



NHS INNOVATION ACCELERATOR

Economic Impact Case Study: Feebris

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Summary

Feebris is a system that enables community users to capture clinically reliable information on patients and assess risk outside of hospitals. For example, care home staff can conduct clinical assessments of care home residents. The system is intended to reduce the resources needed to monitor individuals and to enable early identification of deterioration in patients in the community. An implementation was carried out in 30 care homes in North East London, from which usage data was collated. The metrics relating to the impact on health care resource use, for which pre-implementation data were available, were NHS 111 calls, ambulance call-outs and conveyances, from which A&E visits and hospital admissions have been extrapolated. These data are used in a simple analysis here, which shows a potential benefits value over one year of £518,447, resulting from reduced NHS 111, ambulance and hospital services, if the baseline assumptions made in the analysis hold. This would result in a return on investment (ROI) of 5.07. Due to uncertainties and assumption in the analysis, caution should be taken when interpreting these results.

1. BACKGROUND

Feebris is a system that enables the health of older adults, including care home residents, to be monitored in their own place of residence by family or carers or even by the person themselves. This is intended to enable safe, ongoing monitoring of a person's health with less resource use than would be the case if, for example, a general practitioner (GP) or district nurse (DN) had to visit each time monitoring was required. In some circumstances, in the absence of the system, older adults and residents would not have regular health assessments and, as a consequence, deterioration of their conditions may go unnoticed. The assumed benefit of Feebris in this case study, is the ability to identify the need for intervention earlier and avoid the consequences of deterioration, which can include the use of health care services, including NHS 111 calls, ambulance conveyances, accident and emergency (A&E) visits and hospital admissions.

The Feebris system has both digital and physical elements. It consists of:

- The Feebris Kit, which includes: a smartphone, pulse oximeter, blood pressure (BP) cuff, digital infrared thermometer, wireless digital stethoscope.
- The Carer/Nurse Mobile Application, which allows those undertaking the monitoring to manage the caseloads, conduct clinical assessments, with decision-support algorithms providing alerts, and share any risks with the appropriate clinical professional.
- The Clinical User Portal, which allows GPs or other healthcare professionals to see data and images from the health assessments, to prioritise patients with signs of deterioration and to view detailed patient information and the evolution of vital signs.

The Feebris Kit enables non-clinicians to conduct clinical-level examinations to collect reliable and accurate readings of vital signs. For non-healthcare professionals, there is a risk in the use of remote monitoring systems, that poor quality or false readings are passed onto clinicians, wasting clinical time or provoking misleading clinical decisions. For example, pulse oximeters are small devices that clip onto the end of a finger, using photodetection to measure the saturation of oxygen in the blood, which is a vital sign.¹ The reading can be affected by patient movement, or signal noise due to ambient light, dirt, or nail polish, or poor peripheral circulation (common in older adults). A community user may not recognise these problems. Feebris is 'artificial intelligence (AI)-guided' in that it can select the reliable part of the signal from digital noise, and it can advise the user if a reading appears inconsistent with correct use.² The developers state that this removes a lot of error from the data which may otherwise prevent efficiencies from remote monitoring systems being realised.

Based on the established clinical guidelines, the system triages each person, according to the National Early Warning Score (NEWS), providing indications for action, including for example, to make a GP appointment for the person or to call for an ambulance. NEWS is a tool developed by the Royal College of Physicians, which is designed to improve the detection and response to clinical deterioration in adult patients. It is based on six physiological parameters: respiration rate; oxygen saturation; systolic blood pressure; pulse rate; level of consciousness or new confusion; and temperature. The latest update, as of December 2017, is NEWS2, with a key emphasis on system-wide standardisation and the use of physiological parameters that are already routinely measured.³ For patients with co-morbidities, standardised approaches such as NEWS may be insufficient. In such scenarios, the Feebris platform enables the personalisation of vital signs monitoring, as baselines and thresholds for escalation can be adjusted, with the personalisation first approved by a clinician.

¹ O'Driscoll BR, et al. BTS guideline for oxygen use in adults in healthcare and emergency settings. *Thorax* 2017;72:i1–i90. doi:10.1136/thoraxjnl-2016-209729

² Jones G. The role of AI augmentation in remote patient monitoring. Feebris case study 2. Published June 2021

³ Royal College of Physicians. National Early Warning Score (NEWS) 2: <https://www.rcplondon.ac.uk/projects/outputs/national-early-warning-score-news-2>

The developers of Feebris indicate that there are various settings in which it can be used, including: in care homes; as part of step-down care following hospital discharge (virtual wards); in community and district nursing; in primary care. The benefits of Feebris proposed by the developers vary depending on the setting and include:

- Reducing deterioration due to early detection of problems.
- Reducing the numbers of GP callouts to care homes.
- Reducing calls to NHS 111 and ambulance call outs.
- Reducing accident and emergency department (A&E) visits.
- Reducing avoidable hospital admissions.
- Improving the efficiency of DN home visits.
- Reducing delayed discharge from hospital.

In June 2020, the Feebris technology was deployed in a group of care homes in North East London. For many of the healthcare resource metrics there were no pre-implementation or comparator data available, which would have made a calculation of the full impact of Feebris possible. However, data on the use of NHS 111/999 and ambulance services from the care home, prior to implementation of Feebris, was available and this has been used in this case study to assess the potential economic value of implementing Feebris in this cohort of care homes.

This analysis was developed in summer/autumn 2022 and was based on the information and evidence available at the time. The limitations of the analysis are as follows:

- The only benefits for which pre-implementation data were available were: NHS 111 calls, ambulance call-outs, A&E visits and hospital admissions. As a result, the benefits may be underestimated.
- The data were derived from an observational study for one group of care homes using a 'before and after' analysis, so there is uncertainty in the results and scope for confounding factors to affect the base case data.
- No information was available on the demographics or levels of morbidity in the care home residents, so it is not possible to generalise the results with confidence.
- The developers indicate that the benefits in avoiding health care resource use derive from earlier detection of changes in vital signs and no additional actions are taken when this happens. A GP visit that would have occurred in any case, merely occurs earlier. This assumption has not been tested.
- The implementation of Feebris in the care homes took place during the Covid-19 pandemic, which may have had an impact on the levels of use and the impacts.

2. INPUT COSTS

The implementation in North East London involved 30 care homes, with a total of 1,000 residents. Although the number of residents varied over time, with new admissions and deaths, this is considered by the developers to be a reasonable average for the first year of implementation.

Feebris charges a license fee for the use of the software and a fee for the Feebris Kit. There is also an opportunity cost to care homes for the training of staff and for the time taken to undertake vital signs measures, or checks, with residents. The training costs are calculated on the basis of one registered manager and one care worker being trained in each care home (as advised by the developers). The training takes one hour. These training costs were then attributed over a five-year period, on the assumption that no further training would be needed in that time.

The developers advised us that carrying out checks of vital signs using Feebris takes on average 10 minutes and we have assumed that this would be carried out by a care worker, also that the approval by a clinician would take 5 minutes of GP or prescribing nurse time and would be necessary for 25% of patients on average. The values of these inputs are presented in Table 2.1 for the cohort of 30 care homes with 1,000 residents.

Table 2.1: Costs of using Feebris in 30 care homes with 1,000 residents for one year

Element	Cost	Total for cohort
Cost of Feebris including hardware and software	Based on 2 kits per home at £2,580 per home per year a	£77,400
Cost of Feebris checks	2,064 checks ^b taking 10 mins each of care worker time (£12.92/hr) ^c	£4,446
Cost of clinical approvals	5 minutes per approval for 25% of residents by GP or prescribing nurse ^a average cost of £13.50	£3,375
Costs of training	1 hour of training for a registered manager (£24.92/hr) and a care worker (£12.92/hr) in each care home d (£1,135 apportioned over 5 years)	£227
Total costs for 1 year		£85,448

Sources:

^a Information provided by Feebris

^b Annualised figure from data on implementation in NE London care homes

^c PSSRU.⁴ Average cost of GP and prescribing nurse (Band 7) for 5 minutes

^d Skills for Care. Adult social care workforce data. Workforce estimates.⁵

This shows a total cost of using Feebris for the cohort of 30 care homes, with 1,000 residents, to be £85,448 over one year. This is based on the assumptions set out above.

⁴ Personal Social Services Research Unit. University of Kent. Unit Costs of Health and Social Care 2021

⁵ Available at: <https://www.skillsforcare.org.uk/adult-social-care-workforce-data/Workforce-intelligence/publications/Workforce-estimates.aspx> Accessed 12/10/22

3. OUTCOMES

The Feebris system was implemented in care homes in North East London during the Covid-19 pandemic, and the developers report that it was considered unethical to delay the implementation in order to gather comprehensive baseline data on all of the benefits listed in Section 1 above. While there was no structured data collection from the implementation site and no comparator sites without the system, there are however, data available on calls to NHS 111 and use of ambulances from the care homes for a year prior to implementation of Feebris. This is used below, in a before and after comparison with the same data for the first year of implementation, to assess the potential impact of the system on these events. There are obvious limitations with this form of analysis and scope for confounding factors (such as other initiatives occurring at the same time), to affect the results.

The data relate to three types of service use on behalf of the care home residents:

- 'Incidents': calls to NHS 111/999 where at least one responder arrived on scene.
- 'Conveyances': which are when a person is taken to hospital in an ambulance.
- 'Blue calls': conveyances, where crew have pre-alerted the hospital of their arrival to ensure appropriate response due to the severity of the call.

The following tables show the calculated cost of reductions in these events. The calculations for the costs are set out in Table 3.1.

Table 3.1: Unit costs of health care events

Event	Cost	Source
NHS 111 call	£25.50	Turner et al. ⁶
Ambulance hear and treat and refer	£48	PSSRU 2021. Ambulance services (Weighted average of attendances)
Ambulance see and treat and convey	£265	PSSRU 2021. Ambulance services (Weighted average of attendances)
A&E visit	£269	NHS National Cost Collection 2020/21, Average cost Accident & Emergency.
Non-elective inpatient stays (short stays)	£827	PSSRU 2021. Non-elective inpatient stays (short stays). National average for England
Treatment of sepsis (non-elective long stay)	£6,383	NHS National Cost Collection 2020/21, Average cost Sepsis non-elective long stay

The events are costed by adding the above unit costs listed in Table 3.1, as follows:

- 'Incidents': NHS 111 call, ambulance hear and treat and refer.
- 'Conveyances': NHS 111 call, ambulance see and treat and convey, A&E visit, 23.8% having a short stay hospital admission⁷.
- 'Blue calls': NHS 111 call, ambulance see and treat and convey, inpatient treatment for sepsis.

⁶ Turner J, et al. Impact of NHS 111 Online on the NHS 111 telephone service and urgent care system: a mixed-methods study. Southampton (UK): NIHR Journals Library; 2021 Nov. (Health Services and Delivery Research, No. 9.21.) Chapter

⁷ Taken from: <https://digital.nhs.uk/news/2021/new-figures-released-for-ae-attendances-in-2020-21>).

The data on these events pre- and post-implementation of Feebris, and the economic value of the post-implementation change are shown in Table 3.2.

Table 3.2: Impact of Feebris on 111/999 calls, ambulance conveyances, A&E visits and non-elective hospital admissions over one year for cohort of 30 care homes

Event	1 year pre-implementation activity ^a	1 year post-implementation activity ^a	Difference	Unit cost	Total for cohort
Incidents	134	199	-65	£74	-£4,778
Conveyances	595	371	224	£757	£169,523
Blue calls	214	161	53	£6,674	£353,702
Total					£518,447

Sources:

^a London Ambulance Service conveyance data supplied by North East London Integrated Care System. Duplicate records removed.

Note a negative figure indicates an increase.

These data indicate that the use of Feebris in this cohort of care homes may be responsible for producing a benefits value over one year of £518,447 from reduced NHS 111 calls, ambulance conveyances, A&E visits and hospital admissions.

4. ECONOMIC ANALYSIS

The costs of using Feebris over one year, from Table 2.1 and the benefits from Table 3.2 give the following results:

Economic value of impact over one year	£518,447
Cost of using Feebris over one year	£85,448
Net economic impact	£432,999

A return on investment (ROI) for health care services can be calculated using the formula:

$$\frac{\sum \text{Total discounted benefits} - \sum \text{discounted costs}}{\sum \text{Total discounted costs}}$$

As the data cover only one year, no discounting is required and the results are:

$$\frac{\underline{\underline{£518,447}} - \underline{\underline{£85,448}}}{\underline{\underline{£85,448}}} \quad \text{ROI: 5.07}$$

Public Health England uses a formula for cost: benefit ratio as follows:

$$\frac{\sum \text{Total discounted benefits}}{\sum \text{Total discounted costs}}$$

This gives the following result:

$$\frac{\underline{\underline{£518,447}}}{\underline{\underline{£85,448}}} \quad \text{ROI: 6.07}$$

5. DISCUSSION

The analysis shows a net impact of using Feebris over one year in 30 care homes of £432,999, resulting from reduced use of ambulance services and the consequent admissions to hospital. This results in an ROI of 5.07. As there are other anticipated impacts from use of the system which are not included here, such as reduced GP visits and other health care use, this could be an underestimate of the full impact.

The pre-implementation data on 'incidents' (calls to NHS 111), 'conveyances' (when a person is taken in an ambulance and has an A&E visit) and 'blue calls' (ambulance journeys resulting in a hospital admission) are 0.9, 0.8, and 0.2 per resident per year. This is broadly similar to evidence from published literature, which indicates that care home residents will have, on average, 2 NHS 111 calls per care home resident per year,⁸ 0.98 visits to A&E per year, and 0.7 emergency admissions per year.⁹

The data used in this analysis were provided by the developers, based on London Ambulance Service conveyance data supplied by North East London Integrated Care System. Only pre-implementation data was available for comparative purposes. As a result, there is uncertainty in the results and scope for confounding factors to affect the base case data. The developers have suggested sepsis as a likely cause for blue call events. The high costs of treatment for sepsis partially drives the high level of economic benefit and the ROI.

There are some uncertainties which may affect the results of the analysis. It is not known, for example, how many people conveyed in an ambulance had long or short stay hospital admissions. To be conservative, we have assumed that the admissions prevented would have been short stay. In addition, there are no data on ambulance call-outs which did not result in the conveyance of a patient (with treatment or triage by paramedics, for example), which is a common type of response that would be expected. This implementation of Feebris in the care homes took place during the Covid-19 pandemic, which may have had an impact on the levels of use of the system and on the responses to the results of vital sign checks.

The identification of clinical risks would not, in itself, prevent NHS 111, ambulance or hospital use. Typically, in remote monitoring systems the identification of concerning signs is accompanied by a specific intervention by health care professionals. The developers of Feebris report that the actions prompted by a check-up align with existing patient pathways, but instead happen earlier. As a result, there is no additional resource use or cost. This assumption has not been tested.

The most important benefits of using Feebris would be the impact on the health of patients or care home residents, as a result of earlier detection of health issues or general deterioration. To gather data on this would require a substantive trial and it is not possible to make robust projections on this within the scope of this case study. Nevertheless, one may assume that there would be patient benefits which we have not been able to quantify here.

⁸ Giebel et al. Reducing hospital admissions in older care home residents: a 4-year evaluation of the care home innovation Programme (CHIP). *BMC Health Services Research* (2020) 20:94 <https://doi.org/10.1186/s12913-020-4945-9>

⁹ "The Health Foundation. Improvement Analytics Unit briefing. Emergency admissions to hospital from care homes: how often and what for? 2019

Most of the economic benefits measured in this implementation do not accrue to the care homes using Feebris. They accrue to the healthcare commissioners responsible for funding NHS 111, ambulance and hospital services. However, the ability to better monitor and care for patients would be of benefit to both the residents and the care homes where they reside.