THE HILL

Remote Monitoring in Healthcare

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Contents

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Ishbel is doing a DPhil in primary care, looking at self-monitoring solutions for older patients with multimorbidity. She joined TheHill because she is committed to improving healthcare for those hard-to-reach patients who could benefit the most from an intervention.

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Executive summary

TheHill has been conducting a 'needs-led' research project over the past 6 months to understand how remote monitoring technology can assist in the delivery of care in hospitals and at home.

As part of this project TheHill conducted semi-structured interviews with a range of healthcare professionals from different levels of seniority, in different job roles and in different departments within Oxford University Hospitals NHS Foundation Trust, and across other trusts. Through thematic analysis the findings have revealed the technologies which have worked so far, and what hasn't been so successful. Furthermore, some of the benefits, drawbacks, and future opportunities for remote monitoring were identified. This was all brought together to help make a guide for further remote monitoring developments.

Overall, the interviews identified many benefits, including reduced backlogs, hospital visits, and waiting times. This regularly resulted in more effective use of clinical time, earlier detection, and better patient engagement with their health. These factors simultaneously benefit the patient, healthcare professionals, and the healthcare system.

However, the interviews also highlighted some of the challenges encountered with remote monitoring. These could be grouped into technical challenges, data, and information governance challenges, as well as increasing workloads in some cases. Another key challenge many interviewees came across was sustained funding for innovative remote solutions.

The interviews brought up some interesting discussion points, including the future of machine learning and automation, and what role it has in the future of healthcare.

Background

Remote monitoring is a method of delivering healthcare to patients outside of clinical settings, often but not always leveraging technologies. The vast variation in disease pathways, diagnostics and treatments across the healthcare sector means the definition of remote monitoring is broad. This is a growing area of development that appears to offer significant advantages to patient care. However, there are different opinions as to which opportunities offer genuine cost and time savings and improved care, and how these fit with existing patient pathways.

Remote monitoring can either be active or passive, where the patient either has to actively provide the data or where the data is collected without requiring patient input. This information can be used for diagnosis, acute and chronic disease monitoring and management, or rehabilitation. The concept of remote monitoring has been around for several decades but has gained more attention and adoption in recent years due to advances in technology and an increasing need for remote care. It was first used by NASA in the 60's, to monitor astronaut's health in space, however it wasn't commercialised until the 90's. It has more recently sparked interest as a potential method for alleviating the growing burden on the NHS [1].

For instance, when the Covid-19 pandemic hit, it became a necessity to use remote monitoring as patients were strongly advised to stay at home and away from hospitals. This accelerated many trends in remote monitoring including remote consultations and virtual wards, where a patient who would normally be in the hospital could receive a specific treatment, like on a hospital ward, but at home. Hospitals across the UK are working towards having virtual wards, as well as trialling different remote monitoring solutions. Hospital at home (HaH) was successfully implemented for Covid-19 patients, using conventional pulse oximeters and telephone calls to monitor patients and reduce the risk of infection from non-critical cases. Additionally, some remote monitoring methods were applied to patients with chronic conditions, to keep them away from hospitals during such a high-risk period.

This report discusses some examples of existing remote monitoring technologies and seeks to inform the choice of new methods and the creation of a remote monitoring strategy for Oxford University Hospitals NHS Foundation Trust.

[1] **NHS England. Listening to digital health innovators report 2019: NHS England - Transformation Directorate. 2019.**

Methods

TheHill designed two sets of interview guidelines for clinical staff and thought leaders. Interviews geared towards clinical staff explored project implementations and assessments, while those targeting thought leaders had a broader focus.

Specifically, we ensured each interviewee was asked:

1. What data was collected, and how was it collected?
2. what are the benefits to the patients and staff using the technology?
3. what are the drawbacks and challenges of using the technology?
4. what is the scale of the implementation – number of staff and patients participating in the program?
5. what is the level of engagement with the technology from both staff and patients?

For broader picture questions, we asked:

1. what are the future opportunities of remote monitoring?
2. what would be the challenges to adoption of remote monitoring technology?
3. which areas of technology are most exciting?

This report includes quotes and analysis from interviews conducted between May 2022 and Oct 20222. In total, we interviewed 23 clinical staff, 2 professors, 6 members of management teams, and 1 patient over a span of six months. Interviews lasted around 45 minutes and were all conducted via Microsoft Teams. Initial recruitment was through advertising on NHS forums and contacting different previously identified stakeholders. This led to a snowball in recruitment, where interviewees recommended other people of interest.

TheHill subsequently conducted thematic analysis of the interview transcripts. Initially, two coders independently reviewed 10 sets of interviews. The codes were then compared and confirmed. Major themes from the analysis were presented to TheHill Digital Innovation Ambassadors and start-up founders working on remote monitoring technologies on three separate occasions. The results were presented at a digital ambassador engagement session, which facilitated a focus group discussion. Key insights from the discussion were also analysed and included in this report.

[2] TheHill obtained verbal consent to use and quote the interview in oral and written reports.

Findings

TheHill identified many benefits and challenges facing remote monitoring technologies, as well as numerous opportunities. This section of the report focuses on the current landscape of remote monitoring projects implemented across NHS Trusts and discusses in detail about how these technologies provided a benefit to clinicians and patients, the challenges faced and the opportunities ahead.

Landscape

Through interviews, TheHill identified 13 specialties within OUH and other Trusts with remote monitoring projects; 12 of the specialities provide acute care and one is a care home. Each specialty has progressed to a different degree for its remote monitoring project. Cardiology has implemented seven remote monitoring projects, At the time of interview, Rheumatology has two ongoing projects, Geriatrics and Gerontology are running two parallel programs, Dentistry and Ambulatory Care recently started their remote monitoring projects, Respiratory completed one clinical trial and is operating one project directly facing patients. Primary Care has completed one clinical trial. Psychiatry, Transplant, Gastroenterology, and the care home all have one ongoing project. Meanwhile, Oncology and Paediatrics are in the planning/setting up stage. The degree of measurement and evaluation of projects was also varied. Of the 22 projects identified, 50% had no pre-selected outcomes whilst 50% had clear metrics used to evaluate the projects.

Within the projects that TheHill team has identified, we observed different types of remote monitoring. This can be classified into four broad categories (1) a combination of medical devices and dashboard, (2) app tracking, (3) telemedicine (including phone, text, and video consultation) and (4) questionnaires.

53% of the projects we have identified used a combination of medical devices and dashboard, 30% leveraged telemedicine, 11% opted for questionnaires and 6% adopted app tracking. Each approach has its own pros and cons. The decision to implement RM projects in each of the approaches is dependent on the end goal of the RM project. But each approach comes with some specific pros and cons. In the following table, we briefly discuss the advantages and disadvantages with each approach and specialties that have adopted these types.

Types of remote monitoring projects	Pros	Cons	Applications
a combination of medical devices and dashboard	Measure signals specific to a symptom (ECG)	Hard to distribute and maintain	Cardiology, Maternity, Geriatrics
app tracking	Low cost Easy to distribute	Measure limited symptoms	Cardiology
telemedicine (including phone, text and video consultation)	Low cost	Cannot run medical tests	Psychiatry
questionnaires	Low cost Easy to use	Relies on patient to input data	Rheumatology

Additionally, to recording facts and figures, TheHill also evaluated the overall attitude of our interviewees toward remote monitoring technologies. Out of the 33 interviewees, there were only two interviewees (coming from two different specialties) who negatively assessed the overall existing remote monitoring projects. Crucially, these two interviewees both mentioned the lack of "standardised care pathway" [10] and a "clear progression course (of symptoms) that is predictable" [11] as part of their feedback. The remaining 31 interviewees were either (1) optimistic about their ongoing projects, (2) positive about their experience or (3) neutral about technology, pointing out both pros and cons. This report will provide guidance on how to implement the most cost-effective remote monitoring projects in the following sections.

Benefits to clinicians

We observed that clinicians benefitted greatly from remote monitoring (RM) technologies. Specifically, remote monitoring works effectively as a screening tool and allowed staff to reduce backlog. It also led to fewer hospital visits and allowed clinical staff to use their time efficiently. Furthermore, remote monitoring technologies could also be leveraged as an adaptative measure during the covid pandemic.

Reduced backlog through screening

RM technologies could be effective screening tools and be used to reduce backlogs. For instance, the Rheumatology department used questionnaires coded in Microsoft Forms to clear a backlog of 2600 patients. In particular, patients with rheumatoid arthritis were sent a link to a questionnaire via text messages. The questionnaire

includes a list of multiple-choice questions about medications and RAPID3, a validated screening tool for arthritis. Information gathered through the questionnaire was then automatically compiled into a report and reviewed by the clinical teams along with their EPR. Those in need of face-to-face consultation were scheduled one immediately and those in a stable condition were monitored remotely.

> **"Had a huge back-log of patients during pandemic. Go through patients with a questionnaire to see who still needs an appointment etc. Getting patients who are stable to engage through a questionnaire so they can highlight when they need an appointment rather than routinely"** [22]

In this instance, the use of patient-inputted data helped to appropriately guide treatment options and reduce the number of appointments needed. The Rheumatology department hopes to leverage similar screening tools to empower patient-initiated follow-ups (PIFU) by giving patients a better way to track, record and describe their symptoms.

Reduced hospital visits

RM technologies reduced hospital visits. In a pilot trial run by Cardiolyse, 48 out of the 50 patients who recently received surgery to treat atrial fibrillation opted to use an ECG patch at home, as opposed to traveling to the hospital for checks. Similar examples were also observed in Geriatrics where clinicians were able to deliver point-of-care diagnosis through mobile x-ray and ultrasound machines. Such measure is a preferred option for aging patients with only 2 out of 3000 choosing hospital over at-home care. This reduces carbon emissions and pressure on carparking and could improve patient satisfaction.

Efficient use of clinical time

In most cases, being able to monitor patients remotely helps clinicians to use their clinical time more efficiently. Many house visits involve clinical staff primarily reassuring patients of their stats. With remote monitoring, clinicians can do video consultation and reduce the time spent on traveling. Routine check-ups can be done remotely with data sent to clinicians directly. Together, the saved time allows clinicians to focus more on high-risk patients with the added benefits of extra surveillance.

Adaptive hospital visits

RM technologies have proven to be crucial during the COVID-19 pandemic since they protect clinical staff by reducing contact and therefore can enable lower usage of PPE. We expect RM technologies to continue keeping clinicians and patients safe as the pandemic continues to affect the healthcare system.

Benefits to patients

Apart from clinical staff, RM technologies also directly improved patients' experience by shortening waiting time, increasing engagement and awareness with health, and reducing based on the changes in symptoms.

Shorter waiting time

RM technologies accelerated the turnaround time. With the ECG patches distributed and managed by a third party, cardiology patients were able to start monitoring in a week, as opposed to waiting for 12 weeks to get a device from the hospitals.

Increased engagement and awareness with health

The Cardiology department observed an increase in walking distance among patients who use the app-based 6-min walk test. In particular, the app, implemented by the cardiology department, involves a timer and a GPS tracker that records the distance the users have travelled. The app is intended to replace in-person assessment where patients walk along the hospital corridors with two physiologists present. In this case, the app serves more than a digital assessment tool and can incentivise and encourage patients to exercise more regularly.

Earlier detection, better care

We observed an increased quality of care being delivered to patients. In particular, RM technologies allowed clinicians to detect changes in symptoms earlier and adapt treatment accordingly. identify high-risk patients. In one instance, a well-designed survey allowed clinicians to identity patients in need of early COVID-19 vaccines since those patients were in the immunosuppressed groups.

Reduced hospital visits

RM technologies reduce hospital visits, which is beneficial especially for patients with limited mobility, those that are older, and the more vulnerable. The preference observed in patients to receive care at home is tightly linked to the extra psychological

comfort of receiving treatment at home and, is particularly beneficial to some older patients or those receiving end of life care.

Patient Engagement

We found patient engagement to be a key theme in our analysis. Specifically, patient engagement could vary by speciality and by patient population and is one of the deciding factors affecting the extent to which clinical staff and patients benefit from remote monitoring technologies.

"my friend has an arrhythmia where his heart could stop. One time his heart did stop, and his clinician was alerted to it in the hospital and was able to restart his heart remotely." [7]

"Our patients stay in the environment they are comfortable in, with their family. Hospital deaths can be more dramatic and often families separated." [25]

We observe high patient compliance and acceptance across specialties. For example, the compliance rate reached 94% for an app designed for COPD patients that require responses from patients twice a day five times a week. We also observed that acceptance rate is high, even in the aging patients: *"Only 2 in 3000 patients have opted for hospital over hospital at home." [25].*

Patient engagement is especially beneficial for the remote monitoring services that require patients to initiate contacts. Take the mental health hotline as an example. On average, clinical psychologist trainees receive 12,000 calls per month, with waiting time around 10 mins. However, when patients are not aware of the remote monitoring services provided such as consultants and nurses doing rounds in the virtual wards through video calls, patients don't benefit from them.

Though patient engagement is one of the deciding factors that affect the extent to which patients and clinical staff benefit from RM technologies, the minimum level of patient engagement for the remote monitoring technologies to make a positive impact on our healthcare system is unclear. For instance, Rheumatology cleared the backlog of 2600 patients with 64% of patients responding to questionnaire links sent via texts. The minimum level of patient engagement required for a remote monitoring technology to be effective is dependent on the speciality (i.e., how complicated the disorder is) and the number of resources a department has for in-person consultation.

A limitation of our study was that we largely interviewed clinical and managerial staff, rather than patients themselves. Further work to engage with patients would be helpful to assess their desire for and level of engagement with remote monitoring technologies, and ways to make that engagement more effective.

Challenges

Though there are many benefits that come with remote monitoring, the technology also faces many challenges. We observed most projects had to tackle technical and logistics challenges and navigate compliance for information governance. Some clinical staff reflected that implementation of remote monitoring projects led to increased workload. Some clinical staff also voiced concerns over the social and language barriers that remote monitoring brings.

Technical and logistics challenges

A common technical issue we observed with remote monitoring projects was centred around connection: how to avoid poor Wi-Fi and Bluetooth connection to ensure data collected is transmitted to the clinics. For remote monitoring projects that involve using an external device, a key challenge was the logistics of delivering, and retrieving equipment.

Remote monitoring technologies could be challenging for both staff and patients to use. We observe that targeted training sessions tend to reduce the barriers for clinicians. However, it is harder to coach patients as technological literacy varies more and does not seem to be explained or predicted by age or speciality. While many patients had minimal issues physically using the technology, it could be challenging for others to complete simple processes such as downloading or upgrading an app. It is crucial to find alternatives for patients that are limited by technical issues.

Increased workload

Clinical staff also pointed out increased workload with remote monitoring projects. Some involve Alert Fatigue*, a common challenge with clinical apps. Furthermore, checking reports generated by the device could take a long time: *"Checking 250 reports a week causes data overload" [5].* We observe that the different procedures and interfaces required for each remote monitoring technology increases the workload. But most importantly, works related to remote monitoring projects are not well-integrated with clinical staffs' work stream, resulting in *"Over 1000 phone calls a day, plus home visits, plus looking after the hospital patients. It does not reduce workload ever; remote monitoring makes a lot more work but worth it if can improve care" [11].*

"Data was collected with a blood pressure machine that was dropped off by a midwife. Patients need to mail back the device; or midwives would need to pick them up" [10]

"The devices work very differently (e.g., transmission and interface) and each person use them differently. Thus, you need to figure out how to work with each tech and increase the workload." [16]

***Alert Fatigue:** Where staff are overwhelmed by the number of false alarms or alarms that do not need to be responded to.

Information governance

Some clinical staff expressed concerns with information governance, in particular, who will have access to the collected data. If the device is owned by a third party, how will the data be encrypted and transferred back to the clinic? Lastly, how will the data be used? The process of getting approval from the information governance body could also take a long time, increasing the amount of preparation clinical staff must carry out before launching a project.

Social and language barriers

Some social barriers to accessing care delivered by remote monitoring technologies were expressed by interviewees. In particular, some common prerequisites to participate in the first place involve *"a smart phone and WIFI" [10],* thus *"patients from low socio-economic groups are at a disadvantage" [10].* Language barrier is another one. *"Often language barriers are a problem for these [asylum seekers] population, and finding a translator is hard. Also, the idea of consent is really hard, this is a cultural problem. Often this also displays in the method of not replying" [28].*

> **"Patients sometimes don't have credit to text, so they prefer WhatsApp because it uses wifi. Often we see asylum seekers, they have wifi in the house as they are set up by social care, but don't have credit on their phones"** [28]

EPR integration

Integration with the Electronic Patient Record – or the lack of said integration, for most new remote monitoring technologies – is a technical challenge which leads to barriers to adoption and increased workload for clinical staff.

Too many portals

To our knowledge, all the remote monitoring technologies currently being used by interviewees operate outside of the EPR system. This creates inconvenience and inefficacy for clinical staff when reviewing patient data since they need to sign into multiple portals at the same time and switch between various dashboards. Staff will then go back to EPR to decide on how to proceed with a specific patient.

“Lesson learnt from the real-life BP monitoring project is the importance of integrating collected data with electronic health records.” [10]

Lack of context

Lack of integration from EPR hinders data interpretation and clinical decision making. Data generated by remote monitoring devices doesn’t have medical histories and other key information such as lab tests and medication records displayed with them, which makes deciding the next steps very difficult.

Hard to embed new systems into EPR

The fragmented digital system we observe is partially due to EPR being a closed system, which makes exporting and importing information into and out of EPR a challenging task. Despite many years of effort by lots of people, this remains a key challenge for new technologies.

“In EPR every touch point is time spent and lost, getting data into EPR takes at least 20 minutes. In clinics I spend a lot of time trying to find exercise reports … Streamlining and co-ordinating that admin process should be relatively easy to sort e.g. reports get uploaded as manual part of process then streamline and automate– certainly this is the first line to make sure it is in place” [26]

Opportunities

Remote monitoring has the potential to reduce the burden on healthcare staff and capital resources, reduce costs, and improve the patient experience and patient care. These benefits are rarely all achieved at once, however.

All interviewees were asked about their vision for the future of remote monitoring. Here are some of the themes that emerged.

Data analysis and decision-support

Automation for data management came up in the majority of interviews as a way forward, to keep up with the growing pressure on the NHS. This was typically brought up in the context of filtering out normal data but leaving the medical professionals to look at, and diagnose the abnormalities, as well as writing up summary reports for EPRs. Automation was often paired with using machine learning, used interchangeably, a term used by interviewees, with artificial intelligence (AI), to help predict and improve the algorithms.

"If there was a way of automating physiologists reports and feed patient information to patients without separate clinicians' letters, dictating a letter that avoids duplication of effort and results highlighted and less time spent on actioning results – that would be a critical component." [26.2]

Not only would this relieve some of the burden on staff, but it could also be more accurate for detecting changes, as it eliminates human error.

"no choice but to use AI now, an AI approach should be more accurate, things are less likely to be missed (eg identifying couplets beats)" [4]

While this can be extremely beneficial, there are ethical and regulatory considerations when providing clinical decision support. This doesn't mean it isn't feasible, it just means more research should be conducted in this area.

"Everything leads back to automation or AI and have to consider the regulatory impact – takes decision making of normal versus abnormal out of hands of clinician or specialist who is qualified to make that decision. Going to bump up class of decision making, and this can be a problem" [26.4]

Other important elements of data management included how the data was displayed, specifically if data is presented on a dashboard, and how it is visualised. This discussion was evaluated in the 'challenges to clinicians' section, centred around delivery, increased workload and integration with EPR section.

Remote blood tests

At home blood testing kits were identified as an area for future development, especially for departments that require regular blood testing, as seen in Tuberculosis management.

> **"Blood testing kits could be useful, especially if they have weekly blood tests because they have bad side-effects. This would only be for rare patients, maybe 10"** [28]

Other departments have been using remote blood tests (point of care testing) already, such as diagnostics in geriatrics, and diabetes. One diabetes expert highlighted *"Blood monitoring through a skin patch approach could also be interesting." [7]* This indicates there is clearly still room to develop and improve what is done with remote blood testing and links in with a current OUH pilot called Project Move, where a bus has been outfitted as a mobile clinic to take blood tests closer to home.

Closed loop systems

Closed loop systems refer to a type of technology that provides real-time monitoring and control of a patient's condition. They use advanced algorithms to continuously monitor a patient's vital signs and adjust treatments, such as medication dosages, in response to condition changes.

A key example of a closed loop system currently being used is in diabetes care, where a continuous glucose monitor is combined with an insulin pump to automatically regulate insulin release. This monitors a patient's blood glucose levels in real-time and automatically adjusts insulin delivery to maintain the patient's blood sugar within a target range. Therefore, when the technology works, it offers a higher standard of care.

"I can't imagine a life without the closed loop system" [5]

However, there are some predicted problems associated with closed loop systems, which will need more research. The main issues include becoming completely reliant on technology, which could malfunction, or where other pathways might play a role in the disease pathology. Closed-loop systems rely on algorithms that are based on

specific rules and assumptions and may not be able to account for multiple interacting factors involved in managing complex diseases.

"Closed loop systems – like an artificial pancreas. However, type I diabetes is the only example where this works. Multimorbidity doesn't have one thing to measure and treat so can't do a closed loop. Mono-pathology is the only thing that can work as factors won't be influenced by anything else. Works for a small number of people." [25]

Guidance for future projects

After conducting this project, TheHill were able to identify some recommendations for future remote monitoring innovators.

1. **The product or service must fill a need.** To ensure the remote monitoring method addresses a clinical problem, it is important that the typical care pathways and potential users are considered when designing the intervention, especially considering the range of different users' needs (e.g., healthcare workers and patients). When designing the intervention, it is useful to map out the usual care pathway, identify where the technology fits, and how this improves the pathway. This process will help to develop an escalation of care plan for the data collected. This will also help to explain the proposed benefits. The cost, time, quality (CTQ) framework can help structure this.

> **"Innovators have no clinical idea – they create technology with no use for it and now trying to find a way to use it. It is not solution driven innovation – it is innovation for innovation's sake."** [25]

2. **The technology used should be appropriate**. Many interviewees implied the technology might just be there because it exists, rather than to solve a problem. This meant often something was developed, and then a purpose was 'found'. This problem could be partly responsible for adding to the clinical workload, and therefore, fully understanding the problems and collaborating with future users will help produce something genuinely useful. Some of the most effective remote monitoring solutions used 'low tech' approaches such as telephone calls or texts – whilst others used very sophisticated technology such as the ability to defibrillate remotely. It is important to use the level of technology appropriate to the problem – ideally choosing the simplest and cheapest way to offer the required benefits.

> **"Often new technology is used because it exists not because it is helpful [Attaching to a patient because it already exists rather than because they need it]"** [11]

3. **Collaboration should occur** between trusts, primary and secondary care, industry, and the patient perspectives. This came up in many interviews with different

contexts, between the private sector (e.g., medical device developers), social care, and with the patients. The overall point was that sharing experiences could help solve problems in different departments or trusts.

A big problem was the lack of large-scale adoption and scaling up of projects. Therefore, it is important to examine whether the intervention could work in different departments, for different disease indications, and whether it will still be acceptable in different settings. This will hopefully encourage scale up of successful products.

"We're very much at the start of the remote monitoring journey, each area is doing their own thing individually. I think the key to success is collaboration, with a clearer thought process of where things are going" [23]

"I think getting that main contact within NHS Digital, NHS England (+ devolved nations) - or at least a regular route to them to let them in on our successes and issues with 'red tape' would be a good start. Having that engagement with those guys first could open lots of doors." [26.1]

4. **A clinical champion** was identified as a key driver for success. Having a clinical staff member who enjoys using the intervention and is willing to advocate for the benefits of using it. This will not only help to get the intervention into clinical trials but will also help engage more hesitant staff members.

5. **The intervention should allow clinicians to use their time most effectively.** Several of the interventions were noticed to increase staff workloads. This can be justified if the intervention reduces costs, or increases quality of care, however it is important to look at the intervention pathway and identify if any steps can be eased for the staff (e.g., adding an automated report generator to save the healthcare professional writing a summary at the end).
   How the data is analysed and whether data will be integrated into the EPR should be strongly considered. This was discussed in all interviews, especially different ways of tackling the problem of different portals for different monitoring methods, and how to manage the large quantities of data produced.

6. **Patient engagement** came up in 30 of the interviews (over 90%), as an important factor for success. It is important to consider how the intervention will function in a real-world setting for the intended users, and understand how much input from clinicians, patients, and other stakeholders is required.

7. **Funding** came up in around 80% of interviews, with uncertainty around where to get funding, as well as how to sustain innovation projects past initial trials. An interview with a C-suite employee at NHS England highlighted the £200 million virtual ward funding available for development of virtual wards, with an additional £250 million to be provided in 2024. [34]

   Though these appear to be large sums of money, spreading this over the whole of the UK and including staff costs leaves very little for planning, purchasing, and implementing remote monitoring technologies.

Conclusion

This report identified key areas of success, including benefits to the patients, staff, and institutions. These were especially observed in the reduction of hospital visits using remote triaging techniques, video, and phone consultations. Patients who were able and comfortable doing this found it more convenient to fit around their other commitments. This saved time for healthcare staff, allowing them to focus their time on higher risk patients. A reduction in hospital visits also reduced unnecessary bed days, saving money and other resources for the institutions.

While the benefits can be recognised, there are several challenges that must be overcome before remote monitoring can be implemented optimally. One important factor is whether the intervention adds to the healthcare staff workloads. Continuous monitoring reduces the risk of sporadic episodes of decline being missed, as well as offering reassurance to patients. However, it generates significant quantities of data, which then must be filtered to identify abnormalities. This seemed like a good opportunity for automation and potentially AI, to help filter data and identify which patients require interventions.

A significant discussion point was how remote care would integrate with patient records, specifically if this should be integrated into the Trust's Electronic Patient Record (EPR), or if different databases offer more flexibility. The overall consensus was minimal portals to log into, with easy export/ input functions to have all notes together and easily shared between primary, secondary, and tertiary departments.

This helped to develop some guidelines for future remote monitoring solutions. Along with these guidelines, this report helped identify some of the gaps in knowledge and areas where TheHill could facilitate and support innovation.

References:

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Next steps and further work:

1. **Identify priority areas.** Remote monitoring is not a blanket good thing, but there are areas where patient benefits and cost savings are potentially high. It is important to identify and channel efforts into these areas. Suggestions that came up in the conversations and our analysis include:

    1. Patient initiated follow-up (PIFU) pathways
    2. Preparation for and recovery from surgery (prehab and rehab)
    3. Triage and prioritisation of long waiting lists
    4. Optimising time to discharge of patients in hospitals beds
    5. Management of long-term conditions
    6. Virtual wards

2. **Engage with patients and the public.** Patient engagement to understand the pros and cons of remote monitoring from their perspective, and how to make it an attractive and effective option, is a key next step. Patient perspectives can be found from some existing work, upcoming patient access conversations, and further dedicated conversations if funding allows.

3. **Share best practice.** This is an area where some specialities have been working for years, whilst others are new to the possibilities. It is important to review and learn from best practice, both internally (via the Ambassador's Remote Monitoring Special Interest Group) and externally (via roundtables and other discussions). Best practice sharing could also help to engage those currently running remote monitoring services or departments looking to start out.

4. **Create a procurement and digital strategy.** Where technology is needed, there are many options for remote monitoring equipment and platforms. Having an institutional strategy for which to use would simplify support and maintenance and aid with sharing of resources.