guidance for Commonwealth Home Support Program aged care providers (EV1, EV6, EV7). LifeCurve™ was chosen as it could "*influence industry about the importance of maximising the independence of older Australians to improve quality of life and compress aged related functional decline*" (EV7).

Also in 2020, the University of Auckland included LifeCurve™ as a key part of the 4 year AWESSoM project (Ageing Well through Eating, Sleeping, Socialising and Mobility). ADL SmartCare are working with the University of Auckland to develop, test and adapt LifeCurve™ for use with their ageing Māori, Pacific and Pakeha populations (EV1). The project seeks to "*find out if independent use of the LifeCurve™ App makes a difference in maximising independence, social connection, quality of life, wellbeing and function for older people living in the community*" (EV1).

Impacts on policy and publications

LifeCurve™ and the principles of CFD were also used as part of the Scottish Government's Active and Independent Living Programme in May 2017 to inform healthcare policy and improve the health of the Scottish population. Surveys were completed by 13,448 allied healthcare professionals and their service users, capturing a snapshot of the Scottish population's position on the LifeCurve™. There were 3 general categories of service user: no detectable functional decline; unable to perform heavy housework; or could not perform 10-13 of the ADLs. The annual costs per service user rose substantially with later interventions. An average of £2,700 was spent on "precurve" users, which rose to £12,330 for "late-curve" users. Moving just one space up the LifeCurve™ would save £640 per person per annum, which equates to an annual saving of £5M for the individuals captured in the survey alone (EV8).

In summary

LifeCurve™, based on Newcastle CFD framework and research, has led to timelier implementation of interventions in Scotland and England, increasing independence of individuals and reducing burden on healthcare providers. The utility of LifeCurve™ has been recognised internationally, with recent introduction in Australia and New Zealand.

5. Sources to corroborate the impact

EV1. Letter of support from ADL SmartCare Company Secretary regarding the LifeCurve™ platform. PDF available on request

EV2. Summary data from ADL SmartCare of the number of assessments in local authorities using LifeCurve™ as of 11th June 2020. PDF

EV3. Letter of support from the Service Manager of North Lanarkshire Council. PDF available on request

EV4. Worcestershire City Council webpage titled "Using the LifeCurve to improve care in Worcestershire". 21st June 2019. PDF. http://www.worcestershire.gov.uk/news/article/1828/using_the_lifecurve_to_improve_care_in_worcestershire

EV5. Letter of support from the founder and Managing Director of Eclipse Homecare. PDF available on request

EV6. Commonwealth Home Support Programme, Program Manual 2020-2022. Australian Government Department of Health. Section 2.2, Page 21. PDF

EV7. Email from the Assistant Secretary – Aged Care Regulatory Design and Implementation Branch, Australian Government Department of Health. 31st July 2020. PDF available on request

EV8. Kelso et al. (2020) The Scottish national LifeCurve™ survey: costs of function decline, opportunities to achieve early intervention to support well-being in later life, and meaningfulness of the LifeCurve™ *Public Health.* 180:129-135. DOI: https://doi.org/10.1016/j.puhe.2019.10.014.