Evaluation of Nobi Pilot, Lancashire and South Cumbria

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FORWARD FROM PETER SKINNER: PROGRAMME DIRECTOR, DIGITISING SOCIAL CARE

Over the coming years we expect technology to increasingly become part of how people experience and manage their own care. That may be technology they already have and use differently as their needs change or something purchased specifically to help maintain their independence.

But if I needed care tomorrow, I'm not sure what technologies I would use. Which ones would meet my needs, which would fit in with how I want to live, which would support how I want to be cared for. In short what would work best for me.

The Adult Social Care Technology Fund was intended to help fill in some of the blanks. Evidence from pilots such as this evaluation of the smart Nobi Lamps help to ensure people have the information they need to make more informed decisions – whether they are receiving care, a family member, a social worker or anyone else involved in an individual's care. It will help to make the case for investment to help people live independently for longer and to support care for people that need it. It will also provide key insight to local care systems that want to redesign how they provide care.

The pilot project that was led by Lancashire and South Cumbria ICB provides useful insight into a key priority area for health and social care. We know that falls are a big driver for hospital admissions from the social care sector and that once someone has had a severe fall, they often need further care in future. We also know that there is emerging evidence that supports more widespread use of technologies that enable a more rapid response to, and even prevention of, a fall.

This independent analysis by the University of Lancaster of the evaluation data collected by the ICB helpfully supplements and augments the existing evidence. It demonstrates how technology can reduce the consequences of a fall when it does happen but of particular interest is how using technology to identify the causes of a fall can avoid falls in future. Often it only requires small changes to someone's environment, their lifestyle and their care to reduce their future risk. Hopefully the findings of this report will be useful for other areas as they look at how social care can help to deliver the shift towards more preventative, neighbourhood-based health and care.

Peter Skinner, Programme Director, Digitising Social Care, NHS Transformation Directorate | NHS England

INFOGRAPHIC SUMMARIES

NOBI SMART LAMPS: EVALUATION RESULTS
60 second summary

Evaluation conducted in Lancashire & South Cumbria

The technology prevents falls by reducing the likelihood of experiencing a fall by **32%.**

Technology reduces overall ambulance callouts by **23%.** mainly by reducing callouts leading to hospital transport from nursing & residential care homes.

Effects of the technology on reduction of ambulance transfers from nursing & residential care homes to hospitals is likely to generate **annual net savings between £8,601 and £26,096 per home and between £490,237 and £1,487,480 across all homes.** There is potential for higher annual cost savings after using the device for 3 years

Response time of staff reduced from average of **11 minutes to less than 3 minutes, reducing long lies**

80% staff were confident in using the device to manage falls risks and felt it was easy to use

54% managers felt that there was improvement in residents' wellbeing

Recommendations

- To use the technology in nursing homes for greater potential cost savings.
- To use the playback facility of the device to inform transfers to emergency services.
- To use the device to support medication reviews and environmental changes for preventing falls.
- Build robust and reliable network infrastructure in care homes.

NOBI SMART LAMPS: EVALUATION RESULTS

EXECUTIVE SUMMARY

Falls among older adults can lead to long lies and injuries, causing immense strain on healthcare resources and impacting residents' quality of life.

There is a lack of robust research that evaluated the efficacy and long-term cost-effectiveness of ambient fall detection devices in reducing falls, injuries, long lies, ambulance calls and hospitalisations

Intervention

68 nursing & residential care homes
800 lamps installed in high fall-risk residents' bedrooms.

Objectives

- To determine if this technology prevents falls, long lies, ambulance call outs and hospitalisations.
- To determine if this technology changed how care homes deliver care for residents.
- To determine the impact of this technology of residents' quality of life
- To assess if Nobi lamps can support care in a different way to a 1-1 package of care and be the least restrictive practice.
- To assess if this approach offers value for money.
- To consider how this intervention can be scaled.

Methods

Mixed methods (quantitative+qualitative)

- Technology data about fall occurences everyday.
- NWAS ambulance data
- Questionnaire responses of care home staff and managers about their perception of the device & feedback about device from email exchanges and meetings.
- Site-specific deep-dive case studies.

Key results

Falls prevented

32% reduced risk of falls

Staff response time to falls reduced

11 min → less than 3 minutes

Overall ambulance callouts

Reduced by 1.48 callouts per month per care home translating to 23% decrease mainly by reducing callouts leading to hospital transport.

80% of the staff were confident in using the device to manage falls risks

Better assessment of potential reasons for falls that is useful to make environmental modifications to reduce falls

"You can make environmental changes to people's bedrooms because you can see what's happening."
(Deep dive case study, Kendal care home)

54% managers reported improvement in residents well being

Estimated NHS savings (annualised) due to reduced ambulance call outs resulting in hospital transfer and long hospital stays

From £8,601 and £26,096 per home and £490,237 and £1,487,480 across all homes

There is potential for higher annual cost savings after using the device for 3 years

Recommendations

- To use the technology in nursing homes for greater potential cost savings.
- To use the device in fall prevention programmes in environments similar to residential and nursing care homes where immediate help for falls is available.
- Use the device to support enabling improvement in sleep quality and medication reviews and environmental changes to prevent falls.
- Ensure support from leadership and authorities at care homes for effective scaling up.
- Ensure continuous training for care home staff on the use of the device and ensure open communication with technology provider to address concerns and questions about the device.

60 Second Summary

Falls among older adults can lead to several negative outcomes including long lies (older adults unable to get up after a fall for up to an hour), injuries and fractures leading to hospitalisations and deterioration in quality of life. This report presents the findings of the evaluation of the efficacy of an advanced ambient artificial intelligence-based fall detection device in reducing falls, long lies, hospitalisations and ambulance calls among care home residents across Lancashire & South Cumbria. This evaluation also explored the impact of the use of the device on the quality of care provision and work patterns of care home staff.

These were the key findings of the evaluation:

1. The technology reduces the likelihood of experiencing a fall in a day by about 32%. That is, from an average of 1.85 falls per resident per month to about 1.28 falls per resident per month.
2. There was a reduction in total ambulance call-outs by 23%, that is, 1.48 fewer call-outs per care home per month. Ambulance call-outs resulting in hospital conveyance were statistically significantly reduced by 24%. This suggests the technology facilitated more effective triage, completed remotely by phone or within a care home, reducing the need for hospital transfer e.g. where no head injury was identified in the Nobi footage.
3. The reduction in call-outs is driven mainly by the reduction in call-outs with hospital conveyance.
4. The intervention alone is likely to generate an average annual net saving between £8,601 and £26,096 per home, with annual net savings across all homes between £490,237 and £1,487,480. Higher potential cost savings per year are expected after 3 years of using the device.
5. There was a significant improvement in the care home staff response times to fall occurrences from an average of 11 minutes before the Nobi device was used to an average of 2.99 minutes after this device was implemented. This showed that the device helped in reducing long lies among the residents
6. The majority of the care home managers felt that the use of the technology contributed to an overall improvement in the well-being of the residents (54.2%).
7. The majority of the care home staff felt that the technology was easy to use, and they felt confident in using the technology to manage fall risks (80%).

Thus, the findings of the evaluation showed that the device could be an effective component of personalised multi component fall prevention interventions. This report also provides recommendations for future research on evaluating similar fall detection devices and ways to effectively implement and scale up the device.

EXECUTIVE SUMMARY

Unwitnessed falls that can potentially lead to long lies (older adults unable to get up after a fall for up to an hour), injuries and fractures are a major concern among older adults in the UK, particularly in the Northwest of England. Long lies can also lead to additional health complications such as pressure injuries and dehydration. Falls can lead to increased costs for healthcare services with each ambulance call-out to deal with fall related consequences costing around £252 and hip fractures costing the NHS £14,000 - £14,600 per patient in inpatient care. Therefore, the need for digital technology in Nursing and Residential care homes is being emphasised with the aim of developing a more preventative approach.

This evaluation aimed to analyse a pilot whereby smart lamps ("Nobi" lamps) are placed in the rooms of care home residents at risk of falls. Before we began the range of analyses, we conducted a scoping review aiming to map out what is already known in this area. The findings of the majority of the studies showed that fall detection devices were not effective in reducing falls and injuries but they were effective in reducing hospitalisations, ambulance calls and long lies. However, the review identified a lack of robust research that evaluated the efficacy and long-term cost-effectiveness of ambient fall detection devices in reducing falls, injuries, long lies, ambulance calls and hospitalisations. Thus, a need for further research in this area with larger sample sizes, adequate reporting of methodological details and comparator groups was identified.

Responding to this gap in what we know about how well such technologies support people at risk of falling, an independent evaluation of a pilot implementation of an advanced ambient artificial intelligence-based fall detection device, the Nobi lamps, was conducted. The aim was to assess the technology's effectiveness in improving care provision, staff response times to falls and long lies as well as ambulance calls. We also wanted to know if the technology could work in a preventive manner and be associated with a reduction in number of falls.

The objectives of the evaluation were as follows:

1. To determine whether this technology has reduced resident falls and prevented future falls, reduced the staff response time after a resident has fallen and before help comes (reducing long lies), and reduced ambulance call-outs, distinguishing those leading to hospital conveyance from those where no conveyance occurred.

2. To determine whether this technology has changed how Nursing and Residential care homes deliver care for the residents they support.

3. To determine what impact this technology has had on residents' quality of life.

4. To investigate in what kind of circumstances Nobi lamps can support care in a different way to a 1-1 package of care and be the least restrictive practice?

5. To determine whether this approach offers value for money, using the Northwest Ambulance Service NHS Trust (NWAS) data on ambulance call-outs to infer costs avoided driven by the falls prevention capacities of Nobi.

6. To consider how this intervention can be scaled and sustained

Eight hundred Nobi lamps were implemented across Nursing and Residential care homes across Lancashire and South Cumbria, selected as homes with a relatively high number of ambulance call-outs over the previous 12 months. The lamps were mainly implemented in bedrooms of residents with high risk of falls. Infrastructure checks were conducted by the technology provider to make sure adequate Wi-fi and other infrastructure was present in the homes to use the technology and training on how to use the device was provided to the staff and managers.

A mixed methods approach using a range of data sources was used to meet the objectives. This enables us to look at both whether falls, long lies and ambulance call-outs are reduced, using numerical data (data provided by the Nobi devices, data from the North West Ambulance Service (NWAS), data from a questionnaire, the Care Home Staff & Managers Questionnaire (CHSMQ) and also how such changes might actually be working – what are the mechanisms. This component used qualitative data (staff and managers' experiences) from the questionnaire and from feedback on the perceived benefits and any challenges staff experienced. In order to examine how all this data looks for one specific care home, we also examined it in a "deep dive" case study. This mixed approach is important to enable recommendations for improvements, scaling up or other similar projects, and one set of data can support the other.

Objective 1: The Nobi device was first implemented in Nursing and Residential care homes in learning mode when the technology monitored falls without staff notification, enabling baseline response times to be established prior to full technology deployment. The number of falls in this time period was compared to the falls in the active mode when falls were recorded, and trained care staff were immediately notified to respond to falls. Quantitative analysis compared the fall frequency and staff response times in these two time periods. The results showed a significant improvement in staff response times to falls, with an average reduction of 8 minutes (from 11 minutes in learning mode to just under 3 minutes in active mode). Falls are reduced by about 32%, from an average of 1.85 falls per resident per month in the learning mode to about 1.28 falls per resident per month in active mode. The qualitative data corroborated the quantitative data as the respondents felt that the device helped in reducing long lies among residents. They reported that the playback facility provided by the smart lamps enabled future falls to be prevented, by identifying potential causes of falls. This helped the staff in making environmental modifications to the care home bedrooms such as moving furniture to reduce tripping hazards. The playback facility was also used to support identification of the extent of injuries which could support decisions on ambulance call-outs and subsequent possible conveyance to hospital. The number of call-outs that led to a resident being taken to hospital significantly reduced by 1.48 call-outs per month per care home from a baseline average of 6.58 per month per care home (a 23% decrease).

Objective 2: The open and close-ended questions of the CHSMQ, benefits reporting data and the deep dive case study which included a semi-structured interview with the manager of Kendal care home were analysed to determine whether there were any changes in care provision due to the use of the Nobi device. Most care home staff and managers felt that the device was easy to use and improved their efficiency in responding to falls. The device also helped in personalising care by tailoring the use of the device and care responses according to the fall risk of the residents, for example, by notifying the staff about high-risk residents sitting at the edge of the bed. Most staff and management were confident in using the device but felt that continuous training for the staff was very important to enable them to accurately document fall incidents and manage fall risks. Some care staff reported that the device enabled them to reduce visits to check on specific residents in the night, and others reported that number of nighttime visits could be better targeted to those at higher risk.

Objective 3: The open and close-ended questions of the CHSMQ, benefits reporting data and the deep dive case study were analysed to assess potential impacts on quality of life. There were positive impacts on health-related quality of life and sleep quality as the sleep reports generated by the device allowed staff to identify potential causes of sleep disturbances. Changes in number of night time visits may also have aided sleep quality. Sleep reports also helped in informing medication reviews and/or mental health services.

Objective 4: The qualitative data obtained from the CHSMQ, benefits reporting data, and the deep dive case study demonstrated that there were limited reductions in one-on-one care packages across Nursing and Residential care homes, especially as many of these residents had high fall risks. However, it allowed staff to personalise care by reducing care packages for individuals when required but increasing the monitoring of residents with high fall risks. Data from a separate study with the same lamps and working with just three care homes suggests potential benefit and cost saving.

Objective 5: A quantitative analysis of NWAS data was conducted to compare changes in ambulance call-outs between Nursing and Residential care homes with Nobi installed and those without the device. The findings indicate that the technology decreased the total number of call-outs by 1.485 call-outs per month per care home (23% decrease). This was mainly driven by a reduction in “See & Convey” call-outs (resulting in a hospital visit), by a 0.84 call-out per month per care home (24% decrease). Results were statistically significant. The technology has a strong potential to be cost saving, particularly when targeted at high-risk care home residents at elevated risk of falls. The analysis suggests that Nobi may contribute to both improved life expectancy and enhanced quality of life (by avoiding injurious falls). Cost-saving estimates suggest that this intervention, implemented in approximately 20% of rooms across 57 Nursing and Residential care homes, was likely to have generated annual NHS net savings of between £490,237 and £1,487,480 by reducing costly hospital admissions and subsequent rehabilitation care. These savings are projected to grow over time, as once the upfront installation costs are covered, only ongoing maintenance expenses are incurred from year three onwards. For example, at 5 years, the intervention’s present value of savings could grow to between £2,885,812 and £7,546,005, while at 10 years it could amount to between £6,229,862 and £14,813,813.

Objective 6: Qualitative data obtained from the CHSMQ showed that intention to use the device in the long-term was influenced by the funding available to implement it, cost-effectiveness of the device, and support of the higher authorities. Potential improvements to usability by allowing integration of Nobi data and adequate infrastructure in Nursing and Residential care homes are required for effective scalability of the device.

In summary, results showed that the device can be an effective component of personalised multicomponent fall prevention programmes as it can help in informing medication reviews and environmental modifications to reduce fall risks. However, our analysis of qualitative responses suggested that continuous training of the staff on how to use the device, and open communication between staff, managers and the technology provider is essential for effective use of the device to manage fall risks. Long-term cost-effectiveness, funding to use the device and the views of the higher authorities regarding the device should be considered to effectively scale up the device. Further research would be beneficial to assess the implications of implementation of such technologies for the residents, the Nursing and Residential care homes, the care workers and the NHS more generally in terms of cost effectiveness.

AUDIENCE:

The intended audience of this document consists of the Digital implementation Steering group, ICBs (care workers, social workers, nursing staff), Local Authority tech people and decision-makers, Digital Social Care team at a national level, Dept of Health and Social Care, social workers, nurse practitioners, care home organisations.

SECTION 1: BACKGROUND

1.1 WHAT IS SPECIAL ABOUT CARE TECHNOLOGY AND WHY IT IS NEEDED IN NURSING AND RESIDENTIAL CARE HOMES?

Digital technology is rapidly reshaping adult social care, with tools increasingly designed not just to record care but to actively enhance safety, independence and quality of life. Modern solutions such as AI enabled, sensor-based technology (including Nobi, the Smart Lamp at the focus of this evaluation, see Section 1.3) shift practice from *reactive* monitoring to *preventative* care. Instead of relying on residents to activate alarms or staff to notice incidents, these systems operate discreetly in the background, analysing patterns, detecting risks such as changes in movement or behaviour and alerting staff in real time.

The need for this approach is increasing. Across Lancashire and South Cumbria, providers are supporting people with greater frailty, more advanced dementia and higher levels of clinical complexity, while also facing significant staffing pressures. Falls continue to be the most common incident reported by local care providers, year after year and many Nursing and Residential care homes consistently experience falls rates above 22% per 100 beds. These homes were prioritised for Nobi because they face the greatest risk and have the most to gain from technology that can prevent unwitnessed falls, accelerate staff response and reduce avoidable harm.

By combining early detection, timely intervention and data-driven insights, care technology can support safer environments, relieve pressure on staff and improve residents' quality of life, making it an increasingly vital component of modern adult social care.

1.2 FINANCIAL AND PERSONAL IMPLICATIONS OF UNWITNESSED FALLS

Unwitnessed falls (resulting in long lies or undetected injuries) are a major concern for older people across the UK and particularly in the North West, where high fall rates and pressure on emergency services amplify the risks. Prolonged time on the floor is strongly associated with serious physical harm including dehydration, pressure injuries, rhabdomyolysis (potentially fatal muscle breakdown) and long-term loss of mobility. A systematic UK review found that around 20% of older adults who fall experience a long lie lasting over one hour, resulting in significantly worse health outcomes and higher likelihood of hospitalisation and long term care transitions (Holland & Watkins-Webb, 2025). Similarly, a prospective cohort study in Cambridge, UK, also showed that 30% of people aged 90+ remained on the floor for over an hour after a fall, with long lies strongly linked to serious injuries, hospitalisation and permanent moves into care settings (Fleming et al., 2008; Baji et al., 2023; National Institute for Health and Care Excellence, 2023). This is compounded by ambulance delays: the North West Ambulance Service (NWAS) receives substantial annual 999 call volumes for older fallers, with evidence of extended waits for non-life threatening falls (NWAS, personal communication, August 31, 2022; Centres for Disease Control & Prevention, 2026).

Falls are among the leading causes of emergency admissions from Nursing and Residential care homes in Lancashire and South Cumbria. Ambulance attendances for falls cost around an average of £252 per call-out for care home incidents and nationally, nearly 4 million fall related call-outs occurred over four years, consuming close to £1 billion in ambulance resources (Felgains, 2023; Caring Times, 2024, British Geriatrics Society, n.d.; Digital Bay Tech, n.d.).

Injury rates also carry substantial cost. In the UK, 5% of falls result in fractures and 10% cause serious injury (Caring Times, 2024). Hip fractures, one of the most severe consequences of unwitnessed falls, cost the NHS £14,000 - £14,600 per patient in inpatient care alone and have one year mortality rates above 25% (University of Bristol, 2023; Baji et al., 2022).

Locally, Lancashire's emergency admission rate for falls among older adults is 1,643 per 100,000 (65+), broadly comparable with national patterns and still a major driver of hospital activity and long-term dependency (Department of Health & Social Care, n.d.; Lancaster County Council, 2025).

This context underpins the region's investment in AI enabled care technology. The initial small Lancashire & South Cumbria Smart Nobi lamp pilot (in which Nobi lamps were implemented in 8 bedrooms in Heartland house care home) demonstrated an 84% reduction in falls, 100% detection and a drop in average response times from 57 minutes to under 2 minutes, substantially reducing the likelihood of long lies and associated harm in one care home (Digital Care Hub, n.d.; Nobi, 2024; LeadingAge Centre for Ageing Services Technology, n.d.) and similar levels of benefit in a study with seven care homes (Irving, 2025). The much larger pilot presented here will examine the same measures over a larger number of homes and increased Nobi lamp use.

Local modelling for Lancashire County Council indicates that installing 450 Nobi lamps in high-risk homes could prevent c.45 serious injuries, c.23 fractures and c.5 hip fractures, generating £546,000 in savings over three years (based on REDUCED cost ranges and North West falls prevalence). This aligns with local ICB falls prioritisation methods using incident rates, 999 calls for falls, Provider Assessment and Market Management Solution (PAMMS) quality indicators and Urgent Community Response (UCR) data (NHS Lancashire & South Cumbria Integrated Care Board n.d.; Digital Bay Tech, n.d.).

1.3 DESCRIPTION OF THE NOBI TECHNOLOGY AND ITS POSSIBLE OUTCOMES

Nobi Smart Lamps are an advanced, AI enabled care technology designed to improve safety, reduce unwitnessed falls and support more preventative, insight driven care within residential and nursing home environments. Functioning as both a ceiling light and an intelligent monitoring device, Nobi combines computer vision, optical sensors, radar based vital sign detection and environmental support features within a single discreet unit.

The lamps continuously analyse resident movement using a high performance Nvidia processor capable of over 1 billion calculations per second, enabling real time fall detection with reported 100% accuracy and zero missed falls in UK pilot sites. Once a fall is detected, Nobi issues an immediate alert to staff mobile devices, with early evidence showing a reduction in response times dramatically (from an average of 57 minutes to under 2 minutes) during the initial Lancashire & South Cumbria small scale pilot, thereby eliminating long lie risks and associated harm.

In addition to detecting falls, Nobi supports fall prevention through integrated smart lighting features. Soft, automatic illumination activates when a resident gets out of bed, reducing disorientation and nighttime falls, which are known to be the most injurious. The system also incorporates fall prediction functionality, issuing alerts when unusual or unstable movement patterns are identified, enabling staff to intervene before a fall occurs.

The lamps further contribute to improved safety and care quality through privacy protected incident insight. Image analysis is processed locally on the device. Where a fall occurs, data or images are only shared externally in line with resident consent and configured privacy settings. All data is processed locally within the device to ensure robust privacy. Residents choose between full image, stick figure mode or no image. When a fall does happen, Nobi provides a short sequence of anonymised images to support root cause analysis, enabling homes to identify patterns such as poor footwear, clutter, nighttime wandering or medication effects. This data driven learning supports better care planning and targeted risk reduction interventions. The details of the current features of the Nobi device and the additional features that are being planned to be implemented in the future is presented in appendix 1.

As a result, the anticipated outcomes for Nursing and Residential care homes include:

- Significant reductions in unwitnessed and unreported falls through accurate real-time detection.
- Lower ambulance activity and reduced hospital conveyance by preventing long lie injuries (lying on the floor for 30 minutes or more) and enabling rapid onsite response.
- Improved workforce efficiency, with staff spending less time on routine night checks and more time on personalised care.
- Enhanced safeguarding and quality assurance as a result of objective data that helps demonstrate compliance with CQC expectations around fall prevention and incident learning.
- Greater resident and family reassurance, as timely interventions reduce harm and support safer independent mobility.

- Improved care planning, informed by behavioural and environmental insights derived from continuous, privacy-respecting monitoring.

Nobi Smart Lamps provide an integrated monitoring and prevention system that not only detects events but helps change the circumstances in which falls occur, supporting a proactive, preventative, safer and updated model of residential care.

1.4 BACKGROUND TO THE NOBI PROJECT IN LANCASHIRE AND SOUTH CUMBRIA

Lancashire & South Cumbria ICB accelerated their adoption of Digital Social Care Records (DSCR), aligning to the national ambition for at least 80% of CQC registered providers to be using an assured DSCR by March 2025. National programme updates confirmed the 80% target was on track through 2025, with an assured supplier framework in place to govern quality and standards. This work sat within the wider People at the Heart of Care reform agenda, which committed £150m for adult social care digitisation and set out a plan to scale proven technologies alongside DSCR (Lovell, 2025; Department of Health & Social Care, 2022; Government of UK, 2022; NHS England, n.d.; CARE, n.d.; Digital Health, 2025).

Because Lancashire & South Cumbria ICB met DSCR milestones early, the team were able to allocate a limited portion of the budget to sensor-based falls technology. In July 2023, they rolled out Vayyer radar sensors as a low-cost option. While the devices were low-cost, homes reported false positives (e.g., “falls” that weren’t falls) and significant alarm fatigue. Staff feedback was clear: the tech created workload without proportionate benefit. Those lessons shaped our specification for a second, higher fidelity solution.

Having seen promotional literature on a new product, their potential to detect every fall and cut response times to minutes, the team approached the national programme and secured £40,000 to pilot Nobi Smart Lamps in two care homes with the highest falls and ambulance activity. The package covered 8 lamps per home, installation, training, software updates and dashboard access for seven years.

The pilot focused on:

- Reducing unwitnessed and hidden falls;
- Shortening long lie durations through immediate alerts;
- Lowering ambulance call-outs and conveyance;
- Generating actionable insights to inform care plans (e.g., nighttime mobility, post meal patterns).

Across the two homes, falls fell substantially (range 55% – 84% when prevention features were active) and response times improved to under two minutes in one site, transforming safety and staff confidence (LeadingAge Centre for Ageing Services Technology, n.d.; Nobi, n.d.).

On the strength of the pilot, Nobi was selected for scaleup in 2024/25 as part of the L&SC care technology workstream under the Digitising Social Care umbrella. National policy context remained supportive of sensor-based falls solutions, with invitations for Integrated Care Board (ICB) led bids and exemplars published throughout 2023–2024. Lancashire and South Cumbria (LS&C) ICB was allocated £710,500 for care technology in FY 2024/25, supplemented by DSCR underspends from prior years, to fund approximately 800 Nobi lamps across 80 Nursing and Residential care homes with consistently high falls or 999 calls for falls. This investment complemented our regionwide falls priorities and supported the ICS strategy to reduce avoidable harm, ambulance activity and admissions while strengthening digital maturity (Department of Health & Social Care, 2022; Nursing in Practice, 2024; Government of UK, 2024).

1.5 KEY PARTNERS AND STAKEHOLDERS

The delivery and scaleup of the Nobi Smart Lamp programme in Lancashire and South Cumbria is underpinned by a broad and well-coordinated partnership spanning health, social care, technology suppliers and operational services. Each partner plays a distinct and critical role in ensuring the programme is safe, effective, sustainable and aligned to both national and local priorities.

Delivery of the Nobi programme was led by the L&SC ICB Digital Social Care (DiSC) team, working in partnership with a wide range of organisations across health, social care, and the technology sector. Partners were as follows:

Lancashire & South Cumbria Integrated Care Board (ICB) – Digitising Social Care (DiSC) Team
The ICB provides strategic leadership, programme governance and oversight of quality and safety. It is responsible for commissioning decisions, funding allocation, evaluation oversight and ensuring that the project aligns with the wider draft ICS Falls Strategy and Digitising Social Care programme. The ICB also manages relationships with national teams and assures compliance with DHSC and NHS England requirements. ICB partners also included the Adult Social Care Quality Team (hosted by L&SC ICB) and the ICB All-Age Clinical Care Sector

Local Authority Partners (Four Councils)

- Lancashire County Council
- Blackburn with Darwen Unitary Authority
- Blackpool Unitary Authority
- Westmorland and Furness Unitary Authority

These authorities played a vital role in identifying priority Nursing and Residential care homes, supporting provider engagement, ensuring safe information governance and consent processes and embedding the technology within wider adult social care improvement frameworks. They also ensure alignment with safeguarding, commissioning and quality assurance responsibilities across each locality.

Care Home providers
Participating providers are central to the programme's success. They implement the technology in practice, ensure staff training and adoption, provide feedback on usability and impact and support the evaluation by sharing operational and incident level insights. Their involvement ensures the technology is embedded in day-to-day care and delivers meaningful improvements in resident safety.

Nobi (Technology Partner)
Nobi provides the AI enabled smart lamp technology, technical expertise, installation guidance and ongoing software updates. They support Nursing and Residential care homes with training, analytics and incident-based learning, ensuring the system is used safely and effectively. Their evaluation insights help the ICS understand patterns in falls, long lies and resident mobility.

Porters Care (Installation and Integration Partner)
Porters Care manages physical installation, configuration and troubleshooting of the devices. They ensure each deployment meets the technical requirements for Wi-Fi, electrical safety and device stability. They also act as the primary liaison for aftercare support and maintenance.

North West Ambulance Service (NWAS)
NWAS is a key stakeholder given the strong relationship between falls, long lie events and ambulance call-outs. The service provides incident data, supports evaluation of impact on conveyance rates and helps the ICS measure the programme's contribution to reducing system pressure and improving patient outcomes.

Falls-Lifting and Community Response Services
Urgent Community Response (UCR), falls-lifting teams and community frailty services help contextualise Nobi data and respond to alerts where appropriate. Their involvement is essential in understanding operational impact, response times and opportunities for integrated pathways.

PAMMS (Performance and Quality Reporting)
PAMMS reporting is used to validate fall-related incident activity and triangulate improvements in quality, safety and compliance at provider level. This historic data informed the prioritisation of homes with high falls incidence and continues to support outcome monitoring.

NHS England (NHSE)
NHSE provides national oversight of the Digitising Social Care programme, including the policy framework, funding conditions, technical assurance and evaluation methodology. Their involvement allowed L&SC to secure pilot funding for Nobi and aligns the project with national ambitions for DSCR adoption and sensor-based technologies.

Department of Health and Social Care (DHSC)
DHSC sets the national policy direction through the *People at the Heart of Care* white paper and broader reform agenda, including the £150m digitisation fund and guidance on technology enabled care. The department provides the strategic mandate for adopting digital and sensor-based innovations to reduce harm and improve adult social care outcomes.

Residents and families

1.6 REASONS FOR EVALUATING THE PROJECT

Evaluation of the Nobi Smart Lamp programme is essential to demonstrate whether the technology is delivering the intended improvements in safety, quality and outcomes for people living in Nursing and Residential care homes across Lancashire and South Cumbria. A structured evaluation enables the system to evidence reductions in unwitnessed falls, fall-related injuries, ambulance call-outs and long lie incidents and allows the ICS to quantify changes in response times and resident outcomes following implementation. It also provides the data required to understand the financial impact of the technology, including whether early intervention reduces conveyance, hospital admissions, safeguarding activity or the need for high cost 1:1 care. Given the pressures on both the NHS and adult social care budgets, an understanding of the return on investment is critical for future planning and commissioning decisions.

Equally important is the need to assess how well the technology has been implemented across a diverse provider landscape. Evaluation helps to identify variations in staff engagement, digital skills, WiFi reliability, workflow integration and the everyday practicalities of using the system. This ensures that any future scale-up is informed by real-world insight and that providers receive the right support to embed the technology safely and sustainably. The evaluation also fulfils national assurance requirements linked to the Digital Social Care Fund, administered by NHS England and supported by DHSC, ensuring the programme demonstrates effective use of public funding and contributes learning to the wider digitisation agenda.

A further justification for evaluation is the limited availability of strong, peer-reviewed evidence on the effectiveness of sensor-based fall prevention technology within UK care homes. While there is substantial research describing the harms associated with long lies and the consequences of unwitnessed falls, there remains relatively little published academic evidence demonstrating which ambient or AI-enabled technologies reliably prevent falls, reduce injuries, or improve response times in real world residential settings. Most existing studies focus on wearables, hospital-based technology trials, or small scale supplier evaluations, as can be seen in the literature review presented in Section 2. As a result, Lancashire and South Cumbria's evaluation offers an important opportunity to contribute robust, UK specific evidence to an area that has historically lacked independent research. This will support future investment decisions both locally and nationally, helping the sector to determine which technologies genuinely improve safety and which offer limited value.

Ultimately, this evaluation will play a critical role in shaping future commissioning across the ICS, guiding decisions on scaling Nobi or alternative technologies and informing integrated falls pathways involving NWAS, urgent community response teams, lifting services and primary care. The learning generated will support the development of a more proactive, preventative model of care and strengthen digital maturity across the adult social care sector in the region.

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SECTION 2: SCOPING REVIEW OF EXISTING EVIDENCE ON EFFICACY AND COST-EFFECTIVENESS OF FALL DETECTION DEVICES AIMED AT REDUCING FALL RATES, INJURIES, HOSPITALISATIONS, AMBULANCE CALLS AND LONG LIES

2.1. INTRODUCTION

Accidental falls are a major health concern among older adults as they can result in injuries, and hip and wrist fractures. Older adults with osteoporosis are particularly susceptible to injuries and fractures due to falls (Ward et al., 2012; Vaishya et al., 2020). Falls are also a common cause of ambulance call-outs and hospitalisations among older adults (Blackburn et al., 2022). For example, the Public Health outcomes framework reported that approximately 220,160 emergency hospital admissions in the United Kingdom (UK) in the years 2017 and 2018 were due to falls among individuals above 65 years of age (Public Health England, 2020). Moreover, a potentially serious consequence among older adults is the inability to get up after a fall which can lead to "long lies" (not being able to get up after a fall for over an hour) and further complications such as dehydration, hypothermia and pressure related injuries (Blackburn et al., 2022). Increased falls can also lead to increased healthcare costs for older adults and healthcare systems, with an estimated cost of 2.3 billion to the National Health Services (NHS) in the UK (Blackburn et al., 2022; National Institute for Health and Care Excellence, 2013).

Much of the literature on fall prevention is related to exercise programmes, medication reviews, environmental modifications and home hazard interventions (National Institute for Health and Care Excellence, 2025). However, these interventions can be challenging to design; they are often complex with wide variability in the content and delivery of the components and the effectiveness depends on the extent to which they have been personalised and adapted for individual needs (Lee & Yu, 2020). Moreover, these interventions are not designed to have impact on helping caregivers to attend to older adults who have fallen promptly and on reducing long lies (Blackburn et al., 2022), and this is the focus of this review.

Fall detection devices can reduce long lies among older adults by detecting and sending alerts to the caregivers when a fall occurs, enabling them to promptly intervene (Yeoh Lui et al., 2025). Fall detection devices have traditionally focussed on wearable pendants or alarms that can be worn on the wrist or around the neck and used by the older adult to report a fall by pressing the alarm button (Ward et al., 2012). More recent advancements in fall detection technologies include technologies that use sensors to detect sudden changes in movement and body orientation to automatically detect falls. These can be wearable sensor-based technologies like accelerometers or non-wearable ambient technologies that can be installed in individuals' living environments to automatically detect falls (Yeoh Lui et al., 2025), with fall detection mattresses to detect and reduce the impact of falls being most commonly implemented in care homes (Fernández-Bermejo Ruiz et al., 2022)

Despite the potential of fall detection devices to reduce long lies and prevent falls, there is a lack of reviews and high-quality primary studies (National Institute for Health and Care Excellence, 2025) that have assessed their efficacy and cost-effectiveness in reducing fall incidents, injuries, hospitalisations and long lies (Yeoh Lui et al., 2025). Previous reviews have mainly assessed the technical aspects in terms of specificity, sensitivity and accuracy of fall detection by these devices (Yeoh Lui et al., 2025). Moreover, systematic reviews evaluating efficacy of fall detection devices in reducing fall incidents have only included studies conducted in particular contexts such as hospitals (Cortés et al., 2021) or long-term residential settings such as nursing homes (Yeoh Lui et al., 2025).

Therefore, a scoping review was conducted to ascertain the effectiveness and cost-effectiveness of fall detection devices in reducing fall incidences, injuries, long lies, ambulance calls and hospitalisations. To the best of the authors' knowledge, this is the first review that included evaluation of the cost-effectiveness of the fall detection devices in reducing falls, injuries, long lies and hospitalisations. The scoping review methodology was chosen as it is particularly suitable for mapping relevant literature of interest, especially when the topic is emerging, complex and heterogenous (Peters et al., 2021; Arksey and O'Malley, 2005). Such reviews also draw on evidence from any research methodology and can also include "grey" literature (reports not published in peer reviewed journals, e.g. industry or healthcare reports). Therefore, a scoping review can help in gaining a comprehensive understanding of the literature, identify gaps in the literature and inform future research (Peters et al., 2021).

2.2. METHODS

The scoping review was conducted and reported according to the frameworks by Joanna Briggs Institute (Peters et al., 2021) and Arksey and O'Malley (2005). Formal literature searches were conducted in the databases Medline and Embase from January 2015 to December 2025. The research team used the lower cut-off date of January 2015 to increase the likelihood of including studies that evaluated the effectiveness of recent developments in fall detection technologies such as technologies that integrate artificial intelligence to detect and prevent falls (Li et al., 2025). The detailed search terms and strategies for each database are presented in Appendix 2. Additionally, consultation with the Lancaster and South Cumbria ICB led to identification of relevant grey literature documents for inclusion in the scoping review. Hand-searching of reference lists of reviews and book chapters was also done to identify any relevant studies. The inclusion and exclusion criteria of the studies in the scoping review were as follows:

Inclusion criteria:

- Outcomes: Studies were included if they evaluated the effectiveness and/or cost-effectiveness of any fall detection device in reducing falls, injuries, hospitalisations, ambulance calls and long lies.

- Population: Studies including older adults, above the age of 50 years.

- Interventions: Studies evaluating any fall detection device including wearable devices such as alarms or pendants with a button that the individual needs to press to report a fall, and non-wearable sensor-based devices (e.g. cameras, motion sensors) installed within individuals' living environments were included this review.

  Primary studies reporting multicomponent interventions to detect and prevent falls among older adults such as a combination of medication review, education and fall detection devices were included if a separate analysis was conducted to isolate the effectiveness of the fall detection devices. Reviews reporting multiple interventions to detect and prevent falls among older adults were also included if the effectiveness of the fall detection devices were analysed and reported separately.

- Contexts: Studies conducted in long-term residential care conditions such as nursing homes, in hospitals and in community settings were all included.
- Study designs: No restrictions were placed on the study designs of the included primary studies and reviews, and grey literature were also included.

Exclusion criteria:

- Conference abstracts, opinion pieces, article corrections, intervention protocols without the results regarding the effectiveness of fall detection devices were excluded.
- Studies not written in English were excluded because of lack of resources required for translation.
- Studies including individuals below the age of 50 years.
- Studies conducted in laboratory or simulated conditions were excluded.

2.3. RESULTS

Database searching yielded a total of 3105 records with an additional 5 records identified through consultation with the ICB; 3 further records were identified through hand searching. After removal of duplicates, 2684 abstracts and titles were screened and 2474 were deemed ineligible for inclusion. Of the remaining 210 papers, a further 188 were excluded (reasons given in the PRISMA diagram in Figure 1), leaving 22 records from database searching that were included in the review. Additionally, 6 grey literature reports and 2 studies identified through hand-searching of reference lists were included. Thus, a total of 29 articles consisting of peer-reviewed research articles (n=24) and grey literature reports (n=5) were included in the scoping review.

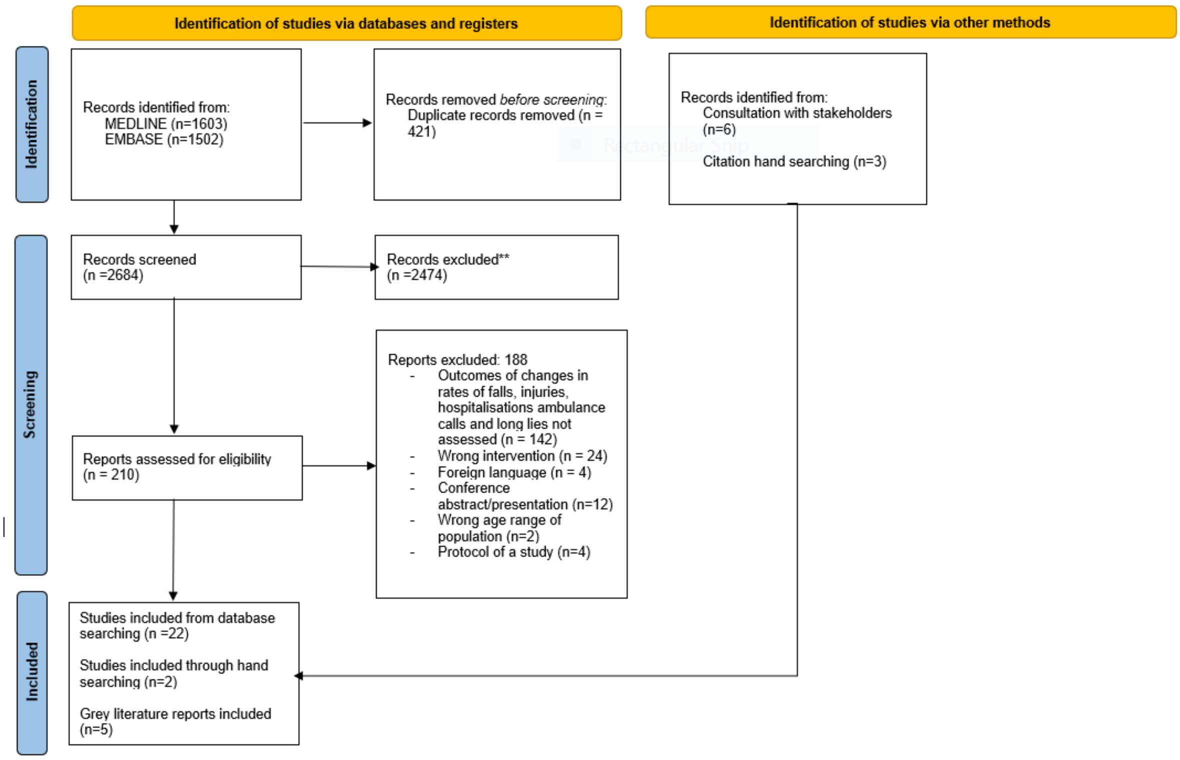

Figure 1: PRISMA diagram (Page et al., 2021) with details regarding inclusion of studies.

2.3.1. INTERVENTION CHARACTERISTICS

The included primary peer-reviewed research studies used various types of fall detection devices including wearable fall detection devices (n=8), ambient fall detection devices (n=7), a combination of wearable and ambient sensors (n=1) to detect falls, and bed and chair alarms (n=1). In the study by Zimmerman et al., (2024), the fall detection device only recorded falls during night-time and the intervention also consisted of LED lights which were installed on the bathroom entry doorframe to enable older adults to see clearly at night. Two studies also provided interventions in addition to the fall detection devices to the intervention group such as social support and support for activities of daily living by a social service provider (Zoellick et al., 2025) and a medication dispenser (Salahub et al., 2025).

Most of the included reviews evaluated studies using a mixture of types of fall detection devices including ambient, wearable and bed/chair alarms (Yeoh Lui et al., 2025; Cortés et al., 2021; Lee et al., 2025; Teh et al., 2025) and fall mattresses with pressure sensors (Lee et al., 2025). Two of the reviews evaluated all types of fall prevention interventions for older adults that included sensor-based fall detection devices (Cameron et al., 2018; Schoberer et al., 2022) and one narrative review (Singh & Bhinde, 2025) only evaluated the efficacy of wearable fall detection devices.

Two grey literature documents reported the results of pilot studies of the ambient fall detection device, the smart Nobi lamp device (Nobi, 2024; Irving, 2025) that is evaluated in this wider report. This device provides abstract anonymised images and a playback recording of the environment and context in which a fall occurred, preserving the privacy of the individuals, alerting staff on time in case of a fall, and providing the facility to check how the fall occurred and confirm details, such as, for example, whether the person bumped their head. When an older adult sits upright in bed at night or leaves their bed, the device also emits a light to enable them to see clearly. Sleep reports are generated by the device to understand care home residents' sleep patterns (Nobi, 2024; Irving, 2025). The pilot study by Irving, (2025) implemented this device in 87 rooms across 7 residential care and nursing homes for a duration of 8 months. A pilot study of this device was also conducted in one UK care home where the device was installed in 8 rooms (Nobi, 2024).

The grey literature report by Gavriilidis (2025) reported the results of an evaluation of another ambient fall detection device called the Ally acoustic monitoring technology that was implemented in 6 care homes in the Southwest, England in the UK. The device uses sensors to detect motion and sounds to detect any fall occurrences and the alerts regarding falls are sent to the care home staff via handheld devices.

2.3.2. EFFECTS OF THE USE OF FALL DETECTION TECHNOLOGIES ON FALL INCIDENCES AND INJURIES

Fifteen of the included primary studies (reported in grey literature reports and peer-reviewed research publications) assessed the effects of the fall detection technologies on fall incidences (Appendix 3) and 7 studies assessed the effects on injurious falls only (Visvanathan et al., 2022; Bayen et al., 2017; Bayen et al., 2021; White, 2018; Comini et al., 2024; Stefanacci et al., 2025; Tarbert et al., 2023). Most studies assessed rates of falls and injuries using the fall detection devices and records of fall incidents that were maintained by the staff in the hospitals or long-term care settings. Only one study assessed fall rates using self-report by asking the patients to recall the number of falls they experienced in the previous year (Zoellick et al., 2025). Three studies (Dollard et al., 2022; Irving, 2025; Gavriilidis, 2025) used a mixed methods approach to assess the effectiveness, acceptability and perceived benefits of fall detection devices. Gavriilidis, (2025) used a questionnaire to assess the care home staff and managers' opinions of the technology and its perceived benefits in reducing falls and injuries. Dollard et al., (2022) used questionnaires and semi-structured interviews with older adults and their family members to assess the perceived benefits of the fall detection device. Irving (2025) used questionnaires and a range of qualitative methods including semi-structured interviews with care home staff and managers and family members of the older adults, observations and testimonials in which families and staff provided feedback about the device. The Health Innovation Network, (2025) reported the findings of a round table discussion regarding fall detection devices in which Integrated Care Boards, local authorities and care providers shared their experiences of implementing fall detection devices to prevent falls in care homes across UK.

Only two studies reported a significant reduction in fall rates in the intervention group compared to the control group (Votruba et al., 2016 & Gervasi et al., 2025), the majority of the studies finding no statistically significant reduction in fall rates in the intervention group as compared to the baseline and control groups. Bayen et al., (2017) conducted a descriptive analysis of the changes in fall rates only and reported that the number of falls decreased from 12 at the beginning of the intervention to 2 during the last month of the intervention. Qualitative findings by Dollard et al., (2022) indicated that participants and their families felt that the wearable fall detection device improved safety of the older adults as they believed that the nurses would be able to attend to them promptly if they experience a fall. They also felt that the device was potentially helpful to reduce falls. The grey literature report by Gavriilidis (2025) reported the results of a descriptive analysis of the changes in fall rates and unwitnessed falls in the residents' bedrooms after using the device compared to the baseline falls rates and unwitnessed falls. The total falls in this study reduced by 49.2%. The grey literature report by Nobi, (2024) also reported only descriptive analysis of changes in fall rates and reported a reduction in fall rates by 80% relative to the baseline fall rates.

The round table discussion of implementation of fall detection devices in care homes (Health Innovation Network, 2025) demonstrated the participants' opinions that these devices can help prevent future falls by understanding causes of falls. Participants felt that this can help the staff to modify older adults' environments to reduce tripping hazards or arrange and inform medication reviews to reduce fall risks. Some participants also mentioned that some of the devices allow them to reduce the checks on residents that are routinely conducted at night which helped in improving residents' sleep patterns and fall risk resulting from fatigue or disorientation. However, it should be noted that the findings of two grey literature reports are anecdotal and the exact methodology of analysis of the data was not reported (Nobi, 2024; Health Innovation Network, 2025). Grey literature report by Irving, (2025) evaluated the efficacy of the Nobi device (an ambient fall detection device) and found an increase in fall rates which was attributed to the increased efficiency of the device in detecting unwitnessed falls.

Two studies reported a reduction in the rates of injurious falls (Stefanacci et al., 2025; Tabert et al., 2023). Stefanacci et al., (2025) and Tabert et al., (2023) evaluated the efficacy of wearable hip protectors that detect and prevent hip fractures and injuries due to falls. Stefanacci et al., (2025) found a significant reduction in major hip injuries from serious hip-impacting falls and fall related hip fractures but there was no reduction in the rates of falls as compared to the control group. The case study by Tabert et al., (2023) demonstrated that 6 out of the total 35 participants experienced a fall and the device prevented hip fractures and major injuries in all 6 of the participants.

All the included reviews assessed the effectiveness of the fall detection devices in reducing fall rates and three reviews assessed the effects of the use of the devices on rates on injurious falls (Schoberer et al., 2022; Lee et al., 2025; Teh et al., 2015). Only one meta-analysis and systematic review that evaluated the efficacy of ambient and wearable fall detection devices and bed/chair alarms found a significant reduction in fall rates in the intervention group compared to control groups (Yeoh Lui et al., 2025). The majority of the reviews did not find a significant reduction in fall rates in the intervention group compared to baseline or control group and highlighted the high risk of bias and poor methodological quality of the included studies. The review by Lee et al., (2025) highlighted the frequent false alarms from some of the devices that contributed to alarm fatigue). Similarly, the NICE guidelines (2025) regarding the prevention of falls among older adults also found limited evidence regarding the effectiveness of fall detection devices to reduce falls. The lack of high-quality studies evaluating the efficacy of these devices was also highlighted (NICE, 2025).

Reviews by Lee et al., (2025) and Teh et al., (2015) did not find a reduction in injurious falls due to the use of the fall detection devices. Only one review (Schoberer et al., 2022) that included 12 RCTs that evaluated the efficacy of hip protector devices showed that these devices reduce the rates of hip fractures, although the methodological quality of these studies was rated as very low.

2.3.3. EFFECTS OF THE USE OF FALL DETECTION TECHNOLOGIES ON HOSPITALISATIONS AND AMBULANCE CALLS

Seven of the included primary studies reported as peer-reviewed research publications and grey literature reports assessed the effects of fall detection devices on hospitalisations and/or ambulance calls (Zoellick et al., 2025; Xiong et al., 2021; Stefanacci et al., 2025; Tarbert et al., 2023; Irving, 2025; Health Innovation Network, 2025; Gavriilidis, 2025). Hospitalisation rates were assessed in all the studies by reviewing the patient or resident records maintained by the staff in hospitals or long-term care settings. A majority of the studies reported a statistically significant reduction in hospitalisations due to falls (Xiong et al., 2021; Irving, 2025; Gavriilidis, 2025), hip fractures and other injuries (Tarbert et al., 2023; Stefanacci et al., 2025). The report by Health Innovation Network, (2025) also reflected the views of care providers and local authorities which indicated that the data collected from sensor-based fall detection devices can help in identifying health issues such as seizures, can inform medication reviews and potentially avoid hospitalisations.

The review by Yeoh Lui et al., (2025) assessed rates of hospitalisations due to falls and the results were inconclusive as the majority of included studies in their review only reported general hospitalisation data and did not report hospitalisations due to falls or fall-related injuries.

Ambulance call-outs were reported by four grey literature reports (Gavriilidis, 2025; Irving, 2025; Health Innovation Network, 2025; Nobi, 2024) and all of them reported a reduction in ambulance call-outs. Nobi, (2024) showed a reduction of 621 ambulance calls in total as compared to baseline rates of ambulance calls. Irving (2025) and Gavriilidis, (2025) also found a reduction in the ambulance call-outs by 65% and 63.7% respectively compared to baseline rates of ambulance calls. The report by Health Innovation Network, (2025) also reflected the views of care providers and local authorities in that they felt that the fall detection technologies have the potential to reduce ambulance calls.

2.3.4. EFFECTS OF THE USE OF FALL DETECTION TECHNOLOGIES ON LONG LIES

Three of the included primary studies reported as peer-reviewed research publications and grey literature reports assessed the effects of fall detection devices on long lies and found that these devices reduce long lies after falls (Bayen et al., 2021; Irving, 2025; Nobi, 2024). Bayen et al., (2021) found a significant improvement in staff response times to falls and a significant reduction in long lies compared to the rates of long lies before the technology was used (baseline levels of long lies). The qualitative data by Irving, (2025) also demonstrated that staff were able to respond to falls quicker which reduced long lies among care home residents. Nobi (2024) found that the technology enabled the care staff to provide help after a fall 28 times faster after the device was installed and the average response times to falls was 2 minutes which demonstrated a reduction in long lies among the residents.

2.3.5. COST-EFFECTIVENESS OF THE USE OF FALL DETECTION TECHNOLOGIES TO REDUCE FALLS, LONG LIES, HOSPITALISATIONS, AMBULANCE CALLS AND INJURIES

Seven of the included primary studies assessed the cost-effectiveness of the fall detection devices (Federici & Pecchia 2021; Irving, 2025; Nobi, 2024; Pham et al., 2023; Salahub et al., 2025; Votruba et al., 2016; Zoellick et al., 2025).

Pham et al., (2023) assessed the cost-effectiveness of AmbIGeM, a fall-prevention system comprising wearable sensors that transmit real-time fall-risk alerts to nursing staff, within Geriatric Evaluation and Management Units. The intervention group experienced fewer falls per admitted patient relative to controls (no technology), confirming clinical effectiveness. The average costs per patient were also lower in the intervention arm, making it a cost-saving technology.

Zoellick et al., (2025) evaluated a multifaceted intervention for community-dwelling adults aged 75 years and older, including a base station, in-home motion sensors, a wearable fall-detection necklace, and social service support. The study examined impacts on emergency department visits, hospitalisations, length of stay, and overall healthcare expenditures. No statistically significant reductions were observed in acute care utilisation or costs, nor were improvements in self-reported quality of life detected. Limited participant engagement was identified as a potential explanation for the findings of no effect.

Votruba et al., (2016) conducted a cost-effectiveness analysis of a telesitter monitoring system in which staff can monitor inpatients through video in inpatient adult units. The system enabled remote staff to verbally redirect patients attempting to stand or leave their beds. Falls and patient companion (one to one monitoring) hours declined from baseline. When combining avoided fall-related costs with reductions in sitter utilisation; up to 94% of the initial investment could be recovered.

Salahub et al., (2025) compared outcomes for patients enrolled in a remote monitoring program with matched controls. The program required a personal alert device and could include a home medication dispenser and/or passive home monitoring sensors. Participants in the intervention group spent more time at home and incurred lower healthcare costs. However, the analysis did not account for the program's implementation costs, precluding a full cost-effectiveness assessment. Quality-of-life outcomes were not evaluated. Federici & Pecchia, (2021) performed a model-based economic evaluation of a not-yet-manufactured device designed to prevent falls related to orthostatic hypotension (a sudden, significant drop in blood pressure upon standing, causing dizziness, light-headedness, and fainting) in older adults. The device would use electrocardiogram data and short-term heart rate variability to predict sudden blood pressure drops. The model relied on strong assumptions regarding both the relationship between orthostatic hypotension and falls and the projected effectiveness of the device. Although the intervention appeared cost-effective at a £20,000 willingness-to-pay threshold, its hypothetical nature and assumption-dependent structure limit the robustness and applicability of the conclusions. Nobi (2024) and Irving, (2025) reported on evaluations of the Nobi system, an AI-enabled, ceiling-mounted lighting technology designed to detect and help prevent falls. Nobi (2024) reported reductions in falls and in prolonged floor stays ("long lies"). Both additionally found decreases in hospital visits, admissions, length of stay, and ambulance call-outs. Both analyses concluded that the technology was cost-saving. There was no formal estimation of effectiveness or costs. Results were based on descriptive statistics only.

Across the literature, causal inference remains limited. Only three studies (Pham et al., Zoellick et al., and Salahub et al.) employed comparative designs with treatment and control groups. Other recurring methodological concerns include subgroup analyses emphasising favourable results, reliance on strong assumptions linking falls to downstream healthcare utilisation, and dependence on self-reported outcomes. Three studies (Federici & Pecchia, 2021; Pham et al., 2023; Zoellick et al., 2025) incorporated quality-of-life measures, an important outcome given the morbidity associated with injurious falls. Only Pham et al., 2023 reported gains in quality of life on a real-world setting (Federici & Pecchia, 2021 evaluated a hypothetical technology). Sensitivity analysis, an essential component of rigorous economic evaluation, was explicitly reported in only one study (Federici & Pecchia, 2021).

Intervention sample sizes at the patient level ranged from 180 to 1,660 participants. Most analyses were conducted at the patient level with only the Nobi evaluations using care-home room–level analyses. The two Nobi evaluations ranged from 8 rooms (one care home) to 87 rooms (seven care homes). Considerable heterogeneity exists across technologies, settings, and national contexts, limiting generalisability. Furthermore, most studies assessed short-term effects over follow-up periods of 8 to 18 months (including pre- and post-intervention phases), leaving longer-term cost-effectiveness uncertain.

2.4 DISCUSSION

2.4.1 SUMMARY OF FINDINGS

Twenty-nine peer reviewed research papers and grey literature reports were included. Most of the studies did not find a significant reduction in fall rates and injurious falls due to the use of fall detection devices. Most of the primary studies that reported a reduction in fall rates and injurious falls tended to be qualitative studies (Dollard et al., 2022), pilot studies without control groups (Irving, 2025; Bayen et al., 2017), case studies (Tabert et al., 2023) or grey literature reports with mainly anecdotal data that did not clearly describe the methodology (Nobi, 2024; Health Innovation Network, 2025). Similar results were reported by the included reviews, and the reviews also highlighted the poor methodological quality of the studies that evaluated the efficacy of fall detection devices (Schoberer et al., 2022; Lee et al., 2025; Teh et al., 2015; Cameron et al., 2018; Singh & Bhinde, 2025; Cortés et al., 2021).

Seven (Zoellick et al., 2025; Xiong et al., 2021; Stefanacci et al., 2025; Tarbert et al., 2023; Irving, 2025; Health Innovation Network, 2025; Gavriilidis, 2025) out of 8 studies that evaluated the effects of fall detection devices on hospitalisations found a significant reduction in hospitalisations in the intervention group. However, one review highlighted the poor reporting of the data regarding fall-related hospitalisations in the included studies because of which the results were inconclusive (Yeoh Lui et al., 2025). All the studies that assessed the effects of fall detection devices on long lies found that these devices were effective in reducing long lies and improving staff response times in attending to older adults after falls. Additionally, all the studies that assessed the impact of the use of fall detection devices on ambulance call-outs found a reduction in ambulance call-outs after the use of the device. However, it should be noted that the some of the studies that assessed the efficacy of fall detection devices in reducing ambulance calls and long lies only reported anecdotal data without precise and detailed information regarding the methodology used (Nobi, 2024; Health Innovation Network, 2025) or only reported descriptive analysis of the changes in these variables compared to the baseline rates (Gavriilidis, 2025; Irving, 2025). This underscores the importance of conducting additional high-quality studies with adequate details about the methodology and the control groups to confirm the efficacy of fall detection devices in reducing ambulance calls and long lies.

2.4.2 IMPLICATIONS FOR PRACTICE, POLICY AND FURTHER RESEARCH

Although most of the interventions were ineffective in reducing fall rates and injurious falls, they were helpful in reducing long lies that could have prevented a further decline in health after a fall and in turn reduced hospitalisations. Additionally, a few of the included studies showed that these devices can help to detect potential causes of falls and help caregivers to put preventative measures in place to prevent falls in the future (Irving, 2025; Bayen et al., 2017; Bayen et al., 2021; Health Innovation Network, 2025). This was demonstrated by Bayen et al., (2017) as the researchers identified, through the video footages of the falls, that the placement of furniture in the rooms contributed to tripping hazards and falls. Additionally, some participants were at high risk of falls due to behavioural patterns of inattention, fatigue and impulsivity. Thus, the fall rates could be reduced in the final month of the intervention by shifting furniture in the rooms of older adults to reduce tripping hazards and checking on the participants who were at high risk of falls every hour instead of every 2 hours at night as majority of the falls occurred at night-time (Bayen et al., 2017). Nobi (2024) also showed a reduction in falls by 80% from baseline fall rates and the average response times of care providers help the residents after a fall was 2 minutes, thereby reducing long lies among the residents. Therefore, these devices could potentially be useful components of personalised fall prevention interventions for older adults as they can inform environmental modifications and medication reviews to reduce fall risks (Irving, 2025).

However, it should be noted that the efficacy of the wearable fall detection devices depends on the consistent use of the device to a large extent (Vargas et al., 2024). Thus, these devices can be particularly problematic for individuals with dementia and other health conditions associated with cognitive impairment as they can forget to wear the device and use it consistently (Ward et al., 2012). Certain behavioural patterns such as agitation and restlessness that are common among individuals with cognitive impairment might also result in the users pulling apart the device if they are uncomfortable with wearing them (Visvanathan et al., 2022). Although ambient technologies can be considered as an alternative, these technologies are more expensive than wearable fall detection technologies (Vargas et al., 2024) because of which more high-quality studies assessing the cost-effectiveness of these devices are needed.

In general, the studies are quite heterogeneous as they evaluate different technologies, settings, and national contexts, thus limiting generalisability. Methodological limitations constrain confidence in the evidence. Only a minority of the studies used comparative designs with control groups, limiting causal inference. Sensitivity analyses were rarely reported. Among the reviewed studies, Pham et al. stands out for applying a comparatively robust methodology, supporting the conclusion that the evaluated technology has the potential to be both cost-saving and quality-of-life enhancing. In contrast, Nobi, (2024) and Irving, (2025) although reporting cost savings, rely primarily on descriptive statistics and lack control groups, thereby limiting the strength of their conclusions. Most studies evaluated short-term outcomes (8–18 months), leaving long-term cost-effectiveness uncertain.

Overall, while fall-prevention technologies show promise, particularly in institutional settings, stronger evidence from well-designed comparative studies with longer follow-up, comprehensive cost and benefit accounting, and rigorous sensitivity analyses is required before firm conclusions regarding cost-effectiveness can be drawn.

The occurrence of false alarms is also another problem with both wearable and non-wearable fall detection devices; too many false alarms can cause alarm fatigue among carers (Lee et al., 2025; Ward et al., 2012). The review by Ward et al., (2012) also highlighted the fact that older adults may have concerns about "bothering the staff" who are responsible for caring for them when false alarms are triggered. Thus, future studies should focus on improving the accuracy of the detection of fall detection devices and reducing false alarms. Another factor affecting the accuracy of fall detection is the infrastructure in which these are used and the availability of strong internet and/or Wi-fi networks (Irving, 2025). Therefore, the technological upgrades required to implement these devices might be expensive especially in some contexts such as care homes in rural areas or with old buildings with poor connectivity (Health Innovation Network, 2025; Irving, 2025).

Additionally, more high-quality studies including larger sample sizes and control groups evaluating the effectiveness of fall detection technologies are needed in the future (Kosse et al., 2013). The reporting of the methodological details also needs to be improved as several included studies in this review did not report adequate details regarding the participant characteristics (e.g. age, health conditions), number and reasons for dropouts and adverse events related to the device and/or the intervention that could have been confounded the results of the studies. The nature of contact with the control group participants during the study duration was also not reported in detail by the included studies. These details should be reported in future studies evaluating the effectiveness of fall detection devices in reducing falls, injuries, hospitalisations, ambulance calls and long lies.

2.4.3 STRENGTHS AND LIMITATIONS

The strengths of this review include the broad examination of literature including grey literature and peer reviewed research papers to clarify key concepts and identify gaps in literature relating to efficacy of fall detection devices in reducing falls, injuries, hospitalisations and long lies. Consultation with the key stakeholders of this project which included the members of the Integrated Care Board of Lancashire and South Cumbria, UK to identify important grey literature documents on fall detection devices and fall prevention interventions also strengthened the review process (Arksey and O'Malley, 2005).

However, this review only included studies reported in English and a meta-analysis or a systematic review was deemed inappropriate because of the heterogeneity in research designs, outcome assessment methods and interventions. Additionally, the developer of a fall detection technology (Nobi device) was the author of one of the grey literature reports (Nobi, 2024) that evaluated the efficacy of this technology which could be potential conflict of interest. Therefore, the results of this report should be interpreted with caution.

2.5 CONCLUSION

The findings of the review have demonstrated that the majority of the included intervention studies did not show a reduction in fall rates and rates of injurious falls among older adults, indicating that more development and research is needed. However, most studies showed a significant reduction in long lies and hospitalisations due to use of fall detection devices. These devices therefore have the potential to reduce additional deterioration of health after a fall, can prevent falls and injuries in the long-term by identifying the potential causes of falls and can inform other interventions such as medication reviews to reduce fall-risks. However, future research in this area requires more high-quality studies with larger sample sizes and control groups. Reporting of the methodological details of the studies also needs to be improved. In addition, accuracy of the devices in detecting falls needs to be improved and infrastructure upgrades and adequate internet connectivity needs to be considered in different contexts for long-term adoption of these devices.

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SECTION 3: AIMS AND OBJECTIVES OF THE EVALUATION

3.1 AIM:

To conduct a multifaceted independent evaluation of the impact of Nobi – Smart Lamp implementation in identified Nursing and Residential care homes across Lancashire and South Cumbria, examining effects on residents, care home staff, and service provision and delivery

3.2 OBJECTIVES:

1. To determine whether this technology has reduced resident falls and prevented future falls, reduced the staff response time after a resident has fallen and before help comes (reducing long lies), and reduced ambulance call-outs, distinguishing those leading to hospital conveyance from those where no conveyance occurred.

2. To determine whether this technology has changed how Nursing and Residential care homes deliver care for the residents they support.

3. To determine what impact this technology has had on residents' quality of life.

4. To investigate in what kind of circumstances Nobi lamps can support care in a different way to a 1-1 package of care and be the least restrictive practice?

5. To determine whether this approach offers value for money, using the North West Ambulance Service NHS Trust (NWAS) data on ambulance call-outs to infer costs avoided driven by the falls prevention capacities of Nobi.

6. To consider how this intervention can be scaled and sustained

3.3 DESCRIPTION OF THE DATA SOURCES: OUTCOMES TO BE EVALUATED USING BOTH QUANTITATIVE AND QUALITATIVE DATA

Summary

The following data will be used in terms of both benefits or negative outcomes: number of falls; number of long lies; ambulance call-outs including data on conveyance to hospital and hospital admissions where available; financial Return on Investment (ROI); amount of 1-1 monitoring and night-time checking; perceived benefits for residents in relation to sleep; perceived benefits for staff in relation to work patterns; other perceived benefits of the smart lamps resulting in prevention of falls or unnecessary ambulance call-outs. The aim is that the different sources of data are combined to examine where one type supports another, and where there may be contradictions.

Impact on Care Home Residents:

Relevant objectives are given to illustrate how we responded to them

Objective 1: To determine whether this technology has reduced resident falls and prevented future falls, reduced the staff response time after a resident has fallen and before help comes (reducing long lies), and reduced ambulance call-outs, distinguishing those leading to hospital conveyance from those where no conveyance occurred.

Using pre- and post-implementation comparisons of data from identified Nursing and Residential care homes, benefits report data and responses on the CHSMQ questionnaire, we assessed the impact of the technology on fall incidence and response times after a fall, and its effectiveness in reducing staff response time and so preventing long lie events.

Objective 3. To determine what impact this technology has had on residents' quality of life

Qualitative data from care home staff and managers who were using the Nobi lamps, will be used to determine observed changes in wellbeing and quality of life. This will be collected through the bespoke survey, the CHSMQ questionnaire, and a benefits feedback report,

Impact on Social Care System and Resources:

Objective 1. To determine whether this technology has reduced resident falls and prevented future falls, reduced the staff response time after a resident has fallen and before help comes (reducing long lies), and reduced ambulance call-outs, distinguishing those leading to hospital conveyance from those where no conveyance occurred.

Objective 5. To determine whether this approach offers value for money, using the North West Ambulance Service NHS Trust (NWAS) data on ambulance call-outs to infer costs avoided driven by the falls prevention capacities of Nobi.

Using North-West Ambulance Service data to compare ambulance call-out rates before and after implementation and in comparison with Nursing and Residential care homes in the region not using the smart lamps (non-randomly allocated controls), we evaluated the system-level and economic impact of the technology, with a focus on potential reductions in ambulance call-out and associated cost savings from avoided ambulance utilisation and hospital admissions following unwitnessed falls.

Impact on Care Home Staff and Service Delivery:

Objective 2. To determine whether this technology has changed how Nursing and Residential care homes deliver care for the residents they support

Using data collected from care home staff and managers, we examined how care home staff and managers perceive, adopt, and use the technology, and how this shapes care package configuration, workforce workload, and responses to resident falls:

(i) Qualitative data from feedback about the Nobi device implementation and use from 59 care home managers or team leaders through email communication and meetings with the ICB;

(ii) Deep dive case study: Qualitative data obtained by conducting a semi-structured interview with the manager of Kendal care home regarding his feedback on the Nobi device and its impact on the residents' safety and care provision by staff members. Additionally, quantitative data from the incident monthly report, three months before and after the activation of Nobi. The incident records include incident details such as where it occurred, the staff response, and the scale of injury along with resident characteristics such as gender, age, and medical diagnosis.

(iii) Qualitative and quantitative data obtained from open-ended and closed questions in a questionnaire (the "CHSMQ") which assessed the care home staff and managers' attitudes towards the Nobi device and the extent to which they found it useful to improve their care provision and residents' safety and well-being. A total of 169 responses were obtained from care home staff, and 59 responses were obtained in from the managers of Nursing and Residential care homes.

SECTION 4: METHODS

4.1. DESIGN, SETTINGS AND ORGANISATION

4.1.1 EXPLANATION OF ROLL OUT

This section explains the roll out of the Smart Nobi lamps pilot and how it has been managed and monitored, including facts and figures on, for example, numbers of Nursing and Residential care homes, numbers of lamps, durations of data gathering, controls.

Funding from NHS England Digitising Adult Social Care team enabled the provision of 800 Nobi Smart Lamps for installation in selected nursing and residential care homes in a programme across Lancashire and South Cumbria (L&SC). This was delivered through a phased and structured deployment model which prioritised Nursing and Residential care homes with the highest levels of falls risk to receive the lamps while ensuring effective oversight, strong quality assurance, and consistency across the Integrated Care Board (ICB) footprint.

4.2 HOW THE PROJECT WAS SET-UP AND MANAGED.

The adult social care market across Lancashire and South Cumbria (L&SC) is large, varied, and predominantly independent sector led. There are around 900 CQC registered providers, including approximately 570 residential homes and nursing homes, alongside home care and supported living services. The landscape is characterised by a high proportion—around 97%—of private organisations, supporting a mix of small family run homes, medium sized regional groups, and larger national providers operating across both rural communities and urban centres. Quality and digital maturity vary significantly, with some areas showing strong engagement with digital solutions and shared care record adoption across regulated care locations, reflecting differing levels of readiness and capacity in the sector.

The Nobi project was established as part of the Adult Social Care Digital Transformation Fund (DTF), which supports the scaling of digital solutions to improve safety, quality, and efficiency in social care settings. Delivery of the Nobi programme was led by the L&SC ICB Digital Social Care (DiSC) team, working in partnership with a wide range of organisations across health, social care, and the technology sector. Key partners are described in Section 1.5. The Nobi Smart Lamp programme across Lancashire and South Cumbria (LSC) was designed and delivered as a phased, structured deployment to ensure safe, efficient, and equitable implementation across the Integrated Care Board (ICB) footprint. The approach prioritised Nursing and Residential care homes with the highest levels of falls risk, while maintaining strong programme oversight, consistent quality assurance, and alignment with national expectations. Funding for the deployment was secured through the NHS England Digitising Adult Social Care (DiSC) programme, enabling the installation of 800 Nobi Smart Lamps across participating nursing and residential care homes. The implementation team is led by Sue Capstick RN, DiSC program lead. Mazz Akhtar is the DiSC Operational manager and Linda Scales the program administrator. Deb Gent, senior commissioner from Lancashire County Council has been available to the program for up to 2 days a week. The Nobi Smart Lamp programme was underpinned by a comprehensive and mature governance framework established by the Lancashire and South Cumbria (LSC) Digital Social Care (DiSC) team. This structure ensured that each stage of the rollout was subject to rigorous oversight, transparent decision making and clinical, technical and operational assurance. Governance was anchored through the Digital Social Care Steering Group, which provided system level accountability and included senior representation from the ICB, Local Authorities, commissioning leads and clinical leaders. The Steering Group met regularly to monitor progress, scrutinise risks, approve key documentation, and ensure alignment with national Digitising Social Care priorities.

Operational delivery was driven through a structured programme management process led by the DiSC Programme Lead, supported by the Operational Manager and project team. Fortnightly programme meetings brought together DiSC colleagues, Nobi and Porters Care to review site survey outcomes, approve the movement of homes between stages, and address technical or implementation risks.

A formal set of approval gateways—covering Stage 1 readiness, Stage 2 learning mode progression and Stage 3 go live authorisation—ensured that homes only advanced once digital infrastructure, workforce readiness, training and clinical safety requirements had been demonstrated.

Additional scrutiny was provided through the monthly Nobi Assurance Meeting, at which the DiSC team reviewed system data, connectivity performance, lamp uptime thresholds and provider level risks. Here, Nobi presented consolidated performance reports—including homes triggering amber or red connectivity thresholds, response times to falls alerts, and any escalation activity—enabling the ICB to challenge, intervene and direct improvement where required. Porters Care contributed operational intelligence and provider level insights gathered through monthly account management calls, ensuring the governance structure incorporated both quantitative metrics and qualitative feedback from frontline staff.

This multilayered governance approach delivered consistent quality assurance across the programme. It provided a clear audit trail from initial eligibility and site survey approval through to ongoing performance monitoring post go live. It also ensured accountability across suppliers and care providers, while giving NHS leaders confidence that the technology was deployed safely, effectively and in a way that maximised benefit for residents, staff and the wider system.

4.2.1 ELIGIBILITY OF HOMES FOR NOBI LAMP ROLL OUT

Eligible homes for Nobi were identified through an analysis of two validated data sources. These were: North West Ambulance Service (NWAS), identifying homes with the highest number of ambulance call-outs; and Provider Assessment and Market Management Solution (PAMMS), a self-reporting system used by all care providers that includes a section on falls which was used to corroborate trends and patterns on falls. Only providers who had achieved Data Security Protection Toolkit (DSPT) “Standards Met” status were eligible.

Six months of NWAS data was analysed to identify 999 calls where “fall” was the reason for the call. By using the Nursing and Residential care homes’ number of beds the ICB were able to calculate the falls rate per care home. It was agreed that if a care home reached 22% of falls they would be eligible for Nobi.

The Nobi lamps were offered to Nursing and Residential care homes that exceeded 22%. As there were 800 lamps available and many homes across the area, we agreed to install them in around one in five bedrooms (approximately 22% of residents) in each participating home. This meant the lamps were used where the need was greatest, while still giving each home enough coverage to see whether they made a difference for residents most at risk of falling.

A longlist of eligible homes was generated by the DiSC team and presented to senior commissioners from each of the four Local Authorities and the ICB Quality Team. Stakeholders were invited to endorse the proposed list or recommend additional homes based on local intelligence. Once agreement was reached, the DiSC team issued an introductory communication outlining the aims of the programme and the offer being made to providers.

4.2.2 RECRUITMENT OF IDENTIFIED NURSING AND RESIDENTIAL CARE HOMES

Nursing and Residential Care homes were required to confirm their interest in participating. Upon confirmation, they were issued with a Microsoft Forms Commitment Form (see Appendix 4), this gave providers a summary of Nobi and what was included in the funded package and requested key information and formal agreement to programme expectations. Once forms were returned, providers were moved into the structured implementation workflow, comprising three stages (see appendix 5). During Stage 1 (readiness) a comprehensive site survey was carried out by Porters Care in each of the resident’s bedrooms, and bathrooms if applicable. After Porters Care completed each comprehensive site survey in the care home the report was submitted to the ICB Digital Social Care (DiSC) team for review.

These surveys provided room level technical assessments, including WiFi signal strength, bandwidth, and environmental suitability, which were used to determine whether each bedroom met Nobi’s operational thresholds. The DiSC team evaluated these findings using the established Red-Amber-Green criteria to determine infrastructure readiness. Homes with Green rated rooms were deemed fully suitable for installation, while Amber rooms required minor remedial actions such as repositioning or adding access points, adjusting network configurations, or enabling consistent 2.4GHz coverage. Red rooms did not meet minimum requirements and could not progress without significant infrastructure changes.

Once the survey was reviewed, the DiSC team considered both the technical suitability and the willingness and capacity of the registered care provider to complete any required remedial work. Some providers were able to act quickly and resolve WiFi or configuration issues within weeks, whereas others required several months or were unable to undertake the work, in which case the home could not move forward in the programme. After the provider confirmed completion of their actions, Porters Care conducted a reaudit to validate improvements, and the updated findings were reviewed again by the DiSC team. A home could only progress to the next implementation stage when all required infrastructure improvements had been successfully completed, technical thresholds were met, contractual documents had been returned, and the DiSC team formally signed the provider off as ready.

Eligible homes now moved across to Stage 2 when Nobi lamps were installed in the bedrooms decided by the registered manager as being most risk of a fall. The home is now placed into LEARNING MODE. During this phase, the Nobi Smart Lamps begin calibrating to their environment by mapping the room layout, learning resident movement patterns, and monitoring connectivity performance. Although the lamps detect activity during this stage, they do not yet send live alerts to staff. Concurrently, Nobi conducts continuous monitoring of WiFi signal strength and stability in every room, identifying any intermittency or weak points that may affect performance. Issues identified in Stage 2 are escalated to the DiSC operational and assurance meetings, where Porters Care and Nobi jointly develop and implement improvement plans.

Alongside the technical learning period, homes receive a sequence of essential training sessions. The first is the “Getting to Know Nobi” introduction, which familiarises care staff with the purpose, features, and benefits of the technology. This is followed by configuration training, where staff learn how to use the Nobi dashboard, add or remove residents, manage alerts, configure inapp calling, and tailor monitoring settings to individual needs. A further onsite falls detection training session allows staff to practise triggering and responding to simulated falls using a live device, ensuring confidence in the system before it becomes operational. Throughout Stage 2, Nobi continues to monitor connectivity and performance until all lamps consistently meet the required 99% uptime threshold. Only when training is complete, the environment is stable, and the lamps demonstrate sustained Green level connectivity does the DiSC team approve the care home to progress to Stage 3 (GoLive).

Stage 3 marks the transition from learning and preparation into full operational use of the Nobi Smart Lamps. A care home is permitted to enter Stage 3 only once all lamps have demonstrated consistent, stable performance in Stage 2, with each device achieving the required 99% connectivity threshold over a sustained monitoring period. At this point, the DiSC team formally approves the home to move to the GoLive stage. GoLive activation makes the lamps fully operational, enabling realtime fall detection alerts, inapp calling, live view functions, and all monitoring features configured during training. The GoLive date is agreed collaboratively between Nobi, Porters Care and the care provider, ensuring staff availability and readiness.

Following activation, Nobi undertakes a structured two week positive monitoring period during which the lamps’ configuration, response patterns, and connectivity performance are closely observed. Any required adjustments—such as modifications to monitoring events or refinements to dashboard settings for individual residents—are made during this window. Care staff continue to receive support in embedding new workflows, including managing alerts, documenting interventions, and drawing insights from the Nobi dashboard. If issues arise, Nobi and Porters Care work jointly with the home to resolve them promptly.

Once the initial follow up period is complete, the home transitions into routine use of the technology, supported for the full three year funded period through ongoing technical assistance, connectivity monitoring, and account management. Monthly check-ins from Porters Care provide an additional layer of assurance, ensuring that lamps remain fully functional and that any issues are addressed quickly. Throughout Stage 3, the DiSC team retains oversight through regular programme and assurance meetings, enabling the ICB to monitor outcomes, maintain quality standards, and ensure that homes remain safely and effectively supported while using Nobi technology.

During Stage 3, once the Nobi Smart Lamps had transitioned to full operational mode, ongoing oversight was maintained through a structured programme of monitoring, data review and assurance. As part of this governance, Nobi presented monthly updates at the ICB Nobi Assurance Group, providing detailed analyses of system performance across all live homes. These presentations highlighted any homes where staff response times to falls alerts or monitoring events exceeded ten minutes, enabling the DiSC team and Nobi to identify emerging risks, patterns and training needs. By reviewing this data collectively, the group could implement targeted quality improvement actions, support providers experiencing operational pressures, and ensure that the intended safety benefits of the technology were consistently realised. This routine performance scrutiny formed a key component of Stage 3, giving the ICB assurance that homes remained safe, responsive and fully engaged in the effective use of the Nobi system.

Ongoing impact monitoring was strengthened through the monthly account management calls that Porters Care held with every participating home. These calls served not only as a technical check-in but also as an opportunity to capture qualitative benefits and frontline feedback about how Nobi was improving safety, resident wellbeing and operational efficiency. Porters Care routinely gathered examples of how Nobi had prevented harm or enabled earlier intervention. Homes reported instances where staff were able to respond within seconds to a resident attempting to stand, preventing what would otherwise have been an unwitnessed fall; situations where nighttime activity data helped explain behavioural changes or episodes of daytime fatigue; and cases where Nobi alerted staff to a resident in difficulty before the individual activated their call bell. Porters Care also identified themes such as reduced long lies, enhanced confidence during night shifts, improved visibility for residents who wandered, and better collaboration with community teams when sharing Nobi's activity insights. These examples were fed back to the DiSC team and routinely discussed at assurance meetings, providing a rich, real world picture of how the technology was improving outcomes. Together with Nobi's connectivity and performance data, these monthly provider insights helped the ICB understand the full breadth of Nobi's impact during Stage 3 and supported continuous quality improvement across the programme. Qualitative data from this feedback were incorporated into analysis.

4.3 DEEP DIVE CASE STUDIES

Three care homes were selected as case study homes for this evaluation: Kendal Care Home, an Abbey Healthcare home based in Kendal, and Wytham Lodge and Ribble View, Exemplar care homes based in Burnley and Preston.

Kendal Care Home is a large care and nursing home with 120 rooms offering residential en-suite bedrooms and nursing suites, including general nursing, EMI nursing, and palliative care. Wytham Lodge and Ribble View provide nursing care for adults living with complex needs arising from brain injuries, Huntington's disease, dementia, mental health conditions, neuro-disabilities and physical disabilities

The focus of the Kendal Care Home case study is an analysis of falls detection and prevention in the home, whereas the focus in Wytham Lodge and Ribble View is the impact of and potential uses of Nobi Lamps in 1-1 care.

At the time point of the Launch (April 2026), only the data from the Kendal care home were available for analysis.

4.4 QUANTITATIVE AND QUALITATIVE DATA SOURCES IN RELATION TO OBJECTIVES

The following table highlights the different data sources used in the analysis for this evaluation report.

Table 4.1 Data Sources

Data Sources: Quantitative	
A. Northwest Ambulance Service (NWAS)	
Description	Monthly call-out data and their outcomes were obtained for all Nursing and Residential care homes across the South Cumbria and Lancashire region. The dataset spans April 2024 to February 2026 and includes 428 Nursing and Residential care homes. Of the 68 Nursing and Residential care homes that implemented the intervention, 57 recorded call-outs during the observation period and were therefore included in the analysis. The remaining 371 homes (never treated) were included as controls. Each call-out record includes a documented outcome, categorised as one of three types: (1) **hear and treat**, where the call handler provides clinical advice remotely without dispatching an ambulance; (2) **see and treat**, where an ambulance is dispatched and Emergency Medical Technicians assess and treat the resident on-site without conveyance to hospital; or (3) **see and convey**, where the resident is transported by ambulance to a major hospital emergency department. Each outcome category was assigned a corresponding unit cost drawn from published King's Fund estimates. [1] The dataset also includes care home characteristics, specifically whether the home is registered as a residential or nursing home, its postcode, and its affiliated NHS place (place-based partnership neighbourhood within an Integrated Care System). Additionally, the number of beds recorded in the internal ICB records for each of the 428 homes was appended to the dataset. These variables were used in a sensitivity analysis to examine whether specific subgroups of care homes exhibited differential impacts from the intervention.
Objectives	Objective 1. To determine whether this technology has reduced resident falls and prevented future falls, reduced the staff response time after a resident has fallen and before help comes (reducing long lies), and reduced ambulance call-outs, distinguishing those leading to hospital conveyance from those where no conveyance occurred. Specifically, this data will enable us to determine if the technology has reduced the overall number of ambulance call-outs in general and the number of call-outs ending in hospital conveyance. Objective 5: To determine whether the technology offers value for money by reducing cost through reducing the number of call-outs per month.
Analysis	Analysis detected whether the monthly number of call-outs & their cost in homes with the technology was reduced after implementation, compared to never-treated homes. Analysis methods used were Callaway and Sanatana's *difference-in-differences across multiple time periods*.
B. Smart Lamp Technology Records	

Description	The smart lamp installed in each room recorded residents' falls, including the time of occurrence and the phase at which the fall occurred. During the **learning phase**, falls were recorded without staff notification, enabling baseline response times to be established prior to full technology deployment. During the **active phase**, falls were recorded, and trained care staff were immediately notified to respond. Additional resident characteristics, including age and gender, were also recorded.
Objectives	Objective 1: To determine whether this technology has reduced resident falls, staff response time after having fallen and before help comes.
Analysis	The dataset was analysed to compare fall frequency between the learning and active phases. This was done using a fixed-effects negative binomial regression model. Residents' characteristics, including age and gender, were included as control variables to determine whether fall rates varied across specific demographic groups.
C. CHSMQ Staff and Manager Survey	
Description	The ICB team designed and distributed an electronic survey to all staff and managers of Nursing and Residential care homes who implemented the technology.
Objectives	Objective 1: To determine whether this technology has reduced resident falls and prevented future falls, reduced the staff response time after a resident has fallen and before help comes (reducing long lies), and reduced ambulance call-outs, distinguishing those leading to hospital conveyance from those where no conveyance occurred. Objective 2. To determine whether this technology has changed how Nursing and Residential care homes deliver care for the residents they support. Objective 3: To determine what impact this technology has had on residents' quality of life. Objective 6: To consider how this intervention can be scaled and sustained.
Analysis	A mixed methods approach was used to analyse this dataset. Quantitative analysis: The responses to the close-ended questions in the dataset was analysed using descriptive statistics to assess changes in care delivery practices, and improvements in residents' well-being, reduction in fall incidents and long lies, sleep patterns, and broader staff and resident outcomes. Bivariate analysis (chi-squared and fisher exact tests) was done to assess whether participation in technology training was significantly associated with staff confidence in using the technology to manage fall risks and to assess if there are any differences in the impact of the technology on night-time monitoring patterns of the residents between residential care and nursing homes. Qualitative analysis: The open-ended questions from the CHSMQ questionnaires completed by the care home staff and managers were analysed using deductive (process in which a pre-existing theory or a framework is used to analyse qualitative data) and inductive thematic analysis (themes and sub-themes are derived from the raw data rather than a pre-existing theory to identify any "emerging" additional themes and sub-themes). The Technology Acceptance model (Davis, 1987) was used to conduct the deductive thematic analysis. The responses were read several times to ensure familiarity with the

	data and initial codes were identified (Braun & Clarke, 2013). These codes were categorised into broader themes using the support of coding software called NVivo v14.
D. Benefits reporting data	
Description	Qualitative data which included feedback about the Nobi device from 69 care home managers or team leaders through email communication and meetings with the ICB.
Objectives	Objective 1: To determine whether this technology has reduced resident falls and prevented future falls, reduced the staff response time after a resident has fallen and before help comes (reducing long lies), and reduced ambulance call-outs, distinguishing those leading to hospital conveyance from those where no conveyance occurred. Objective 2. To determine whether this technology has changed how Nursing and Residential care homes deliver care for the residents they support. Objective 3: To determine what impact this technology has had on residents' quality of life.
Analysis	Qualitative data analysis was done using a combination of deductive and inductive thematic analysis. The Technology Acceptance model (Davis, 1987) was used to conduct the deductive thematic analysis. The responses were read several times to ensure familiarity with the data and initial codes were identified (Braun & Clarke, 2013). These codes were categorised into broader themes using the support of coding software called NVivo v14.
E. "Deep dive" case study-Kendal care home	
Description	Qualitative data was obtained by conducting a semi-structured interview with the manager of Kendal care home regarding his feedback on the Nobi device and its impact on the residents' safety and care provision by staff members. Additionally, the analysis of the Kendal care home staff responses to the CHSMQ questionnaire were analysed and included in this case study. Quantitative incident report data were used to assess differences in fall trends over a three-month period before and after Nobi installation, comparing residents in rooms equipped with Nobi (21 residents) to those without Nobi (80 residents).
Objectives	1. To determine whether this technology has reduced resident falls, staff response time after having fallen and before help comes, ambulance call-outs and hospitalisations, and prevented future falls. 2. To determine whether this technology has changed how Nursing and Residential care homes deliver care for the residents they support. 3. To determine what impact this technology has had on residents' quality of life. 4. To investigate in what kind of circumstances Nobi lamps can support care in a different way to a 1-1 package of care and be the least restrictive practice? 5. To determine whether this approach offers value for money. 6. To consider how this intervention can be scaled and sustained.

Analysis	A mixed methods approach was used for the analysis. Quantitative analysis: Descriptive statistics to assess changes in care delivery practices, and improvements in residents' well-being, reduction in fall incidents and long lies, sleep patterns, and broader staff and resident outcomes. Bivariate analysis (fisher exact test) was done to assess whether participation in technology training was significantly associated with staff confidence in using the technology to manage fall risks. Additionally, a difference-in-differences model was employed to assess the impact of Nobi technology on changes in monthly fall trends, comparing residents in rooms with Nobi to those without (controls).Qualitative analysis: The anonymised transcript of the semi-structured interview with the manager of Kendal care home was analysed using inductive thematic analysis (Naeem et al., 2023). The responses were read several times to ensure familiarity with the data and initial codes were identified (Naeem et al., 2023; Braun & Clarke, 2013). These codes were categorised into broader themes using NVivo v14.

(1) https://www.kingsfund.org.uk/insight-and-analysis/data-and-charts/key-facts-figures-nhs?

4.5 QUALITATIVE DATA ANALYSIS PLANS IN RELATION TO OBJECTIVES

(i) **Open-ended questions in the CHSMQ and benefits reporting data**: The benefits reporting data and the open-ended questions from the CHSMQ questionnaires completed by the care home staff and managers were analysed using deductive and inductive thematic analysis. Deductive thematic analysis is the process in which a pre-existing theory or a framework is used to analyse qualitative data – what do we expect based on what we already know? Inductive thematic analysis, in which themes and sub-themes are derived from the raw data rather than a pre-existing theory, was also used to identify any “emerging” additional themes and sub-themes – that is, what do we find that we hadn’t necessarily expected?

The responses were read several times to ensure familiarity with the data and initial codes were identified (Braun & Clarke, 2013). These codes were categorised into broader themes using the support of coding software called NVivo v14.

Deductive analysis framework:

A previously existing model that is well-known amongst technology developers and researchers was used. This is the Technology Acceptance Model (TAM, Davis, 1987) and it was used as a framework to analyse the data. This means that the sub-themes derived from the data were grouped into the TAM domains which were considered to be the main themes. The TAM proposes that motivation to adopt a technology can be influenced by *perceived ease of use, perceived usefulness, attitude towards using the technology* and the *behavioural intention* to use the technology. *Perceived usefulness* is the extent to which individuals find the technology improves their job performance or effectiveness in doing their tasks. *Perceived ease of use* refers to individuals’ perception of how easy it is to use or interact with the technology. According to the TAM, the perceived usefulness and perceived ease of use affect a person’s intention to use a technology (*behavioural intention to use technology*) and the emotional responses to using the technology (*attitude to technology*). A positive attitude to technology and behavioural intention to use the technology leads to actual adoption of the technology. These TAM constructs that we used in the analysis are shown in Figure 1.

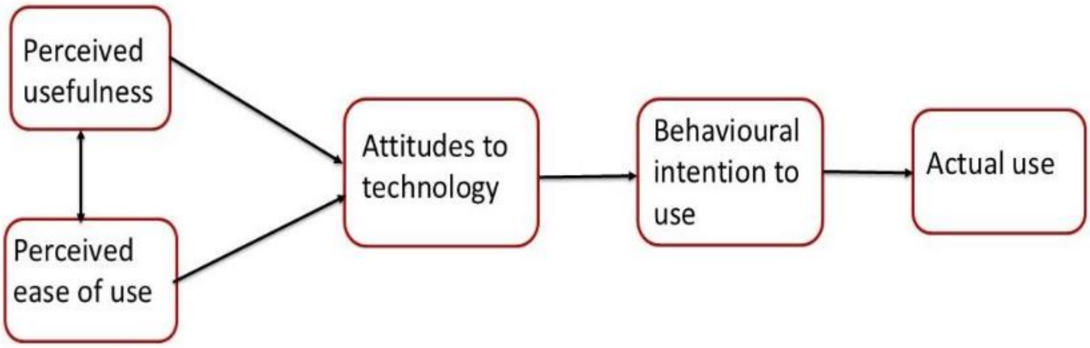

Figure 4.1: Technology Acceptance model (Davis, 1989).

Inductive analysis

Codes that did not fit into the above framework or added to the understanding of the constructs were also extracted and reported.

(ii) **Deep dive case study of Kendal care home**: The anonymised transcript of the semi-structured interview with the manager of Kendal care home was analysed using inductive thematic analysis (Naeem et al., 2023). The responses were read several times to ensure familiarity with the data and initial codes were identified (Naeem et al., 2023; Braun & Clarke, 2013). These codes were categorised into broader themes using NVivo v14.

4.6 EVALUATION APPROACH

4.6.1 IN-HOUSE AND EXTERNAL SKILLS

The Nobi Lamp project in Cumbria and South Lakes was an innovative and extensive project introducing new technology into care and nursing homes. The DiSC Team at the ICB were keen to find out and share the learning from this project more widely. As the project was completing end of March 2026, the team began to determine their approach to the evaluation in Spring 2025.

The three members of the DiSC team had extensive knowledge of the project and good existing working relationships with the participants and stakeholders and wanted to be hands-on in the evaluation and develop their in-house skills. Realising their skills gaps, and wanting to ensure a level of objectivity in the process, the team approached an external evaluator with experience of evaluating Digital Pioneer projects for the ICB as an adviser, and a team of five Health Researchers from Lancaster University were commissioned to analyse, as secondary data, the information the in-house team collected during the evaluation and co-author the report in collaboration with the in-house team.

This combined in-house and external skills approach was time efficient and cost effective, given the tight timescales to the end of the project. In particular, the external data specialists brought a necessary expertise and validity to the data analysis in this evaluation.

4.6.2 A SERVICE IMPROVEMENT EVALUATION APPROACH

The evaluation of the Nobi Lamp Pilot Project in Lancashire and South Cumbria aims to assess the potential service improvements afforded by this new digital approach to social care. By exploring the processes, outcomes and costs of introducing Nobi Lamps into Care and Nursing Homes, the evaluation will identify the initial impacts of Nobi Lamps on resident fall prevention and detection. It will assess if the technology has changed how Nursing and Residential care homes deliver care, the impacts on residents' quality of life, and in what kind of circumstances lamps can support care in a different way to 1-1 care packages.

The evaluation will identify potential service improvements and barriers to service improvements when introducing Nobi Lamps into Residential Care and Nursing homes. It will assess the value of this new digital approach in the care sector. In identifying, assessing and reviewing the impacts of implementing the Nobi Lamp project, this evaluation provides evidence that can inform care policy, commissioning decisions and digital developments in the social care sector.

4.6.3 *A MIXED METHODS INDEPENDENT EVALUATION*

The evaluation from Lancaster University included both qualitative and quantitative data analysis expertise, with researchers from the disciplines of Psychology, Health Research, Organisational Wellbeing and Technology, and Health Economics.

To respond to the objectives (See Section 3), quantitative data were used from the Nobi smart lamps, from the North West Ambulance service and from a questionnaire (the CHSMQ) sent to managers and staff. In addition, qualitative data from emailed feedback on benefits or challenges from care home managers, from open text boxes in the questionnaire, and from an interview as part of the deep dive case study were all analysed.

The approach is that Quantitative data answer the question of whether or not the lamps improve outcomes and by how much, and what might that save in terms of costs, whereas Qualitative data answer the questions of how that is happening – what are the mechanisms of change and what are the changes perceived and experienced by staff that result in the changes in the quantitative outcomes. That is the two types of data support each other. We can triangulate the outcomes of analyses to determine where there are matches and mismatches within the data to enable further interpretation and identify any facilitators or barriers to effectiveness which can be used to determine recommendations for future scaling of the pilot.

SECTION 5: FINDINGS: IMPACT ON NURSING AND RESIDENTIAL CARE HOMES STAFF

5.1 ANALYSIS OF CHSMQ AND BENEFITS REPORTING DATA

The care home staff and managers' responses to the close-ended (agree/disagree or numerical answers, that is, the quantitative data) and open-ended questions (written responses, that is, the qualitative data) of the CHSMQ and the benefits reporting data were analysed. Analysis of this data regarding the impact of the Nobi device on the care home staff's work patterns and efficiency of care provision was conducted to respond to the following objectives:

Objective 1: To determine whether this technology has reduced resident falls, and staff response time when a resident has fallen and before help comes.

Objective 2: *To determine whether this technology has changed how* Nursing and Residential *care homes deliver care for the residents they support*.

Objective 4: To investigate in what kind of circumstances Nobi lamps can support care in a different way to a 1-1 package of care and be the least restrictive practice?

Objective 6: To consider how this intervention can be scaled and sustained.

The staff and managers' responses to the close-ended questions in the CHSMQ were analysed using descriptive statistics (e.g. mean, standard deviation, frequency analysis) and presented in the following section along with the themes and sub-themes from the qualitative data as it supports the quantitative data.

5.2 COMBINED FINDINGS OF QUALITATIVE AND QUANTITATIVE DATA

The analysis of qualitative data led to four different main themes which corresponded to the TAM constructs (See Section 4), i.e., *perceived ease of use, perceived usefulness, attitudes to technology* and *behavioural intention* to use. Nine different sub-themes, derived through an inductive thematic analysis of the data, were grouped into the main themes. Figure 2 depicts the themes and sub-themes related to the impact of the Nobi device on the quality of care provided by the staff at Nursing and Residential care homes and health-related quality of life of the residents.

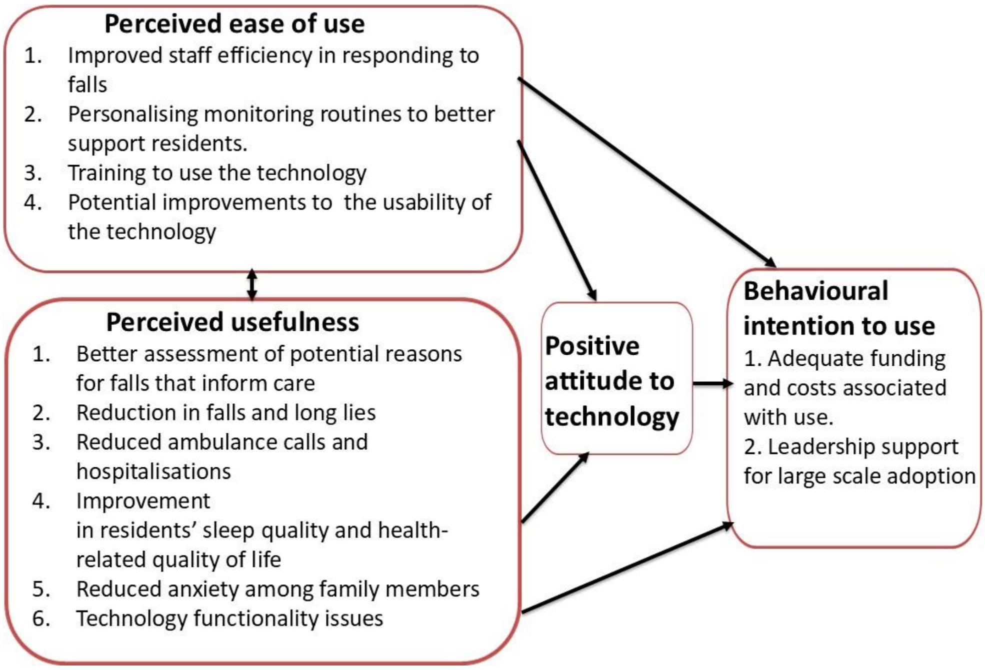

Figure 5.1: Themes and sub-themes related to the impact of the Nobi device on care provision and residents' health-related quality of life (from chapter 5 & 6).

A narrative summary of the main themes and sub-themes is presented in this section. The list of themes and sub-themes along with a few examples of quotations from the data to support them and the dataset from which each quotation was taken are presented in Table 5.1. Staff and managers' names have been replaced by ID codes to preserve anonymity.

Table 5.1: **Themes and sub-themes related to the impact of the Nobi device on the care provision and work patterns of staff**.

Themes	**Sub-themes**	**Quotes supporting the major themes and sub-themes**
Perceived ease of use	Improved staff efficiency in responding to falls	*"I believe the system has benefitted the reporting and recording of accidents. One particular accident was raised with safeguarding and closed immediately as we could give an accurate account and evidence that the injury sustained was unpreventable, all measures in place." ID 144 (CHSMQ staff)* *"Since the installation of Nobi lights in high-risk fall rooms, staff response times to incidents have improved significantly. The lights provide immediate alerts when a fall is detected, allowing staff to intervene quickly" ID 11 (CHSMQ lead returns)*
	Personalising monitoring routines to better support residents.	*With close monitoring of the resident at night (using sleep reports and monitoring alerts), care managers and staff were confident that she could be supported with the Nobi at night and put in a request to reduce the 1:1 support at night. The*

		resident was reviewed and the care reviewers agreed the Nobi can support her care at night and reduced the 1:1 support at night." ID 52 (Benefits reporting data) *"They are able to focus on other tasks whilst on shift with the extra time available." ID 37 (CHSMQ lead returns)*
	Training to use the technology	*Staff have found the interface straightforward and the support from the Nobi team helpful whenever we've had questions." Care home ID 27 (Benefits reporting data)* *"This incident highlights the critical role of technology like the Nobi light system in improving resident safety and supporting transparent investigations. While the care home demonstrated effective use of the system, the case underscores the need for continual staff training and procedural adherence to mitigate risks and enhance care standards." Care home ID 13 (Benefits reporting data)*
	Potential improvements to the usability of the technology	*"We have identified that the current duration of fall footage is often too short to capture what happens before staff enter the room. On several occasions, residents have already managed to get themselves back into their armchair by the time staff arrive, which means we lose valuable insight into how they mobilise and recover independently. Extending the length of the video footage prior to a second person entering the home would greatly support our ability to understand these situations and tailor care plans more effectively." ID 58 (CHSMQ lead returns)* *"Increased compatibility with electronic care systems (we use Person Centred Software) would be extremely helpful." ID 36 (CHSMQ lead returns)*
Perceived usefulness	Better assessment of potential reasons for falls that inform care	*"Look at footage and put in place preventative measures for example moving furniture differently so that the patient/resident won't fall again." Care home ID 30 (Benefits reporting data)* *"We have also had an alert for a fall and when staff have got there the service user was up and about and denied having a fall whereas when we reviewed the nobi escalation they had fallen and are on blood thinning medication so very helpful in this case." Care home ID 56 (benefits reporting data)*
	Technology functionality issues	*"I believe NOBI is a good system as long as you have no WIFI issues, if you do have WIFI issues NOBI is severely compromised." ID 12 (CHSMQ lead returns)*

		"Alarm ringing for staff members/cleaners rather than residents" ID 63 (CHSMQ lead returns) *"The system can be overly sensitive when residents move their arms or legs over the side of the bed. This requires staff to assess whether alerts indicate a genuine "out of bed" event or normal movement." ID 56 (CHSMQ lead returns)*
Positive attitude to the technology		*"I am so pleased with it, surely something that can enhance the safety and care of somebody can only be a positive." Care home ID 1 (Benefits reporting data)*
Behavioural intention to use	Adequate funding and costs associated with use.	*"Depending on cost it would be a discussion I would need to have with our committee." ID 15 (CHSMQ lead returns)*
	Leadership support for large scale adoption	*"It would be up to the Director." ID 32 (CHSMQ lead returns)*

The following section presents a narrative description of the themes and subthemes determined from the qualitative analysis.

5.3. THEME 1: PERCEIVED EASE OF USE

The sub-themes related to the care home staff's perception of how easy it is to use the Nobi device and ways in which the Nobi device made their tasks easier and more efficient were grouped under this theme. Where themes respond directly to our objectives, this is signalled (see Section 3).

Sub-theme 1: Improved staff efficiency in responding to falls

Care home staff and manager responses indicated that the Nobi smart lamps significantly improved accuracy of detection of falls and response times of staff when a fall occurs. (Objective 1). Care home staff also mentioned that the data from the Nobi device helped in improving the recording and reporting of falls and incidents as they now have accurate data to identify the causes of the falls and, in turn, to plan actions to prevent future falls (Objective 2). Additionally, the following quote from a care home manager illustrated that the device helps to quickly detect high-risk behaviours that can lead to falls such as sitting on the edge of the bed, getting out of bed and walking around at night, which can serve to increase the efficiency and speed of staff attendance /intervention if the residents are engaging in these behaviours.

"If an alert comes through that an individual is out of bed, the staff can respond to settle them in a quicker time period." ID 53 (CHSMQ lead returns)

The participants' responses to the close-ended questions in the CHSMQ also supported this finding in that the majority of the staff indicated that the device helped them to respond to falls quicker and the majority of the care home managers mentioned that they felt that there were changes to the staff response times to falls (Figure 5.2).

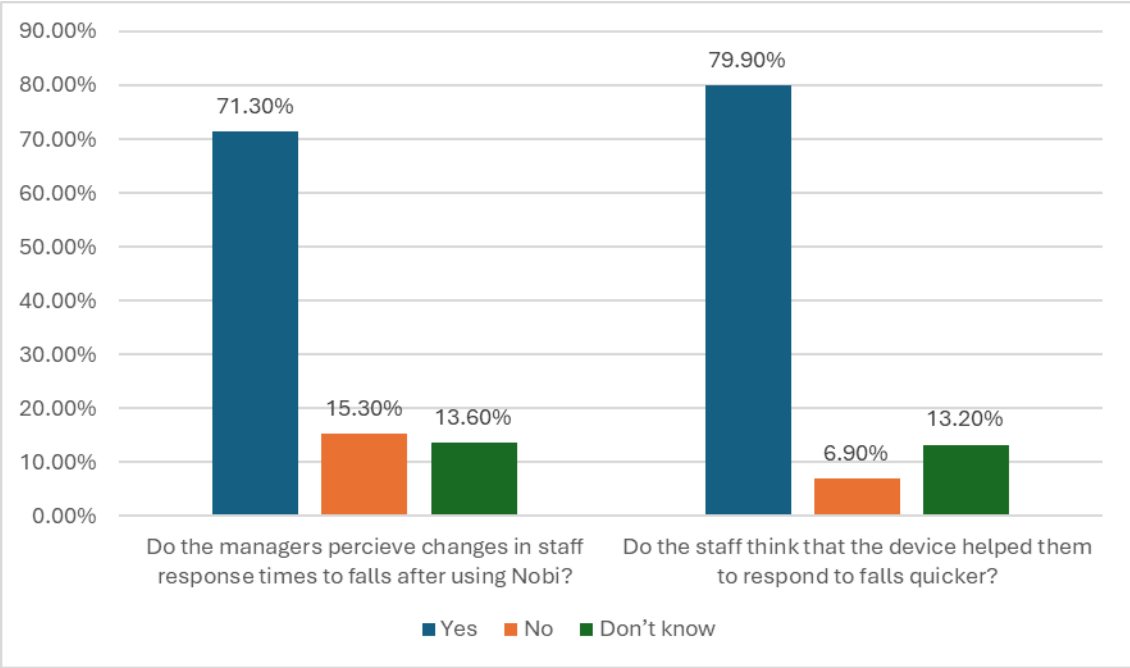

Figure 5.2: Changes in response times and staff efficiency in responding to falls

Overall, the responses indicated that the device improved care home staff's confidence in improving the residents' safety as they felt reassured that they would be notified immediately when a fall has occurred.

<u>Sub-theme 2: </u> Personalising monitoring routines to better support residents.

The majority of the responses indicated that there were no significant changes to staff work patterns and the staff continued to routinely check on the residents to ensure their safety. The responses to the close-ended questions of the CHSMQ also supported this in that the majority of the managers did not feel that there were any changes in night-time monitoring of residents by the staff and most staff did not feel that there was any reduction in the manual checks that they had to perform to ensure residents' safety (Figure 5.3).

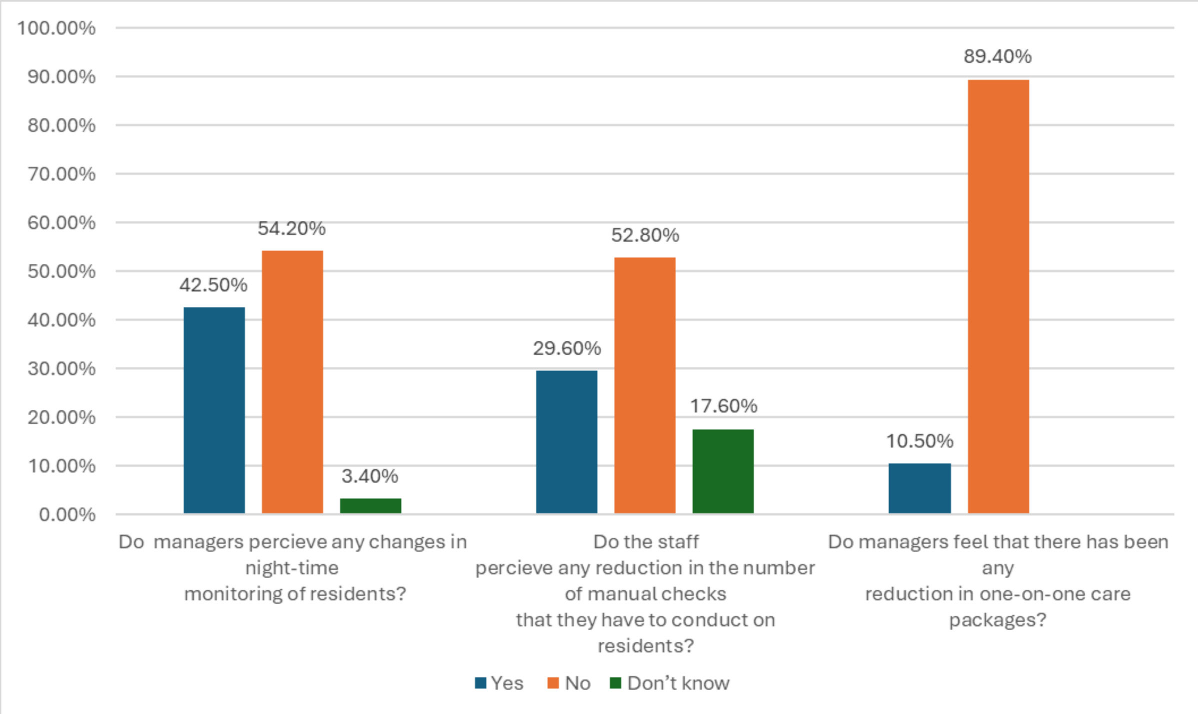

Figure 5.3: Care home managers and staff's perception of changes in monitoring of resident safety.

Indeed, the following response from a care home manager indicated that the staff had to check their residents' safety more frequently due to more frequent alerts for high-risk behaviours for falls such as getting out of bed.

"We continue routine nightly checks, following the data Nobi gives us, some routine checks of residents have been more frequent due to recorded bed exits etc" ID 17 (CHSMQ lead returns)

Additionally, potential differences in frequency of monitoring patterns were explored between nursing and residential care homes as nursing care residents are individuals diagnosed with various medical conditions, and they generally need a higher level of support as compared to residents in residential care homes (Healthcare homes, 2024). A chi square goodness of test was conducted in order to explore the differences in monitoring patterns and frequency. The expected frequency in a few cells was lower than 10, therefore, the Fisher exact test is reported (Pallant, 2021). A larger proportion of managers from the nursing care homes mentioned that there were changes to night-time monitoring routines of residents (53.3%) as compared to the residential care homes (36.5%). However, the fisher exact probability test indicated that there were no significant differences in the monitoring patterns of these two types of care homes (p=0.349).

The qualitative data showed that the Nobi data did help the care home staff and managers to tailor the frequency and patterns of monitoring of the residents according to residents' needs and fall risks. Some residents who were at high risk falling were being monitored more frequently whereas some responses indicated that the staff had to conduct fewer checks at night which helped the residents to sleep without being disturbed and helped the staff to focus on other important tasks during their shifts. The following quote also suggests that the intensive one-on-one care for a few residents with high fall risks could be reduced after the Nobi device was installed in very few Nursing and Residential care homes as the device closely monitored the residents' high-risk behaviours, sleep patterns and fall occurrences (Objective 4).

"With close monitoring of the resident at night (using sleep reports and monitoring alerts), care managers and staff were confident that she could be supported with the Nobi at night and put in a request to reduce the 1:1 support at night. The resident was reviewed and the care reviewers agreed the Nobi can support her care at night and reduced the 1:1 support at night." ID 52 (Benefits reporting data).

However, Figure 3 shows that majority of the care home managers did not reduce the one-on-one monitoring of their residents (89.4%). The following quote by a care home manager shows that one-on-one monitoring could not be reduced for a particular resident as the resident wandered around the room without one-on-one monitoring and experienced a fall.

Due to high falls risk 1.1 is still in place due to recent trial without 1.1 resulting in resident wandering out of bedroom and falling. ID 27 (CHSMQ lead returns)

Overall, the responses indicated that the Nobi device helped Nursing and Residential care homes to personalise and tailor the frequency and patterns of monitoring of residents' safety according to the needs and fall risks of the residents. In a few cases, the device helped the homes to provide fewer restrictive and intrusive care practices and improved the detection of high-risk behaviours which helped the participants to care for the residents more efficiently (Objective 2 & 4).

Sub-theme 3: Training to use the technology

The majority of the staff and managers of the Nursing and Residential care homes perceived the technology to be easy to use, and they felt that they were getting used to using the technology to provide care effectively. Participants also felt that the training provided by the Nobi team on how to use the technology was helpful and their queries on how to use the technology were answered promptly. This is supported by participant responses to the close-ended CHSMQ questions regarding perceived confidence in using the device in that majority of the staff and managers felt confident or very confident in using it (Figure 5.4).

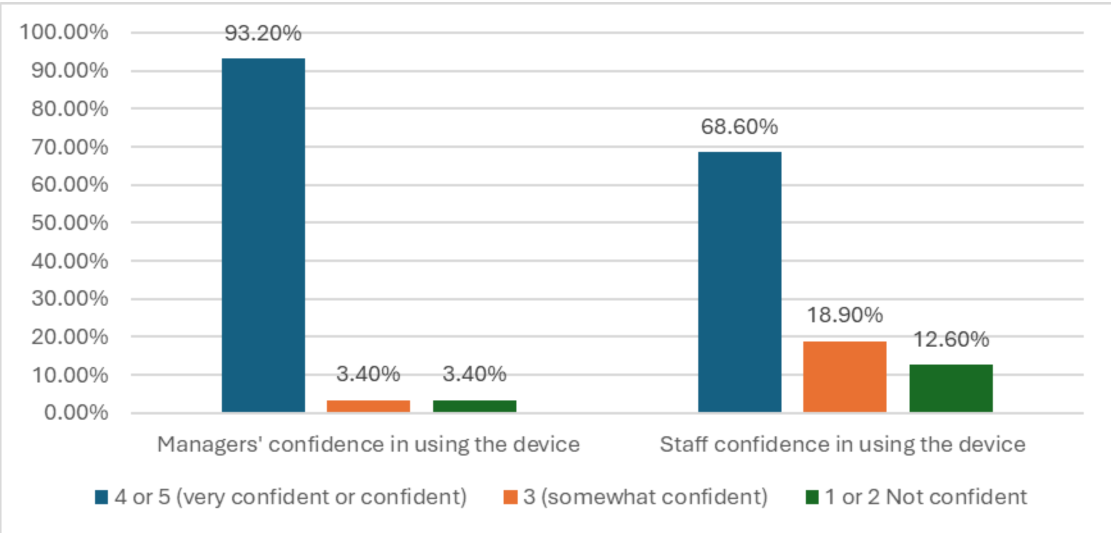

Figure 5.4: Managers and staff confidence in using Nobi.

Additionally, 84.3% of the staff mentioned that it was easy or very easy to respond to the alerts from Nobi about falls, 70.4% mentioned that the device has made their job easier and approximately 80% of the responses indicated that the staff were confident in managing fall risk using Nobi.

However, some responses indicated the importance of ongoing staff training on the use of the Nobi device to detect and prevent falls and accurately document incidents of falls and injuries so that the staff can continue to use it confidently. For example, the following quote from one particular care home manager demonstrated that there was a need for further training to improve the communication among staff about fall incidents and injuries during handovers to ensure continuity across different work shifts and avoid delays in reporting of these incidents.

"Management addressed the delay in identifying the hip bruise as a procedural shortfall. Staff were reminded of the importance of thorough communication during handovers and immediate reporting of

any visible or suspected injuries. Additional training sessions were organised to reinforce these practices." Care home ID 13 (Benefits reporting data)

Although the majority of the staff received training on how to use the device, 22.6% of the staff mentioned that they did not receive any training on how to use the device. A chi square goodness of test was conducted in order to explore if there were any differences in managing fall risks using the Nobi device between the staff who received any training and those who did not receive any training to use the device. The test indicated that that the individuals who received training to use the device were significantly more likely to report that they were confident in managing fall risks using the device than the staff who reported that they did not receive any training, X^2 (df=1, n=159) =42.26, p<0.001. This underscores the importance of training in order to ensure that the staff are able to detect and prevent falls effectively by using the device. Indeed, a number of care home managers reported that a refresher training on the use of Nobi for their staff would be helpful.

Sub-theme 5: Potential improvements to the usability of the technology

Usability of a technology refers to the users' perception of how easy it is to use the technology. A technology could have poor usability due to factors such as complex interfaces or complex controls or buttons (Malden et al., 2025). Although the majority of the responses indicated that the Nobi device was easy to use, some respondents felt that the integration of the device with the electronic care systems at Nursing and Residential care homes would be helpful and improve the usability of the device. Participants also felt that the duration of the fall footage should be extended as it can help the care homes understand the causes of falls and tailor care plans more effectively.

5.4 THEME 2: PERCEIVED USEFULNESS

The sub-themes related to the perception of usefulness of the Nobi device in providing care such as improving the detection of causes of falls and detecting changes in sleep patterns were included in this theme.

Sub-theme 6: Better assessment of potential reasons for falls that inform care

The majority of the care home managers and staff reported that the main benefit of the Nobi device was that they could detect the causes and the events leading up to the falls and that helped actions to be taken which could prevent future falls, such as moving furniture to reduce the risk of residents tripping and falling. Some residents were falling more often at night and these residents' fall risk was reduced by the Nobi alerts for high-risk behaviours such as sitting on the bed or bed exits. (Objectives 1&2). The following quote from a care home manager highlights how the night light function of the Nobi device also helped in reducing falls among some of the residents.

"One lady had presented with bruises in the past but falls had not been witnessed. Nobi lamp has shown that this lady had more falls than had been realised and was regularly falling in the night but getting herself back to bed. Following analysis of the falls the night light function was turned on the Nobi Lamp and a grab rail added to the bed which have significantly decreased the number of falls that this lady is having." Care home ID 32 (Benefits reporting data)

Participants reported that the Nobi device was also helpful to detect falls and injuries for residents who were prescribed anticoagulant medications but denied experiencing a fall as they were able to get up after a fall independently. This allowed the staff to intervene on time and prevent further consequences from the injury.

The following quote also demonstrates that the Nobi device could accurately differentiate between true falls and instances where residents voluntarily lowered themselves on the floor. This helped the staff save time that was earlier required to complete documentation after unwitnessed falls when the residents voluntarily lowered themselves on the floor.

"We can see if a resident falls or puts themselves on the floor which saves time having to complete post falls observations as without NOBI it would be an unwitnessed fall." ID 173 (CHSMQ staff returns).

This is also supported by the care home managers' and staff responses to the close-ended CHSMQ questions (Figure 5.5), in that majority of the managers felt that the Nobi dashboard was helpful or very helpful in personalising care provision and majority of the staff felt that their quality of the care improved after they started using the Nobi device.

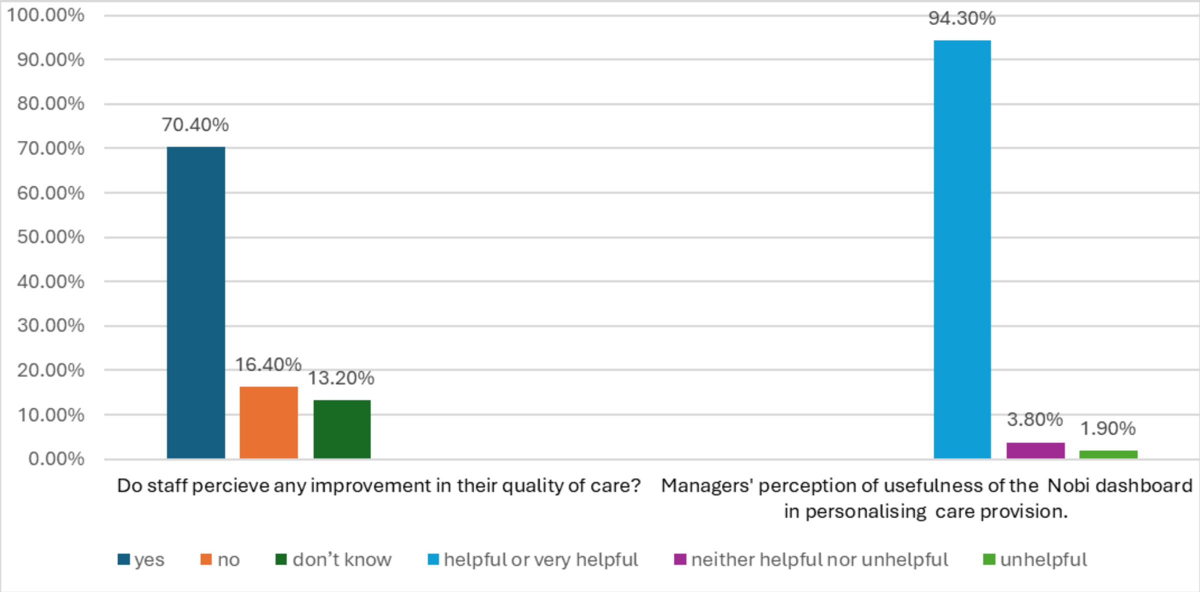

Figure 5.5: Perceived usefulness of the Nobi device and dashboard in improving care provision

Overall, this theme supports Objectives 1 and 2 in terms of demonstrating some of the mechanisms by which falls are prevented and care more precisely focused.

<u>Sub-theme 7: Technology functionality issues</u>

Functionality of a technology refers to the users' perception of whether the technology is functioning as intended, therefore, increasing or reducing the users' confidence (in case of poor functionality) in the effectiveness of the technology (Malden et al., 2025).

Although most of the responses indicated that care home staff and managers found the Nobi device helpful in delivering care to the residents, a few responses indicated that there were some problems with the functionality of the device such as false alerts. For example, some staff reported that the Nobi device was too sensitive to limb movements of the residents when the device was configured to alert the staff about behaviours such as sitting at the edge of the bed or bed exits. Some responses in the CHSMQ by care home staff also indicated that the device provided false alerts when the cleaners attempted to clean the floors. This underscores the importance of reminding the staff to use the presence button to "snooze" the device when the cleaners are in the rooms.

Additionally, some responses also indicated that the Nobi device at times did not detect a fall when it occurred which could be attributed to the fluctuations in Wi-fi connectivity in specific Nursing and Residential care homes.

Overall, this theme illustrates the usefulness of detailed feedback collection from users on the potential continuous improvement of the technology.

5.5 THEME 3: POSITIVE ATTITUDE TO THE TECHNOLOGY

Due to all the above-mentioned benefits of the Nobi device, the care home staff and managers had a positive attitude towards the Nobi device as it had significantly improved their care provision and increased the health and safety of their residents. The following quote from the care home manager indicates the positive attitude to the device and their desire to install it in all the rooms in the care home.

"Wish they had one in every room. A game changer and assisting all carers. Best thing the home has ever purchased." Care home ID 17 (benefits reporting data)

This theme feeds into Theme 4 in terms of the positive attitude increases the likelihood of intention to use, relevant to Objective 6 regarding scaling up.

5.6 THEME 4: BEHAVIOURAL INTENTION TO USE

Initially, funding was provided to the Nursing and Residential care homes to allow installation of the Nobi lamps in 20% of their rooms. The CHSMQ questionnaires for the care home managers assessed the care home managers' willingness to install Nobi devices in the other rooms as well. Therefore, the sub-themes related to the care home managers' intention to install Nobi devices in the other rooms have been grouped into this major theme as it indicates their intention to use the devices in their Nursing and Residential care homes in the long-term.

Sub-theme 8: Adequate funding and costs associated with use

Although the care home managers had a very positive attitude to adopting the Nobi lamps in the long-term, their responses indicated that the decision to install Nobi in the other rooms were dependent on the costs and if they could secure additional funding to support the use of this technology in their Nursing and Residential care homes. The following quote from a care home manager demonstrates the need to secure funding to install more Nobi devices.

"If funding could be secured, we would be very interested in more lamps." Care home ID 56 (benefits reporting data)

Sub-theme 9: Leadership support for large scale adoption

Some responses indicated that the decision to install further Nobi lamps had to be made by the other higher authorities in their Nursing and Residential care homes such as the managing directors, owners of the homes and the other senior management in the head office. This is demonstrated by the following quote from a care home manager who mentioned that the CEO and the trustees of their charity would have to make the decision of installing the Nobi device in the other rooms.

"As we are a charity it would be a decision made via CEO and trustees." ID 57 (CHSMQ lead returns)

5.7. CONCLUSIONS FROM QUALITATIVE FINDINGS, TRIANGULATED WITH QUANTITATIVE FINDINGS FROM THE QUESTIONNAIRE WHERE RELEVANT.

The majority of the care home staff and managers felt that the Nobi device was easy to use and improved the staff's efficiency in responding to falls. Staff were able to promptly attend to the residents after a fall which led to reduction in long lies among residents. The data provided by the Nobi device also helped the staff and management to ascertain the potential causes of falls and prevent them in the future by introducing measures such as moving furniture to reduce tripping hazards in residents' rooms. Additionally, the device helped the Nursing and Residential care homes to deliver more personalised care and tailor the frequency and timing of the monitoring of the residents' safety according to their fall risks.

The majority of the staff and managers mentioned that they felt confident in using the device as it was easy to use, and the training provided to use it was helpful. However, some care home managers emphasised the importance of continued staff training in using the Nobi device to detect and prevent falls and accurately document incidents of falls and injuries. Behavioural intention to use the device in the long-term was influenced by the funding available to implement it, cost-effectiveness of the device, and support of the higher authorities of the organisations. Additionally, infrastructure upgrades such as improvement in Wi-fi systems in the care homes and interoperability of the Nobi device data with the electronic care systems at care homes should be considered in order to effectively scale the device.

SECTION 6: FINDINGS: IMPACT ON NURSING AND RESIDENTIAL CARE HOME RESIDENTS: ANALYSIS BASED ON THE NOBI COLLECTED DATA

6.1 METHODS

When NOBI is first installed, it operates in what is known as learning mode. During this phase, the system collects information on fall events but does not activate its fall-prevention functions or alert staff to potential falls or risks. As a result, learning mode captures fall data without influencing staff behaviour or resident care. This period therefore provides a natural comparison point for the analysis. Once the system switches to active mode, NOBI begins actively generating alerts and providing fall-prevention support, which can influence both the likelihood of falls and staff response times.

Assuming that no other relevant changes occur within the Nursing and Residential care homes between these two phases, we can implement a pre–post comparison between learning mode and active mode.

To estimate the relative risk of falls and variation in response times following the implementation of NOBI, we used fall event data provided by NOBI's monitoring system. The technology was specifically designed to detect and record falls and respective response times, enabling us to observe the number of falls occurring after installation and how long the staff took to provide support to the resident. Because sensors were installed in each room we could track how many falls occurred in a given room on each day. In addition, the system recorded the resident associated with each detected event, which made it possible to construct more granular measures, the number of falls per resident per day, and respective response times.

Specifically, we could examine whether the number of falls and response times observed during active mode was lower than during learning mode. Additionally, because active mode was activated at different times across the Nursing and Residential care homes, we included what statisticians call "day fixed effects" to account for time-specific variation, while to control for potential heterogeneity across residents, we also included individual-level fixed effects in the model. These are were meant to address changes in the number of falls that could be attributed to a certain day (e.g., when resources in the care homes may be lower, as for instance, holiday times), or to individual characteristics (e.g., frailer individuals that could fall more due to their frailty, independently of the technology). The inclusion of these fixed effects gave us more trust that the results were being driven by the technology instead of by different distribution of residents or days across the sites with NOBI in active mode or learning mode.

In the dataset, not all residents were exposed to both operating modes of the NOBI system. In some cases, residents occupied a room while the system was still in learning mode but left the room or the care home before the system switched to active mode. In such situations, the comparison between the two periods may have partly reflected changes in the resident population rather than the effect of the technology itself, potentially biasing our estimates.

Although we included individual fixed effects to help control for time-invariant resident characteristics, we further addressed this issue by restricting the sample to residents who experienced both learning mode and active mode. This approach ensured that the comparison is made within the same individuals over time.

The analysis was conducted for the full sample of residents and for the restricted sample including only residents who experienced both learning mode and active mode of the technology. This is known as a sensitivity analysis – a way of asking the same questions of the data in a different way to check we come up with the same results.

For the response times we used an Ordinary Least Squares regression (OLS).

For the number of falls, we used a Negative Binomial Regression, that is considered an adequate fit when the outcome variable is what statisticians call a "count variable" (e.g., the number of falls in a given time period can be counted).

6.1 DESCRIPTION OF THE DATA SET AND SAMPLE

Descriptive analysis, in Table 6.1, indicates that approximately half of the sample were aged 85 years or older. Among all 840 residents, 268 (50%) were in this age group. Similarly, within the subgroup of residents who experienced both learning and active modes, 332 (51%) were aged 85 years or above.

The sample was predominantly female. Of the 840 residents, 499 (59.4%) were female, and 341 (40.6%) were male. Among the 628 residents who experienced both learning and active modes, 377 (60%) were female, and 251 (40%) were male.

Table 6.1: Age groups and gender of the residents

Variable	Number of Residents with both modes (learning and active)	Percentage	Number of Residents with at least one mode	Percentage
Age-groups				
< 65 years	32	5.19 %	41	4.97 %
65-75 yrs	66	10.71%	92	11.15 %
75-85 yrs	186	30.19 %	268	32.48 %
85-95 yrs	261	42.37 %	346	41.94 %
>= 95 yrs	71	11.53 %	78	9.45 %
Total	**616**	**100 %**	**825**	100 %
Gender				
Female	377	60.03 %	499	59.40 %
Male	251	39.97 %	341	40.60 %
Total	**628**	**100 %**	**840**	**100 %**

Across all residents, the mean duration spent in learning mode was 28 days. For residents who experienced both learning and active modes, the average duration spent in learning mode was 36 days, with active mode continuing through the 31st of December 2026, the "date of data extraction"; see Table 6.2. Additionally, the average number of falls per resident per day was 0.06 during the learning mode, corresponding to approximately 1.85 falls per month. Following Nobi activation, this decreased to 0.03 falls per resident per day among residents observed with at least one mode, or about 1.03 falls per month. For residents observed consistently in both learning and active modes, the average number of falls was 0.04 per resident per day, equivalent to approximately 1.06 falls per month.

Table 6.2: Average number of days residents spent in learning and active modes

	Residents with both modes		**All Residents with at least one mode**	
Variable	**Average N. of falls per resident per day** [i]	**Average N. of Days in Mode Mean (SD)**	**Average N. of falls per resident per day** [i]	**Average N. of Days in Mode Mean (SD)**
Learning Mode	0.06	36 (31.12)	0.06	28 (31.11)
Active Mode	0.04	196 (149.24)	0.03	173 (46.13)

(i) shows the average number of falls per resident per day, not total or absolute averages. This accounts for residents' variation in mode time.

6.3 ARE STAFF RESPONSE TIMES REDUCED? RESPONSES TO OBJECTIVE 1

As illustrated in Table 6.3, the range of response times to a fall alarm varied substantially across residents. Among the 628 residents who experienced both learning and active modes, response time, defined as the time staff took to assist a resident after a fall, showed considerable dispersion in both learning and active modes. During learning mode, response times ranged from 0.02 to 338 minutes, with a mean of 11 minutes (SD = 29.35). As expected, response times during active mode were significantly shorter (t = 13.27, $p < 0.001$). Response times in active mode also had a wide range from 0.02 to 362 minutes, with a mean of 2.99 minutes (SD = 8.55). The large standard deviation and extended upper range indicate a positively skewed distribution driven by a small number of extreme outliers.

Among all 840 residents (those with and without the lamps in their rooms), including 212 who experienced only one mode, during learning mode, response times ranged from 0.02 to 338 minutes, with a mean of 10.84 minutes (SD = 28.99). As expected, response times during active mode were significantly shorter (t = 14.22, $p < 0.001$). Response times in active mode ranged from 0.02 to 362 minutes, with a mean of 2.90 minutes (SD = 8.22).

Table 6.3: Mean response time (minutes) to falls recorded during learning and active modes.

	Residents with both modes	**All Residents with at least one mode**
Mode	Average response time in minutes Mean (SD)	Average response time in minutes Mean (SD)
Learning Mode	11.00 (29.35)	10.84 (28.99)
Active Mode	2.99 (8.55)	2.90 (8.22)

The results (see Table 6.4) indicate that the use of NOBI reduced staff response times by approximately 9 minutes on average. The estimates were consistent across both model specifications and were statistically significant at the 95% confidence level, suggesting a robust reduction in response times associated with the technology.

Table 6.4: The impact of the technology on reducing staff response time.

Variable	**Residents who experienced both Modes Model (1)**	**Residents who experienced at least one Mode Model (2)**
Being in Active Mode	**-9.12** ***	**-9.12*****
Constant	**11.86*****	**11.78*****
F test	164.34	180.02
P-Value	<0.001	<0.001

(*) P-value <0.05, (**) P-value <0.01, (***) P-value <0.001, (NS) P-Value not statistically significant at 95% confidence level.
(i) An ordinary least squares (OLS) regression model was used to evaluate changes in the staff response time in minutes.

6.4 DOES THE TECHNOLOGY HAVE AN IMPACT ON THE NUMBER OF FALLS PER DAY? (OBJECTIVE 1)

Table 6.5 presents results from negative binomial regression models examining the impact of the technology on the number of falls per resident per day among residents who experienced at least one mode. Model (1) reports unadjusted estimates without controlling for date or resident effects. Model (2) extends the analysis by including date fixed effects, while Model (3) includes both date and resident fixed effects. In the fully adjusted model, the estimated effect corresponds to a 31.4% reduction in falls (IRR = 0.686, p < 0.001), suggesting that part of the association is explained by time-specific and resident-level unobserved heterogeneity. All models are statistically significant, with p-values below 0.001.

Table 6.5: Impact of the technology on the number of falls per day among residents who experienced at least one mode. (1) without adjustment, (2) controlling for date variability, (3) controlling for date and resident ID variability[i].

Variable	Model (1)	Model (2)	Model (3)
Being in Active Mode	**0.505** ***	**0.608*****	**0.686*****
Constant	**0.065*****	**0.060*****	**0.537*****
Wald Chi2	231.91	132.77	82.92
P-value Chi2	<0.01	<0.001	<0.001
AIC[1]	48425.75	45521.78	35294.05
BIC[1]	48455.86	45541.85	35313.57

(*) P-value <0.05, (**) P-value <0.01, (***) P-value <0.001, (NS) P-Value not statistically significant at 95% confidence level.
(i) Analysis using negative binomial regression models; Model (1) shows the reduction in number of falls without controlling for date/residents ID, Model (2) adding date as fixed-effects, Model (3) adding both date and residents id as fixed effect assessing the impact of the technology on the incidence rate ratio (IRR) of falls per day.
(1) AIC, BIC are metrics of model fit. Smaller numbers indicate better-fitted models

Table 6.6 reports the results of the sensitivity analysis, focusing only on residents who experienced both learning and active modes. Model (1) reports unadjusted estimates without controlling for date or resident effects. Model (2) extends the analysis by including date fixed effects, while Model (3) includes both date and resident fixed effects. The findings were very similar to those obtained in the full sample. Where the fully adjusted Model 3 shows an estimated effect corresponds to a 32.3% reduction in falls (IRR = 0.677, p < .001). Although the magnitude of the effect decreased slightly with additional controls, the association remained strong and statistically significant across all specifications. Model fit indices (AIC and BIC) improved substantially from Model 1 to Model 3, suggesting that including date and resident ID fixed effects produced a better model. Overall, the results consistently indicate that Active Mode is associated with fewer falls, even after accounting for time-specific and individual-level variation.

Table 6.6: The impact of the technology on the number of falls per day among residents who experienced both modes. (1) without adjustment, (2) controlling for date variability, (3) controlling for date and resident ID variability[i].

Variable	Model (1) (Unadjusted)	Model (2) (Adjusted for Date)	Model (3) (Adjusted for Date & resident ID)
Being in Active Mode	**0.523*****	**0.615*****	**0.677*****
Constant	**0.066*****	**0.057*****	**0.533*****
LR/Wald Chi2	195.87	120.95	88.95
P-value Chi2	<0.01	<0.001	<0.001
AIC[1]	42866.85	39968.75	31290.56
BIC[1]	42896.52	39988.53	31309.81

(*) P-value <0.05, (**) P-value <0.01, (***) P-value <0.001, (NS) P-Value not statistically significant at 95% confidence level.

(i) Analysis using negative binomial regression models; Model (1) shows the reduction in number of falls without controlling for date/residents ID, Model (2) adding date as fixed-effects, Model (3) adding both date and residents id as fixed effect assessing the impact of the technology on the incidence rate ratio (IRR) of falls per day.
(1) AIC, BIC are metrics of model fit. Smaller numbers indicate better-fitted models

The improvement in model fit with additional controls strengthens confidence in the robustness of the findings that the technology appears to have a stable, protective effect, reducing fall incidence even when controlling for factors that typically influence fall risk. The attenuation of the effect size in the fully adjusted model is expected, as resident-level fixed effects account for unobserved characteristics such as mobility, cognitive status, or chronic conditions. Taken together, these models provide the evidence that the Nobi system's Active Mode is associated with a lower daily fall rate among residents. While further research with larger samples and longer observation periods would help confirm these effects, the current results suggest that the technology has a meaningful impact on fall prevention and may offer a valuable tool for enhancing resident safety in care environments.

Table 6.7 presents the results of the negative binomial regression with day and individual fixed effects, estimated using the full sample of residents. In column (1), the estimated risk ratio associated with the technology operating in active mode, relative to learning mode, was 69%. This implies that NOBI was associated with a 31% reduction in the risk of falls. Given the average number of falls per month was 1.85, this would be equivalent to a reduction of 0.57 falls per month. The estimate was statistically significant at the 95% confidence level.

To assess whether the effect of the technology varied across demographic characteristics such as age and gender, Columns (2) and (3) extended the specification by introducing interaction terms for age groups and gender, respectively. The estimated risk ratios for active mode remained similar to those reported in column (1). The interaction terms were not statistically significant, so there was no evidence of the technology having different impacts for different age or gender groups.

The results for age groups (Column 2) indicated that residents aged 95 years and older were associated with a lower risk of falls compared with the other age groups. One possible explanation is that residents in this age group could experience reduced mobility, resulting in fewer opportunities for falls. Additionally, individuals at this age may have been in receipt of more intensive or personalised care, which could further reduce fall risk.

Column (3) introduces gender as a covariate. The results suggest that gender was associated with a higher risk of falls with female residents in the sample experiencing a greater likelihood of falling.

Table 6.7: The impact of the technology on the incidence rate ratio (IRR) of falls per day among residents who experienced at least one mode.

Variable	Model (1)	Model (2)	Model (3)
Being in Active Mode	**0.69** ***	**0.57*** **	**0.65*** **
Age-groups			
< 65 years	-	Reference	-
65-74 yrs	-	0.89 NS	-
75-84 yrs	-	1.14 NS	-
85-94 yrs	-	0.97 NS	-
>= 95 yrs	-	0.29***	-
Mode #Age-groups			
Active # <65 years old	-	Reference	-
Active # 65-74 years old	-	1.10 NS	-
Active # 75-84 years old	-	1.25 NS	-
Active # 85-94 years old	-	1.21 NS	-
Active # >=95 years old	-	1.21 NS	-
Gender			
Male	-	-	Reference
Female	-	-	**1.45** **
Mode # Gender			
Active # Male	-	-	Reference
Active # Female	-	-	1.13 NS
Constant	**0.54*** **	**0.57*** **	**0.47*** **
Wald Chi2	82.92	156.35	108.22
P-value Chi2	<0.001	<0.001	<0.001

(*) P-value <0.05, (**) P-value <0.01, (***) P-value <0.001, (NS) P-Value not statistically significant at 95% confidence level.
(i) A fixed-effects negative binomial regression model was used to evaluate changes in the count of falls per resident per day. Results are reported as incidence rate ratios (IRRs), with values below 1 indicating a reduction in fall incidence associated with Nobi.

Similar findings were observed in the sensitivity analysis, using a subset of residents who experienced both learning and active modes, as shown in Table 6.8. In column (1), the estimated risk ratio associated with the technology operating in active mode, relative to learning mode, was 68%. This implies that NOBI was associated with a 32% reduction in the risk of falls. Given the average number of falls per month was 1.85, this would be equivalent to a reduction of 0.59 falls per month. The estimate was statistically significant at the 95% confidence level.

Table 6.8: Impact of Nobi on reducing the residents' falls among residents who experienced both learning and active modes [i]

Variable	Model (1)	Model (2)	Model (3)
Being in Active Mode	**0.68 *****	**0.57*****	**0.65*****
Age-groups			
< 65 years	-	Reference	-
65-74 yrs	-	0.78^{NS}	-
75-84 yrs	-	1.15^{NS}	-
85-94 yrs	-	0.95^{NS}	-
>= 95 yrs	-	**0.28*****	-
Mode #Age-groups			
Active # <65 years old	-	Reference	-
Active # 65-74 years old	-	1.08^{NS}	-
Active # 75-84 years old	-	1.20^{NS}	-
Active # 85-94 years old	-	1.21^{NS}	-
Active # >=95 years old	-	1.20^{NS}	-
Gender			
Male	-	-	Reference
Female	-	-	**1.32***
Mode # Gender			
Active # Male	-	-	Reference
Active # Female	-	-	1.08^{NS}
Constant	**0.53*****	**0.58*****	**0.48*****
Wald Chi2	88.95	162.66	101.17
P-value Chi2	<0.001	<0.001	<0.001

(*) P-value <0.05, (**) P-value <0.01, (***) P-value <0.001, (NS) P-Value not statistically significant at 95% confidence level.
(i) A fixed-effects negative binomial regression model was used to evaluate changes in the count of falls per resident per day. Results are reported as incidence rate ratios (IRRs), with values below 1 indicating a reduction in fall incidence associated with Nobi.

6.5 IMPACT OF THE TECHNOLOGY ON THE LIKELIHOOD OF FALLING – PREVENTING FALLS (OBJECTIVE 1)

In the previous models, we estimated the effect of NOBI in reducing the number of falls. However, it is also important to examine whether the technology reduces the likelihood of experiencing any fall at all, on a given day.

Falls are relatively rare events and there are occasional instances in which a resident experienced multiple falls within the same day. In such cases, the two types of analysis could yield different estimates. Moreover, if multiple falls recorded within a single day reflected potential recording errors by the technology, analysing whether any fall occurred for a patient, in a day, would provide an additional robustness check for the main results.

Because our outcome variable determined whether a resident experienced at least one fall on a given day or not, the most appropriate statistical methodology was a logistic regression (This type of regression is normally used when the key variable states whether something happens or not).

Table 6.9 shows that the technology reduced the probability of experiencing any fall on a given day to 67% of the baseline risk, corresponding to a 33% reduction in the likelihood of falls compared to learning mode.

Table 6.9: Impact of the technology on preventing falls

Variable	Residents who experienced both Modes Model (1)	Residents who experienced at least one Mode Model (2)
Being in Active Mode	**0.67*****	**0.67*****
LR Chi2	69.17	69.17
P-Value	<0.001	<0.001

(*) P-value <0.05, (**) P-value <0.01, (***) P-value <0.001, (NS) P-Value not statistically significant at 95% confidence level.
(i) A fixed-effects logit regression model was used to evaluate changes in the odds of having a fall per resident per day. Results are reported as odds ratios (ORs), with values below 1 indicating a reduced likelihood of a fall compared to learning mode.

6.6 SUMMARY AND DISCUSSION OF QUANTITATIVE FINDINGS

The results of this study suggest that the NOBI technology was effective in reducing falls among residents in Nursing and Residential care homes. Across our specifications, the technology was associated with a substantial reduction in fall risk, alongside faster staff response times when incidents occur.

These findings are consistent with the broader literature on fall-detection and ambient monitoring technologies, which highlights the potential of sensor-based systems to improve safety for older adults through continuous monitoring and rapid alert mechanisms. Studies of wearable and ambient sensors show that modern fall-detection technologies can achieve high detection accuracy and enable rapid assistance when a fall occurs, often with sensitivities (correct identification of falls) above 90% depending on device configuration.

Several mechanisms may explain how NOBI contributes to fall prevention. First, the technology provides continuous monitoring of residents' movements, allowing early identification of risky behaviours or situations that could lead to a fall. Smart monitoring systems can identify unusual movement patterns, postures, or environmental conditions that signal an elevated fall risk, enabling caregivers to intervene earlier than would otherwise be possible. Sensor-based monitoring technologies have increasingly been used not only to detect falls but also to assess fall risk and guide targeted preventive interventions. These mechanisms are evidenced by the qualitative data below.

Second, the presence of real-time alerts may improve staff awareness and responsiveness to residents' needs. When caregivers are notified that a resident may be at risk of falling, they can intervene more quickly to provide assistance with mobility, transfers, or other activities of daily living. In this sense, NOBI acts as an additional monitoring layer that complements routine care, potentially preventing incidents before they occur.

The reduction in falls observed in this study has important implications for health outcomes. Falls among older adults are associated with a wide range of negative consequences, including fractures, head injuries, hospitalisation, rehabilitation needs, loss of mobility, and mortality. In addition to physical harm, falls can lead to a significant deterioration in quality of life, particularly through the development of fear of falling, which may cause individuals to restrict activity and become increasingly frail. Preventing falls therefore has benefits that extend beyond the immediate avoidance of injury, potentially reducing downstream healthcare utilisation and improving residents' overall well-being.

A second key finding of this study is the reduction in staff response times following a fall. Faster response times may be clinically significant, particularly in situations where a resident is unable to stand up or call for help independently. Extended periods spent on the floor after a fall, commonly referred to as "long lies", are associated with serious complications such as dehydration, hypothermia, pressure injuries, and increased mortality risk. Rapid detection and response can therefore mitigate these adverse outcomes by ensuring that assistance is provided quickly. In addition, faster response may improve residents' perceived safety and confidence in their care environment, as individuals are reassured that assistance will be available promptly if an incident occurs.

Reducing the duration of time spent on the floor may also influence psychological outcomes. Fear of being left unattended after a fall is a major concern among older adults, and technologies that ensure rapid detection and response may help alleviate this anxiety. Greater confidence in monitoring systems may encourage residents to maintain higher levels of mobility and independence, which are themselves important determinants of physical and mental health.

Beyond direct benefits to residents, fall-prevention technologies such as Nobi may also reduce the burden on caregivers, both formal and informal. Falls often require substantial staff time for emergency response, monitoring, and documentation, and may also lead to increased care needs following injury. By preventing falls or enabling earlier intervention, monitoring systems may reduce the intensity of care required. In some cases, technologies that improve monitoring and safety may also reduce the need for one-to-one supervision for high-risk residents, allowing staff resources to be allocated more efficiently. Previous research on assistive monitoring technologies suggests that automated safety systems can support caregiver workload management and enhance supervision without relying exclusively on continuous human observation.

Taken together, the findings suggest that technologies such as NOBI may contribute to safer care environments through a combination of fall prevention, rapid incident detection, and improved response times. These mechanisms operate both before and after a fall event, reducing the probability of falls occurring while also mitigating their consequences when they do occur. As the population of older adults continues to grow, and care systems face increasing workforce pressures, technologies that enhance monitoring and support caregivers may become an increasingly important component of comprehensive fall-prevention strategies.

However, it is important to note that technology should be viewed as complementary to existing fall-prevention practices, rather than as a replacement for clinical care. Effective fall prevention typically involves a combination of environmental modifications, mobility support, medication review, and individualised care planning. Sensor-based monitoring systems may enhance these strategies by providing additional information and enabling faster intervention, but they are most effective when integrated into a broader care framework.

There are several limitations to our analysis. First, during the intervention period, even with a relatively stable care home population, residents inevitably age and are likely to become frailer over time. This natural progression may increase the likelihood of falls independently of the intervention, potentially biasing our results and leading to an underestimation of the effectiveness of NOBI. That said, we consider the study period to be short enough to limit substantial health deterioration. Moreover, care home populations typically experience turnover, with residents leaving and new individuals entering, which tends to maintain a broadly stable population profile.

However, this turnover may also introduce the opposite bias. Based on discussions with Lancashire and South Cumbria ICB and NOBI, it is plausible that less frail residents replaced older, more frail individuals in rooms equipped with NOBI. Such substitution could artificially reduce observed fall rates, attributing improvements to changes in resident composition rather than the technology itself. To mitigate this, we included individual fixed effects (accounting for resident characteristics), which partially account for these compositional changes. We also conducted a robustness check by restricting the sample to residents who experienced both training/learning mode and normal/active mode of NOBI (residents that never left the care homes). The consistency of results across specifications supports the robustness of our findings.

Seasonality may represent an additional source of bias, as fall risk could vary across different times of the year, for example, due to fluctuations in staffing levels during holiday periods. To address this, we incorporated time fixed effects into the model.

Finally, future research would benefit from incorporating a control group. Our current before-and-after design relies on strong assumptions, particularly that no other factors changed between the learning and active modes of the technology that could influence fall rates. A design with a control group would allow for a more rigorous identification of causal effects.

6.7 QUALITATIVE DATA

This section uses the same methodology as Section 5, but this time to look directly at evidence of impact on residents, again, considering how this evidence may support the above quantitative findings of, for example, reduction in falls or long lies (Objective 1) and also to examine whether there are any perceived benefits to the residents' health-related quality of life (Objective 3).

Analysis of data regarding the impact of the Nobi device on the safety and well-being of the care home residents led to a major theme that corresponded to the TAM construct of perceived usefulness. Four different sub-themes, derived through an inductive thematic analysis of the data, were grouped into the main theme. A narrative summary of the main theme and sub-themes is presented in this section following the table. The list of the sub-themes under the major theme along with the illustrative quotes to support them are presented in Table 2. These themes and sub-themes have also been presented in the previous chapter in figure 5.1.

Table 6.10: Theme and sub-themes related to the impact of the Nobi device on care home residents.

Themes	**Sub-themes**	**Quotes supporting the major themes and sub-themes**
Perceived usefulness	Reduction in falls and long lies	*"Being able to support high risk of falls residents when they get out of bed which reduces the number of falls happening." ID 121 (CHSMQ staff returns)* *"Yes, very effective smart lamp preventing falls to a major extent as it helps residents with night light." ID 48 (CHSMQ lead returns)*
	Reduced ambulance calls and hospitalisations	*"I now know if a resident has injured themselves during a fall and if an ambulance may be required." ID 136 (CHSMQ staff returns)* *"On viewing footage this has given the home an opportunity to either escalate or refrain from calling for an ambulance, evidenced residents lowering themself to the floor." ID 63 (CHSMQ lead returns)*
	Improvement in residents' sleep quality and health-related quality of life	*"Reduction in physical checks which results in better sleep patterns." ID 37 (CHSMQ lead returns)* *"Sleep patterns have improved as some have had meds reviews to look at meds and simple things like moving the position of the bed." ID 32 (CHSMQ lead returns)*
	Reduced anxiety among family members of residents	*"We have been very grateful for Nobi. I know that our families are very happy and have reassurance with it being in the rooms." ID 51 (CHSMQ lead returns)*

6.7.1. THEME 1: PERCEIVED USEFULNESS

The sub-themes related to the care home staff and managers' perception of usefulness of the Nobi device in improving residents' health, safety and well-being have been grouped into this major theme.

Sub-theme 1: Reduction in falls and long lies

The responses from care home staff and managers indicated that there was a significant reduction of falls among the residents due to improved detection of residents who were at high risk of falls and notifying the staff about high-risk behaviours such as bed exits. Additionally, the following quote from a care home manager demonstrated that the Nobi device provided alerts of fall incidents to the staff promptly which helped the staff to attend to the residents quickly and reduce the long lies among the residents. The reduction in long lies helped in preventing severe injuries and further deterioration of health of the residents (Objective 1).

"The lights provide immediate alerts when a fall is detected, allowing staff to intervene quickly rather than relying solely on routine checks or waiting for call bells. This has reduced the length of time

residents may remain on the floor and lowered the risk of further injury or distress." ID 11 (CHSMQ lead returns)

The responses also indicated that the light emitted by the Nobi device during night-time helped the residents to see clearly and avoid tripping over objects at night, thereby reducing their fall risk at night. This is supported by the care home managers' responses to the close-ended questions of the CHSMQ questionnaire in that majority of the respondents mentioned that they had observed an improvement in residents' overall well-being (54.2%) and 47.5% of the managers mentioned that the residents reported feeling safer after Nobi was installed.

Overall, this qualitative data supports quantitative findings of reductions in falls and long lies, by giving some information on how that is actually happening. This can inform future developments of the tool, and futures users, of the mechanisms involved in benefits for residents.

Sub-theme 2: Reduced ambulance calls and hospitalisations

Care home staff and managers also reported a reduction in ambulance calls and hospitalisations as they can now clearly see how a fall occurred and if the resident is likely to have sustained severe injuries. The following quote from a care home manager demonstrates that many of the residents in their care homes have been prescribed blood thinner medications (anticoagulants and antiplatelets) because of which the ambulance calls were frequent for these residents in case of unwitnessed falls and suspected head injuries. However, the staff and managers were now able to review the Nobi playback recording and ascertain the severity of the injuries, particularly the likelihood of a head injury, and the requirement for ambulance calls and hospitalisations for these residents. (Objective 1)

"Many residents are on blood thinners. Previously, any unwitnessed fall for these residents was an ambulance call-out in case of a head injury. Now that they are able to review and analyse the fall, they are able to see if there is any likelihood of a head impact and have been able to reduce ambulance call-outs." Care home ID 32 (benefits reporting data)

The Nobi device also helped in detecting instances in which residents voluntarily lowered themselves on the floor, thereby reducing unnecessary ambulance calls in these cases.

As for Theme 1, this theme supports quantitative data, this time on reduced ambulance calls (Objective 1)

Sub-theme 3: Improvement in residents' sleep quality and health-related quality of life

The majority of the staff and managers considered the sleep reports to be helpful in informing residents' medical care, medication reviews and improving residents' sleep quality. The data indicates that these reports helped the staff to detect sleep patterns, restlessness during night and other behaviours such as sitting on the edge of the bed. The staff were able to configure the Nobi device to alert them whenever a resident with poor sleep is engaging in behaviours that are high risk for falls such as exiting the bed and walking at night. The following response from a care home manager demonstrates that the sleep reports showed that a particular resident was experiencing fits because of which she was falling frequently at night. This information helped in informing a medication review and change in medication schedules after which the resident experienced fewer falls. Additionally, the resident's sleep quality improved after the medication review.

"Care staff and manager review Nobi sleep reports each morning and after obtaining relevant consent images change to full view. This enabled care staff to understand what happened to A just before the fall. After closely reviewing the data provided by Nobi, they were able to ascertain that A was suffering a fit which was causing the fall. This was happening multiple times at night, care staff now had strong evidence to take to their primary care weekly ward round to demonstrate resident A required an urgent review and medication review. GP reviewed and amended medication regime, in particular medications taken at night. So far this has resulted in few falls at night and improved sleep reports." Care home ID 2 (benefits reporting data)

The following quote from a care home manager demonstrates that the sleep reports also helped to facilitate mental health referrals by providing objective data on residents' sleep patterns.

“Nobi Lights data has supported mental health referrals by providing objective sleep and night-time behaviour evidence, helping external professionals better understand residents’ needs.” ID 56 (CHSMQ lead returns)

Additionally, some care home staff and managers reported that the staff had to check less frequently to ensure the safety and well-being of residents at night which helped in improving the residents’ sleep quality as they were not frequently disturbed at night. The following quote from a care home manager demonstrated the improvement in sleep quality of the residents due to less frequent night-time checks in the care home.

“Staff at night-time check in on the residents less often which helps prevent disturbing them during the night. This has helped residents get a better overall sleep which has had a positive impact on their physical and mental health during the day.” ID 45 (CHSMQ lead returns)

Note, however, that we found no quantitative evidence indicating an improvement in quality of life. Although surveys were administered before and after the implementation of Nobi to assess changes in health-related quality of life using the EQ-5D, the results (Table 6, in appendices) did not demonstrate any statistically significant differences. This outcome may be attributable to methodological limitations, particularly the absence of a control group. Consequently, the observed lack of variation in health-related quality of life could be influenced by other uncontrolled factors, such as seasonal effects. Nevertheless, given that Nobi reduces the likelihood of falls and subsequent hospital conveyance, improvements in quality of life would be expected through the prevention of the adverse consequences associated with injurious falls.

These reports demonstrate some of the extra impacts that contribute towards improving wellbeing and quality of life for the residents (Objective 3).

Sub-theme 4: Reduced anxiety among family members of residents

The responses indicated that the improved safety and reduction in falls among the residents of the Nursing and Residential care homes led to reduced anxiety and increased peace of mind among the family members of the residents. The family members were reassured that the staff would attend to the residents immediately in case of a fall occurrence, thereby reducing the risk of further deterioration of health of the residents.

This sub-theme contributes to the potentials for scaling up given that it seems that family members were very supportive of its use (Objective 6).

6.8. CONCLUSION

The quantitative and the qualitative data showed that there was a significant reduction in the staff response times to fall incidents (average response time=2.99 minutes after using Nobi) which led to a reduction in the long lies in Nursing and Residential care homes. Potential causes of falls and the extent of the injuries sustained after a fall were detected more effectively, which staff reported led to a reduction in falls. This reported reduction in falls supports the Nobi data analysis above which showed that there was a reduction of fall incidents by 31% after the use of the device. The qualitative data also suggest a reduction in ambulance calls and hospitalisations. Objective Ambulance data from the Northwest Ambulance Service will be examined in more detail in Section 7.

The use of the device also had other positive impacts on the health-related quality of life in that 54.2% of the managers observed an improvement in the overall well-being of the residents. Positive impact on sleep quality of the residents was also observed as the sleep reports generated by the device helped the staff to detect potential causes of sleep disturbance and falls at night. This information helped in informing medical care, medication reviews and referrals to mental health services to improve their sleep. Family members of the residents also had a positive attitude to the use of the device in the homes which can help in scaling up the implementation of the device effectively. In conclusion, the findings demonstrate that the device has the potential to significantly improve resident safety and health-related quality of life and can be useful components of personalised fall prevention interventions.

SECTION 7: RESULTS: IMPACT ON NURSING AND RESIDENTIAL CARE HOMES AND ICB PLACES

This results section presents the analysis of the North-West Ambulance Service (NWAS) data described in Table 4.1, Section 4. The dataset covers Cumbria, Lancashire, Greater Manchester, Merseyside, Cheshire and Glossop (Derbyshire) nursing and residential care homes with reportable ambulance calls, including 428 homes in total. Among these, 57 homes had live Nobi lamps installed, while the remaining homes served as a comparison group. The data included spans from April 2024 to March 2026, which covers the range of at least three months of observations before Nobi was operationalised in the first home (installed July 2024) and at least three months after the installation in the last homes (installed November 2025).

Given the structure of the intervention, in which Nursing and Residential care homes implemented the technology at different dates, we applied an approach that compares how outcomes change over time between treated and untreated groups by examining differences before and after the intervention. This is called a difference-in-differences approach following Callaway and Sant'Anna (2021). The approach accounts for staggered adoption by comparing homes that have already received the intervention with those that never will.

Table 7.1 shows the distribution of Nursing and Residential care homes across the different regions of Lancashire and South Cumbria. It also shows the average number of beds per site, distinguishing by sites that have received the Nobi technology and those which did not, and it shows the percentages of rooms with Nobi lamps, for the treated sites.

Table 7.1: Summary of Nursing and Residential care homes in NWAS database

Places	Total N of Care Homes in NWAS database	N of Care Homes without NOBI	N of Care Homes with NOBI*	N of Beds in Care Homes without NOBI, Mean (SD)	N. of Beds in Care Homes with NOBI, Mean (SD)	Average percentage of lamps/ total rooms in care homes with NOBI
Blackburn	23	18	5	29.72 (20.4)	47.80 (25.2)	21.9%
Blackpool	55	50	5	25.24 (14.8)	37.80 (11.8)	21.0%
Lancashire Central	101	89	12	37.99 (22.3)	43.75 (12.9)	22.6%
Lancashire East	111	96	15	27.79 (19.6)	45.13 (26.6)	21.0%
Lancashire North	68	58	10	27.33 (14.3)	39.90 (30.1)	22.3%
South Cumbria	70	60	10	33.27 (20.9)	65.80 (33.7)	23.5%
Total	**428**	**371**	**57**	**30.80 (19.7)**	**47.14 (26.0)**	**22.0%**

Note that there are differences across regions, both in the number of sites, but also in their average size. Importantly, Nobi has been installed in roughly 20% of the rooms in the treated sites. This means that any findings on this section are only attributed to these 20% of rooms and thus will not capture the overall potential effectiveness of the technology, if applied to 100% of the rooms. On the other hand, it will not account for the cost of the technology if applied to 100% of the rooms either. While extrapolation of the costs would be linear, extrapolation of the effectiveness is not possible because the technology was initially installed in rooms with residents with higher risk of falls, who theoretically benefit more from a fall prevention technology.

7.1 REDUCTION IN AMBULANCE CALL-OUTS AND COST AND BENEFIT ANALYSIS

In order to complete our analysis to determine the answers to our questions in Objectives 1, 5 and 6 (see Section 3), the analysis in this section examines whether NOBI affected the number of NWAS call-outs as a result of the observed reduction in falls (as demonstrated in Section 6). Using the difference-in-differences methodology described above, we estimated the overall change in NWAS call-outs and then further disaggregated the results into three categories: call-outs that did not result in an ambulance dispatch (**"Hear & Treat" call-outs**); those that required an ambulance to be dispatched but did not lead to hospital conveyance **("See & Treat" call-outs);** and those that resulted in hospital conveyance **("See & Convey" call-outs).**

The effectiveness results indicate whether NOBI reduced the number of call-outs (and which types), but in order to compute the potential cost savings generated by NOBI we must also know the cost associated with each avoided call-out. While we have information on the costs of "Hear & Treat" and "See & Treat" call-outs, we do not have complete information on the costs of "See & Convey" call-outs. (Jones et al, 2025) This is because, in particular, after accounting for ambulance and A&E costs, we do not know the proportion of patients who are subsequently hospitalised, the length of their hospital stay, or the type of rehabilitation care they may require.

Given the lack of direct information on these downstream costs, we constructed four scenarios for "See & Convey" call-outs in order to estimate the cost savings associated with the potential reduction in NWAS call-outs.

In **Scenario (1)**, we assume that no admissions occur following call-outs that result in conveyance to hospital, with all transferred residents being discharged after A&E evaluation. Under this assumption, we only include the costs associated with "Hear & Treat", "See & Treat", and "See & Convey" call-outs, as well as carer chaperones and A&E evaluation and care. This is a highly conservative, and to some extent unrealistic scenario, as the academic literature clearly shows that a substantial proportion (40%) of conveyances from care homes to hospital result in hospitalisation (Knowles, et al, 2020). Nevertheless, we included this scenario to provide an absolute lower bound for the potential cost savings of the technology. If the technology demonstrates cost-saving potential under this scenario, it is extremely likely to be cost-saving in a real-world setting.

In **Scenario (2)**, we assumed that among call-outs resulting in conveyance to hospital, there is a 40% probability that patients are admitted for a short stay (1–2 days), while the remaining 60% are discharged after A&E evaluation. This represents a more realistic scenario, as it is estimated that around 40% of care home residents conveyed to hospital are subsequently hospitalised (Knowles et al, 2020). However, it is still likely that among these 40%, particularly in cases of falls among a frail population, some patients may require longer hospital stays.

Therefore, in **Scenario (3)**, we assumed that among call-outs resulting in conveyance to hospital, there is a 40% probability that patients are admitted for a long stay (12 days), while the remaining 60% are discharged after A&E evaluation. This scenario likely overestimates the true hospitalisation costs, since not all of the 40% of patients would require a long stay. Conversely, it still excludes another important cost component, that of rehabilitation.

In **Scenario (4)**, we again assume that among call-outs resulting in conveyance to hospital there is a 40% probability that patients are admitted for a long stay (12 days), with the remaining 60% discharged after A&E evaluation. However, we now also account for the fact that serious injuries, such as hip fractures, often require extensive rehabilitation following discharge. We therefore assume that the same 40% of patients undergo rehabilitation and incur associated rehabilitation costs. This scenario is also likely unrealistic, as not all the 40% of patients would both experience a long hospital stay and require extensive rehabilitation. For this reason, we treat this scenario as an upper bound for the potential cost savings of the technology.

The cost estimates and their respective sources are presented in Table 7.2

Table 7.2 Different costs used in the calculation and their references.

Service	Costs	References
Ambulance Costs		Jones, K. et Al, (2025) *Unit Costs of Health and Social Care 2024 Manual.* Technical report. Personal Social Services Research Unit (University of Kent) & Centre for Health Economics (University of York)
Hear & treat	£66	
See & treat	£327	
See & Convey + Carer chaperons at 19/hr. for an average of 5 hours	£459 [+ £95] = £554	
Hospital and A&E Costs		
A&E Evaluation and Care – Upper range	£563	
Inpatient (nonelective) short stay	£792	
Inpatient (nonelective) long stay	£5,134	
Severe injury that requires rehabilitation with maximum burden on society	£21,120	Public Health England. (2018)

Finally, we applied the same four scenarios to estimate the potential quality-adjusted life years (QALYs) gained through NOBI. QALYs capture not only the quantity of life but also its quality, assigning greater value to years lived in full health than to those lived in poorer health. By preventing falls, NOBI is expected to mitigate QALY losses both by reducing fall-related mortality and by preserving quality of life, avoiding injury, disability, and the psychological consequences such as fear of falling that often follow a fall. In **Scenario (1)**, where no patients are hospitalised, we assume that QALY savings are negligible and therefore set them to zero. In **Scenario (2)**, we assume a small QALY gain associated with avoiding short hospital stays. In **Scenarios (3)** and **(4)**, we assume the maximum QALY loss associated with hip fractures, as long hospital stays are likely to be linked to severe injuries.

This approach has several limitations. First, we cannot definitively attribute the reduction in call-outs entirely to a decrease in falls. While our methodology makes this interpretation plausible, it remains possible that NOBI may have affected other types of call-outs. Second, we do not know the precise QALY loss associated with the hospitalisations considered in our scenarios; therefore, these estimates should be interpreted as informed approximations rather than precise measurements (Public Health England. (2018). Table 7.3 shows the different scenarios with their corresponding costs and QALY calculations.

Table 7.3: The different scenarios of Costs and QALY for call-outs ending in conveyance to the hospital.

Call-outs ending in Conveyance to Hospital	Discharged after A&E	Short Stay Admission (1–2 days)	Long Stay Admission (12 days)	Changes in QALY	Rehabilitation Included	Interpretation
Scenario (1) Very conservative lower bound	**100%** [Costed at £1,117/each]	0%	0%	0%	No	No admissions assumed; minimum cost scenario
Scenario (2) Realistic – assuming mild falls.	**60%** [Costed at £1,117/each]	**40%** [Costed at £1,909/each]	0%	**40%** [0.03 QALY lost/ each]	No	Reflects the typical admission rate with short stays
Scenario (3) Realistic – assuming severe falls	**60%** [Costed at £1,117/each]	0%	**40%** [Costed at £6,251/each]	**40%** [0.193 QALY lost/ each]	No	Assumes all admissions are long stays
Scenario (4) Unlikely upper bound	**60%** [Costed at £1,117/each]	0%	**40%** [Costed at £22,237/each]	**40%** [0.193 QALY lost/ each]	**Yes**	Assumes all admissions are long stays and additional full rehabilitation

7.2 REDUCTION IN AMBULANCE CALL-OUTS

The first column of Table 7.4 indicates that “Hear & Treat” call-outs in Nursing and Residential care homes where NOBI was installed decreased by 0.27 call-outs per month per care home. However, this estimate is not statistically significant, suggesting that the reduction is unlikely to be attributable to the NOBI technology. Similarly, “See & Treat” call-outs show a negative point estimate of 0.37 reduced call-outs per month per care home, but this effect is also not statistically significant and therefore cannot be confidently linked to the implementation of NOBI.

In contrast, “See & Convey” call-outs show a larger estimated reduction of 0.84 call-outs per month per care home (24% decrease), indicating a statistically significant decrease in incidents that result in residents being transported to the hospital. A similar pattern is observed for total call-outs, which decrease by 1.48 call-outs per month per care home (22.5% decrease). While this estimate does not reach statistical significance at the 95% level, it is significant at the 90% level.

Table 7.4: Effect of NOBI on NWAS call-outs - overall sample, residential & nursing home subsamples

Outcomes	Nobi sites - Baseline Mean	Overall [1]		Nursing [2]		Residential [3]	
		Effect per Month/ Per Site	P-Value	Effect per Month/ Per Site	P-Value	Effect per Month/ Per Site	P-Value
Overall N. of Ambulance Call-outs	6.581	-1.483	0.053	-1.923	0.142	-0.788	0.330
N. "See & Convey" Call-outs	3.555	**-0.840**	**0.040**	-1.212	0.057	-0.378	0.459
N. "See & Treat" Call-outs	1.718	-0.370	0.302	-0.572	0.410	-0.087	0.712
N. "Hear & Treat" Call-outs	1.300	-0.271	0.151	-0.131	0.605	-0.326	0.246
Cost- S1 - No Hosp. admission	£4619	**-£1,077**	**0.043**	-£1,550	0.072	-£472	0.444
Cost- S2 – Short Stay	£5745	**-£1,343**	**0.042**	-£1934	0.068	-£591	0.446
Cost- S3 – Long Stay	£1,1919	**-£2801**	**0.040**	-£4,039	0.061	-£1,247	0.452
Cost- S4 – Long term Rehabilitation	£34,650	**-£8168**	**0.040**	-£11,789	0.059	-£3,663	0.456
QALY Gained – S2	-0.0427	**0.010**	**0.040**	0.015	0.057	0.005	0.459
QALY Gained – S3 & S4	-0.2745	**0.065**	**0.040**	0.094	0.057	0.029	0.459

(1) Overall analysis was conducted on 428 Nursing and Residential care homes with 57 sites with Nobi (intervention sites) and 371 sites without Nobi (control sites).
(2) Nursing homes analysis was conducted on 129 homes with 29 sites with Nobi (intervention nursing sites) and 100 sites without Nobi (control nursing sites).
(3) Residential homes analysis was conducted on 299 residential care homes with 28 sites with Nobi (intervention residential sites) and 271 sites without Nobi (control residential sites).
(4) Average Treatment Effect on the Treated (ATT) is the extra improvement (or worsening) seen in the intervention group, after accounting for general trends that would have happened anyway, observed in the control group.

The second and third columns of Table 7.4 separate the results between Nursing and Residential homes in order to identify which type of facility drives the overall findings. For total call-outs in nursing homes, we see similar results to the overall, with significance at the 90% confidence level. None of the results for the residential care home category achieves statistical significance at either the 95% or 90% confidence levels. This suggests that the pooled results may benefit from greater statistical power, as the combined sample reaches significance at the 95% level.

7.3 COST ANALYSIS

The cost results, derived from a model analogous to that used for call-out counts, display similar levels of statistical significance. In all four scenarios, estimates fall slightly short of the 95% confidence threshold but remain statistically significant at the 90% level. In Scenario (1), NOBI generates average savings of £1,057 per care home per month, equivalent to £12,684 per care home annually. In Scenario (2), average monthly savings increase to £1,319, corresponding to £15,828 per year. Scenario (3) produces average savings of £2,753 per month, or £33,036 per year. Finally, Scenario (4) yields average monthly savings of £8,035, which amounts to £96,420 per care home annually.

Table 7.5 shows the costs and QALY associated to this intervention. In this study, the annual cost of the technology is £751 per room (for the first three years), including installation, training, and maintenance. On average, NOBI is installed in 10 rooms per care home, resulting in an annual cost of £7,510 per care home in this experiment. After accounting for these costs, net annual savings amount to £5,174 per care home in Scenario (1), £8,318 in Scenario (2), £25,526 in Scenario (3), and £88,910 in Scenario (4).

Table 7.5: Annual average savings and QALY gains per care home

	Annual average savings and QALY gains			
	Price	Savings	Net Savings	QALY
Scenario (1)	£7,510	£12,919	£5,409	0
Scenario (2)	£7,510	£16,111	£8,601	0.12
Scenario (3)	£7,510	£33,606	£26,096	0.78
Scenario (4)	£7,510	£98,019	£90,509	0.78

Across the 57 Nursing and Residential care homes where NOBI was installed, this corresponds to total annual net savings of £308,336 in Scenario (1), £490,237 in Scenario (2), £1,487,450 in Scenario (3), and £5,159,041in Scenario (4).

If these 57 Nursing and Residential care homes were representative of the broader population of care homes in the NWAS region (an assumption that is unlikely to hold fully, given the selection that was applied, see Section 4), the results could be extrapolated to a scenario in which all Nursing and Residential care homes installed NOBI in approximately 20% of their rooms. Under this hypothetical scenario, savings would apply to 428 Nursing and Residential care homes and would amount to £2,315,225 in Scenario (1), £3,681,077 in Scenario (2), £11,169,144 in Scenario (3), and £38,738,063 in Scenario (4).

Regarding health outcomes, the NOBI technology is estimated to generate average gains of 0.01 QALYs per care home per month in Scenario (2) and 0.065 QALYs per care home per month in Scenarios (3) and (4). This corresponds to annual gains of 0.12 QALYs per care home in Scenario (2) and 0.78 QALYs per care home in Scenarios (3) and (4).

When aggregated across the 57 participating Nursing and Residential care homes, these estimates correspond to total annual gains of 6.89 QALYs in Scenario (2) and 44.33 QALYs in Scenarios (3) and (4). Under the same hypothetical extrapolation to 428 Nursing and Residential care homes installing NOBI in approximately 20% of their rooms, the technology would generate annual gains of 51.74 QALYs in Scenario (2) and 332.84 QALYs in Scenarios (3) and (4).To put this into perspective, if one full lifetime of good health is about 68 years, the total improvement in quality of life generated by the intervention is similar to giving over four people an entire lifetime of good health.

Notably, the intervention displays substantially larger effects on Nursing homes, likely reflecting that these types of care homes have higher-risk residents with a higher likelihood of call-outs ending in hospital conveyance. Therefore, we can see the technology is associated with a statistically significant reduction in “See & Convey” call-outs at the 90% confidence level and narrowly misses significance at the 95% level. A similar pattern emerges in the cost estimates: Nursing homes exhibit statistically significant reductions across all four scenarios, whereas Residential homes do not show statistically significant effects in any scenario.

Table 7.6 reports the net present value (NPV) of the NOBI technology’s direct costs (price), indirect costs (savings), and associated QALY gains under all four scenarios over five- and ten-year horizons per care home. These estimates provide a medium-term assessment of the technology’s value for money. Both costs and benefits are discounted at 3.5% in line with NICE guidelines. Discounting reflects time preference, the principle that resources and benefits available today are valued more highly than those in the future. For example, £1 received today can be invested to generate returns over time, making it more valuable than £1 received later. Accordingly, future costs and benefits are adjusted to their present value to enable consistent comparison.

Table 7.6: Average Net Present Value of costs, savings and QALY gains per care home across 5 and 10 years

	Average net present value per care home							
	5 years				10 years			
	Price	Savings	Net Savings	QALY	Price	Savings	Net savings	QALY
Scenario (1)	£24,658.06	£60,373.40	£35,715.34	0.00	£29,379.59	£111,206.18	£81,826.59	0.00
Scenario (2)	£24,658.06	£75,286.33	£50,628.27	0.56	£29,379.59	£138,675.41	£109,295.82	1.04
Scenario (3)	£24,658.06	£157,044.12	£132,386.05	3.63	£29,379.59	£289,271.05	£259,891.46	6.69
Scenario (4)	£24,658.06	£458,052.85	£433,394.79	3.63	£29,379.59	£843,721.06	£814,341.47	6.69

Note: This table presents the net present value of the costs and QALY associated with the NOBI technology per care home discounted at a rate of 3.5% as per NICE guidelines.

7.4 SCALING UP ACROSS TIME AND REGION

At the five-year horizon, NOBI generates net cost savings per care home of £35,715 in Scenario (1), £50,628 in Scenario (2), £132,386 in Scenario (3), and £433,395 in Scenario (4). The corresponding QALY gains are 0 in Scenario (1), 0.57 in Scenario (2), and 3.63 in both Scenarios (3) and (4).

Extrapolating these results to the 57 Nursing and Residential care homes in which NOBI was installed yields total five-year savings of £2,035,774 in Scenario (1), £2,885,815 in Scenario (2), £7,546,005 in Scenario (3), and £24,703,503 in Scenario (4). The corresponding QALY gains amount to 0 in Scenario (1), 32.20 in Scenario (2), and 207.14 in both Scenarios (3) and (4).

If these 57 Nursing and Residential care homes were representative of the broader population across the NWAS region (an assumption that is unlikely to hold fully), the results could be extrapolated to a hypothetical scenario in which all care homes installed NOBI in approximately 20% of their rooms. Under this scenario, affecting 428 Nursing and Residential care homes, the five-year net cost savings would amount to £15,286,164 in Scenario (1), £21,668,901 in Scenario (2), £56,661,232 in Scenario (3), and £185,492,969 in Scenario (4). The corresponding QALY gains would be 0 in Scenario (1), 241.77 in Scenario (2), and 1555.39 in both Scenarios (3) and (4).

At the ten-year horizon, the NOBI technology yields higher net savings per care home due to the longer time frame. Net cost savings per care home amount to £81,827 in Scenario (1), £109,296 in Scenario (2), £259,892 in Scenario (3), and £814,342 in Scenario (4). The associated QALY gains are 0 in Scenario (1), 1.04 in Scenario (2), and 6.69 in both Scenarios (3) and (4).

When extrapolated to the 57 participating Nursing and Residential care homes, the ten-year total savings correspond to £4,664,116 in Scenario (1), £6,229,862 in Scenario (2), £14,813,813 in Scenario (3), and £46,417,463 in Scenario (4). The corresponding QALY gains amount to 0 in Scenario (1), 59.31 in Scenario (2), and 381.55 in both Scenarios (3) and (4).

Applying the same hypothetical extrapolation to 428 Nursing and Residential care homes installing NOBI in approximately 20% of their rooms results in total ten-year savings of £35,021,780 in Scenario (1), £46,778,610 in Scenario (2), £111,233,544 in Scenario (3), and £348,538,148 in Scenario (4). The associated QALY gains would be 0 in Scenario (1), 445 in Scenario (2), and 2,865 in both Scenarios (3) and (4).

7.5 DISCUSSION

Our results suggest that the technology shows promise of being cost-saving, particularly when applied to the most at-risk groups of care home residents, our selected population here (see Section 4). While our results are not statistically significant at the 95% level for the overall sample and for nursing homes, they are significant at the 90% level. Several factors may be affecting the statistical significance of the results. For example, although the results are based on a selected group (a higher-risk group), we believe that the estimated effects for this group may be slightly underestimated. The reason is that the implementers and the NOBI company indicated that although riskier patients were initially selected, when these residents left, they were replaced by randomly allocated residents. While this would produce an artificial reduction in the number of falls within the "treated" rooms (in the NOBI falls analysis), in the NWAS data, where the comparison is conducted at the care home level, shifting the distribution of risk between NOBI and non-NOBI rooms means that higher-risk patients may not benefit as much from the NOBI technology as they would have if they had been consistently allocated to NOBI rooms. Therefore, our NWAS effects estimates may be in between the true effect of applying NOBI to only the riskier groups, and applying NOBI to a more general population in Nursing and Residential care homes.

There may also have been training effects during the pre-NOBI implementation period due to the upcoming NOBI rollout. These would tend to underestimate the measured effects. We observed some evidence of this in the data, where NOBI seemed to have had some impact just before being implemented. In addition, the relatively small sample of treated sites (57 treated care homes of which only 20% of rooms have NOBI installed), combined with the fact that not all call-outs are due to falls, a larger sample size with a specific tracking of call-outs due to falls would be required to demonstrate unequivocal statistical significance. It is worth noting, however, that increasing the proportion of treated rooms would likely reduce the measured effect of the technology, because it would gradually serve lower fall risk residents.

There are also theoretical considerations that increase our confidence in these results. First, the NOBI fall-level analysis presented in the previous section clearly shows that NOBI reduces falls. Falls are known to be strongly associated with ambulance call-outs and hospitalisations (Knowles et al, 2020). Therefore, it is reasonable to expect that if NOBI reduces falls, it should also reduce ambulance call-outs. In the previous section, we observed that NOBI reduces the number of falls by roughly 30%, and in this section we find that NOBI reduces NWAS call-outs by about 23%. If each fall carries some probability of leading to an ambulance call-out, then a reduction in falls should translate into a similar reduction in call-outs. The magnitudes are indeed similar, although the reduction in call-outs is slightly smaller. This may reflect the possibility that NOBI helps prevent a larger share of less severe falls, thereby weakening the relationship between falls and ambulance call-outs. Finally, other reports in the literature, although methodologically limited, also find large reductions in both falls and ambulance call-outs (Nobi, 2024; Gavriilidis, 2025; Irving 2025). These studies typically do not account for time trends or individual characteristics of the residents (such as risk of falling), nor do they rely on regression-based analysis, but still serve as anecdotal evidence towards supporting the effectiveness of the technology.

As such, although our results do not allow us to definitively conclude that the technology reduces NWAS call-outs, taking into account these limitations, the supporting literature, and the NOBI fall-level results leads us to believe that the technology is very likely to prevent ambulance call-outs and hospitalisations.

Assuming that the technology is indeed effective, we can reasonably infer that it is both cost-saving and QALY-improving. Across the four scenarios we constructed, the technology would remain cost-saving even under our most conservative estimate. Thus, the intervention alone is likely to generate net annual savings of between £308,336 and £5,159,041. We also extrapolated these results over 5- and 10-year horizons. This longer-term perspective is relevant because the cost of NOBI decreases significantly after the first three years. If the technology is paid for upfront for three years, it costs the Lancashire and South Cumbria ICB £2,253 per room, equivalent to £751 per room per year. This price includes installation, training, and maintenance. After the third year, the cost is reduced to maintenance only, at £10 per month per room, which corresponds to £120 per year per room. Because the cost decreases substantially after year three, the cost-saving potential of NOBI increases further in the medium term, even after accounting for discounting. We therefore calculated the net present value of the NOBI technology over 5 and 10-year horizons. The results show that the potential cost savings increase, with a range of £2,035,774 to £24,703,503 at five years and continuing to rise over a ten-year horizon. Note that we are assuming linear effectiveness of the technology throughout time, and no cost-inflation. The former may be likely to some extent, as the representative population of Nursing and Residential care homes is unlikely to significantly change in the medium run. The latter would be small and unlikely to change the results significantly.

Although this range is wide, we believe that the second and third scenarios are the most realistic. In any case, the presence of cost savings alone would be sufficient to support a recommendation to finance the technology. This recommendation, however, remains subject to the uncertainty surrounding the estimated effects and to the potential existence of competing technologies that may generate greater cost savings than NOBI. While some alternatives, such as the acoustic monitoring technology (Gavriilidis, 2025), have reports claiming very optimistic results, they have not been implemented at a comparable scale nor evaluated through a rigorous effectiveness assessment. In particular, their methodologies often lack statistical rigour, as they do not apply appropriate analytical methods or account for confounding factors such as individual characteristics and time trends or fixed effects. Additionally, the recommendation is contingent on the current pricing agreement between NOBI and the Lancashire and South Cumbria Integrated Care Board (ICB). Changes in the competitive landscape for fall-prevention technologies could alter market prices, which in turn may affect the conclusions of this report.

The QALY scenarios suggest that the technology is highly likely to improve quality of life. This is consistent with expectations, as preventing falls reduces the risk of associated adverse outcomes such as mortality, pain, temporary or permanent loss of mobility during rehabilitation, and fear of falling. However, it should be noted that the QALY estimates used in this analysis are derived from the existing literature rather than from data collected directly within this study. As such, they should be interpreted as indicative rather than context-specific estimates of the potential quality-of-life benefits associated with the technology.

It is also important to recognise that the results are likely to be most applicable to Nursing and Residential care homes with the greatest potential to benefit from NOBI and to residents or rooms with the highest expected risk of falls. The implementation analysed in this study took place primarily in larger care homes with higher bed capacity and targeted residents at elevated risk. Furthermore, the participating facilities were located within the Lancashire and South Cumbria region, which may not be representative of other care homes across the wider North West. Consequently, extrapolating these findings to other settings (as explored in the scenarios above) should be undertaken with caution.

Future research should aim to conduct a comprehensive economic evaluation incorporating deterministic and probabilistic sensitivity analyses, cost-effectiveness acceptability curves, and estimates of the expected value of perfect information. Given the remaining uncertainty, the performance of the technology should also be monitored following wider implementation in order to verify its cost-saving potential. This could be achieved by collecting linked hospital-level data, which would enable more precise estimation of the healthcare costs associated with falls.

Finally, the analysis would be strengthened by the direct collection of mortality and quality-of-life data from participating residents, which would allow for more accurate estimation of the health outcomes associated with the technology.

SECTION 8: "DEEP DIVE" CASE STUDY- KENDAL CARE HOME

8.1 INTRODUCTION

As indicated in Section 4, Kendal Care Home is a large residential care and nursing home with 120 rooms offering residential en-suite bedrooms and nursing suites, including general nursing, EMI ("elderly mentally infirm") nursing, and palliative care. It was selected to be our deep dive case study example because of a good number of responses to the CHSMQ questionnaire (quantitative and qualitative responses) and also the manager made himself available for interview, which was conducted by a member of the ICB team. Kendal Care Home also provided their data on falls for all residents with or without the technology during two months before and after technology installation, along with additional residents' characteristics: gender, age, and diagnosis.

The semi-structured interview, conducted with the manager in the Kendal care home, was aimed at assessing the impact of the use of the device on the residents' safety and the care provision by staff members from his perspective. The potential cost-effectiveness of the technology and other factors affecting the long-term adoption of the technology in Kendal care home were also explored. The anonymised transcript of the semi-structured interview was analysed using inductive thematic analysis (Naeem et al., 2023). The responses were read several times to ensure familiarity with the data and initial codes were identified (Naeem et al., 2023; Braun & Clarke, 2013). These codes were categorised into broader themes using NVivo v14.

8.2 RESULTS

8.2.1 QUANTITATIVE RESPONSES IN THE CHSMQ

The findings of the close ended questions that assessed the staff's perception of the ease of use of the device and usefulness of the device (n=30 from Kendal care home) in responding to falls and delivering effective care was analysed using descriptive statistics (e.g. mean, standard deviation, frequency analysis) using SPSS v31 and presented in the following sections along with the themes and sub-themes supporting the quantitative data.

Table 8.1 summarises the responses of the Kendal care home staff to the CHSMQ questionnaire. Sixty percent of the respondents were women. In terms of job description, most of the respondents were healthcare assistants (46.7%). The majority of the staff members were not involved in the implementation of the device in the care home (66.7%) and had not received training on how to use the device (53.3%).

Table 8.1: Summary of Kendal care home staff responses to the CHSMQ (total number of responses=30)

Variable	N (Percentage)
Job role	
Health care Assistant	14 (46.7%)
Registered Nurse	7 (23.3%)
Domestic	3 (10%)
Activity co-ordinator	1 (3.3%)
Team leader	2 (6.7%)
Other	3 (10%)
Ease of using the device to respond to alerts	
Easy or very easy	25 (83.3%)
Neither easy nor difficult	5 (16.7%)
Has Nobi helped the staff in responding to falls quickly?	
Yes	24 (80%)
No	2 (6.7%)
Don’t know	4 (13.3%)
Confidence in using the device	
4 or 5	11 (36.7%)
3	10 (33.3%)
1 or 2	9 (30%)
Are the staff more confident in managing fall risks after using the device?	
Yes	16 (53.3%)
No	6 (20%)
Don’t know	8 (26.7%)
Has the device made the staff’s job easier overall?	
Yes	22 (73.3%)
No	2 (6.7%)
Don’t know	6 (20%)
Improvement in quality of care due to the use of the device	
Yes	24 (80%)
No	1 (3.3%)
Don’t know	5 (16.7%)
Has the use of the device changed how the staff monitor residents at night?	
Yes	14 (46.7%)
No	4 (13.3%)
Don’t know	12 (46.7%)
Has the use of the device reduced the number of manual checks that are performed?	
Yes	15 (50%)
No	9 (30%)
Don’t know	6 (20%)

8.2.2 QUALITATIVE ANALYSIS OF SEMI-STRUCTURED INTERVIEW, COMBINED WITH QUALITATIVE AND QUANTITATIVE CHSMQ RESPONSES

Kendal care home staff responses to the open-ended questions in the CHSMQ are combined with the interview data in this section to triangulate the findings, and the quantitative findings (Table 8.1) used to further support any qualitative outcomes.

Data analysis of the semi-structured interview with the manager of the home led to nine different sub-themes that were grouped under four major themes. A narrative summary of the main themes and sub-themes and the quotes supporting them is presented in the section below and the list of themes and sub-themes are presented in Figure 8.1.

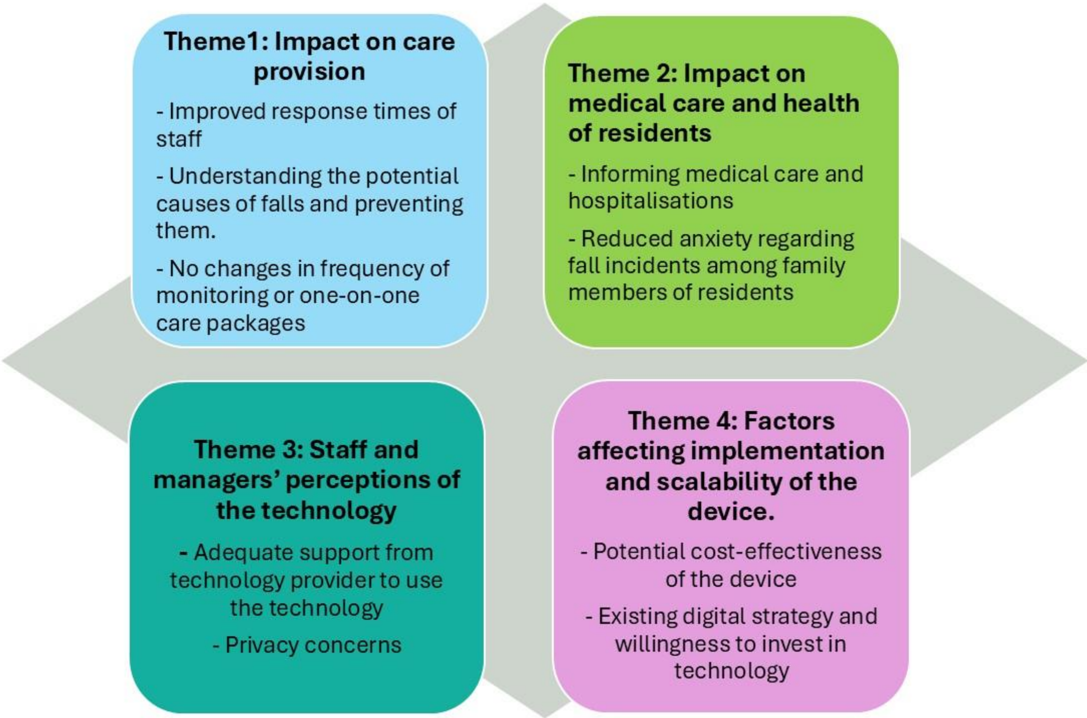

Figure 8.1: Themes and sub-themes related to the impact of the Nobi device on care provision and residents' quality of life in Kendal care home.

Theme 1: Impact on care provision

The sub-themes related to the impact of the use of Nobi on the work patterns of Kendal care home staff and the impact on the care provision are presented in this section.

Sub-theme 1: Improved response times of staff

The interviewee mentioned that staff response times to falls improved significantly as compared to their response times during the learning mode of Nobi. It was reported that this had led to significant decline in long lies among the residents. The learning mode was the period right after installation of Nobi when the staff were being trained on how to use the Nobi; falls occurring during this time were considered as the baseline to which falls in the intervention period were compared. The following quote from the interviewee demonstrates that some residents had a long lie of up to 2 hours during the night-time prior to the Nobi device being used in the Kendal care home and that this has been prevented due to the use of the device.

I think that we are now in those 28 bedrooms and bathrooms, we are now ultra responsive, you know, to have a response time of one minute and 33 seconds is phenomenal. And without the data, without the technology, that that wouldn't happen. We had a lie of nearly two hours in those bedrooms. That will never happen again.

The Kendal care home staff responses to the CHSMQ questionnaire echoes this finding as the following quote from a staff member shows that the alerts from the Nobi device helps the staff to respond promptly and avoid any further deterioration of health due to falls.

"Give immediate alert when any fall occur. So can avoid further risk due to fall" ID 162 (Staff response to CHSMQ)

Additionally, 80% of the Kendal care home staff felt that the Nobi device helped them to attend to falls quickly and 83.3% of the staff felt that it was easy or very easy to respond to alerts from Nobi and respond to falls (Table 1).

In summary, this data supports our Objective 1 in terms of showing a reduction in long lies.

Sub-theme 2: Understanding the potential causes of falls and preventing them.

The interviewee mentioned that the use of the Nobi device completely eliminated unwitnessed falls in the rooms in which the Nobi device was installed in the Kendal care home. This helped the staff and managers to understand how a fall happened by assessing the Nobi data and in turn to take steps to prevent future falls. The following quote highlights how the Nobi data helped reduce the fall risk of a resident by removing a tripping hazard from the residents' room.

You can make environmental changes to people's bedrooms because you can see what's happening. And there was another gentleman who was high falls risk and his suitcase was in his wardrobe, and he kept getting his suitcase out of his wardrobe and putting it behind him and then forgetting it was there and falling over it, so we rang the family up and said look can you do this for us, can you come and collect his suitcase and take it away.

The participant pointed out that the majority of the falls generally occurred in the private areas in the care home like the residents' bedrooms where there is minimal staff supervision. Therefore, the majority of the falls were unwitnessed in the past and the staff had limited information regarding potential causes of falls. However, the Nobi data allowed staff to determine the potential causes of falls which also helped them to improve their documentation regarding falls in the care home.

The Nobi data also helped the staff and managers to work out which residents were at high risk of falls and tailor the use of the device to prevent falls among those residents. The device was changed to a higher setting in these residents' rooms so that the device notified the staff when the residents were engaging in high-risk behaviours like bed-exits in the night and sitting at the edge of the bed. Additionally, due to the reduction in unwitnessed falls, the staff and managers could distinguish between a true fall and an event in which a resident purposefully kneels on the floor.

He's not falling, this is something he's doing intentionally. He has Parkinson's disease and he's looking for something on his floor and he's putting himself down on the floor on purpose and he's kneeling down and looking under his bed and etc. And obviously Nobi reports that. But you can then look at the footage and say, well, actually that's not a fall.

The responses of the staff members to the CHSMQ questions supported the data generated from the interview in that the staff could ascertain the causes of falls by reviewing the Nobi data and prevent them in the future. The following quote from one of the staff members demonstrates this.

"To find out reason for fall and prevent further one." ID 166 (Staff response to CHSMQ)

Additionally, the staff responses to the close-ended questions in the CHSMQ showed that 80% of the staff felt that the Nobi device helped in improving the quality of care in the Kendal care home.

Overall, this data supports our Objective 1 in terms of reducing falls, but also Objective 2 in terms of improving delivery of care

Sub-theme 3: No changes in frequency of monitoring or one-on-one care packages

The potential changes in one-on-one intensive care for residents and changes in frequency of monitoring of the residents was assessed to explore if the use of the device could reduce the amount of time the staff had to spend on checking residents' safety and if residents on one-on-one care packages could be supported in a less restrictive way. The following quote from the interviewee demonstrated that the majority of the devices were installed in the dementia unit in the Kendal care home where the residents were at high risk of falls and they also had limited mobility and incontinence. Therefore, the staff had to conduct the routine checks to ensure their comfort and hygiene.

The largest majority of our lamps are in our dementia nursing unit, where we would be checking people anyway. I mean the lamp's always watching them anyway to make sure that you know that they're safe and that if they fall over, it reports it. But what the lamp doesn't do is check that their hygiene needs are being met properly, and that they're warm, and they're safe, and they're comfortable and dry. That's something that you can't avoid and Nobi can't do that. So, for those people who have very high care needs, it's probably not going to reduce or change the way that we do things.

Similarly, one resident in the care home received one-on-one intensive care which could not be reduced as he was at a very high risk of falls and had a tendency to wander. As the Nobi devices were mainly installed in private areas like residents' bedrooms, it was difficult to track residents who engaged in behaviours such as wandering.

The Kendal care home staff's responses to the CHSMQ questionnaire also demonstrated this in that only 46.7% of the respondents felt that the use of the Nobi lamp led to changes in night-time monitoring of residents (Table 8.1).

Overall, given the range of reasons for regular checks, in this context (bedrooms of people living with dementia), the Nobi lamps seemed unlikely to reduce number of checks. It is important to note that this may be different in other contexts.

Theme 2: Impact on medical care and health of residents

The sub-themes related to the impact of the use of Nobi device on the medical care of the residents have been grouped in this theme, including the impact on hospitalisations and ambulance calls. The sub-themes related to the impact on the family members of the residents have also been grouped in this theme and presented in this section.

Sub-theme 4: Informing medical care and hospitalisations

The interviewee indicated that the Nobi data helped the paramedics to assess the severity of the falls and fall-related injuries accurately. This helped in preventing hospitalisations of some cases, supporting our Objective 1. Additionally, the following quotes demonstrate that the staff and management at Kendal care home could show the data regarding residents' sleep quality in the sleep reports that are generated by the Nobi device to the general practitioner and advocate for medication reviews to improve residents' sleep quality.

Well, one of the other things that we can do, and it's and it's a very useful thing, because it generates sleep reports. So, one of the things that we look at is how is, you know, somebody sleeping at night? So, when you look at a sleep report and you see all these little red things and then a spell of green, you can say to the GP, look they're really disturbed at night, look at what's happening. You would look at things like what sort of medication are they taking, how are they presenting, what are they doing through the day, etc.

We can see sleep patterns. We can see how many times he doesn't fall and how many times he does fall. And you know that things like that can help to shape medication reviews.

Overall, this sub-theme contributes to Objectives 2 and 3 in terms of supporting delivery of improved care and so contributing to the wellbeing and quality of life of residents.

Sub-theme 5: Reduced anxiety regarding fall incidents among family members of residents

The interviewee mentioned that the family members of the residents also had a positive attitude towards the Nobi device as the improved monitoring of the residents and reduction in long lies helped in increasing their peace of mind and reducing their anxiety regarding fall occurrences. The interviewee also mentioned that the staff and managers could let the family members know exactly how the falls occurred and the measures that they would take to prevent them in the future, because of which the family members felt more reassured and less anxious about any fall incidents. This is demonstrated by the following quote by the participant.

For me to be able to tell you exactly what's happened to your mum and that she was on the floor for three minutes and on the 4th minute she was tucked back up in bed safe and sound. That's reassuring, isn't it?

This theme shows benefits for family carers that are additional to our original objectives.

Theme 3: Staff and managers' perceptions of the technology

The sub-themes regarding the care home staff and managers' perceptions of the technology including the perceived ease of use and any concerns or problems with the use of the technology are presented in this section.

<u>Sub-theme 6: Adequate support from technology provider to use the technology</u>

The interviewee mentioned that the staff and management at Kendal care home found it easy to use the mobile app to receive alerts regarding falls from the Nobi device. The following quote also demonstrates that the Nobi team was very efficient in installing the technology and solving any problems with the technology.

The team that came in and did it were superb. They didn't make much mess; you know that they worked around us. They were working upstairs on the dementia nursing floor. There was minimal disruption. They were very quick, very professional, very friendly, friendly group of people. There were a few snags and hitches at the beginning, but the Nobi team and the engineers were very, very helpful and very quick to respond to things.

This theme contributes to the perceived ease of use, which may have an impact on future scaling up of use of the device (Objective 6).

<u>Sub-theme 7: Privacy concerns</u>

Although the device was easy to use, the interviewee reported that the staff were initially concerned about working under camera supervision. Indeed, the following response from a staff in Kendal care home in the CHSMQ questionnaire demonstrates that the staff were concerned about working under camera supervision and they were concerned about their privacy and the residents' privacy.

"Still, there is always a doubt about the staff and residents' privacy during their personal care because a camera is always watching that is making a concern." ID 109 (Staff response to CHSMQ)

However, the interviewee (the manager) mentioned that he explained to the staff that the device does not personally identify the staff members and only the data regarding the response times to falls are saved by the Nobi device, and this explanation reduced the anxiety among the care home staff.

The staff were a little bit worried at first because they thought the lamp was watching them, and I actually said to them the lamp's not interested in you at all and the only way it would be interested in you is if you went into a Nobi equipped bedroom and you fell over. So, the staff have got used to it now, and they're not worried or alarmed by it. You know, they're aware that it's not watching them.

This underscores the importance of regular training regarding the use of the device for the care home staff and an open communication between staff members, management and the Nobi team to answer any questions or concerns of the care home staff. Indeed 46.7% of the staff mentioned that they did not receive any training on how to use Nobi of which the majority were Healthcare assistants who are involved in providing physical and emotional support to the residents. A chi square goodness of test was conducted in order to explore if there were any differences in managing fall risks using the Nobi device between the staff who received any training and those who did not receive any training to use the device. The expected frequency in a few cells was lower than 10, therefore, the Fisher exact test is reported (Pallant, 2021). Results obtained from the fisher exact test also showed the importance of continuous training for the staff as the staff who were provided with training on how to use the Nobi device were significantly more likely to report that they were confident in managing fall risks using the device (p=0.26).

This potential barrier could affect the attitudes of staff (potential adopters) to plan to scale up the tool or adopt it in the first place. Training that acknowledges this fear is important.

Theme 4: Factors affecting implementation and scalability of the device.

Sub-theme 8: Potential cost-effectiveness of the device

The interviewee mentioned that the care home had been using the Nobi device for a short period of time, because of which he could not comment definitively on the cost-effectiveness of the device. However, he reported that the device has the potential to be cost-effective as it can reduce the amount of time that the staff spend in checking the residents' safety and filling out paperwork after fall incidents. The staff could spend that time delivering more person-centred care to the residents and doing other important tasks. Additionally, the following quote shows that the device could also help in reducing ambulance calls and hospital trips which could save NHS costs.

You know, if with minimal effort you can save the NHS - I don't know how much it costs to send somebody to hospital, but an ambulance visits and a trip to A&E for a CT scan. It must be thousands.

The interviewee also mentioned that the device was more cost-effective than the other devices that they have used in the past to detect and prevent falls such as fall mats. Additionally, the participant felt that those who were self-funding their care would be willing to pay for it in the future as the device was very popular among the family members of the residents. This would help in generating more income for the care home.

So, you would look at, one of the key things for Kendal Care home is people that self-fund, that's where a lot of our income is generated. We have nearly 50 self-funders, and if you were to say to somebody who's well to do, I can put this technology into your bedroom for £50 a month. You'd pay it, wouldn't you? Because that's probably about what it costs over the course of a few years.

However, the following quote from the interviewee demonstrated that the Kendal care home had to upgrade the Wi-fi infrastructure to effectively implement the device. This was a significant cost for the care home, although in this instance the costs were offset by the funding provided to use the device by the Integrated Care board.

They came and did a Wi-Fi survey, and the Wi-Fi wasn't good enough. And I said to the directors, look, this is a no brainer if we can have this technology free of charge for three years. So, I've convinced the directors to spend £7000 upgrading the Wi-Fi, which is what we did.

In summary, the interviewee identified further potential ways that scaling up could be accomplished, demonstrating his own positive attitude to the technology and speculating on that of new residents and their families (Objective 6). The interviewee also indicated ways that the tool could become cost effective (Objective 5).

Sub-theme 9: Existing digital strategy and willingness to invest in technology

The interviewee mentioned that their care home has a digital strategy and the care planning and medication management is done electronically in Kendal care home. Thus, the organisation was interested in investing further in technology to improve the care provision.

Once I'd explained at the AGM (Annual general meeting) what the Nobi Lamp does and how it works and the tip of the very large iceberg, it generated, I mean there was people up having presentations all day and my presentation attracted the most amount of questions and the most amount of interest. And I did get an e-mail from the Finance Director the next day saying, "I am actually really interested in this."

This sub-theme clearly supports our Objective 6 in relation to scaling up and further adoption of the device.

8.3 CONCLUSIONS FROM CHSMQ AND INTERVIEW DATA

The staff and management at Kendal care home had a positive attitude towards the Nobi device as it helped the staff in responding promptly to support residents after fall incidents which reduced the long lies among residents. This helped in reducing the anxiety of fall occurrences among the family members of the residents as well. Additionally, the device eliminated the occurrences of unwitnessed falls because of which the staff could accurately assess the potential causes of falls and fall risks of residents and tailor the use of the device to support them more effectively. However, the findings underscore the importance of continuous training for the staff members on the use of the device and an open communication between staff members, management and the Nobi team to address staffs' concerns or questions regarding the technology. Assessment of the long-term cost-effectiveness of the device is also important for effectively scaling the use of the device.

8.4 DEEP DIVE INTO NOBI DATA FOR KENDAL CARE HOME

8.4.1 DESCRIPTION OF THE CONTEXT

We analysed Kendal Care home incident records from July to December 2025 (three months before and after the installation of Nobi). Of the total 118 rooms, 103 reported an incident, and residents' information was recorded in the incident report. Among the 103 rooms, two residents died during the 6-month period, and their rooms and observations were dropped from the record. Of the 101 rooms included in this analysis, 21 had Nobi installed in October 2025, while 80 did not have the technology and were assigned as a comparison 'control' group.

During the three-month pre-installation period, 54% of residents in the control group experienced no falls (43 out of 80), compared with only 19% of residents in rooms where Nobi was later installed (4 out of 21), illustrating their higher risk. A total of 282 incidents were reported in the months before Nobi installation, of which 117 (41%) were falls, and 165 (59%) were non-fall incidents. Among the fall incidents, 10 involved repeated falls occurring on the same day. In the 3-month post-installation period, 277 incidents were reported, including 151 fall incidents (55%) and 126 non-fall incidents (45%). Of the fall incidents reported after installation, 11 involved repeated falls on the same day.

Table 8.2 outlines the frequencies of sociodemographic characteristics for residents in the intervention and control rooms. Among the 21 residents with the technology, 14 (67%) were female, while among the 80 in the control group, 60 (75%) were female. Residents' age in the control group ranged from 56 years old to 102 years old, with a mean age of 84.8 (SD= 9.3) years old, while residents with the technology were slightly older, with a mean age of 86 (SD=6.5) years old, and ranged between 77 years old and 100 years old. The t-test did not show a statistically significant difference in mean age between the control and intervention groups ($t = -0.58$, $p = 0.56$) nor in gender frequency distribution (χ^2 test = 0.59, $p=0.44$). This means that the two groups were similar enough to be compared in the analysis.

Most of the residents (95%) in the intervention group had their primary diagnosis as a neurological disease (e.g., dementia, acquired brain injury, stroke, Parkinson's), while only 60% of residents in the control group had a primary diagnosis of neurological diseases. However, the Pearson Chi-squared test did not show a statistically significant difference in the distribution of primary diagnoses between the control and intervention groups ($\chi^2 = 9.9$, $p = 0.08$).

Overall, Table 8.2 indicates that while the intervention and control groups are comparable in gender distribution, they differ substantially in clinical complexity, with neurological diagnoses being far more prevalent in the intervention rooms. This distinction highlights that residents exposed to the Nobi lamp started from a higher-risk baseline, which is important for interpreting subsequent fall outcomes. To isolate the true effect of the intervention, we use a difference-in-differences (DiD) model to adjust for these underlying differences.

Table 8.2 Sociodemographic characteristics of the residents in the control and intervention rooms

Characteristics	Intervention N (%)	Control N (%)	Total N (%)
Gender			
Female	14 (66.7%)	60 (75%)	74 (73.3%)
Male	7 (33.3%)	20 (25%)	27 (26.7%)
Primary Diagnosis			
Cancer	0 (0%)	5 (6.3%)	5 (5%)
Cardiovascular (e.g. Heart diseases, Hypertension)	0 (0%)	6 (7.6%)	6 (6%)
Mental Disorders (e.g., Psychosis, Schizophrenia)	1 (4.8%)	5 (6.3%)	6 (6%)
Musculoskeletal (e.g., Arthritis, Frailty, MS)	0 (0%)	11 (13.9%)	11 (11%)
Neurological (e.g., Dementia, Parkinsons, Stroke)	20 (95.2%)	48 (60.8%)	68 (68%)
Respiratory & Others (e.g., COPD, Diabetes)	0 (0%)	4 (5.1%)	4 (4%)

8.4.2 CHANGES IN FALL FREQUENCY

We examined changes in fall frequency before and after the installation of the Nobi smart lamp in intervention rooms compared with non-intervention rooms, using a difference-in-differences (DiD) model, which examines changes between before and after the implementation while accounting for general trend changes that would have happened anyway, observed in the control group.

The analysis, illustrated in Table 8.3, shows that rooms with Nobi had a higher baseline fall frequency than control rooms. The overall average number of falls across all rooms (including those with Nobi and those without) increased during the post-installation period, suggesting that more falls were detected in post-installation months (October, November, December) than in pre-installation months (July, August, September). This may be related to the change of seasons, with residents being more likely to fall in winter than in summer.

Table 8.3: Comparison of changes in the frequency of falls recorded before and after Nobi installation[1]

Variable	Model (1)
Average N. Falls per day per resident before Nobi Installation (Control rooms) – M (SD)	0.30 (0.49)
Average N. Falls per day per resident before Nobi Installation (Intervention rooms) – M (SD)	0.63 (0.60)
Post-installation Time	**0.25*****
Intervention (Rooms with Nobi)	**0.33*****
Pre-Post # Intervention -interaction term	**-0.22***
Constant	0.30**
F-Test	11.09
P-Value	<0.001
Adjusted R-squared	0.05

(*) P-value <0.05, (**) P-value <0.01, (***) P-value <0.001, (NS) P-Value not statistically significant at 95% confidence level.

(1) Difference in difference model showing the variation in the average number of falls per day per resident with and without the intervention (Nobi), variation in the average number of falls per day per resident before and after the installation of Nobi, and the changes in the general trend of the average number of falls per resident after Nobi installation.

The interaction between post-installation period and intervention rooms is negative and statistically significant (β = −0.218, $p = 0.034$). This means that, although fall frequency increased overall during the post-installation period, the rise was smaller in Nobi-equipped rooms than in control rooms. In other words, after accounting for general seasonal or facility-wide increases in falls, rooms with Nobi experienced a relative reduction in fall frequency compared with what would have been expected without the intervention. This suggests that the Nobi smart lamp may have had a protective effect, mitigating part of the broader upward trend in falls observed across the care home. Figure 8.2 shows the change in the trends of average daily falls, comparing rooms with Nobi and the control rooms.

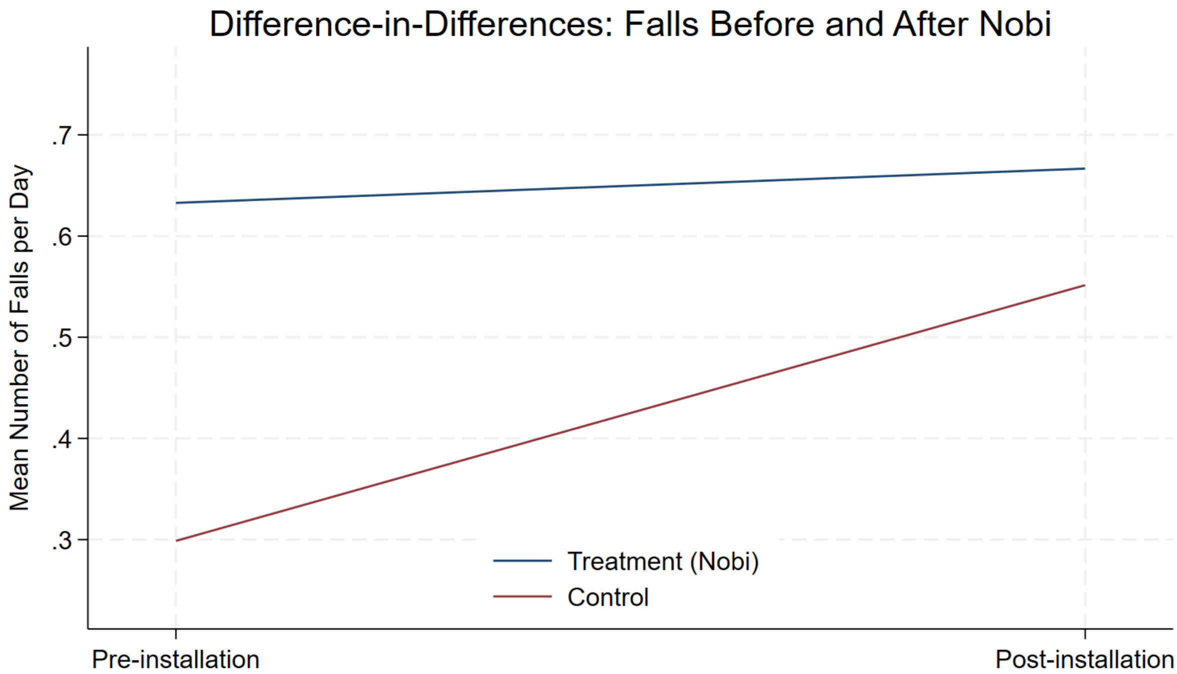

Figure 8.2: difference in the trends in the average number of falls per day between the treatment and control groups, pre- and post-Nobi installation.

Conclusion on number of falls

The sociodemographic profile shows that residents in the intervention rooms differ meaningfully from those in the control rooms, particularly in terms of primary diagnosis. Nearly all residents in intervention rooms (95.2%) had a neurological condition, compared with 60.8% in control rooms. Because neurological disorders—especially dementia and Parkinson's disease—are strongly associated with higher fall risk, the intervention group represents a population with greater underlying vulnerability.

Taken together, the analysis indicates that, while fall frequency rose across all rooms during the post-installation months, likely reflecting seasonal patterns, rooms equipped with the Nobi smart lamp showed a significantly smaller increase than control rooms. Despite starting with a higher baseline fall rate, intervention rooms demonstrated a relative improvement once the general trend was accounted for. These findings suggest that the Nobi system may help reduce fall incidence under conditions where falls would otherwise be expected to rise, highlighting its potential value as a fall-prevention technology in residential care settings.

8.4.3 DEEP DIVE INTO NWAS DATA FOR KENDAL CARE HOME

We explored whether there is a variation in the pattern of ambulance call-out numbers before and after Nobi installation. Using the NWAS database, we reviewed the average number of ambulance call-outs in the pre-installation month (July-August) and compared it to the post-installation months (October to December). There were fewer call-outs reported in the pre-installation months, with only one call-out in all three pre-installation months, compared to 7 call-outs in the post-installation months. Although there was a clear numerical increase in ambulance call-outs in the winter months, following the installation of Nobi, the results showed minimal change and no statistically meaningful variation between periods, as detailed in Table 8.4.

Table 8.4 Average number of monthly call-outs extracted from the NWAS database for the same pre-installation months (July – September) compared to the post-installation months (October – December)

Variable	Pre-Installation Months M (SD)	Post-Installation Months M (SD)	T-Test (P-value)
Total N. of Call-outs	1	7	
Average N of Ambulance Call-outs per month	0.33 (0.58)	2.33 (2.52)	T = -1.34 (p=0.25)
N. “See & Convey” Call-outs	0.00 (0.00)	0.33 (0.58)	T = --1.07 (p=0.35)
N. “See & Treat” Call-outs	0.00 (0.00)	0.67 (1.15)	T = -1.00 (p=0.37)
N. “Hear & Treat” Call-outs	0.33 (0.58)	1.33 (1.15)	T = -1.34 (p=0.25)
Cost- S1 - No Hosp. admission	22.00 (38.11)	678.33 (1062.64)	T = --1.07 (p=0.35)
Cost- S2 – Short Stay	22.00 (38.11)	783.93 (1245.25)	T = --1.07 (p=0.35)
Cost- S3 – Long Stay	22.00 (38.11)	1362.87 (2247.21)	T = -1.03 (p=0.37)
Cost- S4 – Long term Rehabilitation	22.00 (38.11)	3494.33 (5938.41)	T = -1.01 (p=0.37)
QALY Gained – S2	0.00 (0.00)	0.00 (0.01)	T = -1.00 (p=0.37)
QALY Gained – S3 & S4	0.00 (0.00)	-0.03 (0.04)	T = -1.00 (p=0.37)

8.4.4 CONCLUSION

We investigated ambulance call-outs from Kendall Care to assess whether activation of the Nobi technology was associated with changes in emergency service utilisation. However, the very low number of call-outs during the summer months severely limited the feasibility of statistical analysis. Only one ambulance call-out was recorded across the three summer months (July–September), leaving little scope for detecting any meaningful changes following technology deployment. In contrast, ambulance call-outs increased during the winter months, reaching a total of seven. Importantly, this seasonal increase cannot be confidently attributed to falls, as winter periods are well documented to coincide with higher rates of respiratory illnesses and general health deterioration, both of which are known contributors to increased ambulance utilisation. Even if call-outs could be disaggregated by cause, the small number of observations would preclude robust inference, making it impossible to distinguish a true technology effect from random variation. Moreover, there are no theoretical or functional mechanisms within the Nobi technology that would plausibly explain an increase in falls following activation. Consequently, we do not interpret the observed winter increase in ambulance call-outs as being related to the technology. At worst, the findings are consistent with a null effect.

8.5 REFERENCES FOR THE FINDINGS CHAPTERS (CHAPTERS 5, 6, 7 AND 8)

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SECTION 9: DOES NOBI TECHNOLOGY SUPPORT 1-1 CARE?

Since early 2025, the Lancashire and South Cumbria Integrated Care Board (LSC ICB) has undertaken a structured and evidence-informed programme to examine the role of ambient sensor-based technology—specifically the Nobi smart lamp—in supporting care delivery for residents with commissioned one-to-one (1-1) packages. This work emerged from a wider digital transformation agenda, aiming to determine whether technology-enabled observation could offer a clinically safe, person-centred and less restrictive alternative to traditional 1-1 arrangements within care home environments.

The programme's foundations were laid through a focused pilot across three primary sites, each selected on the basis they, already had Nobi installed and had resident profiles with care package complexity. Early implementation data from these homes generated a nuanced picture.

Provider n1 demonstrated the greatest operational traction, with 5 residents receiving approval for 1-1 package adjustments following the introduction of Nobi. Structured follow-up visits and optimisation sessions were scheduled and enacted to ensure adherence to the intervention and monitor emerging outcomes.

In provider n2, the care review practitioner identified 3 residents for adjusted support. Unfortunately, consensus was not reached between the provider and the care review practitioner therefore these did not result in a reduction of care package during the pilot phase. This demonstrated, the importance of adoption to the technology; strengthening pathways; multidisciplinary communication and, data presentation.

Provider n3 voluntarily reduced a package of care for a resident by £80,000 full year effect.

A total of 6 residents had their 1-1 package of care reduced overnight at a saving of £467,296 full year effect, an average saving of £77,882 per resident.

Collectively, these sites provided the empirical grounding necessary to refine processes, clarify eligibility criteria and establish reproducible operational guidance for subsequent scaling activity.

Building on these early findings, Director of Nursing and Senior Responsible Officer for the programme, authorised a significant expansion of scope in October 2025. This decision formally extended the Nobi 1-1 use case beyond the initial pilot cohort to encompass all All Age Continuing Care (AACC) care review practitioners. In doing so, the programme shifted from a limited proof-of-concept to a broader system-wide implementation test, reflecting both the credibility of the emerging evidence and a growing strategic commitment to exploring digital alternatives to high-cost care. This expansion required the rapid development and dissemination of structured training, ensuring that all care review practitioners possessed the necessary understanding of Nobi's configuration parameters, alerting architecture, sleep reporting functions and the wider analytical framework through which technology-enabled monitoring could inform care package decisions. The training also served to standardise assessments across practitioners, reducing variation and supporting equity across the resident cohort.

A further substantive milestone occurred on 1 December 2025, when the programme was formally extended to include both AACC and Individual Patient Activity (IPA) teams. This expansion embedded the technology-supported 1-1 assessment model within routine commissioning and review pathways, signalling the transition of the work from experimental design to operational practice. This integration enabled a unified approach to reviewing 1-1 packages across commissioning boundaries, promoting consistency and strengthening opportunities for shared learning between clinical, operational and digital teams.

Throughout this journey, the programme has been characterised by an iterative learning methodology, combining qualitative insight from care providers with quantitative outcome and activity data generated through Nobi's sensor-based monitoring. Monthly assurance processes, structured governance documentation, and the development of comprehensive end-to-end pathways for homes both with and without existing Nobi installations have underpinned programme oversight. These mechanisms have facilitated consistent monitoring of intervention fidelity, supported the identification of emerging operational risks, and maintained a clear focus on resident safety, experience and dignity.

Taken together, the Nobi 1-1 initiative represents a significant contribution to the evidence base on how ambient assisted living technology can influence commissioning decisions, reduce reliance on restrictive or resource-intensive models of care, and advance a digitally enabled vision for the regulated care market. The work undertaken across LSC ICB demonstrates that successful deployment requires not only technological capability but also structured governance, multidisciplinary engagement, and consistent evaluation frameworks. As the programme progresses toward its formal evaluation in March 2026, the insights generated from the pilot homes, the expansion authorised by senior leadership, and the whole-system mobilisation of AACC and IPA teams continue to inform an evolving understanding of how technology can safely, effectively and sustainably support alternative care models for residents with complex needs.

Once full data are available, we will be adding further data in this section from a further deep dive case study. (end May 2026)

SECTION 10: OVERALL DISCUSSION

This section will begin by briefly highlighting the aims of the Nobi programme. This will be followed by the main findings of the evaluation according to the objectives, recommendations that have emerged as a result of the observations made during the evaluation process and recommendations for future evaluations. Finally, a short conclusion will be offered.

10.1 THE PURPOSE OF THE PROGRAMME:

As outlined at the outset of this report in the financial year 2024/25 Lancashire and South Cumbria ICB were allocated £710,500 for care technology. This was used to fund approximately 800 Nobi lamps across 80 Nursing and Residential care homes with consistently high falls or 999 calls for falls. The aim of the programme was to improve the safety, quality and outcomes for people living in Nursing and Residential care homes across Lancashire and South Cumbria. To determine whether these aims had been achieved, a full and robust independent evaluation of the programme was seen as fundamental.

10.2 SYNTHESIS OF EXISTING EVIDENCE

The scoping review of existing studies of fall detection devices that aimed to reduced falls, injuries, long lies, ambulance calls and hospitalisations (Section 2) demonstrated that there was limited evidence of fall detection devices in reducing falls. Although, the review showed that fall detection devices can help in reducing long lies, ambulance calls and hospitalisations, some of the studies only reported anecdotal evidence without specific and detailed information about methodology. Studies included in this evidence synthesis also lacked comparator groups and detailed information about the methodology of the studies which somewhat constrained the conclusions that could be drawn regarding long-term cost-effectiveness of these devices. Therefore, this robust evaluation using mixed methods data (qualitative and quantitative) to address the following aims and objectives in terms of evaluating the Nobi fall detection device:

1. To determine whether this technology has reduced resident falls, long lies over 30 mins after having fallen and before help comes, ambulance call-outs and hospitalisations, and prevented future falls.

2. To determine whether this technology has changed how Nursing and Residential care homes deliver care for the residents they support.

3. To determine what impact this technology has had on residents' quality of life.

4. To investigate in what kind of circumstances Nobi lamps can support care in a different way to a 1-1 package of care and be the least restrictive practice.

5. To determine whether this approach offers value for money, using the North West Ambulance Service NHS Trust (NWAS) data on ambulance call-outs to infer costs avoided driven by the falls prevention capacities of Nobi.

6. To consider how this intervention can be scaled and sustained.

10.2. MAIN FINDINGS OF THE EVALUATION ACCORDING TO THE OBJECTIVES:

1. Objective 1: Both qualitative and quantitative data showed that there was a significant reduction in the staff response times to fall incidents, thereby reducing long lies. Qualitative

data identified that the device helped in identifying potential causes of falls and the extent of injuries which helped the staff in reducing falls in the future by making environmental modifications to the care home bedrooms such as moving furniture to reduce tripping hazards. Quantitative data supported this in that fall incidents were reduced by 31% as compared to baseline fall rates.

2. Objective 2: The majority of the care home staff and managers felt that Nobi device was easy to use and improved their efficiency in responding to falls. Although the findings showed a limited impact on the frequency of monitoring of residents' safety, the Nursing and Residential care homes could personalise it by tailoring frequency and timing of monitoring according to the fall risks and needs of residents. The majority of the staff and management were confident in using the device but felt that continuous training for the staff was very important to enable them to accurately document fall incidents and manage fall risks. In addition, it was identified that there needed to be an open communication between staff members, management and the Nobi team to address staffs' concerns or questions regarding the technology.

3. Objective 3: There were positive impacts of the use of the device on residents' health-related quality of life as 54.2% of the managers observed an improvement in the overall well-being of the residents. There were positive impacts on sleep quality of residents as the sleep reports generated by the device helped in identifying potential causes of sleep disturbance and falls at night. These reports also helped in informing medication reviews and/or referrals to mental health services which helped in improving sleep and quality of life.

4. Objective 4: Although the findings of the initial pilot of the Nobi device in three primary sites showed reduction of one-on-one care packages across two sites resulting in significant cost-savings, the results of the current evaluation found limited reduction in one-on-one care packages across Nursing and Residential care homes. However, the care home staff could personalise care based on the needs and fall risks of residents, with reduction in one-on-one care packages for a few residents for whom the Nobi device helped in providing least restrictive care practices. However, the one-on-one care packages could not be reduced for residents with high fall risks and some of those living with conditions such as dementia who have a tendency to wander.

5. Objective 5: The NWAS data showed that the technology is cost saving and improving Quality of Life Years (QALYs), especially when applied to older adults with high fall risks, with the results regarding Call-outs leading to hospital conveyance are statistically significant at the 95% level. In order to assess potential cost savings, the researchers assessed four potential scenarios of ambulance call-outs and hospitalisations following occurrences of falls in Nursing and Residential care homes. The first scenario was ambulance call-outs that did not result in an ambulance dispatch. The second scenario was ambulance calls that required ambulance dispatch but did not lead to hospital conveyance. The third scenario was ambulance call-outs that led to hospital conveyance and hospitalisation but residents didn't undergo extensive rehabilitation for injuries. The fourth scenario was that ambulance call-outs that led to hospital conveyance, hospitalisation and led to extensive rehabilitation of 40% of the residents who were hospitalised. Results showed that across the four scenarios, the intervention alone is likely to generate annual net savings between £308,336 and £5,159,041. If considering only scenarios 2 and 3, which are the most realistic, then the interval would be between £490,237 and £1,487,480. Note that there is higher potential for cost savings per year after 3 years of using the device in care homes as only maintenance costs of the device are required after the initial installation costs are paid upfront. For example, for scenarios 2 &3 at 5 years, the present value of the intervention's savings could range from £2,885,812 to £7,546,005, while at 10 years it could range from £6,229,862 to £14,813,813.

6. Objective 6: Behavioural intention to use the device in the long-term was influenced by the funding available to implement it, cost-effectiveness of the device, and support of the higher authorities, e.g. care company CEOs or charity trustees. Potential improvements to usability by allowing integration of Nobi data with electronic care systems were suggested and technology functionality issues demonstrated the need for upgrading infrastructure (e.g. Wifi systems).

10.3 RECOMMENDATIONS

Table 10.1 lists some of the observations from the evaluation and links them to potential recommendations.

Table 10.1: Observations linked to Recommendations

Observation	Recommendation	Who for?
The Nobi lamps make a significant make a significant contribution to personalised fall prevention programmes for older adults.	To consider the use of such technology within falls prevention programmes in Nursing and Residential care homes and other environments where help is at close hand (e.g. sheltered and Extra Care establishments)	Nursing and Residential Care home owners and managers; Local Authorities and ICBs All Age Continuing Care Teams (AACC)
The Nobi lamps support more than just falls; they can also make a significant contribution to personalised frailty rehabilitation and care for older adults.	To use the broader utilities of the device, such as alerting to a resident being unsettled and moving around at night, in supporting older adults living with frailty	Nursing and Residential Care home owners and managers
The device can lead to cost savings related to ambulance call-outs/transfers because of (i) reduction in falls, reductions in health impacts of long lies. (ii) better understanding of falls that have occurred, using playback facility (iii) fewer escorted conveyances to hospital reduce Nursing and Residential care homes costs	To ensure use of playback in calls to emergency services.	NWAS, Nursing and Residential Care home staff and managers
Qualitative data illustrated how the playback facility can be used to determine how a fall occurred	To employ the device to inform environmental modifications to support informing individualised care planning and preventing falls (e.g. furniture layout)	Care home staff and managers.
The device can allow for the reconfiguration of one-to-one care packages leading to potential cost savings and less invasive care for residents, although this may not be possible for people at very high risk of falls or some dementia residents with complex needs or behavioural symptoms	To consider which residents can be safely moved to less restrictive supervision once Nobi lamps are in place in a resident's room	Nursing and Residential Care home staff and managers. Local Authorities and ICBs All Age Continuing Care Teams (AACC)
Evidence showed that the device can provide support relating to sleep improvement and medication reviews	To ensure future adopters are aware of the potentials provided by the lamps to support medication reviews and sleep improvement.	Nursing and Residential Care home owners or trustees, in collaboration with Nobi.
Evidence showed support for use of Nobi data to help with medication reviews and reviews of amount of observation needed.	Highlight the opportunity to use Nobi insights within statutory care reviews and reassessments, for example	Nursing and Residential Care home managers. Local Authorities and

	following falls, hospital discharge, medication changes or reablement, where objective evidence has historically been difficult to access.	ICBs All Age Continuing Care Teams (AACC)
Qualitative evidence from the deep dive case study in Kendal care home showed that the Nobi device can reduce family anxieties related to potential falls of residents with staff reporting influence on family choice of care home.	To ensure potential benefits are clear to families.	Nursing and Residential Care home owners and managers.
Some care homes reported errors in fall detection by the device which was attributed to fluctuating Wi-Fi networks and internet connection.	Ensure reliable Wifi before installing Nobi.	Nursing and Residential Care home owners and managers, Nobi.
Evaluation showed that staff who were trained on how to use the technology were significantly more likely to be confident in using it to manage fall risks. Data also suggested that ongoing staff training was required so that staff could accurately document incidents of falls.	There should be training for all new care home staff on how to use the technology and there should be open communication among the staff, managers and the Nobi team to address any concerns and questions about the technology.	Nursing and Residential Care home managers, Nobi.
Findings indicate that Nobi technology has the potential to generate cost savings to the NHS by reducing falls and ambulance call outs, especially those that result in transfer to hospital. However, this evidence is limited to our data where only the residents at highest risk for falls had Nobi lamps installed in their rooms. The benefits appear to be more pronounced in nursing homes compared to residential care homes.	Assess the feasibility of financing the technology, particularly in nursing homes where the benefits appear to be greater. Nursing and residential homes should endeavour to explore organisational models in which rooms equipped with Nobi are prioritised for residents with the greatest level of need.	Local Authorities, ICBs All Age Continuing Care Teams (AACC), Nursing and Residential care home owners and managers.
Data showed that staff and managers perceived that demonstrating cost-effectiveness and long-term return on investment was essential to gain funding and support from higher authorities to have the device. They felt this is key for long term adoption of the device in Nursing and Residential homes.	Long-term cost-effectiveness of the device, funding to use it, views of the higher authorities regarding the benefits of the device and infrastructure upgrades should be considered for effectively scaling the device	Local Authorities and ICBs All Age Continuing Care Teams (AACC); Nursing and Residential care home owners .
Strong collaboration between the DiSC team, Nobi and Porters Care was beneficial in identifying emerging risks, patterns and training needs to reduce the risk of delays in the programme	Ensure strong collaboration between key stakeholders in scaling up the programme.	Local Authorities and ICBs All Age Continuing Care Teams (AACC), Nobi.
Reviewing data collectively led to targeted quality improvement actions and support for providers experiencing operational pressures. This ensured that the intended safety	Constant interaction between care homes, Nobi and ICB AACC teams is recommended	Local Authorities, ICBs All Age Continuing Care Teams (AACC), Nobi.

benefits of the technology were consistently realised. More knowledge of the functionality of Nobi led to improved care.		
Nobi Smart lamps have been illustrated as an example of best practice in this evaluation.	Use such technology to support other fall prevention programmes including medication reviews and environmental changes as recommended by NICE guidelines (2025). Use these technologies to support the objectives of the 10-year NHS plan (Government of UK, 2025) which aims to focus more on prevention than treatment of ailments, reduce hospitalisations and support people in the community and move from analogue to digital care.	Local Authorities, ICBs All Age Continuing Care Teams (AACC)
Ongoing involvement of the local authority management had an important role	Make the LA statutory role more explicit, particularly how data and insights from Nobi can support safeguarding assurance, quality monitoring and market oversight (e.g. PAMMS, incident reviews, responding to safeguarding concerns), rather than being seen purely as an operational care tool.	Local Authority
Some staff and manager respondents mentioned self-funding for Nobi lamps	The LA position on self-funding needs to be clear. From an LA perspective the idea of family contributions needs handling very carefully. Any consideration of family contributions towards costs would need to be supported by clear local authority guidance to ensure transparency, equity and consistency, and to avoid unintended impacts on access or safeguarding.	Local authority, Nursing and Residential Care homes.

10.4. RECOMMENDATIONS FOR FUTURE EVALUATIONS

- When evaluations focus on similar fall prevention or other care support technologies, robust, large scale studies with clear controls, as in this evaluation, are needed. While selection of Nursing and Residential care homes and residents to be those with greater need is important, future evaluations of the effect of Nobi technology on falls would benefit from incorporating a comparison with a matched control group. Randomisation of care homes (albeit selected for higher need) to receive the lamps would yield more robust and precise estimates while reducing susceptibility to confounding factors such as seasonality and resident selection bias. Other designs such as stepped wedge designs (where all Nursing and Residential care homes get the intervention at different time points, so none miss out) would be recommended.

- Extension of the analysis of this data over a longer period and more care homes could provide greater power and replicate findings to strengthen the evidence.

- Methodological rigour – the combination of quantitative and qualitative methods enables each kind of analysis to support the other and ensures evidence and further implementation is supported by the voices of the end users. The qualitative work clearly showed the mechanisms, or the “how” of the positive impacts demonstrated by the Nobi and NWAS data.

- However, just one interview for the deep dive case study was minimal and so future research may consider interviews with a greater range of staff.

- Many previous studies have suffered from a lack of control groups or sufficient pre and post intervention evidence. This study demonstrates clear advances in quality of data collection that should be replicated in future evaluations.

- Communication on a regular basis (i.e. in this instance with bi-weekly meetings) with the full programme team (including the technology provider) is essential if a robust evaluation is to be developed.

- Future evaluations would be enhanced by including the voices of all people involved as users or beneficiaries of the technology. Ways of including the experiences and opinions of residents and family members would be beneficial.

What would allow for cost effectiveness to be more rigorously assessed

The analyses set out in this document illustrate a notable success story for Nursing and Residential care homes and residents with higher risk of falls. However, for full cost effectiveness analysis, future research should employ random allocation of the Nobi technology across both Nursing and Residential care homes and individual residents. This approach would mitigate selection bias and provide a clearer assessment of the technology’s overall cost-effectiveness, rather than limiting insights to its performance within higher-risk subgroups of homes or residents.

Where feasible, linking hospital data to care home resident records would enable a more comprehensive assessment of the true costs associated with fall-related emergency department visits and hospitalisations. This, in turn, would support a more accurate estimation of the cost-saving potential of Nobi technology.

Conclusions

As a result of the Nobi programme and the subsequent evaluation there have emerged a set of recommendations that should be considered when addressing care interventions of this nature. The observations these are based on serve to demonstrate the positive outcomes of the Nobi programme in terms of improving the quality of life of the residents taking part. This was a result of the intervention preventing/reducing the number of falls through for example, technological monitoring of resident behaviour (leading to better knowledge of how falls occur) which in turn led to the reduction of long lies – all of which have an impact on ambulance call-outs. In addition, family anxieties related to potential falls of their family members were reduced and, in some instances, one-to-one care packages were reconfigured leading to more resident autonomy and the freeing up of care workers’ time. Also demonstrated is the potential cost effectiveness of the programme, particularly in relation to ambulance call-outs/transfers which have an important financial impact on the NHS. In terms of future research, this evaluation report has identified that more work is needed to understand what the implications of these programmes are for the residents, families, the Nursing and Residential care homes, the care workers and for the NHS both in terms of quality of life and cost effectiveness.

Whilst recognising the difficulties of generalising results of specific programmes we would argue that this methodologically robust evaluation and the Nobi programme itself can and should serve as an example of best practice for future technological fall reduction/prevention initiatives.

10.5 REFERENCES

National Institute for Health and Care Excellence. (2013). *Falls in older people: Assessing risk and prevention*. NICE. Available at: https://www.nice.org.uk/guidance/cg161/.

Government of UK (2025). *10 Year Health Plan for England: fit for the future.* Department of Health and Social Care. https://www.gov.uk/government/publications/10-year-health-plan-for-england-fit-for-the-future

LIST OF APPENDICES

All appendices are available in the online zip file (click on link or scan QR code)

https://www.lancaster.ac.uk/c4ar/nobi-appendix