



Future Care Capital

Report

Care Tech Landscape Review

Home Care

Dr. Peter Bloomfield, February 2021



About FCC

Future Care Capital is a charity which undertakes research to advance ideas that will help shape future health and social care policy and deliver better outcomes for individuals living in the UK.

Beginning life as the National Nursery Examination Board in 1945, the charity has evolved throughout its 70-year history and we continue to have Her Majesty the Queen as our Royal Patron.

About the Author

Dr Peter Bloomfield is Head of Policy and Research at Future Care Capital. He has extensive experience of clinical research, technology research & development and technology start-up acceleration.

This research is © Copyright 2021 Future Care Capital. Company Registration: 2887166. Charity Registration: 1036232.

The start-ups, technologies and products described in this report are to inform our audience, Future Care Capital does not endorse any company or solution and is an independent and neutral organisation.



Contents

Foreword	4
Key Findings	5
Introduction	7
Adult social care	7
Technology	9
The Start-up Economy	9
Technology for Care	10
Home Care Technology	11
Case Studies	13
Discussion	15
Understanding the landscape	15
Recommendations	18
References	19
Appendix 1 – Methodology	22
Appendix 2 – Glossary	23
Appendix 3 – Start-up list	26
Appendix 4 – Literature	27



Foreword

The digital technology market is growing rapidly. Technology, and its future development, continues to be a key contributor to solutions for the home care market. This report, *Care Technology Landscape Review*, explores those start-ups deploying technology solutions in that market and the benefits they bring to those providing and receiving care at home.

It should be useful to innovators, technology developers, carers and policymakers alike – raising awareness of the different technology that is available and the potential for technology to enable better independent living for people in their own homes.

The Covid-19 pandemic has highlighted some of the challenges faced by care workers, recipients of care and their families – albeit more in the residential than the home care sector. Most of us, for example, will know someone who is an unpaid carer – a relative, friend, neighbour. The pressures have never been greater for those caring and for those in need of care. The pandemic is already accelerating the adoption of many forms of technology in home and other care settings.

This report identifies that there are major opportunities to improve adult social care provision through the use of technology. This is both in terms of care givers and recipients. The research also concludes that there is a small niche of home care companies using technology in a truly innovative way, although this is small in comparison to healthcare or other sectors. The conclusion is that targeted support and intervention is required to grow the sector in order to provide a defined ecosystem and an adequate range of companies to meet the needs of individuals. In other words, care is not one size fits all and neither are technology solutions.

The Government has invested in national programmes to boost the health tech sector and must now match that investment to meet the needs of those in receipt of care.

Greg Allen, *Chief Executive*



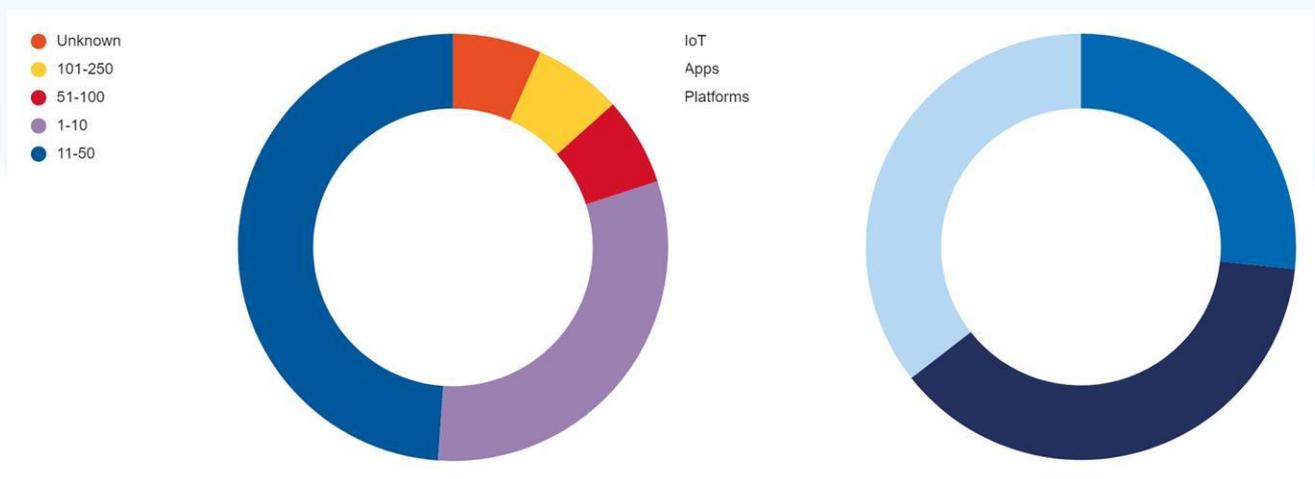
Key Findings

This research explores the tech startups and developers deploying solutions for the home care market. We describe the technologies contributing to the solutions as well as specific implementations. We explore the benefits they bring to those providing support as well as those experiencing care at home. The figures below demonstrate the key findings from this research and should inform a range of audiences looking to make policy decisions, support the adoption of technology in home care settings and enable the growth of the adult social care tech sector.

We were able to identify ~50 technology companies developing solutions for the home care market. Below we describe the technologies, size of company, the regional distribution and the average investment received (where data are available). It is interesting that locations of health innovation research campuses with a focus on longevity did not appear to associate with clusters of companies. This is explored further in the discussion.

Technologies

Our research identified a relatively small population of startup developers and providers of home care technology. Figure 1. shows the distribution of company HQs across England and the type of technology under development. Of the startups we discovered, the main technologies being developed were: IoT (Internet-of-things) based (12), apps for mobiles and tablets (16), or platforms for the coordination of care and care associated functions (15). The IoT startups could also be further subdivided into those making use of AI (2) or testing 5G connectivity (4). Donut charts below demonstrate the breakdown of three main technologies being developed and the number of employees:



Investment

The investment received by these companies is low when compared to other sectors or sector niches, for example healthcare software companies discovered on Crunchbase using the same criteria had received £3.4 M of investment.

Companies developing home care technology solutions: £807,153.71 average investment.

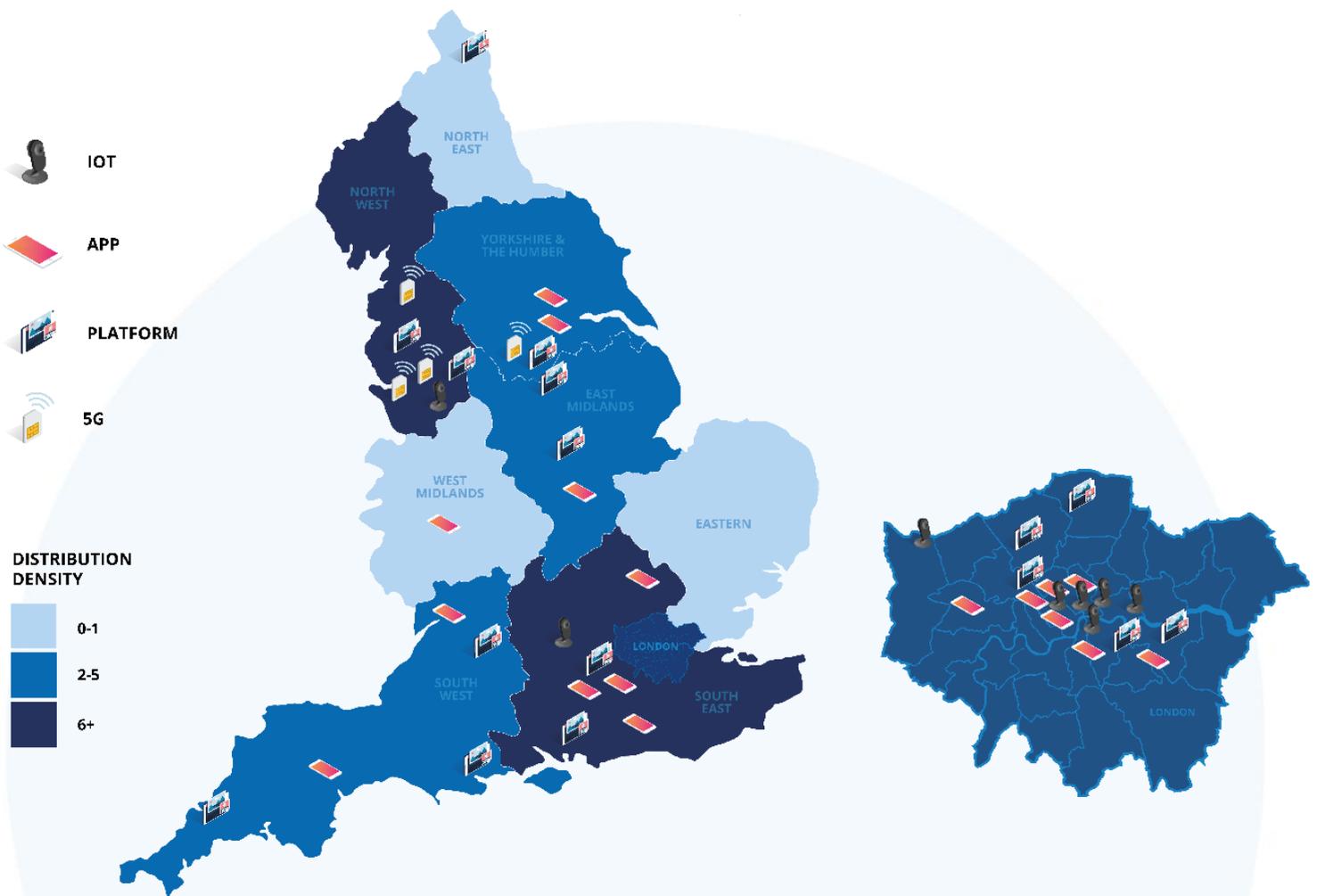


Figure 1. Where are the solution developers based?

This map demonstrates where in England home care solution developers are based and the type of technology being developed. The main technology developed is indicated by icons and the regional distribution is indicated on the left of the figure.

There is some overlap between the technical domains represented here, for example IoT focused startups will typically also have an app or platform associated as part of their product or service offering and, over time, a large proportion of these companies will likely develop AI capabilities to make better use of data streams. In this research, the companies were labelled according to the dominant technology described on their website.



Introduction

This research has been conducted and is being published in a complex social and political context. The COVID-19 pandemic has shone a light on the care sector in the UK and highlighted some of the difficulties faced by care workers, recipients of care and their families, albeit more in the residential than the home care sector. With the UK exiting the EU, many sectors and businesses are experiencing a significant amount of adjustment and the care workforce is particularly affected by alterations to freedom of movement (113,000 care workers are from the EU). The current points-based entry rules exclude care workers [1]. The autumn spending review of 2020, which largely focused on COVID-19 relief, set out an extra £300M of funding split between adult and child social care. This is in addition to the previously allocated annual £1B of funding per year as announced in 2019 [2]. The Improved Better Care Fund (IBCF) also provides access to £2.1B of funding for local authorities to better integrate health and care provision during 2021/22 [2].

Adult social care

The adult social care sector can be difficult to define, with substantial overlap in the different types of care an individual may be in receipt of. Figure 2. below provides an overview of the adult care sector and the different subcategories of care provided in each. COVID-19 has clearly demonstrated gaps in the availability of data about social care and clarity about the number of people in receipt of different types of care, whether as part of publicly or privately funded care services. Here, adult social care was defined as long-term support empowering adults to manage either physical or learning disabilities, or physical or mental illnesses. This includes residential care, disability care, mental health care and home care. The latter area of home care is where we focus on specific technologies.

In our definition of home care, we do not include healthcare, clinical care, palliative or end of life care. We have also excluded tech solutions explicitly designed for to support or facilitate dementia care. Elements of each of these overlap with the sub-sector of the care market explored here. For example, the home care technologies we discuss in more detail, as well as improving quality of care provided, may prove to be transformative for earlier detection of diseases and improved treatment pathways. However, we have opted to focus on a specific and narrow sector, which would be applicable to all those receiving care at home. This decision was made as there are defined programmes for condition specific technology development, whereas home care as a focus area is not as well served. As an example, Care City's testbed innovation clusters for Dementia technology, cardiac rehabilitation and prescribing solutions are good challenge led clusters. Technology solutions in the home offer great opportunity for individuals to be empowered with improve care. The care work force also stands to benefit from many of the technologies and uses discussed here.



Figure 2. What is Adult Social Care?

Table 1 below provides the estimated sizes of the four groups of adult social care described in figure 1 alongside the estimates for the size of associated workforce.

	Population ('000)	Workforce size ('000)	Sources
Mental health	1400	112	[3]
Residential care	293	680	[4,5]
Learning Disability care	951	665	[6,7]
Home Care	>500	715	[8]

Table 1. Adult Social Care in England



For home care, the total size of population covered is very difficult to calculate precisely. The sizes in Table 1 are not simple to interpret because the number of people in the care workforce and the number of people in receipt of care is constantly changing. With an ageing population, and a potential increase in the need for long-term disability care following COVID-19, including for those living with “long COVID”, many of these statistics have the potential to grow considerably. Recent estimates have suggested that the number of individuals needing round the clock care will double by 2035 [9].

UK life expectancy is at its highest point since records began, with average expectancy from birth now being 79.4 years for males and 83.1 years for females [10], although these figures precede the COVID-19 pandemic and demonstrate smaller improvements over previous years. This increased longevity poses both opportunities and challenges. Individuals need to be empowered to live healthier lives for longer, in an independent fashion. Increased spending power and the emergence of a “silver economy” [11] means that lifestyle-based well-being or care solutions may be able to improve the quality of care provided at home. There have however been growing rates of poverty amongst pensioners in recent years [12]. While there is a large amount of local government funded home care, it is thought that >20% of people are funding their own home care directly. It is estimated that ~650 000 people are in receipt of home care in the UK [8]. However, as previously discussed, estimating the size of the home care market is difficult due to a lack of data, recent reports have also demonstrated increases in requests for support amongst adults over 65 years of age [13].

Technology

The global digital technology market is growing rapidly. In the UK, there are thousands of new technology companies each year and sector growth appears to be greater than European counterparts. Investment in technology in the UK has also grown in recent years, whereas in other countries, including the US and China, investment has shrunk [14]. Through 2021 and beyond, the COVID-19 pandemic is liable to accelerate the adoption of many different forms of technology, in a range of sectors, not just health and social care. The term technology can mean several different things, however here we are taking a broad view, with the technologies being digital with data associated functions. The next section of the report examines these technologies and how they are deployed functionally. Investment in digital technology grew throughout 2020 and is one of the more resilient markets when considering COVID-19 or geopolitical developments such as Brexit [15]. In the technology section of this report, we discuss some of the current and emerging technologies which are contributing to this growth. The new technologies which are entering virtually all sectors promise to provide improved efficiencies and productivity gains as well as higher quality, simpler options for businesses and consumers.

The Start-up Economy

The tech sector and startups have received large amounts of public and private investment over the last decade through a range of initiatives. These initiatives include “Silicon Roundabout” in East London, Tech Nation, the Catapult Network and several programmes to facilitate the transfer of technical developments from academia to industry. Recent analysis related to government plans to



achieve spending on research and development equivalent to 2.4% of GDP has estimated that for every £1 of innovation funding committed by government, there is a £7 return on investment [16]. Startups drive sector growth; the global startup economy is worth \$3 Trillion and this has grown greatly in recent years [17]. Small to medium sized enterprises (SMEs, up to 250 employees) make up 99.9% of all businesses in the UK [18] and are key to supply chains and service delivery. In many instances government funded programmes have been linked to private initiatives and industry funding to grow sectors - with significant investment being leveraged to support startups [19]. However, concerns have been raised about the sustainability of such approaches [20]. COVID-19 has also changed the working environment considerably, at least in the short term, making co-working spaces and communal work environments which have supported their incubation unsafe. It is unclear at this stage how this environment may change, particularly for startups which in any other times have huge levels of uncertainty; for example, up to 60% of startups fail within 3 years [21].

Technology for Care

There have been various Central and Local Government initiatives which invest in care technology and run specific interventions or support for the development of new solutions.

These include:

- Care City in London, an innovation centre for healthy aging and regeneration, supporting solution development for specific challenge areas
- The Local Government Association's Social Care Digital Innovation Programme, a three-year collaboration between councils and NHS Digital to provide grant funding for digital innovation in social care
- NHS England's Technology Enabled Care Services programme, which is designed to inform commissioners on telehealth, telecare, telemedicine, telecoaching and self-care apps
- The Academic Health Sciences Network (AHSN) supports social care technology and has specifically investigated applications in care homes

Home care is a growing sector, which stands to benefit from technology development. Startups develop leading-edge solutions and are key to the growth of a sector. Here, we look at the innovative companies developing products and solutions tailored to home care, which can be adopted by councils, care providers, and individuals. We discuss opportunities for the use of digital technologies which could benefit those experiencing care at home and the home care workforce.



Home Care Technology

Here we focus on home care technology, enabling better quality independent living for people in their own homes, while accessing long term care. The technologies in this report and their uses can be transferred to adjacent care settings. Indeed, a large proportion of the startups in Appendix 3. are also developing products for the wider care sector.

In this review, we examine a range of digital technologies which can be used in isolation, or in combination with others. Figure 3 below demonstrates the layering of technologies enabling solution provision. The technology “stack” builds up, from the governance and security measures required to enable a safe and effective deployment of technology. This includes decisions about technology vendors, validity and robustness of approaches and the audit and accountability of decision making. These considerations are largely, but not exclusively, for care providers as well as those involved in technology development. Building on this foundation, the connectivity and storage layer provides the requisite infrastructure for the solutions we explore here. Increasingly we are seeing computation being integrated to this cloud infrastructure and some of the boundaries between layers are less distinct than before. The top layer is where sector specific solutions are typically developed, with interactive products for users and analytical and informative technologies helping provide better care.

Analytic capabilities should inform human decision makers and we believe the care sector is a context where human accountability and decision making should be prioritised. Interactive technology relies heavily on the Internet of Things (IoT), tablets, touch screens, virtual, augmented, and mixed realities. These points of interaction are where the users of technology can observe real-time information and alter some parameters. The interactions with the technology provide information, this can be a continual stream of data or data linked to an event. This data can be used for analysis and the development of data models to represent a care context. This then enables carers to provide better services based on personalised insights, highlight anomalies and flag risks early. These insights can be securely accessed through apps or platform dashboards. The “layers” of technology we discuss in this report bring together the environment, people using care services, and carers. There is a flow of data between the layers and as time progresses there will likely be reorganisation of these layers and functions. The introduction of new tech such as 5G and other enabling infrastructure will bring enable many new possibilities. For example, supporting many more devices simultaneously than is currently possible. This would provide a more efficient, higher quality package of care in the home, or other care context. For a full description of the technologies contributing to the “stack” in Figure 3, see Appendix 2.



Figure 3. Technology and functions applicable to adult social care. The technology “stack” here brings together service users, care workers, technology developers and the care providers. There is static and mobile infrastructure to enable the range of interactions, services, and data flows.



Case Studies

We were able to identify three main technologies being developed by the start-ups we discovered and segmented the companies into four main functional use cases. Solution developers were predominantly working with IoT devices, mobile apps, and platform-based products. Here, we discuss how the technologies can be deployed, with specific reference to care providers, care workers and recipients of care. Figure 4 below, which should be interpreted with use case boxes 1-4, demonstrates some of the technologies which can be deployed for user benefit in a home care setting and the functions they enable:

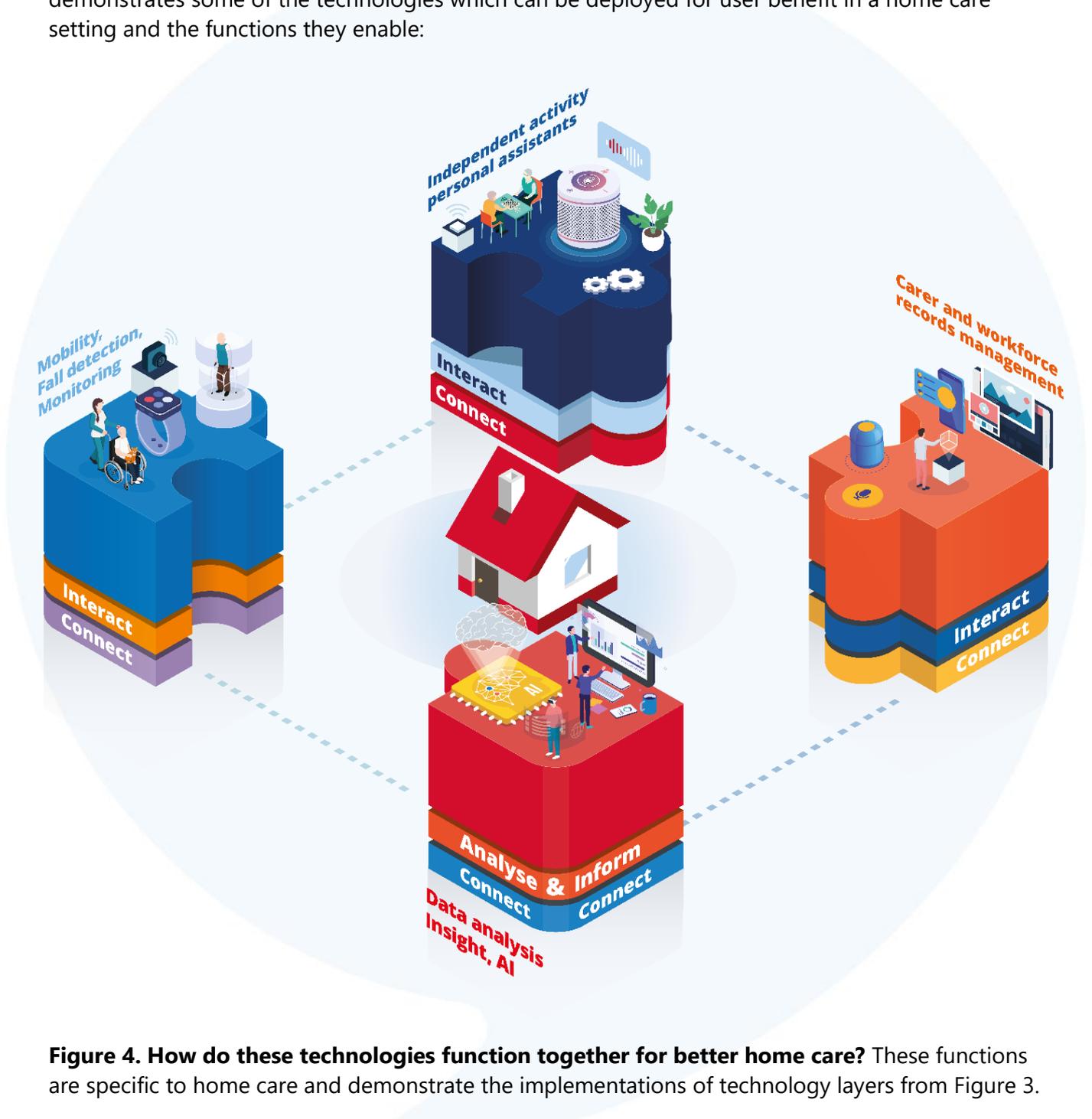


Figure 4. How do these technologies function together for better home care? These functions are specific to home care and demonstrate the implementations of technology layers from Figure 3.

The use case boxes overleaf, relate to the functions and scenarios in Figure 4 and describe the main areas where technology can augment the delivery of care in the home. Alongside the function we have described how the types of technology enable better care provision:



Box 1: Monitoring and well-being – For care provision at home, the ability to monitor and track well-being over time is essential. This can be difficult to provide in rural settings where people are very spread out but large numbers of people in urban settings equally can be hard to monitor regularly. There are a range of personal assistants and devices that can help with this and it is important that the technologies are introduced in the right way to prevent concerns about surveillance and independence. These solutions heavily rely on locally networked IoT sensors and devices. They also require connectivity for downstream data analysis, for which AI and ML approaches may be taken.

Box 2: Carers and records – Care workers are instrumental to managing care at home and the care workforce stands to benefit from a range of technologies and different approaches. Communication is a key part of a carers need, both with recipients of care and their family, as well as with the overall care or service provider. Given the nature of this communication, secure messaging and encryption are of great importance. Beyond communication, carers need to keep standardised, clear reports relating to the care provided and the well-being of those they work with. Digital platforms for record keeping can reduce the amount of time spent on paperwork, be filed more easily, and help track conditions more effectively to improve the overall quality of care provision. The products in this area are largely based on apps and platforms, however over time some of the devices covered in Box 1 would have integrated data streams to provide better monitoring and analysis.

Box 3: Analytics and insights – As highlighted in Box 2, there are multiple benefits from data associated technology within care. This can improve care provision from a service provider, however analytical platforms and personal devices can also be used to empower individuals to manage and understand their own care. As more devices, records and activities become digitally enabled, larger quantities of high-quality data can be collected and analysed for better care provision. This can identify changes in routine, track well-being and escalate concerns for a better overall understanding of a context of care. Our research has identified a range of approaches, including end to end systems of IoT devices with associated platforms, to devices like an Alexa or Google home which sit as a main hub and use AI techniques to analyse data.

Box 4: Independence – Living with independence can mean different things across the spectrum of adult social care. In home care, being able to manage personal care and integrate different services with a lifestyle or specific needs is important. This could be a way of monitoring medication and automatically ordering repeat prescriptions, managing a care schedule to fit with working from home, or receiving home deliveries. This again overlaps with the functions in Boxes 1-3 and predominantly is enabled by IoT, analytics, and connectivity technology. 5G testbed technology has been used to explore these types of solutions and automatic communication with care workers would also help with efficiency and providing insights for better care.

In the examples above and for home care generally, connectivity and infrastructure are largely provided by an individual. As we discussed earlier in the report, where an environment is owned and operated by a care provider, the choice of this infrastructure will be important for the choices of solution for the carers and recipients of care.



Discussion

The present review is an initial exploration to determine whether we can identify or define an ecosystem related to home care technology. This is a first step, and we will take an iterative approach updating and expanding the research over time. Here we have explored the technologies which are being developed and deployed for the benefit of those receiving care at home. At times, the delineation between health and care is hard to make. Similarly, it can be difficult to define the dominant form of technology deployed by a company. For example, when AI and IoT are implemented together. There are instances where companies developing smart home technologies have mentioned potential applications of their products in a home care setting, however they are not specifically developing solutions tailored to the care sector with recipients of care as the focus. Segmentation was conducted in a more conservative fashion, with generalised solutions being excluded and home care specific solutions being included. The methodology used to identify companies is presented in Appendix 1.

We have discussed a range of technologies which can be deployed for a variety of uses in the home care context. Potential improvements in quality of care, through better communication with care providers, safety monitoring for independence, and efficiency gains with specialised management platforms could all be transformative. It will be interesting to see how some of the newer forms of technology we have described, for example VR, are used by recipients of care and the care workforce over time. In our research we did not find specific examples of technology designed for home care using VR, AR, or MR (For more detail see Appendix 3).

Understanding the landscape

Clusters of activity related to a specific form of technology or industry can rapidly drive forward innovation and adoption. Innovation hubs and networks across the country help to build and grow these activities. An ecosystem for a sector is complex and, like a biological ecosystem, is made up of multiple entities, which interact in different ways. To thrive, the ecosystem relies on the success of individual niches. In the example of technology, the innovators, adopters, funders, policymakers, legislators, researchers, and many others, all interacting to enable growth together. From our research we can see where companies are developing products through initiatives with specific technologies in mind, a good example being the companies exploring the use of 5G with the Liverpool 5G Testbed. This is a programme where a combination of organisations are driving forward the technology being developed, as well as the care being provided. A difficulty in conducting this review was searching for small technology focused companies was finding appropriate search terms and labels to identify them. More than half of the companies were discovered outside of company databases, which may also reflect the approach of these companies to marketing, discoverability and either their age or maturity. There are further issues of fragmentation, where small businesses are dealing with different parts of an equally dispersed health and social care sector. Sales cycles can be long and access to the market is very difficult. In healthcare, the NHS App store has provided a marketplace for deployment for health app developers. However, this is potentially limited when considering the diverse nature of products provided in home care. Alongside consumer apps, there are hardware installations and management platforms which will likely need a more tailored approach than many current procurement systems offer. From this initial research it is difficult to define an ecosystem for home care technology. Further work will be useful to map out the interacting organisations and initiatives to better



understand what is required for the growth and development of a more visible ecosystem. We believe a care technology ecosystem should be easiest to find, with a burgeoning sector for an aging population. This could also make it easier for other developers to enter the market from other sectors to repurpose solutions with care appropriate adaptations.

The digital nature of the technology explored here means that companies are not limited to a specific location for their operation or sales, which makes ways of working far more flexible. We are looking at devices and technologies designed to be deployed in people's homes. In many instances these are to better integrate daily life with home care provision. It is interesting to consider the business models and approaches to deployment by the companies, as many of these startups provide their products directly to the consumer or their family.

Digital technology has "disrupted" a range of sectors and the innovation in business model approach is equally at the heart of this as the technology a company develops is. When considering Uber, Netflix or Amazon, the market has been as much changed by the sales approach and methods of interacting with customers as it has with connectivity and algorithmic technology to improve services. Improved customer experience and being able to either track packages ordered online or visualise every step of getting a taxi from A to B, have proven very popular. Improving control and visibility over services can improve the quality of life for all, although we must remember not all have access to technology to feel its benefits. The adult social care sector enables better lives for hundreds of thousands of people in the UK - the quality of care and the well-being of care service users should be of paramount importance for technology developers. We selected start-ups based on whether they were home care specific rather than having products which could be deployed in the care sector and we have not taken a view, here, of the quality of care they deliver or the extent to which they might be said to improve well-being. When considering companies from a sector, application, or use case perspective, it may be helpful to also consider the digital maturity of the sector and its primary users. The technology niches related to AI, IoT and other digital technologies require advanced levels of digital skills and capabilities, as well as well having connectivity and digital infrastructure to enable them. Technology as a sector is expanding rapidly and diffusing into other sectors. In 2020, it was estimated that 1 in 10 jobs in the UK were in the tech industry [22]. As well as new tech associated jobs emerging in the care sector, there will be a degree of digitalization needed in the jobs currently being done. As we see in this review, several services are being developed for carers and the care workforce, but these require people to adapt approaches slightly.

The sector niche presented here, while diverse in forms of technology, is small when compared to other sectors and markets. As a guiding comparison, when searching Crunchbase for startups developing "health care, software" over 600 companies are returned, the pool elucidated here is less than 10% of this. When considering the amount of investment in companies we see £800K on average reported for the home care companies, whereas healthcare software companies average £3.4M. There may be many reasons for such differences, including maturity of sector, costs to overcome to enter the sector, and national adoption opportunities. The funding landscape for social care technology appears to be fragmented, without specific national initiatives supporting entrepreneurs in the way the AHSNs do for health innovation. We did see several care technology companies in locations with AHSNs, however the numbers seem relatively low when compared to healthcare or medtech companies, and we did not specifically determine how many companies here were part of AHSN programmes. It would be useful to further explore this to better understand opportunities for sector growth. Similarly, the digital technology ecosystem in London, measured in



2020, is made up of a vast number of companies. For example, ~550 IoT startups to ~770 AI startups [23], although it seems that few of these cater specifically to home care. As seen in the introduction the tech sector has received vast sums of public and private investment to develop and grow and a range of stakeholders in the tech ecosystem have worked over many years to develop it in this way. The NHSX Tech Plan for Health and Care sets out the vision and progression of tech deployment in health and social care [24]. The infrastructure provisions are an important part of a developing ecosystem. Network connectivity enables the solutions and systems described here and, in many cases, broadband and 4G are sufficient. But, as more technology is developed and integrated in the home for care purposes, the extra bandwidth provided by 5G will be a useful addition, as highlighted in the NHS long-term plan. Successful innovation pilots are difficult to scale to wider adoption and involvement of sector specific stakeholders is crucial for developing effective solutions which customers are interested in adopting. Amongst these stakeholders, care workers and recipients of care are essential to include to ensure high quality, fit for purpose technology is being developed and can be trusted for adoption [25]. Indeed, TechUK recently published a ten-point plan for health and social care technology highlighting these principles for development and adoption [26].

Care is not one size fits all. There are many personal choices, and we should be able to select the right care solution in the way we would any other product which is a part of our daily lives. Much of the research into longevity and aging is associated with management of specific conditions and curing diseases. We have seen some excellent examples of technology which can improve lives without a specific disease or condition focus. Independence, safety, and better management of daily activity can provide improved quality of care and care experiences. The tech industry has a history of setting challenges and solving them, whether in Kaggle data competitions or competitive funded challenges for start-ups. There are challenges and a clear need for viable solutions for adult social care, which need a clear commitment to accelerate growth and progress. The CQC recently discussed the power of innovation for health and social care, concluding that full advantage was not currently being taken [27]. The companies we have found have appeared to cluster in locations where there are health and care technology initiatives (such as the 5G testbed and the South London Health Innovation Network). However, where there are large research centres for longevity research, notably Newcastle and Birmingham, we struggled to identify home care tech companies. This may be because start-ups developing in association with these initiatives are more disease or condition specific or may be tailored to other care settings.

There is a once in a generation opportunity for the deployment of digital technologies to empower and improve the care sector. This would improve quality and provide personally tailored services, which crucially those in the receipt of care, and the care workforce, would want to engage with. However, coordinated national initiatives and sustained efforts are required to achieve this. There is certainly a need for a coordinated longer-term plan for sector development and growth, the recent “integration and innovation” paper from the Department of Health and Social Care sets out the plan for better integration of health and social care systems [28], with the use of technology being linked to people living healthier lives for longer.



Recommendations

- 1** More research is needed to better understand how to enable the development of a wider care technology ecosystem and explore the challenges in care which need to be addressed in order of priority. Once this is in place, a more coordinated, targeted intervention can be implemented to adequately and grow the sector.
- 2** To date, a range of healthcare technology initiatives and programmes have enabled a large sector of solution providers to develop. We have seen that there is a small, promising pool of home care technologies. However, a distinct programme or initiative should be developed. With the right stakeholder engagement, this would adequately grow the sector and encourage the emergence of a greater number of new solutions providing higher quality care. This initiative should retain a clear connection to recipients of care and care workers.
- 3** The research presented here is narrow in focus and covers a single branch of a much larger adult social care sector. A similar exploration of residential care, disability care and mental health technology should be conducted to further inform the sorts of initiatives described in recommendations one and two.



References and Appendices



References

1. **Skills for Care 2020, Adult Social Care Workforce, viewed 15 February 2021,** <<https://www.skillsforcare.org.uk/adult-social-care-workforce-data/Workforce-intelligence/publications/Topics/Workforce-nationality.aspx>>
2. **Commons Library 2020, Adult Social Care Funding (England), viewed 15 February 2021,** <<https://researchbriefings.files.parliament.uk/documents/CBP-7903/CBP-7903.pdf>>
3. **British Medical Association 2019, Measuring progress: Commitments to support and expand the mental health workforce in England, viewed 15 February 2021,** <<https://www.bma.org.uk/media/2405/bma-measuring-progress-of-commitments-for-mental-health-workforce-jan-2020.pdf>>
4. **Office for National Statistics 2020, Impact of coronavirus in care homes in England, viewed 15 February 2021,** <<https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/articles/impactofcoronavirusincarehomesinenglandvivaldi/26mayto19june2020>>
5. **Skills for Care 2020, Adult Social Care Workforce, viewed 15 February 2021,** <<https://www.skillsforcare.org.uk/adult-social-care-workforce-data/Workforce-intelligence/publications/national-information/The-size-and-structure-of-the-adult-social-care-sector-and-workforce-in-England.aspx>>
6. **Mencap 2019, Learning Disability Explained, viewed 15 February 2021,** <<https://www.mencap.org.uk/learning-disability-explained/research-and-statistics/how-common-learning-disability>>
7. **Skills for Care 2019, The adult social care workforce supporting people with learning disabilities and/or autism, viewed 15 February 2021,** <<https://www.skillsforcare.org.uk/adult-social-care-workforce-data/Workforce-intelligence/documents/ASC-learning-disabilities-and-autism-workforce-report-2019.pdf>>
8. **UKHCA 2019, An overview of the UK homecare market viewed 15 February 2021,** <[https://www.ukhca.co.uk/memberdocs/getDownloads.aspx?id=FJzoKCPrOMBr3amxUAXvDvDFqjN20Vhld7CplWKOez9jsTmNfBsk5rAoRCRyFRfHD+ZJypC4x4OdwCwpMlxPXQ==&f=UKHCA market overview 2019.pdf](https://www.ukhca.co.uk/memberdocs/getDownloads.aspx?id=FJzoKCPrOMBr3amxUAXvDvDFqjN20Vhld7CplWKOez9jsTmNfBsk5rAoRCRyFRfHD+ZJypC4x4OdwCwpMlxPXQ==&f=UKHCA%20market%20overview%202019.pdf)>
9. **Kingston, Andrew et al. (2018) Forecasting the care needs of the older population in England over the next 20 years: estimates from the Population Ageing and Care Simulation (PACSim) modelling study. *The Lancet Public Health*, 3: 9, e447 - e455**
10. **Office for National Statistics 2020, National life tables, viewed 15 February 2021,** <<https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/lifeexpectancies/bulletins/nationallifetablesunitedkingdom/2017to2019>>
11. **European Commission 2018, Silver Economy Study, viewed 15 February 2021,** <<https://ec.europa.eu/digital-single-market/en/news/silver-economy-study-how-stimulate-economy-hundreds-millions-euros-year>>
12. **Pensions Age 2020, Pensioner poverty on the rise again, viewed 15 February 2021,** <<https://www.pensionsage.com/pa/Pensioner-poverty-on-the-rise-again.php>>
13. **The King's Fund 2020, Social care 360: access, viewed 15 February 2021,** <<https://www.kingsfund.org.uk/publications/social-care-360/access>>
14. **Tech Nation 2020, 2019: a record year, viewed 15 February 2021,** <<https://technation.io/news/2019-a-record-year-for-uk-tech/>>
15. **PWC 2020, The tech sector in 2020, viewed 15 February 2021,** <<https://www.pwc.co.uk/industries/technology/insights/tech-sector-in-2020.html>>
16. **Science& Technology Select Committee 2020, Balance and effectiveness of research and innovation spending, viewed 15 February 2021,** <<https://publications.parliament.uk/pa/cm201719/cmselect/cmsctech/1453/145305.htm>>



17. **Startup Genome 2020, The Global Startup Ecosystem Report 2020**, viewed 15 February 2021, <<https://startupgenome.com/reports/gser2020>>
18. **FSB 2019, UK Small Business Statistics 2019**, viewed 15 February 2021, <<https://www.fsb.org.uk/uk-small-business-statistics.html>>
19. **Seedcamp 2018, How to build a tech ecosystem: The essential building blocks revisited by Carlos Espinal**, viewed 15 February 2021, <<https://seedcamp.com/resources/how-to-build-a-tech-ecosystem-the-essential-building-blocks-revisited-by-carlos-espinal/>>
20. **Wired 2020, How London's Silicon Roundabout dream turned into a nightmare**, viewed 15 February 2021, <<https://www.wired.co.uk/article/silicon-roundabout-tech-city-property>>
21. **Limelight Digital 2020, The Ultimate List of UK Startup & Small Business Statistics for 2020**, viewed 15 February 2021, <<http://www.limelightdigital.co.uk/ultimate-list-uk-startup-small-business-statistics/>>
22. **CityAM 2020, Tech jobs are an engine at the heart of our 21st century economy**, viewed 15 February 2021, <<https://www.cityam.com/tech-jobs-are-an-engine-at-the-heart-of-our-21st-century-economy/>>
23. **Digital Catapult 2020, London: A Global Leader in Advanced Digital Technologies**, viewed 15 February 2021, <<https://assets.ctfassets.net/nubxhjw091/4IYW6V55YOXHSxBf4WD5B/8b465922b1d0af57c1e878926a8c179d/DC-London-Advanced-Digital-Tech-Report-2020-1.pdf>>
24. **NHSX 2020, NHSX Tech Plan Vision**, viewed 15 February 2021, <<https://jointheconversation.scwcu.nhs.uk/tech-plan>>
25. **CDEI 2020, AI Barometer**, viewed 15 February 2021, <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/894170/CDEI_AI_Barometer.pdf>
26. **TechUK 2021, Ten Point Plan for Healthtech**, viewed 15 February 2021, <<https://www.techuk.org/resource/techuk-publishes-ten-point-plan-for-healthtech.html>>
27. **Care Quality Commission 2021, Enabling innovation and adoption in health and social care: Developing a shared view**, viewed 15 February 2021, <<https://www.cqc.org.uk/publications/themed-work/enabling-innovation-adoption-health-social-care-developing-shared-view>>
28. **Department for Health and Social Care 2021, Integration and Innovation: working together to improve health and social care for all**, viewed 15 February 2021, <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/960549/integration-and-innovation-working-together-to-improve-health-and-social-care-for-all-print-version.pdf>
29. **Pang & Kim (2019) The effectiveness of virtual reality for people with mild cognitive impairment or dementia: a meta-analysis**, *BMC Psychiatry* 19, 219.
30. **NS Healthcare 2019, The Forest of Serenity: A VR app helping terminally ill patients discover drug-free pain relief**, viewed 15 February 2021, <<https://www.ns-healthcare.com/analysis/virtual-reality-palliative-care/>>
31. **Healthcare Newsdesk 2020, VR training for care workers dramatically improves infection control**, viewed 15 February 2021, <<https://healthcare-newsdesk.co.uk/vr-training-for-care-workers-dramatically-improves-infection-control/>>
32. **Digital Catapult 2020, Digital Futures research phase: Intelligent Digital Fabric**, viewed 15 February 2021, <<https://assets.ctfassets.net/nubxhjw091/2PUu9U99HsNo2g9gStpQYA/8ecdefc165c7799ad41c827db5bcd069/DF-report-v3.pdf>>



Appendix 1 - Methodology

In the course of undertaking our Landscape Review, we conducted a variety of searches to inform a narrative which otherwise draws on published reports and company databases to ensure we captured as many types of home care technology and companies developing them as possible.

Companies were discovered through Crunchbase, a platform which helps provide insights for market research and intelligence about public and private companies. Crunchbase information includes investments and funding information, founding members and individuals in leadership positions, mergers and acquisitions, news, and industry trends. There are >79,000 companies based in the UK across 1055 industry labels, with 47 industry groups.

Several steps were taken to collect and clean the data: 116 companies were initially discovered, which was then reduced to 110 after deduplication. Manual cleaning and matching against the criteria set (see methods) further reduced the cohort to 28. Through online searches and comparisons with the literature and acceleration programmes, this was increased to 43 companies in total (15 added), with a further 6 companies determined to have products or approaches, which with adaptation could be included in this ecosystem.

An aggregate list of companies was de-duplicated and cleaned to ensure that company information demonstrated the following:

1. Developing a form of digital technology
2. Registered in England
3. Deploying products or services specifically designed to be deployed in the home care market
4. A startup or company smaller than 250 employees

Data were then quality assured through a series of comparisons with the literature, online searches, and cross referencing with a range of startup acceleration programmes as well as those featured in sources listed at Appendix 2.

To ensure we identified the widest possible range of pertinent companies, we constructed individual searches using the following terms: Social Care, domiciliary care, elderly care, independent living, and home care. The UK was used for the initial location and only active companies with up to 250 employees were included. The combined pool of companies was then deduplicated and manually quality assured against the four criteria above.



Appendix 2 - Glossary

Connectivity and Storage

Fundamental to the deployment of the technologies described here is the underlying infrastructure which enables connectivity, communication, and storage. This is crucial for device operation and interactions between recipients of care and care providers, but also is of great importance for the collection, storage and processing of data, which we will explore in a later section. In the home, WiFi and mobile connectivity are some of the most familiar forms of connectivity. Through this connectivity recipients of care can interact with loved ones, care workers and healthcare professionals, as well as manage deliveries and a range of in-home services.

Cloud computing

The development of cloud computing infrastructure has drastically changed how we use computers and devices and has also changed the physical appearance of such devices. Where an internet connection (including WiFi, mobile data or any of the other forms of connectivity described here) provides access to the cloud, we can store, access and make use of data and online services from any connected location. Reducing the need to store large amounts of data locally or connect to a wired access point, devices and computers have become smaller, lighter and easier to work with and more mobile. This has also enabled the development of new types of technology companies and devices. Streaming of data and real time access or insight has great potential to transform the quality-of-care provision. The use cases explored later demonstrate some of these benefits. At times, data still need to be analysed or processed instantly in the environment they are captured from, without a continuous network connection. This is particularly important to consider when latency, or delays in communication would be life-critical, for example in autonomous vehicles or emergency healthcare scenarios. In a home care scenario, lifestyle sensors or safety alarms need to communicate in real time in a home. Whilst they do not need to be connected to the cloud or wider care system to function properly, uploading data at regular intervals can better inform analytical models making care more efficient and tailored for the benefit of individuals.

Mobile data

Technology for the care workforce is often developed to be used on mobile devices making use of current 4G networks and future 5G networks. At present 5G is mostly enabling connectivity in testbed environments but is being rolled out more broadly over the next five years. 5G offers lower latency and greater bandwidth than 4G and will sit alongside the forms of wireless connectivity discussed here as well as others. This reduced latency and greater bandwidth will allow for real-time connectivity with no delays and will support more devices than is currently possible. This could expand previous deployment pilots to enable support for tens and, even, hundreds of devices in a home to achieve a true Internet-of-Things (IoT) based smart or intelligent environment.

Interactive technology

In recent years, a range of different user centric interactive technologies have been introduced to the home care sector. These can be objects placed in the home, devices which are worn, control panels or displays. The purpose of these interactive technologies is to provide an interface between the physical world a person is active in, and the full range of technologies or services which can improve care and personal well-being. There are several categories of interactive technology to consider in the future of home care, including those detailed below.



Internet of Things (IoT)

The IoT is a concept which underpins a “smart” and connected environment. This can be in the home, or part of a range of different public and private spaces. This category of technology relies heavily on the connectivity and storage described above and is typically embedded in the infrastructure of a given setting, be that walls, furniture, or street level architecture. IoT is made up of networked objects and devices which can provide information from a location in the form of a live data stream, these devices are IoT sensors. IoT objects, known as actuators, in an environment can also be used to make changes to an environment, for example if a temperature sensor detects a drop in temperature, the actuator would increase the temperature. These devices can be very useful in home care for monitoring the environmental conditions and safety. IoT objects can be designed to be innocuous in an environment and sense a range of different stimuli including but not limited to sound, light, humidity, and movement. Depending on the connectivity available IoT cameras, speakers and interactive devices or assistants can be deployed. The richer the data, the better connectivity will be needed. For example, a string of numbers is easy to manage, whereas high resolution video would need a considerable amount of infrastructure. IoT technologies do not typically have computational power built into the device or object, so the analysis of data would generally occur on a separate computing device or remotely in the cloud, we discuss this more in the analysis and informed decision-making section.

Personal devices

Alongside the devices and objects making up IoT technology, there are numerous applications and platforms being developed to run on personal computers, tablets, and mobile phones. The more analytical forms will be discussed later from the perspective of care provision and coordination, however here we will focus on more personal, care recipient focused deployments. These devices can be used to interact with care providers, or family members as well as managing home delivery services, entertainment, lifestyle products and enabling different ways for people to work remotely. Several startups are also developing personal dashboards which allow users to monitor their environment, in conjunction with IoT objects.

Artificial realities

These applications of virtual, augmented, and mixed realities (VR, AR, MR respectively) are in their early stages and, to date, are being used overwhelmingly for gaming or entertainment purposes. VR makes use of headsets to provide an immersive, fully virtual environment. AR often uses a phone, tablet or glasses to overlay and display virtual interactive content on the real environment. Finally, MR is an early-stage concept to create environments where interaction in either virtual space or reality changes something in both spaces. These can be combined with multisensory stimulation or haptic feedback. In this research we did not find start-ups developing different technical realities for home care applications. However, in other parts of the care sector, notably in care homes, several early-stage start-ups are developing experiences and applications to improve care through different artificial realities. Some noteworthy applications in development are, entertainment and reliving historic experiences for patients with dementia [29] or pain reduction in palliative care [30]. Beyond these applications, the technology has also been used to improve training for care workers for infection control. In time further applications will develop for a home care setting [31].

Analysis and informed decision-making

The objects, devices, interfaces and forms of connectivity described above have the capacity to produce and store large quantities of data which can be analysed and used to better inform care



and improve care quality. This data can be used in a variety of ways, from relatively simple statistical analysis, to much more advanced modelling techniques providing predictive insights. The outputs of this analysis can be used very effectively to detect anomalies, suggest better care options and pathways, and help with lifestyle-based scheduling. Personal apps and dashboards can also help individuals better understand their care and how it relates to their well-being. These approaches from both a service provision and personal management perspective can empower people to manage their care in a more efficient manner.

Artificial intelligence, machine learning and data analytics

Data centric technology is advancing at a rapid pace and the emergence of machine learning (ML), artificial intelligence (AI) and analysis of vast quantities of data have provided new possibilities for machines to augment human practice. Current “AI” techniques can provide accurate predictions and analyse or categorise huge quantities of data which at times would be beyond the abilities of a human. They are good at “narrow” applications, where they are designed and implemented for a very specific task, often requiring large amounts of computational power to process data. However, current techniques struggle to provide either a creative approach to a problem or any flexibility in adapting between tasks. For example, an AI based software can currently process text in care records or classify images of medication to track compliance at home. These approaches provide good insights and can be used to highlight issues in care provision but? there is great potential for the use of data from a home care setting to better tailor care for a better personal outcome, for example by improving medication compliance through a monitoring regimen or using in home sensors and automatic lighting to prevent falls at night.

Cyber security

The above technologies, applications and points of interaction relate to data and information which is incredibly personal in nature. At times in adult social care, individuals may lack a capacity to consent, or capacity to consent may change over time. This needs careful consideration when developing products and services in the care sector. Information is currently stored across a range of digital and paper-based records and information governance is at times difficult to track. Cyber security and resilience in these systems is of great importance, where there is an interface between people or processes of different technical sophistication, new security vulnerabilities are introduced. We will see examples later in the research of companies developing care specific solutions for encrypted messaging between care workers and clients. Care records and information about the recipients of care also require specific attention, however there are likely to be further specific needs where monitoring devices and in-home smart technologies are being deployed. As a part of security is decision governance and ethical considerations about deployment of technologies in environments with potentially vulnerable people. We have taken a deliberate view of AI and analytics to ensure it is for informing decision making rather than making a decision on behalf of a recipient of care or a care worker. Accountability and audit of the systems described here is of increasing importance, and the interface between modern technology and legacy systems poses security risks as well as reliability concerns, so it should be considered carefully when adopting the technologies outlined below.

For a more comprehensive technical description of the technologies above and their deployment, the interested reader would benefit from reading “Intelligent Digital Fabric, 2020” [32].



Appendix 3 – Start-up list

Company	Tech focus	# Employees	Headquarters location
Alcove	IoT	1-10	London, England, United Kingdom
Ally Labs	IoT	11-50	London, England, United Kingdom
Birdie	App	51-100	London, England, United Kingdom
Brain in Hand	App	11-50	Exeter, Devon, United Kingdom
Buddi	IoT	51-100	Rickmansworth, Hertfordshire, United Kingdom
Canary Care	IoT	1-10	Abingdon, Oxfordshire, United Kingdom
Care Hires	App	1-10	Leicester, Leicester, United Kingdom
Care rooms	IoT	1-10	London
CareLineLive	App	11-50	Slinfold, West Sussex, United Kingdom
CarePlanner	App	11-50	Bristol, Bristol, City of, United Kingdom
Curam	App	11-50	Stevenage, Hertfordshire, United Kingdom
Edenbridge Healthcare	App	11-50	Wakefield, Wakefield, United Kingdom
ehealthtracker	Platform	1-10	Truro, Cornwall, United Kingdom
Everylife Technologies	App	11-50	Farnborough, Hampshire, United Kingdom
Flexlearn	Platform	11-50	London, England, United Kingdom
Helpr	App	11-50	Surrey KT18 5AD
IEG4	Platform	-	Cheshire SK9 7QD
iMOSPHERE	Platform	11-50	Nottingham, Nottingham, United Kingdom
Inhealthcare	App	11-50	Harrogate, North Yorkshire, United Kingdom
Kemuri	Platform	11-50	Woking, England
Konnektis	App	1-10	London, England, United Kingdom
Lifted	App	1-10	Hanbury, St. Helens, United Kingdom
Liquidlogic	Platform	101-250	Leeds, Leeds, United Kingdom
Log My Care	App	1-10	London, England, United Kingdom
Medvivo Group	Platform	101-250	Chippenham, Wiltshire, United Kingdom
MiiCARE	AI/IoT	11-50	London WC1N 3AX
mobilise	App	-	London, E1 3BL
My Learning Cloud	Platform	11-50	Portsmouth, Hampshire, United Kingdom
Myo Care	App	11-50	London EC2V 7NQ
MySense	AI/IoT	11-50	London SE1 7SP
Nourish Care Systems	Platform	11-50	Bournemouth, Bournemouth, United Kingdom
Pando	App	11-50	London, England, United Kingdom
Paman	5G-IoT	-	Liverpool, Liverpool, United Kingdom
Push to talk/defproc	5G-IoT	1-10	Liverpool, Liverpool, United Kingdom
safehouse technology Ltd	5G-IoT	-	Liverpool, Liverpool, United Kingdom
Sirenum	Platform	50-100	London, England, United Kingdom
SureSafe Alarms UK	IoT	11-50	Liverpool, Liverpool, United Kingdom
Tagtronics Care	Platform	11-50	Darwen, Lancashire, United Kingdom
Teach You	Platform	1-10	Barnsley, Gloucestershire, United Kingdom
Transforming Systems	Platform	11-50	London, England, United Kingdom
VitalSigns Software	5G-IoT	1-10	Leeds, Leeds, United Kingdom
WeMa Life	Platform	1-10	London, England, United Kingdom
Winnovation Training Ltd	Platform	11-50	Blyth, Nottinghamshire, United Kingdom



Appendix 4 - Literature

The below reference list was used to inform the scope of the research and provide a narrative review of sources for data quality checks.

- Essex, Inform report 2019: SOCTIM <https://socitm.net/download/socitm-advisory-care-technology-landscape-review/>
- SEHTA: Tech and Innovation in Care Homes <https://www.sehta.co.uk/cms-data/depot/sehta/Technology-Innovation-in-Care-Homes-The-SEHTA-Review.pdf>
- King's Fund New Models of Care: <https://www.kingsfund.org.uk/sites/default/files/2018-12/New-models-of-home-care.pdf>
- Nuffield Trust, Innovation horizon scanning (NB systematic review of innovations): <https://www.nuffieldtrust.org.uk/files/2019-11/adult-social-care-innovations-horizon-scanning-report-final-13112019.pdf>
- Deloitte 2014 digital health and care: <https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/life-sciences-health-care/deloitte-uk-connected-health.pdf>
- <https://www.ahsnnetwork.com/wp-content/uploads/2020/10/Safer-care-during-COVID-19-AHSN-Network-report.pdf>
- <https://mindmaps.aginganalytics.com/uk-agetech-ecosystem>
- <https://www.digitalsocialcare.co.uk/new-report-and-guidance-on-data-and-cyber-security-for-social-care-services/>
- <https://www.scie.org.uk/publications/reports/report73-technology-changing-lives.asp>



Future Care Capital

INFORM. CONNECT. TRANSFORM.

About Us

Future Care Capital is a charity which undertakes research to advance ideas that will help shape future health and social care policy and deliver better outcomes for individuals living in the UK.

Beginning life as the National Nursery Examination Board in 1945, the charity has evolved throughout its 70-year history and we continue to have Her Majesty the Queen as our Royal Patron.

Further Information

For further details about us, our mission and values, the Board of Trustees and the Executive Team, please visit our website, follow us on Twitter or LinkedIn.



futurecarecapital.org.uk



@FCC_UK



Future Care Capital

Royal Patron: Her Majesty The Queen

Office address: Gillingham House, 38-44 Gillingham Street, London, SW1V 1HU